March 28, 1939. A. BRUNNER 2,152,025

INTERNAL COMBUSTION ENGINE ELECTRIC UNIT

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Fig. 1.

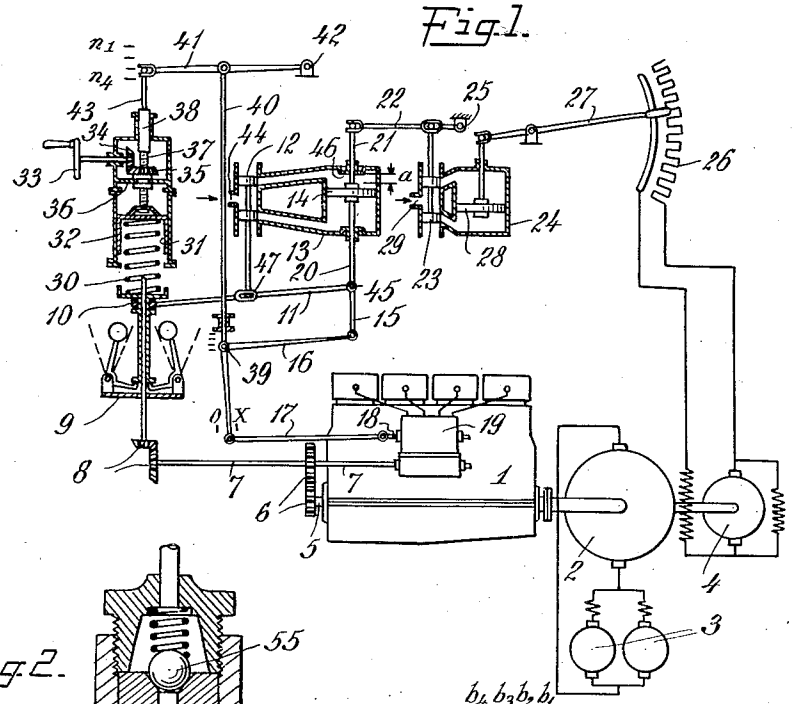
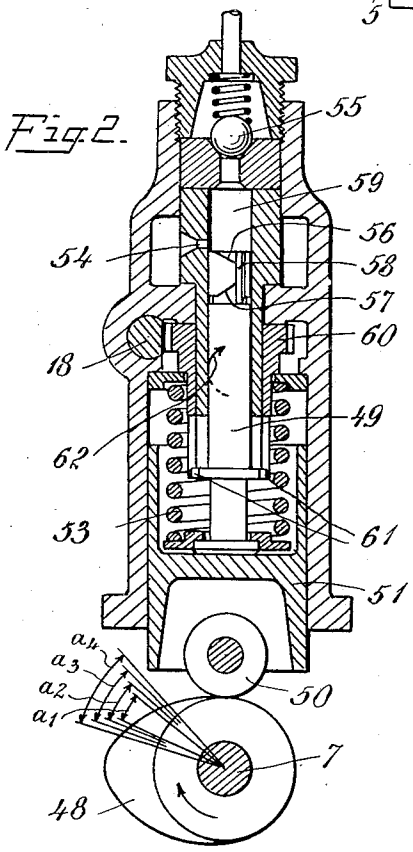


Fig. 2.



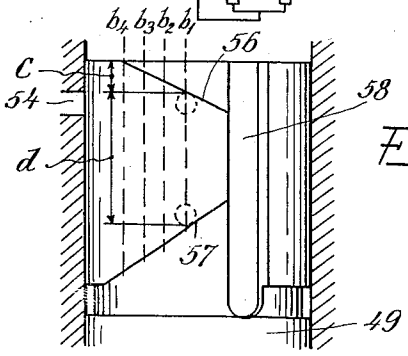
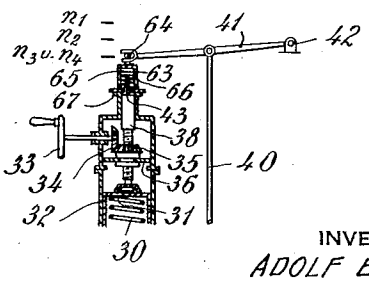


Fig. 3.

Fig. 4.



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Fig. 5.

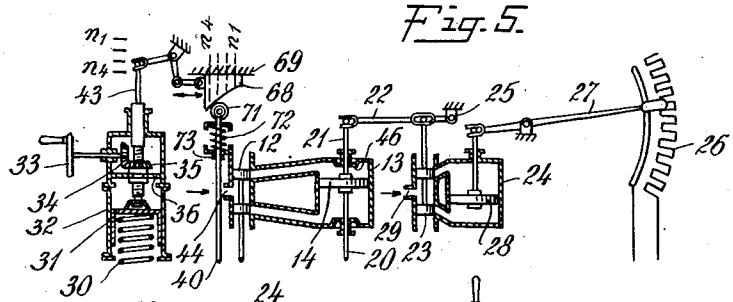


Fig. 6.

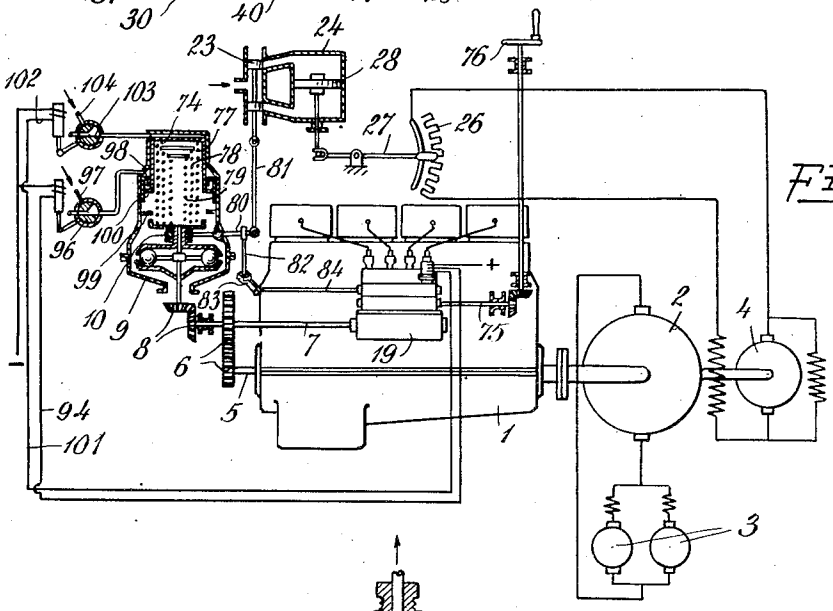
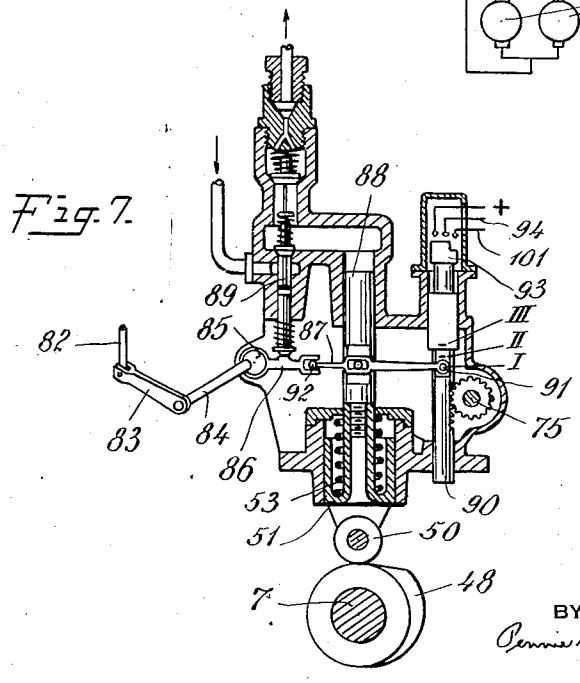


Fig. 7.



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INTERNAL COMBUSTION ENGINE ELECTRIC UNIT

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Application February 5, 1937, Serial No. 124,343
In Switzerland February 12, 1936

4 Claims. (Cl. 290—40)

This invention relates to internal combustion engine-electric power units and has for its object the provision of certain improvements in apparatus of this type. The unit of the invention comprises in combination, an internal combustion engine, means whereby the engine can be set to operate at different speeds, and automatic control apparatus which tends to maintain the engine torque approximately constant for any given speed.

In a power unit according to the present invention, inter-connecting means are provided between a speed setting device for setting the engine speed and a device for regulating the fuel supply to the engine, so that when the speed setting is altered the fuel supply is at the same time modified accordingly, thus anticipating the action of the automatic control apparatus on the fuel supply.

Adjustment may be transmitted from the speed setting device through the interconnecting means to the fuel supply regulating device, or adjustment may be transmitted from the fuel regulating device through the interconnecting means to the speed setting device.

The automatic control apparatus may be connected through lever and link mechanism to the fuel regulating device and the speed setting device acts through the interconnecting means on the lever and link mechanism so as to alter the characteristics thereof. Thus, for example, the automatic control apparatus may be connected through a floating lever to the fuel regulating device, and the speed setting device acts through the interconnecting means on the said floating lever so as to cause bodily adjustment of the normal fulcrum thereof.

Four arrangements, each embodying the invention, are illustrated diagrammatically and by way of example in the accompanying drawings, in which

Figure 1 shows one arrangement;

Figure 2 is a longitudinal section, on an enlarged scale, through one cylinder of the multi-cylinder fuel pump included in Figure 1;

Figure 3 shows, on a larger scale, the arrangement of the control edges on the pump plunger included in Figure 2;

Figure 4 illustrates a modified arrangement;

Figures 5 and 6 show respectively two further arrangements according to the invention; and

Figure 7 is a vertical section, on an enlarged scale, through one of the cylinders of the fuel pump included in Figure 6,

In the arrangement shown in Figure 1, the internal combustion engine 1, which is of the fuel-injection compression-ignition type, drives a main electric generator 2 which supplies current to the traction motors 3 of a Diesel-electric vehicle, the engine 1 also driving an auxiliary current generator 4 which supplies the excitation current for the main generator 2. The crankshaft 5 of the engine 1 drives a gear 6 coupled to a pump camshaft 7 from which the drive is also transmitted through a gear 8 to a centrifugal governor 9.

The engine torque is controlled by automatic control apparatus including the governor 9 whose sleeve 10 is connected to a floating lever 11 which operates a piston valve 12 for controlling a supply of pressure medium to a servo cylinder 13 containing a piston 14. The lower end 15 of the rod of the piston 14 is pivotally connected to one arm of a floating bell-crank lever 16, the other arm of which is connected through a link 17 to a longitudinally movable fuel regulating device 18 whereby the delivery of fuel from the pump 19 to the several cylinders of the engine is regulated. The lower end 15 of the rod of the piston 14 constitutes an integral extension of an upper portion 20 which is extended at 21 above the piston. The extension 21 is connected to a lever 22 which operates a piston valve 23 for controlling a supply of pressure medium to a servo-cylinder 24, the lever 22 being pivoted on a fixed part 25. The excitation current of the main generator 2 is controlled by a resistance 26 the effective value of which is regulated by a rheostat arm 27 connected to the servo-piston 28 arranged within the cylinder 24. Upward or downward movement of the piston valve 23 thus causes pressure medium to be delivered from a supply port 29 to the cylinder 24 either above or below the piston 28, thereby increasing or decreasing the effective value of the resistance 26 so as to decrease or increase the excitation current of the generator 2.

The governor 9 is opposed by a spring 30 against the upper end of which bears a piston 31 movable within a cylinder 32. For the purpose of altering the speed at which the engine is to operate, the tension of the spring 30 is adjusted by means of a speed setting device 33 connected through a bevel pinion 34 to a bevel pinion 35 journalled in a fixed plate 36 carried by the cylinder 32. A screwthreaded shaft 37 bears at its lower end on the piston 31 and cooperates with an internal screwthread of the bevel pinion 35, the upper end of the shaft 37 having a portion 38 of square cross-section which cooperates with a correspondingly formed guide at the upper end of the cylinder 32.

As thus far described, the automatic control apparatus including the governor 9, servo-motors 13 and 24, resistance 26 and fuel regulating device 18, tends to maintain the engine torque constant at any given engine speed as set by the device 33.

The pivot 39 of the floating bell-crank lever 16 is connected through a rod 40 to a point in the length of a lever 41 connected at one end to a fixed pivot 42 and at its other end to an extension 43 of the spindle 37. The bell-crank lever 16, rod 40 and lever 41 thus together constitute mechanism interconnecting the speed setting device 33 and the fuel regulating device 18 so that when altering the speed setting from one engine speed, say, the minimum speed n_1 to another speed, say, a higher speed, such, for example, as the maximum speed n_4, the bell-crank lever 16 is also adjusted so as to effect at the same time adjustment in the fuel supply to the engine, thus tending to anticipate the action of the automatic control apparatus on the fuel supply.

In Figure 1 the parts of the automatic control mechanism and the associated interconnecting mechanism are in the positions which they will occupy when equilibrium has been established between the load on the engine 1 and the quantity of fuel injected at each injection stroke to each of the engine cylinders. If now the load on the generator 2 is altered, say increased, the engine speed will fall so that the weights of the governor 9 will move inwardly and the lever 11 will thus be turned in the counter-clockwise direction about the point 45 which lies between the upper part 20 and lower part 15 of the rod of the piston 14. The piston valve 12 is thus moved downwardly so that pressure medium is admitted from a supply port 44 to the servo-cylinder 13 beneath the piston 14 which is thus raised. The piston valve 23 is therefore lifted so that pressure medium is admitted from the supply port 29 to the servo-cylinder 24 above the piston 28. The piston 28 is in this way moved downwards so that the effective value of the resistance 26 is increased and the excitation current of the generator 2 thereby decreased. Thus, while the upward movement of the piston 14 turns the bell-crank lever 16 about the pivot 39 so as to move the fuel regulating device 18 to the right to increase the quantity of fuel injected by the pump 19, the downward movement of the piston 28 causes the excitation current of the generator 2 to be decreased. The load on the engine is thus reduced and the input increased.

The speed of the engine 1 will therefore rise again and the sleeve 10 of the governor will turn the lever 11 about the pivot 45 in the clockwise direction so that the valve 12 is raised and pressure medium is admitted to the cylinder 13 above the piston 14. When the piston 14 reaches the position shown in Figure 1, that is to say, a distance a from a stop 46 provided in the head of the cylinder 13, the valve 23 will be in the central position shown and the effective value of the resistance 26 will thus remain unaltered. At the same time the fuel regulating device 18 will have been returned to its normal position and the fuel delivery to the engine will be restored to the value corresponding to the engine torque existing prior to the commencement of the regulation. The valve 12 is also returned by means of the lever 11 to the central position shown in so far as the desired engine speed is obtained. If now the engine 1 can deal with the load at the torque set for the given engine speed, the state of equilibrium will be maintained. Otherwise, the rheostat arm 27 will again be adjusted either further to increase the effective value of the resistance 26 or to reduce this value as may be desirable to meet further variations.

When the load on the engine 1 is reduced, regulation of the excitation current of the generator 2 and of the fuel regulating device 18 will take place in the opposite sense to that above described, the excitation current being increased until the valve 23 and the piston 14 are returned to their central positions shown. In the event of large or rapid increases or decreases in the load on the engine, the governor may tend to hunt but the resulting oscillation of the governor sleeve 10 will rapidly die down until the sleeve again reaches the position of equilibrium shown.

The said position of equilibrium of the governor sleeve 10 will be in accordance with the characteristics of the mechanism connecting this sleeve to the piston 14 whose position of equilibrium is in turn determined by the characteristics of the mechanism connecting this piston to the valve 23. Different torques and fuel charges can therefore be set for different set speeds by altering the characteristics of the mechanism connecting the governor sleeve 10 and the fuel regulating device 18. To this end, in the construction shown in Figure 1, the position of the pivot 39 is shifted bodily so as in effect, to alter the effective length of the lower part 15 of the rod of the piston 14. The positions of the sleeve 10 and piston 14 corresponding to load equilibrium remain, however, the same as shown in Figure 1.

If, for increasing the engine speed, the speed setting device 33 is adjusted so as to increase the effective tension of the loading spring 30 by lowering the piston 31, the lever 41 will be turned in the counter-clockwise direction about the pivot 42 whereby the pivot 39 would be moved bodily downwards. The fuel regulating device 18 will thus be moved to the right as viewed in the drawings, so as to increase the supply of fuel to the engine 1 thus tending to anticipate the automatic control of the governor 9. The engine 1 will now be accelerated in advance of the load regulation effected by the servo-piston 28. Owing to the increased tension of the spring 30, the weights of the governor 9 will temporarily move inwardly, since the engine speed has not as yet risen. The sleeve 10 will therefore move downwardly and the piston 14 will move upwardly so that the bell-crank lever 16 will be turned in the counter-clockwise direction about the pivot 39, thus producing a further increase in the fuel supply to the engine, provided that the load on the generator 2 has not already been altered in such a manner that modification of the excitation current is not required. The upward movement of the piston 14 will move the valve 23 upwardly and cause the piston 28 to be moved downwardly, thereby increasing the effective value of the resistance 26 and reducing the excitation current of the generator 22.

When the speed of the engine 1 has reached the desired value, and the excitation of the generator 2 has been correspondingly reduced, the piston 14 will be returned to its normal position shown and the governor 10 to the position of equilibrium. Since, however, the new position of the pivot 39, that is to say, of the lower arm of the bell-crank lever 16 between the minimum fuel setting O and the maximum fuel setting X has been altered, the effective stroke of each fuel pump 19 will also have been changed. The rate of such change will be dependent upon the char-

acteristics of the interconnecting mechanism between the speed setting device 33 and the fuel regulating device 18, so that by suitable construction of this mechanism the reduction of the delivery efficiency of the fuel pump, due to the fuel control directly effected by the speed setting device 33, is compensated for. The arrangement may be such that on the speed setting being increased the engine torque is either increased or reduced.

It will be seen that with the construction above described, for rapid setting of the new load, the direct action of the speed setting device on the centre of rotation of the bell-crank lever 16, that is to say, on the fuel regulating device 18, is of considerable importance for the operation of the engine. Thus, the advantages obtained with acceleration or deceleration of the engine 1 are effected substantially simultaneously with alteration in the speed setting by means of the device 33, that is to say, so as to tend to anticipate the action, on the fuel supply, of the automatic regulating apparatus. The regulation of the fuel supply to the engine necessitated by a change in the speed setting is thus effected without the lag which would otherwise be introduced by the automatic control apparatus. With this arrangement therefore, control of the engine is not delayed until after the load on the main generator 2 has been modified, since the new position of equilibrium on the input side of the power unit will be obtained substantially simultaneously with that on the output side, that is to say, the generator 2.

The maximum load or overload which can be set by the piston 14 is positively determined by the stop 46. If at the maximum speed setting of the engine 1 the overload is thus limited to a given value, the overload determined by the stop 46 will be smaller at a lower speed, that is to say, at a higher position of the pivot 39. The overload for any engine speed will therefore bear approximately the same relationship to the normal load for that engine speed, that is to say, the ratio of the maximum load at any given engine speed to the normal load at that speed will be the same for all engine speeds. For the purpose of varying this ratio, means may be provided for adjusting the position of the stop 46.

In Figure 1 the governor 9 is connected to the fuel regulating device 18 and valve 23 only indirectly, that is to say, by means of the servo-motor 13. If desired, however, the governor may be connected directly to these parts by omitting the servo-motor 13 and mounting the pivot 47 on a fixed part, with the end 45 of the lever 11 connected directly to the left-hand end of the lever 22. The operation of the automatic control apparatus will then remain substantially the same but the gain in time by the direct control of the fuel regulating device 18 from the speed setting device 33 will be less and will be represented mainly by the lag due to the inertia of the governor weights. The action of the stop 46 will, however, remain unaltered, that is to say, even with this direct control from the governor 9 the degree of overload available at low speeds will be less than at high speeds.

The manner in which the fuel regulating device 18 controls the fuel supply to the engine may vary to suit requirements. For example, the fuel regulating device 18 may vary the time during which a suction valve of each fuel pump is maintained open at the commencement of the delivery stroke or the timing of a spill valve operated towards the end of the delivery stroke of the pump plunger. Alternatively, the fuel regulating device may determine the effective stroke of the pump plunger or may rotate the plunger so as to vary the effective point of cut-off of a helical control edge whereby either the commencement or the end of the fuel delivery is altered. If, however, not only the quantity of fuel injected, but also the timing of commencement of injection is to be controlled, an arrangement such as that illustrated in Figures 2 and 3 may be employed, this arrangement being described and claimed in copending Patent application No. 124,342, filed February 5, 1937.

In the construction shown in Figure 1 the cam shaft 7 is furnished with four cams 48 each of which transmits reciprocating movement to a pump plunger 49 through a tappet roller 50 and cylindrical guide 51, each plunger being returned on its suction stroke by a spring 53. During the suction stroke of the plunger 49 fuel is drawn in through a suction port 54 and, during the delivery stroke of the plunger, the fuel charge is delivered past a non-return valve 55 to the corresponding engine cylinder. The plunger 49 is provided with two inclined control edges 56 and 57 so that when, during the suction stroke of the plunger, the control edge 56 uncovers the suction port 54 fuel is drawn through this port into the working chamber 59 of the pump and, when, during the compression stroke of the plunger, the control edge 56 again covers the suction port 54 injection of the fuel commences. Injection is continued until the control edge 57 passes over the suction port 54 whereupon the remainder of the fuel within the compression chamber 59 flows back through a groove 58 in the plunger to the suction port 54. The control edge 56 thus determines the point in the plunger stroke at which injection commences whereas the control edge 57 determines the point in the plunger stroke at which the injection is terminated.

In Figure 3 the relative arrangement of the control edges 56 and 57 and the suction port 54 is indicated. In this figure the plunger 49 is in the position which it occupies shortly after the commencement of fuel injection, that is to say during the delivery stroke of the plunger. The lines b_1, b_2, b_3, and b_4 indicate four rotational positions of the plunger 49 with respect to the suction port 54. Thus, with the plunger in a rotational position in which the point of intersection of the line b_1 with the control edge 56 is in alignment with the suction port 54 the commencement of fuel injection will be delayed until a length c at the upper end of the plunger has passed over the suction port 54. If now the plunger 49 is rotated until the point of intersection of the line b_2 with the control edge 56 is in alignment with the suction port 54 injection will commence slightly earlier, the earliest injection being obtained by turning the plunger 49 until the point of intersection of the line b_4 with the control edge 56 is in alignment with the suction port 54.

The distance d between the upper limit of the suction port 54 and the point of intersection of each of the lines b_1, b_2, b_3, b_4, with the control edge 57 is a measure of the quantity of fuel injected, this quantity being increased by rotation of the plunger 49 from, say, the position b_1, towards the position b_4.

For the purpose of imparting the necessary rotation to the plungers 49 the fuel regulating device 18 is in the form of a rack which engages

a toothed rim on a sleeve 60 slotted at its lower end so as to make a splined engagement with a cross member 61 carried by the plunger 49. Thus, when the fuel regulating member or rack 18 is moved to the right as viewed in Figure 1, each of the plungers 49 of the pump 19 is turned in the direction of the arrow 62 in Figure 2. Each plunger will thus be turned, say from the position b_1 shown in Figure 3, towards the position b_4 so that the commencement of injection will be advanced relatively to the corresponding engine crank and, at the same time, the termination of the injection period will be retarded. Referring to Figures 2 and 3, when the plunger 49 is in the rotational position corresponding to the line b_1 fuel will be injected during the crank angle a_1, the rotational positions of the plunger 49 corresponding to the lines b_2, b_3 and b_4 resulting in fuel injection corresponding to the crank angles a_2, a_3, a_4 of the cam 48.

It will therefore be seen that as the speed setting device 33 is moved to increase the speed setting from a low speed n_1 towards a high speed n_4 the pivot 39 of the bellcrank lever 16 is simultaneously lowered and the fuel supply to the engine is thus modified independently of the governor 9, the lower arm of the bell crank lever 16 being turned from the low fuel supply position 0 towards the high fuel supply position X, each of the plungers 49 being simultaneously rotated from a position corresponding to minimum fuel injection towards the maximum fuel injection position corresponding to the line b_4 and cam angle a_4.

Figure 4 illustrates a modified arrangement in which lost motion is provided between the speed setting device 33 and the interconnecting mechanism through which this is connected to the fuel regulating device. To this end a cylindrical casing 63 is pivotally connected at 64 to the lever 41 and the extension 43 is provided with a head 65 which acts on the upper end of a spring 66 whose lower end bears against an annular flange formed within the casing 63 which itself cooperates with a stop 67 formed at the upper end of the cylinder 32. Thus, though adjustment of the speed setting device 33 to increase the speed setting from a low speed n_1 to higher speeds n_2 and n_3 will result in simultaneous adjustment of the fuel regulating device 18 as above described, further adjustment of the device 33 to increase the speed setting above the value n_3 will result in the spring 66 being compressed since the casing 63 will then bear against the stop 67. In this way direct adjustment of the fuel supply to the engine by adjustment of the device 33 will not take place at speed settings above the value n_3.

In the constructions above described the ratio of movement of the fuel regulating device 18 to the movement of the spindle 37 is dependent on the characteristics of the interconnecting mechanism 41, 40 and 16. If desired, however, the construction may be modified so that the ratio of the fuel setting to the speed setting may vary in accordance with a predetermined requirement. Thus, for example, instead of the change in the fuel supply due to adjustment of the device 33 being proportional to the change in the speed setting, that is to say following a straight line, the relationship between these control values may be different. One such arrangement is shown by way of example in Figure 5 in which a cam member 68 is slidable along a fixed plane 69 and is connected through a bell crank lever 70 to the extension 43. Movement is transmitted from the cam member 68 to a tappet roller 71 at the upper end of the rod 40. The roller 71 is maintained in engagement with the cam member 68 by means of a spring 72 whose lower end bears against a guide 73 for the rod 40.

The law governing the relationship between the alteration in the speed setting and the resulting direct adjustment of the fuel supply may be determined as desired by employing cams of different characteristics. Thus, if desired, the cam member 68 may be such that when the device 33 is adjusted to increase the speed setting the rod 40 is actuated so as to reduce the fuel supply to the engine, instead of an increase in the speed setting by means of the device 33 resulting in the movement of the rod 40 such as to increase the fuel supplied to the engine.

Though in the constructions above described the speed setting device 33 acts through interconnecting mechanism on the fuel regulating device, the arrangement may be such that the speed setting device is controlled from the fuel regulating device. One such arrangement is illustrated by way of example in Figures 6 and 7 in which the governor 9 instead of being opposed by a single spring is opposed by several springs which can be rendered operative successively to increase the speed setting. The supply of power for operating a piston 74 is controlled by a shaft 75 actuated by a regulating handwheel 76. The governor 9 is opposed by three springs 77, 78 and 79, the sleeve 10 of the governor being connected through a rocking lever 80 and link 81 to the piston valve 23 for regulating the excitation current to the generator 2 in the manner described above. The rocking lever 80 is also connected through a link 82 and crank 83 to a shaft 84 carrying four eccentrics 85 each of which controls a bifurcated lever 86. The bifurcated end of each lever 86 cooperates with a rocking lever 87 pivotally connected to the corresponding pump plunger 88. During the suction stroke of the plunger 88 fuel is drawn into the pump chamber past a suction valve 89, the point in the delivery stroke of the plunger 88 at which the corresponding lever 86 raises the valve 89 to terminate the injection being controlled not only by the corresponding eccentric 85, but also in accordance with the position of a plunger 90 which is connected at 91 to the lever 87 and thus determines the position of the pivot 92 at the bifurcated end of the lever 86.

In the event of the load on the power unit altering, say increasing due to an increase in the load on the generator 2, the speed will tend to fall so that the governor sleeve 10 will drop whereby the eccentrics 85 will be turned in the clockwise direction as viewed in Figure 7. The centre of rotation of each of the levers 86 will thus be lowered thereby tending to cause the suction valves 89 to be closed later in the delivery stroke of each of the plungers 88, the quantity of fuel supplied to the engine being thus increased. At the same time the valve 23 is raised so that the piston 28 moves downwardly and the effective value of the resistance 26 is increased thereby decreasing the excitation current of the generator 2. When the position of equilibrium is again reached the sleeve 10, valve 23 and eccentrics 85 will be restored to their central positions shown.

With the parts as shown in Figure 6 the piston

74 is in its fully raised position so that the governor 9 is opposed only by the spring 77, that is to say the speed setting is a minimum. When it is desired to set a higher engine speed the handwheel 76 is rotated in the clockwise direction as viewed from above so that the shaft 75 raises the plunger 90 from the position shown at I to the position II and thus not only increases the fuel supply to the engine but also causes a contact member 93 to connect the positive conductor shown in Figure 7 to a conductor 94. Current is thus supplied to a relay 95 which turns a valve 96 so as to cause pressure medium to be supplied from a supply pipe 97 into an annular cylinder above a piston 98 which is thus moved down until it engages a stop 99 and also an annular flange 100 at the lower end of the piston 74. The piston 74 is thus moved downwardly so as not only to increase the effective tension of the spring 77 but also to render the spring 78 operative, the governor now being opposed by both the springs 77 and 78 for a higher speed setting. By further rotation of the handwheel 76 in the direction above indicated so as to raise the plunger 90 from the position II to the position III the fuel supply is again increased and the contact member 93 connects the positive conductor also to a conductor 101 so as to energize a relay 102. A valve 103 is thus turned so that pressure medium is supplied from a pipe 104 to the cylinder above the piston 74. The piston 74 is thus moved down until the flange 100 thereon engages the stop 99. The governor 9 is now opposed by all the three springs 77, 78 and 79 for the maximum speed setting.

For each speed setting the apparatus operates as above described to control the excitation of the main generator, the parts returning to their central position of equilibrium after the regulation necessitated by the alteration in the speed setting.

It will be seen that when the speed setting is to be altered this is effected substantially simultaneously with a corresponding alteration in the fuel supply to the engine since alterations in the speed setting device are effected by the plunger 90 which, in this construction, constitutes a direct fuel regulating device. In the event therefore of an increase in the speed setting the supply of fuel to the engine is simultaneously increased to give the necessary engine acceleration, thus anticipating the fuel regulation effected by the governor which takes care of the regulation of the excitation current for the generator.

While in known arrangements the speed setting device and that for controlling the excitation current to the main generator are interconnected so that a given torque is obtained for each speed set so as to tend to ensure smooth running at low speeds by injecting a smaller quantity of fuel, in accordance with the present invention not only can the torque be maintained lower at low engine speeds, but in addition the degree of overload available may differ at different engine speeds.

Instead of controlling the fuel supply to the engine by rotating the pump plunger, each plunger may reciprocate within a sleeve which is itself rotatable about the longitudinal axis of the plunger and is furnished with the necessary control edges or ports. The use of a pump in which the commencement and also the termination of injection are simultaneously regulated is advantageous in that not only the engine speed, torque and commencement of injection are simultaneously adjusted but primarily because owing to the limitation of the degree of overload at lower engine speeds, the timing of the commencement of each injection will be in accordance with the quantity of fuel injected.

Though in the construction described the automatic control apparatus includes a governor of the centrifugal type a hydraulic governor may be employed. For example the shaft 7 may drive a pump which supplies liquid pressure medium to a piston opposed by the spring 30 and to which the lever 11 is connected.

It will be understood that the constructions above described are given by way of example only and that details may be modified. For example, instead of the speed setting device comprising a piston such for example as the piston 31 or 74 for determining the loading of the governor, any other suitable means may be employed for this purpose. This also applies to the apparatus for determining the fuel supplied to the engine, that is to say instead of the rack 18 in Figure 1 or the shaft 75 in Figure 6, other suitable means may be employed whereby adjustment of the speed setting causes at the same time substantially direct adjustment of the fuel supply.

I claim:

1. In an internal combustion engine-electric power unit, the combination with a fuel-injection compression-ignition type engine of an electric generator driven thereby, a fuel pump for the injecting of fuel into the engine, a speed setting device operatively connected to the pump for setting the speed at which the engine will operate, and regulating means in engagement with the pump for regulating the quantity of fuel injected into the engine and the timing of injection.

2. An internal combustion engine-electric power unit as claimed in claim 1, in which automatic control apparatus is connected with the pump and the speed setting device, and means are provided whereby the speed setting device and the automatic control apparatus may separately control the supply of fuel to the engine.

3. An internal combustion engine-electric power unit as claimed in claim 1, in which a fuel regulating device is in engagement with the pump controlled by the speed setting device for regulating the timing of commencement of fuel injection, and automatic control apparatus is connected to a second fuel regulating device for regulating the timing of ending the fuel injection.

4. An internal combustion engine-electric power unit as claimed in claim 1, in which the pump comprises a rotatable plunger mounted within a sleeve, said plunger having control edges which determine the timing of injection and quantity of fuel injected.

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