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2,340,994

REGULATING APPARATUS

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Fig. 1.

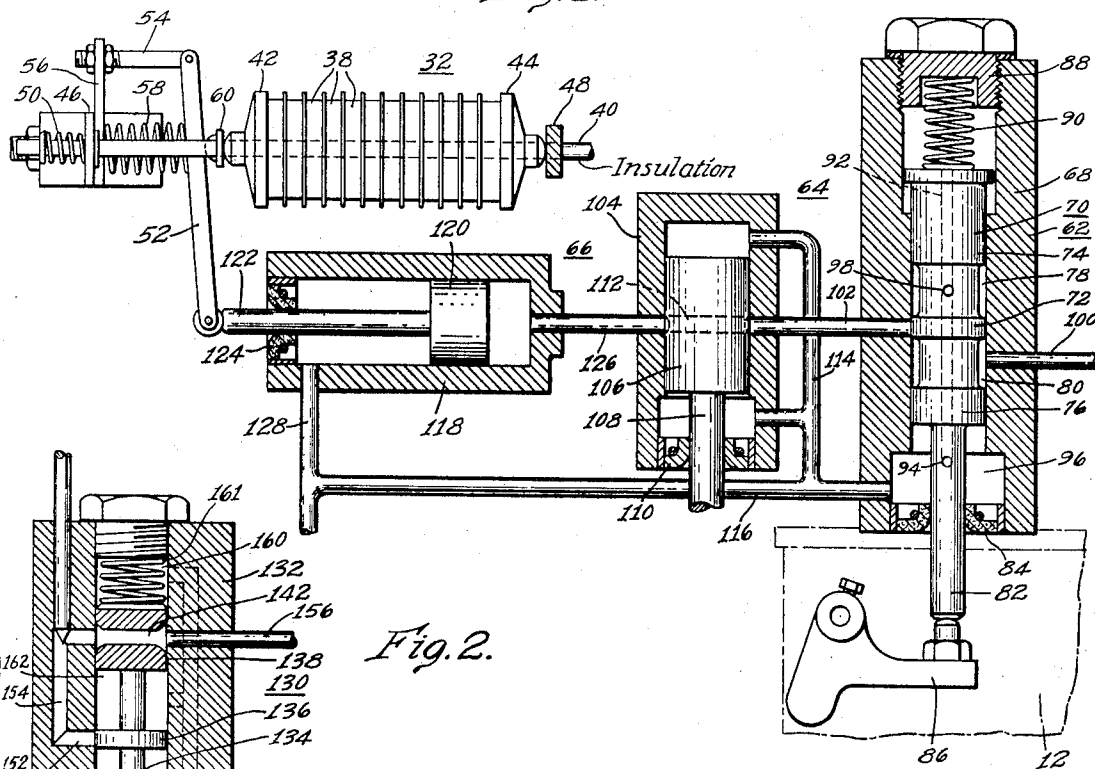


Fig. 2.

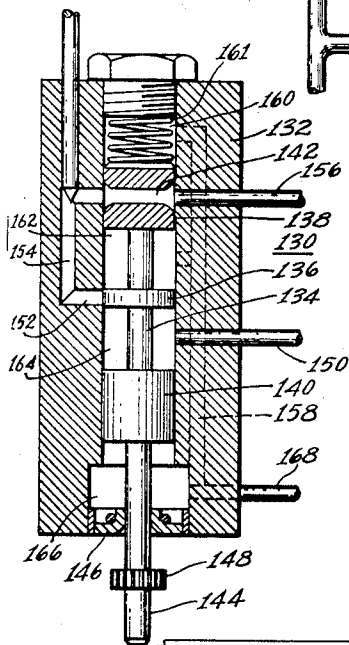
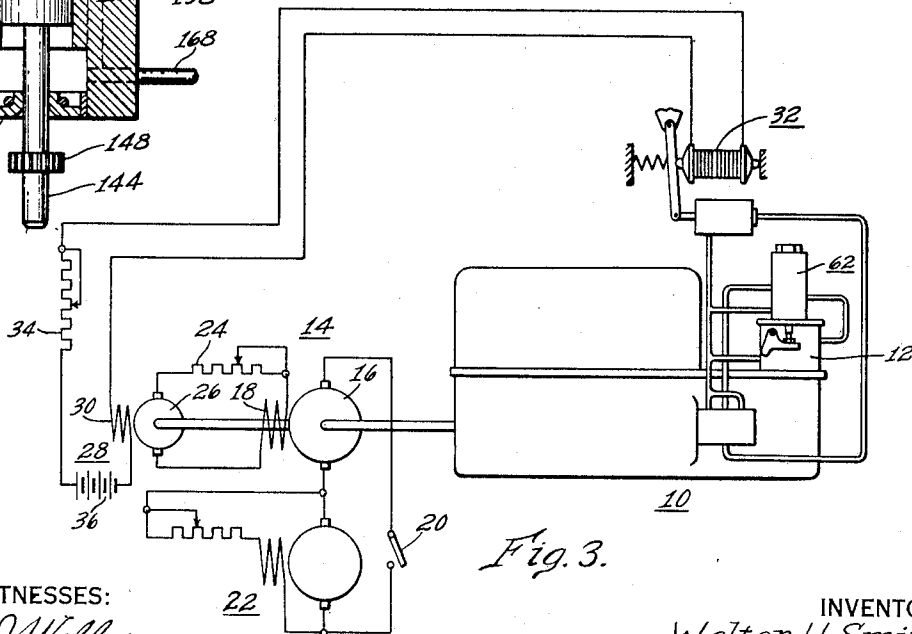


Fig. 3.

WITNESSES:

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REGULATING APPARATUS

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7 Claims. (Cl. 171-229)

This invention relates to regulating apparatus for constant speed engines, and particularly to regulating apparatus for preventing overloading of constant speed engines.

In Diesel electric locomotives, it is necessary to provide for load regulation to prevent overloading of the Diesel engine. Many types of load regulating apparatus have been provided heretofore but they have had certain disadvantages. The different types of known load regulating apparatus are complicated and have large moving parts thereby necessitating more space for mounting the regulating apparatus and greatly adding to the cost of the installation. Another disadvantage of the known types of regulators is that hunting is encountered whereby the control is not sufficiently sensitive to meet given conditions.

An object of this invention is to provide for operating constant speed engines at substantially maximum capacity without overloading and stalling them.

Another object of this invention is to provide anti-hunting regulating apparatus for constant speed engines to maintain the operation of such engines at substantially maximum capacity without overloading and stalling them.

Other objects of the invention will become apparent from the following description when taken in conjunction with the accompanying drawing, in which:

Figure 1 is a view in elevation and partly in section of control apparatus employed in this invention;

Fig. 2 is a view in elevation and partly in section of another embodiment of part of the control apparatus employed in this invention; and

Fig. 3 is a schematic view of the regulating apparatus of this invention.

Referring to Fig. 3 of the drawing, a preferred embodiment of the regulating apparatus is illustrated applied to a Diesel engine 10. The Diesel engine 10 is of the usual type having hand or power operated throttles (not shown) for controlling the operation of the engine and a hydraulic speed governor 12 for preventing overloading of the engine, as will be explained more fully hereinafter. The details of the hydraulic governor 12 are not illustrated as they are well known, the casing of such hydraulic governors including a pump for supplying lubricant under pressure to a point in the system where required.

A generator 14 provided with an armature winding 16 and a field winding 18 is driven by the Diesel engine 10. The armature windings 16 are

connected through an operating switch 20 to a motor 22. The field winding 18 of the generator 14 is electrically connected through a suitable adjustable resistor 24 to the armature 26 of an exciter generator 28 which is also driven by the Diesel engine. The exciter generator 28 also has a field winding 30 connected through a series connected pressure responsive pile resistor 32 and an adjustable field rheostat 34 to be energized from a suitable source of power, such as the battery 36. The pile resistor 32 and the operating mechanism therefor are better shown in Fig. 1.

The pile resistor 32 may be of any of the well known types and in this embodiment is illustrated as comprising a stack of discs 38 slidably mounted on an insulated rod 40 between pressure discs 42 and 44, the assembly being mounted between support members 46 and 48. Although only one stack of discs 38 is visible in the drawing, usually two or more stacks connected in series circuit relation are utilized and are so mounted on insulated rods 40 associated therewith that an equalized pressure can be applied simultaneously to each stack. The ends of the rod 40 of each of the stacks are slidably mounted in the support members 46 and 48, a spring member 50 being provided for normally biasing the rod 40 away from the fixed stop 48 at the other end of the stack.

A pressure applying lever 52 is pivotally carried by an anchor stud 54 which is secured to a lug 56 carried by the support member 46. A pressure spring 58 is positioned between the lug 56 and the lever 52 for normally biasing the lever 52 to apply pressure to the cross bar 60 where more than one stack is employed, or directly to the end cap of the pressure disc 42 to compress the stack of discs. Pile resistors of this general type are disclosed and claimed in my Patent No. 2,276,069, issued March 10, 1942, and assigned to the assignee of this invention.

In order to release the pressure on the stack of discs 38, a control valve member 62, an auxiliary control valve member 64 and a power piston member 66 are provided for so cooperating in response to a decrease in the speed of the engine 10 as to apply an intermittent change of pressure to the end of the lever 52 in opposition to the pressure of the spring 58.

The control valve member 62 is disposed to be mounted on the casing of the hydraulic governor 12 and comprises a sleeve member 68 having a piston valve member 70 slidably disposed therein. The piston valve member 70 is formed of the valve 72 intermediate of the closure members 74

and 78, which cooperate therewith in forming two chambers 78 and 80. The stem 82 of the piston valve member 70 extends through an oil gland 84 at the lower end of the casing member 68 and terminates in a position where it is disposed to be engaged by the actuating lever 86 of the hydraulic governor 12 in a predetermined manner. The upper end of the casing member 68 is closed by means of the threaded cap member 88 forming a reservoir with the end of the piston valve member 70, a spring member 90 being disposed between the end cap member 88 and the upper end of the piston valve member 70 for normally biasing the piston valve member downwardly in the casing member. As illustrated, a passage 92 is provided extending from the end of the piston valve member in the reservoir and terminating in the opening 94 which communicates with a drain chamber 86 provided in the lower end of the casing member. An opening 98 is also provided in the piston valve member 70 communicating between the chamber 78 and the passage 92 for draining the lubricant from the chamber 78 under predetermined conditions. An inlet passage 100 is provided in the casing member 68 and is connected to the hydraulic governor 12 for supplying the lubricant to the chamber 80 under pressure. An outlet passage or port 102 is also provided in the casing member 68 for cooperating with the valve 72 for controlling the outlet of the lubricant from the control valve member 62 or the draining of the lubricant from the power piston member 66 as will be explained more fully hereinafter.

The auxiliary control valve member 64 comprises the casing member 104 having a rotary valve member 106 disposed therein with its stem 108 extending through an oil gland 110 at the lower end thereof. The stem member 108 of the rotary valve member 106 is disposed to be connected either directly or through a suitable gear chain (not shown) to the crankshaft of the Diesel engine 10, and is operated in accordance with the speed of the engine 10. As illustrated, the rotary valve member 106 has a passage 112 there-through which is disposed to be aligned with the ports in the casing member 104 for a given position of the rotary valve member 106. The passage 112, however, may be of any form, depending upon the location of the ports in the casing member 104. In addition to being a single passage 112 as illustrated, a plurality of passages through the rotary valve member 106 may be provided, depending upon the number of desired admissions, one or more, of the lubricant through the auxiliary control valve member 64 per revolution of the engine 10. As illustrated, the chambers formed in the casing member above and below the rotary valve member 106 are connected by the pipe 114 to the drain pipe 116 from the drain chamber 86 of the control valve 62.

The power piston valve member 66 comprises the casing member 118 having a sliding power piston 120 disposed therein with its piston rod 122 extending through the oil gland 124 to a position where it abuts the lever 52 to actuate it under predetermined conditions. The other end of the casing member 118 is connected by the pipe 126 to the outlet port of the auxiliary control valve 64. As there is some leakage of the oil about the piston member 120, a pipe 128 is provided for draining the lubricant from the power piston valve member 66, the drain pipe 116 being connected thereto. This drain pipe 128 provides for returning the lubricant from the

operating mechanism to the reservoir of the engine 10.

In operation, assuming that the engine 10 is adjusted for operating at a particular given speed to drive the governor 12, and assuming that the field rheostat 34 and the pile resistor 32 have been adjusted to so energize the field winding 18 as to cause the generator 14 to generate a predetermined voltage, the switch 20 is manually operated to close the circuit from the armature winding 16 to the motor 22.

If an excessive load is encountered, such as where a locomotive is pulling a grade, the demand on the generator 14 tends to overload the engine 10 so that a decrease in the speed of the engine 10 from the speed which it is desired to maintain results. As the speed of the engine 10 decreases, the governor 12 functions to force the lever 86 in a counter-clockwise direction to actuate the piston valve member 70 of the control valve 62 upwardly against the bias of the spring 90.

As the piston valve 72 moves upwardly to clear the outlet port formed by the passage 102, the lubricant is delivered under pressure from the chamber 80 to the auxiliary control valve member 64, and since the rotary valve member 106 thereof is actuated in accordance with the speed of the engine, the lubricant is delivered by the auxiliary valve member 64 to the power piston member 66 in jets, the number and spacing of which depends upon the number of angular positioning or spacing passages 112 that are provided in the rotary valve member 106 and also the speed of the engine. For a single straight passage 112, as illustrated, in the rotating valve member 106 there will be two passages of the lubricant to the power piston member 66 per revolution of the valve member 64. Likewise, with three passages there will be six admissions of the lubricant to the power piston member 66 per revolution of the valve member 64. On the other hand, if the ports of a single passage are at right angles or 90° from one another, then only one admission of the lubricant is obtained per revolution of the valve member 64.

As the lubricant is delivered to the power piston member 66, the piston 120 is actuated to operate the lever 52 against the bias of the spring member 58 in intermittent steps to release the pressure on the stack of discs 38. The piston 120 of the power piston member 66 moves in small steps depending on the number of revolutions of the engine crankshaft per minute, and it is evident that there will be no swings and no engine hunting or oscillations because the change in the pressure on the stack of discs 38 is in small increments. This change in the pressure on the stack of discs also varies somewhat, depending upon the speed of the engine, for it is evident that the increments of movement of the power piston 120 are a maximum when the engine is operating so as to operate the control valve 62 in such a manner that the passage 102 has a maximum communication with the chamber 80 of the control valve member 62. As the speed of the engine increases so that the governor 12 operates to permit return of the piston valve member 70 to the position shown in Fig. 1, the outlet port 102 from the control valve member is gradually closed while at the same time, the speed of the rotating valve member 106 is increased to decrease the amount of lubricant which is permitted to pass through the passage 112 to the power piston 66.

As the pressure is released on the pile resistor 32, the resistance of the resistor 32 is increased to effect a decrease in the field current of the exciter 28, and consequently, a decrease in the field current of the generator 14. This decrease in the field current of the generator 14 effects a decrease in the voltage generated by the generator to relieve the overload condition on the engine 10. As the engine 10 is brought to the desired speed, the governor 12 and the lever 86 function to release the pressure on the piston valve member 70 of the control valve whereby the valve member 70 returns to the position shown in Fig. 1.

If the engine 10 drops below full load, the valve member 70 of the control valve drops to a position where the valve 72 clears the port connecting with the passage 102 so that the passage 102 then communicates with the chamber 78 to deliver the lubricant from the power piston through the pipe 126 and the rotating valve member 106 of the auxiliary control valve 64 in increments depending upon the speed of the engine to the chamber 78 from which it is drained through the opening 98 and passage 92 to the drain chamber 96 of the control valve 62, and thence returned through the pipe 116 to the reservoir of the engine. Such action functions to permit the spring 58 to apply an intermittent increase of pressure on the pile resistor 32 to decrease its resistance, and consequently increase the excitation of the generator 14 to increase the voltage generated thereby.

The same operation is obtained utilizing the valve illustrated in Fig. 2 of the drawing. In this embodiment the control valve and auxiliary control valve are combined in a single valve member 130 having a casing member 132 and a rotating piston member 134 therein. The piston member 134 carries a control valve 136 disposed intermediate of the closure members 138 and 140, the closure member 138 forming a rotating valve member having a passage 142, either straight or angular, or, if required, more than one passage therein. The end of the rod 144 of the piston member 134 extends through the oil seal 146 and terminates adjacent the lever (not shown) of the governor to be actuated thereby. The end of the rod 144 also carries a suitable gear 148 disposed to be engaged by a gear drive (not shown) and driven in accordance with the speed of the engine.

A passage 150 is provided for delivering the lubricant under pressure to the chamber 164, a port 152 and passage 154 being provided in the casing member 132 for delivering the lubricant under pressure to the rotating valve member 138 when the valve 136 is actuated upwardly. As illustrated, the ends of the passage 142 in the rotating valve member are so enlarged or the entire passage may be so large that for all operative positions of the valve 136, the passage 142 rotates and periodically is in alignment with the passage 154. The other passage 156 is disposed to deliver the lubricant as it is passed by the rotating valve to the power piston to intermittently operate the power piston. A drain passage 158 is connected to the chamber 160 formed above the rotating member and in which the spring 161 is positioned for biasing the piston member against the lever of the governor and chambers 162, 164 and 166 for draining the lubricant from the valve member, the passage 158 being connected to the pipe 168 to the reservoir of the governor. The valve member 130 illustrated functions in the same manner as the more

complicated control valve 62 and the auxiliary control valve 64 of the embodiment illustrated in Fig. 1, it being noted that as the speed of the engine increases the piston member 134 of the valve member 130 drops to a position where the lubricant is intermittently returned from the power piston member through the passage 156, rotating passage 142, and passage 154 to the chamber 162 above the valve 136 and from thence to the drain passage 158. This simplified valve member gives an efficient regulation.

By means of the regulating apparatus of this invention, it is apparent that a substantially constant speed is maintained for constant speed engines without overloading the engine regardless of the load demand on the generator driven by the engine. At all times, the power supplied by the generator is substantially constant, the voltage of the generator varying in accordance with the change in the current demand while the speed of the engine remains substantially constant. Because of the apparatus employed, any change in the load of the engine effects an immediate change in the excitation of the generator, such change in the excitation being directly proportional to the change in the load conditions, for as explained hereinbefore, the control valve and the auxiliary control valve cooperate to adjust the pressure on the pile rheostat in increments which vary in accordance with the speed of the engine. This system is very sensitive, it being found that its operation is independent of the temperature or grade of the lubricant employed in the engine.

Although this invention has been described with reference to a particular embodiment thereof, it is, of course, not to be limited thereto except insofar as is necessitated by the scope of the appended claims.

I claim as my invention:

1. In regulating apparatus for constant speed engines, in combination, a generator provided with an armature winding and a field winding disposed to be driven by the engine, means for energizing the field winding of the generator, a rheostat connected in circuit relation with the energizing means disposed to be operated for controlling the voltage generated by the generator, a pressure responsive means disposed for operating the rheostat, a power piston responsive to pressure disposed to operate the pressure responsive means, a liquid maintained under pressure, a control valve responsive to the speed of the engine for delivering the liquid to and effecting the operation of the power piston, and means operative independently of the power piston and the control valve for rendering the delivery of the liquid from the control valve to the power piston intermittent to give an intermittent operation of the rheostat to prevent hunting and maintain the speed of the engine substantially constant under changing load conditions.

2. In regulating apparatus for constant speed engines, in combination, a generator provided with an armature winding and a field winding disposed to be driven by the engine, means for energizing the field winding of the generator, a rheostat connected in circuit relation with the energizing means disposed to be operated for controlling the voltage generated by the generator, a pressure responsive means disposed for operating the rheostat, a power piston responsive to pressure disposed to operate the pressure responsive means, a liquid maintained under pressure, a control valve responsive to and effecting the

operation of the power piston, and means comprising a valve disposed for operation independently of the operation of the control valve to render the delivery of the liquid from the control valve to the power piston intermittent, the intermittent delivery of the liquid to the power piston effecting the intermittent operation of the rheostat to prevent hunting and maintain the speed of the engine substantially constant under changing load conditions.

3. In regulating apparatus for constant speed engines, in combination, a generator provided with an armature winding and a field winding disposed to be driven by the engine, means for energizing the field winding of the generator, a rheostat connected in circuit relation with the energizing means disposed to be operated for controlling the voltage generated by the generator, a pressure responsive means disposed for operating the rheostat, a power piston responsive to pressure disposed to operate the pressure responsive means, a liquid maintained under pressure, a control valve responsive to the speed of the engine for delivering the liquid to and effecting the operation of the power piston, and means comprising a rotating valve disposed for continuous operation independently of the operation of the control valve to render the delivery of the liquid from the control valve to the power piston intermittent, the intermittent delivery of the liquid to the power piston effecting the intermittent operation of the rheostat to prevent hunting and maintain the speed of the engine substantially constant under changing load conditions.

4. In regulating apparatus for constant speed engines, in combination, a generator provided with an armature winding and a field winding disposed to be driven by the engine, means for energizing the field winding of the generator, a rheostat connected in circuit relation with the energizing means disposed to be operated for controlling the voltage generated by the generator, a pressure responsive means disposed for operating the rheostat, a power piston responsive to pressure disposed to operate the pressure responsive means, a liquid maintained under pressure, a control valve connected to receive the liquid disposed for operation in response to the speed of the engine, and means connecting the control valve and power piston for delivering the liquid to the power piston when the control valve is operated, said means including a valve disposed for operation independently of the operation of the control valve to render the delivery of the liquid to the power piston intermittent, the intermittent delivery of the liquid to the power piston effecting the intermittent operation of the rheostat to prevent hunting and maintain the speed of the engine substantially constant under changing load conditions.

5. In regulating apparatus for constant speed engines, in combination, a generator provided with an armature winding and a field winding disposed to be driven by the engine, means for energizing the field winding of the generator, a rheostat connected in circuit relation with the energizing means disposed to be operated for controlling the voltage generated by the generator, a pressure responsive means disposed for

operating the rheostat, a power piston responsive to pressure disposed to operate the pressure responsive means, a liquid maintained under pressure, a control valve connected to receive the liquid disposed for sliding operation in response to the speed of the engine, and means connecting the control valve and power piston for delivering the liquid to the power piston when the control valve is operated, said means including a rotating valve disposed for continuous operation by the engine independently of the sliding operation of the control valve to render the delivery of the liquid to the power piston intermittent, the intermittent delivery of the liquid to the power piston effecting the intermittent operation of the rheostat to prevent hunting and maintain the speed of the engine substantially constant under changing load conditions.

6. In regulating apparatus for constant speed engines, in combination, a generator provided with an armature winding and a field winding disposed to be driven by the engine, means for energizing the field winding of the generator, a rheostat connected in circuit relation with the energizing means disposed to be operated for controlling the voltage generated by the generator, a pressure responsive means disposed for operating the rheostat, a power piston responsive to pressure disposed to operate the pressure responsive means, a liquid maintained under pressure, valve means responsive to the speed of the engine for delivering the liquid to and effecting the operation of the power piston, the valve means including a sliding valve disposed to connect the power piston to the liquid under pressure and a rotating valve for effecting the delivery of the liquid to the power piston in an intermittent manner, the intermittent delivery of the liquid to the power piston giving an intermittent operation of the rheostat to prevent hunting and maintain the speed of the engine substantially constant under changing load conditions.

7. In regulating apparatus for constant speed engines, in combination, a generator provided with an armature winding and a field winding disposed to be driven by the engine, means for energizing the field winding of the generator, a rheostat connected in circuit relation with the energizing means disposed to be operated for controlling the voltage generated by the generator, a pressure responsive means disposed for operating the rheostat, a power piston responsive to pressure disposed to operate the pressure responsive means, a liquid maintained under pressure, valve means responsive to the speed of the engine for delivering the liquid to and effecting the operation of the power piston, the valve means including a continuously rotating valve member mounted for sliding movement disposed to connect the power piston to the liquid under pressure and effect the delivery of the liquid to the power piston in an intermittent manner, the intermittent delivery of the liquid to the power piston giving an intermittent operation of the rheostat to prevent hunting and maintain the speed of the engine substantially constant under changing load conditions.

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