

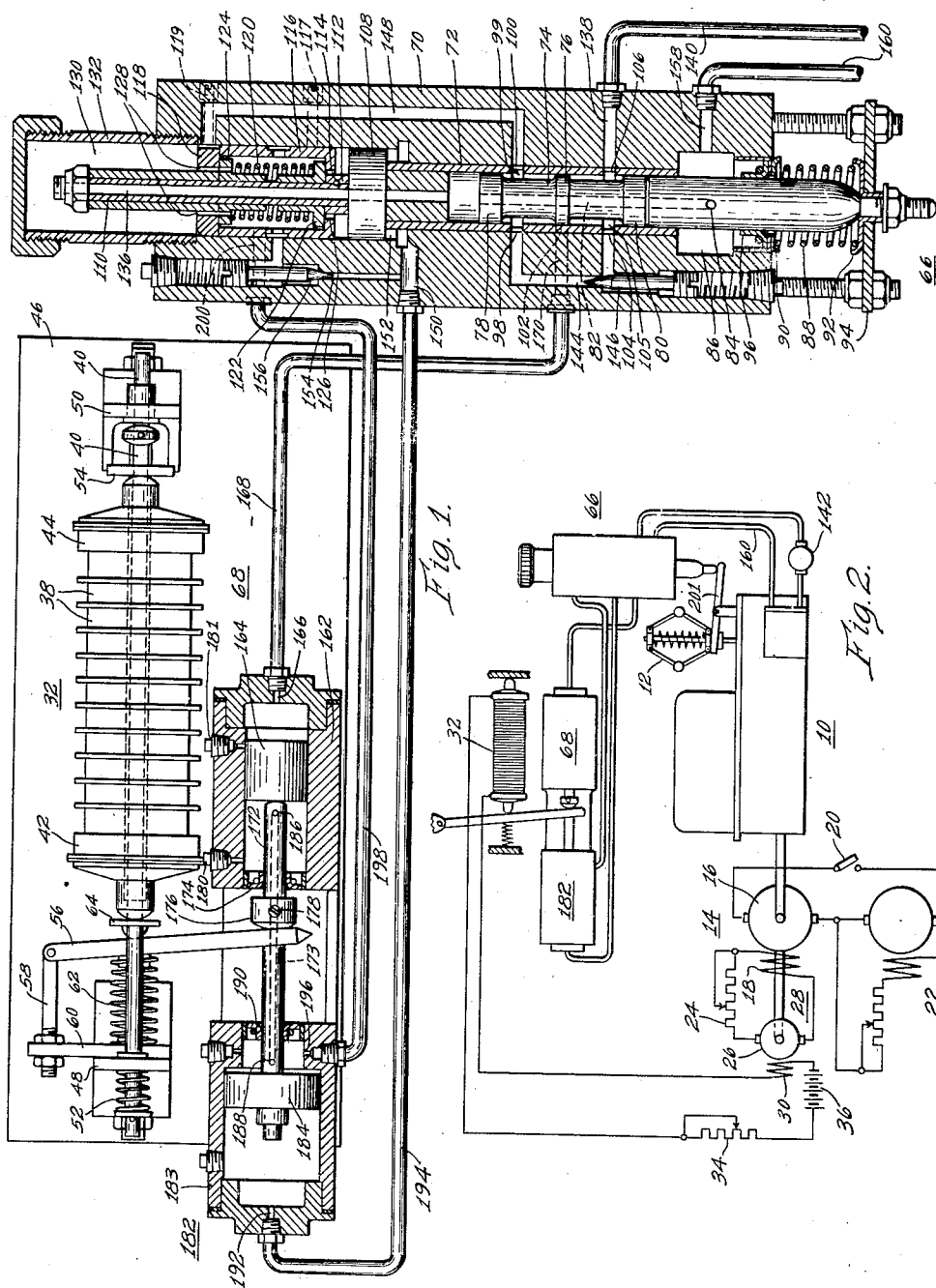
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REGULATING APPARATUS

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REGULATING APPARATUS

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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 thereby 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 this 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, and

Fig. 2 is a schematic view of the regulating apparatus of this invention.

Referring to Fig. 2 of the drawing, the 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 speed governor 12 for preventing overloading of the engine as will be explained more fully hereinafter.

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 28 also has a field winding 30 connected through a series-con-

nected pressure responsive pile resistor 32 and 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 is better shown in Fig. 1.

The pile resistor 32 comprises a stack of disks 38 slidably mounted on an insulated rod 40 between pressure disks 42 and 44, and can be mounted on the panel 46 in any suitable manner. Although only one stack of disks 38 is visible in Fig. 1, usually two or more stacks connected in series circuit relation are utilized and are so mounted that an equalized pressure can be applied simultaneously to each stack. The ends of the rod 40 are slidably mounted in the support members 48 and 50 carried by the panel, a spring member 52 being provided for normally biasing the rod 40 away from the fixed stop 54 carried by the support 50 at the other end of the stack.

A pressure applying lever 56 is pivotally carried by an anchor stud 58 which is secured to a lug 60 carried by the support member 48. A pressure spring 62 is positioned between the lug 60 and the lever 56 for normally biasing the lever 56 to apply pressure to the cross bar 64 where more than one stack is employed, or directly to the end cap of the pressure disk 42 to compress the stack of disks. 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 disks 38, a control valve member 66 and a power piston 68 are provided for so cooperating in response to a decrease in the speed of the engine 10 as to apply pressure to the end of the lever 56 in opposition to the pressure of the spring 62.

The control valve member 66 is formed of a plurality of elements and comprises the casing member 70, a sleeve valve 72 and a piston valve member 74, the casing member and sleeve valve being provided with suitable ports and passages for effecting a predetermined operation of the power piston 68.

The piston valve member 74 is provided with the valve 76 disposed intermediate of the closure members 78 and 80, and is operatively positioned in the sleeve valve member 72. A passage 82 is provided in the piston valve member extending from the upper end thereof and terminating in the opening 84 which opens into the drain chamber 86 in the casing member 70. The piston valve member is maintained in operative position in

the sleeve valve member 72 by reason of the spring member 88 disposed between the end caps 90 and 92 for normally biasing the piston valve member 74 downwardly against the stop 94 carried by the casing member 70. As illustrated, a suitable oil gland 96 is provided adjacent the lower end of the piston valve member 74 for preventing leakage from the chamber 86.

The sleeve valve member 72 is disposed in the casing member 70 for sliding movement relative to the casing member 70 and the piston valve member 74. In order to obtain a predetermined operation of the power piston, as well as the control valve member 66, the sleeve valve 72 is provided with aligned ports 98 and 100 which communicate with the chamber formed between the closure member 78 and the valve 76 of the piston valve member, a port 102 normally aligned with the valve 76 of the piston valve member, and aligned ports 104 and 106 communicating with the chamber formed between the closure member 80 and the valve 76 of the piston valve member 74. The ports 98 and 100 are connected by the groove 99 and the ports 104 and 106 are connected by the groove 105 to insure communication between the connected ports. A piston 108 is also seated on the upper end of the sleeve valve member 72 disposed to be actuated to effect a movement of the sleeve valve member 72 in a predetermined manner.

In order to maintain the sleeve valve 72 and the piston 108 in the normal operative position, the piston is positioned about the valve stem 110 and is secured in such position by the ring collar 112 which is keyed to the stem by the key 114. A bushing 116 having one flanged end is secured in the casing by the set screw 117, the other end of the bushing being closed by the collar 118 which is secured in the casing by the set screw 119. Within the bushing, a compressing spring member 120 is disposed between the flanged collars 122 and 124 the lower collar 122 seating against the upper end of the collar 112. As illustrated clearance is provided between the edge of the flanged end of the bushing 116 and the collar 112 to form the passage 126 and passages 128 are provided through the collar 118 and the flange collar 124, the purpose of which will be explained more fully hereinafter.

A reservoir 130 is formed adjacent the passages 128 by means of the end cap 132 secured to the casing member 70 and disposed about the stem member 110. The stem 110 is provided with a passage 136 which forms a drain from the reservoir 130 and is aligned with a similar passage of the piston 108 and the upper part of the sleeve valve member 72.

As illustrated, port 106 of the sleeve valve member 72 is normally disposed to be aligned with a passage 138 which is disposed to be connected by means of the pipe 140 through a pump 142, illustrated in Fig. 2, to the reservoir of the engine 10. Port 104 of the valve sleeve member 72 is disposed to normally align with one end of a U-shaped passage 144, the other end being aligned with the port 98. As illustrated, a needle valve 146 is provided in the passage 144, the purpose of which will be explained more fully hereinafter. A passage 148 is also provided on the other side of the casing member, one end of the passage terminating in the port 100 of the sleeve valve 72 and the other end terminating in a passage leading to the reservoir 130 at the top of the casing member 70. A passage 150 is also provided in the casing member 70 terminating in a chamber

152 below the sleeve valve piston 108. Another passage 154 is provided having one end in communication with the passage 150 and the other end communicating with the chamber formed by the bushing 116 and the collar member 118. As illustrated, a needle valve 156 is also provided in passage 154 the purpose of which will be explained more fully hereinafter. For purposes of draining the chamber 86, a passage 158 is provided in the casing member 70, and is connected by pipe 160 to the reservoir of the engine 10.

The power piston member 68 is formed of the sleeve 162 having the piston 164 slidably disposed therein, a passage 166 being provided in the closure member of the sleeve 162 disposed to be connected by the pipe 168 to the passage 170 provided in the sleeve member 70, the passage 170 normally being in alignment with the port 102 of the sleeve valve member 72. The piston 164 abuts the rounded end of the piston rod 172 which extends through an oil gland 174. External of the power piston member 68, a collar 176 is adjustably secured to the piston rod 172 by the setscrew 178 the collar 176 being disposed for abutting the lever 56 to effect a movement thereof in response to a movement of the piston 164. The power piston member 68 is provided with suitable vent plugs 180 and 181 for filling the chambers therein with oil or for removing air from the piston member.

As illustrated in the drawing, an auxiliary piston member 182 formed of the casing 183 and the auxiliary piston 184 is so disposed on the panel 46 that the piston 184 is disposed to be actuated by the piston 164 of the power piston member 68. The auxiliary piston 184 of the auxiliary piston member 182 is secured to and carried on the end of the piston rod 172 in any suitable manner. The piston rod 172 has a passage 173 there-through extending between the vent 186 in the power piston member 68 and the vent 188 in the auxiliary piston member 182. An oil gland 190 is provided about the piston rod 172 to prevent leakage of oil from the auxiliary piston member 182, the other end of the auxiliary piston member being connected through a passage 192 to the pipe 194 which connects with the passage 150 of the control valve member 66. For purposes of draining the oil from the chamber formed between the piston 184 and the oil gland 190 of the auxiliary piston member 18, a passage 196 is provided in the casing connected by means of the pipe 198 to the passage 200 in the casing 70. The passage 200 opens into the chamber formed by the bushing 118 and the end collar member 122.

Again referring to Fig. 2 of the drawing, the end of the piston valve member 74 is illustrated as being in position to be actuated by the lever 201 which is pivotally mounted on the engine 10 and disposed to be actuated by the governor 12. Other suitable apparatus (not shown) may be provided for operating the piston valve member 74 of the control valve member 66 in response to different speeds of the engine 10, the showing made in Fig. 2 being merely for the purpose of illustrating the application of this invention for a given speed.

In operation, assuming that the engine 10 is adjusted for operating at a particular given speed to drive the governor 14, and assuming that the field rheostat 34 and carbon 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 op-

erated to close the circuit from the armature winding 16 to the motor 22. It is, of course, to be understood that prior to this time the lubricant has been admitted to the control valve 66 and that the chambers of the piston valve member 68 and the auxiliary piston valve member 180 have been filled. With the engine 10 operating at this given speed, the governor 12 assumes a given position and does not operate the piston valve member 74 of the control valve member 66.

Under such circumstances, the control valve member 66 is preheated since the lubricant of the engine 10 is delivered to the control valve through the pipe 140, passage 138, to the chamber formed between the piston valve 76 and the end closure member 80 of the piston valve member 74. The hot oil normally employed as the lubricant bleeds past the needle valve 146, the setting of which can be regulated to determine the leakage therepast, through the passage 144 into the chamber formed between the piston valve 76 and the end closure member 78 of the piston valve member 74, and from thence to the port 100 and passage 148 to the reservoir 130. The lubricant is drained through the passages 136 and 82 to the drain chamber 86 and returns from thence to the reservoir of the engine 10 by way of the passage 158 and the pipe 160. The admission of the warm lubricant in this manner preheats the components of the control valve member 66 so that it operates efficiently when the speed of the engine 10 changes.

If an excessive load is encountered such as where a locomotive is pulling a grade, the demand on the generator 16 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 201 to actuate the piston valve member 74 upwardly against the bias of the spring 88.

As the piston valve 76 moves past the port 102 in the sleeve valve member 72, the lubricant in the chamber formed between the valve 76 and closure member 80 is delivered under pressure to the power piston member 68 through the port 102, passage 170, pipe 168 and the passage 166. The pressure thus applied to the piston 164 forces the piston 164 to actuate the lever 56 to decrease the pressure on the stack of disks 38 of the pile resistor 32. At the same time the connecting piston rod 172 effects the operation of the auxiliary piston 184 to force the lubricant originally contained in the chamber between the piston 184 and its closure member through the passage 192, pipe 194 and passage 150 of the casing member 70 to the chamber 152 below the piston 108 of the sleeve valve member 72. The application of the pressure to the piston 108 forces the sleeve valve member 72 upwardly against the bias of the spring 120 to a position where the port 102 comes in alignment with the piston valve 76 to prevent further delivery of the lubricant to the power piston 164. The pressure on the piston 108 will be gradually released as the lubricant bleeds from the chamber 152 through the passage 154 past the needle valve 156 to the chamber formed by the bushing 116 and the end collar member 118 and thence through passages 128 to the reservoir 130. The period of time for such drainage can be regulated by the setting of the needle valve 156.

As the pressure is released on the carbon 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. However, as in most cases, the slight movement of the power piston 164 to release the pressure on the pile resistor 32 is insufficient, because of the simultaneous movement of the piston 184, to sufficiently reduce the resistance of the resistor 32 as to relieve the overload condition on the engine 10. Thus, as the slide valve member 72 is returned to its normal position by reason of the bleeding of the lubricant from the chamber 152 beneath the piston 108, the port 102 again becomes open to permit the delivery of the lubricant to the power piston 164 to effect another operation of the lever 56 to release additional pressure from the pile resistor 32. Again the lubricant is simultaneously forced by the auxiliary piston 184 into the chamber 152 to actuate the piston 108 to again raise the sleeve valve member 72 to a position where the delivery of the lubricant to the power piston is interrupted. This cycle is repeated intermittently until the pressure on the pile resistor has been so reduced as to remove the overload condition from the engine 10. As will be evident, the increments of pressure applied to the power piston can be so controlled as to be very small, and thereby prevent the removal of too much pressure from the pile resistor 32 and prevent over-control of the excitation of the generator.

As the engine 10 is brought to the desired speed, the governor 12 and the lever 201 function to release the pressure on the piston valve member 74 whereby the valve member 74 returns to the position shown in Fig. 1. However, the sleeve valve member 72 is still maintained in its upward position by reason of the pressure of the lubricant on the piston 108 which has not had a chance to bleed off past the needle valve 156. Consequently, the lubricant retained between the power piston 164 and its closure member drains backward through the pipe 168 and passage 170 through the port 102 to the chamber formed between the piston valve 76 and its end closure member 78, and from thence through the port 100 and passage 148 to the reservoir 130. The removal of the pressure from the power piston 164 permits the spring member 62 to exert pressure through the lever 56 on the pile resistor 32. If this increase in pressure so decreases the resistance of the pile resistor 32 as to effect an increase in the voltage generated by the generator 14 to thereupon place an overload on the engine 10, then the governor 12 and the lever 201 again function to effect an operation of the piston valve member 74 to again initiate the cooperative operation of the control valve member 66, power valve member 68 and auxiliary piston member 182 to again give a step-by-step operation of the rheostat to maintain the speed of the engine substantially constant over the changing load conditions.

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 constant speed engine. At all times, the power supplied by the generator is substantially constant, the voltage of the generator varying in accordance with the increase in current demand, while the speed of the prime mover for the generator remains substantially constant. The ap-

paratus inherently prevents hunting and prevents over-control of the excitation of the generator.

Although this invention has been described with reference to a particular embodiment thereof and particularly the embodiment in which the lubricating oil of the engine is utilized as the pressure medium it is of course understood that other fluids under pressure and disposed to be heated where required can be used if they are in a closed system with the control valve, power piston and auxiliary piston member. This invention is therefore not to be limited except in so far 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 disposed to operate the pressure responsive means, a control valve responsive to the speed of the engine for effecting the operation of the power piston, and means responsive to the operation of the power piston disposed to operate the control valve to effect the intermittent operation of the power piston to give a step-by-step operation of the rheostat to prevent over control of the excitation of the generator 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 disposed to operate the pressure responsive means, a control valve responsive to the speed of the engine for effecting the operation of the power piston, an auxiliary piston associated with the power piston and responsive to movement thereof, and means associated with the control valve responsive to a movement of the auxiliary piston disposed to operate the control valve to effect the intermittent operation of the power piston to give a step-by-step operation of the rheostat to prevent over-control of the excitation of the generator 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 pressure responsive pile resistor 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 pile resistor,

a power piston disposed to operate the pressure responsive means, an auxiliary piston disposed to be operated by the power piston, a valve member having a main control valve responsive to the speed of the engine and the operation of the auxiliary piston to control and effect an intermittent operation of the power piston, the intermittent operation of the power piston effecting a step-by-step operation of the rheostat to prevent over-control of the excitation of the generator 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 pressure responsive pile resistor 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 pile resistor, a power piston disposed to operate the pressure responsive means, an auxiliary piston disposed to be operated by the power piston, a control valve member having a sleeve valve and a piston valve disposed to cooperate in response to a change in the speed of the engine to effect an operation of the power piston, means associated with the sleeve valve responsive to the operation of the auxiliary piston disposed to operate the sleeve valve to stop the operation of the power piston, and means associated with the sleeve valve operating means disposed to permit the operation of the sleeve valve to a position where it cooperates with the piston valve to effect another operation of the power piston, the sleeve valve and piston valve thereby cooperating to effect an intermittent operation of the power piston, the intermittent operation of the power piston effecting a step-by-step operation of the rheostat to prevent over-control of the excitation of the generator and maintain the speed of the engine substantially constant under changing load conditions.

5. In regulating apparatus for constant speed engines having a lubricating system, 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 pressure responsive 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 the lubricant pressure disposed to operate the pressure responsive means, a control valve responsive to the speed of the engine for delivering the lubricant to the power piston, means responsive to the operation of the power piston disposed to operate the control valve to effect the intermittent operation of the power piston to give a step-by-step operation of the rheostat to prevent over-control of the excitation of the generator, and means associated with the control valve for substantially maintaining it at the temperature of the lubricant in the engine and obtain efficient operation of the apparatus.

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