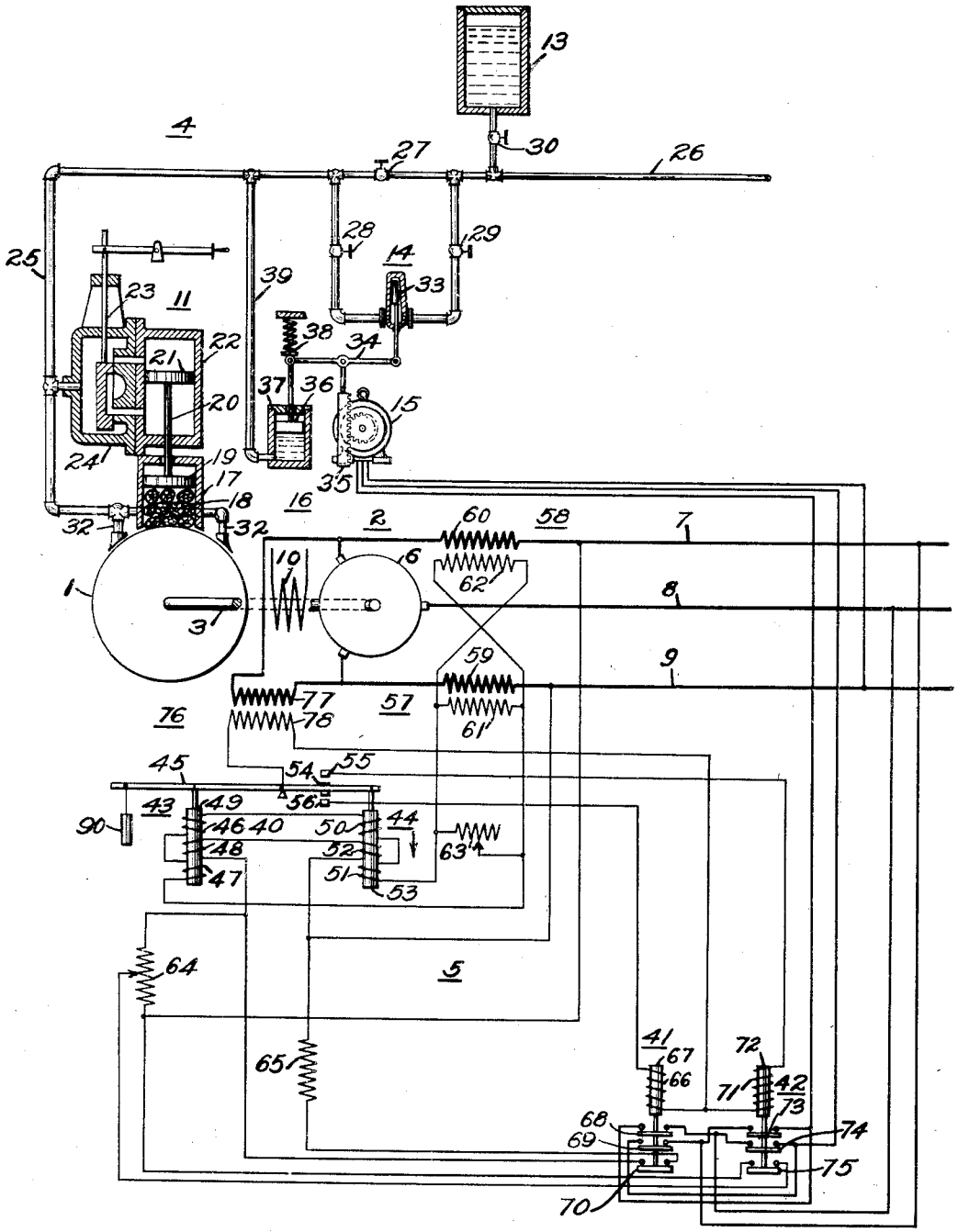
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GRINDER REGULATOR SYSTEM.

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WITNESSES:

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UNITED STATES PATENT OFFICE.

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GRINDER REGULATOR SYSTEM.

Application filed September 11, 1920. Serial No. 409,717.

To all whom it may concern:

Be it known that I, CLARENCE A. BODDIE, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Grinder Regulator Systems, of which the following is a specification.

My invention relates to regulator systems and, particularly, to regulator systems for governing the operation of pulp grinders.

One object of my invention is to provide a regulator system of the above indicated character that shall control the load applied to a pulp grinder in a simple and efficient manner and that shall be provided with means for preventing hunting action.

In operating a pulp grinder, the wood, which is to be ground into pulp, is generally forced against the grinder by hydraulic pressure and such hydraulic pressure is varied to control the load on the grinder. The grinder is operated from any suitable source of power, either electrical or mechanical. In such systems, considerable trouble is experienced in so controlling the hydraulic pressure to govern the grinder load as to prevent the so-called hunting action.

In a grinder regulator system constructed in accordance with my invention, hydraulic pressure is provided for applying the wood to the face of the grinder and an electric motor is provided for operating the grinder. A surge tank is connected to the hydraulic system adjacent to the main valve which controls the hydraulic pressure applied to the grinder. Such surge tank prevents violent or sudden changes in hydraulic pressure upon operation of the main valve and adds greatly to the stability of the system.

A connection is made to the hydraulic system between the main valve and the grinder for operating a piston to oppose the operation of the main valve in increasing or decreasing the hydraulic pressure which is applied to the grinder. Such reactive force operating on the main valve assists in preventing hunting action.

The main motor, which is shown operating the grinder, is preferably a three-phase motor, although any other well-known type of motor may be utilized for such purpose. A main control element, which is operated in accordance with the watts supplied to the main motor, is provided for operating two switches to selectively operate an auxiliary motor. The auxiliary motor operates the main valve in the hydraulic system. The two switches not only control the auxiliary motor but also control reactive forces which so affect the main control element as to prevent hunting action. The two separate means above set forth for preventing hunting action co-operate and insure the operation of the grinder with a constant load and without hunting action.

The single figure in the accompanying drawing is a diagrammatic view of a regulator system constructed in accordance with my invention.

Referring to the drawing, a grinder 1, of any suitable type, is connected to an alternating-current motor 2 in any suitable manner, as by means of a shaft 3. A hydraulic system 4 is provided for applying the load to the grinder 1 and a regulator system 5 is provided for controlling the operation of the hydraulic system 4 in accordance with the watts supplied to the main motor 2. The main motor 2 comprises a rotor 6, which is directly connected to a three-phase supply circuit comprising conductors 7 and 8 and 9, and a field-magnet winding 10 which is energized from any suitable source of current.

The hydraulic system 4 comprises a load-applying device 11, a surge tank 13, a main gate valve 14, an auxiliary motor 15 for operating the gate valve 14, and an anti-hunting device 16 for applying a reactive force to the gate valve 14. The load-applying device 11 comprises a compartment 17, containing the material 18 to be ground into pulp, and a piston head 19 which forces the material 18 into engagement with the face of the grinder 1. The piston head 19 is connected by a rod 20 to a second piston head 21 which operates within a hydraulic cylinder 22. A valve 23, which operates within a pressure chest 24, is provided for applying hydraulic pressure above or below the piston head 21, as desired. The pressure chest 24 is supplied with hydraulic pressure by means of a pipe system 25.

The pipe system 25 is connected to a pipe 26 and the source of hydraulic pressure, either through a valve 27 or through the main valve 14. The auxiliary valve 27 is

only used in case of emergency and, under normal operating conditions, the valve 14 is used for governing the hydraulic pressure applied to the grinder 1. In case it is desired to inspect or repair the main valve 14, two valves 28 and 29 are provided for disconnecting the valve 14 from the hydraulic system.

The surge tank 13 is connected to the hydraulic system, by a valve 30, between the main valve 14 and the source of hydraulic pressure. Sprinklers 32, which maintain a shower upon the grinder 1, are preferably connected directly to the pipe system 25 but, if so desired, any other connection to the source of hydraulic pressure may be utilized.

The gate 33 of the main valve 14 is pivotally connected to a lever arm 34 which is operated not only by the motor 15 but also by the anti-hunting device 16. The motor 15 is mechanically connected to the lever arm 34 in any suitable manner, as by means of a rack and pinion 35, as shown in the drawing. The rack is connected to the lever arm 34 intermediate the connection of such lever arm to the gate 33 and to the anti-hunting device 16. A clockwise rotation of the motor 15 opens the valve 14 to decrease the load upon the grinder 1 and a counter-clockwise rotation of the motor closes the valve 14 to increase the load applied to the grinder 1.

The anti-hunting device 16 comprises a piston 36 which operates within a hydraulic cylinder 37 and which is pivotally connected to the lever arm 34. A spring member 38 is provided for opposing the action of the piston 36 and, a connection 39 is provided for connecting the cylinder 37 to the hydraulic system intermediate the main valve 14 and the load-applying device 11. The anti-hunting device 16 exerts a force tending to oppose any operation of the main valve to increase or to decrease the hydraulic pressure applied to the grinder 1.

The regulator system 5, which controls the operation of the auxiliary motor 15 in accordance with the watts supplied to the main motor 2, comprises a main control element 40 and two switches 41 and 42, which are controlled by the main element 40. The main control element 40 comprises two electromagnets 43 and 44 and a contact arm 45 which is jointly operated by the two electromagnets 43 and 44.

The electromagnet 43 comprises two oppositely-wound current windings 46 and 47, a potential winding 48 and a core armature 49 which is pivotally connected to the contact arm 45. The electromagnet 44 comprises two oppositely-wound current windings 50 and 51, a potential winding 52 and a core armature 53, which is pivotally connected to the contact arm 45. The contact arm 45 carries a contact member 54, which is moved into engagement with stationary contact members 55 and 56, in accordance with the operation of the two electromagnets 43 and 44. A counterweight 90 is mounted on the contact arm 45.

The current windings 51 and 50 of the electromagnet 44 and the current windings 46 and 47 of the electromagnet 43 are connected to two current transformers 57 and 58 in order to be energized in accordance with the current supplied to the motor 2. The current transformers 57 and 58 respectively comprise primary windings 59 and 60 and secondary windings 61 and 62. The primary windings 59 and 60 are connected to the three-phase conductors 7 and 9 and the secondary windings 61 and 62 are directly connected to the current windings of the electromagnets 43 and 44. A resistor 63 is connected across the secondary windings 61 and 62 for adjusting the strength of the current supplied to the current windings of the electromagnets 43 and 44. The potential windings 48 and 52 of the electromagnets 43 and 44 are connected across the three-phase conductors 7 and 9. The windings 48 and 52 are connected to the three-phase circuit in series with a resistor 64 and means is provided for short-circuiting a portion of such resistor for preventing hunting action. Means is also provided for shunting the two windings 48 and 52 by means of a second resistor 65 to prevent hunting action.

The two electromagnets 43 and 44 assist each other in operating the contact arm 45 and each is operated in accordance with the watts supplied to the main motor 2. The current windings of each electromagnet are oppositely wound and are symmetrically disposed with respect to the associated core armature. The potential winding is disposed midway between the two current windings. The electromagnet 43 is assumed to raise the core armature 49 when energized and the electromagnet 44 is assumed to tend to lower the core armature 53 when energized. For a complete description as to the operation of such electromagnets, attention is directed to my companion application, Serial No. 378,731, filed May 4, 1920.

The switch 41 comprises a coil 66, a core armature 67 and two switch members 68 and 69 and an interlock switch member 70, which are connected to the core armature 67. The switch 42 comprises a coil 71, a core armature 72, two switch members 73 and 74 and an interlock switch member 75.

A potential transformer 76, comprising a primary winding 77 and a secondary winding 78, is provided for supplying energy to operate the switches 41 and 42. The primary winding 77 is connected across the supply conductors 7 and 9. One terminal of the secondary winding 78 is connected to the contact member 54, which is mounted

upon the contact arm 45, and the other terminal of the winding 78 is connected to the coils 66 and 71 of the switches 41 and 42. The contact members 55 and 56 are respectively connected to the coils 71 and 66 of the switches 42 and 41. Thus, upon engagement between the contact members 54 and 55, the coil 71 is energized for operating the switch 42, and, upon engagement between the contact members 54 and 56, the coil 66 is energized for operating the switch 41.

One terminal of the auxiliary motor 15 is directly connected to the conductor 9 and the other two terminals of the auxiliary motor are selectively connected across the conductors 7 and 8 by means of the switches 41 and 42. The switch members 68 and 69 of the switch 41 connect two terminals of the motor 15 to the conductors 7 and 8 for operating the motor in a counter-clockwise direction. The switch members 73 and 74 of the switch 42 connect two terminals of the auxiliary motor 15 across the conductors 7 and 8 for effecting rotation of the motor in a clockwise direction. The interlock switch member 70, upon operation of the switch 41, connects the resistor 65 in shunt to the two potential windings 48 and 52 of the main control device to prevent hunting action when the auxiliary motor is being operated in a clockwise direction. The interlock switch member 75, upon operation of the switch 42, serves to short-circuit a portion of the resistor 64 to prevent hunting action when the motor is being operated in a counter-clockwise direction.

If the load upon the grinder 1 becomes abnormally high, an abnormal number of watts is supplied to the main motor 2. Consequently, the electromagnets 43 and 44 are energized to effect engagement between the contact members 54 and 56. Upon engagement between the contact members 54 and 56, a circuit is completed from the transformer 76 for operating the switch 41. Thereupon, the auxiliary motor 15 is operated in a counter-clockwise direction to close the main valve 14. Consequently, the hydraulic pressure supplied to the cylinder 22 for operating the piston 21 is reduced to lower the load on the grinder 1.

Upon change of fluid pressure in the hydraulic system between the main valve 14 and the device 11, the anti-hunting device 16 is operated to oppose the closing operation of the main valve 14. The hydraulic pressure acting upon the piston 36 is reduced and, consequently, the spring member 38 tends to open the main valve 14. Such operation of the anti-hunting device 16 tends to anticipate the effect on the regulator system of the decreased load upon the grinder 1.

Prior to the reduction in the load upon the grinder 1 and simultaneous with the operation of the switch 41, the interlock switch member 70 connects the resistor 65 in shunt to the two potential windings 48 and 52 of the electromagnets 43 and 44. Thus, the setting of the main control device 40 is changed and the electromagnets 43 and 44 are de-energized a certain amount to anticipate the reduction in load upon the grinder 1 and the main motor 2. If no such means were provided for changing the setting of the electromagnets 43 and 44, the regulator would overtravel and cause the so-called hunting action. Consequently, the contact members 54 and 56 are separated just prior to the obtaining of normal load conditions upon the grinder 1.

If the load on the grinder 1 falls below normal value, the energization of the electromagnets 43 and 44 is reduced to effect engagement between the contact members 54 and 55. Upon engagement between the contact members 54 and 55, the coil 71 is connected in circuit to the transformer 76 for operating the switch 42. Thereupon, the auxiliary motor 15 is operated in a clockwise direction to open the valve 14 and, accordingly, to increase the hydraulic pressure which is applied to the load-applying device 11. Thereupon, the load carried by the grinder 1 and the motor 2 is increased.

The increase in pressure in the hydraulic system between the valve 14 and the device 11 operates the anti-hunting device 16 to close the valve 14 and to oppose the action of the motor 15 in opening the valve 14.

The interlock switch member 75 short-circuits a portion of the resistor 64 to increase the energization of the potential windings 48 and 52 and, consequently, to change the setting of the main control element 40. The energization of the electromagnets 43 and 44 is increased to effect separation of the contact members 54 and 55 just prior to the obtaining of normal load conditions on the grinder 1. In such manner, hunting action on the part of the regulator is prevented.

In the above system, particular attention is called to the surge tank 13, the anti-hunting device 16 and the anti-hunting means associated with the regulator 5, all of which stabilize the operation of the system and prevent over-travel and hunting-action.

Modifications in the system and in the arrangement and location of parts may be made within the spirit and scope of my invention, and such modifications are intended to be covered by the appended claims.

I claim as my invention:

1. In a regulator system, the combination with a grinder, a hydraulic system for applying the load to said grinder, and a valve in said hydraulic system for varying the pressure applied to the grinder, of means for operating said valve and means

for reacting upon said valve to oppose its initial operation.

2. In a regulator system, the combination with a grinder, a hydraulic system for applying the load to said grinder, a valve in said hydraulic system, and means for automatically controlling said valve to maintain a constant load on the grinder, of means controlled by hydraulic pressure applied to the grinder for reacting on the valve to prevent hunting action.

3. In a grinder regulator system, the combination with a grinder, an electric motor for operating said grinder, and hydraulic means for applying the load to said grinder, of means for controlling said hydraulic means in accordance with the power supplied to said motor, means reacting on said controlling means for preventing hunting action, and means reacting directly on said hydraulic means to prevent hunting action.

4. In a grinder regulator system, the combination with a grinder, an electric motor for operating said grinder, a hydraulic system for applying the load to said grinder, a valve in said hydraulic system for varying the pressure applied to said grinder, of means for controlling said valve in accordance with the load supplied to said motor and including means to prevent hunting action, and means operated in accordance with the pressure in the hydraulic system for actuating said valve to prevent hunting action.

5. In a grinder regulator system, the combination with a grinder, a main motor for operating said grinder, a hydraulic system for applying the load to said grinder, a valve for varying the pressure on said hydraulic system to vary the load on the grinder, and an auxiliary motor for controlling said valve, of regulating means for controlling said auxiliary motor in accordance with the watts supplied to the main motor, means reacting on said regulating means to prevent hunting action, and means reacting directly on said valve to prevent hunting action.

6. In a regulator system, the combination with a grinder, a main motor for operating said grinder, and means comprising an auxiliary motor for controlling the load applied to said grinder, of means comprising two electromagnets operated in accordance with the watts supplied to the main motor for controlling the operation of said auxiliary motor, and means for varying the energization of said magnets to prevent hunting action.

7. In a regulator system, the combination with a grinder, a three-phase supply circuit, a motor connected to said circuit for operating said grinder, and means comprising an auxiliary motor for controlling the load on said grinder, of means comprising two electromagnets operated in accordance with the watts supplied to the main motor for varying the connection of said auxiliary motor across the supply circuit to control the load on said grinder, and means for varying the energization of said electromagnets to prevent hunting action.

8. In a grinder regulator system, the combination with a grinder, a hydraulic system for applying the load to said grinder, and a valve in said hydraulic system for varying the hydraulic pressure applied to the grinder, of a surge tank connected to the hydraulic system adjacent to said valve, means for operating said valve in accordance with the load on the grinder, and means reacting on said valve in accordance with the hydraulic pressure applied to the grinder for preventing hunting action.

9. In a fluid-pressure regulator system, the combination with means for varying the pressure of said system to maintain predetermined normal pressure therein, of additional means for preventing hunting action of said system comprising means acting in anticipation of the return of normal pressure conditions, and means reacting in accordance with the variations in said pressure.

10. In a regulator system, the combination with fluid-pressure means for applying a load, of regulator means for maintaining said load constant comprising means acting in anticipation of the return of normal load conditions, and additional means reacting in accordance with the variation in said pressure, both of said last-mentioned means cooperating to prevent hunting action.

11. In a regulator system, the combination with a grinder, a pressure system for applying load to said grinder, and means for automatically controlling said pressure system to maintain a constant load upon said grinder, of means for preventing hunting action of said regulator system adapted to be actuated prior to the obtaining of normal load conditions and also coincidently with the return of normal load conditions.

12. In a regulator system, the combination comprising means adapted to have a load applied thereto, a pressure system for applying said load, having a valve mechanism therein, a floating lever connected to said valve mechanism, a motor acting upon said lever to operate said valve, and means also acting upon said lever to react upon said valve mechanism to prevent hunting action.

13. In a regulator system, the combination comprising means adapted to have a load applied thereto, a pressure system for applying said load having a valve mechanism therein, a floating lever connected to said valve mechanism, means for automatically controlling said valve mechanism to main-

tain a substantially constant pressure, and means co-operating with said floating lever to react upon said valve mechanism to prevent hunting action.

14. In a regulator system, the combination with a grinder, means for applying load thereto, and an electric motor for operating said grinder, of regulating means comprising a pair of electromagnets operated in accordance with the watts of said motor circuit, and each comprising a pair of oppositely-disposed current coils and a centrally-located voltage coil, said coils co-operating with a single core armature, a plurality of switches controlled thereby having interlock members respectively co-operating therewith, and a plurality of resistors controlled by said interlock members to vary the settings of said electromagnets.

15. In a regulator system, the combination with a grinder and means for applying load thereto, of means for correcting for variations in said load and comprising anti-hunting means reacting in accordance with corrections for said variations, and additional anti-hunting means acting in anticipation of the full correction for said load variations.

16. In a regulator system, the combination with a grinder, pressure means for applying load thereto, and an electric motor for operating said grinder, of regulator means therefor comprising an electromagnet connected to said motor circuit and having a pair of oppositely-disposed current coils and a centrally-disposed voltage coil, a plurality of switches, and anti-hunting means having an anticipatory action and comprising a resistor controlled by said switches.

17. In a regulator system, the combination with a grinder, pressure means for applying load thereto, and an electric motor for operating said grinder, of regulator means therefor comprising an electromagnet connected to said motor circuit and having a pair of oppositely-disposed current coils and a centrally-disposed voltage coil, a plurality of switches, anti-hunting means having an anticipatory action and comprising a resistor controlled by said switches, and additional anti-hunting means having a reactive action in accordance with the variations in said pressure system.

In testimony whereof, I have hereunto subscribed my name this 8th day of September, 1920.

CLARENCE A. BODDIE.