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PRIME MOVER CONTROL SYSTEM

Filed August 15, 1924

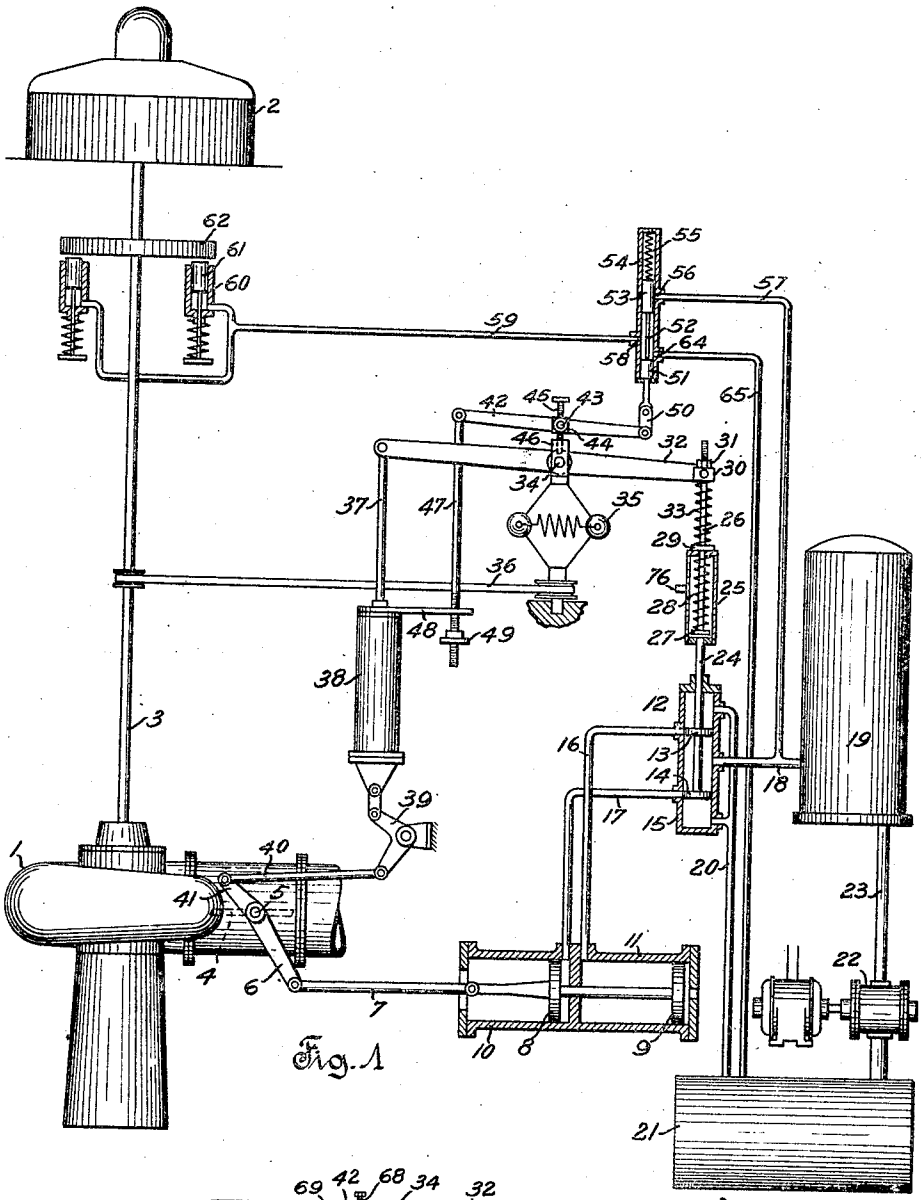


Fig. 1

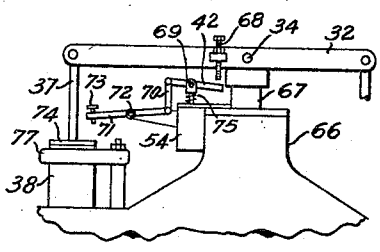


Fig. 2

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PRIME-MOVER-CONTROL SYSTEM.

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This invention relates to prime mover or translating device control systems. More particularly, it relates to a system whereby the prime mover may be stopped. It is especially applicable when it is desired to automatically apply brakes to a prime mover or translating device.

One of the objects of the invention is to provide a system which will automatically apply the brakes when the momentum of the prime mover or translating device has decreased to a predetermined value. Another object is the provision of a system whereby the brakes will be applied when the power input to the prime mover or translating device and the momentum thereof have been reduced a predetermined amount. Still another object is the provision of a system which will cause the automatic application of brakes to a prime mover or translating device under predetermined conditions. Other objects will appear hereinafter as the description of the invention proceeds.

The novel features of the invention will appear from this specification and the accompanying drawing showing two embodiments thereof and forming part of this specification, and all these novel features are intended to be pointed out in the claims.

In the drawings:

Fig. 1 is a diagrammatic showing of the manner in which the invention may be applied in connection with a hydraulic turbine.

Fig. 2 is a side elevation of a modified detail.

Referring now to Fig. 1, this shows a hydraulic turbine 1 adapted to drive a generator 2 through a shaft 3. Water may be admitted to the turbine by means of a gate 4 which is here shown in the open position, the other parts in the figure being in the position they assume when the turbine is running. It is to be understood that any other means may be utilized for admitting operating fluid to the prime mover, as for example, the usual guide vanes used in connection with hydraulic turbines. The term gate is used for the sake of brevity in the specification and claims to indicate any means for admitting operating fluid to the prime mover. The gate 4 is here shown as pivoted at the point 5 and operable by means of a crank 6 connected by a rod 7 to the piston rod of two pistons 8, 9 here shown as operating in separate cylinders 10, 11 respectively. Any other suitable form of servo-motor may be utilized. The admission of fluid under pressure, usually, but not necessarily, oil, to cylinders 10, 11 is controlled by means of a regulating valve 12 provided with two piston valves 13, 14 operating in the cylinder 15. The piston valves 13, 14 are adapted when the regulating valve is in the neutral position, as shown, to close the ports of a pair of pipes 16, 17 communicating with cylinder 15. Cylinder 15 is here shown as provided with an inlet port located between the piston valves 13, 14, and communicating with a pipe 18 connected to a pressure tank 19. Here shown as above and below piston valves 13, 14 respectively are drain ports communicating with a drain pipe 20 which leads to a receiving tank 21. Fluid may be drawn from the receiving tank by means of a motor-driven pump 22 and discharged through a pipe 23 into the pressure tank 19.

The regulating valve 12 is controlled by means responsive to the speed of the prime mover in the following manner. The piston valves 13, 14 are mounted on and carried by a rod 24 which is here shown as provided with a tube 25 through the upper end of which passes a rod 26 provided at its lower end within the tube 25 with a collar 27. The tube 25, or some other part associated with the regulating valve, is provided with a projection 76, for a purpose to be hereinafter set forth. A spring 28 is disposed between collar 27 and the end of tube 25. Above the tube 25 the rod 26 is provided with a collar 29 between which and a swivel nut 30 through which rod 26 passes, is disposed a spring 33. The upper end of rod 26 is threaded and provided with a nut 31 against which the swivel nut 30 is adapted to act. The swivel nut 30 is pivoted to a floating lever 32 having a floating pivot 34 positioned in accordance with a speed responsive device here shown as comprising fly balls 35 which may be driven from the prime mover in any suitable manner as by means of a belt 36. To the other end of the floating lever 32 is pivoted a rod 37 associated with the piston of a dash pot or compensating device 38 which may be of usual or any desired form. The compensating device 38 is raised and lowered in accordance with gate movement through any suitable connection, as by

means for example, of a bell crank 39 connected by means of a rod 40 with a crank 41 operating in unison with the gate 4.

Here shown as also controlled by the fly balls 35 is another floating lever 42 having a floating pivot 43 mounted in a bearing block 44. The position of the floating pivot 43 with respect to that of floating pivot 34 may be adjusted by means of a screw 45 which is threaded in bearing block 44 and in a block 46 associated with the floating pivot 34. To one end of floating lever 42 is pivoted a rod 47 the lower end of which passes freely through a projection 48 here shown as associated with the compensating device 38. The lower end of rod 47 is threaded and provided with a nut 49 which may be engaged by the projection 48 when the latter moves in a downward direction. The other end of floating lever 42 has pivoted thereto a link 50 which is in turn pivoted to a valve member 51 operating in a cylinder 54. The valve member 51 is connected by means of a rod 52 smaller than the diameter of cylinder 54, to another valve member 53 also operating in cylinder 54. The valve members 51, 53 are biased to the position shown in the drawing by any suitable means, as a spring 55. With the parts in the position shown in the drawing the valve member 53 is adapted to close a port 56 communicating with a pipe 57 connected with the pressure tank 19 in any suitable manner Cylinder 54 is provided with another port 58 connected to a pipe 59 communicating with one or more brake cylinders 60 in which pistons 61, here shown as also serving as brake shoes, are adapted to operate and to be forced against a brake disk 62 or any member associated in any suitable manner with shaft 3. The brake shoes 61 may be biased to the non-applied position by springs as shown or in any other suitable manner. Cylinder 54 is provided with a drain port 64 connected to a pipe 65 and thence to the receiving tank 21. In the position of the parts shown the valve member 51 has uncovered drain port 64 thereby permitting fluid to flow from the brake cylinders to the receiving tank. It is to be understood that while the brake cylinders 60 are here shown as provided with fluid under pressure from the same tank as that for supplying a servo-motor, this is not essential, but separate means for providing a source of supply of fluid under pressure may be utilized It is further to be understood that the particular form of valve for controlling the admission of fluid to the brakes is shown merely by way of illustration.

The operation of the system of Fig. 1 is as follows. In this figure the parts are all shown in substantially the position they would occupy if the turbine were in operation and under load. If it is desired to stop the turbine, the projection 76 will be depressed in any suitable manner thereby lowering tube 25 and compressing spring 28 irrespective of the position of floating lever 32. The regulating valve 12 is therefore moved to the gate-closed position thereby admitting fluid under pressure through pipe 17 to cylinder 10 and forcing piston 8 to the left as viewed in the drawing. The gate 4 is therefore moved toward closed position with a speed depending upon the fluid pressure or upon special means forming no part of this invention. Closure of gate 4 rocks the bell crank 39 in a counter-clockwise direction thereby lowering the dash pot 38 and, through the projection 48, the rod 47. The floating lever 42 is therefore rocked in a counter-clockwise direction a predetermined amount depending upon the adjustment of the nut 49. Different conditions may demand different adjustments but ordinarily even complete closure of gate 4 will not serve to raise valve member 53 enough to open port 56. The brakes will therefore not be applied for the reason that fluid under pressure will not be admitted thereto. When however the speed of the turbine and the generator 2 connected thereto have decreased a predetermined amount, as determined by the screw 45, the fly balls 35 will have caused the floating pivot 43 to rise sufficiently so that the right hand end of floating lever 42 will be raised enough to cause valve member 53 to open port 56, thereby admitting fluid under pressure through pipes 57, 59 to the brake cylinder 60 whereupon the brakes are applied. At the same time the drain port 64 is closed by means of valve member 51.

It is of course apparent that as the gate 4 is being closed the speed of the prime mover will drop so that the fly balls 35 will cause the floating pivot 43 to rise while the rod 47 is being drawn downwards by the closing movement of the gate. It is however immaterial whether these actions occur separately or simultaneously. It will be apparent that the brakes will not be applied, depending upon the adjustments, until the power input to the turbine has been reduced to zero or some other predetermined amount and the momentum of the rotating parts has been reduced a predetermined amount, thus preventing undue shock in the application of the brakes and also undue wear on the brake shoes.

Referring now to Fig. 2, this shows a somewhat modified form of control for the valve which controls the application of the brakes. The fly balls are not shown in this figure as they are concealed beneath the housing 66 for the governor parts. A shaft 67 is associated with the fly balls and is adapted to be raised vertically by the fly balls as the speed increases and lowered as

the speed decreases. The floating lever 32 carried by the floating pivot 34 corresponds to the similar parts in Fig. 1. The floating lever 32 is here shown as carrying in any suitable manner an adjustable screw 68 which is adapted to act against one end of a floating lever 42 provided with a floating pivot 69. The other end of floating lever 42 has pivoted thereto, in this instance, a link 70 the other end of which may be pivoted to one end of a lever 71 having a stationary pivot 72. The other end of lever 71 carries an adjustable screw 73 which is adapted to be engaged by the top 74 of the dash pot 38 corresponding to the similar part in Fig. 1. The floating pivot 69 is carried by an operating rod of a valve 54, which valve corresponds to the valve including cylinder 54 of Fig. 1. The operating rod of valve 54 is biased upwardly by means here shown as a spring 75. Downward motion of floating pivot 69 and therefore of the operating rod of valve 54 is adapted to admit fluid under pressure to the brake cylinders in a manner similar to that disclosed in connection with Fig. 1.

The operation of the modification of Fig. 2 is as follows. The parts are shown in this figure in the position that they have when the prime mover is operating at normal speed. When the gate closes a predetermined amount the top 74 of the dash pot engages screw 73 thereby tending to depress floating pivot 69 provided the screw 68 has been lowered, by a reduction in speed, so as to engage lever 42. Or, if the dash pot 38 engages screw 73 first, then a decrease in speed will lower screw 68 which engages lever 42 thereby depressing the operating rod of valve 54.

It should be understood that it is not desired to limit the invention to the exact details of construction shown and described, for obvious modifications may occur to a person skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In a system for stopping a translating device, means for reducing the power input into said translating device, means for absorbing energy from said translating device, and means operatively connecting said energy absorbing means to said translating device in response to a predetermined reduction in said power input and in momentum of said translating device.

2. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a brake for said prime mover, and means for setting said brake when said gate has been closed a predetermined amount, and the speed of said prime mover has fallen to a predetermined value.

3. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a brake for said prime mover, means responsive to the speed of said prime mover, means positioned in accordance with the position of said gate, and means under the joint control of said last two named means for setting said brake.

4. In a control system for a prime mover, a brake for said prime mover, means responsive to the speed of said prime mover, and means controlled by said speed responsive means for setting said brake in response to a reduction in speed to a predetermined value.

5. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, means for operating said gate, means responsive to the speed of said prime mover for controlling said operating means, a brake for said prime mover, and means controlled by said speed responsive means for setting said brake.

6. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a servo-motor for operating said gate, a regulating valve for said servo-motor, means responsive to the speed of said prime mover for controlling said servo-motor, a brake for said prime mover, and means controlled by said speed responsive means for setting said brake.

7. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a servo-motor for operating said gate, a regulating valve for said servo-motor, means responsive to the speed of said prime mover for controlling said servo-motor, a brake for said prime mover, and means including fluid pressure operated means controlled by said speed responsive means for causing setting of said brake.

8. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, means for operating said gate, control means for said operating means, a floating lever, means responsive to the speed of said prime mover for controlling said floating lever, a connection between said floating lever and said control means for said operating means, a brake for said prime mover, and means operatively related to said floating lever for controlling the setting of said brake.

9. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a floating lever, means responsive to the speed of said prime mover for controlling said floating lever, means positioned in accordance with said gate for controlling one portion of said floating lever, a brake for said prime mover, and means for controlling the setting of said brake controlled by another portion of said floating lever.

10. In a control system for a prime mover, a gate for admitting operating fluid to said

prime mover, a floating lever, means responsive to the speed of said prime mover for controlling said floating lever, means for adjusting the controlling effect of said speed responsive means on said floating lever, means positioned in accordance with said gate for controlling one portion of said floating lever, a brake for said prime mover, and means for controlling the setting of said brake controlled by another portion of said floating lever.

11. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a floating lever, means responsive to the speed of said prime mover for controlling said floating lever, means positioned in accordance with said gate for controlling one portion of said floating lever, means for adjusting the controlling effect of said last named means on said floating lever, a brake for said prime mover, and means for controlling the setting of said brake controlled by another portion of said floating lever.

12. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a floating lever, means responsive to the speed of said prime mover for controlling said floating lever, means for adjusting the controlling effect of said speed responsive means on said floating lever, means positioned in accordance with said gate for controlling one portion of said floating lever, means for adjusting the controlling effect of said last named means on said floating lever, a brake for said prime mover, and means for controlling the setting of said brake controlled by another portion of said floating lever.

13. In a control system for a prime mover, a gate for controlling the admission of operating fluid to said prime mover, a brake for said prime mover, means for setting said brake, means responsive to the speed of said prime mover, and means for adjustably predetermining the speed and gate opening at which said brake setting means will be caused to act.

14. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a brake for said prime mover, control means for said brake, means responsive to the speed of said prime mover for controlling said control means, and a lost motion connection between said control means and said gate.

15. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a brake for said prime mover, control means for said brake, means responsive to the speed of said prime mover for controlling said control means, and an adjustable lost motion connection between said control means and said gate.

16. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a brake for said prime mover, control means for said brake having an operating element, a floating lever having its floating pivot connected to said operating element, means positioned in accordance with said gate operatively related with one end of said floating lever, means responsive to the speed of said prime mover, and means whereby said speed responsive means may control the other end of said floating lever.

17. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, a brake for said prime mover, control means for said brake having an operating element, a floating lever having its floating pivot connected to said operating element, means positioned in accordance with said gate operatively related with one end of said floating lever, a servo-motor for operating said gate, a regulating valve for said servo-motor, means responsive to the speed of said prime mover for controlling said regulating valve, and means whereby said speed responsive means may control the other end of said floating lever.

18. In a control system for a prime mover, a gate for admitting operating fluid to said prime mover, means for operating said gate, means responsive to the speed of said prime mover for controlling said operating means, a brake for said prime mover, and means controlled by said speed responsive means for setting said brake in response to a reduction in speed to a predetermined value.

In testimony whereof, the signatures of the inventors are affixed hereto.

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