

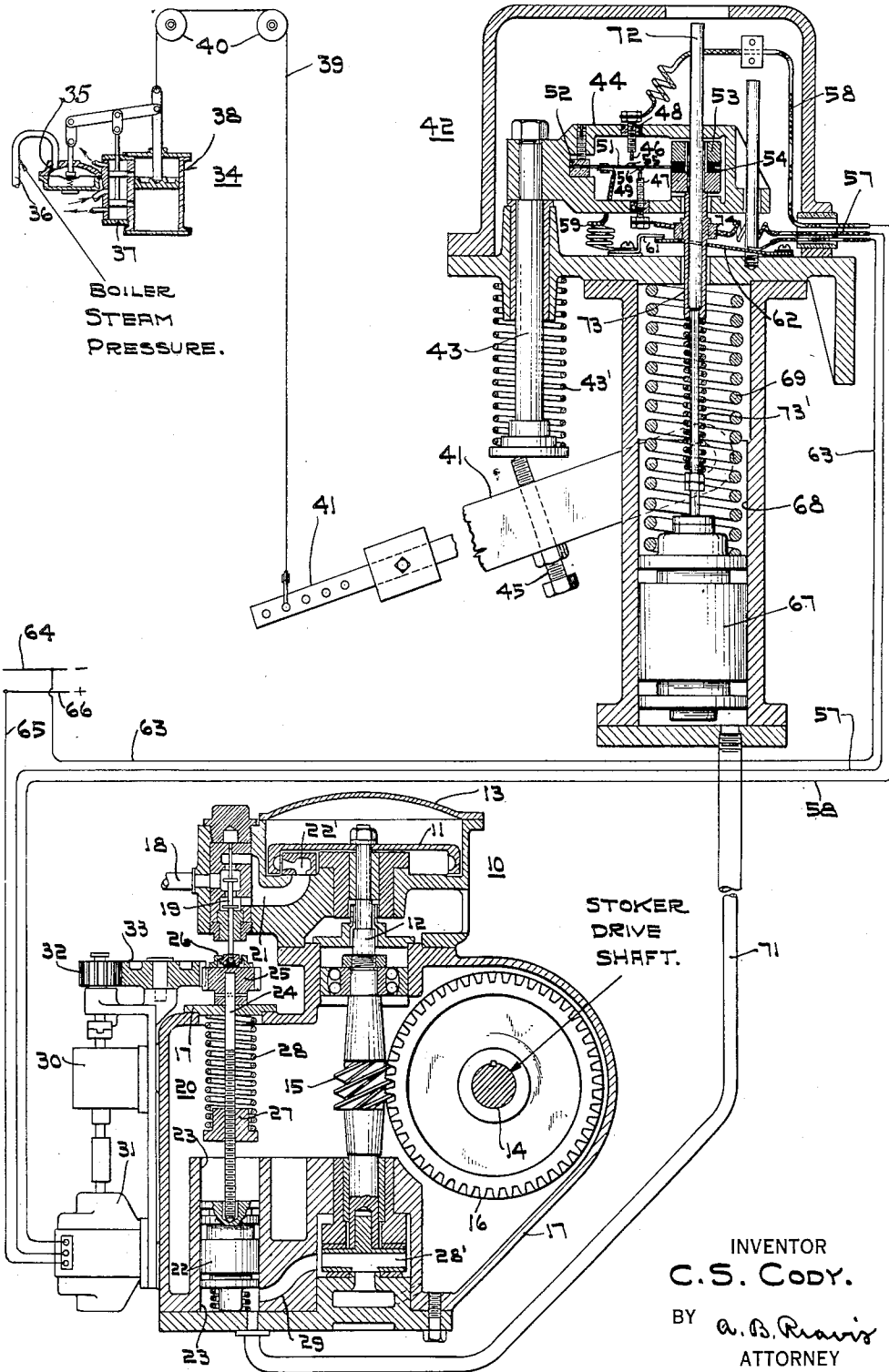
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REGULATING MECHANISM

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REGULATING MECHANISM

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My invention relates to a control mechanism for a variable speed prime mover, and it has for its object to provide an improved mechanism of the character set forth.

5 A more particular object is to provide a control mechanism which will operate to promptly change the speed of the prime mover when called upon to do so.

In accordance with my invention, I provide a 10 speed-responsive governor having speed-changer mechanism operated by an electric motor. A control member closes the contacts for operating the motor to change the speed of the prime mover. A further mechanism is provided for 15 reopening the contacts when the prime mover attains the speed called for by the control member.

The above and other objects are effected by my invention, as will be apparent from the following description and claims taken in accordance with my invention, in which:

The single figure is a diagrammatic view of the control mechanism applied to a prime mover.

25 The present invention is particularly adapted, but of course not limited, to change the speed of a stoker drive turbine in accordance with the steam demand as determined by the steam pressure.

Referring now to the drawing more in detail, 30 I show a steam turbine 10, which includes a rotor 11 mounted on a vertical shaft 12 and a turbine casing 13. The shaft 12 drives a stoker drive shaft 14, through a worm 15 which meshes with a worm gear 16 mounted on the shaft 14. 35 A housing 17, connected to the turbine casing 13, is provided for housing the gearing, and is adapted to be partially filled with the lubricating oil.

Steam is supplied to the turbine from any 40 suitable source through a conduit 18 and admission valve 19. It is conveyed through a passage 21 to nozzles 22', in which it is directed against the rotor 11. The admission valve 19 is actuated by a fluid pressure governor 20, which includes a piston 22 operating in a cylinder 23. 45 The piston 22 operates the valve 19 through a piston rod 24, the upper end of which has fixed thereon a gear wheel 25 and which is rotatably connected to the valve at 26. A spring-holding member or collar 27 is screw threaded on the 50 piston rod 24, and a compression spring 28 is interposed between the collar 27 and the casing 17.

The compressive force of the spring 28 provides sufficient frictional engagement of the

spring with the casing 17 and the collar 27 to prevent turning of the collar 27 upon rotation of the rod 24, the moment of said frictional engagement being greater than the moment of the frictional engagement of the screw threads, so 60 that rotation of the rod 24 results in raising or lowering of the collar 27 with respect to the rod 24.

A centrifugal impeller 28', connected to the lower end of the shaft 12 and receiving fluid 65 from the reservoir formed by the casing 17, provides a fluid pressure which varies as the square of the speed of the turbine. This pressure is conveyed through a passage 29 to the lower end of the cylinder 23, in which it acts 70 on the piston 22 in valve-closing direction against the force of the spring 28.

The operation of the speed-responsive governor 20 is as follows: Upon a decrease in load, the speed of the turbine begins to increase. 75 The fluid pressure developed by the impeller 28' increases and moves the piston 22 upwardly in valve-closing direction against the force of the spring 28. The admission valve 19 reduces the admission of steam to the turbine to restrict 80 the increase in speed.

Upon an increase in load on the turbine, the speed begins to decrease. The fluid pressure developed by the impeller 28' decreases at the same time, and the spring 28 overcomes the force of 85 the pressure on the piston 22 and moves the admission valve 19 in opening direction. The admission of steam is increased to carry the increased load, preventing further decrease in speed.

The speed setting of the governor 20 is varied by rotating the rod 24 to vary the position of the collar 27 with respect to the rod. To provide 90 a higher speed setting, the rod is rotated in the direction for raising the position of the collar 27 with respect to the rod. Since, for a given speed, the spring 28 has a fixed length, the immediate effect of such adjustment is to raise the rod 24, moving the admission valve 19 in opening direction. The speed of the turbine 100 thereupon increases until the increased fluid pressure overcomes the force of the spring 28 and returns the admission valve to approximately the same position. In other words, the position of the collar 27 having been raised with 105 respect to the rod 24, an increased fluid pressure is required to move the admission valve to a given position. An increase in speed setting is thus effected.

To provide a lower speed setting, the rod 24 110

is rotated to lower the position of the collar 27 with respect thereto. The immediate effect of the adjustment is to move the admission valve 19 in closing direction to reduce the steam admission. The speed of the turbine and the fluid pressure then decrease, and the spring 28 moves the admission valve in opening direction. In this case, a lower speed and a lower pressure are required to overcome the force of the spring 28 for a given position of the admission valve. The governor, therefore, maintains a lower speed of the prime mover.

A speed-changer mechanism, including a reversible speed-changer motor 31, is provided for effecting change in speed setting of the governor. The motor 31 is of the split-field type. It is connected through reduction gearing 30 to a gear 32, which in turn is connected to the gear 25 on the shaft 24 through an idler gear 33.

Since the turbine in the present embodiment drives a stoker drive shaft, it is desirable to control the motor 31 by means of a master regulator which is commonly provided in power plants for controlling dampers, etc., in accordance with the steam demand. Such a regulator is shown at 34, and includes a pressure-responsive element 35, subjected to the boiler steam pressure through a conduit 36, a pilot valve 37 and a servo-motor 38. The latter is connected, through a cable 39 extended over pulleys 40, to a lever 41 of a control device, indicated generally by the reference numeral 42.

The control device 42 controls the electric motor 31 to operate the speed changer mechanism of the governor until the turbine attains the speed called for by the position of the lever 41. It includes a vertically movable rod 43 which carries a housing 44. The rod 43 is moved by the lever 41 by means of a bolt 45, which is screw threaded through the lever. A spring 43' may be provided to increase the force for downward movement of the rod 43 and the lever 41. The bolt 45 provides for adjustment of the control device 42 with respect to the regulator 34. The housing 44 carries contactors 46 and 47, which are inserted through insulating bushings 48 and 49, respectively. A conductor leaf 51 is also disposed within the housing 44, and is attached thereto at one end by means of insulating material 52. A weighted collar 53 is attached to the free end of the leaf by means of insulating material 54. The leaf 51 carries contactors 55 and 56, which are adapted to contact with the contactors 46 and 47, respectively.

The contactors 47 and 46 are connected, through conductors 57 and 58, respectively, with the field windings of the motor 31. The leaf 51 is connected through a conductor 59, a contactor 61, a leaf 62 and a conductor 63, with a line conductor 64. The third terminal of the motor 31 is connected through a conductor 65 with the line conductor 66.

The control device 42 further includes a pressure actuated piston 67, which is disposed within a cylinder 68. The piston is biased downwardly by a spring 69. On its lower side it is subjected to the fluid pressure developed by the impeller 28, said pressure being conveyed through a conduit 71 to the lower end of the cylinder 68.

A rod 72 is attached to the piston 67 and extends slidably through the housing 44 and the collar 53. It has a sleeve 73 slidably supported thereon by a spring 73', the upper end of the

sleeve being adapted to abut and raise the collar 53. The rod 72 also carries a collar 74, which is adapted to engage the leaf 62 to open the circuit to the motor 31 when the turbine 10 is shut down.

The operation of the above-described control mechanism is as follows:

Upon a decrease in boiler steam pressure, calling for increased speed of the stoker drive shaft, the regulator 34 moves the lever 41 upwardly through the cable 39. The collar 53 remains stationary during the first part of the upward movement of the housing 44, and moves the right-hand end of the leaf 51 downwardly with respect to the housing 44, thereby bringing the contacts 47 and 56 into engagement. This completes the circuit to the motor 31 effecting operation thereof in speed-increasing direction. This circuit is traced as follows: line conductor 64, conductor 63, leaf 62, contactor 61, conductor 59, leaf 51, contactors 56 and 47, conductor 57, the motor 31, the conductor 65 and the line conductor 66. The motor 31 operates to rotate the rod 24 to raise the position of the collar 27 with respect thereto so as to effect a higher speed setting of the governor 20 as described above. As the speed of the turbine increases the fluid pressure developed by the impeller 28 increases and moves the piston 67 upwardly. The upper end of the sleeve 73 moves the collar 53 upwardly to disengage the contacts 56 and 47, whereupon operation of the speed changer motor 31 ceases. The turbine 10 then continues to operate at increased speed maintained by the governor 20.

Upon an increase in boiler steam pressure, calling for decreased speed of the stoker drive shaft 14, the regulator 34 permits the lever 41 to move downwardly under the force of gravity and of the spring 43'. The housing 44 moves downwardly, and the collar 53, upon being engaged by the upper wall of the housing, compresses the spring 73'. The relative movement of the housing 44 and the collar 53 bends the leaf 51 upwardly with respect to the housing, closing the contacts 55 and 46. The circuit for effecting operation of the motor 31 in speed decreasing direction is now closed as follows: line conductor 64, conductor 63, leaf 62, contactor 61, conductor 59, leaf 51, contactors 55 and 46, conductor 58, motor 31, conductor 65 and the line conductor 66. The motor 31 rotates the rod 24 in the opposite direction to lower the position of the collar 27 with respect thereto, so as to effect a lower speed setting of the governor in the manner described above. As the speed of the turbine decreases, the fluid pressure developed by the impeller 28 also decreases and permits the spring 69 to move the piston 67 downwardly. As the collar 53 is lowered to its central position in the housing 44, the contactors 46 and 55 are disengaged, and operation of the motor 31 ceases. The turbine then continues to operate at a lower speed.

From the above description, it will be seen that I have provided a mechanism wherein a speed setting is provided which is a function of the position of a control member, which in this case may be considered as the lever 41. As the position of the lever 41 is raised, a higher speed setting is effected, and as its position is lowered, a lower speed setting is effected. The speed changer motor continues to operate until the speed called for by the control member is effected, whereupon operation of the motor is

discontinued by means of the fluid pressure moving the collar 53 through the piston 67 to its central position in the housing 44 to open the electrical contacts.

fluid pressure varying as a function of the speed of the prime mover, and means responsive to said fluid pressure for actuating one of the contacts to discontinue operation of the speed changer motor when the prime mover has attained substantially the speed determined by the controlling means.

5 While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon, as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

15 1. The combination with a prime mover, of a control mechanism for changing the speed of the prime mover comprising a governor responsive to the speed of the prime mover, a speed-changer motor for changing the speed setting of the governor, a control member for determining the speed of the prime mover, means for effecting continuing operation of the speed-changer motor when the speed of the prime mover differs from that determined by the control member, means providing a fluid pressure varying as a function of the speed of the prime mover, and means responsive to said fluid pressure for discontinuing operation of the speed-changer motor when the prime mover attains the speed determined by the control member.

20 2. The combination of a prime mover, a governor for the prime mover responsive to the speed thereof, speed changer means including and operated by an electric motor for changing the speed setting of the governor, electrical contacts for controlling the operation of the motor, means for closing the contacts to change the speed of the prime mover, means providing a fluid pressure varying as a function of the speed of the prime mover, and means responsive to said fluid pressure for reopening said contacts when the prime mover has attained the desired speed.

25 3. The combination of a prime mover, a speed-responsive governor for the prime mover, speed-changer means including and operated by an electric motor for changing the speed setting of the governor, electrical contacts for controlling the operation of the motor, controlling means for determining the speed of the prime mover and actuating one of said contacts to operate the speed changer motor when the speed of the prime mover differs from that determined by the controlling means, means providing a

4. A control mechanism for a prime mover for effecting a variety of speeds thereof comprising a speed-responsive governor having speed-changer mechanism, a control member movable to various positions determining various speeds of the prime mover, a second member, means responsive to the speed of the prime mover for moving the second member to various positions corresponding to various speeds, and a mechanism operative when the positions of said members do not correspond substantially to the same speed for operating the speed changer mechanism of the governor in the direction for effecting the speed corresponding to the position of the control member.

5. The combination with a variable-speed prime mover, of a governor for the prime mover acting in response to the speed thereof, speed changer mechanism for changing the speed setting of the governor, a control device having a variety of adjustments corresponding to different speeds of the prime mover, means responsive to a change in the adjustment of the control device for effecting continuing operation of the speed changer mechanism, and means responsive to the speed of the prime mover for stopping the operation of said last-named means when the prime mover has reached a speed corresponding to the adjustment of the control device.

6. The combination with a variable-speed prime mover, of a governor for the prime mover acting in response to the speed thereof, a speed changer motor for changing the speed setting of the governor, electrical contacts for controlling the motor, a control device having a variety of adjustments corresponding to different speeds of the prime mover and operable to close said contacts upon a change in the adjustment thereof for effecting continuing operation of the speed changer motor, and means acting in response to speed of the prime mover for opening said contacts when the prime mover has attained a speed corresponding to the adjustment of the control device.

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