

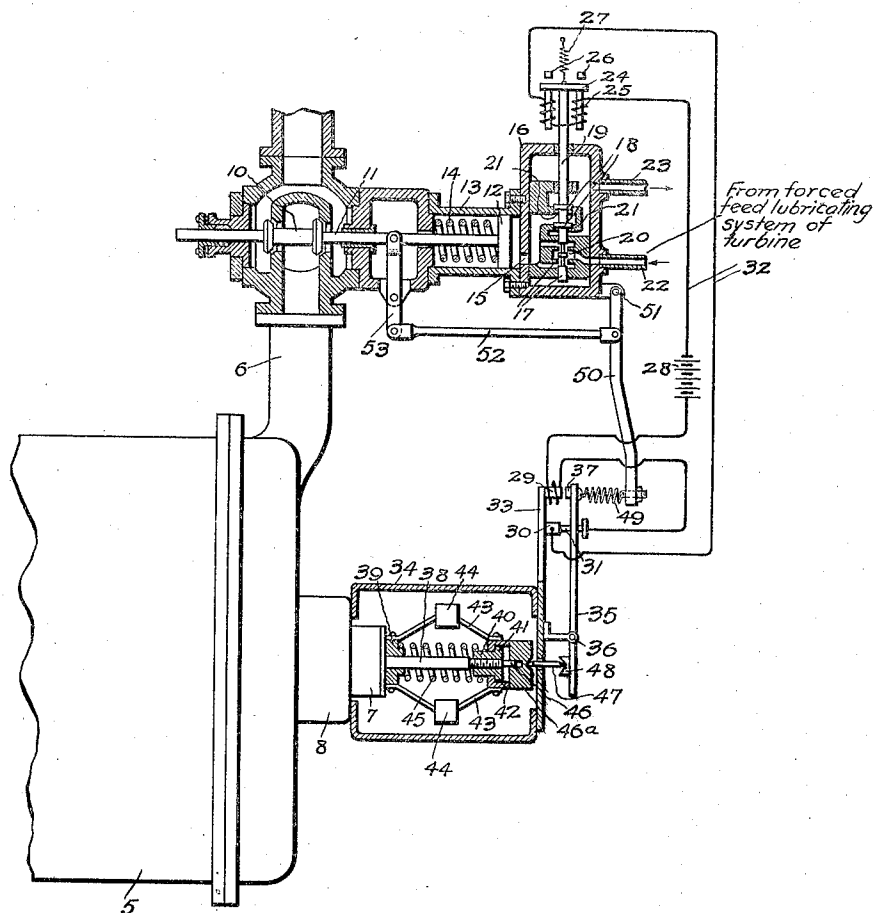
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GOVERNING MECHANISM FOR PRIME MOVERS

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GOVERNING MECHANISM FOR PRIME MOVERS.

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The present invention relates to speed governing mechanisms for prime movers such as elastic fluid turbines and the like, and has for its object to provide an improved apparatus of this character which is simple in structure, reliable in operation, readily manufactured at a low cost, and capable of maintaining close regulation.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the drawing, the figure is a diagrammatic view of an elastic fluid turbine provided with a governing mechanism embodying my invention.

According to the preferred form of my invention, I provide in connection with a prime mover a valve means which controls the admission of elastic fluid thereto which valve means is biased toward closed position by a spring or other suitable means and for operating the valve means I provide a suitable motor for opening it against the force of the biasing means and speed responsive mechanism which at definitely periodic intervals effects operation of the motor to cause it to give the valve a push toward open position, the valve being thereby opened by a succession of impulses. By definitely periodic intervals of time I mean successive intervals of time of definite or appreciable length. Under some conditions the definitely periodic intervals will be of equal duration. With changing conditions the intervals will not be of equal duration but they will always be of a definitely periodic nature. The arrangement is such that when the speed decreases beyond the desired value the motor is operated to move the valve means toward open position and this movement continues until the speed reaches a value a certain amount higher than the desired value when the motor is caused to cease operation and the valve is permitted to move toward closed position under the influence of the biasing force.

It then continues to move toward closed position until the speed again falls below the desired value when the speed responsive mechanism once more comes into operation to cause the motor to move the valve toward open position. Preferably the motor is controlled by opening and closing an electric circuit, the contacts for doing this being controlled by a suitable speed governor. The

arrangement may be such that when the circuit is closed the motor is operated to effect opening of the valve means while when the circuit is interrupted by the speed responsive device or governor the operation of the motor is interrupted and the valve means permitted to move toward closed position. Means are provided to insure a definite change in speed between the opening and closing of the contacts so that the contacts will be definitely separated and closed, and for this purpose I preferably provide a holding magnet in the circuit which acts to hold the contacts closed until there has been a definite speed change. This holding magnet is deenergized as soon as the circuit is broken, whereupon the contacts are definitely separated, and is energized as soon as the circuit is closed again to definitely close the contacts. Also to render the governor non-isochronous, I preferably provide means by which movement of the valve means causes change of the speed at which contact is made and broken whereby there is provided a definite speed range between no load and full load. By suitable adjustments and proportioning of the parts the speed range may be made such as to give stable operation of the governing mechanism. The motor for moving the valve means toward open position may with advantage be a fluid-actuated motor comprising a cylinder, a piston therein connected directly to the valve means and a pilot valve for controlling the admission of actuating fluid to and its discharge from the cylinder, the pilot valve being arranged to have two positions, one in which it admits actuating fluid to the cylinder and another in which it cuts off the actuating fluid supply and permits escape of the actuating fluid from the cylinder. The pilot valve is then actuated by an electromagnet in the circuit controlled by the contacts. By this arrangement but a small current is required in the central circuit which simplifies the matter of opening and closing the circuit.

It will be seen that by my invention the valve means controlling the admission of elastic fluid to the prime mover is opened and held open to any desired degree by a succession of impulses and releases. The periodicity with which the mechanism acts is readily controlled and regulated by proportioning the parts and providing suitable means for dampening or retarding the move-

ments, the arrangement being such that the speed variations between interruptions of the electrical circuit is so small as to be unobjectionable.

Referring to the drawing, 5 indicates an elastic fluid turbine provided with a conduit 6 for the admission of elastic fluid. The shaft of the turbine is indicated at 7 and the high pressure packing at 8. Only the high pressure or admission end of the turbine is illustrated as the details of structure of the turbine form no part of the present invention. The turbine indicated is to be taken as typical of any suitable turbine or other prime mover.

According to my invention, I provide in the admission conduit 6 a valve 10 for regulating the flow of elastic fluid to the turbine which valve is so arranged that it is always urged or biased toward closed position. For example, it may have its stem 11 connected to a piston 12 located in a cylinder 13 and acted upon by a spring 14 which serves always to force the valve toward closed position. The valve is adapted to be opened against the action of spring 14 by fluid pressure admitted to cylinder 13 through an opening 15. Connected to cylinder 13 is a valve casing 16 in which are located two sets of valves 17 and 18 carried by a stem 19 and arranged to open and close ports 20 and 21 in valve casing 16. Valves 17 control the flow of actuating fluid from a supply conduit 22 through ports 20 to the opening 15 in cylinder 16 and valves 18 control the flow of actuating fluid from cylinder 13 through opening 15 and ports 21 to a discharge conduit 23. The arrangement is such that when valves 17 are open valves 18 are closed and when valves 18 are open valves 17 are closed. Casing 16 and valves 17 and 18 form in substance a reversible pilot valve of a fluid-actuated motor comprising piston 12 and cylinder 13.

In connection with the foregoing arrangement I provide means responsive to the speed of the prime mover for periodically reversing the positions of valves 17 and 18, which means that actuating fluid is being either admitted to cylinder 13 through opening 15 to move valve 10 toward open position or is being permitted to escape from cylinder 13 through opening 15 to permit spring 14 to move valve 10 toward closed position, thereby giving to valve 10 definitely periodic impulses. To this end, according to the embodiment of my invention illustrated in the drawing, I connect the end of stem 19 to an armature 24 which moves between the ends of the poles of an electromagnet 25 and suitable fixed stops 26, the armature being biased toward the stops by a spring 27. The winding of electromagnet 25 is connected into an electric circuit including a suitable source of potential 28,

a holding magnet 29, a fixed contact 30 and a movable contact 31, the circuit wires being indicated at 32. Holding magnet 29 and fixed contact 30 are mounted on a stationary arm 33 carried by a housing 34. Movable contact 31 is mounted on a lever arm 35 pivoted on a bracket 36 on housing 34 and carrying at one end an armature 37 which cooperates with holding magnet 29. Connected to the end of turbine shaft 7 is a speed governor which acts on lever arm 35. It comprises a rod 38 fixed to shaft 7 and provided with a fixed collar 39 at its inner end and an axially adjustable nut 40 at its outer end. On nut 40 is a flange 41. Mounted on nut 40 to slide axially thereon is a flanged ring 42 which is connected to fixed collar 39 by leaf springs 43 which carry the governor weights 44. Arranged between collar 39 and ring 42 is a spring 45 which acts to force ring 42 against flange 41 and oppose its movement by the governor weights. On the end of rod 38 is an axially extending pin 46 on which slides a block 46^a which follows the movements of ring 42. In block 46^a is a bearing in which rests one end of a bearing pin 47, the other end of which rests in a bearing 48 on lever arm 35. The action of spring 45 is opposed by a spring 49 connected at one end to lever arm 35 and at the other end to an arm 50 pivoted at 51 on casing 16. Spring 49 is held under tension by arm 50 and when the end of lever arm 50 moves away from lever arm 35 the tension of the spring 49 is increased, while when it is moved in the other direction, the tension is decreased. Arm 50 is pivotally connected to stem 11 of valve 10 by a link 52 and lever 53. Spring 45 can be adjusted by means of nut 40 and spring 49 can be adjusted through its connection with lever arm 50.

In use the governor springs 45 and 49 are adjusted relatively to each other for the desired turbine speed. When this desired turbine speed is exceeded governor weights 44 move outwardly against the action of spring 45 and at a certain predetermined speed spring 49 will become effective to turn lever arm 25 and move contact 31 away from contact 30, thus opening the circuit through electromagnet 25. This deenergizes electromagnet 25 and permits spring 27 to reverse the position of valves 17 and 18, the former being closed to shut off the flow of actuating fluid to cylinder 13 and the latter opened to permit actuating fluid to escape therefrom. As soon as this occurs spring 14 begins to move valve 10 toward closed position to decrease the amount of elastic fluid admitted to the turbine. The speed of the turbine will then begin to decrease and when it reaches a certain lower value, spring 45 of the speed governor will move lever 35 to again bring movable contact 31 into engage-

ment with fixed contact 30 thereby closing the circuit of electromagnet 25. Upon being reenergized, electromagnet 25 will draw armature 24 away from stops 26 back against its pole pieces thereby reversing the position of valves 17 and 18 once more, opening the former and closing the latter. Motive fluid will then be admitted to cylinder 13 to move valve 10 toward open position and thus increase the supply of elastic fluid admitted to the turbine. This causes the turbine to again increase in speed and when the speed again reaches the predetermined higher value the cycle of operation just described will be repeated. The holding magnet 29 is of such strength that there must be a certain definite change in speed before the unbalance between springs 45 and 49 becomes great enough for spring 49 to move lever 35 to separate contacts 30 and 31. As soon as they separate, however, holding magnet 29 is deenergized so it exerts no pulling force on the lever until the circuit is again closed by contacts 30 and 31. The valve 10 is thus opened by a succession of impulses. The time periods of the impulses are regulated by dampening the movements of the apparatus in such a manner that the functions of governing are accomplished as fast as necessary without giving an inconveniently rapid succession of contacts and impulses. This dampening action may be obtained readily by the design of the parts of the apparatus itself or by other suitable means. The flow of the oil to and from cylinder 13 through the ports has a dampening effect and by making the ports of suitable size the desired dampening effect is readily obtained. This dampening effect is caused, as will be readily understood, by the resistance offered to the flow of oil through the ports. Also the proportion and spacings are such that the speed variation between interruptions of the electrical circuit is so small as to be unobjectionable.

To insure stable governing it is desirable that a governing mechanism be non-isochronous, that is, that the full load speed be lower than the no load speed and in the present instance I accomplish this by adjusting the tension of spring 49 with changes in load, the arrangement being such that as the load increases the tension of the spring 49 is increased which means that the mechanism will operate to separate contacts 30, 31 at a lower speed. Any suitable means may be used for adjusting spring 49, that shown comprising the lever arm 50, link 52, and lever arm 53. With this arrangement it will be seen that as valve 10 opens lever 53 is turned on its pivot to push arm 50 toward the right thereby increasing the tension on spring 49. The tension increases as valve 10 opens and the arrangement and proportioning of the parts is such that the desired

change in speed between no load and full load is obtained.

A construction embodying my invention has the advantage that practically no load is imposed on the speed governor, it being called upon merely to make and break an electric circuit. As a result it may be small and very simple in structure so it can be made at a low cost, but at the same time be very sensitive. The amount of current required to operate the apparatus will be small and since a definite break and make of the contacts is insured by the holding magnet 29 no difficulty is experienced with burning or wearing of the contacts. Since valve 10 is operated by successive pushes it will be kept continuously in motion, moving first toward open position and then toward closed position so it has no opportunity to become stuck in any position and since it is biased toward closed position it will always close in case the supply of actuating fluid to cylinder 13 fails. I may with advantage utilize as actuating fluid, fluid taken from the force feed lubricating system for the turbine so that in case the lubricating pressure for the machine fails, control valve 10 will close.

The type of speed governor illustrated is shown only by way of example and it will be understood that any suitable means responsive to the speed of the machine may be used.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve toward closed position, a motor for opening the valve against the action of said biasing means, a reversible controlling means for said motor, and means responsive to the speed of the prime mover for periodically reversing said controlling means, whereby the valve at all times is being moved either toward closed position under the influence of said biasing means or toward open position by said motor.

2. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve toward closed position, a fluid-actuated motor for opening the valve against the action of said biasing means, a reversible valve means for the motor which in one position effects movement of the motor to open the valve and in the other position permits the

valve to close under the influence of said biasing means, and means responsive to the speed of the prime mover for periodically reversing said valve means.

3. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve toward closed position, a fluid-actuated motor for opening the valve against the action of said biasing means, a reversible valve means for the motor which in one position effects movement of the motor to open the valve and in the other position permitting the valve to close under the influence of said biasing means, an electromagnet for moving said valve means, an electric circuit for the electromagnet, controlling means in said circuit, and means responsive to the speed of the prime mover for periodically opening and closing said circuit-controlling means.

4. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve toward closed position, a fluid-actuated motor for opening the valve against the action of said biasing means, a reversible valve means for the motor which in one position effects movement of the motor to open the valve and in the other position permits the valve to close under the influence of said biasing means, an electromagnet for moving said valve means, an electric circuit for the electromagnet, separable contacts in said circuit, and means responsive to the speed of the prime mover for periodically opening and closing said contacts.

5. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, a fluid-actuated motor for the valve, means biasing the motor to a position wherein the said valve is closed, a pilot valve for the motor which has two positions, one in which the motor is caused to move to open the first-named valve and the other in which the motor is permitted to move under the influence of said biasing means to close the first-named valve, electrically-operated means for effecting movement of the pilot valve from one position to the other, an electric circuit in which it is included, separable contacts in said circuit, a lever to which one of said contacts is connected, and means responsive to the speed of the prime mover for moving said lever periodically to open and close said contacts.

6. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, a fluid-actuated motor for the valve, means biasing the motor to a position wherein the valve is closed, a pilot valve for the motor which has two positions, one in which the motor is caused to move to open the first-named valve and the other in which the motor is permitted to move under the

influence of said biasing means to close the first-named valve, electrically-operated means for effecting movement of the pilot valve from one position to the other, an electric circuit in which it is included, separable contacts in said circuit, a lever to which one of said contacts is connected, means responsive to the speed of the prime mover for moving said lever to open and close said contacts, and a holding magnet in said circuit for said lever.

7. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve to closed position, a motor for opening the valve against the force of the biasing means, and means controlled by the speed of the prime mover for periodically supplying actuating medium to said motor.

8. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve to closed position, a motor for opening the valve against the force of the biasing means, means controlled by the speed of the prime mover for periodically supplying actuating medium to said motor, and means for rendering the governing action non-isochronous.

9. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve to closed position, a motor for opening the valve against the force of the biasing means, an electric circuit controlling the supply of actuating medium to said motor, and means responsive to the speed of the prime mover for opening and closing said circuit at definitely periodic intervals of time.

10. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve to closed position, a motor for opening the valve against the force of the biasing means, an electric circuit controlling the supply of actuating medium to said motor, means responsive to the speed of the prime mover for opening and closing said circuit at definitely periodic intervals, and means for rendering the governing action non-isochronous.

11. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, means which biases said valve to closed position, a fluid-actuated motor for opening the valve against the force of said biasing means, a pilot valve controlling the admission of motive fluid to and from the motor, an electric circuit including means for operating the pilot valve, a speed governor for periodically opening and closing said circuit, and means for automatically setting said governor in accordance with the opening of the controlling valve for the prime mover so as to render the governing action non-isochronous.

12. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, a motor for moving the valve, means including an electric circuit for effecting movements of said valve, means responsive to the speed of the prime mover for interrupting said circuit, and a holding magnet in said circuit which serves to prevent interruption of the circuit until a predetermined change in speed has taken place.

13. In combination, a prime mover, a valve controlling the admission of elastic fluid thereto, a motor for moving the valve, means including an electric circuit for effecting movements of said valve, means responsive to the speed of the prime mover for interrupting said circuit, a holding magnet in said circuit which serves to prevent interruption of the circuit until a predetermined change in speed has taken place, and means whereby movement of said valve causes change of the speed at which the speed responsive means interrupts said circuit.

14. In combination, a prime mover, a valve means controlling the admission of elastic fluid thereto, a motor for operating the valve means, means controlling the motor to effect movement of the valve means, said controlling means having two positions, one wherein it effects movement of the valve means toward open position and another wherein it effects movement of the valve means toward closed position, and means responsive to an operating condition

of the prime mover for periodically moving said controlling means from one of its positions to the other.

15. In combination, a prime mover, a valve means controlling the admission of elastic fluid thereto, a motor for operating the valve means, means controlling the motor to effect movement of the valve means, said controlling means having two positions, one wherein it effects movement of the valve means toward open position and another wherein it effects movement of the valve means toward closed position, and means responsive to the speed of the prime mover for periodically moving said controlling means from one of its positions to the other.

16. In combination, a prime mover, a valve means controlling the admission of elastic fluid thereto, a motor for operating the valve means, means controlling the motor to effect movement of the valve means, said controlling means having two positions, one wherein it effects movement of the valve means toward open position and another wherein it effects movement of the valve means toward closed position, an electromagnet for moving said controlling means from one of its positions to the other, an electric circuit for the electromagnet, and means responsive to an operating condition of the prime mover for periodically opening and closing said electric circuit.

In witness whereof, I have hereunto set my hand this 7th day of May, 1923.

WILLIAM L. R. EMMET.