

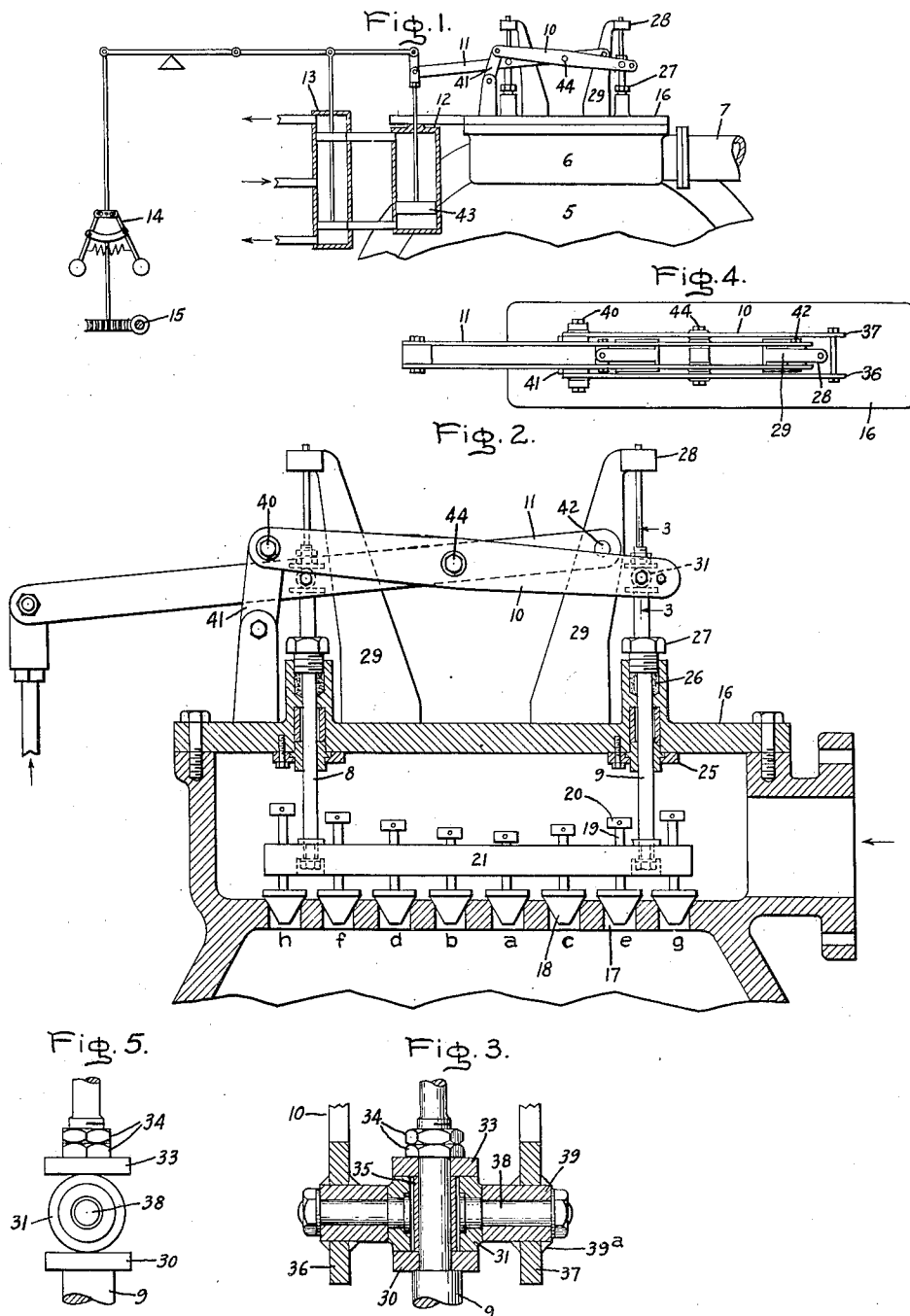
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GOVERNING MECHANISM FOR ELASTIC FLUID TURBINES

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GOVERNING MECHANISM FOR ELASTIC
FLUID TURBINESFranklin R. Ericson, Marblehead, Mass., assignor
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My invention relates to that type of governing mechanism for elastic fluid turbines in which a plurality of valves is employed and actuated successively for controlling the admission of steam or other heated fluid thereto.

The object of my invention is the provision of an improved governing mechanism for elastic fluid turbines and specifically of the means whereby in response to a change in an operating condition of the turbine the valves are caused to open and close in a predetermined sequence and this without objectionable strains and stresses due to temperature changes and other causes.

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 accompanying drawing which is illustrative of my invention, Fig. 1 is a view partly in elevation and partly in section of a steam turbine and its governing mechanism; Fig. 2 is a view in section of a steam chest and the valve operating mechanism; Fig. 3 is a section of the connecting means between one of the levers and an operating rod taken on line 3-3 of Fig. 2; Fig. 4 is a plan view of the operating levers; and Fig. 5 is a detail view of the connection between one of the operating levers and its associated rod.

In the drawing, 5 indicates an elastic fluid turbine of any suitable design to which steam is admitted through a steam or valve chest 6. A conduit 7 serves to admit steam to the chest. The valves inside of the chest are actuated through parallel rods 8 and 9, a pair of overlapping levers 10 and 11 and a motor 12. The motor is controlled by a pilot valve 13 in the ordinary manner, subject to the control of a governor that moves the pilot valve in response to an operating condition of the turbine, in this case a speed governor 14 driven by the turbine shaft 15. All of the parts above mentioned, including the motor and the controlling valve therefor, are mounted on the cover 16 of the steam chest so that expansions and contractions of the chest and the parts carried thereby are in the same direction, and because of that fact objectionable strains and stresses due to temperature changes and other causes, on the parts, are reduced to a minimum. Since the turbine casing supports the valve chest the expansions and contractions thereof are in the same direction as those of the chest and the parts supported thereby. Desirably the surfaces of the turbine and valve chest are protected by heat insulation in the ordinary manner.

Referring more particularly to Fig. 2, the bot-

tom wall of the chest has a series of ports or openings 17 leading to nozzles or other devices for supplying steam to the bucket wheel or wheels. The nozzles are not shown as they are not material to an understanding of the invention and also because they may be of any suitable or usual construction. Each port is provided with a valve 18 having a stem 19 and a stop or collar 20. The valves may be operated in any desired order. As illustrated, they open in the following order: *a, b, c, d, e, f, g, and h* and close in the reverse order. The valves are opened and closed by the horizontally disposed member 21 located within the chest. The valve stems are of different effective lengths, a feature obtained by suitably adjusting the collars or stops 20 thereon. As the member 21 is moved upwardly, it successively engages the stops to open the valves and similarly as the member 21 is moved downwardly, it releases one valve after the other and permits them to close successively. In order to better illustrate the successive operation of the valves the stems are made somewhat longer than are necessary in practice.

In such an arrangement, it is important to have both ends of the member 21 move up and down by the same amount and at the same rate and thereby prevent any tendency for the member to weave or the operating parts to become cramped or stick. With this end in view, the rods 8 and 9 are arranged in parallel relation with their lower ends secured to the member 21 at or near the ends thereof. The openings in the member through which the rods extend are slightly larger than the rods, as indicated in dotted lines, so that the member has a limited degree of freedom in the direction of its length and sidewise pressure on the rods is prevented. Each rod extends upwardly through the cover of the chest, and is directed in its movement by a removable guide 25 that is bolted to the underside of the cover. On the upper side the cover is provided with a tubular extension or gland in which is located a suitable packing 26 that is held under compression by a gland nut 27. The rod extends through the nut and at its upper end is provided with a second guide 28 carried by a bracket 29 forming a part of the cover. By reason of spaced top and bottom guides for each of the rods, their parallel relation is preserved, the axes of the rods being perpendicular to the cover.

Referring to Figs. 3 and 5, which show the means employed for connecting each of the levers 10 and 11 to the parallel rods, 9 indicates one of the rods which has a reduced section so as to

form a shoulder upon which is seated a collar 30. Seated on the collar is a roller 31 above which is a second collar 33 that is held in place by suitable nuts 34 on the rod. In order to prevent the collars 30 and 33 from being set too close together which would result in excessive friction, or too far apart which would result in lost motion in a vertical direction, a tube 35 of determined length is provided, the ends of which engage the collars. The rollers 31 are free to rotate on trunnion pins 38 and thereby reduce friction. In order to ensure rigidity and balance, each of the levers 10 and 11 desirably comprises two parallel members or elements which are suitably united, as shown in Fig. 4, the lever 11 being located in the space between the members 36 and 37 of the lever 10. Pivot pins for the levers are indicated at 40-42-44; 39 indicates bosses on lever 10 which are secured thereto by welds 39a.

Considering further the means for moving the valve actuating member 21 and preserving the desired relation of its ends, a pair of overlapping levers 10 and 11 is provided. The lever 10 has its pivot or fulcrum 40 supported by a swinging link 41 which in turn is supported by a bracket carried by the cover. The function of the link 41 is to compensate for the fact that the lever 10 moves in the arc of a circle although such movement is small. The right-hand end of the lever is connected with the rod 9 by means of the connection above described which permits movement of the lever in the direction of its length as it turns on its pivot under operating conditions. The right-hand end of lever 11 has its pivot or fulcrum 42 mounted on the right-hand bracket 29. This lever is likewise connected to the rod 8 in the same manner as rod 9 which permits motion when the lever swings about its fulcrum 42. Although providing for axial movement with respect to the rods as the levers move on their fulcrums, there is no lost motion in a vertical direction between the levers and the rods as the latter are moved up and down or movement of the rods due to expansion. The lever 11 is extended to the left sufficiently to permit of a connection to the moving piston 43 of the motor 12, as shown in Fig. 1. The two levers are united by a pivotal connection 44 located midway between the axes of the rods 8 and 9, and it is through this connection that movements of the motor and lever 11 are transmitted to lever 10. The pivotal connection is of such character that the parts may move without undue friction. The distance between pivots 42 and 44 being fixed, the link 41 moves slightly as pivot 44 is moved up or down. In order that the movements of both rods may be equal for any given change in load conditions, there is of necessity a definite relation with respect to the positions of the fulcrums of the levers, their points of attachment to the rods, and the location of the pivotal connection 44. The distance between the pivot 40 of lever 10 and the pivotal connection 44 is the same as that between connection 44 and the point of attachment of the lever to the rod 9 which is aligned with the axis of the rod. The distance between the pivot 42 of lever 11 and the pivotal connection 44 is the same as that between connection 44 and the point of attachment of the lever to the rod 8 which is aligned with the axis of the rod.

A feature of particular importance in my improved construction is that expansion and contraction, due to heat changes, take place in the plane of the levers and their movements and

therefore the effect thereof is nil, and binding and consequent friction of the parts is reduced to a minimum.

The movement of the pivotal connection 44 for any load change on the turbine is one half that of the rods, which arrangement has been found to be satisfactory in practice although my invention is not necessarily limited thereto. As an example, but not as a limitation, the rods 8 and 9 in the particular valve mechanism shown may have a lift of $5\frac{1}{2}$ ". When desirable, the various pivotal connections may include means of usual construction to reduce friction.

As will be seen from the foregoing, a change in an operating condition such as an increased load, results in a change of speed which causes the pilot valve 13 to be moved in a manner to cause movement of the piston 43 of the motor 12 upward with the result of moving lever 11 about 42 raising rod 8 and moving 44 upward one half the amount of rod 8. Under conditions of a decrease in load the parts operate in the reverse direction. Pivot 44 being connected to lever 10 will cause lever 10 to move upward fulcrumed about pivot 40. Since the distance from 44 to 40 is the same as from 44 to rod 9, the latter will move twice the distance of fulcrum 44, or exactly the same distance as rod 8, to raise the member 21 and preserve its parallel arrangement and also move valves 17 in predetermined order and thus control the admission of steam from conduit 7. Under conditions of a decrease in load the parts will operate in the reverse direction.

The invention is described in connection with the admission of high pressure steam to a turbine, but the same mechanism can be equally well applied to the control of lower pressure steam within an extraction type of turbine.

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

1. A mechanism of the character described comprising a support, parallel rods mounted on the support and movable with respect thereto, levers mounted on the support and extending toward each other from their respective pivots, the levers being in overlapping relation, a means connecting each of the levers to one of the rods, a device for uniting the levers to insure simultaneous and equal movements of the rods, and a means for actuating the levers.

2. A mechanism of the character described comprising a support, parallel rods mounted on the support and movable at right angles thereto, levers arranged in overlapping relation, pivots for the levers carried by the support and arranged in spaced relation, a power transmitting connection between each lever and one of the rods, a pivotal connection between the levers through which movements of one lever are transmitted to the other, and a means connected to one of the levers for directly moving it and for moving the other lever through the pivotal connection.

3. A mechanism of the character described comprising a support, parallel rods located in the same plane and movable with respect to the support, spaced guides for each rod mounted on the support, levers arranged side by side and pivotally mounted on the support for moving the rods, a connection between each lever and a rod which permits the lever to swing on its pivot without causing binding of the rod, a pivot for uniting the levers located midway between the axes of the rods for causing equal simultaneous movements

of the rods in the same direction, and means acting on one of the levers and through it and the pivot on the other lever for moving both of the rods.

4. A mechanism of the character described comprising a support, parallel rods movably carried by the support, a pair of levers arranged side by side in overlapping relation, a pivot for each of the levers, one of which is fixed in position and the other movable, a connection between each of the levers and a rod for moving the rod and also for compensating for the swinging movement of the lever, a pivotal connection for uniting the pair of levers located at the point of crossing thereof, and means connected to one of the levers for simultaneously actuating both levers through the pivotal connection to cause equal movements of the parallel rods.

5. A mechanism of the character described, comprising a support, parallel movable rods carried by the support, inner and outer overlapping levers for moving the rods, the outer lever having spaced elements arranged side by side with the inner lever located in the space between the elements, pivots for the levers, means connecting each of the levers to one of the rods, a pivotal connection between the inner and outer levers located at a point between the rods, and means for moving the pivotal connection through one of the levers.

6. A mechanism of the character described,

comprising a support, parallel rods carried by the support, spaced brackets mounted on the support, guides for the rods carried by the brackets, a pair of levers arranged side by side, pivots for the levers carried by the brackets, a connection between each lever and a rod which positively moves the rod and permits of a limited amount of lost motion in the direction of the length of the lever to compensate for the movement of the lever about its pivot, a connection between the levers for causing simultaneous and equal movements thereof, and a means acting through the connection on both levers to move them.

7. A mechanism of the character described, comprising a support, rods mounted on the support for longitudinal parallel movements in a plane perpendicular to the support, a separate actuating lever for each rod pivotally supported at one end and connected to a rod at the other, the levers being in a plane perpendicular to the support and crossing each other, and a pivotal means uniting the levers at the point of crossing, the pivotal means of each lever being located half way between the supporting pivot of the lever and the point of connection with a rod, and means for moving the levers and pivotal connection in a manner to cause simultaneous and equal movements of the rods in the same direction at the same rate of speed, the movement of the connection being one-half that of each rod.

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