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B. E. WHEELER

2,645,237

GOVERNOR HEAD VIBRATION DAMPENER

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FIG. 1

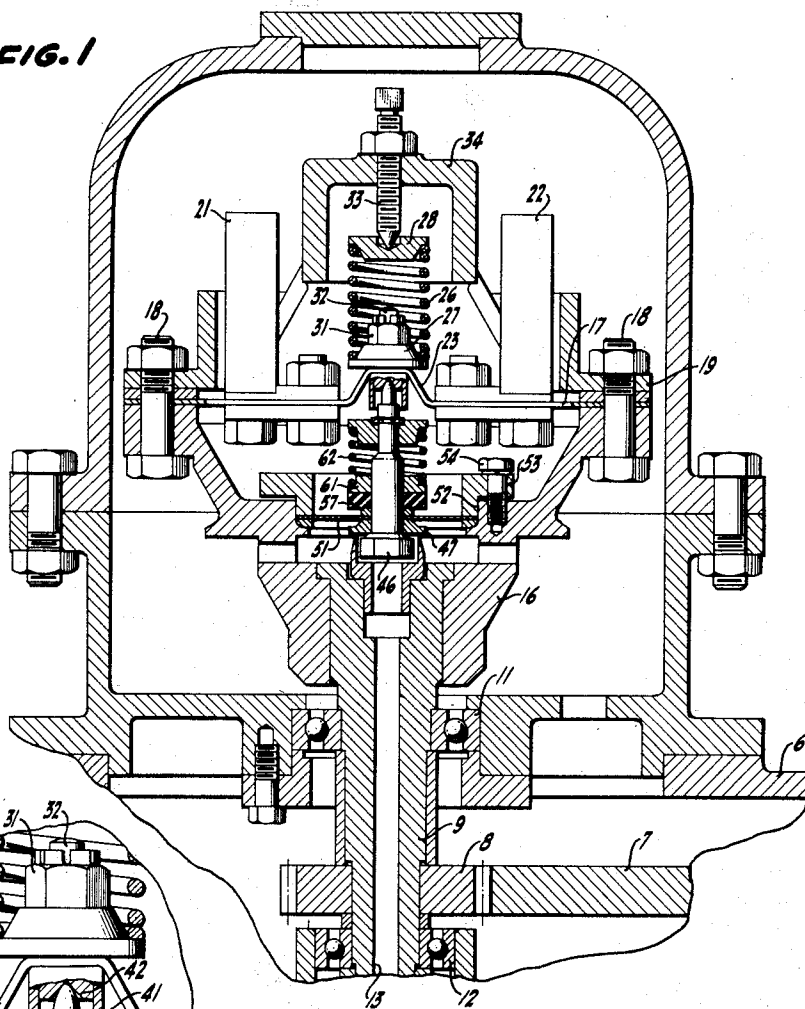
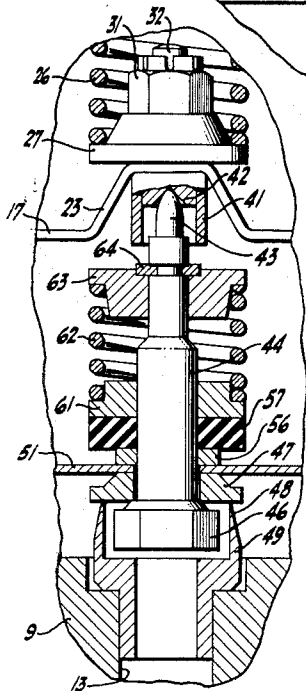


FIG. 2

INVENTOR.
BYRON E. WHEELER
BY *Marion Lott*
ATTORNEY

UNITED STATES PATENT OFFICE

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GOVERNOR HEAD VIBRATION DAMPENER

Byron E. Wheeler, San Francisco, Calif., assignor
to The Pelton Water Wheel Company, a corporation

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6 Claims. (Cl. 137—56)

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My invention relates primarily to speed responsive governors utilized, among other things, in connection with the regulation of the operation of hydraulic turbines such as water wheels connected to electrical generators. Governors utilized in this environment are responsive to rotational speed by the provision of weights or flyballs which occupy different positions in accordance with different speeds, and are effective through a hydraulic mechanism to provide a speed responsive control. The actual movement of the flyballs or centrifugally responsive weights is extremely small, being of the order of several thousandths of an inch, and is resisted usually by a strap spring of very carefully calibrated characteristics. A governor of this general construction is disclosed in the patent to Manious Gottlieb No. 2,237,780 issued April 8, 1941.

In the practical installation of such a governor, it has been found that under some conditions of regulation the unbalanced valve which releases the operating fluid from the hydraulic circuit, tends to bounce on its seat, to surge and to vibrate in such a fashion as not only to disrupt the finely regulated governing of which the structure is otherwise capable, but also seemingly to induce even further surges and changes. Consequently the speed regulation of the system varies over an extremely wide and even destructive range. For example, the ordinary governing range is only a fraction of one per cent of the desired speed, for example one hundredth of one per cent of the desired speed, and some small variation in that amount of regulation is tolerated. When the vibrational surges occur, and they seem to occur somewhat at random or at least in response to a variety of conditions which have not yet been finally established, the speed range is not kept within the desired one hundredth of one per cent and does not vary a mere fraction of one per cent or so, but can vary fifteen or twenty per cent from the desired normal. Such a variation is so great and occurs with such random frequency as not to admit of the use of a governor of the indicated type at all under the indicated environmental surroundings.

It is therefore an object of my invention to provide an improved governor head vibration dampener.

A still further object of my invention is to provide a governor head of the generally indicated kind which is not subject to deleterious vibrational characteristics.

Another object of the invention is to provide a means for dampening vibrations in a governor

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head without unduly reorganizing the general setup of the governor head.

A still further object of the invention is to provide a means for preventing the erratic behavior of governors.

A still further object of the invention is to provide a vibration dampener which operates in several different ways to preclude the existence of deleterious vibration in a governor head.

Other objects, together with the foregoing, are attained in the embodiment of the invention described in the accompanying description and illustrated in the accompanying drawing in which:

Figure 1 is a cross section on a diametrical plane of a governor head of the general type shown in the above mentioned patent, but also incorporating the vibration dampener of my invention, parts of the structure being shown in elevation.

Figure 2 is a cross section similar to Figure 1 but showing the various parts to an enlarged scale, portions of the figure being broken away to reduce its size.

The governor head is usually installed in connection with a regulating mechanism not completely shown but incorporated at least in part in a housing 6, carrying a driving gear 7 connecting to the prime mover mechanism to be governed; for example, to a hydraulic turbine. The gear 7 revolves at a speed proportional to the speed of the turbine. The gear 7 is in mesh with a driven pinion 8 within the casing 6 and mounted on a drive tube 9. The drive tube is mounted in the housing 6 between appropriate anti-friction bearings 11 and 12, and receives hydraulic fluid through the lower end of a central passage 13 from a suitable regulating structure which is not part of the present invention and is therefore not disclosed in detail. Suffice it to say that the flow of hydraulic fluid through the tube 9 is to be regulated pursuant to the speed of rotation of the tube 9 which itself is proportional to the speed of rotation of the prime mover. Adjacent its upper end the drive tube 9 is expanded to provide a rotating yoke 16 comprised of several different parts all revolving in unison.

A governor strap 17 spans the yoke diametrically and is held in position by suitable fastenings 18 passing through the yoke and through an appropriate clamping ring 19. Fixed on the strap 17 are flyball weights 21 and 22, arranged so that their centers of mass are above the governor strap and so that when the weights 21 and 22 respond to centrifugal force they in effect buckle

or deform the strap 17 against its inherent resiliency. The offset center 23 of the strap is therefore buckled upwardly a fraction of an inch as speed increases.

The upward movement of the strap is resisted by a spring 26 coaxial with the tube 9 and interposed between a washer 27 and a plate 28. The washer 27 is held in position by a nut 31 engaging a central bolt 32 passing through the strap 17 whereas the plate 28 is mounted to rock on the lower end of a pointed adjusting screw 33 passing through a dome 34 included in the revolving yoke 16. The effect of this assembly is to urge the strap 17 downwardly against the upward urgency imposed upon it by the outward movement of the weights 21 and 22 as speed increases.

The motion of the strap 17 is utilized to affect the governing flow of fluid through the central passage 13 in the drive tube 9. The lower end of the bolt 32 terminates in a cup 41 conveniently located within the strap offset 23 and having a depression 42 in which the needle nose 43 of a central spindle 44 is socketed. The spindle 44 at its opposite end is enlarged to provide a partly conical head 46 against which a valve disc 47 can rest. The valve disc is also large enough to overlie and upon occasion to seat upon the upper knife edge 48 of a valve seat 49. This seat is a separate hollow body pressed into the upper end of the drive tube 9 and in effect forms a continuation thereof. The valve disc 47 when in seated position on the valve seat 49 prevents fluid flow therebetween. But when the valve disc 47 is lifted from the valve seat 49 flow can take place through the interior passage 13 of the drive tube 9. The arrangement is such that the valve disc 47 is freely movable with the spindle 44 until it abuts the seat 48. To assist in locating the valve disc 47 properly with respect to the seat, the spindle 44 pierces a centering or positioning diaphragm 51 which is a flexible metal disc extending from the spindle and laterally confined between the circular cylindrical walls 52 of a bore in the yoke 16. Within limits the centering diaphragm is axially held by a retaining collar 53 secured by fastening bolts 54.

The centering or positioning diaphragm is disposed next to the valve disc 47 and next to the centering diaphragm 51 is a spacer washer 56. In accordance with my invention, I locate in a position surrounding the spindle 44 and next to the spacing washer 56 a rubber dampening ring 57. The rubber cushion 57 is in the shape of an annulus and is preferably formed or cut from material having considerable internal friction or hysteresis, so that it has the property of converting small amounts of energy. The cushion 57 is placed in a reasonably tight sliding frictional engagement with the spindle 44 so that in addition to deformation of the cushion 57 within the material thereof, any displacement of the cushion axially along the spindle 44 results in a frictional drag which serves also to convert motion energy into heat. The precise material of the cushion 57 is not critical, although it is preferably fabricated of natural or synthetic rubber or like deformable and non-resonant substance.

Resting on the cushion 57 is a ring 61 preferably of metal freely slidable on the spindle 44 and in complete abutment with the cushion 57. The ring is disposed at one end of a helical spring 62 and serves as a guide therefor. The other end of the spring 62 is guided by a keeper 63 surrounding a reduced portion of the spindle 44 and held in position against axial displacement (at

least in one direction) by a locking washer 64 seated in a recess in the keeper and also in a groove in the spindle 44.

In the normal assembly of this structure, the dimensions of the parts are such that it is necessary to compress the spring 62 and to place the cushion 57 under a compressive load before the washer 64 can be snapped into location. Under usual conditions therefor the spring 62 serves to force the cushion 57, the washer 56, the centering diaphragm 51, and the valve disc 47 against the enlarged head 46 of the spindle. The amount of force exerted is substantial so that under customary conditions of operation the assembly acts virtually as though it were a solid structure. In other words, when the strap center 23 moves upwardly, for example, against the urgency of the spring 26, the valve disc 47 and the entire assembly likewise lifts simultaneously therewith, being moved by the hydraulic pressure fluid to provide an enlarged annular opening between the valve seat 49 and the valve disc. However, in the event a force tending to set up a vibration occurs, the extra hydraulic pressure within the interior of the valve seat 49 is sufficient to lift the valve disc 47 slightly against the yielding resistance of the cushion 57, even though the spindle 44 does not move and does not in any way move the strap 23. In this way, under a temporary excessive force the valve disc 47 lifts and then drops slightly to relieve the force by slightly deforming the cushion 57 without in any wise disturbing the rest of the governor system and without, therefore, setting up or maintaining a vibrational characteristic. The cushion 57 not only permits the disc 47 to move upwardly, but likewise due to its deformation and due to any frictional sliding there may be on the spindle 44 absorbs (converts to heat) the energy involved and in effect, therefore, damps out the disturbance so that the system cannot be set into vibration. In practice it has been found that with this arrangement, minor disturbances which otherwise induce very severe disruptions in the governing system are damped out virtually at their source and are not permitted to set up and continue as vibratory phenomena. The governor head consequently retains its ability to govern within extremely close limits.

What is claimed is:

1. A governor head vibration dampener comprising a drive tube rotatable about an axis and terminating in a valve seat concentric with said axis, a yoke on said drive tube symmetrical about said axis, a governor strap symmetrical about said axis, fasteners connecting the ends of said strap to said yoke, weights on said strap, a first spring interposed between and engaging said yoke and said strap, a spindle, one end of said spindle engaging said strap adjacent said first spring, a head on the other end of said spindle, a valve disc slidable on said spindle and adapted to seat on said valve seat, a helical second spring surrounding said spindle, a washer abutting one end of said second spring and fixed with respect to said spindle, a ring slidable on said spindle and abutting the other end of said second spring, and a rubber cushion frictionally engaging said spindle and interposed between said ring and said valve disc.

2. A governor head vibration dampener comprising a drive tube terminating in a valve seat, a yoke on said drive tube, a governor strap spanning said yoke, weights on said strap, a first spring interposed between said yoke and said

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strap, a spindle adjacent one end of said first spring and engaging said strap, a head on the other end of said spindle, a valve disc slidable on said spindle and adapted to seat on said valve seat, a positioning diaphragm secured to said yoke and pierced by said spindle, a rubber cushion frictionally engaging said spindle, and a helical second spring for urging said rubber cushion and said diaphragm and said valve disc against said head.

3. A governor head vibration dampener comprising a drive tube terminating in a valve seat, a speed responsive mechanism driven by said drive tube, a spindle movable toward and away from said valve seat by said speed responsive mechanism, a valve disc movable on said spindle toward and away from said valve seat, a spring for urging said valve disc to move in one direction along said spindle, and an energy absorbing cushion interposed between said valve disc and said spring.

4. A governor head vibration dampener comprising a valve seat, a speed responsive mechanism, a spindle movable toward and away from said valve seat by said speed responsive mechanism, a valve disc movable on said spindle toward and away from said valve seat, a spring for urging said valve disc to move along said spindle toward said valve seat, and an energy absorbing cushion interposed between said valve disc and said spring.

5. A governor head vibration dampener comprising a valve seat, a speed responsive mechanism,

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a spindle movable toward and away from said valve seat by said speed responsive mechanism, a head on said spindle, a valve disc movable on said spindle toward and away from said valve seat, a spring for urging said valve disc to move along said spindle into abutment with said head, and an energy absorbing cushion interposed between said valve disc and said spring and frictionally slidable on said spindle.

6. A governor head vibration dampener comprising a valve seat, a speed responsive mechanism, a spindle movable toward and away from said valve seat by said speed responsive mechanism, a head on said spindle, a valve disc movable on said spindle toward and away from said valve seat, a spring for pressing said valve disc against said head with a predetermined force, and a rubber cushion interposed between said valve disc and said spring and subject to said force.

BYRON E. WHEELER.

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