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VARIABLE SPEED GOVERNOR

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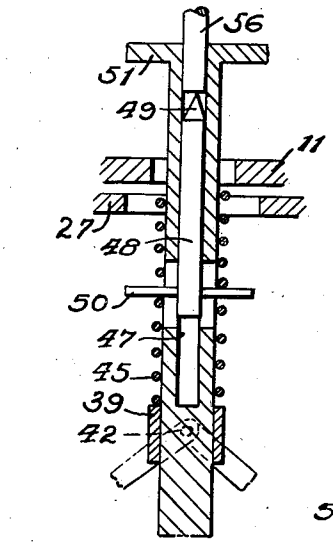


Fig. 2.

Fig. 1.

Inventor

Charles Greeley Abbot.

By Cameron, Kerkam & Sutton

Attorneys

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VARIABLE-SPEED GOVERNOR

Charles Greeley Abbot, Washington, D. C.

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21 Claims. (Cl. 188—184)

This invention relates to governors, and more particularly to governors whereby a desired speed of rotation may be precisely set at different values, suitable for different operating conditions, and this predetermined speed accurately maintained.

A governor of the character referred to may be associated with mechanism which, either because of the intended operation of the mechanism or because of the exigencies of the installation, renders it desirable that the governor operate with equal effectiveness without regard to the orientation of its axis with respect to the horizontal. It is a primary object of this invention to provide a governor which operates equally satisfactorily whether its axis is vertical or disposed at any desired angle to the vertical or even though it be inverted.

Another object of this invention is to provide a governor that is so constructed and arranged that the effect of gravity is balanced out at all orientations of its axis.

Another object of this invention is to provide a governor which will accurately maintain the predetermined speed even though associated with mechanism which in the course of its operation causes the axis of the governor to assume different orientations and wherein the varying effects of gravity on the component parts of the structure at varying orientations of its axis are balanced out.

Another object of this invention is to provide a governor of the character referred to wherein the desired speed may be accurately predetermined by adjusting means incorporated in the governor structure.

Another object of this invention is to provide a governor of the character referred to which is simple and compact in structure and certain and efficient in operation.

Other objects will appear as the description of the invention proceeds.

The invention is capable of receiving a variety of mechanical expressions, one of which is illustrated somewhat diagrammatically on the accompanying drawing, but it is to be expressly understood that the drawing is for purposes of illustration only, and is not intended to be a definition of the limits of the invention, reference being had to the appended claims for that purpose.

In the drawing Fig. 1 is a vertical elevation of an embodiment of the present invention and Fig. 2 is a detail of the provision for adjusting the spring.

Referring in detail to the drawing, 10 and 11 designate any suitable framework, which may be the framework of the mechanism with which the governor is associated, and which in turn may be any suitable clockwork or other rotating mechanism as will be apparent to those skilled in the art. Suitably mounted on the framework 10, 11 as by brackets 12, 13, is a shaft 14 having suitable bearings offering minimum friction to rotation, shaft 14 being shown as having a cone bearing 15 in the bracket 12 and a cone bearing 16 in the end of an adjustable screw 17 mounted in the bracket 13 whereby the mounting of the shaft may be precisely adjusted.

Mounted on the shaft 14 in any suitable way, as by the screw 18 is a supporting member 19, here shown as U-shaped at its central portion and provided with oppositely extending arms 20 and 21. Pivotally supported by said arms 20 and 21, at 22 and 23, respectively, is a rectangular structure composed of light bars 24, 25, 26 and 27 pivoted together at their corners, as indicated at 28, 29, 30 and 31, so as to constitute a readily deformable parallelogram of duplicated opposing side members. Bars 26 and 27 are shown as apertured at 32 and 33, respectively, so that the shaft 14 may pass therethrough with such clearance that under the maximum conditions of deformation of said rectangular structure there will be no contact with the shaft.

Fixed to the bars 26 and 27 in any suitable way are the weights 34 and 35, respectively, said weights being disposed at the diagonally opposite corners of the rectangular structure referred to and taking any suitable form, as heavy cubes of metal whose mass will of course vary as required with the speeds to be controlled, the size of the mechanism involved, etc. Projecting downwardly from the weight 35 is a light pendant member 36, which may be integral with the weight 35 or formed separately therefrom and suitably attached thereto, said member 36 extending to a position in approximate alignment with the weight 34 in a direction at right angles to the axis of the shaft 14 for a reason to be explained. Member 36 is made relatively light so that the major part of the weight of the member 35, 36 is at the weight proper 35, but member 36 is sufficiently stiff to perform the function hereinafter explained, and the combined weight 35, 36 is such as to properly balance the weight 34. While weight 34 has no corresponding extension 36, such an extension could be provided in the interest of exact symmetry and balance about the axis of the shaft 14 if found desirable.

Surrounding the weight 34 and the depending

extremity of member 36 is an annular member 37 suitably supported from the framework 10, as by screws 38, said member 37 having its inner periphery suitably constructed to constitute a friction brake on the members 34 and 36 as they move outwardly under the action of centrifugal force.

Slidably mounted on the shaft 14 is a collar 39 on which two links, 40 and 41, are pivotally mounted at 42, said links being pivotally connected to weight 34 and member 36 at 43 and 44, respectively. Links 40 and 41 are of like construction and length and make equal angles to the axis of the shaft 14. Said links 40 and 41, and also the bars 24, 25, are preferably duplicated on the far side of the device as viewed in the drawing for symmetry about the axis of shaft 14. Attached to said collar 39 in any suitable way and surrounding the shaft 14 is a coil spring 45, said spring at its opposite extremity being attached to the shaft in any suitable way at 46 and being normally in tension but said tension being adjustable as next to be described. The portion of the shaft above the collar 39 is made hollow as indicated at 47 and slidably mounted in said hollow shaft is a pin 48 having a conical extremity 49. The shaft 14 is provided with diametrically opposite slots or keyways through which, and through an aperture in the pin 48, extends a pin 50 that lies between two contiguous coils of the spring 48, here shown as at approximately midway of its length, although the location of the pin 50 with respect to the length of the spring can be varied depending upon the amount of spring between the pin 50 and the collar 39 which is to be effective in varying the adjustment of the governor.

Interposed in the length of the shaft 14, in the form shown, is an open rectangular structure composed of heads 51 and 52 connected by suitable posts 53, the rectangular structure 51, 52, 53 constituting a part of the shaft structure and being formed therewith or attached thereto in any suitable way. Threadedly mounted in the upper hollow end of the shaft 14 (as viewed in the drawing) is a stud 54 carrying, either integrally therewith or suitably attached thereto, a hand wheel 55, here shown as provided with a knurled periphery and certain graduation marks. Projecting from the hand wheel 55 is a pin 56 which enters the bore 47 of the shaft 14 and engages the conical end 49 of the pin 48. The frame surrounding the hand wheel 55 may also be provided with any suitable graduation marks, as indicated at 57, for cooperation with said hand wheel for use in exactly predetermining the adjustment.

Shaft 14 may be driven in any suitable way, as by a gear 58 suitably mounted thereon and in turn driven from the mechanism with which the governor is associated (not shown).

In operation, rotation of the shaft 14 by gear 58 causes the weights 34 and 35, 36 to move radially outwardly under the action of centrifugal force, this movement being at right angles to the axis of the shaft 14 because of the parallelogram structure of the support for said weights. Almost immediately weight 34 engages the inner periphery of ring 37 to effect a frictional delimitation of the speed of rotation, and at the same time the pendant member 36 on weight 35 engages the inner periphery of ring 37, at a location diametrically opposite from where weight 34 engages ring 37, also to frictionally delimit the speed of rotation. Owing to the ready deformability of the light rectangular structure, composed of bars 24, 25, 26 and 27 pivotally mounted in a medial plane at right angles to the shaft 14 and with the weights arranged at the diagonally opposite angles of the parallelogram, the movement of said weights is equal and opposite with respect to the axis of the governor. The outward movement of said weights under centrifugal action is opposed by the tension of the spring 45 fixed to the shaft at 46 and to the collar 39 from which extend the duplicate links 40, 41, it being observed that these links always maintain an equal angular relationship to the axis of the shaft 14. The tension of that part of spring 45 which is below the pin 50 (as viewed in the drawing) can be varied by threading the stud 54 out of or into the bore at the end of the shaft 14 whereby the pin 56 moves the pin 48 downwardly (as viewed in the drawing) to relieve progressively the tension on the lower part of spring 45 between the pin 50 and the collar 39 reducing toward zero the tension thereon and therefore the resilient opposition to outward movement of the weights, or permits the pin 48 to move upwardly under the tension on said spring to restore progressively the tension at the lower part of spring 45 between the pin 50 and the collar 39. By means of the graduation marks on the hand wheel 55 and the post at 57 the amount of tension applied to spring 45 can be nicely adjusted so as to predetermine precisely the tensional opposition to outward movement of the weights under the action of centrifugal force.

It will be observed that a governor constructed as hereinabove explained is symmetrical with respect to the axis of the shaft and as the movable parts constitute a parallelogram pivotally mounted in a medial plane at right angles to the axis of the shaft a precise balance is maintained at all times so that the action of gravity on the component parts is balanced out irrespective to the orientation of the axis of said shaft. Hence the action of the governor is in no way affected by the axis of the shaft 14 assuming different angles with respect to the vertical, and the governor will operate equally satisfactorily irrespective of whether the axis of the shaft 14 is vertical or at any desired angle with respect to the horizontal or the governor is even inverted from the position illustrated on the drawing. Hence the governor of this invention is entirely independent of its orientation and will operate equally well without regard to the position of the axis of shaft 14 whether this position be determined by the initial installation of the governor or whether it is variable because the mechanism with which it is associated, in the course of its operation, causes the governor to assume various orientations. In all positions the speed of rotation is maintained constant until such time as the speed is deliberately varied by operation of the adjusting mechanism described. It will also be observed that the adjusting mechanism is such as to predetermine the speed with precision by varying the tensioning of the spring, and at the same time the structure is relatively simple and compact and readily adjusted.

While the embodiment of the invention illustrated on the drawing has been described with considerable particularity, it is to be expressly understood that the invention is not restricted thereto, as the same is capable of receiving a variety of mechanical expressions within the principles heretofore explained, as will now be apparent to those skilled in the art, and that

changes may be made in the details of construction and arrangement of parts without departing from the spirit of this invention. It is also to be understood that the magnitude of the dimensions, weights, strength of structural elements, etc., may be varied within relatively wide limits depending upon the mechanism with which the governor is to be associated, the speeds to be controlled and the forces to be encountered. Reference is therefore to be had to the appended claims for a definition of this invention.

What is claimed is:

1. A governor including a rotatable shaft, a deformable structure rotated by said shaft and having masses carried by said structure in lateral opposition with respect to said shaft and adapted to deform said structure under the action of centrifugal force, said structure and masses being interconnected to form a system which is always balanced gravitationally at all orientations of said shaft, means rendered operative by the deformation of said structure to apply frictional opposition to the rotation of said structure and delimit the speed of rotation of said shaft when said masses move outwardly under the action of centrifugal force, and resilient means operative to oppose said centrifugally produced deformation to any desired degree.

2. A governor including a rotatable shaft, a deformable structure rotated by said shaft, masses carried by said structure in lateral opposition with respect to said shaft and adapted to deform said structure under the action of centrifugal force, and means rendered operative by the deformation of said structure to apply frictional opposition to the rotation of said structure and delimit the speed of rotation of said shaft when said masses move outwardly under the action of centrifugal force, said parts being so constructed and arranged as to be always balanced with respect to the axis of said shaft and to co-operate in a manner whereby the action of gravity on said parts to alter said centrifugally produced deformation or the speed of rotation of said shaft is balanced out irrespective of the orientation of said axis.

3. A governor including a rotatable shaft, a readily deformable structure rotated by said shaft and always balanced with respect to the axis of said shaft at any orientation thereof, masses carried by said structure in lateral opposition with respect to said shaft, said structure adapted to be deformed laterally about axes at right angles to said shaft when centrifugal force is applied to said masses, adjustable resilient means to oppose deformation of said structure under the action of centrifugal force, and frictional means to delimit the speed of rotation of said structure when said masses move outwardly under the action of centrifugal force.

4. A governor including a rotatable shaft, a readily deformable structure rotated by said shaft, masses carried by said structure in lateral opposition with respect to the axis of said shaft, said structure adapted to be deformed laterally about axes at right angles to said shaft when centrifugal force is applied to said masses, adjustable resilient means to oppose deformation of said structure under the action of centrifugal force, and frictional means to delimit the speed of rotation of said structure when said masses move outwardly under the action of centrifugal force, said parts being so constructed and arranged that they are always balanced with respect to the axis of the shaft and co-operate so that the action of gravity on said parts to alter said centrifugally produced deformation or the speed of rotation of said shaft is balanced out irrespective of the orientation of said axis.

5. A governor including a rotatable shaft, a readily deformable means rotated by said shaft and having masses carried by said means in lateral opposition with respect to said shaft, said means and masses being mounted and interconnected to form a system which is always balanced gravitationally with respect to the axis of said shaft at all orientations thereof, said means adapted to be deformed laterally in a plane parallel to the axis of said shaft by the centrifugal action of said masses, and means co-operating with said masses to apply friction thereto to delimit the speed of rotation of said shaft when said masses move outwardly under the action of centrifugal force.

6. A governor including a rotatable shaft, a readily deformable means rotated by said shaft and having masses carried by said means in lateral opposition with respect to said shaft, said means and masses being mounted and interconnected to form a system which is always balanced gravitationally with respect to the axis of said shaft at all orientations thereof, said means adapted to be deformed laterally in a plane parallel to the axis of said shaft by the centrifugal action of said masses, adjustable resilient means operatively connected to said masses to oppose movement thereof under the action of centrifugal force, and means cooperating with said masses to delimit the speed of rotation thereof when said masses move outwardly under the action of centrifugal force.

7. A governor including a rotatable shaft, a frame rotated by said shaft and disposed parallelly to the axis of said shaft, said frame being composed of like opposite members pivotally connected to provide a readily deformable structure, masses carried by said frame in lateral opposition with respect to the axis of said shaft and forming with said structure a gravitationally balanced system at all orientations, said frame adapted to be deformed by the centrifugal action of said masses, adjustable resilient means for opposing said centrifugally produced deformation, and stationary means co-operating with said masses for frictionally delimiting the speed of rotation thereof when said masses move outwardly under the action of centrifugal force.

8. A governor including a rotatable shaft, a frame rotated by said shaft and composed of like opposite members pivotally connected to provide a structure that is readily deformable in a plane parallel to the axis of said shaft, masses carried by said structure in lateral opposition with respect to said shaft and forming with said structure a gravitationally balanced system at all orientations, said masses adapted under the influence of centrifugal force to produce deformation of said frame laterally, resilient means operatively connected to said masses to oppose movement thereof under the action of centrifugal force, and stationary means co-operating with said masses for frictionally delimiting the speed of rotation thereof when said masses move outwardly under the action of centrifugal force.

9. A governor including a rotatable shaft, a frame rotated by said shaft and composed of like opposite members pivotally connected to provide a readily deformable structure, masses carried by said structure in lateral opposition with respect to said shaft and adapted by centrifugal

action to deform said frame laterally, resilient means operatively connected to said masses to oppose movement thereof under the action of centrifugal force, and means co-operating with said masses for frictionally delimiting the speed of rotation thereof when said weights move outwardly under the action of centrifugal force, all of said parts being so constructed and arranged that they are always balanced with respect to the axis of the shaft and in co-operative relation whereby the action of gravity on said parts to alter said deformation is balanced out irrespective of the orientation of said axis.

10. A governor including a rotatable shaft, a frame driven by said shaft and composed of two pairs of equal and opposite members constituting a rectangle and having its members pivotally connected at the angles of said rectangle, masses carried by said rectangular structure at diagonally opposite corners thereof, and means co-operating with said masses for frictional engagement therewith to delimit the speed of rotation of said shaft.

11. A governor including a rotatable shaft, a frame driven by said shaft and composed of two pairs of equal and opposite members constituting a rectangle and having its members pivotally connected at the angles of said rectangle, masses carried by said rectangular structure at diagonally opposite corners thereof, means co-operating with said masses for frictional engagement therewith to delimit the speed of rotation of said shaft, and resilient means for opposing outward movement of said masses under the action of centrifugal force.

12. A governor including a rotatable shaft, a frame driven by said shaft and composed of two pairs of equal and opposite members constituting a rectangle and having its members pivotally connected at the angles to said rectangle, masses carried by said rectangular structure at diagonally opposite corners thereof, means co-operating with said masses for frictional engagement therewith to delimit the speed of rotation of said shaft, a collar slidable on said shaft, links connecting said collar to said masses, and adjustable resilient means for controlling the movement of said collar on said shaft.

13. A governor including a rotatable shaft, a frame driven by said shaft and composed of two pairs of equal and opposite members constituting a rectangle and having its members pivotally connected at the angles of said rectangle, masses carried by said rectangular structure at diagonally opposite corners thereof, an annular friction member surrounding said masses for engagement thereby to delimit the speed or rotation of said shaft, a collar slidable on said shaft, links connecting said collar to said masses, and adjustable resilient mens for controlling the movement of said collar on said shaft, all of said parts being so constructed and arranged that they are symmetrically disposed with respect to the axis of said shaft in co-operative relation whereby the action of gravity on said parts to alter said centrifugally produced deformation is balanced out irrespective of the orientation of said axis.

14. A governor including a rotatable shaft, a support mounted on said shaft for rotation therewith, a rectangular structure pivotally mounted on said support in a medial plane of said rectangle and composed of two pairs of like opposite members pivoted together at the angles thereof to provide a readily deformable parallelogram, masses carried by said rectangular structure at diagonally opposite corners thereof, and means co-operating with said masses for frictional engagement therewith to delimit the speed of rotation of said masses when said masses move outwardly under the action of centrifugal force.

15. A governor including a rotatable shaft, a support mounted on said shaft for rotation therewith, a rectangular structure pivotally mounted on said support in a medial plane of said rectangle and composed of two pairs of like opposite members pivoted together at the angles thereof to provide a readily deformable parallelogram, masses carried by said rectangular structure at diagonally opposite corners thereof, means co-operating with said masses for frictional engagement therewith to delimit the speed of rotation of said masses when said masses move outwardly under the action of centrifugal force, and adjustable resilient means co-operating with said masses to oppose outward movement thereof under the action of centrifugal force.

16. A governor including a rotatable shaft, a support mounted on said shaft for rotation therewith, a rectangular structure pivotally mounted on said support in a medial plane of said rectangle and composed of two pairs of like opposite members pivoted together at the angles thereof to provide a readily deformable parallelogram, masses carried by said rectangular structure at diagonally opposite corners thereof, means co-operating with said masses for frictional engagement therewith to delimit the speed of rotation of said masses when said masses move outwardly under the action of centrifugal force, a collar slidable on said shaft, links connecting said collar to said masses and disposed symmetrically with respect to the axis of said shaft, and adjustable resilient means for controlling the movement of said collar on said shaft.

17. A governor including a rotatable shaft, a support mounted on said shaft for rotation therewith, a rectangular structure pivotally mounted on said support in a medial plane of the rectangle and composed of two pairs of like opposite members pivoted together at the angles thereof to provide a readily deformable parallelogram, masses carried by said rectangular structure at diagonally opposite corners thereof, means co-operating with said masses for frictional engagement therewith to delimit the speed of rotation of said masses when said masses move outwardly under the action of centrifugal force, a collar slidable on said shaft, links connecting said collar to said masses and disposed symmetrically with respect to the axis of said shaft, resilient means for controlling the movement of said collar on said shaft, and means for adjusting the tension of said resilient means.

18. A governor including a rotatable shaft, a support mounted on said shaft for rotation therewith, a rectangular structure pivotally mounted on said support in a medial plane of the rectangle and composed of two pairs of like opposite members pivoted together at the angles thereof to provide a readily deformable parallelogram, masses carried by said rectangular structure at diagonally opposite corners thereof, means co-operating with said masses for frictional engagement therewith to delimit the speed of rotation of said masses when said masses move outwardly under the action of centrifugal force, a collar slidable on said shaft, links connecting said collar to said masses and disposed symmetrically with

respect to the axis of said shaft, and adjustable resilient means for controlling the movement of said collar on said shaft, all of said parts being so constructed and arranged that they are symmetrical with respect to the axis of the shaft in co-operative relation whereby the action of gravity on said parts is balanced out irrespective of the orientation of said axis.

19. A governor including a rotatable shaft, a deformable structure supported from said rotatable shaft and including two elements of considerable inertia opposed laterally with respect to said shaft and means interconnecting said elements to maintain the same in gravitational balance at all orientations of said shaft, said structure adapted to be deformed laterally of said shaft by the centrifugal action of said elements, means whereby said lateral deformation produces friction tending to retard said rotation, and a single adjustable tensive means adapted to restrain the deformation of said structure, all of said parts being symmetrically arranged with respect to the axis of said shaft in co-operative relation whereby it is adapted to rotate at a determined constant mean speed independent of the orientation of said shaft or changes of orientation during operation.

20. A governor including a rotatable shaft, a deformable structure supported from said rotatable shaft and including two elements of considerable inertia opposed laterally with respect to said shaft and means interconnecting said elements to maintain the same in gravitational balance at all orientations of said shaft, said structure adapted to be deformed laterally of said shaft by the centrifugal action of said elements, means whereby said lateral deformation produces friction tending to retard said rotation, tensive means acting in the direction of the length of the shaft and adapted to restrain the deformation of said structure, and means for regulating the tension of said last named element to provide alterable speeds of rotation, all of said parts being symmetrically arranged with respect to the axis of said shaft in co-operative relation whereby it is adapted to rotate at a determined but alterable constant mean speed independent of the orientation of said shaft or changes of orientation during operation.

21. A governor comprising a hollow shaft adapted for rotation, a support attached transversely thereto, two bearings in said support equally spaced from said shaft, said bearings adapted to sustain axes at right angles to said shaft, a linkage pivoted to said bearings, said linkage adapted to extend and contract in parallel motion, friction members attached to said linkage equally spaced from said shaft, a stationary hollow cylindrical element parallel and symmetrical to said shaft, said friction members adapted to make frictional contact with said cylindrical element when said linkage is extended, a second linkage attached to said friction members adapted to contract said first named linkage, so as to cause said members to recede from said cylindrical element, a spring attached to said shaft and to said second linkage adapted to apply tensive force to said second linkage, a slidable rod within said hollow shaft, a pin fixed transversely to said rod and adapted to vary the tension of said spring, and means adapted to adjust the position of said rod within said shaft, the whole system adapted to introduce friction between said members and said cylindrical element when said shaft attains a desired speed of rotation and under centrifugal force said members separate sufficiently against the regulated tension of said spring, and said whole system having its masses at all times balanced with respect to said shaft so that the speed of rotation is unaffected by gravitational attraction whatever the orientation of the governor in respect to said attraction.

CHARLES GREELEY ABBOT.