Jan. 1, 1952 E. M. KUEMMERLEIN 2,580,556

CENTRIFUGAL GOVERNOR

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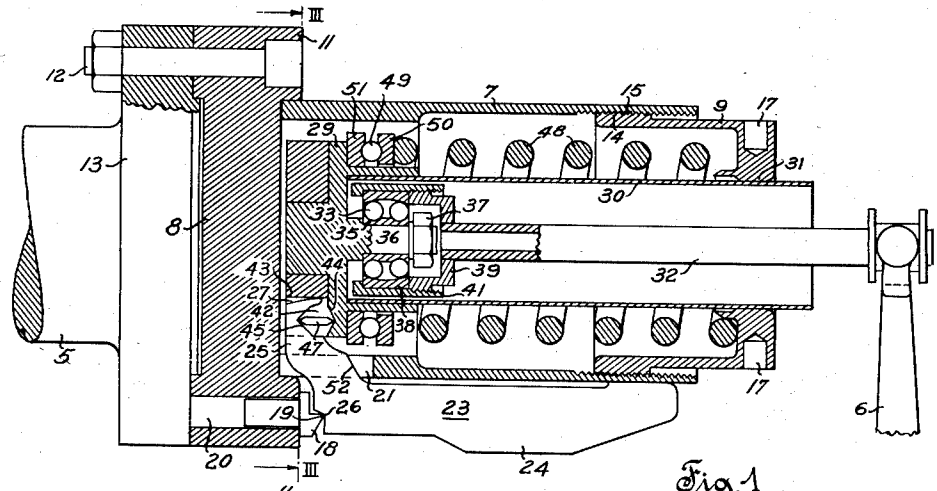


Fig. 1

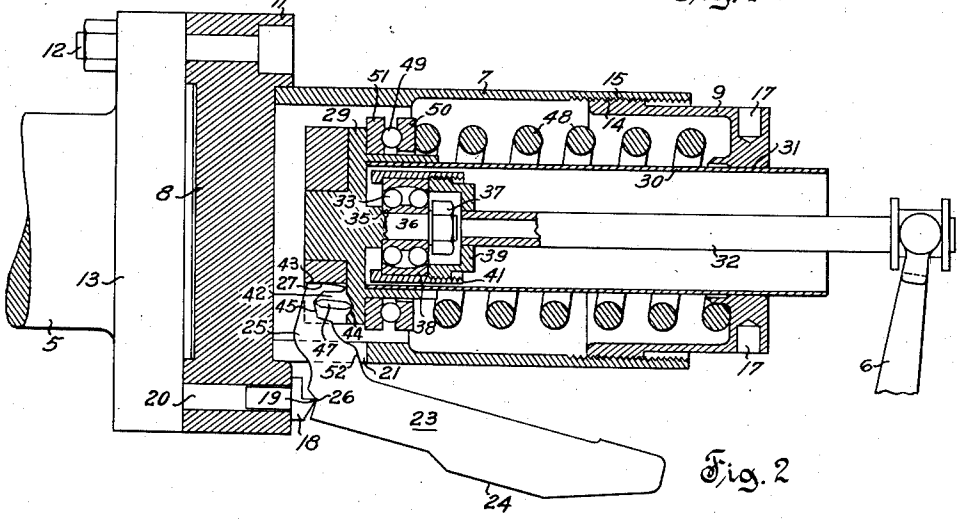


Fig. 2

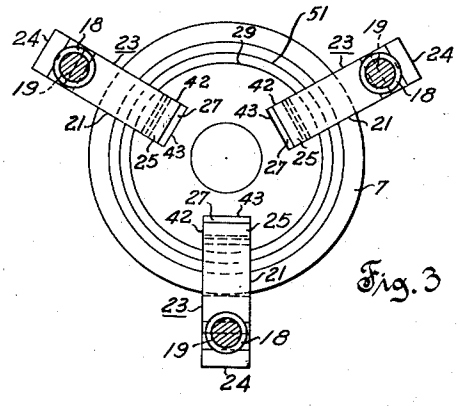


Fig. 3

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## CENTRIFUGAL GOVERNOR

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The present invention relates generally to improvements in governors, and relates more particularly to improvements in the construction and operation of speed governors of the centrifugally actuated type.

It is customary to construct centrifugal governors with one or more weights carried by a rotary member, such as the shaft of the machine or engine to be governed, and adapted to be actuated by centrifugal force against the yielding resistance of a spring or the like to accomplish certain desired work upon attainment of a predetermined speed of rotation. The speed at which the weights are adapted to be actuated to perform the desired work may usually be preselected by adjustment of the tension on the spring or other means providing the resistance to the movement of the weights. The weight or weights adapted to react by centrifugal force to perform the desired work may be in the form of a plunger device, a set of flyballs, two or more weights fulcrumed to form levers, or some similar means suitably positioned and associated with the control mechanism.

In prior art governing devices of the type wherein a plurality of weights fulcrumed to form levers are provided, the weights are usually adapted for cooperation with a governor spindle or plunger whereby the spindle or plunger is caused to move axially to operate a lever, switch, valve or the like upon displacement of the main body of the weights about their respective pivots by centrifugal force. Considerable difficulty, however, has heretofore been encountered in aligning the spindle or plunger of such devices with the rotatable elements, including the rotary shaft, and in maintaining such alignment during operation without incurring considerable friction between the various parts. Numerous attempts have been made to overcome these difficulties, but such attempts have invariably resulted in provision of complicated and relatively expensive mechanism.

It is therefore an object of the present invention to provide an improved governor of the centrifugally actuated type which obviates the objectionable features of the prior art systems and devices.

Another object of the present invention is to provide an improved centrifugal governor in which the axially movable spindle or plunger is positioned and guided by the weights.

Another object of my invention is to provide an improved centrifugal governor which is rigid and compact in construction and which may be

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readily assembled and sold as a unitary assembly at moderate cost.

Another object of this invention is to provide an improved centrifugal governor of the type wherein the weights act as levers to actuate a spindle or plunger and in which the friction between the various parts is minimized.

A further object of the present invention is to provide an improved centrifugal governor which may be readily adjusted without removal of any parts and which is highly sensitive and efficient in operation.

An additional object of my present invention is to provide an improved governor comprising, a base formed for attachment to a rotary shaft, a spindle movable axially relative to the shaft, a plurality of weights formed for cooperation with the base and with the spindle for moving the spindle axially, each of the weights being formed with a portion having a surface adapted to cooperate with the spindle for positioning and guiding the spindle centrally of the shaft during axial movement thereof, and resilient means tending to resist axial movement of the spindle.

Additional objects and advantages of the present invention will be apparent from the following detailed description.

A clear conception of one embodiment of the present improvement and of the mode of constructing and of utilizing devices built in accordance with my invention may be had by referring to the drawing accompanying and forming a part of this specification, wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a vertical sectional view through a governor embodying the invention, showing the same applied to a rotary shaft and with the weights in neutral or inoperative position;

Fig. 2 is a similar section through the governor but with the weights swung laterally outward about their pivots to operative position; and

Fig. 3 is a transverse sectional view through the governor taken along the line III—III of Fig. 1.

Referring to the drawing, the numeral 5 designates a rotary shaft which is adapted to be driven in a usual manner by an engine or the like (not shown) connected by suitable control mechanism, well known in the art, to a device operable by the governor and herein illustrated as a lever 6 for actuating the control mechanism.

The improved governor is partially housed within a cylinder formed by a cylindrical wall 7 provided at one end with a base 8 and at the op-

posite end with an adjustable head 9. The base 8 is of somewhat greater diameter than the cylindrical wall 7 to provide an annular flange 11 and may be secured to the wall as by welding or the like. The governor is mounted on the end of the shaft 5 in any suitable manner, as by means of bolts 12 coacting with the base flange 11 and a flange 13 of the rotary shaft. The head 9 is provided with screw threads 14 formed for coaction with screw threads 15 in the wall 7 for adjusting the position of the head for purposes hereinafter more fully set forth, and peripheral sockets 17 are preferably formed in the head for receiving the jaws of a spanner wrench.

Spaced at equal distances on the flange 11, a plurality of fulcrum blocks 18 (preferably three as shown) each having an extended knife edge 19 are provided. The blocks 18 are preferably loosely swiveled for self-centering in recesses or holes 20 formed in the flange 11, and the cylindrical wall 7 is provided with a like number of similarly spaced apertures 21 adjacent the base 8. A weight 23 having a main body portion 24 and an arm 25 is fulcrumed at pivot point 26 on the knife edge 19 of each of the blocks 18 with the arm 25 thereof extended through the corresponding aperture 21 of the cylindrical housing wall. The arm 25 of each of the weights 23 has the extended portion thereof formed as an arcuate rolling surface 27 generated with a radius equal to the distance from the pivot or fulcrum point 26 of the weight to the arcuate surface for reasons as will hereinafter more clearly appear. Each weight is also formed with an angular surface 52 adapted to coact with the cylindrical wall 7 to limit movement of the weights as they are swung laterally outward about their pivots.

Within the cylindrical housing of the governor, a floating guide member 29 carrying an elongated guiding tube 30 formed for guiding coaction with the annular lip 31 of a central opening in the head 9 is provided. Housed within the tube 30 and cooperable at one end with the guide member 29 and pivotally associated at the opposite end with the control lever 6 is a spindle 32. The guide member 29 is shown herein as being mounted for rotation relative to the spindle 32 through the expedient of a ball bearing 33, the inner race 35 of which is secured to a shank 36 of the guide member 29 by means of a nut 37 and the outer race 38 of which is secured to the head 39 of the spindle 32 by means of a clamping ring 41 screw threaded to the spindle head and forming a housing for the bearing. However, the guide member 29 may be formed integral with spindle 32 if desired, with the bearing interposed between the spindle and the lever 6 for rotation of the spindle relative to the lever. Likewise, the guide member 29 is shown herein as being formed of two parts, united as by welding for simplicity in machining and assembling, but this member 29 may obviously be made in one piece.

A plurality of rectangular pockets 42, equal in number to the apertures 21 in the wall 7 and spaced a like distance apart, are formed in the guide member 29. Each of the pockets 42 is adapted to receive the arm 25 of one of the weights 23, and each pocket is formed with an inner lateral guiding surface 43 with which the arcuate rolling surface 27 of the weight arm is adapted to coact for positioning and guiding the member 29. The outwardly extending surface of each pocket 42 is preferably provided with a groove or V-shaped depression 44, and the arm of each weight is provided with a similar groove 45. A link 47 having opposite knife edge bearing surfaces coacting with the grooves 44, 45 is provided in each of the pockets 42, thereby forming a pivotal connection between each of the weights and the floating guide member.

To constantly urge the guide member 29 toward the base 8 and prevent disengagement of the weights, a spring 48 is provided. The spring 48 is positioned within the cylindrical wall 7 and is seated at one end on the inner surface of the adjusting head 9 and at the opposite end on the free race 50 of a ball bearing 49, the race 51 of which is carried by the guide member 29. Tension on the spring 48 may be varied by screwing the adjusting head 9 to the desired position, and the bearing 49 may obviously be eliminated, if desired, without materially affecting the operation of the device, this bearing being provided only for the purpose of permitting free relative rotation between the spring and the guide member 29 during adjustments in the tension on the spring.

In assembling the improved governor, the cylindrical wall 7 is first secured to the base 8 in any suitable manner with the apertures 21 aligned with the holes 20 into which the blocks 18 are next inserted. The weights 23 are then positioned with the pivot point 26 of each weight resting on the knife edge 19 of its corresponding fulcrum block 18 and with the arms 25 thereof extending through the apertures 21 into the cylinder. With the weights swung laterally outward to the fullest extent, such movement being limited by contact of the angular surface 52 with the wall 7, and with the base in horizontal position, the links 47 may be positioned with a knife edge of each link seated in the groove 45 of each weight arm 25 and the link resting against the inner side wall of the groove in substantially vertical position. The guide member 29 and spindle 32 may be assembled separately as a unit by securing the inner race 35 of bearing 33 to the shank 36 of the guide member by means of nut 37 and securing the outer race 38 of the bearing to the spindle head 39 by means of clamping ring 41 and finally mounting the guide tube 30 and bearing 49, if utilized, in place on the guide member. With the links 47 positioned as described, the guide member and spindle assemblage may next be slid axially into position within the cylinder with the pockets 42, formed therein, receiving the weight arms 25 and links 47. As the guide member 29 is moved axially toward the base, each link 47 slides into position with the opposite knife edges thereof in grooves 44, 45 and each weight is caused to rotate about its pivot 26 until the body 24 is stopped by the wall 7 as shown in Fig. 1. Finally, the spring 48 is seated on the bearing 49, or directly on the guide member if the bearing is omitted, and the head 9 is screwed into place by means of a spanner wrench or the like to complete the assemblage of the unit. After the governor has been thus assembled with the various parts in the position shown in Fig. 1, it is apparent that the unit may be applied to any rotary shaft provided with a suitable flange 13 to which the base 8 can be secured and the spindle 32 may be connected in any suitable manner to control mechanism for performing the desired work.

In operation after assemblage and mounting, the device may first be adjusted in an obvious manner for response at the desired speed of rotation of the shaft 5 by adjusting the tension on the spring through the expedient of the threaded

adjusting head 9, thereby establishing the proper resilient resistance to axial movement of the spindle by the lever weights as they are subjected to centrifugal force during rotation. As the shaft carrying the governor is rotated, the weights remain in inactive position with the bodies thereof seated on the outer surface of the cylindrical wall 7, as illustrated in Fig. 1, by reason of the resistance to movement established by the spring until attainment of the speed for which the governor has been adjusted. During rotation of the shaft the entire governing unit is rotated therewith with the exception of the spindle 32. As the speed for which the governor has been adjusted is reached, the tendency of the spring to resist movement of the spindle and weights is overcome by centrifugal force acting on the weights; and the weights are swung laterally outward about their pivots, causing the guide member and spindle, through the expedient of links 47, to move axially away from the base against the resistance of the spring to actuate the lever 6 for performing the desired work. As the speed of the rotary shaft is reduced, the tendency of the spring overcomes the centrifugal force acting on the weights, and the weights are therefore rotated about their pivots to neutral or inoperative position. Throughout axial movement of the spindle and guide member and as the weights are rotated in either direction about their pivots, the arcuate rolling surfaces 27 formed on the weights remain in constant contact with the inner lateral guiding surfaces 43 of the member 29 to position and guide the member and the spindle centrally of the shaft. Obviously, the tube 30 is likewise guided throughout axial movement by the lip 31 of the adjusting head, thereby providing guide means for the guide member and spindle at two axially spaced points.

From the foregoing detailed description, it is apparent that the present invention provides an improved centrifugal governor wherein all parts are maintained in constant alignment throughout the operation thereof with a minimum of frictional resistance. The improved governor is simple, rigid and compact in construction with comparatively few parts requiring careful machining, and it is nevertheless highly sensitive in operation. The axially movable spindle is moved by the action of the weights against the action of the spring and no separate means need be provided for positioning and guiding the spindle during such movements, the weights being so formed as to position and guide the spindle throughout axial movement thereof. Governors constructed in accordance with the present invention may be sold as unitary assemblages independently of other equipment and may be readily installed and applied to existing machinery by a novice, and may likewise be readily adjusted, without removal of parts, over a wide range to meet particular requirements.

While my improved device has been illustrated and described as being provided with three weights, any desired number such as will serve to guide the spindle and guide member at two or more radial points may be provided. The size and shape of the weights may likewise be varied to meet any particular operating requirements, and the main body of the weights may be lengthened or shortened or increased or decreased in thickness to response within the desired ranges. If a highly sensitive governor is not a necessary requirement, the knife edge link 47 may be eliminated and the extended portion of the weight arm adjacent the arcuate surface may be formed for direct coaction with the guide member for transmitting movement of the weights to the guide member and spindle for moving the same axially. The fulcrum blocks carried by the base flange are preferably loosely mounted in their sockets for self-centering the same with respect to the weights carried thereby as well as for self-centering the unit. While the guide member 29 has been herein shown and described as being formed of two parts united by welding after machining and with the guide member and spindle rotatable relative to each other, these parts may be formed as a single integral unit as hereinabove indicated, if desired, and the bearing 49 may also be eliminated. By forming the angular surfaces 52 as herein described, a simple limit stop for each of the weights is provided, thereby eliminating the possibility of the weights becoming disengaged in the event the spring should break during operation.



It should therefore be understood that it is not desired to limit the present invention to the exact details of construction or to the precise mode of operation herein shown and described, since various modifications within the scope of the claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. A centrifugal governor, comprising: a base formed for rotation with a rotatable shaft; axially movable means; means including a plurality of centrifugally movable weights, rotatable in unison with said base, for causing axial movement of said axially movable means; said base and said weights comprising means for mounting said weight for centrifugal movement including cooperating pairs of knife edge and knife edge seat elements, at least one of the elements of each pair being mounted for swivelling movement for self-alignment.

2. In a governor to be centrifugally actuated by a rotatable shaft, a base for connection with the shaft, a plurality of fulcrum blocks pivotally mounted on the base, a plurality of centrifugally actuable weights severally mounted on the fulcrum blocks, means pivotally mounted on and movable axially of the shaft by the weights upon centrifugal movement thereof, the fulcrum blocks pivoting for coaxial positioning with and for retention of the axially movable means in coaxial position with the shaft by the weights, and means resisting axial movement of the first said means.

3. In a governor to be centrifugally actuated by a rotatable shaft, a base for connection with the shaft, a plurality of knife-edged fulcrum blocks pivotally mounted on the base, a plurality of centrifugally actuable weights having V-grooves for several mountings of the weights on the fulcrum blocks, means pivotally mounted on the weights and movable axially of the shaft thereby upon centrifugal movement thereof, the weights having arcuate surfaces for contact with the said means and the fulcrum blocks pivoting for bringing the arcuate weight surfaces into and retaining the surfaces in contact with said means for continuous coaxial positioning thereof with the shaft, and means resisting axial movement of the first said means.

4. A centrifugal governor comprising: a base formed for rotation with a rotatable shaft; means rotatable coaxially and in unison with

said base and movable axially relatively to said base; means biasing said rotatable means in an axial direction; a plurality of centrifugally movable pivoted weights rotatable in unison with said base; means interposed between said weights and said rotatable means having surfaces serving solely to cause axial movement of said rotatable means against said bias in response to centrifugal movement of said weight and to cause said rotatable means to rotate in unison with said base; and means interposed between said weights and said rotatable means having cooperable surfaces rotatable in unison about the axis of said base serving solely to maintain said rotatable means coaxial with said base during said axial movement of said rotatable means, one of said surfaces being a plane surface parallel to the axis of said rotatable means and the surface cooperable therewith being arcuate and concentric with the axis of the pivot of the respective weight.

5. A centrifugal governor comprising: a base formed for rotation with a rotatable shaft; means rotatable coaxially and in unison with said base and movable axially relatively to said base; means biasing said rotatable means in an axial direction; a plurality of centrifugally movable weights rotatable in unison with said base; means interposed between said weights and said rotatable means having cooperating knife edge and seat surfaces serving solely to cause axial movement of said rotatable means against said bias in response to centrifugal movement of said weight and to cause said rotatable means to rotate in unison with said base; and means interposed between said weights and said rotatable means having cooperable surfaces rotatable in unison about the axis of said base serving solely to maintain said rotatable means coaxial with said base during said axial movement of said rotatable means.

6. A centrifugal governor comprising: a base formed for rotation with a rotatable shaft; means rotatable coaxially and in unison with said base and movable axially relatively to said base; means biasing said rotatable means in an axial direction; a plurality of centrifugally movable weights rotatable in unison with said base; means including links knife edged at both ends respectively interposed between and cooperating with seats in said weights and said rotatable means serving solely to cause axial movement of said rotatable means against said bias in response to centrifugal movement of said weight and to cause said rotatable means to rotate in unison with said base; and means interposed between said weights and said rotatable means having cooperable surfaces rotatable in unison about the axis of said base serving solely to maintain said rotatable means coaxial with said base during said axial movement of said rotatable means.

7. In a governor to be centrifugally actuated by a rotatable shaft, a base for connection with the shaft, a plurality of centrifugally actuable weights pivotally mounted on the base, rotatable means movable axially of the shaft upon centrifugal movement of the weights, means including links pivoting on the weights and pivotally supporting the axially movable means, for rotating said axially movable means in unison with said base and for transmitting centrifugal movement of the weights as axial movement of the rotatable means, and means resisting axial movement of the first said means.



8. In a governor to be centrifugally actuated by a rotatable shaft, a base for connection with the shaft, a plurality of centrifugally actuable weights pivotally mounted on the base and having V-grooves therein, rotatable means movable axially of the shaft upon centrifugal movement of the weights, the rotatable means having V-grooves therein facing the V-grooves in the weights, means including links knife edged at both ends having the edges severally bearing in the grooves in the weights and in the rotatable means for rotating said rotatable means and transmitting centrifugal movement of the weights to the rotatable means substantially parallel with the axis thereof, and means resisting axial movement of the first said means.

9. A centrifugal governor, comprising: a base formed for rotation with a rotatable shaft; axially movable means; a plurality of centrifugally movable weights rotatable in unison with said base; means for causing axial movement of said axially movable means in response to centrifugal movement of said weights and for determining the general plane of centrifugal movement of the respective weights; and said base and said weights comprising means for mounting said weights for centrifugal movement including cooperating pairs of knife edge and knife edge seat elements, at least one of the elements of each pair being mounted for swivelling movement for self-alignment.

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