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CENTRIFUGAL REGULATING DEVICE.

APPLICATION FILED SEPT. 5, 1916.

1,392,890. Patented Oct. 4, 1921.

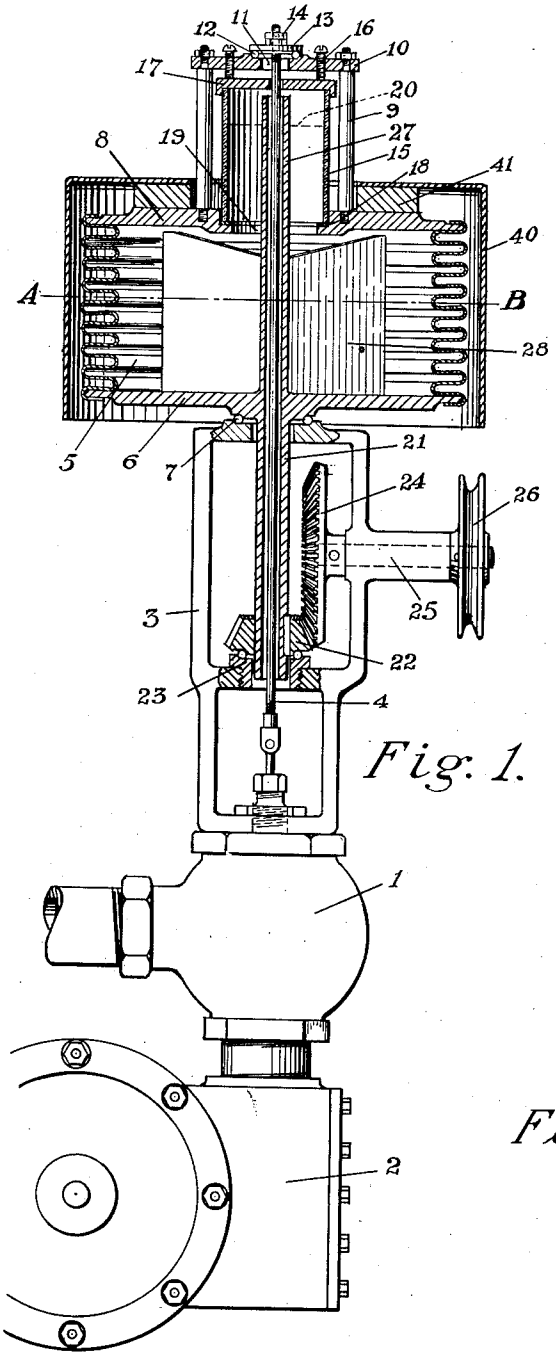


Fig. 1.

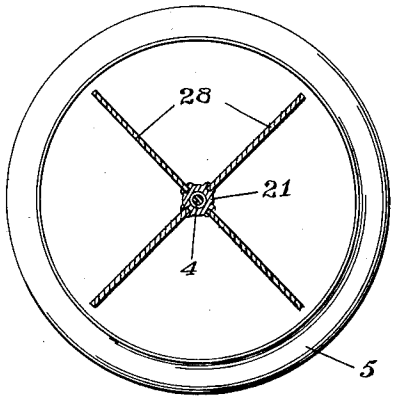


Fig. 2.

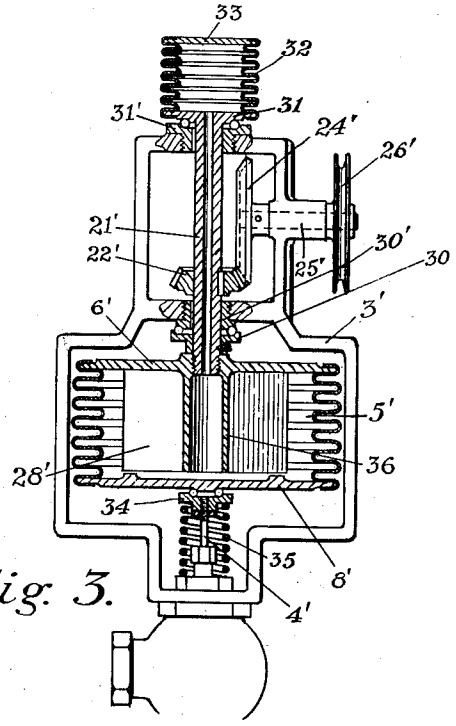


Fig. 3.

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CENTRIFUGAL REGULATING DEVICE.

1,392,890. Specification of Letters Patent. Patented Oct. 4, 1921.

Application filed September 5, 1916. Serial No. 118,539.

To all whom it may concern:

Be it known that I, WESTON M. FULTON, a citizen of the United States of America, and a resident of Knoxville, Tennessee, have invented a new and useful Improvement in Centrifugal Regulating Devices, which invention is fully set forth in the following specification.

This invention relates to centrifugal regulating devices, and is particularly designed as a speed governor.

It is an object of this invention to provide a centrifugal regulator that is simple in construction, is compact in design, opposes relatively small frictional resistance to operative movement, and is efficient in operation. A further object of this invention is to provide a device of the type characterized which is "dead-beat" and will not "hunt," and which will not get "hung-up" whereby is avoided all danger of an engine racing. Yet another object of this invention is to provide a centrifugal regulator employing a vessel having an axially extensible and collapsible wall operatively related to a means to be controlled and subjected to the centrifugal pressure developed by a material which is contained within the vessel and radially movable under centrifugal force. Other objects will appear as the description proceeds.

Stated briefly, the invention comprises a vessel having an axially extensible and collapsible wall, preferably in the form of a corrugated wall, having a movable element, as a movable end wall, operatively related to any suitable means to be controlled, said vessel containing a material radially movable under centrifugal force, as a ponderable fluid, and provision being made for rotating said fluid, as by rotating said vessel, whereby the increase and decrease of centrifugal pressure developed by the rotation of said fluid will cause an axial extension and contraction of said wall respectively, and said movable element operate the means to be controlled.

The invention is capable of receiving a variety of mechanical expressions, two of which for the purpose of illustration have been shown on the accompanying drawing; but it is to be expressly understood that the drawing is for purposes of illustration only, and is not to be construed as definitive of the limts of the invention, reference being had to the appended claims for that purpose.

Referring to the drawing, wherein the same reference characters designate corresponding parts in the several figures,

Figure 1 is an elevation, partly in section, of one embodiment of the invention;

Fig. 2 is a horizontal section on the line A—B of Fig. 1;

Fig. 3 is an elevation, partly in section, of a modified embodiment of the invention.

Referring particularly to Fig. 1, 1 represents a means to be controlled. In the embodiment shown on the drawing, this means is a valve in a conduit leading to any suitable device, as a steam chest, diagrammatically illustrated at 2. It is to be expressly understood, however, that the valve at 1 is but typical of any suitable means to be controlled by the regulator embodying the present invention.

Mounted on the housing of the valve at 1, in the form shown, is a frame 3 through which extends the axially movable but non-rotatable valve stem 4. Above the frame 3 is an axially extensible and contractible or collapsible vessel 5, having its lateral tubular wall preferably constructed of corrugated resilient metal, as brass, whereby such wall is possessed of an inherent resiliency. Said lateral wall, owing to the corrugations, therefore comprises a plurality of reëntrant sections angularly related to the axis of the vessel, each of said sections being connected to adjacent sections at its opposite ends. Fixedly secured to one end of said lateral wall, as by brazing thereto, is an end wall 6 supported in rotative engagement with the upper face of the frame 3, a ball bearing indicated at 7 being desirably interposed between the wall and the frame. Fixedly secured to the other end of said lateral wall, as by brazing thereto, is a second end wall 8 which is designed to be axially movable with respect to the end wall 6, and which will be referred to as the movable element of the vessel. In the form shown a plate 10 is suitably supported upon the movable end wall 8, as by columns 9, and is in operative relation to the valve-stem 4. Said valve stem passes loosely through an aperture 11 provided in said plate 10; and as said stem is non-rotatable, while said plate is rotatable, a ball-bearing, as indicated at 12, is desirably interposed

between such plate 10 and a collar 13 suitably secured on the valve-stem, as by jamnuts 14.

The vessel 5 is filled with a material radially movable under centrifugal force, such as a ponderable fluid, as oil, water, or mercury. A reservoir for the fluid is preferably provided, such reservoir being in communication with the interior of the vessel. In the embodiment illustrated in Fig. 1, this reservoir is a cylindrical glass vessel 15 secured on the movable end wall 8 in any convenient way, as by screws 16 passing through the plate 10 and engaging a cap 17 constituting a cover for said vessel. The vessel 15 preferably rests on a washer 18 carried by the end wall 8 to prevent fracture of the cylinder. Reservoir 15 is in communication with the interior of the vessel 5 through aperture 19 provided in the movable end wall 8, and the fluid is made to extend to any preferred height within the reservoir such, for example, as indicated by the dotted line 20.

To rotate the extensible and collapsible vessel 5 in the form shown, a sleeve 21 is secured to the end wall 6, and may be integral therewith. This sleeve at its lower end carries a bevel gear 22 which may have bearing on a sleeve 23 carried by the frame 3. Bevel gear 22 is rotated by bevel gear 24 on stub shaft 25 which carries a pulley 26 adapted to be rotated from any suitable source of power. Sleeve 21 is preferably extended above the end wall 6, as illustrated at 27, to within a short distance of the cap of the reservoir 15. This sleeve 21, 27 is made of a bore somewhat larger than the valve-stem 4, whereby the annular space between the stem and the sleeve constitutes a conduit for the admission of air to the upper surface of the fluid in the reservoir 15. The extension 27 of sleeve 21 also preferably carries within the vessel 5 a plurality of vanes 28, four being shown in the illustrated embodiment, whereby the fluid within this vessel is brought quickly to the speed of the vessel so that the inertia of such fluid may not interfere with the sensitiveness of the regulator.

A second embodiment of the invention is illustrated in Fig. 3, wherein the extensible and collapsible vessel 5′ is supported by a frame 3′ mounted upon the means to be controlled, as a casing for a valve as in Fig. 1. In this embodiment of the invention, end wall 6′ is received, as by screw-threaded engagement, on the end of a rotatable tubular member 21′ carrying a bevel gear 22′ in engagement with a second bevel gear 24′ on the stub shaft 25′. Member 21′ carries a bearing member 30, and the frame 3′ carries a bearing sleeve 30′, between which and the bearing member 30 balls or rollers may be interposed. The upper end of the member 21′ is provided with a flange 31 bearing on sleeve 31′ carried by the frame 3′, balls or rollers being desirably interposed. Said flange 31 is shown as an end wall of an extensible and collapsible corrugated-metal vessel 32 closed at its opposite end by a movable wall 33. Vessel 32 is designed to constitute a reservoir for the fluid within the vessel 5′, and is in communication with such vessel through the bore of the member 21′. The movable end wall 8′ of the vessel 5′ is operatively related to the means to be controlled, as the valve-stem 4′, by the provision of a collar 34 on the end of the stem 4′, between which collar and the end wall 8′ balls or rollers may be interposed. Collar 34 is maintained in operative relation to the movable end wall 8′, by a coil spring 35 interposed between the collar 34 and the frame 3′, or an adjusting nut thereon. Within the vessel 5′ are vanes 28′, as in the embodiment of Fig. 1, and such vanes are preferably carried by a cylindrical sleeve-like member 36 within the vessel 5′, which sleeve may desirably be integral with the end wall 6′. Said cylindrical member 36 terminates short of the movable end wall 8′, and its bore is in communication with the bore of the tubular member 21′.

In operation, referring to Fig. 1, and assuming pulley 26 to be rotated from a source of power, bevel gear 24 rotates bevel gear 22, and the latter, through sleeve 21, produces a corresponding rotation of the extensible and collapsible vessel 5. Owing to the vanes 28 within said vessel 5, the fluid contained within the vessel is brought quickly to the speed of rotation of the vessel, and the centrifugal force developed by the rotation of such fluid causes said fluid to exert pressure on the walls of said vessel, which pressure acting on the inwardly directed or reëntrant annular wall- sections formed by the corrugations causes said vessel to expand axially. There being a tendency to form a vortex at the center of the vessel which will be supplied with fluid from the reservoir 15, the level of the fluid in said reservoir drops and, owing to the employment of glass as a material for such reservoir the visible height of the fluid therein constitutes a measure of the rotative speed of the vessel. As the fluid level drops in the reservoir 15, air may flow to the upper surface thereof through the conduit provided by the annular space between valve-stem 4 and sleeve 21. As the centrifugal force of the rotated fluid varies, the pressure upon the walls of the vessel correspondingly varies to vary the operative length of the lateral wall whereby, end wall 6 being axially stationary and end wall 8 being free to move, the latter rises and falls in the direction of the length of the vessel, carrying with it the plate 10 and, through engage-

ment of the latter with the collar 13, elevating or lowering the valve-stem 4 to close or open the valve. It will be observed that while the plate 10 is free to rotate with respect to the collar 13, the valve-stem responds to any axial movement of such plate produced by a corresponding movement of the movable end wall 8.

In the embodiment shown in Fig. 3, end wall 6′ is held axially stationary by tubular member 21′ through the coöperation of bearing member 30 and flange 31 with the frame-carried bearing sleeves 30′ and 31′ respectively, while end wall 8′ is free to move axially in response to increases of centrifugal pressure, bearing down upon the stem 4′ and closing the valve against the tension of the spring 35. In this embodiment of the invention, vessel 32 is filled with the fluid with which vessel 5′ is filled, and as fluid flows therefrom to the vessel 5′ to compensate for the tendency of the fluid to form a vortex in the latter, end wall 33 of said vessel 32 follows the surface of the liquid owing to the inherent resiliency of the vessel 32 and atmospheric pressure upon the exterior of said end wall 33.

If desired, the extensible and collapsible vessel may be provided with a protective housing, as illustrated at 40 in Fig. 1, such housing being suitably supported as by a collar 41 carried by the movable end wall 8.

Where the reservoir for the fluid is made of transparent material, as in the embodiment of Fig. 1, and where the surface of the fluid is also exposed to evaporation, it is desirable that the wall of the reservoir be provided with a line indicating the normal surface level therein, whereby evaporation of the fluid may be detected.

It is to be further observed that the relative position of the end wall 33 in the embodiment of Fig. 3 constitutes a measure of the rotative speed of the vessel, as well as does the fluid level 20 in the embodiment of Fig. 1.

While the illustrated embodiments of the invention have been described with considerable particularity, it is to be expressly understood that the invention is not limited to such illustrated embodiments, as the invention is capable of other expressions some of which will readily suggest themselves to those skilled in the art; furthermore, certain parts thereof are capable of use without other parts thereof. Therefore, the limits of the invention are to be determined by reference to the claims hereto appended.

What is claimed is:

1. In combination with means to be controlled, a vessel containing a fluid and having a tubular wall which is axially extensible and contractible in the direction of its length under the increase and decrease, respectively, of the centrifugal pressure developed by the rotation of said fluid, and means connecting an axially movable element of said vessel with said means to be controlled.

2. In combination with means to be controlled, a rotatable extensible and collapsible corrugated vessel containing a material radially movable by centrifugal force, and means moved by extension and collapse of said vessel and operatively related to said means to be controlled.

3. In combination with means to be controlled, a vessel containing a material radially movable by centrifugal force, said vessel having a tubular side wall which is axially extensible in response to centrifugal pressure developed by said material, means whereby said material is rotated to develop centrifugal pressure in said vessel, and operative connections between a movable element of said vessel and said means to be controlled.

4. In combination with means to be controlled, a corrugated vessel containing a liquid and extensible in response to centrifugal pressure developed therein by said liquid, means for rotating said vessel, and operative connections between a movable wall of said vessel and said means to be controlled.

5. In combination with means to be controlled, a vessel containing a fluid and having a corrugated wall which is axially extensible in response to centrifugal pressure developed by said fluid, said vessel having a movable element operatively connected to said means to be controlled, vanes in said vessel, and means for rotating said vessel and vanes.

6. In combination with means to be controlled, a vessel having an axially extensible and collapsible corrugated wall and a movable element operatively related to said means to be controlled, means to rotate said vessel, a fluid in said vessel, and a reservoir for said fluid in communication with said vessel.

7. In combination with means to be controlled, a vessel having an axially extensible and collapsible lateral wall and a movable end wall operatively related to said means to be controlled, means to rotate said vessel, a fluid in said vessel, a reservoir for said fluid in communication with said vessel, and means admitting air to said reservoir.

8. In combination with means to be controlled, a vessel having a tubular axially extensible and collapsible lateral wall and an axially movable wall operatively related to said means to be controlled, means to rotate said vessel, and a fluid in said vessel adapted to operate said extensible and collapsible wall by variations of centrifugal pressure.

9. In combination with means to be controlled, a vessel containing a fluid and having a corrugated wall which is axially ex-

tensible in response to centrifugal pressure developed by said fluid, means for rotating said vessel, and non-rotatable means connecting a movable element of said vessel and said means to be controlled.

10. In combination with means to be controlled and extensible and collapsible vessel having a movable element, a fluid in said vessel, means for rotating said vessel, a reservoir for said fluid supported on said movable element, non-rotatable means connecting said movable element and said means to be controlled, and means surrounding said connecting means and admitting air to said reservoir.

11. In combination with means to be controlled, an extensible and collapsible vesesl having a movable element, a fluid in said vessel, means for rotating said vessel, a reservoir for said fluid supported on said movable element, non-rotatable means connecting said movable element and said means to be controlled, means surrounding said connecting means and admitting air to said reservoir, and vanes in said vessel carried by said last-mentioned means.

12. In combination with means to be controlled, a vessel having an extensible and collapsible corrugated lateral wall and an axially-movable end wall, a fluid in said vessel, means whereby said fluid is rotated to develop centrifugal pressure in said vessel, and operative connections between said end wall and said means to be controlled.

13. In combination with means to be controlled, a vessel provided with a movable end wall and a lateral wall comprising a plurality of connected reëntrant sections, operative connections between said movable end wall and said means to be controlled, a fluid in said vessel, and means for rotating said fluid to develop centrifugal pressure on said lateral wall.

14. In combination with means to be controlled, a vessel provided with a relatively stationary end wall, a relatively movable end wall, and a lateral wall connecting said end walls and comprising a plurality of connected reëntrant sections, means to rotate said vessel, a fluid in said vessel, and operative connections between said movable end wall and said means to be controlled.

15. In combination with means to be controlled, a vessel provided with a movable end wall and a corrugated lateral wall, operative connections between said end wall and said means to be controlled, a fluid in said vessel, a transparent reservoir for the fluid in communication with said vessel, and means to rotate said vessel.

16. In combination with means to be controlled, a vessel provided with a movable end wall and a lateral wall comprising sections angularly related to the axis of the vessel, each of said sections being connected to adjacent sections at its opposite ends, a fluid in said vessel, means to rotate said fluid, and operative connections between said end wall and said means to be controlled.

17. In combination with means to be controlled, a tubular wall which is axially extensible and contractible and operatively connected to said means to be controlled, and means for subjecting said wall to centrifugal pressure to vary the operative length of said wall and operate said means to be controlled.

In testimony whereof I have signed this specification.

WESTON M. FULTON.