No. 709,795.

Patented Sept. 23, 1902.

R. J. PATTERSON.

STEAM ENGINE GOVERNOR.

(Application filed Apr. 13, 1901.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.

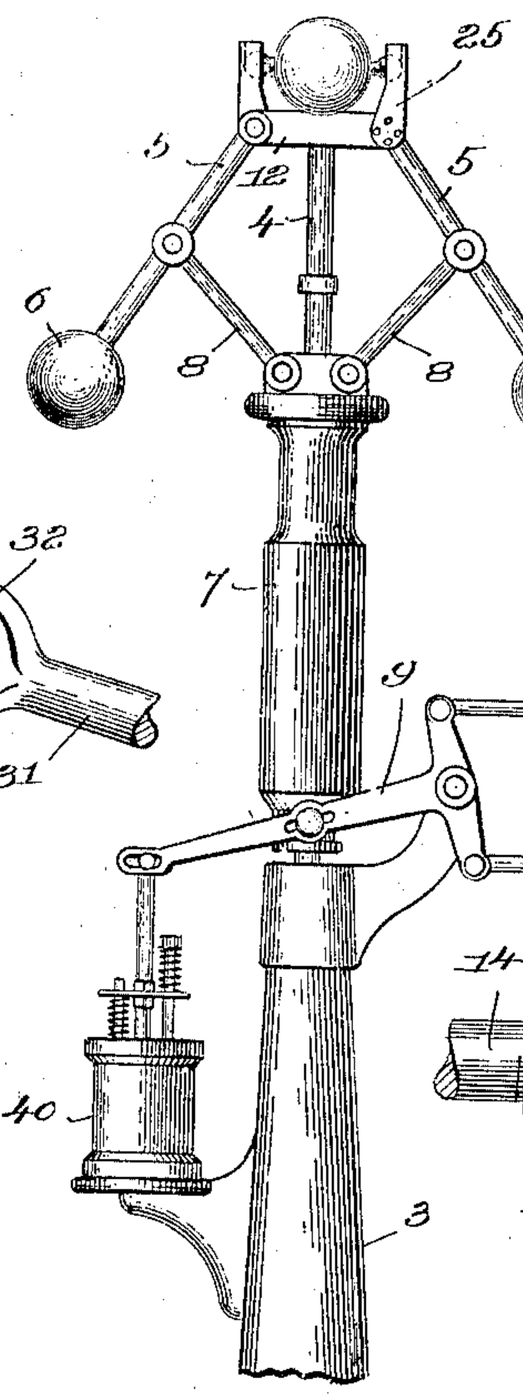

Fig. 11.

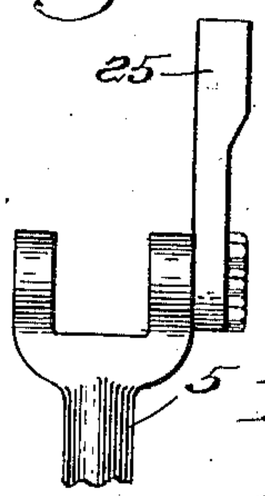

Fig. 7.

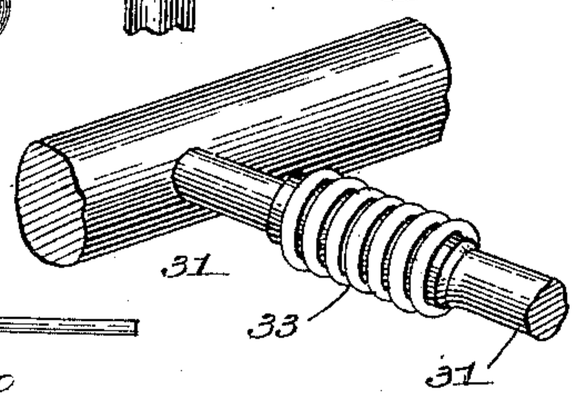

Fig. 6.

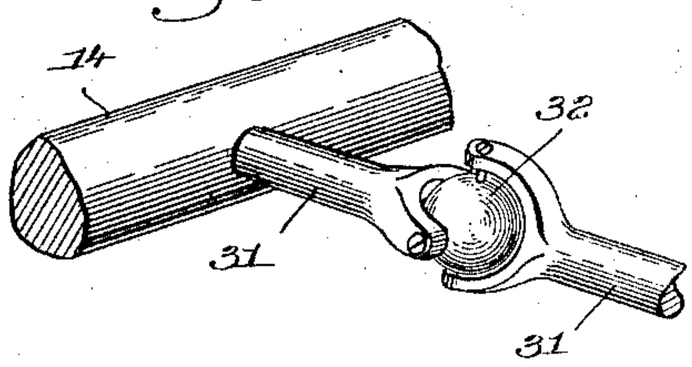

Fig. 3.

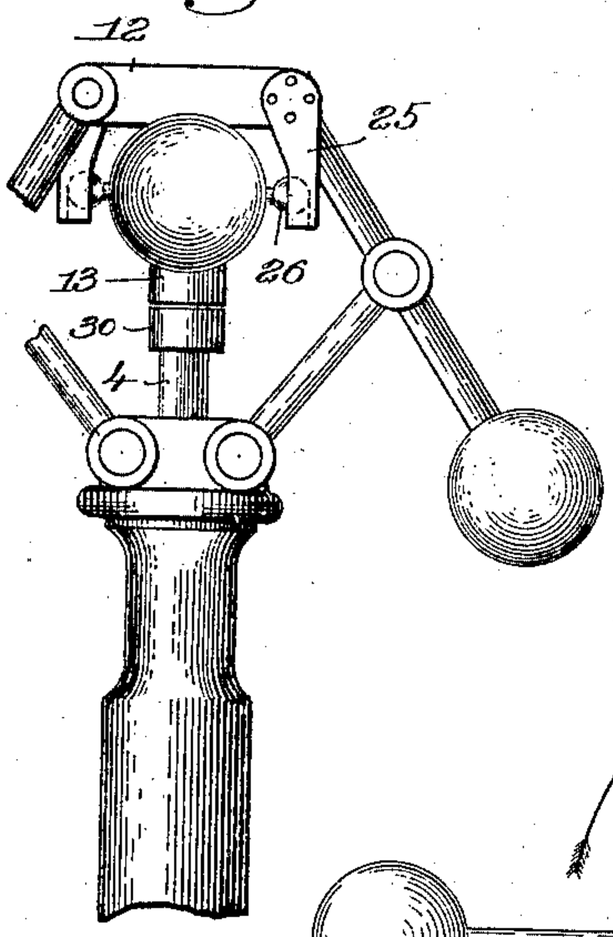

Fig. 8.

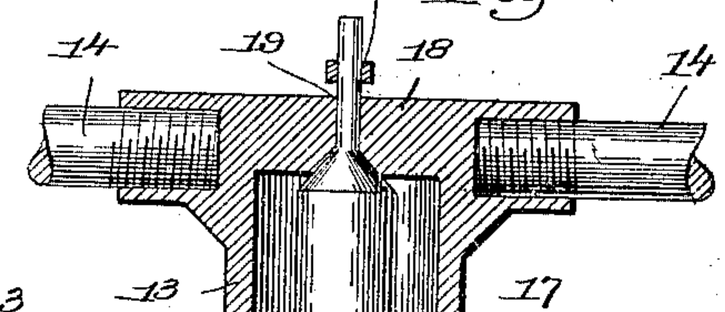

Fig. 2.

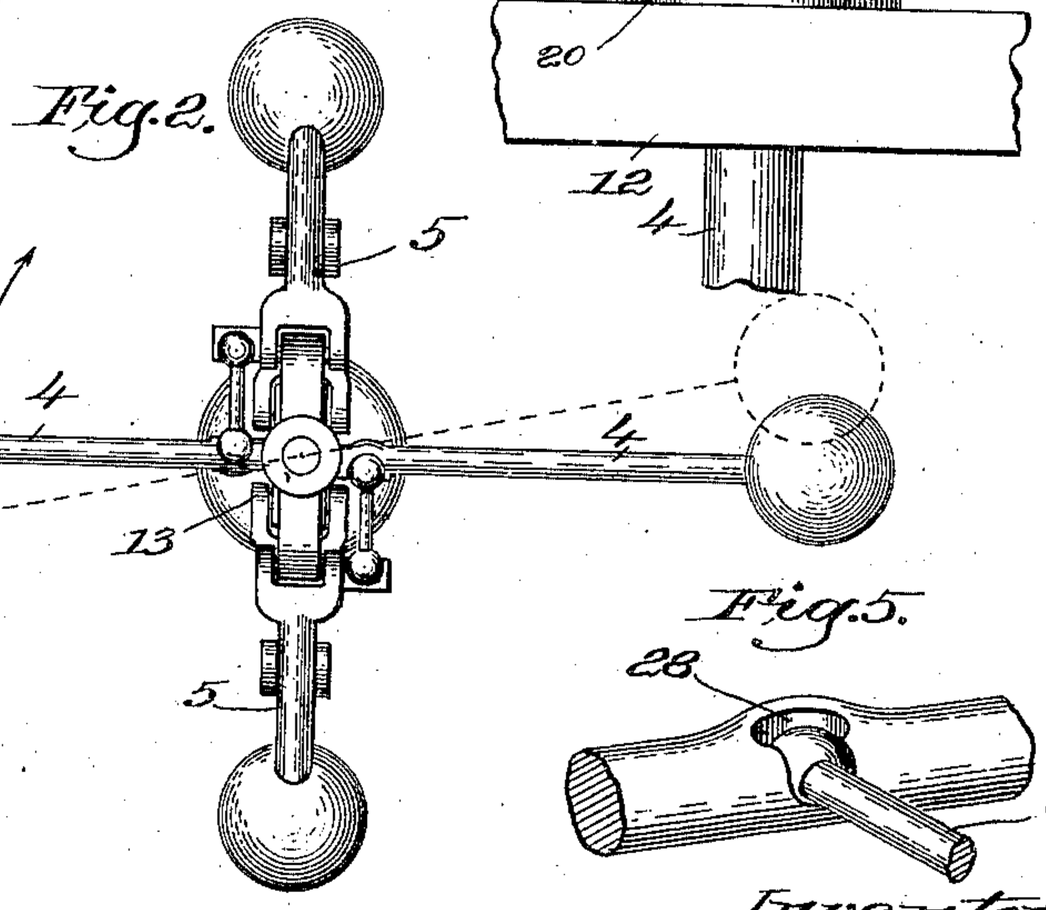

Fig. 4.

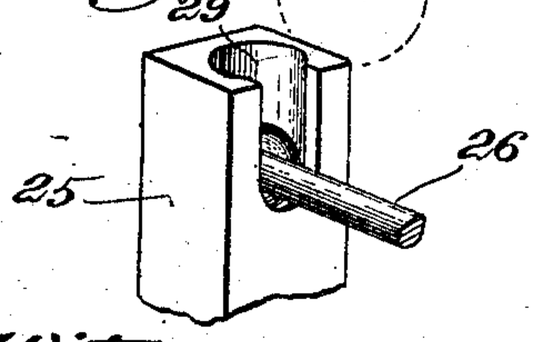

Fig. 5.

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STEAM ENGINE GOVERNOR.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 9.

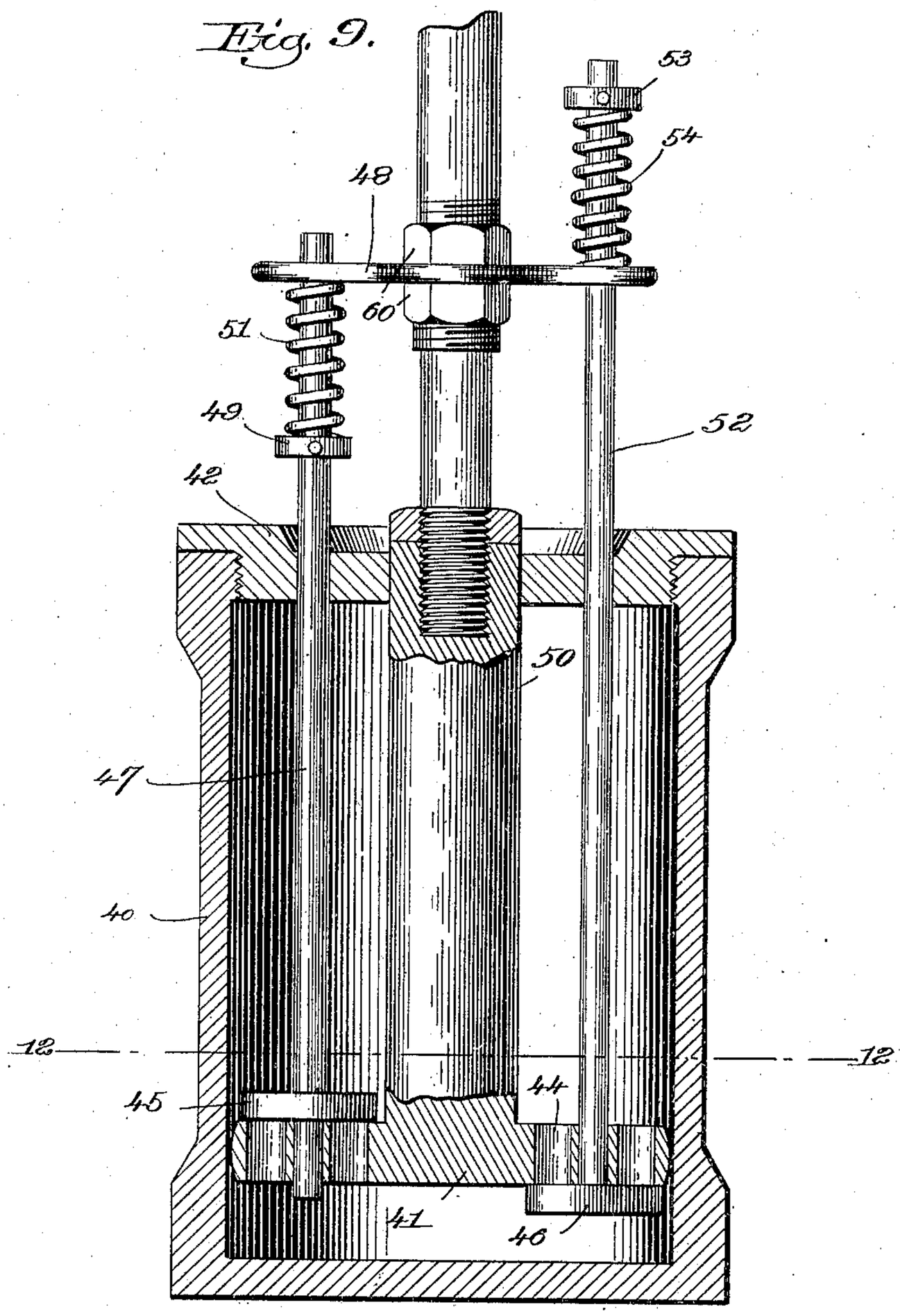
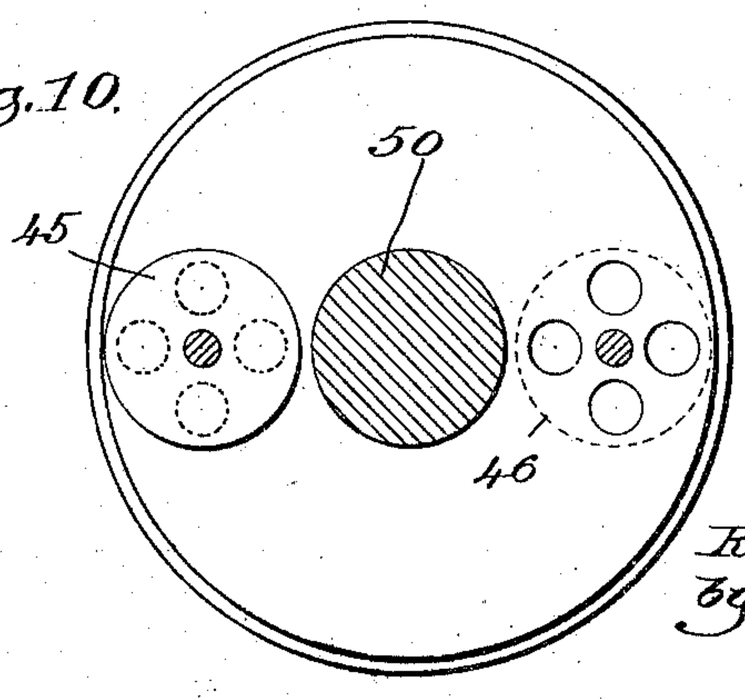


Fig. 10.



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UNITED STATES PATENT OFFICE.

RALPH J. PATTERSON, OF WOBURN, MASSACHUSETTS.

STEAM-ENGINE GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 709,795, dated September 23, 1902.

Application filed April 13, 1901. Serial No. 55,603. (No model.)

To all whom it may concern:

Be it known that I, RALPH J. PATTERSON, a citizen of the United States, and a resident of Woburn, county of Middlesex, State of Massachusetts, have invented an Improvement in Steam-Engine Governors, of which the following description, in connection with the accompanying drawings, is a specification, like numerals on the drawings representing like parts.

My invention relates to governors for steam-engines; and it has for its particular object to provide an inertia attachment of such a character that it can be applied to any ordinary form of centrifugal governor without altering in any way the construction of the governor, the inertia device when applied making the governor perfectly isochronous. The attachment which I prefer to use comprises a head which may be mounted for rotation upon the usual spindle of the governor, preferably at the upper end of the spindle above the cross-head to which the centrifugal arms are attached. The said head has extending in opposite directions arms to the ends of which are attached inertia-weights, and the centrifugal arms of the governor have detachably secured thereto at their upper ends vertically-extending arms which are preferably flexibly connected to the arms of the inertia device. As the governor rotates, the connections between the governor-arms and the inertia-arms cause the inertia device to rotate synchronously with the governor; but if at any time the speed of the engine decreases the inertia device, by reason of its inertia, seeks to move ahead of the centrifugal system, and such forward movement of the inertia device relative to the centrifugal system operates to assist in throwing the centrifugal arms down, and thereby lengthens the cut-off of the engine. When, on the other hand, the speed of the engine suddenly increases, the inertia device, by reason of its inertia, falls behind the centrifugal system, and such lagging movement of the inertia device tends to throw the centrifugal arms outward to thereby shorten the cut-off.

In connection with my inertia attachment I preferably employ a dash-pot of peculiar shape and which is so constructed that it may be adjusted to move freely in one direction and be retarded in its movement in the opposite direction. This form of dash-pot is especially useful in connection with Corliss engine-governors which are used on engines that are directly coupled to alternators which are designed to work in parallel.

In the drawings, Figure 1 is an elevation of a centrifugal governor with my improvements applied thereto. Fig. 2 is a top plan view thereof. Fig. 3 shows a modification. Figs. 4 and 5 show one form of flexible connection between the arms of the inertia device and the centrifugal arms of the governor. Figs. 6 and 7 show modifications of the flexible connection. Fig. 8 is a detail hereinafter to be described. Fig. 9 is an enlarged sectional view of my improved dash-pot. Fig. 10 is a section on the line 12 12, Fig. 9; and Fig. 11 is a detail hereinafter to be described.

Referring to Fig. 1, the governor proper, including the standard 3, the spindle 4, the governor-arms 5, with the centrifugal weights 6 attached thereto, the weight or sleeve 7, to which the governor-arms 5 are connected by the links 8, the three-arm lever 9, to which the reach-rods 10 are connected, is and may be of any usual construction, my invention relating to an inertia attachment which is adapted to be applied to a centrifugal governor of the ordinary type and to a dash-pot of peculiar construction, as will be presently described.

In Figs. 1 and 2 the upper end of the governor-spindle 4, which projects beyond the cross-head 12, to which the governor or centrifugal arms 5 are pivoted, has mounted thereon for rotation a head 13, having extending therefrom in opposite directions the inertia-arms 14, said arms carrying at their ends the inertia-weights 15. One convenient way of thus mounting the head 13 upon the upper end of the spindle 4 is illustrated in Fig. 8, wherein the upper end of the spindle 4 has attached thereto the pivot-bearing 17, having the conical bearing-surface 18, and the head 13 is a hub-like member having a central aperture 19 therein through which the neck 20 of the pivotal bearing 17 projects, the said head 13 being supported for turning movement upon the conical bearing-surface 18. The lower end of the said hub has preferably secured

therein the cup-bearing 21, in which may be mounted antifriction-balls 22, the said ball-bearing serving to center the hook-like head, as will be obvious. I desire it understood, however, that any other form of pivotal connection between the head 13 and the upper end of the spindle 4 may be employed if desired.

The forked end of the governor-arms 5 have attached thereto in any suitable way, as by bolts or screws, the vertically-extending arm 25, the said arm being thus rigidly connected to the governor-arm 5, so as to turn therewith about the pivot of the said governor-arm. Each inertia-arm 14 is connected to one of said vertically-extending arms by means of a flexible connection, the said connection in Figs. 1 and 2 being in the nature of a link 26, which is pivotally connected at its ends to the inertia-arms and the vertically-extending arms, respectively. Preferably I make each end of the link with the spherical portion 27 and provide each inertia-arm 14 with a correspondingly-shaped seat 28 to receive the spherical end of the link, and the upper end of the vertically-extending arms 25 will be provided with a suitable socket 29 to receive the end of the link. Preferably I will so position the sockets 28 in the inertia-arms 14 that the distance between the same and the axis of the spindle 4 will be the same as the distance between the pivotal point of the governor-arms 5 and the point of connection between the links 26 and the vertically-extending arms 25.

The operation of the inertia device constructed as above described will be readily understood by those skilled in the art. Assuming that the engine is running at a certain speed, it will be seen that both the inertia and the centrifugal systems of the governor are running synchronously. If at any time the speed of the engine tends to increase, the speed of the centrifugal system will tend to increase in the same ratio. The inertia of the inertia device, however, prevents the said inertia device from increasing its speed to correspond with the increased speed of the centrifugal system, and the said inertia device therefore lags behind the centrifugal system, assuming the position relative to the centrifugal arms 5 shown in dotted lines in Fig. 2, it being understood that the arrow in said figure indicates the direction of rotation of the governor. This lagging of the inertia-arms 14 behind the centrifugal system operates through the links 26 to assist in raising the centrifugal weights 6, thereby operating the valves to shorten the cut-off in the usual manner. Any tendency to decrease the speed of the engine operates in just the opposite way through the inertia device to assist in throwing the centrifugal weights down. My attachment, therefore, when applied to a centrifugal governor serves to resist any tendency to increase or decrease the speed, and thus renders the governor isochronous in its action. Furthermore, the construction of my inertia device is such that it may be applied to any centrifugal governor now in use, and does not, therefore, require a specially-constructed governor. To apply the attachment to the governor, it is only necessary to secure the head 13 upon the upper end of the spindle and bolt or secure the detachable arms 25 to the ends of the governor-arm 5.

Referring to Fig. 3, a slightly-modified form of my invention is shown wherein the head 13′ is mounted upon the spindle 4 of the governor immediately beneath the cross-head 12 instead of above the same, as in Fig. 1, the said head being supported upon a collar 30, fast on the said spindle. In this embodiment of my invention the vertically-extending arms 25′ extend downwardly from the cross-head 12 and are connected to the inertia-arms by links 26′, similar in construction to links 26 in Fig. 2. The action of the governor is, however, the same as in the other modification.

Instead of employing the link connection between the inertia-arms 14 and the vertically-extending arms 25, I may employ a connection having a universal joint, as shown in Fig. 6, wherein the inertia-arms 14 and the vertically-extending arms 25 have each connected thereto the stems 31, which are connected together by a universal joint 32 of any ordinary construction. Another form of flexible connection is illustrated in Fig. 7, wherein the stems 31′ are connected together by a coiled spring 33 instead of the universal joint 32. A flexible connection between the arms 25 and the inertia-arms 14 is necessary, because during the movement of the governor-arms 5 the upper ends of the arms 25 move in the arc of a circle, while the inertia-arms move in a horizontal plane.

Where the engines are directly coupled to alternators which are to be operated in parallel, I preferably use in connection with my inertia attachment above described a special form of dash-pot, which is so constructed that it may be adjusted to move either uniformly in both directions or freely in one direction and with a retarded movement in the opposite direction. A dash-pot having this construction is illustrated in detail in Figs. 12 and 13, wherein 40 is the usual cylinder containing a suitable resistance medium, such as oil, said cylinder being mounted in any suitable way on the standard 3 of the governor, as usual in this class of devices. Inclosed in the cylinder 40 is a piston 41, having its stem 50 projecting through the head 42 of the cylinder and connected in any usual way to one end of the three-arm lever 9. The piston 41 is provided with two ports or series of ports 43 44, respectively, the said ports being controlled by valves 45 and 46, which open in opposite directions, one valve opening to allow the piston to descend and the other valve opening to allow the piston to rise. The valve 45, which is the valve to open

as the piston 41 is descending, is mounted on the top of the piston 41, as shown in Fig. 12, and its stem 47 projects up through the piston-head 42 and through a suitable aperture in a cross-piece 48, which is rigidly held between the adjusting-nuts 60 on the stem 50 of the piston. A suitable stop-collar 49 is adjustably mounted on the valve-stem 47 below the cross-piece 48, and a coil-spring 51, encircling the valve-stem, is confined between the cross-piece 48 and the collar 49, said spring serving to yieldingly hold the valve 45 to its seat. The valve 46, which is supported underneath the piston 41, has its stem 52 extended up through the cylinder-head 42 and through the opposite piece of the cross-piece 48, as in Fig. 12, an adjustable stop-collar 53 being mounted upon the said valve-stem above the cross-piece 48 and a spring 54 being confined between the said stop-collar and said cross-piece, said spring also serving to yieldingly hold the valve 46 to its seat. By adjusting the stop-collars 49 and 53 so that the tension of the springs 51 and 54 is equal it will be readily seen that the piston of the dash-pot may move in either direction with equal freedom. The valves 45 and 46 allow the resistance medium to pass from one side of the stem to the other. When, however, it is desired to adjust the dash-pot so that it will move freely in one direction but will be retarded in the other direction, one of the stop-collars 53 is adjusted so as to compress the spring between the same and the cross-piece 48, so that the tension on one spring will be greater than that on the other. When so adjusted, it will be obvious that the valve which is held to its seat by the compressed spring will not open as freely as the other valve, and consequently the piston will be retarded in its movement in one direction. The same result could be secured by replacing one of the springs 51 54 by a light spring and the other by a heavy spring.

When my governor, including the novel dash-pot, is used on engines that are coupled directly to alternators which are to be operated in parallel, the dash-pot will preferably be so adjusted that the piston may move freely upward, but will be retarded in its movement downward, whereby the governor may move freely in a direction to shorten the cut-off, but will be retarded in its movement in the direction to lengthen the cut-off. When it is desired to connect in parallel direct coupled alternators, the engine controlling the alternator which is to be thrown in parallel with the active alternator and which is hereinafter termed the "inactive" alternator is started up until it is running nearly synchronously with the engine running the active alternator, and when the engines are running nearly synchronously the switch is thrown to couple the alternators. It is very difficult, however, to so govern the speed of the engine of the inactive alternator from the throttle that the said alternator will be running exactly synchronously with the active alternator when the switch is thrown, so that where ordinary governors are used on the engines the engine running the inactive alternator will either forge ahead or lag behind the other engine before the alternators get into step, thus producing "cross-currents" or "surging," as it is termed, between the alternators. Where my improved dash-pot and inertia device are used, any tendency of one engine to forge ahead of the other and beyond its normal speed is counteracted by the inertia device of the governor and by the free movement of the dash-pot upward, the inertia device and the dash-pot causing the centrifugal weight 6 to immediately fly outward and shorten the cut-off. On the other hand, if when the switch is thrown to couple the alternators the engine running the active alternator tends to lag the dash-pot prevents the inertia device from acting immediately and causes the engine to take steam very gradually, so that there is no sudden forging ahead of said engine, and consequently no danger of cross-currents or surging between the alternators.

Where my governor is to be used on an ordinary engine, the springs controlling the valves in the dash-pot will be of equal tension, so that the dash-pot can move with the same freedom in each direction.

I have found by experiment that an inertia device constructed as mine gives sufficient steadiness to the governor, so that a dash-pot is not absolutely essential, and I may therefore under some circumstances entirely omit the dash-pot and rely entirely on the inertia device for steadying the action of the governor.

So far as I am aware, I am the first to invent an inertia attachment which may be applied to the existing type of governors without in any way altering the construction of the governor, and in my claims I desire to cover this feature of my invention.

Various changes may be made in the construction of the device without departing from the spirit and scope of my invention, and I desire to have it understood that I contemplate making such changes as come within the scope of the appended claims.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an engine-governor, a governor-spindle, centrifugal arms pivoted thereto, vertically-disposed arms rigidly but detachably connected to the said centrifugal arms at their pivotal point of connection with the governor-spindle, an inertia-weight loosely carried by said governor-spindle, and flexible connections between the said vertically-disposed arms and the inertia-weight.

2. In a centrifugal governor, a governor-spindle, centrifugal levers connected thereto, vertical arms detachably secured to the said centrifugal levers at their pivotal points, a

head mounted for rotation on said governor-spindle and having oppositely-disposed arms extending therefrom, inertia-weights on said arms, and flexible connections between said vertically-disposed arms and the arms supporting the inertia-weights.

3. In a centrifugal governor, a governor-spindle, centrifugal levers connected thereto, vertical arms detachably secured to the said centrifugal levers at their pivotal points, a head mounted for rotation on said governor-spindle and having oppositely-disposed arms extending therefrom, inertia-weights on said arms, links pivotally connected to said vertically-disposed arms, and to the arms supporting the inertia-weights.

4. In a centrifugal governor, a governor-spindle, centrifugal levers connected thereto, vertical arms detachably secured to the said centrifugal levers at their pivotal points, a head mounted for rotation on said governor-spindle and having oppositely-disposed arms extending therefrom, inertia-weights on said arms, links pivotally connected to said vertically-disposed arms and to the arms supporting the inertia-weights, the distance between the axis of the governor-spindle and the point of connection between the said links and the arms supporting the inertia-weights being equal to the distance between the axis about which the centrifugal levers turn and the point of pivotal connection between the said links and the vertically-disposed arms.

5. In an apparatus of the class described, a centrifugal governor, combined with a dash-pot connected to the reach-rods of the engine, said dash-pot comprising a cylinder containing a resistance medium, a piston in said cylinder, and adjustable mechanism to independently regulate the speed of the piston in each direction, whereby the said piston may be made to move more freely in one direction than in the other.

6. In an apparatus of the class described, a centrifugal governor, an inertia device carried thereby, combined with a dash-pot connected to the reach-rods of the engine, said dash-pot comprising a cylinder containing a resistance medium, a piston in said cylinder, and adjustable mechanism to independently regulate the speed of the piston in each direction, whereby the said piston may be made to move more freely in one direction than in the other.

7. A dash-pot for engine-governors, comprising a cylinder containing a resistance medium, a piston working in said cylinder, said piston having two ports or openings therethrough, and spring-pressed valves controlling said ports and opening in opposite directions, the stems of said valves extending through the head of the cylinder.

8. A dash-pot for engine-governors, comprising a cylinder containing a resistance medium, a piston working in said cylinder, said piston having two ports or openings therethrough, spring-pressed valves controlling said ports and opening in opposite directions, and means operable from the outside of the cylinder to vary the tension on the two springs independently, whereby the piston may be made to move more freely in one direction than in the other.

9. A dash-pot for engine-governors, comprising a cylinder containing a resistance medium, a piston in said cylinder having two ports therein, spring-controlled valves controlling said ports, said valves opening in opposite directions and having their stems projecting through the head of the cylinder, and means for adjusting the tension of the springs, whereby the valves may be so regulated that the piston will move freely in one direction but will be retarded in its movement in the opposite direction.

10. A dash-pot for engine-governors, comprising a cylinder containing a resistance medium, a piston in said cylinder having two ports therein, valves controlling said ports and opening in opposite directions, each valve being carried by a stem which projects through the head of the cylinder, a cross-piece fast on the piston-rod, and means of yieldingly connecting said valve-stems to said cross-piece.

11. In an engine-governor, a governor-spindle, weighted centrifugal levers pivoted thereto, vertically-disposed arms detachably secured to said centrifugal levers at their pivotal point, an inertia-weight loosely carried by said governor-spindle, and flexible connections between the said arms and the inertia-weight, combined with a dash-pot connected to the governor, said dash-pot comprising a cylinder containing a resistance medium, a piston working therein, said piston having two ports, spring-controlled valves controlling said ports, and opening in opposite directions, and means for adjusting the tension of the springs.

12. In an engine-governor, a governor-spindle, weighted centrifugal levers pivoted thereto, vertically-disposed arms rigidly but detachably secured to said centrifugal levers, said vertical arms extending upwardly beyond the pivotal points of the said centrifugal levers, an inertia-weight loosely carried by said governor-spindle, and flexible connections between said vertically-disposed arms and the inertia-weight.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RALPH J. PATTERSON.

Witnesses:

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