No. 788,373. PATENTED APR. 25, 1905.

C. PFEIFFER.

GOVERNOR.

APPLICATION FILED OCT. 11, 1904.

3 SHEETS—SHEET 1.

Fig. 1.

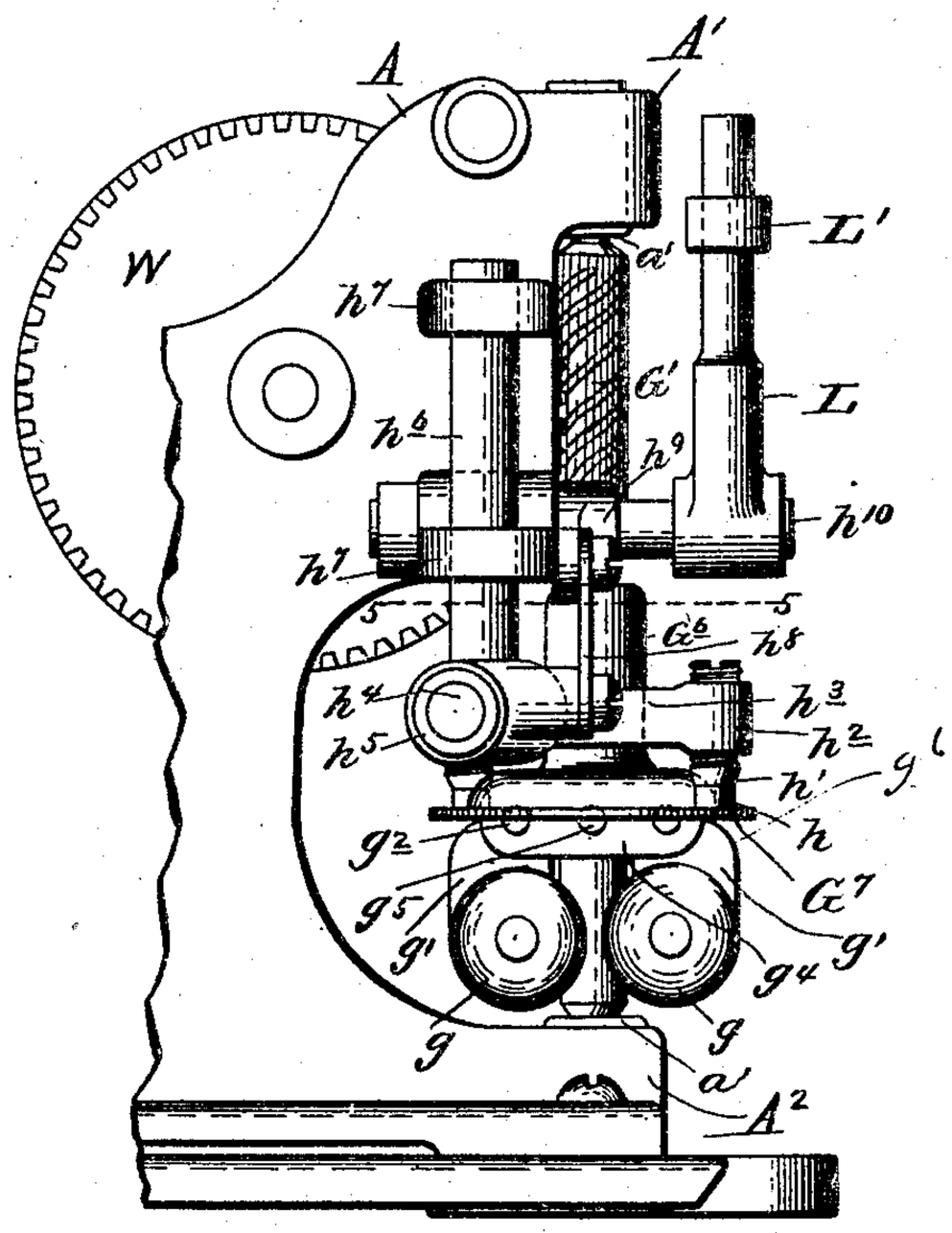
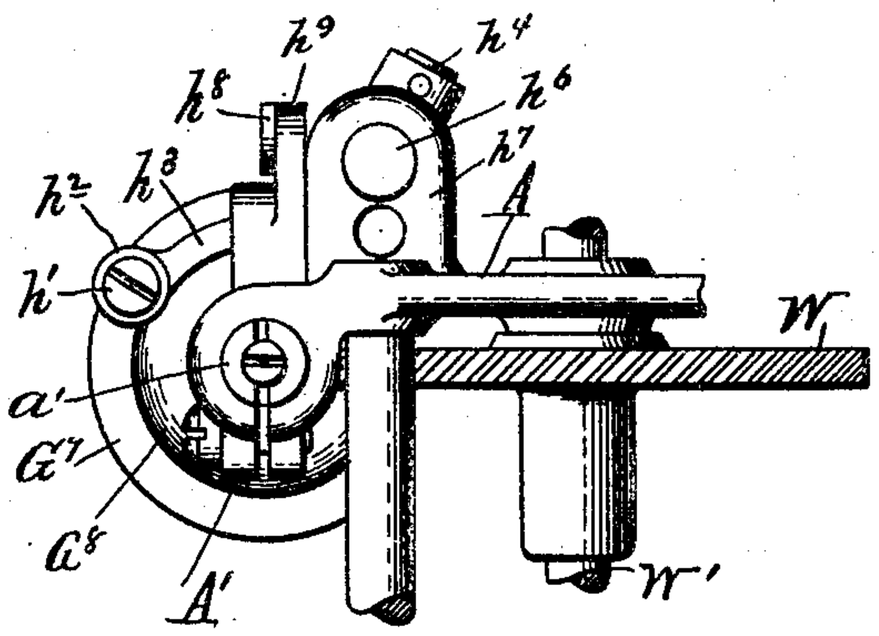


Fig. 4.



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3 SHEETS—SHEET 2.

Fig. 2.

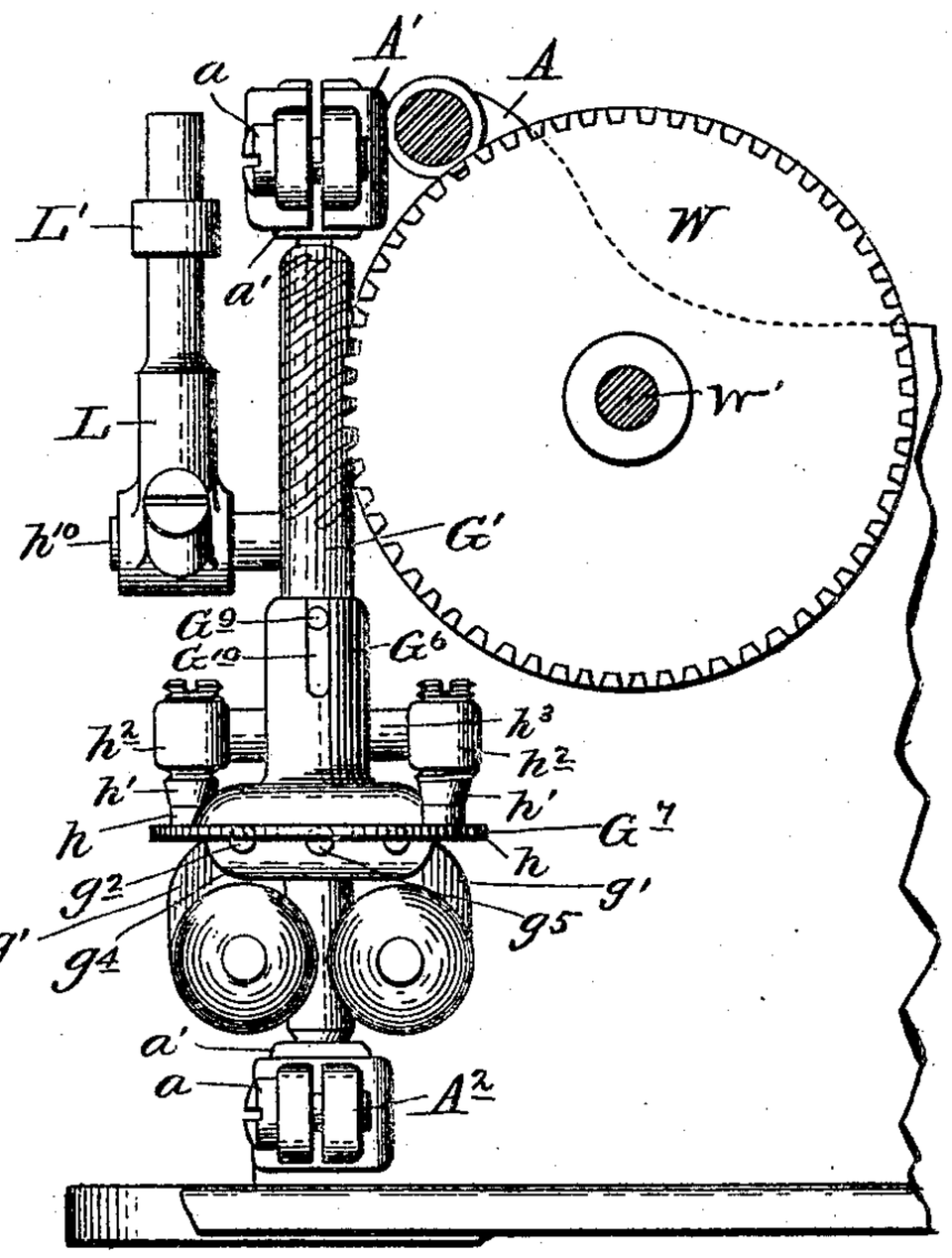


Fig. 6.

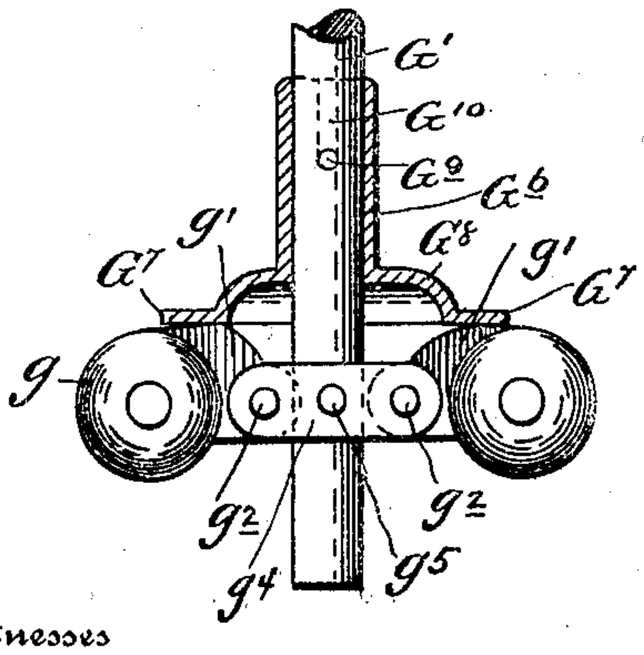
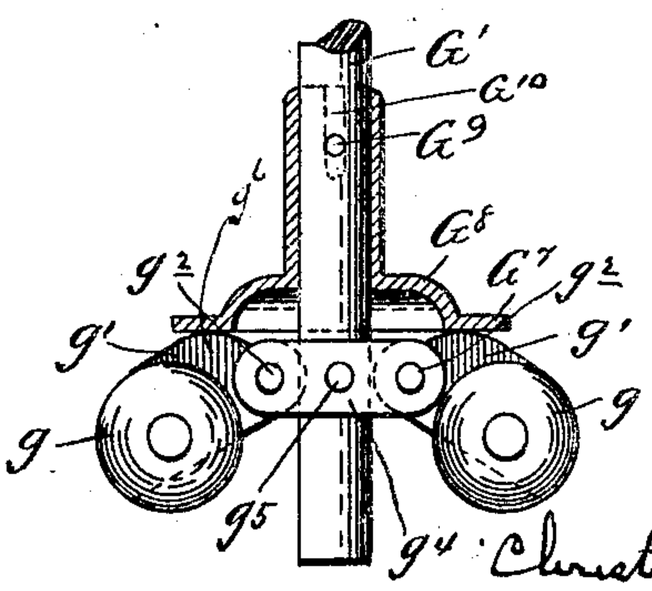


Fig. 7.



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3 SHEETS—SHEET 3.

Fig. 3.

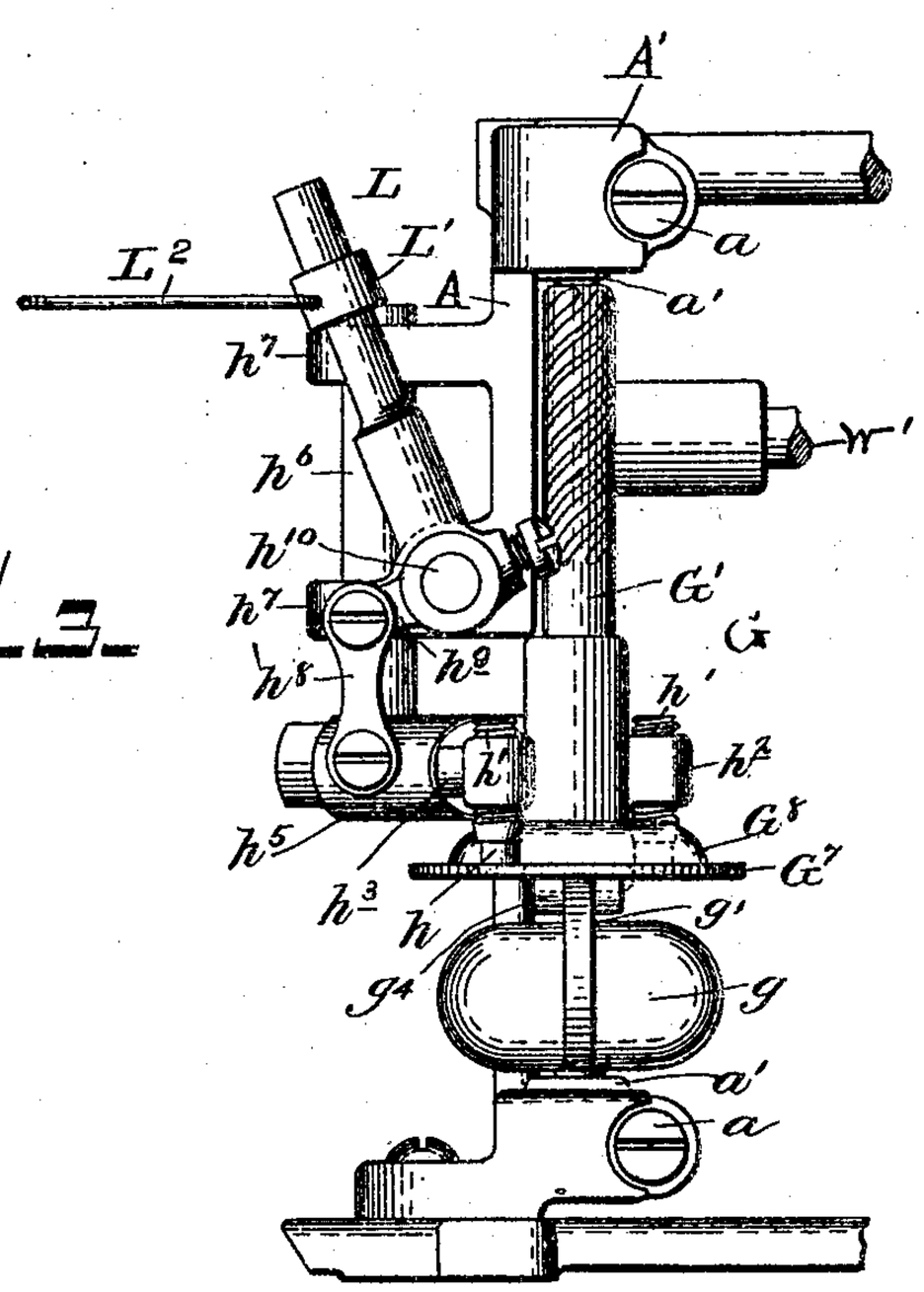


Fig. 5.

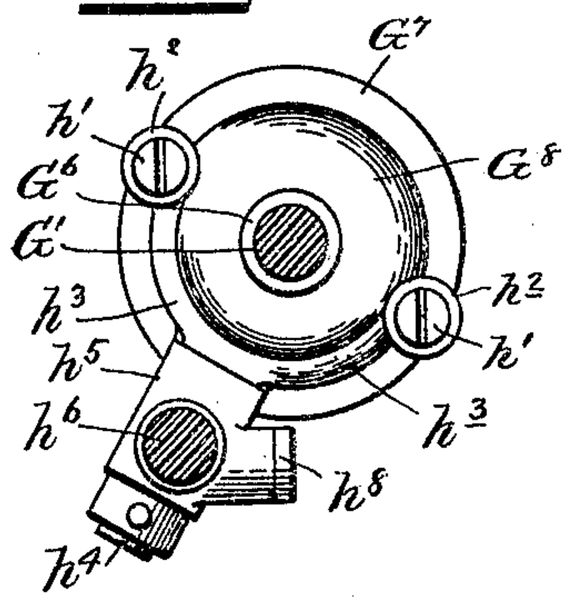
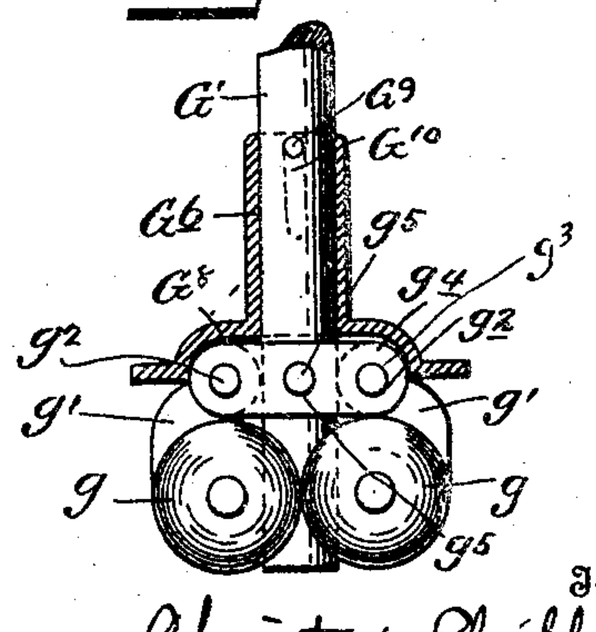


Fig. 8.



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No. 788,373. Patented April 25, 1905.

UNITED STATES PATENT OFFICE.

CHRISTIAN PFEIFFER, OF NEW BRITAIN, CONNECTICUT, ASSIGNOR TO NORTH & PFEIFFER MANUFACTURING COMPANY, OF NEW BRITAIN, CONNECTICUT, A CORPORATION OF CONNECTICUT.

GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 788,373, dated April 25, 1905.

Application filed October 11, 1904. Serial No. 228,014.

To all whom it may concern:

Be it known that I, CHRISTIAN PFEIFFER, a citizen of the United States, residing at New Britain, in the county of Hartford, State of Connecticut, have invented certain new and useful Improvements in Governors, of which the following is a description, reference being had to the accompanying drawings and to the letters of reference marked thereon.

This invention relates to a governor for spring-motors, and is an improvement on the governor shown in my application filed March 2, 1904, Serial No. 196,210.

In this construction the screw or worm, the worm-gear, the bearings, and frame are substantially the same as shown and described in the above application.

This improvement consists in the form and construction of the friction-disk and the manner in which it is mounted on the governor-shaft, the form and construction of the weighted arms, the manner in which the arms are attached, and the peculiar action of the arms in combination with the sliding disk.

The object of this governor is to allow the motor to be run at a variable speed at the will of the operator, to run steady at any speed within its range and any tension of the main spring of the motor. The governor may be mounted either horizontal or vertical, and the ball may be above the pivot or suspended below, as the action depends on centrifugal force.

In my former application I have shown the balls above the pivot, and in my improved construction I have suspended the balls below the pivot. In both forms of construction the sliding sleeve and friction-disk are lifted when the balls are thrown out.

The speed of the governor is controlled by means of a brake acting on the friction-disk. The friction between the brake and disk is varied by the position of the balls, so that when the brake is raised and the balls are thrown out the friction is less and the governor runs faster than when the brake is depressed and the balls are drawn closer together and revolving in a smaller circle. In the usual construction this action is obtained by means of springs attached to the balls or the arms. These springs restrain the balls and limit the pressure on the brake by the tension of the springs overcoming the centrifugal force of the balls, the strength of the springs being made so that when the balls are farther apart and revolving at a greater velocity the pressure on the brake is less, because the tension of the spring has increased more than the centrifugal force of the balls, so that the speed at which the governor will run depends on these springs, and as in practice it is difficult to make any springs exactly alike, for the reason that a slight variation in the hardness or size of the wire, the size of the winding-mandrel, the closeness of the coils, or the tension on the wire while winding the spring will cause a corresponding variation in the strength of the spring. It has therefore been necessary to use some regulating device to compensate for the variation in the springs.

The device commonly used in spring-motors is a cam-action, which may be made to conform to the requirements of the motor upon which it is to be used, and it is made to give the necessary movement to the brake, the friction-disk, and the position of the balls and to conform to the tension of the springs, and consequently the friction on the brake allows the motor to run at the desired speed. The same result might be accomplished by an adjustment to give the proper tension to the springs when first used and also to provide a means of keeping uniform tension on the springs when they become weakened by use, which will cause the motor to run slower. The objection to any such device is that it increases the cost of manufacture, adds complication and liability to break, or gets out of order, as the parts would necessarily be small and delicate.

From the above-stated facts it is evident that the peculiar action and construction of this class of governors, its great range of speeds, and ease of control make it particularly adapted to spring-motors or like mechanisms; but in all the forms heretofore used

it has been expensive to manufacture, and the springs are liable to break or become weak through use, which changes the speed or renders it useless.

The objects of my invention are to overcome the above-stated objections. These objects I accomplish by the construction shown in the accompanying drawings, in which—

Figure 1 is a side elevation of my improved centrifugal governor. Fig. 2 is a similar view looking from the opposite side. Fig. 3 is a front elevation. Fig. 4 is a plan. Fig. 5 is a sectional plan view on line 5 5, Fig. 1; and Figs. 6, 7, and 8 are detail sectional views of the governor-arms and the friction-disk.

In the accompanying drawings I have used the same letters as used in the above-cited application to designate the same or similar parts of the governor to more readily distinguish my improvements.

In my improved form of construction I have used the frame A, with the brackets A′ A² and clamping-screws *a a*, for holding the bearing-blocks *a′ a′* and also the shaft G′.

The governor-slide G is formed of a sleeve or extension G⁶ and the flange or friction-disk G⁷, a part of which is arched, as at G⁸. The outer portion of the disk G⁷ is flat on both the upper and lower surfaces, the under side being the bearing-surface for the governor-arms *g′*, and the top surface acts upon the brake-shoes *h h*. The arch *g*⁸ overlaps the arms *g′*, so as to bring the lower surface of the disk G⁷ in alinement with the center of the pivot-pins *g*² when the balls are in their normal position, as shown in Fig. 8.

The balls or weights *g* may be made integral with the arms *g′* or, as in the construction shown, where the balls are made in halves and fastened to opposite sides of the arms by a rivet, through the center or by any suitable means.

The arms *g′* are attached to the shaft G′ by means of the cross-piece or yoke *g*⁴, which is made in two parts and rigidly fastened to the shaft G′ by the rivet *g*⁵. The pivot-pins *g*² are rigidly fastened in the arms *g′* and revolve freely in the holes *g*³ in the yoke *g*⁴, the position of the parts being such that when the governor is at rest the balls *g g* are suspended below the yoke and governor-slide, the balls having grooves in their adjacent sides to clear the shaft and allow the balls to come together, so that the center of the balls and the pivot-pins *g*² are in vertical alinement. When the governor is running at full speed, the balls are thrown out until the center of the balls and the pivot upon which they swing are in horizontal alinement, as shown in Fig. 6, the balls swinging through an arc of ninety degrees.

The construction of the arms *g′* and their action on the governor-slide are as follows: The parts of the arms *g′* within the yoke *g*⁴ are made concentric with the pivots *g*², forming a half-circle from a point in line with the center of the pivot, the outside part of each arm being enlarged in a curve to a point in line with the outer tangent of the ball, which is parallel with the line through the center of the ball, to form a cam *g*⁶, the shape of which cam varies the pressure on the brake by the change of position of the point of contact between the arms and the friction-disk, (see Figs. 6 and 7,) or, in other words, the speed of the motor is controlled by changing the leverage of the balls, and consequently the pressure between the brake and friction-disk. The sleeve G⁶ is slidably mounted on the shaft G′ and held from rotation therein by the pin G⁹, which pin is rigidly fixed in the shaft and extends outwardly through the slots G¹⁰ in the sleeve.

The construction and action of the brake are as follows: The brake-blocks *h h*, of suitable material—such as wood, leather &c.—are carried by the threaded holders *h′ h′*. The holders *h′ h′* are mounted in the threaded openings *h*² *h*², formed in the arms *h*³ *h*³, the arms being curved and forming a yoke partly surrounding the governor-shaft to bring the two brake-blocks *h h* in alinement with the center of the governor-shaft or at diametrically opposite points over the disk G⁷. The arms *h*³ *h*³ are made integral with the stem *h*⁴, which stem is rotatably mounted in the hub or bearing-sleeve *h*⁵, formed integral with the vertically-sliding rod *h*⁶, which is mounted in the brackets *h*⁷ *h*⁷. The parts *h′*, *h*², *h*³, and *h*⁴ form a brake-carrier in which the brake-holders *h′ h′* are capable of independent vertical adjustment. The link *h*⁸ is pivotally attached to the hub *h*⁵ and to the crank *h*⁹, rigidly mounted on the shaft *h*¹⁰.

L designates the "tempo-lever" or operating-lever of the speed-controller and has mounted upon it the collar L′, which is attached, by means of a link L², to the operating-handle of a musical instrument or other mechanism (not shown) with which the motor is to be used.

The above-described parts in combination constitute the governor or speed-controller as applied to a spring-motor, (not shown,) but from which the governor is actuated by the worm-wheel W on a shaft W′, gearing with the worm on shaft G′.

The operation will now be described: It will be seen that a rocking or swinging movement of the lever L will through the shaft *h*¹⁰ and the crank *h*⁹ impart a vertical movement to the sliding rod *h*⁶, the arms *h*³, and the brake-blocks *h*. The object in using two brake-blocks *h h* is to secure steadiness of motion without absolute "truth" of the disk G⁷, as making this to run perfectly true would be expensive, and even if made so it would be liable to be thrown out of true by causes not under control of the maker, and if not true it will cause an unsteadiness of speed when run-

ning slow unless some device is used to compensate for possible irregularities in the surface which runs against the brake, and for this purpose I have invented the above rocking brake-carrier, and the action is as follows: If the disk is not true, it will wabble, the high point being opposite the low point. It will be seen that this construction of the brake allows a rocking motion of the arms h^3, which carry the brake-blocks $h\,h$, by reason of the stem h^4 being free to revolve in the hub h^5 of the rod h^6, thus securing a uniform pressure at diametrically opposite points and overcoming any tendency to jump. Any inequalities may be further compensated for by independently adjusting the brake-holders $h'\,h'$. In practice when the motor-spring is wound the stored-up energy therein tends to revolve the governor through the worm W and is restrained by the friction of the brake upon the disk. When the motor is stopped, the balls are down and are held in this position by the pressure of the brake on the friction-disk. It will be seen (see Fig. 8) that in the governor-slide the junction of the inner edge of the disk G^7 with the lower edge of the arch G^8 forms a corner or edge which rests on a shoulder at the junction of the curves forming the shape of the top and outer surface of the arms g'. When, through the lever L and the other above-described parts of the brake mechanism, the brake-blocks h are lifted sufficiently to diminish the pressure and friction on the disk G^7, the governor will revolve and the centritugal force of the balls g tending to throw them outward an upward or lifting force will be exerted at the point of contact between the arms g' and the disk G^7, the balls swinging farther outward and upward as the disk is allowed to rise by lifting the brake. By this construction the balls may be made to swing outward and upward until the centers of the balls are in alinement with the centers of the pivots upon which they swing, as shown in Fig. 6. The shape of the arms g' is such that as the balls swing out the point of contact between the arms and disk is moved outwardly, thus changing the leverage, and consequently the lifting power of the arms and balls.

From the well-known laws of centrifugal force and mechanical powers it will be understood that there are two causes or forces acting through the above-described mechanism whereby the speed of the motor is governed, the first being centrifugal force, which tends to cause the balls to fly outward in the plane of the circle in which they revolve, but being restrained by the arms and being suspended from a point above the center of gravity, giving a swinging movement to the arms and an outward-and-upward movement to the balls until the centers of the balls are in the same plane as the centers of their pivots when both the upward and outward movement will cease, and the force of the balls acting directly outward there is no pressure exerted upon the arms except the weight of the disk and other parts of the governor-slide and that which is applied by the brake.

It is evident that as the balls rise and approach the level of the pivots the upward force is diminished, and therefore the power of the balls acting on the brake, which reduces the friction of the brake on the disk and allows the motor to run faster, or if the balls are forced downward by pressure of the brake through the disk upon the arms the leverage of the upwardly-acting force is increased, and therefore the friction on the brake, which will cause the motor to run slower. The other cause for variation in speed is the location of the point at which the pressure is applied to force the balls downward, or, in other words, the leverage at which the force of the balls acts upwardly when applied, as in the novel construction and action of this invention.

It has been found in practice that while the speed may be varied by the position of the balls and consequent brake-power the speed does not vary uniformly or in direct ratio to the rise and fall of the balls, and as it is necessary that the variation should be constant, that is for illustration, the increase or decrease in speed must be ten revolutions of the governor to each space on the graduated indicator for the operating-handle, (not shown.)

It has been customary to use a cam to depress the brake and a spring for lifting it, thus varying the movement of the brake and governor to compensate for the irregular action thereof, and thereby obtain the speed required. There are many objections to this form of construction, one of which is that each motor has to be timed or regulated by an expensive operation of fitting the cam, and as it is very desirable that all parts of the mechanism may be made duplicate I have invented the above form of construction to obtain the desired action, in which I have applied the second of the above-mentioned causes for controlling the speed, by means of which I have secured a uniform change of speed in direct proportion to the movement of the brake by the operating-lever. As before stated, the point of contact between the disk and governor-arms is changing its position as the arms rise or are depressed by the disk. This change of position is due to the cams g^6 on the arms g' bearing upon the lower surface of the disk and altering the leverage of the balls and compensating for the lack of uniformity and securing a smooth even regulation and control at the will of the operator.

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

1. The combination in a centrifugal governor, with the governor-shaft and its disk, of a horizontal, swiveled yoke or brake carrier straddling the shaft and provided in its ends

with independently-adjustable brake-holders having brake-blocks to engage the said disk; substantially as described.

2. The combination, in a centrifugal governor with the governor-shaft and its disk, of a vertically-sliding rod, a horizontal yoke or brake carrier pivoted to the lower end of said rod to rock and straddling the said shaft, independently-adjustable brake-holders mounted in the ends of the yoke and provided with brake-blocks to engage said disk, and mechanism for operating said sliding rod; substantially as described.

3. The combination, in a centrifugal governor, with the governor-shaft and its disk, of a vertically-sliding rod having a bearing in its lower end, a horizontal yoke or brake carrier provided with a stem turning freely in said bearing; the ends of the yoke having threaded openings, threaded brake-carriers mounted in said openings and provided with brake-blocks to engage the disk at opposite sides of said shaft, and mechanism for operating said sliding rod; substantially as described.

4. The combination, in a centrifugal governor, with the governor-shaft and its disk, of a vertically-sliding rod, a horizontal yoke or brake carrier swiveled to the lower end of said rod and straddling the said shaft, brake-blocks on said arms to engage the said disk, a rocking lever, and a link connecting said lever to the said sliding rod; substantially as described.

5. In a centrifugal governor, the combination with a governor-shaft and a sliding disk mounted thereon, of bearings at opposite sides of the shaft, weighted governor-arms pivoted to said bearings and provided on their outer sides beyond their pivots with cam-surfaces to engage the disk; substantially as described.

6. In a centrifugal governor, the combination with the governor-shaft and a sliding disk mounted thereon and having an arched center, of bearings at opposite sides of the shaft and normally lying within the said arched center, weighted governor-arms pivoted to said bearings with their axes in the plane of the horizontal outer portion of the disk and provided on their outer sides beyond their pivots with cam-surfaces to engage the disk first at the angle or corner formed by the juncture of its arched and horizontal portions; substantially as described.

7. A centrifugal governor and brake mechanism, comprising the governor-shaft, a sliding disk thereon arched at its center, bearings at opposite sides of the shaft and normally lying within said arched center, weighted governor-arms pivoted to said bearings with their axes in the plane of the horizontal outer portion of the disk, and provided beyond their pivots with cam-surfaces to engage the disk first at the angle or corner formed by the juncture of its arched and horizontal portions, a swiveled yoke or brake carrier having brake-blocks to engage the other face of the horizontal portion of the disk at opposite sides of the shaft, and a vertically-sliding rod to which said yoke or brake carrier is swiveled; substantially as described.

8. In a centrifugal governor, the combination with the disk of a brake-carrier provided with threaded apertures over the disk and threaded brake-block holders mounted adjustably in said apertures; substantially as described.

9. In a centrifugal governor, the combination with the disk, of a vertically-movable rod, a self-adjusting brake-carrier, at the lower end of the rod, having threaded apertures over the disk, and threaded brake-block holders mounted in said threaded apertures; substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

CHRISTIAN PFEIFFER.

Witnesses:

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ANNA MALMFELDT.