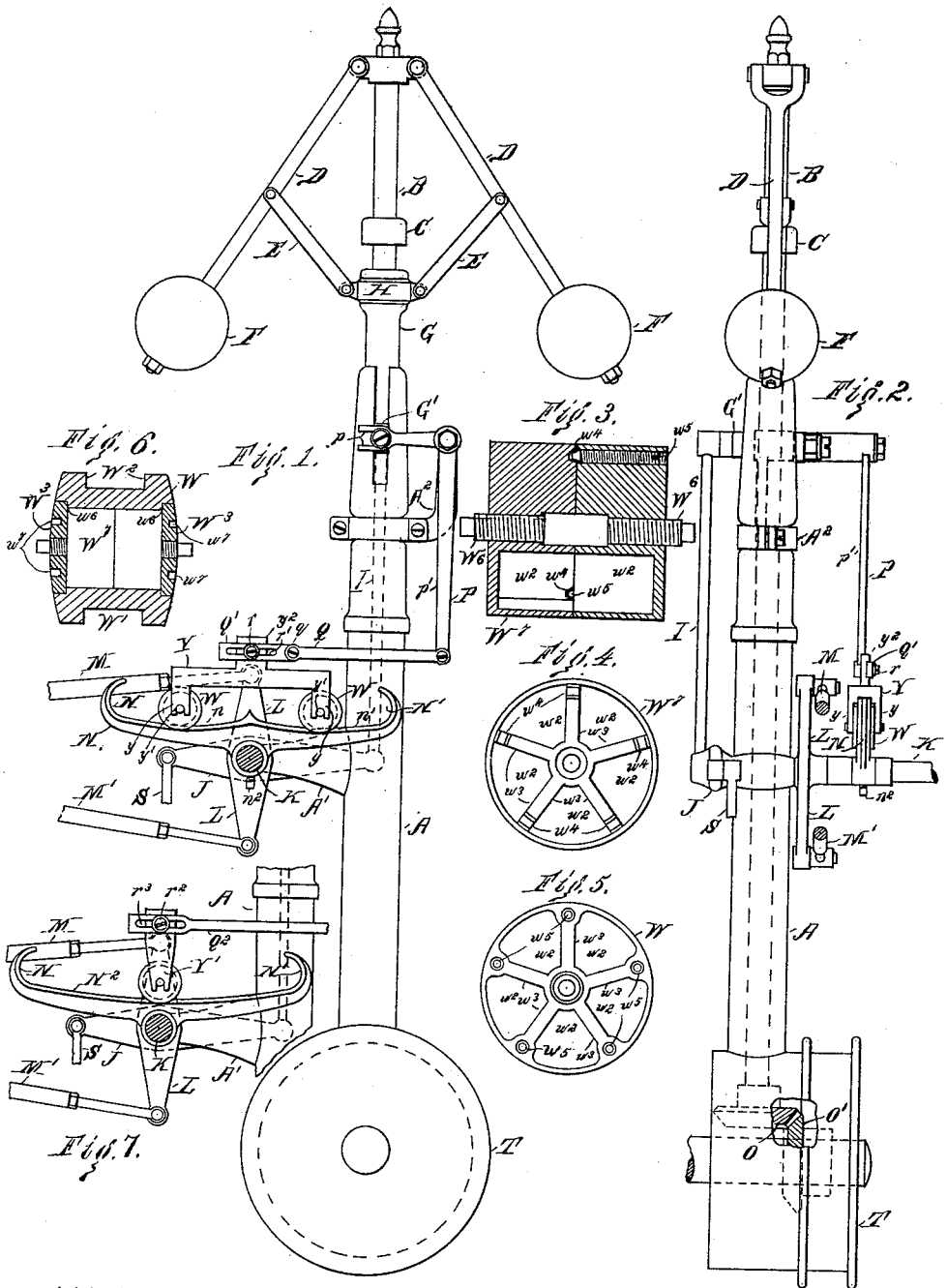
(No Model.)

F. A. GALE.

SPEED GOVERNOR.

No. 346,472. Patented Aug. 3, 1886.



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UNITED STATES PATENT OFFICE.

FRANK A. GALE, OF LOWELL, MASSACHUSETTS.

SPEED-GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 346,472, dated August 3, 1886.

Application filed October 8, 1885. Serial No. 179,290. (No model.)

To all whom it may concern:

Be it known that I, FRANK A. GALE, a citizen of the United States, residing at Lowell, in the county of Middlesex and Commonwealth of Massachusetts, have invented a certain new and useful Improvement in Speed-Governors, of which the following is a specification.

My invention relates to speed-governors for steam, water, and other motors and engines; and it consists in an improvement (hereinafter described) on the devices described in Letters Patent No. 301,712, granted July 8, 1884, to me for speed-governors.

In the accompanying drawings, Figures 1 and 2 are respectively a front elevation and a side elevation of a centrifugal or ball governor—such as is commonly used with steam-engines—its stand, the driving-pulley, the cut-off shaft, the arm usually secured thereto, part of the cut-off rods and dash-pot rod, and my invention applied to the cut-off shaft, a part of the miter-gears being shown in Fig. 2 through a break or opening in the lower part of the stand; Fig. 3, a central vertical section of the mercury-chamber on the line *x x* in Figs. 4 and 5; Figs. 4 and 5, elevations of the inner ends of the halves of the mercury-chamber; Fig. 6, a vertical cross-section of the flanged rolling weight through the center thereof, showing the mercury-chamber in elevation; Fig. 7, a front elevation of a part of the governor-stand, the cut-off shaft, the arm secured thereto, part of the cut-off rods and dash-pot rod, and a modified form of my improvement.

The governor-stand A, the regulator-shaft B, the stop-collar C, arms D D, balls F F, sleeve G, sliding on the regulator-shaft, the collar H, connected by the links E E to the arms D D, and turning freely in a groove around said sleeve G, the guide-pin G′, projecting from the sleeve G through a vertical slot, *a*, in the top of the stand A, to prevent the rotation of said sleeve G, the regulator-rod I, pivoted to the sleeve G at its upper end and at its lower end to the double arm J, secured on the cut-off shaft K, the latter turning in a bracket, A′, on the stand A, the other end of said arm J being pivoted to the upper end of the dash-pot rod S, other arms, L L, secured to said cut-off shaft and pivoted to the cut-off rods M M′, to operate the cut-off valves, (not shown,) the miter-gears O O′, and the driving-pulley T, are all of the usual construction and operation and as shown in said patent.

Instead of the "correction-arc" shown and described in said patent, having a single curve on its upper surface, I prefer to use a double arc, or, in other words, a double arm, the upper surface of which is curved from the middle outward in each direction in arcs of circles *n n′*, of equal radii but different centers. The double arm N is provided in its middle with a hub, which receives the shaft K, and with a set-screw, n^2, which turns in said hub, and thrusts against said shaft, and prevents said arm N from turning thereon. The upper surface of the arm N is of uniform width, and serves as a track for two rolling weights, W. These weights, like that shown in said patent, are cylindrical, and are each provided with flanges W^2 W^2, or, in other words, with an annular groove, W′, concentric with said weight, and as wide as the upper surface of said arm N, the flanges of said weights serving to keep the weights on the track or upper surface of the arm N. The ends of the arm N are provided with hooks N′, to prevent the weights from rolling off from the ends of said arm, as shown in said patent, said hooks being preferably curved to fit said weights. The weights W are placed one on each side of the middle of the arm N, said arm N being so adjusted on the cut-off shaft K, by means of the set-screw n^2, that with an average load or resistance the weights will stand at equal distances from the middle of said arm.

Instead of the disks or washers of heavy material, shown in said patent as placed within the weight W, I use for a supplementary weight a mercury-chamber, W^7, which consists of two cylinders, *w w′*, each provided with a central aperture to receive a screw, W^6, said apertures being threaded to engage with said screw. Each of said cylinders is provided with several compartments w^2, separated from each other by radial walls w^3, which meet in the center of the cylinder. The compartments w^2 are equal in size to each other, and the number of them is the same in each cylinder.

The inner ends of the cylinders are ground to fit each other accurately. These cylinders are partly filled with mercury, and secured to-

gether, by means of the screw W^6, in such a manner that the divisions between the compartments in one cylinder are each in the same plane with some division of the other cylinder. The walls w^3 in one of the cylinders are each cut away for a slight distance at w^4, just inside of the shell of said cylinder. The other cylinder of said mercury-chamber is provided with as many screws w^5 as there are radial walls in said cylinder, each of said screws having a diameter sufficient to close one of the openings w^4, and turning in a threaded hole in one of said walls parallel with the axis of the cylinder. By turning these screws w^5 their points may be made to project from the inner end of the cylinder in which they turn into the openings w^4. The amount of the projection of said screws into said openings will regulate the size of said openings and regulate the flow of mercury from compartment to compartment of the mercury-chamber.

The object of the mercury-chamber is to prevent a too rapid movement of the weights W on the arm N when said arm is rocked, the mercury tending to settle in the lower part of the chamber, and making the center of gravity of the weight and its contents below the geometrical center of said weight, but flowing from one compartment to another of said chamber more or less rapidly, according to the size of the openings w^4, as the weight is rotated. The mercury-chamber is retained in place in the weight W by circular caps W^3, which close the central opening of said weight and rest against annular shoulders w^6, being held in position by central screw-threaded holes, which engage the screw W^6, said caps being provided with holes w^7, at equal distances from the centers of said caps, to admit a forked wrench. The ends of the screw W^6 are not threaded, and are of somewhat reduced size. A bar, Y, is provided at each end with a down-hanging fork, $y\ y$, which straddles one of said weights, each tine of each fork having in its lower end a round-bottomed slot, y', to receive and have a running fit on a reduced end of one of the screws W^6, which screws serve as the axle of said weights. When the weights are in position in the forks $y\ y$, the distance from center to center of said weights is preferably the same as the distance between the centers about which the arcs $n\ n'$ are described. The bar Y has on its upper side midway between its ends an upward projection, y^2.

To a bracket, A^2, secured to the stand A, is pivoted a bell-crank lever, P, the upper horizontal arm of which is provided at its outer end with a fork, p, which embraces the outer end of the guide-pin G'. The lower nearly vertical arm, p', of said lever P is jointed at its lower end to a connecting-rod, Q, the other end of said connecting-rod being jointed at q to a slotted plate, Q', which is secured to the projection y^2 on the bar Y by a set-screw, r, which passes through a slot, r', into said projection y^2.

It will appear from the foregoing description that as the balls F F are thrown outward by centrifugal force the sleeve G and guide-pin G' will be raised, and the bar Y, through the connecting-rod Q and lever P, will be crowded to the left in Fig. 1, having a tendency to rock the cut-off shaft K in the same direction it would be rocked by the governor alone, so that the device above described has the same effect as the one shown in said patent—namely, to augment the action of the governor in cutting off the steam at an earlier part of the stroke and immediately reducing the speed of the engine; also, that as the balls F F fall the motion of the bar Y and weights W will be reversed, and will tend to augment the action of the governor in increasing the amount of steam admitted to the cylinder, and therefore increasing the speed of the engine. It will be seen, also, that the weights have a positive motion in one direction or the other as the balls F F rise or fall with a variation of resistance, and will be moved in spite of any slight obstruction, as of grease or lint on the track $n\ n'$. Any cylindrical flanged weight provided with an axle the ends of which project beyond its end may be used with the bar Y and lever P.

In Fig. 7 the double arm N^2 has a single correction-arc, as shown in said patent, and a single weight is used, said weight being like the one hereinbefore described. Instead of the bar Y a single fork, Y', is used, straddling the weight, and slotted to receive the ends of the axle or screw W^6, just as the forks $y\ y$ do. To the fork Y is connected a rod, Q^2, by means of a screw, r^2, which passes through a slot, r^3, in the end of said connecting-rod—that is to say, the plate R is omitted in Fig. 7, and the fork Y' is allowed to rock on the axle of the weight to accommodate itself to the position of the connecting-rod Q^2 and the lever P. The slot r^3 allows the weight to be adjusted to occupy the middle of the arm N^2 with an average resistance.

Instead of mercury any heavy liquid may be used in the mercury-chamber.

The use of two weights, each on a separate arc, is preferable to the use of two weights on the same arc, as shown in said patent, because two weights on a single arc are likely sometimes to stick together, and sometimes to separate and then come together with a jar, making their action less certain.

I claim as my invention—

1. The combination of a speed-governor, a shaft, means, substantially as described, of rocking said shaft by the variation of the speed of said governor, an arm secured to said shaft and provided on its upper surface with an arc, a weight adapted to roll on said arc, and having an axle with projecting ends, and a lever, one end of which is connected to said governor, and the other end of which is connected to the axles of said weight, as and for the purpose specified.

2. The combination of a speed-governor, a shaft, means, substantially as described, of rocking said shaft by the variation of the speed

of said governor, a double arm secured to said shaft, and having its upper surface curved from the middle outward to form two arcs, and two weights adapted to roll upon said arcs, as and for the purpose specified.

3. The combination of a speed-governor, a shaft, means, substantially as described, of rocking the same by the variation of the speed of said governor, a double arm having on its upper surface two arcs, two weights provided with flanges, and with projecting central axles, and a bar provided with forks adapted to straddle said weights, the lower ends of the tines of said forks being slotted to receive the ends of the shafts of said weights, whereby the motion of said governor will move said weights in a direction to augment the action of said governor, as and for the purpose specified.

4. The combination of a speed-governor, a shaft, means, substantially as described, of rocking the same by the variation of the speed of said governor, a double arm having on its upper surface two arcs, two weights provided with flanges, and with projecting central axles, a bar provided with forks adapted to straddle said weights, the lower ends of the tines of said forks being slotted to receive the ends of the axles of said weights, and a connecting-rod jointed to said bar and to a bell-crank lever, said bell-crank lever provided with a fork adapted to engage the guide-pin of said governor, whereby the motion of said governor will move said weights in a direction to augment the action of said governor, as and for the purpose specified.

5. The supplementary weight or chamber consisting of a hollow cylinder having closed ends, and radial partitions, said partitions having small openings near the outer shell of said cylinder, in order that a liquid partly filling said cylinder may pass slowly from one compartment to another thereof as the same is rotated about its axis, as and for the purpose specified.

6. The chamber consisting of a hollow cylinder having closed ends, radial partitions, and a screw-threaded central opening, said cylinder being formed in halves, and said halves being united by a screw passed through said central opening, the partitions of one-half of said cylinder having small openings at their inner ends, near the outer shell of said cylinder, and regulating-screws turning in threaded holes in the partitions of the other of said halves and projecting into said last-named openings, in order that a liquid partly filling said cylinder may pass from one compartment to another thereof through said last-named opening as said cylinder is rotated about its axis, and that the rapidity with which such liquid flows from compartment to compartment of said cylinder may be varied by turning said screws, as and for the purpose specified.

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