(No Model.)

3 Sheets—Sheet 1.

# A. CAMPBELL.

## SPEED REGULATOR.

No. 361,128. Patented Apr. 12, 1887.

Fig. 2.

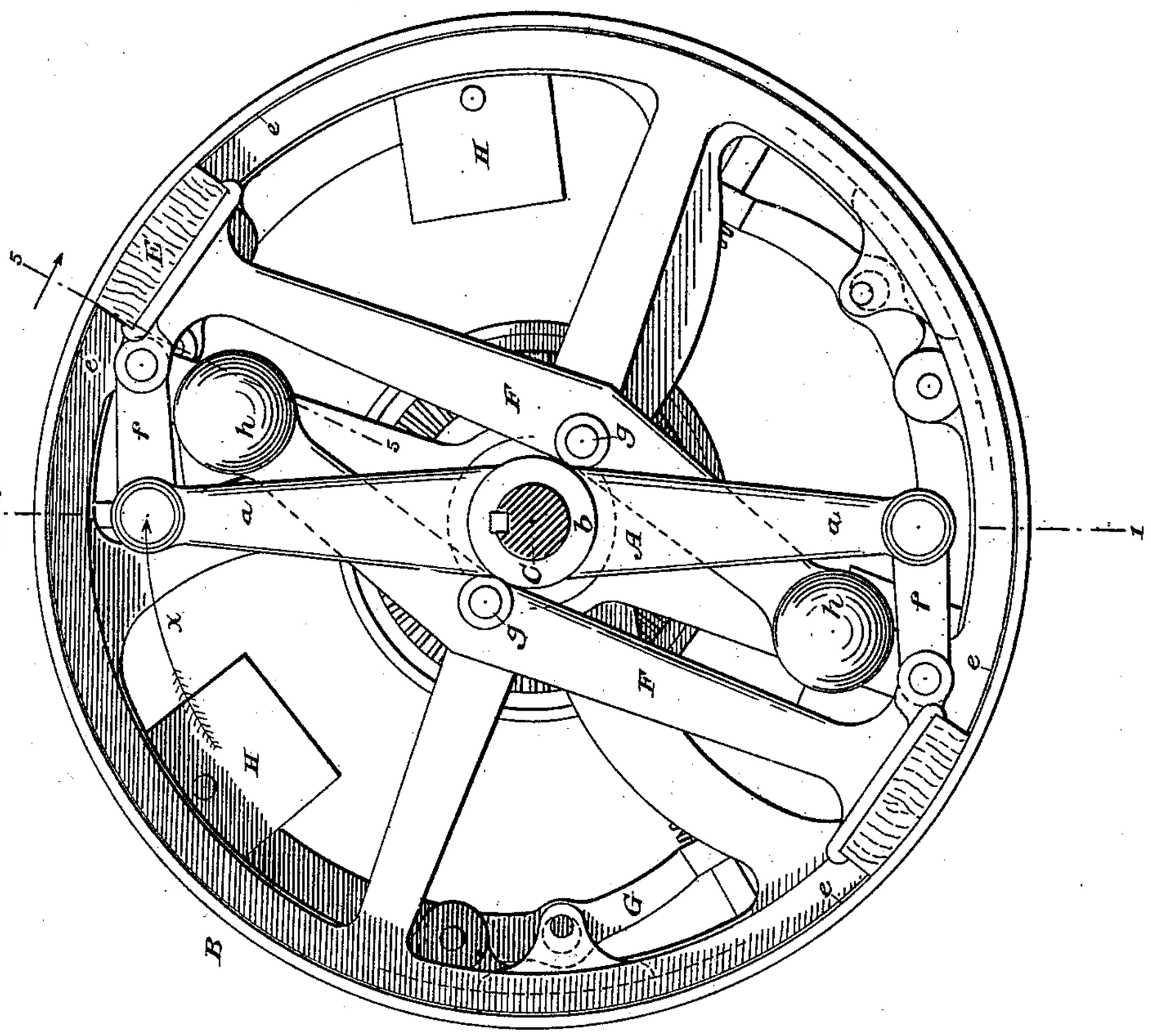
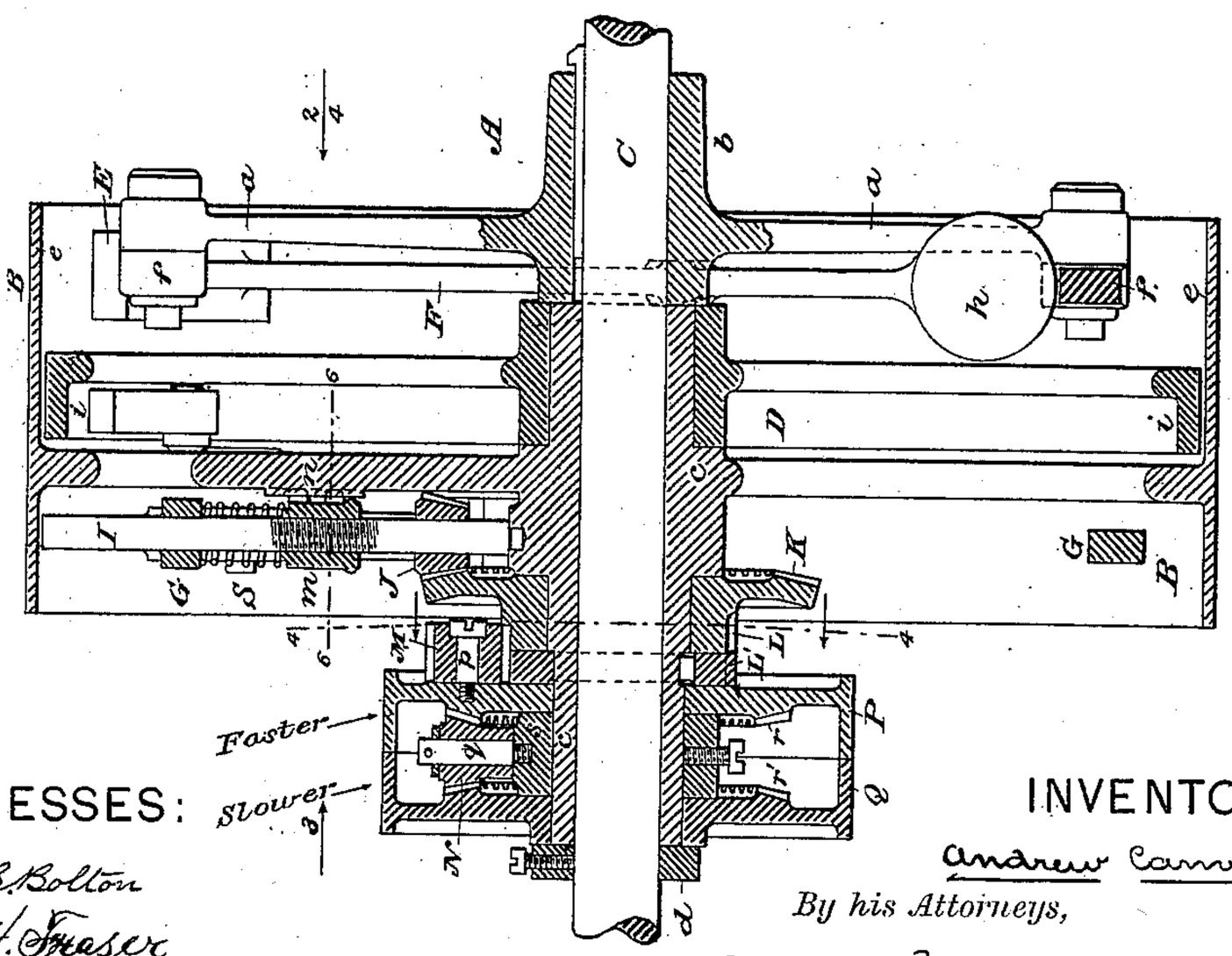



Fig. 1.



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# A. CAMPBELL.

## SPEED REGULATOR.

No. 361,128. Patented Apr. 12, 1887.

Fig. 3.

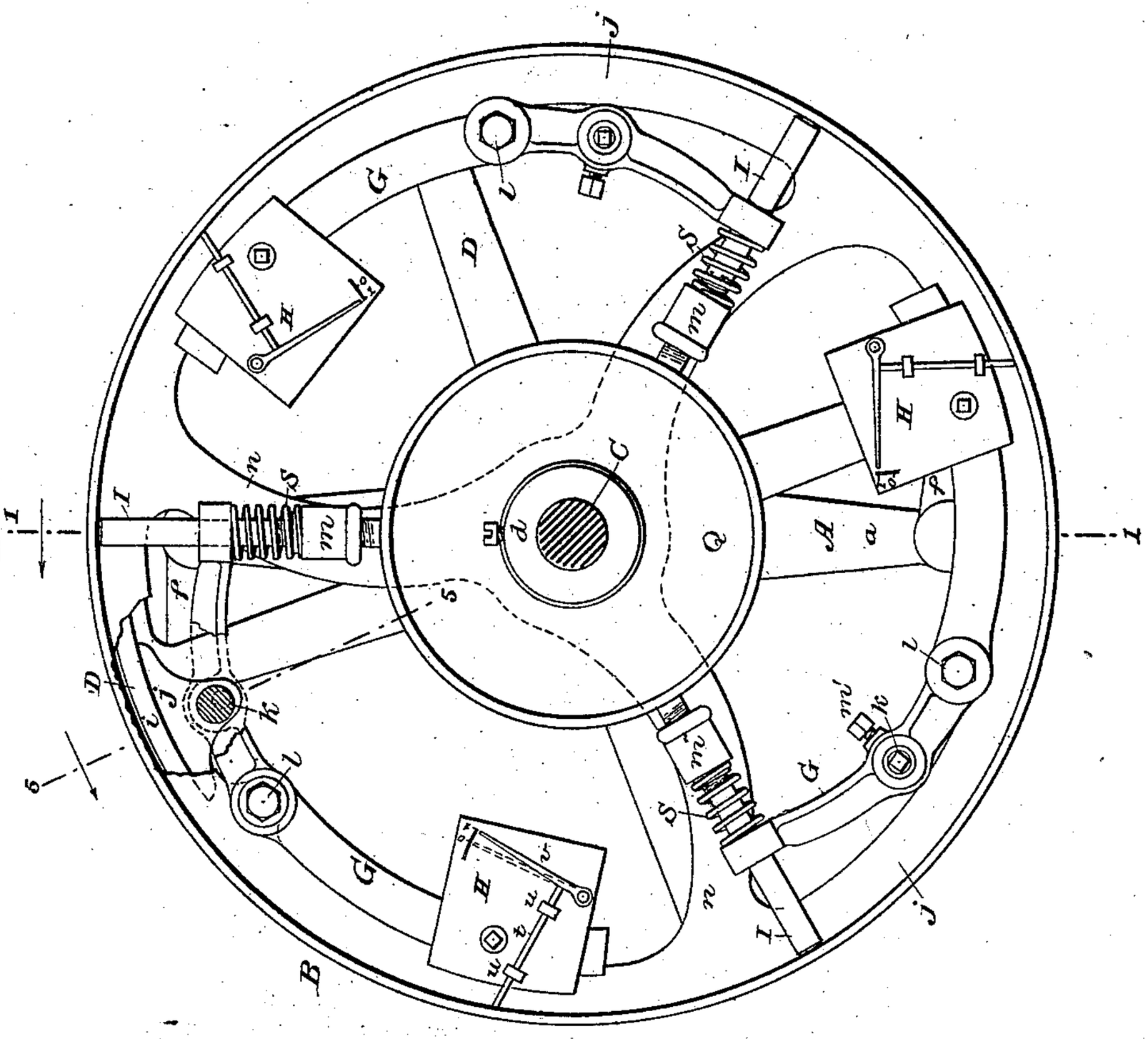



Fig. 4.

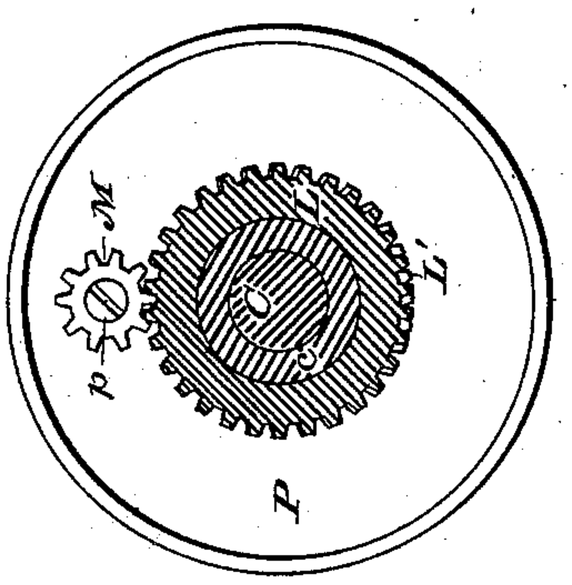



Fig. 5.

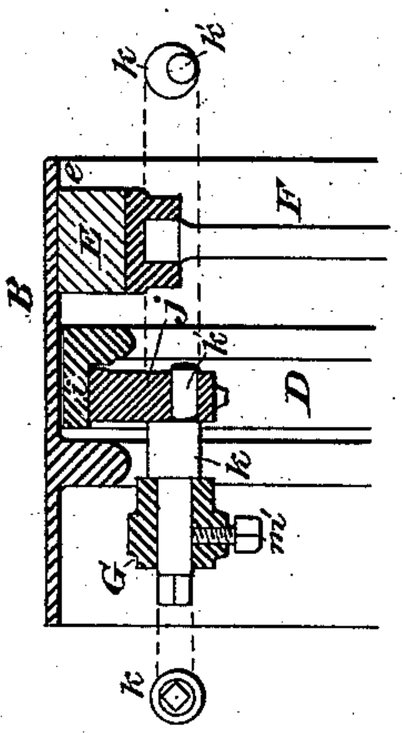
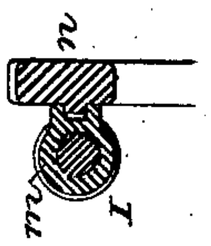



Fig. 6.

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Burke Fraser & Bennett

(No Model.) 3 Sheets—Sheet 3.

# A. CAMPBELL.

## SPEED REGULATOR.

No. 361,128. Patented Apr. 12, 1887.

Fig. 6.

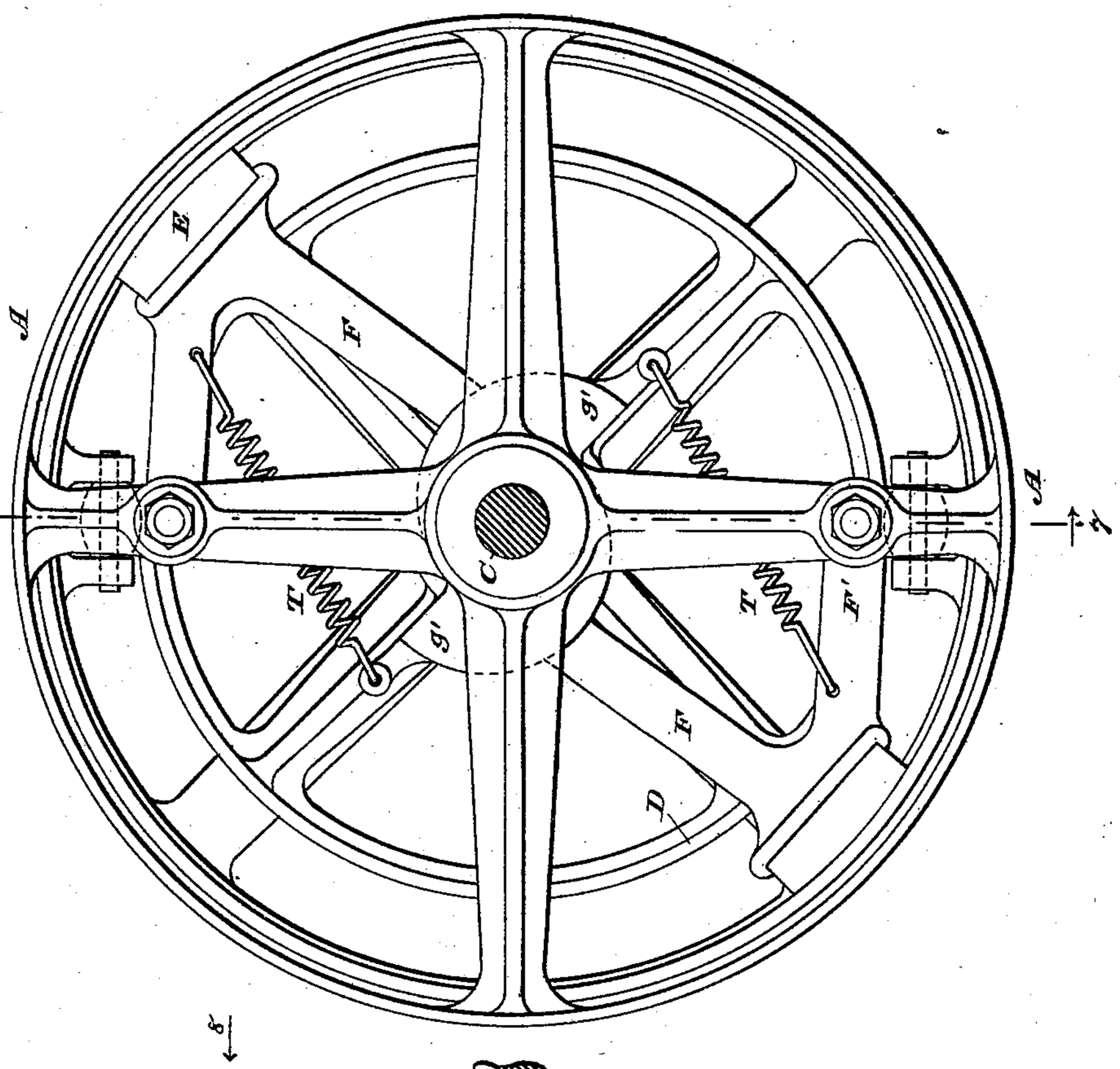
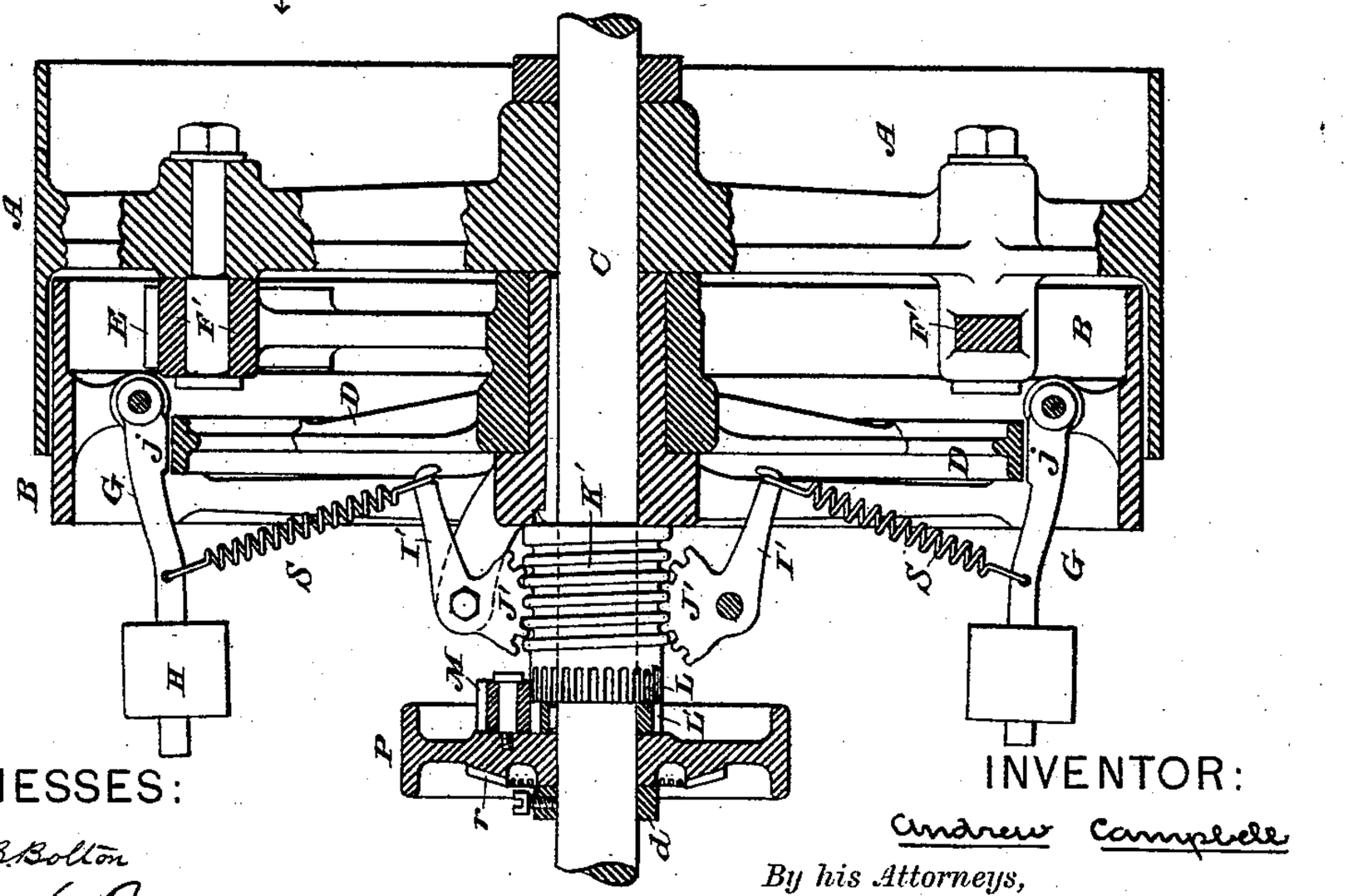



Fig. 7.

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# UNITED STATES PATENT OFFICE.

ANDREW CAMPBELL, OF BROOKLYN, ASSIGNOR TO JOHN McLOUGHLIN AND EDMUND McLOUGHLIN, OF NEW YORK, N. Y.

## SPEED-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 361,128, dated April 12, 1887.

Application filed October 4, 1884 Renewed December 1, 1886. Serial No. 220,369. (No model.)

*To all whom it may concern:*

Be it known that I, ANDREW CAMPBELL, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Speed-Regulators, of which the following is a specification.

This invention relates to speed regulators or governors of that class wherein a driver bearing a frictional surface drives a driven part by frictional contact, which contact, when the speed becomes too great, is automatically relieved or diminished by the action of a centrifugal governor borne by the driven part. This governor consists of a weight retracted by a spring, which, as it flies outward by centrifugal force, acts to separate the frictional surfaces or to relieve the pressure upon them, whereby some slip is permitted and the driven part is rotated at a slower speed than that of the driver.

Speed-regulators of this character are described and claimed in two previous applications for patents filed by me, respectively, on January 14, 1884, Serial No. 117,484, and March 22, 1884, Serial No. 125,224. The first of these, while comprehending, broadly, the entire essential principle on which speed-governors of this class must be constructed, was designed and adapted most particularly for driving one part at a comparatively low speed from a driver rotating at a high speed, there being a constant slip between the frictional surfaces proportioned, primarily, to the desired reduction of speed and determined automatically by the centrifugal governor. The latter application covers a different construction of speed-regulator, working on the same principle, but better adapted for transmitting heavy pressure and designed for driving the driven part at very nearly the same speed as the driver, a small difference only being provided for sufficient to cover the fluctuations in speed to which the driver may be subject. Both these mechanisms are well adapted for their purpose; but I have found that they are not sufficiently sensitive in their action to render them fully applicable to certain kinds of machinery where an extremely steady speed is desirable, and they are also subject to the objection that when heavy power is transmitted through them their frictional surfaces wear away too rapidly, requiring too frequent inspection and renewal. To overcome these objections and provide a speed-governor that shall be extremely sensitive to slight variations in speed, and yet at the same time capable of transmitting very excessive pressures without undue wear of the frictional surfaces, is the aim of my present invention.

My improved speed-regulator is shown in Figures 1 to 6 of the accompanying drawings in its preferred form. Fig. 1 is a diametrical section cut in a plane parallel with the axis of the shaft, as denoted by dotted lines 1 1 in Figs. 2 and 3. Fig. 2 is an elevation looking in the direction of arrow 2 in Fig. 1. Fig. 3 is an elevation of the opposite side, looking in the direction of arrow 3 in Fig. 1. Fig. 4 is a transverse section cut on the line 4 4 in Fig. 1, and looking in the same direction as Fig. 2; and Figs. 5 and 6 are fragmentary sections cut, respectively, on the lines 5 5, Fig. 3, and 6 6 in Fig. 1. Figs. 7 and 8 show a modification of the apparatus.

I will first describe the construction shown in Figs. 1 to 6.

Referring first to Figs. 1, 2, and 3, let A designate, generally, the driving and B the driven part. In the particular construction shown the driver A consists of two radial arms, *a a*, formed on a hub, *b*, which is keyed to a rotary shaft, C. The driven part B is shown as a pulley, which is mounted freely on the shaft C, its hub *c* being confined longitudinally between the hub *b* and a set-collar, *d*. A secondary or supplementary wheel, D, is arranged within the pulley B, being mounted loosely on the hub *c* thereof. This wheel is normally clamped frictionally to the pulley B, so as to revolve with it, being released from it by means of a centrifugal governor whenever the rotation becomes too rapid.

The arms *a a* of the driver A are connected at their ends by means of links *f f* to brake-shoes E E, Fig. 2, which engage the inner surface, *e*, of the rim of the pulley B. The brake-shoes E E are mounted on the ends of two levers or bars, F F, which are pivoted at *g g* to the hub of wheel D and bear on their other

ends counterbalance-weights *h h*, whereby they are equally balanced on opposite sides of their pivots *g g*.

The operation may now be understood. Assuming a load or resistance to be upon the pulley B acting to resist its rotation, and that the wheel D is frictionally clamped to it, so that it also, but to a less degree, resists rotation, if then power be applied to the shaft C and the driver A be thereby rotated in the direction of the arrow *x* in Fig. 2 the arms *a a* will press through the links *f f* against the brake-shoes E E, and, in consequence of the angle at which the pressure is communicated through the links, move the brake-shoes both forward and outward, so that they will press against the frictional surface *e* on the pulley B, and consequently react through the bars F F on the pivots *g g* of the latter. The pressure on these pivots will tend to rotate the wheel D, and if this wheel were free it would rotate, the pressure on the brake-shoes E E would be instantly relieved, and the driver would simply rotate, carrying the wheel D before it and pushing the brake-shoes around within the flange of the pulley B without rotating the latter; but as the wheel D is clamped to the pulley B the pressure upon the pivots *g g*, being at a great disadvantage of leverage, is insufficient to turn it, and its resistance at these pivots is transmitted through the bars F F to the brake-shoes, pressing the latter out against the surface *e*, and, by the continued forward pressure through the links *f f*, wedging the shoes continually more firmly against the surface *e* until the pressure thereagainst is sufficient to overcome the load imposed upon the pulley B and to start it and cause it to revolve with the driver. This clutching action is instantaneous and remarkably powerful. As soon as the pulley B attains the speed at which it is destined to run, the centrifugal governor, already referred to, commences to act to release the clamp or brake by which the wheel D is held to the pulley B, thereby decreasing the resistance of the wheel D to the pressure of the bars F F on it at the pivots *g g*, and consequently reducing the outward thrust of the bars against the brake-shoes and the pressure of the latter against the surface *e*, and hence permitting the brake-shoes to slide more or less over this surface, thereby driving the pulley B at a slower speed than that at which the brake-shoes are moving. In case the pulley B should revolve too fast, the brake or clamp which holds the wheel D to it would be wholly released, leaving the wheel D free, so that it would oppose no further resistance at *g g* and the brake-shoes E E would revolve freely within the rim of the pulley until the latter slowed down to the normal speed again.

I will now describe the brake or clamp for binding the wheel D to the pulley B and the governor for releasing it when the speed increases. The wheel D has a rim, *i*, which affords a frictional surface, against which work three brake-shoes, *j j j*, which are mounted on three governor-levers, G G G. These levers are fulcrumed on tap screws or pins *l l*, fixed in ears or lugs projecting inward from the rim of pulley B, and each lever bears on one arm a weight, H, and on the other the brake-shoe *j*, and the extremity of the latter arm is pressed outward against by a spring, S. The three springs S S are coiled around three screw-threaded rods, I I, each of which is stepped at one end in the hub *c* of the pulley B, and its other end, after passing through a hole in the end of lever G, whereby it is guided, abuts against the inner surface of the rim of the pulley, so that it cannot move endwise. On each rod I is screwed a nut, *m*, against which the spring S abuts, and by screwing which up or down the tension of the spring may be adjusted. When the pulley B is at rest or running slowly, the springs S S press out on the levers G G and force the brake-shoes *j j* against the rim *i* of the wheel D; but when the speed exceeds that for which the governor is adjusted, the weights H H fly outward, tilt the levers G G against the pressure of the springs, and draw back the shoes *j j* until they no longer bear against the rim *i*. The wheel D thus is freed by the centrifugal action of the governor. Instead of three levers G G, with their weights and springs, two, four, one, or other number may be used.

It is obvious that the greater the tension of the springs S S the stronger will they resist the flying out of the weights H H, and the higher the speed that is necessary to cause the governor to act to throw off the brake. Hence, by changing the tension of the springs, the speed at which the pulley B will be driven may be varied. I have provided a simple means for effecting this change of tension, and so speeding the pulley up or down, either while it is running or standing still. This mechanism I will now describe.

The nut *m* is non-rotative, being formed with lugs on its back which engage a rib on the spoke *n* of the pulley B, as best shown in Figs. 1 and 6. The nuts are fed up and down by rotating the rods I I, for which purpose each rod I has a bevel-pinion, J, fixed to it, and all three pinions J J mesh with a bevel-wheel, K, which has its bearing on the hub *c* of the pulley. The hub of this wheel K terminates in a gear, L, (shown in section in Fig. 4,) having, for instance, twenty-eight teeth, and next to this gear a gear, L′, is arranged, having, for instance, twenty-nine teeth, or one tooth more (or less) than the wheel L, and both mesh with a broad-faced pinion, M, thereby constituting a differential gear. The gear L′ is in the form of a ring, and is keyed or otherwise fixed on the hub *c* of the pulley B. If the pinion M be held stationary while the pulley B and gear L′ revolve, the gear L will be driven either forward or backward the distance of one tooth at each revolution, thus rotating the gear K and pinions J J proportionately and either tightening or slackening the springs S S.

The pinion M is mounted freely on a stud, *p*, fixed to a wheel, P, which is mounted loosely on the hub *c*. The rim of this wheel is formed like that of a belt-pulley, and by its side is another like wheel, Q. The rims of the wheels P and Q come close together and inclose the space between them. On their adjacent surfaces, facing each other within their rims, they are formed with bevel gear-teeth *r* and *r'*, and between these is a bevel-pinion, N, meshing with both. This pinion turns freely on a pin, *q*, fixed to a collar, *s*, which is fastened to the hub *c*, so that the pinion N must be carried around with the pulley B. The collar *d* holds both the hub *c* and the hub of the wheel Q in place.

In ordinary running the wheels K, P, and Q are all carried around with the hub *c*, so that the pinions J J and screw-rods I I are not rotated on their axes. When, however, it is desired to cause the pulley B to rotate either faster or slower, the attendant applies a brake or resistance to either one or the other of the wheels P Q. This he does by throwing a leather strap around the wheel so as to bear upon its rim, or by pressing a brake-shoe against it, or by holding it with his hands, or in any other convenient manner. If it is desired that the pulley B shall run faster, the wheel P will be thus retarded. In this case the pinion M will stand still, or at least its axis will revolve slower than the hub *c* and gear L', and consequently the gears L and K will be revolved slowly forward, thus rotating the pinions J J and screws I I, and causing the nuts *m m* to compress the springs S S to greater tension. If, however, it is desired that the pulley B shall run slower, the attendant will apply a brake to the wheel Q, thus holding it stationary or retarding it, and the continued flying around of the planet-pinion N will cause the wheel P to revolve at greater speed than the hub *c* and gear L', so that the pinion M in traveling around the latter acts to turn the gears L and K backward, and so rotate the pinions J J and screws I I, and screws down the nuts *m m*, thereby slackening the springs S S. In either case the attendant will continue to apply the brakes to the wheel P or Q until the speed of the pulley B shall have been increased or diminished to the desired extent, whereupon, on his releasing the brake, the pulley will continue to revolve at that speed. The pinion M, by engaging the teeth of the two gears L I', of equal pitch, acts as a lock to prevent the rotation of either relatively to the other until the pinion is itself carried around them by the increased or decreased speed of the wheel P.

I will now describe how at starting I adjust the springs S S of the three governor-levers, in order that all the three brake-shoes *j j j* shall bear with the same pressure upon the rim *i*. This adjustment is important, as otherwise only one brake would do all the work until the wear of its shoe should bring the others to the same tension. The device for this purpose which I have provided, and which forms part of the governor, consists of a slender pin, *t*, arranged to move freely in two perforated lugs, *u u*, on the weight H, with its outer end resting against the rim of the pulley B and its inner end coming against a light hand or index, *v*. This hand is fastened frictionally at its fulcrum *w*, so that it may be turned to any position, and will remain there. The hand points to a scale on which are two marks, "0" and "1." The adjustment in question is made before the wheels K, P, Q, and N are put in place in the apparatus. The screw-rods I I are turned until the springs S S are all brought apparently to the same tension. Then all the hands *v v* are set to point to the marks 0 0 on the scales, and the apparatus is rotated at the desired speed. The weights H H in flying outward push the pins *t t* against the pulley-rim, and the pins press the hands *v v* toward the center. When the apparatus is stopped, the hands *v v* will be found pushed to varying distances from the marks 0 0, according to the varying tensions of the three springs. The tensions will then be readjusted and the same trial repeated. If all the hands *v v* point exactly to the marks 1 1 on the scales, the adjustments are correct. If they do not, the tension will be again adjusted until this result is attained. The pins *t t* and hands *v v* may then be removed, if desired. The parts are so proportioned that the amount of movement of the levers G G necessary to free the brake-shoes *j j* is just sufficient to move the hands *v v* from 0 to 1. After this relative adjustment of the springs S S is perfected, the wheels K, M, P, Q, and N are placed in position, and the apparatus is ready for operation. The speeding up or down by means of the pulleys P Q does not affect the relative adjustment of the springs S S.

The wear of the brake shoes *j j* may be taken up from time to time by partially rotating the pins *k k*. These pins are formed with an eccentric portion, *k'*, Fig. 5, on which the brake-shoes are mounted. When the shoes are new, the pins *k* are set with this eccentric on the side farthest from the rim *i*, and at each adjustment the pins are turned until the eccentric finally stands on the side nearest the rim. The pins *k k* are turned by placing a wrench on their squared ends, and are held by set-screws *m' m'*.

The construction of the bars F F with counterbalance-weights *h h* is an important feature of my machine, as the weights act to neutralize the centrifugal force which tends to throw the shoes E E and the adjacent links and bars outward against the pulley-rim. If the bars F F were not counterbalanced this centrifugal action would cause the shoes to be always pressed against the rim, and would prevent the release of the driven part when the speed becomes too great.

It will be observed that the peculiar and distinctive feature of my present invention, as compared with the constructions shown in my

said previous applications, is that there are two driven parts, one through which the power is transmitted to the work and another which does no work, but which is acted upon by the governor to determine the transmission of power to the first. The pulley or other driven part B is driven by one brake and carries a governor, which acts not on that brake, but on another brake which bears upon an entirely distinct part—the supplementary wheel D. This wheel D has no resistance to overcome, except that of keeping up to its work the brake through which power is transmitted from the driver to the driven part, and this it does at so great a mechanical advantage that the resistance from that source is very slight, and consequently the brake controlled by the governor which binds it to the driven part requires but little power, and may be operated by a governor having very light weights and feeble springs, when compared with what would be required if all the power were required to be transmitted through this brake. I thus secure extreme sensitiveness, because of the comparative lightness of the governor and the slight work its brake is called upon to perform, while the heavy brake through which the power is transmitted acts at great mechanical advantage in securing adhesion upon the frictional surfaces, and yet releases itself instantaneously when the resistance afforded by the wheel D ceases.

The brake-shoes *j j* of the governor-brake are almost free from wear, since their work is so slight, and the wear of the brake-shoes E E of the power-brake is taken up automatically by the movement of the bars F F and links *f f* until they are worn nearly through, when they are easily replaced by new shoes without in the least disturbing the adjustments of the governor.

In Figs. 7 and 8 I have shown a modification of the apparatus wherein a loose pulley is the driver and a wheel fixed to the shaft becomes the driven part. Fig. 7 is a diametrical section cut in the plane of the line 7 7 in Fig. 8, and Fig. 8 is an elevation looking in the direction of arrow 8 in Fig. 7. The pulley A is driven by a belt and imparts motion to the wheel B, keyed to the shaft C. The spokes of the pulley A have arms F′ F′ jointed to them, which arms bear the brake-shoes E E and extend back angularly, as bars F F, and their ends rest against a double snail, *g′*, formed on the hub of the secondary wheel D. When the wheel D is retarded, the bars F F ride up on these snails and press out the shoes E E against the rim of the wheel B, and when the wheel D is released it is turned by springs T T to draw back the snails and relieve the outward pressure on the bars F F. The springs T T also serve to draw in the arms F′ F′, bars F F, and shoes E E, and counteract the effect of centrifugal force, being thus the equivalents of the counter-weights *h h* in Fig. 2.

The governor-levers G G have no separate brake-shoes *j*, but bear directly on the periphery of wheel D, and are drawn inward by tensile springs S S, which are re enforced against levers I′ I′, which terminate in worm gears or segments J′ J′, which gears mesh with a worm or screw, K′, which is formed on the same hub as the gear L. The gear L′, pinion M, and wheel P are the same as in the previous construction, and the operation of speeding up or down is the same.

I claim as my invention—

1. In a speed-regulator wherein the power is transmitted from the driving to the driven part by contact of frictional surfaces controlled by a governor carried by the driven part, the means, substantially as set forth, for automatically pressing said surfaces together or relieving the pressures thereon, consisting of the combination, with the governor and a friction brake or clamp actuated thereby, of an intermediate part or wheel acted on by said brake or clamp and arranged to control the pressure of the power-brake against the driven part.

2. In a speed-regulator, the combination of the driving part, a power-brake carried thereby, the driven part having a frictional surface acted on by said brake, an intermediate or secondary wheel or part arranged to control the action of said power-brake, a governor borne by the driven part, and a brake or clamp engaging said secondary wheel or part, substantially as set forth.

3. The combination, to form a speed-regulator, of the driving part, a power-brake carried thereby, a secondary or intermediate wheel connected with and receiving the reaction of said brake, the driven part having a frictional surface acted on by said brake, a brake or clamp binding said secondary wheel to said driven part, and a centrifugal governor arranged in connection with said brake or clamp and carried by the driven part, substantially as set forth.

4. The combination, to form a speed-regulator, of a driving part, a driven part, a power-brake intervening between the two, a freely-mounted intermediate wheel or part receiving the reaction of said brake, a friction brake or clamp borne by the driven part engaging a frictional surface on said intermediate wheel, a spring arranged to press said friction-brake against said wheel, and a weight or centrifugal governor arranged to counteract said spring and release said friction-brake upon attaining a certain speed, substantially as set forth.

5. The combination of driving part A, driven part B, having frictional surface *e*, brake-shoe E, connected to said driving part, bar F, carrying said brake-shoe, freely-mounted wheel D, arranged to receive the reactive thrust of said bar and thus by its resistance to press the brake-shoe against the frictional surface, and a centrifugal governor and brake borne by the driven part and normally engaging said wheel D, substantially as set forth.

6. In a speed-regulator, the combination of driving part A, driven part B, secondary

wheel D, bars F F, pivoted or fulcrumed to said wheel D, brake-shoes E E, mounted each on one end of one bar F, counter-weights *h h*, borne on the opposite arms of said bars, and a centrifugal governor and brake borne by the driven part and normally engaging said wheel D, substantially as set forth.

7. In a speed-regulator, the combination, with the speed-controlling governor borne by the driven part, of means, substantially as set forth, for altering the tension of the retracting spring or springs thereof, the same consisting of two wheels carried by the driven part, geared oppositely to each other, and suitable gearing, substantially as set forth, interposed between one of said wheels and the part against which said spring reacts, whereby the frictional retardation of one of said wheels will turn said gearing in one direction and relax said spring or springs and the retardation of the other wheel will turn said gearing oppositely and increase the tension of said spring or springs.

8. In a speed-regulator, the combination, with the speed-controlling governor borne by the driven part, of means for altering the tension of the retracting spring or springs thereof, consisting of a rotative wheel carried by the driven part, a planet-pinion borne thereby, and a pair of differential gears, one fixed to the driven part, the other rotative thereon, and both meshing with said pinion, and the latter gear connected with the part against which said spring or springs react by suitable gearing, substantially as described.

9. In a speed-regulator employing two or more centrifugal governors retracted by springs, the means herein described for facilitating the equal adjustment of the tension of the springs of the respective governors, which consists of the combination, with each governor-arm, of a loose rod, *t*, and frictionally-mounted hand or index *v*, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ANDREW CAMPBELL.

Witnesses:

ARTHUR C. FRASER,

M. B. CAMPBELL.