(No Model.) 3 Sheets—Sheet 1.

A. L. IDE.

STEAM ENGINE GOVERNOR.

No. 308,498. Patented Nov. 25, 1884.

Fig. 1.

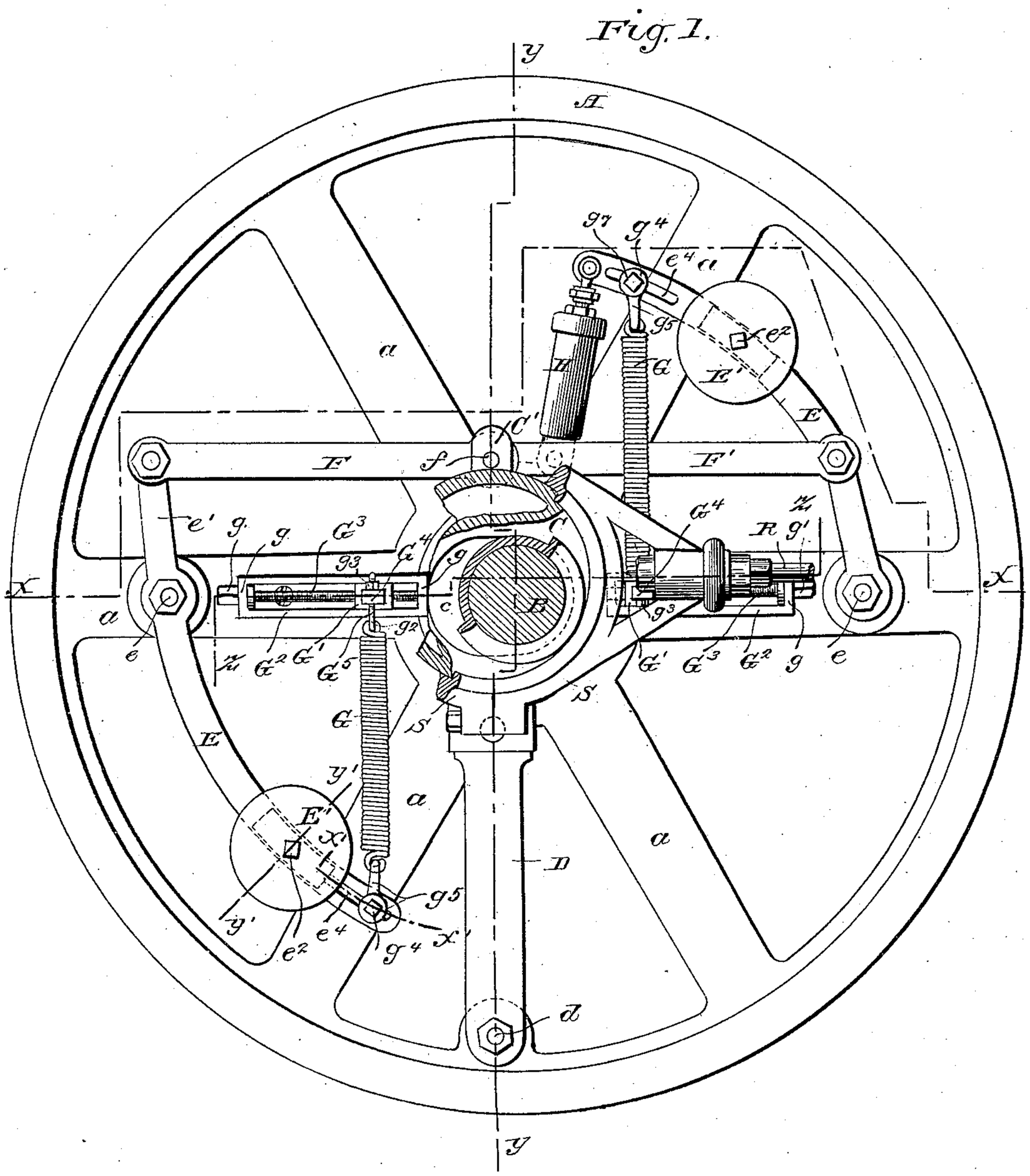
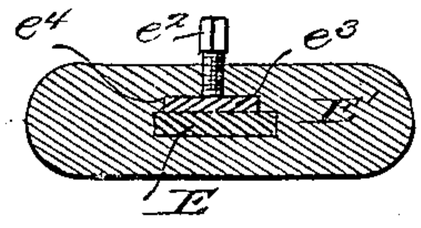


Fig. 7.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

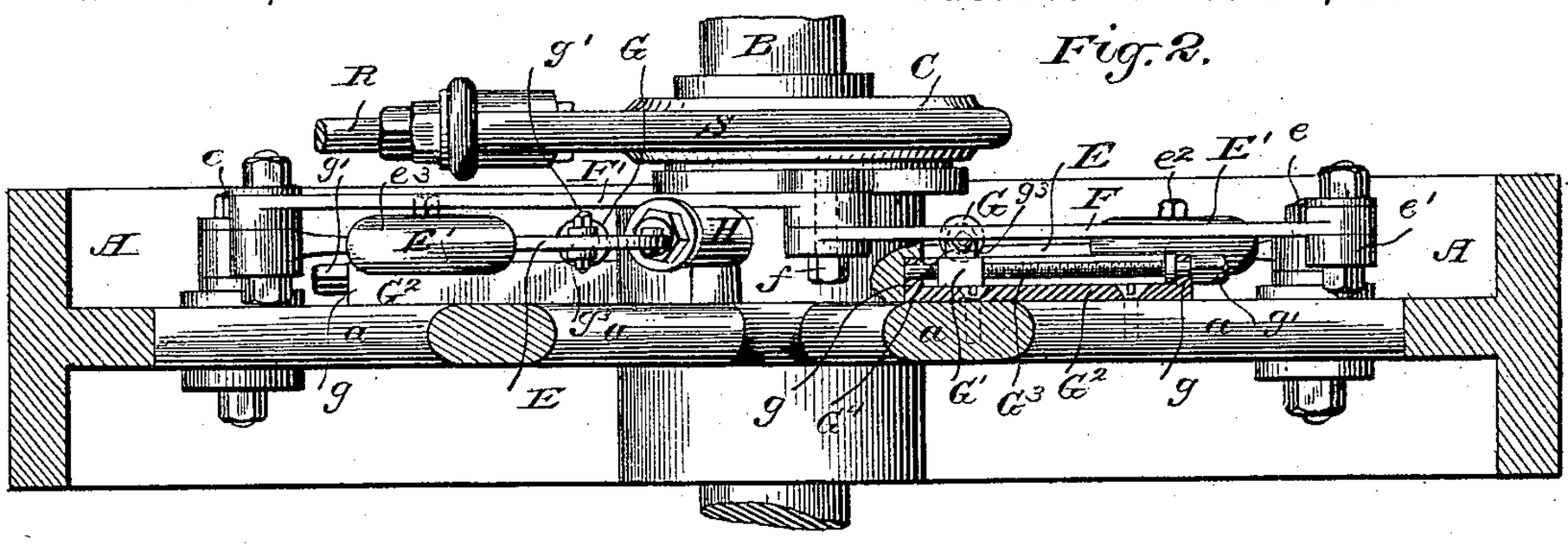


Fig. 3.

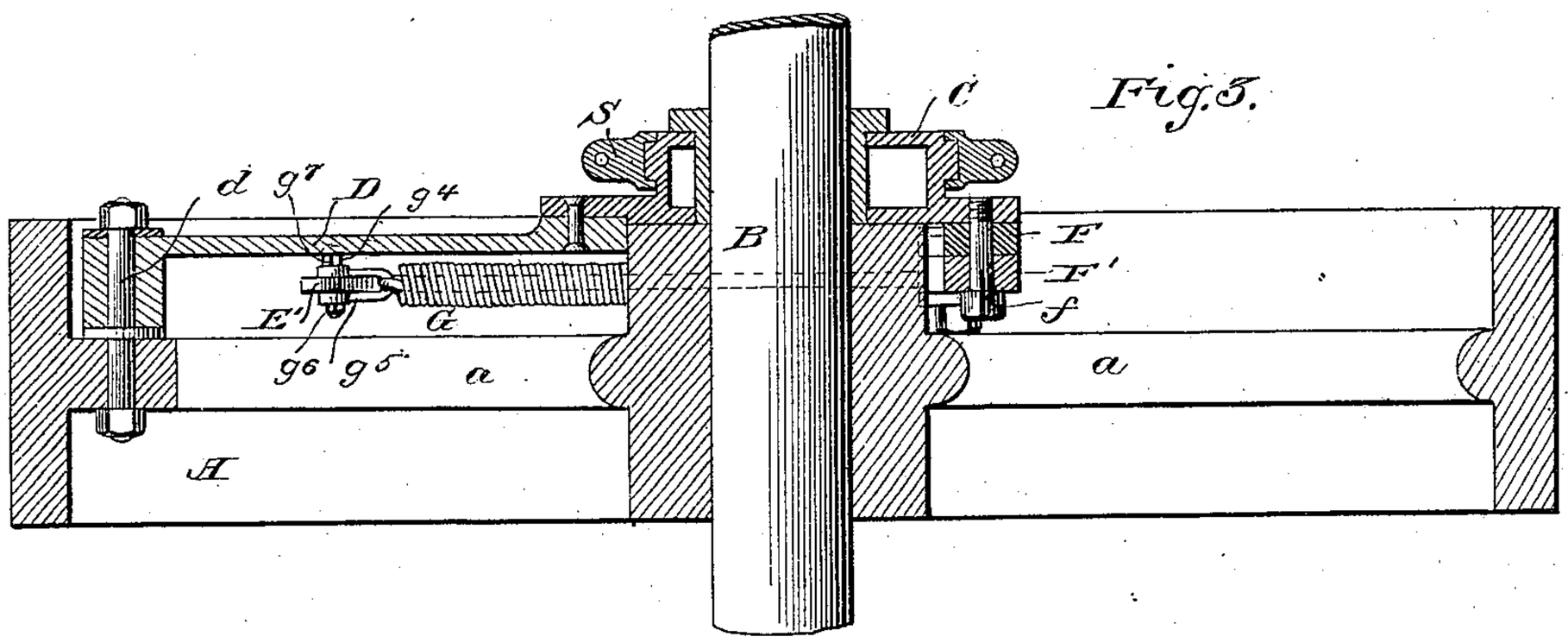


Fig. 4.

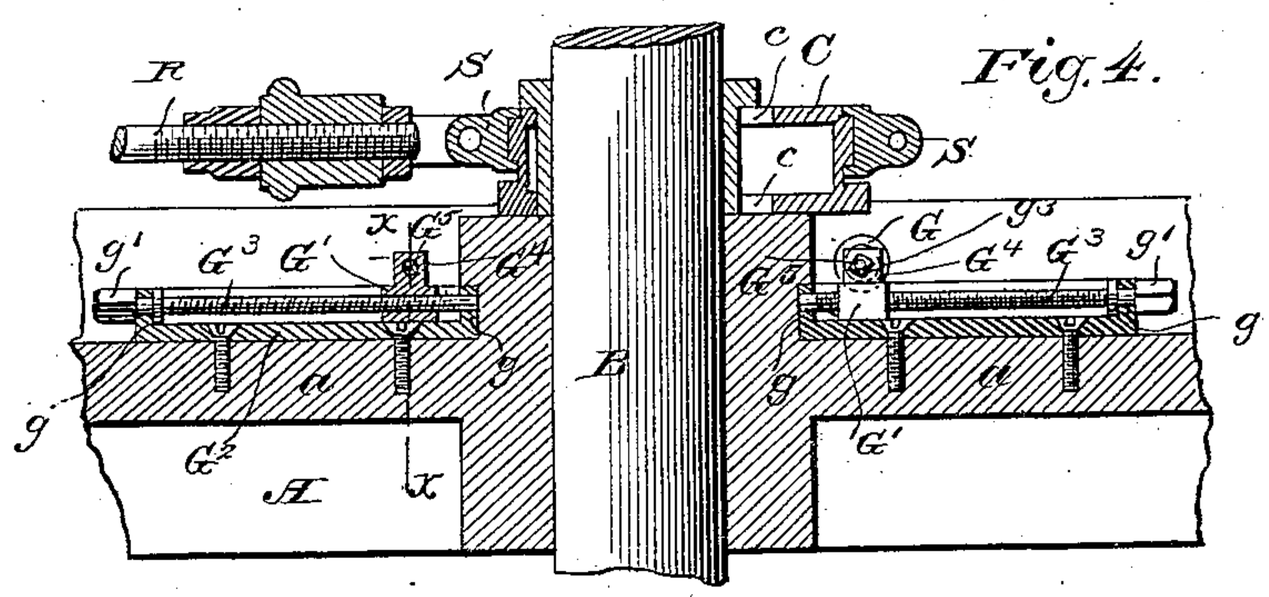


Fig. 5.

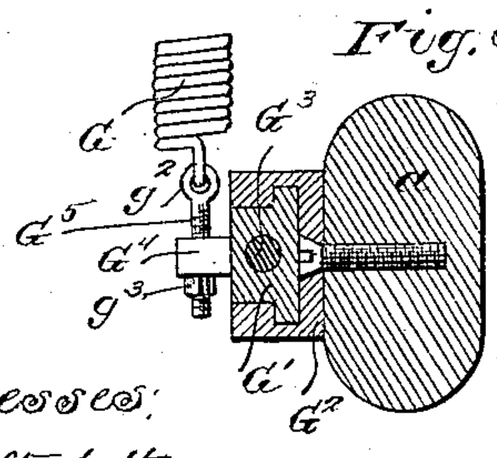
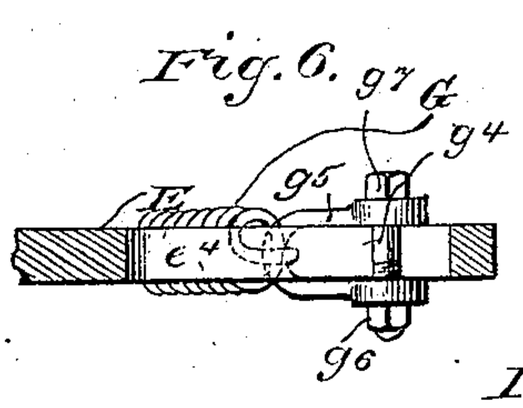


Fig. 6.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 8.

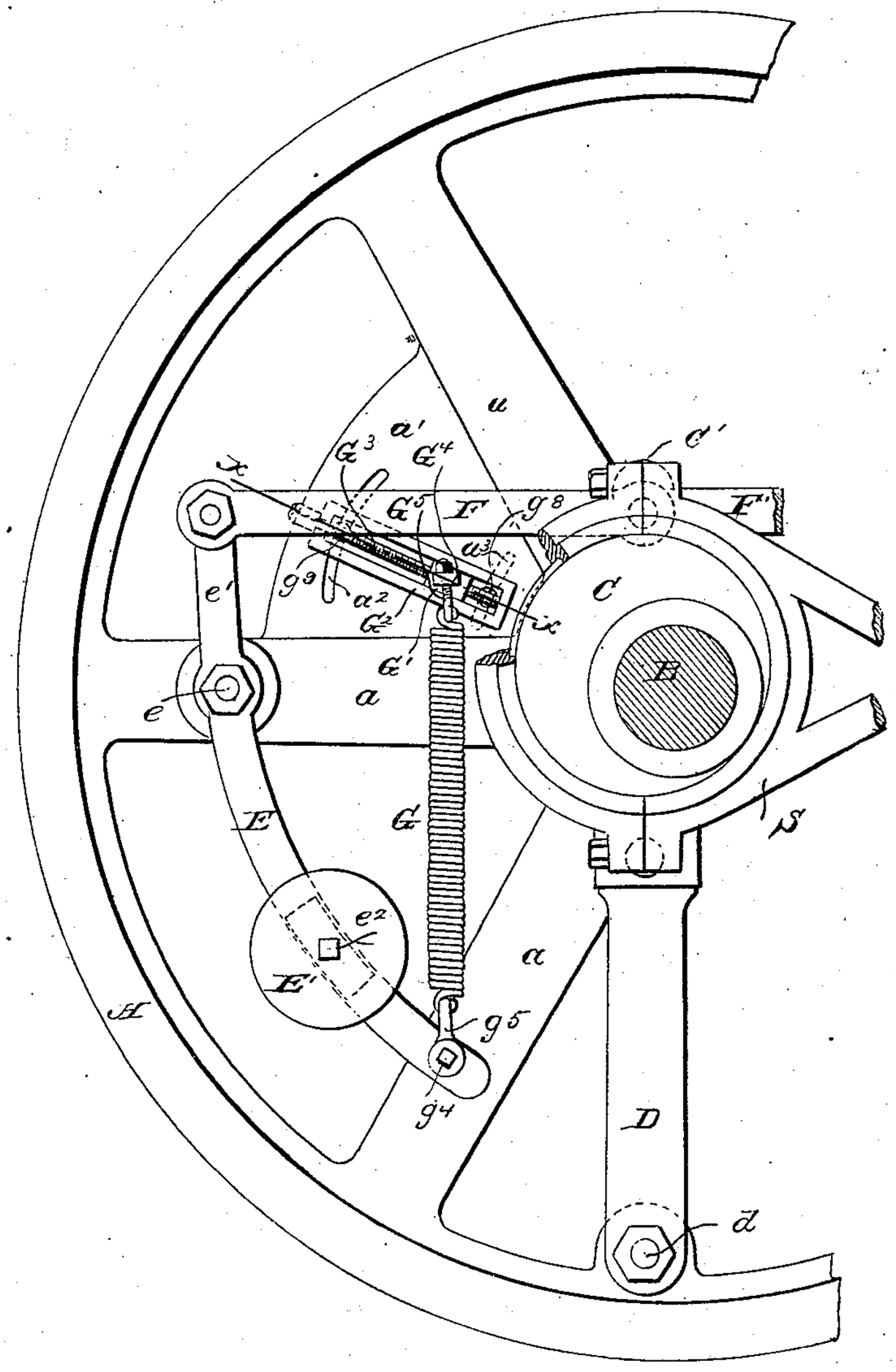
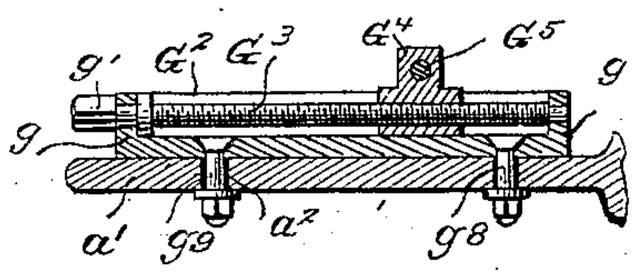


Fig. 9.



Witnesses:
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Inventor:
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UNITED STATES PATENT OFFICE.

ALBERT L. IDE, OF SPRINGFIELD, ILLINOIS.

STEAM-ENGINE GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 308,498, dated November 25, 1884.

Application filed April 25, 1884. (No model.)

To all whom it may concern:

Be it known that I, ALBERT L. IDE, of Springfield, in the county of Sangamon and State of Illinois, have invented certain new and useful Improvements in Steam-Engine Governors; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to that class of steam-engine governors known as "fly-wheel" governors, or those which comprise a laterally-movable eccentric upon the crank-shaft of the engine and centrifugally-acting weights operating in connection with centripetally-acting springs, to vary the position of the said eccentric, so as to regulate the movements of the valve, and thereby produce a uniform speed in the engine.

The object of the invention is to provide an improved construction in such governors, whereby the force or tension exerted by the springs may be readily and accurately adjusted with reference to the opposing force exerted by the centrifugal action of the weights; and it consists in the matters hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a side elevation of a fly-wheel governor constructed in accordance with my invention. Fig. 2 is a section of the pulley on the indirect line *x x* of Fig. 1. Fig. 3 is a section of the pulley and other parts on the indirect line *y y* of Fig. 1. Fig. 4 is a fragmentary section of the pulley and other parts taken upon line *z z* of Fig. 1. Fig. 5 is a detail sectional view taken upon line *x x* of Fig. 4. Fig. 6 is a detail sectional view taken upon the line *x' x'* of Fig. 1. Fig. 7 is a detail sectional view taken upon line *y' y'* of Fig. 1. Fig. 8 is a detail view showing another form of device embodying my invention. Fig. 9 is a detail section taken upon line *x x* of Fig. 8.

As shown in the drawings, A is a pulley or balance-wheel having arms *a*, and secured by a central hub to the shaft B.

C is an eccentric having a slot or opening, *c*, through which the shaft B is inserted; and D is an arm attached to the eccentric and supporting it from the body of the pulley by a pivot-pin, *d*, shown in Figs. 1 and 3 as being secured to the pulley A at a point adjacent to the outer rim of the said pulley.

S is the eccentric-strap applied in any approved manner to the eccentric and joined with the valve-rod R.

E E are two levers fulcrumed by means of pivot-pins *e* to opposite points of the pulley A and constructed to swing in a vertical plane, and E' are weights which are adjustably secured to said levers. The weight-levers project in opposite directions from the pivot-pins, so that the weights E' thereon, when properly located, stand at diametrically-opposite points of the pulley and counterbalance each other. One of the levers E is extended beyond its fulcrum *e* by a short arm, *e'*, and to the extremity of the said arm *e'* and to the opposite lever, E, at a point an equal distance from the fulcrum thereof, are pivoted the outer ends of the two connecting-rods F F', whose inner ends are pivotally joined to the eccentric C, preferably by means of a pin, *f*, inserted through the said rods, and a lug, C', located on the eccentric at a point opposite the supporting-arm D, said rods F F' being arranged substantially in a line with each other and at right angles with said supporting-arm.

Near the free ends of the levers E, and at points equally distant from their fulcra, coiled springs G are connected therewith, and the opposite ends of the said springs are attached to the pulley near the end thereof.

H is a dash-pot which is provided with a suitable piston and piston-rod, the cylinder of the dash-pot and the piston thereof being connected, respectively, with the extremity of one of the arms E and with the wheel, so as to control or regulate the movement of said arms, in the manner fully set forth in an application for Letters Patent of the United States for which application was made by me on the 11th day of July, 1883.

It will be observed from the construction and location of the arms E and the connecting-rods F F', above described, that the lever E, which is provided with the arm *e'*, for the attachment of the connecting-rod F, operates,

when the weight E′ thereon is thrown outwardly by centrifugal force, to thrust the connecting-rod F inwardly, and to thereby carry the eccentric laterally upon the crank-shaft, while the other lever E operates, through the medium of the connecting-rod F′, connected therewith, to pull upon the eccentric in the same direction in which the rod F tends to move it. The points of connection between the connecting-rods F F′ and the arms E being in both cases the same distance from the pivotal points of said arms, it is obvious that the weights E′, when placed at equal distances from the pivotal points of both arms, will operate with the same force to move the eccentric.

The several parts of the governor hereinbefore described are constructed and operate substantially in the manner set forth in the application for Letters Patent of the United States before referred to as made by me on the 11th day of July, 1883, and now pending. Such parts do not, however, with the exception of the dash-pot hereinbefore referred to, form the subject-matter of claims in said application, the parts of the governor considered to be new being claimed herein.

In governors constructed in the manner above described the position of the eccentric is determined by the opposing and self-balancing forces exerted by the centripetally-acting springs and the centrifugally-acting weights connected with said springs, the intention being to hold the eccentric permanently in a certain position for a given speed of the wheel, and to vary the position of the eccentric exactly as the speed of the wheel is varied. A change in the speed of the engine will obviously be accomplished either by shifting the weights upon the levers, so as to bring them nearer to or farther from the fulcra of the levers, or by changing the tension of the springs. The means herein shown for adjustably securing the weights upon the levers preferably consist of tap-screws e^2, inserted through the sides of the weights E′, and constructed to abut against blocks e^3, which rest against the levers and are placed in recesses e^4 in the weights, the purpose of the said blocks being to prevent the end of the set-screw from marring the surface of the levers.

In adjusting the governor for a certain speed the weights are moved to such points upon the levers that when the desired speed is exceeded the centrifugal action of the weights will overcome the force of the springs and the levers will move outwardly and produce the desired movement in the eccentric.

In order to obtain a sensitive action and accurate regulation with the class of governors described the weights and springs must be so adjusted that a slight variation in the speed of the wheel will cause an extreme movement of the weights, and in order to produce this sensitive action the weights must be relatively so adjusted that the resistance of the springs will increase just in proportion as the centrifugal force of the weights increases in their outward movement. Springs of equal size and proportion, on account of differences in temper and other causes, are not always of the same strength, and also act with different degrees of force when stretched to the same extent.

Means are usually provided for adjusting the length of the springs, so that they may be adjusted so as to operate with the desired effect in opposition to the weights when the latter are in their normal positions; but, inasmuch as the centrifugal action of the weights increases in the same proportion in all parts of their movement, it is impossible, by the use of the adjusting devices described only to so adjust the springs and weights that the resistance of the springs will vary exactly in proportion to the centrifugal force of the weights at all points in the movement of the latter.

I have found that by connecting the ends of the springs that are secured to the wheel in such manner that they may be adjusted thereon nearer to or farther from the pivotal points of the levers the resistance of the springs and the centrifugal force of the weights may be equalized in all portions of the throw of the latter. This result is obtained by such adjustment of the springs for the reason that when the ends of the said springs are placed close to the pivotal points of the levers the same amount of outward movement of the weights will stretch the springs to a less extent, and the weights will operate with proportionately greater effect at the outer portion of their movement than when the springs are more nearly at right angles to the levers, so that by moving the ends of the springs nearer to or farther from the pivots of the levers while running the engine with light and heavy loads, and with a speed-indicator attached, a point can be found after a few trials where the resistance in the stretch of the springs will just equal the centrifugal force of the weights at all points in their outward movement.

It is obvious that the springs will act with less effect upon the levers as their points of attachment to the wheel are brought nearer to the pivotal points thereof, and it therefore becomes necessary to increase the tension of the springs by stretching them more tightly (so as to counteract the centrifugal action of the weights and to preserve the desired speed in the engine) when the springs are adjusted in the manner mentioned.

The adjustments of the springs above mentioned may be accomplished by any suitable or well-known construction in the connections between the said springs and the wheel; but as a preferred construction in such connections, they are, as herein shown, made as follows: The springs G, at their points of attachment to the wheel, are secured to sliding blocks G′, held in guides G^2, attached, as shown in Figs.

1, 2, 3, 4, and 5, to opposite spokes *a* upon said wheel, said guides, as illustrated in said figures, being arranged radially of the wheel and in line with the pivot-pins *e* of the levers E, so that when the said blocks G′ are moved in the guides they will be carried nearer to or farther from the said pivot-pins. The blocks G′ are preferably held and moved in the guides G^2 by means of threaded shafts G^3, having bearings at their ends in stationary projections *g*, attached to or forming part of said guides, said shafts being constructed to pass through threaded apertures in said blocks G, and provided upon their ends with square heads *g′*, by which they may be rotated and the blocks moved. The blocks G′ are preferably provided with projecting lugs G^4, through a small aperture in which lugs are inserted threaded bolts G^5, provided at one end with an eye, g^2, in which the end of the wire composing the spring is inserted, and upon which is placed a nut, g^3, constructed to rest against the lug G^4, and by which the spring may be lengthened or shortened, and its tension thereby adjusted as desired.

In the operation of adjusting the springs and weights, when the parts are constructed as above described, the blocks G′, to which the inner ends of the springs are attached, are placed approximately in the position which they are usually found to take when finally adjusted and a spring of the same size is used, and the weights are then shifted upon the levers to points at which they will overcome the resistance of the springs and move the levers outwardly from their normal positions when the speed at which it is desired to run the engine is exceeded. After the weights and springs are adjusted in this manner, the blocks G′ are then moved in or out by rotating the shafts G^3 until a point is found at which the greatest sensitiveness is obtained—that is, a point at which a very slight increase above the desired speed will produce an extreme movement of the weights.

It is obvious that if the resistance of the springs increases relatively to the centrifugal force of the weights in their outward movement a greater increase of speed will be requisite to give the weights full throw than when the resistance of the springs varies exactly in proportion to the force of the weights, and the regulation will, therefore, in the first case be less sensitive than in the last. If, however, the spring is so adjusted that the centrifugal action of the weights increases to a greater extent than the resistance of the springs, the regulation will be too sensitive—that is to say, the weights will be thrown outwardly, so as to suddenly check the speed of the engine, when the springs will draw them inwardly, so as to again give too great a speed, and a vibrating movement in the weights will thus result. The most sensitive action is obtained when the blocks G′ are nearest the pivots of the levers, and in practice the said blocks are moved toward the said pivots in adjusting the springs until a point is reached at which the greatest sensitiveness is obtained that is possible without causing the vibratory movement in the weights above described.

In the form of device illustrated in Fig. 8 the guides G^2, instead of being arranged in line with the pivots *e* of the levers, as hereinbefore described, are placed upon the wheel with their ends which are adjacent to the said pivots at a greater distance from the points of attachment of the springs to the levers than their inner ends.

When the guides are located in the manner first described, it is necessary, in the adjustment of the springs, as before stated, to increase the tension upon the springs when the blocks G′ are moved toward the pivot-points of the levers in order to retain the desired strain upon the springs at such time, and by locating the guides with their outer ends more distant from the ends of the levers and the points of attachment of the outer ends of the springs than their inner ends, the inner ends of the springs, as the blocks G′ are moved outwardly, will obviously be carried away from the ends of the levers and the desired increase of tension given thereto without the necessity of a separate adjustment of the springs for this purpose.

The guides G^2 in the construction last described are preferably attached to the wheel by adjustable connections, so that their position may be changed thereon and they may be placed at any angle and with their outer ends at any distance from the ends of the levers desired.

As a preferred means of adjustably connecting the guides with the wheel, the said wheel, as shown in Figs. 8 and 9, is provided with flat webs *a′* in its portion between the arms *a* adjacent to the pivot-points of the levers, and the guides are secured upon the faces of said webs, the means of securing them thereon, herein shown, consisting of bolts g^8 and g^9, passing through apertures in the webs, as more clearly shown in Fig. 9.

The bolt g^8 adjacent to the hub of the wheel may be constructed to form a pivot for the inner end of the guide, and the bolt g^9 at the outer end of said guide may pass through a slot, a^2, concentric with the bolt g^8, whereby the position of the outer end of the said guide may be shifted, and it may be placed at any desired angle upon the wheel. The bolt g^8 may also be inserted through a slot, as indicated in dotted lines at a^3 in Fig. 8, so as to permit a bodily adjustment of the guide.

When the inclined guide G^2 last described and shown in Figs. 8 and 9 is used, it obviously becomes unnecessary to also use the eyebolts G^5 and nuts g^3 or other adjusting device for increasing or decreasing the tension of the spring when the inner end of the latter is adjusted nearer to or farther from the pivot-point of the lever; but in practice such

device for adjusting the tension of the spring is preferably used in connection with said inclined guide in order that slight differences in the length or stiffness of the springs used may be readily compensated for in the first adjustment of the parts.

It is found desirable to connect the springs G with the levers by devices constructed to permit them to be adjusted longitudinally thereof, whereby a considerable change in the tension of the springs may be quickly accomplished as may be necessary in the first adjustment of the governor for operation, or when the weights are shifted upon the levers.

A preferred construction in the means for connecting the springs with the ends of the levers whereby the adjustment mentioned may be accomplished is illustrated in Figs. 1, 2, 3, and 6, in which the end portion of each arm E exterior to the weight E′ is provided with a longitudinal slot, e^4, through which is inserted a bolt, g^4, the end of which bolt at either side of the lever passes through suitable apertures in the ends of a yoke or clevis, g^5, to which the outer end of the spring G is secured. This construction is more clearly illustrated in Fig. 6, the bolt g^4, as therein shown, being inserted through the slot e^4 and the end of the clevis, the latter being clamped to the lever by means of a nut, g^6, operating in connection with a head, g^7, upon the opposite end of the bolt.

The object of the construction described, whereby the spring is connected with the lever through the medium of the yoke or clevis g^5, is to cause the said spring to act in a direct line upon the lever so as to have no tendency to twist said lever, as would be the case were said spring attached at one side thereof.

Any location or arrangement of the devices connecting the springs with the wheel that will permit a transverse movement of the inner ends of the springs, or one by which said inner ends may be shifted to points nearer to or farther from the pivot-points of the levers, will obviously produce the same effect as the one shown; and the invention as set forth in the appended claims is not, therefore, limited to the particular features of construction herein shown as one means of carrying out said invention except in the claims in which such features of construction are specifically set forth.

I claim as my invention—

1. The combination, with a fly-wheel, A, a laterally-movable eccentric, C, and a pivoted weight-lever, E, connected with the said eccentric, of a spring, G, connected at its ends with the free end of the lever and with the fly-wheel, and having its end that is attached to the fly-wheel adjustable upon the latter nearer to or farther from the pivot of the lever, substantially as and for the purpose set forth.

2. The combination, with a fly-wheel, A, a laterally-movable eccentric C, and a pivoted weight-lever, E, connected with the said eccentric, of a spring, G, connected at its ends with the lever and wheel, said spring having adjustable connections with the wheel and lever whereby its tension may be varied, and having its end that is attached to the wheel also adjustable upon the latter nearer to or farther from the pivot of the lever, substantially as and for the purpose set forth.

3. The combination, with the fly-wheel A, a laterally-movable eccentric, C, and a pivoted weight-lever, E, connected with the said eccentric, of a block, G′, movably attached to the wheel and adjustable thereon nearer to or farther from the pivot of the weight-lever, and a spring, G, attached at its outer end to the free end of said lever, and having adjustable connection with the said block, substantially as and for the purpose set forth.

4. The combination, with the fly-wheel A, the laterally-movable eccentric C, and a pivoted weight-lever, E, connected with the said eccentric, of a guide, G^2, secured to the said wheel, a block, G′, adjustably held in said guide, and a spring, G, connected with the free end of said lever and with the said block G′, substantially as and for the purpose set forth.

5. The combination, with a fly-wheel, A, the laterally-movable eccentric C, and a pivoted weight-lever, E, connected with the said eccentric, of a guide, G^2, secured to said wheel with its outer end at a greater distance from the free end of the lever than its inner end, a block, G′, movably secured in said guide and adjustable longitudinally thereof, and a spring, G, connected with the free end of said lever and with the said block G′, substantially as and for the purpose set forth.

6. The combination, with a fly-wheel, A, a laterally-movable eccentric, C, and a pivoted weight-lever, E, connected with the said eccentric, of a guide, G^2, adjustably secured to said wheel, a block, G′, movably secured in said guide and adjustable longitudinally thereof, and a spring, G, connected with the free end of said lever and with the said block G′.

7. The combination, with a fly-wheel, A, a laterally-movable eccentric, C, and a pivoted weight-lever, E, connected with said eccentric, of a guide, G^2, pivotally connected with the said wheel at one end and adjustably secured thereto at its opposite end, a block, G′, movably secured in said guide and adjustable longitudinally thereof, and a spring, G, connected with the free end of said lever and with the block G′, substantially as and for the purpose set forth.

8. The combination, with a fly-wheel, A, a laterally-movable eccentric, C, and a pivoted weight-lever, E, connected with said eccentric, of a guide, G^2, upon the said wheel, a movable block, G′, a threaded shaft, G^3, having bearings upon the wheel, and engaged with a threaded aperture in the block, and a spring, G, connected with the free end of the

lever E and with the said block, substantially as and for the purpose set forth.

9. The combination, with a fly-wheel, A, a laterally-movable eccentric, C, and a pivoted weight-lever connected with the said eccentric, of a spring, G, connected at its ends with the free end of the lever and with the fly-wheel, and having its end which is connected with the lever adjustable longitudinally of the latter, substantially as and for the purpose set forth.

10. The combination, with a fly-wheel, A, a laterally-movable eccentric, C, and a pivoted weight-lever connected with the said eccentric, and provided with a slot, *e*, in its free end, of a spring, G, connected at its inner end with the wheel, a clevis, g^5, affording attachment for the outer end of the spring, and a bolt, g^4, passing through the slot and clevis, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

ALBERT L. IDE.

Witnesses:

C. CLARENCE POOLE,

OLIVER E. PAGIN.