(No Model.)

3 Sheets—Sheet 1.

A. CAMPBELL.

SPEED REGULATOR.

No. 345,670. Patented July 20, 1886.

Fig. 1.

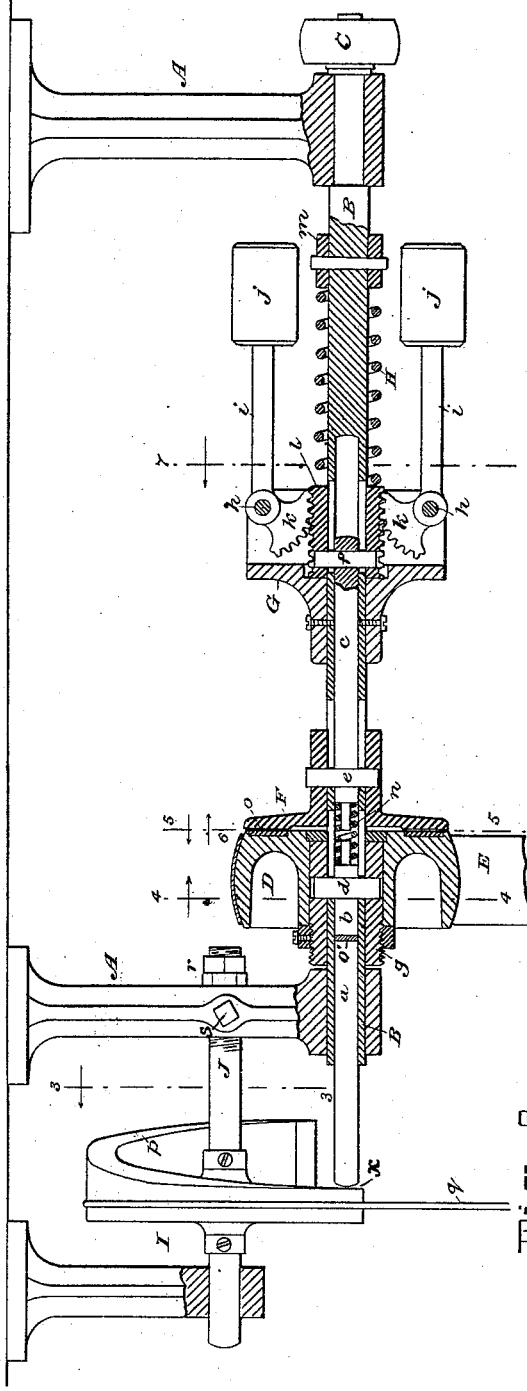


Fig. 7.

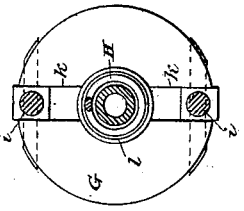


Fig. 6.

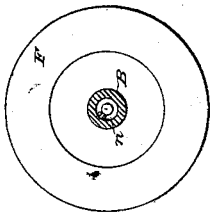


Fig. 5.

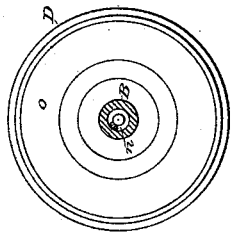


Fig. 4.

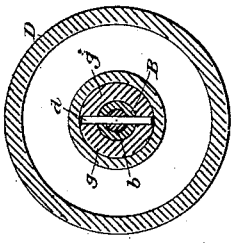
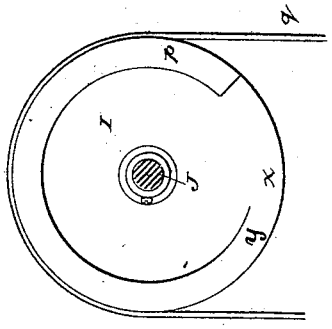


Fig. 3.



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(No Model.)

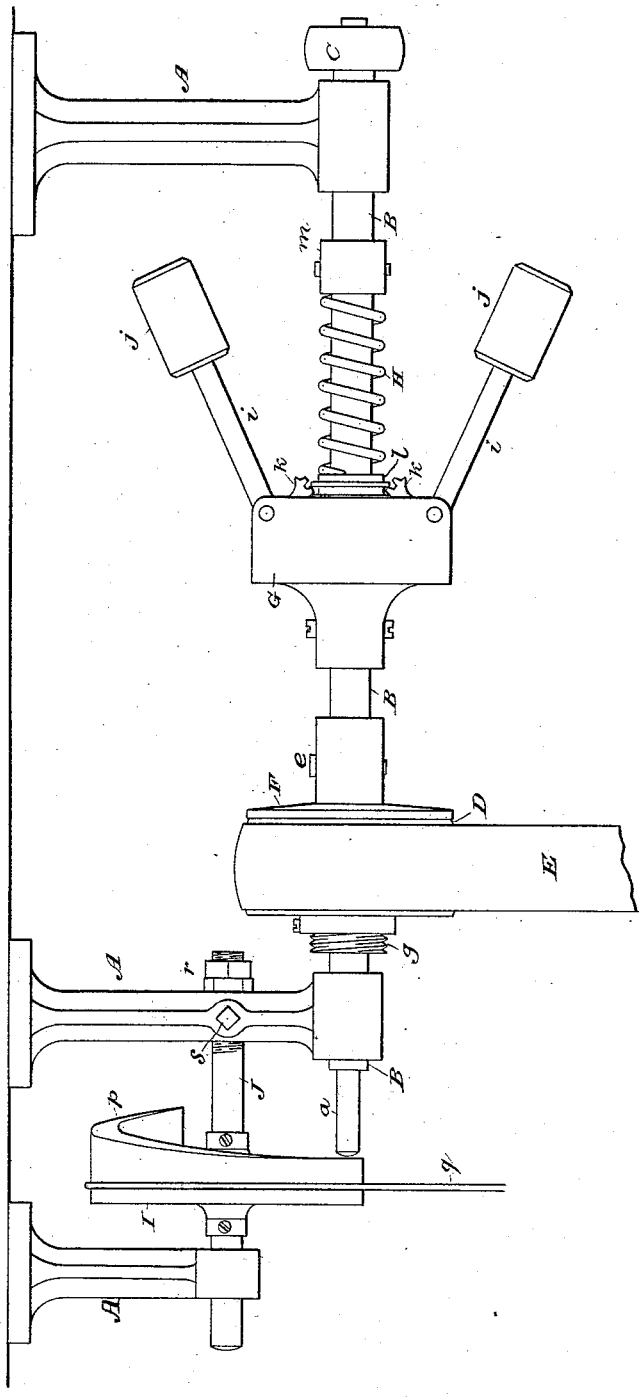
3 Sheets—Sheet 2.

A. CAMPBELL,

SPEED REGULATOR.

No. 345,670. Patented July 20, 1886.

Fig. 2.



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3 Sheets—Sheet 3.

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SPEED REGULATOR.

No. 345,670. Patented July 20, 1886.

Fig. 8.

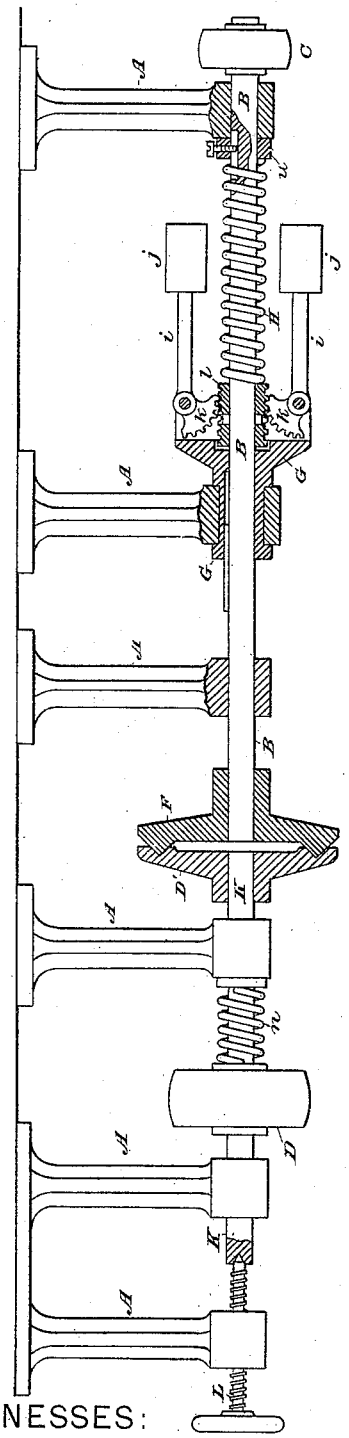
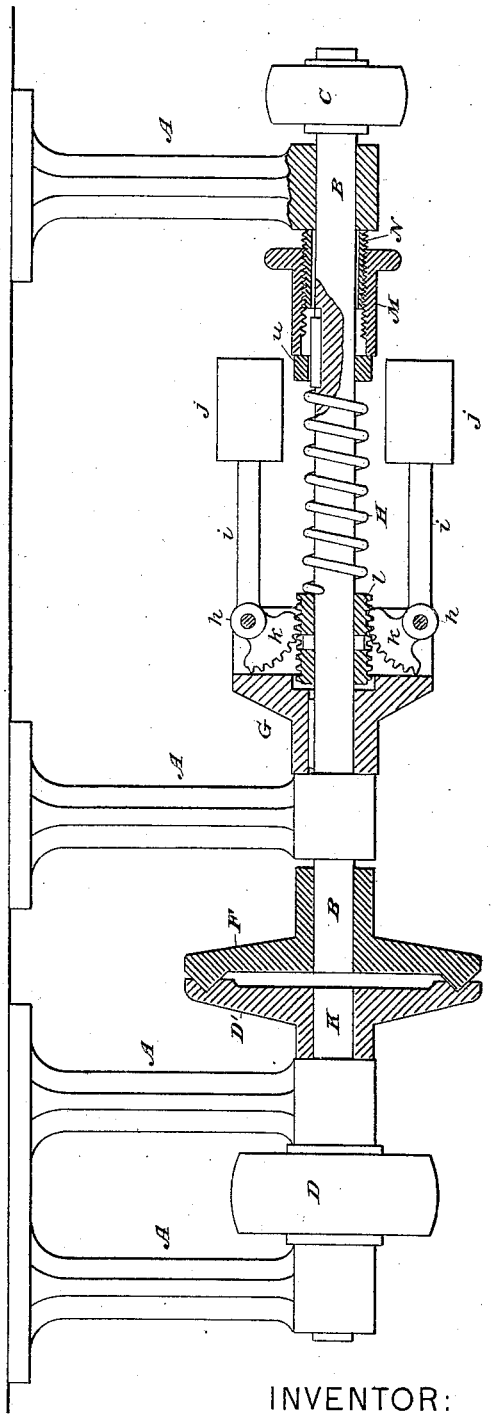


Fig. 9.



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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. 345,670, dated July 20, 1886

Application filed January 14, 1884. Renewed March 6, 1886. Serial No. 194,357. (No model.)

To all whom it may concern:

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

My invention relates to a means for maintaining a uniform speed on a driven shaft, although the driving shaft or pulley may vary in its speed. The speed of the driver must, however, always equal or exceed the speed of the driven shaft.

My invention is especially applicable to counter-shafts, which it is desired shall be driven at a uniform speed, even though the driving shaft or pulley from which the counter-shaft receives its motion shall have a variable velocity, as is usually the case with such shafts or pulleys.

My invention is based on the principle that the velocity which one rotating frictional surface will impart to another is due to the pressure of one of the surfaces on the other, and this pressure I control by a governor, which rotates with or is driven by the driven shaft. If, then, a friction-pulley on the driver be brought into contact with a friction-pulley on the driven shaft, the degree of pressure of one frictional surface on the other will measure the relative speeds of the two. Now, if this pressure be so adjusted normally that a speed of fifteen hundred revolutions per minute of the driver will impart a speed of four hundred revolutions per minute to the driven shaft, it is only necessary to provide the driven shaft with a governor that will, when the speed of fifteen hundred revolutions is exceeded, relieve the pressure on the frictional surfaces, and when it falls below fifteen hundred revolutions increase it, and we may maintain a perfectly uniform speed of the driven shaft. Now, if we wish to increase the normal speed of the driven shaft—say, in the ratio of six hundred to fifteen hundred—it is only necessary to provide a means for increasing the normal pressure on the frictional surfaces, and the governor will maintain this ratio. Such means I have provided. Indeed, I have provided means whereby the speed of the driven shaft may be gradually increased or decreased at any time by the operator, and a means, in addition to this, whereby the initial or normal ratio of the speed may be changed.

In the drawings which serve to illustrate my invention, Figure 1 is a longitudinal mid-section of a counter-shaft provided with my improved speed-regulator in its preferred form. This view shows all the parts in their normal position. Fig. 2 is a side elevation of the same, showing the speed ratio increased, and illustrating the operation of the cam device for effecting this result. Figs. 3, 4, 5, 6, and 7 are cross-sections on lines 3 3, 4 4, 5 5, 6 6, and 7 7, respectively. Figs. 8 and 9 illustrate modifications that will be fully described hereinafter.

A A represent suitable hangers or bearings in which is rotatively mounted a counter-shaft, B. On one end of this shaft is a pulley, C, or other medium for communicating motion to any machine—as a lathe, for example. This shaft B is tubular for a part of its length, and in the hollow thus formed is fitted a shaft or pin, *a*, a shaft, *b*, and a shaft, *c*. These may be of the same diameter, and I have so shown them. These internal shafts are capable of endwise movement in the hollow of shaft B, but shafts *b* and *c* are compelled to turn with shaft B by reason of keys *d*, *e*, and *f*, which play in slots in the tubular shaft B.

On the shaft B is mounted to slide a collared sleeve-bearing, *g*, which is secured to shaft *b* by the key *d*. On this sleeve-bearing is mounted to rotate freely a driving-pulley, D, to which motion may be imparted by a belt, E.

F is a friction-disk mounted to slide on the shaft B, and fixed to the shaft *c* by a key, *e*.

To the shaft B is secured at the proper point a boss, G, in which are fulcrumed or pivoted at *h h* the governor-arms *i i*, provided with balls or weights *j j*. The arms *i* are provided with toothed racks *k k*, which mesh with teeth on a rack, *l*, mounted to slide on the shaft B, but secured to the shaft *c* by key *f*. I have shown this as a cylindrical tubular rack, and I prefer to construct it in this form; but the form is not essential.

H is a helical spring, which embraces shaft B, and is arranged between the sliding rack *l* and a fixed collar, *m*, on shaft B.

Between the ends of shaft *b* and *c* is arranged a spring, *n*, which tends to press the disk F

away from the friction surface or plate *o* on the pulley D. The function of this spring will be best understood when I come to describe the operation.

The shaft *a* is simply a pin which is not connected with any rotating part. At one end it abuts against a washer, *o'*, which is interposed between it and the left-hand end of shaft *b*, and at the other end it abuts, or may abut, against a cam, *p*, on the face of a rotatively-mounted cam-disk, I. This disk is mounted to rotate on a non-rotative shaft, J, between collars on the latter. Its rotation may be conveniently effected by an endless chain or rope, *q*, which takes in a groove in the periphery of the disk.

It will be observed by inspection of Fig. 1 that the movement of the pulley D to the left, or from the disk F, is limited by the end of the slot in shaft B engaged by key *d*, and that the movement of disk F to the left, or toward pulley D, is limited by the contact of rack *l* with boss G. It will also be seen that the spring H tends to draw the governor-balls in toward the shaft B, and that it also tends to press the disk F up to pulley D. Now, if the disk I be so turned that the cam *p* does not press on the end of shaft *a*—that is to say, if the point on said disk which I will call the "neutral" point (*x* in Fig. 3) be brought to coincide with the end of *a*, then the spring *n* is free to separate the disk F and pulley D very slightly, and the latter may rotate freely without driving the shaft; but if the cam-disk I be rotated a little further, until the pulley D be pressed into frictional contact with the disk F, the shaft will be rotated and the ratio between the speed at which it rotates and that at which the driver rotates will be directly as the pressure. This movement of disk I will bring in coincidence with the end of shaft *a* that point on disk I which I will call the "normal" point, (*y* in Fig. 3,) because the pressure due to this position establishes the normal relative velocity between the driver and the driven, which may be, for example, fifteen hundred to four hundred. It will be seen that the pressure of one frictional surface on another depends upon the compression of spring H, and is measured by the angle at which the arms of the governor stand when the apparatus is at rest.

I will now describe the operation of the speed-regulator, assuming that the shaft B is standing at rest, as in Fig. 1, and the pulley D is revolving. The operator turns the disk I until the normal point on its face (*y* in Fig. 3) coincides with the end of shaft *a*. This forces pulley D against disk E with sufficient force to slightly compress spring H, and thus throw the balls *j* of the governor out at a slight angle. The pulley D, which is the driver, will now, by reason of the friction, impart rotary motion to shaft B, say in the proportion relatively of four hundred to fifteen hundred, this ratio being controlled by the tension of spring H. Now, if the speed of the pulley D increases, the balls of the governor will be thrown out, and this will compress spring H, and relieve the frictional pressure of F on D until that pressure is reached which will reduce the speed of the shaft to four hundred again. Now, if it be desired to increase the ratio of the speeds, say to fifteen hundred and six hundred, the operator has only to rotate disk I until the cam *p* acts upon shaft *a* and presses it in far enough to impart the proper tension to spring H, when the normal ratio will be raised. The amount of movement to be given to disk I to effect this will depend, of course, on the character of cam *p* and that of spring H.

In Fig. 2 I have shown the disk rotated part way around and the balls *j* standing out at a normal angle.

If desired, the shaft J may be provided with a screw and nuts, *r*, for adjusting it endwise, and a set-screw, *s*, for fixing it in place after adjustment. This construction enables me to set the cam and disk in toward the pulley D, so that greater frictional pressure may be attained than is capable of being attained by the cam *p* as it stands, and higher speeds attained for the counter-shaft.

Fig. 8 illustrates a modification of my speed-regulator in which the same principles are embodied, but some changes in the construction are made. In this case the pulley D is keyed directly to a driving-shaft, K, on which is fixed a friction-disk, D', provided with a V-groove to receive a V on the friction-disk F. This latter is mounted and fixed directly on the counter-shaft B. Both shafts K and B are capable of endwise movement in their bearings. The rack *l* is keyed to the shaft B, and the boss G is splined on the shaft and rotates in a fixed collared bearing, so that it may not move endwise with the shaft, but rotate with it. The spring H abuts against a collar, *u*, splined on the shaft and abutting against the bearing of the latter. The spring *n* is interposed between the pulley D and one of the fixed bearings for shaft K, friction-washers being interposed, if necessary.

For the disk I and its cam *p* a screw, *l*, arranged to bear against the end of the shaft K is provided. This operates the same as the device shown in Fig. 1, but it necessitates the movement of the counter-shaft endwise in its bearings.

Fig. 9 illustrates another modification, which operates precisely the same as the devices before described. In this construction the driving-pulley D is mounted fixedly on a rotative shaft, K, which has no endwise movement. Shaft K bears a friction-disk, D', which contacts with a friction-disk, F, on a counter-shaft, B. This shaft B is capable of very slight endwise movement. The governor-boss G is splined on the shaft B, and abuts against a fixed part, as a bearing, A, for example. The tubular rack *l* is fixed to shaft B.

In lieu of the screw L (shown in Fig. 8) and cam *p*, (shown in Fig. 1,) I have substituted a tubular compression-screw, M, working on

a fixed screw-threaded boss, N, as a means of compressing spring H.

I do not wish to limit myself to any particular construction or arrangement of mechanism for carrying out my invention. I have shown it in three forms; but considerable departure may be made from these without materially affecting the principle of operation embodied therein.

The essential features of the invention are the driving by frictional contact and the regulation of this by a governor, whereby any increase in the speed of the driver lessens the pressure of one frictional surface on the other.

It is obvious that the pin or shaft *a* might form simply a prolongation of shaft *b;* but in this case it would rotate on the disk I or cam *p*. I prefer the construction shown.

The spring *n* is not absolutely essential; but I prefer to use it, in order to assure the separation of the frictional surfaces when the pressure is relaxed or removed.

The governor need not be a ball-governor, necessarily, and it might be driven from the counter-shaft by a belt, if proper means were provided for communicating its action to the friction disks. A weight might also be substituted for spring H in some cases.

My speed-regulator has an important advantage over those wherein the weight of governor-balls alone is relied on to keep the frictional surfaces pressed together normally, in that it is practically impossible to get by this means an adequate pressure; and so far as I am aware no means have ever been employed for regulating or varying this pressure. Moreover, the use of weights practically limits the application of the invention to vertical shafts. I may employ a spring of great power for this purpose, and I find it necessary to do so in applying my regulator to ordinary machinery; and I employ means for regulating the tension of this spring to suit the power to be transmitted and the velocity or speed to be imparted.

Having thus described my invention, I claim—

1. A speed-regulator comprising a rotating driver provided with a frictional driving-surface, a rotating driven shaft or part also provided with a frictional surface, a spring for pressing these frictional surfaces together, and a governor controlled by the driven shaft or part arranged to control the pressure of one frictional surface on the other, whereby a uniform speed of the driven shaft or part is attained, substantially as set forth.

2. The combination, to form a speed-regulator, of a rotating driver bearing a friction disk or surface, a driven shaft or part bearing a friction disk or surface, a spring arranged to press the two frictional surfaces together, a governor arranged to control by its rotation the pressure of one frictional surface on the other, and means, substantially as described, for pressing the two frictional surfaces together, and thereby increasing the normal tension of the spring, substantially as set forth.

3. The combination, in a speed-regulator, of a rotating driver bearing a frictional disk or surface and adapted to move parallel with its axis of rotation, a driven shaft provided with a disk or part having a frictional surface, and said disk being capable of movement parallel with its axis, a spring mounted on the driven shaft and arranged to press the two frictional surfaces together, a ball-governor mounted on and adapted to rotate with the driven shaft, and tending by its rotation to compress the spring and relieve the pressure of the frictional surfaces one on the other, and means, substantially as described, for pressing the friction-surface on the driver against the friction-surface on the driven shaft, and thus compressing the spring normally, substantially as set forth.

4. The combination, with the tubular or partly tubular shaft B, rotatively mounted, of the loose pulley D, provided with a suitable friction-face, the collared bearing-sleeve *g*, connected with the shaft *b*, the said shaft *b*, the friction-disk F, secured to shaft *c*, the said shaft *c*, and the rack *l*, secured thereto, the spring H, arranged as shown, the boss G, secured to shaft B, and the arms *i*, bearing balls *j*, and racks *k'*, all arranged to operate substantially as set forth.

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

ANDREW CAMPBELL.

Witnesses:

HENRY CONNETT,

ARTHUR C. FRASER.