(No Model.) 2 Sheets—Sheet 1.

C. NICHOLSON.

SPRING MOTOR.

No. 401,052. Patented Apr. 9, 1889.

Fig. 1.

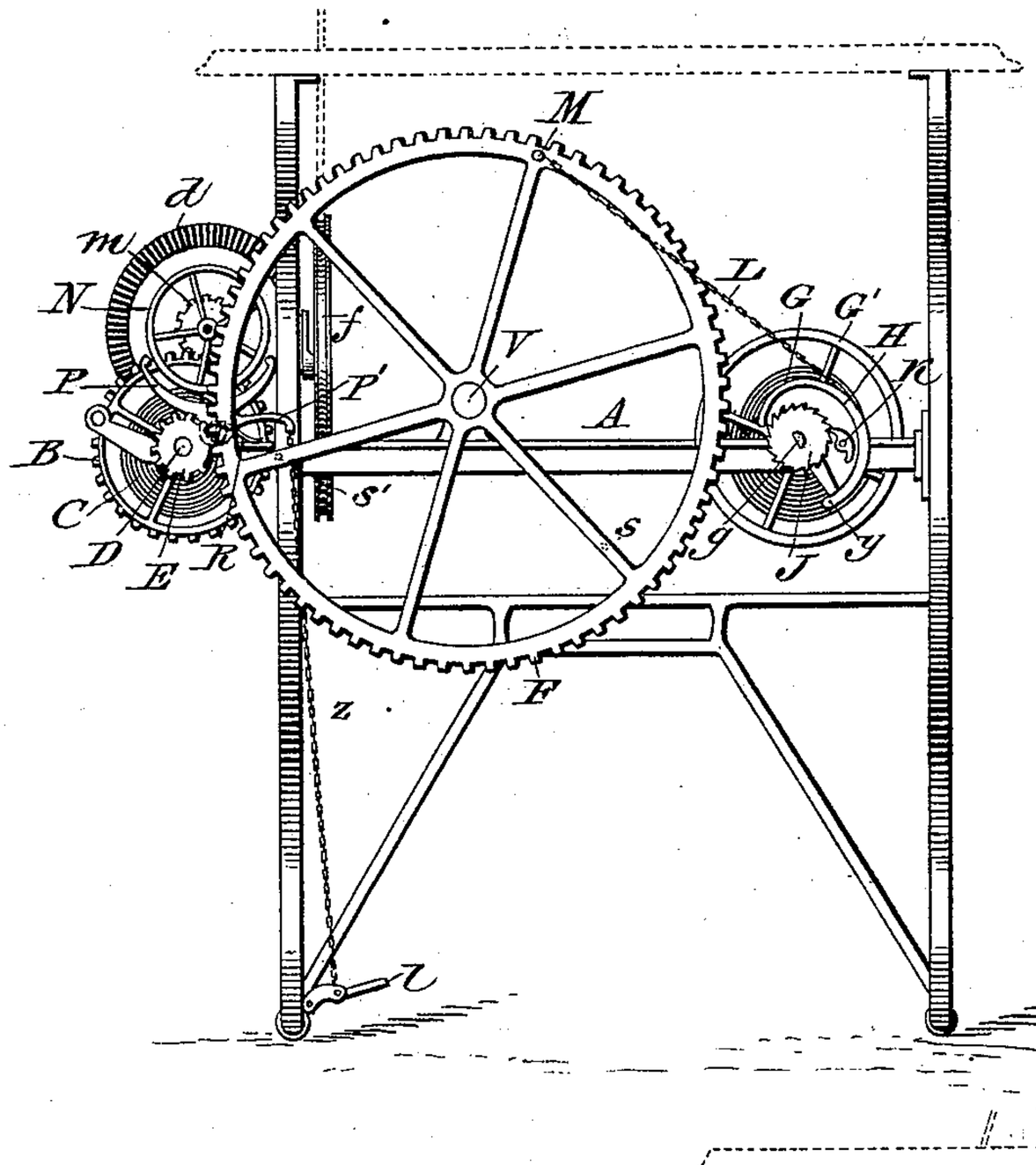


Fig. 2.

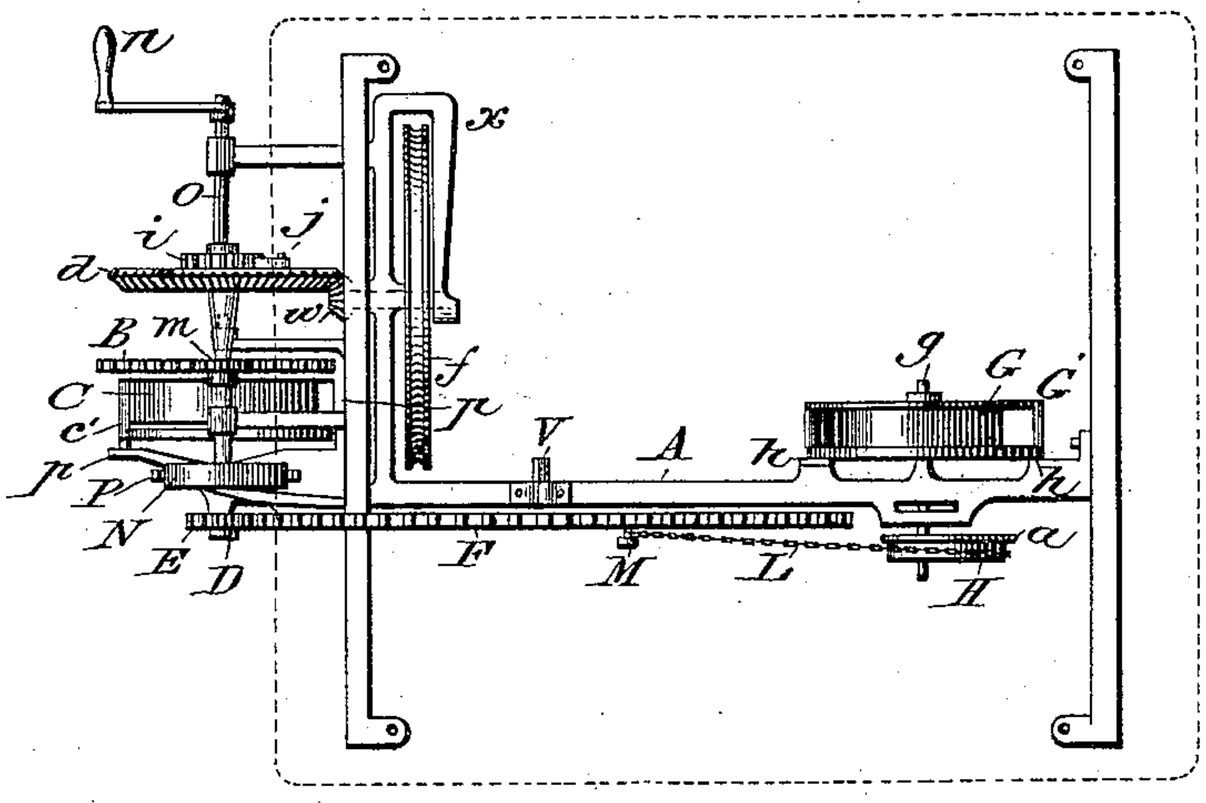
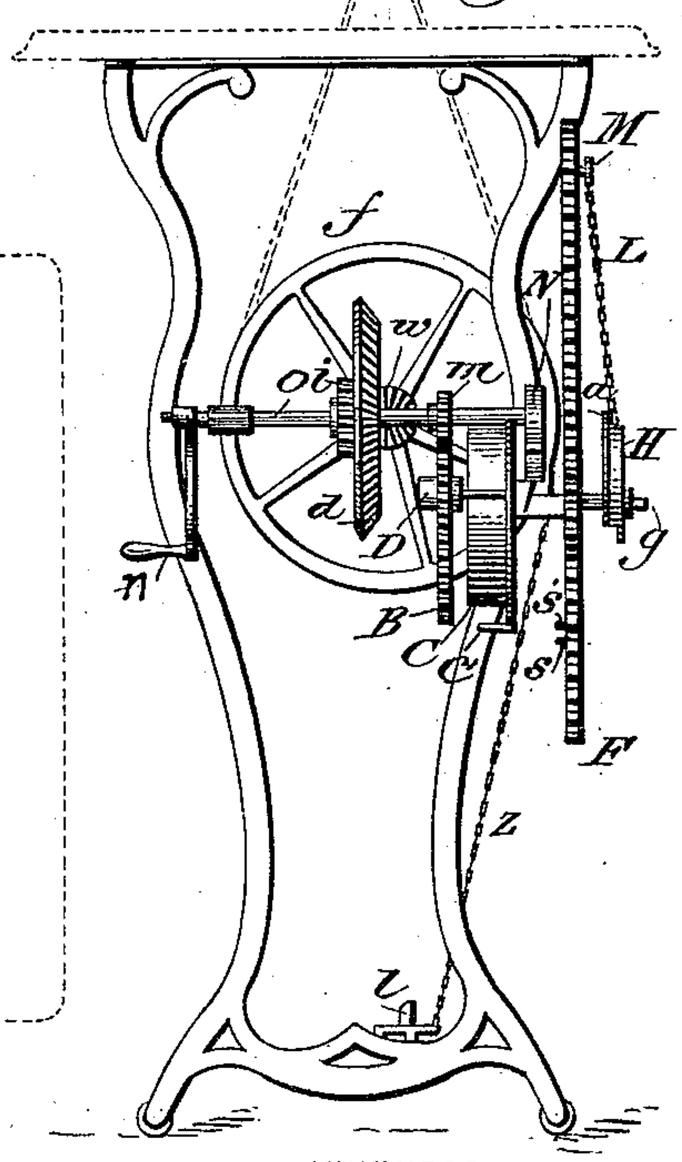


Fig. 3.



WITNESSES:

Thos. J. Warbridge

Henry A. Wiand

INVENTOR,

Charles Nicholson

BY

A. S. Stockwell

his

ATTORNEY.

(No Model.) 2 Sheets—Sheet 2.

C. NICHOLSON.

SPRING MOTOR.

No. 401,052. Patented Apr. 9, 1889.

Fig. 6.

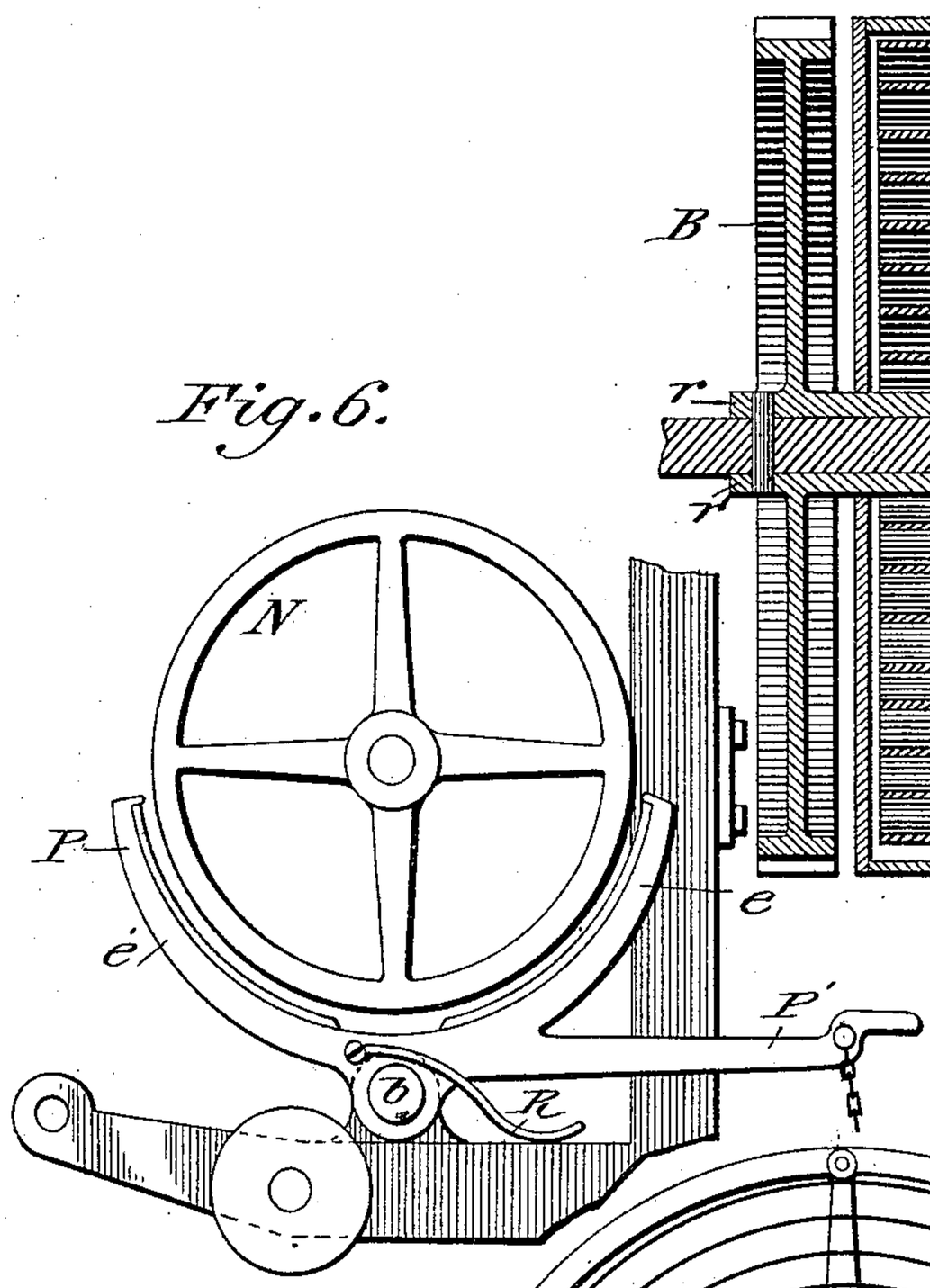
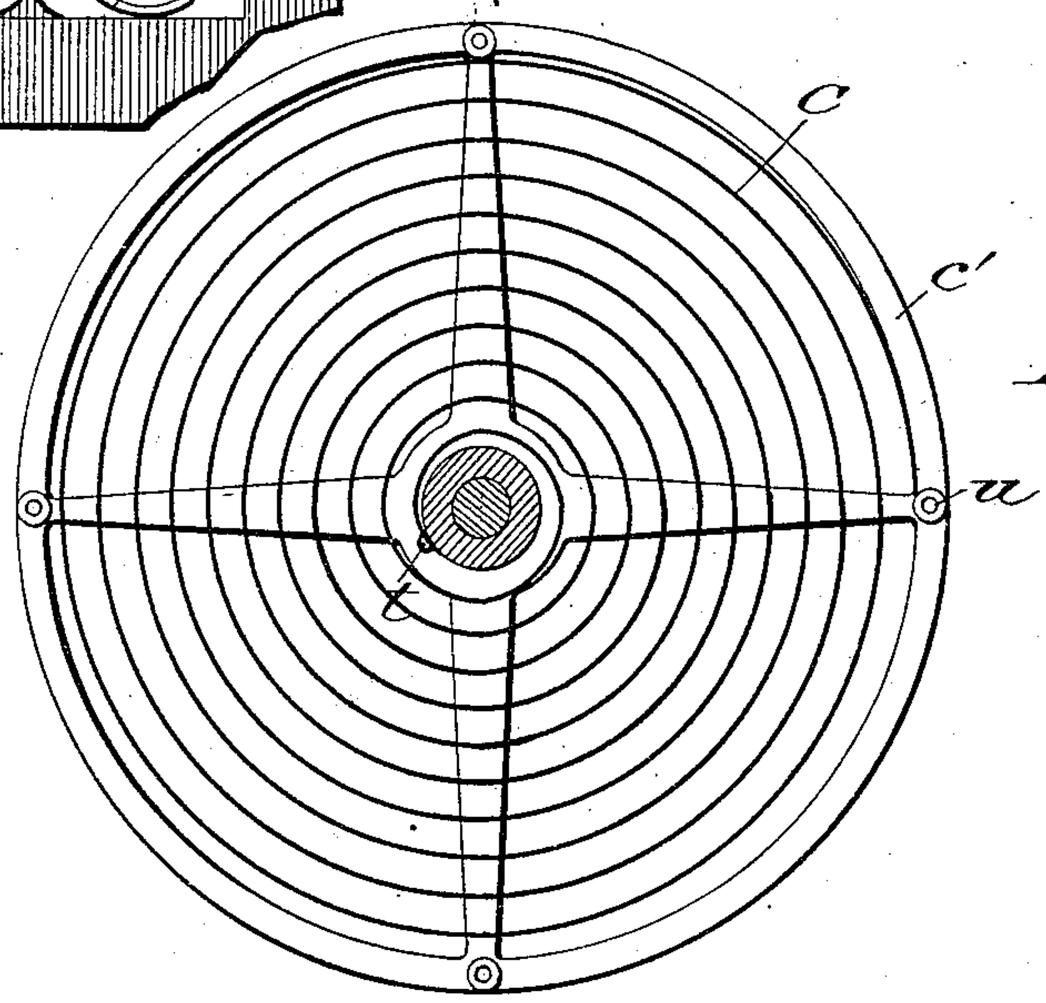


Fig. 4.

Fig. 5.



WITNESSES:

Thos. J. Wartkins

Henry A. Weaver

INVENTOR,

Charles Nicholson

BY

A. E. Stockwell

his

ATTORNEY,

UNITED STATES PATENT OFFICE.

CHARLES NICHOLSON, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE NICHOLSON STORAGE POWER AND SPRING MOTOR COMPANY, OF WASHINGTON, DISTRICT OF COLUMBIA.

SPRING-MOTOR.

SPECIFICATION forming part of Letters Patent No. 401,052, dated April 9, 1889.

Application filed February 4, 1887. Serial No. 226,497. (No model.)

To all whom it may concern:

Be it known that I, CHARLES NICHOLSON, a citizen of the United States, residing in the city and county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Spring-Motors, which improvements are fully set forth in the following specification and accompanying drawings.

It is well known that spring-motors acting against a uniform resistance run faster at the start than toward the end, and that this irregularity of motion is one of the principal causes why this convenient source of power is rarely used for the driving of machinery, to which it is otherwise well adapted.

My invention is designed to equalize the power of spring-motors, so that the same may furnish a constant force from the beginning to the end of its run. I provide a regulating-spring, which, when the motor-spring is being wound up, and also when the same is running down, supplies the regulating force adapted to render the power of the motor uniform. The two springs, however, having necessarily different normal tensions, their resulting force cannot be constant throughout the whole run without special arrangements; and I therefore provide that during one part of the winding up of the motor-spring the regulating-spring shall resist and during the other part it shall aid that movement. Similarly, during one part of the unwinding of the motor-spring the regulating-spring is arranged to retard and during the other part to aid that movement. In order to obtain this result, the motor-spring is mechanically connected with the regulating-spring by a lever, the resultant force of which acts alternately in one direction and the other, and the relations of the parts are such as to render the effective force of the motor uniform.

While the regulator is the main feature of my invention, it also comprises, as a secondary feature, an improved stop-motion, which is actuated automatically by the motor itself, but which may also be actuated by the operator at will. All this will more fully appear from the following detailed description of one of the numerous forms which my invention may assume; but I desire it to be understood that I do not confine myself to the specific embodiment of the same hereinafter shown and described.

I have shown in Figure 1 a front elevation of my improved spring-motor connected with a sewing-machine; in Fig. 2 a plan view, and in Fig. 3 an end view, of the same. Fig. 4 is sectional view of the motor-spring and its case with the driving-wheel mounted upon the axis of the same. Fig. 5 is a plan view of the motor-spring with one side of the case removed and the axis in section, and Fig. 6 is a side elevation of the stop-motion device.

Similar letters refer to similar parts throughout the entire views.

In order to a clear comprehension of my invention, we may at first consider it as composed of a bearing-frame and three parts or sections, according to the three main functions performed by the different parts, viz., the motive or power-giving part, the equalizing or regulating part, and the stop-motion device, though we shall not regard this division in the specific explanation.

The bearing-frame A has suitable bearings for connecting or attaching the motor to the machinery or parts desired. The motive or power-giving part consists of the driving-wheel B and its shaft D, the motor-spring C and its case *c'*. The equalizing part consists of the pinion E on the end of the driving-gear shaft D, the cog-wheel F, the equalizing-spring G and its case G', the cam H, the ratchet-wheel J, the pawl K, the chain L, and the stud M. The stop-motion device consists of the wheel N upon the end of the crank-shaft O, the arc brake P, (consisting of two arms, *e e'*, and the lever P',) the spring R, and the spurs *s s'* upon the wheel F, which engage the lever P' of the brake. The inner end of the driving-spring C is secured to the extended hub of the driving-wheel B.

In Fig. 4 may be seen sectional views of the driving-wheel and its hub, the driving-wheel shaft, and the motor-spring. D is the shaft. *r r* is the hub of the driving-wheel, extending, as shown, along the shaft D through

the spring C. The inner end of this spring is secured to the hub *r r*, as shown in sectional view, Fig. 5. The outer end of this spring is secured to its case C′ at *u*, Fig. 5. This case is firmly fastened to the bearing-frame A, as at *p p*, Fig. 2. The equalizing-spring G and its case G′ have similar connections, the inner end of the spring being fastened to the shaft *g* and the outer end to the case G′, this case being fastened to the bearing-frame at *h h*, Fig. 2. The cam H revolves loosely on the shaft *g* on the opposite side of the bearing-frame from the equalizing-spring. The ratchet-wheel J is secured to the shaft *g*, while the pawl K has its bearing on the cam H. On the inner side of the cam is a raised rim or flange, *a*, Figs. 2 and 3, which keeps the chain L in place on the periphery of the cam. One end of the chain is fastened to the cam at its outer end, *y*, and the other end of the chain is fastened to the stud M on the rim of the wheel F, thus connecting that wheel and the equalizing-spring. The cog-wheel F is attached to the bearing-frame by the small shaft V, upon which it turns. This wheel connects with the motor-spring through the pinion E. The stop-motion or brake-wheel N is fastened securely on the end of the crank-shaft O. The brake-shoe P, which bears upon this wheel, is fastened to the bearing-frame by a stud, *b*, Fig. 6, upon which it turns. The lever P′ of the brake extends by the inner side of wheel F, as shown in Fig. 1, to catch the spurs *s s′* on that wheel as it revolves. The spring R has one end fastened to the brake and the other resting upon the bearing-frame, as shown in Figs. 1 and 6. The brake is thus held in position clear of the stop-motion wheel, except when pressed against that wheel by the spurs *s s′*.

The power of the motor-spring is communicated through the driving-wheel B to the object desired either by belting or spur-gear. In the drawings I show my motor adapted and attached (by means of the proper bearings of the frame A) to a sewing-machine, the driving-wheel B connecting with the gear of the sewing-machine by means of the pinion *m* on the shaft O; and with the addition of the beveled gear-wheel *d*, the pawl *j* and ratchet *i*, the beveled pinion *w* and its shaft, the belt-wheel *f* upon that shaft, the crank *n*, and the foot-brake consisting of the foot-lever *l* and cable *z*, my invention becomes a practical spring-motor for sewing-machines.

I will now explain the manner in which and the principles upon which my motor operates, and will suppose the motor run down. The crank *n* is turned to the right, causing the revolution of the shaft O. The beveled gear-wheel *d* is connected to this shaft by the ratchet-wheel *i* and pawl *j*, the ratchet-wheel being fastened solidly to the shaft O and the pawl having its bearings on the gear-wheel *d*. When storing up power the pawl becomes disengaged from the ratchet, thus allowing the motor-spring to be wound up without revolving the beveled gear-wheel *d;* but when the motion of the shaft O is reversed by the action of the motor-spring the pawl engages the ratchet and causes the beveled gear-wheel *d* to turn. This moves the beveled pinion *w* and its shaft and the belt-wheel *f*, which imparts motion to the sewing-machine by the usual cord or belt. (Shown by dotted lines in Figs. 1 and 3.) The revolution of the pinion *m* in the process of storing up power causes the driving-wheel B, with which it connects, also to revolve. The inner end of the motor-spring, it will be remembered, is fastened to the hub of the wheel B; hence the revolution to the right of that wheel winds up the motor-spring. The driving-wheel, acting upon its shaft D, turns the pinion E, which imparts motion to the wheel F, and through the connections of that wheel to the equalizing-spring G.

The equalizing device is so adjusted as at one time to supplement and at another time to counteract the force of the motor-spring, so that the amount of force required in winding or storing up power is the same from beginning to end, and the power given out by the motor is uniform. The result is reached in my equalizing device by retarding the winding of the motor-spring during the first half and supplementing the winding during the last half, and by counteracting the force of the motor-spring during the first part of its running and adding to its force during the last part. In order to clearly explain how this result is reached, I will give the construction, adjustment, and operation of the equalizing device at some length.

The spring G and its case G′ are fastened as explained above. This spring is kept wound up to the degree required for general use. The cam H is loose on the shaft *g*, thus permitting, when the pawl K and ratchet J are disengaged, the shaft to be turned and the tension of the equalizing-spring to be changed without moving the cam and disarranging the adjustment of the wheel F and the cam. If the tension needs decreasing, the pawl is lifted back by the finger while the spring is changed to the desired degree of tension. The wheel F is so adjusted that when the motor has run down, the radius of the wheel passing through stud M (which in the drawings is represented by the spoke corresponding to the letters V M) is at right angles, or nearly so, to the chain L, the spur *s′* being then in contact with the under side of the brake-lever P′, as shown in Fig. 1. When the motor-spring is fully wound up, the stud M has moved to the lower side of the wheel to about the position of reference-letter F, Fig. 1, and the radius of wheel F passing through stud M is again at right angles, or nearly so, to chain L, the spur *s* now being in contact with the upper side of the brake-lever P′. In these two extreme positions of wheel F the force of the regulating-spring upon wheel F, and consequently upon the motor-spring,

(through the pinion E,) is exerted to best advantage, because said force is in these positions applied at right angles to the angular lever formed by the two radii of the wheel drawn to the point M and to the point of engagement of wheel F with pinion E, respectively. If the angle formed between the line connecting the center of wheel F with the point upon the cam G from which chain L proceeds and the line of said chain decreases, the mechanical effect of a force acting upon wheel F through chain L also decreases, and if said angle increases the resultant mechanical effect also increases.

It should be remembered that wheel F turns loosely upon its shaft V. As this wheel turns in the act of winding up the motor-spring the stud M moves to the left, as seen from the side shown in Figs. 1 and 2, and the angle upon which the mechanical effect of spring C upon wheel F depends decreases and becomes zero when chain L is in a line passing through the center of wheel F. During this phase of operation the tension of the motor-spring increases, the tension of the regulating or equalizing spring also increases, and the effective leverage of wheel F decreases.

In the position of the parts shown in Fig. 1 the tension of the motor-spring is at its minimum, and it requires only a comparatively small force to wind it up. At the same time the tension of the equalizing-spring is near its minimum, while the leverage upon wheel F is at its maximum. The winding up of the motor-spring is therefore resisted by the increasing tension of the equalizing-spring, which reacts through the continuously-decreasing leverage of wheel F; but it will be observed that the amount of motion imparted by wheel F to spring C is great at first, and becomes smaller as chain L approaches the line of the diameter of the wheel, and is zero when this line is reached. The relations of the forces of the two springs and the dimensions of the wheel F are such as to make the resistance to the winding up constant from beginning to end of this phase of operation. As the winding up of the motor-spring is continued its tension is continually increased, and it requires a continuously-increasing force to overcome this tension. A part of this force is now supplied by the unwinding of spring C, for as soon as the chain L has crossed the center of wheel F, and while wheel F continues to move in its original direction, it is assisted in that movement by the reverse movement of cam H, which now takes up the slack of chain L.

It is not necessary to follow the movements of the parts and variations of forces up to the point where the winding up of the motor-spring is arrested, since it must now be clear that the resistance to the winding up will be constant during this second phase of operation as it was during the first. The winding up of the motor-spring is arrested when stud M reaches a point at about reference-letter F, Fig. 1. The spur *s* then comes in contact with brake-lever P′, bearing it down and throwing the brake-arm *e′* against wheel N, which instantly stops further motion. The motor-spring is now wound up to its maximum, and the power is stored up and held ready for use.

When the brake is released, the motor is set in motion by the recoil of the motor-spring, reversing the motion of wheel F, as is well understood, and it will now be clear that the equalizing-spring will retard the motion during the first half of the recoil of the motor-spring and will accelerate the same during the second half of the recoil until the radius passing through stud M is again at about a right angle to the chain L. When the wheel F reaches this position, spur *s′* catches the brake-lever, lifting it up and throwing the brake-arm *e* against wheel N, whereby the machine is stopped. As in the winding up of the motor, so in the running down of the same, the resultant force of the two springs, as modified by the variation of leverage of the wheel F, will be constant, and if such motor is caused to operate against a uniform resistance its speed will necessarily be uniform; but it is clear that volute springs are not ordinarily constructed with absolute accuracy, and they will therefore not furnish absolute uniformity of speed. To provide against this disturbing cause I employ the cam H, which will neutralize the inaccuracies of motion due to unavoidable defects of the springs, friction, and other disturbing causes. This cam H may be shaped, as indicated, upon the line of a volute, and is placed upon the axis of spring G in such position as to effect its object. I thus provide a compact neat motor which winds with uniform ease and which supplies uniform power.

If in the use of the motor at any time more power is needed—as, for instance, in the use of a sewing-machine goods sewed at one time are heavier than those worked upon at another time—this increased power is easily obtained by winding the motor-spring partly up, shifting the wheel F on its shaft so as to disengage it from the pinion E, then turning the wheel back to the starting position and shifting it back upon its shaft, so as to again engage the pinion E. By then winding the motor-spring until checked by the stop-motion device a greater tension of the motor-spring is secured, and consequently an increase of power. If the power is too strong, it is decreased by removing the wheel F, turning it in the opposite direction, and again adjusting it as before, thus working the motor-spring at a lower tension.

The equalizing device is not to increase or decrease either the power or speed of the motor, but to secure a steady run and flow of power when the degree desired is ascertained. We will suppose, for example, the needed power is ten pounds. When run down there is no power. The motor-spring is wound

up until its tension exerts a power of twenty pounds. Now, the equalizing device, instead of allowing the motor to graduate from twenty pounds to nothing, equalizes the force at ten pounds in the manner I have described. Suppose again the revolution of the driving-wheel B, when the motor-spring is wound up, to be four hundred per minute. When the spring is run down the revolution is nothing. The equalizing device regulates the speed and makes the revolution uniform at two hundred per minute during the entire run.

Having fully described my invention, I therefore claim and desire to secure by Letters Patent—

1. In a spring-motor, the combination of a motor-spring and an equalizing-spring with a wheel connected to the motor-spring and a chain and cam connecting the equalizing-spring with the rim of the wheel, substantially as described.

2. In a spring-motor, the combination of a volute motor-spring connected with a gear-wheel and a volute equalizing-spring, a cam of suitable pitch connected with the equalizing-spring, and a chain connecting the cam with the rim of the wheel, substantially as described.

3. In a spring-motor, the combination of a volute motor-spring and a similar equalizing-spring with a driving-wheel connected to the motor-spring, and a chain and cam connecting the equalizing-spring with a stud in the radius of the wheel, which radius in the revolution of the wheel crosses the line of the chain, whereby the equalizing-spring will alternately oppose and assist the motor-spring, substantially as described.

4. In a spring-motor, the combination of a friction-wheel and a friction brake-shoe with a wheel driven by a motor, and spurs upon said wheel for actuating the brake-shoe automatically when the motor arrives at the limits of its run in storing and yielding power, substantially as described.

CHARLES NICHOLSON.

Witnesses:
THOS. J. MARTIN, Jr.,
HENRY A. WEIAND.