L. C. DAVIDSON.

STEP-BY-STEP MOTOR.

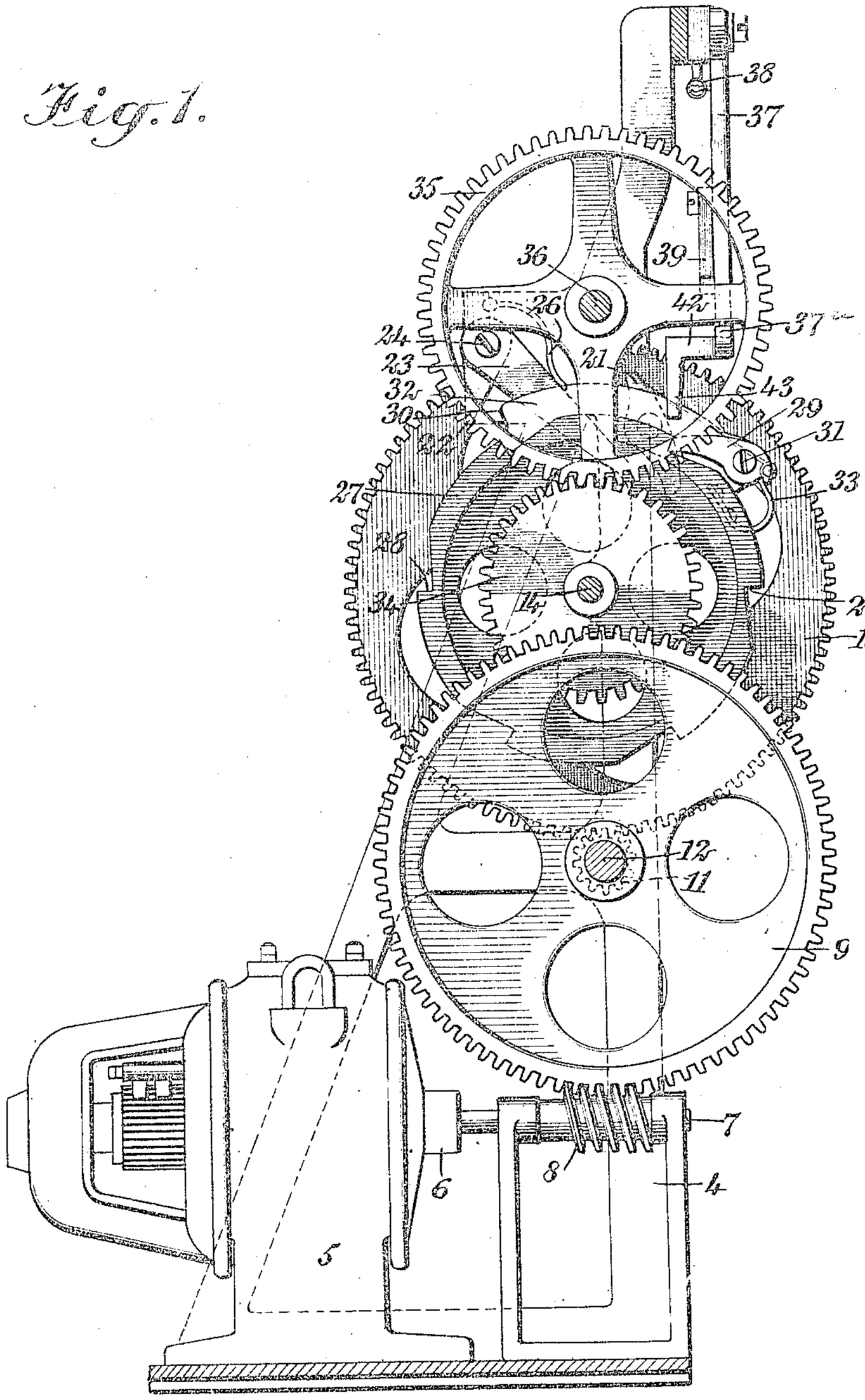
APPLICATION FILED JULY 1, 1907.

934,889

Patented Sept. 21, 1909.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

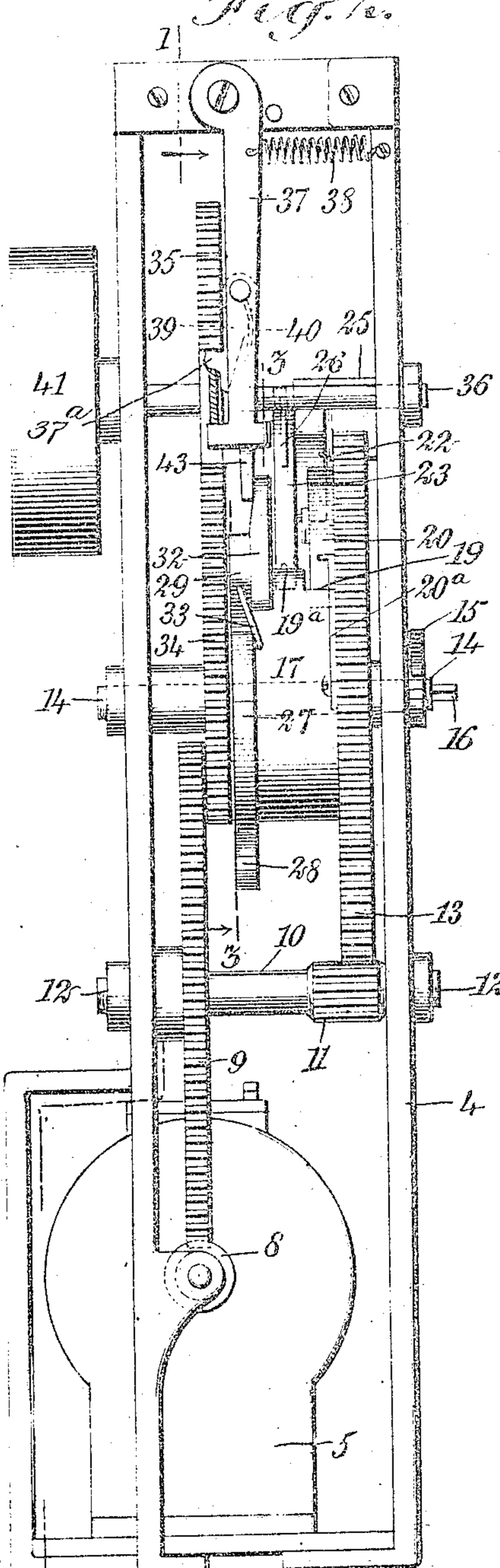


Fig. 3.

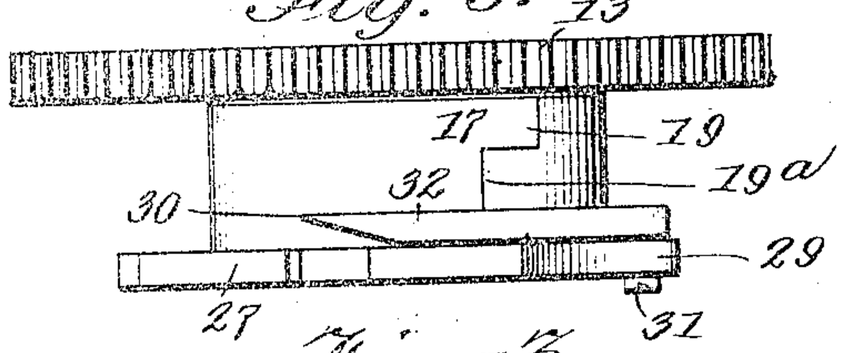
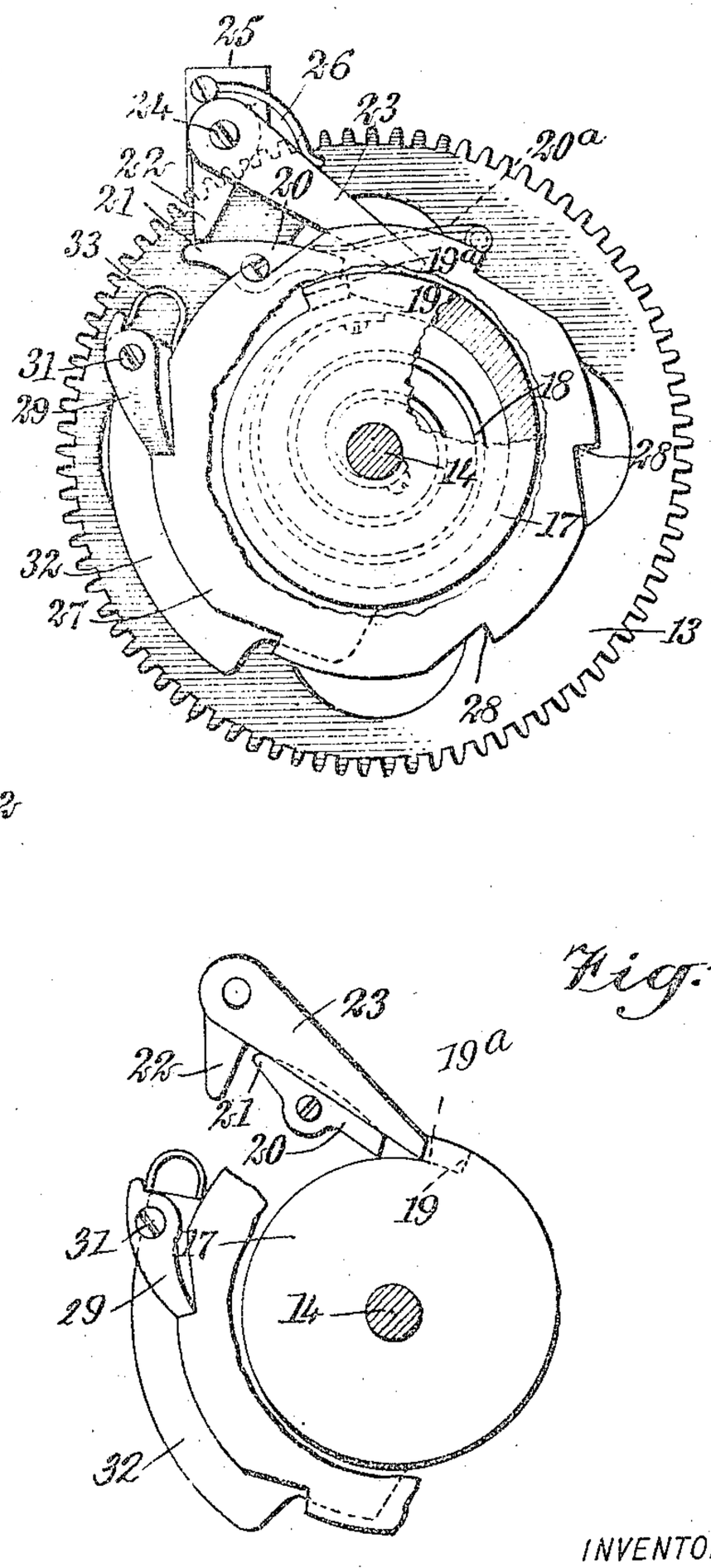


Fig. 4.



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UNITED STATES PATENT OFFICE.

LYMAN CRITTENDEN DAVIDSON, OF CALGARY, ALBERTA, CANADA, ASSIGNOR TO BIG 4 MANUFACTURING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

STEP-BY-STEP MOTOR.

934,889. Specification of Letters Patent. Patented Sept. 21, 1909.

Application filed July 1, 1907. Serial No. 381,655.

To all whom it may concern:

Be it known that I, LYMAN CRITTENDEN DAVIDSON, a citizen of the United States, and a resident of Calgary, in the Province of Alberta and Dominion of Canada, have invented a new and Improved Step-by-Step Motor, of which the following is a full, clear, and exact description.

My invention relates to motors, my more particular object being to apply power to the motor constantly, while the power is transmitted from the motor to the driven mechanism at intervals only, assuming the character of successive impulses of greater energy than that which is received at the moment by the motor.

My improved motor admits of general application in the arts, but is of special value in connection with bulletin boards and advertising devices having movable curtains to be actuated step-by-step, and also in connection with pile drivers and analogous machines.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a vertical cross section through my improved motor, showing the entire train of gearing employed together with the electric motor mechanism for transmitting power to the device, and showing also, in the upper portion of the figure, the wheel propelled step by step for transmitting power to the mechanism to be driven; this view is taken on the line 1—1 of Fig. 2, in the direction of the arrow; Fig. 2 is a side elevation of the motor, showing the manner in which the ratchet and pawls are mounted so as to accomplish the step-by-step movement; Fig. 3 is a fragmentary vertical section upon the line 3—3 of Fig. 2, looking in the direction of the arrow and showing the spring barrel and its accompanying parts employed for receiving power steadily, and for transmitting it in successive impulses; and Fig. 4 is a fragmentary elevation of certain parts shown in the upper portion of Fig. 3; these parts occupying for the moment, however, a different position. Fig. 5 is an elevation of the spring barrel and parts carried by it.

The general framework is shown at 4 and the electric motor at 5, the latter being provided with an armature 6 and an armature shaft 7, these parts rotating constantly in the same direction. Mounted rigidly upon the armature shaft 7 is a worm 8 which meshes with a worm gear 9. The latter is connected rigidly with a sleeve 10 carrying a pinion 11, the gear 9, sleeve 10 and pinion 11 being loosely mounted upon a fixed axle 12. Meshing with the pinion 11 is a gear wheel 13 mounted loosely upon an axle 14 which is normally stationary, but is provided with ratchet mechanism 15 and an angular end 16. By turning the angular end 16 the axle 14 may be turned and set so as to remain stationary during the running of the machine. The purpose of thus turning the axle 14 and setting it is to adjust the tension of the spring barrel 17. This spring barrel is provided with a spiral spring 18, one end of which is secured internally to the spring barrel, the other end being connected rigidly with the axle 14. By turning the angular end 16 and allowing the ratchet mechanism 15 to hold the axle 14 in different positions, the tension of the spiral spring 18 may be regulated at will, and consequently the power of the spring barrel controlled as desired. The spring barrel is provided with notches 19, 19^a, as shown in Fig. 3. A pawl 20 is journaled upon the gear wheel 13 and is adapted to engage the notch 19. As may be seen from Fig. 2, the notches 19, 19^a are disposed in different planes. The pawl 20 is provided with an extending portion 21, and lying partially within the path of this extending portion is a limiting stop 22, which member I designate as a trip. This limiting stop is stationary and is supported by the projection 25. The gear wheel 13 rotates in a so-called clockwise direction, according to Fig. 3, and the extending portion 21 of the pawl 20 is at intervals brought into engagement with the trip 22, which slightly rocks the pawl 20 and withdraws it from the notch 19. Another pawl 23 is mounted upon a pivot 24, the latter being supported by a

stationary projection 25. This projection is connected rigidly with the frame. Mounted upon the latter is a leaf spring 26 which engages the upper surface of the pawl 23, and presses this pawl downwardly into gentle engagement with the outer periphery of the spring barrel 17. The pawl 23 is disposed partially within the path of the notch 19ª so that whenever the spring barrel turns in a contra-clockwise direction, according to Fig. 3, its rotation is stopped abruptly by the pawl 23.

A leaf spring 20ª is mounted upon the gear wheel 13 and engages the pawl 20 so as to force its inner end downward and facilitate the entrance of this end into the notch 19.

A ratchet wheel 27, provided with notches 28, is mounted loosely upon the axle 14, and is engaged by a pawl 29. A beveled plate 32 is mounted rigidly upon the spring barrel 17. This cam at one of its ends is provided with a comparatively thin portion 30 and its other end is provided with a pivot pin 31 for supporting the pawl 29. A leaf spring 33 is connected at its inner end with the spring barrel, its outer end engaging the pawl 29 and forcing the same gently against the surface of the ratchet wheel 27. A gear wheel 34 is connected rigidly with the ratchet wheel 27, both of said members considered as a unit, being loose relatively to the stationary shaft 14. The gear wheel 34 meshes with a larger gear wheel 35, the latter being rigidly mounted upon a shaft 36. A swinging arm 37 is journaled upon the upper portion of the framework and provided with a detent 37ª. This swinging arm is normally drawn to the right by a spiral spring 38. This arm 37 carries a pawl 39 which is pressed to the left by a spring 40. The detent 37ª and pawl 39 engage respectively the opposite edges of one of the spokes of the wheel 35 and thus periodically lock this wheel against accidental rotation either forward or backward.

A pulley 41 is mounted rigidly upon the revoluble shaft 36, and may be used for transmitting power from the machine. The lower end of the arm 37 carries a horizontal portion 42, and from the latter depends a wedge-shaped lug 43. This lug is disposed partially within the path of the cam 32 so that when the spring barrel 17 carrying the cam 32 is rotated, the cam 32 pushes the lug 43 to the left and causes the detent 37ª and the pawl 39 to lock the gear wheel 35.

The operation of my device is as follows: The pulley 41 is connected with the mechanism to be driven, and the angular end 16 of the axle 14 is turned, if need be, until the spring 18 acquires a proper degree of tension. The electric motor 5 is next started into action; the revoluble shaft 7 being thus set in motion, the worm 8 turns the gear wheel 9 steadily in a contra-clockwise direction, according to Figs. 1 and 3. Hence, the pinion 11 causes the gear 13 to turn in a clockwise direction, according to these figures. The rotation of the gear wheel 13 is steady. The pawl 20, carried by the gear wheel 13, is normally in engagement with the notch 19. As the gear wheel 13 turns, however, carrying with it spring barrel 17 by pawl 20 the projecting portion 21 of said pawl is brought against the stationary trip 22, and the pawl is thus caused to rock. This releases the spring barrel 17, and the latter being under tension from the spiral spring 18, turns in a contra-clockwise direction, according to Fig. 3; it makes almost a complete revolution and is stopped, as indicated in Fig. 4, by the lodgment of the notch 19ª against the inner end of the pawl 23. During this time the motion of the gear wheel 13 is not interfered with, and a moment afterward, the inner end of the pawl 20 lodges in the notch 19 and again turns the spring barrel around until the pawl 20 is again tripped. These motions of the spring barrel 17 continue so long as power is supplied to the electric motor 5; that is to say, the spring barrel 17 turns slowly in a clockwise direction for substantially a revolution at the same rate of speed as the gear 13, and then the spring barrel suddenly turns in the opposite direction, being brought abruptly to a stop and instantly resumes its slower travel as before. Each time the spring barrel 17 performs this reflex movement under impulse of the spring 18, the cam 32 engages the lug 43 and, being beveled, moves the swinging arm 37 to the left, according to Fig. 2, so that the pawl 39 locks the gear wheel 35. The spring 38, pulling constantly upon the arm 37, releases it from the wheel 35 as soon as the blade 32 turns a sufficient distance to clear the lug 43. The result is that this gear wheel, the shaft 36 and pulley 41, are periodically locked and released in accordance with the intermittent motion conferred upon them. The action of the machine is thus rendered positive. Each time the spring barrel 17 moves under the impulse of the spring 18, the pawl 29 (being mounted upon the cam 32 which is fixed upon the spring barrel) engages some one of the notches 28 and turns the ratchet wheel 27. This wheel being fixed relatively to the gear wheel 34, transmits the intermittent motion through this gear wheel to the gear wheel 35.

From the above it will be seen that the train of gearing extending from the motor to the spring barrel, is composed of revoluble members, each of which moves at its own substantially constant rate of speed, whereas, from the spring barrel upward, the gear

members all move intermittently. The net result is that the pulley 41 is stationary most of the time, but at regular intervals, receives impulse motions which send it spinning always in the same direction, and its motion, after receiving each impulse, is suddenly brought to a stop.

It is desirable that the gear wheel 35 shall always move the same distance whenever acted upon through an impulse from the gear wheel 34 and spring barrel. This is especially necessary in instances where a movable member, driven by the gear wheel 35, must always travel a given distance and thus have a true and positive step-by-step motion. It is also desirable that the gear wheel 35 shall be locked positively after performing each of its movements and released positively just before each of its movements.

In order to attain the two objects just mentioned, it is essential that there shall be a definite mathematical relation between the number of teeth carried by the gear wheel 35, the number of notches carried by the ratchet wheel 27 and the number of teeth upon the gear wheel 34. For instance, if the gear wheel 34 has thirty-six teeth and the ratchet wheel 27 has six notches, the gear wheel 35 may have sixty teeth. In this instance the gear wheel 35 will turn exactly one half revolution after each impulse, and will then be locked positively until released in time for the next impulse. The gear wheel 34 makes not quite a complete revolution for each impulse given by the spring barrel. In the drawings, the gear wheel 34 has thirty-six teeth and turns for each step exactly five-sixths of a revolution, thus leaving six teeth idle. The space occupied by these six teeth represents the degree of movement necessary to allow the gear 13 to overrun the ratchet wheel 27 during the time required for tripping the pawl, release of spring barrel 17, and reflex rotation of the spring barrel until caught by the pawl 23. Contrast Figs. 3 and 4.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. The combination of a normally stationary axle, a barrel revolubly mounted thereupon and provided with notches, a spring connected with said barrel and with said axle for the purpose of turning said barrel relatively to said axle, mechanism including a pawl for applying power to said barrel for the purpose of winding said spring, a stationary trip member disposed partially within the path of travel of said pawl for the purpose of releasing said pawl from said barrel, thus allowing the latter to turn under the impulse of said spring, a pawl for engaging another of said notches and thus stopping rotation of said spring barrel from the impulse of said spring, gearing connected with said spring barrel so as to be driven thereby, and mechanism for periodically locking and unlocking said gearing.

2. The combination of a normally stationary axle, a cog wheel revolubly mounted thereupon and driven continuously, a barrel revolubly mounted upon said stationary axle and movable relatively to said cog wheel, a spring connected with said barrel and with said axle, means for periodically connecting said cog wheel to said barrel so as to temporarily turn said barrel against the tension of said spring, mechanism for periodically liberating said spring barrel from its connection with said cog wheel so as to allow said spring barrel to turn under impulse of said spring, means for limiting the rotation of said spring barrel relatively to said stationary axle when released, a ratchet wheel mounted upon said axle and revoluble relatively thereto, said ratchet wheel being connected with said spring barrel and driven thereby, a gear member connected rigidly with said ratchet wheel, gearing connected with said ratchet wheel and driven thereby, said gearing including a driven member for transmitting power from the motor, and mechanism for locking said last-mentioned driven member after each of its movements.

3. The combination of a normally stationary axle, a barrel revolubly mounted thereupon and provided with notches, a spring connected with said barrel and with said axle for the purpose of turning said barrel relatively to said axle, means for applying power to said barrel so as to wind said spring, said means including a pawl normally engaging some one of said notches of said barrel, mechanism for periodically tripping said pawl so as to release said barrel therefrom, thus allowing said barrel to turn backward under impulse of said spring, and a second pawl for engaging another of said notches and thus stopping rotation of said barrel.

4. The combination of a normally stationary axle, a cog wheel revolubly mounted thereupon and driven continuously, a barrel mounted loosely upon said stationary axle and movable relatively to said cog wheel, a spring connected with said barrel and with said axle, means for periodically connecting said cog wheel to said barrel so as to temporarily turn said barrel against the tension of said spring, trip mechanism for the purpose of periodically liberating said spring barrel from its connection with said cog wheel so as to allow said spring barrel to turn under impulse of said spring, means for limiting the rotation of said spring bar-

rel relatively to said stationary axle when released, a ratchet wheel mounted upon said axle and revoluble relatively thereto, said ratchet wheel being connected with said spring barrel and driven thereby, and a gear member connected rigidly with said ratchet wheel.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LYMAN CRITTENDEN DAVIDSON.

Witnesses:
WALTON HARRISON,
EVERARD B. MARSHALL.