(No Model.) 6 Sheets—Sheet 1.

S. B. WORTMANN.

SPRING MOTOR.

No. 523,190. Patented July 17, 1894.

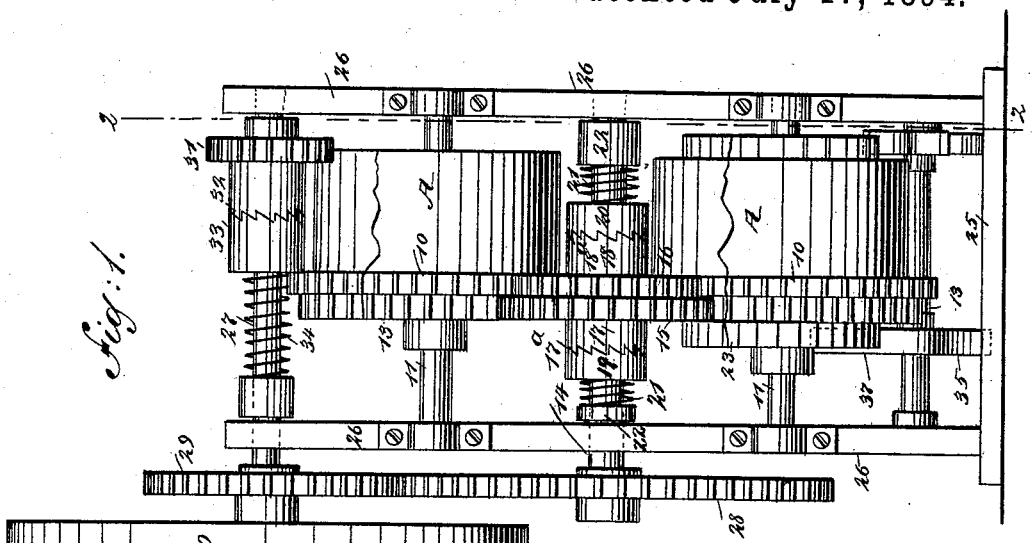

Fig. 1.

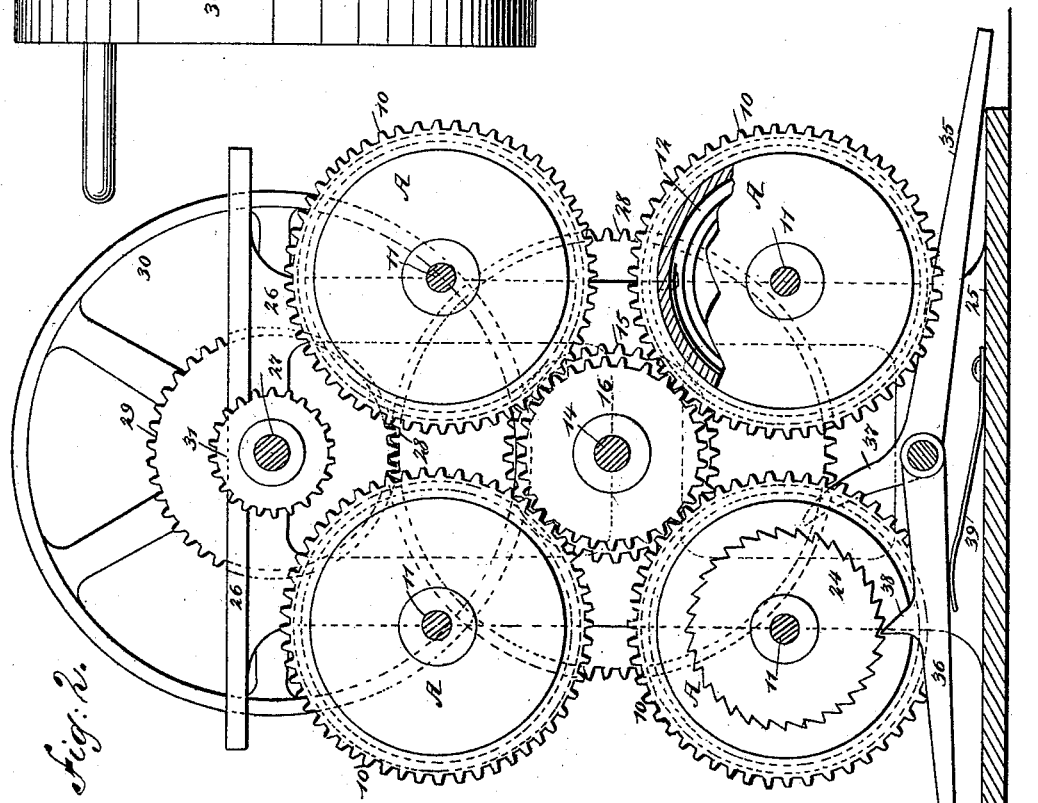

Fig. 2.

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SPRING MOTOR.

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Fig: 4.

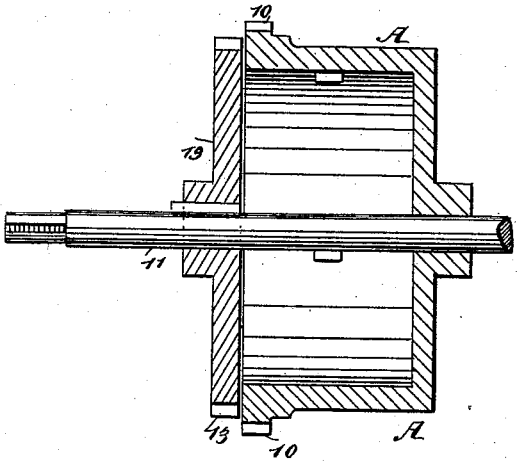


Fig: 3.

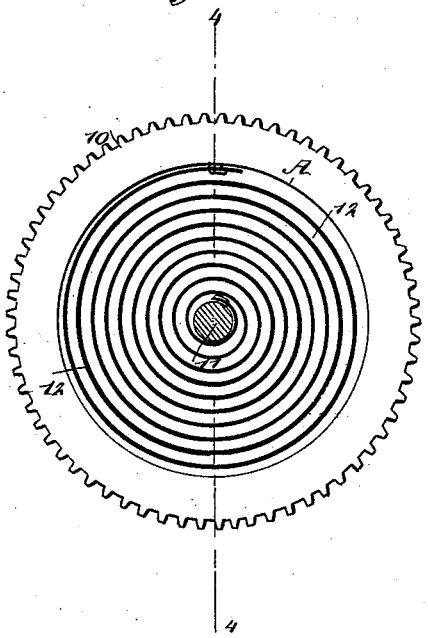


Fig: 5.

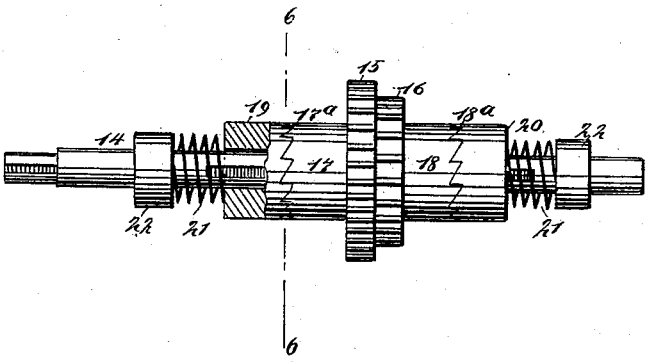
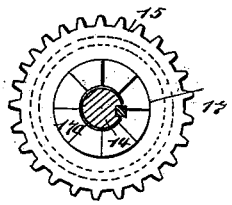


Fig: 6.



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SPRING MOTOR.

No. 523,190. Patented July 17, 1894.

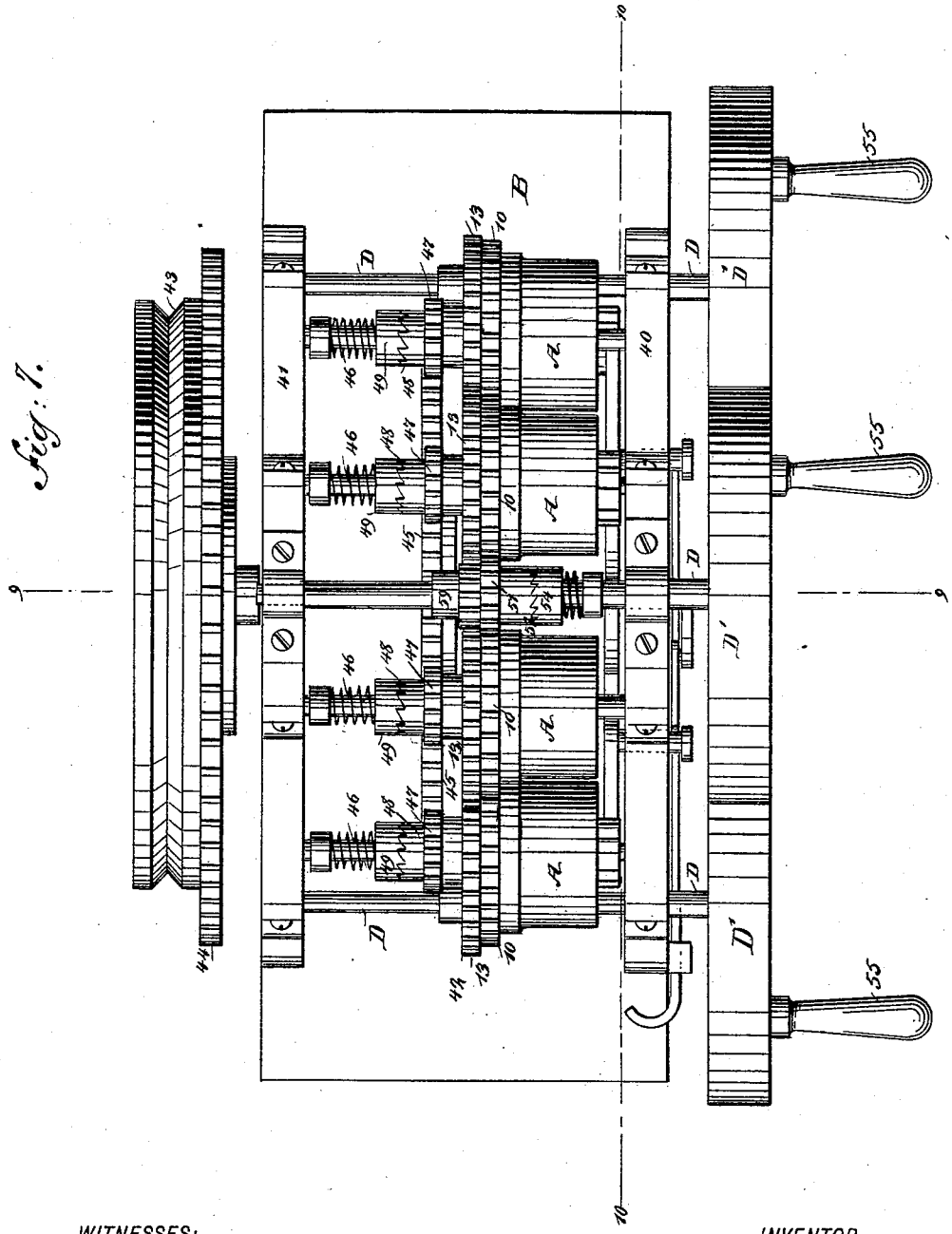

Fig. 7.

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(No Model.)

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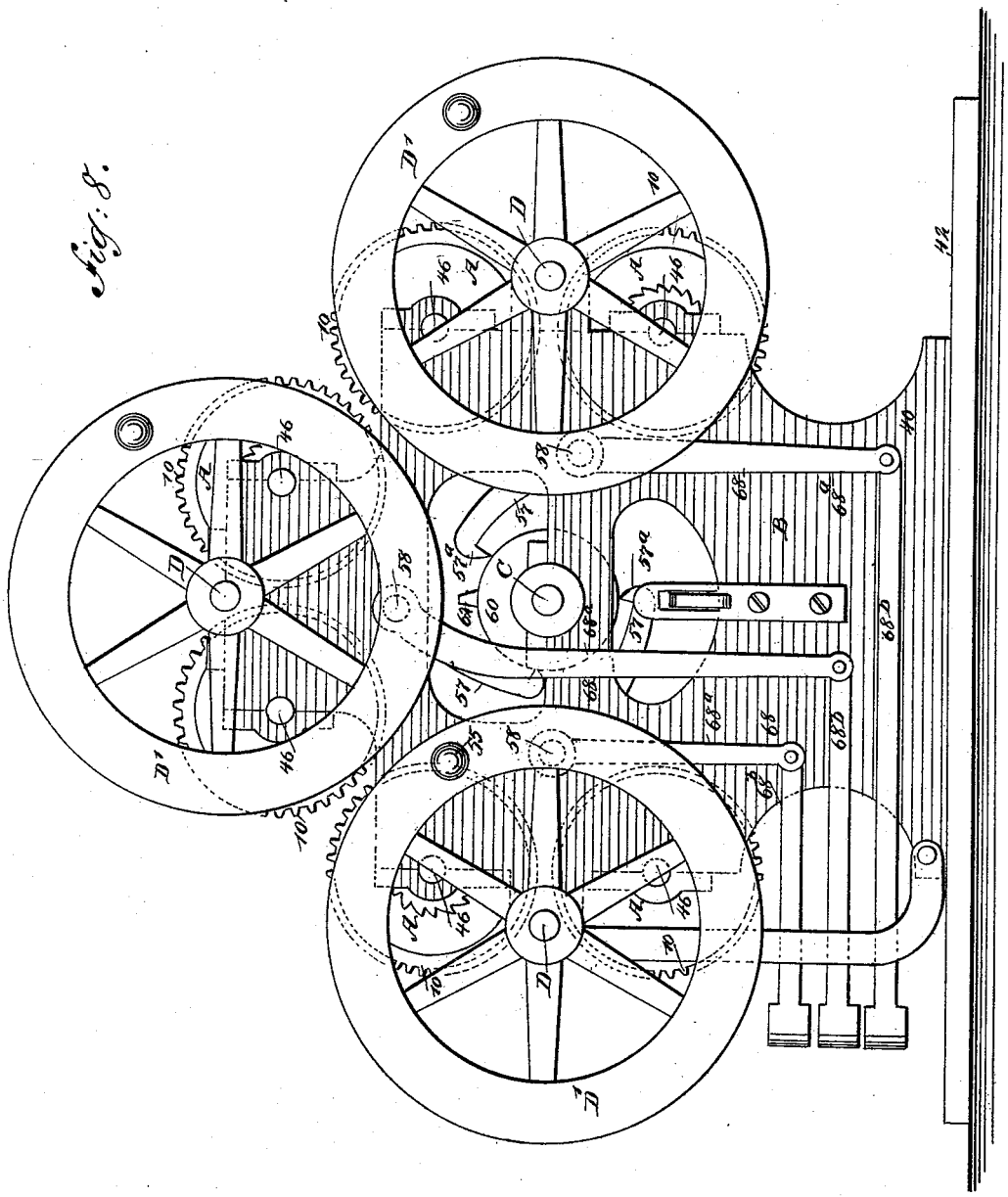
SPRING MOTOR.

No. 523,190. Patented July 17, 1894.

Fig. 8.



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(No Model.)

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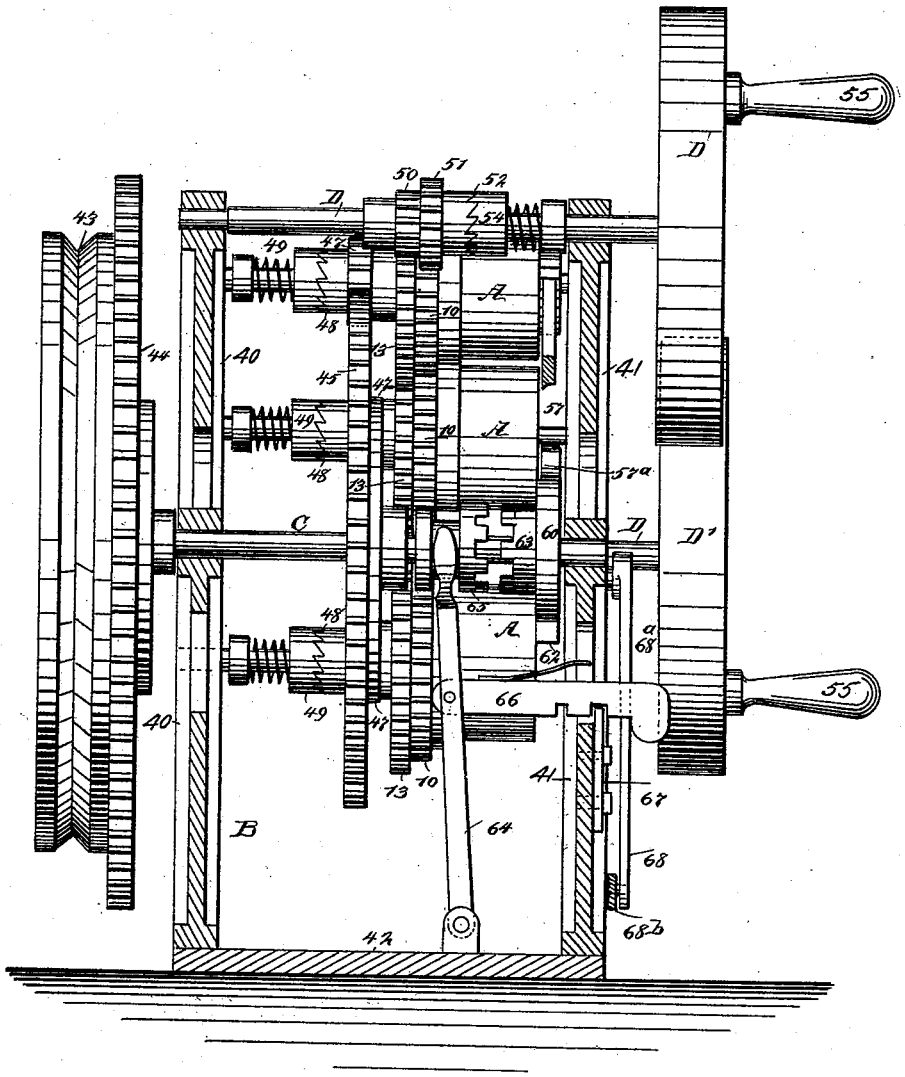
No. 523,190. Patented July 17, 1894.

Fig: 9.



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(No Model.) 6 Sheets—Sheet 6.

S. B. WORTMANN.

SPRING MOTOR.

No. 523,190. Patented July 17, 1894.

Fig. 11.

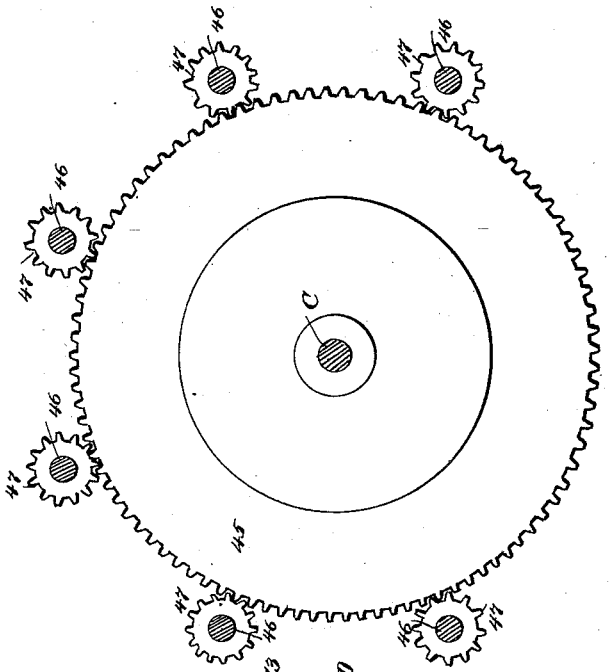
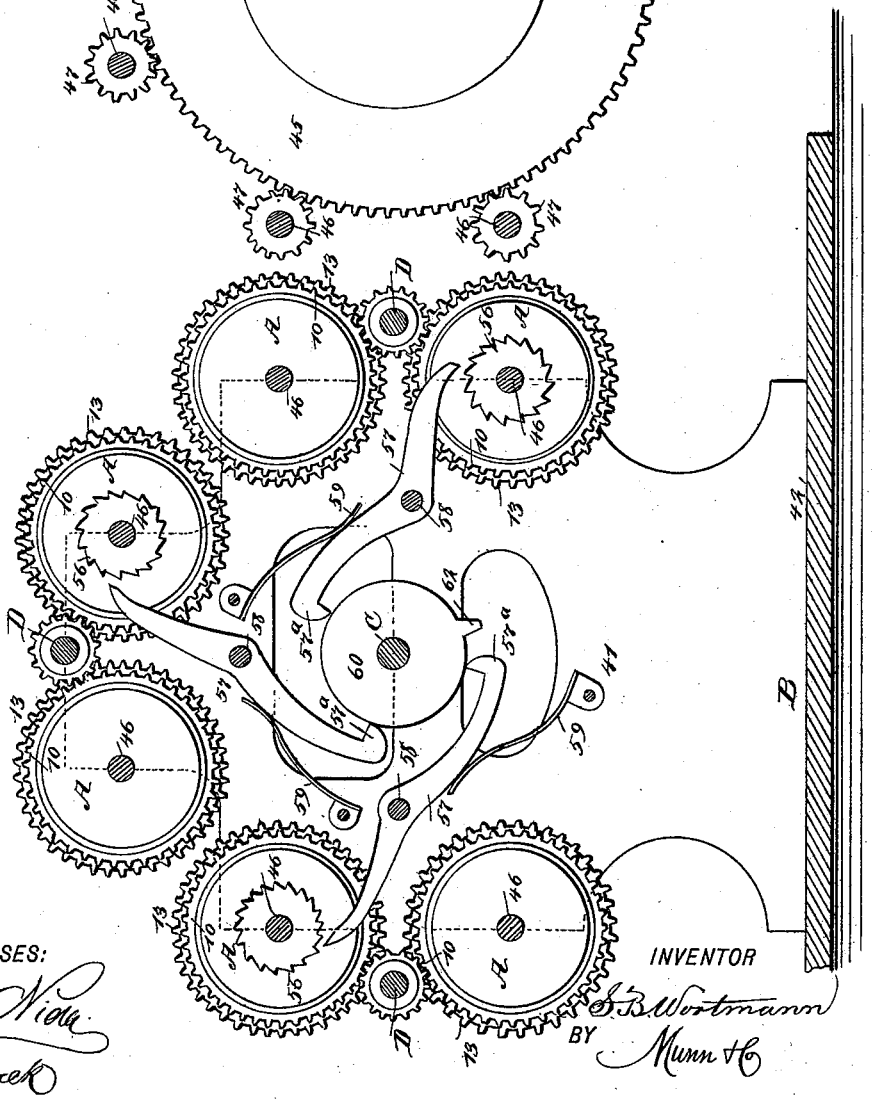


Fig. 10.



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UNITED STATES PATENT OFFICE.

SIGISMUND B. WORTMANN, OF NEW YORK, N. Y.

SPRING-MOTOR.

SPECIFICATION forming part of Letters Patent No. 523,190, dated July 17, 1894.

Application filed March 13, 1893. Serial No. 465,790. (No model.)

To all whom it may concern:

Be it known that I, SIGISMUND B. WORTMANN, of New York city, in the county and State of New York, have invented a new and useful Improvement in Spring-Motors, of which the following is a full, clear, and exact description.

My invention relates to an improvement in motors, and especially to that class of motors deriving their power from coiled springs.

The prime object of the invention is to improve upon the construction of the motor or mechanical movement for which Letters Patent were granted to myself October 27, 1891, No. 461,993, October 27, 1891, No. 461,994, and February 2, 1892, No. 468,167, and by said improvements to accomplish the following results: to concentrate power derived from a predetermined number of springs and transfer it to a power shaft, and to provide a means whereby the springs although they may be made very powerful may be wound singly and independently, or collectively while the power shaft is still or while it is in motion, and to accomplish the above results with a comparatively small outlay of power on the part of the attendant or manipulator, and if the machine is in operation without interfering with or interrupting the motion of the power shaft thus enabling the power of two or more springs, the period of unwinding being properly timed, to be concentrated to a required or predetermined extent in a power shaft. Further to provide a means whereby any number of springs contained in suitable drums may be grouped around the drive shaft, imparting motion thereto, the said shaft being in communication with the power shaft, and also to provide a means wherein by the revolution of the drive shaft around which the springs are grouped, all the springs in the group may be simultaneously wound up; and again to provide a means whereby any number of groupings of drive shafts and springs may be employed, each shaft being in communication with a common power shaft, and any desired group of springs be wound up by the rotation of its drive shaft without interfering in the least with the springs in other groups whether they be inactive or in action, and without, as heretofore stated, interrupting the motion of the common power shaft, thereby obtaining a constant and regular movement of the power shaft, while any group of springs in the combined groupings is wound or kept wound.

A further feature of the invention is to so gear the spring drums with their drive shafts, that a multiple of returns of the springs over the number of windings, the returns being, for example, in a ratio of about seven to one, and likewise to dispense with a multiple of counter shafts and gear to obtain the many returns of the springs by connecting the springs firmly with their drive shafts, and by connecting the drive shafts practically in a direct manner with a single power shaft, friction is reduced to a minimum and all the power that the springs are capable of exerting is imparted to the lower shaft.

It is another object of the invention to provide a means whereby the drums will revolve upon their shafts with comparatively little friction, as clutches or shifting mechanisms need not be connected with the spring drums as in the former patents. The springs are so wound that the drive shafts are revolved in the same direction when turned by the power of the springs as when they are utilized to wind the springs.

It is another feature of the invention to provide each drive shaft with a balance wheel of a predetermined size and weight, which wheel may be utilized for winding the springs connected with the shaft and to employ a shifting mechanism common to all the drive shafts, which will act at intervals and automatically upon all the drive shafts but will momentarily disconnect them from the power shaft and place them in winding connection with the spring drums grouped around them, whereby, during the period that the change or shifting operation is taking place, the momentum or power contained in the balance wheel connected with the particular shaft being acted upon, will be exerted to wind the springs around that shaft, thereby imparting to them renewed life; and at approximately the time the power of the balance wheel is exhausted, the connection between the drive shaft and the power shaft is again automatically brought about. Thus while one group of springs is driving the power shaft another set is being re-wound, and the power shaft

will continue to revolve uninterruptedly for a longer period of time than will be necessary to again fully rewind all of the springs. Before any group of springs has run down to such an extent as not to exert proper force upon the power shaft, each set may alternately be stopped and fully rewound and again be brought into action without stopping the action of any set or sets operating at the time upon the power shaft, or interrupting the motion of said shaft.

The invention consists in the novel construction and combination of the several parts, as will be hereinafter fully set forth, and pointed out in the claims.

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

Figure 1 is a side elevation of a motor constructed in accordance with my invention and adapted especially for use in connection with clock movements, and Fig. 2 is a vertical section through the form of the motor shown in Fig. 1, the section being taken on the line 2—2 of the said figure. Fig. 3 is an inner face view of one of the drums and springs employed in all forms of the motor. Fig. 4 is a section taken practically on the line 4—4 of Fig. 3, through the drum, illustrating in elevation the drum shaft, and illustrating also in vertical section a gear used in connection with the drum and fast upon the drum shaft. Fig. 5 is a side elevation, partly in section, of what may be termed a combined driving and winding shaft, illustrating the pinions thereof and the clutches governing them, the pinions being adapted to operate in connection with the drum and the drum shaft gear, and Fig. 6 is a section taken practically on the line 6—6 of Fig. 5. Fig. 7 is a plan view of a motor constructed in accordance with my invention, adapted for general use for the application of power to any machine. Fig. 8 is a side elevation of the motor shown in Fig. 7. Fig. 9 is a vertical transverse section through the frame of the motor, showing the shafts, clutches and drums, together with the gearing, in side elevation. Fig. 10 is a vertical section taken longitudinally through the motor, and practically on the line 10—10 of Fig. 7; and Fig. 11 is a sectional view, illustrating the connection between the several compound driving and winding shafts with the power shaft.

I will first describe the especial construction of the drums A employed, the manner in which they are connected with the drum shaft, the relation they sustain thereto and their relation to the driving and winding shaft, together with the differential gearing adapted to effect a connection between the drum, the drum shaft and the compound winding and driving shaft.

The drum A, employed may be of any material and may be of any size. It is preferably made closed at one end, its outer end or side and open at its inner end or side; and at the inner end or side an exterior gear 10, is formed, preferably integral with the drum, although it may be produced in any other approved manner. The drum is loosely mounted upon a drum shaft 11, and within the drum a spring 12, is coiled, one end of the spring being attached to the drum shaft and the other end to the inner peripheral face of the drum, as shown in Fig. 3, the connection being made in any approved manner. The drum shaft carries a gear 13, which closes the open end or side of the drum, as shown in Fig. 4. The gear 13, is keyed or otherwise secured firmly to the shaft 11, so that the two may turn together; and preferably the diameter of the shaft gear 13, is less than the diameter of the drum gear 10. If in practice it is found desirable or advantageous the order in the size of these gears may be reversed.

The gears 10 and 13, constitute two of a set of differential gearing, the other two gears being carried by what I term a compound winding and driving shaft 14. These two gears are really pinions and are designated as 15 and 16, best illustrated in Fig. 5. The pinion 15, is shown larger than the pinion 16, and the larger pinion is adapted to mesh with the drum shaft gear, while the smaller pinion is to mesh with the gear 10 upon the drum. These two pinions are independent in their action, and both of them have formed preferably integral with their outer faces sleeves designated as 17 and 18. The inner faces of the two pinions are ordinarily placed practically in contact, and the outer edge of the sleeve 18, as well as the sleeve 17, is provided with a clutch face, and the said clutch faces are designated respectively as 17^a and 18^a, the teeth of the two faces being inclined in opposite directions.

The clutch face of the sleeve 17 of the larger pinion 15, is engaged by a clutch 19, attached to the shaft by a feather, or in any other manner known to the trade, whereby the clutch will turn with the shaft and yet have sliding movement thereon; and the clutch face 18^a of the smaller pinion 16, is engaged by a clutch 20, connected with the shaft in like manner as the clutch 19.

The two clutches 19 and 20, are held in engagement with the clutches of the pinions 15 and 16, preferably through the medium of springs 21, coiled around the shaft and having bearing against the clutches and against collars 22, produced upon the shaft.

There are two ways in which the springs in the drum may be wound; the preferred way consists in placing a ratchet wheel 23, shown in Fig. 1, upon the side of the drum shaft gear 13, and when the winding is to take place a detent is made to engage with the teeth of the ratchet wheel, which acts as a stop upon the drum shaft 11. The compound driving and winding shaft 14, is then turned by means of a fly wheel, hand wheel, crank, or any ap-

plied power, for example, to the right, whereupon the clutch 20, will engage with the clutch section of the small pinion 16, and that pinion will be revolved, while the clutch 19, will simply slip up the clutch section of the opposing pinion 15; and as the pinion 16 turns it will revolve the drum and consequently wind the spring; and owing to the peculiar gearing between the compound or winding and driving shaft and the drum, and the location of the drum upon the drum shaft, every revolution of the drum as it is rotated through the medium of the compound winding and driving shaft will produce many returns upon the unwinding of the spring, as for example, the gearing may be so calculated that the drum shaft will return seven times for each full winding or coil of the spring. When winding in this manner, and the detent is removed from engagement with the drum shaft gear 13, the spring in uncoiling will cause the compound shaft to turn in the same direction in which it was wound.

The other manner of winding the spring consists in securing a ratchet wheel 24, as shown in Fig. 2, to the outer end or face of the drum, and when a suitable detent is engaged with this ratchet wheel the drum is held stationary, and when the shaft is revolved it is turned to the left instead of the right, and the clutch 19 will act upon the pinion 15 to turn it, while the opposite clutch will be wholly inactive and the pinion 15 meshing with the drum shaft gear 13 will revolve said shaft and the spring will be wound around the shaft; and when the power of the spring is to be exerted upon the compound driving and winding shaft, after such a winding, the said compound winding and driving shaft will be turned in the same direction as when the drum was utilized to wind the spring, that is to say, the shaft will be turned in a contrary direction to that in which it was revolved to rotate the drum shaft. Thus, under the construction above set forth, the spring not only can readily be wound either from its inner or its outer end, but owing to the differential gear employed to connect the drum and drum shaft with the winding or driving shaft, the said shaft will be revolved when the force of the spring is exerted freely upon it many revolutions before the spring will unwind itself; in fact, there will be a multiple of returns for every winding of the spring, and a motor in which the drum and its connections are employed will require but little applied power, while the power obtained from the motor will be comparatively considerable and of long duration there being but little loss of power through friction.

The principle of the construction above set forth and shown in Figs. 3, 4, 5 and 6, has been very fully set forth in the patents referred to in the preamble of this specification.

In applying the spring drum and compound winding and driving shaft as a motive power for clock mechanism, the construction may be effected as shown in Figs. 1 and 2, in which views a machine is shown comprising a base 25, and uprights or standards 26. In the center of the frame so made the compound winding and driving shaft is located; and the drum shafts 11, as shown in Fig. 2, are grouped around the compound winding and driving shaft 14, two at each side, and all of the drum gears and likewise the drum shaft gears 13, are in mesh with the pinions 15 and 16 on the winding and drive shaft. Thus it will be observed that by rotating the said shaft, the springs carried by all of the drums will be simultaneously wound up; and further, the action of all the springs in unwinding will be brought to bear upon the compound winding and driving shaft, concentrating in said shaft a large proportion of their applied power; and in the form of the machine shown, this power is communicated to the power shaft 27, journaled in the upper central portion of the frame through the medium of a large gear 28, connected with the driving and winding shaft preferably at one end, and a smaller gear 29, located upon the power shaft, and a winding is effected by applying a hand wheel 30 to one end of the power shaft; or a crank, or other form of device may be substituted for the said hand wheel. The power shaft is provided in this instance with a gear 31 loosely mounted thereon, and this gear is to be brought in communication with the mechanism of the clock to which the machine is to be applied. The gear 31, is provided with a clutch face 32, the clutch face being engaged by a clutch 33, controlled by a spring 34 and mounted to slide upon yet turn with the power shaft; and when the power gear 31, is thus provided with a clutch the power shaft may be turned in one direction without revolving the power gear.

In Fig. 2 I have shown two levers designated as 35 and 36 as fulcrumed at the base portion of the machine, the lever 35, being provided with a detent or pawl 37, and the lever 36 with a like addition 38. The lever 36, is pressed upward by a spring 39, in a manner to cause its pawl to engage with the ratchet wheel 24 upon a lower drum; while the pawl of the lever 35, may be thrown in connection with the ratchet wheel 23 located upon the drum shaft gear 13, belonging to the drum carrying the ratchet 24, the two ratchet wheels 23 and 24 having their teeth facing in opposite directions.

It is only necessary that a brake or pawl should be applied to one drum or one drum shaft gear, since all of the drums and gears are connected through the medium of the winding or driving shaft, and in practice but one of the levers 35 and 36 need be employed; but if both are used, one or the other must be out of action, and the lever 36, when brought in locking engagement with the drum may be held in such engagement by the spring 39 until it is pressed downward or locked in its lower position; but when the le-

ver 36, is used as a check upon the drum, any portion of the machine may be taken apart for the purpose of cleaning or repair.

When a motor is to be constructed for driving various kinds of machinery, for example, it may be built as illustrated in Figs. 7, 8, 9, 10, and 11. The frame B, is made as light as possible consistent with strength, and comprises two sides or uprights 40 and 41 and a base 42. The main or power shaft C, is journaled in suitable boxes located ordinarily at or near the center of the sides of the frame, and the said power shaft at one end has keyed or otherwise secured thereon a driving pulley 43, which may be belted in any approved manner to the machine to be driven; the said power shaft may also be provided with a large spur gear 44, having a predetermined number of teeth, which spur gear or wheel may be geared to the machine to be driven in any manner known to the trade, and the pulley when employed in connection with the gear will act as a balance or fly wheel. A master wheel or gear 45, is firmly secured upon the power shaft, preferably at a point between its bearings, and through the medium of the master wheel, which is geared directly with the drum shafts, the power shaft is revolved.

In the machine motor shown I have illustrated the power shaft as surrounded by three sets of spring drums A, two drums constituting a set, one set being located at the front, another at the back and the third at the upper portion of the frame. Each set of spring drums is identical in construction, and a description of one set will answer for them all; but the drum shafts 46 of the front and rear drums are located in vertical alignment, one above the other, as shown in Fig. 10, while the drum shafts of the upper set are placed in horizontal alignment, one opposite the other.

The drum shafts are journaled in boxes located in or upon the sides of the frame, and in addition to carrying the drums A and the differential gears 10 and 13, have mounted thereon to turn therewith pinions 47, one pinion being located upon each drum shaft; and each pinion is in constant engagement with the master wheel or gear 45, as shown in Fig. 11. The pinions 47 are preferably placed near the outer differential gear 13, or the gear secured upon the drum shaft. The construction of the drums and their revolution with their differential gears are the same as heretofore described and shown in Figs. 3 and 4, but in the machine motor the shaft gear 13, wherever employed, is illustrated as being of greater diameter than the drum gear 10, and in the former description of the differential gear mention was made of the desirability of such a change at times.

Each pinion 47, is provided with a clutch face 48, adapted to be engaged by a spring-controlled clutch 49. The clutches are splined or otherwise held to turn with the drum shafts, and the pinions are loosely mounted upon said drum shafts. When the springs in the drums are being wound the clutches slip over the clutch faces of the pinions and fail to act in a driving capacity, and the pinions at that time exert no power upon the master gear; but when the springs are expanded, or are otherwise in driving action, the clutches engage the pinions, force them to revolve, and contribute to the revolution of the master gear. Between the drums of each set a winding shaft D, is located, the said shaft being journaled in the sides of the frame. Each shaft D, carries two pinions of different diameters, which are designated respectively as 50 and 51. These pinions mesh with the drum and drum shaft gears 10 and 13, and together with these latter gears make up the differential sets of gears of the drums. The pinions 50 and 51, are equivalents of the pinions 15 and 16 heretofore referred to and illustrated in Fig. 5; but their arrangement upon the shaft is slightly different, the pinion 50 being pinned, wedged or otherwise secured directly upon the shaft, while the pinion 51, is provided with a clutch face 52, engaged by a spring controlled clutch 54, held to revolve upon the shaft. Both pinions are not brought into action at the same time, however, when the fixed pinions 50, are used for winding the springs, and they are preferably employed for that purpose. In this case the pinions 51, are not acted upon by their clutches. When the pinion 50, is used for winding the latter is much more rapidly accomplished and a greater number of returns are obtained for one revolution of the winding shaft than can be obtained by using both pinions 50 and 51. Therefore, I call the first named method of winding the short winding and the second method the long winding; and when the short winding is employed, that is to say, when only the pinions 50 on the winding shaft are brought into action, the winding shaft turns in the same direction when being revolved for winding purposes, or while the springs of the drum are unwinding. Each winding shaft D, is provided at one end with a balance or fly wheel D', and these wheels are also usually provided with handles, 55, whereby the wheels may be revolved and the winding action on the part of the shafts D procured. One drum of each set carries securely attached to it a ratchet wheel 56, as shown in Fig. 10, and each ratchet wheel is engaged by a pawl 57, said pawls being pivoted ordinarily at their centers, as is shown in said Fig. 10. The pivots 58 of the pawls are ordinarily circularly placed around the power shaft, their outer ends being adapted for engagement with the ratchet wheels, but are normally held out of such engagement by springs 59.

It is sometimes desirable to construct a motor in such manner that it will at predetermined intervals act to partially rewind the springs, and repeat such winding for a given number of times, thus obtaining for one full

and positive winding a great duration, or a long continuation of driving power. In such an event the pawls back of their fulcrums are provided with heads 57ª, and said heads are normally held in engagement with a crank disk 60 by the springs 59, as shown in the said Fig. 10. An eccentric, or any equivalent thereof, may be substituted for the crank disk, and the latter consists of a disk loosely mounted upon the power shaft and provided with a peripheral stud or finger 62, adapted to engage with the heads of the pawls and to act alternately upon said heads to throw the opposite ends of the pawls in engagement with the winding drums and thereby temporarily prevent the unwinding of the latter. The balance wheels attached to the winding shafts whose motion has been arrested continue to revolve by reason of their momentum, and thus in revolving secure winding of the springs contained in the drums whose action has been stopped. The crank disk is further provided with a clutch face 63, adapted for engagement with a clutch 65 having sliding movement upon the power shaft and turning with it. When the crank disk is to be brought into action the clutch embraces it, and this is accomplished by operating a shifting lever 64 connected with the clutch and ordinarily pivoted in the base of the frame, as shown in Fig. 9, which figure also illustrates one means for locking the shifting lever in any one of two positions, consisting of a spring controlled latch 66, connected with the shifting lever and fitted for engagement with the keeper 67 of any approved type.

The pivot points 58 of the pawls are located in one side of the frame, and each pivot point is connected with a brake lever 68. The levers are ordinarily constructed in two sections, 68ª and 68ᵇ, the sections being pivotally connected, and the levers are preferably of the elbow or angle type; one end of each brake lever is carried and secured to a pivot 58 upon the frame, while the opposite ends of the levers are carried to any point within convenient reach of the operator.

In the operation of the motor, when the winding shafts are manipulated to wind the springs, as has heretofore been stated, by reason of the peculiar construction of the drums and differential gearing connected with the winding shafts, the springs will give many returns for each winding of the said shafts.

The machine may be made to run without the eccentric or crank disk, that is to say, without bringing into action the rewinding mechanism. In this event, the springs after having been wound are permitted to unwind by carrying the pawls out of engagement with the ratchets upon the drums, and all of the springs will impart their combined power to the power shaft; and when one set of springs is to a predetermined extent unwound, thus lessening their power, that particular set may be wound up by manipulating the winding or balance wheel connected with the winding shaft of that set, the clutch upon the drum shafts of that set at that time ceasing to act and thus allowing the pinions connected with that set to turn freely; and thus by alternately rewinding wholly or partially the various sets of drums the motor may be kept in operation as long as deemed practicable, and a uniform speed will be attained by the power shaft, that is to say, a number of spring drums may be employed which will really impart to the power shaft more power than is absolutely necessary or required, so that when even one set of drums is cut out in order to be rewound the remaining sets in action will give a sufficient power to the said power shaft. It will be understood that when a set of springs is to be rewound the brake lever in connection with the drums of that set will be manipulated in a manner to apply the pawls to the ratchet wheel of the set.

When the motor is to be employed to automatically rewind itself to a predetermined extent, the sets of springs are wound up and alternately set in motion, so that in the natural order of events one set of springs would follow the other in fully unwinding. The crank disk is then set in communication with the clutch upon the power shaft, and as the power shaft is revolved the finger on the crank disk by engaging with the heads of the several pawls will, when lifting said pawls, throw them into locking action with a set of springs, thus temporarily stopping the unwinding of the springs but not interfering with the revolution of the winding shaft, which will be continued to be revolved by the momentum or stored power contained in the balance wheel connected with the shaft, the clutch upon the shaft enabling this to be accomplished. Thus the drums being stopped from revolving, and the winding shaft continuing to revolve, the springs in the drums will be rewound to a certain or predetermined extent. In the meanwhile, the other sets of spring drums are in full action, and before the finger of the crank disk will engage with another pawl to rewind that set of springs it will have released the pawl connected with the set just partially wound, and that set will be brought into full action. By this means the motor may be made to run for a great length of time, and by fully rewinding the several sets of springs when they have been reduced in strength by means of many windings, a predetermined power and speed may be constantly maintained in the power shaft.

In this specification I have stated that in the construction of the motor, friction is reduced to a minimum, and for purposes of exemplification I will specify that in the drawings I have shown a system of differential gears comprising only the drum gear 10, and the drum shaft gear 13, these gears being of different diameters, and two pinions of varying diameters which mesh with the gears 10 and 13. The gearing is for example so calculated

that for every one winding or complete revolution of the winding shaft the drum spring to be wound is given a half coil, and for every two revolutions of the winding shaft the spring is wound a complete coil, the gears on the winding shaft being one-half the size of those on the spring drum. Under these circumstances, supposing the spring in the drum to be given eight coils in order to place it under full tension, to accomplish this complete winding of the spring the winding shaft is revolved sixteen times; now when the spring unwinds to transmit power, the differential gearing between the drum, drum shaft and winding shaft will give ten revolutions of the drum for every time it was once turned in winding the spring, therefore, as the winding shaft is turned sixteen times in winding up the spring, the spring in unwinding will give one hundred and sixty return revolutions to the winding shaft from which power may be taken. Thus it will be observed that the spring having received eight coils, and giving one hundred and sixty revolutions to the winding shaft will yield in this instance twenty-fold return for the power expended in winding it, and this multiple return is obtained by the employment of but two gears, two meshing pinions and a single shaft, in addition to the drum or spring shaft, and it is evident that as the spring or drum shaft acts directly upon the winding or power shaft, there is comparatively but little friction; in fact, the friction is reduced to a minimum, and yet the full power of the spring is obtained.

The great saving in power and the vast reduction in friction obtained in my machine over the old method of accomplishing the same result, will be readily understood and appreciated when the old method is known. Under the old method, in addition to the drum shaft and its gear, four auxiliary or countershafts must be employed, carrying in the aggregate three gears and four pinions, the first three shafts being each provided with a gear and pinion, and the last shaft is provided with one pinion only, power being taken from it. In the operation of this system of gearing the first set of gears may be made to receive twenty returns from the spring for two windings thereof; the next set forty returns for four windings; the third set eighty returns for eight windings, and finally the fourth or power shaft will be given one hundred and sixty revolutions from the uncoiling of the spring for sixteen revolutions of the pinion on the shaft in winding up the spring. The result in each case is the same, but I accomplish it with but one shaft in addition to the drum shaft and two gears, in addition to two more on the drum shaft, thus producing a compact structure with little friction, while under the old system, the four additional shafts used and the seven additional gears necessary, not only generate a great amount of friction but require the erection of an exceedingly bulky structure when embodying the spring power in a motor or other machine.

It is observed that the master gear 45 and the pinions 47 employed in the form of construction illustrated by Figs. 7 to 11, do not contribute to the above result which consists in obtaining a multiple of returns of the winding shaft or shafts for every winding of the spring, but the said master gear and pinions serve merely to transmit the rotation of the winding shafts to a common power shaft.

In addition to the economy of space and the reduction of friction which I obtain by my improved method, I am enabled to obtain the full power of the spring employed, as its action is direct upon the power shaft, while under the old system, even although as many returns from the spring are obtained, the same power from the spring is not received by the power shaft, owing to the transmission of power through so many intermediate gears and shafts, and the fact that the immense amount of friction thereby generated absorbs the major portion of the power of the spring, comparatively little being communicated to the last or power shaft; therefore, I claim to obtain from a spring its maximum strength by imposing upon it a minimum of friction, and at the same time I bring the driving and driven shafts in close and direct relation. This I am enabled to do through the medium of the differential gearing heretofore described.

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

1. In a spring motor, the combination, with a power shaft and a master wheel carried thereby, of a drum shaft, a spring drum loosely mounted upon said shaft and provided with an attached gear, and likewise a gear differing in diameter to the drum gear and secured to the drum shaft, a pinion located upon the drum shaft and meshing with the master wheel, a winding shaft, and two pinions of differing diameters located upon the winding shaft, meshing one with the drum and the other with the drum shaft gear, one of the said pinions being clutch controlled, substantially as shown and described.

2. In a spring motor, the combination, with a power shaft, a master wheel mounted thereon to turn therewith, a drum shaft, a spring drum loosely mounted upon said shaft and provided with an attached gear, a second gear differing in diameter to that of the drum gear and secured to the drum shaft, and a clutch controlled pinion carried by the drum shaft and meshing with the master wheel, of a winding shaft, two pinions of varying diameter located upon the winding shaft, meshing one with the drum and the other with the drum shaft gear, one pinion being attached to the winding shaft and the other clutch controlled, a balance wheel also serving as a hand wheel and power storage wheel secured

to the winding shaft, and a power pulley attached to the power shaft, substantially as herein shown and described.

3. In a spring motor, the combination, with a power shaft, a master wheel carried thereby, a series of drum shafts grouped around the power shaft, each drum shaft being provided with a spring drum loosely mounted thereon, having an integral gear, and likewise a gear of different diameter than that of the drum gear and secured to the drum shaft, and a clutch controlled pinion also mounted upon each drum shaft and meshing with the master wheel, of a winding shaft common to each pair of drum shafts, each winding shaft being provided with pinions of different diameters, one fixed and the other clutch-controlled, the pinions being adapted to mesh with the drum and drum shaft gears, and balance wheels also serving as hand wheels and for the storage of power secured one to each winding shaft, as and for the purpose set forth.

4. In a spring motor, the combination, with a power shaft, a master wheel carried thereby, a series of drum shafts grouped around the power shaft, each drum shaft being provided with a spring drum loosely mounted thereon, having an integral gear and likewise a gear of different diameter from that of the drum gear and secured to the drum shaft, and a clutch controlled pinion also mounted upon each drum shaft and meshing with the master wheel, of a winding shaft common to each pair of drum shafts, each winding shaft being provided with pinions of differing diameters, one fixed and the other clutch-controlled, the pinions being adapted to mesh with the drum and drum shaft gears, balance wheels also serving as hand wheels and for the storage of power, secured one to each winding shaft, a brake mechanism carried by the power shaft, detents engaging with the brake mechanism and adapted to control the movement of the drum shafts, and means, substantially as shown and described, for bringing the detents into alternate action, as and for the purpose set forth.

5. In a spring motor, the combination, with a power shaft, a master wheel carried thereby, a group of drum shafts located around the power shaft, the drum shafts being provided with clutch controlled pinions meshing with the master wheel, a spring drum loosely mounted thereon and provided with a gear, and a gear of different diameter to that of the drum gear and secured to the drum shaft, of a winding shaft common to each pair of drum shafts, said winding shaft being provided with differential pinions meshing with the differential gears of the drum shafts, one gear of the winding shaft being secured thereto and the other clutch-controlled, a balance wheel secured to each of the winding shafts, which also serves as a hand wheel, a brake mechanism carried by the power shaft and capable of being thrown in or out of gear therewith, detents connecting the brake mechanism through a ratchet connection with a drum shaft of each pair, and a means, substantially as shown and described, for bringing each detent into alternate action through the medium of the brake mechanism, as and for the purpose specified.

6. In a spring motor, the combination, with a power shaft, a master wheel carried thereby, a group of drum shafts located around the power shaft, the drum shafts being provided with clutch-controlled pinions meshing with the master wheel, a spring drum loosely mounted thereon and provided with a gear, and a gear of different diameter to that of the drum gear and secured to the drum shaft, of a winding shaft common to each pair of drum shafts, the said winding shaft being provided with differential pinions meshing with the differential gears of the drum shafts, one gear of the winding shaft being secured thereto and the other clutch-controlled, a balance wheel secured to each of the winding shafts, which also serves as a hand wheel a brake mechanism carried by the power shaft to rotate therewith, ratchets connected one with a drum shaft of each pair, spring-controlled detents engaging with the brake mechanism and with ratchets, and a shifting mechanism connected with each detent, whereby they may be brought into action to stop the revolution of any set of drum gears, permitting the winding shaft of that set to act to rewind the drums and thus obtain a reinforcement of power, substantially as and for the purpose specified.

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