March 25, 1930. J. B. BROWNING 1,751,903

ELECTRICALLY WOUND SPRING MOTOR

Filed Nov. 9, 1921 2 Sheets-Sheet 1

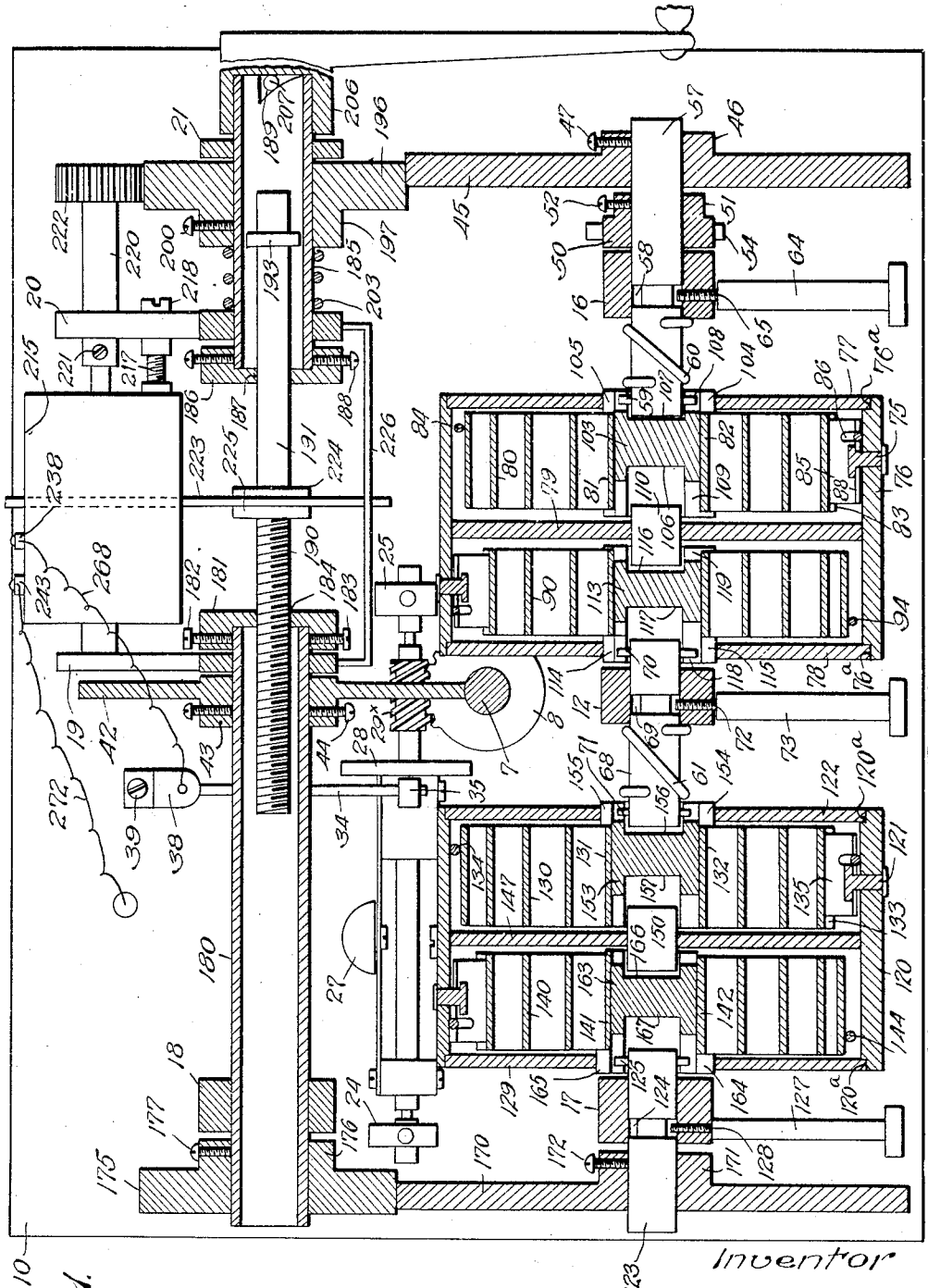


Fig. 1.

Inventor

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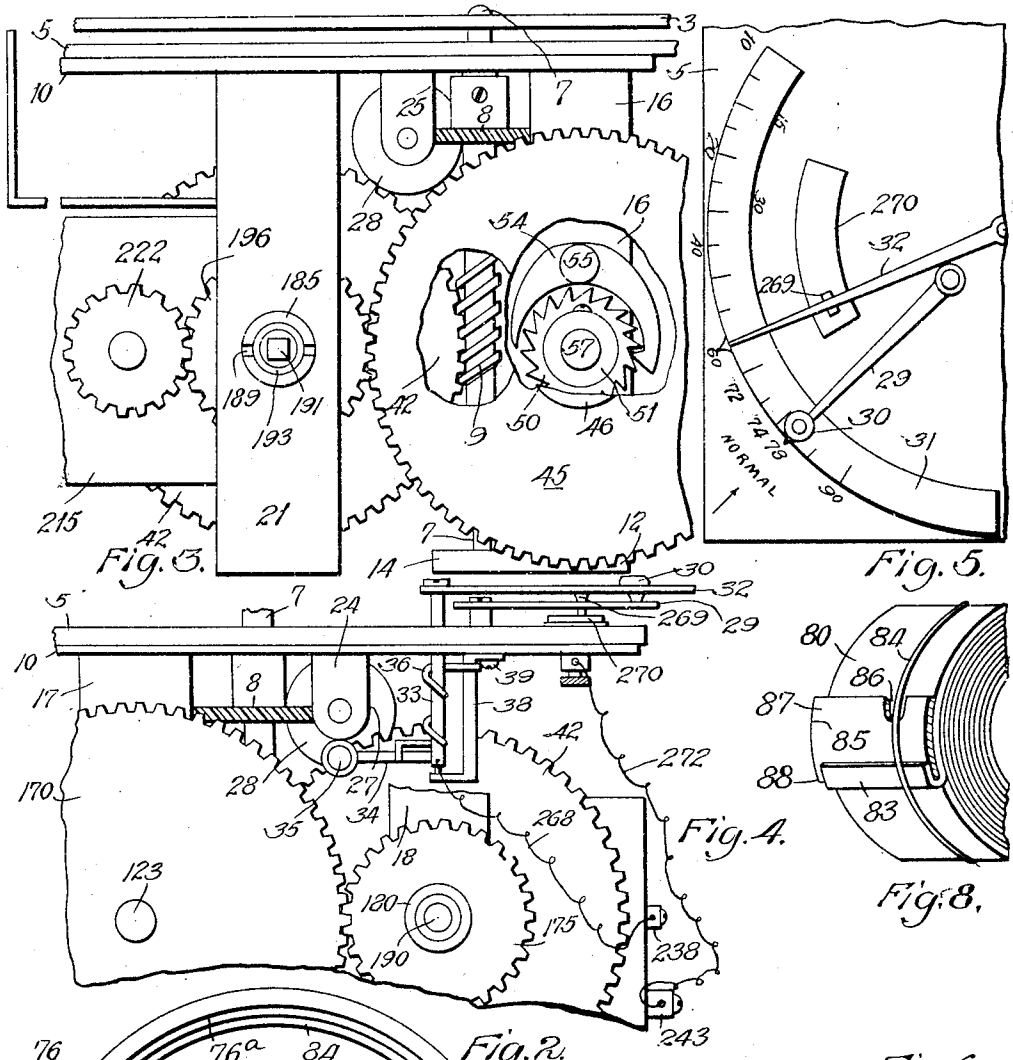
By Ray Belmont Whitman

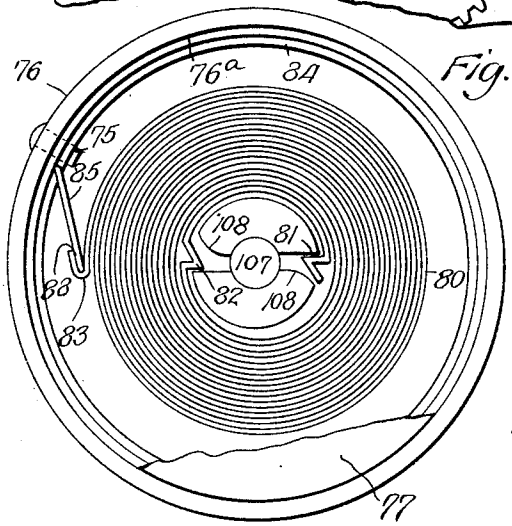
Attorney

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ELECTRICALLY WOUND SPRING MOTOR

Filed Nov. 9, 1921 2 Sheets-Sheet 2





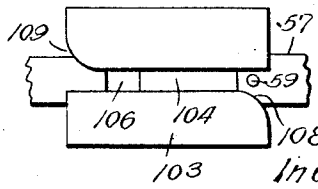


Fig. 7.

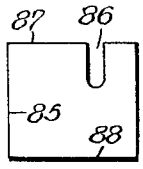


Fig. 6.

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Patented Mar. 25, 1930

1,751,903

UNITED STATES PATENT OFFICE

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ELECTRICALLY-WOUND SPRING MOTOR

Application filed November 9, 1921. Serial No. 513,972.

One of the objects of this invention is to provide a spring motor comprising a plurality of driving units arranged in series, each including a spring cage or inclosure, a spring and shaft contained therein if a single spring unit, two springs and two shafts contained therein if a plural unit, and in which the driving units may be readily separated and taken apart for repairs.

Further objects and advantages are: to provide an improved spring motor of simple and durable construction in which all the running parts are so constructed and standardized that they may be used either in a motor embodying a single one or two spring unit or one embodying a plurality of one or two spring units, and in which duplicate parts may be employed in building up single or double units, plural unit motor being only necessary to provide different sizes of the supporting frame for different sizes of motors; to avoid a long spring shaft between widely separated bearings; to avoid a plurality of sleeves rotatably mounted on a long spring shaft; to provide a serial spring shaft in sections, a section of which forms the inner element of an improved power unit, said sections being movable with respect to each other; to provide supports with aligned bearings for sections of a serial spring shaft; to connect up a plurality of spring units in series through a series of shafts; to provide an improved electric winding means and automatic electric switch operated by said means; to provide an improved winding means to prevent over-winding of the springs; to provide an improved means to remove a spring with its connecting shaft from its inclosing element without uncoiling the spring; to arrange a turntable spindle substantially central with all the running parts arranged around the spindle to economize vertical and lateral space; to provide means to indicate the quantity of driving power contained in the units at any time; to provide improved means to indicate and regulate the speed of rotation of the table spindle; to provide improved means to prevent the outer element from breaking the outer end of the spring, when winding the spring against the inner element or shaft to permit the outer end of the spring to gradually move away from the outer element when winding, permitting each spiral of the spring to retain a true circle around its axis of rotation, thus insuring the equal distribution of power between the several associated series of springs; to provide a simple, positive catch or disengageable connection between the spring and cage by winding the spring against the cage and disconnectible upon reverse rotation and removable from the cage by a longitudinal movement of the spring without uncoiling, avoiding the tendency toward any irregular action by any particular spring, such as the breaking, cramping, slipping, jumping and irregular movement of the several springs arranged in series due to connecting the outer end of the spring rigidly to the outer element, which when winding and uncoiling form a series of irregular spirals around the inner element.

Another object is to provide a simple, cheap spring retaining ring to permit the spring to remain normally expanded when out of use and to be removed from a spring cage without uncoiling or inserted without coiling, also interchangeable in a single or plural unit; to provide a shaft or inner element of simple form interchangeable in a single spring or double spring unit, provided with a plurality of positive connections for the spring, which automatically disconnect themselves from the spring upon reverse rotation and upon a longitudinal movement of the inner element with respect to the spring or the spring with respect to the outer element; to provide improved means for mounting each driving unit, single or double, between pivots, the pivots being arranged to equally distribute the power of the several series of springs, they being adjustable through their supports to permit the removal of one unit without moving any one other unit, single or plural.

Another object is to provide each spring with a separate spring shaft, provided with pivot bearings and a clutch element at each end, to permit the transmission of power from one unit to another through the mentioned pivots and mentioned supports, thus

avoiding the disadvantages of widely separated bearings or a long shaft and a plurality of sleeves. I have found in practise much of the irregular movement of springs arranged in series is due to the binding of the sleeves on the shaft and the outer end of the spring being connected to the barrel.

In the accompanying drawings, which illustrate a preferred form of the invention:—

Figure 1 is a bottom plan view in section of a plural spring unit, plural unit motor;

Figure 2 is an end view of the spring unit arranged in a spring cage;

Figure 3 is a side view of a portion of Figure 1, partly in section and partly broken away to show the winding mechanism;

Figure 4 is a side view of a portion of the opposite side of Figure 1;

Figure 5 is a plan view of the motor board, partly broken away and showing parts of the brake and regulating device;

Figure 6 is a plan view of the catch connection between the end of the spring and the cage;

Figure 7 is a side view of the spring shaft, showing the ratchet grooves, and

Figure 8 is a perspective view showing a fragmentary portion of the spring and the retaining ring therefor.

Referring to the drawings, one embodiment of this invention is shown (Fig. 1), as applied to a talking machine, having the usual motor board 5, which forms part of any suitable cabinet, and including a plate 10, arranged beneath the board and secured thereto by any suitable means. This frame 10, may be a one piece casting or of a pressing of any suitable material, and including the supporting brackets which depend therefrom, which form bearings for supporting the motor proper as well as the turntable spindle rotated thereby and other running parts, which may be arranged in various relative positions to efficiently accomplish their purpose.

As shown the plate 10, is provided with depending bracket 12, provided with a bottom projection 14, adapted to form a bottom bearing for the spindle 7, so as to extend vertically through an aligned opening through the supporting plate 10, and an opening in the motor board 5, in a well known manner. Depending from the plate 10, are a number of other brackets, 16 and 17 (see Fig. 1), adapted to form bearings for the pivots on which the units are mounted as will hereafter appear. There are also depending from the plate 10, other brackets, 18, 19, 20 and 21, also provided with aligning openings adapted to form bearings for the running parts of the winding attachment and driving gear. By forming the frame and depending brackets of a single casting with all the bearings in close alignment, the machinery necessary to finish the same is reduced, and the drilling between long bearings is eliminated and a maximum of rigidity is obtained. There are also provided two brackets, 24 and 25, depending from the plate 10, provided with aligned bearings for rotatably mounting the governor 27, the speed of which may be regulated by a lever 29, adjustably mounted on the board 5, a scale 31, attached to the board 5, marked in revolutions per minute and a speed indicating lever 32, which is pivoted in a bracket 38. The lever 32, is mounted on a pivot 33, which is provided with a lever arm 34, having a friction pad 35, bearing on the friction disc 28, of the governor 27. The bracket 38, is rigidly secured to the plate 10, by the bracket screw 39. The friction pad 35 follows the movement of the governor moving the lever 32, which indicates the speed of rotation on the scale 31 until it moves up to the projection 30, provided on the adjusted lever 29, which limits the movement of the friction disc 28. A light spring 36, is coiled around the pivot 33, one end of which is connected to the pivot and the other to the bracket 38, in any well known manner, causing a slight tension of the friction pad 35, against the governor friction 28, in such a manner that when the movement of the governor friction changes the pad 35, will follow this change of movement, moving the lever 32, correspondingly and indicating any change of speed on the scale 31.

It is evident that the governor 27, could be located in numerous other positions on the supporting plate 10, if so desired. As shown, the governor spindle is provided with a worm $29^{\times}$, adapted to mesh and to be driven by the gear 8, suitably secured to the vertical turntable spindle 7, or any other form of construction might be used to drive the governor, which regulates the speed of the spindle 7. Various forms of transmission may be used to transmit the power produced by the motor to the driven members as the spindle 7.

In order to produce a substantially noiseless, smooth running motor and regularly operating multiple spring motor of the character indicated in the statement of this invention, the motor is so arranged that the several spring units thereof are so arranged in series, interconnected and associated with the other parts of the device that the power of each is delivered to the transmission mechanism, so as to obtain the counter-balancing and neutralizing effect of one unit against any irregular action by any other spring unit in the series, the transmission friction is substantially reduced by eliminating the usual long shaft around which are usually a plurality of sleeves connected in series to the springs. I have discovered that this is best accomplished by connecting each spring of the series to a separate shaft, mounting each shaft which is contained in each unit between pivots and supporting each pivot that transmits power in a separate bracket and having

its ends projecting freely therefrom, the ends of each spring in each unit connected in such a manner to its inner and outer element to permit each coil in winding or unwinding to move in a gradually changing spiral around its axis of normal rotation.

The spindle 7, is mounted through the plate 10, and supported at its lower end in the lug 14, of the bracket 12; a record support 3, of a well known form is mounted at its upper end above the plate 10. The spindle is provided with a worm 9, which meshes with the worm wheel 42. A plurality of spring units, single or double, are arranged in series to drive this worm wheel to best accomplish the desired results in this invention (shown in Fig. 1). The plural units are provided with two springs, detachably arranged in series therein. The power for winding these springs is transmitted from the improved winding device, which will be hereafter described to the winding gear 45, which is adjustably mounted on the free end of the first pivot 57, by a set screw 47, through the hub 46. A ratchet 50, is also adjustably mounted on the pivot 57, by a set screw 52, through a hub 51. A pawl 54, is pivoted to the bracket 16, by a pawl stud 55, to permit the ratchet to turn in one direction only. The pivot 57, is rotatably and slidingly mounted through a bearing in the bracket 16, and provided with removable pin 59, extending transversely through same; the pivot is also provided with a circular recess 58. To prevent longitudinal movement of the pivot 57, through the support 16, a thumb screw 64, provided with an elongated handle is threaded into the bracket 16, with the threaded portion 65, projecting through the bearing into the recess 58, just enough to prevent longitudinal movement of the pivot through the bearing but not enough to interfere in the least with the rotary movement of the pivot.

Depending from the plate 10, is a second bracket 12, with an aligning bearing, through which is rotatably and slidingly mounted in alignment a second pivot 68, provided with a circular groove 69, to receive the threaded portion 72, of the thumb screw 73, and removable pins 70 and 71, traversing each end and forming clutch members. A plural spring unit is supported by and rotatably mounted on and between these two pivots 57 and 68; arranged in series within this plural unit casing or outer element 76, are two springs, reversely wound, as has been the custom for the past twenty years, but instead of hooking the ends of the spring to the casing as has been the custom in the past, each spring is provided with a catch 85, which grips a projection 75, of the casing 76.

The first spring 80, of the series is coiled within a retaining ring 84, from which it is never removed, making a convenient carrier for the spring normally expanded. Provided at the outer end of the spring is a clip 83, which engages one end 88, of the catch 85; the other end 87, of the catch is provided with a notch 86, which permits the free ends 87 of 85, to project beyond the retaining ring 84 and engage the projection 75. The second spring 90, is reversely coiled in the casing 76, on the opposite side of the dividing plate 79, within its retaining ring 94, with its outer end connected to the catch in the same manner as the first spring.

The first spring 80, is provided with an inner element 103, or stub spring shaft, provided with a plurality of recesses 104—105, extending from end to end, adapted to engage the inner projections 81 and 82, of the spring 80. The advantage of providing a plurality of recesses is that they may be made comparatively shallow, or if the end projection of the spring breaks or changes its form the remaining projection will remain operative, or if one of the recesses becomes worn the other will remain effective.

Each end of the shaft is provided with a pivot bearing 106—107, and a transverse ratchet slot 108—109 across each end, which form the female portion of a clutch member. The second spring 90, of the series, is provided with a duplicate shaft 113, provided with duplicate recesses 114—115, pivot bearings 116—117, and end slots 118—119.

Arranged between the two shafts, 103—113, secured to the dividing plate 79, is a stub pivot 110, having a bearing in the pivot bearing 106, of the shaft 103 and the bearing 116, of the shaft 113, permitting rotation of one shaft with respect to the other. Depending from the frame plate 10, is a third bracket 17, provided with an aligning bearing, through which is similarly mounted a third pivot 123, also provided with a circular groove 124, to receive the projecting portion 128, of the thumb screw 127, and a removable pin 125, traversing one end and forming a clutch member. A duplicate second plural spring unit 120, is supported by and rotatably mounted on and between the projecting ends of the pivots 68—123. Arranged within this unit is a third spring 130, wound reversely from the second spring, but in the same direction as the first spring of the first unit and provided with a similar catch 135, which connects with a projection 121, of the casing 120. A duplicate retaining ring 134, lip 133 on the outer end of the spring 130 and projections 131 and 132, on the inner end of the spring are provided. A fourth spring 140, is reversely wound into the casing 120 on the opposite side of a duplicate plate 147, which is snugly fitted into the casing 120, within its retaining ring 144, with the outer ends connected to the catch in the same manner as the others. The third and fourth spring in the second unit of the series are each provided with duplicate stub shafts 153 and 163, provided with recesses 154, 155, 164 and 165, to engage the

inner projections 131, 132 of 130 and 141, 142 of 140, of each spring. Each end of each shaft is provided with duplicate pivot bearings, 156 and 166, 157 and 167 and duplicate transverse ratchet slots. The stub pivot 150, is secured to the dividing plate 147, and arranged in the inner bearings 156 and 167 of the shafts 153 and 163, and the outer end of each shaft is disengageably connected to their respective supporting pivots 68 and 123.

The outer end of each shaft also has a bearing on and through the caps or cover plates 77—78—122—129; these plates are preferably disk shaped and, as shown in Figures 1 and 2, fit snugly into the cylindrical recesses 76^a and 120^a provided in the ends of the cylindrical casings 76 and 120. If it is desired to increase the number of series or plural power units, it is only necessary to increase the number of brackets. All the depending brackets are arranged with their bearings in alignment, permitting the use of a one piece casting drilled with one operation.

Adjustably mounted on the outer end of the third pivot 123, is a duplicate 170, of the gear 45, provided with a hub 171, and set screw 172. To transmit the power of the spring units to the spindle 7, from the gear 170, an additional series of depending brackets 18, 19, 20, 21, are provided with aligning bearings. A hollow shaft 180, is rotatably mounted through the brackets 18 and 19, on the outer end of which is adjustably mounted a smaller gear 175, meshing with the gear 170, provided with a hub and set screw 176—177; toward the other end is also adjustably mounted a large worm wheel 42, provided with a hub and set screw 43—44, which drives the worm 9, which is supported by the bracket 12 and 14, arranged between the adjacent units 76 and 120.

To prevent overwinding the springs, an improved winding device is provided, which consists of a hollow winding shaft, 185, rotatably mounted through the brackets 20 and 21, in alignment with the hollow shaft 180. Securely attached to the inner end of the shaft 180, is a cap 181, attached with set screws 182—183, and provided with a central tapped threaded portion 184, through which threads a threaded shaft 190, into the hollow portion of the shaft 180. A square portion of the shaft 191, is provided at the other end of the shaft and slides through a cap 186, which is secured to the shaft 185, by the set screw 188, provided with a central square opening 187; securely attached to the end of the square shaft 191, is provided a round washer 193, which snugly slides through the hollow portion of the winding shaft 185. Mounted on the winding shaft is a winding gear 196, which is provided with a hub 197, attached to the shaft 185 by set screw 200. A tensioned spring 203, is arranged around the shaft 185, having a bearing on the bracket 20, and the hub 197. The outer end of the shaft is provided with a ratchet groove, which forms the female portion of a clutch member. A hollow winding crank 206, is removably fitted around the winding shaft 185, and is provided with pin 207, transversing the hollow portion of the crank adapted to fit into the groove 189 of the shaft 185, when it is extended.

To prevent longitudinal movement of the gear 196, and the crank 206, on the shaft 185, there is provided a supporting bracket 21. If it is not desired to use the winding crank 206, the clutch pin 207 may be disengaged from the slot 189, and the electric motor 215 may be used to wind the spring of the motor when direct or alternating current is convenient. This motor is attached to the bracket 20, by a bolt 217, and nut 218, and mounted between the brackets 19 and 20, through which the shaft of the motor has a bearing. A hollow shaft 220, is adjustably connected to the shaft of the motor by a set screw 221, which has a bearing through the bracket 20. At the outer end of the shaft 220 is provided a winding gear 222, which meshes with the winding gear 196. The motor may be attached in other convenient positions in any well known manner so arranged that it will automatically wind up the machine when run down and will automatically stop when the machine is wound up, without any care from an operator. This combination of the two motors is a great saving of electric power and will insure a steady running of the spring motor, most essential in sound recording and reproduction.

Talking machines now in use that are operated by a continuous current, direct or alternating, do not always have a steady flow of current, the slightest change of which will cause the machine to misgovern and because of their continuous use and precise requirements frequently get out of repair and are generally unsatisfactory. In my improvement the amount of time that I use the current to wind up the springs is only a fraction of the time used if the current was used continuously, taking about ten seconds to wind a spring motor to run thirty minutes. Such a motor would require about 150 turns by hand to wind up, which becomes a matter of some labor. The arrangement is such that the springs may be wound either by hand or power means without interfering with each other.

A bracket 223 is mounted on the shaft 190, between two washers 224 and 225, which are secured to the shaft 190. A guide rod 226, is secured to the depending brackets 19 and 20, on which a portion of the bracket 223 slides forward and backward. The moving bracket extends upward and above the board 5. Its position indicates when the springs are wound up or run down.

If it is desired to electrically wind the machine after each record, then this may be accomplished by the operation of the speed indicating arm 32, which carries a current wire 268, connected to the binding post 238, of the electric motor, and to the contact plate 269 carried by the arm 32; this plate slides over the contact plate 270 arranged beneath the arm 32, and is connected to the wire 272, which leads to and is connected to the binding post 243 of the electric motor, forming a circuit when the two contact plates are together. The operation of this electric switch is automatic and is controlled by the centrifugal movement of the governor. When a record is started it takes a number of seconds for the record to gather its momentum; during this time the governor is running at a reduced speed, which slowly carries the lever 32 and the contact point 269 over its connecting plates, until full speed is reached, which is normally seventy-eight (78) revolutions a minute. After the lever 32 passes seventy-four (74) revolutions per minute, the contact is broken, thus stopping the electric motor. The time required for the machine to gather its momentum is long enough for the electric motor to wind the springs to play a normal record, but if the speed should fall to seventy-four (74) revolutions per minute, the contact is made again, the electric motor partially rewinds the spring, until contact 269 leaves contact 270. The spring motor again slows down until electric contact is again made, and thus lever 32 oscillates back and forth near the end of contact 270, which will keep the motor running slightly below normal. When the machine is stopped the centrifugal force of the governor is released, allowing the governor springs to push down the friction disc, and as the indicator arm 32, is tensioned on the governor disc it follows the governor movement back to zero. While the arm 32 is moving back from seventy-four revolutions per minute to twenty revolutions per minute, the electric motor is working, but before it reaches zero the connection is broken until the machine is again started. The electric motor may be operated by the movement of the hand by moving the lever and knob 29 and 30, if desired.

The operating of the several parts and transmission of power of the several units shown in Figure 1, is as follows:

The machine may be wound by the crank 206, turning the gear 196, against the gear 45, which turns the first pivot 57. To prevent reverse winding a ratchet 50, is secured to the pivot and a pawl is pivoted on to the bracket 16. The pivot 57 turns through the bracket 16, and is clutched to the shaft 103, which turns the spring 80, against the cage 76, thus turning the cage 76 against the spring 90, to the second shaft 113, to second pivot 68, which turns through the bracket 12, and is clutched to the third shaft 153, to third spring 130, to cage 120, from cage 120, to the fourth spring 140, to fourth shaft 163, to third pivot 123, which turns through the bracket 17, turning the large gear 170 to small gear 175, thus turning the hollow shaft 180, and large worm wheel 42, which drives the spindle 7, which is governed by the governor 27, through a small worm 29× and worm wheel 8.

For every turn of the winding gear 196, a corresponding turn of the gear 175 is made in the same direction of rotation, providing both large gears are the same size and both small gears are the same size. If it takes eighty (80) turns of the key and gear 196 to wind the four springs ninety-five (95) percent of their limit, the gear 175, will turn eighty (80) times before the machine runs down. When the machine is wound eighty (80) turns, the threaded portion 190, will feed through the tapped nut 181, into the hollow portion of the shaft 180, and the square portion 191 of the shaft will be drawn out of the hollow portion of the shaft 185, and if the winding of the shaft 185, is continued, then the washer 193, carried on the end of the square shaft 191, will engage the cap 186, drawing the hollow shaft 185, through the brackets 20—21 which will cause the slot 189, to disengage from the pin 207, of the winding crank 206, thus preventing any further winding of the shaft 185, at the same time moving the gear 196 out of engagement with the winding gear 45, and pinion gear 222, of the electric motor. During rotation of the spindle 7, the gear 175 will turn as the power of the springs is transmitted therethrough, turning the hollow shaft 180, and feeding the threaded portion 190, back again toward the shaft 185, permitting the square portion 191, to slide or feed back again into the shaft 185, permitting the spring 203, to press the hub 197 of the gear 196, causing the winding shaft to feed back into an engageable position with the crank pin 207, and at the same time moving the gear 196 back into engagement with the winding gear 45, and the winding pinion 222 of the electric motor.

It will be seen that this improved arrangement will not only prevent overwinding of the springs, but all of the other turning parts of the machine, greatly adding to the life of the machines and springs, and at the same time preventing the very noisy and objectionable jumping of the springs, due to overwinding, which is one of the great objections to the use of a spring motor. It will be seen that this improved switch is very simple yet very positive, and will prevent the electric motor from overwinding the machine. The normal operations of the automatic electric switch are arranged to prevent the overwinding of the motor. The spring motors now in use require to be disassembled very frequently to regraphite the springs or to re-

move the accumulation of dirty, hard, dry graphite from between the leaves and around the spring case, which greatly reduces the efficiency of the springs as well as to lubricate other turning parts; also to replace springs that frequently break.

Quite frequently when the motors are reassembled they do not run so well due to the gears and turning parts not being exactly replaced, which is very difficult, if not impossible, for the average repairman. When it is desired to remove a spring unit for any cause from this improved motor, any one unit may be removed and replaced without distrubing any one other unit in the series, or any of the gears or connecting parts, and this may be done without the use of any tool of any kind and frequently without soiling the hands, by any inexperienced operator. To do this, after the machine has been allowed to run all the way down, all that is necesary to do is to loosen the thumb screw 73, if it is desired to remove the plural unit 120 from the motor until the threaded portion 72 clears the groove 69 of the pivot 68, and with the other hand move the unit 120 towards the casting 12, which will cause the pivot 68 to move longitudinally through the bearing and further project into the pivot bearing 117 of the shaft 113, in the unit 76. The thumb screw 73, is then tightened, which will hold the pivot 68 in its adjusted position. The unit 120 will then fall from or may easily be removed by a slight movement with respect to its pivot clutches. Either one of the shafts 153 or 163 may be removed longitudinally from the cages through the bearing of the cover plates 122 and 129. As the cover plates are snugly but not tightly fitted to the cage, they may be easily removed by striking the sides of the cage against the bench or table and the bottom one will drop out and the spring may then be removed from the cage by a longitudinal movement of the spring with respect to the cage. A new spring with its contained shaft within its wire container may then be replaced in the same manner as the removal; the caps or covers refitted and the unit replaced between the brackets with the pivot bearings of the shafts in alignment with the pivots; then by reloosing the thumb screw 73, the compressed spring 61, arranged around the pivot 68, will cause the pivot 68 to move forward into the aligned pivot bearing of the shaft 153, and then by a slight rotary movement of the unit the clutch members of both pivots will interlock with the clutch members of the shafts; the thumb screw may then be tightened and the threaded portion 72, will project slightly into the recess provided on the pivot, thus preventing any longitudinal movement of the pivot through the bearing of the bracket. The pivot spring 60, on pivot 57, will act in the same manner to connect the pivot and shaft.

It will be further noted that by reason of the manner in which the springs are connected to their outer element, the entire width of the spring bears against the end of the catch and hence its entire width may be utilized in transmitting power when the outer element is used to wind the spring against the inner element, and at the same time preventing the breaking away of the outer end of the spring from the outer element, which frequently occurs in spring units now in use when the winding is against the inner element.

It will be further noted that the shafts are all provided with a plurality of longitudinal recesses, extending the full length of the shaft, and that the springs are provided with corresponding projections; this will permit the inserting or removal of either end of the shaft in or from either side of the spring, and as the springs lap around the shaft they bind their projections firmly in place on the shafts; if the shafts are rotated in the wrong direction the projections are forced out of the recesses and the rotation may be continued without injury to either the spring or the shaft. It quite frequently happens in three or four spring motors now in use, when a plurality of sleeves are mounted on a shaft that when one spring breaks, this reverse rotation breaks one or all of the inner ends of the springs, or so badly damages them that they have to be removed.

It is obvious from the foregoing that I have provided an improved sectional spring shaft arranged between and through a plurality of depending brackets. Each separate section that is supported by a separate bracket is removable with respect to each other, and each section that comprises the inner element of a power unit is also rotatable and movable with respect to each other, all of the sections being separately connected together, the arrangement being such that the power of a plurality of units arranged in series is transmitted through all the series in an even regular and noiseless manner, the power in one unit balancing the power in another unit until all the power is transmitted to the main spindle in the manner required in a talking machine motor.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

1. A spring motor, having in combination, a supporting frame provided with a plurality of depending brackets; a shaft rotatably mounted through each bracket, being substantially centrally supported and having each of its ends freely projecting therefrom on each side of said brackets, and a spring unit mounted on and between the free ends of said shafts between said brackets, said units being freely removable therefrom without removing said shafts from said brackets.

2. In a spring motor, having in combina-

tion, a plurality of brackets, a shaft projecting freely through each of said brackets, each being supported and having its ends freely projecting therefrom on each side of said brackets, and a spring unit mounted on the free ends of said shafts between said brackets, said units being freely removable from between said shafts without removing any of said shafts from said brackets.

3. In a spring motor, having in combination, a supporting frame, a plurality of brackets supported by said frame, provided with aligning bearings, a shaft rotatably mounted through each bracket in spaced axial alignment, having its ends freely projecting therefrom on each side of said bracket, and a spring unit mounted on the free ends of said shafts between each of said brackets, any one of said units being freely removable therefrom without changing the position of any other unit arranged between said brackets.

4. In combination a plurality of supports, a pivot shaft arranged through each of said supports, a plurality of spring units disengageably connected together each being mounted between said shafts, one of which is rotatable and removable with respect to the other from said shafts without removing any of said shafts from said supports.

5. In combination, a plurality of pivots, a support for each of said pivots and a plurality of springs rotatably arranged between a pair of said pivots to act in series, one series being freely disengageable from the others of said series from between a pair of said pivots without removing any of said pivots from said supports.

6. The combination of a plurality of pivots, a central support for each of said pivots arranged in alignment, and a spring unit rotatably mounted on said pivots on opposite sides of said supports to act in series, any one of said pivots being partially removable from any one of said supports in either direction to permit one series to be disconnected from another of said series.

7. The combination with a supporting frame, a plurality of pivots adjustably supported in spaced axial alignment by said frame, a power unit rotatably mounted on said pivots in said space including a spring cage, a central shaft and a spring coiled around said shaft connecting said shaft to said cage, said unit being removable from said frame by the adjustment of one of said pivots.

8. In a spring motor, having in combination a supporting frame, a plurality of brackets, supported by said frame provided with aligning bearings, a pivot rotatably mounted in each of said bearings in spaced axial alignment having its ends freely projecting therefrom on each side of said bracket, a plurality of spring units operatively connected together and rotatable with respect to each other mounted on said pivots in said space between said brackets and removable therefrom without removing said pivots from said brackets.

9. The combination with a supporting frame, a plurality of pivots adjustably supported in spaced axial alignment by said frame, a power unit rotatably mounted on said pivots in said space, including two pivoted central shafts, a spring reversely coiled around each of said shafts, a spring cage surrounding said springs and shafts operatively connecting said springs and shafts in series, said unit being removable from said frame by the adjustment of one of said pivots.

10. A spring motor comprising a sectional shaft and a plurality of power units surrounding said shaft, each of said units including a rotatable spring cage, a spring coiled within each of said cages and operatively connected thereto and a central shaft comprising a portion of said sectional shaft arranged within and between said cages and disengageably connected to both of said springs to transmit power from one unit to another unit.

11. A spring motor having in combination, a supporting frame, a sectional shaft rotatably mounted through said frame, a winding gear and a driving gear mounted on separate sections at opposite ends of said shaft, a power unit rotatably mounted on and between said shaft sections, connecting said gears and freely removable therefrom without removing either of said sections from said frame, and means to prevent longitudinal movement of said shaft sections through said frame.

12. A spring motor, having in combination, a supporting frame, a sectional spring shaft having its sections substantially centrally supported by said frame, a winding gear and a ratchet removably mounted on the outer end of one of said sections, an oscillating pawl attached to said frame to prevent reverse rotation of said ratchet, a driving gear mounted on the outer end of the terminal shaft section, a series of springs coiled around separate sections of said shaft connecting said gears, said gears, ratchet and springs being removable from said shaft sections without removing said sections from said frame, and means to prevent longitudinal movement of said gears, ratchet and springs, a hollow winding shaft supported by said frame parallel to said sectional spring shaft rotatably mounted therethrough, a winding pinion secured to said winding shaft in co-operation with said winding gear, a hollow driven shaft supported by said frame parallel to said spring shaft in axial alignment with said winding shaft rotatably mounted therethrough.

13. A spring motor having in combination, a supporting frame provided with a

plurality of depending brackets, a winding shaft and a driven shaft in axial alignment and a plurality of spring shaft sections in axial alignment mounted through said brackets parallel to said winding and driven shaft and having their free ends projecting from said brackets and means to prevent longitudinal movement of said shafts through said brackets, a main shaft mounted through said frame and on one of said spring shaft brackets a plurality of power units arranged in series between said spring shaft sections on each side of said main shaft, means to wind said units arranged on said winding shaft connected to said units, and means to regulate the speed of said main shaft including means to indicate the speed of said main shaft.

14. A spring motor comprising a sectional spring shaft and a support for each section of said shaft, a plurality of power units pivoted between sections of said shaft, each of said units including a rotatable spring cage surrounding said shaft, a pivoted section of said shaft extending within said cage and a spring coiled around said shaft section and connecting said section with said cage, said units being removable from between said sections of said shaft without removing said shaft sections from said supports.

15. A power unit for spring motors including a spring cage, a spring retainer within the cage, a spring normally expanded in operative position within the retainer, a connecting element connected to the end of the spring within the retainer, having a portion projecting beyond the retainer and disengageably connected to the cage, the spring retainer with its contained spring and connecting element being removable from the cage without further coiling or uncoiling the spring or removing the connecting element.

16. A power unit for spring motors including a spring cage, closed at both ends, having each end formed with substantially centrally aligned apertures, a plurality of spring shafts within the cage and independently rotatable with respect to each other and the cage adapted to register with the apertures, a plurality of normally expanded springs freely disengageably connecting the shafts with the cage arranged to act in series, each of said shafts being journalled at one end in one of said apertures, means, including a wall in said cage, to separate said springs provided with pivots having a bearing journalled at the inner ends of each shaft, containing means to limit the springs' expansion, removable with the springs, each of said springs and their containers and each of said shafts being removable and interchangeable with respect to each other in said cage.

17. An interchangeable power unit for spring motors including a spring cage, a dividing plate provided with a central pivot carried thereby, a cover for said cage having a bearing aligned with said pivot, a spring shaft having a bearing on said pivot and through said cover and yielding means connecting said shaft with said cage.

18. In a spring motor, the combination with a spring inclosure rotatable about a given axis, of a clutch member arranged in said inclosure and rotatable with respect thereto about said axis; a spring arranged within said inclosure operatively connecting said spring inclosure to said clutch member; a second clutch member arranged in said closure to rotate about said axis and with respect to said first mentioned clutch member, a second spring connecting said inclosure with said second clutch member, a coaxially mounted pivot disengageably connected to said first mentioned clutch member, and a second coaxially mounted pivot disengageably connected to said second mentioned clutch member.

19. In a motor, the combination with a pair of spring inclosures rotatable about a given axis, of a clutch member arranged in said inclosure and rotatable with respect thereto about said axis; a spring arranged within each of said inclosures operatively connecting said inclosures and said clutch members, a coaxially mounted pivot disengageably connected to each of said clutch members.

20. In a spring motor the combination with a pair of spring inclosures rotatable about a given axis, of a pair of clutch members arranged in each of said inclosures and rotatable with respect thereto and each other about said axis, a pair of springs arranged in each of said inclosures operatively connected thereto and to said clutch members, a coaxially mounted pivot disengageably connected to one of said clutch members in one of said inclosures, a second coaxially mounted pivot disengageably connected to one of said clutch members in each of said inclosures, and a third coaxially mounted pivot disengageably connected to another of said clutch members in the other of said inclosures.

21. In a spring motor, the combination of a motor frame having a plurality of bearings therethrough, and each bearing supporting a pivot journalled therethrough with its free ends projecting freely from opposite sides of each bearing, power units rotatably mounted on said pivots between said bearings and removable transversely therefrom without removing said pivots from said bearings, a ratchet wheel mounted on one of said pivots in co-operation with a pawl pivoted to said frame to prevent reverse rotation of said pivot while the other pivots are free to rotate in series to transmit power of the units in series.

22. In a multiple spring motor, a spindle, a governor for regulating the speed of said

spindle and means for driving said spindle, including a plurality of aligned pivots and a plurality of power units located on opposite sides of said spindle, said spindle arranged in between said units, each of said units containing a plurality of springs, means to disengageably connect said springs in series whereby the power of any spring is transmitted to said spindle.

23. In a spring motor, the combination with a plurality of spring shafts and pivots, each provided with clutch members and each disengageably clutched together, a plurality of springs coiled around said shafts, and a plurality of spring cages inclosing said springs and disengageably clutching said springs in series.

24. A power unit for spring motors including a spring cage inclosing a plurality of spring shafts, a plurality of pivots extending within said cage, each outer end of said shafts having a bearing in said cage and on said pivots and movable with respect to each other, a plurality of coiled springs arranged in and clutched to said cage connecting said shafts and pivots in series.

25. A power unit for spring motors including a spring cage, a spring normally expanded coiled within said cage and freely disengageably connected thereto and removable therefrom by rotation normally expanded, a second spring cage and a second spring normally expanded coiled within said second spring cage and freely disengageably connected thereto and removable therefrom by rotation normally expanded, a spring shaft extending in each of said cages and freely disengageably connected to each of said springs.

26. An interchangeable power unit for spring motors, including a spring cage provided with a plurality of clutch elements, a plurality of normally expanded springs located in axial alignment in said cage and clutched thereto, a shaft for each of said springs located in said cage and clutched to each of said springs, the arrangement being such that either spring normally expanded may be withdrawn laterally from said cage.

27. A power unit for spring motors including a spring cage open at both ends and having a wall transversing the centre of said cage provided with a projection of the form of a pivot, a removable cover for each end of said cage having a centrally aligned aperture, a spring shaft journalled through each aperture and on said pivot, a spring connected to each of said shafts and to said cage.

28. A power unit for spring motors including a spring cage provided with a central pivot, covers for said cage having a bearing aligned with said pivot, a spring disengageably connected to said cage adjacent each cover, a clutch member disengageably connected to each of said springs in series having a bearing on said pivot and through said covers.

29. The combination with a supporting frame, a pivot adjustable axially supported by said frame, a power unit supported by said frame and said pivot, means to retain said pivot in axial adjustment to permit the removal of said unit from said frame and yielding means to move said pivot into operative position after said retaining means has been released.

30. The combination with a supporting frame, a plurality of pivots adjustable axially supported by said frame, a power unit supported between said pivots, means to retain said pivots in axial adjustment to permit the removal of said unit from between said pivots and yielding means to move said pivots back into operative position after said retaining means has been released.

31. A power unit for spring motors, including a spring cage, a plurality of springs and shafts arranged in said cage and a plurality of pivots extending in said cage, a pair of which are connected in series by said springs and shafts.

32. A spring motor having in combination a supporting frame, a main shaft mounted in said frame, a spring shaft mounted in said frame, a power unit mounted on said spring shaft, a paralleled winding shaft mounted in said frame to transmit power to said unit through said spring shaft, a driven shaft mounted in said frame paralleled to said spring shaft in axial alignment with said winding shaft to transmit power from said unit to said main shaft.

33. The combination in a motor, of a frame, a spring shaft supported by said frame, power spring means supported upon said shaft, a winding gear and a driven gear mounted in said frame in axial alignment, means to wind said winding gear, and means to be driven by said driven gear also mounted in said frame in axial alignment.

34. The combination in an integral motor frame, of a spring shaft supported in said frame, a plurality of double spring power units movably mounted in said frame and separably clutched together through said shaft.

35. The combination in an integral motor frame, of a spring shaft supported in said frame, a plurality of power units movably mounted in said frame and separably clutched together through said shaft, one of which is a double spring power unit.

36. The combination in an integral motor frame, of a spring shaft supported in said frame, a plurality of double spring power units movably mounted on said shaft and separably clutched together.

37. The combination in an integral motor frame, of a spring shaft supported in said frame, a plurality of power units movably

mounted on said shaft and separably clutched together, one of which is a double spring power unit.

38. A power unit for spring motors, comprising a spring cage, a projection carried by said cage, a spring retainer embodying an annular band, a spring positioned within said retainer, an anchor plate associated with the outer end of the spring for anchoring the outer end of the spring to the cage.

39. A power unit for spring motors, comprising a spring retainer embodying an annular band, a spring positioned within the retainer, an anchor plate associated with the outer end of the spring projecting outside of the retaining band.

40. The combination in a motor frame, of a spring shaft supported in said frame, a plurality of double spring power units movably mounted on said shaft carried by said frame separably connected together in series, one of said units being freely removable from said frame without removing another of said units from said frame.

41. The combination in a motor frame, of a spring shaft supported in said frame, a plurality of spring power units, at least one of which is a double spring power unit, movably mounted on said shaft carried by said frame separably connected together in series, one of said units being freely removable from said frame without removing another of said units from said frame.

42. The combination in a motor frame, of a plurality of integral standards provided with aligned bearings carried by said frame, one of the standards being provided with a transverse arm extending in a direction transversely of the alignment of the bearings, a horizontal shaft carried by said bearings, a double spring power unit carried by said shaft and the frame having a bearing aligned with a bearing in the arm, a vertical shaft extending through said bearing in said frame and supported at its lower end in the bearing of said transverse arm.

43. The combination in a motor frame having a base plate and a plurality of integral standards carried by said plate, of a vertical shaft having a bearing through said plate and supported at its lower end by one of said standards, and a horizontal shaft also having a bearing on a plurality of said standards one of which supports the vertical shaft and a double spring power unit carried by said shaft.

44. The combination in a motor frame having a base plate and a depending standard carried by said plate, of a vertical shaft and a sectionable horizontal shaft each of which have a bearing in said standard.

45. A power unit for spring motors including a spring cage open at both ends, a cover plate for each end of said cage, each of said plates being provided with substantially central aligning apertures, an element within the cage independently rotatable thereof and adapted to register in alignment with said apertures, a power spring connecting said element and said cage, said element being journaled at one end in one of said apertures and a clutch member for winding said springs provided at one end of said element.

46. In a spring motor, the combination with a shaft, of a plurality of double spring power units movably mounted on said shaft separably clutched together.

47. In a spring motor, the combination with a shaft, of a plurality of spring power units movably mounted on said shaft separably clutched together, one of which is a double spring power unit.

48. In a spring motor, the combination with a shaft, of a double spring power unit movably mounted on said shaft, including separate spring units separably clutched together through a plurality of central clutch elements.

In testimony whereof I have affixed my signature.

JOHN BAILEY BROWNING.