June 14, 1955 P. K. DUNCAN 2,710,674

SPEED REGULATING MECHANISM

Filed Aug. 24, 1953 3 Sheets-Sheet 1

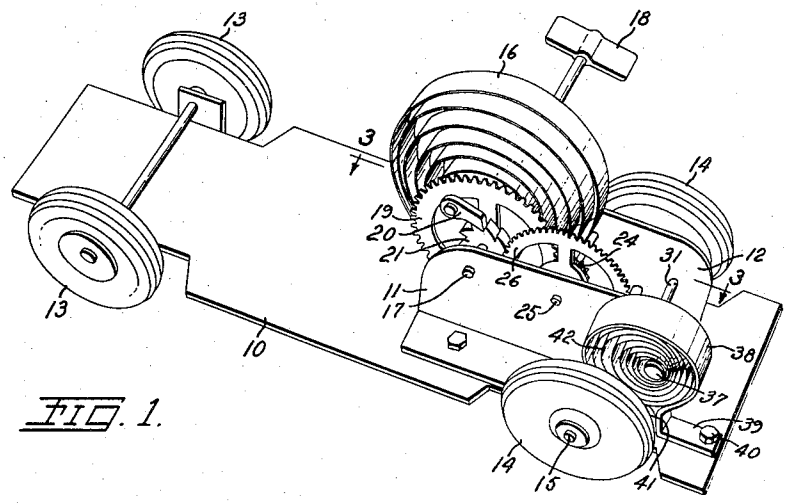


FIG. 1.

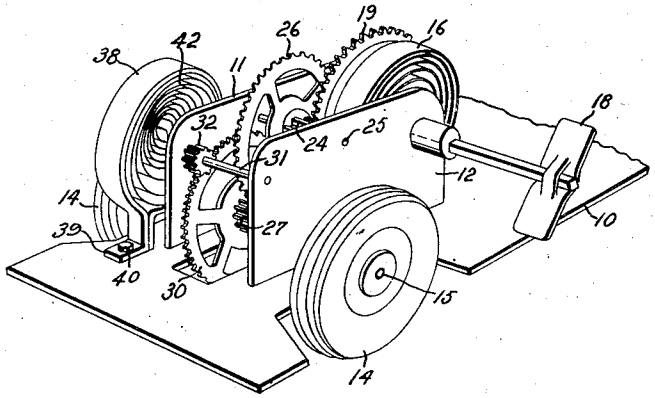


FIG. 2.

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June 14, 1955 P. K. DUNCAN 2,710,674

SPEED REGULATING MECHANISM

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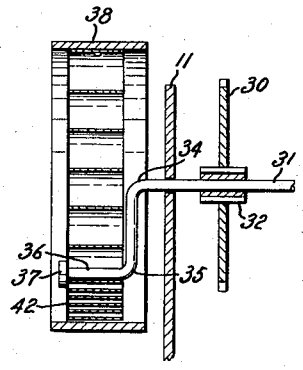


FIG. 4.

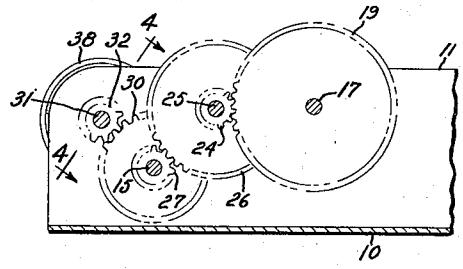


FIG. 3.

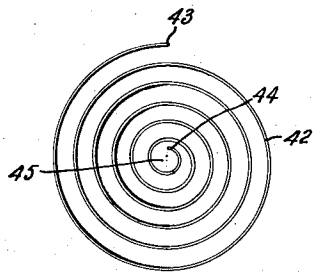


FIG. 5.

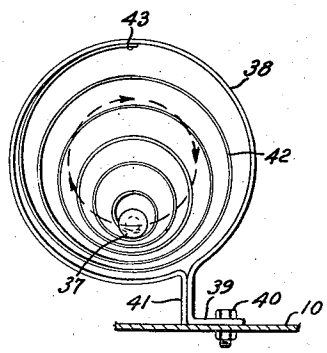


FIG. 6.

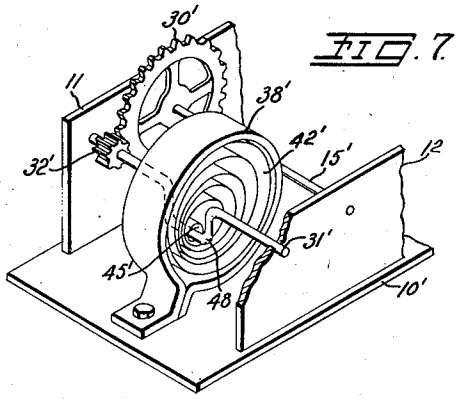


FIG. 7.

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SPEED REGULATING MECHANISM

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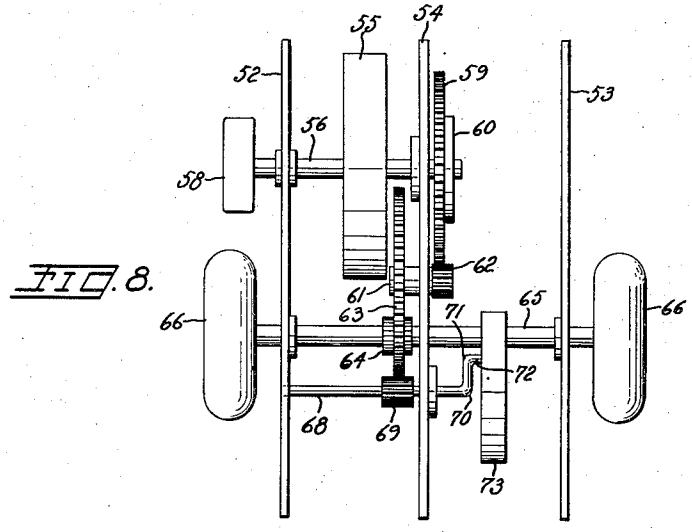


FIG. 8.

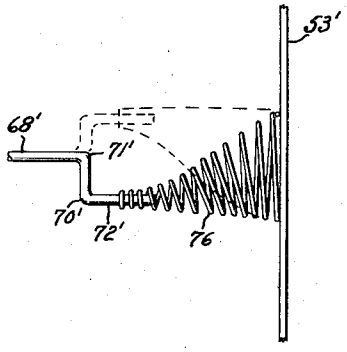


FIG. 9.

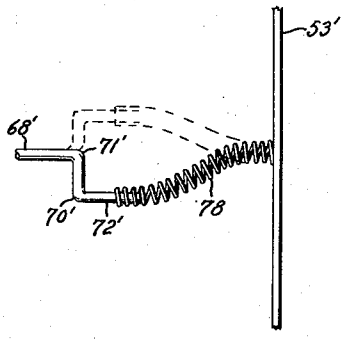


FIG. 10.

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2,710,674

SPEED REGULATING MECHANISM

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Application August 24, 1953, Serial No. 376,139

14 Claims. (Cl. 185—37)

This invention relates to a speed regulating mechanism or governor for spring powered motors such as motors utilized to operate toy vehicles and the like.

The present invention is intended to provide a low-cost, simple and effective speed regulating mechanism for spring wound motors utilized to drive toy vehicles and the like and to overcome shortcomings of prior speed regulating mechanisms which, because of their high cost, cumbersome mechanism, or poor speed regulation, have not met with commercial success. The invention is illustrated herein as applied to spring wound motors for toy vehicles, although it may be applied to other mechanisms.

Economy of manufacture is a primary consideration in the manufacture of toys because such field of manufacture is well developed and highly competitive. It has heretofore been proposed to equip toy motors with speed regulating devices or governors to produce a slow unwinding of the main spring and prolong the operation of the toy. Such prior speed regulating devices have generally been in the form of dash pot mechanisms or heavy flywheels which are expensive to manufacture in relation to the value of the toy and which occupy a large amount of space when connected to the motor mechanism of the toy. Prior devices have also attempted the use of springs to engage and disengage clutch members, but an inherent disadvantage is present in such devices in that the retarding force thereby produced is not uniform but rather is irregular due to the repeated engagement and disengagement of the clutch, whereby the movement of the gear mechanism controlled by said governor is not smooth and the vehicle does not run at a smooth and constant speed.

It is therefore an object of the present invention to provide a speed control mechanism or governor for spring wound motors which produces a substantially uniform operating speed for the gear train of the toy motor, the retarding force being effective to operate the toy at a fairly constant running speed throughout substantially all of the unwinding of the main spring of the toy motor.

It is another object to utilize radial deflection of the convolutions of a coil spring or other resilient member to produce a uniform retarding force to the powered gear train of a toy vehicle.

It is another object to provide retarding means for a spring wound motor having a minimum of gears in its gear train.

It is a further object to provide a speed control mechanism for spring wound motors which is compact in size, simple in construction, and has a minimum of moving parts.

A still further object is to provide a speed control mechanism which is economical to manufacture and reliable in operation.

In general, the speed control mechanism of the present invention is utilized in connection with the train of gears of a spring wound motor for a toy vehicle or other device

and comprises spring means to produce a retarding force to control the unwinding of the main spring of the motor. The retarding spring means has one end secured to the vehicle in a fixed position and its other end is free to move to distort or deflect the convolutions of said spring means and has bearing means to receive an offset or crank portion of a driven shaft rotatably mounted on the frame of the vehicle. The spring means is coiled and mounted on the frame of the vehicle so as to be axially aligned with the shaft but when the offset portion is mounted in the bearing means of the spring, the convolutions of said spring are deflected in a radial direction. When the main spring unwinds and the driven shaft rotates, the offset portion of the shaft carries the free end of the spring in an orbit around the axis of the spring. The radial deflection of the convolutions of the spring produce a substantially uniform retarding force on the shaft in all angular positions of the shaft.

The invention will be better understood and additional objects and advantages will become apparent from the following description taken in connection with the accompanying drawings which illustrate preferred forms of the device. It is to be understood, however, that the invention may take other forms, and that all such modifications and variations within the scope of the appended claims, and which will occur to persons skilled in the art, are included in the invention.

In the drawings:

Figure 1 is a perspective view of the chassis of a toy vehicle showing the spring wound motor of the vehicle and the speed regulating mechanism of the present invention mounted thereon;

Figure 2 is another perspective view of the chassis of the toy vehicle taken from the opposite side of Figure 1;

Figure 3 is a sectional view taken on the line 3—3 of Figure 1, showing the train of gears and its driving connection with the speed regulating mechanism of the invention;

Figure 4 is a sectional view taken on the line 4—4 of Figure 3;

Figure 5 is a view of the coil spring of the speed regulating mechanism in relaxed condition before being mounted on the frame of the vehicle;

Figure 6 is a view showing the deflection of the convolutions of the spring of Figure 5 when said spring is mounted in operative relation to the motor to be controlled;

Figure 7 is a fragmentary perspective view of the rear end of the toy chassis showing a modification of the invention;

Figure 8 is a top plan view of a further modification;

Figure 9 is a fragmentary side elevational view of a further modification of the spring means wherein a conical spring is utilized to provide the retarding force; and

Figure 10 is a fragmentary side elevational view of a modification in which the speed regulating means utilizes a straight spiral spring.

Referring now more particularly to the drawings and as best seen in Figures 1 and 2, the invention is applied to the chassis of a toy vehicle comprising a horizontal frame plate **10**, vertical side plates **11** and **12**, front wheels **13**, and rear wheels **14** secured to and rotatable with the rear axle **15**. The body of the toy is not shown in the drawings.

Power to propel the toy is supplied by a spring wound motor comprising a main spring **16** carried on shaft **17** journaled in side plates **11** and **12** of the chassis. The shaft **17** also carries a winding key **18**, a gear **19** having a spring pressed pawl **20** mounted thereon, and a ratchet wheel **21**. The gear **19** meshes with a pinion **24** mounted on a second shaft **25** also journaled in the plates **11** and

12. A gear 26 is mounted on shaft 25 and meshes with a pinion 27 mounted on rear axle 15.

The main spring 16 has its inner end secured to the shaft 17 and its outer end secured to the frame of the toy. The gear 19 is loosely mounted on the shaft 17 and, referring to Figure 1, is driven in a counterclockwise direction by the ratchet wheel 21 and pawl 20 when the main spring unwinds. Winding of the spring is accomplished by turning the key 18 clockwise as viewed in Figure 1. The rear axle is driven counterclockwise at a relatively fast speed compared to the rate of rotation of the shaft 17 because of the step-up in gearing by gears 19 and 26 and pinions 24 and 27. The structure thus far described is conventional and the speed control mechanism of the present invention will now be described in detail.

Referring now to Figures 2 and 3, a gear 30 is mounted on the rear axle 15 and rotates therewith. Journaled in the side plates 11 and 12 is a shaft 31 having pinion 32 mounted thereon which meshes with the gear 30 to drive the shaft 31. As best seen in Figure 4, one end of the shaft 31 extends through the plate 11 and is provided with two right angle bends 34 and 35 forming an offset portion on crank 36. The end of the crank 36 may be threaded to receive an enlarged head or cap 37.

Mounted on the chassis of the vehicle is a housing 38 which comprises a strap of metal bent in circular configuration and having one end 39 extended and bent so as to be secured to the frame plate 10 by a bolt or rivet 40. The other end 41 of the strap is welded to the end 39 to make the housing rigid, Figure 6. The housing 38 could, however, be cast as an annular piece and merely welded or otherwise secured to the side plate 11.

A coil spring 42 is mounted in the housing and provides the retarding force to control the unwinding of the main spring. The spring 42 is preferably formed from flat spring stock but may be round or square spring material or also, instead of a coiled spring, a non-metallic substance such as sponge or rubber in a cylindrical block or other form may be used.

Figure 5 is an edge view of the coil spring 42 in relaxed position before it is mounted in the housing, the spring having an outer end 43 and inner end 44. The center of the spring is formed to provide a bearing eye 45 and as seen in Figure 5 the spring is in a relaxed condition with inner end 44 of the spring being approximately in the center thereof. The outer end 43 of the spring is secured to the inside wall of the housing, Figure 6, allowing inner end 44 to move freely in all radial directions, but, however, opposed by the force of the convolutions which tend to return the spring to its Figure 5 or relaxed position. The spring and housing are positioned so that the center of the spring in its relaxed or repose position, Figure 5, is axially aligned with the portion of the shaft 31 which extends between the side plates 11 and 12. When the spring is mounted in the housing, offset portion 36 of the shaft 31 is journaled in the eye 45 of the spring, thereby acting as an eccentric and moving the bearing eye off center and deflecting the convolutions of the spring in a radial direction. If desired, the spring may carry a bearing to receive the offset shaft portion 36. The cap 37 is threaded on the end of the shaft portion 36 to prevent displacement of the portion 36 from the eye 45, although this cap is not absolutely necessary.

If desired, the housing 38 may be omitted and the outer end 43 of the spring welded or otherwise connected to the plate 11 of the vehicle or other parts of the frame. It is only necessary that the spring be mounted so that in its repose position the inner convolution be centered on the axis of the driven shaft 31 to provide a uniform retarding force on the shaft in all rotative positions.

As the main spring unwinds, the shaft 31 rotates in a clockwise direction, as viewed in Figure 6, the offset

shaft portion 36 following the orbit path shown by the arrows. The spring tends to return to its relaxed or repose position, i. e., wherein the center portion thereof is axially aligned with the shaft 31 and rotation of the offset shaft portion in the path shown is resisted by the convolutions of the spring which because of their distorted or deflected condition exert inward or centripetal forces opposing the rotation of the crank 36. The coil spring is equally deflected in all angular positions of the crank and the retarding force that the convolutions exert against rotation is uniform at all points of rotation, thereby producing a smooth rotation of the shaft 31 and rear axle 13 and producing a smooth running speed for the toy vehicle.

The work and energy required to distort and rapidly change the shape of the convolutions of the spring 42 oppose rotation of the crank 36 and shaft 31. When the main spring 16 is wound tightly there is obviously a greater force acting through the train of gears to tend to increase the speed of rotation of the gears and shafts. However, when the rate of rotation of shaft 31 is increased, the crank 36 will be subjected to greater opposing and retarding forces because of the increased rate of spring flexure, and such opposing forces control the rate of unwinding of the main spring to maintain an almost uniform speed of the vehicle throughout the entire unwinding of the main spring. When the energy exerted by the main spring is almost exhausted, the speed of the vehicle will decrease only slightly, and as the rate of rotation of crank 36 decreases, lesser retarding forces are exerted thereon, allowing the main spring to unwind almost completely before the vehicle stops. The energy absorbed by spring 42 is not entirely dissipated as in a friction governor but is largely returned to the gear train thereby minimizing energy loss from the system and providing a relatively efficient transmission of power.

The rear axle 15 rotates relatively fast in comparison with shaft 17 which carries the main spring 16 because of the gearing ratio in the gear train. The shaft 31 is further geared up and due to the high speed of rotation of said shaft only a small retarding force is necessary to control the unwinding of the main spring and the speed of the vehicle. The governor spring 42 may therefore be formed of light spring stock, and, of course, the effective retarding force may be varied by the thickness of the spring stock, the width of the spring stock, the number of convolutions and the radius of the crank throw. The relatively high speed of rotation of crank shaft 31 magnifies any speed variations in terms of spring flexures per unit time whereby the governing action is sufficiently sensitive to variation to be remarkably effective in maintaining the speed quite uniform.

It is to be understood that the shaft 31 may take other forms to provide the radial deflection of the spring 42. For example, instead of the shaft being provided with the offset portion 36, the shaft may be straight and have a cam secured thereon which would provide eccentric motion for the inner coil of the spring, thus producing the desired radial deflections of the convolutions of the spring. It is also within the contemplation of this invention to provide the rear axle with an offset portion intermediate its ends for engagement with the eye of the spring means.

Figure 7 shows a modified form of the invention. In this embodiment a shaft 31' having pinion 32' mounted thereon is journaled in the side plates 11 and 12, and said shaft is provided with an offset or crank portion 48 intermediate the ends thereof, the pinion 32' being driven by gear 30' mounted on rear axle 15'. A housing 38' is mounted on the plate 10' and carries a coil spring 43' with its outer end secured to the inside wall of the housing and its inner end being free to move radially and forming an eye 45'. The housing and spring are mounted so that the spring in it repose position is axially aligned with the shaft 31'. In assembled relation, the crank 48 is journaled in the eye 45' of the spring 42' and moves the inner-

most convolutions of the spring in an orbit around the center to deflect the convolutions of the spring. A smooth retarding inward force is exerted on the shaft 31' by the deflection of the spring convolutions as the crank 48 rotates upon unwinding of the main spring.

Figure 8 is a further modification and in this embodiment the spring wound motor and speed regulating mechanism are supported between side walls 52 and 53 and a central wall 54 of the vehicle. The motor comprises a main spring 55 carried on shaft 56 journaled in the side wall 52 and central wall 54. The shaft 56 also carries a winding key 58, a gear 59 loosely mounted thereon and a ratchet and pawl mechanism 60 for driving the gear in only one direction of rotation. Journaled in the central wall 54 and protruding from each side thereof is a stub shaft 61 having a pinion 62 on one end which meshes with the gear 59. A gear 63 is mounted on the other end of the stub shaft 61 and meshes with a pinion 64 fixedly mounted on the rear axle 65 of the vehicle which is journaled in the side walls 52 and 53 and has wheels 66 mounted on its outer ends.

The speed regulating mechanism comprises a shaft 68 journaled in side walls 52 and 54, the shaft 68 having a pinion 69 secured thereon which also meshes with gear 63. The shaft 68 has a pair of right angle bends 70 and 71 to form an offset portion or crank 72. Securely mounted on the bottom frame plate is a circular housing 73 having a coil spring mounted therein which receives in its innermost convolution the crank portion 72 of the shaft 68 and operates to retard the rotation of the shaft 68 as in the other embodiments. The Figure 8 embodiment is an economical gear train and speed regulating mechanism whereby the gear 63 drives both axle 65 and the shaft 68 of the speed regulating mechanism. Such structure utilizes the same number of gears in the gear train as the other embodiments and yet provides driving means for the speed regulating mechanism by the mere addition of the pinion 69. In this embodiment the crank shaft will rotate more slowly and consequently will receive more torque from the gear train, but the coil spring in the speed regulating mechanism may be formed from heavier spring stock to compensate for the additional torque and to provide a substantially uniform rotation of shaft 68 and a smooth running speed for the vehicle.

Figure 9 is a modification showing the use of a spiral conical spring 76 to produce the retardation and uniform unwinding of the main spring. This spring may advantageously be used with the frame structure of the Figure 8 embodiment whereby a shaft 68' having right angle bends 70' and 71' to form an offset portion 72 may be journaled in a side wall and central wall. The base or large end of the spring is secured to a side wall 53' and the spring is mounted on the side wall so that it is axially aligned with the main portion of the shaft 68'. The smaller end of the spring 76 is adapted to receive the offset portion 72 of the shaft 68' and when the parts are so assembled the convolutions of the spring are deflected and are moved out of axial alignment with the shaft 68'. The convolutions of the spring thus being deflected produce a uniform retarding force at each point of revolution of the shaft.

Figure 10 shows the use of a straight spiral spring 78 to provide the retarding action. One end of the spring is mounted on the wall 53' and the other end is free to move in the orbit of travel of the offset portion 72' of the shaft 68 to provide the retarding force to the shaft 68'.

The improved governing action of the present speed regulating device permits the use of a longer and stronger main spring in the spring motors of toys and the like to provide longer operation at substantially constant speed. With a less effective governor a spring motor tends to race when tightly wound and to slow down gradually until it stops when the spring becomes unwound, whereby it is usually necessary to limit the capacity of conventional spring motors in order to limit the initial overspeeding.

Having now described my invention and in what manner the same may be used, what I claim as new and desire to protect by Letters Patent is:

1. A speed regulating device for a spring motor and the like having a driven shaft, comprising an eccentric element on said shaft, and a resilient member disposed about said eccentric element and having a portion thereof engaging said eccentric element with uniform radially directed force in all angular positions of said eccentric element, said engaging portion being biased toward the axis of said eccentric element by the natural elasticity of said member.

2. A speed regulating device for a spring motor and the like having a driven shaft, comprising an eccentric element on said shaft, and a resilient member having one portion thereof mounted in coaxial relation to said shaft and another portion thereof engaging said eccentric element with uniform radially directed centripetal force in all angular positions of said eccentric element.

3. A governor for a driven shaft comprising an eccentric on said shaft, a spring, and means in said spring to receive said eccentric, said means when disconnected from said eccentric having a repose position in said spring axially aligned with said driven shaft, said spring being deflectable when said means is mounted on said eccentric to exert a substantially uniform retarding force on the rotation of said eccentric and said shaft in all angular positions thereof.

4. A governor for a driven shaft comprising an eccentric on said shaft, and spring means having a central bearing to receive said eccentric, said bearing when disconnected from said eccentric having a repose position centered on the axis of said shaft, said spring means being deflectable when mounted on said eccentric to exert a substantially uniform retarding force to the rotation of said eccentric and said shaft.

5. A governor for a driven shaft comprising a crank on said shaft, and spring means having a crank attachment with said crank, said crank attachment when disconnected from said crank having a repose position centered on the axis of said shaft, said spring means being deflectable to accommodate the rotation of the crank and exerting a substantially uniform retarding force on said crank in all positions of the crank.

6. A governor for a driven shaft comprising a crank on said shaft, spring means securely mounted relative to said shaft, a crank bearing in said spring means to rotatably receive said crank, said crank bearing when disconnected from said crank having a repose position in axial alignment with said shaft, said spring means being deflectable to accommodate the rotation of said crank and exerting a substantially uniform radial force on said crank in all positions of the crank.

7. In a speed regulating device, a driven shaft, an offset portion in said shaft, a spring having a plurality of convolutions, said spring in relaxed position having its innermost convolution axially aligned with said shaft, said offset portion of said shaft being journaled in said innermost convolution whereby the convolutions of said spring are deflected radially to exert a retarding force to the rotation of said offset shaft portion when said shaft is driven by said gear train.

8. A speed regulating device for a toy vehicle utilizing a spring wound motor, comprising a coil spring, the outer end of said coil spring being fixedly secured to said vehicle and the inner end of said spring forming an eye and being free to move radially to deflect the convolutions of said spring, a driven shaft connected with said motor and having an offset portion journaled in said spring eye, the deflection of said convolutions of said spring exerting a retarding force to the rotation of said offset shaft portion.

9. In a toy vehicle, the combination with a main spring and train of gears of a shaft driven by said train of gears, a crank on said shaft and rotatable therewith, and a coil

spring mounted on said vehicle, said spring having a central eye to rotatably receive said crank therein whereby the coils of said spring are distorted radially by said crank to provide a retarding force to the rotation of said crank when said shaft is driven by said gear train.

10. A speed regulating device for a spring wound motor comprising a housing, a coil spring carried in said housing and having its outer end fixedly secured thereto and its inner end forming an eye and being free to move radially to deflect the convolutions of said spring, and a rotatable shaft driven by said spring wound motor, said shaft having an eccentric journaled in said spring eye, the deflection of the convolutions of said spring exerting a retarding force to the rotation of said eccentric.

11. In a toy vehicle, the combination with a main spring and train of gears of a shaft driven by said train of gears, an offset portion on said shaft and rotatable therewith, a coil spring mounted on said vehicle, said spring having a central eye forming a bearing, said offset shaft portion being journaled in said bearing to deflect the coils of said spring to provide a retarding force to the rotation of said offset portion when said shaft is driven by said gear train.

12. A governor for a driven shaft comprising a crank on said shaft, a spiral spring having one end fixedly secured relative to said shaft and its other end rotatably receiving said crank, said spring when disconnected from said crank having a repose position in axial alignment with said driven shaft, said spring being deflectable when mounted on said crank to exert a substantially uniform retarding force to the rotation of said crank.

13. A speed regulating device for a spring motor and the like having a driven shaft, comprising an eccentric element on said shaft, and an elongated resilient member having one end mounted in alignment with the axis of said shaft and the other end engaging said eccentric element.

14. A speed regulating device for a spring motor and the like having a driven shaft, comprising an eccentric element on said shaft, and an elongated coil spring having one end mounted in alignment with the axis of said shaft and the other end engaging said eccentric element.

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