

**Nov. 9, 1965**

**R. LOHR**

**3,216,529**

## SPRING MOTOR DRIVE

Filed Sept. 23, 1963

2 Sheets-Sheet 1

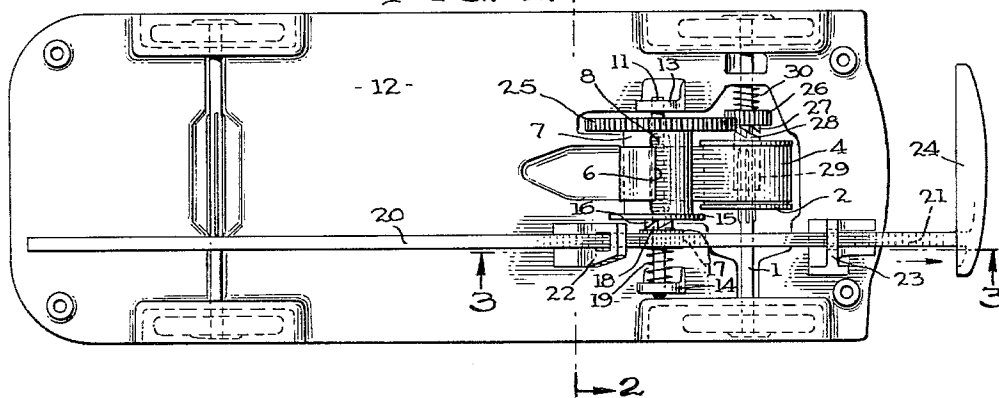
FIG. 1.  $\rightarrow 2$ 

FIG.2.

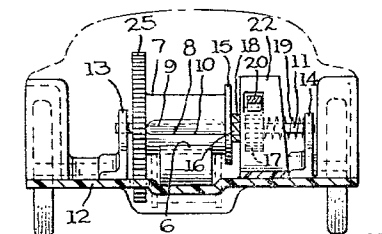


FIG. 3.

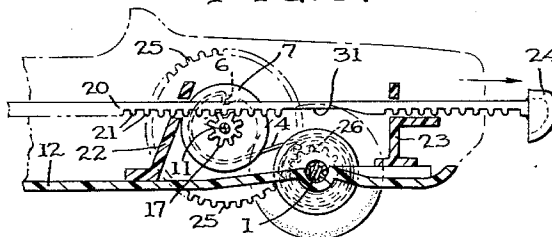


FIG. 4.

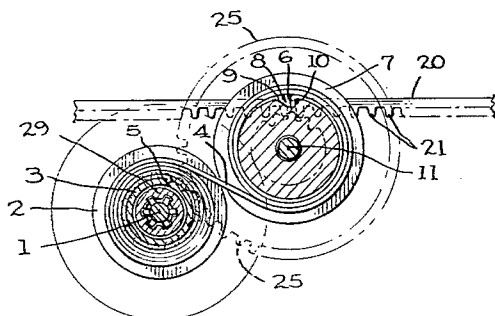
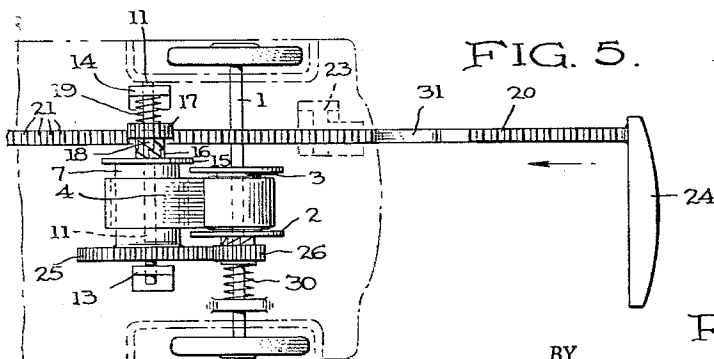


FIG. 5.



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FIG. 6.

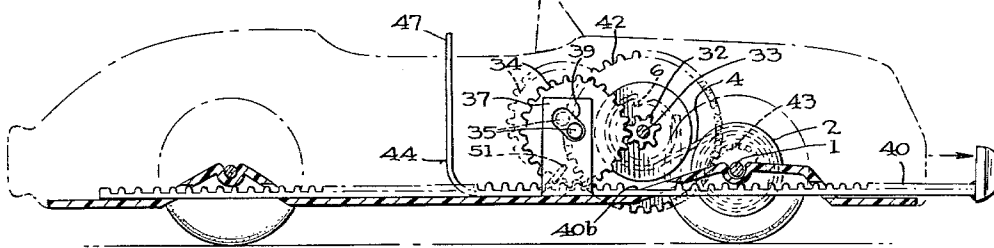


FIG. 7.

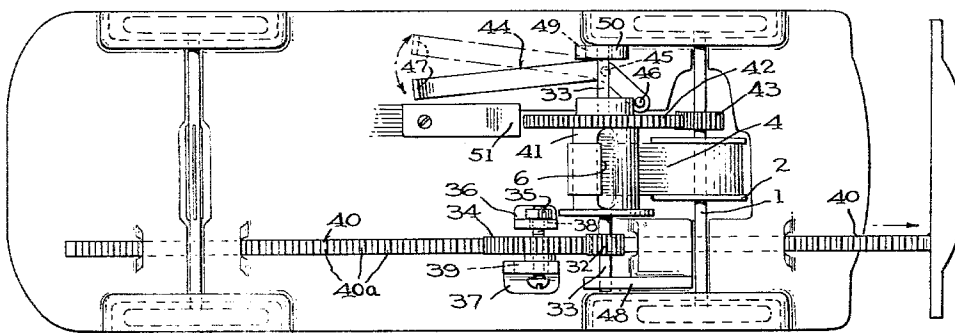
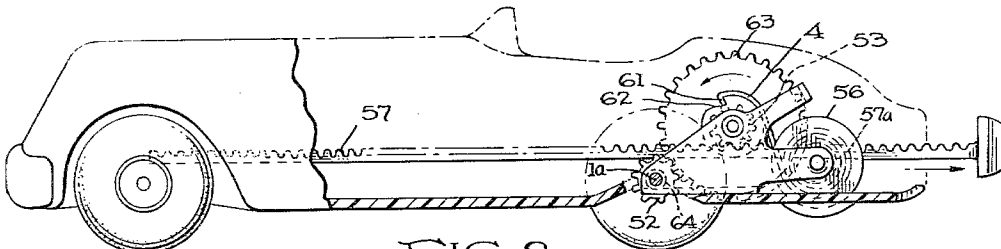


FIG. 8.

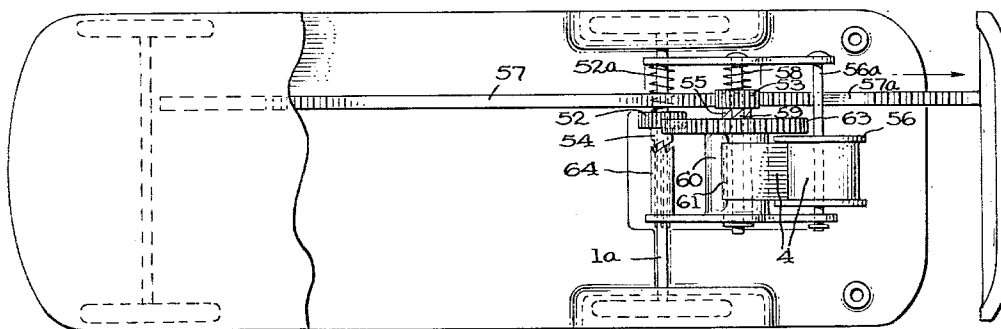


FIG. 9.

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3,216,529

## SPRING MOTOR DRIVE

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2 Claims. (Cl. 185—39)

This invention relates generally to motor drives and more particularly, to a spring motor drive especially adapted for use in various types of toys, such as toy vehicles, animated toys, music boxes, etc.

Most of the prior motor devices for toys which comprise spring means have included a clock-type, helically wound spring, usually having its inner terminal portion anchored in fixed relationship to the toy device and further having a free outer terminal portion which is moved circumferentially by the application of a key in order to wind the spring about itself.

Alternately, it is common to anchor the outer free terminal portion of the spring and to subsequently energize the spring by winding the inner terminal portion upon a rotating shaft axially disposed within the spring. In either instance, the spring material is relatively thick, and when at rest, the adjacent helices of the spring are spaced apart from one another. Energy is stored up by this type of spring when the helices are wound tightly upon one another, thereby reducing the radii of each of the helices.

In these cases, the free outer or inner terminal portion of the spring is connected by means of a hub or gearing to the portion of the device being driven. When the motor is released, the compressed helices begin to unwind with a progressively decreasing force output, which results in a gradual running down of the device operation. When the spring has become unwound, the movement of the toy device is abruptly halted, since usually no means are provided for permitting continuous movement of the device once the spring has returned to its normal or at rest position.

One of the most desirable features in a motor-driven device is to take advantage of the inertial force built up during actuation of the motor drive in order to continue operation of the device when the spring driving means has returned to its normal or at rest position.

Accordingly, one of the primary objects of this invention is to provide a constant force spring motor drive comprising a prestressed spring and including means providing for free-wheeling of the drive means upon expenditure of the driving force of the spring.

Another object of this invention is to provide a spring motor drive including rectilinear winding means forming a portion of the device being driven.

Still another object of this invention is to provide a spring motor drive adapted to provide a constant force for propelling a toy or the like, and including drive means associated with a shaft thereof to provide a one-way driving force to said shaft.

A further object of this invention is to provide a constant force spring motor drive for a toy or the like having a driven shaft and including free-wheeling means associated with said drive and shaft.

One other object of this invention is to provide a constant force spring drive system including a spring storage reel and a power drum wherein means are provided to insure automatic engagement and disengagement between said spring and drum.

With these and other objects in view which will more readily appear as the nature of the invention is better understood, the invention consists in the novel construction, combination, and arrangements of parts, hereinafter more fully described, illustrated, and claimed.

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A preferred and practical embodiment of the invention is shown in the accompanying drawings, in which:

FIGURE 1 is a top plan view of the invention as applied to a toy vehicle with the winding rack being withdrawn from the device.

FIGURE 2 is a vertical sectional view taken along the lines 2—2 of FIGURE 1 and shows the outer terminal portion of the spring disengaged from the slot in the power drum.

FIGURE 3 is a partial vertical sectional view taken along the line 3—3 of FIGURE 1.

FIGURE 4 is a partial vertical sectional view on an enlarged scale and shows the relationship of the spring housing spool and power drum as seen from the side opposite to that illustrated in FIGURE 3.

FIGURE 5 is a partial bottom plan view of the invention as shown in FIGURE 1 as the various elements appear during the inward stroke of the winding rack.

FIGURE 6 is a side elevation partly in section of another embodiment of the invention as seen during withdrawal of the winding rack.

FIGURE 7 is a top plan view of the invention illustrated in FIGURE 6.

FIGURE 8 is a side elevation partly in section of still another embodiment of the invention.

FIGURE 9 is a top plan view partly in section of the invention illustrated in FIGURE 8, showing the various elements during the withdrawal of the winding rack.

Similar reference characters designate corresponding parts throughout the several figures of the drawing.

Referring now to the drawings, particularly FIGURES 1—5, it will be seen that the spring motor drive is herein illustrated in association with a toy vehicle such as an automobile. It will be understood that the drive system set forth therein may be utilized in devices other than toy vehicles. It could obviously be adapted to power any device wherein a constant force output is desired.

In the present embodiment, the driving means is associated with the front axle 1 of a toy vehicle and includes a storage spool or reel 2 having an inner hub 3 slidably disposed upon the intermediate portion of the axle. The spool 2 acts as a housing for the storage of the spring 4 which comprises a strip of prestressed spring material which actually is considerably thinner than the graphic illustrations contained in the subject drawings. The spring 4 is of the type manufactured by Hunter Spring Company under the name "Neg'ator" and is provided at its inner terminal portion with retaining means such as a hook 5 (FIG. 4) for securing this portion to the hub 3 of the spool. The opposite, or outer terminal portion of the spring is provided with a prominent hook portion 6, as will be most clearly seen in FIGURE 4, which hook portion 6 is preferably formed at an angle at least 90° to the adjacent portion of the spring, for reasons which will readily be apparent immediately hereinafter.

Mounted in the vehicle in close proximity and parallel to the spool 2 is a power drum 7 having a longitudinal slot 8 axially disposed in the face thereof and extending the length thereof. FIGURE 4 again most clearly shows the nature of this slot, generally designated 8, which comprises an inclined ramp 9 and a hook-engaging wall 10 which is preferably inclined at least 90° to an imaginary line tangential to the peripheral edge of the wall 10. The point in providing at least a 90° bend to the hook portion 6 of the spring and in providing that the wall 10 of the slot 8 be similarly disposed will be readily apparent upon reviewing particularly FIGURES 2 and 4, the object being to insure positive engagement between the hook portion 6 and slot 8 when said hook portion is brought into contact with the drum 7.

The drum 7 is slidably journaled upon a power shaft 11 which in turn is fixed to the floor-pan 12 of the vehicle

by means of suitable bearing supports 13 and 14. One face 15 of the power drum 7 is provided with ratchet 16 rigidly secured thereto. Cooperating with this ratchet 16 is a winding pinion 17 slidably disposed upon the power shaft 11 and having a ratchet 18 fixed to one side thereof which engages with the complementary ratchet 16 on the power drum. A compression spring 19 fitted over the power shaft 11 bears on the one end against the fixed support 14 and constantly urges at the other end the winding pinion 17 and its ratchet 18 towards engagement with the ratchet 16 integral with the power drum 7.

Means are provided in the form of a winding rack 20 having teeth 21 on one side thereof for rotating the winding pinion 17 to actuate the power drum 7. In the embodiment illustrated in FIGURES 1-5, the winding rack 20 is journaled within a rear support 22 and a front support 23 mounted to the floor-pan 12 in such manner as to permanently position the winding rack teeth 21 in engagement with the teeth of the winding pinion 17, as most clearly shown in FIGURE 3.

Any suitable means may be provided at the outer end of the winding rack 20 to enable one to readily grasp the winding rack to actuate the same. In this instance, a handle 24 is attached to the outer end of the winding rack, which handle is also the front grill of the toy vehicle. It will be understood that the handle could form any portion of the structure such as a bumper or some other device. Integrally attached to the side of the drum 7 opposite the side containing the pinion 16, is a large drive gear 25. This gear is in constant mesh with a driving pinion 26 slidably mounted on the axle 1 of the vehicle and including a ratchet 27 on one face thereof. Cooperating with the ratchet 27 is a complementary ratchet 28 which is rigidly attached to the axle by any suitable means. In this case, the ratchet section 28 is formed at one end of a sleeve 29 which is splined to the medial portion of the axle 1.

As most clearly illustrated in FIGURE 4, the inner diameter of the hub 3 of the spring spool 2 is slightly greater than the outer diameter of the sleeve 29 to provide a sliding fit therebetween.

A spring 30 carried by the axle 1 constantly bears against the outside of the drive pinion 26 to continually urge the opposed ratchet teeth 27 and 28 into engagement. This action is similar to that previously described in connection with the winding pinion 17 and the related ratchet teeth 16 and 18. However, one distinction between the pinions 17 and 26 should be noted. Each of these two pinions provides for engagement and therefore disengagement in opposite directions, for reasons which will become readily apparent hereinafter.

The operation of the above described device will now be explained. When it is desired to energize the power drum 7 in order to provide driving means to propel the toy vehicle, the operator grasps the vehicle with one hand and with the other, pulls the winding rack 20 out from the vehicle by means of the handle 24. Since the spring 4 may be quite long, for example, several feet it will be seen that merely one pull on the handle 24 will not be sufficient to transfer the entire length of the spring 4 from the storage spool 2 to the power drum 7.

Upon the initial withdrawal of the rack 20 from the device, it will be seen that the pinion 17 will be rotated clockwise as viewed in FIGURES 1 and 3. This motion transmits through the engagement of ratchet teeth 16 and 18 similar clockwise movement to the power drum 7 to cause the hook-engaging wall 10 of the slot 8 in the power drum to pick up the hook portion 6 of the spring 4. The outer terminal portion of the spring 4 adjacent the hook portion 6 is provided with a reverse arc so that this portion of the spring will constantly bear against the surface of the drum 7, even when not engaged by the slot 8 as is clearly shown in FIGURE 2. It will thus follow that withdrawal of the winding rack 20 causes clockwise rotation of the drum 7 so that the slot 8 will eventually pick

up the hook portion 6 of the spring after sufficient rotation of the drum 7 and retain the end of the spring during subsequent clockwise rotation of the drum 7.

The inner end of the rack opposite the outer or handle end may be provided with any suitable stop means such as an enlargement (not shown) to prevent complete withdrawal of the rack. Such stop means would abut the rear support 22 to limit the winding stroke of the rack. Obviously, the length of the rack 20 is limited only by the length of the vehicle body and actually could project beyond the rear thereof, although some realism in the case of a toy vehicle would be lost if such were the case.

During the winding strokes, the elements appear as in FIGURES 1 and 3, wherein it will be seen that the winding pinion 17 is drawn into engagement with the drum 7, due to the locking of the ratchet teeth 16 and 18. The clockwise rotation of the large drive gear 25 causes counter-clockwise rotation of the constant mesh drive pinion 26, but due to the inclination of the opposed ratchet teeth 27 and 28, the pinion 26 merely free-wheels during this movement. It will thus follow that the vehicle may be held firmly against the floor during actuation of the winding rack due to the above-mentioned clutch action.

When the direction of the winding rack is reversed and it is pushed back into the vehicle, the elements appear as in FIGURE 5 wherein the drive pinion 26 and its ratchet 27 are pushed into engagement with the ratchet 28 which is secured to the axle 1. Since the wheels of the vehicle are immobilized either by the operator's hand or held against the floor, it will be seen that the locking of the ratchets 27 and 28 prevents unwinding of the power drum 7 due to the meshing of gear 25 with pinion 26. As the teeth 21 of the rack 20 pass rearwardly around the pinion 17, the pinion free-wheels about power shaft 11 because of disengagement between the ratchets 16 and 18.

After several rectilinear movements of the winding rack 20, the majority of the prestressed spring 4 will be transferred from the storage reel or spool 2 to the power drum 7. During this transfer of the spring it will be noted, particularly from FIGURES 3 and 4 that the spring is bent back upon itself whereby a reverse bend is produced throughout the entire length of the spring. This feature increases the stress upon the spring to provide additional energy therein.

When the majority of the spring has been transferred to the power drum 7, the handle 24 is pushed back into the device and the operator releases his hold upon the vehicle whereupon the force of the spring attempting to wind itself back upon the spool 2 causes the power drum to rotate counter-clockwise. This motion, transmitted through the large drive gear 25, causes clockwise rotation of the drive pinion 26, which drives the axle of the toy through the engaged ratchet teeth 27 and 28.

When the majority of the spring has been withdrawn from the power drum 7 back to the storage spool 2, the hook portion 6 of the spring will be forced out of the slot 8 in the power drum due to the inclined ramp portion 9 of the slot 8. This feature is most desirable as it permits continued counter-clockwise rotation of the power drum 7 to take full advantage of the inertia built up therein during the unwinding of the spring 4. This results in a continuation of the positive driving force to the axle after the spring has completed its action. When the force of inertia in the power drum is spent, the remaining inertia in the vehicle, built up by the forward motion thereof, is utilized to continue the forward travel of the vehicle by means of the ratchet relationship between the drive pinion 26 and the axle 1. It will be seen that continued forward motion of the vehicle and the resultant clockwise rotation of the axle 1 and its integral ratchet teeth 28 will cause the drive pinion 26 to be pushed away from the spool 2 into the position illustrated in FIGURE 1. In this manner, the axle 1

may continue to rotate clockwise without having any effect upon the large gear 25 of the power drum. Very little force is required to push the drive pinion 26 into the position illustrated in FIGURE 1, since it will be understood that the spring 30 is relatively weak as it does not require much force to urge the slidably mounted pinion 26 into its position of engagement.

As noted in FIGURES 3 and 5, the undersurface of the winding rack 20 is provided with a clear section 31 which is free of any teeth. The surface 31 is deep enough so that when the rack is in its fully retracted position, the clear section 31 will be oppositely disposed above the winding pinion 17 and free of any contact therewith. In this manner, the loaded power drum 7 will be free to rotate counter-clockwise to transmit its energy to the drive pinion 26 by way of the large drive gear 25, since the pinion 17 will rotate free of engagement with any teeth 21.

The embodiment illustrated in FIGURES 6 and 7 illustrates another arrangement of the spring motor drive wherein means other than ratchet teeth are provided to obtain one-way action of the various gears. In this form, the winding pinion 32 is indirectly actuated and is rigidly attached to the power drum shaft 33. The one-way motion or clutch action is obtained by means of an additional winding gear 34 which is mounted upon a shaft 35 having its ends journaled in a pair of supports 36 and 37 attached to the floor-pan of the vehicle. The bearing surface 38 of the support 36 provide a loose fit for one end of the shaft 35, while the bearing surface contained in the support 37 for the other end of the shaft 35 comprises an elongated inclined slot 39 as most clearly illustrated in FIGURE 6.

When the rack 40 is withdrawn from the vehicle, the teeth 40a thereon engage the teeth of the gear 34 to rotate same counter-clockwise. This causes the winding pinion 32 to be rotated clockwise whereby the spring 4 will be picked up and wound about the power drum 41 as previously described in connection with the embodiment set forth in FIGURES 1-5. When the winding rack 40 is pushed back into the vehicle, the force of the winding rack teeth 40a pushing against the teeth of the gear 34 causes this gear and its related shaft 35 to be pushed upwardly and rearwardly. In this manner, the shaft 35 will assume the displaced position as illustrated by broken lines in FIGURE 6. This movement disengages the teeth of the gear 34 from the winding pinion 32 so that the power drum 41 is not unwound during retraction of the winding rack 40. When the winding rack is pulled out again, the force of gravity, plus the movement of the teeth 40a of the winding rack against the bottom of the gear 34, will cause the gear 34 to return to the full line position as shown in FIGURE 6, whereby the drum 41 will be further rotated clockwise to continue winding of the spring from the spool 2 to the drum 41.

A clear area 40b on the rack 40 is provided so that when the winding strokes are completed and the rack is pushed all the way back into the vehicle, this area will be disposed immediately beneath the teeth of the winding gear 34 to permit free rotation of this gear during subsequent unwinding of the power drum.

Means are included in this embodiment for disengaging the large drive gear 42 integral with the power drum 41 from the drive pinion 43 which in this case is secured to the front axle 1 of the vehicle. This means includes a lever generally designated 44 which is pivotally mounted as at 45 to the floor-pan and includes an actuating pin 46 at one end thereof and a manually operative handle portion 47 at the other end thereof. The power drum shaft 33 is loosely journaled at one end to a support 48 while the opposite end adjacent to the drive gear 42 is contained within a horizontal elongated slot 49 provided in a support 50. It will therefore be apparent by referring to FIGURE 7, that when the handle 47 of the lever 44 is moved to the position shown in broken lines, the actuat-

ing pin 46 will be arcuately moved with respect to the pivot point 45 in such a manner that the adjacent end of the shaft 33 will be displaced rearwardly within the elongated slot 49. This movement causes disengagement of the teeth of the large drive gear 42 from the teeth of the axle pinion 43. This displacement also causes the teeth of the gear 42 to be moved rearwardly into locking engagement with the spring finger 51 attached to the floor-pan of the vehicle so that it is now impossible for the power drum 41 to unwind. When it is desired to release the drive means, the handle 47 is moved to the full line position shown in FIGURE 6, which disengages the finger 51 from the gear 42 and meshes this gear with the drive pinion 43 to propel the vehicle.

The form of the invention illustrated in FIGURES 8 and 9 is somewhat similar to that set forth in FIGURES 1-5, in that both the drive pinion 52 and winding pinion 53 are provided with integral ratchet teeth 54 and 55, respectively, to achieve one-way engagement. In this form of the invention, the rear axle 1a of a toy vehicle is shown as being supplied with the motive force and the spring storage spool 56 is slidably mounted remotely from the axle upon a shaft 56a. Generally, the arrangement in this form and operation thereof is similar to the first described form in that withdrawal of the winding rack 57 causes rotation of the winding pinion 53, which is urged by means of spring 58 into engagement with the ratchet 59 fixed to the winding drum 60 to cause the free end 61 of the spring 4 to be picked up by the slot 62 in the drum. During the winding action, the axle 1a is prevented from rotating due to disengagement or free-wheeling of the drive pinion 52 against the action of the spring 52a.

During return of the winding rack 57, the ratchet teeth 55 and 59 are separated from one another against the force of the spring 58. When the majority of the spring has been transferred to the drum 60 and the toy device is released, the force of the spring 4 returning to the spool 56 causes clockwise rotation of the drum 60 and its integral large drive gear 63.

The rotation of the gear 63 causes counter-clockwise rotation of the drive pinion 52 which is in constant mesh therewith to cause further rotation of a ratchet axle sleeve 64 which is fixed to the axle 1a. Again, a clear area 57a is provided in the rack 57 to permit free rotating of the winding pinion 53 during operation of the drive system.

It should be stressed that the basic structure of the subject invention, namely, the prestressed tightly wound helical spring carried by a storage reel and having a power drum provided with free-wheeling means, may be utilized in combination with any of various types of devices wherever a constant-force drive system is desirable. Likewise, it will be understood that other forms of winding means may be used in place of the rigid gear racks shown in the present instance such as for example, flexible pull cords or the like. Although the instant motor drives are arranged parallel to the vehicle axles, the spring reels and power drums can be readily adapted to provide for transverse power take-off by the use of suitable gearing such as a crown gear. Quite obviously the gearing may be modified to obtain various output speeds according to the types of device being powered. Also, with any one gear selection, the speed may be regulated by the inclusion of suitable well-known frictional drag means.

I claim:

1. A spring motor drive, comprising, in combination, a prestressed spring wound upon itself and carried by a rotatable spool, a rotary power drum including means for releasably engaging the free outer end of said spring when said drum is rotated in one direction to permit winding of said spring upon said drum, winding means for rotating said drum to engage the free outer end of said spring to wind said spring around said drum, said winding means including clutch means providing

disengagement between said winding means and drum as said drum rotates in an unwinding direction, drive means connected to said drum for providing a power take-off during unwinding of said drum by said spring, said drive means including a pair of gears, one of said gears concentrically mounted on said drum, said drum including an axial shift, pivotal lever means operable to displace said shaft to disengage said pair of gears, and a locking finger engageable by said gear displaced with said shaft to prevent rotation of said drum.

2. A spring motor drive, comprising, in combination, a prestressed spring wound upon itself and carried by a rotatable spool, engagement means on the outer free end of said spring, a rotary power drum including means for releasably engaging the free outer end of said spring when said drum is rotated in one direction to permit winding of said spring upon said drum, the terminal portion of said spring adjacent said engagement means having a reverse arc to insure that said portion of the spring will bear against the peripheral surface of said drum, winding means including a reciprocable toothed rack meshed with a pinion connected to said drum for rotating said drum to engage the free outer end of said spring to wind said spring around said drum, said winding means including clutch means providing disengagement between said winding means and drum when said rack is moved in one direction and as said drum rotates in an unwinding direc-

tion, drive means connected to said drum for providing a power take-off during unwinding of said drum by said spring, said drive means including a drive shaft and a pair of gears, said drum including an axial shaft, one of said gears mounted on said drum shaft and the other of said gears mounted on said drive shaft, and means operable to displace one of said gears to disengage said drive means when said spring is unwound from said drum to permit continued rotation of said drive shaft without rotation of said drum.

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|    | EDGAR W. GEOGHEGAN, <i>Examiner.</i>     |       |                |  |  |