United States Patent

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[54] **IMPULSE-ACTUATED SPRING MOTOR**
3 Claims, 3 Drawing Figs.

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[51] Int. Cl. F03g 1/00
[50] Field of Search ..... 185/39, 41, 44, 37, DIG. 1; 60/7 A; 74/422, 88, 89.1, 89.11, 89.12

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ABSTRACT: An impulse-actuated spring motor in which a main spring is coupled to a retractable plunger having a rack formed longitudinally thereon, the spring being stretched and subjected to tension when the plunger is physically struck on the free end thereof. The rack engages a spring-biased pinion which is normally coupled to a gear train but is decoupled therefrom during the forward stroke of the plunger resulting from the blow. The return stroke of the plunger is brought about by the tension of the main spring, the pinion being then recoupled to the gear train to operate same.

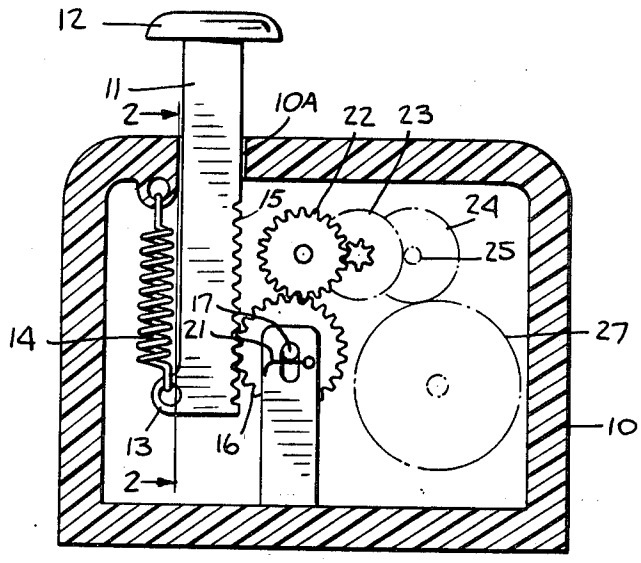


Fig. 1.

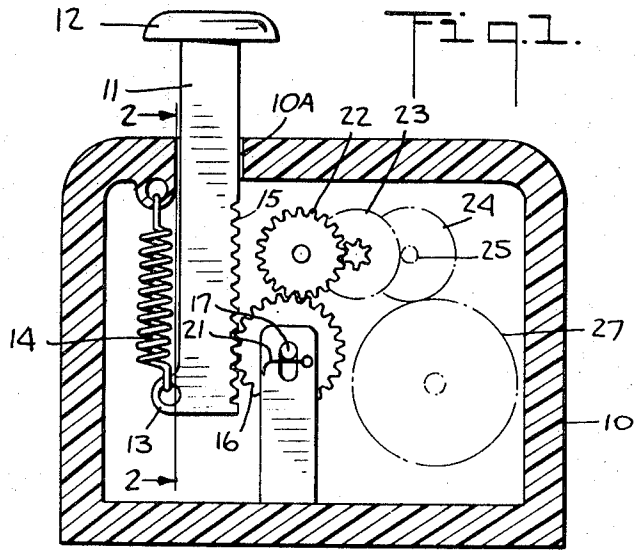


Fig. 3.

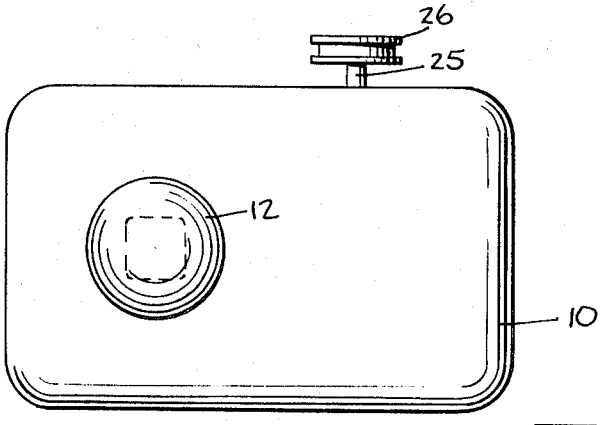
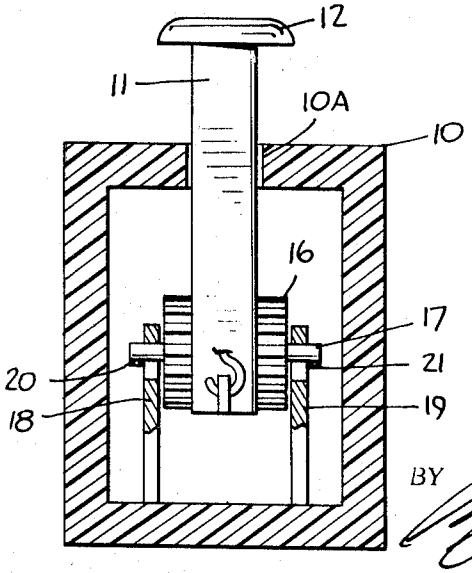


Fig. 2.



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IMPULSE-ACTUATED SPRING MOTOR

BACKGROUND OF INVENTION

This invention relates generally to spring-operated mechanical motors, and more particularly to a motor whose spring is energized by an impulse or blow.

A spring is an elastic body that alters its shape or undergoes displacement under a force. The tension of a spring is directly proportional to the displacement produced by the force, provided the elastic limit of the spring has not been exceeded. Various types of springs have been used as sources of mechanical power, the kinetic energy used for winding it being transformed into potential or stored energy which, when released, serves to drive a gear train or other load.

Thus timepieces and toys having moving parts make use of a torsion spring in which the spring is spiralled about a center and is wound manually to provide mechanical power for driving the mechanism associated therewith. In conventional spring motors, whether using torsion springs or springs of any other type, energy is stored therein by a twisting, pushing or swinging motion obtained by the direct manual manipulation of an operating element such as a key, lever or handle.

When the spring motor is adapted to operate a toy and incorporates a torsion spring, the child is ordinarily required to employ both hands in winding the motor. One hand grasps the winding key or other tool used to wind up the spring, while the other holds the body of the toy to prevent its rotation as winding takes place. Though this operation is very simple for an adult to carry out, it nevertheless entails a degree of muscular coordination that may be lacking in some small children. Hence, the child may be altogether unable to wind his toy, or he may not be able to wind it up fully. In either event, the child experiences frustration.

Moreover, torsion springs, particularly those intended to run toys, if designed for example to drive a toy racing car for 2 minutes or more, require a fair degree of energy to wind fully. The more tightly wound the spring becomes, the more energy necessary to continue winding. Hence, even where the child is well coordinated, he may not have the strength to fully wind his toy. Also, with a spring motor of large capacity, it takes more than a few seconds to wind the motor, so that after the toy motor runs down, the player is required to rewind the toy. This time factor is bothersome to a child and he may therefore lose interest in his toy after a few plays.

SUMMARY OF INVENTION

In view of the foregoing, it is the main object of this invention to provide a spring motor which is actuated by an impulse or blow to provide motive power for toys and other devices having moving parts.

As compared to conventional spring motors in which energy is stored by winding, an impulse-actuated motor has several significant advantages. Other factors being equal, such as the strength of the child, more energy can be developed by a blow due to the force resulting from momentum than by twisting, pushing or swinging actions. With a blow, only one hand need be used and the child is not required to use the other hand for holding the toy. Moreover, since a one-handed blow may be struck with minimum precision, little muscular coordination is entailed. Finally, the time required for supplying energy to the motor is markedly reduced, for with a single blow one may fully energize the motor.

Also, an object of the invention is to provide an impulse-actuated spring motor which is of simple, inexpensive design and which operates efficiently and reliably.

Briefly stated, these objects are attained in an impulse-actuated spring motor in which a helical main spring is coupled to one end of a plunger having a rack formed longitudinally thereon, the other end of the plunger having an exposed impact head which, when physically struck, produces a forward stroke of the plunger, thereby stretching the spring to create tension. The rack engages a spring-biased pinion which is normally coupled to a gear train, but is decoupled therefrom during the forward stroke of the plunger. The return stroke of the plunger is brought about by the tension of the main spring, the pinion being then recoupled to the gear train during the return stroke and acting to drive the gear train.

OUTLINE OF DRAWING

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawing, wherein:

FIG. 1 is a side elevational view of an impulse-actuated spring-operated motor in accordance with the invention;

FIG. 2 is a transverse section taken on the plane indicated by line 2—2 in FIG. 1; and

FIG. 3 is a plan view of the motor.

DESCRIPTION OF INVENTION

Referring now to the drawing, the impulse-actuated spring motor in accordance with the invention comprises a casing **10**, which may be formed of a suitable plastic material and is provided with an opening **10A** which accommodates a retractable plunger **11**. A portion of plunger **11** is normally urged upwardly through the opening and terminates at its upper end in an impact knob or head **12** which may be made of rubber of other suitable material capable of withstanding repeated blows.

The lower end of plunger **11** is provided with a lateral bracket **13**. A helical main spring **14**, which is disposed in parallel relation to one side of the plunger, is connected between bracket **13** and the upper wall of casing **10**, the spring normally tending to keep the plunger in its extended position in which head **12** is raised above the casing. But when head **12** is struck, the plunger is retracted within the casing until the head abuts the wall thereof, thereby stretching spring **14**.

A rack **15** is formed or attached to the other side of the plunger, the rack being constituted by a row of teeth running longitudinally along the plunger. Rack **15** engages a pinion **16** mounted on a shaft **17** whose ends are received by a pair of slotted bearings **18** and **19**, so that the shaft is free to move up and down within the slot limits. Shaft **17** is normally maintained by light, flat springs **20** and **21** in its raised position within the bearings, at which position pinion **16** borne on the shaft intermeshes with the first wheel **22** in a gear train further including intermediate wheel **23** and output wheel **24**. Output wheel **24** is mounted on a shaft **25** coupled to a pulley **26** or other means to drive a toy or other load. Coupled to output gear **24** is a speed-governing device, such as a fly wheel **27**. In practice, the speed governor may be an escapement or the load itself, depending on the application.

The weight of pinion **16** and shaft **17** is counterbalanced by light springs **20** and **21**. Pinion **16** acts as a directional discriminator, in that when head **12** is struck either by the hand of the operator or by a blow delivered with a mallet or other tool, the plunger is sharply retracted, and since the rack **15** thereon is in engagement with the pinion, it pushes the pinion downwardly against the action of light springs **20** and **21** to a degree determined by the lower limit of the slotted bearings **18** and **19**, thereby effecting disengagement of the pinion **16** with the first wheel **22** of the gear train.

At the same time during the forward or downward stroke of plunger **11**, main spring **14** is stretched to create a tension which thereafter acts to reextend the plunger as the spring regains its original size. Thus the kinetic energy of the blow is converted into the potential energy of the stretched spring. As the spring returns to its original length in the course of the return stroke of the plunger, the upward movement of the rack restores engagement between pinion **16** and the first wheel **22**, and as the rack continues to rise, the gear train turns to operate the toy or whatever load is coupled thereto. In practice, the load may be coupled at any suitable point in the gear train, depending on the application.

The rate at which the potential energy of the main spring is transformed into kinetic energy at the load is determined by the gear ratio of the system and friction, as well as the inertia of the load and of the speed moderating or governing device. The system can be kept going indefinitely by blows repeated just as the head reaches its rest position or at any shorter interval.

The more rapidly blows are delivered, the more tension, on the average, is exerted by the main spring. A gong mechanism may be coupled by a suitable lever system to cause the gong to be struck at the moment the plunger reaches its full extension, thereby putting the player on notice of the need to recharge the main spring.

While there has been shown a preferred embodiment of the invention, it is to be understood that many changes may be made therein without departing from the essential spirit of the invention. Thus, instead of a directional discriminator in the form of a spring-biased pinion in a slotted bearing, one may use a ratchet and pawl arrangement or a spring clutch or other directional means. Also, instead of a helical main spring, any other form may be used in conjunction with the plunger as long as the arrangement is such as to effect spring deformation when the impact head is struck.

What I claim is:

1. An impulse-actuated spring motor comprising:

a. a vertically mounted plunger having a rack formed longitudinally thereon, said plunger being mounted for reciprocation and having an impact head at one end thereof, which when physically struck undergoes a forward stroke;

b. a helical main spring operatively coupled to said plunger and disposed in parallel relationship thereto normally to maintain it in an extended position, said spring being stretched during the forward stroke of the plunger in response to a blow struck on said head to create a tension which acts during the return stroke of the plunger, to reextend said plunger,

c. unidirectional means operatively coupled to said rack to convert the movement of said rack during the return stroke of said plunger to rotary motion for driving a load, said means being decoupled from said rack during said forward stroke, said unidirectional means including a spring-biased pinion engaging said rack, and

d. a gear train having a first wheel normally in engagement with said pinion, said spring-biased pinion being retracted from said first wheel during the forward stroke of the plunger.

2. A motor as set forth in claim 1, further including a casing enclosing the elements thereof, said casing having an opening to accommodate said plunger, whereby in the extended position thereof the head is raised above said casing and at the end of the forward stroke the head abuts said casing.

3. A motor as set forth in claim 1 wherein said gear train is coupled to a load, and further including a speed governor operatively coupled to said train and constituted by a fly wheel coupled to the output gear of said train.

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