

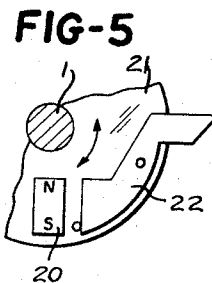
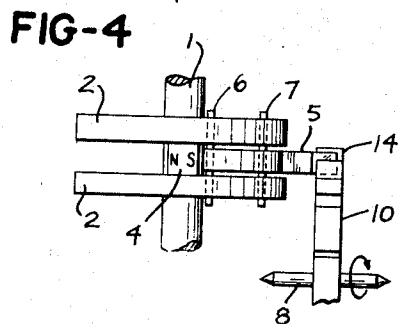
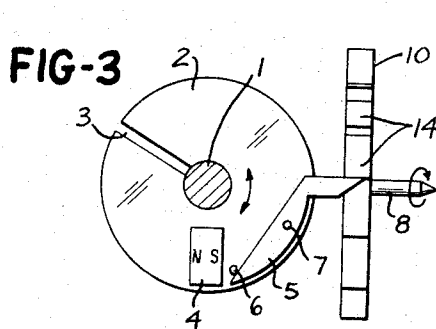
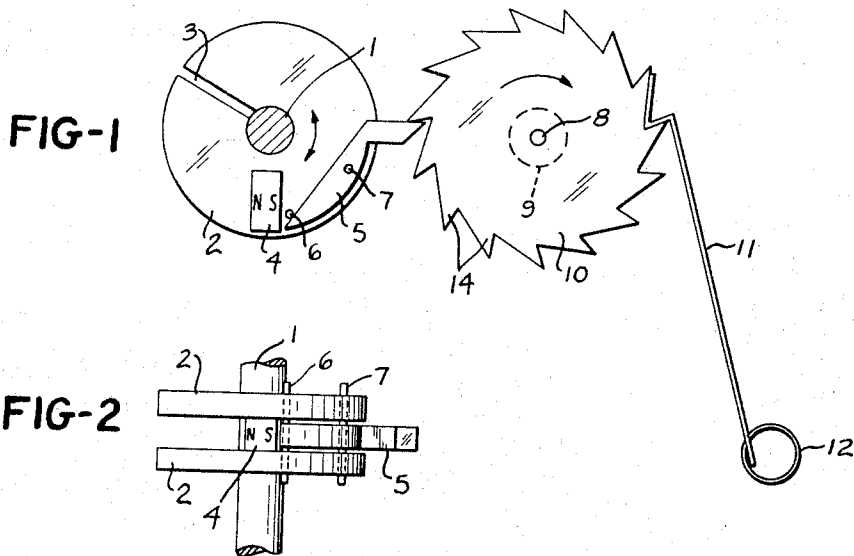
July 4, 1967

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3,329,032

STEPPING DEVICE FOR ELECTRONIC AND ELECTRICAL CLOCKS

Filed Nov. 15, 1965



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STEPPING DEVICE FOR ELECTRONIC AND ELECTRICAL CLOCKS

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Filed Nov. 15, 1965, Ser. No. 507,768

Claims priority, application Switzerland, May 11, 1965,

6,656/65

7 Claims. (Cl. 74—126)

This invention relates to a stepping drive and is particularly concerned with such a drive for use in transmitting the movement of the oscillatory member of a clockwork, especially of an electric or electronic clock or watch, to a rotary member at the input end of the drive train that leads to the element or elements to be driven, clock or watch hands, for example.

The transmitting of the motion of the oscillatory member of a clockwork to the drive train leading to the clock hands, or the like, is well known, and many times includes reduction gearing such as one or more worm transmission. With spring driven clockworks, the oscillatory member is driven by a rotary member which is biased by the clock spring and the oscillatory member operates through an escapement mechanism to regulate the speed of rotation of the rotary member.

With electric or electronic clocks, the oscillatory member is itself the driver for the clockwork and must transmit power to the clockwork drive.

The use of gear driver and the like for the transmission of motion and driving power from the oscillatory member to the drive train of an electric or electronic clocks occasions difficulties because the drive must be extremely compact, as small as 4 mm. in diameter, for example, and the manufacture of such small components is difficult and expensive. Furthermore, with such small gears, especially worm and wheel arrangements, normal manufacturing tolerances can produce situations where gear teeth will catch on each other and this can lead to faulty operation of the clockwork and even, at times, can cause the clockwork to stop.

It has been attempted to drive a rotary notched or toothed wheel by a spring on the oscillatory member but such a drive exhibits too much resistance to return of the oscillatory member following a driving stroke thereof to be practical. Such springs must also be small and, when constructed strong enough to have the necessary long life, are stiff and cause shock in the clockwork, especially on the return movement of the oscillatory member.

With the foregoing in mind, it is a primary object of the present invention to provide a drive arrangement of the nature referred to above which does not have the drawbacks referred to.

Another object of this invention is the provision of a stepping drive connecting an oscillatory member with a rotary member which is free of springs.

Another object of this invention is the provision of a stepping drive connecting an oscillatory member with a rotary member which can be made extremely small but which is accurate and positive and which causes substantially no loss of power in the clockwork.

The several objects referred to above as well as still other objects and advantages of the present invention will become more apparent upon reference to the following specification taken in connection with the accompanying drawings in which:

FIGURE 1 is a schematic view showing the oscillatory member of a clockwork, the rotary member driven thereof and the drive mechanism with the axes of the members substantially parallel;

FIGURE 2 is a fragmentary plan view of FIGURE 1;

FIGURE 3 is a view like FIGURE 1 but shows the

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oscillatory and rotary members arranged with their axes at angles to each other;

FIGURE 4 is a partial plan view of FIGURE 3; and FIGURE 5 is a view of a modification.

Referring to the drawings more in detail, numeral 1 is an oscillatory shaft driven by any suitable clockwork drive mechanism of a known type.

Plates or discs 2 having radial slits 3 are mounted on shaft 1 to form a platform or support. A tiny permanent magnet 4 is mounted on the platform between plates or discs 2. The plates or discs are preferably of non-magnetic material so magnet 4 has its field adjacent thereto.

A pawl member 5 is supported on the platform, preferably between plates or discs 2, on pivot pin 7 which permits the pawl member to turn on the platform. A stop pin 6 is provided on the platform to abut and stop pawl member 5 before its end closest to magnet 4 can engage the magnet whereby it is prevented that pawl member 5 will be subjected to more than a predetermined small force due to magnet 4 and which force will, of course, decrease when the pawl member moves on pivot 7 to increase the distance between the pawl member and the magnet.

The end of pawl member 5 remote from magnet 4 is formed to engage teeth 14 of a wheel 10 mounted on shaft 8 on which is also carried drive pinion 9 which meshes with another gear of the drive train (not shown) of the clockwork.

The teeth 14 are shaped like saw teeth so that upon counterclockwise movement of shaft 1, pawl member 5, held by magnet 4 against pin 6, will engage a tooth of wheel 10 and advance the wheel in the clockwise direction one tooth. Upon return movement of shaft 1, however, pawl member 5 will engage the inclined side of a tooth 14 and will be caused to pivot on pin 7 and step over the said tooth.

The small force of magnet 4 will reduce as the pawl member 5 tilts on pivot pin 7 and there is thus substantially no loss of power in the mechanism and, for the same reason, there will be substantially shock-free operation of the mechanism.

The wheel 10 has associated therewith a detent in the form of a long leaf spring 11 which has one end shaped to conform to the space between adjacent ones of the teeth on wheel 10 and its other end anchored in the stationary pin 12. The detent permits wheel 10 to turn in the clockwise direction but prevents it from turning in the counter clockwise direction.

FIGURES 1 and 2 show the invention wherein the axes of the oscillatory and rotary members are parallel whereas FIGURES 3 and 4 show their members with their axes at right angles to each other. The same reference numerals employed in FIGURES 1 and 2 are also employed in FIGURES 3 and 4.

FIGURE 5 shows how a magnet 20 on a platform 21 could be arranged to present both poles to the adjacent end of pawl member 22, instead of only one pole of the magnet as in the case of FIGURES 1-4. The end of pawl member 22 adjacent magnet 20 thus forms a shunt for the magnet. The choice of arrangements of the magnet on the platform and the particular spacing between the magnet and the pawl member to determine the force excited by the magnet on the pawl member can be made depending upon the particular circumstances.

The device can be made extremely small and is quite reliable in operation.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions; and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. An oscillatory member, a rotary member adjacent said oscillatory member, said rotary member having teeth on the periphery thereof shaped like saw teeth, a pawl pivotally mounted intermediate its ends on said oscillatory member near the periphery of said oscillatory member and having one end projecting beyond the periphery of said oscillatory member and adapted to engage the teeth of said rotary member, stop means on said oscillatory member operable to engage and stop said pawl in a predetermined rotated position on said oscillatory member in one direction of pivotal movement thereof on said oscillatory member and in which position said one end of said pawl will be disposed so as drivingly to engage said teeth in one direction of movement of said oscillatory member, said one end of said pawl camming over said teeth in the other direction of movement of said oscillatory member, cooperating magnetic elements on said oscillatory member adjacent the other end of said pawl and on the other end of said pawl, at least one of said elements being permanently magnetized, said elements cooperating to bias said pawl toward said predetermined position on said oscillatory member, said elements being spaced circumferentially of said oscillatory member when said pawl is in said predetermined position, and detent means operatively associated with said rotary member operable to permit said rotary member to rotate in one direction only.

2. The combination according to claim 1 in which the said element on said oscillatory member is a bar-like permanent magnet extending substantially radially of said oscillatory member, said pawl being formed of magnetic material, said magnet and said other end of said pawl converging toward the periphery of said oscillatory member when said pawl is in said predetermined position on said oscillatory member whereby tilting of said pawl about its pivotal connection with said oscillatory member when said one end of said pawl cams over the teeth of said

rotary member will reduce the force with which the magnet acts on said pawl.

3. The combination according to claim 2 in which said detent means is a leaf spring having an end part engaging said rotary member, said end part being shaped to conform to the space between adjacent ones of said teeth, and said oscillatory member is in the form of a shaft and a pair of discs thereon in axially spaced relation, said magnet and said pawl being disposed between said discs.

4. The combination according to claim 3 in which said discs are non-magnetic.

5. The combination according to claim 2 in which said magnet is arranged so that one pole only is effective on said pawl.

6. The combination according to claim 1 in which said detent means is a leaf spring having an end part engaging said rotary member, said end part being shaped to conform to the space between adjacent ones of said teeth.

7. The combination according to claim 1 in which the said element on said oscillatory member is a bar-like permanent magnet extending substantially radially of said oscillatory member, said pawl being formed of magnetic material, said magnet and said other end of said pawl being in spaced parallel relation when said pawl is in said predetermined position on said oscillatory member so that both poles of the magnet are effective on said pawl.

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