March 17, 1931. M. HELM ET AL 1,796,992

GEAR BACKLASH COMPENSATOR

Filed Nov. 26, 1929

Fig. 1.

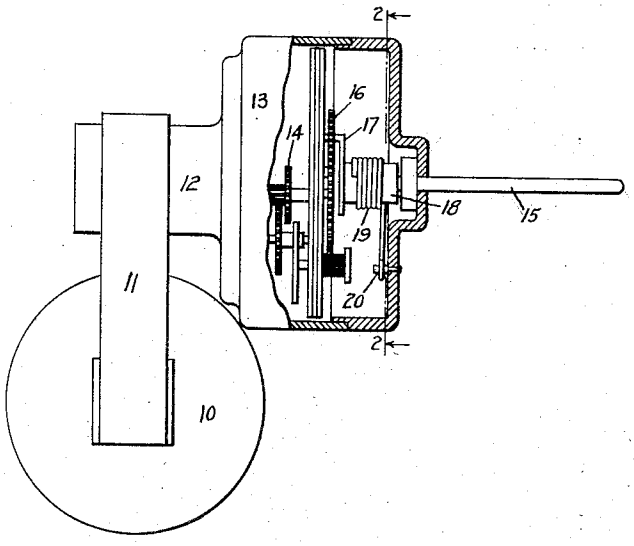


Fig. 2.

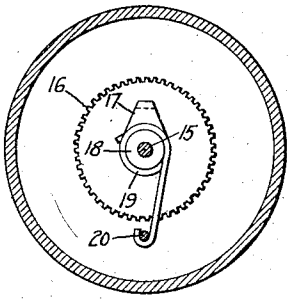
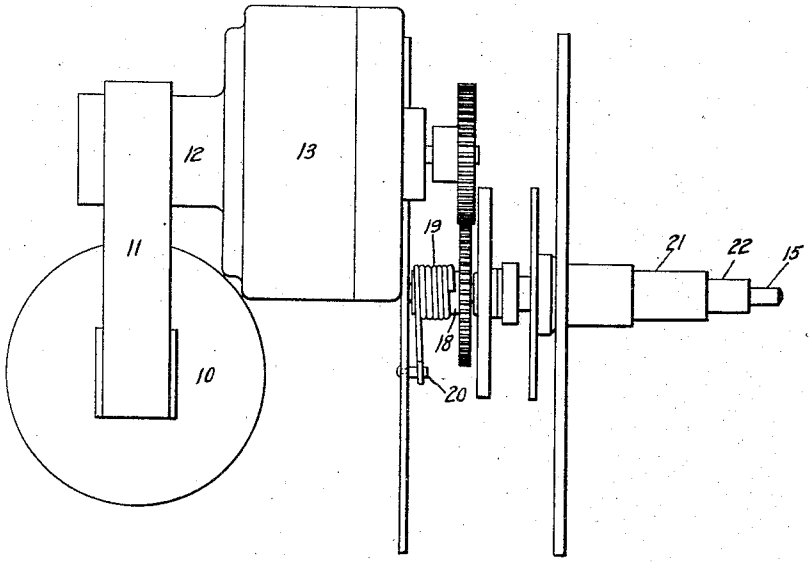


Fig. 3.



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UNITED STATES PATENT OFFICE

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GEAR-BACKLASH COMPENSATOR

Application filed November 26, 1929, Serial No. 409,964, and in Germany February 26, 1929.

Our invention relates to means for eliminating the backlash in gear trains and has particular application to the gear trains employed in connection with clocks driven by high speed motors.

In one form of well known electric clock the hands are driven through a train of gears from a synchronous motor operating at a high speed. For example the motor may operate at 3600 revolutions per minute, whereas the minute hand of the clock makes only one revolution per hour. The amount of gear reduction necessary for this great difference in speed is correspondingly large. The torque of the motor is small and the gears must necessarily have sufficient clearance to prevent binding. As a result there is present in gear trains of this character an appreciable amount of backlash which is undesirable from the standpoint of noise and accuracy. Our invention provides a simple expedient for eliminating such backlash without introducing any other undesirable features and we accomplish this object by providing a special constant torque brake at the low speed end of the gear train.

The features of our invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. For a better understanding of our invention reference is made in the following description to the accompanying drawing in which Fig. 1 represents a view partially in section of a synchronous motor driven gear train of the character employed for driving the hands of a clock to which our invention has been applied; Fig. 2 is an end view taken on line 2—2 of Fig. 1, and Fig. 3 shows another modification where the brake mechanism is mounted external to the usual gear casing.

Referring to Fig. 1, 10 represents the field coil and 11 the stator iron of a self-starting synchronous motor. The rotor of the motor is not shown but it will be understood that the rotor is contained within the reduced portion 12 of a gear casing 13. The latter encloses and supports a gear reducing train 14 between the motor and a low speed shaft 15 which may be considered to be the minute hand shaft of the clock. The details of such a motor drive are described in United States Patent 1,495,936, Henry E Warren, May 27, 1924. The gear reduction between the rotor of the motor and shaft 15 may be 3600 to 1 for example and the clearance between different gears and gear teeth must be such as to prevent binding and excessive friction since the torque of this form of motor is low and is used primarily as a timing device and not to drive any appreciable load. As a result there is considerable backlash in the gear train between the motor and terminal shaft 15 which tends to make the device noisy and to introduce small but troublesome inaccuracies in the rotative position of the terminal shaft 15.

To compensate for or eliminate this backlash without causing binding or appreciable additional load on the driving motor we impose a small constant braking action on the low speed, high torque end of the gear train. It will be noted that the shaft 15 is driven from gear 16 through an arm 17 and that the arm 17 is secured to an enlarged sleeve 18 fastened to the shaft 15. The brake comprises a spring 19 having one end coiled about sleeve 18 and the other end fastened to the stationary gear casing at 20. The free end of the spring is coiled about the shaft in a direction opposite to the direction of rotation of the shaft. The direction of rotation of sleeve 18 is therefore such as to tend to unwind the coiled portion of the spring as indicated by the arrow in Fig. 2. This type of brake has the important advantage over an ordinary brake in slipping at a very definite and constant torque value. The torque value or braking action corresponds to the amount of force necessary to uncoil the spring thereby increasing its diameter to an amount very slightly greater than the sleeve upon which it rides. The torque value can be determined in advance by adjusting the inner diameter of the spiral spring when unsupported. By this simple expedient the backlash between the motor and terminal shaft is eliminated. The additional load on the motor is negligible since the brake is at the low speed, high torque end of the gear train. Because the braking action is always equal to a constant spring tension the braking action is constant but can be

initially adjusted to just the correct value desired.

In Fig. 3 parts similar to those of Fig. 1 are indicated by like reference characters. The action is similar to that previously described but the brake is outside the gear casing 13 where it is accessible for adjustment. 21 and 22 represent additional shafts concentric with shaft 15 for driving other clock hands or devices at appropriate speeds. It will be noted that if attempts were made to drive the shaft 15 in the opposite direction the spring would tighten and would ordinarily prevent such backward rotation. This feature may be advantageous where backward rotation is to be prevented.

Having described the essential features of our invention and a preferred embodiment and application thereof we desire to embrace within the scope of the appended claims such other embodiments and applications as fall fairly within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States, is:—

1. In a gear drive, a gear train, driving means at one end of said gear train, a shaft driven from the other end of said gear train in a given direction of rotation, and means for eliminating backlash, in said gear train comprising a spiral spring having one end fastened to a stationary support and the other end coiled about said shaft in a direction opposite to the direction of rotation thereof.

2. In a gear drive, a high speed electric motor, a low speed shaft, reduction gears between said motor and shaft for driving the latter in a given direction, and means for eliminating backlash in said gear train comprising a coiled spring closely surrounding the low speed shaft having one end secured to a stationary support, the direction of rotation of the shaft being such as to uncoil said spring and increase its diameter.

In witness whereof, we have hereunto set out hands this 29th day of October, 1929.

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SIEGFRIED GIERS.