

UNITED STATES PATENT OFFICE.

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INTERMITTENT-GEAR MECHANISM.

1,074,362.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, LODEWYK JAN RUTGER HOLST, a citizen of the United States, residing at Lansdowne, in the county of Delaware and State of Pennsylvania, have invented certain new and useful Improvements in Intermittent-Gear Mechanism, of which the following is a specification.

The purpose of my present invention is to provide means for converting continuous rotary movement into intermittent rotary movement in such manner that the period of rest for the intermittently moving shaft will bear any desired predetermined relation to the period of rotation of such shaft while elements of the mechanism by which the movement is transmitted to the intermittently moving shaft are in continuous moving engagement with the continuously rotating shaft.

The nature and scope of my present invention will be more fully understood from the following description taken in connection with the accompanying drawings forming part hereof, in which—

Figure 1, is a sectional front elevation of one form of my invention, taken on the line A—B, of Fig. 2. Fig. 2, is a sectional side elevation on the line C—D, of Fig. 1. Fig. 3, is a diagram, in plan, on an enlarged scale of a cam and star-wheel, showing curves for producing a rest of five-sixths ($5/6$) and a movement of one-sixth ($1/6$) of the star-wheel during a revolution of the cam and shown in this view in a position at the beginning of movement of the said star-wheel; and Fig. 4, is a similar view, in plan, of a cam and star-wheel designed to produce three times one-fifth ($1/5$) movement of the star-wheel in a complete revolution of the cam, with a period of two-fifteenths ($2/15$) movement and thirteen-forty-fifths ($13/45$) rest of the said star-wheel between successive movements.

The corresponding parts in these figures are indicated by the same letters and numerals.

Referring to Fig. 4, which illustrates the general principle of the invention of which Figs. 1, 2 and 3, show special adaptations for a specific purpose, 1, is an intermittent shaft carrying integrally with it a star-wheel 3, which in this instance is five-pointed; and 2, is a continuously rotating shaft, to which a cam 4, is rigidly secured; the said cam showing as a suitable example,

three equi-distant recesses in its circumference, the upper one $T T_1$, being in a position at the beginning of movement of the star-wheel 3, and when the cam 4, is being rotated in the direction of the arrow. In this instance, the said star-wheel will move, as indicated by its arrow. The same relative position of the cam and star-wheel illustrates the end of a period of movement of the star-wheel, if motion is imparted to the cam in a direction opposite to that indicated by the arrow, in which case the star-wheel will also have moved in a direction opposite to that as indicated by the arrow.

By way of example and for the purpose of illustrating that the frequency of movement of the intermittent shaft and the speed of its movement are independent of each other and from the number of points in the star, the diameter 2^r , of the star-wheel circle has been chosen two-thirds ($2/3$) of the diameter 2^R , of the cam circle, giving thus a relative speed of rotation of $1\frac{1}{2}$ to 1. As there are five points on the star-wheel 3, each rotation thereof will be one-fifth ($1/5$) of 360° , or 72° , which motion takes place during 72° , times two-thirds ($\frac{2}{3}$) or 48° degrees of rotation of the cam 4, and as the latter is provided with three recesses, such movement of the star-wheel 3, will occur three times during one complete revolution of the cam. The duration of each partial rotation of the star-wheel 3, will thus be equal to $48/360$ or two-fifteenths ($2/15$) of a revolution of the cam 4, and the period of rest in the case illustrated will be one-third ($\frac{1}{3}$) of the remaining thirteen-fifteenths ($13/15$) or thirteen-forty-fifths ($13/45$) of the time occupied by a complete revolution of the cam 4. However, it is evident that when desired, the recesses $T T_1$, $T_2 T_3$ and $T_4 T_5$, need not be spaced equally around the cam 4, thereby allowing the occurrence of successive partial rotations of the star-wheel shaft to take place at unequal time intervals, in each cycle, as shown by the location of the dotted recess-curve above the point T_2 .

The preceding description explains how and when the star-wheel 3, can move, but the means, whereby this wheel is actually rotated, still remains to be fully explained.

It will be observed that the cam 4, is adapted to positively lock the star-wheel against rotation so long as the circular periphery is in contact with the star-wheel

curve. However at the instant that the point T, of the recess becomes tangent to the deepest point of the star-wheel curve the cam unlocks the star and the gear 5, ceases to slip over the flat face of the star-wheel, and by frictional contact sets it in rotation, causing thereby the point F, to gradually descend in the recess T T₁, the curve of which is preferably constructed in accordance with involute tooth form so that the curve F T, is at all times in tangential contact with the curve T T₁. After one-half of the angular displacement of the star-point F, has been completed, this point reaches the deepest part of the symmetrical curve T T₁, and then the cam curve begins to act also as an actual driver of the star-wheel, cooperating in that function with the gears 5 and 6, until the point T₁, has reached the highest point of the adjoining curve F G₃, of the star-wheel 3, at which instant, this wheel becomes again locked by the engagement of the circular periphery of the cam 4, with one-half and more of the star-wheel curve. This moment in the relative position of the star-wheel 3, and the cam 4, is also illustrated in Fig. 4, when the direction of rotation is chosen opposite to that indicated by the arrows. The gear 5, again slips over the flat surface of the star-wheel and continues to do so until the next tangent point T₂ of the recess T₂ T₃, arrives at the highest point in the star-wheel curve.

The mechanical details of the gears 5 and 6, are clearly illustrated in Figs. 1 and 2, in which the gears 5 and 6, form the equivalent for the gears 5 and 6, described in relation with Fig. 4.

The cam 4, illustrated in Fig. 2, carries on its flat face and concentric with its circular circumference a spur-gear 6, rigidly attached to the same. This spur-gear 6, meshes with a gear 5, mounted on the spindle 2, and pressed in frictional contact with the surface of the star-wheel 3, by any suitable friction device, such for instance, as is shown in Fig. 2, in which 7, represents a friction washer held between the star-wheel 3, and the gear 5, pressure being exerted by the coil-spring 8, and which can be regulated by means of the nut 9.

Fig. 1, shows the gears 5 and 6, the star-wheel 3, and the cam 4, in front elevation. The pitch diameter of the gear 5, relates to the pitch diameter of the gear 6, as the radius r, of the star-wheel circle relates to the radius R, of the cam circle. Thus when continuously rotating the shaft 2, as illustrated in Figs. 1 and 2, the gears 5 and 6, being in mesh, will rotate with velocities inversely proportionate to their pitch diameters, causing thereby the gear 5, to slip over the washer 7, until the tangent point T₁, of the recess T T₁, in the cam 4, comes tangent with the deepest point of the star-

wheel curve, when the friction of the gear 5, will cause the star-wheel 3, to participate in its movement until the tangent point T₁, comes tangent with the deepest point of the adjoining curve of the star-wheel 3, when the latter becomes locked by the circular circumference of the cam 4, until the tangent point T, of its recess has completed one revolution, when the entire cycle repeats, as before.

When laying out cams and star-wheels of equal or unequal radii, such as illustrated by way of example in Fig. 4, it is desirable to first determine the relative and absolute pitch diameters of the gears, as they must possess a full number of teeth each, which condition when coupled with the system of diametrical pitch calculation determines the exact distance E H, between the two shafts or spindles 1 and 2. This center-distance being then known, a line E F, is drawn, making one-half ($\frac{1}{2}$) the central angle of the star-wheel polygon with the line E H. In the instance illustrated in Fig. 4, the star-wheel forms a pentagon with a central angle of 72°, so that the line E F, inclines 36°, to the line E H. Next a line H F, is drawn through the point H, at an angle with the line E H, equal to 36°, and multiplied by the gear proportion, in this instance two-thirds ($\frac{2}{3}$), resulting in an angle of 24°, embraced between the lines F H, and E H. If then E F, be chosen as the radius for the star-wheel circle, and H F, as the radius for the cam circle and the curves F T, G—G₁—G₂—G₃—F, of the star-wheel be centered from points H, H₁ H₂, H₃ and H₄, equally divided around a circle of a radius E H, from the center E, the circumferential velocity of the star-wheel when moving, will equal the circumferential velocity of the cam, and as furthermore the recess T T₁, is shaped to conform with the rules of involute tooth construction, there will be at all times during the periods of rest as of motion of the star-wheel circumferential contact between the successive points of the periphery of the cam and the star-wheel, to thereby insure smooth and noiseless operation of this mechanism.

It will be further understood from the foregoing description of the said mechanism, that the gear 6, maintains the gear 5, in continuous rotation during the rotation of the cam 4, and hence a continuous driving torque is transmitted to the star-wheel, which latter will obey such torque whenever the location of the recess or recesses in the cam 4, unlocks the star-wheel.

Having thus described the nature and objects of my said invention, what I claim as new and desire to secure by Letters Patent is:—

1. In intermittent gear mechanism, an intermittently rotating star-wheel, a continu-

ously rotating cam, and means to transmit to said intermittently rotating star-wheel a continuous driving torque from said continuously rotating cam.

5 2. In intermittent gear mechanism, an intermittently rotating star-wheel and a continuously rotating cam, being permanently in peripheral contact with each other and means to transmit to said star-wheel a continuous driving torque from said cam.

10 3. In intermittent gear mechanism, an intermittently rotatable star-wheel, a gear co-axial and in frictional contact therewith, a cam, a gear co-axial and in rigid contact
15 therewith, the periphery of said cam engaging the periphery of said star-wheel and said gears meshing with each other, to thereby exert on said star-wheel continuously the driving torque of said cam, so as
20 to rotate said star-wheel during the passage of the recessed portion of said cam.

4. In intermittent gear mechanism, an intermittently rotating shaft, a star-wheel rigidly attached thereto, a gear co-axial and in frictional contact therewith, a continu- 25
ously rotating shaft, a cam and a co-axial gear both in rigid connection with said continuously rotating shaft, said cam engaging said star-wheel and said gears engaging
30 each other, to thereby exert a continuous torque on said intermittently rotating shaft by the continuous torque of said continuously rotating shaft, to intermittently rotate said star-wheel during the periods of pas-
35 sage of the recessed portion of said cam.

In witness whereof, I have hereunto set my signature in the presence of the two subscribing witnesses hereto.

LODEWYK JAN RUTGER HOLST.

Witnesses:

THOMAS M. SMITH,
HELEN F. MILLER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."