Dec. 16, 1969 J. HERMANN ET AL 3,484,804

DEVICE FOR TRANSFORMING AN OSCILLATING MOTION INTO A UNIDIRECTIONAL ROTATION

Filed Dec. 24, 1968 3 Sheets-Sheet 1

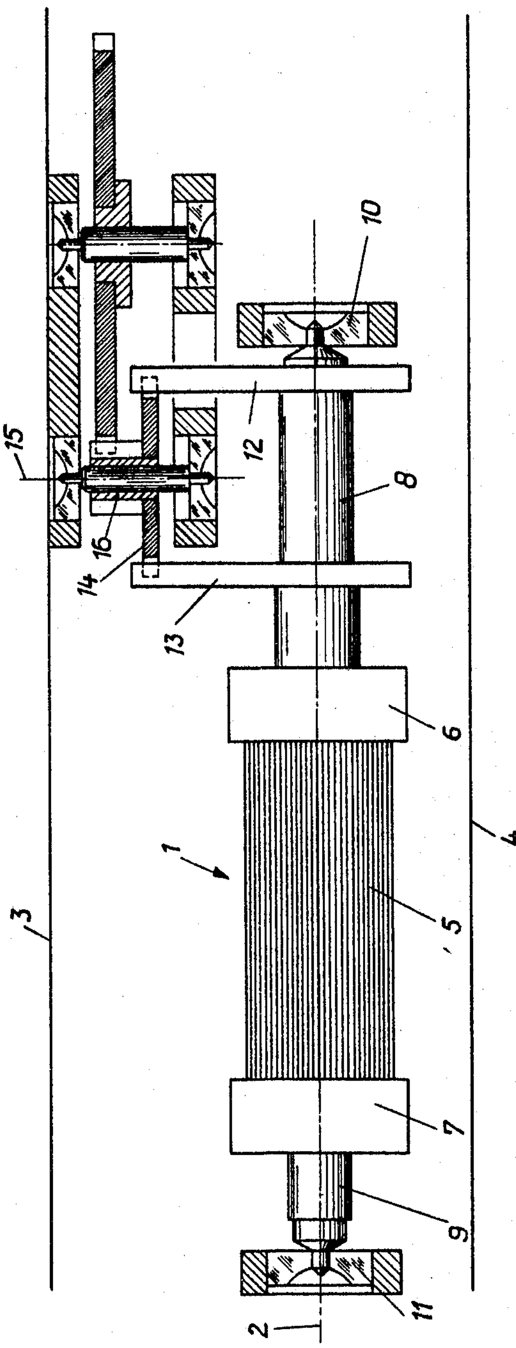

Fig. 1

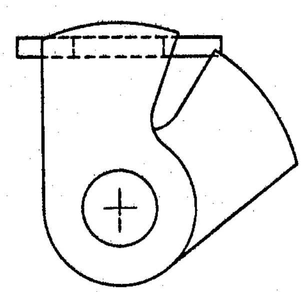

Fig. 5

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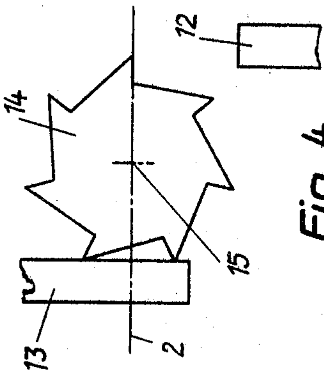

Fig. 4

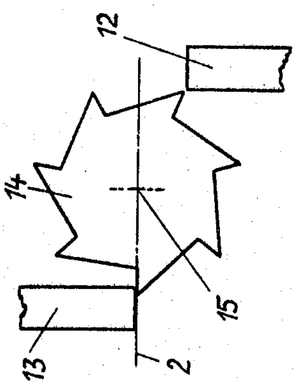

Fig. 3

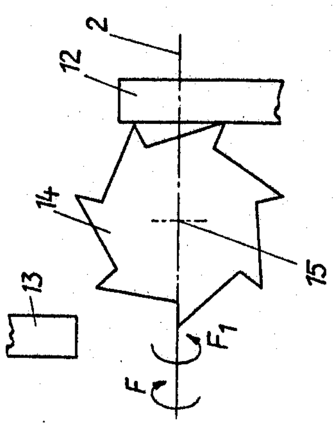

Fig. 2

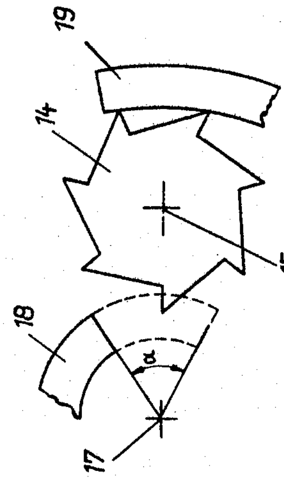

Fig. 7

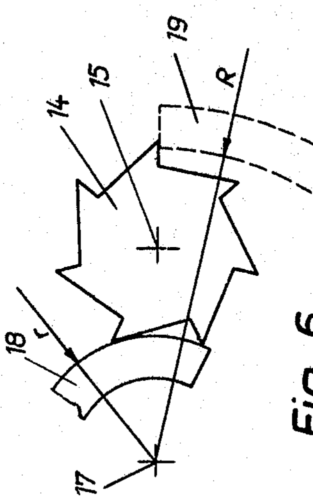

Fig. 6

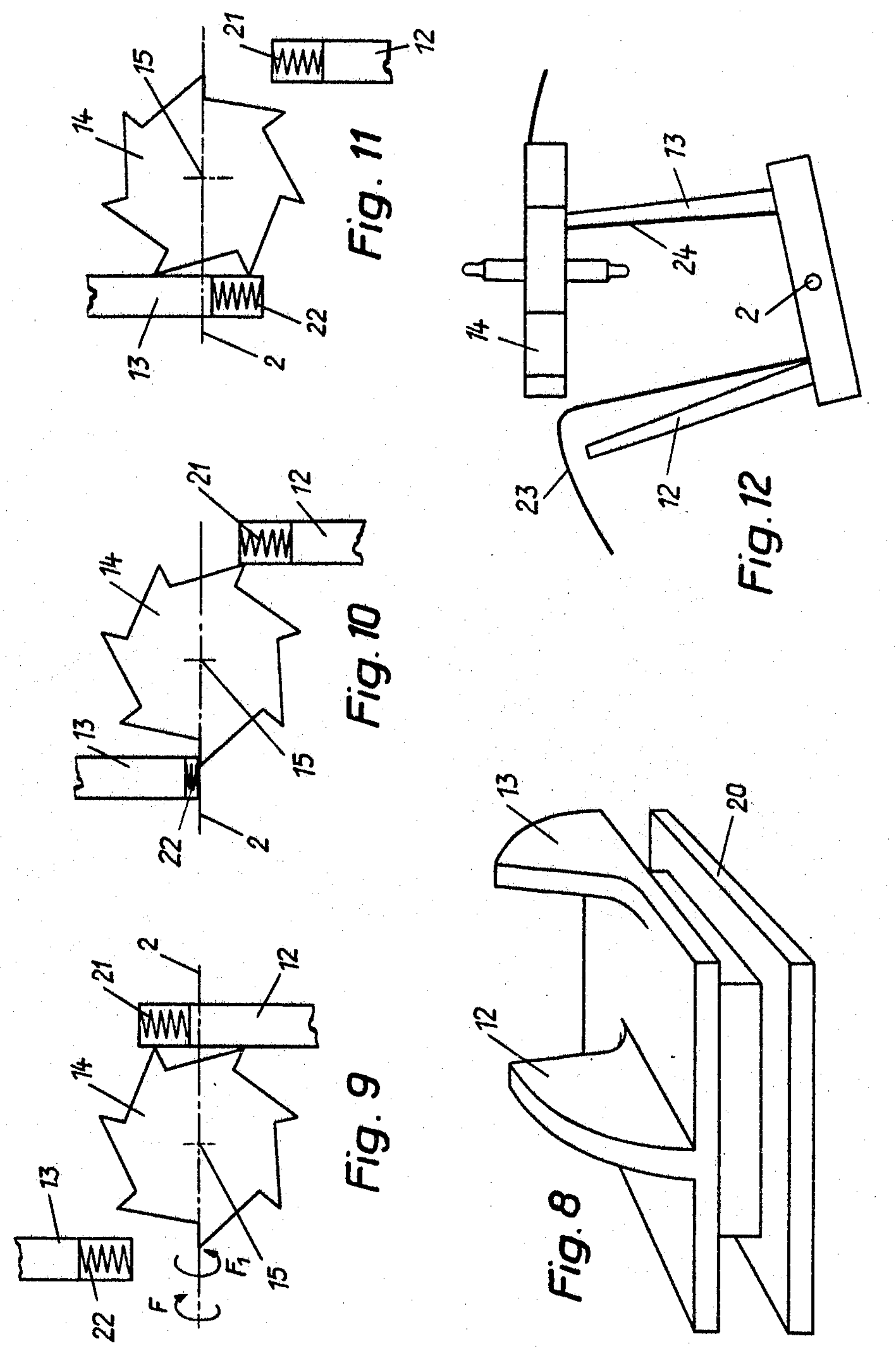

Fig. 11
Fig. 10
Fig. 9
Fig. 12
Fig. 8

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DEVICE FOR TRANSFORMING AN OSCILLATING MOTION INTO A UNIDIRECTIONAL ROTATION

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Int. Cl. G04c 3/00
U.S. Cl. 58—23 12 Claims

ABSTRACT OF THE DISCLOSURE

Two oscillating pawls alternately drive a ratchet of a horological mechanism step-by-step in the same sense, each pawl temporarily holding the wheel against return movement while the other pawl is inactive.

BACKGROUND OF THE INVENTION

The present invention concerns a device for transforming an oscillating motion into a unidirectional rotation.

The problem of the transformation of an oscillating motion into a rotary motion is well known in horology, as well as in the case of horological pieces having a spring driving motor as in the case of horological pieces having a regulating motor driven by electrical means.

In this last category, two kinds of mechanical transformers are generally used, the transformer with a pawl mounted on a resilient strip and the driving anchor which engages the teeth of the wheel in order to cause its rotation.

The transforming devices provided with a pawl have the disadvantage of requiring a second pawl to prevent a return motion of the driven wheel, since the wheel is locked in one direction only by the positioning pawl, which allows this wheel to advance accidentally under the influence of too great an impulse received from the driving pawl or owing to the effect of a shock when the same pawl is in its position of rest.

The anchor transforming devices have nearly radial engagement with the driven wheel, i.e. nearly perpendicular to the motion of the wheel, which causes considerable friction and consequently a low efficiency.

SUMMARY OF THE INVENTION

The present invention enables the abovementioned disadvantages to be remedied. It consequently concerns a device for transforming an oscillating motion into a unidirectional rotation, comprising two members connected to a support mounted to oscillate around an axis and arranged on this support in such a manner as to alternatively engage in the teeth of a wheel for driving the latter step-by-step, characterized in that the wheel has an odd number of teeth, and in that the trajectory of each one of the members intersects the outer circumference of the wheel in two points the connecting radii of which form in the centre of the wheel an angle which is practically equal to the pitch of the teeth, the chords respectively connecting the points of intersectoin of the circumference with the trajectory of each one of the members being perpendicular to a common diameter of this wheel.

The force applied by such a transforming device is practically tangential to the wheel and thus applied in the direction of its rotation, so that friction is considerably reduced and the efficiency increased.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a side view, partly in cross section, of a transforming device of the invention incorporated in a horological mechanism.

FIGS. 2 and 4 are schematic plan views of the transforming device of FIGURE 1.

FIG. 5 is a schematic end view of the transforming device of FIG. 1, showing the wheel **14** and the relative angular positions of the pawls **12** and **13**.

FIGS. 6 and 7 are schematic plan views of another embodiment.

FIG. 8 is a perspective view of a variant of the embodiment shown in FIGS. 1 to 5.

FIGS. 9 to 11 are plan views of another variant.

FIG. 12 is a view in elevation schematically showing the resilient parts illustrated in FIGS. 9 to 11.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The horological mechanism shown in FIG. 1 comprises a motor **1** oscillating around an axis **2** parallel to the upper and lower faces of the movement, respectively **3** and **4**. The movable armature of the motor comprises a coil **5** in the shape of a frame secured by means of an adhesive in two recesses **6** and **7** respectively formed in the inner ends of two rods **8** and **9** coaxial with the axis **2**, and the outer ends of which are pivoted in bearings **10** and **11**, respectively. The rod **8** carries two rigid-armed pawls **12** and **13** secured to this rod and the free ends of which are arranged on either side of a wheel **14** pivoted around an axis **15** which is perpendicular to and in the same plane as the axis **2** of the motor **1**. This wheel **14** is connected by its pinion **16** to the demultiplicating gear train of the indicating hands as in the classical horological mechanisms.

As may be seen in the FIGS. 2 to 4, the wheel **14** is provided with ratchet teeth. The two pawls **12** and **13** describe around and axis of oscillation **2** two planes parallel to the axis of rotation **15** of the wheel **14** which intersects the outer circumference of the wheel, as defined by the tips of the teeth, along a chord, joining the tips of two adjacent teeth. As the wheel **14** has an odd number of teeth, a tooth is always diametrically opposite to a gap. The two pawls **12** and **13** occupy a predetermined angular position in relation to one another around the axis **2**. Thus, the path of movement of each pawl intersects the outer circumference of the wheel **14** at two points, such that the radial lines drawn therethrough define an angle substantially equal to the pitch of the wheel teeth. The two chords thus defined by the movement of the pawls are perpendicular to a common diameter of the wheel.

The core of the armature coil **5** extends between the two inner ends of the rods **8** and **9**, and can be considered an extension or part of the rod **8**.

In FIG. 2, the face of the pawl **12** rests against the tops of two teeth of the wheel **14** which is thus angularly positioned. The pawls **12** and **13** which were rotating in the direction of the arrow F around the axis **2** have arrived the end of their travel in the position shown in this figure and are at the beginning of a rotation in the opposite direction F1. The pawl **12** is first disengaged from the wheel **14** as shown in FIG. 3 and the pawl **13** comes into contact with a tool of the wheel **14** which is diametrically opposite to the chord joining the two adjacent teeth resting against the face of the pawl **12**. The tooth in contact with the pawl **13** is displaced by the latter until its summit slips against the face of the pawl **13** which forms a chord with the summit of the adjacent tooth. At this moment the direction of oscillation changes until the pawls return to the position shown in FIG. 2.

In the embodiment illustrated in FIGS. 6 and 7, the principle of operation is identical with that of the FIGS. 2 to 5. This embodiment differs from the preceding one by the fact that the axes **15** and **17** respectively of the wheel **14** and the oscillator are parallel. The pawls **18** and **19** are consequently no longer axially spaced around the axis of oscillation, but are concentric with this axis. As the radii separating the pawls **18** and **19** from the axis of rotation are different, the angular distribution of the contact of the teeth with each of the arms is consequently no longer identical. The advance of the wheel **14** is effected in the same way as described above, but the positioning is no longer obtained by means of a plane surface but by means of the arcs of circles of the arms of the pawls **18** and **19** which are concentric with the axis of oscillation **17**.

A variant of the first embodiment is illustrated in FIG. 8 in which the pawls **12** and **13** are secured to a movable frame **20** forming part of an electro-dynamic driving system. This part **20** and the pawls **12** and **13** can be obtained in the shape of a single moulding which leads to an extremely simple practical solution.

In the described embodiments, there exists a very short moment during which the wheel **14** is not locked, the moment between the instant when a pawl leaves the wheel and the instant when the other pawl comes into contact with a tooth. This difference between the release of the wheel by one pawl and the coming into contact of the other pawl with a tooth is made necessary for reasons relating to the safe operation, in order to avoid the risk of the mechanism becoming blocked. The FIGS. 9 to 12 ilustrate a variant intended to ensure continuous locking whilst avoiding all risks of seizing or blocking of the mechanism. To this end, each pawl **12** and **13** is provided at its driving end with a resilient part **21** and **22** respectively which may be constituted by various means. The operation illustrated in these figures and in particular in FIG. 10 shows the function of this resilient zone. In fact, it may be seen that if the pawls are rotating in the direction F1, for instance, the resilient zone **21** of the pawl **12** is still in contact with a tooth of the wheel **14** whilst the resilient zone **22** of the pawl **13** has come into contact with a tooth of the wheel **14**. As the wheel is still locked by the pawl **12**, the zone **22** is compressed, and when the pawl **12** has released the tooth it is retaining, the resilient zone **22** will be able to return to its normal position driving the wheel **14** until the pawl arrives in the position shown in FIG. 11, after which the pawls begin to rotate in the direction F to come to the position shown in FIG. 9 passing meanwhile through the compression phase of the resilient zone **21**, as described with reference to FIG. 10 for the resilient zone **22**.

FIG. 12 illustrates an embodiment for obtaining the resilient zones **21** and **22**. Two springs **23** and **24** are secured at, or near to, the base of each pawl in such a manner as to create a resilient contact between the wheel **14** and the pawls **12** and **13**.

What is claimed is:

1. Device for transforming and oscillating motion into a unidirectional rotation, comprising a toothed wheel mounted free to rotate, the tips of the teeth thereof defining a wheel outer circumference, a support mounted to oscillate about an axis, two members on said support and moving therewith for alternately engaging the teeth of said wheel to drive the latter step-by-step in one direction, and wherein the improvement comprises that said wheel incorporates an odd number of teeth, and that the path of movement of each of said two members intersects said wheel outer circumference at two points the radial lines of which define an angle substantially equal to the pitch of the wheel teeth, and wherein the respective chords connecting the two intersections of the path of movement of each said member with the said wheel outer circumference are perpendicular to a common diameter of said wheel, whereby each said member locks said wheel, at respectively different times, against return movement for a part of each complete oscillation of said support.

2. The device as defined in claim **1**, wherein the axis of oscillation of said support is perpendicular to the axis of said wheel, and each said member has at least one surface perpendicular to the axis of oscillation of said support.

3. The device as defined in claim **1**, including a driving face for each said member that contacts the teeth of said wheel, and resilient means arranged in front of each said driving face for contacting a tooth of said wheel while the other said member is still locking said wheel, whereby the latter is never free to rotate in the return direction.

4. The device as defined in claim **3**, wherein each said member projects from said support, and said resilient means are each a springy strip secured at, or near to, the base of a respective said member and which diverges from its member in the direction of the end thereof remote from said support.

5. The device as defined in claim **1**, wherein the axis of oscillation of said support is parallel to the axis of said wheel.

6. The device as defined in claim **5**, including a surface incorporated by a respective said member for contacting two adjacent teeth of said wheel for locking the latter in position, after the respective member has driven it one step, for a part of one complete oscillation of said support, and wherein said surface of each said member defines an arc of a circle concentric with the axis of oscillation of said support.

7. The device as defined in claim **1**, including an oscillating motor, a coil constituting the armature for said motor and mounted on said support, and wherein said support constitutes the core of said motor coil.

8. The device as defined in claim **2**, including an oscillating motor, a coil constituting the armature for said motor and mounted on said support, and wherein said support constitutes the core of said motor coil.

9. The device as defined in claim **7**, wherein said members are integral with said support.

10. The device as defined in claim **8**, wherein said members are integral with said support.

11. The device as defined in claim **1**, wherein each said member is a pawl.

12. The device as defined in claim **1**, wherein said wheel is a ratchet wheel and each said member is a pawl, and said wheel and members are part of the works of a horological mechanism.

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