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COUNTING MECHANISM

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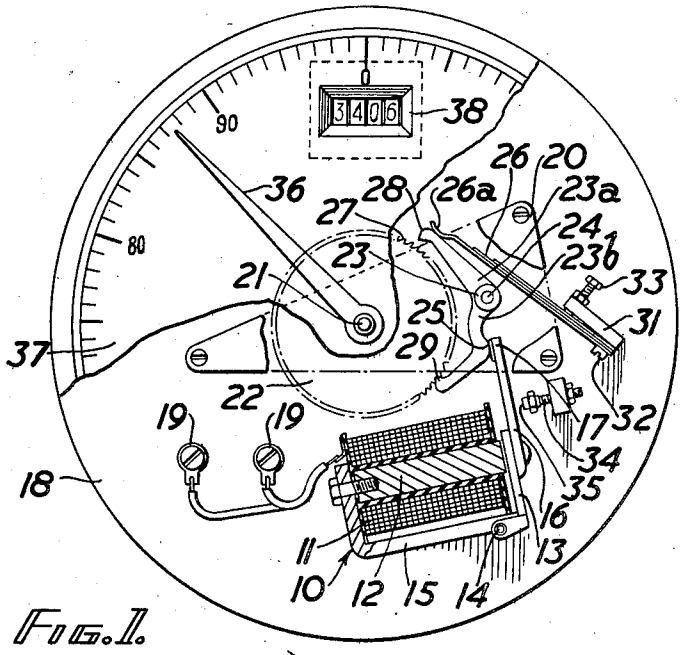


FIG. 1.

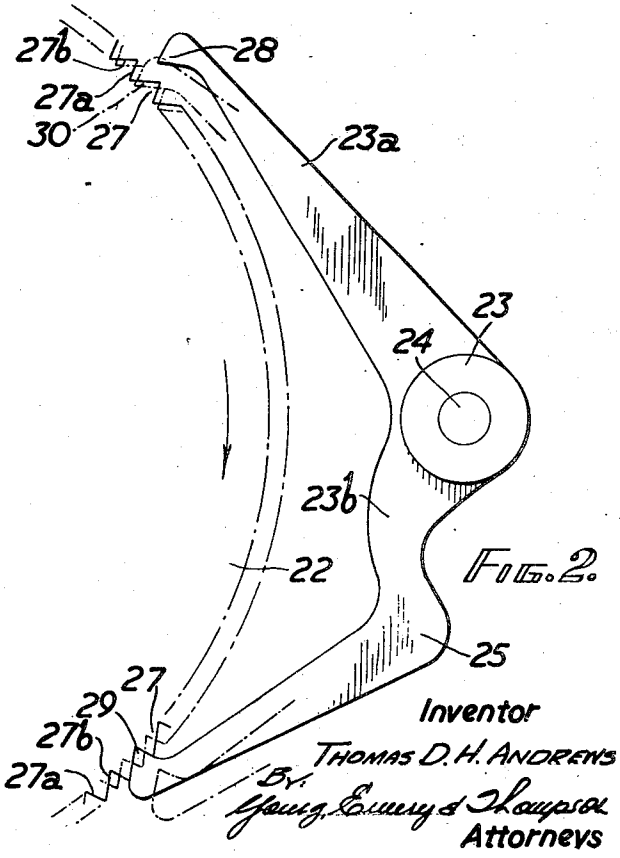


FIG. 2.

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COUNTING MECHANISM

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6 Claims. (Cl. 235—92)

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This invention relates to counting mechanisms and is more particularly, though not exclusively, concerned with a counting device which is operated by electromagnetic means. It has for its object to provide a counting mechanism of small size and unfailing accuracy which, when required, can be operated at very high counting frequencies, and which is capable of prolonged periods of use without attention.

According to the invention a counting mechanism comprises a movable member or members having associated therewith a plurality of spaced jaws or pallets the movement of which causes step-by-step rotation of a toothed wheel, and means whereby the extent of such rotation can be measured.

Preferably spring loading means are provided and the jaws or pallets are moved in one direction by the movable member or members and returned to their original position by the spring loading means. These oscillations of the jaws or pallets cause the step-by-step rotation of the toothed wheel, partial rotation of the latter being effected when the jaws or pallets are moved by the movable member or members and further partial rotation in the same direction when the jaws or pallets are returned by the spring loading means.

If desired, the counting mechanism may be electrically operated, the movable member or members comprising the armature of an electromagnet and being hingedly mounted with respect to the latter. Preferably a single movable member is employed and the jaws or pallets are carried by a separate element associated with the movable member.

One embodiment of an electrically operated counting mechanism will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a frontal part-sectional elevation of the counting mechanism, part of the dial and a side plate being broken away to enable details of the mechanism to be seen, and

Figure 2 is a detail view on a considerably larger scale of the jaws or pallets and a substantially C-shaped rocking element by which they are carried, a portion of the wheel also being shown and the positions of the teeth of the wheel and the jaws or pallets when the electromagnet is not energised being indicated in broken lines.

Referring to the drawings, the electromagnet 10 comprises a U-shaped member of ferrous material, the coil 11 of the magnet being wound on one of the limbs of the U which thus forms the core 12 of the electromagnet. The movable member 13, also of ferrous material, is mounted on a rolling-type hinge 14 secured to the free end of the other limb 15 of the U, the movable member and hinge being arranged in such manner that a small gap is left between the movable member 13 and the free ends of the limbs of the U. By this arrangement a substantially closed magnetic field is provided, and energisation of the coil 11 will cause the movable member 13, which forms the armature of the electromagnet, to be drawn inwardly about the hinge 14 towards the core 12. The movable member 13 extends inwardly slightly beyond the core 12 so as to complete the iron circuit of the electromagnet 10, and to its free end an extension lever 16 is riveted, the lever being constructed of light alloy to lessen the mass of the oscillating system. At the end of the extension lever 16 a hole is drilled to receive a flat-headed hardened stud 17 which is riveted in position with the head facing inwardly.

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The base of the counting mechanism comprises a circular non-magnetic base plate 18 to which the electromagnet 10 is attached in any convenient manner, terminals 19 being provided for the ends of the coil 11. A triangular side plate 20 is arranged substantially centrally of the base plate 18 and is spaced therefrom, the central portion of this plate being shown broken away in Figure 1. Two transverse shafts are rotatably carried by bearings in the side and base plates, one shaft 21 being disposed centrally of the base plate 18 and having a hardened toothed wheel 22 secured thereon, the radius of the wheel being substantially less than the distance between the shafts. An inverted substantially C-shaped rocking element 23, the movment of which causes step-by-step rotation of the toothed wheel 22, is mounted substantially centrally on the outer shaft 24, the limbs 23*a*, 23*b* of the C-shaped element projecting towards the toothed wheel. The lower limb 23*b* of the C-shaped element 23 is looped outwardly, the outer curved portion 25 of the loop being hardened. This outer curved portion 25 is positioned so as to make contact with the head of the stud 17, contact being maintained by means of a laminated and adjustable leaf spring 26 which presses inwardly against the outer end of the upper limb 23*a* of the C-shaped element 23. As well as maintaining contact between the curved portion 25 of the C-shaped element and the stud 17 on the extension lever 16 secured to the movable member 13, the spring 26 also serves to return all these parts to their original positions after they have been moved by energisation of the electromagnet 10.

Fine V-shaped teeth 27 are formed on the wheel 22, the included angle between adjacent faces of the teeth being slightly less than a right-angle, as shown clearly in full lines in Figure 2. The teeth are not symmetrical, but are inclined about a radial line drawn through their apices so that the leading faces 27*a* of the teeth facing

the direction in which the wheel 22 is required to rotate (indicated by an arrow in Figure 2) are more steeply inclined in the tangential direction than their trailing faces 27b. These teeth are engaged by hardened V-shaped jaws or pallets 28, 29 formed on the inwardly projecting ends of the C-shaped element 23, the jaws or pallets being arranged so that when one of the jaws or pallets is fully engaged with the teeth (as shown in Figure 2 in which the lower pallet 29 is shown in full lines in the fully engaged position) the other is slightly raised out of mesh with the teeth.

It will be understood that when an electrical impulse is fed to the coil 11 of the electromagnet 10 the movable member 13 is drawn inwardly towards the core 12 of the latter, this movement being transmitted through the extension lever 16 to the curved portion 25 of the C-shaped element 23 and resulting in a slight turning movement of the latter on its shaft 24, whilst when the electromagnet is de-energised the leaf spring 26 returns the C-shaped element 23 and the movable member 13 to their original positions. Thus each jaw or pallet 28, 29 is engaged alternately with a tooth 27 of the wheel 22 each time an electrical impulse is fed to the electromagnet. The position of the outer transverse shaft 24 on which the C-shaped element 23 rocks and the length of the limbs 23a, 23b of the latter are arranged so that the jaws or pallets 28, 29 engage with the teeth 27 in a direction substantially at right-angles to the tangential, the angle subtended by the jaws or pallets at the centre of the wheel being approximately 90°. The jaws or pallets 28, 29 are shaped so that the angle between the faces of each jaw or pallet is slightly less than the included angle between adjacent teeth of the wheel 22, and are so spaced apart and disposed about the shaft 24 that as one jaw or pallet leaves the base of one of the teeth 27, the other engages with the trailing face 27b of a tooth further around the periphery of the wheel at a point approximately centrally positioned along its trailing face.

As shown clearly in Figure 2, when the electromagnet 10 is energised the jaw or pallet 28 moves to the position shown in full lines and will be withdrawn from the leading face 27a of a tooth whilst the other jaw or pallet 29 will engage with the trailing face 27b of another tooth and drive the wheel 22 forwards in the direction of the arrow for a distance corresponding approximately to half the pitch of the teeth. At this point the wheel 22 is locked against further rotation by the steeply inclined leading face 27a of the following tooth abutting the jaw or pallet 29. When the electromagnet 10 is de-energised the reverse action takes place, the jaw or pallet 28 being urged inwardly by the spring 26 and engaging with the trailing face 27b of a tooth at a point approximately half-way along its length, as shown at 30 in Figure 2. The wheel 22 is thereby again rotated for a similar distance in the same direction after which it is again locked against further rotation by contact between the leading face 27a of a tooth and the jaw or pallet 28. Thus for each energisation and de-energisation of the electromagnet 10 the wheel 22 rotates an angular distance corresponding to the distance between adjacent teeth.

An upwardly projecting lug 31 is secured to the base plate 18 to which the outer end of the leaf spring 26 is anchored by a screw 32, a screw and locknut 33 being disposed inwardly thereof on the lug to adjust the pressure exerted by the spring on the upper limb 23a of the C-shaped element 23. The inner end of the spring which bears on the upper limb 23a is curved, as shown at 26a, to lessen the sliding friction between the spring and the limb, and the portion of the latter on which the spring bears is hardened. It will be appreciated that the spring 26 presses inwardly against the C-shaped element 23 at a point substantially opposite the jaw or pallet 28, the pressure being exerted radially towards the toothed wheel 22. Thus the force of the spring is employed as advantageously as possible, whilst the friction between the curved end 26a of the spring and the C-shaped element 23 is reduced to the minimum. Outward movement of the extension lever 16 and movable member 13 is limited by an adjustable stop 34 fitted with a rubber end cap 35, the latter not only helping to silence the armature system but also serving to store some energy which is returned to the system on the inward stroke.

To lessen the resistance to inwards movement of the movable member 13, which, in addition to moving the lower limb 23b of the C-shaped element 23 inwardly and thus partially rotating the wheel 22, has also to overcome the inward pressure of the leaf spring 26, the jaws or pallets 28, 29 are so arranged in relationship to the teeth 27 of the wheel that the angular movement imparted to the latter by contact with the jaw or pallet 29 is less than the angular movement imparted by contact with the jaw or pallet 28. The jaw or pallet 29 is positioned that it makes initial contact with the trailing face 27b of a tooth at a point inwards of its centre, whilst the jaw or pallet 28 makes contact with the trailing face of another tooth at a point outwards of its centre.

To register the degree of rotation of the toothed wheel 22 the central shaft 21 on which it is mounted is extended upwardly through the side plate 20 and carries an indicating finger 36 behind which a suitable marked dial 37 is positioned. For convenience in counting, the wheel 22 is preferably formed with 100 teeth and the dial 37 carries 100 divisions. Thus for each separate movement of the C-shaped element 23 the indicating finger 36 moves half a division. The central shaft 21 is also connected by gearing to other suitable recording mechanism, for example a counter of the coaxial drum type 38, whereby the number of complete revolutions of the shaft may be ascertained. The complete mechanism is housed in a suitable case (not illustrated).

It will be appreciated that the use of non-magnetic light alloy material for the extension of the movable member 13 not only reduces the weight of the oscillating system but also prevents transmission of magnetism to the jaws or pallets 28, 29. When the movable member is drawn towards the core 12 of the electromagnet 10 the engagement of the jaw or pallet with the wheel 22 limits its further movement and this engagement is arranged so that a very small air gap is left between the movable member 13 and the core of the electromagnet, thus reducing any chance of magnetic sticking between the core and the movable member.

The counting mechanism described is equally suitable for both low and high counting frequencies and is applicable, for example, to the counting of radiation pulses from radioactive material, the mechanism being capable of counting at frequencies in excess of 100 per second. When the device is required to operate at abnormally

high frequencies it is only necessary to increase the pressure exerted by the leaf spring 26 by means of the adjusting screw 33. The hardened wearing and contact surfaces and the lightness of the moving parts enable the mechanism to operate for prolonged periods without attention.

I claim:

1. A counting mechanism comprising in combination a ratchet wheel provided with a large number of fine asymmetrical teeth, the longer flanks of which are straight, a rocking element mounted about an axis positioned outwardly from but closely adjacent to the periphery of the ratchet wheel, a movable member separate from said rocking element and pressing against the latter at a point on one side of said axis, means for imparting motion to said movable member to turn said rocking element in one direction about such axis, spring loading means which press radially inwards relatively to the ratchet wheel against said rocking element on the opposite side of said axis to effect turning movement of the rocking element in the opposite direction, spaced jaws on said rocking element positioned one on each side of said axis, said jaws engaging alternately with the longer flanks of spaced teeth of the ratchet wheel in a direction substantially at right angles to the tangential to effect step-by-step rotation of the ratchet wheel, the spacing of said jaws being such that the arc of the ratchet wheel located between the jaws is less than a semi-circle and the spring loading means pressing on the rocking element at a point adjacent one of said jaws, and means for measuring the extent of rotation of the ratchet wheel.

2. A counting mechanism comprising in combination a ratchet wheel provided with a large number of fine teeth having straight flanks, a pivoted rocking element having two limbs which extend around the ratchet wheel for a distance less than half its periphery and provided with jaws arranged one towards the outer end of each limb, the pivotal axis of said rocking element being arranged substantially centrally thereof and outwardly from but closely adjacent to the periphery of the ratchet wheel, a movable member which presses inwardly towards said ratchet wheel against one of said limbs of the rocking element at a point intermediate one of said jaws and the pivotal axis to effect a turning movement of the rocking element in one direction, spring loading means which press radially inwards relatively to said ratchet wheel against the other of said limbs of the rocking element at a point adjacent the other of said jaws, means for imparting motion to said movable member to turn said rocking element about its pivotal axis so that its jaws alternately engage with spaced teeth of the ratchet wheel in a substantially radial direction to effect step-by-step rotation of the latter, and means whereby the extent of such rotation can be measured.

3. A counting mechanism comprising in combination an electromagnet, an armature pivotally mounted on one side of said electromagnet and extending outwardly beyond and at substantially right angles to the core of said electromagnet, a ratchet wheel having at least one hundred asymmetrical teeth the longer flanks of which are straight, a substantially C-shaped rocking element pivoted near its centre to extend around the periphery of the ratchet wheel for approximately 90° of said periphery, the pivotal axis of

said C-shaped element being arranged outwardly from but closely adjacent to the periphery of the ratchet wheel and substantially in line with the axis of said armature, two jaws on said C-shaped element arranged one at each end of the latter, spring loading means which press inwardly against the C-shaped element at a point adjacent the jaw remote from the electromagnet to effect rocking movement in one direction of the C-shaped element and outward movement of the armature, the free end of the latter pressing inwardly against the C-shaped element at a point intermediate its pivotal axis and the other of said jaws to effect rocking movement of the C-shaped element in the other direction when the electromagnet is energised, the jaws alternately engaging with the teeth of the ratchet wheel in a substantially radial direction to effect step-by-step rotation of the latter, and means whereby the extent of such rotation can be measured.

4. A counting mechanism according to claim 1, wherein said means for imparting motion to the movable member comprises an electromagnet of substantially U shape having its coil wound on one of the limbs of the U to form the core of the electromagnet, said movable member, which forms the armature of the electromagnet, being hinged to the free end of the other limb of the U from which it projects over the core and outwardly thereof to bear against said rocking element.

5. A counting mechanism according to claim 1, wherein the jaws are arranged out of register with the teeth of the ratchet wheel so that one of said jaws makes initial contact with the longer flank of one of the spaced teeth of the ratchet wheel at a point on one side of the centre of said flank whilst the other of said jaws makes initial contact with the longer flank of another spaced tooth at a point on the other side of the centre of the flank of said second tooth so that the angular movement imparted to the ratchet wheel by contact with one jaw is less than half the angular spacing between adjacent teeth whilst the angular movement imparted to the ratchet wheel by the other jaw is greater than half such spacing, the sum of the angular movements imparted by both jaws equalling the angular spacing between adjacent teeth.

6. A counting mechanism according to claim 1, and further comprising a rotatably mounted shaft by which said ratchet wheel is fixedly carried, said means for measuring the extent of rotation of the ratchet wheel comprising a radially arranged indicating finger secured to said shaft to indicate individual units of count up to the number of teeth on said ratchet wheel, and a counter of the coaxial drum type driven from said shaft to record the number of complete revolutions of the latter.

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