Feb. 12, 1963 F. SOLARI 3,077,302

STEPPING DEVICE WITH ACCUMULATION OF ENERGY FOR MECHANICAL COUNTER

Filed Aug. 15, 1960

3 Sheets-Sheet 1

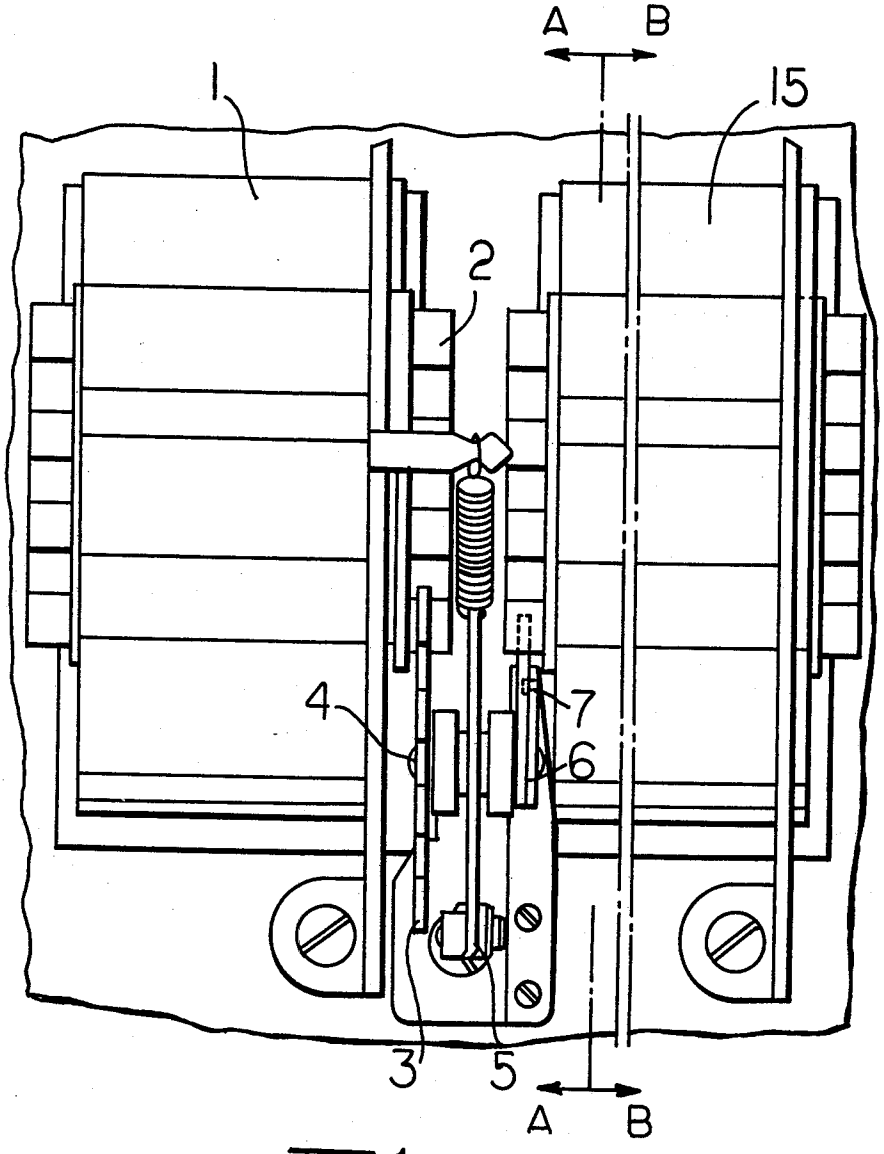

FIG. 1

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Filed Aug. 15, 1960 3 Sheets-Sheet 2

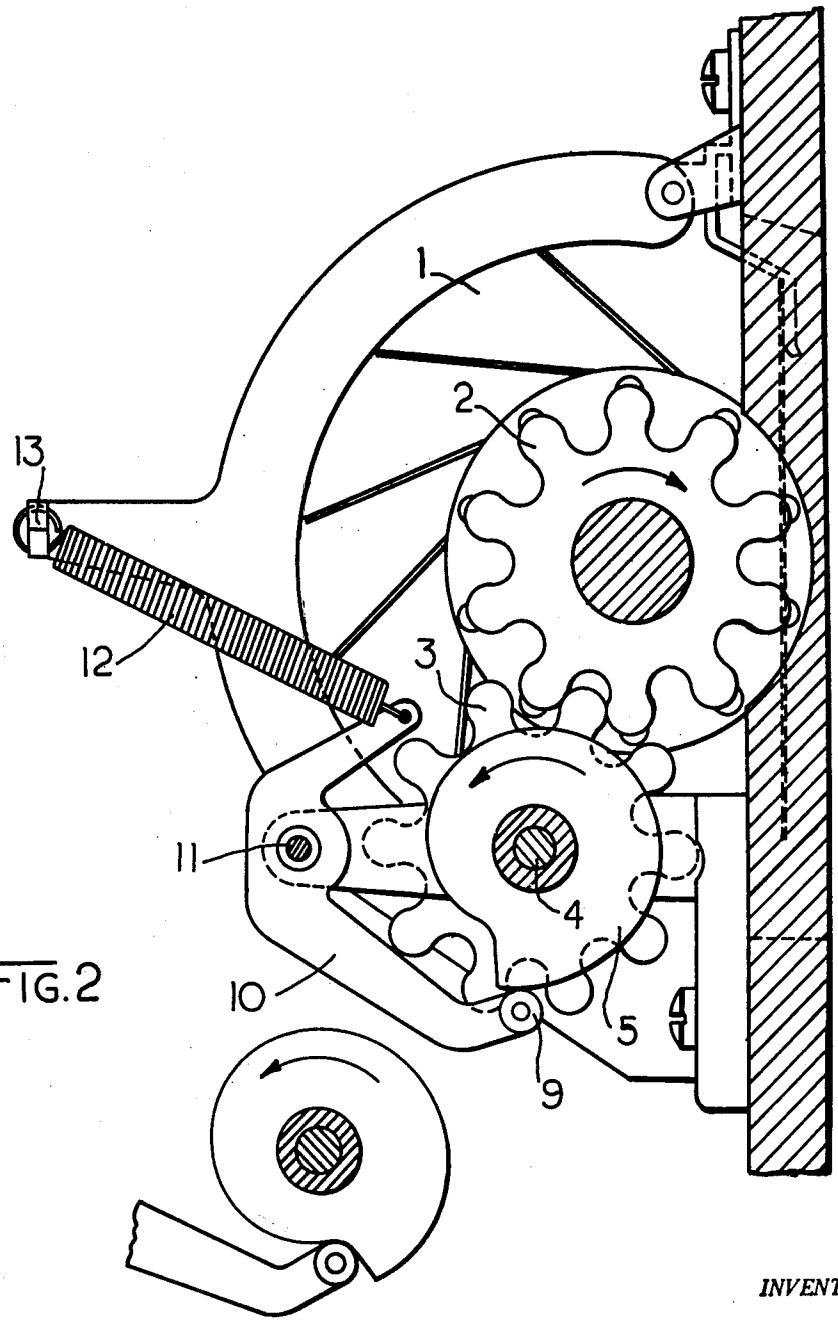

FIG.2

FIG.2A

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Filed Aug. 15, 1960 3 Sheets-Sheet 3

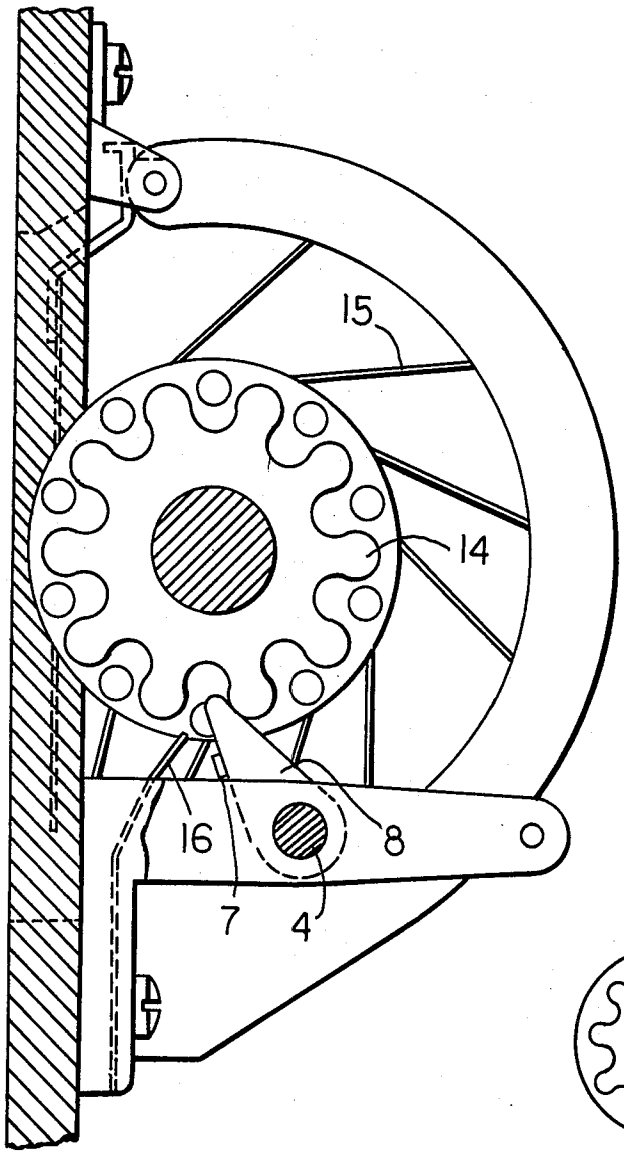

FIG.3

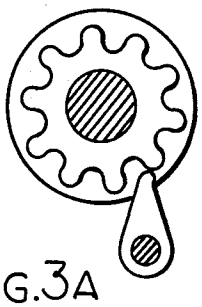

FIG.3A

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3,077,302

STEPPING DEVICE WITH ACCUMULATION OF ENERGY FOR MECHANICAL COUNTER

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Claims priority, application Italy Apr. 6. 1960
3 Claims. (Cl. 235—134)

Mechanical counters are known for computing and indicating quantities of objects or of physical phenomena based on the principle that each unit of the phenomenon or of the physical quantity to be computed and indicated advances by a certain angle a roll, which may be a pallet roll, a full drum, or be of another form, which is of no importance for the purposes of the present invention. These counters may serve for any system of numeration, but by way of example reference is made in the following to the decimal system, while it is evident that the improvement covered in the present invention can be applied to any system, for instance duodecimal or sexagesimal.

In the known decimal counters, the pallet roll or the drum which counts and indicates the units rotates angularly by 36 deg. for each unit counted; after 324 deg., that is, after the number 9 has appeared, the next rotation of 36 deg., takes along for another 36 deg., by means of a known device, the tens roll, which advances by one step while the units roll passes from "9" to "zero." The same occurs for the step from the tens to the hundreds, from the hundreds to the thousands, and so forth.

The torsional moment necessary for the advance of the units and for the carry-over of the tens, hundreds, and so forth, is always caused by the same source of energy.

It follows, therefore, that the driving organ must have a sufficient force to insure the simultaneous advance of an adequate number of rolls intended to function together. For example, to pass from the number 9999 to the number 10,000 the simultaneous rotation of 5 rolls is necessary, requiring a considerable total force. Moreover; the sum of the plays betwen the various mechanical organs (which cannot be reduced to zero), as these plays under the stress are all taken up in the same direction, brings it about that the various numbers composing the indication are not perfectly aligned.

In mechanical counters, then, whose pilot organ cannot, for reasons of cost, dimensions, required sensitivity, or other reasons, be built with sufficient power for a regular functioning, one must resort to a servomotor. The present invention relates to a stepping device for mechanical counters in general with drums or rotating rolls, whose purpose it is to accumulate energy during the advance of the single roll and to restore said energy in the instant in which the carryover to the next roll occurs. In this way one achieves regular functioning also when the driving organ has available a power little greater than for driving the units roll alone and one always obtains the exact alignment of all numbers composing the indication.

The device in question, applicable to counters of the type where a roll or drum progressively advancing by n successive equidistant angular positions is equipped with an organ capable of producing during $1/n$ of its rotation an angular shift of a subsequent roll (is), characterized by the fact that the roll is integral with a cam on which there presses freely the end of an elastic element, the profile of said cam being rapidly decreasing in the section corresponding to said $1/n$ of a turn and uniformly increasing for the remaining portion of its development. A form of construction has been illustrated by way of example in the annexed drawings, in which:

FIG. 1 is the rear view of this counter, with the tens stepping device.

FIG. 2 is the section A—A', viewed toward the units roll (in the position showing "9").

FIG. 2A illustrates a detail thereof, in the position showing "zero."

FIG. 3 is the section B—B', viewed toward the tens roll (in the position corresponding to the indication "9" of the units).

FIG. 3A is a detail of the preceding, in the position corresponding to the indication "zero" of the units.

The units roll **1**, FIGS. 1 and 2, is secured to the toothed wheel **2**, which meshes with the toothed wheel **3** integral through pin **4** with cam **5** and the lever **6** equipped with a tooth **7**.

On the same pin is mounted the pawl **8**, FIG. 3, retained by tooth **7**. On cam **5**, FIG. 3, there runs the small roll **9**, pivoted loose on one end of lever **10**, which has the fulcrum in the fixed point **11** and the other end hooked to a helical spring **12**, which in turn is anchored at the fixed point **13**.

The loose pawl **8**, FIG. 3, engages the toothed wheel **14**, integral with the tens roll **15**. On the fixed frame is fastened the brake spring **16**.

Under the action of the external impulse, the units roll **1**, FIG. 2, rotates one step, or 36 deg. in the present case of a decimal counter, with every unit of the physical quantity counted. Similarly there rotate the toothed wheel **2**, the toothed wheel **3**, the cam **5** and the level **6**, which takes along in rotation the loose pawl **8**, FIG. 3. When the units roll shows "9," the pawl **8**, taken along by level **6**, engages with the toothed wheel **14**, FIG. 3, of the tens roll **15** and advances it 36 deg. or one step, disengaging when the units roll has passed from indication "9" to *"zero."*

The small roll **9**, which was in the position shown in FIGURE 3A when the units roll indicated "zero," has followed during the graded passage from "zero" to "9" the external profile of cam **5**, until reaching the position illustrated in FIGURE 3, progressively tensioning the spring **12**, through lever **10**. When the units roll passes from "9" to "zero" and at the same time the tens roll advances one step, the small roll **9** travels rapidly, over the steep section of the cam, moving into the position shown in FIGURE 2A.

Traveling over the steep section of the cam, the small roll **9**, exerts, under the action of the spring **12**, which discharges the accumulated energy, a pressure on this cam which gives rise to a couple acting in the same direction as the movement.

This couple furnishes the supplementary energy necessary for the rapid advance of the tens roll.

Moreover, the small roll **9**, moving into the hollow of the cam corresponding to the "zero" indication, causes the exact position of the cam, taking up all plays; and hence causing an exact alignment of the numbers.

For counters having more than two rolls, the same process repeats itself in the carry-over from the tens to the hundreds, from the hundreds to the thousands and so forth.

Pawl **8**, FIG. 3, is mounted loose on pin **4** and is taken along by tooth **7**, of lever **6** for the purpose of obtaining, in counters with zero setting, that this zero setting occurs regularly.

In fact, if all pawls of the various devices had been mounted fixed on the shaft like the toothed wheel **3** and the cam **5**, FIG. 2, there would have been a rigid connection between two rolls every time the pawl **8**, had engaged with a tooth of wheel **14** of the next roll.

Let us suppose, in a simple example of only 3, counting rolls, that the number 396 has been totalled, or any other number with the number "9" in the second position; in zero setting, the shaft constituting the pivot of the rolls is caused to rotate by a complete revolution.

During rotation, this shaft gradually engages all rolls returning them to zero, and causing the rolls displaying the number zero to rotate one complete revolution, the rolls displaying the number "1" 9/10 of a revolution, those with the number "2" 8/10 of a revolution, and so forth to the rolls displaying the number "9" which it causes to execute 1/10 of a revolution.

Now, returning to the example of zeroing the number 396, let us see what happens. The zero setting shaft starts to rotate, after 3/10 of a revolution it engages the hundreds roll and takes it along in rotation, but because the tens roll shows "9," the advancing pawl **8** (FIG. 3), was already in position of engagement with a tooth of the toothed wheel of the hundreds roll; the rotation of this roll therefore shifts forward by 1/10 of a revolution also the tens roll, that is, until it disengages pawl **8**. Thus, while the hundreds roll passes from number "3" to "4," the tens roll passes from "9" to "zero."

When, then, the units roll, taken along by the zero setting shaft, passes from number "9" to "zero," it will, with its pawl **8**, shift, the tens roll by another tenth of a revolution; in this manner, instead of having "000" on completed zero setting, one obtains "010."

If, however, pawl **8**, is loose the backward movement is rendered impossible, that is, the taking along of the roll of a lower order by the roll of a higher order.

The small spring **16**, serves to force pawl **8** to apply against tooth **7** of lever **6**, before entering into engagement with the toothed wheel **14** of the next roll, thus eliminating all possible interference between the teeth.

I claim:

1. In an indicating mechanism for mechanical counters of the type in which a cylindrical drum advances progressively through n successive equidistant angular positions comprising, in combination:

(a) a driving member adapted to produce during $1/n$ of its rotation an angular shift of the next cylindrical drum;

(b) a cam having a profile rapidly decreasing in the section corresponding to said fraction $1/n$ of a revolution and uniformly increasing for the remaining portion of its development, said cam being operatively interconnected with said driving member,

(c) resilient means exerting pressure on said cam, and

(d) a shaft for supporting the drum and cam so that the resilient means acting on the cam will give additional force to the cam and driving member to actuate the next cylindrical drum.

2. An indicating mechanism according to claim 1 in which:

(a) said resilient means comprises a rocker lever having a spring with one end connected to one arm of said lever and the other end connected to a fixed point, and

(b) a roller mounted on the other end of the arm of said rocker lever for exerting force on the profile of said cam.

3. An indicating mechanism according to claim 2 in which:

(a) said driving member comprises a pawl mounted loose on said shaft so that it will move only in the transfer direction,

(b) a lever rigidly mounted on said shaft, and

(c) said lever provided with a tooth adapted to engage the pawl to move it forward as the shaft rotates.

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