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[54] **STEPPING MECHANISM FOR DIGITAL TIMEPIECE**

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[52] **U.S. Cl.** ..... **58/125 B**; 58/5; 58/7; 58/58

[51] **Int. Cl.** **G04b 19/24**; G04c 19/02

[58] **Field of Search** ..... 58/5, 7, 58, 125 B, 126 A

[56] **References Cited**

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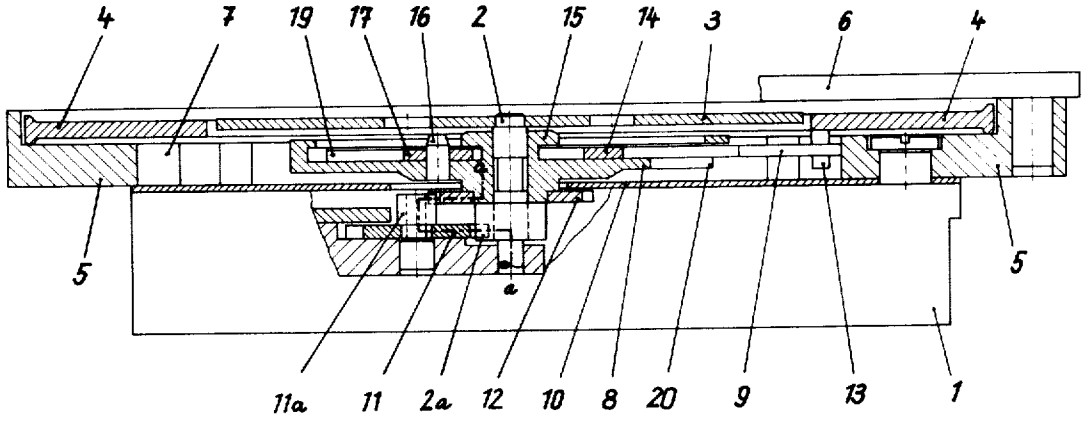
Primary Examiner—Edith Simmons Jackmon

[57] **ABSTRACT**

Serving to advance digital indicating means of a timepiece having a central drive element, the mechanism comprises a stationary peripheral series of teeth, a stepping finger, which is mounted to be rotatable and radially displaceable relative to said central drive element and engageable with said series of teeth and coupled to said digital indicating means for joint rotation, a one-way coupling element, which is eccentric with respect to and operatively connected to said central drive element to revolve around the same in a predetermined direction and arranged to repeatedly withdraw said stepping finger from said series of teeth after respective intervals of time, and spring means urging said stepping finger radially outwardly and in said predetermined direction of revolution, whereby said spring means are arranged to impart a rotation to said spring finger and digital indicating means in said predetermined direction of revolution when said stepping finger has thus been withdrawn and until said stepping finger reengages said series of teeth.

10 Claims, 4 Drawing Figures



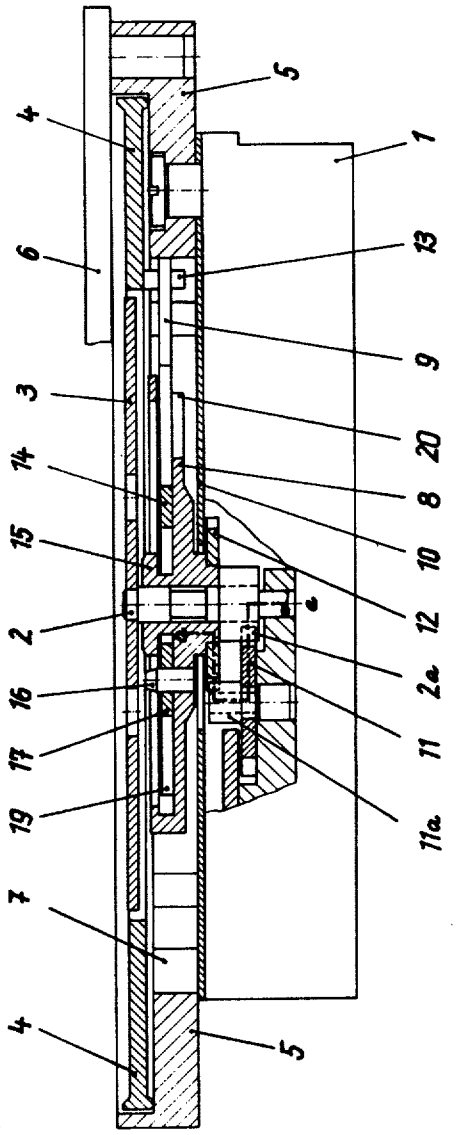


Fig. 1

Fig. 2

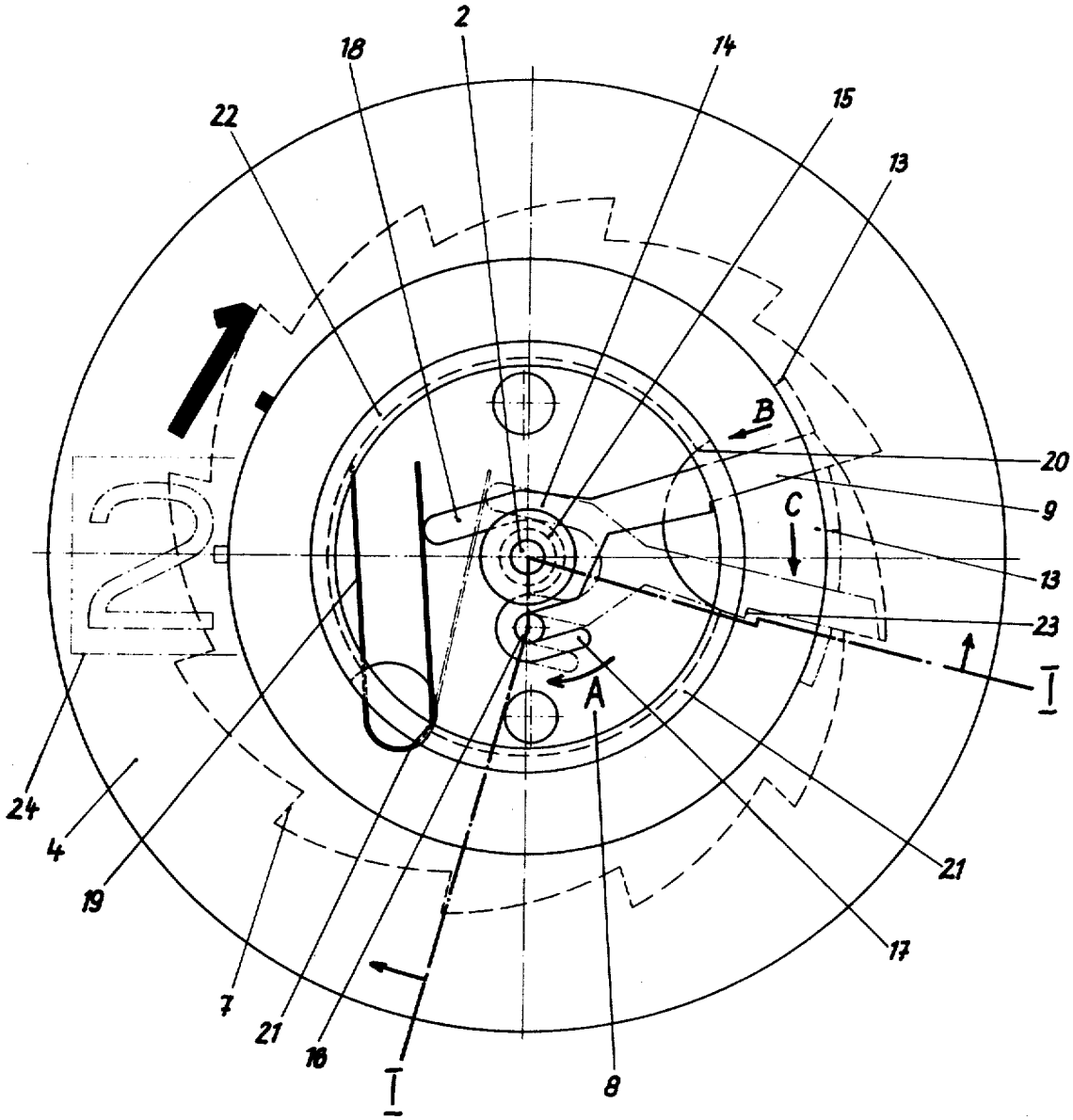


Fig.3

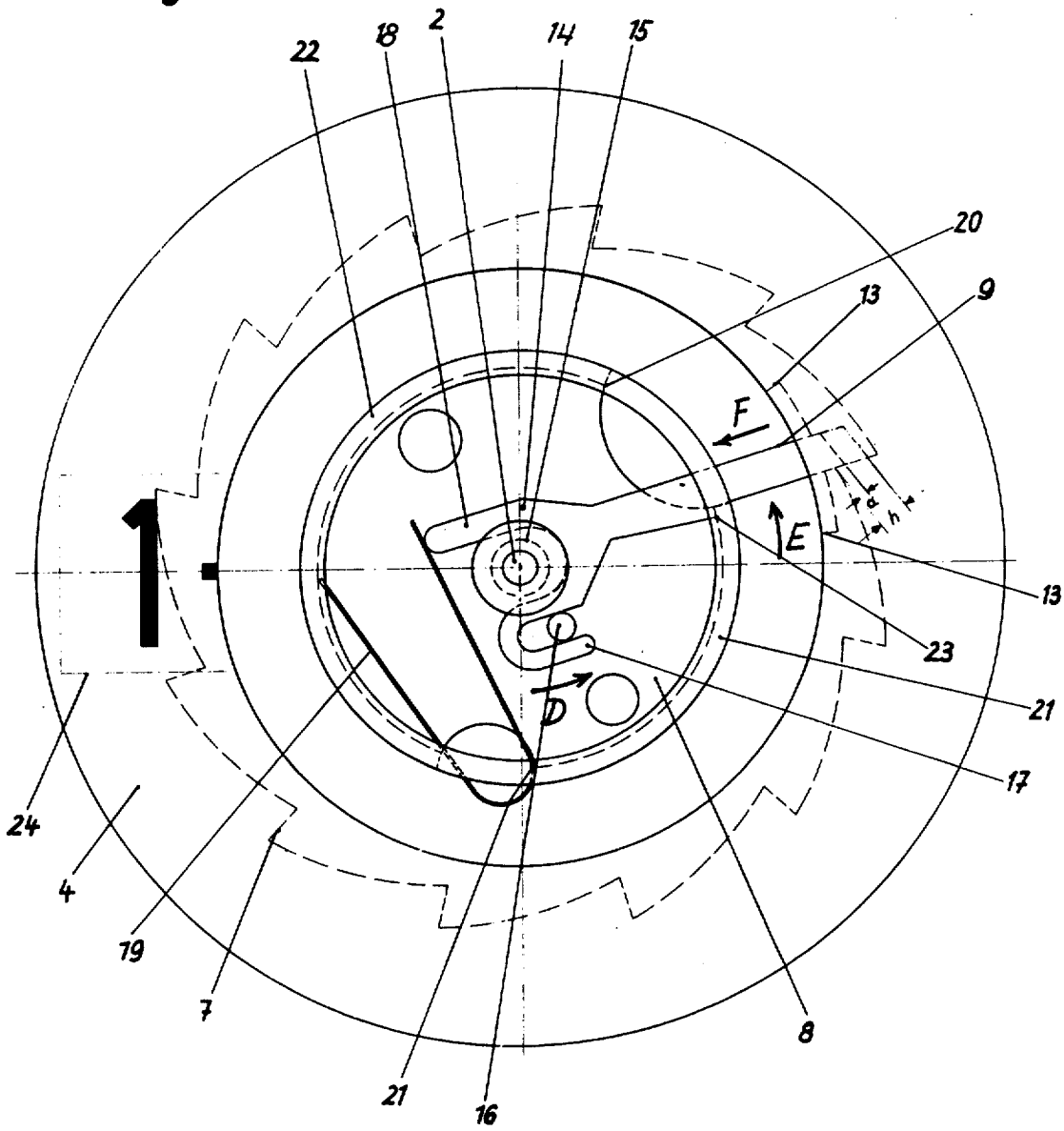
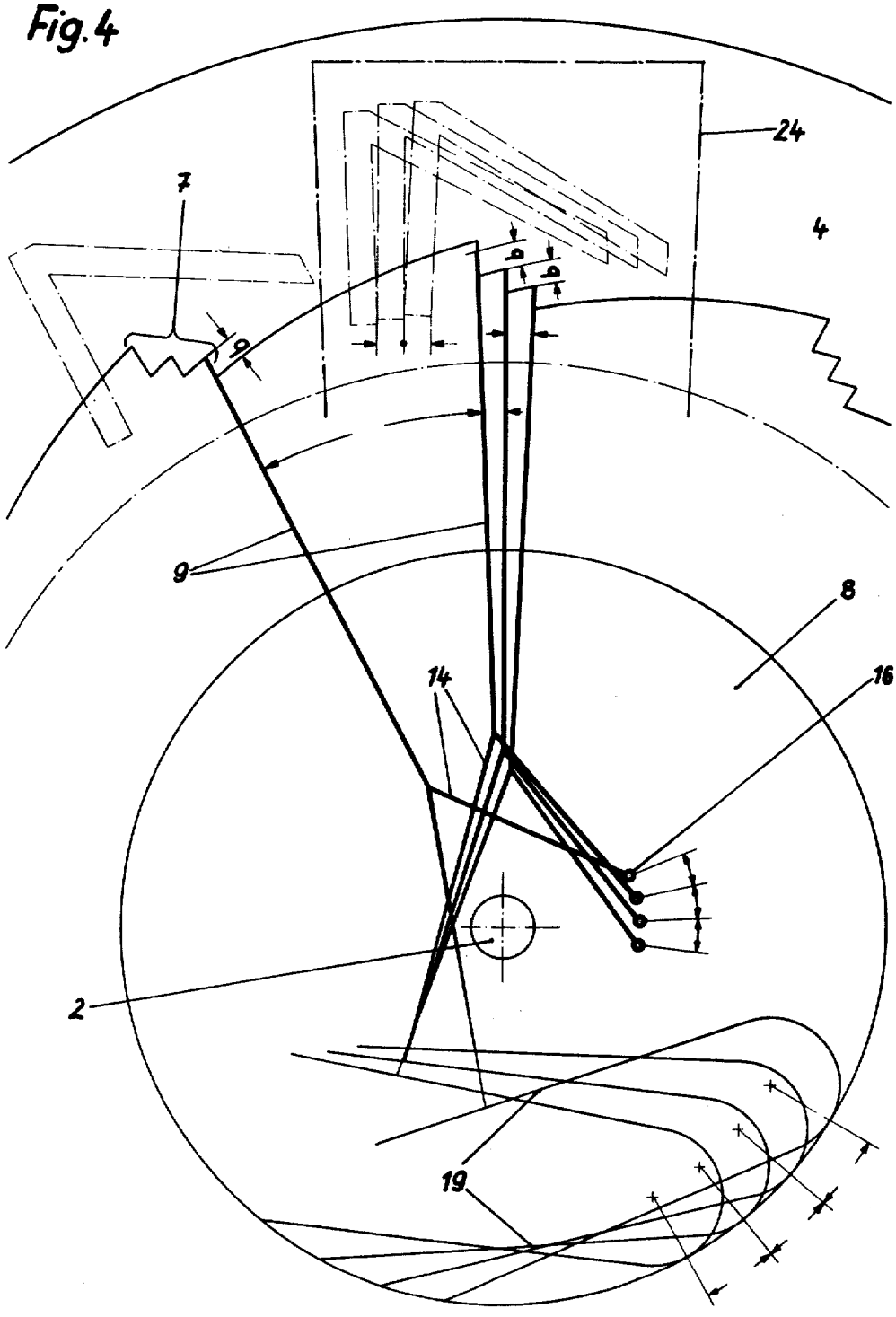


Fig. 4



STEPPING MECHANISM FOR DIGITAL TIMEPIECE

This invention relates to a stepping mechanism for timepieces having digital indicating means, particularly for the hour-indicating means of watches, which mechanism comprises a stepping finger, which cooperates with a series of teeth. The stepping mechanism may also be used for dateindicating means.

Such stepping mechanisms are known, inter alia, in watches, particularly wrist watches, which are provided with digital indicating means. In these known mechanisms a rotating leaf spring imparts the hour step to an hour ring. For this function, the rotating leaf spring is stressed in engagement with a stop and when the spring has been sufficiently deflected it jumps over the stop to impart the step to the ring.

This hour-stepping mechanism is inaccurate because the stepping jump of the spring is influenced by tolerances in the spring length, spring material, and mounting, so that the hour step tends to vary. Whereas the indication of minutes and seconds is accurate to a second in modern precision movements, there is then an undesired inaccuracy as regards the time of the hour step. Besides, the spring mechanism gives rise to difficulties when the movement is set back because the reverse rotation may cause a breakage of the spring.

It is an object of the invention to provide for a quick stepping of the hour-indicating means exactly at the correct time and to enable a setting of the movement also in a reverse direction. In a stepping mechanism for timepiece movements, particularly for stepping the hour-indicating means in watches, comprising a stepping finger cooperating with a series of teeth, this object is accomplished according to the invention in that the stepping finger is arranged to be rotatable and radially displaceable relative to the central drive element and is spring-urged into engagement with a peripheral series of teeth, an eccentrically disposed driven, one-way coupling element withdraws the stepping finger out of the series of teeth and the stepping finger then jumps forward under spring force by one tooth pitch and in this movement imparts a quick step by one unit preferably to the hour ring. This arrangement results in an accurate step and the movement may be set back without damage.

Specifically, the stepping finger may have a fork which embraces the central drive element and may be hooked on one side as with a hook into the eccentric coupling element and on the other side bears with the extended fork prong on a preferably U-shaped spring. The stepping finger and the spring are mounted on a rotatable disc, the fork extends under a flange of the central drive element and the finger extends through a slot in a raised rim of the disc into engagement with the peripheral series of teeth, which consists of ratchet teeth. The rotary disc is driven by reducer gears and carries a one-way coupling element for driving the stepping finger.

According to a further feature of the invention, that portion of the stepping finger which extends through the rotary disc may have a step by which the stepping finger is held at the edge slot of the rotary disc in a partly extended position during a reverse rotation so that the stepping finger need not be retracted against spring force throughout the entire height of each tooth when the movement is set back.

Finally, each tooth of the peripheral series of teeth may be divided into tooth steps for partial stepping operations so that the indication of time in the hour window may be stepped forward by partial steps during an hour and a visual indication of part of the hour is given without need for an exact reading of the minute indication.

Embodiments of the stepping mechanism for timepiece movements according to the invention, as used for stepping the hour-indicating means in digital watches, are shown diagrammatically and by way of example in the drawing, in which

FIG. 1 is a transverse sectional view taken on line I—I in FIG. 2 and showing a stepping mechanism,

FIGS. 2 and 3 are top plan views showing that stepping mechanism during the stepping jump and as the indicating mechanism is set back, respectively, and

FIG. 4 is a diagrammatic elevation showing a stepping mechanism for imparting partial steps.

As is apparent from the drawing, particularly from FIG. 1, a watch movement 1 has a cannon 2, which carries a minute disc 3. The cannon 2 carries also a rotary disc 8 provided with a stepping finger 9 for driving an hour ring 4, which is guided on a ring bearing 5 and is covered on top by a dial 6. The ring 4 covers ratchet teeth 7. The rotary disc 8 is vertically located by a retaining plate 10. Motion is imparted from a cannon pinion 2*a* through a minute wheel 11 and a minute pinion 11a to an hour wheel 12 and the rotary disc 8, as indicated by the line *a*—*a* in FIG. 1. The movement shown in FIG. 1 is arranged for a 12-hour indication so that the tooth pitch and step angle are 30°. In case of a 24-hour indication the angle is 15° per hour so that the tooth pitch is 15° 0too. To enable a stepping of the hour ring 4, the latter has laterally bent lugs 13 which engage the stepping finger 9 on both sides.

As is particularly apparent from FIGS. 2 and 3, the stepping finger 9 has a fork 14, which embraces the hub 15 of the rotary disc 8 so that the finger 9 is mounted to be rotatable and radially displaceable. The finger 9 is provided on one side with a hook 17, which is hooked into an eccentric one-way coupling pin 16 on the rotary disc 8. On the other side, the finger 9 has an extended prong 18, which engages a U-shaped spring 19. The finger 9 extends through a slot 20 in the raised rim of the rotary disc 8 and into engagement with the series of teeth 7. When the disc 8 rotates in the direction A, the coupling pin 16 withdraws the stepping finger 9 from the series of teeth 7 in the direction B and after a rotation of 30° the finger jumps in the direction C into the position shown in dash-dot lines in FIG. 2 in engagement with the next following of the teeth 7. By this operation of the finger 6, the hour ring 4, which engages the finger 9 on both sides with lugs 13, is advanced by one tooth pitch so that the next hour is indicated.

The bight of the U-shaped spring 19 is located in a cut-out 21 in the rimg 22 of the rotary disc and one leg and of the spring extends under a radially inwardly extending top portion of the rim 22, as is apparent from the drawing. It is apparent that the U-shaped spring 19 can well be mounted, just as the stepping finger 9. The stepping finger 9 has also a shoulder 23 and as is apparent from FIG. 3 said shoulder snaps into engagement with the rim 22 at the rim slot 20 moving in the direction E after a withdrawal of the finger in the direction F at the ratchet tooth 7 during a reverse rotation of the disc in the direction D. As the reverse rotation is con-

tinued, the finger **9** then need not be moved against the action of the spring **19** throughout the height *h* of each tooth but only over the height *a* of a tip portion of each tooth.

FIG. **4** shows an arrangement for imparting partial steps *h*. The cannon **2**, the rotary disc **8**, the stepping finger **9** provided with the fork **14**, the one-way coupling member **14** and the U-shaped spring **19** are only diagrammatically indicated, just as the teeth **7** engaged by the stepping finger **9**. In this case each tooth **7** has steps *h* so that the stepping finger performs a plurality of smaller steps during an hour before the final hour step is performed. As a result, the indicated hour, in this case the 7 on the hour ring **4**, is advanced in the hour window **24** of the dial **6** during the progress of the hour, as is indicated in dash-dot lines, whereafter the final hour step is performed to expose the 8 on the hour ring.

What is claimed is:

1. In a timepiece having a central drive element and digital indicating means, the provision of a stepping mechanism for advancing said digital indicating means, said mechanism comprising

a stationary peripheral series of teeth,

a stepping finger, which is mounted to be rotatable and radially displaceable relative to said central drive element and engageable with said series of teeth and coupled to said digital indicating means for joint rotation,

a one-way coupling element, which is eccentric with respect to and operatively connected to said central drive element to revolve around the same in a predetermined direction and arranged to repeatedly withdraw said stepping finger from said series of teeth after respective intervals of time, and

spring means urging said stepping finger radially outwardly and in said predetermined direction of revolution,

whereby said spring means are arranged to impart a rotation to said stepping figure and digital indicating means in said predetermined direction of revolution when said stepping finger has thus been withdrawn and until said stepping finger reengages said series of teeth.

2. A stepping mechanism as set forth in claim **1**, which is incorporated in a watch in which said digital indicating means consists of hour-indicating means.

3. A stepping mechanism as set forth in claim **1**, in which

said stepping finger has a fork high embraces said central drive element,

said fork has on one side of said finger an extended prong which bears on said spring means and

said stepping finger has on its other side a hook which embraces said coupling element.

4. A stepping mechanism as set forth in claim **3**, in which said spring means consist of a U-shaped spring.

5. A stepping mechanism as set forth in claim **3**, in a timepiece in which said central drive element has a radial flange, in which mechanism

a rotary disc is provided, which has a raised rim formed with a peripheral slot,

said spring is mounted on said disc,

said fork embraces said central drive element under said radial flange,

and said stepping finger extends through said slot into engagement with said series of teeth.

6. A stepping mechanism as set forth in claim **5**, in a timepiece having speed-chaning gears driven by said central drive element, in which mechanism

said rotary disc is operatively connected to said speed-changing gears and carries said coupling element.

7. A stepping finger as set forth in claim **5**, in which

said rim has a cut-out and a radially inwardly extending top portion, and

said spring means comprises a U-shaped spring having a bight which is located in said cut-out and a leg end which engages said top portion from below.

8. A stepping mechanism as set forth in claim **5**, in which

said rotary disc is mounted for rotation around said central drive element and

a retaining plate is provided, which interengages with said rotary disc to axially locate the same.

9. A stepping mechanism as set forth in claim **5**, in which said stepping finger is formed with a step adjacent to said rim and said step is adapted to engage said rim and limit the radially outward movement of said stepping finger during a rotation of said finger opposite to the direction of rotation of said coupling element.

10. A stepping mechanism as set forth in claim **1**, in which each of said teeth is provided with a plurality of steps which are engageable by said finger to permit of a stepping of said digital indicating means by increments corresponding to part of a unit of time represented by a digit.

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