United States Patent

Tarbet

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[54] **STEPPING DEVICE FOR ROTATING THE TABLE OF A SAMPLE CHANGING EQUIPMENT**

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[51] **Int. Cl.**.....**G04b 15/08**

[58] **Field of Search**.....74/1.5; 58/121, 116; 185/38

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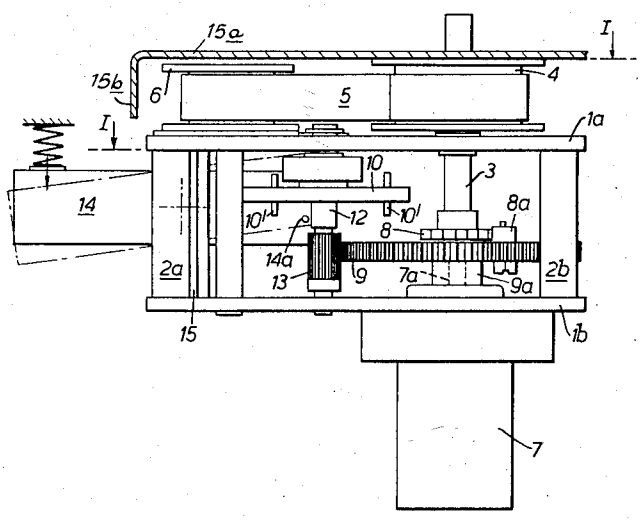
[57] **ABSTRACT**

A stepping device for a sample changer turntable is driven by spring means, which may be tensioned by rotation of the turntable, and suitably coupled fluid damper means controls the stepped rotation of the turntable. A stepping escapement for the device may comprise a disk carrying pins which project on both sides thereof and a lever carrying co-operating posts.

8 Claims, 3 Drawing Figures



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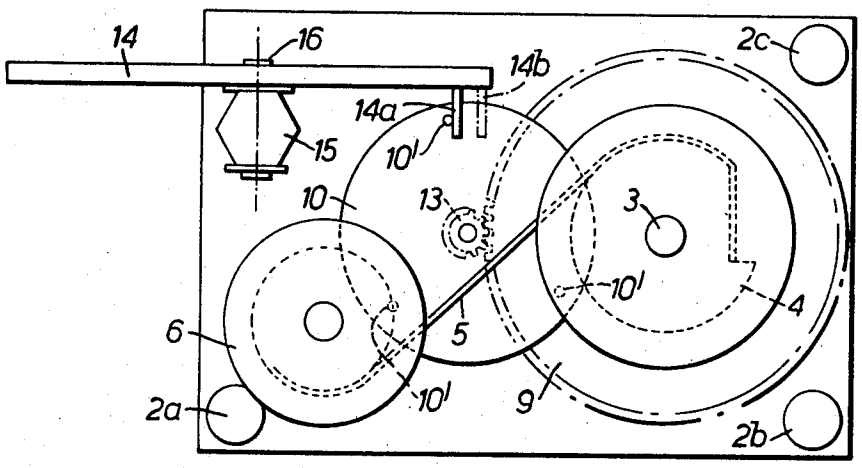

FIG. 1.

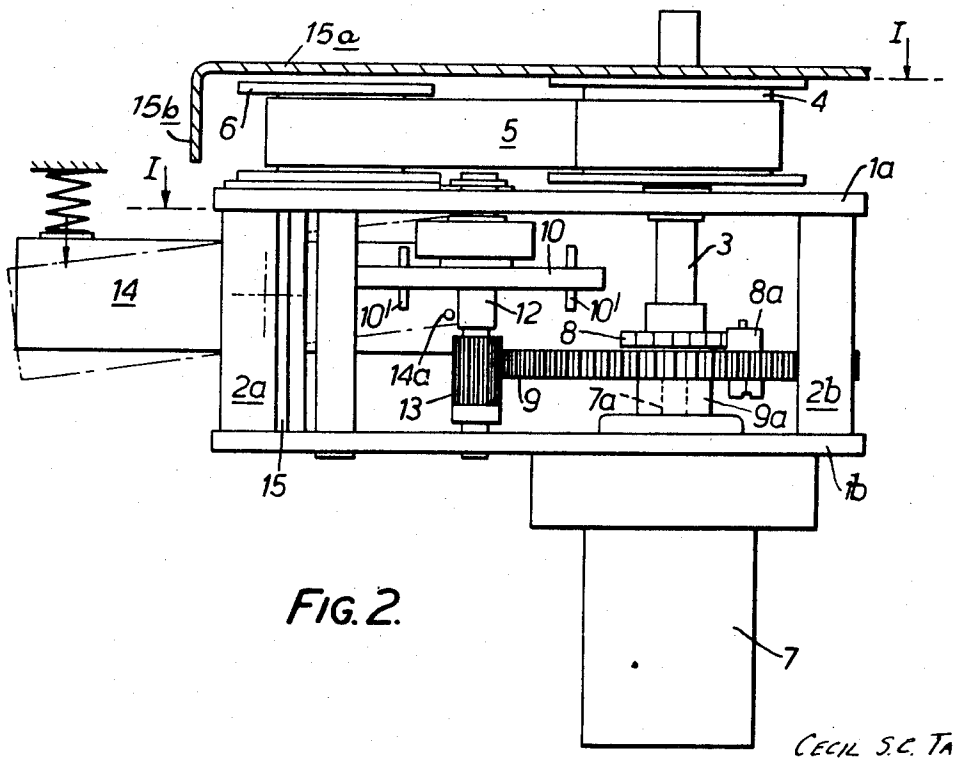

FIG. 2.

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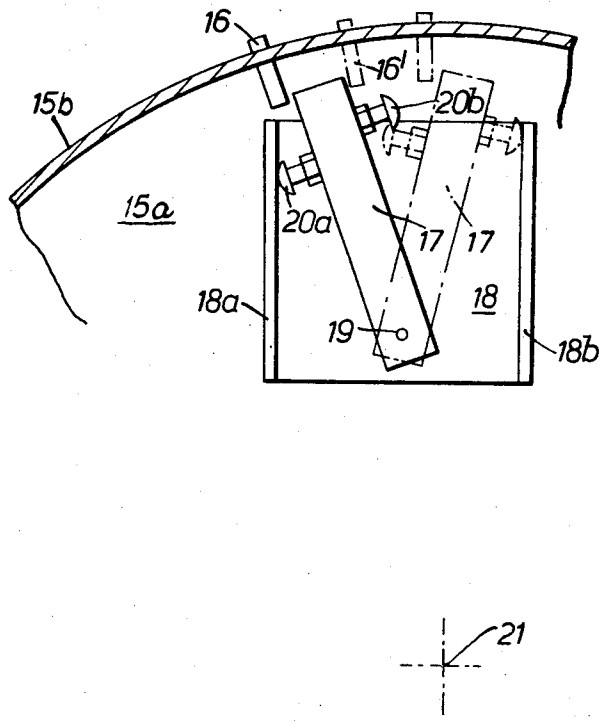

FIG. 3.

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STEPPING DEVICE FOR ROTATING THE TABLE OF A SAMPLE CHANGING EQUIPMENT

This invention relates to a stepping device for rotating the table of a sample changing equipment, and to an escapement mechanism for use in such a stepping device.

According to the present invention, a stepping device for rotating the table of a sample changing equipment comprises a drive shaft, a drive spring coupled to the drive shaft to drive the latter, an escapement geared to the drive shaft to impose a stepped rotation to the drive shaft, and a fluid damper coupled to the drive shaft to restrain the rotation of the latter. Preferably a constant-tension drive spring is used.

The invention also comprises an escapement mechanism comprising a pivotally mounted disc carrying a number of pins spaced around a circle concentric with the disc pivot and each mounted to project on both sides of the disc, and a co-pending lever carrying a pair of posts which extend into the path of the pins on either side of the disc, and which are staggered along the path of the pins to permit stepwise rotation of the disc by successively blocking and releasing the passage of each pin by reciprocation.

The lever may be caused to reciprocate by external means, thus synchronizing the operation of the escapement with reference to external events.

In sample changing equipment embodying the invention, it is possible to provide co-operating stop means on a sub-turntable and on a static portion of the machine to limit the rotation of the sub-turntable to one revolution. One member of the co-operating stop means may be movably mounted so that in spite of the thickness of the stop, the full number of turntable positions is available. In a preferred embodiment the stop means comprise a fixed pin on a downwardly depending flange of the sub-turntable and a pivot arm mounted with suitable limit stops on the base of the machine.

The invention will now be described in greater detail with reference to the accompanying drawings, of which:

FIG. **1** is a sectional plan view of a stepping drive mechanism according to the invention;

FIG. **2** is a side elevation of the mechanism of FIG. **1**, showing the section line I—I along which that figure is taken; and

FIG. **3** is a fragmentary sectional view of a sample changer embodying the invention, and provided with a rotation limiting stop.

The mechanism illustrated in the drawings is constructed on a frame consisting of two plates **1***a*, **1***b*, spaced by posts **2***a*, **2***b* and **2***c*. A drive shaft **3** is journalled in the plate **1***a* and carries the torque drum **4** of a constant-tension drive spring arrangement which further includes the constant-tension spring **5** and a take-up spool **6**, which latter is also journalled in the plate **1***a*.

The plate **1***b* carries a rotary fluid damper **7**. This damper has a cylindrical body provided with a set of stationary vanes, and a shaft **7***a* which carries a co-operating set of vanes, and contains a filling of silicone fluid which permits relatively unimpeded slow rotation of the shaft **7***a*, while providing strong damping to rapid rotation.

The free end of the drive shaft **3** is recessed to fit over the adjacent end of the damper shaft **7***a*. The two shafts are coupled for rotation by means of a ratchet wheel **8** mounted on drive shaft **3**, and a co-operating pawl **8***a* which is carried on a gear wheel **9** which in turn is mounted on the damper shaft **7***a* by a mounting boss **9***a*, the gear **9** and its mounting boss **9***a* being partly counterbored to clear the end of shaft **3**. The sense of the ratchet and pawl arrangement is such that driven rotation of the drive shaft **3** by the spring **5** causes the damper shaft to rotate, while the drive shaft is disconnected from the damper shaft when the rotation of the drive shaft is reversed to wind up the spring.

Rotation of the drive shaft **3** is regulated by an escapement mechanism consisting of an escapement wheel **10** and co-operating escapement lever **14**. Three pins **10'** are carried by the wheel **10** at points spaced equidistantly around a circle concentric with the axis of the wheel, and each pin **10'** projects equally on both sides of the wheel in a direction normal to the plane of the latter. The escapement wheel is mounted on a shaft **12** which is journalled in the plates **1***a* and **1***b* and which also carries a pinion **13** which meshes with the gear **9** on the damper shaft. For a sampler table of **30** stations the ratio of the gear **9** and pinion **13** is 10:1.

Stepping of the escapement wheel **10** is controlled by an escapement lever **14** which is supported on a block **15** carried between the plates **1***a* and **1***b*. The lever is supported by means of a pivot **16** held in a transverse bore in the block, and lies parallel to a tangent to the wheel **10**. The end of the lever adjacent the wheel **10** carries a pair of pallets **14***a*, **14***b*, which project one on either side of the wheel **10**, and are so spaced apart laterally of the wheel and along the tangent to the wheel that each oscillation of the lever **14** to and from its reset position illustrated by broken lines in FIG. **2**, allows the passage of one pin **10'** as the wheel **10** rotates. FIG. **1** shows the situation after the movement of the lever to its trip position, shown in solid lines, when the lower end of the previous pin has been released by pallet **14***b* and the upper end of pin **10'** has been intercepted by pallet **14***a* which moves into the path of the upper end of the pin before the full release of the lower end of the previous pin from pallet **14***b*. On return of the lever to its reset position the pallet **14***a* will release the upper end of pin **10'** and the wheel will rotate a small amount until the lower end of pin **10'** is intercepted by pallet **14***b*. The pallet **14***b* also moves into the path of the pin **10'** before the pallet **14***a* releases the upper end of the pin. Even if the tripping frequency is high, and the lever moves again to its reset position before movement of the wheel **10** is complete, pallet **14***b* will again intercept the lower end of the next pin **10'** and stop the rotation, the error in drive shaft rotation represented by the spacing of the pallets being negligible. The lever **14** is in practice operable to "trip" by linkage to a movable sample probe of a sample changer, which in turn may be driven by a synchronous motor in accordance with a pre-set program. Thus, as the probe is lifted from one sample cell of a series carried by the table, the lever **14** is moved to "trip", and as the probe is lowered, the lever **14** is reset, thereby causing the table to rotate by one step and bring the next sample cell under the descending probe. In the embodiment described, rewinding of the spring is effected by

rotation of the drive shaft in a clock-wise direction as seen in FIG. 1 during which time the ratchet arrangement disconnects the fluid damper.

In some cases, it may be preferred to limit the rotation of a sample-changer turntable to a single revolution, to avoid over-running and consequent mixing of samples in the sample cells in the event that the sample changer is left unattended for a period greater than that required for a single revolution. Limitation to a single revolution may be achieved by providing co-operating stop means on the sub-turntable indicated at **15***a* in FIG. **2** and on the main frame of the machine incorporating an escapement. A suitable stop arrangement is shown diagrammatically in FIG. **3**, in which one of the co-operating stop members is pivotable to allow a full revolution of the sub-turntable in spite of the space occupied by the stop means. The downwardly depending rim **15***b* of the sub-turntable is provided with a radially inwardly projecting stop pin **16**. The co-operating stop member takes the form of a lever **17** pivotally mounted on the base of a 'U'-bracket **18** which in turn is mounted on the frame of the machine. The upstanding side members **18***a* and **18***b* of the 'U'-bracket act as stops for the pivotal movement of the stop member **17** about its pivot **19** and adjustment screws **20***a* and **20***b* are provided for fine adjustment of the limits of travel of the stop member **17**. In the position illustrated in the drawings, the turntable is being rotated in a clockwise direction about its center **21** to tension the spring **5**, and further rotation of the turntable about its center in the direction shown can be continued until the adjusting screw **20***b* abuts the member **18***b* and the stop pin **16** abuts the stop member **17**. This is indicated in dotted lines in FIG. **3**.

Operation of the turntable can now continue until the stop pin **16** is moved through an angle almost equal to 360°. The pin **16** will then abut the righthand edge of the stop member **17** and continued movement of the turntable under the influence of the spring **5** will cause the stop member **17** to pivot in an anticlockwise direction about its pivot **19** until the screw **20***a* abuts the member **18***a* and the motion of the turntable is arrested. The final position of the stop pin **16** when the turntable is arrested is indicated at **16'**.

It will be seen that the device described above permits positive stepping of the table of the sampling equipment with an adequate amount of power available for the drive, while it will be appreciated that the provision of the fluid damper controls the rotation of the table so that samples carried by the table are not spilled during stepping as a result of sudden acceleration or deceleration. Furthermore, the use of a constant-tension spring is particularly advantageous, since it ensures constancy of operation while the spring is tensioned.

I claim:

1. A stepping device for rotating the table of a sample changing equipment comprising:

a. a drive shaft;

b. a drive spring means coupled to said drive shaft;

c. a stepping escapement geared to said drive shaft; and

d. a fluid damper coupled to said drive shaft to restrain the rotation of the latter.

2. A device according to claim **1** in which said drive spring means comprises a constant-tension spring.

3. A stepping device as claimed in claim **1** in which said fluid damper is coupled to said drive shaft by a unidirectional coupling.

4. An escapement mechanism for a stepping device, said mechanism comprising:

a. a pivotally mounted disc carrying a number of pins spaced around a circle concentric with the disc pivot and each projecting on both sides of the disc; and

b. a co-operating lever carrying a pair of posts extending into the path of said pins on either side of said disc, said posts being staggered along the path of said pins.

5. A mechanism according to claim **4** in which said lever includes an extended portion for cooperation with an actuating linkage.

6. A device according to claim **1**, further comprising equipment including a static portion, a sub-turntable rotatable by said shaft, and co-operating rotation-limiting stop means on said sub-turntable and said static portion, respectively.

7. A device according to claim **6** in which one member of the co-operating stop means is moveably mounted.

8. A device according to claim **7** wherein said sub-turntable carries a downwardly depending flange and said stop means comprises a fixed pin on said downwardly depending flange and a pivot arm mounted with limit stops on said static portion.

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