United States Patent [19]

Boyles

[11] **3,780,524**

[45] **Dec. 25, 1973**

[54] **DIGITAL DISPLAY INDICATOR**

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[73] Assignee: **General Electric Company,** Bridgeport, Conn.

[22] Filed: **Mar. 8, 1973**

[21] Appl. No.: **339,419**

[52] **U.S. Cl.** ..... **58/125 C,** 58/2, 58/7, 58/9, 58/23 D, 58/125 R, 235/134, 235/140, 235/142

[51] **Int. Cl.** **G04b 19/02**

[58] **Field of Search** ..... 58/125 C, 125 R, 58/2, 4 A, 23 D, 7, 9, 126 E, 138, 139; 235/103, 116, 119, 92, 133, 134, 136, 139, 235/140, 142; 40/33, 77.4, 77.9, 78, 78.03, 78.11

[56] **References Cited**

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3,574,995	4/1971	Turner	58/125 C
3,487,572	1/1970	Beguin	40/78.07 X
2,040,421	5/1936	Almquist	58/125 C

Primary Examiner—Richard B. Wilkinson
Assistant Examiner—Vit W. Miska
Attorney—George R. Powers et al.

[57] **ABSTRACT**

A digital display indicator wherein a plurality of numerals are carried on a rotatable drum 38 so that the numerals may be successively brought into position behind a viewing window 52. An eccentrically mounted drive finger 74 accurately indexes a ratchet wheel of the rotatable drum from one position to a next succeeding position while the finger holds a spring loaded detent lever away from the ratchet wheel.

9 Claims, 11 Drawing Figures

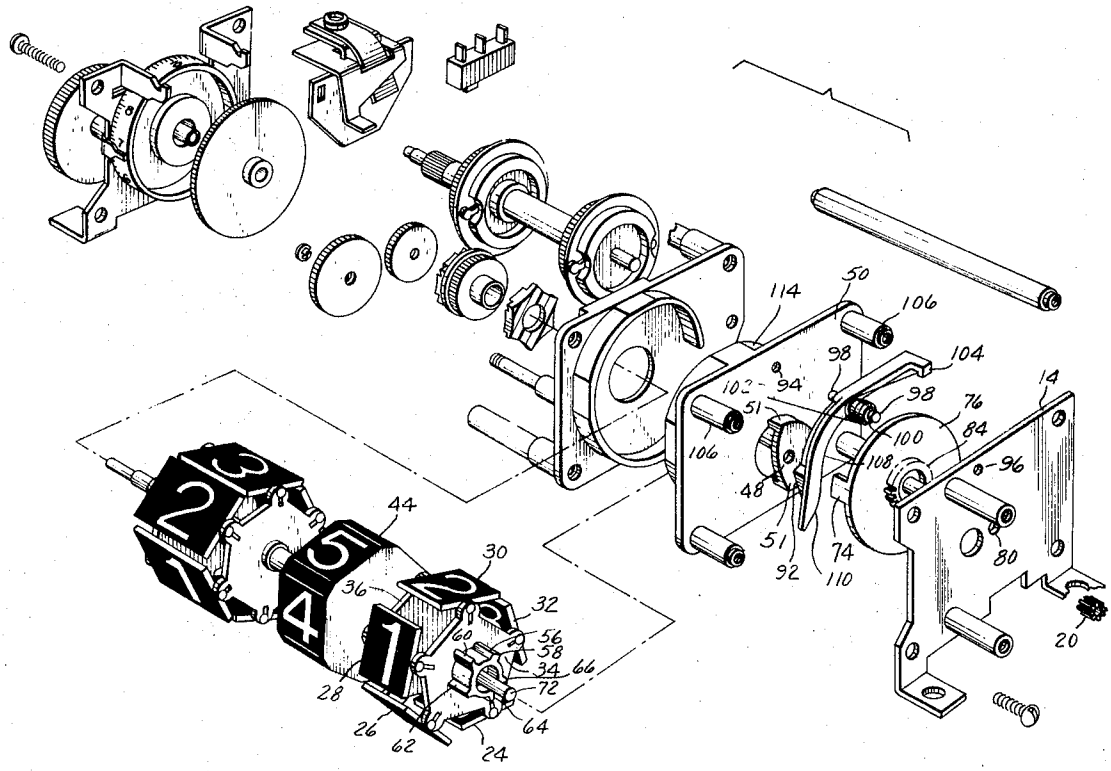


FIG. 1.

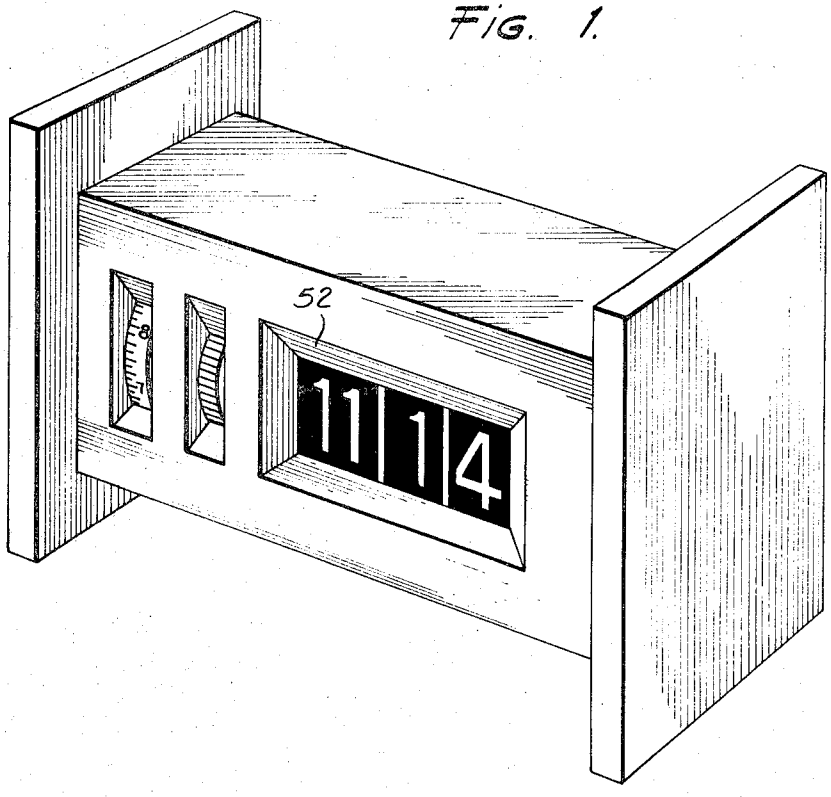


FIG. 2.

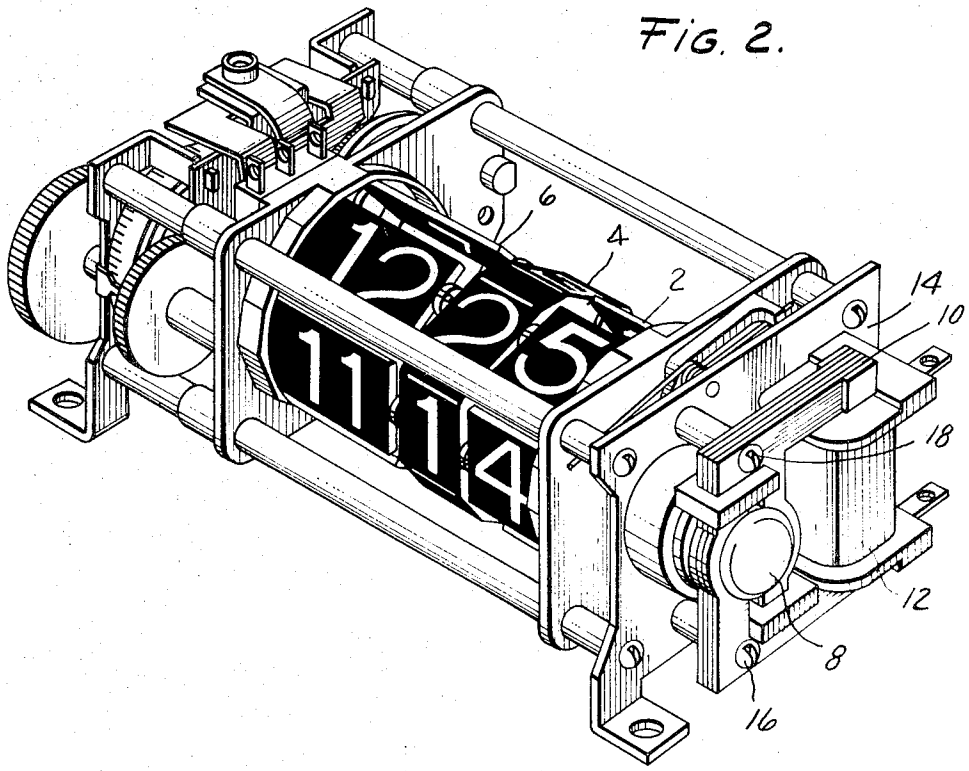
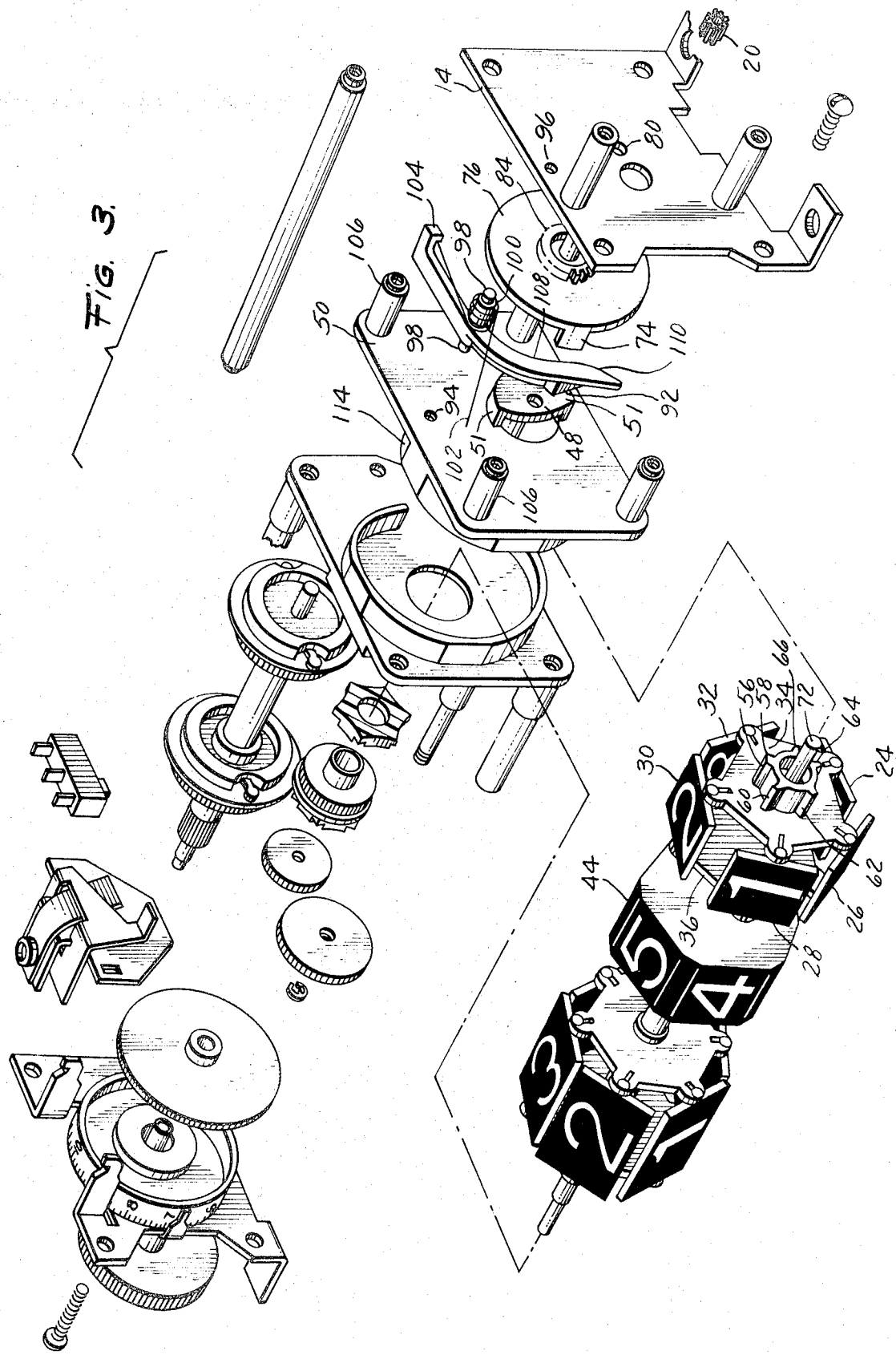


FIG. 3.


14
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114
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FIG. 4.

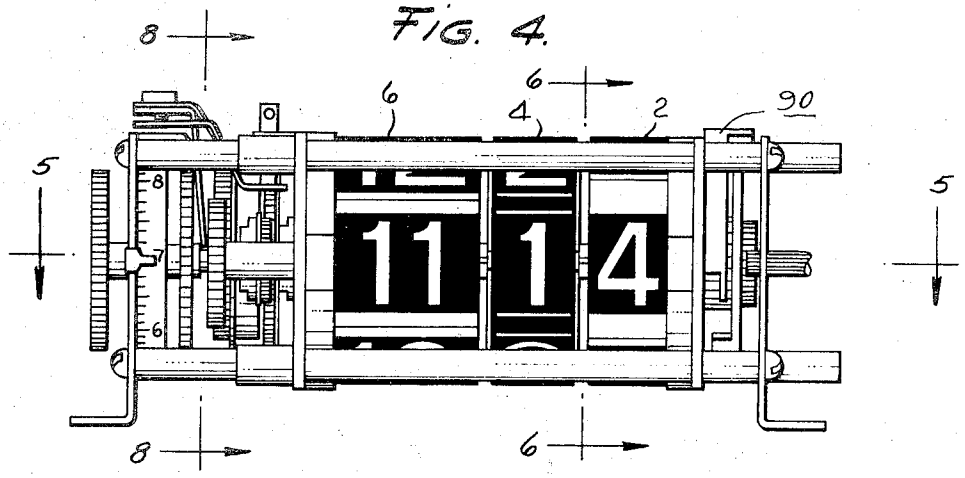


FIG. 5.

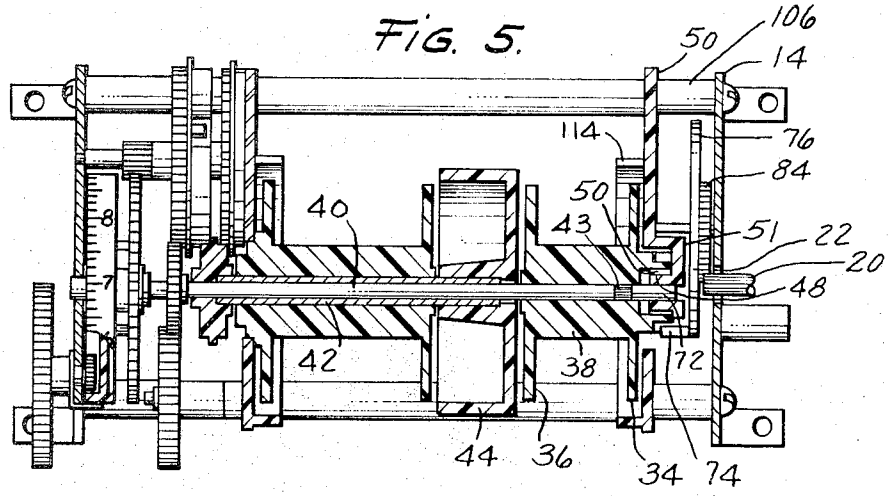


FIG. 6.

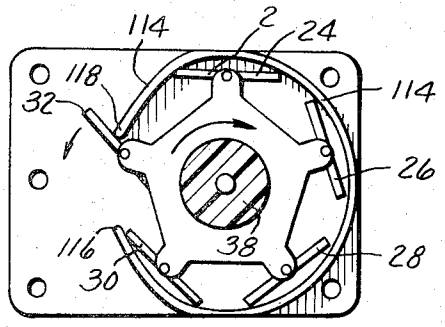


FIG. 7.

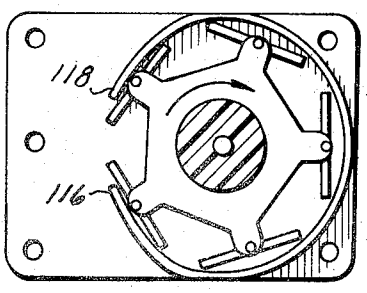


FIG. 8.

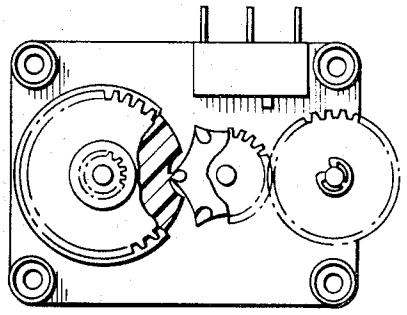


FIG. 9.

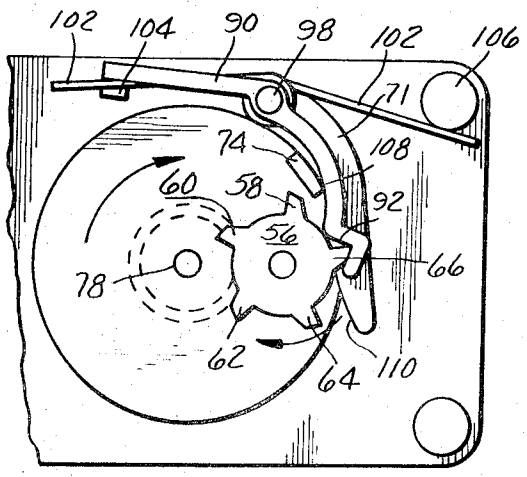


FIG. 10.

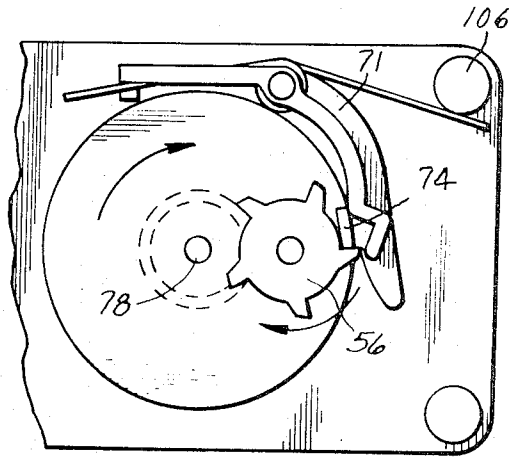
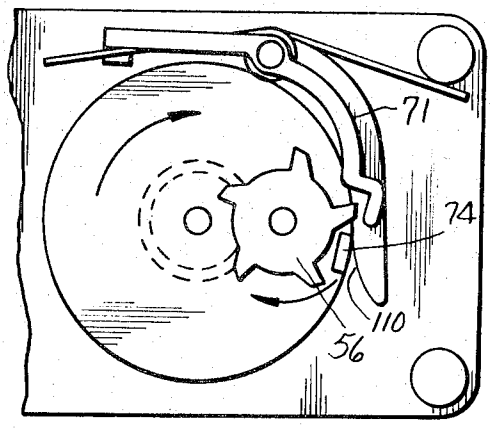


FIG. 11.



DIGITAL DISPLAY INDICATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a digital display indicator, and more particularly to a display indicator wherein a plurality of numerals are carried on a rotatable member so that the numerals may be successively brought into position behind a viewing window.

With such a digital indicator it is especially desirable that the indexing of the rotatable member from one numeral to a next succeeding numeral occur relatively rapidly in about five seconds of time. Thus, the numerals are indexed in an intermittent fashion rather than being gradually and continuously moved into position behind a viewing window.

2. Description of the Prior Art

The prior art includes many different constructions and arrangements for quickly moving clock numerals and other numerals from one position to a next succeeding position. Geneva gears are frequently employed, and for example, in one prior art construction as shown in U.S. Pat. No. 2,040,421 to Almquist dated May 12, 1936, a Geneva wheel 67 is utilized for rapidly indexing a numeral disc 69.

In another prior art construction as shown in a patent to Clark, U.S. Pat. No. 2,748,560 dated June 5, 1956, there is shown a rotatable actuating finger mechanism 61 which is positioned within a numeral drum for rapidly indexing the drum from one numeral to the next succeeding numeral.

With such digital display indicators it is also desirable that the numerals be held in a particular viewing position after they have been indexed, and for example, it is especially desirable in a clock that the numerals for indicating hours, tens of hours and minutes be displayed and held in line behind a viewing aperture or lens. In a prior patent to Meyer, U.S. Pat. No. 2,968,143 dated Jan. 17, 1961, a spring member 6 is provided for holding a star wheel 5 and an hour wheel 7 to which it is attached in an appropriate position behind a viewing window 10. Other spring loaded detent and ratchet type mechanisms have also been utilized for holding numeral drums in their appropriate positions, and one of the problems with such mechanisms is that they usually emit clicking sounds as the spring loaded members are inserted between the teeth of a gear or ratchet.

This invention is concerned with such digital display indicators, and more particularly, to a unique construction for holding a rotatable numeral drum behind a viewing window and for quickly advancing the numeral drum from one position to a next succeeding position.

Accordingly, it is a primary object of my invention to provide an improved digital display indicator which may be reliably and quickly indexed from one numeral to a next succeeding numeral, and wherein the rotatable indicator member may be held in its appropriate viewing position without the use of mechanisms that emit clicking noises which are commonly associated with spring loaded detents.

It is a further object of my invention to provide an improved digital display indicator having relatively few parts which may be readily manufactured and assembled to each other.

It is also an object of my invention to provide an improved digital display indicator which has very low torque requirements.

SUMMARY OF THE INVENTION

In accordance with one of the aspects of this invention, a digital indicator includes a rotatable indicator member having a plurality of numerals arranged thereon in sequential order so that the numerals may be successively brought into a viewing position. A toothed wheel is fixed to the rotatable indicator member and is mounted for rotation with the indicator member. A spring loaded lever is mounted adjacent to the toothed wheel and is spring urged into engagement with the teeth of the wheel for holding the numerals of the rotatable indicator member in particular viewing positions. A drive member is positioned adjacent to the wheel for incrementally moving the wheel to bring successive numerals into a viewing position. The drive member has an axis which is spaced from the axis of the toothed wheel and the member is provided with an eccentric drive finger for contacting one of the teeth of the wheel each time the drive member makes a revolution.

With this construction, the drive finger advances the sprocket and the rotatable indicator member an angular distance corresponding to that necessary to bring the next numeral of the rotatable indicator member into a viewing position. The relative locations of the teeth of the wheel and the spring loaded lever with respect to the path of movement of the drive finger are such that upon rotation of the drive finger in a wheel advancing direction, the finger first contacts the lever to gradually lift the lever out of engagement with the teeth of the wheel and drive finger then holds the detent lever away from the sprocket while the finger engages one of the teeth of the wheel to move the wheel and the rotatable indicator member to the next numeral position. Then, continued rotation of the finger gradually lowers the detent lever into a position on a tooth of the sprocket to permit the detent lever to hold the wheel and the rotatable indicator member in an appropriate numeral viewing position.

By this arrangement, the drive finger reliably and accurately quickly moves the wheel and the rotatable indicator member from one numeral position to the next numeral position in a relatively short indexing period of time, and moreover, the drive finger cooperates with the detent lever to gradually raise and lower the detent lever to its holding position so that the detent lever does not make any objectionable clicking noises as it is moved into and out of engagement with the toothed wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and attendant advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing in which:

FIG. 1 is a front perspective view of a digital clock constructed in accordance with my invention;

FIG. 2 is a front perspective view generally similar to FIG. 1 with the outer casing removed for purposes of illustration;

FIG. 3 is a fragmentary exploded front perspective view of the clock illustrated in FIGS. 1 and 2;

FIG. 4 is a front elevational view of the clock shown in FIG. 2;

FIG. 5 is a cross-sectional view of the clock taken substantially on the plane of 5—5 of FIG. 4;

FIG. 6 is a cross-sectional view of the digital clock taken substantially on the plane of 6—6 of FIG. 4 showing one of the numeral pages being flipped to display a numeral on the other side of the page;

FIG. 7 is a cross-sectional view of the clock also taken on the plane of 6—6 of FIG. 4 showing the numeral pages in a different operating position;

FIG. 8 is a cross-sectional view of the clock taken substantially on the plane of 8—8 of FIG. 4;

FIG. 9 is a cross-sectional view of the clock taken substantially on the plane 9—9 of FIG. 4 showing the details of construction of my unique drive finger and detent lever for advancing a minutes drum from one position to a next succeeding position and for holding the minutes drum in an accurate viewing position, the parts being shown with the detent lever holding the ratchet wheel of the minutes indicator member in an accurate viewing position;

FIG. 10 is a cross-sectional view of the digital clock also taken substantially on the plane of 9—9 of FIG. 4 showing my improved drive finger arrangement with the finger holding the detent lever away from the ratchet wheel while the finger moves the ratchet wheel from one position to a next succeeding position; and

FIG. 11 is a cross-sectional view of the digital clock also taken substantially on the plane of 9—9 of FIG. 4 showing the finger gradually lowering the detent lever onto one of the teeth of the ratchet wheel.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, and first particularly to FIGS. 1 and 2, there is shown a digital clock which includes my unique mechanism for indexing and holding a display indicator without making undesired noise such as clicking sounds which sometimes occur in devices of this type. As shown, the digital clock numerals may conventionally include three sets of pages 2, 4 and 6 for indicating minutes, tens of minutes, and hours, respectively.

The digital clock may be driven by a conventional self-starting synchronous motor 8 having a magnetic core 10 and energizing coil 12. As shown in FIG. 2, the motor may be readily attached to an end plate 14 of the clock by means of screws 16 and 18 or other suitable securing means. As shown more particularly in FIGS. 2, 3, 6 and 7, the minutes numerals are printed or otherwise formed on both sides of five pages 24, 26, 28, 30 and 32, and the pages are pivotally mounted on flanges 34 and 36 of the rotatable minutes drum 38.

As shown more particularly in FIG. 5, the minutes spool drum 38 is fixed to a centrally positioned shaft 40 by means of knurling 43 or other suitable connecting means. As shown, the shaft 40 extends a considerable distance to the left of the spool and is supported for rotation within a concentric hollow shaft 42 of a tens of minutes display indicator drum 44. The right end portion 72 of the shaft 40 is rotatably supported within a bearing 48 which is integrally formed with a supporting plate 50. As shown more particularly in FIGS. 3 and 5, the plate 50 may be formed of plastic or other suitable material, and it includes an outwardly extending portion 51 for integrally connecting the bearing portion 48 with the main portion of the supporting plate 50.

The details of the tens of minutes, and hours display indicators 4 and 6, and the Geneva drive mechanisms for actuating these display indicators do not form a part of this invention and are described and illustrated in greater detail in my copending application (6D-4474), Ser. No. 339,213, filed Mar. 8, 1973, assigned to the same assignee as the present invention.

MINUTES INDEXING AND HOLDING CONSTRUCTION

In accordance with my invention the minutes drum 38 is quickly indexed from one numeral position to a next succeeding numeral position in about five seconds of time, and it is uniquely held in appropriate positions to display numerals midway between the upper and lower edges of a viewing window 52 illustrated in FIG. 1. As shown more particularly in FIGS. 3 and 5, a ratchet wheel 56 having five teeth 58, 60, 62, 64 and 66, may be integrally formed with the drum 38 for incrementally driving the drum.

A drive finger 74 is eccentrically mounted for rotation with respect to the ratchet wheel to engage and move one tooth of the ratchet wheel for each revolution of the drive finger 74. As shown more particularly in FIGS. 3 and 5, the drive finger 74 may be integrally formed on a reduction gear unit 76 which is positioned between the output shaft 20 of the electric motor 8 and the ratchet wheel 56. A shaft 78 is integrally formed with the reduction gear unit 76 and is mounted for rotation within apertures 80 which are provided in mounting plates 14 and 50. The apertures 80 are located somewhat rearwardly of the axis of the ratchet wheel 56 in order to provide the desired eccentricity between the ratchet teeth and the drive finger 74. With this construction, the output pinion 20 of the motor drives a gear 84 of the integrally formed reduction gear unit 76 to move the drive finger 74 at one revolution per minute. With reference to FIG. 3, it can be appreciated that the drive finger 74 will remain in engagement with a tooth of the ratchet wheel 56 for about 30 degrees of travel of the reduction gear unit 76, and accordingly, movement of the minutes numeral drum 38 from one position to a next succeeding position will occur in the relatively short span of about five seconds.

A uniquely shaped and positioned detent lever 90 is provided for holding the sprocket 56 in any one of a plurality of numeral positions. As shown more particularly in FIGS. 3 and 9, the detent lever is elongated and curved to partially surround the sprocket. It may be formed of a single piece of plastic and includes a detent notch 92 for receiving one of the teeth of the sprocket wheel, and an integrally formed pivot pin 98 which is mounted in apertures 94 and 96 which may be conveniently formed in plates 50 and 14 respectively. The central portion of the lever includes an enlarged lug portion 100 for receiving spring 102 to urge the lever in a counterclockwise direction as shown in FIG. 3 or a clockwise direction as viewed in FIG. 9. As shown, the spring is coiled around the lug 100 and one end of the spring 102 is held by an outwardly extending finger 104 which may be integrally formed with the detent lever 74 while the other end of the spring 102 may be positioned under a lug 106 which extends between plates 14 and 50.

As shown more particularly in FIGS. 9 and 10, a cam surface 108 is formed on one side of the detent notch 92 for cooperating with the drive finger 74 to permit

the drive finger to gradually move into engagement with the detent lever **90** to lift the detent notch **92** above the ratchet wheel so that the drive finger **74** may then engage and move one of the ratchet teeth **60** from one incremental position to the next succeeding incremented position. A cam surface **110** is formed on the other side of the detent lever notch **92** for gradually lowering the detent notch **92** over the next succeeding ratchet tooth to be indexed in order to hold the minutes drive wheel so that one of the numerals is accurately displayed midway between the upper and lower edges of the viewing window **52.** Thus, the cam surfaces **108** and **110** of the detent lever are uniquely related to the drive finger **74** so that the drive finger gradually raises and lowers the detent lever without causing an objectionable clicking noise.

With particular reference to FIGS. **9, 10** and **11,** it can be appreciated that the cam surface **108** for gradually lifting the detent lever **90** against the force of spring **102** is relatively long and is positioned with respect to the drive finger **74** so that the finger is placed in contact with it for about 20° of the rotation of the drive finger **74** prior to the point where the drive finger engages a tooth of the ratchet wheel. Thus, the torque required for lifting the detent lever **90** at a given instant is relatively low since the force is applied over a relatively long period of time.

It can also be appreciated from FIGS. **9, 10** and **11** that the principal portion of ratchet wheel **56** is located within the path of movement of the drive finger **74.** Such a construction has lower torque requirements than a conventional interengaging gear wheel construction wherein substantial portions of the paths of movements of the gears are spaced from each other and do not envelop each other. As shown more particularly in FIG. **10** of applicant, it can be appreciated that with this construction there is less sliding friction between the drive finger and the ratchet wheel and accordingly, the torque required for lifting the detent lever and indexing the ratchet wheel is relatively low.

In accordance with my invention, the mechanism for flipping pages to display numerals which are formed on both sides of the pages is uniquely incorporated with supporting plate **50** in order to achieve an inexpensive display indicator having relatively few parts. As shown more particularly in FIGS. **3, 5, 6** and **7,** a generally circular skirt member **114** is integrally formed with the plate **50** and extends outwardly to the left in order to the left in order to flip the pages. As shown in FIGS. **6** and **7** the generally circular skirt **114** does not extend **360** degrees but is formed with a gap or cutout portion **116** of approximately **30** degrees for tipping and flipping the display pages **24, 26, 28, 30** and **32.** With this construction, as the drum **38** is rotated in the direction of the arrow shown in FIG. **6,** when one of the pages reaches the cutout portion **116** of the skirt it is not confined by the skirt and the leading portion of the page moves outwardly beyond the skirt. Thus, as the pages moves through the gap or cutout portion of the skirt, it abuts a lower edge cam portion **118** of the skirt which flips the page to display a new numeral. It can be appreciated that after the page has been flipped to display a numeral which had been positioned on the back side of the page, the skirt **114** will hold the page in its desired position until it again reaches the gap **116** in the skirt.

OPERATION

In operation, the output pinion **20** of the synchronous motor **8** rotates gear **84** of the reduction gear unit **76** to move the drive finger **74** at one revolution per minute. The drive finger engages cam surface **108** of the detent lever **90** to gradually lift the detent notch **92** against the force of spring **102.** The drive finger **74** then contacts and moves one of the teeth of the ratchet wheel **56** from one numeral position to the next succeeding numeral position, and the drive finger **74** then gradually lowers the detent lever to position the detent notch **92** on top of the next succeeding tooth to be indexed in order to accurately hold one of the minutes numerals in an appropriate viewing position.

With particular reference to FIGS. **6** and **7,** it can be seen that while the pages which are located at the front of the display indicator are being moved from one display position to the next succeeding numeral position, the pages at the rear of the display indicator are being flipped so that the numeral which had been facing inwardly is flipped to face outwardly. As the drum **38** is rotated the pages at the rear of the display indicator are flipped by the cam portion **118** of the skirt.

From the foregoing discussion, it will be appreciated that my improved construction for indexing and holding a display indicator in appropriate viewing positions may be readily with relatively few parts. The ratchet wheel **56** may be integrally formed with the minutes drum **38** at the time that the entire minutes drum or spool is being molded from suitable plastic. In like manner, the drive finger **74** and the reduction gear unit **76** including its integrally formed shaft **78** may be formed in a single molding operation. These parts are uniquely and inexpensively held on the digital clock by simply forming apertures in the mounting plates **14** and **50.**

With my improved indexing mechanism it can also be appreciated that the digital display indicator is quickly moved from one number to the next succeeding number in a relatively short period of time, and the numerals are held in their appropriate viewing positions by a spring loaded detent lever which is relatively quietly operated by the drive finger **74.**

What I claim is:

1. A digital indicator for visually displaying numerals comprising:

a. a rotatable indicator member having a plurality of numerals arranged thereon in sequential order so that they may be successively brought into a viewing position;

b. a toothed wheel fixed to said indicator member for rotation therewith;

c. a lever having a surface for engaging successive teeth of said toothed wheel for holding the numerals of said rotatable indicator member in particular viewing positions;

d. spring means for urging the surface of said lever toward the teeth of said toothed wheel;

e. a drive member for incrementally moving said toothed wheel to bring successive numerals into a viewing position, said drive member being fixed to a shaft spaced from said toothed wheel and said drive member having a drive finger for contacting one of the teeth of said toothed wheel each time the drive member makes a revolution, the drive finger advancing the toothed wheel and said rotatable indicator member an angular distance correspond-

ing to that necessary to bring the next numeral of the rotatable indicator into a viewing position; and

f. said lever being positioned in the path of said drive finger such that upon rotation of the drive finger the lever is moved away from the teeth of the toothed wheel by the drive finger thereby enabling the drive finger to contact one of the teeth of the toothed wheel to advance the toothed wheel and the indicator member to a succeeding numeral position.

2. A digital indicator as defined in claim **1** wherein said lever includes a notch for engaging one of the teeth of said ratchet for holding the toothed wheel and the rotatable indicator member in an appropriate numeral viewing position.

3. A digital indicator as defined in claim **2** wherein said lever includes cam surfaces on opposite sides of said notch for cooperation with said drive finger, said drive finger contacting one of said cam surfaces to lift the lever above the teeth of the toothed wheel and said finger contacting and sliding on the other can surface for gradually lowering the lever to position the notch of the lever on one of the teeth of the toothed wheel so that the lever does not make any objectionable clicking noises as it is moved into and out of engagement with the toothed wheel.

4. A digital indicator as defined in claim **1** wherein the digital indicator also includes:

a. a pair of mounting plates arranged generally parallel to each other for supporting said lever and other components of said digital indicator, said lever being formed from a single piece of plastic and further including an integrally formed pivot pattern extending generally perpendicular to the main body portion of the lever; and

b. an aperture formed in each of said mounting plates for pivotally supporting said lever between the plates.

5. A digital indicator as defined in claim **4** wherein said lever further includes an outwardly extending tab integrally formed at one end of the lever, and said digital indicator also includes:

a. a spacer post arranged generally perpendicular to said mounting plates and positioned therebetween for supporting said mounting plates with respect to each other; and

b. a spring having two end portions and a coiled central portion, the coiled central portion being positioned around the pivot portion of the detent lever, one of the end portions of said spring being in contact with the tab on the detent lever and the other end portion of the spring being in contact with the spacer post for resiliently urging the detent lever into contact with the teeth of said toothed wheel.

6. A digital indicator as defined in claim **4** wherein one of said mounting plates includes a skirt having a gap integrally formed therewith, said skirt extending outwardly form the mounting plate toward said rotatable indicator member for holding the pages in appropriate display positions and for flipping the pages from one numeral to another numeral.

7. A digital indicator as defined in claim **1** wherein said drive member for incrementally moving said toothed wheel includes an integrally formed gear, an axial pivot fixed to said gear, an enlarged wheel fixed to said gear, and a drive finger fixed to an outer surface of said enlarged wheel.

8. A digital indicator as defined in claim **1** wherein said digital indicator also includes:

a. an integrally formed gear, an axial pivot fixed to said gear, an enlarged wheel fixed to said gear, and a drive finger fixed to an outer surface of said enlarged wheel;

b. a pair of mounting plates arranged generally parallel to each other for supporting said lever and other components of said digital indicator, said lever being formed from a single piece of plastic and further including an integrally formed pivot portion extending generally perpendicular to the main body portion of the lever; and

c. an aperture formed in each of said plates for rotatably supporting said lever.

9. A digital indicator as defined in claim **1** wherein the drive member has a path of movement which is greater than the diameter of said toothed wheel and the major portion of said toothed wheel is positioned within the path of movement of said drive member.

* * * * *