

PATENT SPECIFICATION (11)

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 (72) Inventor ROBERT LEE BOYLES



(54) DIGITAL DISPLAY INDICATOR

(71) We, GENERAL ELECTRIC COMPANY, a corporation organized and existing under the laws of the State of New York, United States of America, of 1 River Road, Schenectady 12305, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

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.

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.

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 minutes and minutes be displayed and held in line behind a viewing aperture or lens. Spring loaded detent and ratchet type mechanisms have 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.

The invention provides a digital indicator for visually displayed 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 successively in the viewing position;

(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 the 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 corresponding to that necessary to bring the next numeral of the rotatable indicator into the 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 while the drive finger advances the toothed wheel and the indicator member to a succeeding numeral position, whereafter the drive finger releases the lever to engage the toothed wheel.

The relative locations of the teeth of the wheel and the spring loaded lever with res-

pect 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 the drive finger then holds the lever away from the teeth, 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 wheel 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, accurately and 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.

In order that the invention may be clearly understood, a preferred embodiment thereof will now be described by way of example only with reference to the accompanying drawings, in which:—

Fig. 1 is a perspective view of a digital clock constructed in accordance with the embodiment of the 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 8—8 of Fig. 4 showing the details of construction of the 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 toothed wheel or

sprocket of the minutes indicator member in an accurate viewing position;

Fig. 9 is a cross-sectional view of the digital clock also taken substantially on the plane of 8—8 of Fig. 4 showing the drive finger arrangement with the finger holding the detent lever away from the toothed wheel while the finger moves the toothed wheel from one position to a next succeeding position; and

Fig. 10 is a cross-sectional view of the digital clock also taken substantially on the plane of 8—8 of Fig. 4 showing the finger gradually lowering the detent lever onto one of the teeth of the toothed wheel.

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

The digital clock is 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 is 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. 3, 5, 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 or 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 driving arrangement for the tens of minutes drum 44 is described and claimed in our co-pending patent application No. 9063/74 (Serial No. 1,455,859). 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 plastics or other suitable material, and it includes an outwardly extending portion 51 integrally connecting the bearing portion 48 with the main portion of the supporting plate 50.

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 held in appropriate positions to display numerals mid-

way 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 toothed wheel or sprocket 56 having five teeth 58, 60, 62, 64 and 66, is integrally formed with the drum 38 for incrementally driving the drum.

A drive finger 74 is eccentrically mounted for rotation with respect to the toothed wheel to engage and move one tooth of the wheel for each revolution of the drive finger 74. As shown more particularly in Figs. 3 and 5, the drive finger 74 is integrally formed on a reduction gear unit 76 which is positioned between the output pinion 20 of the electric motor 8 and the toothed wheel 56. A shaft 78 (Fig. 8) 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 toothed wheel 56 in order to provide the desired eccentricity between the 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 and Fig. 8, it can be appreciated that the drive finger 74 will remain in engagement with a tooth of the 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 detent lever 90 is provided for holding the toothed wheel or sprocket 56 in any one of a plurality of numeral positions. As shown more particularly in Figs. 3 and 8, the detent lever is elongated and curved to partially surround the sprocket. It includes a detent notch 92 for receiving one of the teeth of the sprocket, and an integrally formed pivot pin 98 which is mounted in apertures 94 and 96 conveniently formed in plates 50 and 14 respectively. The central portion of the lever also 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. 8. As shown, the spring is coiled around the lug 100 and one end of the spring 102 is held by a laterally extending tab 104 which is integrally formed with the detent lever 90 while the other end of the spring 102 is positioned under a spacer post 106 which extends between plates 14 and 50.

As shown more particularly in Figs. 8 and 9, 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 teeth of the wheel or sprocket 56 from one incremental position to the next succeeding incremental position. A cam surface 110 is formed on the other side of the lever detent 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 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. 8, 9 and 10, 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 degrees 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. 8, 9 and 10 that the principal portion of toothed wheel or sprocket 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. 9, it can be appreciated that with this construction there is less sliding friction between the drive finger and the toothed wheel and accordingly, the torque required for indexing the wheel is relatively low.

The mechanism for flipping pages to display numerals which are formed on both sides of the pages is 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 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 on the drum 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 as shown in Fig. 7. Thus, as the page 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 as shown in Fig. 6 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 new position until it again reaches the gap 116 in the skirt.

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 driven finger 74 then contacts and moves one of the teeth of the wheel or sprocket 56 from one numeral position to the next succeeding numeral position, and the driven 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. 3, 6 and 7, it can be seen that while the pages 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 by the cam portion 118 of the skirt so that the numeral which had been facing inwardly is flipped to face outwardly.

From the foregoing discussion, it will be appreciated that our construction for indexing and holding a display indicator in appropriate viewing positions may be readily formed with relatively few parts. The toothed wheel or sprocket 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 plastics. 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 inexpensively held on the digital clock by simply forming apertures in the mounting plates 14 and 50.

WHAT WE 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 successively in the viewing position;
- 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 the 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 corresponding to that necessary to bring the next numeral of the rotatable indicator into the 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 while the drive finger advances the toothed wheel and the indicator member to a succeeding numeral position, whereafter the drive finger releases the lever to engage the toothed wheel.

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

3. A digital indicator as claimed 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 cam 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

32. With this construction, as the drum 38 is rotated in the direction of the arrow shown on the drum 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 as shown in Fig. 7. Thus, as the page 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 as shown in Fig. 6 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 new position until it again reaches the gap 116 in the skirt.

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 driven finger 74 then contacts and moves one of the teeth of the wheel or sprocket 56 from one numeral position to the next succeeding numeral position, and the driven 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. 3, 6 and 7, it can be seen that while the pages 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 by the cam portion 118 of the skirt so that the numeral which had been facing inwardly is flipped to face outwardly.

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WHAT WE 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; 65
- b) a toothed wheel fixed to said indicator member for rotation therewith; 70
- c) a lever having a surface for engaging successive teeth of said toothed wheel for holding the numerals of said rotatable indicator member successively in the viewing position; 75
- d) spring means for urging the surface of said lever toward the teeth of said toothed wheel; 80
- e) a drive member for incrementally moving said toothed wheel to bring successive numerals into the 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 corresponding to that necessary to bring the next numeral of the rotatable indicator into the viewing position; and 85
- 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 while the drive finger advances the toothed wheel and the indicator member to a succeeding numeral position, whereafter the drive finger releases the lever to engage the toothed wheel. 90 95 100 105

2. A digital indicator as claimed in claim 1 wherein said lever includes a notch for engaging one of the teeth of said toothed wheel for holding the toothed wheel and the rotatable indicator member in an appropriate numeral viewing position. 110

3. A digital indicator as claimed 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 cam 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 115 120



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make any objectionable clicking noises as it is moved into and out of engagement with the toothed wheel.

4. A digital indicator as claimed in any one of claims 1 to 3, wherein the digital indicator also includes:

- a) a pair of mounting plates arranged generally parallel to each other and supporting said lever and other components of said digital indicator, said lever being formed from a single piece of plastics and further including an integrally formed pivot portion 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 claimed in claim 4 wherein said lever further includes a laterally 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 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 lever into contact with the teeth of said toothed wheel.

6. A digital indicator as claimed in claim 4 or claim 5, wherein one of said mounting plates includes a skirt having a gap formed therein, said skirt extending laterally from the mounting plate toward pivotally mounted numeral bearing pages of the digital display indicator for holding the pages in appropriate display positions and for flipping the pages from one numeral to another numeral as the pages leave the gap.

7. A digital indicator as claimed in any one of the preceding claims, wherein said drive member for incrementally moving said toothed wheel includes a gear, an axial pivot fixed to said gear, and a drive finger projecting laterally from one surface of said enlarged wheel.

8. A digital indicator as claimed in any one of the preceding claims, 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.

9. A digital indicator as claimed in claim 1 for visually displaying numerals, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

J. A. BLEACH,
Agent for the Applicants.

