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[54] **DIGITAL CLOCK DISPLAY**

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[52] **U.S. Cl.** ..... **40/28 C**, 58/50 R, 40/106.53, 40/132 G

[51] **Int. Cl.** **G09f 11/00**

[58] **Field of Search** ..... 40/132 G, 28 C, 106.52, 40/106.53, 28 R, 106.51, 130 R, 130 E, 132 G; 58/1 R, 2, 4 R, 4 A, 4 M, 45, 50 R, 125 R, 125 B, 125 C, 152 R, 152 A, 152 F, 152 G, 126 A, 127 R

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Assistant Examiner—U. Weldon
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[57] **ABSTRACT**

An opaque face plate has openings arranged in rectangular arrays, with each array representing one digit of a multi-digit number. A light source is mounted behind the face plate and an opaque, orbitally movable plate is mounted between each rectangular array of openings and the light source. Each orbitally movable plate has sets of orbitally arranged openings so that each opening, when moved into alignment with a corresponding opening in the array of openings, will transmit light through that opening in the faceplate. The geometrical pattern of light transmission through each orbitally movable plate is arranged to produce a time sequence of digits in each of the rectangular arrays of openings so that the invention may function as an illuminated digital clock. Drive means is coupled to the orbitally movable plates to drive the plates in predetermined correlation around their respective orbits. A transparent light-diffusing element may be wound over each opening in the face plate to spread the light transmitted through the openings and make the openings appear larger than they actually are.

3 Claims, 6 Drawing Figures

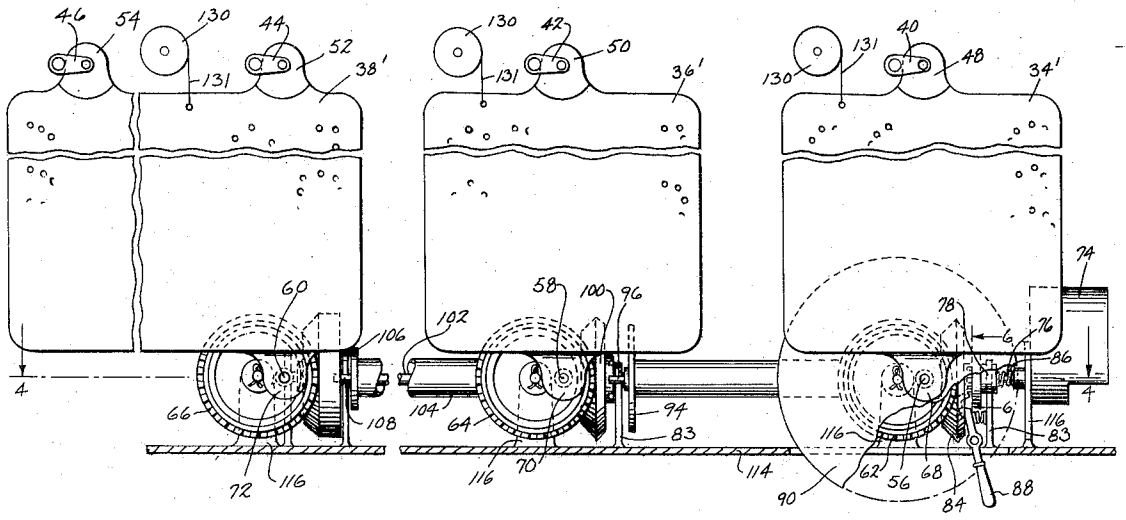


Fig. 1

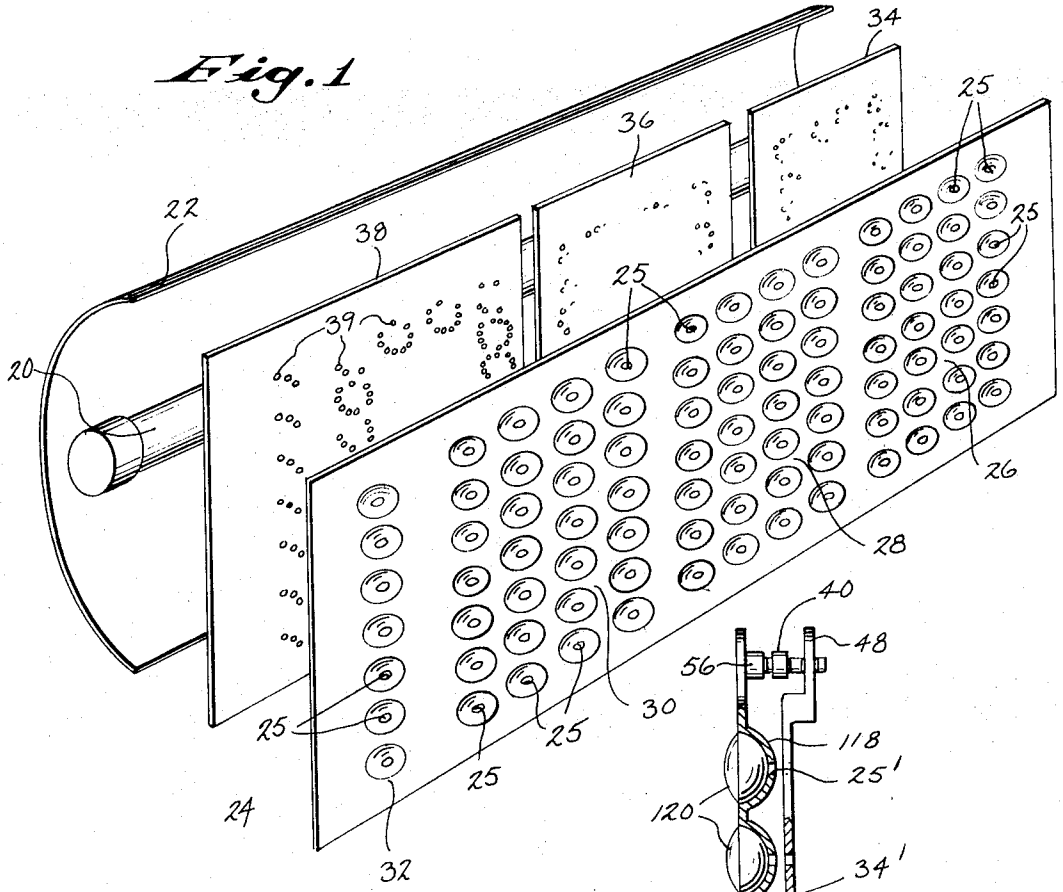


Fig. 5

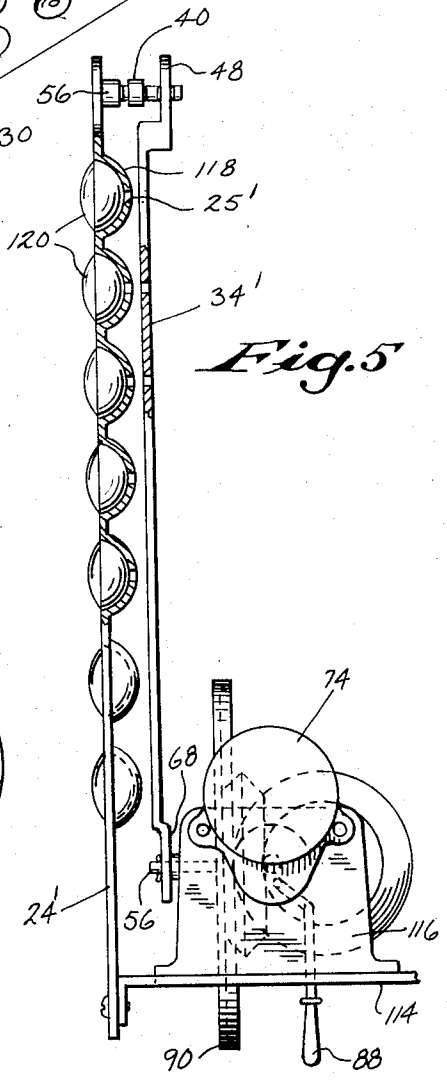


Fig. 6

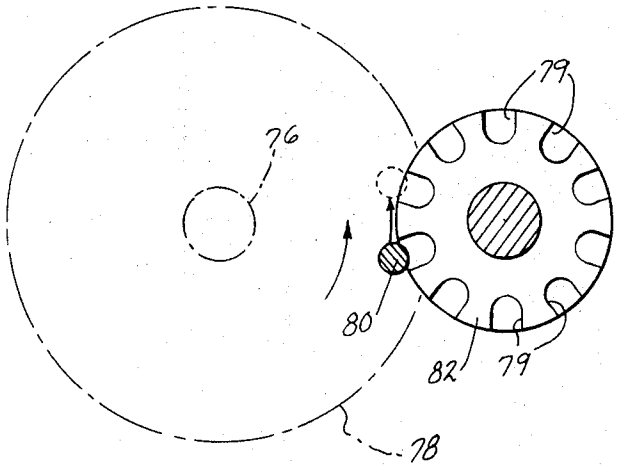
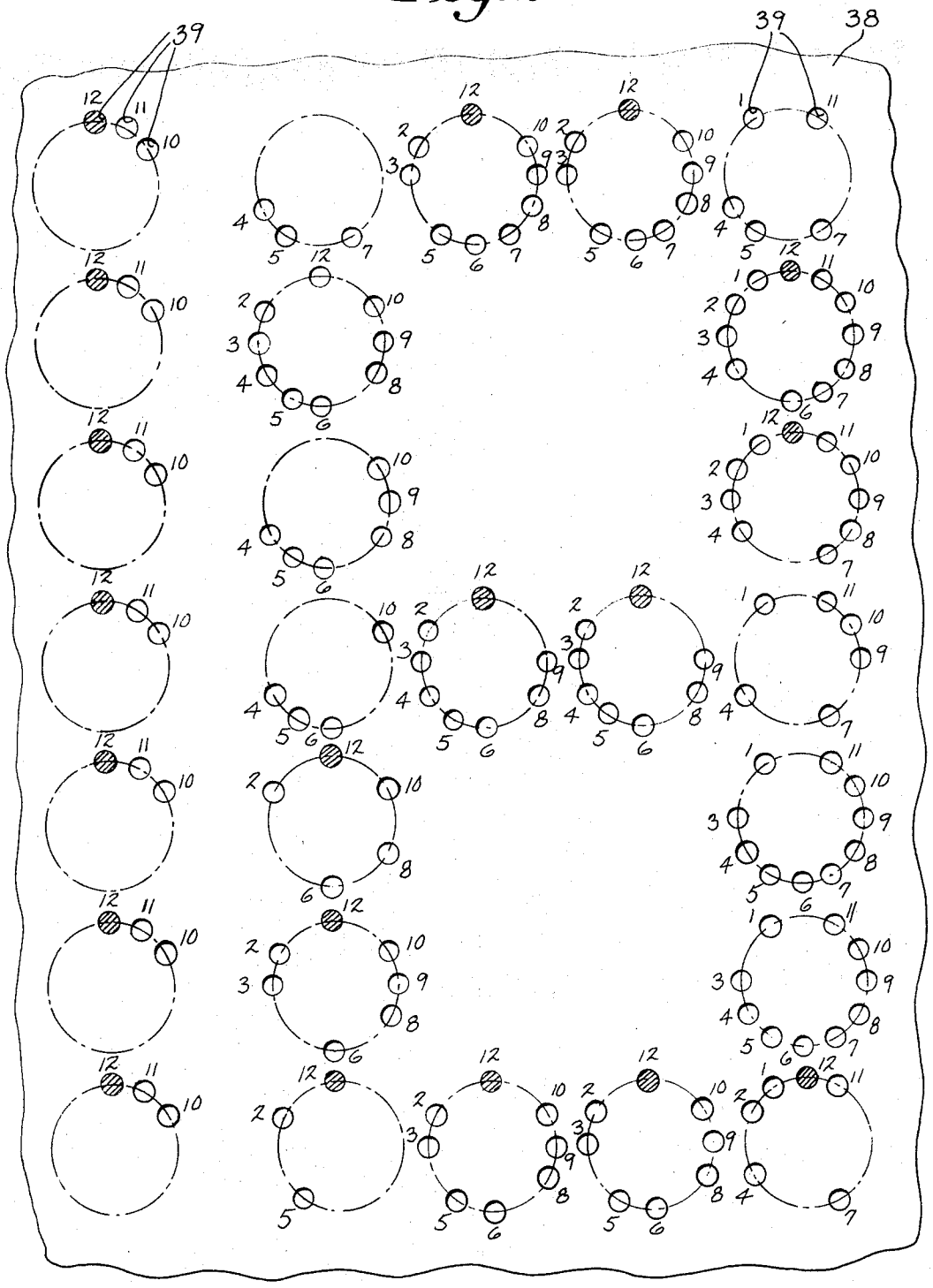


Fig. 2



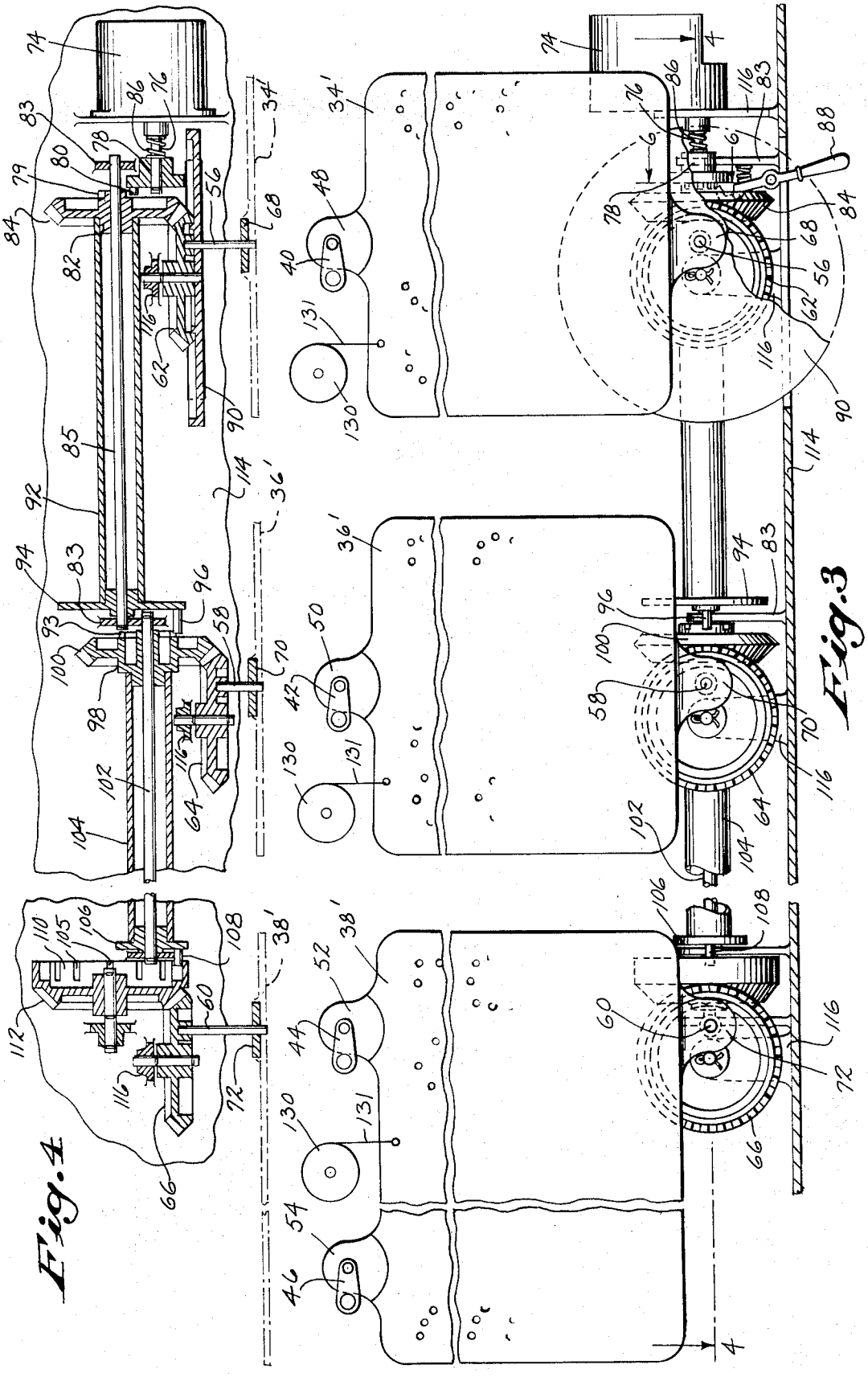


Fig. 3

Fig. 4

DIGITAL CLOCK DISPLAY

BACKGROUND OF THE INVENTION

In the past, digital numerical displays or letter displays have been proposed which make use of arrays of light bulbs together with electrical switch means for activating predetermined geometrical patterns of the light bulbs in a predetermined manner. Such digital displays have been used in advertising displays which featured a sequential verbal message, or the time of day, temperature, or the like. Although these displays have been quite effective, their use in the past has been limited by the high cost of the multitude of light bulbs required, by the difficulty of locating and replacing burned-out bulbs, and by the complicated switching circuits that are required to effect the sequential switching of the light bulbs.

Accordingly, one principal object of the invention is to provide a digital display device that does not require electrical switching circuits but, instead, utilizes a relatively simple mechanical movement.

Another object of this invention is to provide a digital display device of the above noted type which is capable of accurately displaying the time of day.

A further object of the invention is to provide a digital display device which does not require a plurality of light bulbs but which may be activated by a single light bulb.

An additional object of this invention is to provide a digital display device which is relatively simple in structure, inexpensive in cost, and reliable in operation.

SUMMARY OF THE INVENTION

In accordance with this invention, the above noted objects are achieved by providing a light source, an opaque face plate mounted in front of the light source with at least two arrays of openings in the face plate, a plurality of orbitally movable plates, the orbitally movable plates being mounted between the face plate and the light source opposite a corresponding array of openings and having orbitally arranged openings therein, each opening being positioned to admit light to a corresponding opening in the face plate when the orbitally movable plate is in a predetermined orbital position. The arrays of openings in the face plate are arranged to represent a plurality of different characters when light is transmitted through a predetermined grouping of the openings. The openings in the orbitally movable plates are arranged to selectively transmit light from the light source through predetermined groupings of openings in the arrays to produce a predetermined sequence of characters as the orbitally movable plates are moved around their orbits. Means are provided for mechanically driving the orbitally movable plates around their orbits in correlated timing to produce predetermined sequences of multiple character displays. In order to enhance the visibility of the display, a light diffusing element may be mounted over each opening in the face plate to make each opening appear to be larger than it really is.

In the preferred embodiment of the invention, the display is a series of numerals that signify the time of day.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic exploded perspective view showing the light source, face plate, and orbitally movable plates of one illustrative embodiment of the invention;

FIG. 2 is an enlarged plan view of a portion of one of the orbitally movable plates shown in FIG. 1 showing the orbitally arranged openings therein;

FIG. 3 is an elevational view of a mechanical mechanism for driving a set of orbitally movable plates through their orbital movements;

FIG. 4 is a cross-sectional plan view taken on the line 4—4 of FIG. 3;

FIG. 5 is a side elevational view of the embodiment illustrated in FIGS. 3 and 4, parts of the plates being broken away and shown in section; and

FIG. 6 is an enlarged detail sectional view taken on the line 6—6 of FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the basic units of one illustrative embodiment of the invention are diagrammatically shown in exploded perspective form. These basic units include a fluorescent lamp **20**, a curved reflector **22** for reflecting the light from the lamp **20** over a relatively large rectangular surface, an opaque rectangular face plate **24** which has openings **25** formed therein and arranged to form three rectangular arrays of openings **26, 28,** and **30–32,** and three orbitally movable plates **34, 36,** and **38** which are mounted between the face plate **24** and the light bulb **20.** The array **30–32** is a two-part array as will be hereinafter explained.

The arrays of openings in the face plate **24** are rectangular in this particular embodiment of the invention but might be of other shapes, and each of the arrays **26, 28,** and **30** is adapted to display any one of the digits **0** through **9** by passing light through selected groupings of the openings **25.** For example, to represent the numeral **1,** one vertical column of the openings will have light admitted therethrough while the other vertical columns of openings will be blocked. For the other numerals, the appropriate geometrical configuration will be apparent to those skilled in the art.

This particular embodiment of the invention is a digital clock for displaying the time of day, wherein the array of openings **26** represents the minute digit, the array of openings **28** represents the 10-minute digit, and the two-part array **30–32** taken together represent the hour digit or digits. Since there are only twelve hours in civilian clocks, the last digit which is represented by array part **32** will be only the presence or absence of the numeral **1** and, hence, this array part is composed of merely one vertical column of light openings.

The orbitally movable plates **34, 36,** and **38** which are positioned between the face plate **24** and the light source **20–22** have orbitally arranged sets of openings **39** therein for admitting light through predetermined geometrical configurations of openings in the face plate **24** to produce the above noted digital figures representing the time of day.

FIG. 2 shows a detail plan view of the orbital openings on the orbitally movable plate **38** for producing the hour digits. Each opening of each circle of openings **39** is alignable with one and only one opening **25** in the face plate **24.** Openings around the circle which are not in alignment at a particular time are in other orbital positions and are movable to an orbital position of alignment with the face plate opening. The numerals adjacent the openings in the plate **38** (FIG. 2) designate

those openings which, when moved to positions of alignment with the openings **25** of the face plate, will allow light from the source **20** to shine through the face plate and create the particular numeral identified in FIG. **2.** Thus it will be noted that the orbital openings in the row at the left of FIG. **2** which correspond to the array part **32** on the face plate, contain three openings which are alignable with the corresponding openings **25** on the face plate **24** in the tenth, eleventh, and twelfth orbital positions of the orbitally movable plate **38** to produce the numeral **1** only at a time when the hour reading on the clock is **10, 11** or **12.** This, of course, reflects the fact that the **1** is displayed in array part **32** for the tenth, eleventh, and twelfth hours only, and in all other orbital positions the orbitally movable plate **38** blocks the light through all of the openings in the array **32** of the face plate as no number **1** in the array **32** is required for single digit numbers in the hour portion of the clock.

The array part **30** is somewhat more complicated, but it is designed along these same lines. Referring again to FIGS. **1** and **2,** it will be seen that there is one circle of orbitally disposed openings **39** in the orbitally movable plate **38** of FIG. **2** for each single opening **25** in the array part **30.** In the example shown in FIG. **2,** the geometric pattern formed by the openings for the twelfth orbital position is made clearer by darkening the corresponding openings. It will be seen that the openings marked **12** on the left hand side produce a straight line which produces the digit **1,** and in the four vertical columns of openings on the right, which comprise the array part **30,** the openings **12** trace a curved path which produces the digit **2.**

The spaced circle of openings **39** in the orbitally movable plate **38** are arranged to produce the numbers **1** through **12** in sequence as the plate is moved through its orbital positions one through twelve. The particular openings in the face plate **24** which will be open to admit light therethrough correspond to those which are indicated by the numerals adjacent the openings in FIG. **2.** An example for the number **12** has been given above in the twelfth position of the orbitally movable plate **38.** When the plate **38** moves from the twelfth position to the first position, all of the openings marked **1** in FIG. **2** will align with all of the openings in the right hand vertical row of the array **30,** and all of the other openings will be out of alignment and the panel **38** will block light. It will be noted that all of the openings marked **1** in FIG. **2** align with the right-hand vertical column of openings in the face plate **24,** which means that only the right-hand vertical column of openings will have light passing through in the array **30–32.** This represents the numeral **1.** In the second through twelfth orbital position of the orbitally movable plate **38,** the geometric configuration follows the numbers shown in FIG. **2** to give the corresponding geometrical shape of the required hour digit.

The orbitally movable plates **34** and **36** are similar to plate **38** in construction, although since they need to cover only six digits (0 through 5) and 10 digits (0 through 9) respectively, instead of 12, there would be only six orbital positions for the plate **36** and ten orbital positions for the plate **34.** Also, the orbital plates **34** and **36** would be driven through one complete orbit in a 10-minute and a 1-hour cycle, respectively, instead of for the 12-hour cycle required for the orbitally movable plate **38.** The timing of the cycles will be discussed in greater detail in connection with the driving means for driving the orbitally movable plates.

Although FIG. **1** illustrates the orbitally movable plates **34, 36,** and **38** diagrammatically, it is apparent that means are required for supporting the plates for motion in an orbital path and also for driving the plates in predetermined synchronism to produce the digital numbers indicating the time of day. FIGS. **3, 4, 5,** and **6** indicate one illustrative mechanical means of achieving the above noted objectives. Referring to FIG. **3,** three orbitally movable plates **34', 36',** and **38'** are suspended for orbital movement by means of upper crank members **40, 42, 44,** and **46,** and lower eccentric pins **56, 58** and **60** which act as drive members for the orbitally movable plates **34', 36',** and **38',** and which will be discussed later. Only a few of the openings for the plates **34', 36',** and **38'** are shown in FIG. **3,** it being understood that the openings are the same as has heretofore been described in connection with FIGS. **1** and **2.** The upper cranks **40, 42, 44,** and **46** are pivotally attached at one end to projecting tabs **48, 50, 52,** and **54** which project upwardly from the orbitally movable plates **34', 36',** and **38'.** The other ends of the cranks, **40, 42, 44,** and **46** are pivotally attached to the rear of the upper margins of a front plate **24',** as indicated for the crank **40** in FIG. **5,** at the numeral **56.** The tabs **48, 50, 52,** and **54** are recessed out and away from the crank arms **40, 42, 44,** and **46** so that the cranks can be swung completely around without interference.

Before describing the orbital drive which is attached to the orbitally movable plate **34',** it will be helpful to review the requirements for the movement of each of these plates. Orbitally movable plate **34',** which corresponds to orbitally movable plate **34** described above, produces the last digit of the time of day number, i.e., the number of minutes. Accordingly, the character which will be displayed through the orbitally movable plate **34'** must be indexable through ten positions so as to display the numerals 0 through 9 and must be indexed from one position to the next every minute. In other words, the orbitally movable plate **34'** must be moved through approximately 36° every minute on the minute. There will be orbital groupings like that on the right hand side of FIG. **2,** but the number of openings in each orbital grouping will vary and will be arranged to display the minute digits as above explained.

The next orbitally movable plate **36',** corresponding to the plate **36** of FIG. **1,** has to be indexed by one position for every ten minutes from 0 to 60. This requires that the orbital movement of plate **36'** should have six indexable positions of 60° each to cause the display of the digits 0 through 5, and that the plate should be indexed from one position to the next every 10 minutes on the minute. The remaining orbitally movable plate **38'** is similar to the plate **38** shown in FIGS. **1** and **2,** and it must have 12 indexable positions of 30° each which are indexed every hour on the hour to display the numerals 1 through 12.

The orbitally movable plates **34', 36',** and **38'** are driven around their orbit from below by means of eccentric pins **56, 58,** and **60** (FIG. **4**) which are eccentrically mounted on bevel gears **62, 64,** and **66.** The pins **56, 68,** and **60** project from the corresponding bevel gear and are attached to downwardly projecting tabs **68, 70,** and **72.** The crank radius of eccentric pins **56, 58,** and **60** is the same as the crank radius of crank arms **40, 42,** and **44-46** from which the orbitally movable

plates are suspended on their upper edges. Thus, as the bevel gears 62, 64, and 66 are rotated the orbitally movable plates 34', 36', and 38' are driven around in an orbit which is determined by the crank radius of the crank pins 40, 42, 44–46, and the crank radius of the eccentric pins 56, 58, and 60.

The drive source for the unit consists of an electric motor 74 having a shaft 76 upon which is carried a wheel 78 having an intermittent drive pin 80 for coaction with the notched hub 82 of a bevel gear 84. The hub 82 of bevel gear 84 is journalled about the axis of a shaft 85 which is supported at its ends on fixed frame portions 83. The bevel gear 84 engages bevel gear 62, whereby the two gears rotate together. The shaft 76 is rotated at a speed of one revolution per minute by the motor 74, which means that the wheel 78 and intermittent drive pin 80 will make one revolution per minute. Referring to FIG. 6, this means that the intermittent drive pin 80 will engage one of the ten radial notches 79 (FIG. 6) in the hub 82 and move the hub 82 through an angle of 36° before becoming disengaged from a notch 79. The hub 82 will, therefore, be intermittently engaged and moved through a 36° arc every minute on the minute, and this will cause the bevel gear 84 to rotate through the same arc every minute on the minute, which in turn drives the bevel gear 62.

In order to provide for hand-setting of the mechanism, the wheel 78 is slideably splined to the shaft 76, and although it is normally biased outwardly by a spring 86, it can be moved against the force of the spring 86 by a manual clutch handle 88 to temporarily disengage the intermittent drive pin 80 from the hub 82. An enlarged hand wheel 90, which projects below the frame as in FIG. 3, is attached to the bevel gear 62. By turning the lower portion of this wheel by hand, the mechanism, such as a clock, may be set.

A sleeve 92 is attached to the hub 82 and rotates therewith. A wheel 94 carrying an intermittent drive pin 96 is attached to the end of the sleeve 92. The sleeve 92 is rotated intermittently along with the bevel gear 84 so as to complete one full revolution every ten minutes. Six notches 93 are cut in the hub 98 and the intermittent drive pin 96 engages the notches 93 in hub 98 so as to advance the hub 60° for every complete revolution of the intermittent drive pin 96. This drives bevel gear 64 at a rate of one revolution per hour.

The bevel gear 100 is journalled about the axis of a shaft 102, and a sleeve 104 is attached to the hub 98. A wheel 106 carrying an intermittent drive pin 108 is attached to the end of sleeve 104. The intermittent drive pin 108 engages notches 105 formed in a cylindrical projection 110 of a bevel gear 112, which gear engages the bevel gear 66. There are twelve notches 105 in the cylindrical projection 110 representing 12 hours and the intermittent drive pin 108 engages one of the notches 105 in the member 110 every hour on the hour and moves the member 110 through a 30° arc. Twelve of these 30° arcs equal 36°.

The above-described mechanical drive members are mounted upon a base plate 114 which has upwardly projecting brackets 116 for supporting the various parts of the mechanism. Although the lamp 20 and reflector 22 are only shown in FIG. 1, it is obvious that a similar lamp and reflector must be mounted on the right hand side of the base 114 of FIG. 5 to illuminate the back of the orbitally movable plates 34', 36', and 38'. Any one or more sources of light may be employed.

The openings 25' in face plate 24' (FIG. 5) can be flush with the outer surface of the face plate if desired, but in the preferred embodiment of the invention a novel arrangement of hemispherical recesses 118 is employed, which support lenses 120. The lenses 120 act as a light diffusing element which spreads the light transmitted through the small openings 25' and makes them appear larger than they actually are.

It is preferred to utilize counterbalancing wind-up springs 130 (FIG. 3) which are suitably supported from the frame and which have wind-up spring tapes 131 connected to the orbitally movable panels as shown. When the panels move downwardly they will pull on the wound tapes 131. Then when the panels are ready to move upwardly the spring wind mechanism in the members 130 will act through the tapes to urge the panels upwardly and thus relieve the motor 74.

From the foregoing description it will be apparent that this invention provides a digital display device that does not require a complicated electrical switching circuit, but is instead operated by a relatively simple mechanical movement. And, although this invention has been illustrated with reference to one specific embodiment thereof, it should be understood that the invention is by no means limited to the disclosed embodiment since many modifications can be made in the disclosed structure without changing its basic principles of operation. Many of such modifications will be apparent to those skilled in the art, and this invention includes all such modifications as may fall within the scope of the following claims.

What is claimed is:

1. A display device comprising a light source, an opaque face plate mounted in front of said light source, at least two arrays of openings formed in said face plate, each of said arrays of openings being arranged to represent characters when light is transmitted through a predetermined grouping of said openings, a plurality of movable opaque plates arranged edgewise of one another in row formation and each positioned behind a cooperative array of openings in the face plate, means mounting each of said movable plates for orbital movement between said light source and said cooperative array of openings of the face plate, each of said orbitally movable plates having a plurality of differently arranged sets of orbitally arranged openings therethrough, each opening of a set of orbitally arranged openings being alignable with one opening of the cooperative array of openings in said face plate and being positioned at a predetermined orbital position to admit light to an aligned opening in said face plate depending upon the position of the movable plate, whereby the aligned openings of the sets produce a different character for each of said orbital positions, and means for orbitally moving said orbitally movable plates at different rates of speed but in correlation with each other to produce a predetermined sequence of characters in each array of openings in said face plate.

2. A display device as claimed in claim 1 in which the means for orbitally moving said orbitally movable plates comprises the following: a bevel gear for each movable plate positioned in parallelism therewith, means including an eccentric pin projecting from each bevel gear for causing the orbital movement of its plate, a second bevel gear at right angles to and engaged with

the first bevel gear for each plate, means for driving one of said second bevel gears at a predetermined rate of speed, and means for transmitting movement from said last-mentioned bevel gear to the second bevel gear for another orbitally movable plate for driving the latter at a different rate of speed.

3. A display device as claimed in claim 2 wherein the movable plates are disposed in vertical planes and wherein there is spring means connected with each movable plate in a position to aid the drive means when a plate is being moved in a direction against the force of gravity.

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