Oct. 11, 1938. F. R. BORGFELDT 2,133,052

ELECTRIC CLOCK

Filed May 3, 1935 2 Sheets-Sheet 1

Fig. 1.

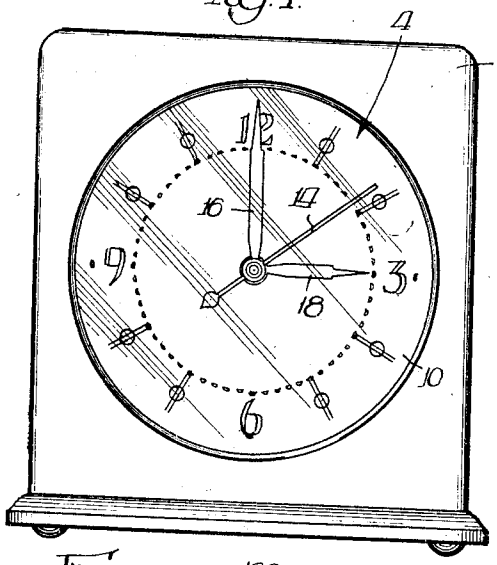


Fig. 2.

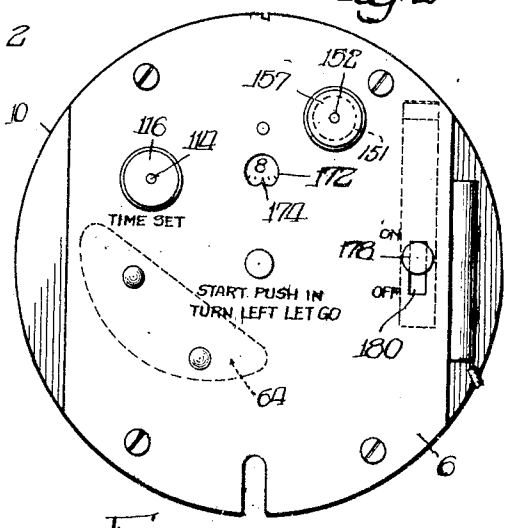


Fig. 4.

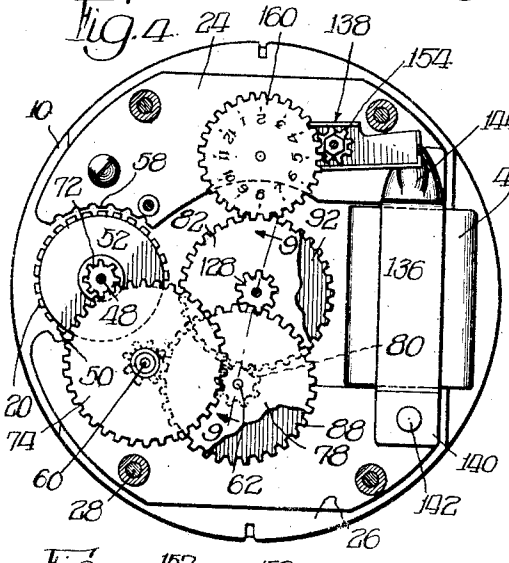


Fig. 5.

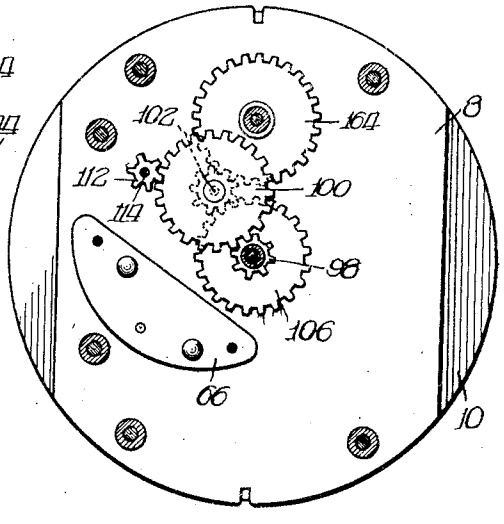
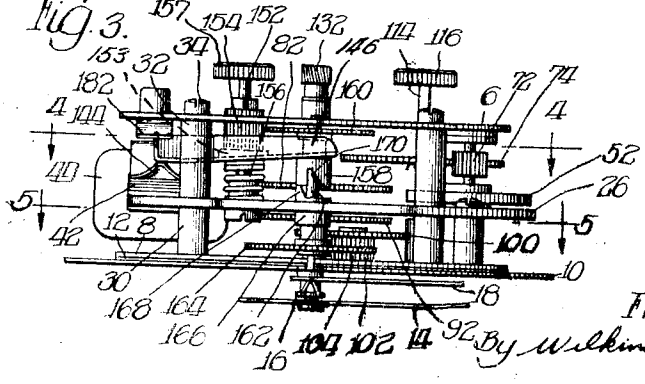


Fig. 3.



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Fig. 6.

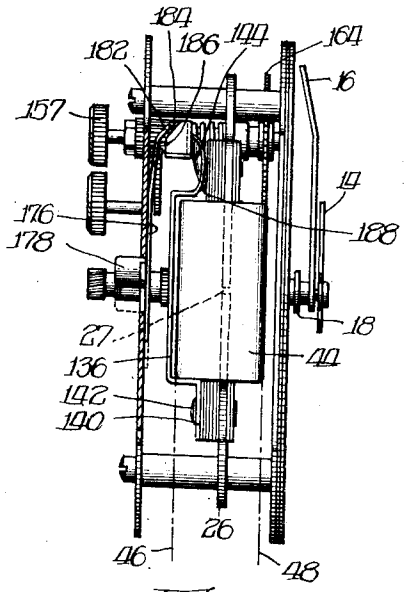


Fig. 7.

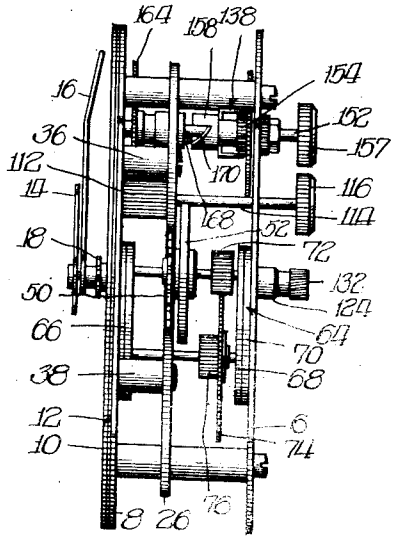


Fig. 8.

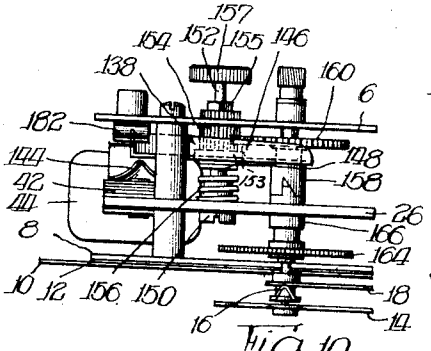


Fig. 9.

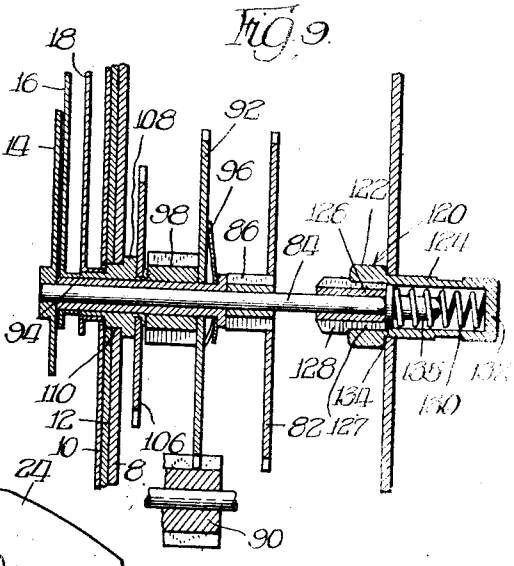
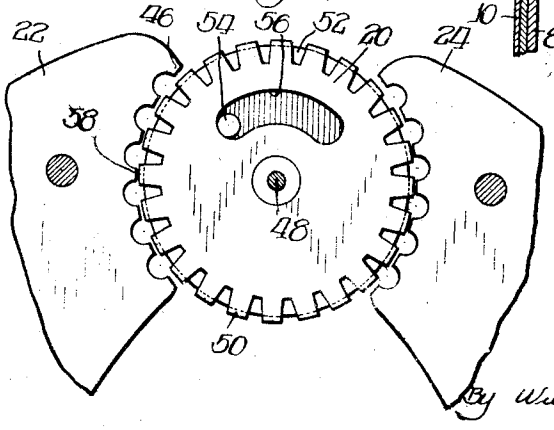


Fig. 10.



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UNITED STATES PATENT OFFICE

2,133,052

ELECTRIC CLOCK

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Application May 3, 1935, Serial No. 19,666

10 Claims. (Cl. 58—38)

The present invention relates to electric clocks.

Among the objects of the present invention is to provide an electric clock which is simple in construction, which can be economically manufactured, and which is free from undesirable noises during its operation.

The present invention includes as an object the idea of providing a novel motor of the non-self-starting synchronous type particularly adapted for use in driving a gear train of a clock mechanism, wherein the rotor and the field poles are of such a construction that the motor will operate more efficiently and is characterized by its freedom from noise.

Another object of the present invention is to provide novel means in a motor driven clock mechanism for starting the rotor of this motor.

Still another object of the present invention is to provide novel starting means for the rotor of a non-self-starting synchronous motor. More particularly, the present invention includes the idea of providing a starter adapted to releasably engage one of the gears used in driving the second hand of the clock from the rotor. Such means also serves as a bearing for this second shaft.

Still another object within the purview of the present invention is to provide a novel alarm setting means operated by the train of gears for the clock mechanism for operating the alarm.

Another object of the present invention is to provide means for adjusting this alarm setting means and the means thereof for controlling operation of the buzzer.

The present invention further comprehends the idea of providing novel means for holding the buzzer in its inoperative position, such holding means placing the buzzer under stress whereby this buzzer is not responsive to the alternating periodicity in the electrical circuit, thus eliminating undesirable alternating current hum.

Still a further object of the present invention is to provide a novel alarm setting mechanism operated by the train of gears for the clock, the same including a gear having indicia on the face thereof visible through an opening in the back plate of the clock for indicating the alarm setting.

Another object of the present invention is to provide a novel alarm setting device including meshing gears one of which gears is mounted on the shaft for the buzzer control mechanism and mounted within an opening in the rear plate of the clock mechanism, and the other of which gears is provided with indicia on one face thereof which is visible through another opening in the plate for indicating the alarm setting.

Other objects, features, capabilities and advantages are comprehended by the invention, as will later appear and as are inherently possessed thereby.

Referring to the drawings:

Figure 1 is a view in front elevation of an electric clock made in accordance with the present invention;

Figure 2 is a view in elevation of the back of the clock mechanism;

Figure 3 is an end view of the clock mechanism of Figure 2 of the drawings;

Figure 4 is a view in cross section of the clock mechanism taken in the plane represented by line 4—4 of Figure 3 of the drawings;

Figure 5 is a view in cross section of the clock mechanism taken in the plane represented by line 5—5 of Figure 3 of the drawings;

Figure 6 is a view in elevation of the rear of the clock mechanism;

Figure 7 is a view in elevation of the front of the clock mechanism;

Figure 8 is a fragmentary view in elevation corresponding to Figure 3 of the drawings, showing the alarm mechanism in its operating position;

Figure 9 is a detached view in cross section taken in the plane represented by line 9—9 of Figure 4 of the drawings; and

Figure 10 is an enlarged fragmentary view in cross section taken in the plane represented by line 10—10 of Figure 7 of the drawings and showing the rotor and field structure of the electric motor.

Referring now more in detail to the drawings, an electric clock made in accordance with the present invention is shown as comprising a casing 2 having an opening therein for receiving the clock mechanism which is generally referred to as 4. This clock mechanism comprises a rear plate 6 and a front plate 8 upon which is mounted a dial 10 having the clock numerals painted or otherwise placed thereon, a pad 12 being interposed between the dial 10 and the front plate 8. The clock is provided with the second, minute and hour hands 14, 16 and 18, respectively, mounted for movement over the dial and driven by a train of gears, as will be hereinafter more fully disclosed.

The train of gears for the clock mechanism is driven by means of a synchronous motor of the non-self-starting type, this motor comprising a rotor 20 and a field structure. The field struc-

ture includes a yoke 26, which, in the embodiment disclosed, comprises two plates 22 and 24 spaced as at 27 and mounted between the plates 6 and 8 at a plurality of points between pillars 30 and 32 which are staked to the plates 8 and 6, respectively, and have an end protruding into an opening provided in the yoke 26, these pillars being maintained in position to rigidly mount the yoke 26 as by means of a bolt 34 passing downwardly therethrough and engaging threads in the pillars 30. The plates 22 and 24 are further rigidly held by pillars 36 and 38 having an end staked to the front plate 8 and interlocking within openings provided in these plates, bolts 40 being provided in threaded engagement with the pillars for securely holding the ends of these plates in operative position.

Mounted on the central part of the yoke 26 and spanning the gap 27 is a plurality of strips of metal 42 around which is a winding 44 forming an exciter for the motor, this winding being connected through leads 46 and 48 to any suitable source of alternating current. The yoke, together with the laminations 42, provide a core for the winding 44 to provide an alternating flux at the ends of plates 22 and 24. As shown in Figure 10 of the drawings, the plates 22 and 24 terminate in opposite relation to the axis of the rotor 20 and are each formed with a plurality of polar projections 46, the plates being unlaminated and the polar projections being unwound. The rotor 20 is fixedly mounted upon the shaft 48 for rotation and is likewise formed with a plurality of unlaminated and unwound polar projections 50. Adjacent to the rotor 20 and freely mounted upon the shaft 48 is an inertia member 52 provided with a pin 54 projecting within the slot 56 formed in the rotor 20, this inertia member 52 being provided to secure uniform rotation of the rotor even though there may be fluctuations in the alternating current circuit. It has been found that improved operation in a synchronous motor of the type disclosed can be effected by varying the angular spacing of the polar projections 46 and 50 of the field poles and rotor, respectively. The spacing between the polar projections 46 and 50 is a minimum at the center polar projection 58 of the pole pieces of the field structure and gradually increases to a maximum between the end polar projections 46 and the projections on the rotor.

Where it is desirable to construct the projections on the rotor and the field poles of substantially the same width and to provide a motor with these air gaps varying in width as disclosed, then the angular spacing between the centers of the projections on the field poles must be less than the angular spacing between the centers of the projections on the rotor in order to provide a motor which will operate with a minimum amount of hunting. Such a construction is disclosed in Figure 10 of the drawings wherein the polar projections 46 are angularly spaced apart approximately 14°–20°, while the angular spacing of the polar projections 50 on the rotor is approximately 15°.

However, a motor of improved construction incorporating these air gaps which vary in width may be provided wherein the angular spacing of the projections on the rotor and the field poles is the same. In this case, however, there must be a difference in width of the projections on the rotor and field poles in order to properly align the projections on the rotor and field poles to secure a motor which will operate with a minimum of hunting. The projections on the rotor may be wider than the projections on the field poles, or vice versa, in order to obtain the desired results.

Heretofore, where the angular spacing of the rotor and field projections have been equal and the rotor mounted concentrically between the field projections, undesirable noise is present due to the shifting of the rotor shaft in its bearings, this being caused by uncontrolled flux strength at different points in the gap between the rotor and field projection. This may be due to the internal characteristics of the metal at different points both in the rotor and field projections.

The present invention comprehends the idea of eliminating this undesirable noise. By providing an air gap having its narrowest point between the rotor and field poles at approximately the center of field poles the flux is concentrated at these points, the shifting of the rotor within its bearings is decreased to a minimum. In order to provide for these air gaps which vary in width as above described, the angular spacing of the projections on the rotor and the field poles must vary in order that the projections may be in alignment, which feature is desirable to provide a motor wherein there is a minimum of hunting of the rotor.

In Figure 10 of the drawings, the projections on the rotor and field poles are substantially of the same width.

The rotor shaft 48, as well as shafts 60 and 62 spaced therefrom, are mounted in bearings 64 and 66 which are secured to plates 6 and 8, respectively, each of which bearings comprises an outer plate 68 of compressed fibrous material especially treated to retain lubricant, and an inner metallic plate 70 adjacent plates 6 and 8 which are formed with openings to receive the ends of these shafts and to retain a sufficient amount of lubricant to properly lubricate these shafts over a considerable length of time.

Fixed upon the rotor shaft 48 is a pinion 72 adapted to mesh with a gear 74 formed from compressed fibrous material in order to provide a smooth and noiseless operating gear train. This gear 74 is mounted on the shaft 60 and is provided with a pinion 76 adjacent thereto which meshes and drives gear 78 fixed to shaft 62. A pinion 80 is fixed to shaft 62 adjacent gear 78 which meshes with gear 82 which is fixed to a second shaft 84 which extends forwardly through the front plate 8 and has the second hand 14 mounted thereon. The gear 82 has a pinion 86 fixed thereto meshing with the gear 88 freely mounted upon the shaft 62, which gear has a pinion 90 fixed thereto which meshes with gear 92 movably mounted upon the sleeve 94 rotatably mounted upon the second shaft 84. Sleeve 94 is driven by gear 92 through the spring clutch 96 and has mounted upon its outer end a minute hand 16. Pressed on the sleeve 94 is a pinion 98 which meshes with gear 100 mounted upon a stub shaft 102 which is staked to the front plate 8, this gear driving a pinion 104 fixed thereto which meshes with gear 106 fixed upon sleeve 108, this sleeve being freely mounted upon the sleeve 94 for the minute hand. Sleeve 108 has mounted upon its outer end the hour hand 18. It will be noted that the second shaft 84 and the concentrically arranged freely rotatable sleeves 94 and 108 extend through opening 110 in the face plate 8 for operating the hands of the clock. Gear 100 meshes with a pinion 112 fixed to a shaft 114 which is journaled in the front and rear plates 6 and 8 and has a knob 116 secured thereto ad-

jacent the back plate, this knob being adapted to rotate pinion 112 which, through gear 100, rotates pinion 98 for setting the minute hand 16, gear 92 at this time remaining stationary because of the spring clutch 96 which permits this setting without affecting this gear. Rotation of gear 100 effects rotation of pinion 104 which meshes with gear 106, thereby rotating sleeve 108 which sets the hour hand 18. It is of course understood that the various gears above described are constructed in the proper ratio one to the other in order to move the second, minute and hour hands in their proper relation to one another.

In an electric clock of the type herein disclosed, the desirability of providing a motor of the non-self-starting synchronous type is well known and with such motors it is necessary to provide a starting device for initially rotating the rotor to a speed above the synchronous speed thereof after which the rotor assumes its normal speed of rotation in the alternating current circuit. The present clock mechanism accordingly comprehends providing a starter for initially rotating the rotor, such a starting means comprising a hollow starter knob 120 mounted in an opening in the back plate 6. This sleeve has an enlarged shoulder 122 adapted to abut the back plate 6 and is provided with an outer restricted body portion 124 projecting through the plate, which portion is adapted to be grasped for rotation thereof. Fitted within the enlarged portion 122 is a hub 126 of a pinion 128 which provides a bearing for the rear end of the second shaft 84. This pinion 128 is in abutting relation with the enlarged portion 122 and the hub is formed with spaced leaves 127 substantially the pitch diameter of the pinion and forming air passages therebetween communicating with the chamber of the hollow knob 120. The enlarged part 122 of the knob 120 is normally held in abutting relation with the inside face of the back plate by means of a coil spring 130, disposed between the end 132 of the knob and the enlarged head 134 of a pin 135, the head 134 normally abutting the bushing 126 and a shoulder adjacent thereto formed on the knob 120. It will be clearly seen that this starting mechanism forms a suitable bearing for the inner end of the second shaft 84 and that the inner cavity provides a suitable reservoir for maintaining a supply of lubricant, which may seep between the walls of the knob and the enlarged head 134 to properly lubricate the inner end of the second shaft 84.

When it is desired to start the rotor, the starter 122 is pressed inwardly against the action of coil spring 130 until the spur or pinion gear 128 meshes with gear 78. Inward movement of the knob 120 is limited by engagement of the rear wall 132 with the shank of pin 135 which also serves to position coil spring 130. Rotation of the starter 120 causes rotation of gear 78, which meshes with pinion 76 fixed in relation to gear 74, which meshes with pinion 72 mounted on the rotor shaft 48. The starter 120 may be spun and through the gears enumerated causes the rotor to rotate to a speed above its normal operating speed, whereupon the same may be released and the rotor allowed to fall into its normal synchronous operating speed.

The present invention also contemplates an alarm mechanism which may be incorporated in this clock, such mechanism including a buzzer 136 and an alarm setting device generally referred to as 138. The buzzer is substantially U-shaped in construction and is formed from a thin flexible plate of metal and has an end flange 140 secured by means of a rivet, or the like, 142 to one end of the core of the field structure. The central portion of the buzzer extends upwardly and over the winding 44 to embrace one side thereof, this buzzer terminating in an end 144 adapted, when released, to vibrate under the electrical impulses of the flux produced by the windings and core to produce an audible signal.

The operation of the buzzer is automatically controlled by a lever 146 which is mounted upon a shaft 148 extending between the yoke 26 and the rear plate 6. This shaft is in the form of a threaded screw having a head 150 and a threaded end 152, upon which is threaded a pinion 154 extending through an opening 151 in plate 6 and being journaled therein. Pinion 154 is locked in its adjusted position by means of a lock nut 155 and a knob 157 threaded on the shaft 148 may be provided for rotating the same. The lever 146 is substantially U-shaped in cross section whereby the side walls thereof embrace the gear 154. The lever 146 is maintained in abutting relation with a washer 153 mounted on shaft 148 adjacent the pinion 154 and moved, as hereinafter more fully disclosed, by a coil spring 156 disposed between yoke 26 and the lever 146. The outer end of lever 146 extends over end 144 of the buzzer and engages therewith when the alarm mechanism is in inoperative position to prevent the buzzer from operating. This lever has its other end bifurcated to receive the collared end of cam member 158 which is fixed to gear 160 slidably mounted upon a shaft 162 which is journaled in the back plate 6 and front plate 8. Fixed to this shaft is a gear 164 which meshes with the pinion 104 of the gear train operated by the rotor 20. Mounted adjacent the gear 164 is a cam member 166 extending through an opening in the yoke 26. This cam member is provided with a projection 168 adapted to ride over the end surface of cam 158 during normal operation of the clock, but is adapted to receive notch 170 of cam member 158 when the time as indicated by the hands on the face of the clock corresponds to the alarm setting. The position of notch 170 of the cam member 158 may be changed as desired through pinion 154 which meshes with gear 160. Setting of cam 158 is indicated by indicia on the rear face of gear 160, as shown in Figures 2 and 4 of the drawings, such indicia being visible through an opening 172 in the plate 6 of the clock mechanism, this opening being formed with a pointer 174 which accurately indicates the setting of gear 160 through rotation of the knob 157. When it is desired to set the alarm mechanism for any given time, knob 157 is rotated until such time is indicated on the face of the gear 160 coinciding with the pointer 174. This rotation of cam member 158 disposes the notch 170 in such a position that projection 168 of cam member 166 will be oppositely disposed thereto to permit cam member 158 to move into association with the cam 166 under the action of coil spring 156 when the clock mechanism has operated to move the hands on the face of the clock to the time as indicated by the alarm setting. Movement of cam 158 into association with cam 166 causes lever 146 to pivot or fulcrum on the edge of washer 153 to move its outer end from engaging relation with the end 144 of the buzzer to permit its vibration.

The alarm lever 146 is manually controlled by a cut-off mechanism including plate 176 secured to the back plate 6 by a knob 178 operable with-

in a slot 180 formed in this back plate. This plate 176 has an end 182 movable into engagement with the edge 186 over the sloping edge 184 of the turned-up end of the lever 146 when the knob 178 is moved into its "off" position. This manually operated cut-off mechanism causes the lever 146 to press the end 144 of the buzzer toward the laminated core and about a protuberance 188 provided in the end 144 which forms a fulcrum at its point of engagement with the laminated core. This downward pressure on the end 144 causes a slight upward bowing of that part of the buzzer 136 which embraces the winding 44 to place the same under stress so that the buzzer is not responsive to the alternating periodicity in the alternating circuit which would cause undesirable alternating current hum.

It will be noted that the coil spring 156 may be placed under any desired compression by adjusting the pinion 154 and locking the same by means of the lock nut 155. This coil spring functions to automatically move cam member 158 into association with cam member 156 when the notch 170 thereof is engaged by projection 168 and to move the lever 146 out of engagement with the end of buzzer 136, when the cut-off mechanism has been manually operated to move arm 176 thereof out of engagement with lever 146, to permit operation of the buzzer. This coil spring also holds the lever 146 in association with gear 154 and the position of lever 146 determines the stress placed upon the central portion of the buzzer when the alarm mechanism is in its "off" position. It is of course understood that after the alarm has operated due to the engagement of projection 168 in notch 158, knob 178 may be moved to effect engagement of plate 176 with the lever 146 and to apply pressure on the end 144 of the buzzer to prevent its further operation.

While I have herein described and upon the drawings shown illustrative embodiments of the invention, it is to be understood that the invention is not limited thereto but may comprehend other constructions, arrangements of parts, details and features without departing from the spirit of the invention.

I claim:

1. In an electric clock, the combination of a gear train, a motor for driving said gear train, said motor comprising a rotor and a field structure producing a magnetic field, said field structure having a core and a winding, a magnetizable buzzer having one end connected to said core and the other free end being in juxtaposition thereto and adapted to be vibrated by said magnetic field, said buzzer embracing said winding and adapted to engage said core intermediate its ends, and a manually operated alarm setting means having means for holding said buzzer inoperative during a portion of the operation of said gear train, said means being operated by said gear train for automatically releasing said buzzer at a predetermined point in the operation of said gear train, and alarm shut off means cooperating with the other end of said buzzer to move the same about its point of engagement with said core for placing a stress in said buzzer to eliminate undesirable noises during operation of said motor.

2. In an electric clock, the combination of a gear train, a motor for driving said gear train, a buzzer operated by said motor to effect an audible signal, and a manually operated alarm setting means including intermeshing gears mounted on spaced shafts, a lever mounted on one of said shafts associated with said means, and means mounted on the other of said shafts for controlling the operation of said lever, said last-named means having means to maintain said lever in position to hold said buzzer in inoperative position during a portion of the operation of said first-named gear train and to allow movement of said lever to release said buzzer at a predetermined point in the operation of said first-named gear train.

3. In an electric clock, the combination of a gear train provided with a cam, a motor for driving said gear train, a buzzer operated by said motor to effect an audible signal, and a manually operated alarm setting means including intermeshing gears mounted on spaced shafts, a lever mounted on one of said shafts and having an end engaging said buzzer, an alarm cam mounted on the other of said shafts and associated with the other end of said lever and movable in accordance with the alarm setting by said last-named gear train, said alarm cam cooperating with the cam associated with said first-named gear train to hold said lever in a position to render said buzzer inoperative during a period of operation of said first-named gear train and said cams having means cooperating to release said lever from engagement with said buzzer at a predetermined point in the operation of said first-named gear train.

4. In an electric clock, the combination of an electrically operated buzzer, a gear train having an alarm cam, a manually operated alarm setting means comprising a shaft, a lever movably mounted on said shaft, said lever having an end engageable with said buzzer and having a cam associated with the other end thereof cooperating with said first-named cam, said cams having cooperating surfaces adapted to maintain said lever in position to hold said buzzer in inoperative position during a portion of the operation of said gear train and to allow movement of said lever in respect to said shaft to release the engagement of said first-named end with said buzzer at a predetermined point in the operation of said gear train.

5. In an electric clock, the combination of an electrically operated buzzer, a gear train having an alarm cam, a manually operated alarm setting means comprising a shaft, a lever movably mounted on said shaft, said lever having an end engageable with said buzzer and having a cam associated with the other end thereof cooperating with said first-named cam, said cams having cooperating surfaces adapted to maintain said lever in position to hold said buzzer in inoperative position during a portion of the operation of said gear train and to allow movement of said lever in respect to said shaft to release the engagement of said first-named end with said buzzer at a predetermined point in the operation of said gear train, and a spring engaging said lever for moving said lever.

6. In an electric clock, the combination of an electrically operated buzzer, a gear train having an alarm cam, a manually operated alarm setting means comprising spaced shafts having cooperating gears, a cam movable by one of said gears and cooperating with said first named cam, a lever movably mounted on one of said shafts and having an end adapted to cooperate with said buzzer and having its other end operated by said last named cam, said cams having cooperating surfaces adapted to maintain said lever

in position to hold said buzzer in inoperative position during a portion of the operation of said gear train and to allow movement of said lever in respect to said shaft to release the engagement of said first-named end with said buzzer at a predetermined point in the operation of said gear train.

7. In an electric clock, the combination of an electrically operated buzzer, a gear train having an alarm cam, a manually operated alarm setting means comprising spaced shafts having cooperating gears, a cam movable by one of said gears and cooperating with said first named cam, a lever movably mounted on one of said shafts and having an end adapted to cooperate with said buzzer and having its other end operated by said last named cam, said cams having cooperating surfaces adapted to maintain said lever in position to hold said buzzer in inoperative position during a portion of the operation of said gear train and to allow movement of said lever in respect to said shaft to release the engagement of said first-named end with said buzzer at a predetermined point in the operation of said gear train, and means for adjusting the position of said lever axially on the shaft therefor to prevent undesirable hum in said buzzer.

8. In an electric clock, the combination of an electrically operated buzzer, a gear train having an alarm cam, a manually operated alarm setting means comprising a shaft, a lever movably mounted on said shaft, said lever having an end engageable with said buzzer and having a cam associated with the other end thereof cooperating with said first named cam, said cams having cooperating surfaces adapted to maintain said lever in position to hold said buzzer in inoperative position during a portion of the operation of said gear train and to allow movement of said lever in respect to said shaft to release the engagement of said first-named end with said buzzer at a predetermined point in the operation of said gear train, and manually operated means cooperating with said first named end for controlling operation of said buzzer.

9. In an electric clock, the combination of an electric motor having a field core producing a magnetic field, a winding embracing said field core, a magnetizable flexible member associated with said core and winding and adapted to be vibrated by said magnetic field to effect an audible signal, said flexible member being connected at one end to said core on one side of said winding, said member extending over said winding and having its other end in the other side of said winding, said member being adapted to contact intermediate its ends with said core on the second-named side of said winding, and means normally applying pressure on the second-named end of said member whereby said member is fulcrumed about its point of engagement with said core to cause a bow thereof thereby stressing the same to eliminate undesirable noises during operation of said motor.

10. In an electric clock, the combination of a gear train, an electric motor for driving said gear train, said motor having a field core producing a magnetic field, a winding embracing said field core, a magnetizable flexible member associated with said core and winding and adapted to be vibrated by said magnetic field to effect an audible signal, said flexible member being connected at one end to said core on one side of said winding, said member extending over said winding and having its other end on the other side of said winding, said member being adapted to contact intermediate its ends with said core on the second-named side of said winding, manually operated alarm setting means, said gear train and said alarm setting means having cooperating means associated therewith, means operated by said cooperating means adapted to apply pressure on the second-named end of said member during a portion of the operation of said gear train whereby said member is fulcrumed about its point of engagement with said core to cause a bow thereof and to hold the same inoperative and at the same time stressing said member to eliminate undesirable noises during operation of said motor, said cooperating means also having means operating said last-named means to release said pressure on said member to permit operation thereof at a predetermined point in the operation of said gear train.

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