June 6, 1950 R. B. JOHNSON ET AL 2,510,583

SECONDARY TIMEKEEPING APPARATUS

Filed April 10, 1946 2 Sheets-Sheet 1

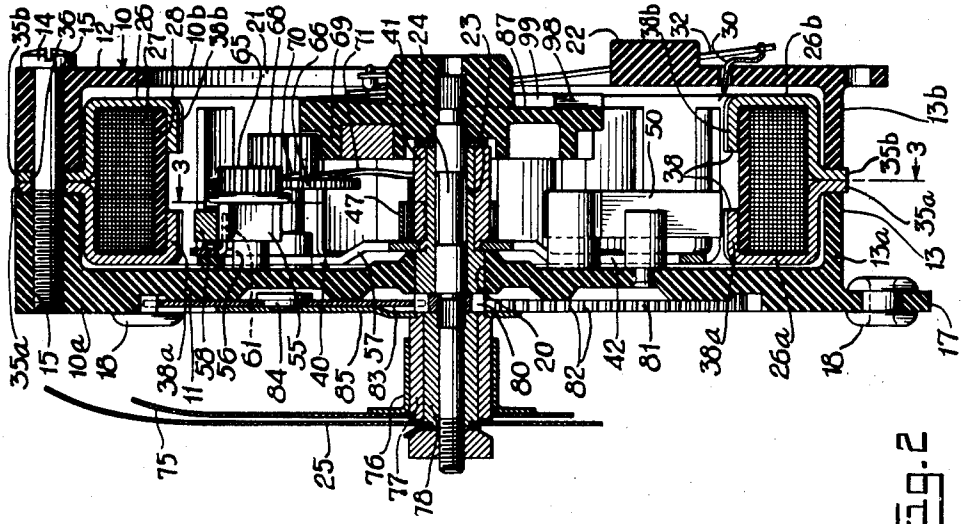


Fig. 2

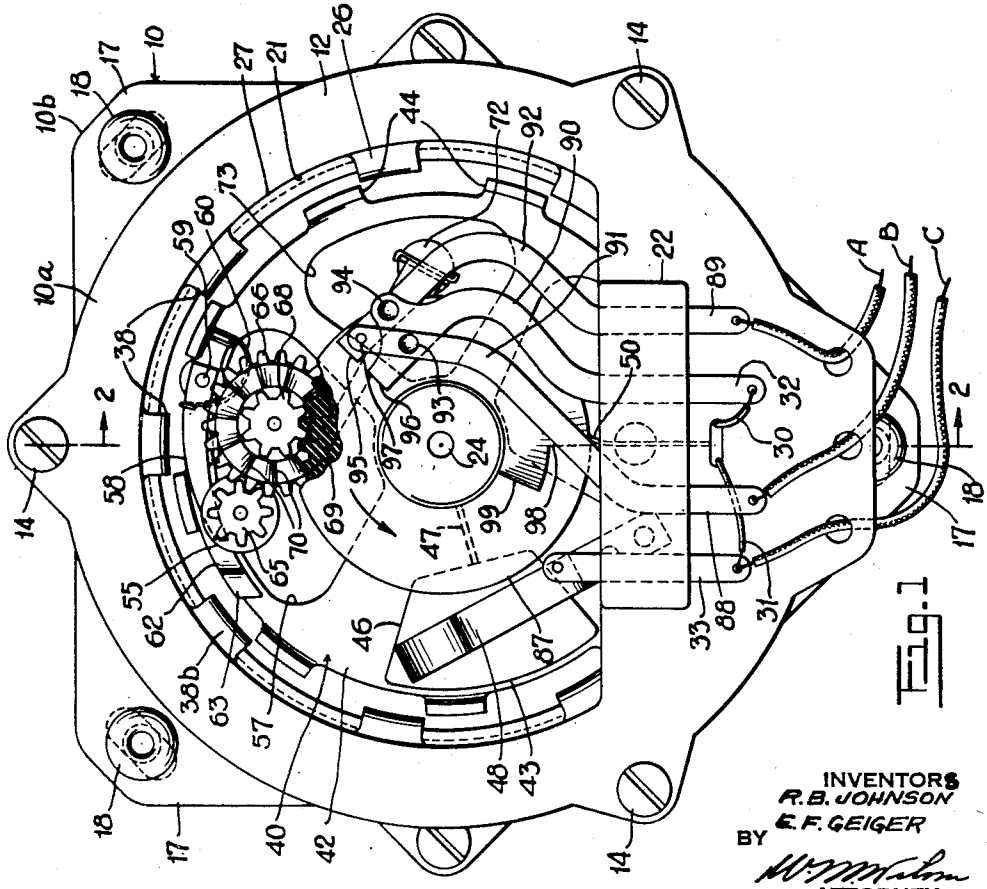


Fig. 1

INVENTORS
R. B. JOHNSON
E. F. GEIGER
BY
ATTORNEY

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SECONDARY TIMEKEEPING APPARATUS

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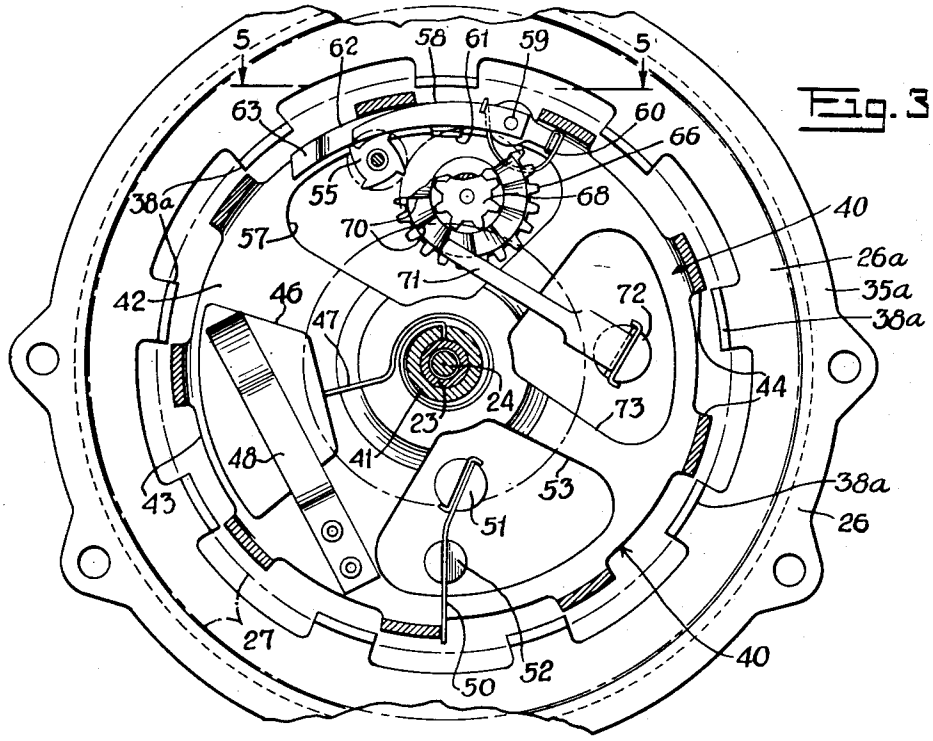


Fig. 3

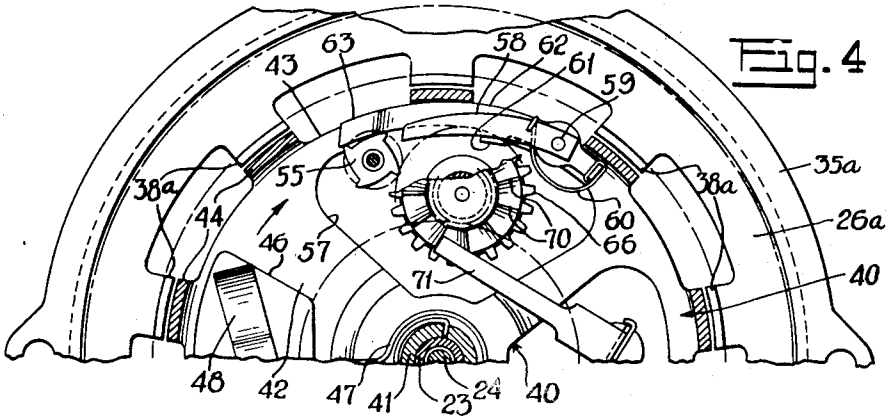


Fig. 4

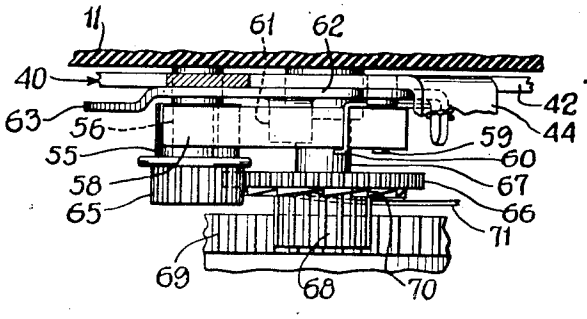


Fig. 5

INVENTORS
R. B. JOHNSON
E. F. GEIGER
BY
ATTORNEY

Patented June 6, 1950

2,510,583

UNITED STATES PATENT OFFICE

2,510,583

SECONDARY TIMEKEEPING APPARATUS

Reynold B. Johnson and Edward F. Geiger, Binghamton, N. Y., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application April 10, 1946, Serial No. 661,123

6 Claims. (Cl. 58—26)

1

This invention relates generally to clocks, and clock systems, of the type disclosed in U. S. patent to Bryce, No. 1,687,491, granted October 16, 1928, and more particularly, this invention has to do with improvements in secondary clocks and similar time-keeping apparatus of the type which are operated by electrical impulses transmitted at predetermined time intervals under the control of a master clock.

An object of this invention is to provide secondary clock apparatus of the type referred to which is of improved construction and arrangement of parts.

A further object of the invention is to provide a secondary clock of the minute impulse type which is extremely quiet in its operation, such quietness of operation being effected by virtue of certain counterbalancing spring biasing means employed in connection with the present invention.

A still further object is to provide secondary clock apparatus of the impulse type which is composed of relatively few parts and which is relatively low in cost.

A further object is to provide an impulse type secondary clock which has an improved construction and arrangement of magnet coil and armature and which may be operated either by an A. C. or a D. C. signal impulse.

A still further object is to provide a secondary clock having an annular coil and an oscillating armature disposed within said coil and which is provided with an improved form of mechanism for transmitting the oscillatory motion of the armature to a time indicating means.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a rear elevational view disclosing one preferred form of secondary clock apparatus constructed in accordance with the present invention;

Fig. 2 is a vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary vertical sectional view taken on the line 3—3 of Fig. 2 with the annular

2

magnet coil omitted but the outline thereof being indicated by the dot-and-dash lines, the view showing the normal or non-energized position of the armature;

Fig. 4 is a fragmentary vertical section taken on the same plane as Fig. 3 and showing the armature in its energized or attracted position; and

Fig. 5 is a fragmentary horizontal section showing in plan the mechanism for transmitting the motion of the oscillatory armature to the time indicating shaft.

Referring now in detail to the construction illustrated, the reference numeral 10 indicates a clock supporting housing which may be formed of any suitable non-magnetic material such, for example, as a molded insulating material. As shown, the housing is shaped substantially as a drum and comprises a circular front wall 11, a rear wall 12, and a cylindrical side wall 13. In order to facilitate manufacture and assembly, the housing 10 is preferably divided along a median transverse plane into a front half 10*a* and a rear half 10*b* which are detachably secured together by any suitable means such, for example, as screws 14. The screws 14 extend through an opening 15 in the rear part 10*b* and engage a threaded opening 16 in the front part 10*a*. The front part 10*a* is formed with outwardly extending supporting ears 17 having openings formed therein. In each of these openings is mounted a rubber grommet 18 through which is adapted to extend the means for securing the housing 10 within the conventional clock casing (not shown). The rubber grommets minimize the transmission of vibrations from the clock housing to its casing and thereby aid in reducing clock operating noises.

The front half 10*a* of the housing includes the circular end wall 11 which is provided with an opening 20 through the center thereof. As shown, the front half 13*a* of the cylindrical side wall 13 is joined to the periphery of the end wall 11 and is formed as a continuation of the rear half 13*b* of the cylindrical side wall which is formed on the rear half 10*b* of the casing. The rear end wall 12 is formed with an opening 21 in the upper part thereof to permit access to the clock mechanism within the housing 10, and is also formed with a terminal mounting block 22 on the lower

part thereof which serves as a means for holding terminal straps for making electrical connections.

A bearing sleeve 23 is fixed at one end thereof within the central opening 20 in the front end wall 11 and the sleeve 23 extends rearwardly coaxially within the housing as shown in Fig. 2. A minutes shaft 24 is journalled within the central bore of the sleeve 23 and extends forwardly beyond the front end wall 11 and the conventional minutes hand 25 is secured to the outer forward end thereof.

Arranged concentrically within the drum-shaped housing 10 and supported from the cylindrical side wall 13 thereof, is a hollow annular supporting member 26, in which is disposed an annular magnet coil 27. The coil 27 is circularly wound in the conventional manner on a mounting ring 28 of suitable insulating material. The two terminal wires 30 and 31 of the coil are shown in Fig. 1 as attached, respectively, to terminal straps 32 and 33 carried by the mounting block 22.

As shown in Fig. 2, the annular supporting member 26 is channel or U-shaped in cross section with the open side of the U at the inner circumference thereof. The member 26 is formed of a suitable permeable material; and, in order to facilitate manufacture and assembly, is divided along a median transverse plane into symmetrical halves 26*a* and 26*b*, respectively. The halves are formed with abutting flanges 35*a* and 35*b*, respectively, which extend radially outward from the outer circumferential wall thereof and are disposed between the front and rear halves 10*a* and 10*b* of the housing 10. The flanges 35*a* and 35*b* are provided with aligned openings 36 through which the housing securing screws 14 extend. Thus, the screws 14 serve as a means for detachably securing together two halves of the housing 10 and the two halves of the annular supporting member 26 and as a means for holding the supporting member 26 in its proper concentric relation with respect to the axis of the housing 10.

The annular supporting member 26 includes a plurality of circumferentially spaced pairs 38 of pole pieces, the pole pieces of each pair 38 being indicated, respectively, by the reference numerals 38*a* and 38*b*. The pole pieces 38*a* and 38*b* of each pair are formed integral with the two opposite sides of the member 26 and they extend inwardly toward one another across the open inner side of the channel-shaped supporting member and terminate short of one another to provide an air gap therebetween. As shown in Fig. 3, there are nine pairs 38 of pole pieces provided. The ring-shaped strip 28 of insulating material in conjunction with the pairs of pole pieces 38*a* and 38*b*, serve to hold the coil 27 within the supporting member 26.

An oscillating armature 40 is journalled on the axially disposed supporting sleeve 23 and comprises a central hub 41 mounted on the sleeve 23, and a disk-like web 42 fixed at its center to the hub and extending radially outwardly from the latter and terminating at its periphery in a circular rim 43 from which extends a plurality of separate flanges 44. The rim 43 and flanges 44 are made of a suitable permeable material and the flanges form armature elements which coact with the pairs 38 of pole pieces of the supporting member 26. The flanges are spaced circumferentially about the rim 43 and correspond in number and spacing to the pairs 38 of pole pieces. The arrangement of the flanges is such that when the magnet coil 27 is energized, the resulting magnetic force moves the flanges 44 circumferentially into bridging relation with respect to their corresponding pairs 38 of pole pieces 38*a* and 38*b* and thereby rotates the armature 40 from its normal or non-energized position shown in Fig. 3 to its energized position shown in Fig. 4.

Biasing means is provided for constantly urging the armature 40 to rotate in a direction opposite to the magnetic force of the coil and back to its normal or non-energized position. This biasing means advantageously comprises a weight 46 fixed to the outer end of a spring 47, the inner end of the spring being wound spirally around and anchored to the hub 41 of the armature 40. In order to dampen vibratory movements of the weight 46, a leaf spring 48 is fixed at one end to the web 42 of the armature and the other or outer end thereof lightly engages the side of the weight 46.

A resilient stop device is provided for stopping movement of the armature at its normal or non-energized position when the armature is moved from its energized position by the force of the weight 46. The weight 46, in conjunction with the stop device, will then hold the armature at its normal or non-energized position. This resilient stop device is shown as comprising a leaf spring 50 anchored to posts 51 and 52 which extend inwardly from the end wall 11 of the housing 10 and through a cut-out opening 53 in the web 42. As shown in Fig. 3, the spring 50 extends downward from the post 52 and into the path of movement of one of the armature flanges 44, the latter striking the lower end of the spring 50 and being held against the spring by the weight 46 to determine the non-energized position of the armature 40.

In accordance with the present invention, a motion-transmitting means is provided in the illustrative embodiment which functions to convert the oscillatory movement of the armature 40 between its energized and non-energized positions into intermittent time-keeping rotation of the minutes shaft 24. This means comprises a pawl-and-ratchet mechanism driving a train of gears with the last gear of the train being fixed to the minutes shaft. As shown in Figs. 2, 3, 4, and 5, a four-tooth ratchet wheel 55 is mounted for rotation about a fixed stud 56 projecting inwardly of the housing from the end wall 11 thereof and through a cut-out opening 57 in the web 42 of the armature. Coacting with the ratchet 55 is a pawl 58 pivotally mounted on a pin 59 extending from the rim 43 of the armature 40. The pawl is biased toward a stop flange 61 formed on the rim 43 by a suitable spring 60. The construction and arrangement is such that when the armature is rotated due to the energizing of the coil 27 from its normal position of Figs. 3 and 5 to its energized position of Fig. 4, the pawl 58 is carried back over one tooth of the ratchet wheel 55. When the coil is deenergized, the weight 46 rotates the armature back to its normal position of Figs. 3 and 5, and in so doing, the pawl 58 engages a tooth of the ratchet wheel 55 and thereby advances the ratchet wheel counterclockwise, as viewed in Figs. 3 and 4, one increment of rotary movement. At the end of this advancing stroke, the pawl 58 overlies the next tooth of the ratchet wheel and thereby prevents overthrow movement of the ratchet and also holds the latter at the advanced position. As shown in Fig. 5, a plate 62 is pivoted to the rim 43 of the armature 40 and is formed with an outwardly extending offset

end portion 63 which is shaped so as to form a continuation of the pawl 58. When the armature 40 is rotated to its energized position of Fig. 4, the offset portion 63 of the plate 62 follows the pawl 58 and at the end of such movement the portion 63 overlies two teeth of the ratchet wheel 55 and thereby locks the latter against movement in either direction. As the pawl 58 moves on an advancing stroke, the offset end portion 63 leads the pawl and releases the ratchet wheel for movement before it is engaged by the pawl.

As shown more clearly in Figs. 1, 2, and 5, a driving pinion 65 is formed integral with the ratchet wheel 55, and the pinion 65 meshes with a gear 66 mounted for rotation on a stud 67 fixed to the end wall 11 of the housing and also extending through the opening 57 in the web 42. A pinion gear 68 is fixed concentrically to the side of the gear 66 and meshes with a large gear 69 which is suitably fixed to the minutes shaft 24. As shown in Figs. 3 and 4, the side of the gear 66 is formed with radially disposed ratchet teeth 70 which are adapted to be engaged by the outer free end of a leaf spring detent 71, the latter being fixed at its other end to a stud 72 projecting inwardly from the end wall 11 and through a cut-out opening 73 in the armature 40. As will be apparent, the spring detent 71 coacts with the teeth 70 to prevent retrograde movement of the gears and ratchet.

It will thus be seen that as the magnet coil 27 is energized and then deenergized, the armature moves from its normal position to its energized position and then back to its normal position and in so doing the increment of movement imparted to the ratchet wheel 55 by the pawl 58 is transmitted by the gearing just described to the minutes indicating shaft 24. As a result, the shaft 24 is rotated a predetermined angular distance in a time-keeping direction. As is well known to those skilled in this art, energizing impulses are transmitted to secondary clocks, under the control of a master clock (not shown), once each minute and as a result the minutes hand of each secondary clock is advanced an angular distance equal to one minute.

In accordance with the present invention, a novel means is incorporated in the secondary clock, which functions to drive an hours indicating member from the minutes indicating member. As shown more clearly in Fig. 2, the hours hand 75 is fixed to a sleeve 76 frictionally mounted on a hub 77 which is, in turn, journalled on a sleeve 78 that rotates with the minutes shaft 24. The intermittent rotary motion of the minutes shaft 24 is transmitted to the hours hand 75 for advancing the latter its proportionate amount, by means of a planetary gear train which comprises a pinion 80 fixed to the minutes shaft 24, a stationary ring gear 81 fixed within a circular depression in the forward face of the end wall 11 of the housing 10 and provided with internal gear teeth 82, and a planetary gear 83 meshing both with the teeth of the pinion 80 and also with the teeth of the ring gear 81 and mounted for rotation on a stud 84 carried by the outer end of a planet arm 85, the latter being fixed at its inner end to the hub 77 carrying the hours hand. Thus, as the minutes shaft is advanced, the just described simple form of planetary gearing advances the hours hand at its proportionate rate.

As stated hereinabove, the secondary time-keeping apparatus of the present invention is designed for use as a controlled secondary element of an automatic synchronizing clock system like

that disclosed in Bryce U. S. Patent No. 1,687,491. In such a system, certain contacts are provided in the secondary which control the reception of time signals from the master clock in accordance with the time-indicating position of the secondary.

In the illustrative embodiment, the terminal gear 69 of the clock driving train is advantageously composed of a suitable molded insulating material, and the rear face thereof is shaped as a cam surface 87, which functions to operate contacts according to the time-indicating position of the secondary. As shown, in Fig. 1, the terminal strap 32 previously mentioned, and additional terminal straps 88 and 89 are secured to the block 22 and are constructed with inwardly extending spring extensions 90, 91 and 92, respectively. A contact point 93 is formed on the extension 91 which is adapted to engage the extension 90 and the latter is formed with a contact point 94 adapted to engage the extension 92. The spring extension 91 is biased toward the intermediate extension 90 and the spring extension 92 is biased away from the intermediate extension 90. The outermost end 95 of the spring extension 92 engages the cam face 87 adjacent the outer periphery thereof and the outermost end 96 of the intermediate extension 90 engages the cam face 87 at points spaced radially inward of the end 95. The outermost end of the extension 91 carries a spacing pin 97 of insulating material which is adapted to engage the extension 92. The shape of the cam surface 87 is on the order of a helix with the axis of the gear 69 as the center. As will be noted from an examination of Figs. 1 and 2, the height of the cam surface 87 is the same along any given radial line, except at the high point of the cam surface where the outer portion engaged by extension 92 terminates at a drop-off point 98 and the inner portion terminates at a drop-off point 99 angularly spaced from the point 98. Thus, for any portion of the cam surface, 87, except the angular space between the points 98 and 99, the innermost ends 95 and 96 of extensions 92 and 90, respectively, engage cam surfaces of the same height and the contact point 94 engages and thereby provides electrical contact between extensions 90 and 92 and the spacing pin 97 engaging the extension 92 holds the extension 91 and its contact points 93 out of electrical contact with the intermediate extension 90. As the clock advances, the cam surface 87 rotates in the direction of the arrow, Fig. 1. Thus, the end 95 of the extension 92 reaches its drop-off point 98 while the end 96 of extension 90 is still engaging a high part of the cam surface. As the end 95 of extension 92 drops off the high point 98, it breaks the electrical connection with the intermediate extension 90, and permits the contact point 93 on extension 91 to move with the latter and into electrical engagement with the extension 90. It will be apparent that the foregoing provides a simple, effective and inexpensive form of contact construction and actuating means therefor.

The strap 89 is connected to the A wire of the Bryce synchronizing clock system disclosed in Patent No. 1,687,491, referred to above; the strap 88 is connected to the B wire of the clock system; the strap 32 is connected to one end of the magnet coil 27 by the wire 30; and the strap 33, which is connected by the wire 31 to the other end of the magnet coil 27, is also connected to the C or ground wire of the Bryce clock system.

As is fully disclosed in the Bryce patent re-

ferred to, the clock advancing signals are transmitted each minute over both the A and B wires from the sixtieth minute of the master clock to the beginning of the synchronizing period which is, for example, the forty-ninth minute. During the synchronizing period, from the forty-ninth to and including the fifty-ninth minute, signals are only transmitted over the A wire. The rapid clock advancing impulses of the Bryce system are transmitted over the A wire during the fifty-ninth minute. The drop-off point 98 is arranged chronologically so that as the secondary clock moves from its fifty-ninth minute indicating positon to its sixtieth minute indicating position the point 95 of extension 92 drops off the point 98 and thereby disconnects the A wire and connects the B wire to the magnet coil. Thus, if the secondary is on time, the rapid impulses over the A wire during the fifty-ninth minute will not be transmitted to the coil 27 and the latter will receive the sixtieth minute impulse over the B wire. The drop-off 99 is spaced angularly from point 98 about ten minutes so that at about ten minutes past each hour, extensions 90 and 92 will again engage the cam surface 97 at equal heights and impulses over the A wire will again be transmitted to the magnet coil.

While there have been shown and described and pointed out the fundamental novel features of the invention, as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a secondary clock of the electrical impulse type, the combination of an annular magnet coil arranged with its axis approximately horizontal; a plurality of pairs of pole elements arranged in spaced relation circumferentially around said coil; an oscillatory armature mounted for rotary movement about the axis of said coil and including a plurality of circumferentially spaced armature elements corresponding in number and spacing to said pairs of pole elements and being arranged so that upon energization of said coil the resulting magnetic force moves said armature elements circumferentially and into bridging relation with respect to corresponding pairs of pole elements and thereby effects rotation of said armature from a retracted position to an advanced position; a torque-applying weight; means resiliently securing said weight to said armature in a position when the armature approaches its retracted posi- outwardly from the axis of rotation of the armature whereby the mass of said weight, by the force of gravity, constantly applies a torque to said armature tending to restore the same to its retracted position; a resilient abutment positioned in the path of movement of the armature and designed for engagement with the latter when the armature approaches its retracted position; said resilient securing means and resilient abutment counterbalancing each other when the armature is in its retracted position and together determining the fully retracted position of the armature; a time indicating element; and motion-transmitting means actuated by movement of said armature from its retracted to its advanced position for advancing said time indicating element.

2. In a secondary clock of the type adapted to be advanced by regularly spaced electrical impulses the combination of a drum-shaped housing including a circular end wall and a cylindrical side wall joined to the periphery of the end wall; a bearing sleeve arranged axially of the housing and extending through the center of said end wall; a time indicating shaft journalled within said sleeve; a hollow coil-supporting ring arranged coaxially within said housing and about the inner periphery of the side wall thereof and being secured to the latter and said ring having an open inner periphery and being formed of permeable material and including a plurality of pairs of pole pieces arranged in spaced relation about the inner circumference of the ring and the pole pieces of each pair extending inwardly toward one another from opposite sides of the ring and terminating short of one another to provide an air gap therebetween; an annular magnet coil concentrically disposed within said ring; an oscillating armature comprising a hub journalled on said bearing sleeve, a disk-like web extending radially from the hub and including an annular outer rim, and a plurality of armature elements formed of permeable material and extending, respectively, from the outer rim in directions parallel to the rotary axis and being spaced from one another about an imaginary circle concentric with the rotary axis, the armature elements corresponding in number and spacing to said pairs of pole pieces and being so arranged that upon energization of said coil the resulting magnetic force moves said armature elements circumferentially into bridging relation with respect to corresponding pairs of pole pieces and thereby effects rotation of said armature from a normal or non-energized position to an energized position; biasing means constantly urging the armature to rotate in a direction opposed to the magnetic force and towards its said normal position; a stop device secured to said housing and adapted to be engaged by and to stop rotation by said biasing means at said normal position; and motion-transmitting means actuated by movement of said armature between its said energized and non-energized positions and operable, when so actuated, to advance said time shaft one increment of movement.

3. In a secondary clock of the type adapted to be advanced by regularly spaced electrical impulses the combination of a drum-shaped housing including a circular end wall and a cylindrical side wall joined to the periphery of the end wall; a bearing sleeve arranged axially of the housing and extending through the center of said end wall; a time-indicating shaft journalled within said sleeve; a hollow coil-supporting ring arranged coaxially within said housing and about the inner periphery of the side wall thereof and being secured to the latter and said ring having an open inner periphery and being formed of permeable material and including a plurality of pairs of pole pieces arranged in spaced relation about the inner circumference of the ring and the pole pieces of each pair extending inwardly toward one another from opposite sides of the ring and terminating short of one another to provide an air gap therebetween; an annular magnet coil concentrically disposed within said ring; an oscillating armature comprising a hub journalled on said bearing sleeve, a disk-like web extending radially from the hub and including

an annular outer rim, and a plurality of armature elements formed of permeable material and extending, respectively, from the outer rim in directions parallel to the rotary axis and being spaced from one another about an imaginary circle concentric with the rotary axis, the armature elements corresponding in number and spacing to said pairs of pole pieces and being so arranged that upon energization of said coil the resulting magnetic force moves said armature elements circumferentially into bridging relation with respect to corresponding pairs of pole pieces and thereby effects rotation of said armature from a normal or non-energized position to an enrgized position; a weight resiliently secured to said armature at points spaced laterally from the rotary axis thereof and so as to constantly urge the armature to rotate in a direction opposed to the magnetic force and towards its said normal position; a resilient stop device secured to said housing and adapted to be engaged by and to stop rotation of the armature by said weight at said normal position; a ratchet supported by said housing and mounted to rotate about a fixed axis; a pawl pivoted on said armature and coacting with said ratchet to rotate the latter one increment of movement upon movement of said armature between its normal and energized positions; and gearing means for transmitting motion from said ratchet to said time shaft.

4. In a secondary clock of the electrical impulse type, the combination of an annular magnet coil arranged with its axis approximately horizontal; a plurality of pairs of pole elements arranged in spaced relation circumferentially around said coil; an oscillatory armature mounted for rotary movement about the axis of said coil and including a plurality of circumferentially spaced armature elements corresponding in number and spacing to said pairs of pole elements and being arranged so that upon energization of said coil the resulting magnetic force moves said armature elements circumferentially and into bridging relation with respect to corresponding pairs of pole elements and thereby effects rotation of said armature from a retracted position to an advanced position; a torque-applying weight; means resiliently securing said weight to said armature in a position wherein its center of mass is spaced radially outwardly from the axis of rotation of the armature whereby the mass of said weight, by the force of gravity, constantly applies a torque to said armature tending to restore the same to its retracted position; a resilient abutment positioned in the path of movement of the armature and designed for engagement with the latter when the armature approaches its retracted position; said resilient securing means and resilient abutment counterbalancing each other when the armature is in its retracted position and together determining the fully retracted position of the armature; a time indicating element; a spring element frictionally bearing against said weight and serving to dampen the inherent oscillatory movements of the latter as the armature reaches either of its limiting positions; and motion-transmitting means actuated by movement of said armature from its retracted to its advanced position for advancing said time indicating element.

5. In a secondary clock of the electrical impulse type, the combination of a magnet coil having a substantially horizontal axis; a plurality of pairs of pole elements arranged in spaced relationship circumferentially around said coil; an oscillatable armature mounted for rotary movement about the axis of said coil and including a plurality of circumferentially spaced armature elements corresponding in number and spacing to said pairs of pole elements and being arranged so that upon energization of the coil the resulting magnetic force moves the armature element circumferentially and into bridging relation with respect to corresponding pairs of pole elements to thereby effect rotation of the armature from a retracted position to an advanced position; means normally biasing said armature in a direction opposite to the direction effected by said magnetic force whereby said armature is normally urged toward its retracted position; a ratchet wheel mounted for rotation about a fixed axis and occupying a position adjacent the periphery of said armature; a pawl mounted on said armature adjacent the periphery thereof; said ratchet being formed with a series of teeth thereon, one of which normally projects into the path of movement of said pawl as the latter moves with the armature from its retracted to its advanced position, said pawl occupying a position when the armature is in its advanced position wherein it bridges two adjacent teeth on the ratchet wheel and prevents either overthrow or return movement of the ratchet wheel; a finger mounted on said armature and occupying a position wherein when the armature is in its attracted position it overlies two adjacent teeth on said ratchet wheel and locks the latter against movement in either direction; a time indicating element; and means operatively connecting said ratchet wheel and said time indicating element in driving relationship.

6. In a secondary clock of the electrical impulse type, the combination of an annular magnet coil having a substantially horizontal axis; a plurality of pairs of pole elements arranged in spaced relationship circumferentially around said coil; a spider-like oscillatable armature having web portions with openings existing therebetween mounted for rotary movement about the axis of said coil and including a plurality of circumferentially spaced armature elements corresponding in number and spacing to said pairs of pole elements and being arranged so that upon energization of the coil the resulting magnetic force moves said armature circumferentially into bridging relationship with respect to corresponding pairs of pole elements and thereby effects movement of the armature from a retracted position to an advanced position; means normally biasing said armature to its retracted position; a time indicating element; motion-transmitting means actuated by movement of the armature from its retracted to its advanced position to advance said time indicating element, said motion-transmitting means including a ratchet wheel mounted for rotation about a fixed axis parallel to the axis of rotation of said armature, said ratchet wheel occupying a position within one of the openings existing between said web portions, the periphery of said ratchet wheel being positioned close to the periphery of said armature; a pawl mounted on said armature adjacent the periphery thereof and operable upon movement of the armature from its retracted to its advanced position to engage a tooth on said ratchet wheel and impart an increment of motion to the latter, said pawl when the armature is in its advanced position bearing against a pair of adjacent teeth on the ratchet wheel and prevent-

ing overthrow or retrograde movement of the ratchet wheel; and a finger mounted on said armature adjacent the periphery thereof and positioned relative to said pawl whereby when said armature moves to its attracted position the finger engages the pair of teeth released by said pawl to lock said ratchet wheel against movement in either direction.

REYNOLD B. JOHNSON.
EDWARD F. GEIGER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
204,607	Powell	June 4, 1878
604,453	Blodgett	May 24, 1898
1,739,885	Zbinden	Dec. 17, 1929
2,000,600	Loeffler	May 7, 1935
2,089,280	Loeffler	Oct. 10, 1937

FOREIGN PATENTS

Number	Country	Date
16,117	Great Britain	July 10, 1909

Certificate of Correction

Patent No. 2,510,583 June 6, 1950

REYNOLD B. JOHNSON ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 7, line 59, strike out "when the armature approaches its retracted posi-" and insert instead *wherein its center of mass is spaced radially*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day of September, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.