Nov. 5, 1929. G. P. COWLES 1,734,941

ELECTRICAL ACTUATING MEANS FOR CLOCKS AND OTHER INSTRUMENTS

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Fig. 1.

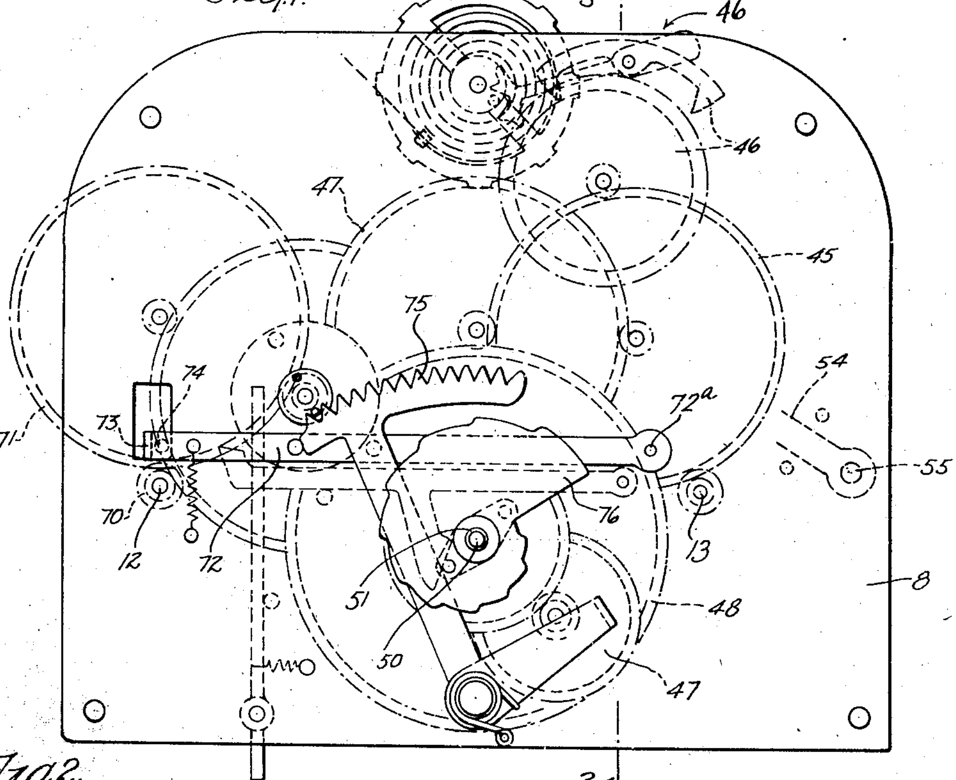

Fig. 2.

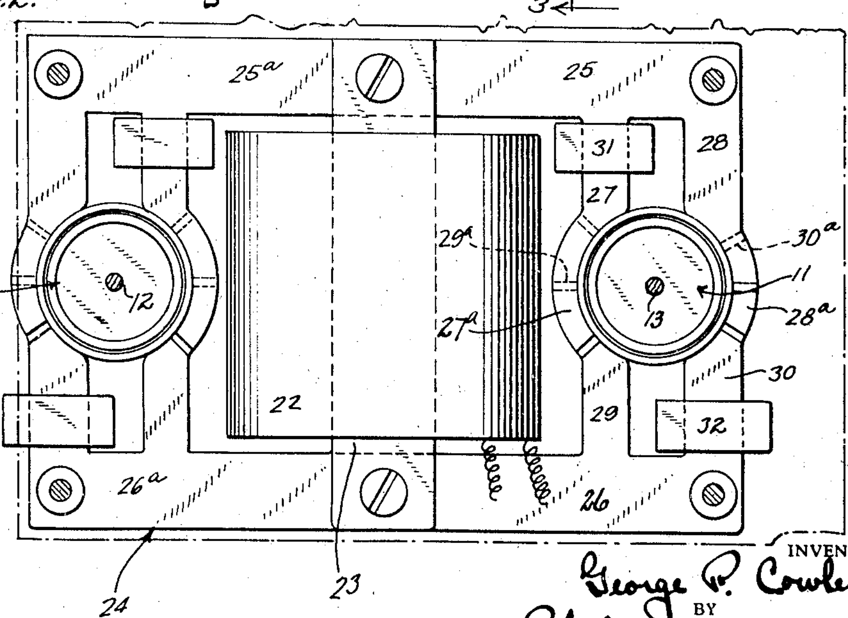

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Fig. 3

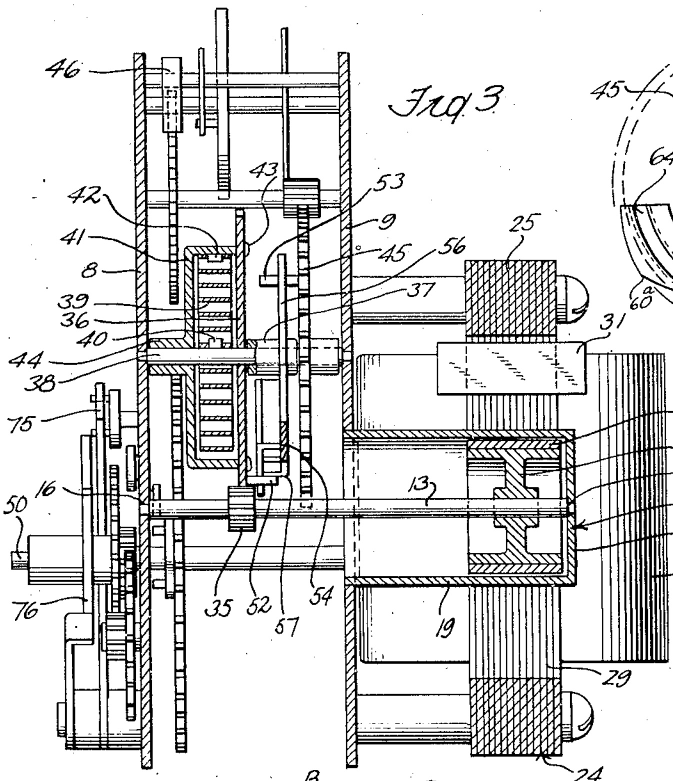


Fig. 6

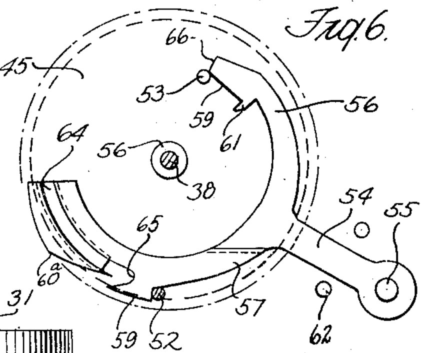


Fig. 4

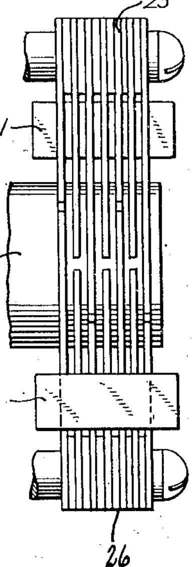
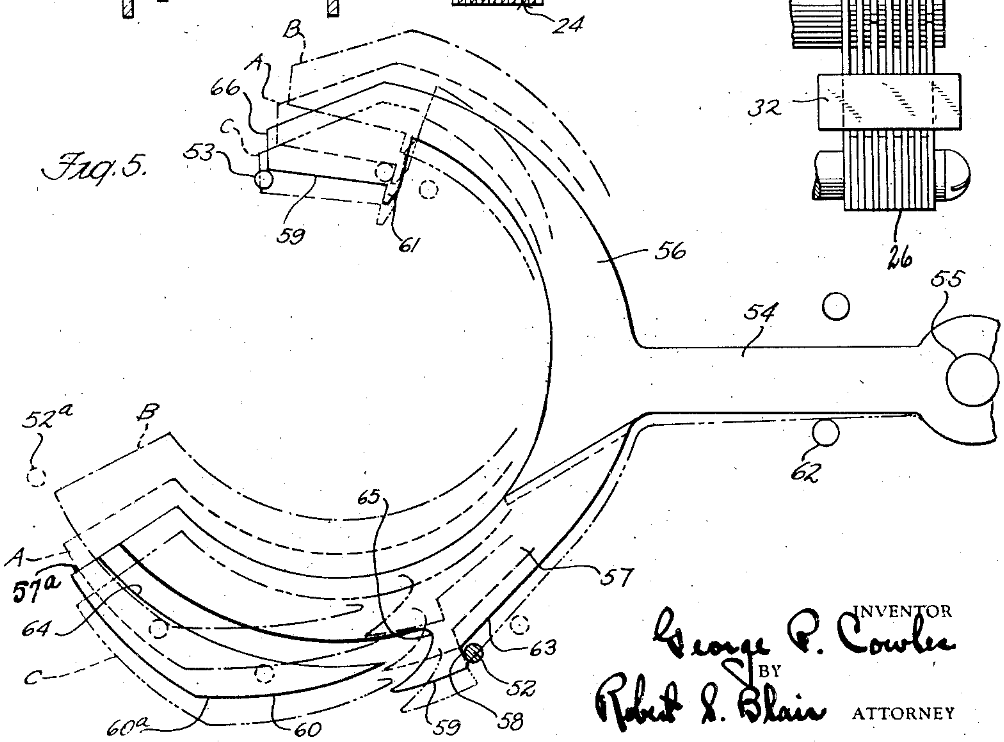


Fig. 5.



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UNITED STATES PATENT OFFICE

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ELECTRICAL ACTUATING MEANS FOR CLOCKS AND OTHER INSTRUMENTS

Application filed January 5, 1928. Serial No. 244,720.

This invention relates to electrical actuating means for clocks and other instruments and, with regard to certain more specific features thereof, to electrically driven clocks.

One of the objects of the invention is to provide an electrically actuating means of the above nature which is practical and efficient. Another object is to provide an electrical actuating means of the above nature which is simple in construction and dependable in operation. Another object is to provide an electric motor for driving clocks or other measuring or like instruments which is small, compact, economical to run and inexpensive to build. Another object is to provide a device of the above nature by means of which a plurality of independent mechanisms may be actuated economically. Another object is to provide an electrically actuated clock which is accurate and dependable. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which is shown one of the various possible embodiments of this invention,

Figure 1 is a front elevation of a clock mechanism;

Figure 2 is a rear elevation of an electrical actuating means or motor which, in the embodiment here shown, is mounted upon the rear of the clock mechanism seen in Figure 1;

Figure 3 is a section taken substantially as indicated by the section line 3—3 in Figure 1;

Figure 4 is an end view of the electrical driving means;

Figure 5 is a detail view showing part of the clock mechanism in various positions, and

Figure 6 is another view of the part shown in Figure 5 and on a smaller scale than the scale used in Figure 5.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring now to the drawings more in detail, I have shown the electrical actuating means herein in conjunction with, and for supplying energy to drive, a clock mechanism. As shown most clearly in Figure 3, the clock mechanism which I have illustrated is mounted upon and supported by two spaced frame members, a front frame member 8 and a rear frame member 9, and I have shown the electrical actuating means or motor mounted upon the rear side of the frame member 9.

Referring to Figure 2, the electrical driving means or motor which I have shown herein includes two rotors indicated generally in Figure 2 by the reference numerals 10 and 11. The two rotors are mounted respectively upon shafts 12 and 13 which are rotatably supported in any suitable manner; for example, as shown in Figure 3, the shaft 13 is shown having a bearing at one end in the frame member 8 of the clock mechanism at 16 and having a bearing at the other end 17 in the end face 18 of a tubular member 19 which is made of a suitable non-magnetic material such as brass, for example, and which surrounds the rotor, being suitably secured to the frame member 9 of the clock mechanism and projecting rearwardly therefrom.

The two rotors, which I have indicated generally by the numbers 10 and 11 in Figure 2, are preferably similar in construction and similarly supported so that one only need be described in detail. The rotors may be of any suitable construction which adapts them to rotate in a rotating magnetic field and to thus operate upon the principle of the induction motor. For example, the rotors may be constructed substantially as is illustrated in Figure 3, consisting of an open-ended cylinder 20 of iron or other magnetic material secured about an inner member or spider 21 of suitable non-magnetic material such as brass, the member 21 being fixed upon the rotor shaft.

Referring again to Figure 2, there is shown a winding or coil 22 which may be connected to any suitable source of single phase alternating current such, for example, as a house lighting circuit. The magnetic fields in which the two rotors 10 and 11 operate are produced by this single coil 22. The winding or coil 22 surrounds the middle leg or arm 23 of a stator core construction which is indicated generally by the reference numeral 24, this stator core or frame being made of a suitable magnetic material throughout, preferably laminated sheet iron, as indicated in the drawings. The stator frame includes two spaced arms 25 and 26 extending outwardly from the middle leg 23 on one side thereof and two corresponding arms or legs 25^a and 26^a extending outwardly on the other side thereof. The stator core or frame shown herein is of substantially the same construction on both sides of the center leg 23, the two rotors 10 and 11 cooperating with portions of the stator frame which are substantially identical, and therefore it will be sufficient to describe in detail the frame or core construction on one side only of the center leg 23 or the portion cooperating with one rotor only. Considering, therefore, the construction at the righthand side of the center leg, as viewed in Figure 2, the two arms 25 and 26 are at their ends provided with, or shaped so as to provide, suitable pole pieces for coaction with the rotor 11. Thus, the laminations making up the stator frame portions 25 and 26 are shaped to provide pole pieces 27, 28, 29 and 30, the latter in turn having curved extensions forming pole tips 27^a, 28^a, 29^a and 30^a respectively. The pole tips 27^a and 29^a may be inter-leaved and also the pole tips 28^a and 30^a, this inter-leaved arrangement being achieved by extending certain of the laminations of the pole pieces toward one another, but with appropriate air gaps between their side faces and end faces, as will be clear from a consideration of Figure 4. The air gaps may be achieved in various ways and without the inter-leaved arrangement if desired. As will be clearly seen in Figure 2, the inter-leaved pole tips extend substantially about the rotor 11.

Considering now the action of these parts, as the current flowing through the coil 22 sets up a magnetic flux in the stator core frame 24, and considering the flux set up during or as a result of a single half cycle of the energizing current, this flux may be considered as passing through the core leg 23, thence through the part 25, whence it becomes subdivided into a flux component passing through the pole piece 27 and another flux component passing through the pole piece 28. These two flux components pass through the iron of the rotor 11, suitably guided by the pole tips, and thence through the core part 26 and back to the core part 23.

The two flux components are given an appropriate phase displacement with respect to one another by any suitable means; preferably, this is achieved by means of the members 31 and 32, each consisting of a band of suitable conducting material such as copper or brass extending about the pole pieces 27 and 30 respectively and forming in effect a single turn of a conductor short-circuited upon itself and extending about these portions of the magnetic circuit. A flux component sets up a current in the members 31 and 32, which current so reacts upon the flux that this flux component is thrown out of phase with respect to the other flux component. The two flux components, thus thrown out of phase, produce the effect of a rotating magnetic field which tends to rotate the rotor 11.

As the one half cycle of the energizing current in the coil 22 is completed, and the succeeding half cycle comes on, the flux set up by the coil 22 is reversed and the two flux components above described are also reversed in direction, but with the same results, so that the rotating magnetic field is constantly maintained and exerts a constant torque on the rotor 11.

At the same time that the flux is acting upon the rotor 11 as above described, another portion of the flux produced by the current in the same coil 22 pasess through the magnetic circuit including the arms 25^a and 26^a on the opposite side of the center leg 23. This latter portion of the flux coacts with the rotor 10 and in the same manner and with the same action and effect upon the rotor 10 as has been described above in connection with the rotor 11, so that a constant torque is exerted upon the rotor 10.

The single coil 22 thus sets up a magnetic flux which continually tends to rotate the two independent rotors 10 and 11 as long as a proper source of energy is applied across the coil. The flux set up by the single coil drives the two rotors independently of each other and without one being affected by stopping or starting or change in load upon the other. In the embodiment shown herein, employed in conjunction with a clock mechanism, I have shown two rotors, but it is to be understood that the core frame 24 may be extended or differently shaped to accommodate at larger number of rotors each driven by the magnetic flux set up by the coil 22 and each independent of the others. In conjunction with the clock mechanism here shown, two rotors are all that are required, as will be pointed out more fully hereinafter but with certain types of measuring instruments or other similar instruments it may be found desirable to increase the number of rotors.

In the embodiment here shown, the rotor 11 is adapted to supply energy for driving the time train of the clock mechanism and the rotor 10 is adapted for supplying energy to actuate the strike train or strike mechanism. Referring now to Figure 3, the shaft 13 of the rotor 11 extends between the two clock frame members 8 and 9 and has fixed thereon a gear

35. This gear 35 meshes with a larger gear 36 which is formed integrally with or fixed upon a hub or sleeve 37, the sleeve 37 being rotatably mounted upon a shaft 38 which is a part of the clock mechanism. About the shaft 38 is a coil spring 39 the inner end of which is connected at 40 to the shaft 38, the spring 39 being thus connected to rotate the shaft 38 as it uncoils. The spring 38 is preferably enclosed in a housing member 41 and the outer end of the spring is fixed to the inner side of this housing member at 42. The housing member 41 is fixed to the gear 36, as by means of rivetted-over lugs 43 and, with the gear 36, it is rotatably mounted about the shaft 38 by means of a hub portion 44.

As the spring 39 uncoils and rotates the shaft 38, it drives the gear 45 which is fixed upon the shaft 38, and the gear 45 drives the hands of the clock held in check by a suitable escapement mechanism which is indicated generally by the numeral 46. The escapement mechanism and the gearing through which the spring 39 drives the hands of the clock are shown herein only diagrammatically and need not be described in detail since they may take any of various well-known forms. It is thought sufficient to point out herein that, as shown in Figure 1, the escapement 46 controls the speed of rotation of the gear 45 under the drive of the spring 39 and, from the gear 45, through suitable gearing indicated only in part at 47, 48 and 49, the center arbor 50 and sleeve 51 thereabout are rotated at the proper speeds to move the hour hand and minute hand.

In the particular arrangement of parts shown herein, the gear 45, and hence the shaft 38 about which the spring is coiled, rotate once a minute. It is to be understood, however, that the spring may coact with a part of the clock mechanism which rotates once a minute or once an hour or at any other suitable intervals of time. From the description above, it will be understood that the outer end of the spring 39 is anchored to the housing 41, or the gear 36, and that, as the clock is driven, the inner end of the spring turns with the shaft 38 and gradually uncoils, a constant driving force being provided by the spring for driving the time train of the clock. Still referring to Figure 3, projecting rearwardly from the face of the gear or disk 36 is a pin 52, and projecting forwardly from the face of the gear 45 is a pin 53, the two pins being positioned preferably at different distances radially from the axis of the shaft 38. Cooperating with these two pins 52 and 53 is a lever 54 which is suitably pivoted upon the frame of the clock, as shown at 55 in Figure 1. This lever 54 has an arm 56 for cooperating with the pin 53 and an arm 57 for cooperating with the pin 52, as will be described in detail.

The magnetic flux set up by the coil 22 exerts a constant torque on the rotor 11 tending to turn the same and to turn the shaft 13 therewith. It will be seen that when the shaft 13 rotates it turns the gear or plate 36 and the housing member 41, and its direction of rotation is such as to wind up or coil the spring 39. Turning now to Figures 3 and 5, in the position of the parts shown in Figure 3, and in the full line position of the lever 54 shown in Figure 5, the pin 52 is positioned against a shoulder 58 on the lever arm 57; the rotor shaft 13, tending to rotate the plate 36 in a direction to coil the spring 39, holds the pin 52 against the shoulder 58 and the shoulder 58 thus holds the rotor shaft 13 and the rotor 11 stationary against the action of the magnetic flux tending to turn them. The force exerted by the spring 39 in tending to uncoil opposes the force of the rotor, but the torque produced by the magnetic flux is sufficient to overcome this spring pressure and to hold the pin 52 against the stop shoulder 58. As the spring uncoils in driving the clock, the pin 53 moves around with the gear 45 and approaches the full line position shown in Figure 5; it then moves under the surface 59 of the lever arm 56 and, as the drive of the clock continues, the pin 53 raises the lever 54 about its pivot 55 until the shoulder 58 is raised out of the path of the pin 52; as soon as this occurs, the rotor shaft turns the plate 36 to wind up or coil the spring, the pin 52 moving across the surface 59 of the lever arm and thence across the surface 60. When the rotor has rotated the plate 36 a sufficient distance to bring the pin 52 under the portion 60^a of the surface 60, the lever is raised, by the action of the pin 52 on the surface 60, from the dotted line position A to the doted line position B. This raises the lever arm 56 so that the pin 53 clears the downwardly projecting lug 61, the time train of the clock being driven uninterruptedly by the action of the spring during the period of time that the spring is being wound by the rotation of the rotor shaft 13. When the pin 52 has moved off the end of the lever arm 57 and reached a position in the neighborhood of that shown at 52^a in Figure 5, the pin 53 has moved beyond the projection 61, and the lever 54 thereupon drops against its lower stop 62. When the rotor shaft 13 has rotated the disk 36 through one rotation, the pin 52 thereupon comes again against the shoulder 58 of the lever arm 57 and the winding of the spring is stopped.

Thus, with each rotation of the gear 45, or at predetermined intervals of time depending upon the speed of rotation of the gear 45, the spring 39 is wound up or coiled through one turn by the action of the rotor shaft 13. The spring may thus be kept at a proper and substantially uniform tension for most efficient action, the tension being determined by the characteristics given to the spring when built. The spring delivers a constant power for driving the clock and, automatically and at predetermined intervals, the spring is wound. The magnetic flux set up by the coil 22 exerts a constant torque upon the rotor 11 and hence, so long as the proper current flows through the coil, the driving force necessary to wind the spring is always available in the rotor shaft 13.

If the source of electrical energy supplying current to the coil 22 fails for any reason, the action of the spring 39 will rotate the plate or gear 36 and the pin 52 in a counter-clockwise direction, as viewed in Figure 5; as the pin 52 rotates in this counter-clockwise direction, it leaves the surface 63 of the lever arm 57 and permits the lever to drop against the lower stop 62, the lever arms 56 and 57 coming into the dotted line position C. This brings into the counter-clockwise path of travel of the pin 52 a groove 64 in the end portion of the lever arm 57. As the pin 52 continues its counter-clockwise rotation it enters into the groove 64 and comes against a shoulder 65 of the lever arm 57, and here the counter-clockwise rotation of the pin and of the gear or plate 36 is arrested.

When the lever drops to the dotted line position C, due to failure of the power and consequent counter-clockwise rotation of the pin 52, the extreme end 66 of the lever arm 56 drops into the path of movement of the pin 53. Thus, the power having failed, the time train will continue to move under the drive of the spring 39 until the pin 53 comes against the end 66, at which point the clock will stop. When the coil 22 is again energized, the pin 52 is quickly moved by the rotor shaft in a clockwise direction to again wind up the spring and until it comes against the shoulder 58; the pin 52 moving against the surface 63 raises the lever to bring the part 66 out of the path of the pin 53 and thereupon the drive of the time train of the clock starts.

If the electrical energy fails at a time when the pin 53 is positioned beneath the surface 59 the pin 52 will rotate in counter-clockwise direction until it comes against the end 57^a of the lever arm 57. The clock will continue to run until the pin 53 comes against the projection 61 at the end of the surface 59. Thereupon, when the coil 22 is again energized, the pin 52 is moved by the rotor shaft in a clockwise direction and, the shoulder 58 being held out of its path by the action of the pin 53 on the surface 59, the pin 52 immediately winds the spring through one turn as hereinbefore described, its action upon the surface 60^a raising the lever to permit the pin 53 to clear the projection 61 whereby the drive of the time train is restored.

From the above it will be seen that the time train of the clock is dependably provided with driving energy from the action of the magnetic flux upon the rotor 11. The rotor at predetermined intervals stores up energy in the spring and the spring constantly drives the time train with accurate and uniform results which are not affected by variations in the supply of electrical energy. It may be here noted that the electrical constants of the coil 22, of the short-circuited windings or conductors 31 and 32 and of the rotors 10 and 11, and the constants of the magnetic circuit coacting therewith, are so selected and proportioned with respect to one another that an ample power output by the rotor 11 may be achieved while, at the same time, the rotor 11 may be held against rotation or "stalled" as above described without impairment of the apparatus and without materially increasing the electrical energy supplied thereto.

Considering now the rotor 10, which is adapted herein to drive or actuate the strike mechanism of the clock, reference is had to Figure 1. In this figure there is shown the rotor shaft 12 upon which is a gear 70 meshing with a gear 71. From this gear 71 the strike mechanism of the clock is actuated. The strike mechanism is not shown in detail herein since it may take any of various well-known forms and its details are in themselves unimportant as relating to the features of this invention. Referring to Figure 1, it may be noted, however, that the strike mechanism is held stationary and released at the proper intervals by means of a lever 72. This lever 72 has at its end a projection 73 which cooperates with a pin 74 projecting from the face of the gear 71. When it is time for the clock to strike, the lever 72 is raised about its pivot 72^a by suitable mechanism rotating in the time train, and the part 73 of the lever is thereby raised out of the path of the pin 74. The gear 71 is thus permitted to rotate and actuates the strike mechanism, the number of strokes being predetermined by a suitable mechanism which includes a rack 75 and a cam 76 and which need not be described in detail herein.

The magnetic flux set up by the coil 22 and acting upon the rotor 10 and the rotor shaft 12 exerts a constant torque tending to rotate the gear 71. When the stop lever 72 is released by the mechanism actuated by the time train, the rotor 10 rotates to drive the strike mechanism. It has been mentioned above that the electrical constants and the constants of the magnetic circuit are so selected and proportioned that the rotor 11 may be held against rotation or "stalled" without impairment of the apparatus or materially increasing the electrical energy supplied thereto. This same applies to the rotor 10 which is "stalled" or held against rotation in opposition to the drag of the magnetic flux and is released at intervals to actuate the strike mechanism.

From the foregoing, it will be seen that there is herein provided an electrical actuating means which is thoroughly practical and efficient and economical of electrical energy, as well as economical of parts required in its construction. The two rotors are independent of each other, and the magnetic flux which rotates them although it is supplied by a single coil, exerts a torque upon the independent rotors of such a nature that the operation of one rotor does not affect the other or others. The magnetic flux set up by the coil is divided between the several rotors and is constantly available to exert a torque tending to drive the rotors.

Furthermore, it is to be clearly understood that the present invention is not limited to the specific type of rotors disclosed, but the use of many other types of rotors—non-synchronous and synchronous, non-self-starting and self-starting—is within its general spirit and scope.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiments above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In apparatus of the general nature of that herein described, in combination, a time train, a strike mechanism, a winding for conducting an alternating current, means providing a magnetic circuit for the passage of flux set up by current flow in said winding, a rotor in said magnetic circuit adapted to be rotated by the passage of said flux and adapted by its rotation to supply energy to drive said time train, and a second rotor in said magnetic circuit adapted to be rotated by the action of said flux and adapted by its rotation to supply energy to actuate said strike mechanism.

2. In apparatus of the general nature of that herein described, in combination, a time train, a strike mechanism, a winding for conducting an alternating current, means providing a magnetic circuit for the passage of flux set up by current flow in said winding, a rotor in said magnetic circuit adapted to be rotated by the passage of said flux and adapted by its rotation to supply energy to drive said time train, a second rotor in said magnetic circuit adapted to be rotated by the action of said flux and adapted by its rotation to supply energy to actuate said strike mechanism, means adapted to hold said second rotor stationary against the action thereon of said flux, and means for releasing said holding means at predetermined intervals to permit said rotor to rotate and to actuate said strike mechanism.

3. In apparatus of the general nature of that herein described, in combination, a time train, a strike mechanism, a winding for conducting an alternating current, means providing a magnetic circuit for the passage of flux set up by current flow in said winding, a rotor in said magnetic circuit adapted to be rotated by the passage of said flux and adapted by its rotation to supply energy to drive said time train, a second rotor in said magnetic circuit adapted to be rotated by the action of said flux and adapted by its rotation to supply energy to actuate said strike mechanism, a coiled spring connected to drive said time train as it uncoils, means for connecting said first rotor to coil said spring, and means for rendering said first rotor effective to coil said spring at predetermined intervals of time.

4. In apparatus of the general nature of that herein described, in combination, a time train, a strike mechanism, a winding for conducting an alternating current, means providing a magnetic circuit for the passage of flux set up by current flow in said winding, a rotor in said magnetic circuit adapted to be rotated by the passage of said flux and adapted by its rotation to supply energy to drive said time train, a second rotor in said magnetic circuit adapted to be rotated by the action of said flux and adapted by its rotation to supply energy to actuate said strike mechanism, a coiled spring connected to drive said time train as it uncoils, means for connecting said first rotor to coil said spring, means for holding said first rotor stationary against the action thereon of said flux, and means for releasing said holding means at predetermined intervals to permit said first rotor to rotate and to coil said spring.

5. In apparatus of the general nature of that herein described, in combination, a time train, a strike mechanism, a winding for conducting an alternating current, means providing a magnetic circuit for the passage of flux set up by current flow in said winding, a rotor in said magnetic circuit adapted to be rotated by the passage of said flux and adapted by its rotation to supply energy to drive said time train, a second rotor in said magnetic circuit adapted to be rotated by the action of said flux and adapted by its rotation to supply energy to actuate said strike mechanism, means adapted to hold said second rotor stationary against the action thereon of said flux, means for releasing said holding means at predetermined intervals to permit said rotor to rotate and to actuate said strike mechanism, a coiled spring connected to drive said time train as it uncoils, means for connecting said first rotor to coil said spring, means for holding said first rotor stationary against the action thereon of said flux, and means for releasing said holding means at predetermined intervals to permit said first rotor to rotate and to coil said spring.

6. In an electric clock, a stator field core

frame providing a plurality of independent magnetic circuits for the passage of magnetic flux, a single winding surrounding a portion of said frame, a rotor in each of said magnetic circuits adapted to be rotated by the passage of flux therethrough, and a time train driven by one of said rotors and auxiliary mechanism driven by another of said rotors.

7. In an electric clock, unitary means for conducting an alternating current, a stator field core frame having an arm located within said means, said frame having two pairs of spaced arms connected with said first arm and spaced outwardly therefrom, and rotors between each of said two pairs of spaced arms adapted to form with said arms two magnetic circuits for the passage of magnetic flux, one of said rotors being connected to a time train the other rotor being connected to auxiliary mechanism.

8. In an electric clock, unitary means for conducting an alternating current, a stator field core frame having an arm located within said means, said frame having two pairs of spaced arms connected with said first arm and spaced outwardly therefrom, and rotors between each of said two pairs of spaced arms adapted to form with said arms two magnetic circuits for the passage of magnetic flux, one of said rotors being connected to a time train, the other of said rotors being connected to a strike mechanism.

9. In an electric clock, a plurality of rotors, unitary means for producing a single field for energizing all of said rotors, a timing mechanism connected to one of said rotors and adapted to be driven by energy derived from said field, and an auxiliary mechanism operatively connected to another of said rotors.

10. In an electric timing device, a plurality of rotors, unitary means for producing a magnetic field common to said rotors, timing mechanism driven by one of said rotors, and auxiliary mechanism driven by another of said rotors.

11. In an electric timing mechanism, a plurality of rotors, unitary means for producing a magnetic field common to all of said rotors, a core energized by said field and including a plurality of portions each having a rotating magntic field therein, and clock mechanisms driven by each of said rotors.

12. In a timing device, a plurality of rotors, unitary means for producing a common field for energizing said rotors, a timing mechanism operatively connected to one of said rotors, and a time-controlled mechanism operatively connected to another of said rotors.

13. In a timing device, a plurality of rotors, unitary means for producing a field common to said rotors, and timing mechanisms operatively connected to each of said rotors.

14. In an electric clock, a plurality of rotors, unitary means for producing a field common to said rotors, means connected with one of said rotors for periodically winding a time-train-operating spring, and means connected with another of said rotors for periodically operating time striking mechanism.

15. In a timing device, a plurality of rotors, unitary means for producing a field common to said rotors, means connecting one of said rotors with a train of gears operating time-indicating means, and auxiliary mechanism connected to another of said rotors.

In testimony whereof, I have signed my name to this specification this 15th day of December, 1927.

GEORGE P. COWLES.