April 17, 1934. R. KNOPP 1,955,588

ELECTRIC CLOCK

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Fig. 1.

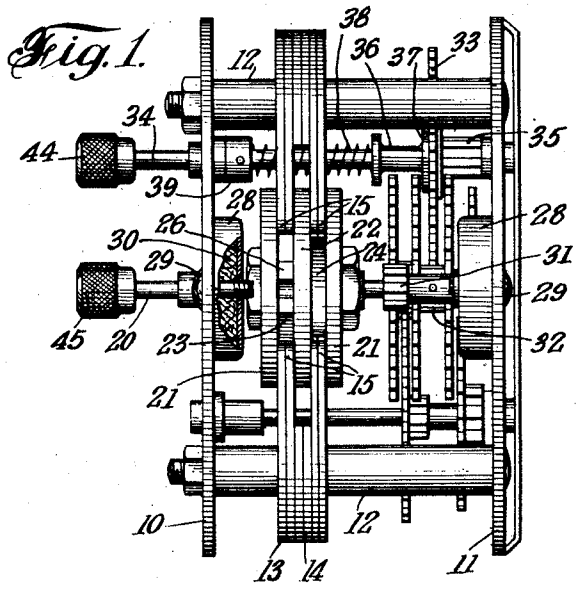
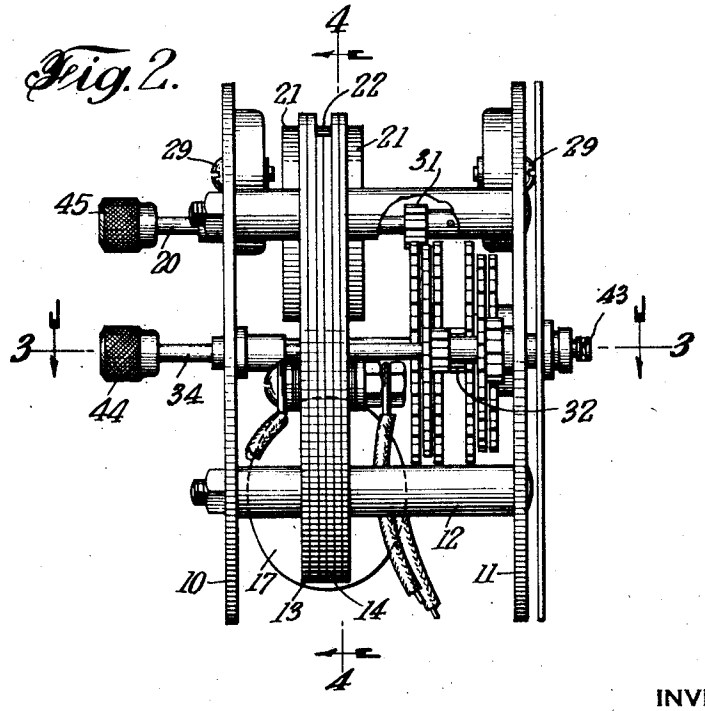



Fig. 2.




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Fig. 3.

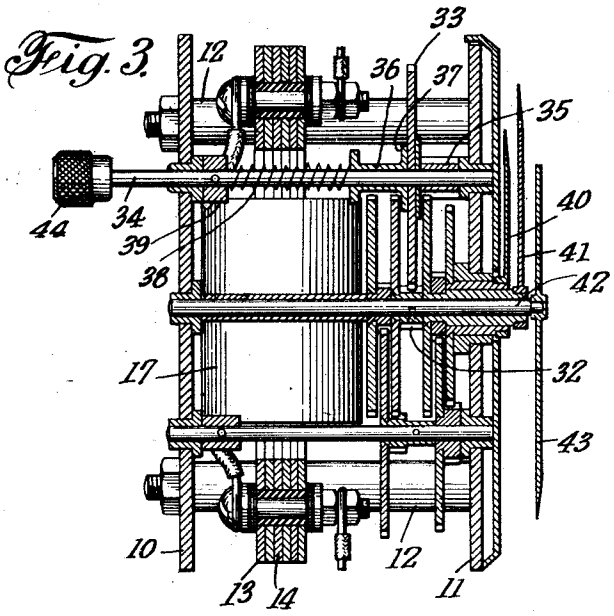
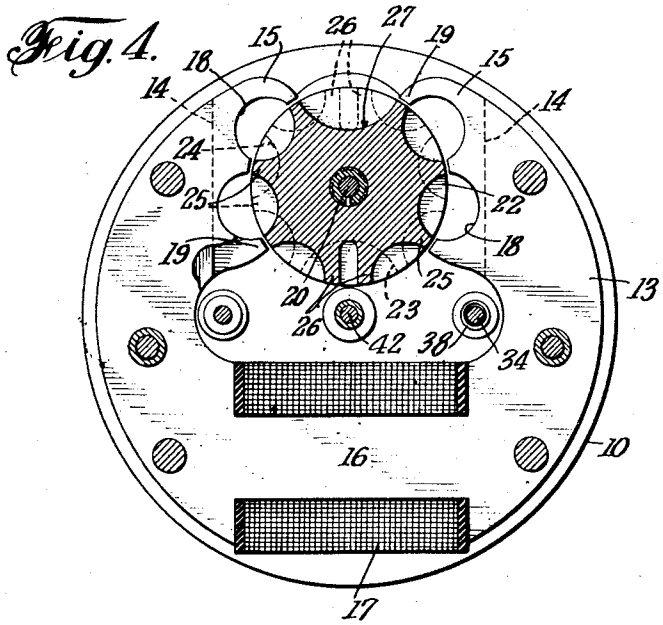



Fig. 4.




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# UNITED STATES PATENT OFFICE

1,955,588

## ELECTRIC CLOCK

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Application June 27, 1931, Serial No. 547,271

4 Claims. (Cl. 172—275)

This invention relates to electric movements generally, and more particularly to clocks adapted to be driven directly by alternating current supplied from electric light circuits.

While synchronous motors generally, and clock devices operated by such motors are not new, my invention involves a new departure in the construction of the armature and the pole pieces of the field magnet, and a new principle in the operation of the armature between such pole pieces.

One of the objects of my invention is the improvement in synchronous motor driven clocks, in which the armature consists of a plurality of armature units adapted to maintain constant polarity, so that one unit of the armature will be positive at one half thereof and negative at the other half, while the other unit will maintain a polarity opposite to the former unit, so that the portion of the other unit, adjacent to the positive half of the first unit, will be negative, while the negative half of the first unit coincides with the positive half of the second unit. Through this arrangement the pole pieces, the polarity of which are alternating, will alternately attract and repulse portions of the armature.

Another object of my invention is to provide an arrangement of pole pieces, so constructed as to produce a more favorable cooperation between the armature units and the field magnet.

The foregoing and still further objects of my invention will become more fully apparent from the following description, and the accompanying illustrations, forming part of my disclosure, but by no means intended to limit the same to the actual showing, and in which:

Fig. 1 is a top view of a clock movement, with the lubricating means partially in section.

Fig. 2 is an elevation of the clock movement.

Fig. 3 is a cross-sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a cross-sectional view taken on line 4—4 of Fig. 2.

Referring now to the drawings, numerals 10 and 11 represent end plates of a clock movement, held apart by spacer arrangements 12. Secured and held by these spacer arrangements is a field magnet 13 composed of a plurality of laminations of which the inner laminations, indicated at 14, are shorter than the outer laminations, which latter terminate into bifurcated extensions 15, as clearly seen in Fig. 1.

At the lower reduced center portion 16 of the field magnet (see Fig. 4) there is arranged field coil 17 adapted to be directly connected with the lighting circuit.

The pole ends of the field magnet are recessed, as indicated at 18 in Fig. 4, so as to provide three distinct prongs 19, separated by even gaps formed by the recesses 18.

The rotor, or armature of my device is mounted on a shaft 20 and consists of non-magnetic outer discs 21 and a similar non-magnetic center disc 22, while between the three discs are arranged soft iron armature members 23, preferably made of laminated construction.

Referring now specifically to Fig. 4, the laminated armature members consist of circular discs provided with an arrangement of prongs 25, spaced in the same way as are prongs 19 of the field magnet, and double prongs 26, arranged oppositely to a large cut-out 27.

From the arrangement in Fig. 4, it will be observed that the armature unit 24, shown in full lines, is arranged in offset position to armature unit 23, shown in broken lines, and that the double prongs 26 of armature unit 24 are diametrically opposite the same double prongs of unit 23. In other words both units are symmetrically secured to one another, but reversed as to the arrangement of double prongs 26. In this manner the uniformly spaced groups of prongs 25 of unit 23 are disposed centrally between uniformly spaced groups of prongs 25 of unit 24.

The bearing portions of shaft 20 pass through lubricating caps or chambers 28, secured at 29 to their respective end plates 10 and 11. These lubricating chambers are preferably filled with an absorbent material indicated at 30 (Fig. 1) saturated with a lubricant which is intended to lubricate the bearings and shaft.

The rotary movement of the armature shaft 20 is transmitted from pinion 31 through a series of gear trains to a pinion 32, which latter is in engagement with a gear 33, loosely mounted up on a clock hand setting shaft 34. Adjacent the gear 33 there will be observed a flanged pinion 35 in fixed engagement with shaft 34, while at the opposite face of gear 33 is mounted a flanged sleeve 36, the flange 37 of which bears against the left face of gear 33. This sleeve is held under tension by means of spring 38 bearing with one of its ends against the smaller flange of sleeve 36, while its other end bears against a set ring 39, secured to shaft 34.

Pinion 35, fixedly mounted to shaft 34, is in engagement with a train of gears, adapted to operate clock hands 40 and 41. This operation normally takes place through the transmission of the rotary movement from the armature shaft 29, to the first mentioned gear train and pinion 32, and from there to gear 33 which, while in frictional engagement with pinion 35, transmits the movement to the gear train operating hands 40 and 41. Pinion 32 is mounted on an intermediate shaft 42, at the end of which a second hand 43 is secured.

Shaft 34 of loose gear 33 is provided with a knurled knob 44, by means of which shaft 34 may be rotated independently of gear 33. The manual

rotation of shaft 34 will cause pinion 35 to transmit its motion to the clock hand operating gear train section, whereby the setting of the clock hands may be accomplished without affecting gear 33 and the preceding gear train section connecting armature shaft 20 with gear 33. Armature shaft 20 is also provided with a knurled operating knob 45, intended for the purpose of initially starting the rotation of the armature.

Referring again to Fig. 4, the two armature units 23 and 24, made of laminated soft iron, have specific characteristics in that one half of one unit constantly remains positive while the other half of the unit constantly remains negative. The other armature, unit is polarized in just the opposite way, so that its negative half will be adjacent to the positive half of the first unit and its positive half will be adjacent to the negative half of that unit. Due to the aforesaid characteristics of the units, it becomes obvious that through the alternating changes in the potentials of the pole pieces the prongs of the armature units will become alternately attracted and repulsed in synchronism with the alternating impulses surging through the magnetic field.

In observing Fig. 4, and assuming that the vertical center line through that figure divides the armature units 23 and 24 into two halves, the left hand half of unit 24, for example should be held to be positive, while its right hand half is to be negative. The armature unit 23 is similarly divided and its left hand half is assumed to be negative, while its right hand half is to be positive. These units are assumed to maintain constantly their respective polarities while in operation.

The clock is first started by connecting it to an alternating current power line or lighting circuit and then twirling the rotor in a clockwise direction by means of the starting knob 45.

Now further assuming that at the moment the left hand pole piece of the stator becomes positive, its prongs will repulse the prongs of rotor 24, while they will attract the prongs of rotor 23, which are negative. When the prongs of 23 reach prongs 19 of the left hand pole end of the stator, the polarity of the latter has changed from positive to negative. This change causes the repulsion of the prongs of rotor 23, and the attraction of the prongs of rotor 24 which are positive.

The same mode of operation applies to the right hand pole end of the stator, but in reversed order. The operation of the armature within the stator is due to the aforesaid characteristics of the rotor, in that the unit halves always maintain their respective polarities, whereby a rapid change in position of the rotor in respect to the stator takes place in synchronism with the impulses received by the stator.

The armature consisting of the two laminated units, spaced and held between non-magnetic discs 21 and 22, constitutes a fly wheel, the moment the inertia of which is intended to overcome any irregularities due to the repeated magnetic impulses and to convert to continuous rotary motion the jerky impulses.

As stated before, the armature units are made of soft iron and do not become permanently magnetized. For this reason the device as explained above, is not of the self-starting type.

In the foregoing description I have explained the construction of a specific form of my device. However, my invention is capable of wide variations within equivalent limits, and since I contemplate changes and such variations as may become necessary or desirable in the use of my device for adaptation in various fields, I do not restrict myself to the various details shown and described, and I reserve for myself the right to make such changes or variations within the scope of my invention, as set forth in the annexed claims.

I claim:

1. In a synchronous motor, a stator and a rotor, said stator having bifurcated polar ends comprising a plurality of laminations of which the inner laminations are shorter than the outer laminations, each of the said polar ends being recessed to provide a plurality of prongs separated by even gaps formed by the said recesses, the said rotor comprising non-magnetic outer discs, a non-magnetic center disc, and a disc of magnetic material between the center disc and each outer disc, each of said magnetic discs being provided with prongs spaced similarly as the prongs of said polar ends but in diametrically offset relation with respect to each other.

2. In a synchronous motor, a stator and a rotor, said stator being provided with a pair of bifurcated pole pieces, each of the said pole pieces being recessed to provide a plurality of prongs separated by even gaps formed by the said recesses, the said rotor comprising a pair of discs of magnetic material and a disc intermediate the discs of said pair and of non-magnetic material, said magnetic discs being provided with prongs spaced similarly as the prongs of said pole pieces but diametrically offset in relation with each other, each of said magnetic discs being further provided with a double prong, the double prong of one magnetic disc being located diametrically opposite the double prong of the other disc.

3. In a synchronous motor, a stator and a rotor, said stator having bifurcated polar ends comprising a plurality of laminations of which the inner laminations are shorter than the outer laminations, each of said polar ends being recessed to provide a plurality of prongs separated by even gaps formed by said recesses, the said rotor comprising non-magnetic outer discs, a non-magnetic center disc, and a disc of magnetic material between the center disc and each outer disc, each of said magnetic discs being provided with prongs spaced similarly as the prongs of said polar ends and also provided with a double prong, said magnetic discs being so disposed relative to each other that their respective double prongs are diametrically opposite each other and their respective other prongs are diametrically offset with respect to the corresponding prongs of the other.

4. In a synchronous motor, a stator and a rotor, said stator having bifurcated polar ends comprising a plurality of laminations of which the inner laminations are shorter than the outer laminations, each of said polar ends being recessed to provide a plurality of prongs separated by even gaps formed by the said recesses, the said rotor comprising a pair of discs of magnetic material, each of said discs being provided with a plurality of prongs spaced similarly as the prongs of said polar ends, and also provided with a double prong, said magnetic discs being so disposed relative to each other that their respective double prongs are diametrically opposite each other and their respective other prongs are diametrically offset with respect to the corresponding prongs of the other.

RUDOLPH KNOPP.