Jan. 27, 1953 A. T. WESTLAKE, JR 2,626,500

ELECTRIC CLOCKWORK MOVEMENT

Filed July 15, 1948

Fig. 1

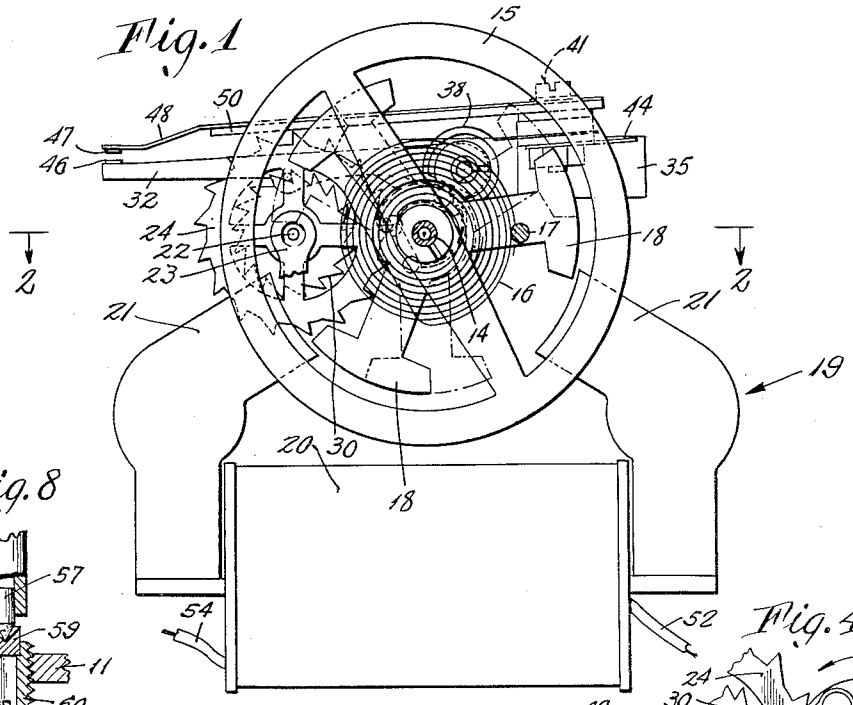


Fig. 8

Fig. 3

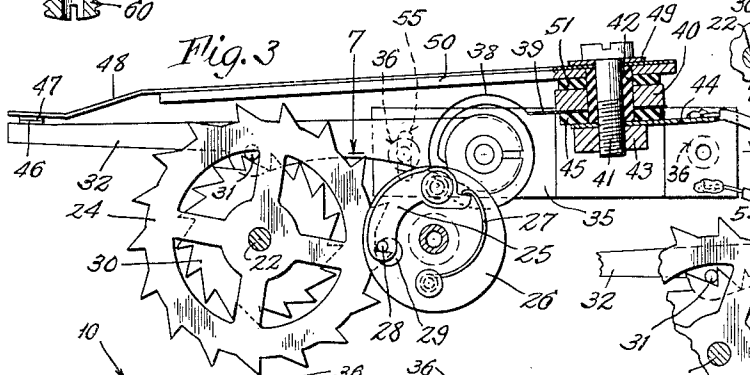


Fig. 4

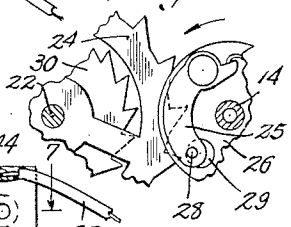


Fig. 5

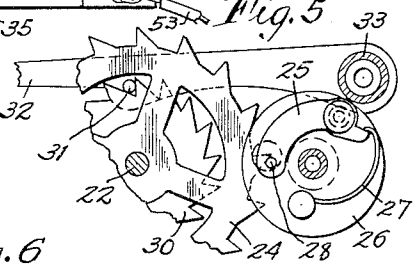


Fig. 2

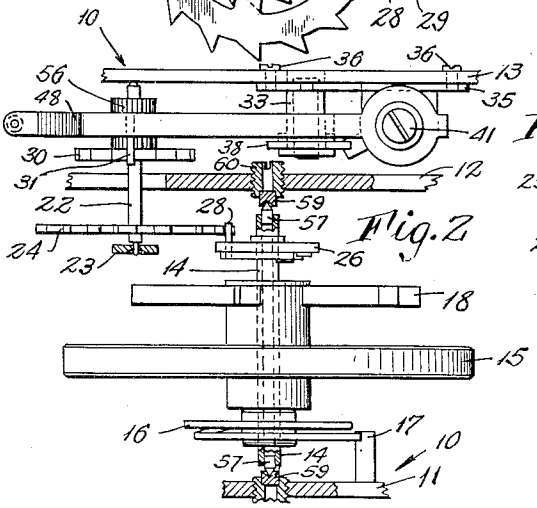


Fig. 6

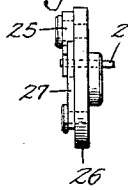
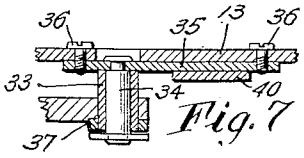


Fig. 7



INVENTOR.

Allen T. Westlake, Jr.

BY

Johnson and Kline

ATTORNEYS

Patented Jan. 27, 1953

2,626,500

UNITED STATES PATENT OFFICE

2,626,500

ELECTRIC CLOCKWORK MOVEMENT

Allen T. Westlake, Jr., Bridgeport, Conn., assignor to Casco Products Corporation, Bridgeport, Conn., a corporation of Connecticut

Application July 15, 1948, Serial No. 38,802

4 Claims. (Cl. 58—28)

1

This invention relates to clockwork movements having oscillating driving members which are electromagnetically powered.

Clockwork movements of the above type usually have a main staff carrying a balance wheel and a magnet armature, the main staff and parts carried thereon oscillating according to a predetermined period. Operatively associated with the magnet armature is an electromagnet the circuit of which is controlled by contacts which are in turn operated in response to the oscillations of the main staff.

Such clockwork movements are usually of quite small size, being intended for use in automobiles and the like and being constructed to respond to extremely small electrical impulses or currents whereby the battery or generating system which operates them is not drained to any appreciable extent by the operation of the clock. Important considerations and objectives in the construction and operation of such movements include the reduction of friction to as small a value as possible, the attainment of high reliability of performance such that maintenance and servicing are not required over an extended period, the attainment of accuracy in the period of movement of the oscillating main staff whereby the clock will keep accurate time, and the simplification of the structure to obtain economy in manufacture.

An object of the present invention is to provide an improved clockwork movement of the above type, which is extremely accurate in the keeping of time, is economical in construction and reliable in operation over an extended period of use whereby maintenance and servicing are reduced to such an extent as to be practically eliminated, while at the same time having improved current economy and requiring only extremely small magnetic impulses to operate it so that the drain from the battery or other current source is reduced to a minute, desirable small value.

A further object of the invention is to provide an improved clockwork movement as characterized above, in which servicing when required may be accomplished easily and conveniently, and with a minimum of time and expense.

In accomplishing the above objects the invention provides a clockwork movement comprising the combination with an electromagnetically powered oscillating driving member or staff having a click or pawl periodically engaging a driven member in the form of a ratchet wheel unidirectionally driven with an intermittent movement, of a novel detent, contact and contact-actuating means associated with the driven member and controlling the application of the electromagnetic power for the oscillating staff, the said means being automatically operated in timed relation with the oscillations of the staff, and being so arranged as to impose a reduced, minimum mechanical load on the driving and driven members.

2

To effect such reduction of mechanical load, the improved detent, contact and contact-actuating means of this invention provides for a mechanical advantage by a unique structure comprising a second and smaller ratchet wheel, which is coupled to turn simultaneously with the first ratchet wheel, and by the provision of a pair of elongate contact arms carrying cooperable contacts, one of said arms being movable and spring urged, and having a pin engaging and following the teeth of the said smaller ratchet wheel. Since the driving force of the pawl carried by the oscillating staff is applied to the periphery of the larger ratchet wheel, and since the contact-actuating load is applied to the periphery of the smaller ratchet wheel, the said driving force required to overcome the load need not be so great, and therefore the electromagnetic power and current to produce the same may be smaller causing less battery drain.

Considering that the load imposed in the driving of the clock hands constitutes but a small fraction of the load to which the driving member is subjected, the remainder and by far the greater fraction of the load being that imposed by the contact-actuating means in clocks of the above type, it will be appreciated that any substantial decrease in the mechanical load imposed by said actuating means will result in a correspondingly great and advantageous economy in the current consumption of the clockwork movement.

Preferably the contact arms carrying the cooperable contacts, and the pin which engages the teeth of the smaller ratchet wheel, are incorporated in a unitary assemblage which is separate from the frame of the clock movement, and which is removably secured to the frame for quick and convenient replacement, and also for easy adjustment. The reduction of operating current effected by the organization of the present invention has a beneficial effect on the contacts in that it reduces arcing and pitting thereof and provides for an extended useful life. If after considerable usage it should be found necessary, however, to service the contacts, this may be readily accomplished in the above organization, since the contact arm assemblage may be readily removed as a unit from a clock movement and replaced by a new unit properly adjusted as to spring tension and having bright and smooth

contact surfaces. By adjustably mounting the assemblage on the clock movement frame, the relation between the follower pin and the second ratchet wheel may be readily adjusted to provide for proper operation of the cooperable parts. The contact arms of the assemblage are preferably mounted so that they may move or swing about different centers spaced from each other, thereby to provide a wiping engagement of the contacts which minimizes pitting and the collecting of dirt, etc.

The main or oscillating staff which is electromagnetically powered is hollow at its ends, being preferably formed of a tube, and has inserts (of precious metal alloy) with pointed portions protruding to constitute pivots, the said inserts being of a special precious metal alloy having advantageous bearing properties. The frame of the clock movement has jewel bearings mounted in adjusting screws, the bearings having conical recesses to receive the alloy pivots of the main staff. I have found that due to the very light loading of the main staff it is now possible to use pointed or conical special metal pivots or bearings having a low inherent friction without adverse effect from wear and usage, and that such bearings further reduce the friction to an extent where oil or other lubricant is not necessary. Therefore, I have eliminated to a great extent the effect of differences in temperatures which have heretofore resulted in inaccuracies in clock movements because of the lubricant congealing or changing its viscosity, collecting dirt, becoming rancid and losing its lubricating properties, etc. In the organization provided, the use of precious metal alloys having special characteristics for the bearings is restricted to the inserts at the ends of the main staff, and the staff itself may therefore be formed of a non-precious metal for the sake of economy.

Other features and advantages will hereinafter appear.

In the accompanying drawings:

Figure 1 is an elevational view of the improved clockwork movement as provided by the invention.

Fig. 2 is a plan view shown partly in section, taken on line 2—2 of Fig. 1.

Fig. 3 is a detail in elevation of the driving and driven members of the movement, and of the detent, contact and contact-actuating means, the driving pawl being fully engaged with the driven ratchet wheel.

Fig. 4 is a fragmentary view showing the driving pawl and driven ratchet wheel of the clockwork movement, the pawl being disengaged from the ratchet after it had advanced the ratchet through part of a revolution.

Fig. 5 is a view like Fig. 4 but showing the pawl on its return stroke, being cammed inward by one of the ratchet teeth.

Fig. 6 is an edge elevational view of the driving pawl assembly.

Fig. 7 is a fragmentary sectional view, reduced, taken on line 7—7 of Fig. 3, and

Fig. 8 is a detail in section of one of the pivots and bearings for the main or oscillating staff of the clockwork movement.

As shown, the improved clockwork movement of the invention comprises a frame 10 having members or plates 11, 12 and 13, Fig. 2, located in spaced, substantially parallel relation, the plates 11 and 12 rotatably carrying an oscillatable main staff 14 having a balance wheel 15. The staff 14 has connected to it a hairspring 16 of the usual spiral configuration, the outer end of the spring 16 being joined to a post 17 secured to the frame member 11.

For imparting turning impulses to the main staff 14 a magnetic armature 18 is secured to the staff, and electromagnetic power means 19, in the form of an electric coil 20 and pole pieces 21, is operatively associated with the armature 18 as shown in Fig. 1.

The main staff 14 is made to oscillate by periodic controlled energization of the magnet coil 20 in a manner to be later more fully described. Oscillations of the staff 14 are utilized to impart a uni-directional intermittent or stepped movement to a spindle 22 rotatably carried by the frame 10, one end of the spindle bearing on the plate 13 of the frame and the other end bearing on an arm 23 secured to the frame 10 in any suitable manner. The transmission between the staff 14, which is herein referred to as the driving member, and the spindle 22 which is referred to as the driven member, includes a ratchet wheel 24 mounted on the spindle 22, and a click or pawl 25 engageable with the teeth of the ratchet wheel 24, the pawl being pivotally carried on a circular plate 26 secured to the staff 14 and being normally urged outwardly with respect to the staff by a leaf spring 27 which has one end secured to the plate 26. The pawl carries a driving pin 28 which extends through an aperture 29 in the plate 26, thereby to limit the movement of the pawl 25, the pin 28 being the member which engages the teeth of the ratchet wheel 24.

Referring to Figs. 3, 4 and 5 it will be noted that counterclockwise rotation of the main staff 14 results in the driving pin 28 of the pawl 25 striking the radially extending surface of one of the ratchet wheel teeth and causing the ratchet wheel 24 to turn clockwise through part of a revolution, in a manner well understood in the art. Fig. 3 shows the positions of the parts during initial engagement of the driving pin 28 with the ratchet wheel, Fig. 4 shows the positions of the parts as the driving pin 28 is being disengaged from the ratchet wheel during the counterclockwise travel of the pawl 25, and Fig. 5 shows the driving pin 28 on its return travel engaging a camming surface of one of the teeth of the ratchet wheel and being cammed inwardly thereby so as to by-pass the said tooth without causing a reversal of movement of the wheel 24.

In accordance with the present invention a novel detent, contact and contact-actuating means is provided in conjunction with the driven spindle 22 whereby energization of the magnet coil 20 may be effected in timed relation to the oscillations of the main staff 14, and whereby a desirable and effective detent action is had for the spindle 22, while at the same time imposing a mechanical load on the spindle which is considerably reduced, in comparison with prior clockwork movements of the instant type, to an advantageous small value such that the energizing current of the magnet 20 may be very low. By this organization the drain on the battery of the clockwork mechanism may be very small, and the deterioration of the contacts controlling the circuit for a coil 20 considerably reduced, thereby greatly minimizing the necessity for servicing or maintenance work. Also, in accordance with the invention, the improved and novel detent and contact means includes a unitary contact and contact arm assemblage which is separate from the clockwork

frame 10 and which is mounted thereon for quick and convenient removal and replacement, and is adjustable thereon to enable its proper relation to the cooperable means on the driven member 22 to be readily attained.

Accordingly, referring to Figs. 1, 2 and 3, the driven spindle 22 is provided with a second ratchet wheel 30 which is of smaller diameter than the ratchet wheel 24 but has the same number of teeth as the larger ratchet wheel. For cooperation with the teeth of the ratchet wheel 30 a cylindrical follower pin 31 is provided, rigidly carried substantially midway between the ends of an arm 32 which is rigidly secured at one end to a sleeve 33 rotatably carried by a pivot stud 34, mounted on a base plate 35 secured by screws 36 to the frame member 13. The sleeve 33 has fixedly attached to it a collar 37 carrying a spiral hairspring 38, Fig. 3, the outer end of which spring is secured to a tab 39 anchored to the mounting or base plate 35. The tab 39 is fastened to an angle bracket 40 which may be attached to the plate 35 by welding or other suitable means. Preferably the securement of the tab 39 to the bracket 40 is effected by a bolt 41 passing through an insulating sleeve or bushing 42 in the bracket, the bolt having a nut 43 bearing against a contact tab 44, and there being an insulating washer 45 interposed between the tabs 39 and 44. The function of the contact tab 44 will later be brought out.

At its other end the contact arm 32, which is yieldably urged counterclockwise by the spring 38, mounts an electrical contact 46 which is cooperable with a second electrical contact 47 carried by a resilient contact arm 48 secured at its other end under a washer 49 disposed against the head of the bolt 41. A rigid member 50 extends along the greater part of the length of the arm 48, and is adapted to normally engage the said arm, the member 50 being also clamped by the bolt 41 and being insulated from the bracket 40 by an interposed insulating washer 51. It will be noted that electrical connection may thus be established to the resilient contact arm 48 through the bolt 41, by connecting a lead wire 52 to the tab 44, and the said arm, bolt and tab are insulated from the bracket 40 and from the tab 39, coil spring 38 and contact arm 32. Connection to the contact arms 32 may be made by a lead wire 53 secured to the base plate 35 as shown in Fig. 3. The lead wire 52 may go to one end of the coil 20, the other end of the coil being brought out through a lead wire 54 as shown in Fig. 1. The lead wires 53 and 54 may be connected to a suitable source of energy, as a battery for example.

Referring to Fig. 3, the frame member 13 is provided with a slot 55 through which one of the screws 36 extends, and by this arrangement the mounting plate 35 which carries the contact arms 32 and 48 may be adjustably positioned on the frame 10 and the proper relation between the small ratchet wheel 30 and the follower pin 31 which is engageable with the ratchet wheel, may be readily attained.

Considering Fig. 3, when the ratchet wheels 24 and 30 are turned in a clockwise direction the teeth of the latter wheel will cam the follower pin 31 on the contact arm 32 upward, and will periodically allow the pin to drop down in the troughs between the teeth. In Fig. 3 the pin 31 has been cammed upwardly just sufficient to cause engagement between the contacts 46 and 47. Further clockwise movement of the ratchet wheel 30 will cause the contact arm 32 to be slightly further raised, resulting in the contact arm 48 being raised and separating slightly from the rigid backing member 50. As the follower pin 31 is allowed to drop in the trough between two teeth, the contact arm 32 will drop and separate the contacts 46 and 47 from each other, such separation being effected because the resilient contact arm 47 is prevented from following the contact arm 32 by the presence of the rigid backing member 50. The organization and arrangement of the parts is such that when the armature 18 is in the position shown in Fig. 2 and is rotating counterclockwise the contacts 46 and 47 will be disengaged from each other. As the armature continues its counterclockwise movement the positions of the parts shown in Fig. 3 will be attained, wherein the contacts 46 and 47 are brought into engagement thereby energizing the magnet coil 20. The position of the armature 18 for such engagement and energization is shown in dotted outline in Fig. 1. The energizing coil 20 will cause the armature 18 when in the dotted line position of Fig. 1 to be attracted in a manner to provide a counterclockwise turning moment to the armature, tending to align the poles thereof with the field poles 21. Prior to such alignment occurring however the contacts 46 and 47 will become separated from each other and the coil 20 will be deenergized, whereupon the inertia of the armature 18 and balance wheel 15 will cause the armature poles to swing counterclockwise past the field poles 21. The hair spring 16 will now exert a progressively increasing influence on the main staff 14 and will eventually halt the counterclockwise turning thereof and reverse the turning. Upon such reversal the follower pin 31, having dropped into a trough between two teeth on the ratchet 30, will prevent counterclockwise turning of the driven spindle 22, and the driving pin 28 of the pawl 25 will by-pass the next or succeeding tooth of the ratchet wheel 24 as shown in Fig. 5. The hairspring 16 will exert a progressively increasing force or load on the staff 14 and halt the clockwise turning thereof, and will reverse the direction of the said staff whereupon the cycle will be repeated.

By the provision of the ratchet wheels 24 and 30 of different diameters, the latter wheel being the smaller and being the actuator of the contact assembly for the coil 20, the mechanical load imposed on the driven spindle 22 is considerably reduced, and the force required between the driving pin 28 of the pawl 25 and the teeth of the ratchet wheel 24 is therefore not as great as was heretofore necessary. As a consequence, the magnetic force between the armature 18 and the electromagnetic power means 19 need not be so great, and the energizing current for the coil 20 may be relatively small. A reduction in the energizing current for the coil 20 has a beneficial effect on the contacts 46 and 47, materially reducing the arcing and pitting of said contacts and enabling these to have a much longer useful life. Also, in addition to the reduction of mechanical load on the driven spindle 22 effected by the above organization, the follower pin 31 on the contact arm 32, under the action of the spiral coil spring 38 provides an effective detent for the driven spindle, and the rounded or cylindrical surface of the pin 31 results in a camming action occurring after the crest of a tooth on the wheel

30 has passed the center of the pin. This enables the pin to impart a clockwise turning movement to the driven spindle 22, and causes completion of the movement of said spindle, which movement was initiated by the driving member 28 of the pawl 25. It is therefore seen that, by the present invention, an extremely simple and economical-to-fabricate combination detent, contact and contact-actuating means is provided which produces the highly desirable result of a decreased mechanical load on the driven spindle 22.

The intermittent clockwise movement of the spindle 22 may be transmitted to a gear train and to clock hands (not shown) by a pinion 56 on the spindle 22, Fig. 2.

Inasmuch as the load imposed on the driven spindle 22 in order to operate the clock gear train is very small compared with the load imposed in actuating the contact mechanism in clocks of the instant type, it will be appreciated that any reduction in the contact actuating load will result in a very appreciable reduction in the total load on the spindle 22, and therefore a great decrease may be effected in the energizing current of the coil 20. As a result, the organization as provided by the present invention whereby the mechanical load of the contact-actuating means is reduced to a minimum value, results in a substantial reduction in the current required for the coil 20 and results in greatly increased useful life of the contacts 46 and 47. Therefore the necessity for servicing of the clockwork movement is practically eliminated, since most of such servicing involves the contact means.

In accordance with the present invention, improved economical bearing means are provided for the main staff 14 whereby friction on said staff is held to a minimum and maintained at such low value regardless of age or usage. In accomplishing this, referring to Figs. 2 and 8, the main staff 14 is made hollow at its ends and is preferably formed of a tubular section of non-precious metal. In each end of the staff 14 inserts 57 are provided, formed of precious metal alloy, the said inserts having pointed portions 58 protruding from the staff ends and forming pivots. I have found that a non-oxidizable or non-corrosive alloy of gold, platinum, silver and copper, having a high gold content and a low inherent friction characteristic, provides an extremely advantageous metal for the inserts 57, since the residue or powder formed by wearing away of the alloy does not create much friction, but instead is especially free of abrasive action. The precious metal pivots of the staff 14 are carried in jewel bearings 59 having conical recesses to receive the pointed portions 58 of the pivots, the said bearings being mounted in screws 60 carried by the frame members 11 and 12. By the provision of the above improved bearings for the main staff 14, together with the organization whereby a relatively light driving force is required between the pawl 25 and the ratchet wheel 24, the friction on the main staff is made very small, and the pivots for the said staff therefore do not require any lubrication whatsoever. The absence of lubrication is of considerable advantage since it nullifies the effect of changes in temperature, which changes may cause congealing or rancidity of lubricant and consequent impairment of the lubricating qualities thereof. Therefore by the provision of the novel combination disclosed herein I may produce a clock movement which is accurate and reliable in its operation over a greatly extended period of time, which does not require servicing or maintenance operations since there is no lubricant to become congealed or rancid and since the contact assemblage is relatively free from arcing and pitting, the contacts thereof remaining bright and clean in spite of age or extensive use.

If for any reason it should be necessary, however, to service or replace the contacts after very long usage, this may be readily accomplished by removing the entire contact and contact arm assemblage from the frame 10, by removing the screws 36. A new assemblage may be incorporated in the clock movement quickly and without difficulty to replace the old assemblage, and an adjustment easily effected by virtue of the slot 55 in the frame member 13.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

I claim:

1. In a clockwork movement, an oscillatable spindle; magnetic means including an electromagnet for imparting a turning movement to the spindle; a large ratchet wheel and a small ratchet wheel connected together for simultaneous rotation; means carried by the spindle and engageable with the large ratchet wheel for unidirectionally driving said wheel with an intermittent movement when the spindle is oscillating; and means including a movable part actuated by the small ratchet wheel and including contacts one of which is connected with said electromagnet for completing a circuit therethrough in timed relation to oscillations of said spindle, said means completing the circuit whenever the movable part is in engagement with the tips of the teeth of said wheel.

2. In a clockwork movement, a frame; an oscillatable spindle carried by the frame; driving means for said spindle, including an electromagnet carried by the frame; a contact assemblage connected to the electromagnet to control the circuit thereof, said assemblage comprising a pair of cooperable contact arms and a base carrying the arms, at least one of said arms being movable and said assemblage being separate from said frame; means for removably mounting the contact assemblage on the frame, including means for adjusting the assemblage with respect to the frame; and means for actuating said movable contact arm in response to movement of the oscillatable spindle and in timed relation to the oscillations thereof.

3. In a clockwork movement, a frame; an oscillatable spindle carried by the frame; driving means for said spindle, including an electromagnet carried by the frame; a contact assemblage connected to the electromagnet to control the circuit thereof, said assemblage comprising a pair of arms having cooperable contacts at one pair of juxtaposed ends, and comprising a base carrying the arms, said juxtaposed ends of the arms being movable and the other ends of the arms being spaced apart to provide for wiping engagement of the contacts and said assemblage being separate from said frame; means for removably mounting the contact assemblage on the frame, including means for adjusting the assemblage with respect to the frame; and means for actuating said movable contact arm in response to movement of the oscillatable spindle and in timed relation to the oscillations thereof.

4. The invention as defined in claim 1, in which the small ratchet wheel and movable part prevent movement of the large ratchet wheel in the

direction opposite to that in which it is driven in response to oscillation of the spindle.

ALLEN T. WESTLAKE, JR.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,175,610	Core	Mar. 14, 1916
1,546,075	Horn	July 14, 1925
1,561,673	Ulery et al.	Nov. 17, 1925
1,964,857	Neumann	July 3, 1934
2,084,226	Strahm	June 15, 1937
2,125,638	Hubert	Aug. 2, 1938
2,150,516	Minneker	Mar. 14, 1939
2,194,896	Gromann	Mar. 26, 1940
2,311,964	Quabatte et al.	Feb. 23, 1943

FOREIGN PATENTS

Number	Country	Date
188,079	Switzerland	Mar. 1, 1937
855,412	France	Feb. 12, 1940