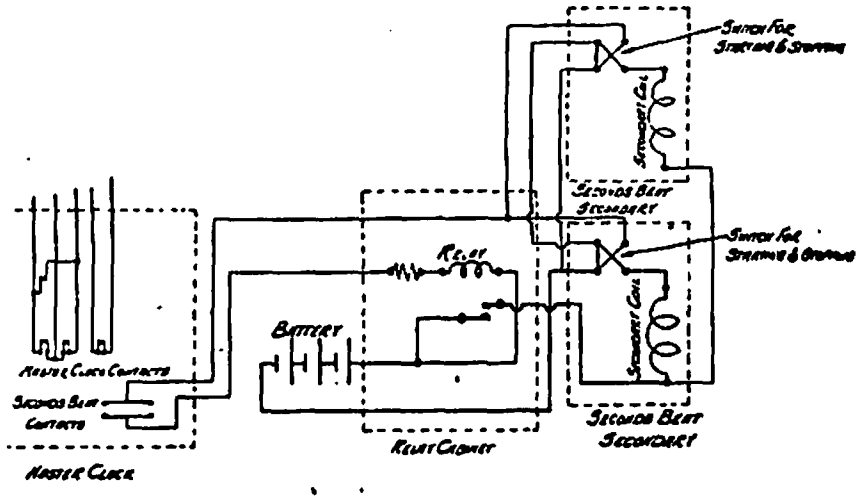
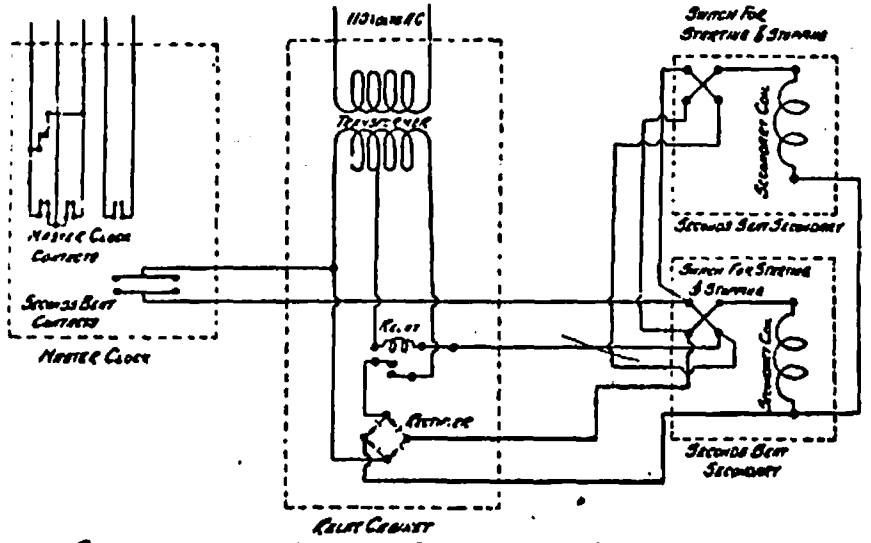


SCHEMATIC WIRING DIAGRAM SHOWING SECONDS BEAT SECONDARY OPERATING FROM DIRECT CURRENT

Fig. 3



SCHEMATIC WIRING DIAGRAM SHOWING SECONDS BEAT SECONDARY OPERATING FROM ALTERNATING CURRENT

Fig. 4

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SECONDARIES

By Secondary Clocks, we mean those clocks that operate from a master clock and are used to indicate the time. Their movement usually consists of a magnet, ratchet and pawl arrangement. They are made in several types as follows:

ROTOR SECONDARY MOVEMENT

Style 561-8

The Silent secondary movement operates upon the same general principle as our No. 561 secondary movement. It is designed to operate secondaries up to and including 24" dials.

The movement is practically silent, very efficient, sturdy in construction, and has very few moving parts (See Fig. 1). The armature is of the oscillating type and is equipped with non-metallic stops which insures silent and smooth operation.

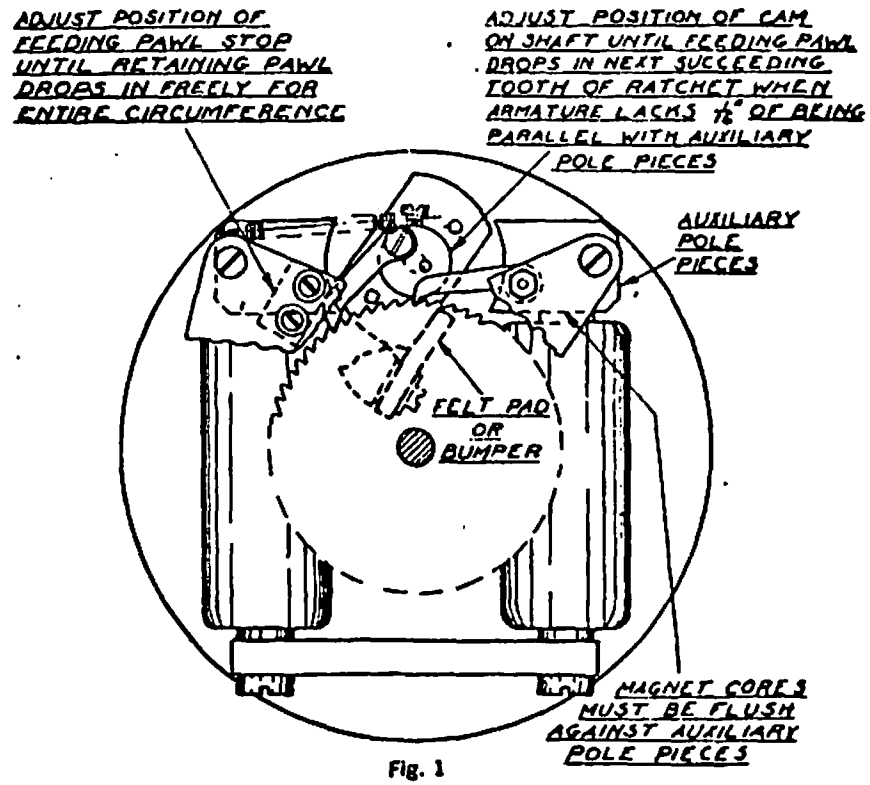

Fig. 1

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The electro-magnets are of the double coil type which insures high efficiency or a strong pull from a small current.

The electro-magnet which consists of two coils and a soft iron yoke is mounted rigidly to the main plate. The pole pieces of the electro-magnet are flush against two auxiliary pole pieces between which the armature oscillates. The auxiliary pole pieces are also mounted rigidly to the main plate. The inside ends of the auxiliary pole pieces are cut circular so that the armature may oscillate between them and have as small an air gap as possible. This construction insures the highest possible efficiency from the electro-magnet.

The armature consists of several laminated pieces of soft iron riveted together so as to form a rectangular block, the ends of which are cut circular to fit the auxiliary pole pieces. The armature oscillates thru an angle of approximately 70 degrees. Normally, the ends of the armature overlap the auxiliary pole pieces approximately 3/32". The armature is held in this position by the tension of the armature return or driving spring. When the electro-magnet receives an impulse, the magnetic circuit is completed thru the armature, rotating same until it forms a bridge between the two auxiliary pole pieces. The armature is held in this position for the duration of the impulse and then the driving spring returns it to its normal position.

Attached to the armature shaft is a disc which carries the feeding pawl and a locking pin. As the armature is attracted the disc is turned, until the feeding pawl engages the next succeeding tooth in the ratchet. At the same time, the locking pin is traveling down toward the top of the retaining pawl. The secondary cannot advance when the impulse is on as the locking pin prevents the retaining pawl from rising sufficiently to let the ratchet move. As the armature returns to its normal position, the feeding pawl is wedged between its stop and the ratchet which forms a positive lock.

The secondary is designed so that only one spring is used and that for the return of the armature to its de-energized position. Both the retaining pawl and the feeding pawl operate by gravity.

The movement is equipped with a felt pad which acts as a cushion for the armature, stopping its momentum and preventing it from over-throwing past its strongest field.

ADJUSTMENTS

1. Adjust the stop for the feed pawl until the retaining pawl will just drop freely in the ratchet for its entire circumference.

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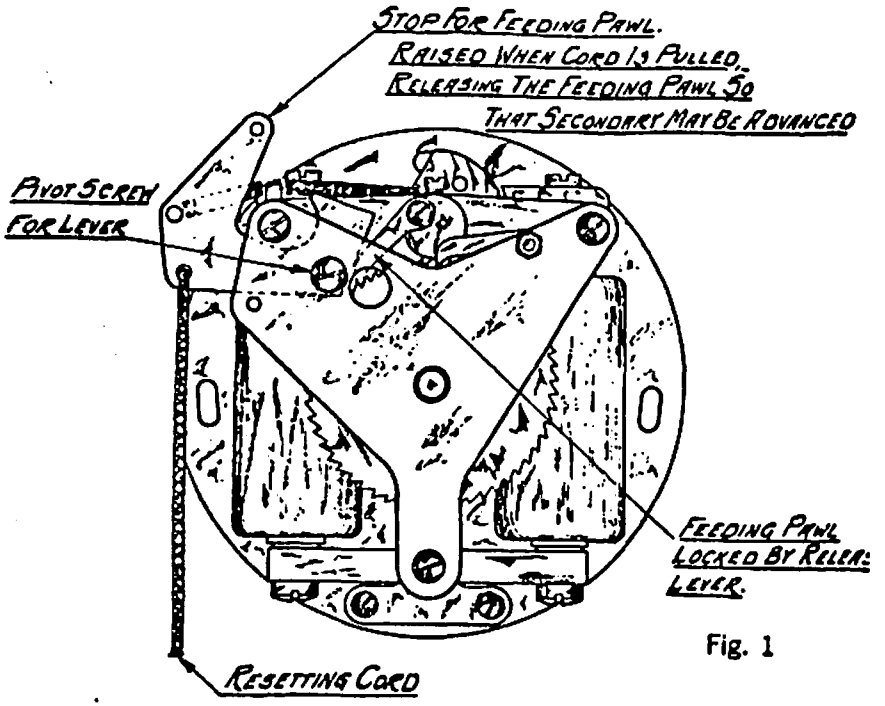

Fig. 1

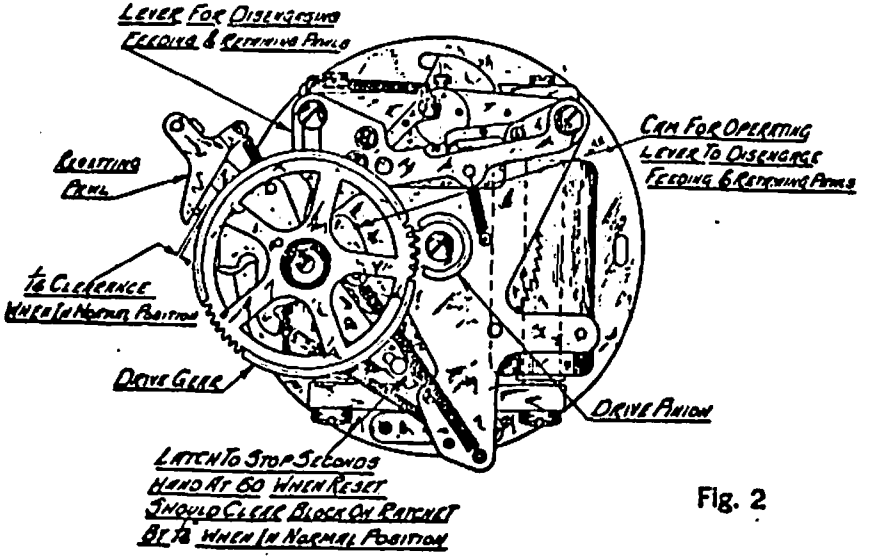

Fig. 2

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Either the manually or mechanically reset secondaries may be equipped with a bell which is mechanically tapped every 15 seconds. The operating mechanism for the bell is a cam and lever and its function is easily understood upon examination.

WIRING ARRANGEMENT

When the operating power is DC and only 1 or 2 seconds beat secondaries are used, no relay cabinet is necessary. It is necessary to run only two wires to each secondary, and connect the switch in series with one of the lead wires. However, if 3 or more seconds beat secondaries are used on D.C. a relay cabinet is necessary. The relay cabinet has one circuit closing relay to carry the current to the secondaries. It is then necessary to run three wires to each secondary. The switch is then wired so as to cut out the secondary coil and also the relay coil provided no other secondaries are in operation. The principle of operation of the D.C. operated seconds beat secondary will be easily understood by studying the wiring diagram Fig. 3.

It is well to remember that the seconds beat contact is entirely independent of the rapid impulse contact in the master clock.

Whenever the operating power for the seconds beat secondaries is obtained from A.C. supply thru a copper plate rectifier, a relay cabinet is required and it is necessary to run 4 wires to each secondary and switch as both A.C. power to the relay coils and the D.C. power to the secondary electro-magnets has to be cut off and one wire cannot be used as a common return for both kinds of current. This will be easily understood by studying the wiring Diagram Fig. 4.

The wiring is somewhat complicated by the fact that the relay is controlled from several switches in parallel and all have to be turned off before the relay will cease to operate.

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2. Adjust the position of the disc on the armature shaft until the feed pawl will just drop into the next succeeding tooth of the ratchet when the armature is moved until it lacks 1/16" of being parallel with the auxiliary pole pieces.

3. Adjust the felt bumper or armature stop until the armature will travel 1/16" beyond the level of the auxiliary pole pieces. When the armature returns slowly, its stop should be the felt pad and not the feed pawl striking its fibre stop.

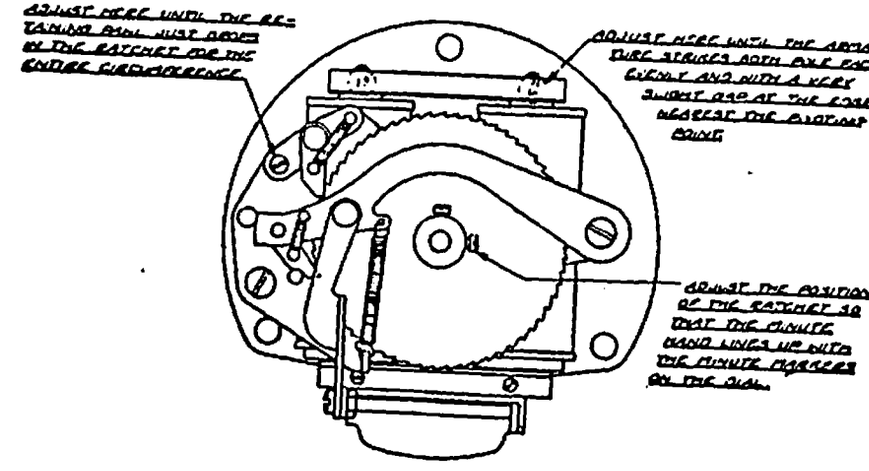
4. Adjust the armature return spring for satisfactory operation on a 25% drop in voltage.

5. The position of the entire movement may be adjusted, by loosening the three mounting screws, until the minute hand lines up with the minute marker.

HEAVY DUTY SECONDARY MOVEMENTS NO. 562-563

These types of secondary movements are made in two sizes. The principle of operation and adjustments are the same on all. The larger of these movements is equipped with a fan escapement to retard the movement of large hands. If the large hands were stopped suddenly, damage to the secondary or the hands slipping out of time would result. The fan escapement requires no adjustments but all gears must mesh correctly and work very freely.

This type of secondary movement is used in the electric drive dial recorder as well as on secondary time units too large for the No. 561 movement to operate.



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The operation of this type of secondary is similar to the No. 561. Each minute the armature is attracted, it moves a feeding pawl until it engages the next tooth in the ratchet. Then when the armature is released, the feeding pawl moves the ratchet 1/60th of a revolution to designate one minute.

The magnets are of the double coil type which give a much stronger pull needed for the larger hands.

ADJUSTMENTS

1. Liner must fit snugly against the armature.

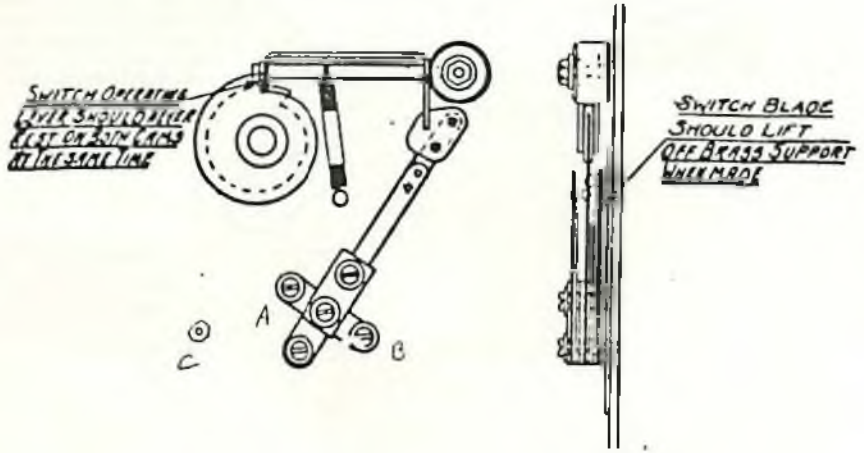
2. Adjust the position of the coils so that the armature will strike them squarely.

3. Adjust the position of the ratchet on the shaft and the position of the retaining pawl so that the feeding pawl will take from 1 1/4 to 1 1/3 of a tooth and the retaining pawl will drop in freely.

4. Adjust the armature return spring for satisfactory operation on a 25# voltage drop.

ADJUSTMENT OF SUPERVISING SWITCHES

The cam for operating the switch is properly timed at the factory and should never require changing, however, the timing of the switch may be adjusted by shifting the position of the entire switch block assembly. The secondary unit should transfer to the "B" wire just before it reaches the 59th minute and to the "A" wire just before the fourth minute. A quick drop of the lever from the cam is essential. If the lever rides down the face of the cam there is danger of a poor contact.



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As explained previously the large gear is the driving gear when resetting. When the secondary is running this gear revolves but does not work. The pawl for this gear is held out of engagement by a light coil spring. The pull chain is attached to the pawl in such a way that when pulled it causes the pawl to engage the gear and rotate it.

A part of the pawl lever acts as a cam and is turned each time the reset cord is pulled. This cam serves two purposes; viz., releases the latch pawl for the ratchet and operates the lever for raising the feeding and retaining pawls. When the chain is released a spring returns the cam and pawl to their original position.

When the cam releases the latch lever for the ratchet a light spring pulls it in position to engage a stop on the ratchet. The purpose of the latchet is to hold the ratchet until the feeding and retaining pawls are again engaged with it. The latch is made in two parts, one movable (lengthwise) and one stationary. The movable segment cushions the impact of the ratchet when it stops and also serves to hold it firmly against the stop on the other section thus positively locating the ratchet at its exact position.

The lever for operating the feeding and retaining pawls operates them soon after the latch is in position. This positively drops them back in position before the latch is released.

ADJUSTMENTS

1. All adjustments on movement are standard.

2. All moving parts must be free from binds and work very freely.

3. When in its normal position the pawl for operating the large drive gear should clear the gear by 1/16".

4. The lever for the above pawl which also is the cam should stop in such a position that the pawl will engage the gear freely without forcing it in either direction.

5. The latch should clear the block on the ratchet by 1/16" when in its normal position.

6. The latch should overlap the block on the ratchet 1/32" when latched or when the reset cord is held down.

7. The lever should release the feeding pawl when it is 1/16" from the top of the cam. The retaining pawl has already been released at this time.

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The function of the seconds beat secondary may be compared to a stop watch, only the dial is large and visible from a distance and the starting and stopping may be controlled from any convenient point. The starting and stopping is controlled electrically by means of a switch which cuts out the driving electromagnet and also the control relay provided so other seconds beat secondaries on the same circuit are in operation. The switch may be either the pendent type on an attachment cord or the flush type mounted in a single gang switch box.

The seconds beat secondaries are made in two types; viz. manual reset and mechanical reset.. The resetting of the manual reset type is accomplished by pulling a cord and turning the knob that protrudes thru the hole in center of the protection glass. The resetting of the mechanical reset type is accomplished by merely pulling the reset cord.

The manual reset is obviously the more simple. It consists of a lever arrangement for disengaging the feeding pawl so that the secondary may be advanced. As stated before this lever is operated by a pull chain. A nurled knob protrudes thru a hole in the center of the protection glass. Turning this knob in a clockwise direction advances the seconds hand. This knob and likewise the hands are locked in position except when the pull chain has disengaged the feeding pawl. It may be necessary to advance the seconds pointer several revolutions before both hands are returned to their original positions as the gear ratio of minutes hand to seconds hand is 60 to 1.

The mechanism reset seconds beat secondary is a little more complete in that pulling the reset cord releases both the feeding and retaining pawls and also furnishes the power for resetting the secondary. It will be noted that in this type of seconds beat secondary the hands move counter clockwise while being reset.

The reset mechanism consists of a pinion gear with coil spring mounted inside, large driving gear, pawl for operating drive gear, stop pawl for ratchet, lever for raising feeding and retaining pawls and cam for operating same.

The pinion gear is mounted on the ratchet shaft and connected to it thru a coil spring. When the ratchet advances the pinion gear also advances which in turn drives the large gear. When resetting the procedure is reversed and the large drive gear is operated by the pull cord. This rotates the pinion which in turn operates the ratchet. The purpose of the spring is to enable the pinion gear to start revolving before the pawls are released thus building up enough tension to positively latch the ratchet when the seconds hand is restored to its original position.

Page 1a

Make certain that the center switch blade does not touch both the "A" and "B" switch blades at the same time. The brass supports for the "A" and "B" switch blades should be adjusted so that the center switch blade makes equal and positive contact with each, and so that the switch operating lever never rides on both cams at the same time. This assures that the full tension of the switch operating lever spring is applied to the switch.

MONARCH SECONDARY MOVEMENT

This type of secondary is now obsolete although there are a great number in the field to be serviced. It is of the single coil type, the return magnetic path being through the cast iron back frame.

ADJUSTMENTS

1. Adjust the forward stop for the armature for .003" clearance between the armature and core with current on the magnet.

2. Adjust the feeding pawl stop, position of the retaining pawl and position of the ratchet on its arbor so that the retaining pawl will drop freely in the ratchet for the entire circumference and the feeding pawl will take between 1 1/4 and 1 1/3 teeth in the ratchet at each impulse.

3. Adjust the armature return spring for satisfactory operation on a 25% drop in voltage.

Note: If the feeding pawl stop screw is pointed, replace same with a standard screw.

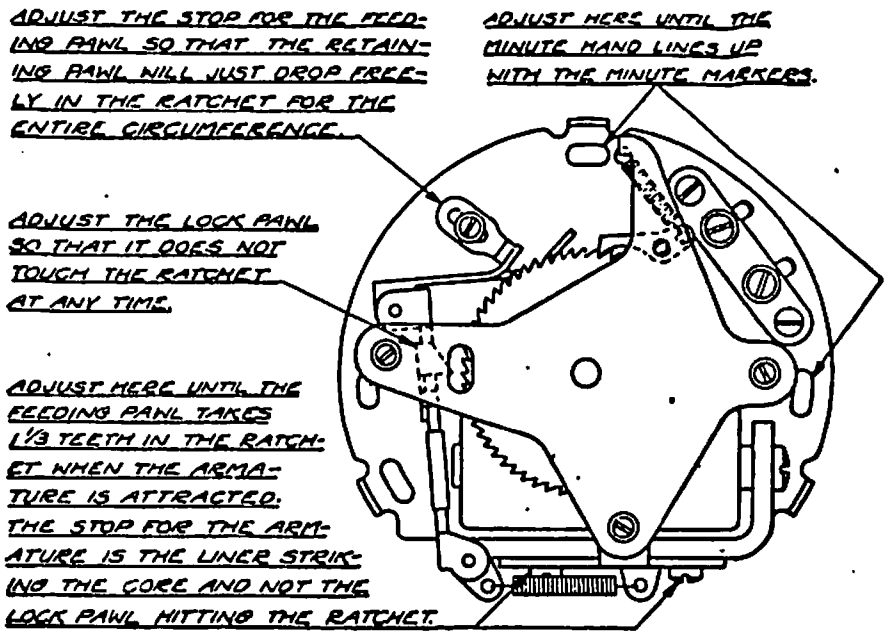
SECONDARY MOVEMENT NO. 561

This type of secondary also operates on the ratchet and pawl principle The ratchet is automatically locked in every position. The feeding pawl is of the self locking type, being wedged under the stop when in its normal position. A locking pawl is provided to lock the ratchet when the armature is attracted. The magnet is of the one coil type, the return magnetic path being through the Norway iron support bracket.

The armature is kept from touching the core by a thin brass liner attached to the armature. This provides a magnetic air gap and prevents the armature from sticking due to residual magnetism. To prevent the magnetism from having a secondary path through the upper part of the armature, the feeding pawl and the ratchet wheel, a magnetic air gap is provided between the armature and feeding pawl by the use of brass spacing washers.

Page

This type of secondary may be equipped with self regulating contacts, the operation of which will be fully explained in the bulletin of Self Regulating Systems.



ADJUSTMENTS

1. Armature muat hit squarely against core.

2. Forward stop for armature must be the armature liner striking the core and not the locking pawl hitting the ratchet.

3. Shift the entire magnet assembly until the feeding pawl takes from 1 1/4 to 1 1/3 teeth in the ratchet when the ratchet is held against the retaining pawl.

4. Adjust the armature return stop so that the retaining pawl will drop in freely for the entire circumference of the ratchet.

5. Adjust the height of the feeding pawl stop for a clearance of .008" betweea the stop and the feeding pawl when on the high point of the ratchet tooth.

6. Adjust the position of the locking pawl so that it will enter the ratchet tooth without hitting on either side. The purpose of the lockiag pawl is to prevent the ratchet from moving ahead on the impulse.

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2. To get proper clearance between armature and yokes, move the rubber stop block. This is done by loosening the two screws which hold the stop block bracket to the main plate.

3. When the armature is attracted, the feeding pawl should travel 1-1/3 teeth of the minute wheel.

4. The retaining pawl should fall freely in all ratchet teeth with a minimum of back lash. Adjust rubber stop block to get this condition.

5. When the "A" side of the S. R. switch is made, the upper contact leaf spring should be raised 1/32" from its support bar.

6. When the "B" side is made, the lower switch finger should drop 1/32" from its support bar.

7. When the secondary is at its 58th minute the pin on the minute ratchet wheel must not touch the contact operating arm. You should be able to raise the insulator on the contact operating arm up from the center S. R. switch finger 1/32".

8. The armature pull back spring should have sufficient tension to advance the secondary from the 58th to the 59th minute when the armature is released slowly. The amount of spring tension may be varied by loosening the set screw to which the spring is attached and rotating the collar as desired.

9. When all adjustments are properly made and the movement free of binds, satisfactory operation will be obtained on 2/3 of normal operating voltage.

SECONDS BEAT SECONDARY

The seconds beat secondary usually consists of two dials mounted on one mat. One dial is our regular hours and minutes dial and the other dial is usually our standard 1 to 12 hour dial arranged to read minute and seconds by the aid of a heavy minute hand and a light weight red seconds pointer. The hours and minutes secondary is operated by our standard self regulating rotor movement. The minutes and seconds secondary is operated by our standard rotor type movement equipped with means for starting, stopping and resetting.

The minute hand is geared to the seconds hand in practically the same manner as the hour hand to the minute hand in a standard secondary only the ratio is 60 to 1 instead of 12 to 1. The minute hand moves one minute to every revolution of the aeconds hand, therefore, 60 minutes completes one cycle of the seconds beat secondary.

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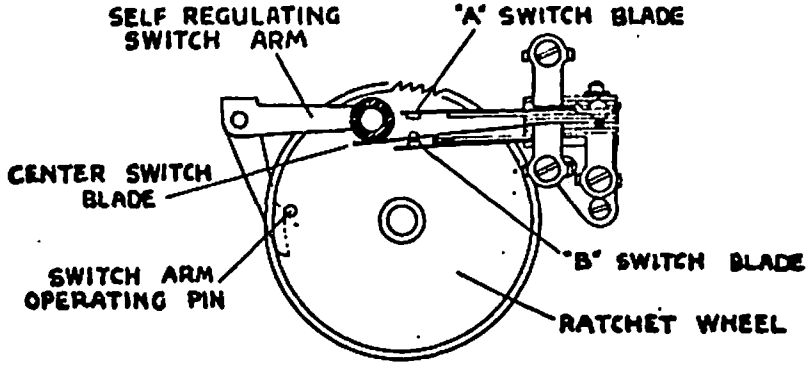
ly 13 degrees. When the electro-magnet is de-energized and the armature is released the ends of the armature overlap the auxiliary pole pieces approximately 1/16". The armature is held in position by the tension of the armature return or driving spring.

The secondary clock is designed so that only one spring is used and that for the return of the armature to its de-energized position. Both the retaining pawl and the feeding pawl operate by gravity.

The hour hand is geared to the minute hand in the ratio of 12 to 1, therefore, when the minute hand has made 12 revolutions, the hour hand will have made one.



CUT OUT VIEW - SELF REGULATING SWITCH ASSEMBLY - 561-C MOV'T

FIG. 3

ADJUSTMENTS

1. The rocking armature should not strike the pole pieces on either side. When the armature is attracted there should be equal clearance on both sides sufficient to enable one to insert a thin piece of paper between the armature and yoke. If the armature is not centered, loosen the two screws which hold the brass bearing plate to the yokes and move the bearing plate until the clearance is the same at both ends.

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7. Adjust the armature return spring for satisfactory operation on a 25% drop in voltage.

POLARIZED SECONDARY MOVEMENT NO. 564

The Polarized Secondary is so called because the principle of operation depends upon the attraction and repulsion of unlike and like poles of a magnet. It is particularly adapted to schools and hospitals because it is noiseless in operation. The principle upon which it operates is as follows:

The first law of magnetism states that unlike poles attract and like poles repel each other.

Placed in this secondary is an electro-magnet which is energized each minute. The current reverses with each impulse, therefore, polarity changes accordingly.

The direction of flow of this current is alternated by special contacts installed in the master clock, working in conjunction with the twin relay cabinet.

Revolving between these alternating poles is an armature which is always kept at the same polarity by a permanent magnet. The armature revolves one quarter of a turn or 90 degrees each minute, being designed in two sectors so that when the heel of one sector is at the north pole of the electro-magnet, the toe of the same sector in one case and the toe of the next sector in the other case is approaching the south pole of the electro-magnet and vice versa. As the current in the electro-magnet is reversed, changing polarity of the pole pieces, the heel of the armature sector is pushed away from the like pole and the unlike pole exerts a pull on the toe of the same sector or the next sector depending upon the position of the armature. This brings the armature into position for the next minute.

The magnetic path for the permanent magnet is from the top end of the permanent magnet, through the worm, worm shaft, armature and electro-magnet cores to the opposite end of the permanent magnet. This will always keep the sectors of the armature at the same polarity.

When the electro-magnet receives an impulse, there is a magnetic circuit created between its north and south poles through the armature sectors.

The energization of the electro-magnet causes the armature to turn through an arc of 90 degrees.

The electro-magnet remains energized for approximately two seconds, therefore, after the armature moves, it must be held in such a position that the

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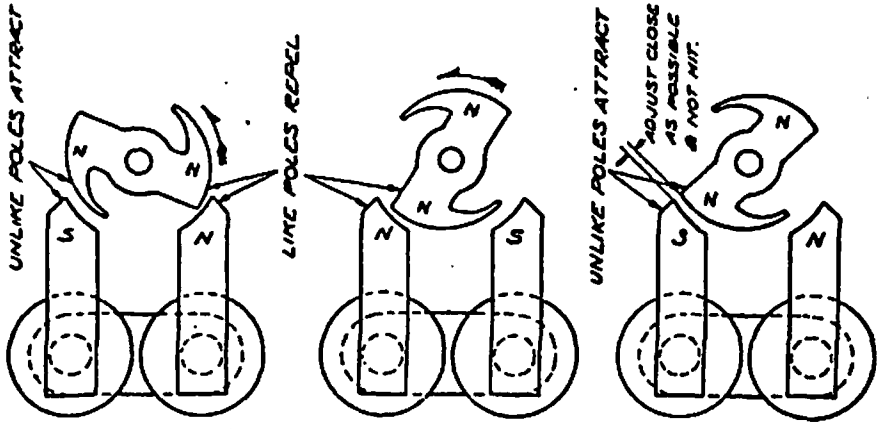
hands of the secondary will line up with the minute marker. To hold the armature in the proper position, its sectors are so designed that the largest air gap between the armature and pole pieces is at the toe of each sector. It will be remembered that the armature, being induced by the permanent magnet, is always of the same polarity, therefore, bearing this in mind and the direction of rotation of the armature as well as the polarity of the poles of the electro-magnet, it will be noticed that ualike poles (of the armature and pole pieces) are attracted through the smaller air gap. This holds the minute hand on the minute marker.

Attached to the armature is a worm which is connected to the hands by a train of gears.



CURRENT REVERSED BY MASTER CLOCK CONTACTS - EVERY MINUTE.

ADJUSTMENTS

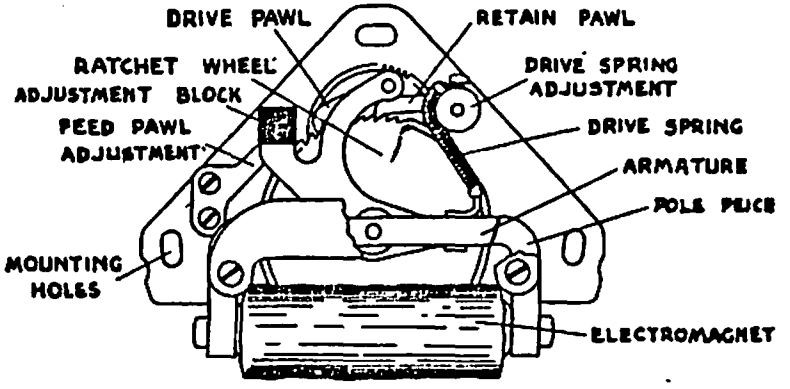
Adjust the two bridges on the secondary so that the worm and armature shaft will spin freely and at the same time keep the heel of the sector as close to the electro-magnet pole pieces as possible. The closer this adjustment is made and still allow the armature to spin freely, the more positive will be the operation.

Any ratchet and pawl equipment may be operated from a polarized system but the polarized secondaries cannot be operated from a ratchet and pawl system unless a current reversing relay is used.

561-C SECONDARY MOVEMENT

The electro-magnet is of the single coil type which insures positive operation and high efficiency. The armature is of the rocking type and operates between two pole pieces which are extensions to the magnet core. The rocking type armature insures quiet operation, as there is no contact of armature and pole pieces to make a noise. The feeding pawl is attached to the armature and rocks with it. When the electro-magnet receives an impulse, it is energized and draws back the feeding pawl until it engages the next tooth of the ratchet. When the impulse is completed, a spring attached to the armature returns the armature and the feeding pawl to their normal positions and at the same time advances the ratchet one tooth. The ratchet has 60 teeth, and as the minute hand is attached to the same shaft, advancing the ratchet one tooth advances the minute hand one minute. In the case of half minute impulse secondary clocks, the ratchet has 60 teeth and advances a minute each impulse through reduction gears.

To prevent the possibility of the secondary clock advancing when the armature is attracted, a safety or interlocking feature is provided. The ratchet feed pawl locks the retaining pawl in place thus holding the ratchet in place during the time the feed pawl is out of its locked position. When the feeding pawl is in its normal position, it is wedged or locked behind a rubber stop which positively locks the ratchet.



CUT OUT VIEW - DRIVE MECHANISM - 561-C MOV'T
FIG. 2

The single pole electro-magnet is assembled between the magnetic iron pole pieces which are mounted rigidly to the main plate. The inside end of the pole pieces are cut at an angle so that the armature may oscillate between them and have as small an air gap as possible. This construction insures the highest possible efficiency from the electro-magnet.

The armature is a block of magnetic iron, the ends of which are cut to fit the pole pieces. The armature oscillates through an angle of approximate-

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