CLASSIC BRITISH

ELECTRIC ANALOGUE CAR CLOCKS

Part 2 Kienzle electric car clocks

(**as fitted to "Classic" cars up to the late 1970s**)

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INTRODUCTION:

Part 1 dealt with some common Smiths clocks. Here we look at Kienzle clocks which were provided in both European and English cars.

I'm assuming most readers will have some basic mechanical and electrical "nous". For the most part these are necessary to carry out repairs to these clocks.

Some of the information presented here is duplicated from part 1, Smiths clocks. This duplication has been done in order to produce a stand-alone document without any need to refer to other documents. The basic operation and repair information set out in this document applies to all clocks of a specific type.

Servicing information presented in this document has been gathered from servicing these clocks on the workbench. No manufacturer's service information is to hand.

To "electrify" the clockwork mechanism, two common methods were used. One simply retained the clockwork mechanism and wound the clock spring electrically. Another method was to use a balance assembly as both a time regulating device and as the source of energy to drive the clock. The Kienzle electrically wound clock described later is an example of the first method and the Transistorised Impulse Clock an example of the second.

Later on, transistors were used to perform switching of the driving coils. Kienzle produced clocks using a balance with magnets attached and fixed coils mounted on a circuit board. This is the opposite of the Smiths "CET" and "CTE" ranges which had moving coils and fixed magnets. Multiple hairsprings were not required and a helical spring was used in lieu of the more common hairspring found on balance wheels. A smaller diameter balance wheel assembly incorporated two magnets which moved past the trigger/impulse coil pair. As the balance wheel moved, a transistor was switched on providing a kick to the balance assembly to move it through the magnetic field, driving the hands of the clock through a gear train. This was still a clockwork style mechanism using the balance wheel for both timing and an energy source.

The work described in this document is of an intricate nature. Only attempt servicing these clocks if you are happy working with (very) small objects and have the tools to do so.

When working on any clock, do not distort the hairspring. Doing so will affect the timekeeping of the re-assembled clock. The coils of a hairspring must not touch each other as the hairspring contracts. If this happens, timing will be affected and in severe cases may stop the clock.

Later still "quartz" clocks were developed. These employed an electronic circuit to drive either a synchronous or a stepper motor which moved the hands of the clock through a gear train. A quartz crystal was used to provide an accurate frequency reference to drive the motor which turned at a speed proportional to the driving frequency. The motor provided continuous, constant speed, drive for the clock – the oscillating balance wheel was no longer required.

The down side of these "advances" in car clock technology, is that the later clocks are seldom reasonably repairable.

I'd like to mention Rocky Hamilton, of the Triumph Owners Club in Christchurch, New Zealand, for kick-starting me on this project and providing some of the clocks I have used for photographs here and, in some cases, to refresh my memory as to the repair process.
(He may never be forgiven!)

KIENZLE ANALOGUE ELECTRIC/ELECTRONIC CAR CLOCKS:

Kienzle was at one time part of VDO and VDO branded clocks are frequently "badge-engineered" Kienzle clocks. VDO/Kienzle clocks are commonly found in German-made vehicles but were also supplied in English vehicles in the 1970s, Smiths having ceased making car clocks in about 1972.

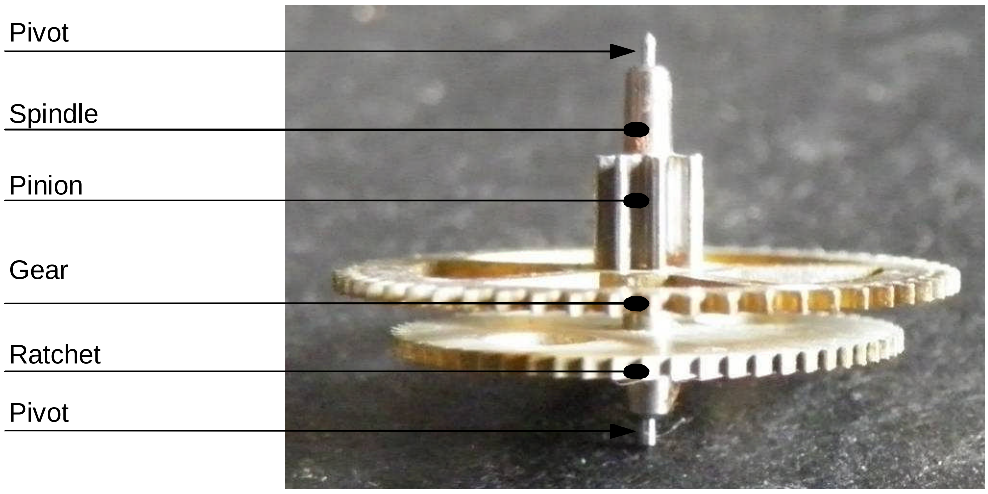
Three types of Kienzle clocks are described below. The works of most of their clocks should be similar to these. The round clocks use spun-on bezels made from very thin chrome-plated hard brass. You will be lucky if a bezel only splits a little bit when it is removed. There may be new replacement bezels available but I haven't found them (yet). Refer to Appendix A for some information about removing these bezels with minimum damage.

The time-setting knob is retained in the "glass" by a pressed-on boss and cannot be readily removed without damaging the glass (actually plastic).

If working with these clocks, note where everything fits grouping parts together and/or make some sketches or take photographs to show where parts fit to aid with re-assembly.

When describing operations on these clocks, "front" has been used to refer to parts located towards dial. "Rear" refers to the other end of the clock.

Clock gears are usually described as "wheels". Within this document I have used "wheel" to refer to the entire assembly as in the photograph below. Many wheels are compound gears and where required, individual gears on wheels are described as "pinion" for the smaller diameter gear and "gear" for the larger diameter gear. The wheels are mounted on arbors, or spindles, and these will be referenced as such within the text.



Parts of a clock wheel as named in this document. This is the main drive wheel as removed from a Kienzle electrically wound clock.

1. *Electrically wound clock:*

This clock is essentially a clockwork movement, the mainspring being "wound" electrically. The clock would only run for two to three minutes once electrical power was removed. This model of clock is self-starting. You may be able to hear the solenoid energising every couple of minutes. Regulation of these clocks was provided at the rear of the case, covered with a small piece of plastic tape or a date-code sticker. Adjustment was by way of a slotted shaft which accepts a small screwdriver. The works are retained in the case with three nuts at the back of the case, one of which also retains the "earth" terminal. Also note no second hand.
This particular clock is a **Kienzle type 607.** Other Kienzle car clocks using this type of movement will be of similar construction.

The "beauty" of this style of clock, from a manufacturing perspective, was that the clockwork mechanism was already developed and electrifying clocks in this manner required only replacement of the mainspring assembly.

TABLE 1 – COMMON ELECTRICALLY WOUND CLOCK FAULTS:

FAULT	**CAUSE**	**REMEDY**
ELECTRICAL:		
No continuity between case and supply terminal	Dirty or eroded contacts Fusible link open (if fitted) Clockwork mechanism not operating thus holding points open.	Clean and dress contacts Repair fusible link or replace with thermistor. (*Section 1.2*) Clean and repair mechanism
High resistance (>30 Ohms) between supply terminals	Solenoid coil damaged - open circuit ***Note 1***	Repair or replace solenoid assembly.
Clock "chatters" when powered up	Drive pawl not engaging	Check drive pawl spring tension Clean drive pawl and shaft.
MECHANICAL*:*		
Clock doesn't run	Mainspring broken or jammed Drive pawl not engaging Seized pivots Damaged balance assembly or corrosion on balance pivots	Clean and lubricate mechanism, adjust, repair or replace parts as required. Polish pivots and protect with a coat of sewing machine oil.
Timekeeping poor	Dirt or wear in mechanism Regulator needs adjustment	Clean and lubricate mechanism Adjust regulation as needed

Note 1: See section 1.2. If insufficient care is taken the solenoid coil wire may break away from the armature clamp plate. It may not be practicable to repair such a break. (fig. 1.3)

1.1. Electrically wound clock circuit diagram:

Fig.1.1 shows the circuit diagram for this clock. There is not much to it. Most likely the clock ceasing to work will be due to either this fusible link opening or the clockwork mechanism getting dirty (stiff) or worn. To test the clock, connect to a nominal 12V source. If it doesn't run (you should hear it wind) then it needs attention. You cannot determine the exact cause nor remedy the fault without removing the clock mechanism from its case.

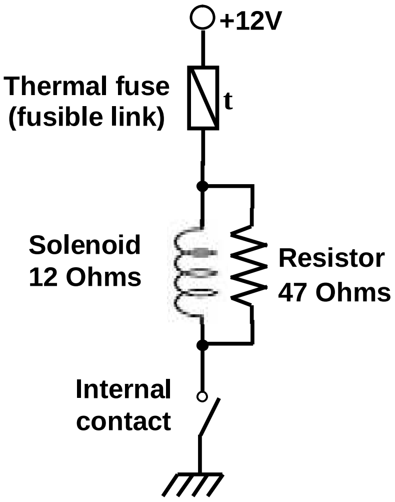


Figure 1.1: Electrical circuit diagram of a late model Kienzle electrically wound car clock. Coil resistance is as measured on an available clock.

Other (earlier?) models of this clock are fitted with c15 Ohm coils and parallel resistor of 100 Ohms giving a combined resistance of c13 Ohms. A variant (later?) with a coil of 11 Ohms and a parallel resistor of 56 Ohms giving a combined resistance of c9.2 Ohms.

A resistance between 8 and 15 Ohms measured between supply terminal and case indicates the solenoid assembly is most probably good.

The thermal fuse (*Section 1.2*) may have been bypassed in some clocks of this type in the course of previous repair.

There is nothing in this clock "ex-factory" that is polarity sensitive. In some cases owners/repairers may have added a diode to this circuit to quench the spark as the internal contacts open. It could be that a diode was added in later production units. Such a modification will render the clock polarity sensitive with no external indication that this has been done.

Despite that, these clocks are marked as negative earth clocks. Treat as polarity sensitive until proven otherwise.

1.2. The thermal fuse (fusible link):

The following comments describe the thermal fuse, or fusible link, as found in these clocks. The fusible link on the left in *fig. 1.2* has partially failed and completely failed soon after this photograph was taken. Failure of this fuse link is attributed to insufficient tension in the pawl spring as noted in section 1.7. (Another type of excess current protection mechanism is shown in *fig. 1.16* at the end of this section.)

As shown in *fig 1.2* below, this fusible link ***is not*** a soldered joint. It comprises a connecting pin of low melting point alloy holding the spring-loaded terminals together. There is no evident "wetting" of these spring-loaded terminals as would be found in a true soldered joint. It appears this connecting pin is inserted through the two eyelet terminals and the shank is deformed by heating to retain the pin in place. The formed lug on the solenoid eyelet is then folded over the pin

Figure 1.2: Magnified view of fusible links in Kienzle type 607 clock. Fusible link at left appears to have partially failed already. Right-hand picture shows an intact fuse assembly.

To solder this joint with (very) low melting point solder will not supply the protection that this fusible link assembly is intended to provide. A soldered joint would have very low resistance where a metal-to-metal contact joint of this nature would provide a small resistance, increasing as excess current passed through it, thus raising the temperature of the assembly until the fuse link melted.

The fusible link can be replaced with a resettable fuse or PTC thermistor. A Littlefuse LVR106S device appears to work well. On test, simulated welded contacts quickly reduced the current to <80mA with a device surface temperature of 55 deg. C. Another thermistor that shows promise in this application is the EPCOS B59985C0120A070. For this device, current is <74mA and a surface temperature of 74 deg. C. (Refer also Appendix D.)

Fig 1.3 below shows how these thermistors may be fitted to the winding assembly.

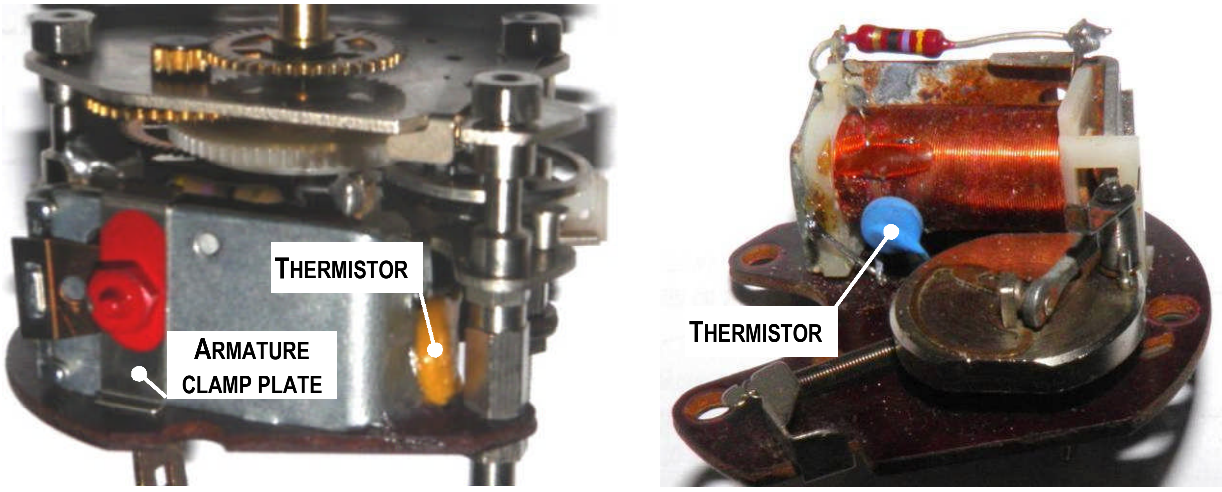


FIGURE 1.3: Thermistors fitted to Kienzle type 607 car clocks. Photograph on the left shows a Littlefuse LVR016S thermistor fitted. Leads were soldered to each of the original eyelet terminals.
On the right, an EPCOS B59985C0120A070 thermistor fitted where the lower (spring) contact had previously been removed and a wire link soldered between the supply terminal plate, below the solenoid, and its upper fixed terminal. This wire was removed and the thermistor soldered in its place.

1.3. Electrically wound clock mechanical schematic diagram:

Figs. 1.4 below shows how the various parts of the clock interact but does not represent the physical layout of the mechanism. It does, however, identify the names of the various components as used in this section.

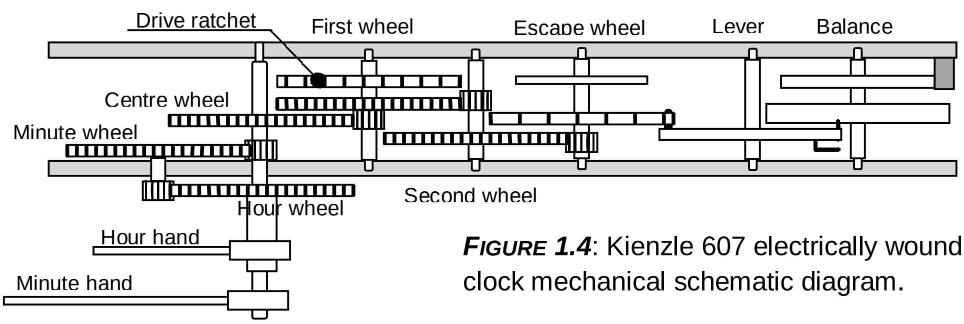


FIGURE 1.4: Kienzle 607 electrically wound clock mechanical schematic diagram.

1.4. Removing the clock from the case:

Remove the bezel. Refer Appendix A for how to do this with minimum damage to the bezel.

There are four components to the bezel/dress ring assembly: the bezel itself, a plastic or aluminium ring painted matt black on its outer surface, a castellated shroud and the sealing rubber within the bezel. The aluminium ring sits on the fingers of the castellated shroud. The rubber sealing ring is a separate component that sits within the bezel but is not glued in place.

The clock mechanism is rubber mounted and secured with three nuts. Two of these nuts have plain washers beneath them. The third nut is a standard nut with a lock washer underneath and this connects with an earth strap rivetted to the case. A separate metal sleeve sits inside this grommet. Remove these three nuts and the clock can be pushed clear by applying slight pressure to the supply terminal at the rear.

FIGURE 1.5: Photograph of clock mechanism removed from case and dial assembly. Note there is a thin dished brass thrust washer (not shown here) between the hour wheel and the dial. *Fig. 1.11* shows this thrust washer.

1.5. Dismantling the clockwork mechanism:

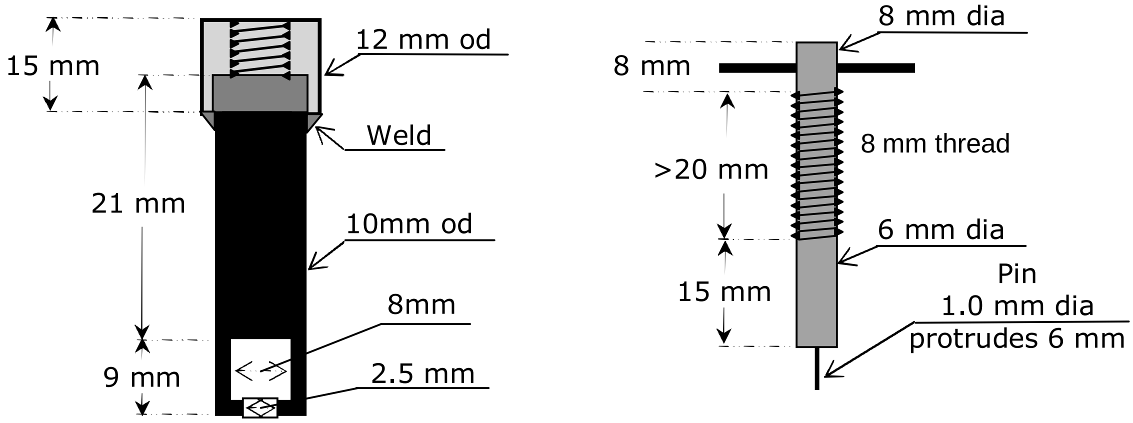
Once the clock has been removed from the case, remove the electric winding mechanism by undoing three nuts holding it in place. The winding mechanism can then be pulled clear. Connection between the winding/mainspring assembly and the rest of the clock is by way of a pawl and ratchet – the pawl is part of the winding assembly and bears against a ratchet wheel that is part of the clockwork mechanism.

Next remove the hands. The time-setting boss/minute hand is tightly pressed on to the centre spindle and a tool is needed to remove this. A sketch of such a tool is shown in *fig. 1.6*. Without a tool like this, repair of these clocks is not practicable. Once the minute hand/time setting dog assembly has been removed, remove hour by twisting and pulling. This tool can also be used to dis-assemble the time setting knob assembly which is prone to sticking due to corrosion on the setting knob shaft.

Once the dial is removed, the clockwork mechanism can be dismantled. Note there are two items that cannot readily be separated from the support plates; the balance assembly and the minute wheel. A special tool is required to remove the balance assembly hairspring from its anchor post and a further tool to remove the hour driving wheel. Also, the balance wheel hairspring is passed through the regulator curb-block. If you have access to a tool to remove the hairspring securing pin make a note of this for reassembly. With care the balance need not be fully removed and can be cleaned and lubricated in-situ.

FIGURE 1.6: KIENZLE MINUTE HAND AND TIME SETTING BOSS PULLER:

Material: SILVER STEEL



Holding the clock mechanism vertical in a small vice undo three nuts on the front support plate. This will free the balance front bearing/endshake adjustment plate. Remove this and the front support plate can then be lifted clear. The centre spindle will stay with the rear plate as should most other components. The hour wheel will be released, it is held in place by the centre spindle and the captive minute wheel.

Fig. 1.7 below shows the partially disassembled clockwork mechanism. This is a standard clock works comprising a gear train, escapement and balance wheel type regulator. To clean, soak in isopropyl alcohol for an hour to soften any oil-bound dirt. Wash the parts with a small brush then peg all pivot holes (refer Appendix B) and rinse support plates. Clean all spindles and pivot journals with manila card or craft paper that has been wetted with solvent. If absolutely necessary, polish rough spindles with metal polish and thoroughly clean.
Rinse parts and allow to dry. Note that the balance endshake adjusting screw will be locked with lacquer below the plate. Dip a cotton bud in nail polish remover or acetone and use to remove this lacquer.

FIGURE 1.7: View of clock with front support plate removed. Numbers below each label indicate the order in which these wheels are replaced when reassembling the clock.

Reassemble the wheels as shown in *fig. 1.7* lubricating the pivots as you go. The lever has a "cage" on the arm that meshes with a pin on the balance wheel. Make sure that these mesh and line up before fitting the front support plate. There are two brass posts, or "banking pins", attached to the underside of the support plate and the lever arm must sit between these. In later clocks, with the capped minute wheel pinion (*fig. 1.5*), pass the centre wheel spindle through the hour wheel as you assemble the clock. A bit of "jiggling with a pair of tweezers will almost certainly be needed to get the pivots lined up with the holes. Once the front support plate is in place, and everything aligned, fit the balance front bearing support plate and align the pivot with the jewel bearing then secure the assembly with the original screws.

Check the balance endshake and adjust so that there is just discernible endshake in the balance assembly. Lock the adjusting screw in place with new lacquer (or nail polish) and allow the lacquer to dry.

1.6. Repairing the winding mechanism:

The figures below show the electrical winding mechanism of the Kienzle type 607 car clock. *Fig.1.8* shows the complete assembly within the clock and *figs 1.9 & 1.10* show its components in assembled and disassembled forms. The fusible link had been removed from this particular clock previously and replaced by the short wire between the power supply terminal and the coil, visible in *fig. 1.10*. Any further disassembly of this winding mechanism is not necessary if the coil is sound.

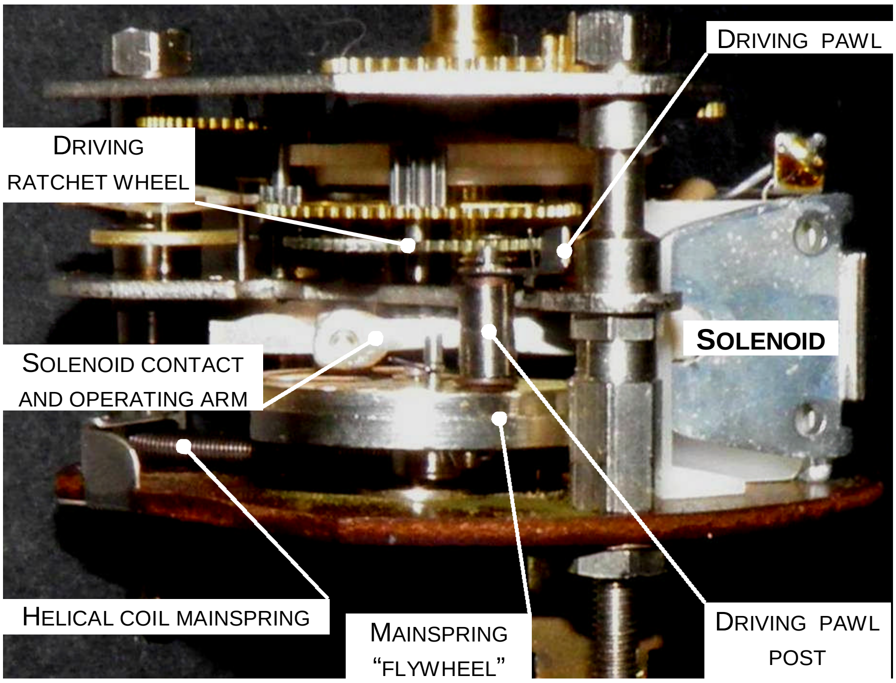


FIGURE 1.8: Internal view of a Kienzle electrically wound clock showing the main winding mechanism components. When the solenoid operates, this pawl rides over the teeth on the driving wheel and re-engages.

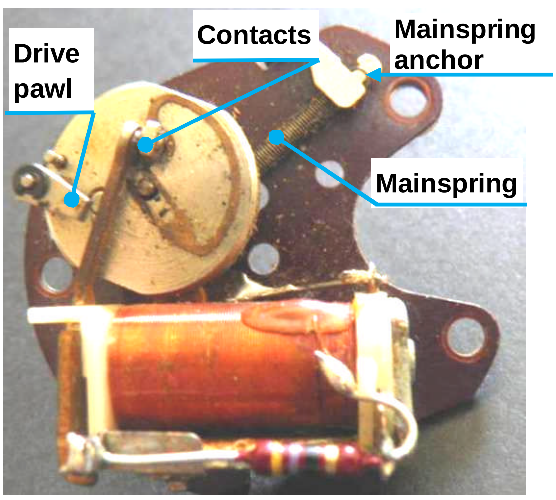


FIGURE 1.9: Kienzle electrically wound car clock winding mechanism. The mainspring is attached to a post beneath the flywheel/contact assembly.

The circular piece of copper on top of the flywheel provides electrical contact from a metal grounding plate beneath the base-board. It also serves to retain the flywheel on its shaft. Earlier clocks have a standard type circlip here..

The drive pawl is retained on its shaft by a small circlip.
A nut on the coil assembly retains the armature. Removing this nut allows the armature to be removed thus permitting removal of the flywheel. The coil assembly is peened to the fibreboard base plate.

If disassembling the winding mechanism to the extent shown in *fig.1.10*, or when removing the armature, be very careful. The armature is clamped beneath a plate to which both the swamp resistor and the coil lead are soldered. Gently swing this clamp plate (see *fig 1.3*) away from the assembly support plate and move as little as possible, consistent with permitting the armature to be removed, in order to avoid breaking the coil lead. Alternatively unsolder the resistor and coil lead before removing the clamp plate and armature.

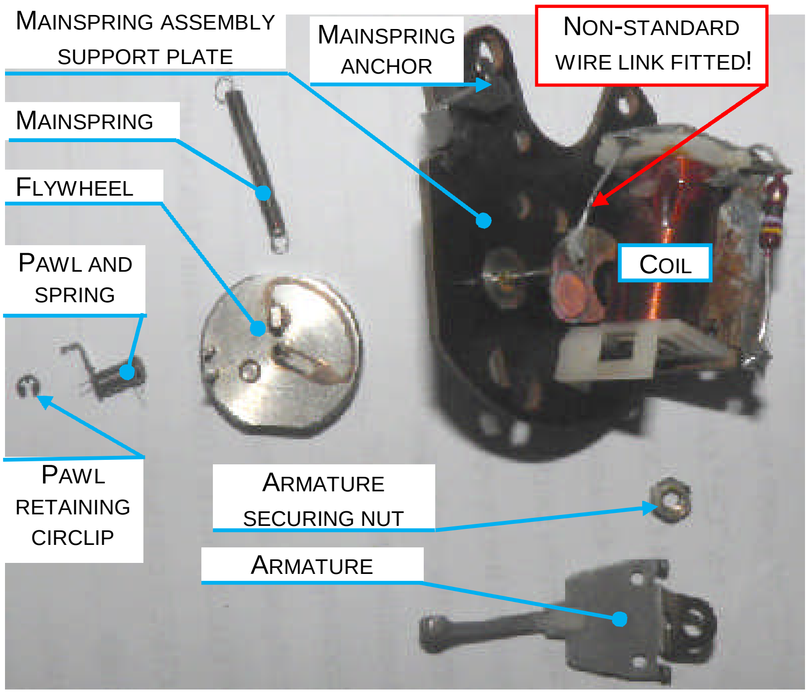


FIGURE 1.10: Component parts of the electrical winding mechanism.

The pawl mounts on the longer of the two pins visible on the flywheel beside the pawl. The upper pin is an anchor for the pawl spring.

The mainspring sits below the flywheel; the base of the pressed-in anchor post can be seen near the pawl mounting post. The other end of the mainspring hooks onto the anchor on the support plate and the spring itself sits below this.

The armature is connected to the coil assembly by a nut that threads onto a stud on the body of the solenoid (not visible). The connection is by way of a phosphor bronze spring plate attached to the armature in later clocks. Set so that armature sits flush against the core of the solenoid when energised.

Clean all the parts. An interdental brush can be used to clean the bores of the flywheel and driving pawl.

Note: Different solenoids and mainsprings are used in these clocks. If making one clock from several, do not swap these items. Keep mainsprings and solenoids together replacing winding mechanisms as complete units.

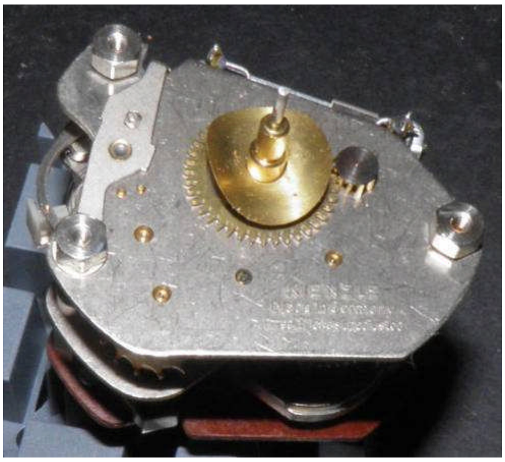
Once all parts have been cleaned and dried, re-assembly is straightforward. Dress the contacts with a points file or emery paper. Clean the contacts with solvent to remove any dirt or abrasive residue. Lightly oil the flywheel and driving pawl pins. ***Preload the mainspring by turning the flywheel one turn from its at-rest position before fitting the armature.*** Hold the armature square against the solenoid core then tighten the securing nut. There is no lock washer under the armature securing nut, so lock with lacquer. Check that the armature is clear of the clock frame and flywheel. Briefly connect a 12V supply between the supply terminal and the metal grounding plate. The coil armature should give the flywheel a good kick. If that happens then it is good to go.

1.7. Final assembly:

Fit the clockwork and winding mechanisms together ensuring that the pawl engages properly with the ratchet wheel. ***Ensure the pawl firmly contacts the ratchet wheel. If the pawl tension spring is weak, a full turn beyond the point at which its spring first applies pressure to the pawl may be required. Failure to check this can cause the winding mechanism to chatter and open the fusible link.***

Secure the winding assembly with the three nuts. Check that the clock winds and runs when the clock is connected to a 12 Volt supply. Should it fail to run then find out why. If the winding mechanism "chatters" then recheck operation of the pawl and ratchet. Place the regulator quadrant at its mid-point. The clock works should now look like that in fig. 1.11.

FIGURE 1.11: Assembled clock ready to fit to the case. The late dial assembly fits on top of this movement, the three protruding hexagon screw heads fitting into corresponding moulded sockets on the plastic dial backing/support plate,
Older clocks have dial support plates attached to the top of these screws. (*Refer fig. 1.14 below*)



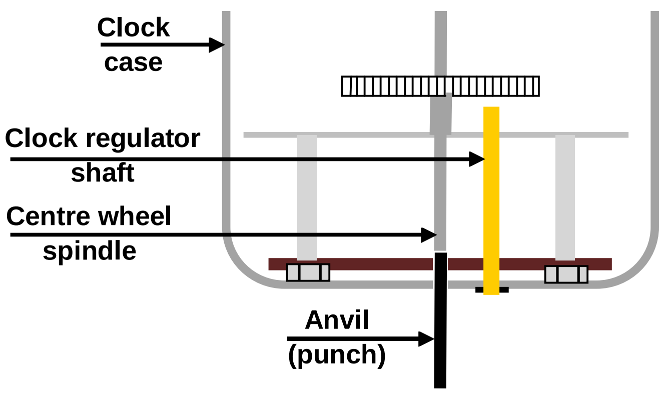
It is *easier to* fit the works into the case before fitting the dial, particularly when the supply terminal blade has been bent. This works for the later clocks with a plastic dial carrier and those with a screw mounted dial. There is a third type of dial mount in which the dial plate is retained by three tangs bent over legs on a dial support plate and this dial must be fitted to the works before fitting to the case.

Fit the works to the case and tighten the nuts:

With the clock face-up, lightly oil and place the washers on the hour wheel and place the dial assembly over the works ensuring that the nuts sit in the moulded sockets of the dial assembly. Fit the hour hand at the 12 o'clock position ensuring it is pressed fully home against the shoulder on the hour wheel. The fit should be firm. To fit the minute hand use a press, if available, or a small hammer (≤ 4oz). A suitable anvil is required to support the centre wheel spindle. This anvil may take the form of a 3mm diameter rod or punch held securely in a small vice. Press the minute hand in place and align.with the hour hand at 12 o'clock. With the anvil held vertical, sit the rear end of the centre wheel spindle on it – see *fig. 1.12* - and firmly press or tap the minute hand boss onto the centre spindle as shown in *figs 1.12 & 1.13,* ensuring you strike the top of the boss squarely. Check that the minute hand assembly does not interfere with the hour hand and that discernable endfloat in the minute hand is present. Fit the dress plates. Fit the bezel in place but do not re-spin it yet.

FIGURE 1.12: Cross-section diagram of clock showing centre spindle and means of supporting it while fitting minute hand assembly. A 3mm punch or rod held securely in a vise is passed through the holes in the case and baseplate to support the centre spindle when fitting the minute hand assembly.

Drive the minute hand onto the spindle until the top of the spindle is level with the bottom of the grooves in the minute hand boss as shown in *fig.1.13* below.



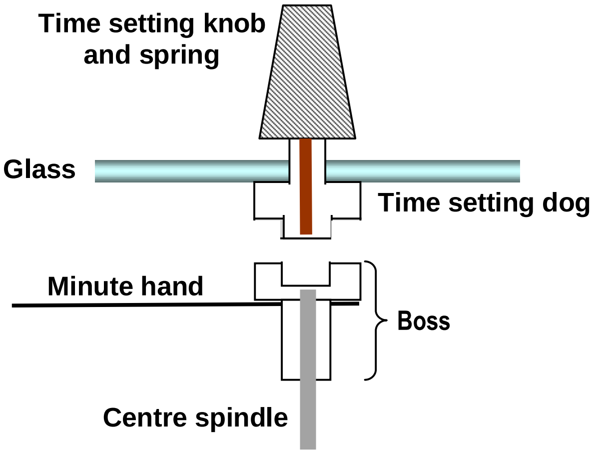


FIGURE 1.13: Cross sectional sketch of minute hand and boss showing the final position of the centre spindle (grey) within it. Photograph on right is a purpose-made anvil to support the centre spindle when fitting the minute hand assembly. (*Refer Fig. 1.12 above.)*
The centre shaft position is not absolutely critical but the pointer assembly must not foul on the dial or hour hand. The time adjusting mechanism must be clear of the boss but must fully engage when the time setting knob is pressed in. Note that the shaft in the time-setting dog (brown) is set flush with the surface of the tooth.

Run the clock for at least 24 hours to check timekeeping. Adjust regulator as required. If you look closely at the case you will see "+" and "-" marked beside the regulator screw indicating increase or decrease of clock speed respectively. Adjust as required but only in small increments until timekeeping is acceptable (within a minute per day).

If you have made a jig similar to that shown in Appendix A then place a 1 – 2 mm thick shim into the recess and sit the clock face down into the jig. A strip of plastic film placed around the edge of the bezel to tighten it in the jig will help to re-spin the bezel and protect a painted finish. Roll the edge of the bezel over the rim of the case with a suitable tool, pressing down on the clock as you go. When finished, place a piece of adhesive tape over the centre hole and regulator screw to minimise dust ingress to the clock.

Figure 1.14 shows variations in dial mounting methods found between clocks of this type. Typically, earlier clocks will have a wire passing throughthe rear of the case to connect to the power supply where later clocks will be fitted with a spade terminal.

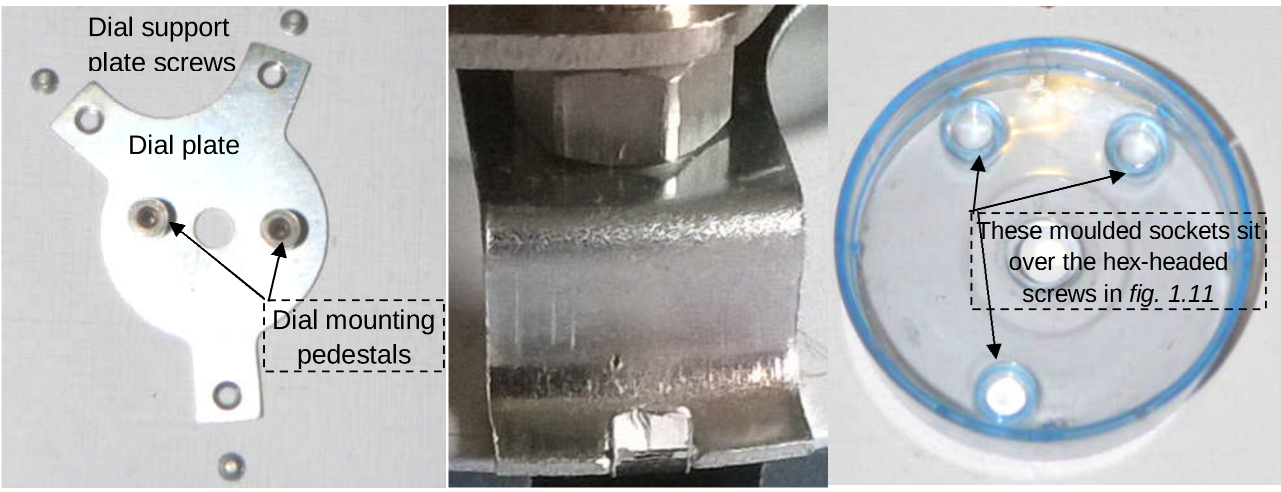


FIGURE 1.14: Several methods of fitting the dial plates are used within these clocks. Some clocks (early on left) have a flat dial support plate secured to the front of the clock with raised, threaded pedestals for the dial mounting screws Other clocks (later centre) have a similar dial support plate with formed legs supporting the dial plate which is secured with crimped lugs. In later clocks (right) the dial attaches to the plastic carrier by the mounting lugs which enter into slots in the plastic carrier and are bent over to fix the dial in place.

Fig. 1.15 shows a VDO branded solenoid assembly (3-7-10-SA 12/24V) from an unknown electrically wound clock. This solenoid is protected against damage by a bimetal strip that opens the circuit when heated by continuous or excessive current.

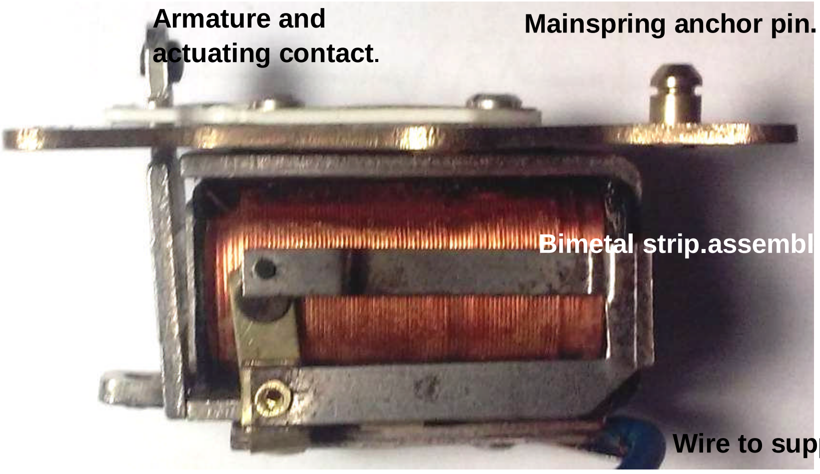


FIGURE 1.15: VDO replacement solenoid for electrically wound clock.

1.8. Other brand clocks:

Similar clocks to the Kienzle electrically wound clock exist. Many American car brands through to the 1970s used electrically wound type clocks. The photograph in *fig. 1.16* at right is of a Borg branded clock. Similarities with the Kienzle clock are clear. This is a 1970s era clock.

This particular clock is assembled with swaged fastenings and is clearly not designed to be serviced. With care the clock can be dismantled though parts are unlikely to be found other than in "donor" clocks that may be acquired.

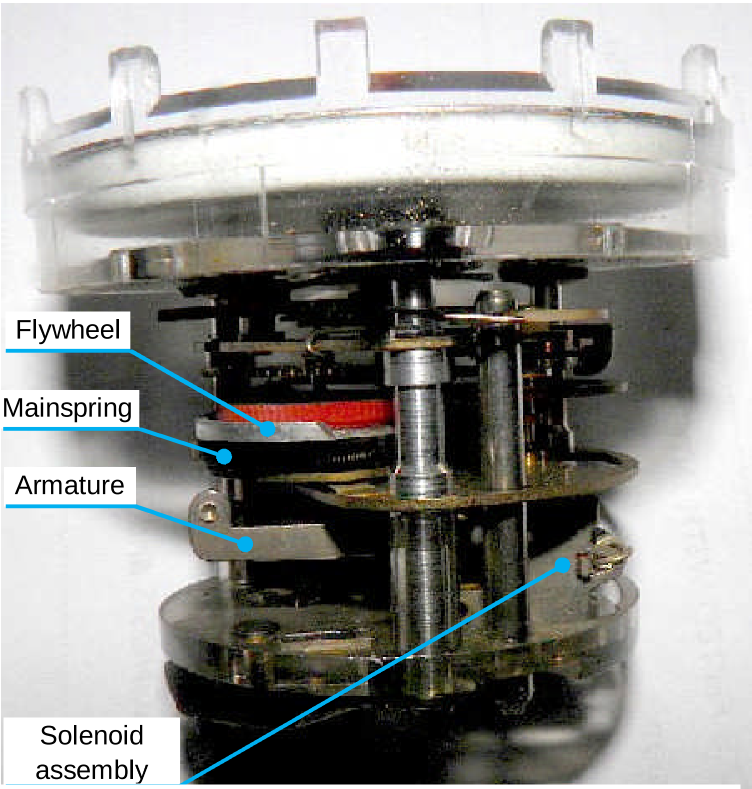


FIGURE 1.16: Another brand of clock. This electrically wound clock is branded "Borg". Photo shows similarity to the Kienzle electrically wound clock.

2. *Transistorised impulse clock*

A later style of Kienzle clock, fitted with a second hand. This is a polarity sensitive (-ve earth only) clock and resembles that used by Smiths in their "CET/CTE" series clocks. In this clock the two coils are fitted to the circuit board and the magnets are incorporated in a balance wheel supported in two jewel bearings. Rather than hairsprings (Smiths CTE clocks had fixed magnets and coils on the balance with three hairsprings attached to the balance wheel to connect everything), these clocks are regulated by torsion in a helical coil spring. The electronic circuit used two transistors, one as a trigger device and another to provide the pulse to drive the clock mechanism, which is still a clockwork type mechanism. These clocks are self-starting.

The construction of these clocks is such that all electronic components, including coils, are mounted on a removable circuit board with no need to disassemble the mechanical portion of the clock. Since failure of the electronic components is the most likely means of clock failure, this construction makes for a simple repair.

The clock mechanism is mostly plastic but the centre wheel spindle is steel running in a pivot hole in a metal plate. This pivot hole and the associated spindle journal will need cleaning and lubrication. Lubricate as a minimum.

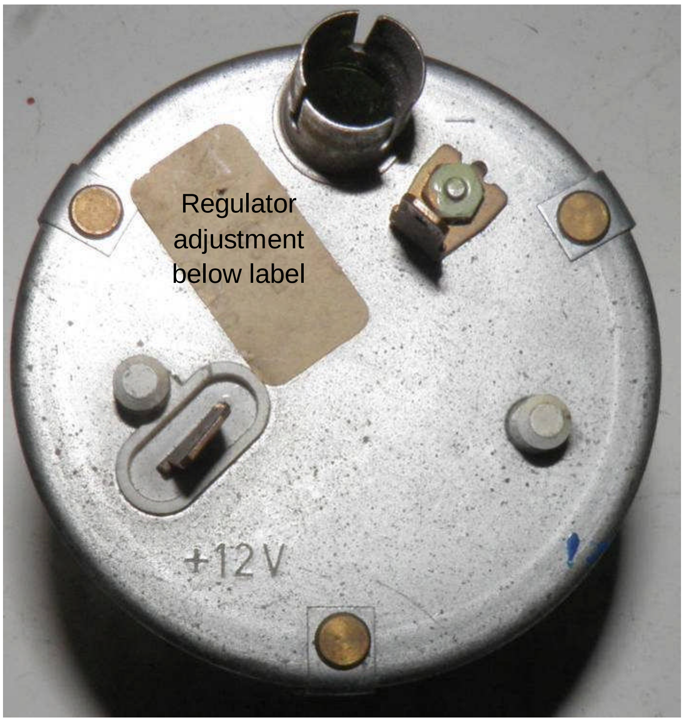
2.1. Disassembling the clock:

Remove the bezel (refer Appendix A). There is a single nut holding the clock mechanism in the case and the earth terminal to the rear of the case. Undo this nut and press firmly on the supply terminal. The entire clock is then withdrawn from the case. There is a moulded plastic insulator that fits over two of the internal studs and around the supply terminal. This may come away with the rest of the clock or it could stay inside the case. Don't lose it! Carefully remove the minute and hour hands. These are mounted on hexagonal bosses and can be easily pulled free and passed over the second hand. Remove two nuts from the rear of the clock. A long shouldered nut is located on the stud adjacent to the coil assembly. The other nut fits over the stud adjacent to the supply terminal.

Figure 2.1: Showing the rear of the case prior to removal of the internal assemblies.

The nut retaining the internal assemblies and the earth terminal can be seen in the upper right of this photograph. Note the paint/lacquer locking this nut in place.

The adhesive label carrying a manufacturing date code also covers the clock regulator control.



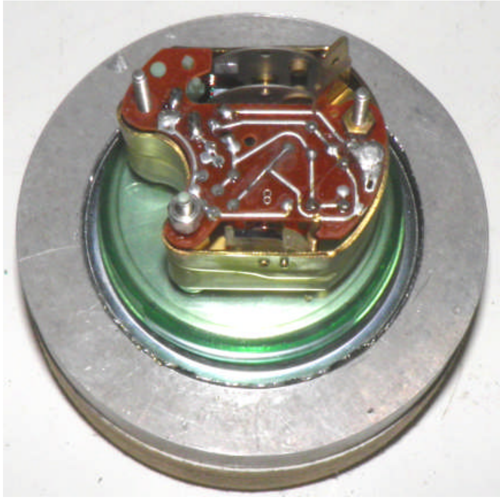


FIGURE 2.2: Showing the clock internal works as removed from the case.

The clock is sitting in a simple jig to prevent the bezel splitting and it works well the first time the bezel is removed.

A brass nut on the stud beside the +12V terminal and a plated steel shouldered nut below the earth terminal retaining the internal assemblies can be seen in this photograph.

Gently remove the printed circuit board. Some resistance will be felt here as a spring clip connects to one of the studs below the circuit board. Refer to fig. z which shows the earth contact. Using a small screwdriver gently prise this upward and the board should come free. There is a nylon insulating bush under the board below the supply terminal. This simply pulls off. Refer to *fig. 2.4*.

The balance assembly can now be lifted off the studs. *Fig.2.3* shows the major sub-assemblies of this clock.

If you observe the area around the gear train assembly you will notice that the dial assembly is retained by two moulded nubs that are part of the dial assembly. These can be seen circled in *fig. 2.11*. Press lightly outwards and downwards to free them. Once they are "unclipped" the dial assembly can be withdrawn over the second hand and put to one side.

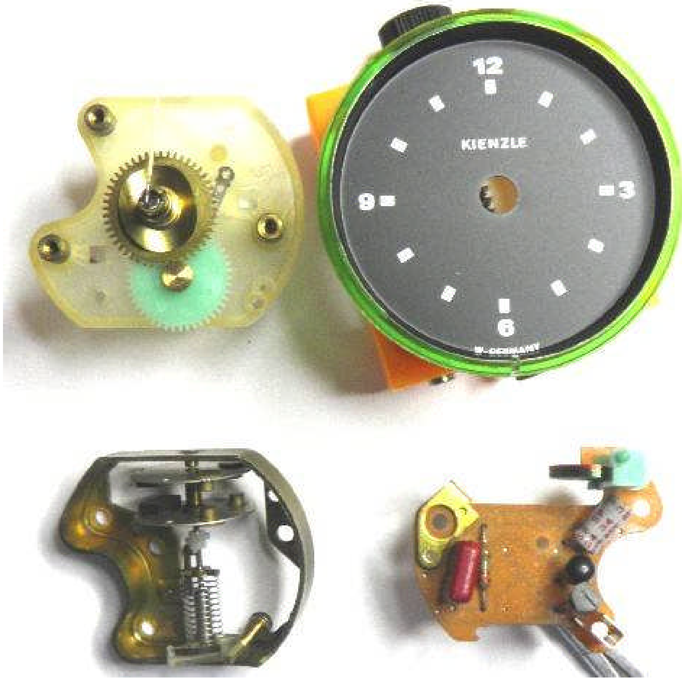


FIGURE 2.3: Major sub-assemblies of a Kienzle impulse clock. Clockwise from upper left:

Gear train and clock frame assembly

Dial assembly

Circuit board

Balance assembly

The only repairable part is the circuit board. The balance wheel endshake is set at manufacture and the adjustment nut is locked with solder.

The metal strip visible below the gears of the gear train is a spring that bears against the impulse wheel spindle. A similar bronze spring on the balance assembly provides a thrust bearing for the centre spindle (second hand).

Carefully remove the gear train bearing plate which is pressed over two moulded posts on the rear of the clock frame. (It is also retained by the balance assembly when the clock is assembled.) Do this with the front (dial side) of the frame down as this will release most of the gears in the gear train. The centre spindle can then be gently pulled free which also releases the second hand. Be careful not to apply side forces while removing this wheel. It passes through a moulded tube on the frame and this can be broken rendering the clock unserviceable. (This is the easiest way of removing the second hand without damage.) There is a green intermediate gear retained with a brass pin which must be removed before the minute and hour hand gears are free. Mark which of the three holes this pin sits in and drive from the frame with a (very) small hammer and punch. A sewing needle with the eye and the point ground off does a great job as a punch here. Support the frame clear of the green gear while doing this.

All the mechanical components are ready to be inspected and cleaned. Due to the several types of plastic present, isopropyl alcohol is a good solvent to use and is readily available. Clean with a small brush, making sure all traces of dirt are removed.

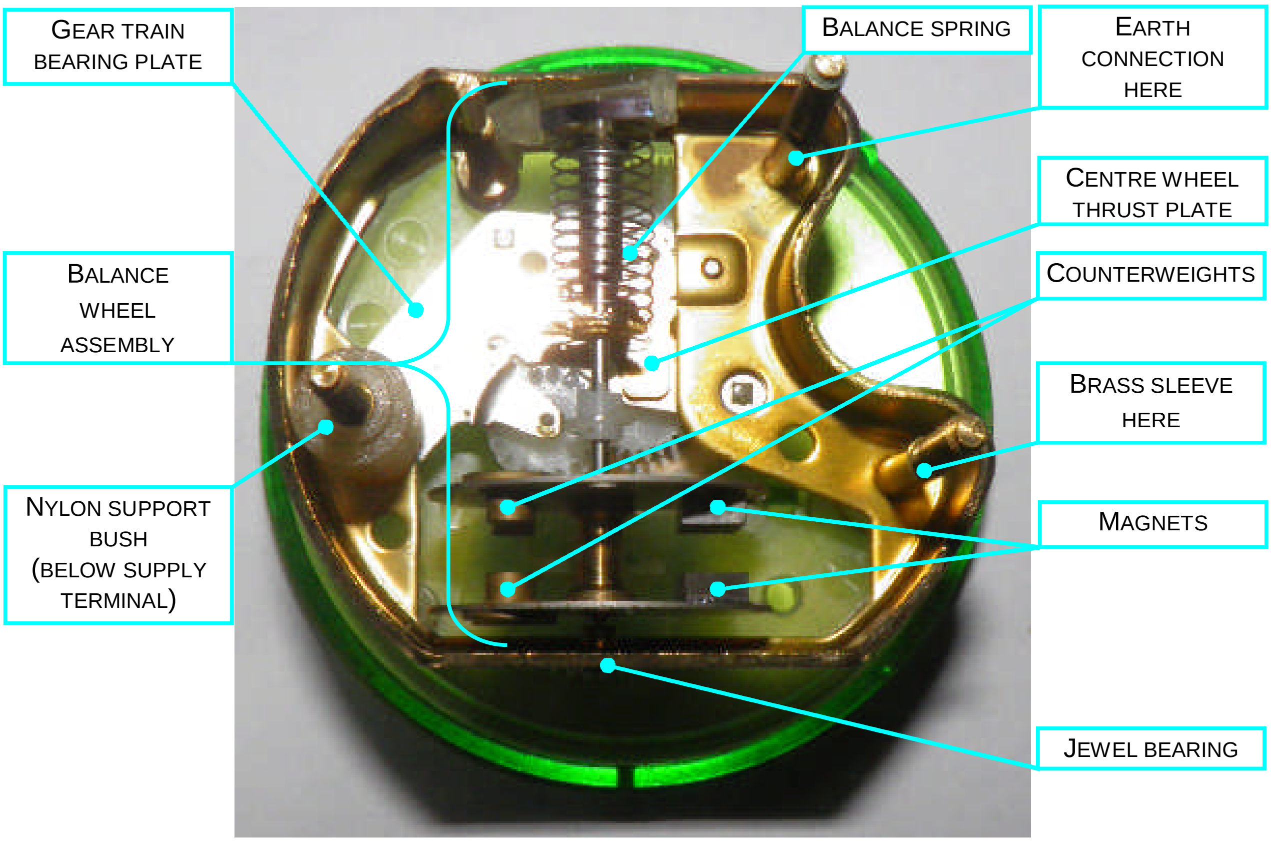
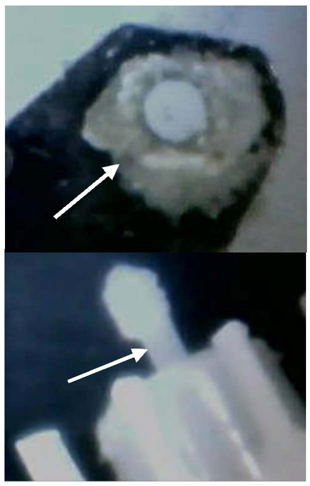


FIGURE 2.4: Balance and clock frame assemblies of a Kienzle transistorised clock. The clock has been removed from the case and only the circuit board removed in this view.

Pay particular attention to the impulse wheel pivot in the bearing plate (figs 2.5, 2.10).

FIGURE 2.5: Showing damage (arrows) to impulse wheel pivot. Evidence of damage, the white plastic dust around the pivot hole (upper photo), was visible once the circuit board was removed from the clock assembly. The lower photo shows abrasion of the plastic pivot. There is not much you can do about this and the cause of this damage is not known for certain. So far this damage has been noted in one clock only.



This clock was running very slow and losing tens of minutes a day. At times the second hand was seen to be stopped but later would start moving again of its own accord.

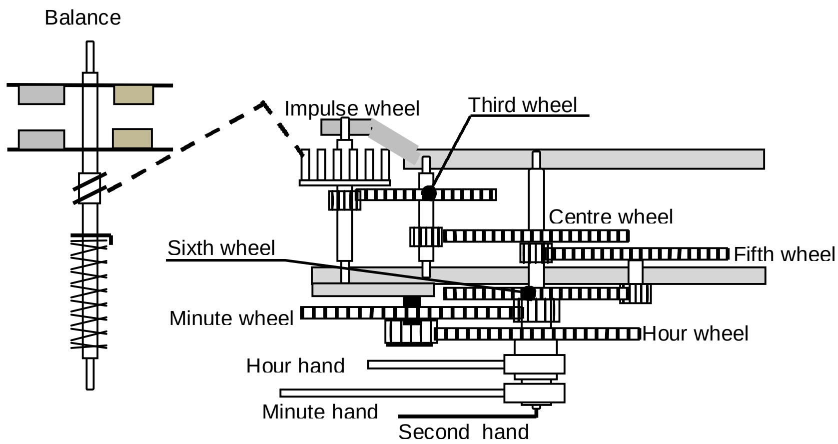
There is a certain amount of side loading on this pivot and presumably this has caused the wear against an unlubricated (?) metal surface.

2.2. Transistorised Impulse clock mechanical schematic diagram:

The diagram in *fig. 2.6* below attempts to show a mechanical schematic of this clock. Wheel numbers are normally numbered from the power source, mainspring, weights or motor, increasing in number until the regulator is reached. In these clocks the regulator and the power source are one and the same so I have numbered accordingly which would have the balance as the "first" wheel etc. References to the different components will use these names.

FIGURE 2.6: Mechanical schematic of this transistor impulse clock.

The dashed line shows where the balance drive gear connects with the impulse wheel. The balance itself is at a right-angle to the remainder of the gear train.



2.3. Transistorised Impulse clock circuit board schematic diagram:

The electronic circuit (*fig. 2.7*) and board (*fig.2.9*) of these clocks are shown below. Other than the coil assembly, there is nothing special about the components on this board and provided the mechanical parts are in working condition, repair should be a practical undertaking by an owner with a basic electronic knowledge.

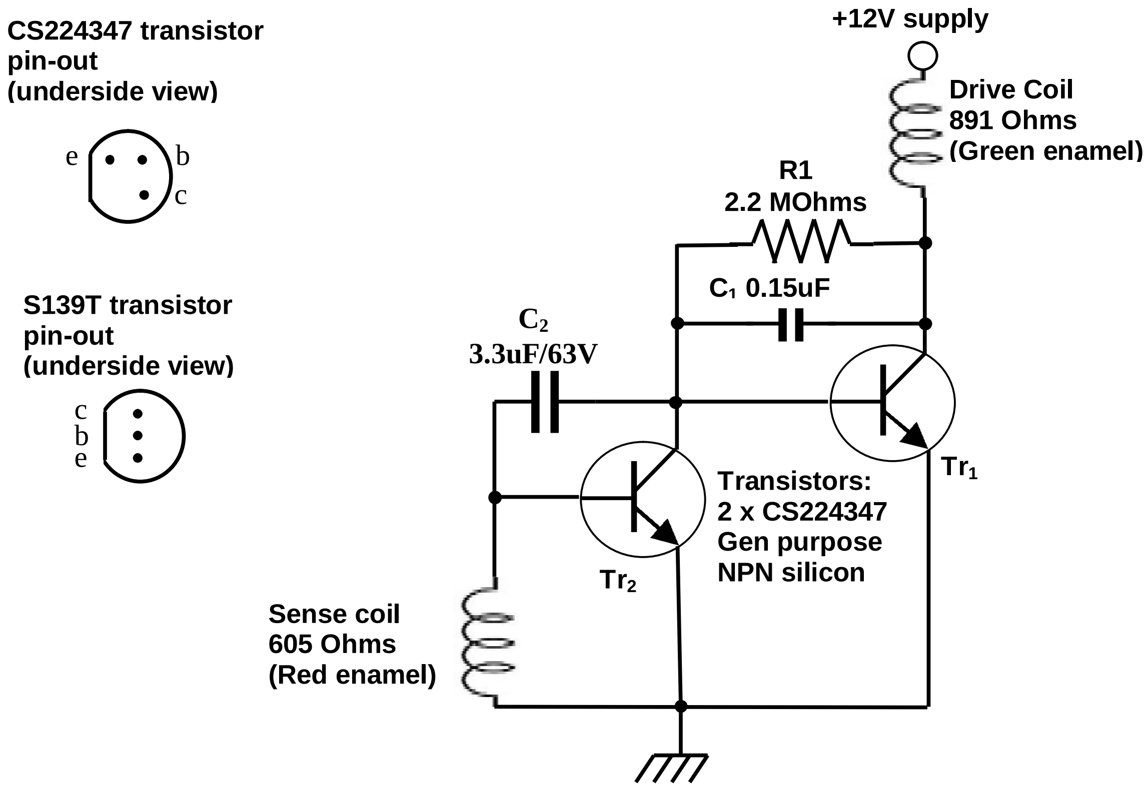


***Figure 2.7*:** Circuit diagram of Kienzle electronic car clock. Coil resistances are as measured on a clock to hand. Measured values in other clocks may vary from these but should be similar.
Transistors found in another clock of this type were marked "S139T"

Almost any general-purpose, small signal, NPN transistor such as a BC547 or 2N2222 will work in this circuit. Capacitors and resistor are standard E12 values and should be easy to source if needed.

Only damage to the coil assembly itself should impair repair of one of these clocks. This could only really happen if it has been damaged while removing the circuit board.

Note: If you have done any work on the circuit board, such as replacing transistor(s) then check the earth connection (Refer *fig. 2.8*). The spring clip that provides connection to the frame is held by a single through-hole pin and soldering around this pin may weaken this joint. It may also fail simply by removing the circuit board. If you have removed the circuit board from one of these clocks then it is worthwhile to re-make this connection once the circuit board is back in place and before final assembly of the clock.

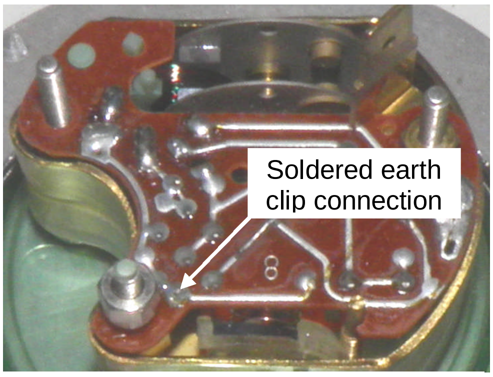


FIGURE 2.8: Location of earth connection. Soldered joints are poor mechanical joints so re-solder before final assembly of clock.

The electronics need to be checked which is readily done with a multimeter. If it is known that the clock has been connected with the wrong polarity, replace both transistors and C_2. Check the coils for continuity and if these check out fit the balance assembly to the frame and connect 12 Volts. Clock should start.

Regulation of these clocks is again at the rear of the clock and is achieved by altering the effective length of the helical balance wheel spring.

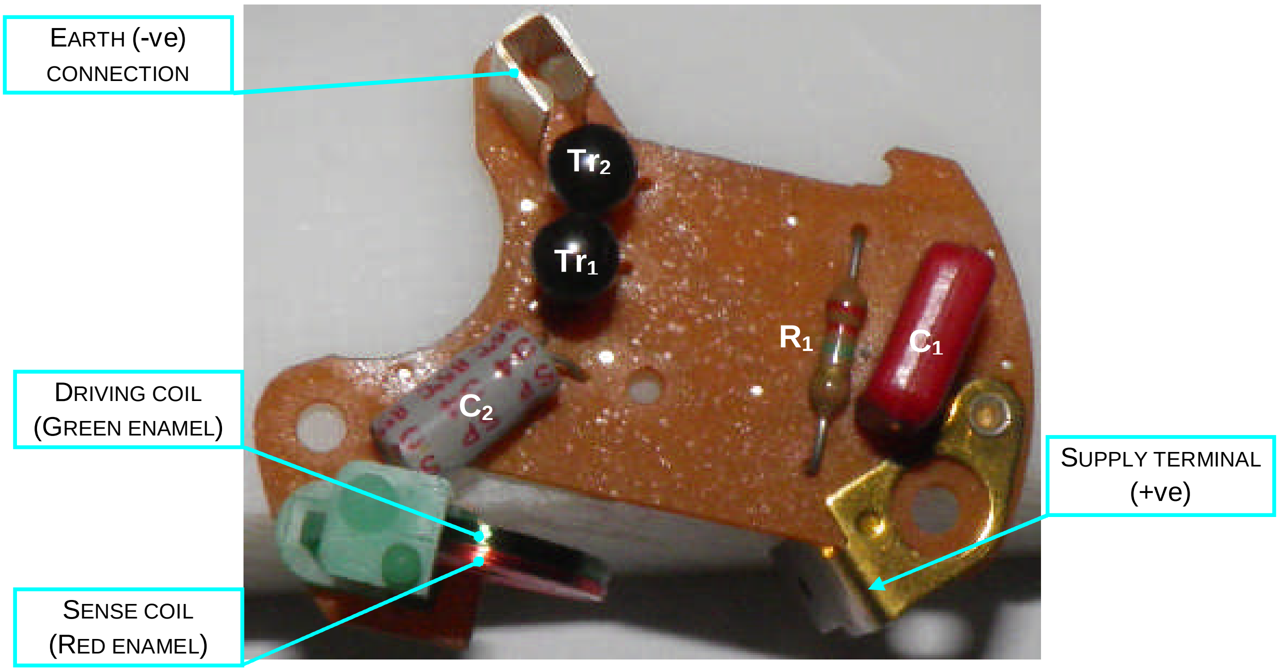


***FIGURE 2.9*:** Component (under) side of circuit board of a Kienzle transistor impulse clock.

2.4. Reassembling the clock:

Fig.2.10 shows most of the mechanical components of the clock. Reassembly is not hard but there are several points to note here:

The "sixth wheel" sits between the minute and hour wheels. The minute wheel must be in place before the fourth wheel and associated pin are fitted. Fit these two items before assembling the rest of the movement.

The centre wheel spindle has a steel spindle running in the metal support plate. This will need to be oiled during reassembly. Not shown is a small steel washer that sits between the centre wheel and frame. Lubricate with a smear of low-viscosity silicone oil on each surface.

Don't fit the second hand until after the balance wheel assembly, circuit board and dial assembly have been refitted. The second hand fits to the centre wheel spindle and this is axially supported by a plate that is part of the balance wheel assembly (see *fig. 2.4*).

The "fifth wheel" transfers motion from one side of the frame moulding to the minute wheel on the other. The front bearing is the flat surface shown in *fig. 2.10*.

Place the frame, studs down, on a flat surface and fit the sixth wheel. Smear a trace of oil on the sixth wheel shaft and place the hour wheel over it. Slide the minute wheel, with the pinion facing up, between the two wheels, line up the pin and push the pin into its hole. Check that the teeth of these wheels mesh and tap the pin fully home. Lightly oil any metal pivots then fit the bearing plate. Turn this assembly over and fit the remaining wheels. *Fig. 2.11* shows the gears fitted to the frame and gives the order of fitting. Lubricate plastic pivots in metal bearing plate with silicone oil.

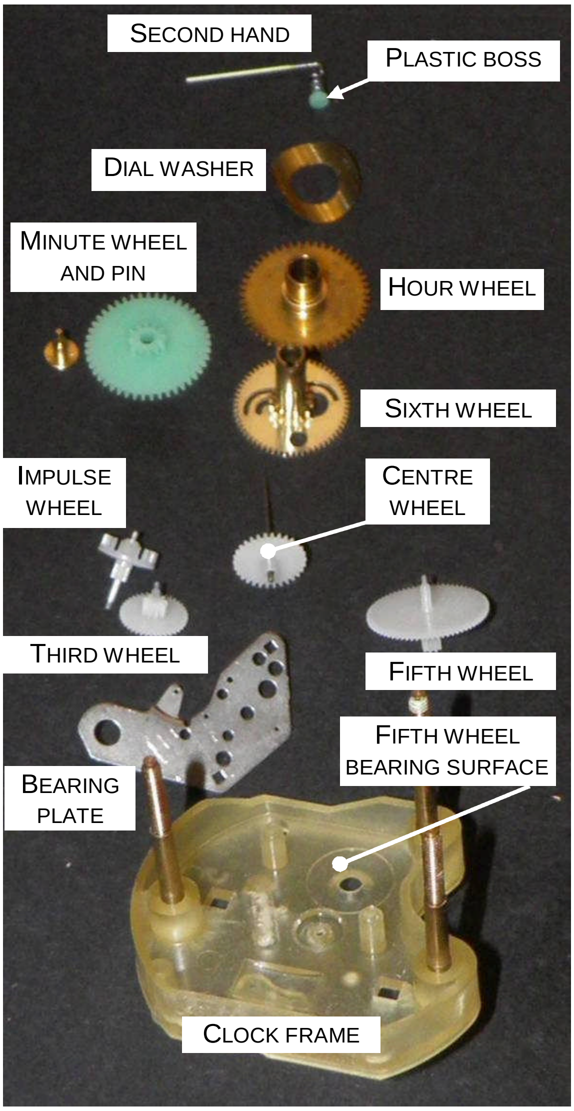


FIGURE 2.10: Showing the components of the transistor impulse clock gear train.

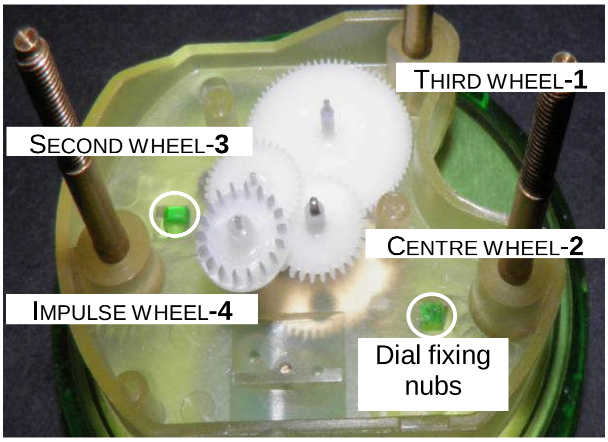


FIGURE 2.11: - **Reassembling the gear train:**

This photograph shows the wheel locations when assembled onto the frame prior to fitting the bearing plate. Numbers following the names indicate the order of fitting.

Oil pivots then place the support plate over the stud and gently lower onto the wheel pivots. With everything lined up press the support plate onto the moulded posts.

Dial fixing nubs are circled.

Ensure that the pivots line up with their respective holes in the bearing plate. Do not force the plate but ease down aligning pivots as necessary. Take care as the plastic pivots are easily distorted while refitting.

The balance assembly (see *fig. 2.4*) in these clocks should give little trouble. It is a robust unit and the jewel bearings should not wear significantly for many years.

Once the bearing plate is correctly fitted, fit the balance assembly and circuit board and secure with the correct nuts. Not shown is a brass sleeve that sits beneath the circuit board on the stud that has no nut. (Marked on *fig. 2.4*.)

Place a little oil on the upper face of the hour wheel shoulder and fit the plain washer (not shown) over the hour wheel pipe followed by the dial washer. Rotate the washer to spread the oil then fit the dial assembly and pointers. Test run for an hour or two to ensure the clock is operating reliably then refit to case and run for 24 hours to check timekeeping. Adjust regulator and recheck timekeeping. Repeat as necessary until error is less than one minute per day.

These clocks are quite similar to Smiths "CE" type clocks in that they have a similar Jaeger style drive method but use transistors to do the impulse coil switching. Unlike Sniths CE clocks they are self-starting. They also require a large swing of the balance wheel (about 540 degrees or 270 degrees each side of rest position) to advance the clock and anything that causes this swing to reduce has the potential to stop the clock. The main culprits here are damaged transistors or dirt. Spray lubrication of the works may stop these clocks due to excessive drag created by a "sticky" lubricant, particularly on the large surface area on the dial-side bearing surface of the fifth wheel.

3. *Quartz clock:*

A typical quartz electronic clock. The electronics drive a simple Lavet-type stepper motor which drives the hands through a train of plastic gears. Analogue car clocks since the mid 1970s are of this type. Black pin (circled) at lower right is time-setting shaft, less pressed-on knob.

This particular unit is of unknown origin but is similar to clocks fitted to some Jaguar cars. These clocks are built to be replaced rather than repaired.

3.1. Kienzle quartz clock mechanical schematic diagram:

Mechanically, the quartz clock is very simple. The first, second and minute wheels are compound gears reducing the r.p.m. of the motor to drive the centre wheel (second hand), third wheel (minute hand) and hour wheel at the appropriate reduced rate. R.p.m. for this motor is unknown but will be no more than one r.p.m.

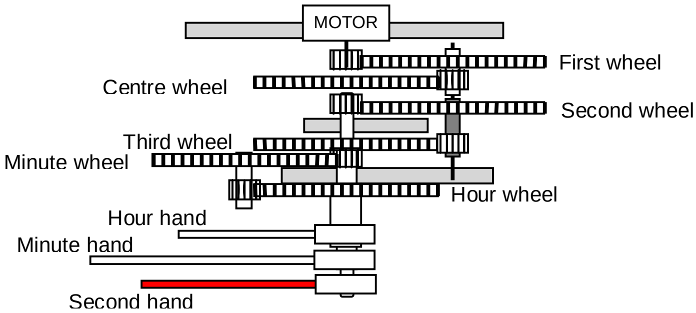


FIGURE 3.1: Kienzle quartz clock mechanical schematic

3.2. Kienzle quartz clock circuit diagrams:

Most of the works of these clocks are contained within an integrated circuit, marked "16551" in this clock, for which no equivalent has been found. Note that other VDO/Kienzle clocks (refer *fig 3.3*) employed integrated circuits such as the SCL5419AE (= SAJ300R?) but this IC has different pinouts. These integrated circuits are CMOS devices so suitable anti-static precautions will need to be taken when working with these circuit boards.

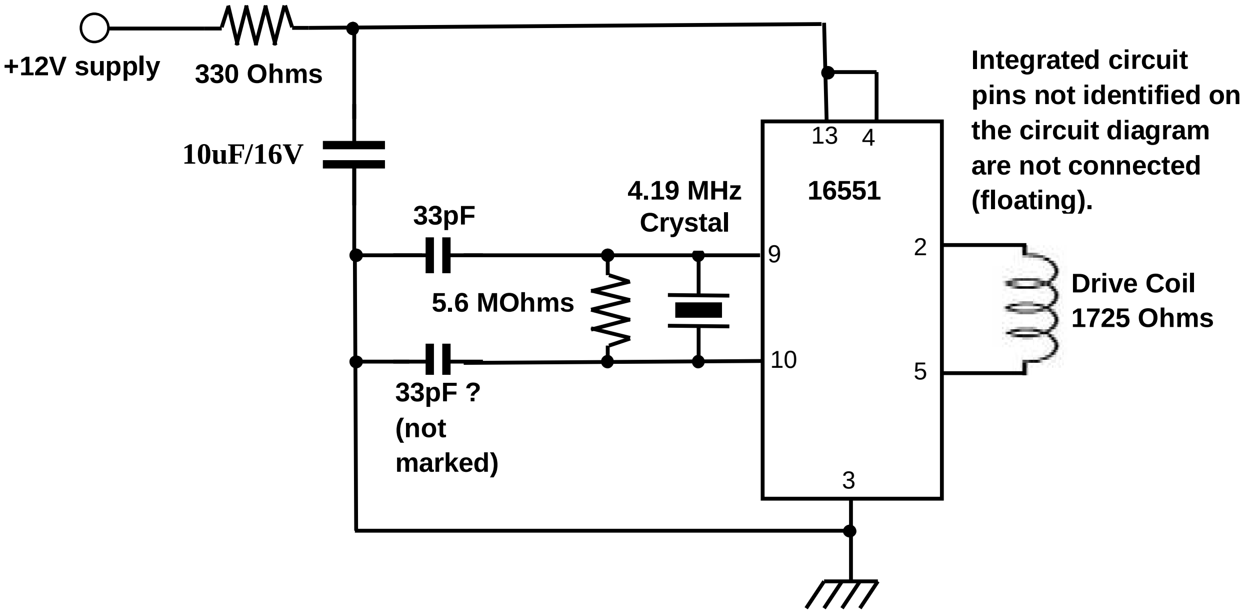


FIGURE 3.2: Kienzle Quartz car clock circuit diagram. Coil resistance is as measured on a clock to hand.

Component values set out in the circuit diagram, *fig. 3.2* are those from an available clock. Values may differ in other (later/earlier) clocks. The 4.19MHz specified on the circuit diagram is a "standard" frequency for this type of application.

An alternative circuit for these clocks is presented in *fig.3.3*.

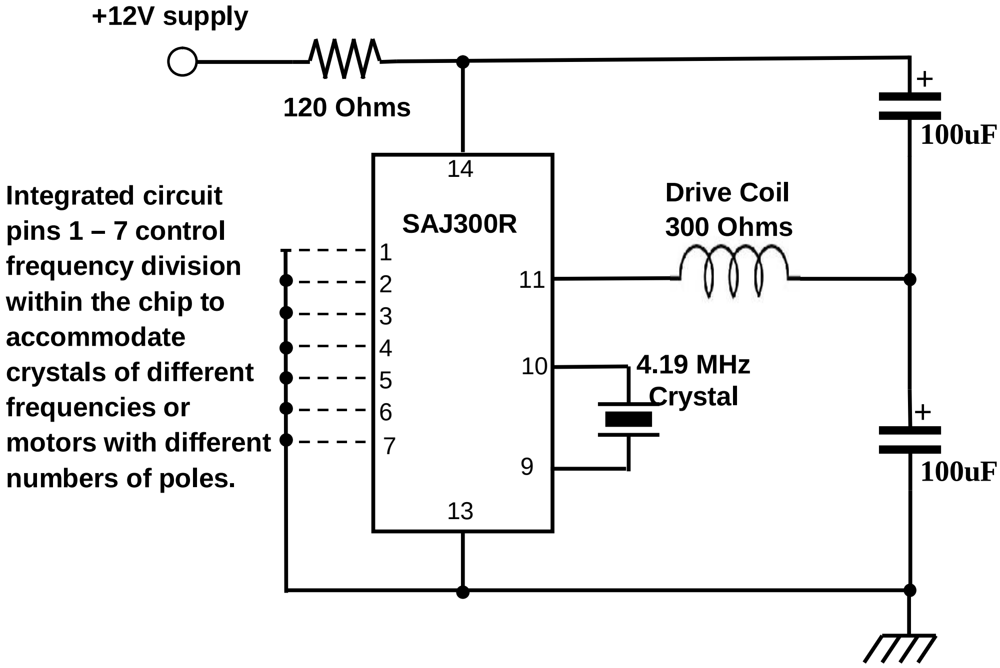
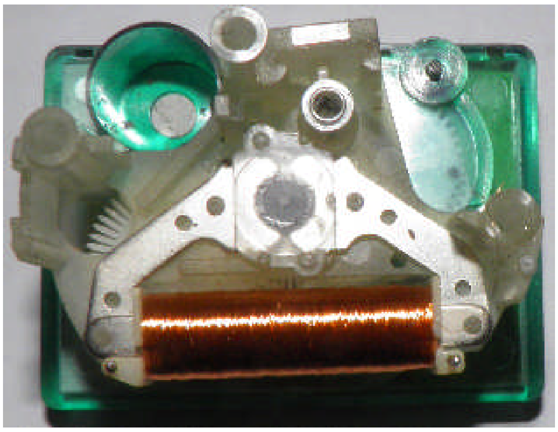


FIGURE 3.3: Clock circuit from ITT SAJ300R datasheet which is a similar circuit to that used in some types of Kienzle, and presumably other brands, of Quartz car clock.

The most likely cause of failure of these clocks will be due to reverse-polarity supply connection. The integrated circuit is unlikely to survive and the aluminium electrolytic capacitor may also show signs of distress – a domed top on the can. The motor drive coil also may overheat.

If servicing the circuit board be very careful when separating the circuit board from the clock itself. In this clock, two pins connect the circuit board and the coil. These pins are set in the plastic coil frame and unsoldering can release them from the plastic and break the very thin wire used (0.1mm or less). See *fig 3.4* above and *fig. 3.5* on next page. If this happens to the inner coil lead it can't be fixed short of rewinding the coil. The outer lead isn't such a big deal as it can be readily reconnected.



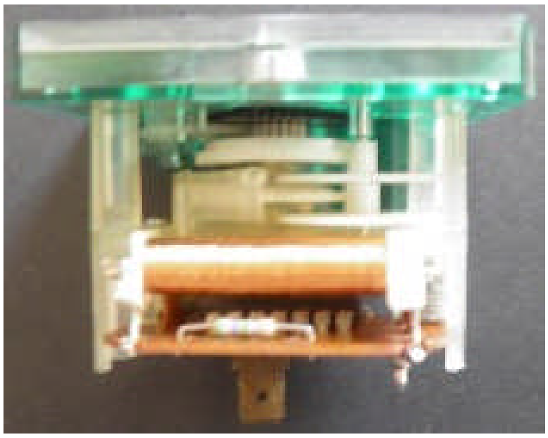


***FIGURE 3.4*:** Kienzle Quartz car clock:
Left - stepper motor. This sort of motor is in common use today for battery clocks and many modern automotive gauges. Pins at each end of the coil connect to the circuit board. If dismantling one of these clocks, be very careful removing these pins from the circuit board as they will almost certainly pull free from the coil former with heat and the coil wires broken. Hold with small pliers or forceps if you are dismantling the clock to repair.
Right – View of clock showing gear train driving minute and hour hands.

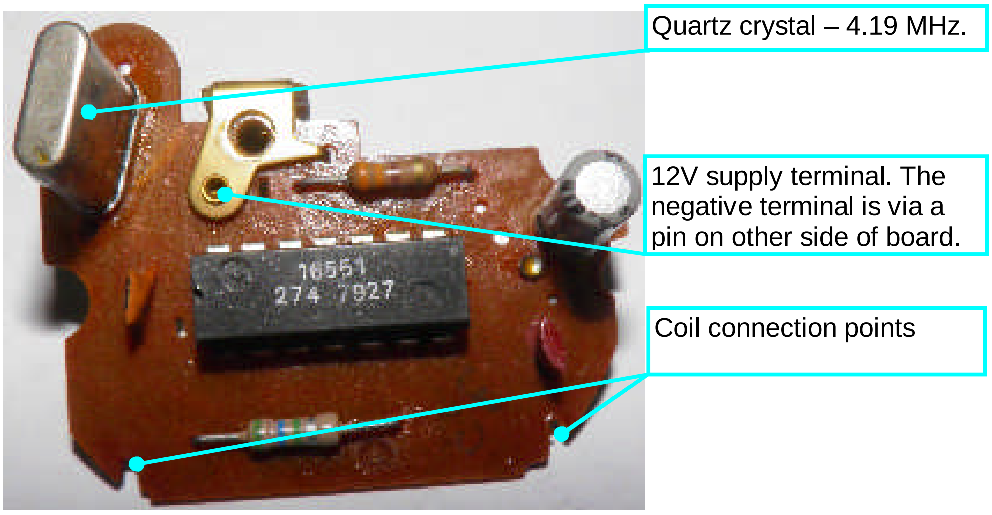


FIGURE 3.5: Kienzle Quartz car clock printed circuit board. The integrated circuit may be a “special” and no equivalent has been identified (yet). This integrated circuit is the most likely cause of failure – reverse polarity connected – and repair is a viable option if a suitable IC is found.

As noted near the start of this document, later clocks are designed to be replaced rather than repaired. This applies particularly to these quartz clocks and “repair” is not commercially worthwhile. It is doubtful that it is worthwhile repairing your own clock. In some cases it is not practicable to even open up a clock, though with this particular clock the internals are readily accessible.

Appendix A: List of tools required to service these clocks:

The following is a list of Tools and Equipment necessary for the servicing of Kienzle Electric Car Clocks.

Common tools:

Set of jewellers screwdrivers (blade)

Small Phillips or posidrive screwdrivers

Blade screwdriver (bezel removal)

Small vice (suction base – a suction base "hobby" vice is good)

Small parallel punches

Tweezers – needle-nosed

Magnifying glass/eye glass or similar

Small knife or blade (sharp)

Small hammer (tack hammer or watchmaker's hammer)

Digital Multimeter (Ohms, diode-check, Volts and mA)

Small soldering iron (<20W)

Special tools:

Hand puller (See *fig. 1.5* for electrially wound clock hand puller.)

Balance support †

Bezel removal jig (see next page) †

Centre wheel spindle support anvil

Consumables:

Peg-wood, skewers or toothpicks

Rosin-cored solder (18 SWG or finer.)

Clock or sewing machine oil

Silicone grease or petroleum jelly

Silicone oil

Replacement electronic components as required

Cleaning fluid (isopropyl alcohol)

Cotton buds

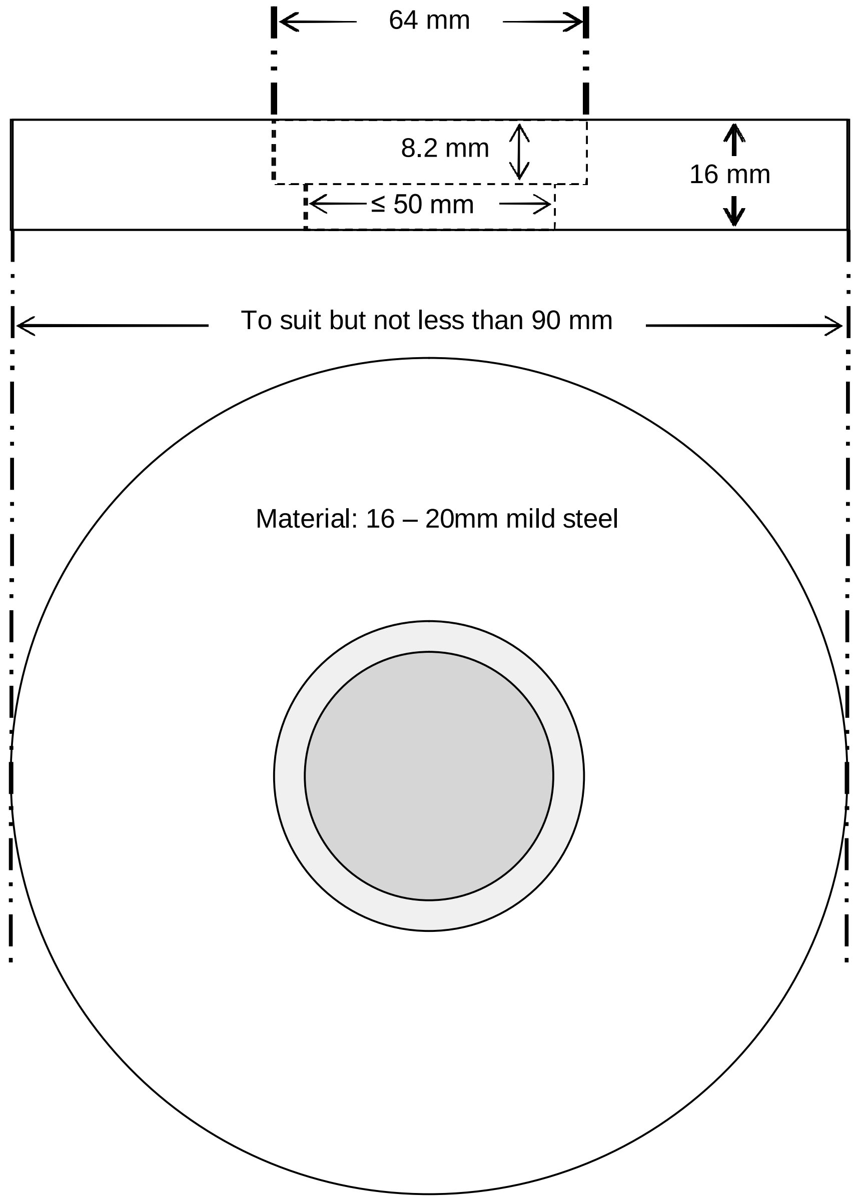
Isopropyl alcohol or similar solvent

Acetone or Acetone-based nail polish remover

Items marked † are readily made or substituted for.

Sketch of jig to support clock for bezel removal. This could be made from almost any rigid material, steel having the best longevity but for doing a single clock some scrap Perspex, or even tempered wallboard, could do the job. Cut a 64mm diameter hole with a hole-saw. The clock is placed face-down in this jig and the bezel “un-spun” by levering between the case and edge of the bezel around the circumference with a blade screwdriver. A hose clamp may be used for this job but needs to be repositioned to ensure the working area of the bezel is fully supported as you progress around the circumference. 12mm plate may be used but a plastic or wood spacer of at least 4mm thick will be needed to sit below the jig to ensure that no force is applied to the hand setting knob or “glass”.

A similar, suitably dimensioned jig could be made for removing any size spun-on bezel from a gauge.



The following is from a Smiths service document and shows the official tool for spinning (and unofficially re-spinning) bezels. This does a much neater job than any other method. Pressing the edge of a bezel over by any other method will result in metal "peaks" in the metal rim.

(Note: the official spun-on bezel removing method involves replacing the spinning wheel shown below with a cutter to cut the bezel off the gauge. This is fine when new bezels are plentiful but this is not likely to be the case for the clocks described above.)

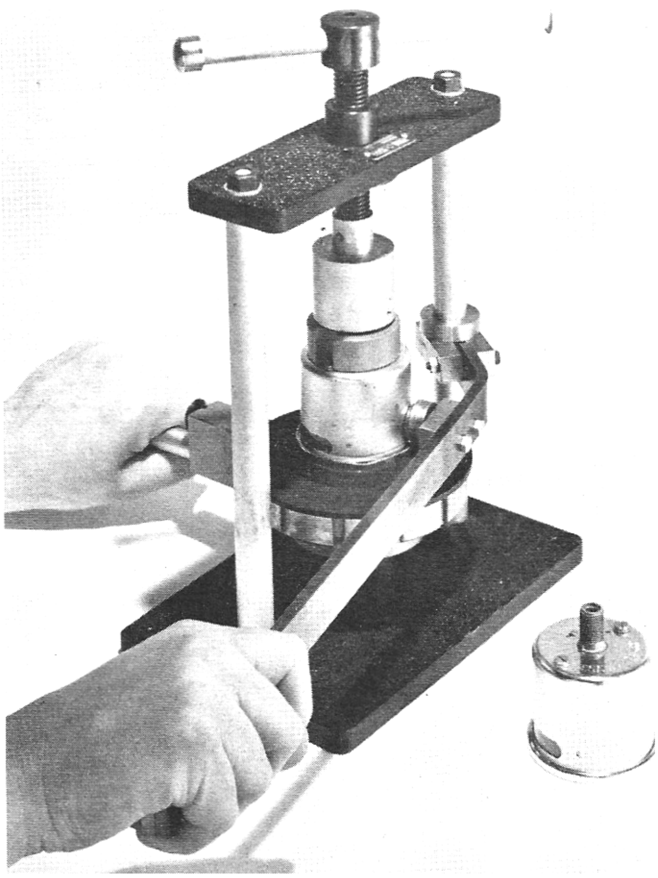
FITTING THE BEZEL

Fit the bezel fixture SR/D 140 with the appropriate steel plate and rubber pad.

Slacken the centre clamp screw and position the fibre pad over the back of the instrument. Place the instrument with the bezel face down on the rubber pad. Tighten the centre clamp screw to grip the instrument. Set the ratchet to turn the table clockwise and adjust the height of the spinning wheel until it is just above the level of the case.

Rotate the table and exert a pressure on the spinning arm downwards and slightly towards the instrument.

When the bezel is entirely spun over the instrument can be removed from the tool.



Spinning Attachment SR/D 361/STD

APPENDIX B: PEGGING PIVOT HOLES:

Pegging is simply cleaning a hole with a wooden peg (or skewer, toothpick).as shown in *fig.A.1* at right. Sharpen the peg to a point, narrow enough to enter the hole you are cleaning. Dip the peg in the solvent of your choice (acetone is probably best if you have it) and rotate the peg while pressing firmly into the hole, approaching from the spindle side of the plate. ***Do not peg the jewel bearings.*** Press hard enough so that the peg passes fully through the hole. Taking extra care to support any bearing posts. Remove the peg and sharpen to expose a clean wood surface and repeat for each pivot hole until the peg comes out clean. When all holes are done, rinse the plate in clean solvent and allow to dry.

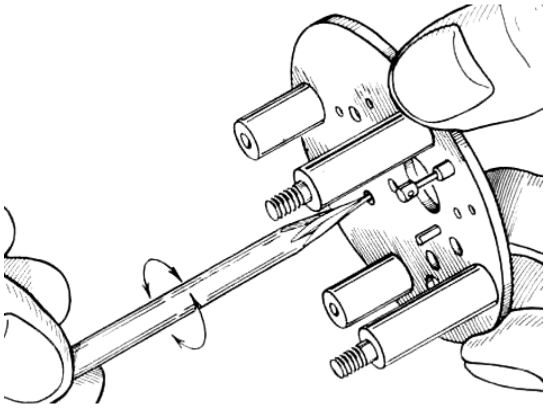


***FIGURE.A.1**: Pegging Pivot Holes*

Polish the pivots on each wheel. Use some manila card or craft paper for this job. This material is mildly abrasive and good for removing dirt but not metal. Cut into strips, fold lengthwise and dip into solvent. Lay the pivot between the fold and turn using a back and forth motion. Pinch the paper against the pivot with your fingers while you do this. **Do not use abrasive (emery) paper!!** Polishing compounds should be avoided unless you can guarantee that all traces of these abrasives, because that is what they are, are removed. Clean in solvent again and leave to dry.

Once all the parts are dry, you can start re-assembling the clock.

= =

Appendix C: Quick and dirty Keinzle clock fix:

1. Electrically wound clock:

   These clocks are particularly awkward to reassemble when completely dismantled. In many cases the clocks can be “got going” again with a repair to the winding mechanism which is the usual mode of failure. This part is not too bad to fix.

   If the clockwork mechanism looks clean and corrosion-free, then cleaning the clockwork mechanism without dismantling is possible. The clockwork assembly can be immersed in isopropyl alcohol and left to soak for an hour or two. Swirl in the solvent or wash under a jet from a wash bottle and dry. Lubricate all pivots and it should be good to go. Use a needle dipped in oil for lubricating.

   DO NOT ALLOW ANY SOLVENT TO CONTACT THE DIAL IF DOING THIS.

Appendix D:- PTC thermistor investigations:

With regard to the alternatives given below, these devices are not polarised so can be fitted to a vehicle of either chassis polarity (positive or negative earth).

Some basic experimentation with readily available PTC thermistor devices was carried out. Results of this testing is set out in the table below.

Manufacturer	Manufacturer part number	Resistance Ω @ 17.5□ C	Test Voltage	Locked current mA	Temperature @ locked current □ C	Trip condition
Amphenol	YQS5853PTF	9.4	14.00	105	63	Lock
EPCOS	B59985C0120A070	5.0	14.00	74	79	Chatter
Littlefuse	LVR016S	4.7	14.00	80	55	Chatter
Vishay	PTCCL07H441DBE	3.3	14.00	86	96	Lock
Vishay	PTCCL15H251HBE	12.8	14.00	111	72	Lock
Vishay	PTCCL09H471DBE	2.9	14.00	98	83	Lock

Testing involved simply taking a winding mechanism from a clock and applying 14V dc to it. The solenoid was "free-running" operating at a rate of several times a second - 10 estimated. This simulated the condition where the pawl failed to engage the ratchet wheel. "Locked current" was measured with the contacts closed and the solenoid continuously energised.

Text in the "Trip conditions" column has the following meaning

Chatter Device tripped after a short period of continuous "free-running" operation

Lock Device did not trip after several minutes of "free-running" but tripped when the contacts were held together.

Locked current temperatures are approximate and were measured with a surface temperature probe (Testo 0613 1912). The temperature at which a stable reading was obtained are recorded but this is low, the probe acting as a heatsink as evidenced by an increase of several milliamps in the locked current reading.

From the results above, a Littlefuse LVR016S device was fitted to a repaired clock and run on the bench. The EPCOS B59985C0120A070 would be equally suitable and no doubt there are other devices that would do the job.

APPENDIX E: CAERBONT KIENZLE CAR CLOCK EXAMPLES:

Caerbont Automotive Instruments still sell “Smiths” and “Kienzle” branded car clocks with modern internals. These are produced in both 52 and 60 mm diameter models. To date, these clocks have a “CA” prefix and the internal works are isolated from the case - separate positive and negative terminals are present on the rear of the case allowing these clocks to be fitted to cars of either chassis polarity. The polarity of the connections must adhere to the markings on the rear of the clock.

These clocks typically have a single knob on the front of the clock for setting time.

This range of clocks has no facility for the user to adjust the timekeeping (regulation).The timebase is a quartz crystal and regulation is set during production. Motive power may be either a synchronous motor or stepper-motor.

Examples of current Kienzle car clocks

Triumph Stag Mark 1 Time Clock

52mm Analogue Clock with floodlit illumination and centre reset. Black dial, white print and pointers, and black half 'V' bezel

Part Number
CA1100-16B

Triumph Stag Mark 2 Analogue Clock

Triumph Stag mark2 52mm analogue clock with centre reset, black dial and white bold print. Half 'V' chrome and black bezel.

Part Number
CA1100-17C

Range Rover Series 1 Analogue Time Clock

52mm Analogue clock the the Classic series 1 Range Rover. Black dial, satin black full V bezel and white print. Floodlit illumination. Kienzle Logo on Dial

Part Number
CA1100-28B

Change log

Date	Version	Change list
December 2021	1.0	Initial document
July 2022	2.0	Minor rewording of text/correction of typos. Details of fusible link assembly in electrically wound clocks added and subsequent renumbering of this section. Explicit instructions added.
April 2024	2.1	Basic editing and typo corrections. Test results for thermistors in type 607 clock added as an appendix.