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 the 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 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 rewound 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 electric clock described later is an example of the first method and the Smiths (see part 1) "CE" clock 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.

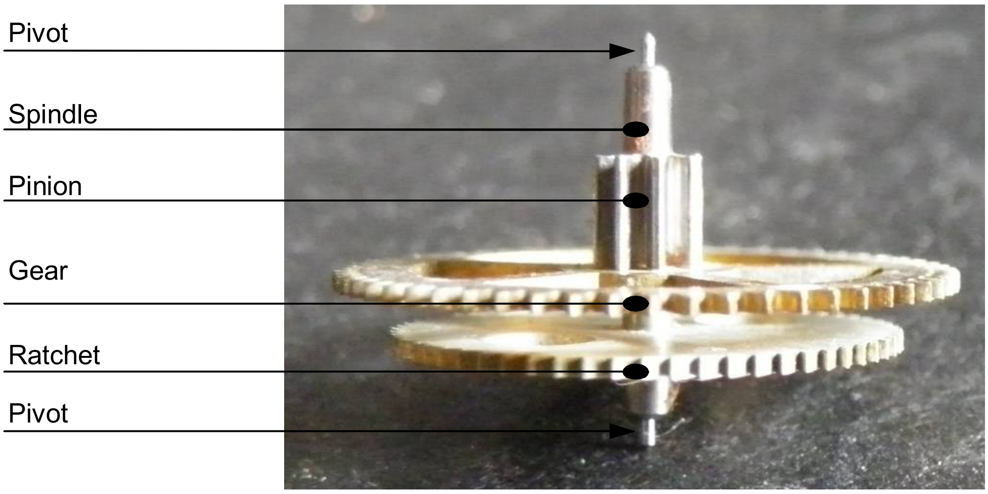
Three types of Kienzle clocks are described below. The works of most of their clocks should be similar to these. The round clocks use spun-on bezels made from very thin chrome-plated hard brass. You will be lucky if a bezel only splits a little bit when it is removed. There may be new replacement bezels 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 rewound 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 not polarity sensitive and 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** (marked "607b" on the mainspring support plate). Most probably there were several Kienzle car clocks using this type of movement and these will be of similar construction.

1.1. Electrical rewind 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 thermal fuse opening or the clockwork mechanism getting dirty (stiff) or worn. In order to fix this, the clock must be removed from its case.

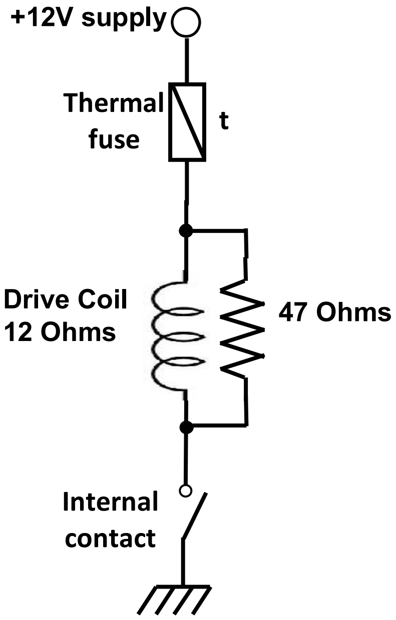


FIGURE 1.1: Electrical circuit diagram of Kienzle electrically rewound car clock. Coil resistance are as measured on an available clock.

The thermal fuse may have been bypassed in some clocks of this type in the course of previous repair as was done with this particular clock.

There is nothing in this clock "ex-factory" that is polarity sensitive. In some cases owners/repairers 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 negative earth until proven otherwise.

The internal thermal fuse comprises two spring-loaded contacts inside the clock soldered together with (very) low melting point solder. In case of the clock drawing excessive current, this joint heats up, the solder melts and removes power from the clock internals. The fuse can be repaired if the original low melting point solder joint can be re-made. Don't add regular solder (60/40 or 70/30 lead/tin type) to the joint as its melting point is too high to be effective as a fuse.

To test, connect to a 12V source. If it doesn't run (you should hear it rewind) then it needs attention. You cannot determine the cause without removing the clock mechanism from its case.

Electrically rewound clock troubleshooting:		
Fault	Cause	
ELECTRICAL:		
No continuity between case and supply terminal	Dirty or eroded contacts Open circuit resistor or coil Thermal fuse blown (if fitted) Clockwork mechanism not operating thus holding points open.	Clean and dress contacts Replace resistor (coil if practical) Repair thermal fuse assy or bypass and use external component Clean and repair mechanism
Clock "chatters" when powered up	Drive pawl not engaging	Check drive pawl spring Clean drive pawl and shaft.
MECHANICAL:		
Clock doesn't run	Mainspring broken or jammed Drive pawl not engaging Seized pivots Damaged balance assembly	Clean and lubricate mechanism, repair or replace parts as required.
Timekeeping poor	Dirt or wear in mechanism Regulation needs adjustment	Clean and lubricate mechanism Adjust regulation as needed

1.2. Electrical rewind clock mechanical schematic diagram:

Fig. 1.2 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.

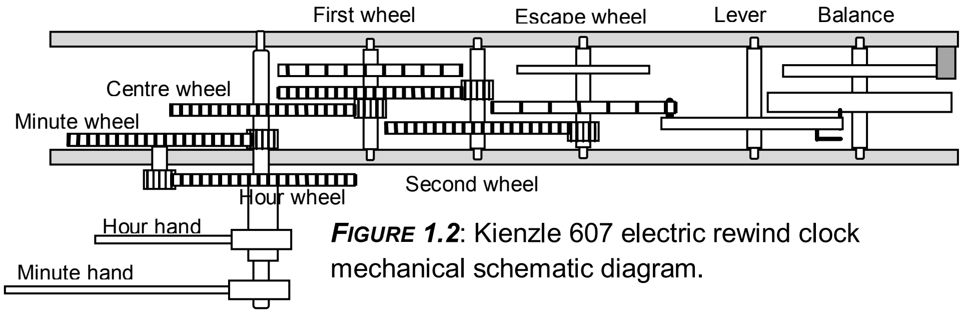


FIGURE 1.2: Kienzle 607 electric rewind clock mechanical schematic diagram.

1.3. 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, an 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 with three nuts. Two of these nuts have formed noses that sit inside the rubber mounting and have a plain washer underneath them. The third nut is a standard nut with a lock washer underneath and this connects with an earth strap rivetted to the case. Remove these three nuts and the clock can be pushed clear by applying slight pressure to the supply terminal at the rear.

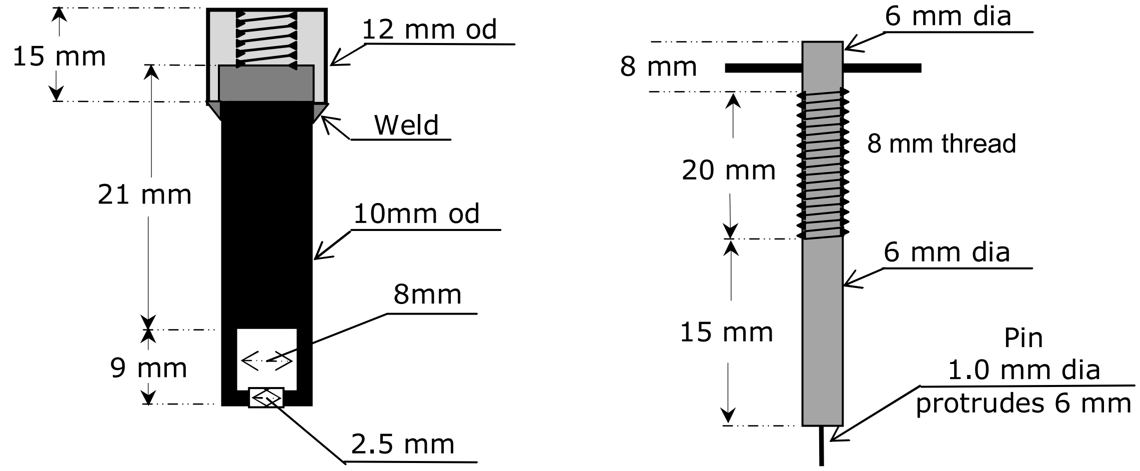
1.4. Dismantling the clockwork mechanism:

Once the clock has been removed from the case, remove the electric rewind mechanism by undoing three nuts holding it in place. The rewind mechanism can then be pulled clear. Connection between the rewind/mainspring assembly and the rest of the clock is by way of a pawl and ratchet – the pawl is part of the rewind assembly and bears against a ratchet wheel that is part of the clockwork mechanism. See section 1.5, "Repairing rewind mechanism" below.

Next the hands can then be removed. The time-setting dog/minute hand is tightly pressed on to the centre spindle and a puller is needed to remove this. A sketch of such a puller is shown in fig. 1.3. Without a tool like this, repair to, or lubrication of, these clocks is not possible. Once the minute hand/time setting dog assembly has been removed, remove hour hand with a forked lever or similar tool taking care to ensure that force is applied to the raised part of the dial and using a piece of cardboard to protect the dial itself. On a good day the hour hand and boss can be removed by twisting and pulling.

FIGURE 1.3: KIENZLE MINUTE HAND AND TIME SETTING DOG PULLER:

Material: SILVER STEEL



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 the minute wheel can be cleaned and lubricated in-situ.

Note there is a brass washer and thin dished thrust washer (not shown here) between the hour wheel and the dial. Refer *fig. 1.9* for a picture of this thrust washer.

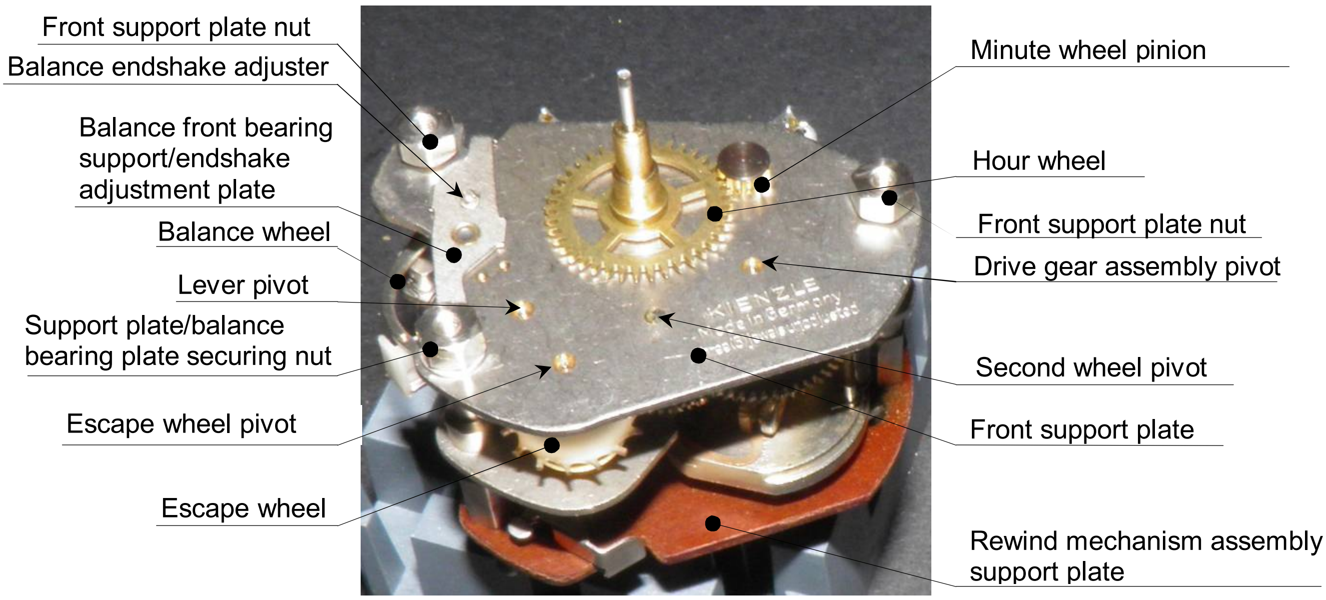


FIGURE 1.4: Photograph of clock mechanism as removed from case– front uppermost. Washers between hour wheel and dial are not shown.

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.

Figure 1.5 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 re-wash.

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 1.5: 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. 1.5* 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. Remember to place the hour wheel in position above the support plate and in mesh with the minute wheel pinion. 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.

1.5. Repairing the rewind mechanism:

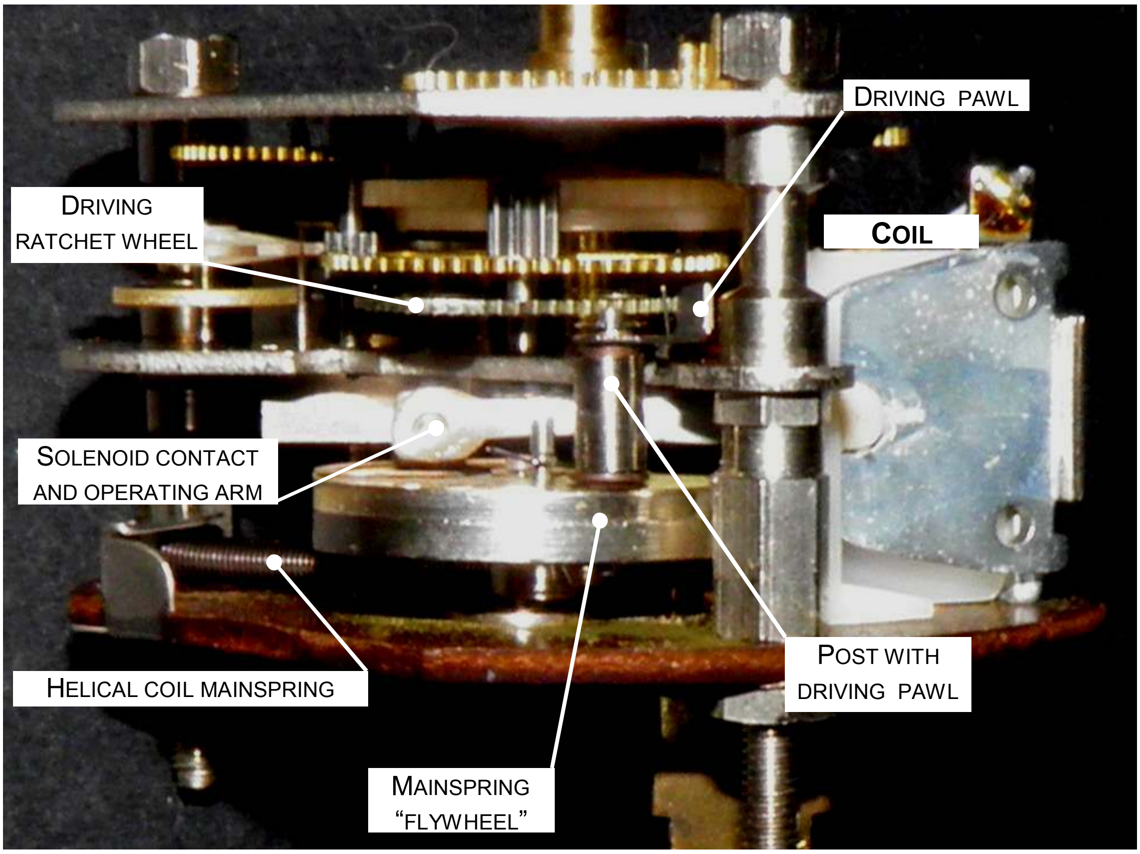


FIGURE 1.6: Internal view of 1970s Kienzle electrically rewound clock showing the main rewind mechanism components. A pair of contacts, one mounted on the solenoid and another on the mainspring flywheel make contact when the mainspring is in its rest position, energising the solenoid, drawing the operating arm rapidly toward the centre of the clock. This rotates the mainspring flywheel and tensions the mainspring, also opening the solenoid contacts releasing the solenoid and returning the operating arm to its rest position until next time the contacts close which causes this sequence to repeat for as long as a suitable electric power supply is connected. A pawl attached to a post fitted on the mainspring flywheel connects the mainspring to the clock mechanism through the driving wheel. When the solenoid operates, this pawl rides over the teeth on the driving wheel and re-engages once the solenoid returns to its rest position.

The figures below show the electric rewind mechanism of the Kienzle type 607 car clock. *Fig.1.7* shows the complete assembly and *fig. 1.8* shows its main components. Not shown is the thermal fuse which had been removed from this particular clock previously and replaced by the short wire between the power supply terminal and the coil which is visible in *fig. 1.8*. Any further disassembly of this rewind mechanism is not necessary if the coil is sound.
Clean all the parts. An interdental brush can be used to clean the bores of the flywheel and driving pawl.

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 spring by turning the flywheel one turn from its at-rest position before fitting the armature.*** There is no lock washer under the armature securing nut, so use a weak threadlocker here. 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.

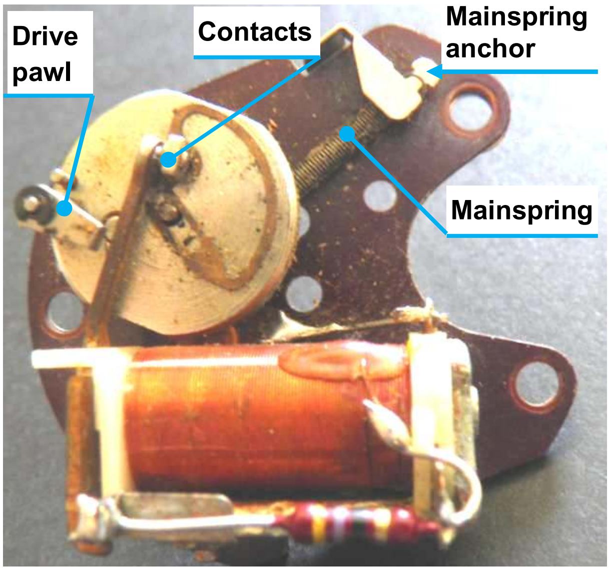


Figure 1.7: Kienzle electrically rewound car clock rewind mechanism. The mainspring is attached to a post beneath the flywheel/contact assembly.
This is from the clock shown above and despite the rust on the relay armature it works well. The contacts are clean but slightly pitted.

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. This same metal plate is formed to provide an anchor for the mainspring.

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.

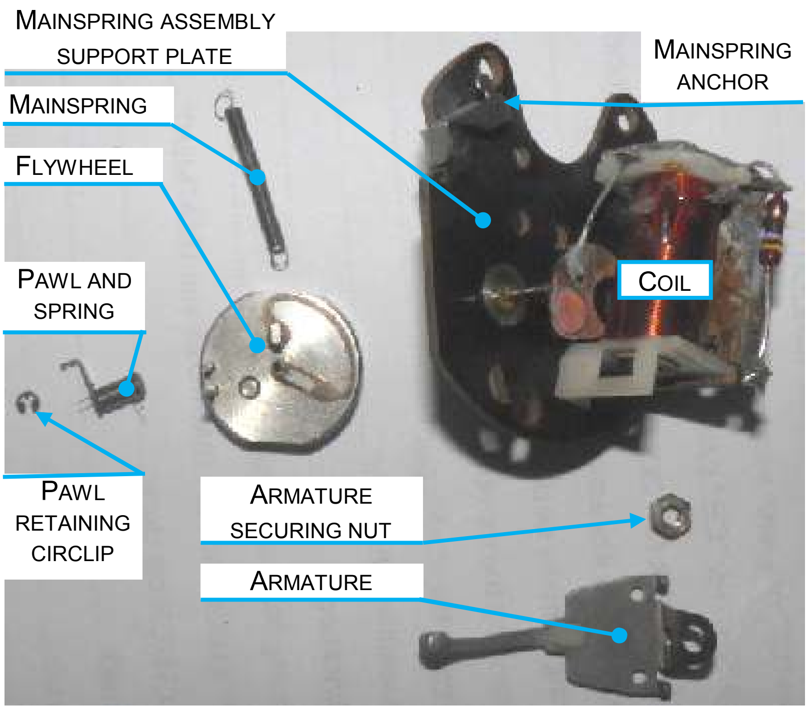


Figure 1.8: Component parts of the electrical rewinding mechanism.

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

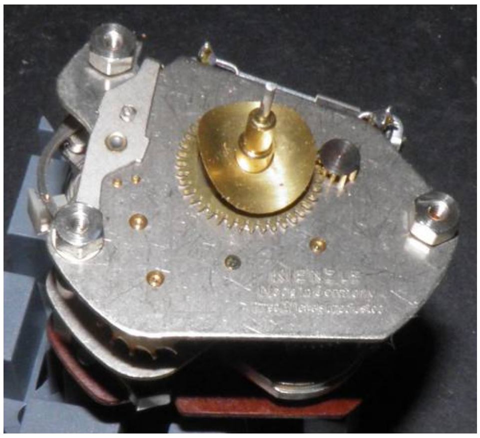
The mainspring sits below the flywheel; the base of the pressed-in anchor post can be seen near the pawl mounting post. The other end of the mainspring hooks onto the anchor on the support plate and the spring itself sits below this.

The armature is connected to the coil assembly by a nut that threads onto studs on the body of the coil (not visible). The connection is by way of a phosphor bronze spring plate attached to the armature.

1.6. Final assembly:

Fit the clockwork and rewind mechanisms together ensuring that the pawl engages properly with the ratchet wheel and the pawl spring is pressing the pawl against the ratchet. Secure the rewind assembly with the three plain nuts. Check that the clock rewinds and runs when the clock is connected to a 12 Volt supply. Should it fail to run then find out why. If the rewind 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. 1.9* but do not fit the washers to the hour wheel. Fit the works to the case and tighten the nuts.

Figure 1.9: Assembled clock ready to fit to the case. The dial assembly fits on top of this movement, the three nuts fitting into corresponding moulded sockets,



With the clock face-up, lightly oil and place the washers on the hour wheel and place the dial over the works ensuring that the front nuts enter the moulded sockets of the dial assembly. Fit the hour hand ensuring it is pressed fully home against the shoulder on the hour wheel. The fit should be fairly tight. Then fit the minute hand ensuring it does not interfere with the hour hand. Sit the rubber seal in the bezel and fit the dress plates and bezel to the case. Recheck clock operation.

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 rounded steel rod, pressing down on the clock as you go.

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 a day).

1.7. Other brand clocks:

Similar clocks to the Kienzle electric rewind clock exist. Many American car brands from the 1930s through to the 1970s used electric rewind type clocks. The photograph at right is of a West German Borg branded clock and similarities with the Kienzle clock are clear. IThis one is a 1970s era clock.

This particular clock is assembled with peened and glued fastenings and is clearly not designed to be serviced. Whether it is possible to repair it remains to be seen.

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.

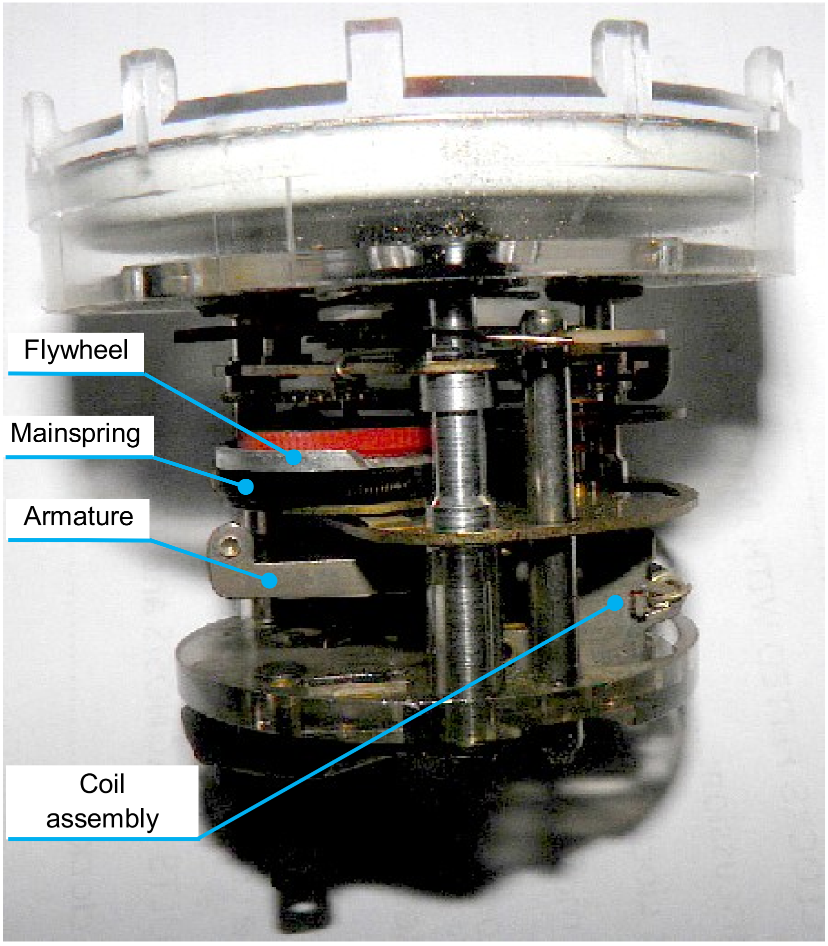


FIGURE 1.10: Another brand of clock. This electrically wound clock is branded "Borg". Photo shows similarity to the Kienzle electrically wound clock.

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. Lubrication 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.

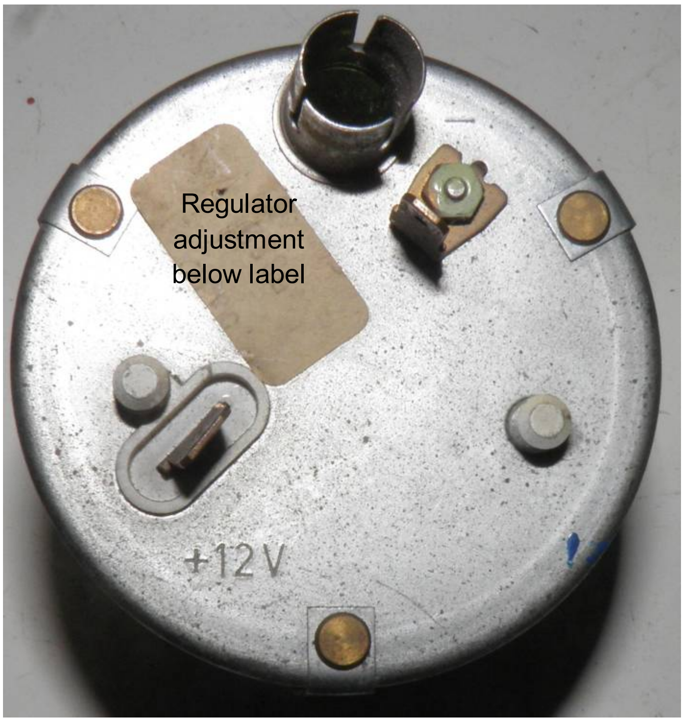


***FIGURE* 2.2:** Showing the clock internal works as removed from the case.

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 retaining the internal assemblies below the earth terminal 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 reasonably available. Clean with a small brush, making sure all traces of dirt are removed.

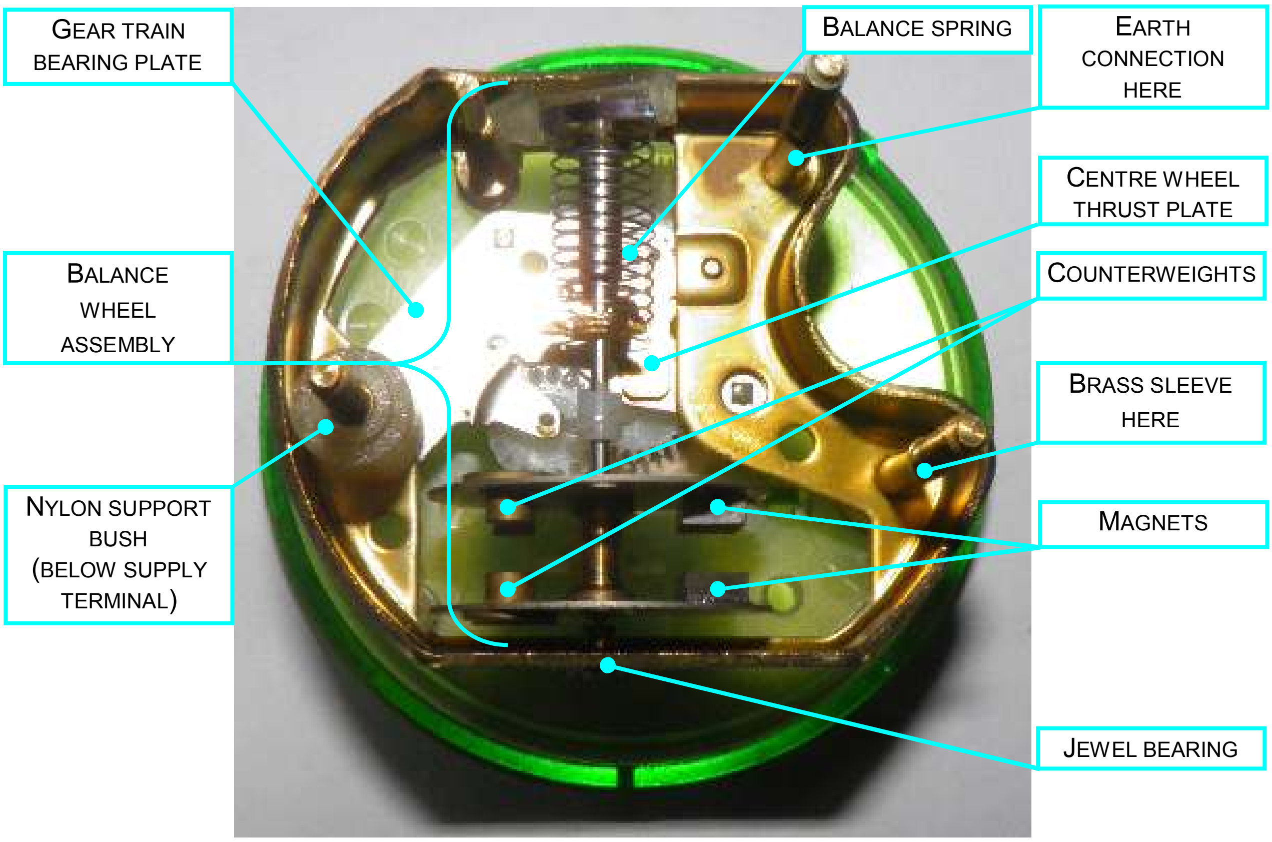


FIGURE 2.4: Balance and clock frame assemblies of a Kienzle transistorised clock. The clock has been removed from the case and only the circuit board removed in this view.

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.

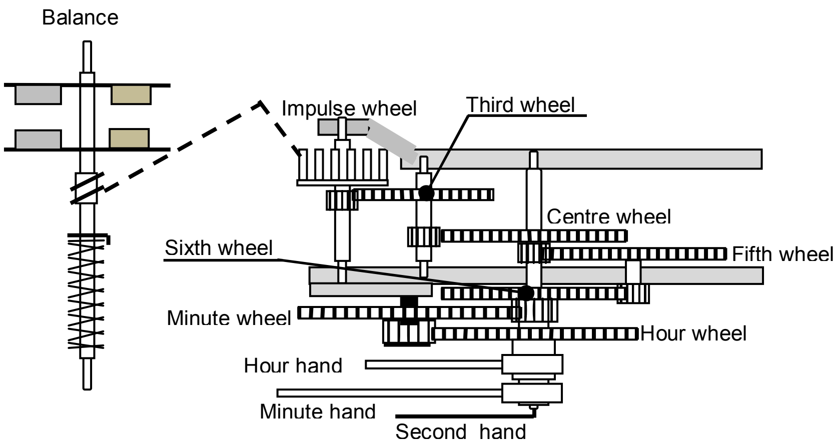
There is a certain amount of side loading on this pivot and presumably this has caused the wear against an unlubricated (?) metal surface.

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.

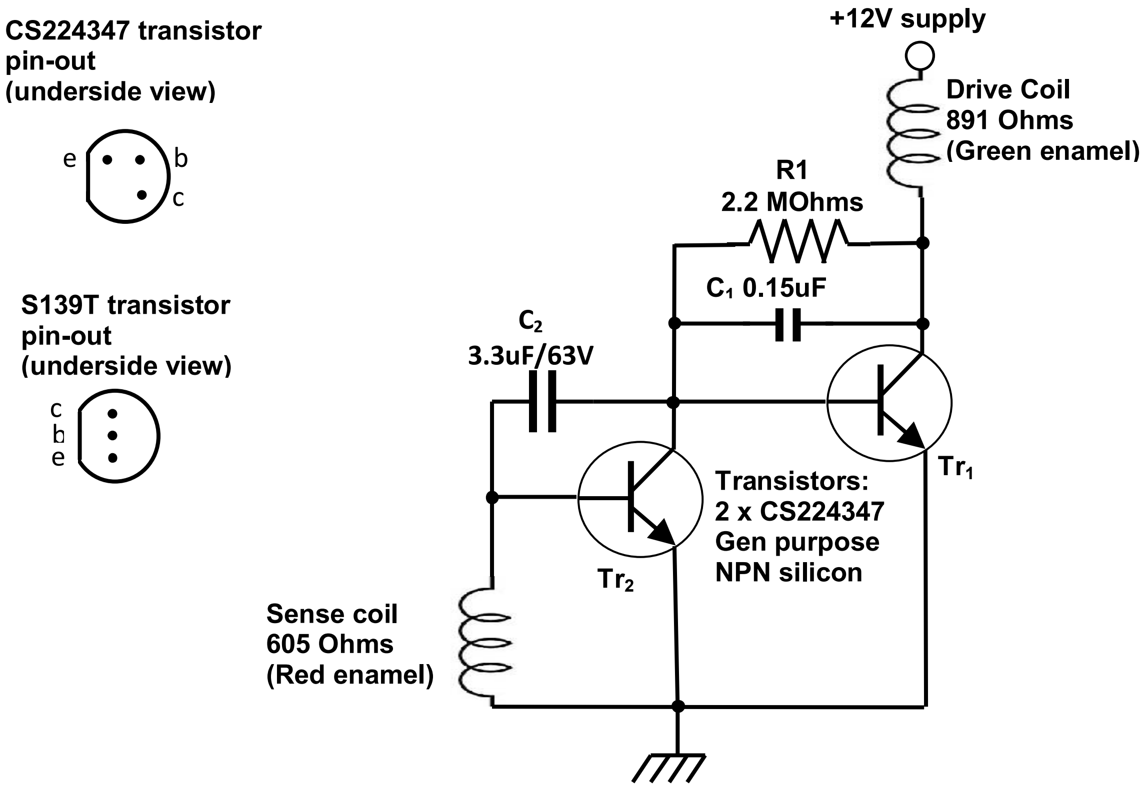


Figure 2.7: Circuit diagram of Kienzle electronic car clock. Coil resistances are as measured on a clock to hand. Measured values in other clocks may vary from these but should be similar.
Transistors found in another clock of this type were marked "S139T"

Almost any general-purpose, small signal, NPN transistor such as a BC547 or 2N2222 should 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.

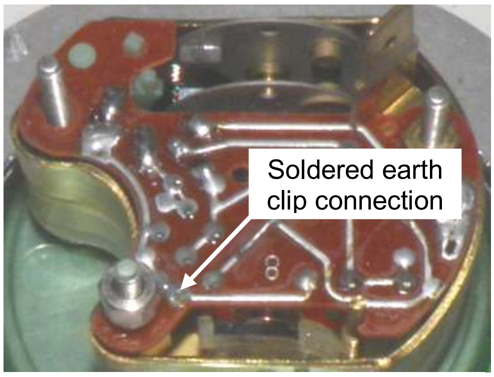


FIGURE 2.8: Location of earth connection. Soldered joints are poor mechanical joints so re-solder before final assembly of clock.

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.

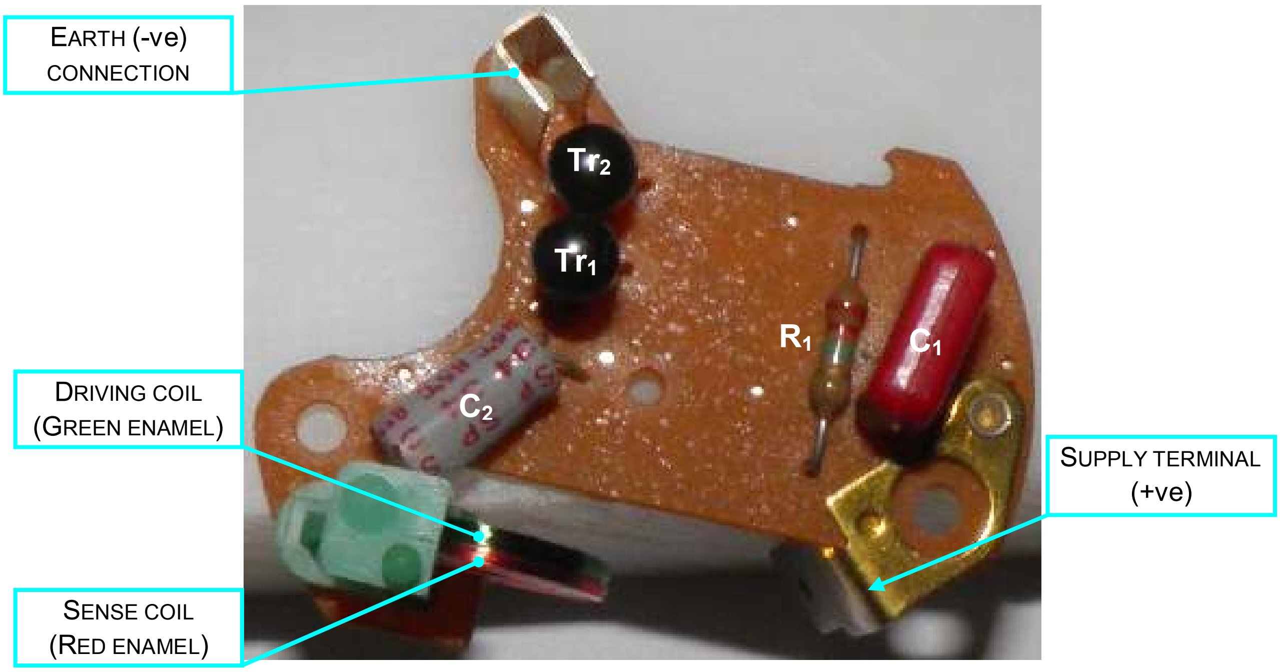


FIGURE 2.9: Component (under) side of circuit board of a Kienzle transistor impulse clock.

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.

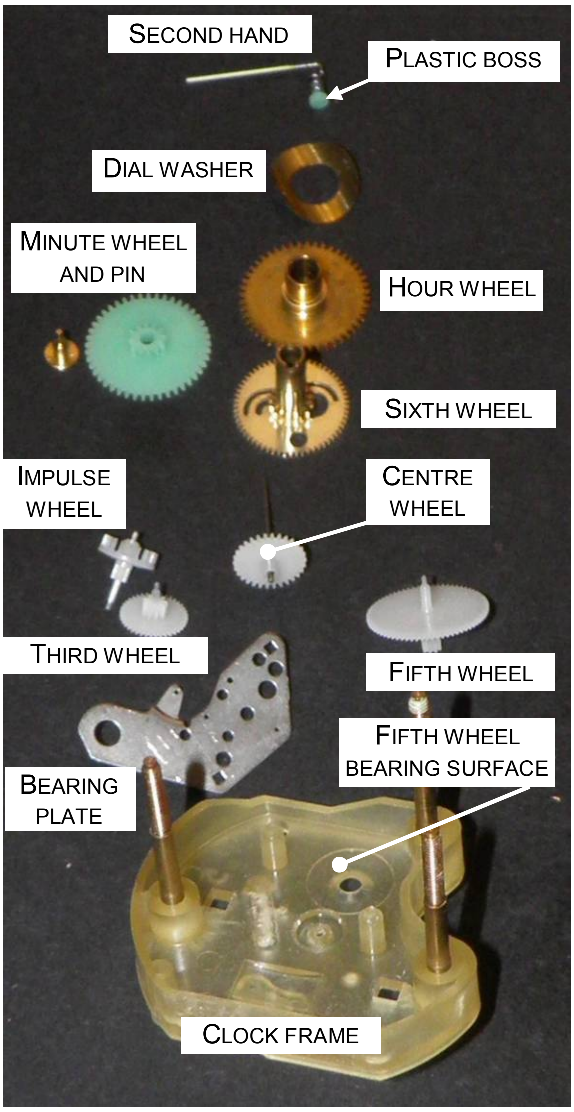


FIGURE 2.10: Showing the components of the transistor impulse clock gear train.

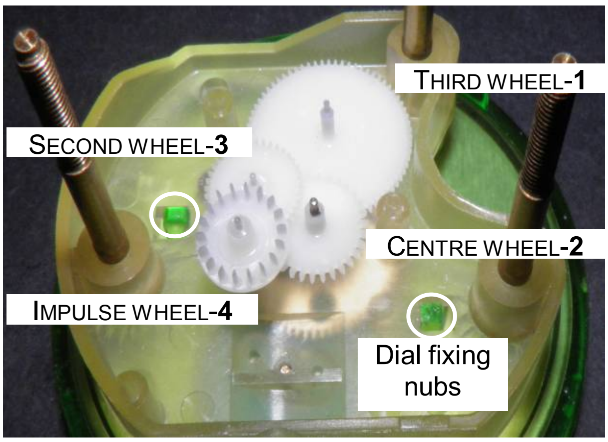


FIGURE 2.11: - **Reassembling the gear train:**

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. In fact, these clocks seem to run for decades without any trouble.

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. Like Smiths "CE" clocks, they 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 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.

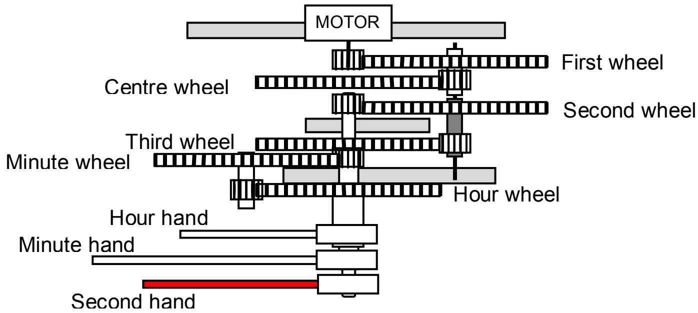


FIGURE 3.1: Kienzle quartz clock mechanical schematic

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.

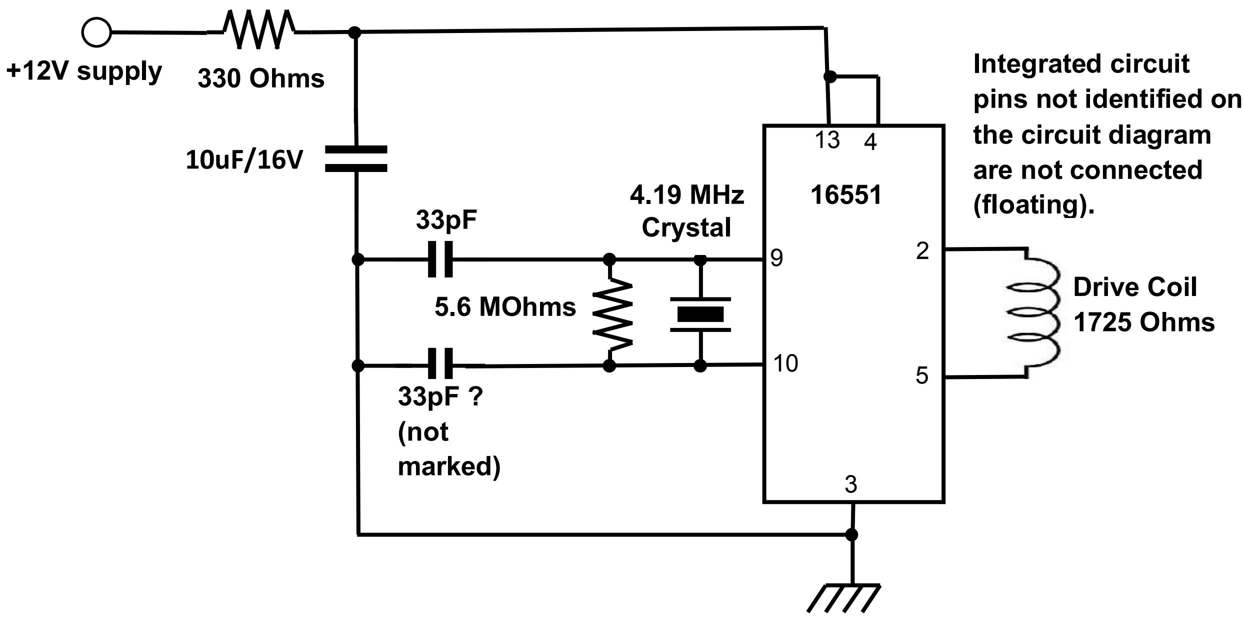


FIGURE 3.2: Kienzle Quartz car clock circuit diagram. Coil resistance is as measured on a clock to hand.

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*.

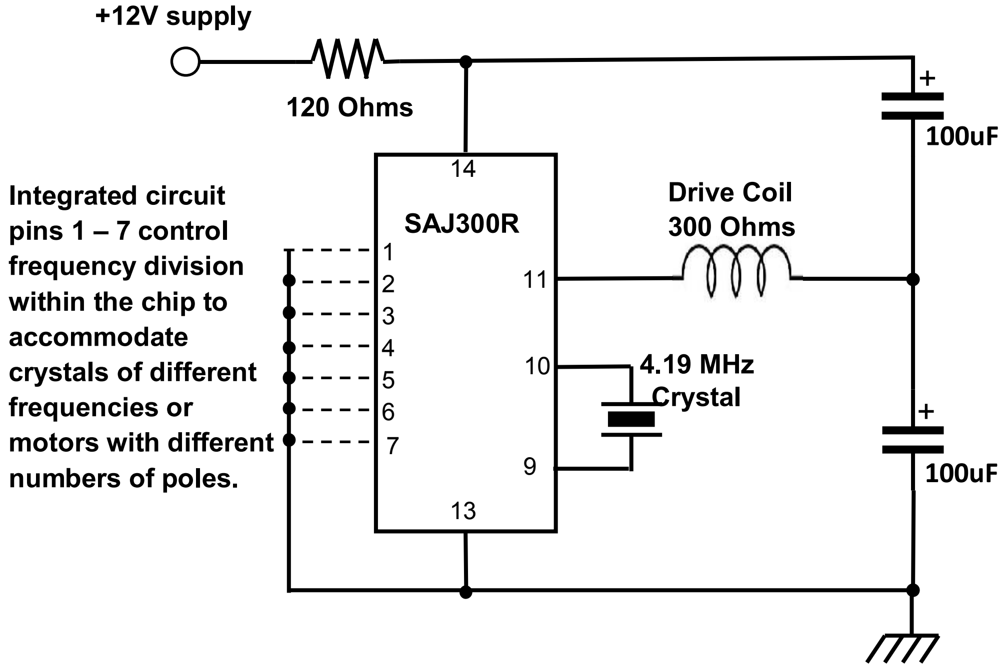
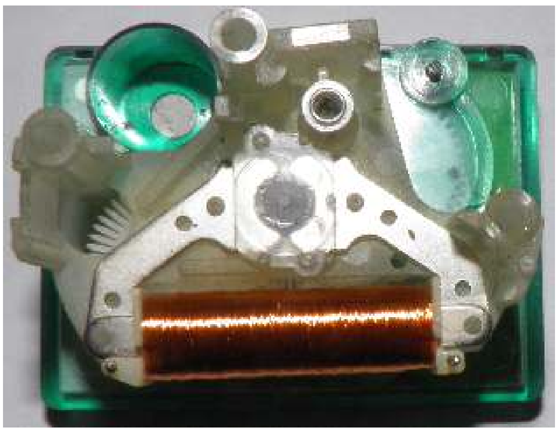


FIGURE 3.3: Clock circuit from ITT SAJ300R datasheet which is a similar circuit to that used in some types of Kienzle, and presumably other brands, of Quartz car clock.

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.



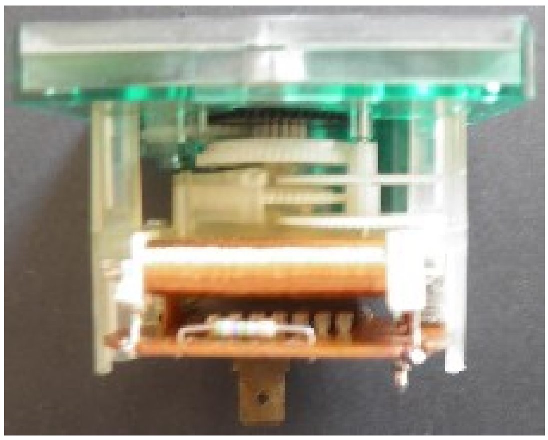


FIGURE 3.4: Kienzle Quartz car clock:
Left - stepper motor. This sort of motor is in common use today for battery clocks and many modern automotive gauges. Pins at each end of the coil connect to the circuit board. If dismantling one of these clocks, be very careful removing these pins from the circuit 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.

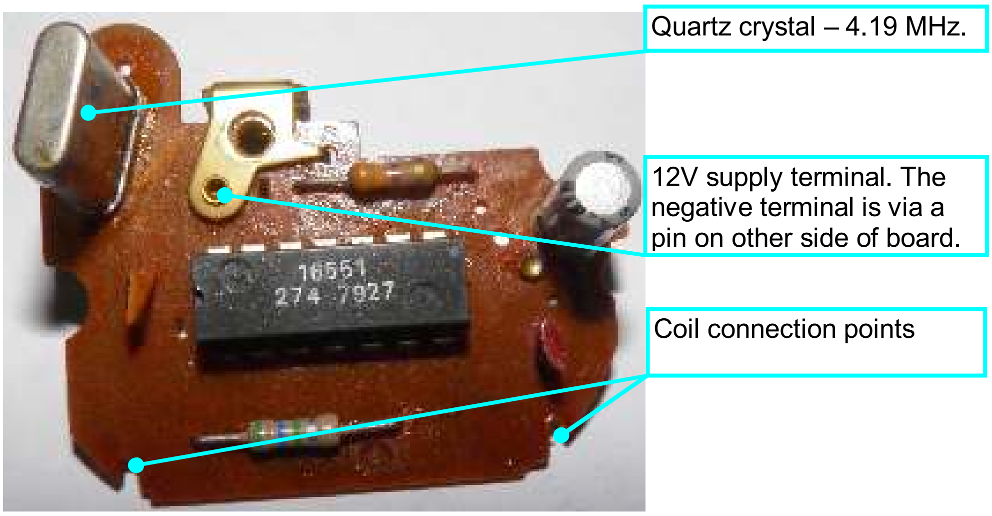


FIGURE 3.5: Kienzle Quartz car clock printed circuit board. The integrated circuit may be a “special” and no equivalent has been identified (yet). This integrated circuit is the most likely cause of failure – reverse polarity connected – and repair is a viable option if a suitable IC is found.

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 pullers
Balance support **†**
Bezel removal jig (see next page) **†**

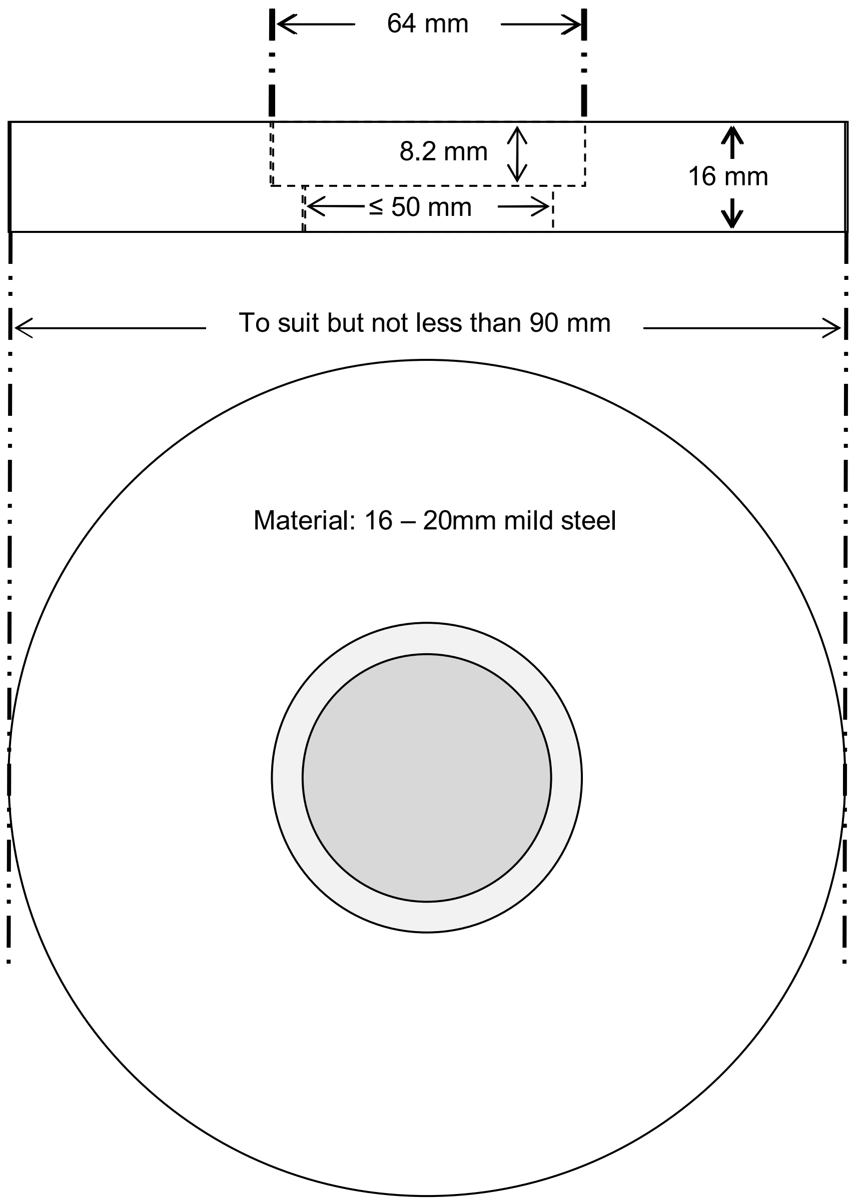
Consumables:

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
Acetone
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, particularly when re-spinning a bezel. Pressing the edge of a bezel over by any other method results 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.)

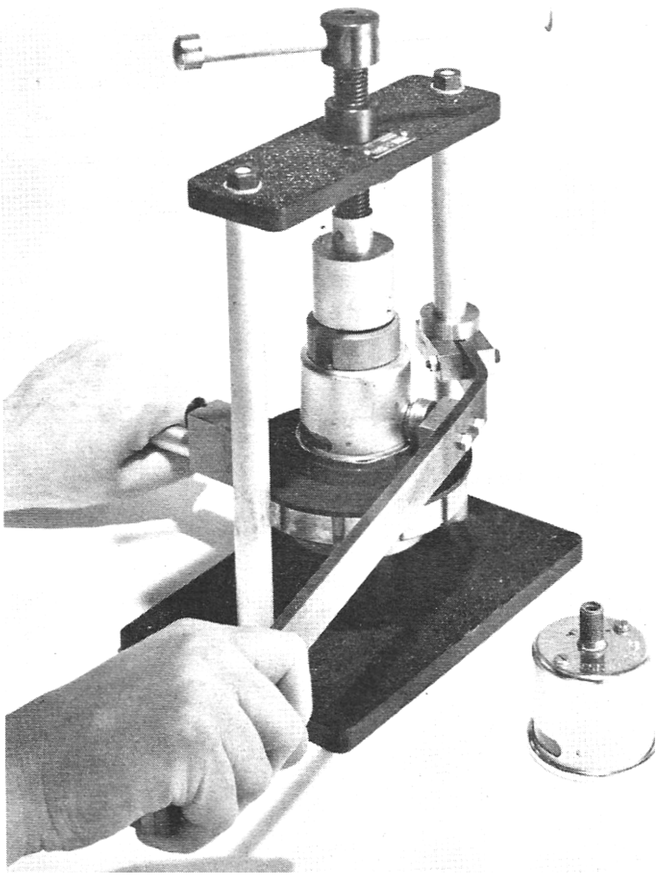
FITTING THE BEZEL

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.

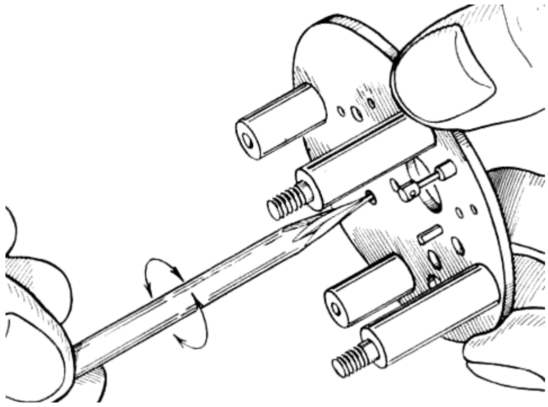


***FIGURE.A.1**: Pegging Pivot Holes*

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 Kienzle clock fix:

1. Electric rewind 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 electric rewind 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: 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