Bobs Clock Repair
Trouble Shooting Notes

by Bob Tascione

Introduction:

Following is a compilation of some common ailments encountered in clock repair. Although there are numerous reasons a clock may not be performing well it's usually fairly easy to zero in on the main cause for the clocks failure. I need to explain here that the "main cause" is not always the only cause of a clocks problem. Often there will be several less obvious reasons. Addressing only the "main cause" by applying only one solution to effect repair could be setting you or your customer up for more serious future problems. A clocks true problem may actually be comprised of the accumulation of many smaller ailments such as badly worn pivot holes, dirt, scoured pivots, scoured pallets, set mainspring etc.

A common example of this would be the 8 day clock brought in due to premature stopping. After a good cleaning, oiling, bushing job and replacement of the old mainspring with a new one of the exact same

dimensions the clock still stops running after a couple of days. Upon further inspection the clockmaker notices that applying a small amount of pressure on the great wheel with his thumb gives the mainspring just enough extra power to get the clock running again with good motion to the pendulum. He then determines that someone in the past must have inserted an improper mainspring of insufficient strength. His remedy? Insert a stronger mainspring of course.

Although improper mainspring replacement is something you will see periodically it's not usually the case. Upon closer inspection this clock would have revealed its true culprit; a bent pivot with additional scoured and grooved pivots. In essence what the clock maker has done is accelerate the wear and tear on the clock by adding additional, unnecessary tension throughout the movements time train or worse set the movement up for a possibly disastrous scenario. If the bent pivot in this movement was weakened enough when the bending occurred it could possibly snap with this additional power stored in the movement. Snapping a pivot is not good. If things let loose in a fully wound clock...well you get the picture.

So...please keep in mind while reading the following list that it is in no way a complete anthology on clock repair remedies nor is it meant to be a trouble shooting list of exact causes with exact remedies for a given problem but is intended solely to help guide you towards the cause or causes of a problematic clocks ailments by giving you options to consider which will hopefully help narrow down your search.

It's for this reason that a clock brought in for repair should always be regarded as a restoration project not just a simple repair job.

Hand Problems:

Let's cover some simple problems that can occur in the time train first. Some of these are pretty obvious. In this section we will assume the clock is clean and that the mainspring or weight, whichever applies, is wound up.

Bent or loosely fitted hands are common problems. If the clock is stopping check the hands and make certain they are not catching on one another or dragging along the dial or glass during any part of their

revolution around the dial. This can be caused by the movement being mounted crooked in the case, the case back being warped or the dial not being attached properly to the movement. A tapered pin or retaining clip missing from a dial post, a loose or bent dial foot or a bent or otherwise distorted dial are sometimes at fault. Loose fitting, floppy minute hands are encountered often, especially on American clocks. You often find the square hole in the hand has either worn too large for the square on the minute post or an unsuitable replacement hand was used in the past.

If the hands are a good fit but they move back and forth easily towards the dial then you probably need a new hand washer. These washers can be purchased in assortments from most supply houses. Try to get a good complete assortment as you will use them often. Also avoid stacking washers to get a good fit but rather try to find one washer of the correct thickness or cupped height to do the job.

It's amazing the percentage of clocks you will see that have been meticulously restored inside but are left with wobbly, badly fitted hands. A customer will interact with a clock by winding the mainspring and by

setting the hands. Imagine the impression left if the hands flop around during setting.

Sympathetic Vibration:

Another common problem is something called sympathetic vibration. To put it simply this is when energy from the movement is transferred to some external object. The external object can be the clock case, table, wall, or floor depending on the location of the clock. Theoretically this phenomenon always occurs to some extent, but when kept under control it is negligible.

A timepiece is usually designed to deliver enough power to the escape wheel to keep the escapement and pendulum going with a bit left over for any small imperfections in the clocks construction and to allow for a certain amount of dirt and wear. Sympathetic vibration will often sap enough of this energy to actually stop a clock. You can see this vibration in action by placing a ticking mantle clock on a table that is sitting on a thick carpet and then placing another stopped clock on the same table next to it. After a few minutes you should see the stopped clocks

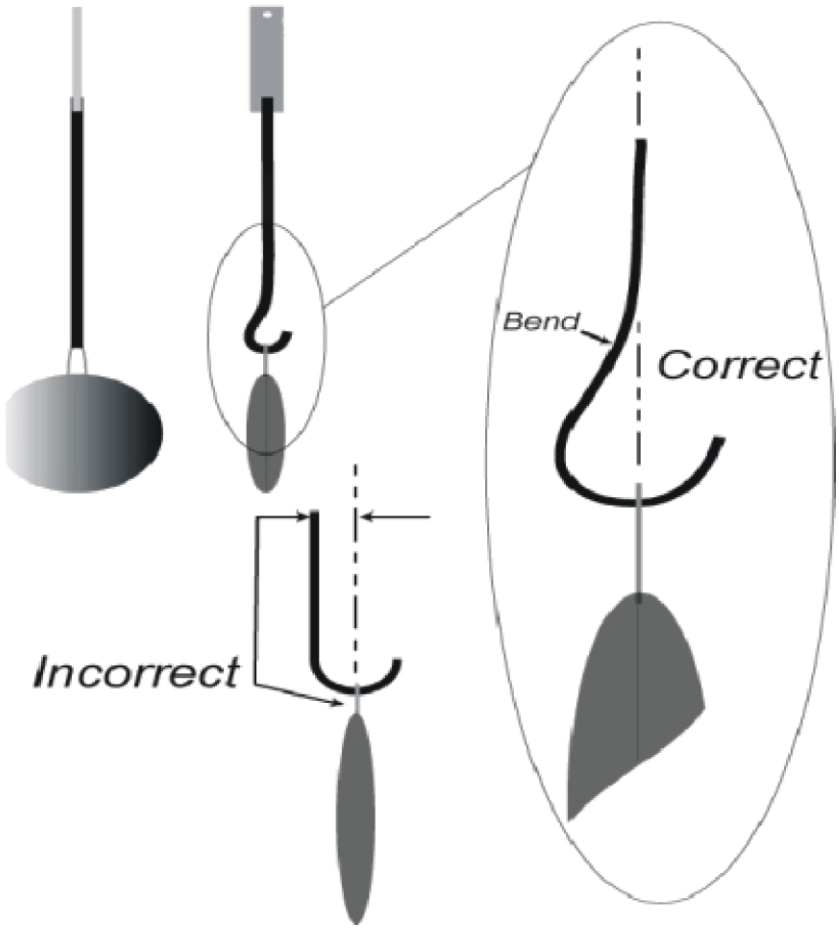
pendulum swinging slightly. If you observe a floor clock sitting on carpet that is not secured to the wall or to the floor beneath the carpet you will actually see the weights swinging in sympathy to the pendulum. When the weights have dropped down far enough to equal the length of the pendulum they will swing at their greatest amplitude. This is because the lengths are equal and at resonance. It's similar to holding two tuning forks that are tuned to the same frequency. If you strike one the other will begin vibrating.

You will encounter this problem regularly when doing service calls on tall case clocks. If the clock is located on a carpeted floor it should also be secured to the wall or at least adjustable pointed case feet which poke through the carpet and hit the floor beneath should be used. If this isn't done the entire case will sway back and forth in unison with the pendulum. If you stand back and observe the clock you can actually see this motion with reference to a point on the wall behind it. A significant amount of power is being spent to keep the case moving and since the movement was designed to swing the pendulum, not the clock it will probably stop after a little dirt gets in there. Of course the same thing occurs if the clock is on an uneven hard floor and the

case feet are not adjusted to compensate for it. You can see the importance of a clock being secure on a wall, floor or sturdy table and that the movement is secure in its case. It's really all about energy conservation. After all, the power is intended to transfer from the train, through the escapement and ultimately to the pendulum. Which brings us to....

Suspension springs:

Here is another problem you will see often. A bent, kinked, twisted or torn suspension spring can cause a clock to stop. If the spring looks damaged at all it should be replaced. If a clock has a wobbly pendulum it is often caused by a twisted or partially torn spring. Like hand washers you can and should purchase a good assortment of suspension springs. There are different assortments available. American suspension springs come with the pendulum wire attached as one unit. You only need to bend a hook shape at the end of the wire to hold the pendulum bob. When bending a wire pendulum for the bob the hook must be shaped so that the bob hangs in line with the

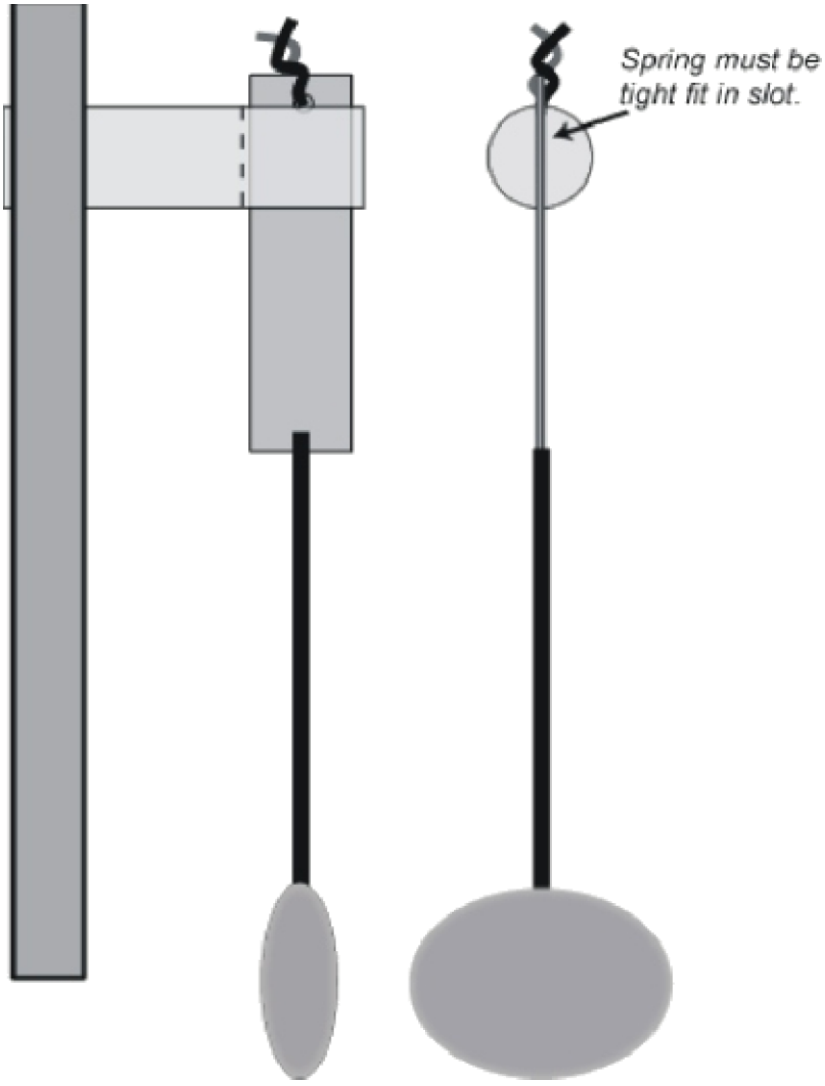


wire.

If it's off center it will also cause the bob to wobble. You will change suspension springs often so it's always good to have them on hand. If you need to order springs individually you will find that most suppliers use catalogs, some even online with pictures of springs to help match your damaged spring to.

If you find that the suspension spring is in good shape and that the wheel train appears to deliver sufficient power to the escape wheel then your problem most likely lies somewhere in the escapement. Check that the crutch or crutch wire isn't too sloppy or too tight where it engages the pendulum for impulse. Too much play and the crutch loop will have to travel too far to catch up to the swinging pendulum before imparting impulse. The wider the gap in the crutch wire the longer it takes the crutch to catch up to the pendulum rod. This results in the pendulum receiving an abrupt hit late in its oscillation rather than a full steady push. A partial push means a weaker impulse to the pendulum which again equates to energy loss.

There are various ways a suspension spring can be attached to its block. They often fit into a slotted post or block held by either a tapered pin or a screw. Make certain that it is held snugly in the slot. If it's allowed to twist back and forth in



the

block it could cause the pendulum to wobble and will of course be wasting energy. Some American clocks have a slotted post that the spring slides into and is just held friction tight without a tapered pin or screw. The suspension spring is kept from falling through by means of a small pip at the top of the spring or a small loop of wire which passes through a hole at the top. This spring must also be tight in the slot. Always check to

see that the post is attached solidly to the movement. In some cases you will find a block attached to the back of the clock case such as in Vienna Regulators. This too must be secure.

Movement Distortion:

If you have a movement that runs well on a movement stand but loses pendulum motion or stops when fastened down in its case you should check for either bent movement feet or a warped case. Any distortion of the movement resulting from tightening it down to an uneven surface can cause the train to bind. Any noticeable rocking of the movement before tightening it down, even the slightest amount, can cause the clock to stop and or have a sluggish or non-functioning strike or chime.

Loose Verge:

If you notice that after a period of time a clock becomes out of beat even though it has not been moved then the

clutching assembly which enables a beat setting adjustment to be made has probably become too loose and is allowing the clock to slip out of beat. You will need to tighten the clutching between the crutch and the anchor or verge. Unlike the one piece wire crutch mechanism where you must bend the impulse wire until the beat is set, this clutching action is used to set the beat without having to bend anything to accomplish it. This clutch sometimes loosens up and must be tightened. There are different setups used in clock design and they are usually pretty easy to figure out. Often times you will need to press the clutching pieces together by tapping them with a punch until it feels right.

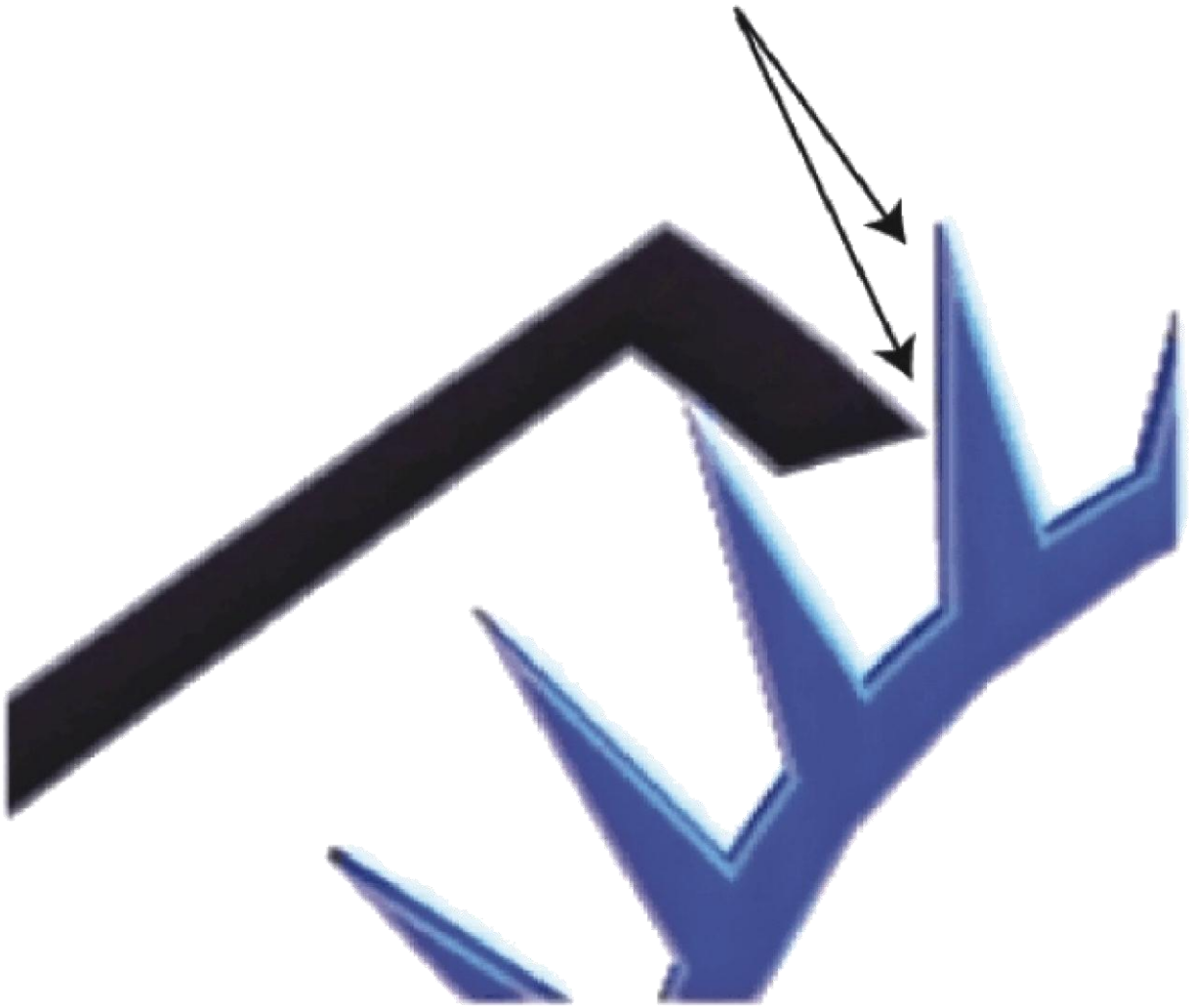
Bent escape wheel teeth:

Here is something you will run into quite often. The number one reason escape wheel teeth become bent is from adjusting the beat when the crutch mechanism is too tight. Care must be taken that a pallet is not pressing against the top or any other part of an escape wheel tooth while adjusting an impulse crutch. If the clutching is too tight it could easily bend or break the tip off of an escape wheel tooth.

Bent or broken escape teeth are apparent when listening to the clock tic. If the tick is uneven and repeats itself with a regular pattern then you probably have a problem with an escape tooth or teeth. A tooth can usually be straightened without much trouble. If the teeth are badly damaged or if the tips are broken off any of the teeth then the wheel will need to be "topped" first.

There are machines called topping tools that are used for such an operation but one can usually do a decent topping job just by spinning the escape wheel in a lathe while gently filing the passing teeth with a fine coarse file. Care must be taken not to remove any more material than is necessary. If more than just the tip is broken off then the tooth will need to be replaced or a new wheel installed. After topping a wheel the sharp tips of the teeth will have been removed leaving flat topped teeth. The backs of the teeth (not the locking face) must then have a small amount of material removed to return the original fine tip and to make certain there is still enough clearance for the pallet to swing and enter behind the tooth when the opposite pallet is unlocking from a tooth.

After topping wheel material must be removed from the back of a tooth to maintain sharp point of tooth and clearance for pallet to enter space between teeth as shown.



Shallow Escapement Locking Depth:

The engagement of the verge with the escape wheel is critical. This locking depth must be adjusted to allow for maximum power transfer to the pendulum. Too shallow a depth results in too short of an impulse period between the pallet and escape wheel tooth which equates to limited power transfer. This can cause a clock to stop running even when the rest of the mechanism is in excellent condition. If there is plenty of power to the escape wheel then the verge depth is suspect.

If the clock is running exceptionally fast the escape wheel could be running away or "tripping". This occurs when the locking depth of the verge is not quite deep enough to engage and stop every tooth that comes along and will bounce along the top of a tooth or sometimes several teeth before finally catching and locking one. This can quickly dull the sharp tips of the escape wheel teeth.

Mainspring Catching and Slipping:

A spring driven clock derives all of its power from the mainspring. The mainspring must be in good condition with no burrs, rust or kinks and must be clean and properly lubricated if it is expected to deliver its full power to the works. The coils must be able to slide freely with no obstruction as it slowly unwinds. If its surface has any burrs or scratches it may catch or bind in places causing uneven power transfer to the train.

A sticky mainspring can usually be detected by listening to the clock. If the coils cannot slide smoothly along the surfaces of one another they will tend to stick together for awhile until finally slipping. This slipping is often loud enough to be heard from across a room and when you hear it you will know what it is. The sticking together of the coils causes uneven power distribution and will reveal itself in fluctuating tick amplitude.

If you notice that the clock has a soft tick and then becomes noticeably louder then soft again and does not follow any predictable pattern then there is a good

chance the mainspring needs some attention. The arc of the pendulum may also vary if the spring sticks together for long periods of time and then suddenly slips. Of course there are other situations that can cause similar symptoms such as bent pivots or bent wheel teeth but these symptoms will usually repeat themselves in a regular pattern.

When winding a mainspring for the first time after it has been cleaned and greased it's very important to wind it fully, let it back down and then wind it fully again. If using a mainspring winder do this in the winder several times and then inspect the spring to see that the grease has spread evenly over the entire spring. This includes the most inner coils where most of the pressure is exerted.

Multiple windings help to distribute the grease evenly along the springs width and length. Failing to do this will often cause uneven power distribution throughout the duration of the first few windings.
This makes it almost impossible to correctly time out any clock or watch during its first winding.

So... after applying grease remember to fully wind, unwind then wind again. Actually, doing this several

times will help to insure that the entire spring has been properly lubricated. Also, if a spring is defective and destined to break it will usually happen within the first few windings. Far better to have it break in the mainspring winder than in the clock.

Improper Mainspring Replacement:

As mentioned earlier in this guide improper mainspring replacement is something you will encounter periodically in clock and watch repair. Often a clockmaker does not possess or cannot locate an exact replacement spring for a timepiece, substituting the original spring for one with the nearest dimensions possible. If certain precautions are not considered this may result in difficult to diagnose problems. If a mainspring is chosen that is too wide it will press against the bottom and cap of the barrel which will result in jamming the mainspring and can obstruct the smooth slipping motion necessary for a spring to function correctly. If the barrel cap is not seated flat in its barrel seat then too wide a spring is suspect.

Often, tolerances are so close in watches and clocks that you will see scratch or wear marks scraped on the outside of a protruding cap by a close running center wheel, center wheel bridge, barrel bridge or plate. It's necessary to mention here that these same symptoms can occur from a spring that has been incorrectly wound into a barrel by hand rather than with a mainspring winder. If not done properly it can distort the spring into a conical shape. You can check this by laying the spring on a flat surface. If it doesn't lay flat but instead assumes a cone shape then when installed in the barrel it will exert some pressure on the bottom and cap of the barrel dissipating some of its energy in the wrong direction.

Mainspring Grease

You probably noticed that we use very inexpensive mainspring greases and clock oils in the beginners clock repair video courses. These courses are intended to teach the beginner practical theory and repair techniques through the video and animation medium without distracting the student with details about the numerous types of oils and cleaning solutions available to the clockmaker. I believe this information can is better addressed through text.

In some instances your choice of grease and oil is very important. We will discuss the different oils available in a moment but for now a bit about mainspring lubricants.

There are some great mainspring lubricants available on the market. One good one is "Keystone Mainspring Lubricant" which can be purchased at this time at Mile Hi Clock Supplies which is listed in the reference

section at the end of this guide. I personally like something more fluid than a heavy grease when applying to the most common sized mainsprings. Many clockmakers, as well as myself, use a 90 weight EP (EP stands for Extreme Pressure) oil which can be purchased at any auto parts store. Others use synthetics such as "Slick 50" etc. The 90 weight oil is thin enough to be applied with a brush yet thick enough to allow for a smooth, even slipping of the spring coils. I use the Keystone Lubricant for heavier mainsprings like those found in fusee clocks. The 90 weight oil also works well in the plate holes where the mainspring arbors, great wheel pivots and other heavy load bearing pivots revolve a full 360 degrees.

About Oils

Horological oils are different than most other oils. Oils used in clocks and watches have been specifically formulated to stay where they are applied. Unlike other oils like A1 and automotive oils which are made to flow and disperse along surface areas, clock and watch oils must stay in a plates oil sink even when the plate is vertical or placed upside down. Oils like A1 will tend to

flow out of the sink onto the plate drawing nearly all but a tiny film of oil out with it. This thin film quickly drys out leaving the clock pivots dry.

I learned how important an oils quality can be for watches and clocks back in the early 1970s. Prior to this period horological oils were derived from whales and porpoise jaws. The natural oiliness and viscosity of this oil has been known and used for centuries in the clock and watch industry. During the 1970s these oils were justifiably banned due to environmental concerns.

The replacement oils that first emerged on the market were far inferior to these oils and to the oils available today. I would sometimes receive clocks back within just a few weeks that had stopped running as a result of dry pivot holes and surfaces. Better synthetic oils soon hit the market making the repairmans life a lot easier and they have continued to improve over the years, although they still can not match the whale and porpoise oils used in the past.

This was a valuable lesson. Those of us practicing watch and clock repair learned how a variation in the quality of oil could make such a huge difference in a

timepieces performance. Using the correct oil is EXTREMELY IMPORTANT. These days, even the cheaper clock oils work pretty well, but there is a difference between cheap oil and more expensive, quality oils.

In some instances using the correct oil for a given situation is critical. In the 1980s, in an attempt to reduce production costs many clock movement manufacturers began producing movements using softer, less expensive, far easier to machine and produce steels for arbors and pivots and then chrome plating the steel parts to make the surfaces smoother and harder. Names such as Hermle and Kieninger as well as cuckoo clock manufacturers like Regula use this technique. The standard clock oils do not work well with these pivots. The best oil I know of that was formulated for this type of movement is Etsyntha 859 clock oil. It is a bit pricy but is absolutely necessary for these clocks. Once the pivots in these clocks begin to show pitting and flaking of the chrome plating it will be necessary to replace the arbor and wheel or preferably the entire movement. These movements can be purchased from several suppliers here in the U.S. I highly recommend Butterworthsclocks (see directory at

the end of this guide). Mark Butterworth not only has the greatest selection of new movements around but is an authority on Hermle and other modern movements and very generously parts with his knowledge.

When the plating begins to deteriorate the pivot will begin cutting into the brass plate holes quickly wearing them out. Polishing these pivots will remove the plating, revealing the soft steel beneath. Hard, polished steels run smoothly in brass holes but soft steel will tend to grab at the brass which will result in a sluggish gear train. In fairness to the customer and to yourself it is best to replace the movement. Etsynthia 859 will help insure longevity and smooth running of the pivot and hence, the clock. I use LaPerle oil for most American, French, German etc. clocks of average size and Mobius oils for larger English tall cases, fusees etc.

Resources:

Clock Supply Houses

TimeSavers (tools, parts and supplies)
Box 12700
Scottsdale, AZ
85267 800-
552-1520 480-
483-3711
http://www.timesavers.com

S. LaRose Inc. (tools, parts and supplies)
3223 Yanceyville St.
Greensboro, NC 27405
888-752-7673
336-621-1936
http://www.slarose.com

Norkro Clock Supplies (tools, parts and supplies)
2209 NW Mill Pond Rd.
Portland, OR 97229
800-566-7576
http://www.norkro.com

Empire Clock (tools, parts and supplies)
1295 Rice Street
St. Paul, MN 55117

800-333-8463
651-487-2885
http://www.empireclock.com

Merritts Antiques Inc. (tools, parts and supplies)
1860 Weavertown Road
P.O. Box 277
Douglasville, PA 19518-0277 610-689-9541 http://www.merritts.com

Mile Hi Clock Supplies (Manufacturer of Keystone Tools and Mainspring Lubricants)
877-906-1200 Order Line
303-469-1220 Assistance
http://members.aol.com/milehiclck

Butterworthsclocks (supplier of Hermle, Urgos, Kininger Herr cuckoo etc. movements)
5300 59th. Ave. West
Muscatine, IA 52761
563-263-6759
http://www.buttersworthclocks.com

Horological Tools

Sherline Products Inc. (lathes, mills and accessories)
3235 Executive Ridge
Vista, CA 92081-8527
800-541-0735
760-727-5857
http://www.sherline.com

P.P. Thornton LTD (clock wheel cutters)
The Old Bakehouse
Upper Tysoe
Warwickshire
CV35 0TR United Kingdom

TimeTrax (clock timing machines)
Can be purchased at http://www.merritts.com Makers of TimeTraxhttp://www.adamsbrown.com

Microset (clock timing machines)
805-687-5116 http://www.bmumford.com

Horological Associations and Forums

National Association of Watch and Clock Collectors (NAWCC)
514 Poplar St.
Columbia, PA 17512
717-684-8261
http://www.nawcc.org

American Watch-Clockmakers Institute (AWCI)
701 Enterprise Dr.
Harrison, OH 45030-1696
513-367-9800
http://www.awci.com

British Horological Institute (BHI)
Upton Hall, Upton
Newark, Notts, UK Ng23 5TE
(01636)813795
http://www.bhi.co.uk

Horological Book Sellers

Arlington Books

http://www.arlingtonbooks.com

US Books
http://www.usbooks.com

Recommended Books

The Clock Repair First Reader.... P.E. Balcomb

The Clock Repair Primer.... P.E. Balcomb

The Top 300 Trade Secrets of a Master Clockmaker.... J.M. Huckabee

Clock Repair Basics.... Steven Conover

Clock Repair Skills.... Steven Conover

Chime Clock Repair.... Steven Conover

Clock Repair Tips.... B.C. Tipton

Practical Clock Repairing.... Donald DeCarle

Clock Design & Construction.... Laurie Penman