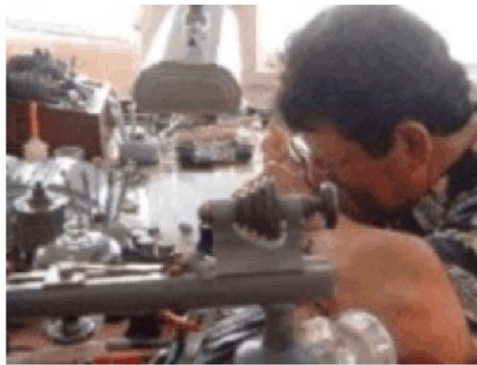


Bobs Watch Repair Trouble Shooting Notes 1



by Bob Tascione

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INTRODUCTION:

Following is a list of some common causes for a watch to perform poorly and some remedies to help get it back into acceptable running order. It is normal for an ailing watch to be inflicted with more than one of these problems at the same time so a thorough examination is necessary before an accurate evaluation of its condition can be made.

Many of the symptoms mentioned here can and often do result from a dirty and or dry movement. It is for this reason that it can be difficult to determine all that is wrong with a watch until it has first been cleaned and oiled. Of course there are some obvious problems that can be diagnosed prior to cleaning such as a broken balance staff, mainspring or hole jewel but many other problems can be much more subtle and evasive. By cleaning the watch first you

will have lifted a veil that often hides the real cause of a watches problems. When starting out in watch repair it can sometimes make life a lot easier by cleaning a watch right from the start.

Although there may be many reasons a watch may not be performing as it should it is usually not difficult to pin down the problem. Following are some simple techniques one can utilize to help zero in on a problem.

Diagnosing a watch can be simplified by addressing the movement in parts or sections rather than as a whole. A movement can be compartmentalized by sectioning it into separate assemblies and sub-assemblies. When approached in this manner individual assemblies in this manner individual assemblies can be tested for any abnormalities. We accomplish this by isolating each assembly from the remainder of the movement. By doing this we can now diagnose just one assembly at a time without complicating things with interference from any other part of the watch. Viewing a movement in this manner is much easier than it appears. A watch

actually is comprised of a group of assemblies working synergistically beginning with the winding mechanism which is used to input power into the movement ending with the escapement which of course allows the power to "escape" from the movement in predetermined intervals. All other assemblies such as the motor or mainspring assembly, the motion works, wheel train, and the pallet, which is actually part of the escapement mechanism but will sometimes be dealt with separately, dwell somewhere between these two. There can be others also such as calendar mechanisms, automatic winding, etc. but these can be looked at as sub-assemblies or modules that are actually attached and interlinked with the basic watch movement. We will isolate certain assemblies in some of the following trouble shooting examples. So let's get started with some common trouble shooting techniques.

MAINSRING PROBLEMS:

Coming in second place right behind a dirty, dry

watch would be mainspring trouble. The mainspring is the power source for a watch. It is the motor that delivers just the correct amount of power to the wheel train to allow the mechanism to function correctly with a little extra left over to help overcome the effect of a small amount of dirt and wear. Without adequate power the mechanism will fall short of its expectations. This effect will be noticeable in several ways. The first and most extreme symptom will be a watch that doesn't run at all which of course will often, but not always be the case if the barrel hook or barrel arbor hook are not catching but rather are slipping past the ends of the spring when winding. This as well as a broken or slipping mainspring will be revealed by a winding crown that turns endlessly. This does not apply to automatic watches which we will discuss in a moment. There are other non mainspring related problems that may give the same symptom which we will also cover a little later but these are much less common. The condition of the mainspring is extremely important. A spring that has lost its ability to deliver its full power for the duration for which it was originally intended should always be replaced. If the spring can no longer

deliver full power to the gear train the performance of the watch will suffer even though the overall condition of the movement may be excellent. I always recommend changing the mainspring if possible when cleaning a watch as they are inexpensive and simple to replace. If a replacement is difficult to locate and the spring looks good then it is VERY IMPORTANT to clean it well and lubricate it thoroughly with a good quality mainspring grease that is made for the caliber or size of the watch you are working on. Too thick of a grease will prevent the spring from unwinding smoothly inside the barrel and will periodically catch in places releasing itself with occasional slipping. This action causes intervals of irregular power distribution affecting the performance of the watch. A dirty, dry or sticky mainspring will cause the same thing. If the motion of the balance wheel changes periodically then a sticky mainspring may be the problem. These same principals apply to watches with automatic winding except that when fully wound the mainspring is designed to slip forward in its barrel slightly to avoid breakage from excessive wrist motion.

OVER WOUND WATCH:

One of the most common complaints a watchmaker hears from a customer about a watch is that it no longer runs because it has been over wound (wound too tight). Actually this is a mis-conception and is not at all the case. For some reason the watch has stopped running. The owner then winds the watch believing this is all that is needed. If the watch doesn't start again the owner believes it has been wound so tight that it somehow jammed the spring or winding mechanism. Of course the watch must be running to allow the mainspring to release its tension and until this happens the spring will store this power indefinitely as potential energy. In other words the watch stays wound. The owner believes he has done something wrong by somehow jamming the mainspring when actually any number of things may have stopped the watch.

POSITIONAL ERROR:

Most watches are adjusted in positions. This means that the watch has been fine tuned to maintain a certain amount of accuracy when placed in various physical positions. Positional error is the timing error or difference in rate a watch displays between these different positions. Often times after a watch has been cleaned and oiled it will run well with good balance wheel motion in one position but when changed to another position the amplitude of the balance will drop considerably. Positional error cannot be dealt with until the amplitude of the balance is acceptable in all positions. There should always be a small drop in balance amplitude when a watch is moved from a horizontal position i.e. dial up or dial down, to a vertical position. Friction is the reason for this. In the horizontal position the balance pivot is exerting most of its pressure down onto one cap jewel. If the shape of the pivot is correct and the cap jewel is in good condition then the inertia of the balance will experience little resistance from friction. An analogy of this would be a spinning top on a smooth glass surface. When changed to a vertical position both balance pivots will experience greater friction due to an increase in surface contact along

the sides of the pivot from the walls of the hole jewels. The amplitude of the balance can tell us a great deal about the condition of a watch. Poor balance motion in any position tells us there is a problem somewhere that must be corrected. A watch that exhibits good balance motion in one horizontal position, say dial up, but has poor or no motion when turned over to its other horizontal position, dial down, could suffer from one or more of several possible problems. Some of these problems could emanate from somewhere in the train or may be in the balance assembly itself. If the problem is not obvious then it will be helpful to isolate the balance from the driving portion of the watch. This is easily accomplished by removing the pallet from the movement. We can now impart a few puffs from a watch blower to the balance wheel to observe the balance motion while placing the movement in various positions. If the motion is now acceptable when changing between dial up and dial down then we have eliminated the balance assembly as the problem and the problem is somewhere in the drive train or pallet assembly.

If on the other hand the motion still changes excessively then the clearance between the balance

wheel and center wheel should be checked in both positions. The balance or hairspring will sometimes hit the underside of the center wheel during part of its oscillation. This can be caused by a wobbly balance wheel that is loose or crooked on the balance staff, an out of flat hairspring (if the hairspring is hitting the center wheel) a wobbly center wheel that is out of flat, a cracked upper cap jewel or a broken upper balance staff pivot. If all is well then there is either something interfering with the balance assembly such as a screw protruding through the pillar plate or balance cock etc. or is in the balance assembly itself.

Check the balance staff pivots under high magnification to see if they are bent or scored. The pivots must have a perfect shape (see pic) with a well polished surface. Any imperfection on either pivot will most likely result in balance amplitude inconsistencies between positions. If they are scored then you should either polish or replace the pivots.

The balance hole and cap jewels must also be in perfect condition. Most modern watches use synthetic

sapphire jewels providing an extremely hard, highly polished bearing for the balance staff pivots to run in. A crack or chip in a hole jewel may produce a sharp cutting edge which can easily cut grooves into a pivot or worse eventually reduce the diameter of a pivot much like a cutting tool would do in a lathe. A damaged hole or cap jewel will exert a different amount of friction on a pivot in different positions resulting in amplitude variations.

Next check to see that the hairspring is true and flat. If it is out of flat (pic) it could be hitting the balance arm or the overcoil may be contacting the underside of the balance cock in one or more positions. It is sometimes difficult to see contact being made as it may occur for only an instant during each oscillation of the balance. This too will result in amplitude variations.

The hairspring must be in excellent condition. It must be true (completely concentric) with no kinks. Make certain the spring is between the regulator pins. If it has jumped out from between the pins the spring may be making contact with the outside of

one of the pins when placed in one position and then move away from the pin when the position is changed. This will result in a rate increase during pin contact and a rate decrease when no contact is made. Also check the space between the regulator pins. If they are too far apart the hairspring may only hit one of the pins in one position and may make no contact with either pin when the position is changed. The spring should move back and forth between the slot making contact with both pins during a balance oscillation. If the spacing looks good but contact is made with one pin only then the spring may need a small adjustment. This can usually be done with a fine point tweezer by bending the spring in or out slightly just in front of the hairspring stud. The regulator pins must also be straight up and down. Pins that are not parallel with a hairspring may cause the hairspring to tilt up and down (wobble) during the oscillation. Again this may result in spring contact with the balance arm or underside of the balance cock.

A dirty, rusty or magnetized hairspring can also cause positional error. While the balance is

oscillating the spring may stick together in one or more positions while breathing normally in others. Sticking hairsprings are very common so always check them under high magnification to determine their condition.

Another reason for periodic amplitude fluctuations could be...

Mainspring Barrel Problems:

...a distorted or tilted mainspring barrel cap. If one edge of the barrel cap has lifted or popped out of its seat it could drag along the pillar plate or bridges or even hit the center wheel. This can actually stop a watch. This is a very common problem and can sometimes be difficult to diagnose. Look for wear or scratch marks along the barrel cap surface. You can check to see if there is any contact between these surfaces by removing the pallet assembly and allowing the train to spin slowly. It's important to remove the hands from the watch before allowing the train to spin and to also regulate the velocity of the

spinning train by applying a small amount of pressure to the second or third wheel with your finger tip. If allowed to run freely backlash of the wheel teeth may occur which can sometimes cause damage to fragile train teeth, pivots and or jewels.

Again, barrel cap problems occur often. It may just be that the cap was never pressed firmly down into its barrel seat. If the cap can be pressed in with a snap you will probably be ok. If on the other hand it just will not stay seated then there may be a more serious problem. Check that the mainspring is sitting all the way down inside the barrel and that the entire spring sits below the barrel cap seat. If the spring does stand above the cap seat and can not be pressed down below it then the spring may have been replaced with one that is too wide. If this is the case then it must be replaced with one of the correct size.

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. If the coils cannot slide smoothly along the surfaces of one another they will tend to stick together for awhile until finally slipping. The sticking together of the coils causes uneven power distribution and will reveal itself in fluctuating tick amplitude. If you notice that the watch 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 or motion of the balance wheel 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.

This helps 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 watch or clock 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 watch.

Improper mainspring replacement is something you will encounter periodically in both watch and clock repair. Often a watchmaker does not possess or cannot locate an exact replacement spring for an older 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 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 as mentioned earlier too wide a spring is suspect. Again, tolerances are so close in watches and clocks that you will often 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.

Lubricants, Oils & Mainspring Grease:

Yes, the oil you choose does make a difference. It's important that only oils made specifically for watches are used in watch repair. These oils are formulated not to spread like most other oils are designed to do but rather to stay in one place when applied. Following is an excerpt from "Bobs Clock Repair Trouble Shooting Notes" that explains a bit about oils and applies to watches as well as clocks. After the excerpt we will go over which oils and greases I like to use.

"About Oils

1. 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 dries out leaving the clock pivots dry.

I learned how important an oil's 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 timepieces 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 repairman's 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 watch and clock oils work pretty well, but there is a difference between cheap oil and more expensive, quality oils."

Many watchmakers use one grade of oil for all calibers (movement sizes) and sections of a watch. This is to say that the same oil used to lubricate the wheel train is also used on the winding mechanism, calendar, autowind assembly, and escapement possibly using a thicker oil or fine grease for the mainspring. In my opinion this is a big mistake. Many specially formulated oils have been developed for different movement calibers, and for the different sections of a movement. These oils meet the specific needs of each assembly in a watch. One example would be the ultra fine oil perfectly matched viscosity that is now available for the pallets and balance assembly. These oils help add to the performance of a watch as well as extending the required times between servicing.

My oils of preference are produced by Mobius. I use Mobius 941 Escapement Oil for the pallets. Mobius Synt-A-Lube 9010 for the balance jewels. For standard mainsprings 8200 Mainspring Lube, and for automatic springs 8201 Mainspring Oil. I also use 8200 in the winding mechanisms (manual and automatic) of smaller caliber watches and Mobius Microgliss D-5 for 10 ligne and larger. If the budget's a bit tight then using Mobius 8000 Mechanical is a good all purpose oil that can be used everywhere (except for the mainspring) with decent all around performance.

RESOURCES:

Watch Supply Houses:

Otto Freí

<http://www.ofrei.com>

126 2nd. St.

Oakland, California

94607 USA

510-832-0355

Cas-Ker Co.

<http://www.casker.com>

2550 Civic Center Drive

Cincinnati, Ohio

45231 USA

800-487-0408

WATCH REPAIR TOOLS:

Dashto

<http://www.dashto.com>

used Watch & Clock Materials

Tom Mister keeps an excellent supply of parts,
tools etc.

Uncle Larrys Watch Shop

<http://www.execulink.com/~lfoord/index/horology.htm>

used Watchmakers Tools and Horological
Material
and Books

519-539-3129

Woodstock, Ontario, CANADA

Sherline Products Inc. (Lathes, mills and
accessories suitable for Pocket Watch and
Clock Repair)

<http://www.sherline.com>

3235 Executive Ridge

Vista, CA 92081-8527

800-541-0735

760-727-5857

Microset (Watch & Clock Timing Machines)

<http://www.bmumgord.com>

805-687-5116

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, Ohio

45030-1696

<http://www.awci.com>

513-367-9800

British Horological Institute (BHI)

Upton Hall, Upton

Newark, Notts, UK

NG235TE

(01636) 813 795

<http://www.bhi.co.uk>

Horological Book Sellers:

US Books.com

<http://www.usbooks.com>

Arlington Books.com

<http://www.arlingtonbooks.com>

Recommended Books:

Practical Watch RepairingDonald de Carle

Watch & Clock Making & RepairGazeley, W.J.

The Joseph Bulova School of Watchmaking

Training Manual (excellent)

Watch Repairing, Cleaning & Adjusting....Garrard,

F.J.

Watch Repairer's Manual.... Henry Fried

Watch Escapements....Henry Fried

Bench Practices for Watch & Clockmakers....Henry

Fried

The Watchmakers Lathe....Goodrich, W.

The Escapements....Britton F.J.

Watchmaking....George Daniels (beautiful and excellent book on making watches by most renowned living watchmaker George Daniels...very expensive...not necessary for learning to repair).

