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Understanding the Deadbeat Escapement

Please allow me to start with the fact that far too many read about potential escapement faults and assume that is where the problem lies. Unless there is an obvious fault, the escapement is the last place one should look as to why a clock is not running. Sherlock Holmes and Mr. Spock both have stated when you eliminate all the other possibilities, then whatever is left, however unlikely, is the only answer. Meaning that all other faults must be dealt with first before anyone starts adjusting the escapement.

I have no idea whether or not the pendulum amplitude is sufficient on any deadbeat escapement and do not know of any "formula" for such a thing. In my opinion the amplitude is dictated by how the deadbeat is designed. If it allows for a deep sliding of the escape wheel tooth on the locking surface of the pallet, then you can expect a wide swing. This is NOT adjustable and however it swings, it swings, and the proof in in the timekeeping and not the observable pendulum amplitude.

The best anyone can do is make sure that the pendulum leader and crutch are as tight as possible and yet free. This is a source of power loss and whether it is in the middle has little to do with anything except if it's rubbing (too close) or coming loose (too far away).

That all said the important stuff is what we are told again and again and that is all 4 pivots must be highly polished (smooth) and all 4 bearing must be internally smooth and tight around the pivot while still allowing it to turn much the same as in the relationship of the leader and crutch. The individual pivots should be allowed to tilt ever so slightly as a means of assuring that it will allow the wheel to turn freely. This is like a high wire act and where testing and experience comes into play greatly.

I can't emphasize this enough because the recoil can have lots of slop around the bearing holes but the deadbeat and half deadbeat cannot.

Now the good old rant of locks and drops. Locks are relative easy on the deadbeat because the contact surface of the escape tooth must engage the pallet on the locking surface. The locking surface is the part of the pallet that is relatively straight and above the slightly curved impulse surface. The tooth must engage on the impulse surface and then slide up that surface. The sliding upward is angled such that the escape wheel does not move, hence the term deadbeat. This is NOT adjustable except for the smoothness of that surface, which most times is fine and does not need our intervention.

Where the tooth contacts the locking surface is adjustable by either bending verge or individual pallet manipulation, assuming you have adjustable pallets. You MUST understand how the escapement acts before you make any changes and these changes are usually the reason for the fault in the first place, so use care and only as your last resort.

For comparison, the recoil's locking and impulse surfaces are the same surface. Here the escape wheel tooth slides on the curved pallet (verge) surface and the escape wheel moves backwards as it slides, until it reverses direction and pushes the tooth away. The fact that both surfaces are the same, causing the wheel to move backwards, is why it's called a recoil.

Drops on the deadbeat should be a small as possible while still allowing for good escapement action. Drops allow the escape wheel to turn and if set too large will rob power and greatly increase escapement wear. It is the checking of the drops that tell us the condition of each escape tooth and hopefully you will not have to adjust these but if you do this is the check for success or failure of your escape tooth movement. Once the drop is set, then it's set, unless the pallet are moved in some fashion. With drops, most all escapements act the same as far as adjustment but I still urge everyone to get a copy of the table in the 400-day repair guide. It is invaluable. Better yet buy the 10th edition repair guide from Horolovar or whatever source you are comfortable with.

Along with the above, it's essential for an extremely smooth locking pallet surface as well as an extremely smooth impulse surface. The vast majority of the time these are fine in that they are very hard steel and done to near perfection at the time of manufacture. But if they get messed up, I would not tackle their polishing and would ask someone to do that job or replace the entire anchor if available.

This is my rant for the month and the closest I get is the 400-day clock and I don't see many of those. The Atmos is a deadbeat but it's a cold day in hell if I have to "play" with the escapement, except to make sure the pallets are aligned and secure.

To summarize: My advise is polish all 4 pivots as best you can, very lightly use a smoothing broach on the bearings, peg all 4 bearings, rebush any bearing that has any play what-so-ever, polish the crutch and contact points of the leader, make sure that relationship is as tight as good escapement action will allow, check for good escapement locking and small drops, finally run the clock and leave it for 24 hours and observe the amplitude and timekeeping. If the timekeeping is good, then forget it, if not then start diagnosing by observation and the best of luck to you.

Do not try and polish the pallets because most likely you will change the angles and the result will be a mess. Hire a professional who can state they have experience if you feel the need to polish the lock and sliding surfaces on the pallets.

I'm no escapement expert but I do understand how they work and how to adjust them. There is no short cut or easy fix. If anyone does not understand an escapement, then I advise you to read, read and read. Or on you own clocks, play, play, play. I did this to see if I could convey my understanding of the deadbeat, if I was successful, then great, and if I was unsuccessful, sorry.

Below is the chart from the Horolovar 400-day Clock Repair Guide and I strongly urge all to purchase a copy and as of this file date the latest is the 10th edition. This guide is copyrighted to Horolovar.

Horolovar (Chris Nimon)
PO Box 942
Lancaster, OH 43130
740-277-7083
E-mail address: horolovar@gmail.com
Web page address: http://www.thehorolovarcompany.com/

Mike

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TROUBLE SHOOTING CHART
(Graham or Pin Pallet Escapement)

COMMON SYMPTOMS				CORRECTIONS			
Entrance Pallet Drop	Exit Pallet Drop	Entrance Pallet Lock	Exit Pallet Lock	Eccentric Nut*	Entrance Pallet	Exit Pallet	Pallet Lifting Surface Angles†
More	Less	Normal	Normal	Raise Pivot Hole			
Less	More	Normal	Normal	Lower Pivot Hole			
Normal	Normal	Deep	Deep		Move Up	Move Up	
Normal	Normal	Shallow	Shallow		Move Down	Move Down	
More	Less	Deep	Deep	Raise (§) Pivot Hole			
Normal	Normal	Deep	Shallow		Move Down		Make Entrance Pallet Steeper
Normal	Normal	Shallow	Deep			Move Down	Make Exit Pallet Steeper
Normal	Normal	Very Shallow	Deep			Move Down	Make Exit Pallet Steeper
Normal	Normal	Deep	Very Deep			Move Up	Make Exit Pallet Less Steep

* It is assumed that the eccentric nut carries the *anchor* pivot. If it carries the *escape wheel* pivot, correction should be made just the opposite to that indicated.

† Rather than attempting to grind and polish the pallets, you may find it more convenient to replace them.

§ If the locks become shallow in making this adjustment, consider this a new symptom and make further corrections as indicated.

Note these three basic rules of thumb:

(1) If drops are equal, do not move the eccentric nut.
(2) If drops are unequal, do not move the pallets.
(3) If locks are unequal, change the lifting surface angle of one or both pallets.

TABLE OF ADJUSTMENTS
(Graham or Pin Pallet Escapement)

WHEN YOU DO THIS:			THE RESULT IS THIS:			
Eccentric Nut	Entrance Pallet	Exit Pallet	Entrance Pallet Lock	Exit Pallet Lock	Entrance Pallet Drop	Exit Pallet Drop
Raise Pivot Hole			Decreases	Decreases	Decreases	Increases
Lower Pivot Hole			Increases	Increases	Increases	Decreases
	Move Up		Decreases	Decreases	No Change	No Change
	Move Down		Increases	Increases	No Change	No Change
		Move Up	Decreases	Decreases	No Change	No Change
		Move Down	Increases	Increases	No Change	No Change
	Move Up	Move Up	Decreases*	Decreases*	No Change	No Change
	Move Down	Move Down	Increases*	Increases*	No Change	No Change

** by the total of the combined distances both pallets are moved.*