

Claw & Shuttle Management in Tobin Video Transfer TVT S8 R8 and D8 Telecine Models

1. Introduction

TCS uses inspected and reconditioned Bell & Howell 8mm silent modular mechanisms for making most of our line of telecine equipment. After hundreds of hours of operation, the mechanism may develop an unsteady picture and possibly loss of loops. This can be due to lack of lubrication, claw misadjustment, or wear of various parts. Evidently B&H did not envision that their 8mm equipment would be used enough (for showing home movies once in a while in residential use) for any parts to wear out, so their original service instruction manuals are inadequate for long-term maintenance. However, we suggest that a manual be obtained as a general guide.

The film is pulled down to each next picture by an intermittent pulldown claw, which yanks down the film at about 10 times the average film travel speed, in just a few thousandths of a second or so. Because of the high speed and inertia of the claw assembly and the film, worn parts will cause picture unsteadiness if there is excessive play in the components, as the final picture position at the end of each pulldown cycle will then fluctuate. The problem may start as a frameline position shift when changing speeds, or as unsteadiness at only the highest speed. In a severe case, film loops will be lost as the up-down claw travel will be insufficient for the claw to properly enter the next perforation in line.

Notching of the pulldown claw is another fault, most likely found in Super-8 and Dual-8 models. This is because the narrow Super-8 perforations require in turn a narrow pulldown claw, which concentrates the force and wear. In addition, the standards for Super-8 call for only a single claw tooth to register the perforation that is 2 frames above the film gate, the same as in the camera, to neutralize picture unsteadiness if the film manufacturer's perforating is uneven. (The second tooth is a "backup" for passing damaged film or splices.) This prevents the wear from being shared between two, and also wider, claw teeth as found in Regular-8 equipment. The claw moves in an arc from the claw pivot point, causing the claw to also rub sideways across the bottom of each film perforation when it pulls the film downwards, causing a notch to eventually form. In severe cases, the notch can catch on the film when the in-out cam tries to withdraw it to start the next pulldown cycle, possibly causing a "banging" noise when it is suddenly released. (In Dual-8 equipment, the claw is not in the correct standardized location for Super-8 film, but instead is in a compromise position that will work, though imperfectly, for both film formats. Owing to the perforation pitch difference between film formats, still only one tooth is active for each, and both are prone to developing notches.)

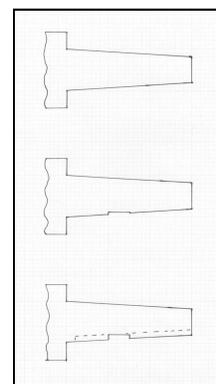
2. First: try lubrication

There are separate instruction sheets pertaining to Claw Pivot Lubrication. Essentially, you remove the front panel assembly and squirt some lubricant into the claw pivot area. We currently recommend a special lube that goes in thin and watery to penetrate into the pin area at the center of the pivot assembly through narrow clearances, and then solidifies into a sticky grease that will stay in place. Ordinary grease will not go in far enough, and oil will run out. If lubrication does not help, then the more intrusive steps below are needed.

3. Initial claw notch inspection

Swing open the film gate so the region of the pulldown claw is visible. On Super-8 and Dual-8 models the claw is located above the aperture (where the camera looks at the film). On Regular-8 models the claw is below the aperture. Turn the Manual Advance knob so the claw is protruding from its slot, and in about the middle of the downwards stroke. Remove the Optics Cover so you can push gently on the back of the pulldown claw arm so the teeth stick out further for better access. With your fingernail, feel the bottom of the upper claw tooth to check for a notch. If the upper claw has been filed down already and is undersized, the notch could instead develop on the bottom of the lower claw tooth.

If there is a quite noticeable notch, figure on disassembling the TVT and repairing or replacing the claw and shuttle assembly. Filing down the notch is a very "iffy" procedure that can easily break off the claw tooth and ruin it, so it would be wise to obtain a projector to use for cannibalizing needed parts, just in case. It is very unlikely that you could find a new original replacement part. The following shows the suitable used B&H projectors from which



Top: new claw

Middle: worn but should still work

Bottom: excess wear, needs filing up to dotted line

a usable claw assembly could be salvaged, to fit into the Heavy Duty TVT models:

<u>Format</u>	<u>Preferred Projector</u>	<u>Alternate</u>
Regular-8	256	245, 248 *
Super-8	346	356, 357, 461 *
Dual-8	456	466

* These will require that the Framer lever be adapted to fit.

The opposite case will apply if repairing the My Own Telecine models which use the original Framer arrangement. No TCS manual is specific to these, but the repair procedure is similar. The case is removed with 4 3/16" hex head screws on the panel and 2 probably 1/4" hex head screws on the bottom:

<u>Format</u>	<u>Projector</u>
Super-8	356, 357, 461
Dual-8	456, 466

4. Initial claw play inspection

Swing open the film gate so the region of the pulldown claw is visible. Turn the Manual Advance knob so the claw is protruding from its slot, and in the middle of the downwards stroke. The claw must be in the middle of the stroke, as there will be additional normal up and down play in other parts of the cycle.

With your finger or perhaps a wooden toothpick, watch closely such as with a magnifying glass, and gently wiggle the claw up and down so see if there is any free play. Only no, or a very tiny, movement is acceptable. It is normal to have a "rubbery" feel from flexing of the pulldown claw arm itself, but not normal to be able to move the claw up or down a few thousandths of an inch and have it stay there. If you prefer, you can remove the Optics Cover and try moving the claw arm directly. For this check, make sure the Manual Advance knob does not turn a little and give a false indication. Any free play is removed by disassembling the mechanism and adjusting the shuttle assembly as described below.

While you are at it, look at the claw and see if the position and protrusion are normal. Turn the Manual Advance knob CCW (counter-clockwise) to view the claw action, through several revolutions. At no point in the up-down cycle should either claw tooth hit or rub against the metal edges of its channel. While the claw is sticking out during the pulldown cycle, it should be about .035" or .040" (0.9 or 1.0mm) out from the surface of the film gate. For the retrace part of the cycle, the claw should be just below the surface of the film gate.

There are adjustments for these faults below that normally do not require replacing the claw. However it might still be a good idea to have a spare parts projector as the claw teeth are easily damaged.

5. Disassembly of the TVT

Ensure the TVT is unplugged. Remove the Manual Advance knob with a .050" (1.27mm) Allen hex key, such as McMaster-Carr catalog number 7122A13. Remove the front panel's 12 screws around the periphery using a #2 Phillips screwdriver. Ease out the panel's right side first by about 3 inches, then slide the panel to the right so the Manual Advance knob shaft passes through the slot in the case. Unplug the 2 power supply cables from the power supplies mounted to the case. Take note of which is which. Normally Red and Black wires go to the 12 volt supply, and Yellow and Blue wires go to the 15, 18 or 24 volt supply. Pry the Molex connectors off past the locking ramps using a flat-blade screwdriver, to not pull the wires out from their crimped-on contacts. The supplies are marked in small print, which may be hard to locate, as to their rated voltage in case you later forget which is which.

Mark the timing belt, timing pulleys and up-down cam to enable correct re-assembly without having to re-do the timing adjustments, if they have not already been marked in prior servicing. Put a white dot on the belt next to the setscrew of the 10-tooth motor pulley, such as with Liquid Paper, White-Out or other fast-drying paint. Without moving anything, put a white line on the belt that corresponds to another new white line on a main shaft pulley tooth. On the visible front face of the up-down cam put another white mark that generally agrees with the

one on the main shaft pulley, to avoid putting the main pulley back on 180° out of sync which will also upset the timing. Tease the timing belt over to the right edge of both pulleys, then off the side of the main shaft pulley, then turn the pulley by hand to remove the belt the rest of the way.

If the TVT has a shutter, correct phasing is important if it is a type that is adjustable. If it is a cut-down original black steel shutter, it will only correctly go on one way with no phasing adjustment needed, so just mark an “R” for Rear on the visible side with pencil, to put it back on the right way round. If it is a TCS newly manufactured stainless steel shutter, mark the edge of a main shaft pulley tooth with sharp pencil on white paint to indicate where the edge of a shutter blade will line up when re-assembled. These latter are mostly dual-use shutters adjustable for either 8mm format and have a range of phasing adjustment, and the final setting of most is critical. These are already stamped with an “X” on one side to show which way around it goes back on.

If the timing belt is damaged during removal, or if it appears to be nearly worn out, it would be a good idea to have a spare on hand. The sizes are slightly unusual and not carried by every industrial supplier, but are normally on hand at Stock Drive Products. If you want one, order it well ahead of time since they are sometimes “out-of-stock drive” instead and will back-order the item for possibly weeks or more. As yet we can’t recall one ever wearing out as they are very durable. Following are the industry standard sizes, and SDP stock numbers, for belts that fit the usual pulley sets (by numbers of teeth):

<u>Pulley Set</u>	<u>Standard Size</u>	<u>SDP Stock Number</u>
10 & 20 True Speed	112XL025	A 6R 3-056025
10 & 30	124XL025	A 6R 3-062025
10 & 35	128XL025	A 6R 3-064025
10 & 30 My Own Telecine	104XL025	A 6R 3-052025
10 & 30, 12 & 30 16mm	146XL025	A 6R 3-073025

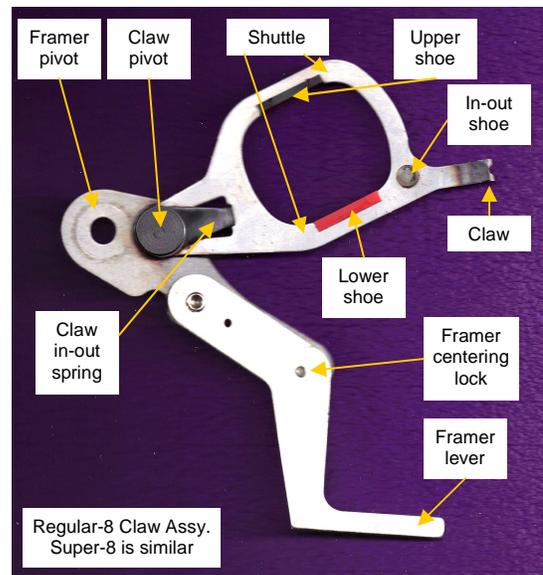
6. Removal of Shuttle & Claw

Study the parts to see how they fit together. In case of Regular-8, note the square tab as part of the framer pivot, near the Claw Pivot, that adjusts the claw centering and mark above and below it with a black waterproof marker (or possibly white paint) to show how it is presently set. This will save time in re-assembly.

Remove the main shaft timing pulley’s two screws. These might be #1 Phillips, or require a 5/32" (4mm) or so flat blade screwdriver, or need a 5/64" Allen hex driver. For the first two types, a long shaft screwdriver will make the job easier. A long ball-end driver is preferable for the latter for quick screw removal, such as McMaster-Carr 5497A68. Slide the pulley to the right, up and out.

If there is a shutter, it slides off next. Then remove the in-out cam plate, taking note of which way round it is installed.

Take out the one screw from the framer pivot that retains the shuttle and claw assembly. Note the order and direction of the special shoulder screw, tension washer, for 8mm the eccentric piece with square tab, spacer, and special nut. Move the assembly to the right and lift it out, being careful to not damage the claw teeth or lose the two plastic shoes that fit on the shuttle and ride on the up-down cam. These might be black, white or red. If the Framer lever is the adapted type with a black plastic cap, this will just slide off.



7. Filing down the claw notch

First remove the 2 plastic shoes, taking note of which position each is in, and which way round. Wipe off grease, dirt and oil from all. If the claw has a notch worn into one of the teeth, put the claw arm in a vise so that

nothing important will get crushed, and file it down with a fine-tooth flat jeweler's file. Keep the taper on the claw tooth the same as before and avoid making sharp edges. Do not apply too much pressure or the tooth will snap off. If the tooth is harder than usual you might have to use a diamond-coated file to cut it. If the tooth is soft, files easily, bends while filing and does not appear to have been hardened, this is a bad sign and additional filing, or replacement, should be anticipated before too long. In this case, now might be the time to think about ordering a parts projector.

8. Adjust end play on main shaft

Push back and forth axially on the ends of the main shaft. It should only slide a miniscule amount, say .001"-.002" or roughly equal to the thickness of a piece of paper. This can be best judged by looking at where the up-down cam meets the right-hand bearing. If it is too tight and feels at all stiff to turn, it may seize up and stall, perhaps with temperature change. If there is too much end play, it will cause the claw protrusion to be inadequate and variable, causing unsteadiness and loss of film loops. If it needs adjusting, loosen the 2 setscrews in the up-down cam with a .072" 6-flute Bristol spline key, available from McMaster-Carr as catalog number 7048A17. The setscrews are deep, may be concealed by old grease, and might be very tight. Move the cam to the desired condition of shaft end play and re-tighten the setscrews. Note that the cam is probably a tight fit on the shaft and hard to move. If the setscrews have previously embossed the shaft so the cam wants to shift and re-seat into the same position as before, rotate the cam a bit relative to the shaft. Put a little light oil on each end of the two sintered bronze bearings that the shaft spins inside, and on the washers and retaining ring on the left end of the shaft. Oiling these washers will hopefully reduce wear and the future need to re-adjust the end play, as they are under constant pressure and running friction because of the claw's in-out restoring spring. Check to verify smooth easy rotation of the cam, and only microscopic end play of the shaft. Smooth rotation is important for the next step, to not interfere with judging the required amount and position of drag of the plastic shuttle shoes.

9. Adjusting shuttle tightness

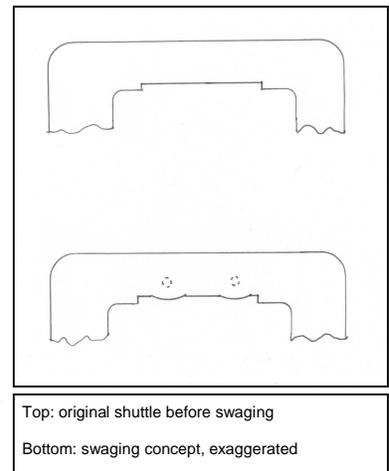
A typically objectionable amount of jitter, caused by a small amount of looseness in the shuttle, can be corrected by swaging the shuttle. For this, remove the shoes keeping track of how they were installed, lay the cleaned shuttle area on an anvil or similar solid metal object, and hit a center punch or small pin punch with a hammer at two points above the shoe notch as shown. A moderate hit will reduce the thickness of the shuttle at that point, and more importantly for our purposes spread the metal sideways for a tighter fit on the up-down cam. We suggest doing this to only the upper part of the shuttle, to avoid distorting the shape of the bottom part and the bottom shoe, which determine where the claw ends up at the end of the stroke.

A tightening on the order of a thousandth of an inch or so (.001" or .025mm) is all we need to do, in many cases. Don't hit too hard at first until you get a feel for it. The purpose of tightening is to "put the brakes on" the rapidly moving claw arm when it is going the fastest and has been riding on a loose part of the cam, so its last remaining movement is only slight and it will therefore stop in the correct position. At the same time, the shoes must not be tight at all degrees of cam rotation, or they will inhibit the claw from exiting the film perforation fast enough after the end of the pulldown, causing loss of film loops.

After one swaging attempt, re-install the shuttle shoes in the same orientation as originally. Temporarily re-assemble the claw and shuttle assembly and the in-out cam and pulley on the up-down cam to check for fit. At this stage installation of the shutter (if any), and exact timing of the pulley, are not necessary. Make sure that the claw teeth are not hitting the sides of their channel. Turn the pulley by hand CCW and see if there is a noticeable but light degree of stiffness to the rotation, when the claw is about in the middle or so of its down stroke. There will also be light stiffness in the middle of the up stroke, but this is less critical and the down stroke stiffness should be the one that is optimized.

If there is no noticeable stiffness, remove all the parts and try another swaging, then re-assemble and try the fit again. If the stiffness is excessive and the cam screeches to a halt and the pulley must be forced to turn past this point, remove all parts and very lightly file the spread-out portion of the shuttle to remove a very small part of the metal where the shuttle pushes the shoe against the up-down cam, then re-assemble and try the fit again.

Once the right amount of shoe stiffness has been established, remove the claw assembly and check that



the shuttle area is still straight where it has been swaged, to help ensure that the claw protrusion is still correct. Then re-assemble all of the parts as they were originally oriented. Apply a small amount of grease to the up-down and in-out cams.

One might imagine that re-installing the plastic shoes switched left for right might be a good stopgap measure to reduce play and increase the drag. However, a new perfectly flat shoe riding on a more or less cylindrical surface has a very small contact area, in theory infinitely small, and will tend to wear rapidly. Re-using the same shoe area as before ensures that its slightly curved surface contour will expose a much greater area to the cam, therefore reducing the wear rate.

In case the claw assembly is beyond repair, and must be replaced, some extra cautions are needed. First it would be a good idea to re-set the Framer centering on the new claw, by loosening the locking screw, adjusting to match the original, and re-tightening. This should be a good starting point to reduce risk of breaking the claw.

The replacement claw will come with a pair of plastic shoes, which might or might not be a good fit on the original cam. The shoes were made in three thicknesses where they ride on the cam. These are intended to compensate for undersize cams or oversize shuttle openings. Mix and match the different color shoes for the best initial fit on the cam. The different colors represent size increases in .005" (.125mm) steps which are far too coarse for a good non-jittering fit unless you are very lucky. In practice, select shoes that are a bit loose and then tighten up by swaging the shuttle. Or, conversely, pick shoes that are tight and then loosen them up by filing the shuttle. Shoe color codes, and the thickness against the cam, that we have seen include:

<u>Shoe Color</u>	<u>Thickness</u>
Black	.030 "
Red	.035 "
White	.040 "
Metal (old flat type)	.030 "

Final claw adjustments are described in the B&H service manuals for the projector models given previously. Manuals can be obtained from internet sources and the Ebay auction site. These include:

1. Claw centering in its channel and averaging in the middle of the film perforations.
2. Claw straightness, tilt and .040" (sometimes given as .035") protrusion, by bending if required.
3. Framer adjustment range so as to not hit top or bottom of channel with claw, and to give equal range of adjustment up and down.

Re-assemble the claw parts. Hold the shuttle forward on the up-down cam so the shoes don't come off. Slide on the in-out cam the right way round, with the two mounting holes matching the threaded holes in the up-down cam, and with the extra hole matching the extra hole in the up-down cam. Slide on the shutter (if any) with the R to the rear, the X forward if super-8 and X to the rear if regular-8, and the extra hole matching the extra hole in the cams. Slide on the timing pulley with the white mark in general agreement with the up-down cam and with the holes lined up. Install the two original screws, which are #3-48 thread. Adjust the shutter timing to match the pencil mark before final tightening of the screws. Slip the timing belt around the motor pulley with the white timing dot matching the setscrew, and with the white line matching the one on the shutter pulley, then turn by hand to slip the belt back over on to the shutter pulley. It should not be necessary to loosen the motor attaching screws. Re-install the power connectors, slip the panel back into the case, install the 12 screws and the Manual Advance knob. Test all functions before placing back into service.

p.s.— A way of tightening up the shuttle without bashing it, might be to put a sliver or two of household aluminum foil between the shuttle and the shoe. We have not tried this out to see if it will stay put.

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