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<td>Show worn mechanical detents</td>
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Introduction
The microscopes in the Olympus BH-2 line have largely been replaced in the professional and clinical world, due to their advancing age and the lack of repair parts from Olympus. A great many of these microscopes were produced in their day, and because of this they are readily available on the used market for very reasonable prices. Thanks to their excellent build quality and solid optical performance, these scopes are now very popular with hobbyists, providing an affordable, high-quality alternative to the Chinese-made scopes prevalent today.

One issue that might be encountered when purchasing either the BHS or BHT version of these microscopes is that the grease in the BH2-6RE modular revolving nosepiece assembly may be dried and gummy, resulting in a stiff or gritty feel of the revolving nosepiece.

Another issue that may be encountered is with the mechanical detents in the revolving nosepiece. After many years of hard service, especially if the nosepiece assembly has not been periodically lubricated throughout its life, one or more of the detent stops may be worn to the point where the detents are sloppy and the affected objectives do not maintain proper radial indexing. At best, this is annoying to the operator, and at worst can render the revolving nosepiece unusable.

This document describes the complete teardown, cleaning, lubrication, and reassembly of the BH2-6RE modular revolving nosepiece assembly on a BHS or BHT microscope stand. Completion of this maintenance procedure should restore the proper feel to the nosepiece turret. Additionally, this maintenance should reduce further wear of the mechanical detent stops. Note that if the detents stops are already excessively worn, there is no repair for this other than the replacement of the revolving turret.

Scope of this Document
The procedures detailed in this document directly apply to the BH2-6RE (six-position) revolving modular nosepiece assembly used on the Olympus BHS and BHT microscope stands. This procedure is also applicable the BH2-5RE (five-position) modular revolving nosepiece assembly, due to its similarity with the six-position nosepiece.

Note that the original Olympus service literature did not address the teardown and repair of the various revolving nosepiece assemblies used on BH-2 stands, as these were field-replaceable assemblies that were considered unserviceable by Olympus.

Tools and Supplies Needed
The following tools and supplies will be needed to complete the teardown, cleaning, lubrication, and reassembly of the BH2-6RE modular revolving nosepiece assembly:

- Center punch or nailset tool
- Cleaning solvent (see recommendations below)
- Electric heat gun (item 1 of Appendix 1)
- Lens-spanner tool (item 5 of Appendix 1)
- Lubricant (see recommendations below)
- Screwdriver set, JIS (item 2 of Appendix 1)
- Silicone RTV adhesive, black (item 6 of Appendix 1)

Recommended Lubricant Type
Plastilube® Brake Grease or Mobilgrease28® grease (item 7 of Appendix 1) are recommended for use in the BH2-6RE modular revolving nosepiece assembly. Both Plastilube® Brake Grease and Mobilgrease28® are medium greases which will remain stable and serviceable for many years to come.

Recommended Solvents
Some sort of solvent will be needed to clean the old grease from the components of the BH2-6RE modular revolving nosepiece assembly. Solvents that can be used are acetone, diethyl ether, heptane, hexane, mineral spirits, turpentine, and xylene. Regardless of which solvent is chosen, make sure that adequate ventilation is present during the cleaning process, and that any necessary personal protective equipment is utilized to minimize exposure. Consult the MSDS sheet before using any unfamiliar solvents. Many of the solvents listed above are flammable, and their vapors may represent an explosion hazard if mishandled. Whichever solvents are chosen, be sure to follow all manufacturer’s instructions and safety precautions. Many solvents will damage rubber or plastic parts, or the finish of painted surfaces. Isopropyl alcohol or 409 Cleaner may be safely used to clean most painted surfaces. Mineral spirits works well with both Plastilube® and Mobilgrease28® greases.

Remove the Objectives from the Nosepiece
Before beginning the teardown of the BH2-6RE modular revolving nosepiece assembly, remove the nosepiece assembly from the microscope stand, remove all the objectives from the revolving turret, and store the objectives someplace where they will be protected from physical damage, dust, and debris.

Label Parts for Identification and Reassembly
During the teardown of the BH2-6RE modular revolving nosepiece assembly, be sure to bag and tag the various parts as they are removed, to prevent their loss and to facilitate their proper identification during the reassembly process.
The BH2-6RE Modular Revolving Nosepiece

Figure 1 shows the six-position BH2-6RE modular revolving nosepiece assembly used on the Olympus BHS and BHT microscope stands.

The BH2-6RE modular revolving nosepiece assembly consists of a six-position turret assembly, which is made up of an inner stationary base, an outer revolving turret, miscellaneous parts and a protective cover. Attached to the turret assembly is a machined dovetail slide, for mounting the BH2-6RE onto the BHS/BHT stand (see Figure 2).

Figure 1 – The BH2-6RE modular revolving nosepiece

Figure 2 – Basic components of the BH2-6RE

The procedure to disassemble, clean/re-grease, and reassemble the BH2-6RE modular revolving nosepiece assembly is detailed in the following sections.

Remove the Dovetail Slide

The dovetail slide attaches to the stationary base of the turret assembly via four M2.6X5 pan-head screws. Use a suitable JIS screwdriver to remove these four M2.6X5 screws (see Figure 3) and then remove the loose dovetail slide from the stationary base (see Figure 4).

Figure 3 – Remove four screws securing the dovetail slide

Figure 4 – Remove the loose dovetail slide

Remove the Cover from the Turret Assembly

Use a suitable JIS screwdriver to remove the three M2X3 countersink screws securing the protective cover onto the stationary base (see Figure 5) and remove the protective cover from the turret assembly (see Figure 6).

Figure 5 – Remove screws securing the cover in place
Figure 6 – Remove the protective cover

Figure 7 – The turret assembly (without cover)

Remove Lock Ring for Pivot-Adjustment Screw
The slotted lock ring for the pivot-adjustment screw (see Figure 7) can be difficult to remove unless the proper tool is used. Do not attempt to remove the slotted lock ring and pivot-adjustment screw unless you have access to such a tool, since the slot in the lock ring will likely be damaged if you use an improper tool, making removal of the lock ring much more difficult. A suitable tool for this task can be easily made by filing or grinding a relief notch for the pivot-adjustment screw in the center of the blade of a large slotted screwdriver, as shown in Figure 8. Note that if you decide to make such a tool, be sure that the tip of the screwdriver you select has a blade width matching the outer diameter of the slotted lock ring, and that the thickness of the blade is such that it will seat fully into the slot of the slotted lock ring.

Figure 8 – Screwdriver modified to remove slotted lock ring

Prevent the Revolving Turret from Spinning
Before attempting to loosen the slotted lock ring, the revolving turret must first be locked in position relative to the stationary base, to allow for sufficient torque to be applied to the slotted lock ring to loosen and remove it. To lock the revolving turret, first spin the revolving turret until the bore in the stationary base aligns with one of the six threaded objective bores in the revolving turret. Next, insert a small screwdriver handle of the appropriate size into the two bores (see Figure 9). This will prevent the revolving turret from moving relative to the stationary base when torque is applied to loosen the slotted lock ring, without causing any damage to the fragile brass threads in the revolving turret.

Figure 9 – Insert screwdriver into bores to lock the turret

Loosen and Remove the Slotted Lock Ring
Hold the turret assembly by grasping the knurled-rubber grip ring on the outer perimeter of the revolving turret and use the slotted screwdriver with the notched

---

1 Don’t even think about using a pair of needle-nose pliers to loosen the slotted lock ring. It will end badly if you do this. Don’t ask me how I know this.
tip (see Figure 8) to loosen the slotted lock ring securing the pivot-adjustment screw to the stationary base (see Figure 10).

Once the slotted lock ring has been loosened, remove the screwdriver handle from the bores in the revolving turret and the stationary base (which is locking the revolving turret to the stationary base) to get it out of the way. Unscrew and remove the slotted lock ring from the pivot-adjustment screw (see Figure 11).

The pivot-adjustment screw. Do not allow this bearing ball to fall out or it may become lost.

Remove the Center-Pivot Bearing Ball
Use a tweezers to remove the ¼” bearing ball from the center bore in the stationary base (see Figure 13).

Remove the Mechanical Detent Stop
The next step is to remove the mechanical detent stop. Use a suitable JIS screwdriver to remove the two M2x4 pan-head screws securing this stop to the stationary base of the turret assembly (see Figure 14). These screws are staked in place with adhesive and can be surprisingly stubborn, so be sure to use the proper JIS screwdriver to prevent damaging the screw heads. It might also be helpful to heat the screws with a heat gun before loosening them, but do not melt the black knurled-rubber grip ring in the process.
Remove the screws securing the detent stop
Remove the loose mechanical detent stop from the stationary base (see Figure 15).

Remove the Black Knurled-Rubber Grip Ring
Carefully remove the black knurled-rubber grip ring from the outer perimeter of the revolving turret (see Figure 16), being careful not to stretch or damage it in the process. This ring is held onto the turret with a few spots of adhesive, so proceed carefully here.

Remove the Threaded Retaining Ring
The stationary base is held inside the recess of the revolving turret by the threaded retaining ring (see Figure 17).

Place the turret assembly into a suitable work vise and use a heat gun to thoroughly heat the turret assembly, to soften the internal grease. Then use a center punch or nailset tool to loosen the threaded retaining ring by placing the tip of the tool into one of the four tooling holes in the threaded retaining ring (see Figure 17) and driving the threaded retaining ring counter-clockwise by carefully tapping the tool with a small hammer or mallet (see Figure 18). Be careful and do not accidentally put the center punch or nailset tool into one of the six detent notches in the revolving turret (instead of into one of the four tooling holes in the threaded retaining ring), or the revolving turret will be irreparably damaged when the punch is struck by the mallet.

Continue loosening the threaded retaining ring and remove it, being careful that the perimeter bearing balls beneath the threaded retaining ring do not fall out and become lost in the process (see Figure 19).
Remove the Perimeter Bearing Balls
Carefully remove the 3/32” bearing balls (there are 83 of them) from the perimeter of the stationary base. A small magnet can come in handy here (see Figure 20).

Remove the Stationary Base from the Turret
Once the perimeter bearing balls have been removed, lift the stationary base free of the recess in the revolving turret and remove it (see Figure 21).

Clean Grease from the Various Components
Use a suitable solvent (e.g., acetone) to thoroughly clean all the old grease from the stationary base, revolving turret, threaded retaining ring, perimeter bearing balls, center-pivot ball, mechanical detent stop, pivot-adjustment screw, and the slotted lock ring, in preparation for reassembly.

Reinstall Stationary Base into Revolving Turret
Hold the stationary base such that the center pivot is facing downwards, and then lower the stationary base into the recess of the revolving turret (see Figure 22).

Apply Ring of Grease for the Perimeter Balls
The next step is to apply grease the ring into which the perimeter bearing balls will be placed. Carefully apply a ring of grease (item 7 of Appendix 1) into the channel formed between the outer perimeter of the stationary base and the inner perimeter of the revolving turret (see Figure 23). Do not apply too much grease here, to minimize the squeeze-out that will occur when the threaded retaining ring is reinstalled to hold the stationary base into the recess of the revolving turret.

Reinstall the Perimeter Bearing Balls
Use tweezers to carefully set the 3/32” bearing balls (there are 83 of them) into the grease ring (see Figure...
placing the bearing balls as close together as possible as you proceed.

Figure 24 – Place the bearing balls into the ring of grease

Reinstall the Threaded Retaining Ring
Carefully engage the threads of the threaded retaining ring with the threads in the revolving turret (see Figure 25).

Figure 25 – Engage the threaded retaining ring

Use a suitable lens spanner tool (item 5 of Appendix 1) in a pair of opposing tooling holes to tighten the threaded retaining ring\(^2\) (see Figure 26).

Figure 26 – Tighten the threaded retaining ring

While holding the stationary base in one hand, spin the revolving turret multiple times in both directions with the other hand, to drive out any excess grease from beneath the threaded retaining ring. Use dry cotton swabs to remove any grease squeeze-out (see Figure 27). Do not use a solvent here, otherwise the solvent may run into the revolving turret mechanism and foul the grease within.

Figure 27 – Remove any grease squeeze-out

Apply Grease to the Center-Pivot Bore
Apply a small amount of grease (item 7 of Appendix 1) into the center-pivot bore of the stationary base for the \(\frac{1}{4}''\) bearing ball (see Figure 28).

Figure 28 – Apply grease to the center-pivot bore

Reinstall the Center-Pivot Bearing Ball
Now that the center-pivot bore has been greased, reinstall the \(\frac{1}{4}''\) bearing ball into the freshly greased center-pivot bore. The grease will hold the center-pivot bearing ball in the proper position during subsequent reinstallation of the pivot-adjustment screw (see Figure 29).

Figure 29 – Reinstall the center-pivot bearing ball
Apply Grease to Top of the Center-Pivot Ball
Apply a small amount of grease (item 7 of Appendix 1) onto the top of the ¼” bearing ball in the center-pivot bore (see Figure 30).

Reinstall the Pivot-Adjustment Screw
Use a suitable slotted screwdriver to reinstall the pivot-adjustment screw into the threaded bore in the center of the stationary base (see Figure 31). Carefully snug the adjustment screw just to the point where a slight bit of resistance is felt. Test the feel of the revolving turret. If the motion feels rough, back the screw off a bit until it feels smooth. Leave the screw in this position.

Reinstall the Slotted Lock Ring
Carefully engage the threads of the slotted lock ring with the pivot-adjustment screw (see Figure 32).

Spin the revolving turret until one of the six threaded objective bores in the revolving turret aligns with the bore in the stationary base. Insert a suitably sized screwdriver handle into these bores to lock the revolving turret to the stationary base. Use a suitable tool (see Figure 8) to snug the slotted lock ring down to lock the pivot-adjustment screw in place (see Figure 33). Do not allow the pivot-adjustment screw to rotate while tightening the slotted lock ring.

Verify the Feel of the Revolving Nosepiece
Hold the turret assembly by gripping the stationary base in one hand and spin the revolving turret with the other hand. The motion of the turret should not feel gritty, erratic, or excessively stiff. If it does, loosen the slotted lock ring, readjust the pivot-adjustment screw, and retighten the slotted lock ring (as described above) until the turret motion feels acceptable.
Clean Off Any Visible Grease
Use a suitable solvent (e.g., mineral spirits) and a clean rag or tissue to thoroughly clean any visible grease from the exterior of the turret assembly. Be careful while removing the excess grease, to prevent any of the solvent from dripping into the revolving turret mechanism and fouling the grease within.

Reinstall the Mechanical Detent Stop
Place the mechanical detent stop in position on the stationary base, aligning the two holes in the mechanical detent stop with the two tapped holes in the stationary base (see Figure 34). Make sure the stop ball on the mechanical detent stop is facing downwards.

Reinstall the Protective Cover
Place the protective cover into position on the back side of the turret assembly, lining up the three holes in the protective cover with the three tapped holes in the stationary base (see Figure 37).

Apply Grease to the Mechanical Detents
Apply fresh grease (item 7 of Appendix 1) to the six mechanical detent notches in the revolving turret (see Figure 36). Be careful that you do not get grease anywhere else.
**Reinstall the Dovetail Slide**

Place the dovetail slide into position on the back side of the turret assembly, lining up the four holes in the dovetail slide with the four corresponding tapped holes in the stationary base (see Figure 39). Be sure to orient the dovetail slide such that the relief notch (see inset of Figure 39) is facing downwards and towards the slotted lock ring on the pivot-adjustment screw.

**Figure 39 – Position dovetail slide onto stationary base**

Use a suitable JIS screwdriver to reinstall four M2.6×5 pan-head screws to secure the dovetail slide onto the stationary base of the turret assembly (see Figure 40).

**Figure 40 – Secure dovetail slide onto stationary base**

**Reinstall the Knurled-Rubber Grip Ring**

The final assembly step for the turret assembly is to reinstall the black knurled-rubber grip ring around the outer perimeter of the revolving turret and secure it in place with a suitable color-matching adhesive. Black silicone RTV is a good choice of adhesive here, since it will bond well with the metal of the revolving turret as well as to the black knurled-rubber grip ring. Additionally, any of the inevitable squeeze-out that is not removed will not be visible. Apply two dabs of black silicone RTV (item 6 of Appendix 1) onto the outer perimeter of the revolving turret, spaced approximately 180° apart (see Figure 41).

**Figure 41 – Apply black silicone RTV to revolving turret**

Carefully reinstall the knurled-rubber grip ring onto the outer perimeter of the revolving turret, making sure to not stretch or damage the grip ring (see Figure 42).

**Figure 42 – Reinstall the knurled-rubber grip ring**

Use dry cotton swabs to thoroughly remove any visible silicone RTV squeeze-out (see Figure 43).

**Figure 43 – Remove any silicone RTV squeeze-out**

**Ready for Service**

The newly reconditioned BH2-6RE modular revolving nosepiece assembly is now ready to be put back into service (see Figure 44).
Requirements for Periodic Maintenance

Periodic cleaning and application of fresh grease to the mechanical detent notches in the stationary base is necessary to minimize wear of the mechanical detents, thereby maximizing the useful service life of the BH2-6RE. This can be easily accomplished by simply removing the protective cover, cleaning and re-greasing the detent notches, and then reinstalling the protective cover per the procedures detailed in this document. The dovetail slide does not need to be removed to perform this periodic maintenance. If the equipment sees heavy usage, this service should be performed on a six-month interval.

Problems with the Turret Assembly

A few problems with the turret assembly can sometimes be found in the reassembled nosepiece. The first will be seen if one or more of the mechanical detents are excessively worn. This will cause radial float of the revolving turret in one or more of the objective positions, and these objectives will have trouble returning to and maintaining their proper index position. This can make it difficult to utilize some illumination types, such as phase contrast, since the phase annuli will not be able to hold an acceptable alignment due to variations in objective indexing.

The other problem that may be seen is caused by overall float of the revolving turret, relative to the center point of the stationary base. If there is excess play in the center-pivot ball, such that the turret is not held in the exact center point, the whole turret may move slightly, resulting in poor objective centering and all that that entails. This problem may be encountered if the threaded retaining ring has not been properly snugged down, or if the center pivot-adjustment screw has not been properly adjusted to remove the play in the center-pivot mechanism.

A Few Words about JIS Screws

Screws with JIS heads are frequently found in much of the equipment designed and manufactured in Japan. JIS screws look very much like standard Phillips screws, but they differ in that JIS screws were designed to not cam-out under torque, whereas Phillips screws were designed to intentionally cam-out, as a means to limit the torque applied to the fasteners. Because of this crucial difference in the geometry of the two driver types, JIS screws will be damaged by standard Phillips drivers if too much torque is applied. JIS screws can usually be identified by the presence of a single dot, or by an “X”, stamped into one of the four quadrants of the cross-point depression (see Figure 45).

Original Olympus Documentation

A scanned PDF of an early version of the *Olympus Research Microscope Series BH2 (BHS) Repair Manual* is available for download at various microscope-related hobbyist sites on the internet. This document can be found by searching for the title in an internet search engine, such as Google or Bing.

How to Contact the Author

Please feel free to direct any questions or comments regarding this document (or Olympus BH-2 microscopes in general) to the author at the email address on the cover of this document.

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3 Field experience has shown that even heavily used scopes (such as those used in hospitals and clinical lab settings), when lubricated on a six-month interval, can be expected to provide many years of trouble-free service.
Appendix 1
Inspecting the Rotating Turret for Wear of the Mechanical Detents

The photos below show the rotating turret from a BH2-5RE modular revolving nosepiece which has severely worn mechanical detents, as a result of extensive use and a poor service history. The rotating turret is made of brass (a soft metal), with a hard, corrosion and wear-resistant layer of dull, silver-colored plating on the exposed surface. When the hard plating in the area of the mechanical detents begins to wear away, as a result of severe use without routine cleaning and re-greasing of the detents, the underlying brass will then be exposed. This exposed brass will then wear quickly with continued usage, soon rendering the nosepiece unusable. Figure 46 shows the complete turret, with brass exposed in the area of the mechanical detents. Figure 47 shows a close-up of one of the mechanical detents, where the wear can clearly be seen.

Figure 46 - Rotating turret with severely worn mechanical detents

Figure 47 - Close-up view of a worn mechanical detent notch
Appendix 2
Sources for Replacement Parts, Tools, and Supplies Referenced in this Document

Table 1 lists specific information for the various parts, tools, and supplies discussed in this document. The pricing and availability listed below is accurate as of July 2020 but is subject to change without notice.

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<td>Plastilube® Brake Grease, 75 cc</td>
<td>Plastilube®</td>
<td>ATE70015</td>
<td>Autohausaz</td>
<td>1161688</td>
<td>$8.35</td>
</tr>
<tr>
<td></td>
<td>Mobilgrease2B® grease, 13.4 oz.</td>
<td>Mobil</td>
<td>Mobilgrease2B®</td>
<td>Amazon</td>
<td>---</td>
<td>$24.26</td>
</tr>
</tbody>
</table>

Table 1 – Parts, Tools, and Supplies

Table 2 lists the contact information for the vendors referenced in Table 1.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>URL</th>
<th>Local Phone</th>
<th>Toll Free</th>
<th>Fax</th>
<th>email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon</td>
<td><a href="http://www.amazon.com">www.amazon.com</a></td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Autohausaz</td>
<td><a href="http://www.autohausaz.com">www.autohausaz.com</a></td>
<td>---</td>
<td>1-800-240-4620</td>
<td>---</td>
<td><a href="mailto:sales@autohausaz.com">sales@autohausaz.com</a></td>
</tr>
<tr>
<td>Harbor Freight Tools</td>
<td><a href="http://www.harborfreight.com">www.harborfreight.com</a></td>
<td>---</td>
<td>1-800-423-2567</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Table 2 – Vendor Listing