Complete Teardown, Cleaning, and Reassembly of the Olympus BH-NRE Modular Revolving Nosepiece

Revision 3

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Revision History		
Revision	**Description of Changes**	**Date**
1	*** Initial release ***	December 15, 2018
2	Common format, minor changes, update greases, added Appendix 1	May 20, 2021
3	Clarified usage on BH-2.	August 16, 2021

Table of Contents

Introduction 4
Scope of this Document 4
Tools Needed 4
A Few Words about JIS Screws 4
Supplies Needed 4
Recommended Lubricant Type 4
Recommended Solvents 5
Safety Considerations with Solvents 5
Solvent Compatibility with Parts and Finishes 5
Before Starting the Overhaul 5
Remove the Objectives from the Nosepiece 5
Label Parts for Identification and Reassembly 5
Service the BH-NRE Modular Nosepiece 5
Remove the Cover from the Turret Assembly 5
Remove the Dovetail Slide 6
Remove the Mechanical Detent Stop 6
Remove Lock Ring for the Pivot-Adjustment Screw 7
Remove the Pivot-Adjustment Screw 8
Remove the Center-Pivot Bearing Ball 8
Remove the Threaded Retaining Ring 8
Remove the Perimeter Bearing Balls 9
Remove the Stationary Base from the Turret 9
Clean Grease from the Various Components 9
Apply Grease to Perimeter of Stationary Base 9
Reinstall Stationary Base into Revolving Turret 10
Reinstall the Perimeter Bearing Balls 10
Reinstall the Threaded Retaining Ring 10
Apply Grease to the Center-Pivot Bore 11
Reinstall the Center-Pivot Bearing Ball 11
Apply Grease to Top of the Center-Pivot Ball 11
Reinstall the Pivot-Adjustment Screw 11
Reinstall the Slotted Lock Ring 11
Verify the Feel of the Revolving Nosepiece 12
Clean Off Any Visible Grease 12
Reinstall the Mechanical Detent Stop 12
Reinstall the Dovetail Slide 12
Apply Grease to the Mechanical Detents 13
Reinstall the Protective Cover 13
Ready for Service 14
Requirements for Periodic Maintenance 14
Problems with the Turret Assembly 14
Original Olympus Documentation 14
Olympus Research Microscopes Series BH2 (BHS) Repair Manual 14
Olympus Research Microscope BH2 Repair Manual 14
Acknowledgements 15
How to Contact the Author 15
Appendix 1 16
Inspecting the Revolving Turret for Wear of the Mechanical Detents 16
Appendix 2 17
Sources for Replacement Parts, Tools, and Supplies Referenced in this Document 17

Table of Figures

Figure 1 – A typical JIS screw 4
Figure 2 – The BH-NRE modular revolving nosepiece 5
Figure 3 – Basic components of the BH-NRE 5
Figure 4 – Remove screws securing the cover in place 6
Figure 5 – Remove the protective cover 6
Figure 6 – The turret assembly (without cover) 6
Figure 7 – Remove four screws securing the dovetail slide 6
Figure 8 – Remove the loose dovetail slide 6
Figure 9 – Remove the screws securing the detent stop 7
Figure 10 – Remove the mechanical detent stop 7
Figure 11 – Screwdriver modified to remove slotted lock ring 7
Figure 12 – Insert screwdriver into bores to lock turret 7
Figure 13 – Loosen the slotted lock ring 8
Figure 14 – Remove the slotted lock ring 8
Figure 15 – Remove the pivot-adjustment screw 8
Figure 16 – Remove the center-pivot bearing ball 8
Figure 17 – Components of the turret assembly 8
Figure 18 – Loosen the threaded retaining ring 9
Figure 19 – Remove the threaded retaining ring 9
Figure 20 – Remove the perimeter bearing balls 9
Figure 21 – Lift and remove the stationary base 9
Figure 22 – All parts cleaned and ready for reassembly 9
Figure 23 – Apply ring of fresh grease to stationary base 10
Figure 24 – Reinstall stationary base into revolving turret 10
Figure 25 – Place the bearing balls into the ring of grease 10
Figure 26 – Engage the threaded retaining ring 10
Figure 27 – Tighten the threaded retaining ring 10
Figure 28 – Thoroughly remove any grease squeeze-out 11
Figure 29 – Apply grease to the center-pivot bore 11
Figure 30 – Place bearing ball into the center-pivot bore 11
Figure 31 – Apply grease to the top of the bearing ball 11
Figure 32 – Reinstall the pivot-adjustment screw 11
Figure 33 – Reinstall the slotted lock ring 12
Figure 34 – Tighten the slotted lock ring 12
Figure 35 – Place the mechanical detent stop in position 12
Figure 36 – Secure the detent stop with two screws 12
Figure 37 – Position dovetail slide onto stationary base 13
Figure 38 – Secure dovetail slide onto stationary base 13
Figure 39 – Apply grease to the four detent notches 13
Figure 40 – Place cover in position on the turret assembly 13
Figure 41 – Secure protective cover using three screws 13
Figure 42 – BH-NRE ready to be put back into service 14
Figure 43 - Revolving turret with severely worn mechanical detents 16
Figure 44 – Close-up view of a worn mechanical detent notch 16

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 one these microscopes is that the grease in the BH-NRE 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 (see **Appendix 1**). 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 BH-NRE (4-position) modular revolving nosepiece assembly as may be found on a BH or BH-2 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 apply to the BH-NRE 4-position revolving modular nosepiece assembly (with 25mm objective mounts to accept Olympus short barrel NEO objectives) as used for reflected darkfield illumination on Olympus BH and occasionally BH-2 microscope stands.

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

Tools Needed

The following tools will be needed to complete the teardown, cleaning, lubrication, and reassembly of the BH-NRE modular revolving nosepiece assembly.

- Center punch or nailset tool
- Electric heat gun (item T1 of **Appendix 2**)
- Screwdriver set, JIS (item T2 of **Appendix 2**)
- Lens spanner tool (item T3 of **Appendix 2**)

A Few Words about JIS Screws

Screws with JIS heads are frequently found in much of the older 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 1**).

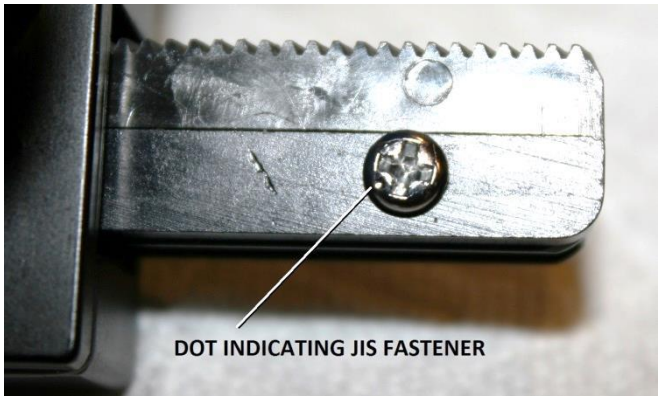


Figure 1 – A typical JIS screw

Supplies Needed

The following supplies will be needed to complete the teardown, cleaning, lubrication, and reassembly of the BH-NRE modular revolving nosepiece assembly.

- Cleaning solvent (see recommendations below)
- Lubricant (see recommendations below)

Recommended Lubricant Type

Plastilube® Brake Grease or Mobilgrease28® grease (item S1 of **Appendix 2**) are recommended for use in the BH-NRE modular revolving nosepiece assembly. Both Plastilube® Brake Grease and Mobilgrease28® are medium-consistency 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 BH-NRE modular revolving nosepiece assembly. Solvents that can be used are acetone, diethyl ether, heptane, hexane, mineral spirits, turpentine, and xylene. Mineral spirits works well with both Plastilube® and Mobilgrease28®.

Safety Considerations with Solvents

Regardless of which solvents are 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 safety data sheet (SDS or MSDS) 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 of the manufacturer's instructions and safety precautions.

Solvent Compatibility with Parts and Finishes

Many solvents will damage the finish of painted surfaces or will dissolve or damage plastic parts (isopropyl alcohol or 409 Cleaner may be safely used to clean most painted surfaces). Do not allow untested solvents to contact any plastic parts or painted surfaces. Before using a solvent to clean plastic parts or painted surfaces, test a small amount of the solvent in an inconspicuous area (such as inside a plastic knob) to ensure compatibility with the plastic part or painted surface. Never use xylene to clean nylon parts, as xylene dissolves nylon. Isopropyl alcohol and trichloroethylene will cause swelling of nylon due to solvent absorption. The list of solvents generally considered safe for nylon includes acetone, diethyl ether, heptane, mineral spirits, naphthalene, and turpentine.

Before Starting the Overhaul

Remove the Objectives from the Nosepiece

Before beginning the teardown of the BH-NRE 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 BH-NRE 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 subsequent reassembly process.

Service the BH-NRE Modular Nosepiece

Figure 2 shows the 4-position BH-NRE modular revolving nosepiece assembly used on the Olympus BH and BH-2 microscope stands.

Figure 2 – The BH-NRE modular revolving nosepiece

The BH-NRE modular revolving nosepiece assembly consists of a 4-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 BH-NRE onto the BH/BH-2 stand (see **Figure 3**).

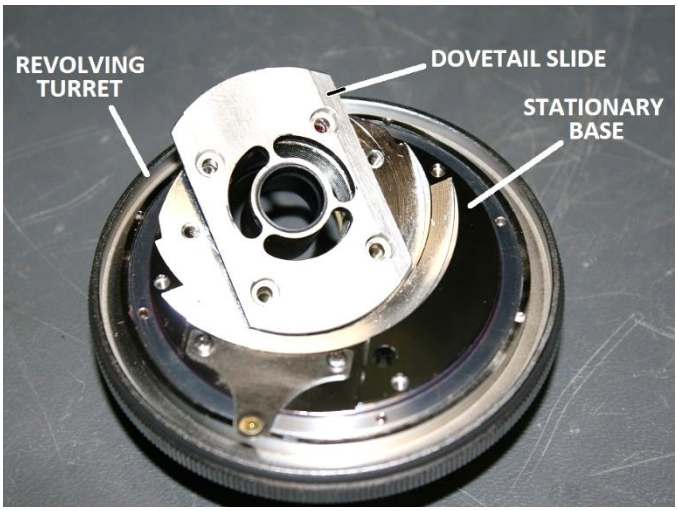


Figure 3 – Basic components of the BH-NRE

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

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 4) and remove the loose protective cover from the turret assembly (see Figure 5).

Figure 4 – Remove screws securing the cover in place

Figure 5 – Remove the protective cover

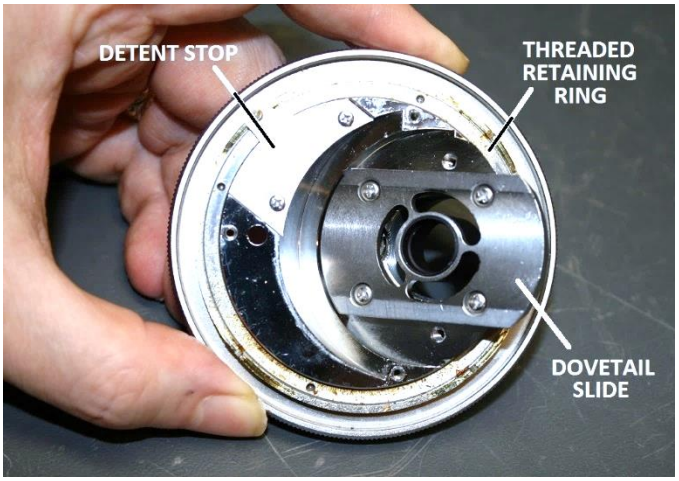


Figure 6 – The turret assembly (without cover)

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 7) and then remove the loose dovetail slide from the stationary base (see Figure 8).

Figure 7 – Remove four screws securing the dovetail slide

Figure 8 – Remove the loose dovetail slide

Remove the Mechanical Detent Stop

The next step is to remove the mechanical detent stop from the stationary base of the turret assembly. Use a suitable JIS screwdriver to remove the two M2X4 pan-head screws securing the detent stop to the stationary base (see Figure 9). Note that these screws are usually staked in place with adhesive and can be surprisingly stubborn to remove, 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, and to apply a solvent (acetone) to the threads as the screw is loosened.

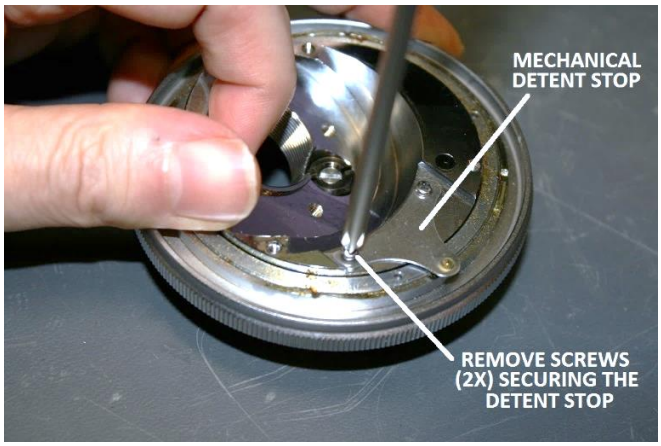


Figure 9 – Remove the screws securing the detent stop

Remove the loose mechanical detent stop from the stationary base (see **Figure 10**).

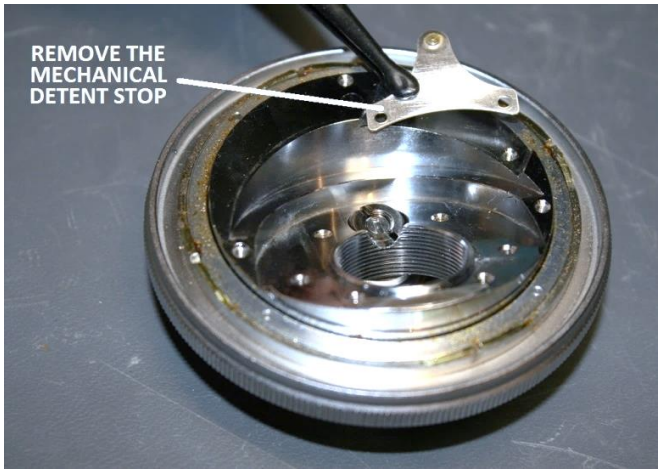


Figure 10 – Remove the mechanical detent stop

Remove Lock Ring for the Pivot-Adjustment Screw

The slotted lock ring for the pivot-adjustment screw 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[1].

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 11**. 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.

[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.

Figure 11 – 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 four threaded objective bores in the revolving turret. Next, insert a small screwdriver handle of the appropriate size into the two bores (see **Figure 12**). 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 12 – Insert screwdriver into bores to lock turret

Loosen and Remove the Slotted Lock Ring

Hold the turret assembly by grasping the knurled ring on the outer perimeter of the revolving turret and use the slotted screwdriver with the notched tip (see **Figure 11**) to loosen the slotted lock ring securing the pivot-adjustment screw to the stationary base (see **Figure 13**).

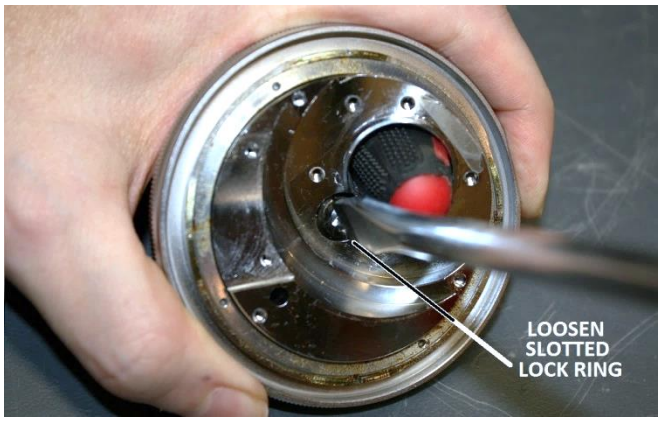


Figure 13 – Loosen the slotted lock ring

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 14**).

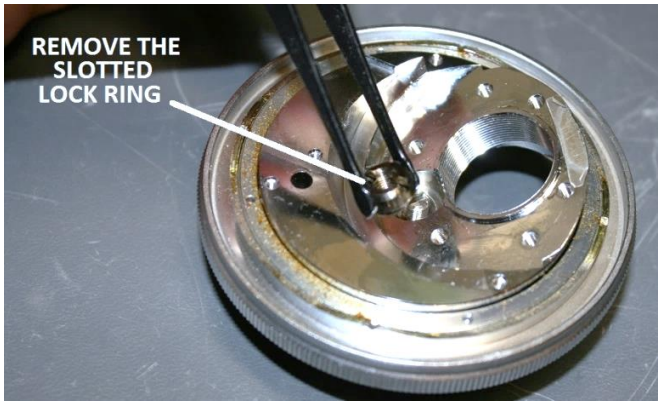


Figure 14 – Remove the slotted lock ring

Remove the Pivot-Adjustment Screw

With the slotted lock ring removed, use a suitable slotted screwdriver to unscrew and remove the pivot-adjustment screw from the center bore of the stationary base (see **Figure 15**). There is a ¼" bearing ball in the center bore of the stationary base, beneath the pivot-adjustment screw. Do not allow this bearing ball to fall out or it may become lost.

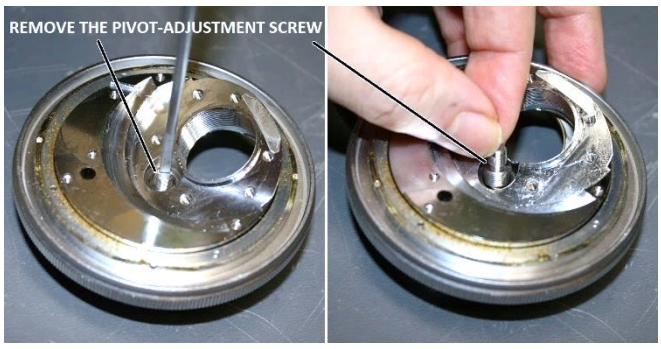


Figure 15 – Remove the pivot-adjustment screw

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 16**).

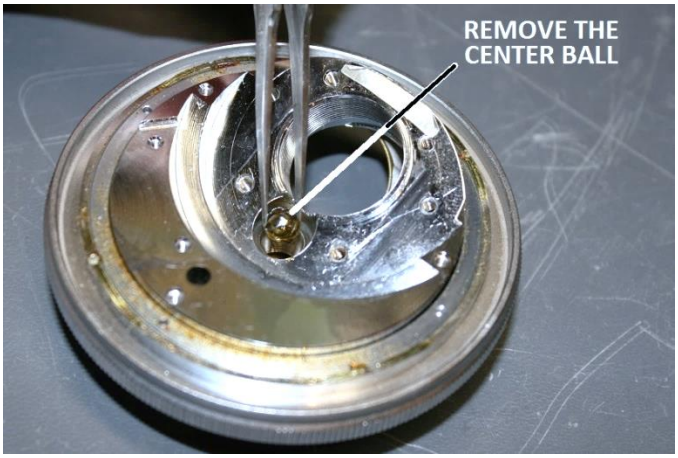


Figure 16 – Remove the center-pivot bearing ball

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**).

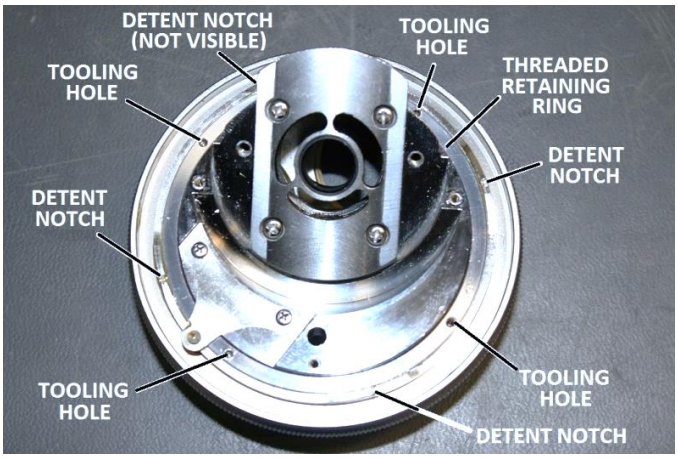


Figure 17 – Components of the turret assembly

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 four 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.

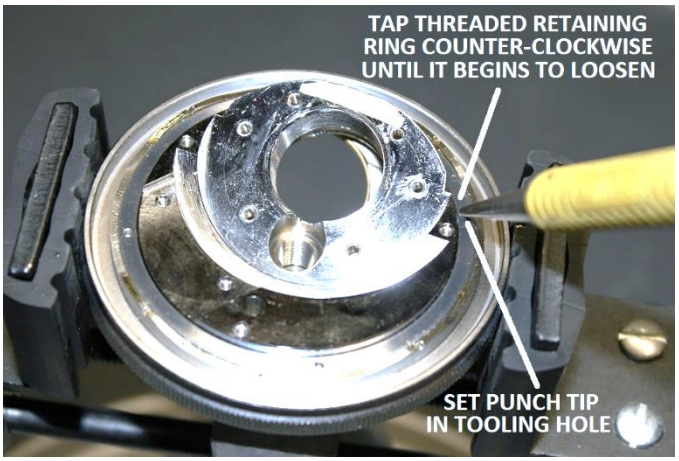


Figure 18 – Loosen the threaded retaining ring

Once the threaded retaining ring has broken loose, use the punch, or a suitable lens spanner tool (item T3 of **Appendix 2**) to continue loosening 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**).

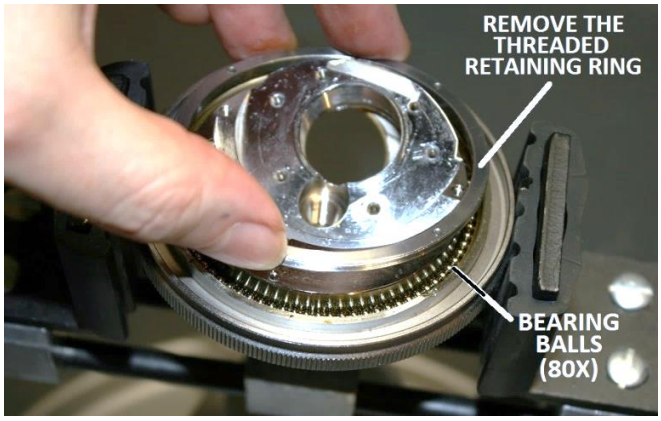


Figure 19 – Remove the threaded retaining ring

Remove the Perimeter Bearing Balls

Carefully remove the 3/32" bearing balls (there are 80 of them) from the perimeter of the stationary base. A small magnet can come in handy here (see **Figure 20**).

Figure 20 – Remove the perimeter bearing balls

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**).

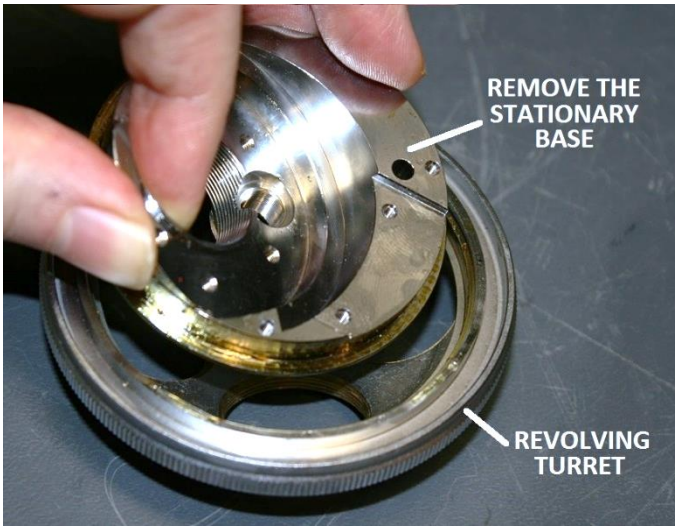


Figure 21 – Lift and remove the stationary base

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. The various parts of the BH-NRE modular revolving nosepiece are shown in **Figure 22**.

Figure 22 – All parts cleaned and ready for reassembly

Apply Grease to Perimeter of Stationary Base

Apply a ring of fresh grease (item S1 of **Appendix 2**) into the step edge around the outer perimeter of the stationary base (see **Figure 23**).

Figure 23 – Apply ring of fresh grease to stationary base

Reinstall Stationary Base into Revolving Turret

Hold the stationary base such that the center pivot is facing downwards, and then lower the greased stationary base into the recess of the revolving turret (see **Figure 24**).

Figure 24 – Reinstall stationary base into revolving turret

Reinstall the Perimeter Bearing Balls

Use tweezers to carefully set the 3/32" bearing balls (there are 80 of them) into the grease ring (see **Figure 25**), placing the bearing balls as close together as possible as you proceed.

Figure 25 – 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 26**). Make sure the tooling holes are facing upwards.

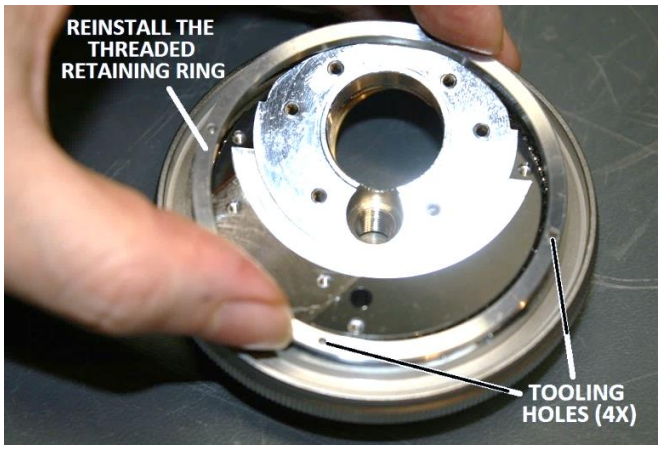


Figure 26 – Engage the threaded retaining ring

Use a suitable lens spanner tool (item T3 of **Appendix 2**) with the pointed tips seated into a pair of opposing tooling on the threaded retaining ring to carefully tighten the threaded retaining ring[2] (see **Figure 27**).

Figure 27 – Tighten the threaded retaining ring

While holding the stationary base in one hand, quickly 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 28**). Do not use a solvent to clean this grease squeeze-out, otherwise the solvent may run into the revolving turret mechanism and foul the grease within. Repeat this step as necessary until no further grease squeezes out when the revolving turret is spun.

[2] Or use a center punch or nailset tool to snug the threaded retaining ring by placing the tip of the tool into one of the four tooling holes and lightly tapping the tool with a small hammer or mallet to drive the threaded retaining ring clockwise.

Figure 28 – Thoroughly remove any grease squeeze-out

Apply Grease to the Center-Pivot Bore

Apply a small amount of grease (item S1 of **Appendix 2**) into the center-pivot bore of the stationary base for the ¼" bearing ball (see **Figure 29**).

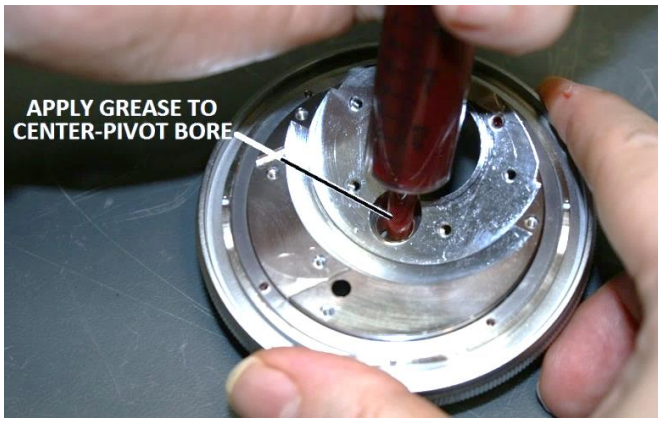


Figure 29 – Apply grease to the center-pivot bore

Reinstall the Center-Pivot Bearing Ball

Now that the center-pivot bore has been greased, reinstall the ¼" 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 30**).

Figure 30 – Place bearing ball into the center-pivot bore

Apply Grease to Top of the Center-Pivot Ball

Apply a small amount of grease (item S1 of **Appendix 2**) onto the top of the ¼" bearing ball in the center-pivot bore (see **Figure 31**).

Figure 31 – Apply grease to the top of the bearing ball

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 32**). Carefully snug the adjustment screw just to the point where a slight bit of resistance is felt. Leave the screw in this position and test the feel of the revolving turret. If the motion feels stiff, rough, or gritty, back the pivot-adjustment screw off a bit until it feels smooth. Leave the pivot--adjustment screw in this position.

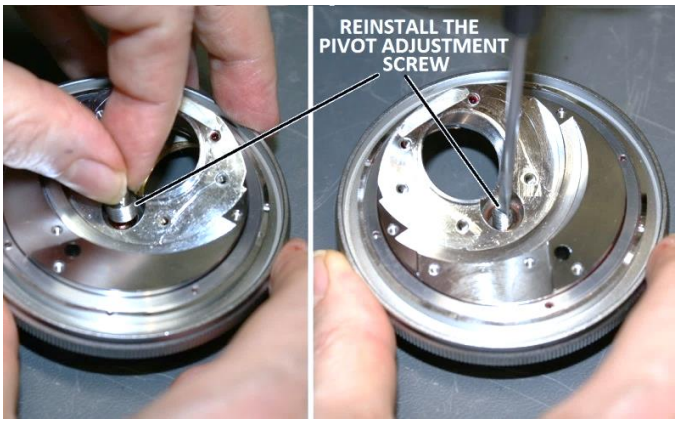


Figure 32 – Reinstall the pivot-adjustment screw

Reinstall the Slotted Lock Ring

While being careful to not allow the pivot-adjustment screw to rotate from the preset position set in the step above, engage the threads of the slotted lock ring with the threads of the pivot-adjustment screw (see **Figure 33**).

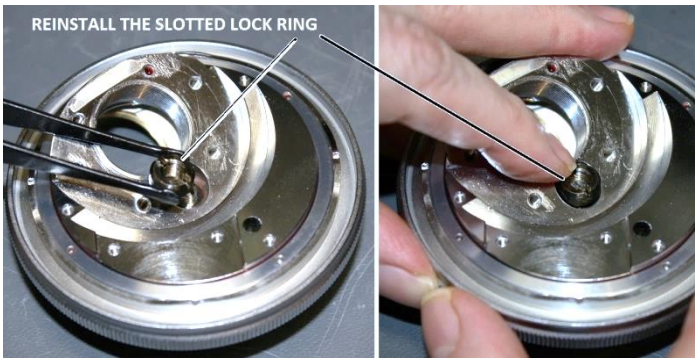


Figure 33 – Reinstall the slotted lock ring

Spin the revolving turret until one of the four 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 11**) to snug the slotted lock ring down to lock the pivot-adjustment screw in place (see **Figure 34**). Do not allow the pivot-adjustment screw to rotate while tightening the slotted lock ring. Remove the screwdriver from the bores after the slotted lock ring has been tightened.

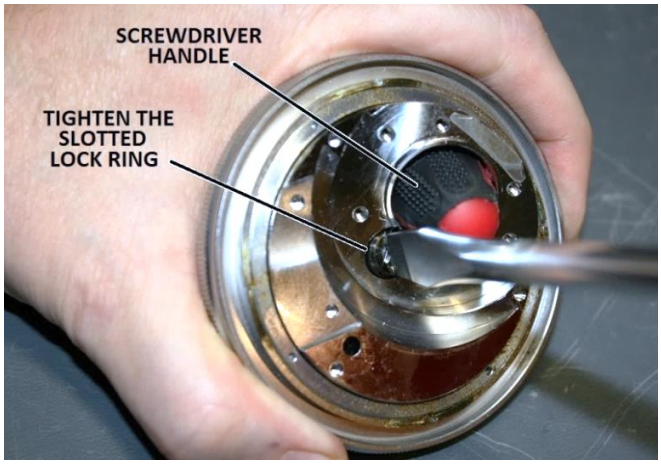


Figure 34 – Tighten the slotted lock ring

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 feel gritty or stiff, 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 plate with the two tapped holes in the stationary base (see **Figure 35**). When positioning the mechanical detent stop, make sure that you orient it such that the detent ball (which is cemented to the mechanical detent stop plate) is facing downwards, towards the stationary base, so that it will engage with the V-notches in the base as the revolving turret is turned.

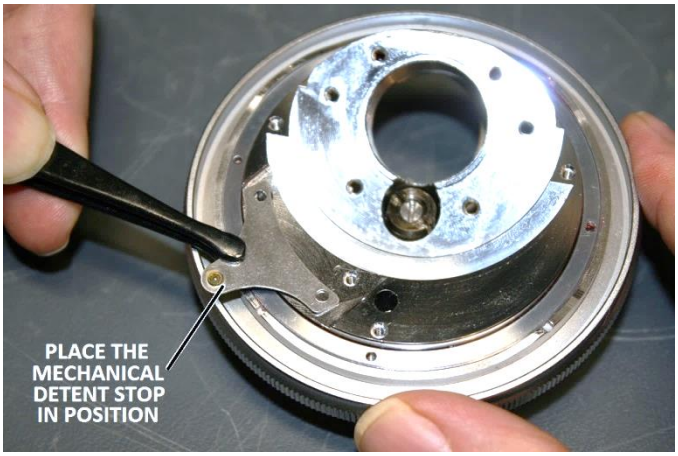


Figure 35 – Place the mechanical detent stop in position

Use a suitable JIS screwdriver to reinstall two M2X4 pan-head screws to secure the mechanical detent stop into place on the stationary base, with the detent ball facing downwards (see **Figure 36**).

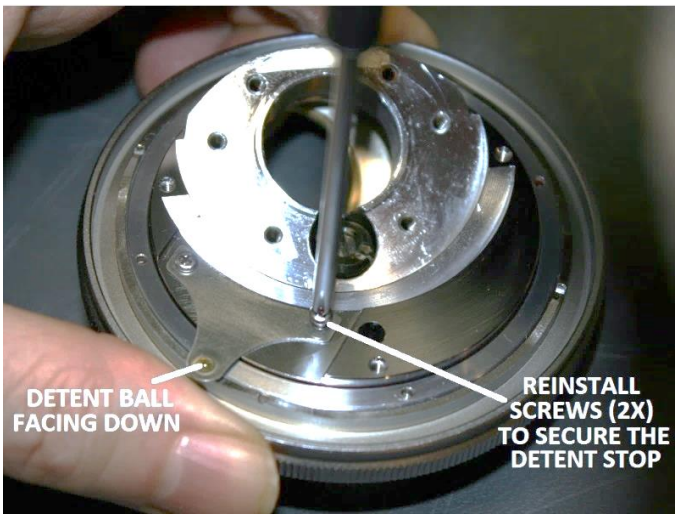


Figure 36 – Secure the detent stop with two screws

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 37**). Be sure to orient the dovetail slide such that the relief notch (shown in the inset of **Figure 37**) is facing downwards and towards the slotted lock ring and pivot-adjustment screw in the center of the stationary base.

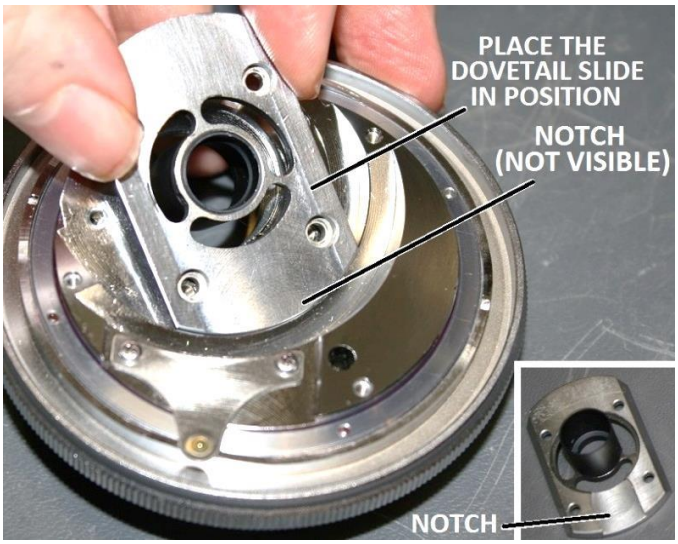


Figure 37 – Position dovetail slide onto stationary base

While holding the dovetail slide in this position on the stationary base, use a suitable JIS screwdriver to reinstall four M2.6X5 pan-head screws to secure the dovetail slide onto the stationary base of the turret assembly (see **Figure 38**).

Figure 38 – Secure dovetail slide onto stationary base

Apply Grease to the Mechanical Detents

Apply fresh grease (item S1 of **Appendix 2**) to the four mechanical detent notches in the revolving turret (see **Figure 39**). Be careful that you do not get grease anywhere else.

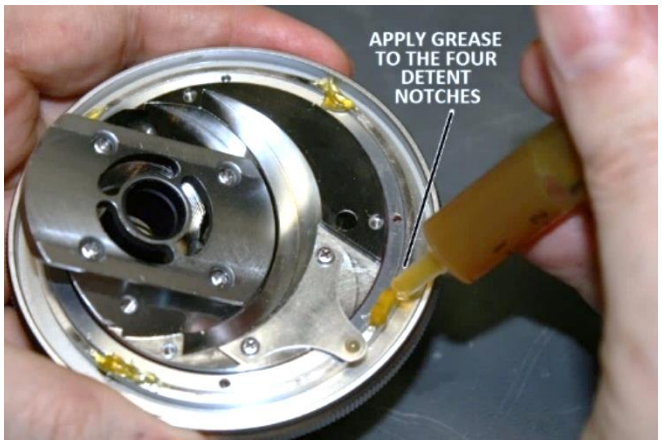


Figure 39 – Apply grease to the four detent notches

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 40**).

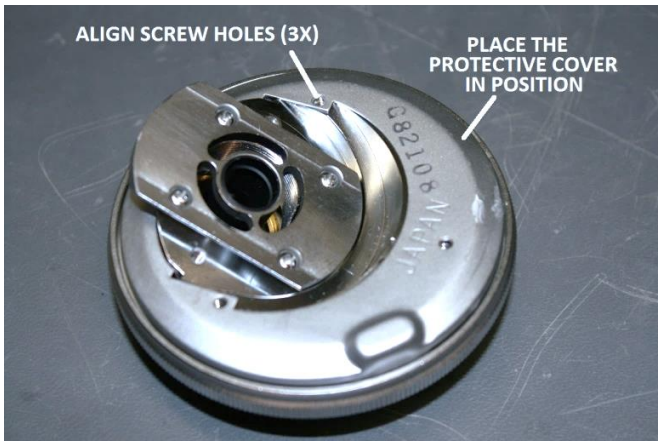


Figure 40 – Place cover in position on the turret assembly

Use a suitable JIS screwdriver to reinstall three M2X3 countersink screws to secure the protective cover onto the stationary base (see **Figure 41**).

Figure 41 – Secure protective cover using three screws

Ready for Service

The newly reconditioned BH-NRE modular revolving nosepiece assembly is now ready to provide many more years of service (see **Figure 42**).

Figure 42 – BH-NRE ready to be put back into service

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 BH-NRE. 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[3].

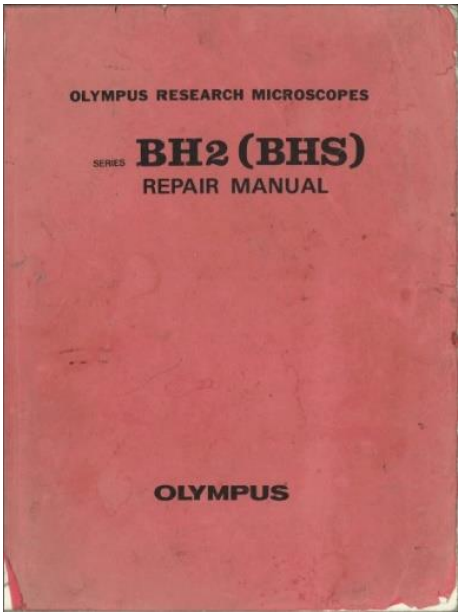
Problems with the Turret Assembly

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 (see **Appendix 1**). 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.

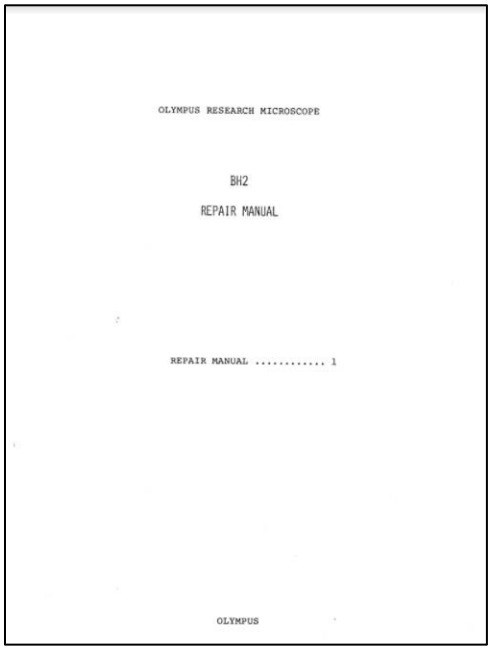
The other problem that may be seen is caused by overall float of the revolving turret, relative to the center point of the stationary base. If there is excess play in the center-pivot ball, such that the turret is not held in the exact center point, the revolving turret may move slightly, resulting in 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.

Original Olympus Documentation

Scanned versions of the following PDF service manuals are available for download at various microscope-related hobbyist sites on the internet. These can also be found by searching for the titles in an internet search engine, such as Google.



Olympus Research Microscopes Series BH2 (BHS) Repair Manual



Olympus Research Microscope BH2 Repair Manual

[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.

Acknowledgements

Special thanks to Joe Haralson for supplying the hardware used for this project.

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 listed on the cover of this document.

Appendix 1
Inspecting the Revolving Turret for Wear of the Mechanical Detents

The photos below show the revolving 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 revolving turret is made of brass (a soft metal), with a hard, corrosion/wear-resistant layer of dull, silver-colored plating on the exposed surface. When the hard plating in the area of the mechanical detents begin 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 very quickly with continued usage, soon rendering the nosepiece assembly unusable. **Figure 43** shows an example of a revolving turret with severe wear. Exposed brass is visible in the areas of the mechanical detents. **Figure 44** shows a close-up of one of the mechanical detents, where the wear can clearly be seen.

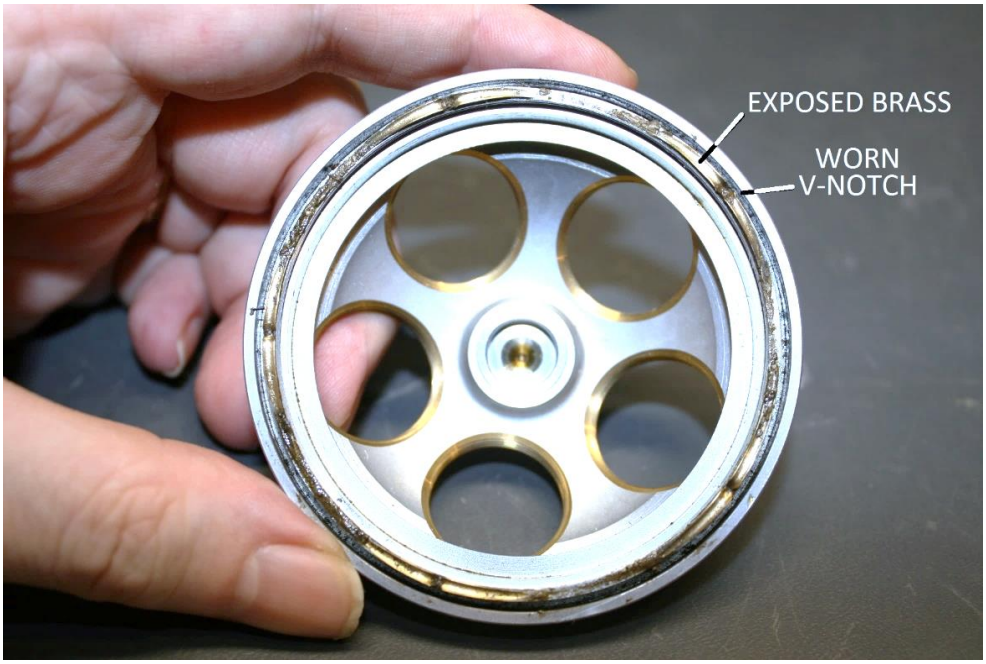


Figure 43 – Revolving turret with severely worn mechanical detents

Figure 44 – Close-up view of a worn mechanical detent notch

Appendix 2
Sources for Replacement Parts, Tools, and Supplies Referenced in this Document

Table 1, **Table 2**, and **Table 3** list specific information for the various tools, supplies, and parts discussed in this document. The pricing and availability listed below is accurate as-of August 2021 but is subject to change without notice.

Item	Description	Manufacturer	Manufacturer Model #	Vendor	Vendor #	Price
T1	Heat gun, electric, 1500W	Drill Master	---	Harbor Freight	96289	$12.99
T2	Screwdriver set, JIS, 4 pieces	Hozan	JIS-4	Amazon	---	$19.10
T3	Lens spanner tool, pointed	various	---	Amazon	---	$14.95

Table 1 –Tools referenced in this document

Item	Description	Manufacturer	Manufacturer Model #	Vendor	Vendor #	Price
S1	Plastilube® Brake Grease, 75 cc	Plastilube®	ATE70015	Amazon	---	$10.88
	Plastilube® Brake Grease, 75 cc	Plastilube®	ATE70015	Autohausaz	1161688	$8.35
	Mobilgrease28 grease, 13.4 oz.	Mobil	Mobilgrease28	Amazon	---	$22.75

Table 2 –Supplies referenced in this document

Item	Description	Manufacturer	Manufacturer Model #	Vendor	Vendor #	Price
P1	Bearing balls, chrome steel, 3/32” G25, 100-count	various	---	Amazon	---	$4.92
P2	Bearing balls, chrome steel, 1/4”, G25, 100-count	various	---	Amazon	---	$5.99

Table 3 – Parts referenced in this document

Table 4 lists the contact information for the vendors referenced in **Table 1**, **Table 2**, and **Table 3**.

Vendor	URL	Local Phone	Toll Free	Fax	email
Amazon	www.amazon.com	---	---	---	---
Harbor Freight Tools	www.harborfreight.com	---	1-800-423-2567	---	---

Table 4 – Vendor Listing