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

Revision 1

Revision History		
Revision	**Description of Changes**	**Date**
1	*** Initial release ***	December 15, 2018

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Introduction

The microscopes in the Olympus BH and BH-2 lines 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. 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 (four-position) modular revolving nosepiece assembly 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 four-position revolving modular nosepiece assembly (with 25mm objective mounts) as used on Olympus BH and 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 and Supplies Needed

The following tools and supplies will be needed to complete the teardown, cleaning, lubrication, and reassembly of the BH-NRE 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**)

Recommended Lubricant Type

Mobilith SHC™ 220 synthetic grease (item 6 of **Appendix 1**) is recommended for use in the BH-NRE modular revolving nosepiece assembly. SHC™ 220 synthetic grease 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. 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 SHC™ 220 synthetic grease.

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.

The BH-NRE Modular Revolving Nosepiece

Figure 1 shows the four-position BH-NRE modular revolving nosepiece assembly used on the Olympus BH and BH-2 microscope stands.

Figure 1 – The BH-NRE modular revolving nosepiece

The BH-NRE modular revolving nosepiece assembly consists of a four-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 2**).

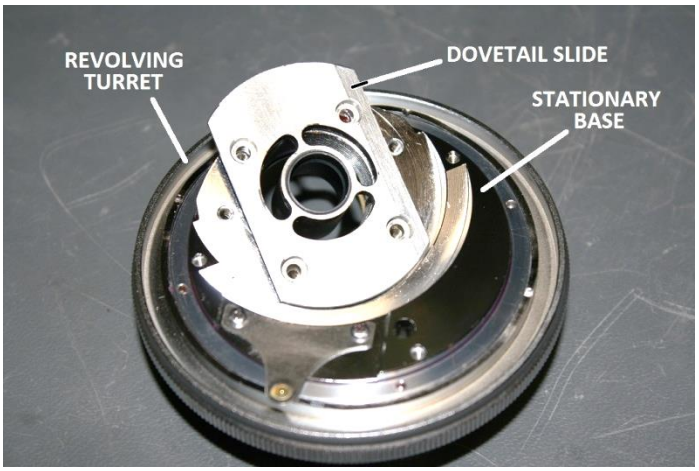

Figure 2 – Basic components of the BH-NRE

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 3**) and remove the protective cover from the turret assembly (see **Figure 4**).

Figure 3 – Remove screws securing the cover in place

Figure 4 – Remove the protective cover

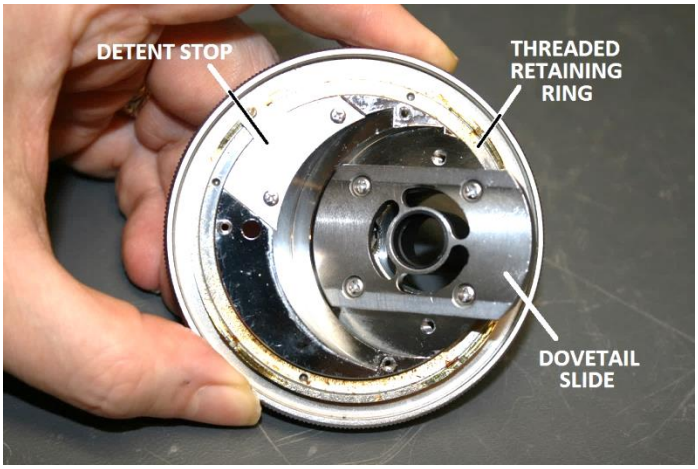

Figure 5 – The turret assembly (without cover)

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

Figure 6 – Remove four screws securing the dovetail slide

Figure 7 – Remove the loose dovetail slide

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 the detent stop to the stationary base of the turret assembly (see **Figure 8**). 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.

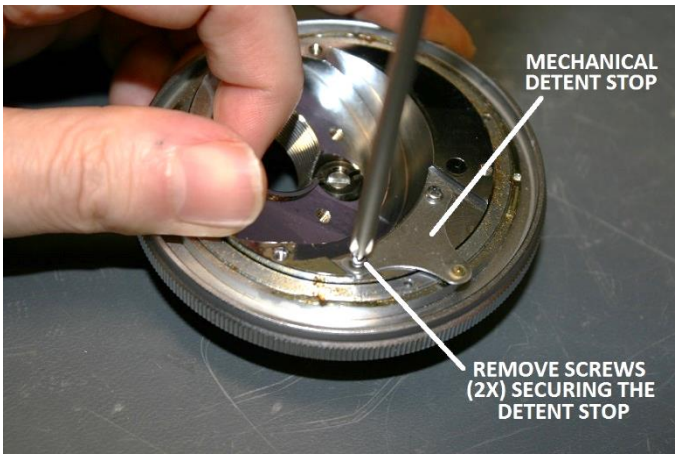

Figure 8 – Remove the screws securing the detent stop

Remove the loose mechanical detent stop from the stationary base (see **Figure 9**).

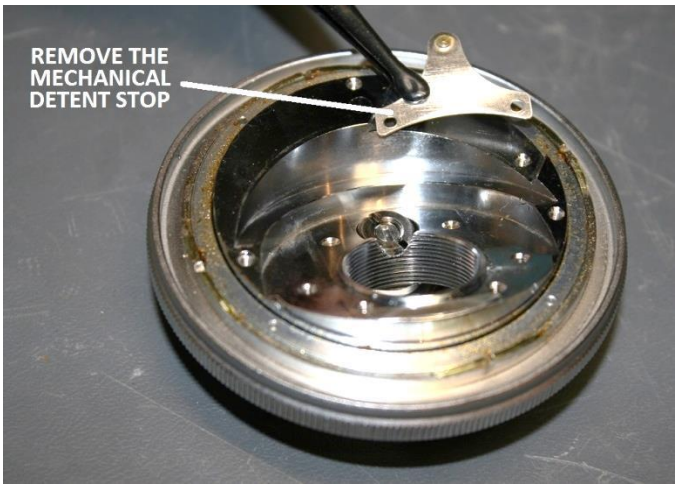

Figure 9 – Remove the mechanical detent stop

Remove Lock Ring for 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 10**. 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 10 – Screwdriver modified to remove 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.

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 11**). 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 11 – 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 10**) to loosen the slotted lock ring securing the pivot-adjustment screw to the stationary base (see **Figure 12**).

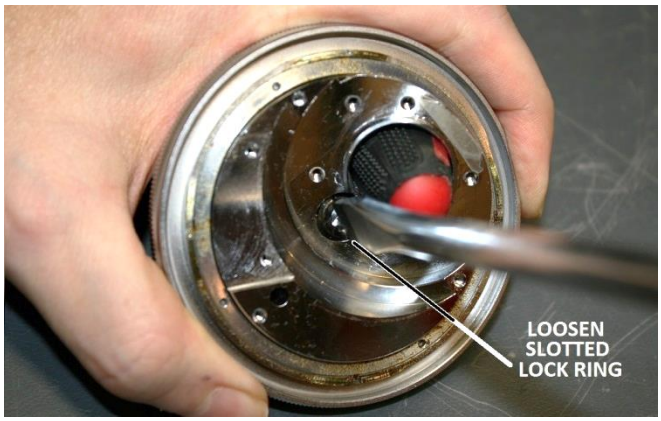

Figure 12 – Loosen the slotted lock ring

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 13**).

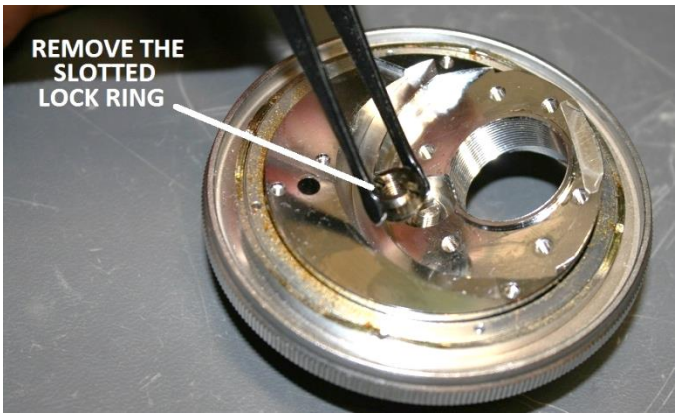

Figure 13 – Remove the slotted lock ring

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 14**). 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.

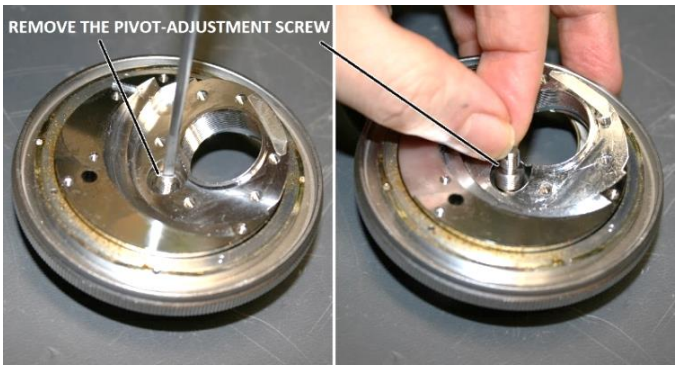

Figure 14 – Remove the pivot-adjustment screw

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 15**).

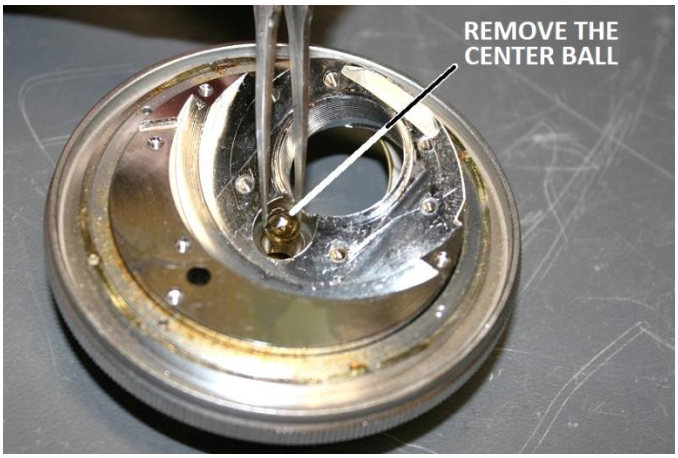

Figure 15 – Remove the center-pivot bearing ball

Remove the Threaded Retaining Ring

The stationary base is held inside the recess of the revolving turret by the threaded retaining ring (see Figure 16).

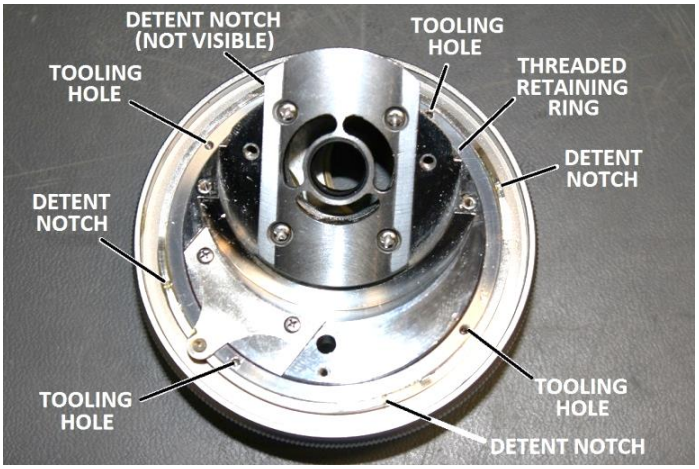

Figure 16 – Components of the turret assembly

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 16) and driving the threaded retaining ring counter-clockwise by carefully tapping the tool with a small hammer or mallet (see Figure 17). 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 17 – Loosen the threaded retaining ring

Once the threaded retaining ring has broken loose, use the punch (or a suitable lens spanner tool) 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 18).

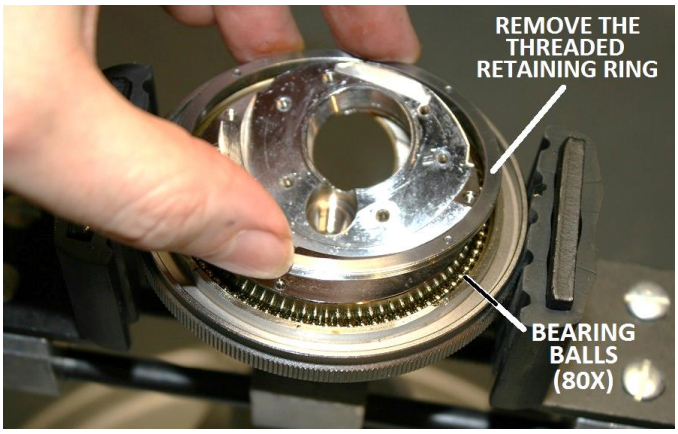

Figure 18 – Remove the threaded retaining ring

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 19).

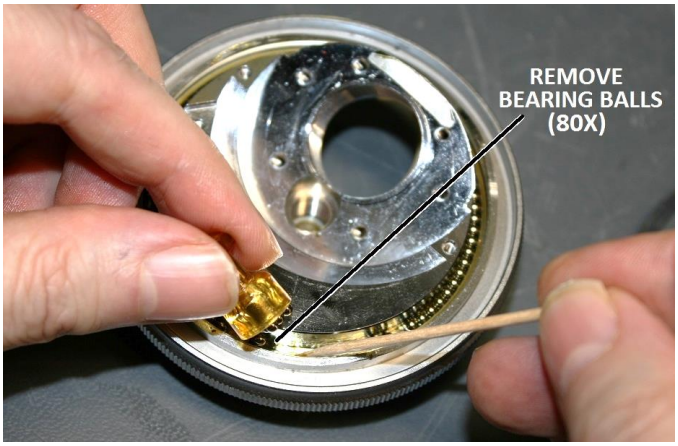

Figure 19 – Remove the perimeter bearing balls

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 20).

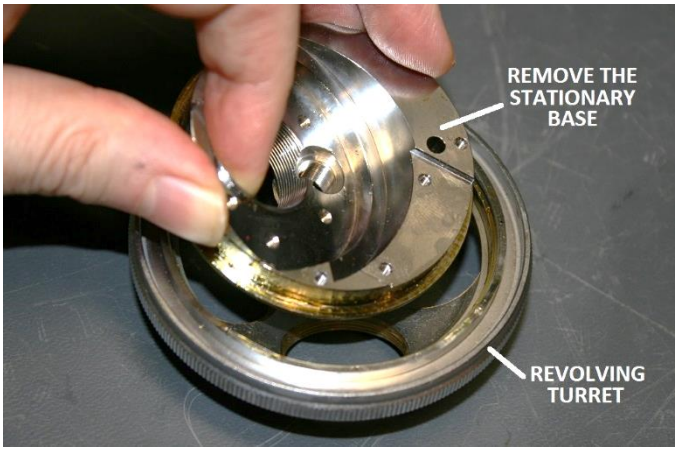

Figure 20 – Lift and remove the stationary base

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 21**.

Figure 21 – All parts cleaned and ready for reassembly

Apply Grease to Perimeter of Stationary Base

Apply a ring of fresh grease (item 6 of **Appendix 1**) into the step edge around the outer perimeter of the stationary base (see **Figure 22**).

Figure 22 – 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 23**).

Figure 23 – 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 24**), 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**). Make sure the tooling holes are facing upwards.

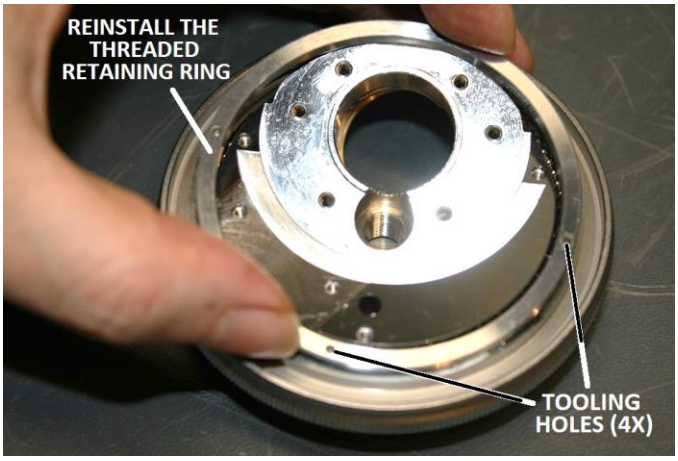

Figure 25 – Engage the threaded retaining ring

Use a suitable lens spanner tool (item 5 of **Appendix 1**) with the pointed tips seated into a pair of opposing tooling on the threaded retaining ring 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, 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 27**). Do not use a solvent here, 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.

Figure 27 – Thoroughly remove any grease squeeze-out

Apply Grease to the Center-Pivot Bore

Apply a small amount of grease (item 6 of **Appendix 1**) into the center-pivot bore of the stationary base for the ¼" bearing ball (see **Figure 28**).

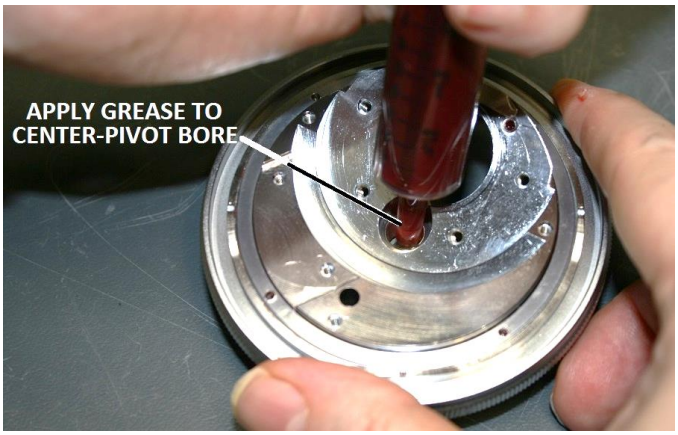

Figure 28 – Apply grease to the center-pivot bore

Reinstall the Center-Pivot Bearing Ball

Now that the center-pivot bore has been greased, reinstall the 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 29**).

Figure 29 – Place bearing ball into the center-pivot bore

Apply Grease to Top of the Center-Pivot Ball

Apply a small amount of grease (item 6 of **Appendix 1**) onto the top of the ¼" bearing ball in the center-pivot bore (see **Figure 30**).

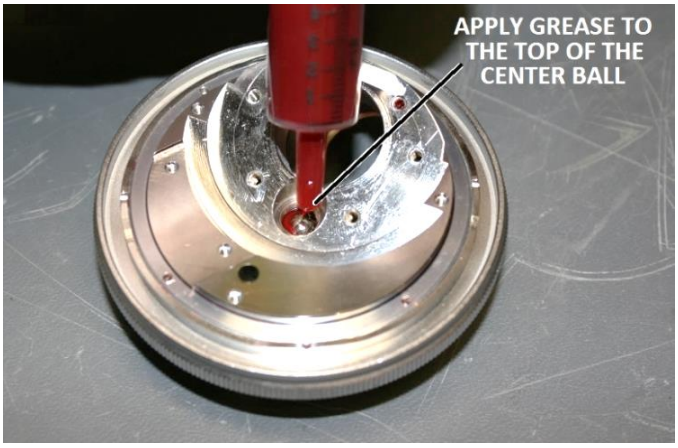

Figure 30 – Apply grease to the top of the bearing ball

[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.

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. 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 screw in this position.

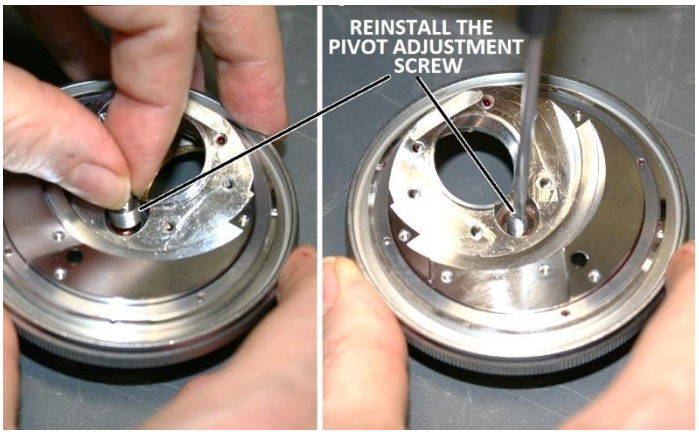

Figure 31 – Reinstall the pivot-adjustment screw

Reinstall the Slotted Lock Ring

While not allowing the pivot-adjustment screw to rotate, carefully engage the threads of the slotted lock ring with the pivot-adjustment screw (see **Figure 32**).

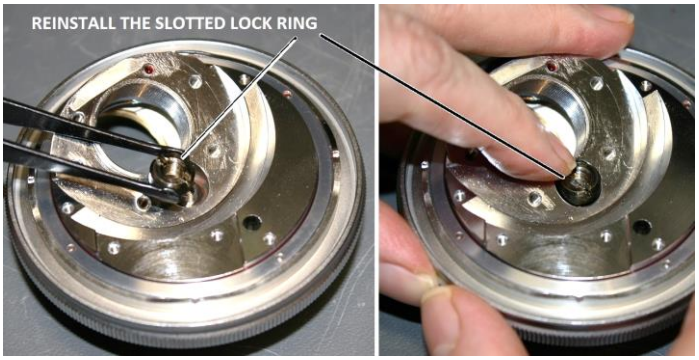

Figure 32 – Reinstall the slotted lock ring

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 10**) 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. Remove the screwdriver from the bores after the slotted lock ring has been tightened.

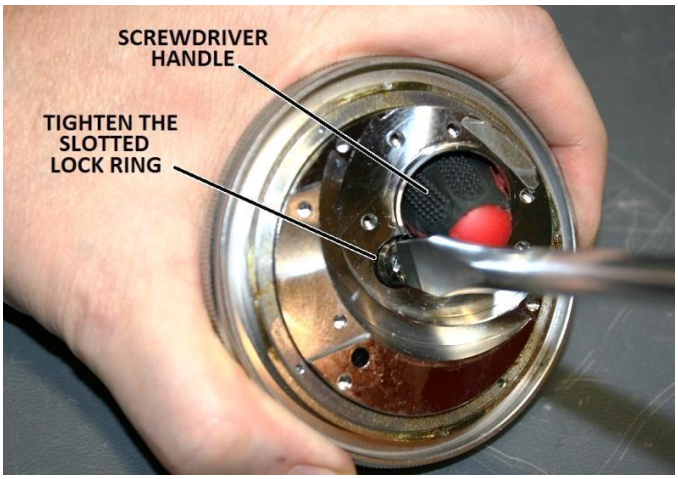

Figure 33 – Tighten the slotted lock ring

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 with the two tapped holes in the stationary base (see **Figure 34**). Make sure the detent ball on the mechanical detent stop is facing downwards.

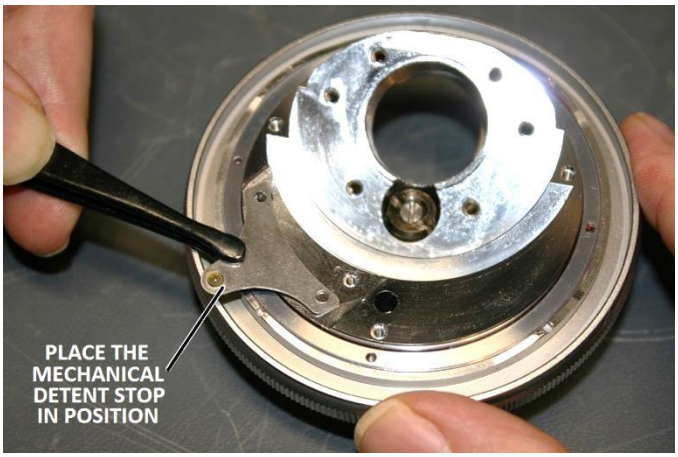

Figure 34 – Place the mechanical detent stop in position

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 downeards (see **Figure 35**).

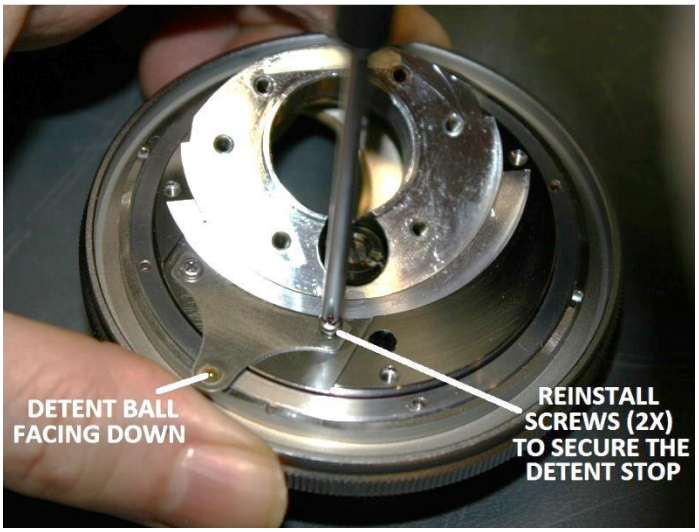

Figure 35 – Secure the detent stop with two screws

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 36**). Be sure to orient the dovetail slide such that the relief notch (shown in the inset of **Figure 36**) is facing downwards and towards the slotted lock ring and pivot-adjustment screw in the center of the stationary base.

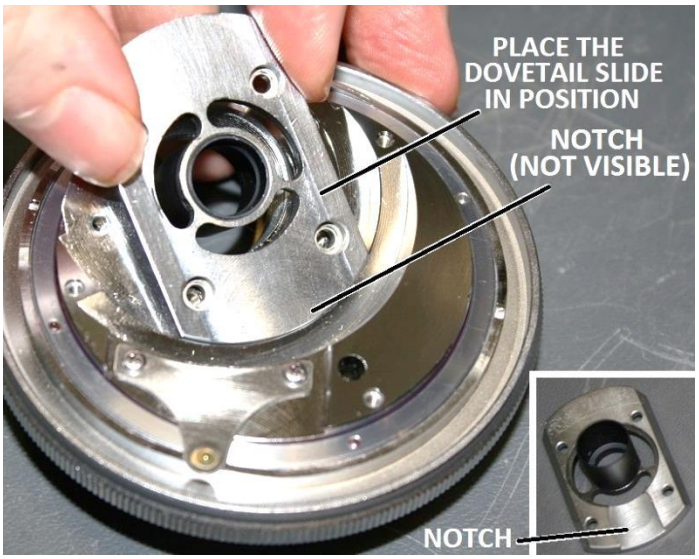

Figure 36 – Position dovetail slide onto stationary base

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 37**).

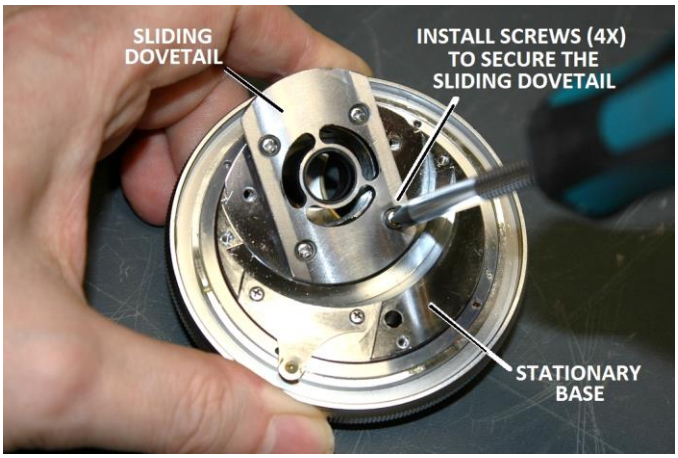

Figure 37 – Secure dovetail slide onto stationary base

Apply Grease to the Mechanical Detents

Apply fresh grease (item 6 of **Appendix 1**) to the four mechanical detent notches in the revolving turret (see **Figure 38**). Be careful that you do not get grease anywhere else.

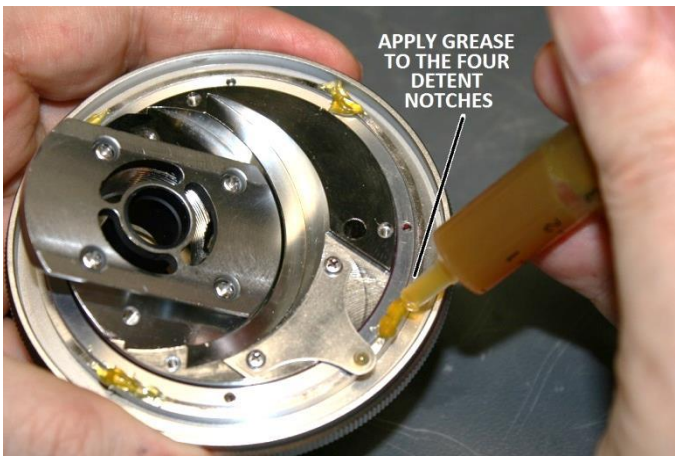

Figure 38 – Apply grease to the four detent notches

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 39**).

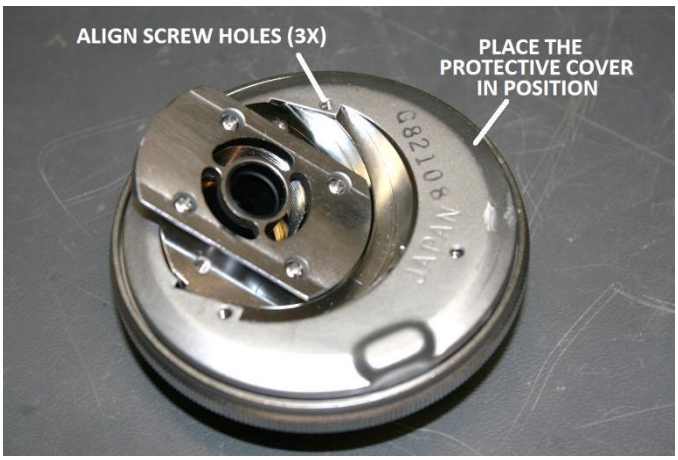

Figure 39 – Place cover in position on the turret assembly

Use a suitable JIS screwdriver to reinstall three M2X3 countersink screws to secure the protective cover onto the stationary base (see **Figure 40**).

Figure 40 – Secure protective cover using three screws

Ready for Service

The newly reconditioned BH-NRE modular revolving nosepiece assembly is now ready to be put back into service (see **Figure 41**).

Figure 41 – 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. 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 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 42**).

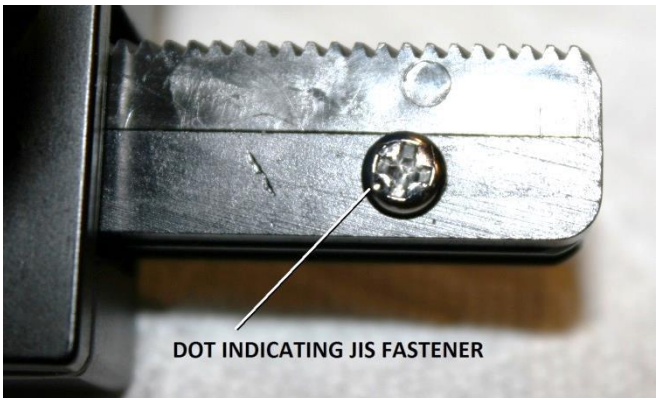

Figure 42 – A typical JIS Screw

[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.

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.

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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

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 December 2018 but is subject to change without notice.

Item	Description	Manufacturer	Manufacturer Model #	Vendor	Vendor #	Price
1	Heat gun, electric, 1500W	Drill Master	---	Harbor Freight	96289	$12.99
2	Screwdriver set, JIS, 4 pieces	Hozan	JIS-4	Amazon	---	$19.10
3	Bearing balls, chrome steel, 3/32" G25, 100-count	various	---	Amazon	---	$4.92
4	Bearing balls, chrome steel, 1/4", G25, 100-count	various	---	Amazon	---	$5.99
5	Lens spanner tool, pointed	various	---	Amazon	---	$14.95
6	Mobilith SHC™ 220 synthetic grease, 13.4oz	Mobil	SHC™ 220	Amazon	---	$18.87

Table 1 – Parts, Tools, and Supplies

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

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

Table 2 – Vendor Listing