Complete Teardown, Cleaning, and Reassembly of the Olympus BHTU Reverse Nosepiece Assembly

(Revision 1)

Revision History		
Revision	**Description of Changes**	**Date**
1	*** Initial release ***	June 1, 2017

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Introduction

The microscopes in the Olympus BH-2 line (BHS, BHSU, BHT, and BHTU) 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 are they 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 of these scopes is that the grease in the rotating nosepiece may be dried and gummy, resulting in stiff or gritty rotation of the nosepiece.

Another issue that may be encountered is with the mechanical detents in the rotating nosepiece. After many years of hard service, especially if the rotating nosepiece 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 scope unusable for some illumination techniques, such as phase contrast.

This document describes the complete teardown, cleaning, lubrication, and reassembly of the reverse nosepiece assembly on a BHTU microscope stand. Completion of this procedure should restore the proper feel to the rotation of the nosepiece, and should minimize further wear of the mechanical detent stops[1].

Scope of this Document

The procedure detailed in this document directly applies to the Olympus BHSU and BHTU microscope stands. This procedure can also be helpful with the modular nosepieces of the BHS and BHT stands, with some modifications.

Note that the Olympus service literature does not address the teardown and repair of the turret assembly, as this field-replaceable assembly was 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 reverse nosepiece assembly on an Olympus BHSU or BHTU microscope stand:

- Center punch or nailset tool
- Cleaning solvent (see recommendations below)
- Electric heat gun (item 1 of Appendix 1)
- Lubricant (see recommendation below)
- Screwdriver set, JIS[2] (item 2 of Appendix 1)
- Soft-jaw pliers (item 6 of Appendix 1)

Recommended Lubricant Type

Plastilube® Brake Grease (item 5 of Appendix 1) is recommended for use in the BHSU/BHTU reverse nosepiece assembly. Plastilube® Brake Grease is a heavy grease 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 turret 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. Do not get any of the solvents on the knurled rubber collar around the outer circumference of the nosepiece turret, or it may be damaged by the exposure.

Remove the Objectives from the Nosepiece

Before beginning the removal and teardown of the reverse nosepiece assembly, remove all the objectives from the rotating turret and store them someplace where they will be protected from physical damage, dust, and debris.

Label Parts for Identification and Reassembly

During the teardown of the reverse nosepiece assembly and turret assembly (if applicable), be sure to bag and tag the various parts, to prevent their loss and to facilitate their proper identification during reassembly.

Remove the Reverse Nosepiece Assembly

The reverse nosepiece assembly consists of the turret assembly, with attached wedge mount and corrective

[1] Note that if the detent stops are already excessively worn, there is no fix for this other than to replace the rotating turret in the turret assembly.

[2] See discussion of JIS screws in the section ***A Few Words about JIS Screws*** on page 14.

optics assembly[3]. The reverse nosepiece assembly is secured to the top of the microscope arm by three screws (see **Figure 1**), and must be removed from the arm as a complete assembly.

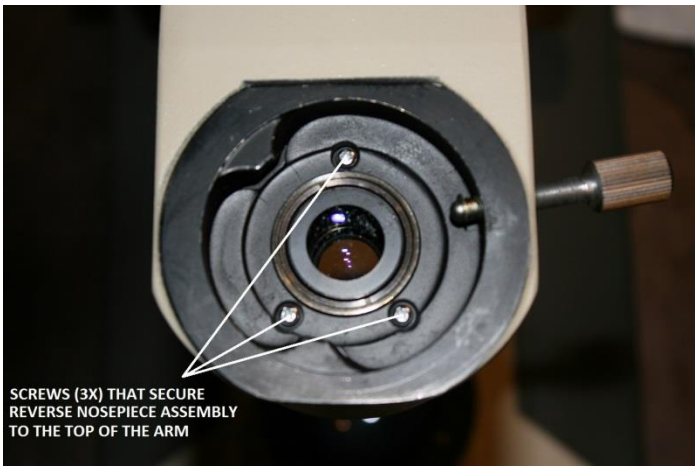

Figure 1 – Screws securing reverse nosepiece assembly

Be careful when removing the three screws holding the reverse nosepiece assembly to the top of the arm, to prevent the assembly from dropping from the arm when the last screw holding it in place is removed. To prevent the reverse nosepiece assembly from dropping, hold it in place with one hand, and using a suitable JIS screwdriver, remove the three screws securing it to the arm with the other hand (see **Figure 2**).

Figure 2 – Remove the reverse nosepiece assembly

Figure 3 shows the reverse nosepiece assembly after it has been removed from the top of the arm. The reverse nosepiece assembly consists of the turret assembly (with knurled rubber collar), the wedge mount, and the corrective optics assembly.

[3] The corrective optics assembly was added to the BHSU and BHTU stands to correct for the difference in tube length introduced with the incorporation of the wedge mount, which was used to "reverse" the turret assembly.

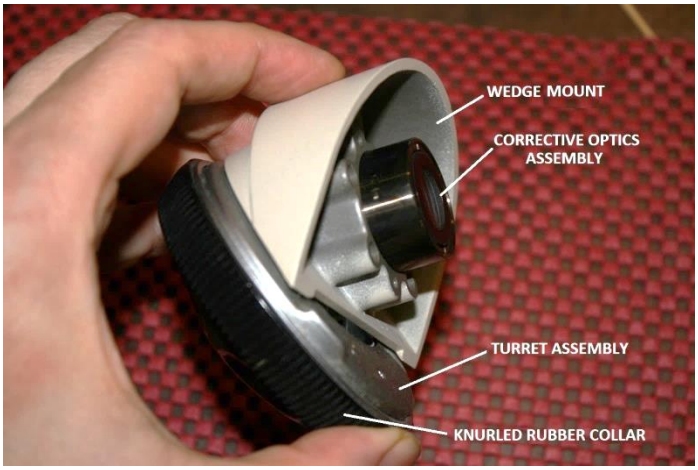

Figure 3 – The reverse nosepiece assembly

Remove Corrective Optics and Wedge Mount

The wedge mount is attached to the stationary base of the turret assembly with four long screws, and also by the corrective optics assembly, whose threaded end screws into the stationary base.

Before attempting to remove the corrective optics assembly, use a suitable JIS screwdriver to remove the four long screws securing the wedge mount to the turret assembly (see **Figure 4**). Removing these screws first will prevent the wedge mount from binding with the barrel of the corrective optics assembly when the corrective optics assembly is unscrewed and removed.

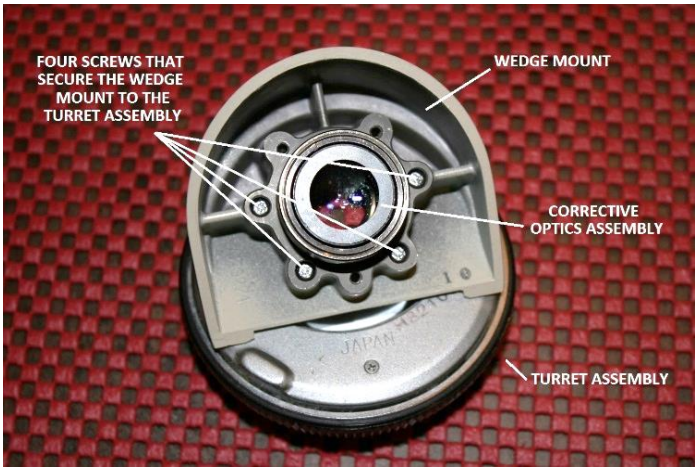

Figure 4 – Remove the screws securing the wedge mount

Once the four screws securing the wedge mount to the turret assembly have been removed, use non-marring pliers or a suitable strap wrench (to not cause any damage) to grip the barrel of the corrective optics assembly and loosen the corrective optics assembly by rotating it counter-clockwise (see **Figure 5**).

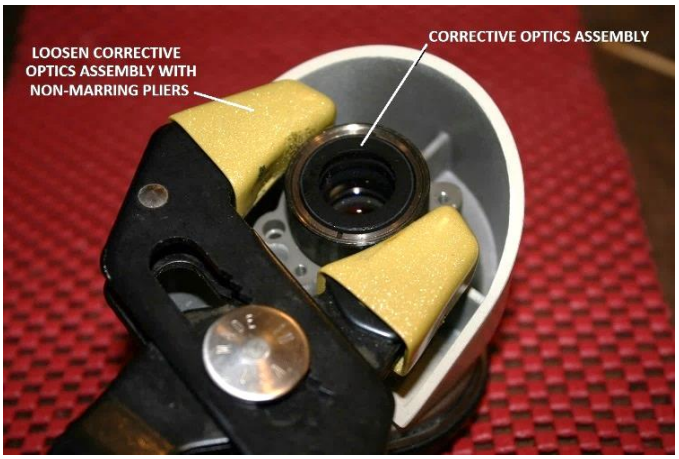

Figure 5 – Loosen the corrective optics assembly

Unscrew and remove the corrective optics assembly that is now holding the wedge mount in place on the turret assembly (see **Figure 6**). Once the corrective optics assembly has been removed, place it someplace where it will be protected from physical damage, dust, and debris.

Figure 6 – Remove the corrective optics assembly

Now that the four screws and the corrective optics assembly have been removed, remove the (now loose) wedge mount from the turret assembly (see **Figure 7**).

Figure 7 – Remove the wedge mount

Remove the Cover from the Turret Assembly

The protective cover is secured to the stationary base of the turret assembly with three small, counter-sinked flat-head screws (see **Figure 8**).

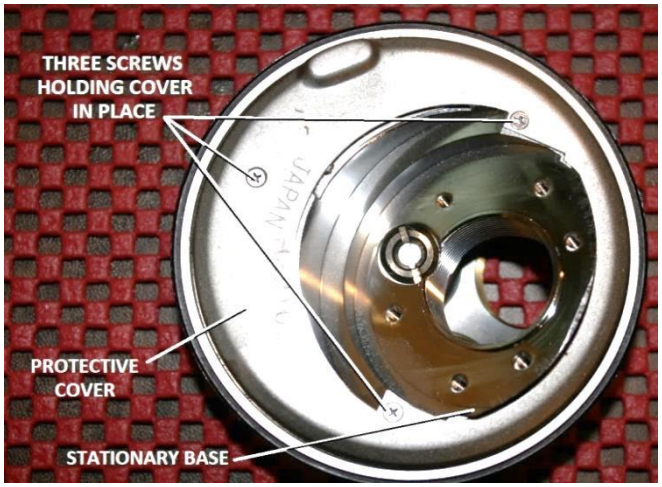

Figure 8 – Screws securing cover to the stationary base

Use a suitable JIS screwdriver to remove the three small, flat-head screws (see **Figure 9**). Remove the (now loose) protective cover (see **Figure 10**).

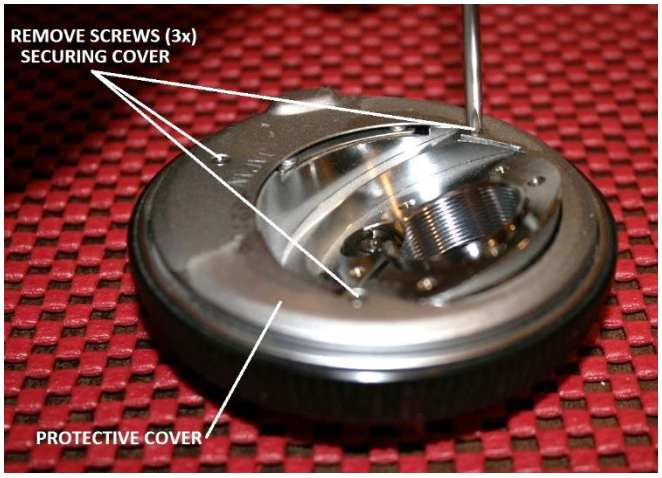

Figure 9 – Remove the screws holding the cover in place

Figure 10 – Remove the protective cover

Test the Feel of the Nosepiece Rotation

Hold the turret assembly by gripping the stationary base in one hand and rotate the knurled rubber collar with the other hand. Note the feel of the mechanism as you rotate the knurled rubber collar. If the rotation feels excessively stiff or gritty, continue and perform the teardown, cleaning, lubrication, and reassembly of the turret assembly, as described below. If the rotation feels acceptable, skip ahead to the ***Clean Old Grease from Mechanical Detents*** section of this document.

Remove the Knurled Rubber Collar

Carefully remove the knurled rubber collar from the turret assembly, taking care not to stretch the collar in the process (see **Figure 11**). This will prevent it from being damaged by the vise, by the application of heat from the heat gun, or by exposure to solvents during the subsequent teardown and rebuild operations.

Figure 11 – Remove the knurled rubber collar

Remove the Mechanical Detent Stop

Use a suitable JIS screwdriver to remove the two small screws securing the detent stop to the stationary base of the turret assembly (see **Figure 12**). These screws can be quite stubborn, so be sure to use the proper screwdriver here, to prevent damaging the screw heads.

Figure 12 – Remove the screws securing the detent stop

Remove the (now loose) detent stop (see **Figure 13**).

Figure 13 – Remove the detent stop

The back side of the turret assembly, with the knurled rubber collar and detent stop removed, is shown in **Figure 14**.

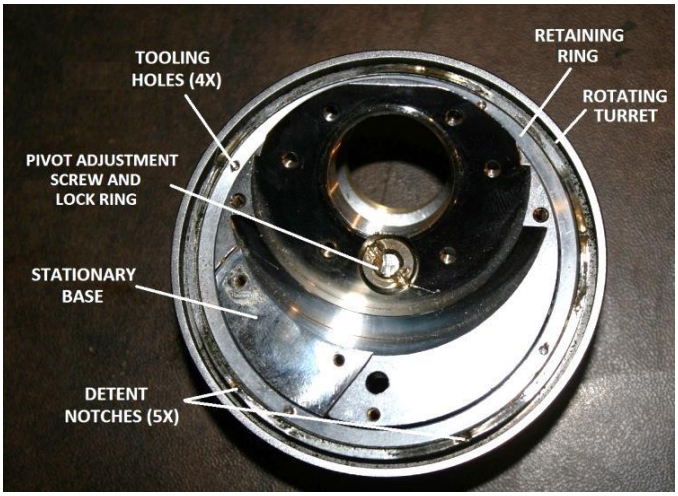

Figure 14 – The turret assembly (back view)

Pivot Adjustment Screw and Lock Ring

The pivot adjustment screw and lock ring (see **Figure 14**) can be difficult to remove, even with the proper tools. Because of this, it is recommended to not attempt to remove the pivot screw unless absolutely necessary (see the section ***Problems with the Turret Assembly*** on page 14 for additional information).

The turret assembly can be disassembled by removing the threaded retaining ring and leaving the pivot adjustment screw locked in position. If removal or adjustment of the pivot screw is needed, the lock ring must be loosened first, using a suitable tool (e.g., a wide-tipped slotted screwdriver with a notch ground or filed in the center to clear the pivot adjustment screw), after the application of heat to loosen any adhesive.

Apply Heat to Loosen the Retaining Ring

Mount the turret assembly in a suitable work vise, and use a heat gun to heat the turret assembly to loosen the grease under the threaded retaining ring so that the ring can be removed (see **Figure 15**).

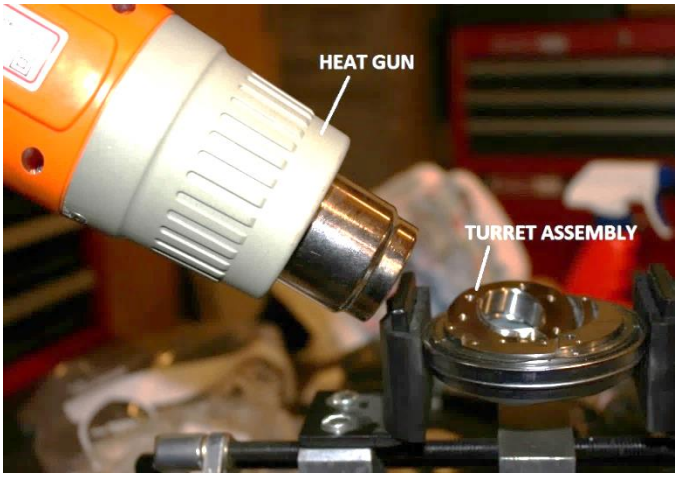

Figure 15 – Apply heat to loosen the retaining ring

Loosen and Remove the Retaining Ring

With the (still warm) turret assembly clamped in the work vise, use a suitable center punch or nailset tool to loosen the threaded retaining ring. Place the tip of the center punch or nailset tool into one of the four tooling holes in the retaining ring (see **Figure 14**) and drive the retaining ring counter-clockwise by carefully tapping the center punch or nailset tool with a small hammer or mallet[4] until loosened (see **Figure 16**).

Figure 16 – Loosen the threaded retaining ring

Continue loosening the threaded retaining ring and remove it, being careful that the perimeter bearing balls underneath the retaining ring do not fall out and become lost in the process (see **Figure 17**).

[4] Be careful and do not accidentally put the center punch or nailset tool into one of the five detent notches in the rotating turret (instead of into one of the four tooling holes in the retaining ring), or the rotating turret will be irreparably damaged when the punch is struck by the hammer.

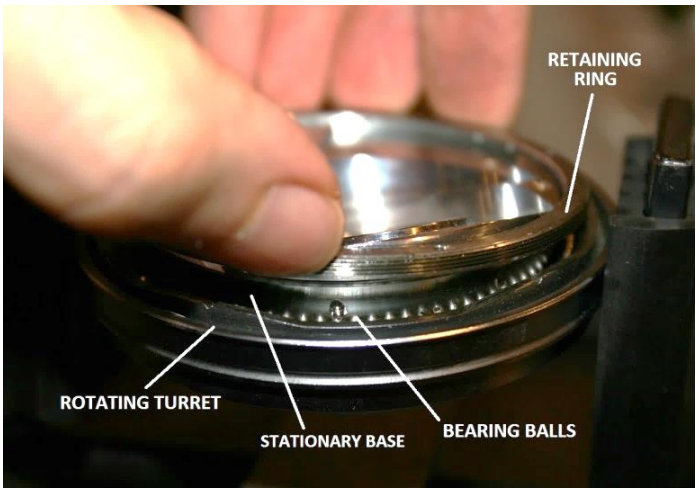

Figure 17 – Remove the threaded retaining ring

Remove the Perimeter Bearing Balls

Carefully remove the eighty 3/32" bearing balls from the perimeter of the turret assembly. A small magnet can come in handy here (see **Figure 18**).

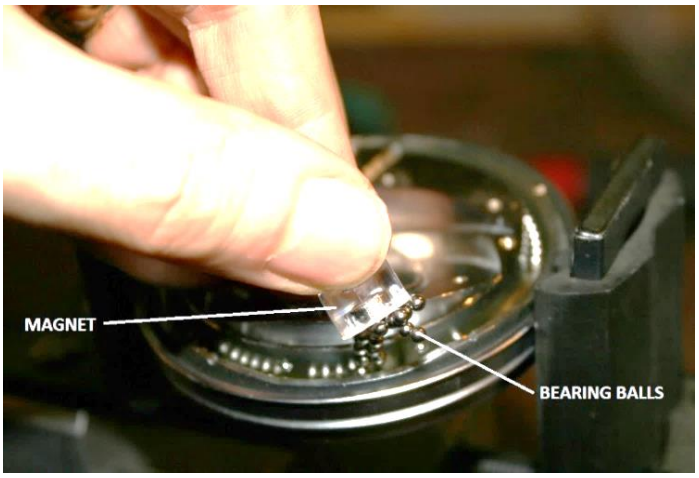

Figure 18 – Remove the perimeter bearing balls

Remove the Stationary Base from the Turret

Lift the stationary base free of the rotating turret and remove it (see **Figure 19**).

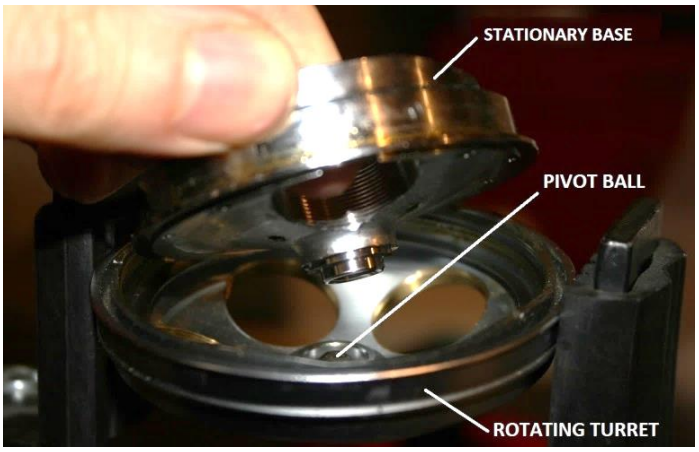

Figure 19 – Remove the stationary base from turret

Remove the Pivot Ball

There is a ¼" steel bearing ball which functions as the center pivot for the rotating turret, allowing the turret to rotate about the center point of the stationary base. This steel bearing ball will be found stuck in either the center pivot of the rotating turret (most likely), or else in the center pivot of the stationary base (less likely). Wherever it is found, carefully remove it (see **Figure 20**).

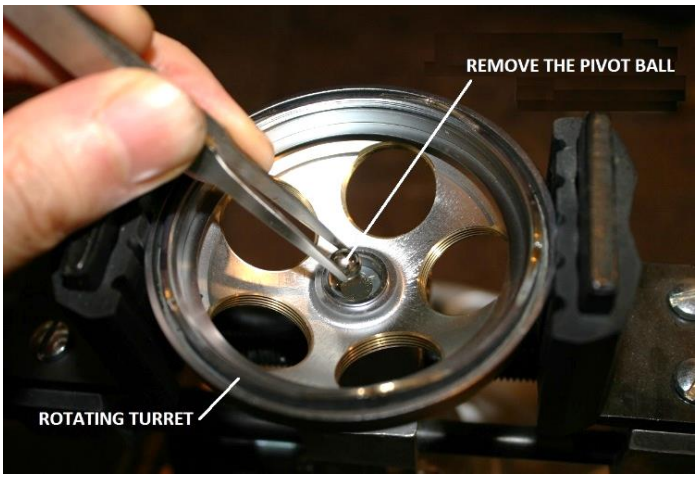

Figure 20 – Remove the pivot ball

Clean Grease from the Various Components

Using a suitable solvent (e.g., acetone), thoroughly clean all of the old grease from the stationary base, rotating turret, threaded retaining ring, bearing balls, and the pivot ball (see **Figure 21**).

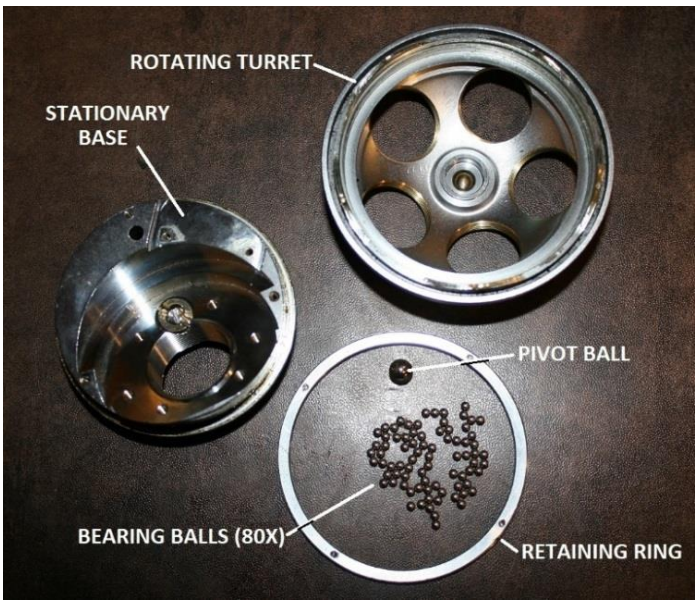

Figure 21 – All components cleaned of old grease

Grease the Center Pivot of the Rotating Turret

Apply a small amount of fresh grease to the center pivot of the rotating turret (see **Figure 22**).

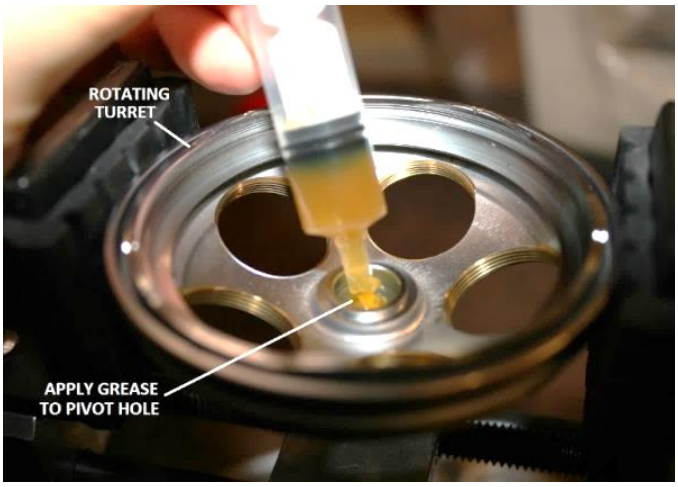

Figure 22 – Grease center pivot of the rotating turret

Reinstall the Pivot Ball

Reinstall the pivot ball into the freshly greased center pivot of the rotating turret. The grease will hold the ball in the proper position during subsequent reassembly of the turret assembly (see **Figure 23**).

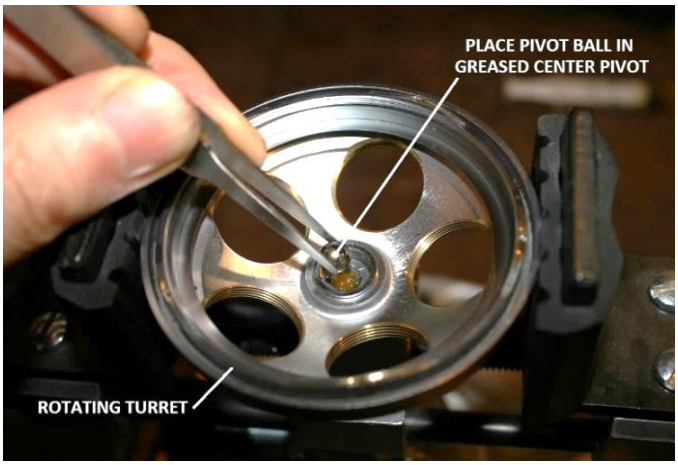

Figure 23 – Reinstall pivot ball in the center pivot

Grease the Center Pivot of the Stationary Base

Apply a small amount of fresh grease to the center pivot of the stationary base (see **Figure 24**).

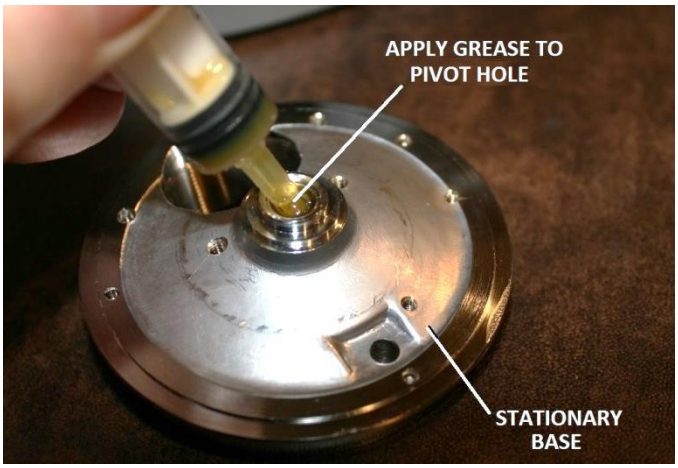

Figure 24 – Grease center pivot of the stationary base

Reinstall Stationary Base in Rotating Turret

Orient the stationary base such that the center pivot is facing downwards, and lower the stationary base into the rotating turret, being careful to not dislodge the center pivot ball in the rotating turret while doing so (see **Figure 25**). When correctly assembled, the center pivot of the stationary base should sit atop the pivot ball, which should in turn sit in the center pivot of the rotating nosepiece.

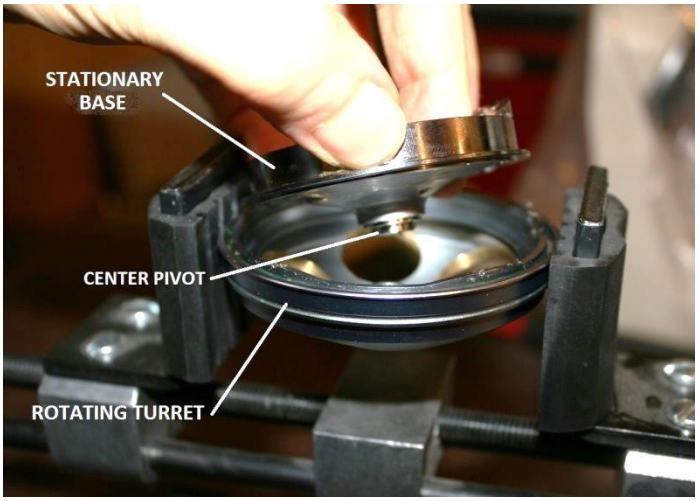

Figure 25 – Reinstall the stationary base into the turret

Apply Ring of Grease around the Perimeter

Apply a ring of fresh grease around the perimeter of the turret assembly for the perimeter bearing balls (see **Figure 26**). The grease should go in the channel formed between the outer perimeter of the stationary base and the inner perimeter of the rotating turret (see **Figure 27**). Do not apply too much grease here, or the retaining ring will not be able to be reinstalled properly, as the excess grease will not allow the ring to fully seat.

Figure 26 – Apply ring of fresh grease for the bearing balls

Figure 27 – Ring of grease ready for bearing balls

Reinstall the Perimeter Bearing Balls

Use tweezers to carefully arrange the eighty 3/32" bearing balls around the perimeter grease ring (see **Figure 28**), placing the bearing balls as close together as possible as you proceed (see **Figure 29**).

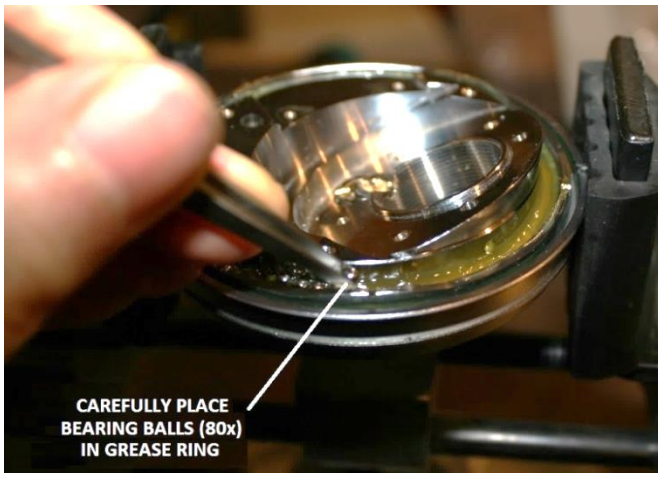

Figure 28 – Place the bearing balls in the ring of grease

Figure 29 – The bearing balls set in the grease ring

Reinstall the Retaining Ring

The next step is to reinstall the threaded retaining ring, to keep the perimeter bearing balls in place and to secure the stationary base within the rotating turret. Carefully engage the threads of the threaded retaining ring with the threads in the rotating turret (see **Figure 30**). Once the threaded retaining ring has been engaged with the rotating turret, use a suitable center punch or nailset tool to snug the threaded retaining ring into the rotating turret, by placing the tool in one of the four tooling holes (see **Figure 14**) and lightly tapping the tool with a small hammer or mallet to tighten the retaining ring. At this point, the rotation of the turret should feel smooth and not too stiff.

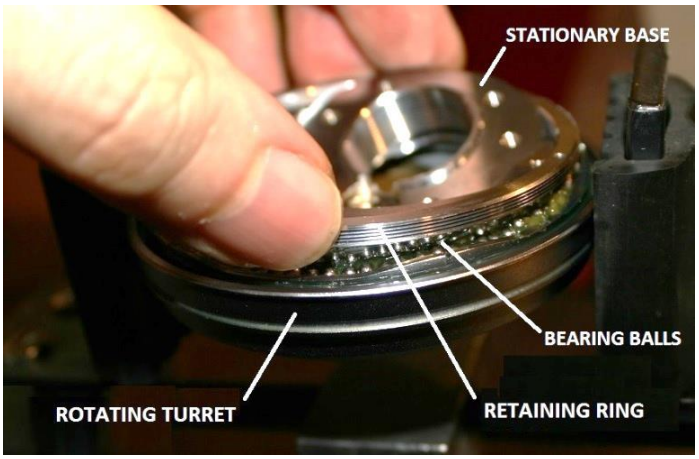

Figure 30 – Reinstall the threaded retaining ring

Reinstall the Mechanical Detent Stop

Once the threaded retaining ring is in place and the turret rotation is found to be acceptably smooth, place the mechanical detent stop in position on the stationary base of the turret assembly (see **Figure 31**).

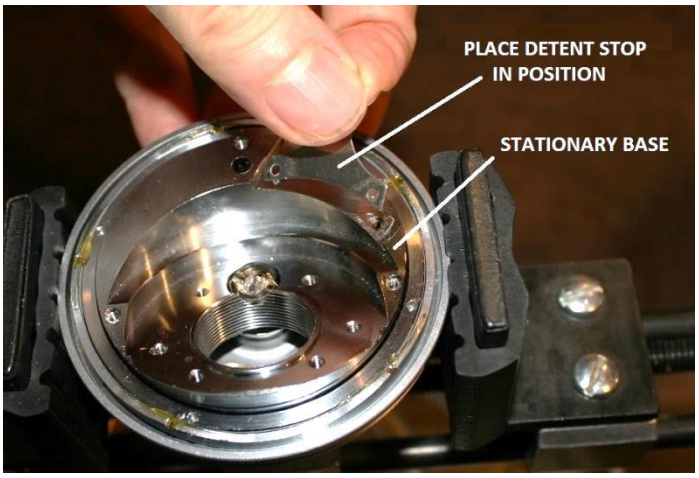

Figure 31 – Place the mechanical detent stop in position

Use a suitable JIS screwdriver to secure the mechanical detent stop in place with the two small, pan-head screws (and **Figure 32**).

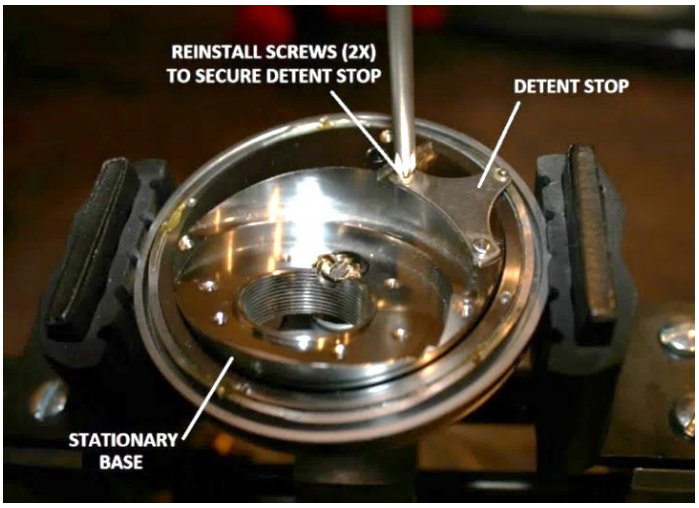

Figure 32 – Secure the detent stop with two screws

Clean Off Any Visible Grease

Using a suitable solvent (e.g., acetone) and a clean rag or tissue, thoroughly clean any visible grease from the exterior of the turret assembly. Be careful while doing this, to prevent any of the solvent from dripping into the rotating turret mechanism and fouling the grease within.

Reinstall the Knurled Rubber Collar

Carefully reinstall the knurled rubber collar, taking care not to stretch the collar in the process (see **Figure 33**).

Figure 33 – Reinstall the knurled rubber collar

Verify the Feel of the Nosepiece Rotation

Hold the turret assembly by gripping the stationary base in one hand and rotate the knurled rubber collar with the other hand. The rotation should no longer feel excessively stiff or gritty.

Clean Old Grease from Mechanical Detents

Use a suitable solvent (e.g., acetone) and a cotton swab to clean any old grease from the mechanical detent notches in the rotating turret. Do not allow any of the solvent to drip into the rotating turret mechanism, or it may foul the grease within the turret mechanism (see **Figure 34**).

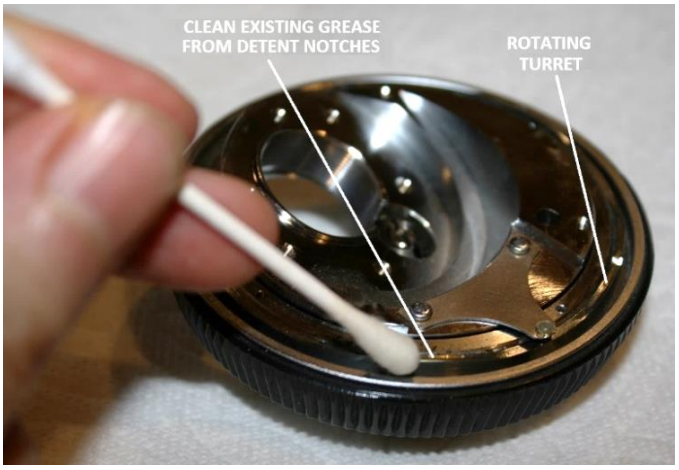

Figure 34 – Clean old grease from the mechanical detents

Apply Fresh Grease to the Mechanical Detents

After the old grease has been removed from the detent notches in the rotating turret, apply fresh grease to the detent notches (see **Figure 35**). Periodic cleaning and application of fresh grease to these mechanical detent notches is necessary to minimize wear of the mechanical detents, thereby maximizing the useful service life of the turret assembly.

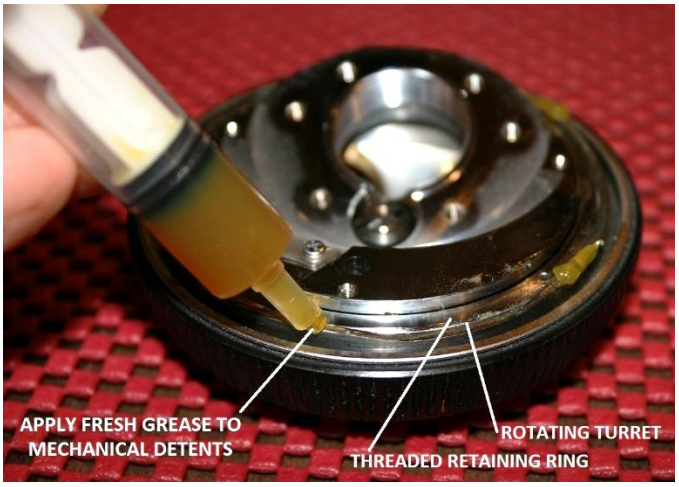

Figure 35 – Apply fresh grease to the detent notches

Reinstall the Cover on the Turret Assembly

Place the protective cover in position on the back side of the turret assembly, lining up the three holes in the protective cover with the three corresponding threaded holes in the stationary base (see **Figure 36**).

Figure 36 – Place cover in position on the turret assembly

Use a suitable JIS screwdriver to reinstall the three small, flat-head screws to secure the protective cover onto the stationary base of the turret assembly (see **Figure 37**). The purpose of the protective cover is to prevent dust and debris from getting in and fouling the mechanical detent stops and the rotating mechanism.

Figure 37 – Secure protective cover using three screws

Reinstall Wedge Mount and Corrective Optics

In order to guarantee proper optical alignment of the rotating turret, and in order to place minimal mechanical strain in the corrective optics (for polarizing work), reinstall the wedge mount and corrective optics assembly per the following procedure.

First, place the wedge mount in position on the turret assembly, holding the wedge mount such that the four screw holes in the wedge mount line up with the four threaded holes in the stationary base. This will place the wedge mount in the proper physical position for the corrective optics assembly to be reinstalled (see **Figure 38**).

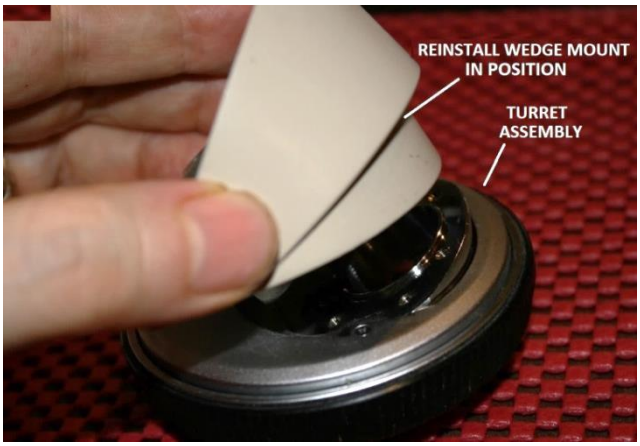

Figure 38 – Place the wedge mount in position

Next, screw the corrective optics assembly into the threaded hole in the stationary base (see Figure 39). Tighten the corrective optics assembly until it is hand tight, then back it off approximately ¼ turn. The barrel fits the hole in the wedge mount with very tight tolerances, and this holds the wedge mount in the proper physical location as the screws are installed.

Figure 39 – Reinstall the corrective optics assembly

Now, use a suitable JIS screwdriver to reinstall the four screws to secure the wedge mount to the turret assembly (see Figure 40).

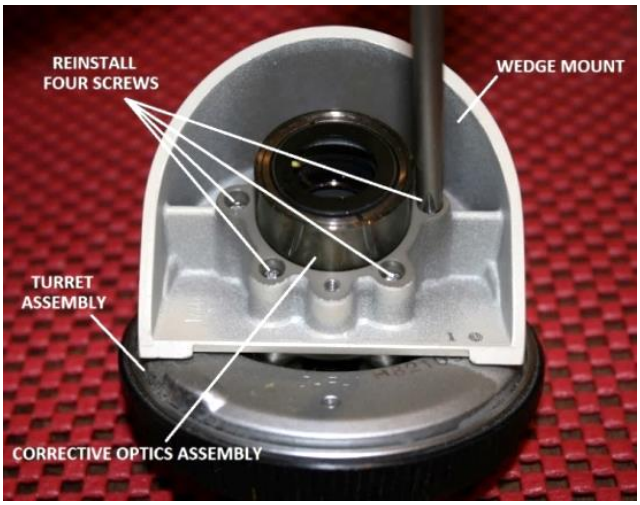

Figure 40 – Reinstall screws to secure the wedge mount

And finally, use non-marring pliers or a suitable strap wrench (to not cause any damage) to grip the barrel of the corrective optics assembly and tighten the corrective optics assembly a bit beyond hand tight (see Figure 41).

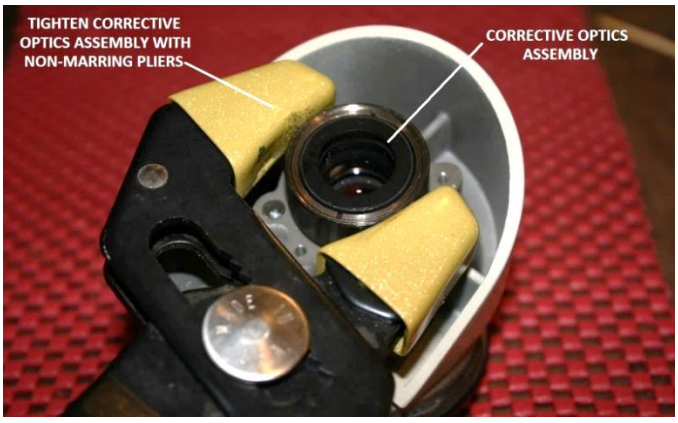

Figure 41 – Tighten the corrective optics assembly

Reinstall the Reverse Nosepiece Assembly

Hold the reverse nosepiece assembly in place on the top of the arm (see Figure 42) and align the screw holes in the arm with the threaded holes in the wedge mount on the reverse nosepiece assembly (see Figure 43).

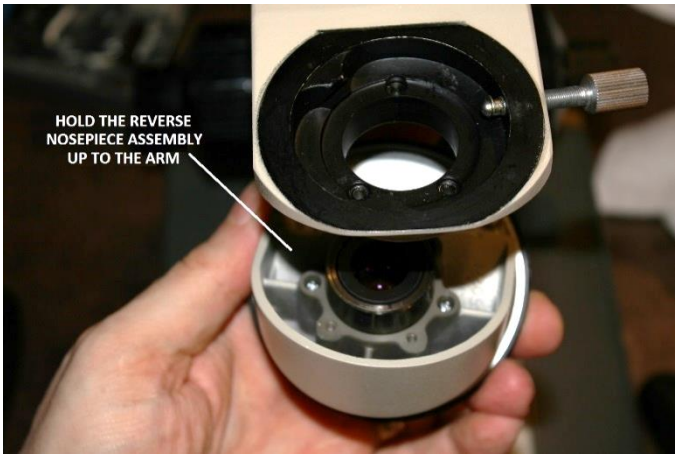

Figure 42 – Hold reverse nosepiece assembly up to arm

Figure 43 – Align holes for the mounting screws

While holding the reverse nosepiece assembly in this position, use a suitable JIS screwdriver to reinstall the three screws to secure it in place on the top of the arm (see **Figure 44).**

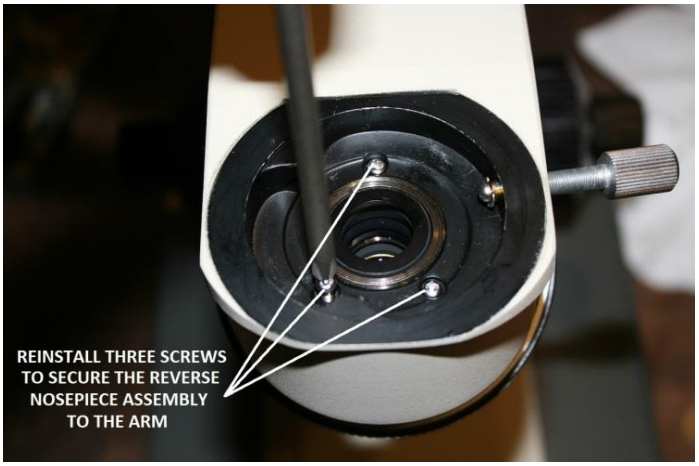

Figure 44 – Reinstall three screws to secure it to the arm

Ready for Service

The microscope stand with the newly reconditioned reverse rotating nosepiece is now ready to be put back into service.

Requirements for Periodic Maintenance

If the microscope stand sees heavy usage, the mechanical detents stops should be periodically cleaned and regreased per this procedure, to minimize wear on the stops. The required interval for this maintenance depends on the usage to which the equipment is subjected. Field experience has shown that even heavily used scopes (such as those used in hospitals and clinical lab settings), lubricated on a 6-month interval, can be expected to provide many years of trouble-free service.

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 turret in the affected 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 rotating 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 needs to be adjusted to remove the play in the pivot ball.

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.

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 (see **Figure 45**). This document can be found by searching for the title in an internet search engine, such as Google or Bing.

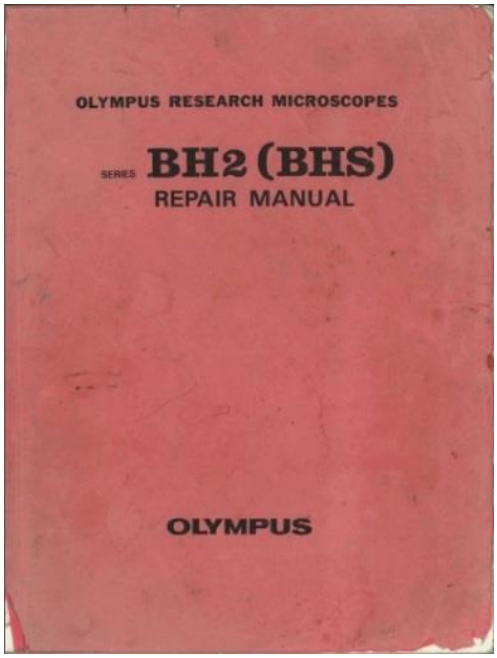

Figure 45 – The Olympus BHS repair manual

How to Contact the Author

Please feel free to direct any questions or comments regarding this document to the author, at the following email address: carlh6902@ieee.org

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 June 2017, 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	---	$19.70
3	Bearing balls, chrome steel, 3/32" G25, 100 count	various	---	Amazon	---	$7.51
4	Bearing balls, chrome steel, 1/4", G25, 100 count	various	---	Amazon	---	$5.95
5	Brake Grease, Plastilube®, 35 cc	Plastilube®	ATE70014	Amazon	---	$8.82
	Brake Grease, Plastilube®, 75 cc	Plastilube®	ATE70015	Amazon		$8.42
6	Pliers, soft-jaw	---	Non-Scratch Pliers	Micro-Mark	---	$34.95
	Pliers, non-scratch	Tamiya	74061	Amazon	---	$26.27

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	---	---
Micro Mark	www.micromark.com	---	1-800-225-1066	1-908-665-9383	info@micromark.com

Table 2 – Vendor Listing