Leitz Ortholux Nosepiece maintenance

Scope

The “black era” Leitz Ortholux microscopes were manufactured from approx. 1937 to 1974. During this period Leitz manufactured several different nosepiece models and variants.

These maintenance notes describe the disassembly, cleaning, greasing and reassembly of an Ortholux nosepiece designed for five objectives. In large parts the notes should also apply to other contemporary Leitz microscope nosepieces.

Grease

The nosepiece’s closeness to the delicate objectives makes it important to select greases that don’t emit semi-volatile components that could condense as a hazy film on the glass surfaces. The grease should also stay in place, i.e., it should not migrate along surfaces or fall off as droplets or particles.

One could even argue that the safest option would be to avoid any grease at all in the microscope’s nosepiece.

Nosepiece and Turret Introduction

Although Leitz generally strived for component standardization there is some variation of nosepiece/ turret designs depending on the microscope model and the year of manufacture. There also a variety of different turret models available. Early nosepieces didn’t seem to have any ball bearings, only a simple plain bearing (i.e., a greased sliding surface) at the turret axle. The dual bearing design covered in this writeup was apparently introduced sometime later in the “black era”.

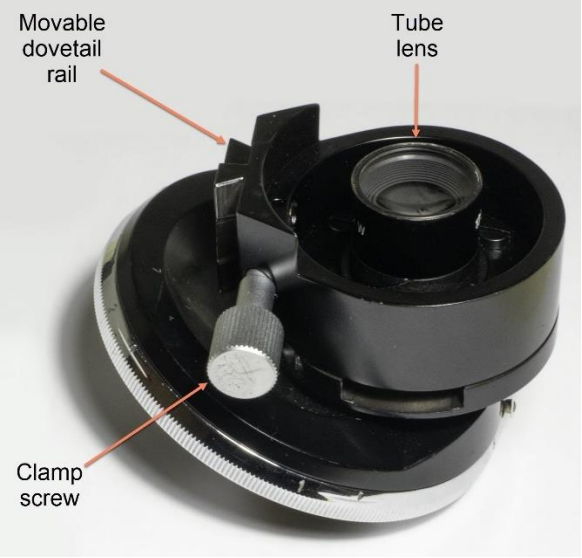

Figure 1: Nosepiece with turret, the latter facing downwards

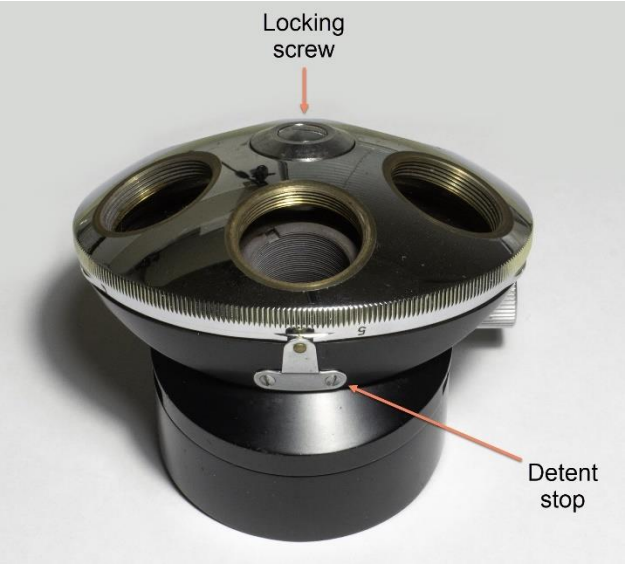

Figure 2: Nosepiece with turret, the latter facing upwards

The maintenance work according to these notes is not difficult, but two issues deserve some attention. First, the bearing balls are quite small (1.5 mm and 1.0 mm) and easy to lose. Second, when the bearings are assembled it is important that the bearing balls are not allowed to come out of the retainer. Don't allow the bearing to come apart once it has been assembled. This is to ensure that all balls are properly seated and that the bearings will work as intended.

Maintenance Notes

1. Remove the nosepiece from the microscope.

Remove all objectives from the turret. Lower the microscope stage as much as possible to leave space for the removal of the nosepiece. Loosen the nosepiece's dovetail clamp screw (Figure 1) and carefully pull the nosepiece downwards to release it from the microscope. Remove the clamp screw from the nosepiece. Remove the movable dovetail rail (Figure 1) together with the two small springs below it. Clean the screw, the rail, and the springs with solvent (e.g., white spirit.)

2. Remove the nosepiece's tube lens.

Remove the tube lens (Figure 1) to protect it from getting dirty or damaged during the work on the nosepiece. Without touching the glass surface, grip the side of the tube lens and carefully rotate the lens back and forth in small increments while pulling it out of the nosepiece's sleeve attachment. If it is stuck, put a wide rubber band around it for protection (the kind of rubber band that grocery shops use to wrap around broccoli), grip it carefully with adjustable pliers and carefully wiggle it and pull it out. Put the tube lens aside to protect it from dust and dirt.

3. Check the detent stop.

The detent stop (Figure 2) is a rather simple mechanism that holds the turret's objectives in the correct position aligned in the microscope's optical path. Rotate the turret and check that the detent stop properly latches to and holds the turret in the required working positions. If it doesn't, either the detent stop ridge or the corresponding notches on the turret periphery may have worn out. Repair of faulting parts like these is not easy, so unfortunately the best option is probably to try to have them replaced. The detent stop doesn't need to be removed unless it is dirty or corroded and needs cleaning. To remove it, use a properly fitted screwdriver to carefully loosen and remove the two tiny screws that hold it. Clean the detent stop and the screw heads by rubbing with cotton swabs dipped in Autosol Metal Polish. Wash the parts using an old toothbrush and warm water with a few drops of dish detergent and let them dry. In case there is rust left that resisted the Autosol polishing, try to treat the parts in water with 5-10% citric acid over the night (or a couple of days) before a new attempt is made with Autosol. Reattach the detent stop.

4. Remove the small inner ball bearing from the front center of the nosepiece turret.

Refer to Figure 3 and Figure 4. During this operation the tiny balls (1.0 mm) from the turret's ball bearings may scatter and get lost. It may therefore be helpful to do the work with the nosepiece placed in a confined area, like a bowl with a piece of cloth or a paper towel placed on the bottom. Also prepare a small glass vial with solvent (e.g., white spirit) for cleaning of the bearing components. Loosen the locking screw (Figure 2) in the center of the turret using a snugly fitting screwdriver. Carefully, without disturbing the underlying bearing, remove the locking washer below. Next, carefully remove the inner ball bearing's upper race washer – some of the bearing balls may stick to its underside, be sure not to

lose these. Carefully remove the brass bearing retainer and transfer it into the glass vial with the solvent. Use a pointed toothpick to push the bearing balls out of the retainer holes. Because the balls are very small and easy to lose, it may be helpful to also use a magnifier and perhaps tweezers with pointed tips. The inner bearing of this nosepiece had 12 pieces of 1.0 mm balls, but the size and numbers may vary in different nosepiece models. Finally remove the remaining lower race.

If you accidentally lose a bearing ball, new balls can be purchased from Amazon and other vendors.

Figure 3: Nosepiece with turret; after the inner ball bearing has been removed.

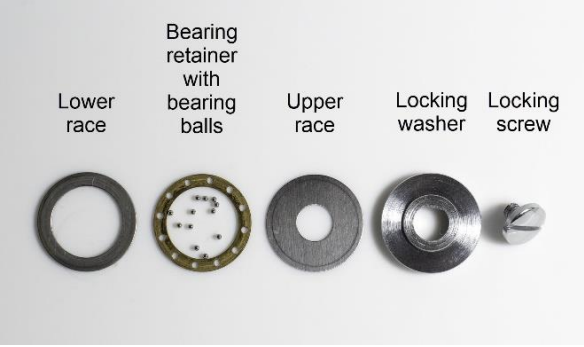

Figure 4: The parts of the inner ball bearing after removal and disassembly.

5. Remove the turret from the nosepiece base.

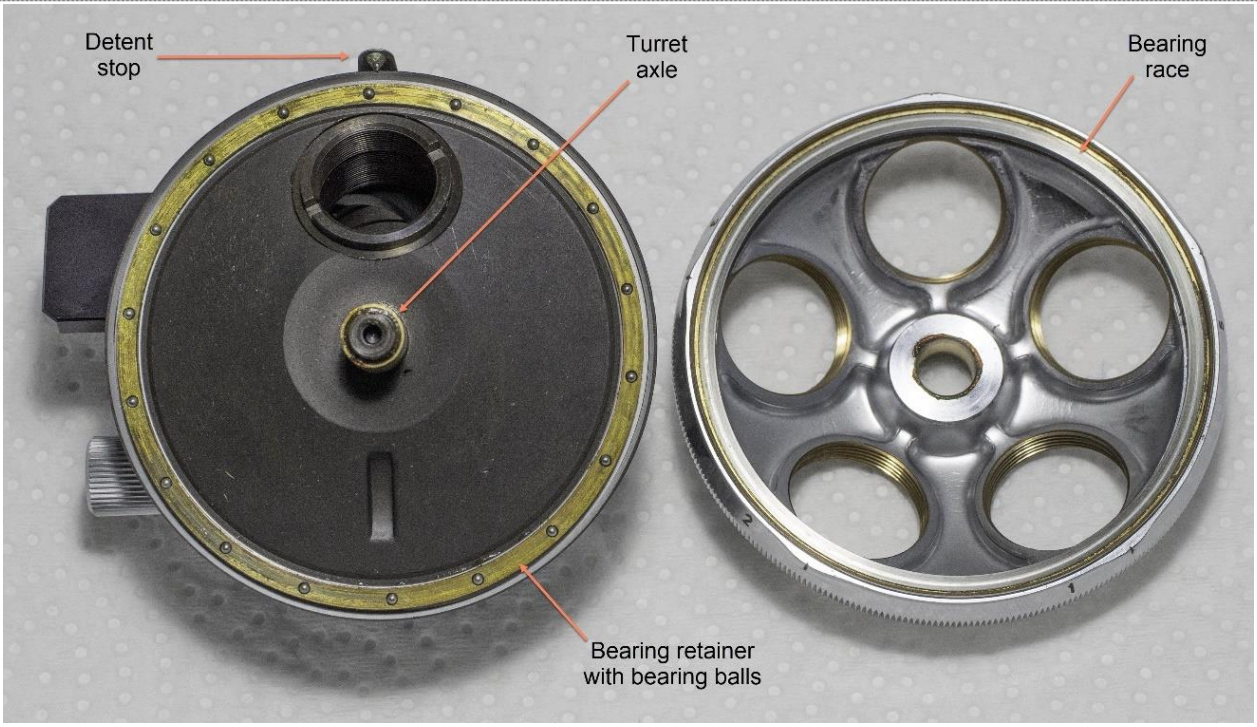

Figure 5: Turret (right) removed from the nosepiece base (left). The large ball bearing retainer (brass) with most of the bearing balls sits on the nosepiece base's race.

Prepare a second glass vial with solvent (e.g., white spirit) to contain the balls from the large outer ball bearing. Hold the turret's periphery and rotate it back and forth with small movements, and at the same time carefully pull it away from the nosepiece base. As the turret separates from the turret axle (Figure 5) be careful not to lose any of the small (1.5 mm) bearing balls. Pick up the large brass bearing retainer and all balls and put them into the solvent vial. Use a pointed toothpick to push out any balls that are stuck in the retainer. Check the bearing races of the nosepiece and the turret to make sure that there are no balls left. The nosepiece in Figure 5 has 18 bearing balls with 1.5 mm diameter, but it seems that some later bearing models could have up to 32 balls.

6. Clean off old grease from all sliding surfaces.

Use a piece of cloth or tissue wetted with solvent to wipe off old grease from the turret axle in the nosepiece. Use cotton swabs wetted with solvent to clean the large race surfaces of the nosepiece and on the inside of the turret. If necessary, also clean the race of the small ball bearing on the outside of the turret. Then proceed to clean the bearing parts left soaking in the glass vials. The large brass bearing retainer is wiped clean with a piece of cloth or with cotton swabs wetted with solvent. If the retainer surface has solid deposits from old grease or corrosion products clean it by rubbing with cotton swabs dipped in Autosol Metal Polish. Remove all traces of abrasives by washing the retainer first in solvent and then with an old toothbrush and warm water with a few drops of dish detergent. Wipe the retainer dry. Then proceed by cleaning the two race washers and the brass retainer of the small bearing in the same way. Finally pick up the small balls one by one with tweezers, wipe them dry using a lint free microfiber cloth and collect them in another dry vial. Don't use tissue paper for this, because it leaves a lot of paper fiber on the ball surfaces. For convenience, keep the inner bearing balls (1.0 mm) separated from the outer bearing balls (1.5 mm.) Take care not to lose any of the balls, they are prone to pop away and disappear.

7. Check that the turret rotates freely on the turret axle.

Apply a thin layer of grease (Mobilgrease 28) on the sides of the turret axle and on the inside of the turret's axle bore. Without including any of the bearings attach the turret to the nosepiece while rotating the turret back and forth. The turret should rotate freely and easily without any tendency for galling. If it doesn't, remove the turret, wipe the grease off the nosepiece's axle and sand the side of the axle lightly for 10-20 seconds with a very fine sandpaper (280, or finer). During sanding try to protect the nosepiece from the sanding debris. Thoroughly clean the nosepiece and the axle from any remaining abrasives, grease the axle again, attach the turret and test again if it rotates freely. Repeat the sanding and testing cycle until the turret rotates satisfactory. In the unlikely event that the turret should seize on the nosepiece axle (yes, it can happen) apply some penetrating oil (for example, WD-40) and let it sit over the night. Use an electric heat gun to blow hot air towards the center of the turret until it warms up and then rotate the turret back and forth while pulling it upwards. The stuck turret should release nicely, just be careful not to overdo it with the heat gun.

8. Attach the turret to the nosepiece including the large outer ball bearing.

Apply Mobilgrease 28 (but don't overdo it) on both sides of the large brass bearing retainer. The layers don't need to be entirely even. Put the greased retainer straight down on the nosepiece's bearing race, like in Figure 5. The grease will keep the retainer stuck in the correct position in the nosepiece race. Using two toothpicks rotate the retainer a few mm back and forth to allow some grease to reach into the holes for the balls. Using tweezers (and perhaps magnifiers) pick the 1.5 mm bearing balls one by

one and put them into the retainer holes. Use a pointed toothpick to push them fully down into the holes. The grease will help to keep them properly seated. Check that all balls are present and properly seated. Take the turret, position it on top of the axle of the nosepiece, and then smoothly and in one single movement push it all the way down on the turret axle until it stops. It is essential that the turret is assembled onto the nosepiece without dislodging any of the bearing balls from the retainer. Therefore, don't wiggle the turret during the push, and don't stop the pushing movement before the turret is snugly in place. Once the turret has come in place, you will need to prevent it from accidentally separate again (even if the separation is minimal) - this is to ensure that the bearing balls don't become dislodged. Should a separation accidentally happen, you will need to remove the turret, check that all balls are properly seated in the retainer, and reassemble the turret.

Check that the turret still rotates freely on the axle by simultaneously lightly pushing it down and rotating it.

9. Assemble the inner ball bearing in the groove at the center of the turret and lock the turret to the nosepiece.

Refer to Figure 4 above (going from the left side to the right side) for the order of the components. First put the lower race into the groove. Then hold the retainer between your thumb and index finger, apply Mobilgrease 28 on both sides, and put the retainer on top of the lower race. Use two pointed toothpicks to rotate the retainer a few mm to allow some grease to reach into the holes. Use tweezers (and perhaps a magnifier) to pick the 1.0 mm bearing balls one by one and place them in the retainer holes. Use a toothpick to push them fully down. Check that all bearings are present and properly seated. Carefully, and in one smooth movement, put the upper race on top of the retainer with the balls. In the same way as before, be careful to avoid that the bearing balls dislodge. This is somewhat tricky because the upper race is prone to accidental wiggling. Carefully add the locking washer, making sure that it is properly aligned and fits into the small depression on the top of the axle. Finally secure the turret with the locking screw (tight, but not overtightened.) Check that the turret still rotates freely and that the detent stop works properly.

10. Mount the previously removed and cleaned dovetail components to the nosepiece.

Lightly grease (Mobilgrease 28) all sliding surfaces of the movable dovetail rail, grease the two springs and place them into the two bores in the rail, and lightly grease the threads of the dovetail clamping screw. Assemble the dovetail parts on the nosepiece and attach the clamping screw. Rotate the clamping screw to check that the dovetail rail properly and smoothly tightens and opens.

11. Reattach the tube lens to the nosepiece.

Reattach the tube lens (Figure 1) to the nosepiece. Be careful to avoid fingerprints or dirt on the lens surfaces.