Leitz Condenser no. 56 – Maintenance Notes

Introduction

Leitz condenser No. 56 (Figure 1) with Leitz catalog number 512 807 is a dual lens brightfield condenser where the top lens is capable of yielding an n.a. (numerical aperture) of 0.90. The lower lens is protected in the condenser house between the top lens and the aperture diaphragm. The condenser is designed to be used with Leitz microscopes with 160 mm mechanical t.l. (tube length), except for those microscopes that belong to the Diaplan and Aristoplan family. The condenser can be used with objectives from 4x magnification and higher for a field-of-view index of up to 20 mm, and there are no supplemental or auxiliary lenses that need to be moved in and out of the optical path. An oil immersion cap with n.a. 1.25 is however available (Leitz catalog no. 512 652) for attachment on top of the front lens. The eight-blade aperture diaphragm is adjusted with a lever that has an unnumbered arbitrary scale (supposedly 0-10.) There is a slot for inserting various filter slides and darkground or phase contrast ring stops. The filter slides are held in place by a spring-loaded locking lever. On the microscope the condenser is easily interchangeable thanks to its standardized dovetail slide. The condenser doesn't have any built-in centering mechanism - the centering of the entire condenser is done with the centering mechanism built into the microscope's condenser holder. Supposedly, the filter slide's locking lever is so precise that a separate phase contrast ring stop centering mechanism should not be necessary.

Figure 1: Leitz condenser No. 56.

Figure 2: The n.a. 1.25 oil immersion cap for condenser no. 56.

Figure 3: Condenser no. 56 with a darkground slide inserted in the position where it is outside of the optical path.

Figure 4: Condenser no. 56 with a darkground slide inserted in the position where it is within the optical path.

Figure 5: Three examples of plastic filter slides for condenser no. 56: A colorless frosted diffuser slide, a blue daylight conversion filter, and an annulus for darkground microscopy.

Leitz universal condenser UKL (UK from German **U**niversal**k**ondensor, and supposedly **L** for Laborlux; with Leitz catalog number 513 558) is optically identical with condenser no. 56, except that instead of a filter slide slot, it has a turret with spaces for various darkground and phase contrast ring stops (Figure 6.)

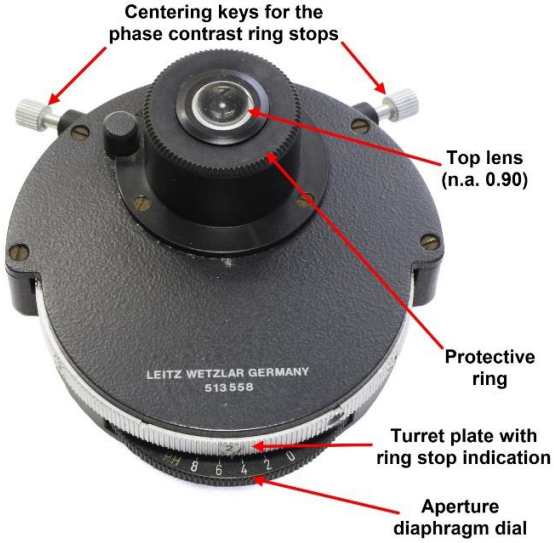

Figure 6: Leitz Universal Condenser UKL.

Scope

After nearly 50 years of use the no. 56 condenser may typically be dirty (dust, corrosion, and/or immersion oil contamination) and may sometimes suffer from a sluggish or frozen aperture diaphragm.

These maintenance notes describe the disassembly and some cleaning (and occasionally greasing) procedures for the Leitz no. 56 condenser.

General user instructions for the no. 56 condenser are available in the Leitz Laborlux S - Instructions.

About Iris Diaphragms

Refer to the Internet for general descriptions, drawings, and animations of how iris diaphragms work.

Iris diaphragm blades are cut out from thin steel sheets. They are sensitive to corrosion (rust) and mechanical abuse. A common problem with iris diaphragms is that they can become sluggish or stuck due to old, hardened oil, typically immersion oil. It appears that Leitz refrained from lubricating the aperture diaphragms in the no. 56 condenser. Generally, iris diaphragm blades may become bent and dented if the diaphragm is forced to close beyond its designated limit, but the 56 condenser has protection against such damage. The aperture diaphragm has however no protection from damage if it is poked from the underside of the condenser. Bent or damaged diaphragm blades are potentially serious problems and can be difficult or impossible to repair.

Rusty iris diaphragm blades are not uncommon in older microscope condensers. Light rust doesn't impair the function of the iris diaphragm but be aware that rust dust/particles may fall down on any lens that is below the diaphragm.

To take apart an iris diaphragm is easy but putting it together again with all the blades in proper order can be challenging. If the diaphragm blades are bruised or not completely flat and even, then your patience will face the ultimate test. But it certainly *can* be done, as examples of successful attempts see this article and this video clip. Fortunately, issues like a sluggish or stuck aperture diaphragm can often be remedied without taking it completely apart.

Work Preparations

Before you go ahead with fixing your no. 56 condenser there are two things to consider:

i. Check that the condenser's top lens is in good shape. Inspect its outer lens surface, this is best done with a stereo microscope. Further servicing of the condenser is probably not very meaningful unless you know that the top lens is in good shape and without any persistent surface blemishes.

ii. Plan ahead. Get an idea of which parts of the condenser you need to fix. Then you can focus on these parts only and save time and effort by avoiding disassembling the entire condenser.

Maintenance Notes

1. Remove the protective ring from the condenser top.

The only reason to remove the black plastic protective ring (Figure 1 and Figure 9) from the condenser is to be able to replace it with an immersion oil cap (Figure 2 and Appendix: The n.a. 1.25 oil immersion cap.) There are no serviceable parts below the protective ring.

Remove the protective ring (Figure 1) from the condenser top by unscrewing it. It is attached to the condenser top by a thread and has a knurled rim to allow for a better finger grip. It may however for various reasons remain more or less stuck. If required, use a wide rubber band to get a better grip around its knurled rim. If that doesn't help, try the following:

a) Soak the thread with solvent: It's not uncommon that condensers have been subjected to overflowing immersion oil. If the oil has penetrated the threads and been sitting there for years, it may have solidified into a resin- or glue-like mass. Treating the thread with solvent may dissolve the hardened oil and facilitate the removal of the protective ring. A disadvantage is that solvent treatment is slow because it takes some time for the solvent to penetrate and soften the old, hardened oil in the clogged thread. Here is a suggestion for how to do it:

Figure 7: The protective ring wrapped with a gauze bandage strip wetted with white spirit.

Wrap the rim of the protective ring with a few turns of a gauze bandage strip (Figure 7.) Use a pipette or an eyedropper to wet the strip with solvent. For optimal efficiency keep the strip well wetted all the time but avoid overflowing. White spirit works well as the solvent because it has a good dissolving capability and is only moderately volatile, so it will be sufficient to re-wet the strip only every 4-12 hours. It may be a good idea to put a second bandage strip 5-10 mm below the first strip (as in Figure 7) to protect the condenser by catching any accidental solvent overflow. Keep the solvent working for 2-3 days making sure that the strip is well wetted all the time, and then try to release the protective ring again with the aid of the wide rubber band.

b) Squeeze the thread in a vise: Clamp the top 3 millimeters (but not more than 3 mm, otherwise you may damage the condenser) of the condenser (Figure 8) in a vise where the jaws have been lined with some suitable plastic protecting covers. Gently squeeze the condenser top with the vise, turn the condenser 90 degrees and squeeze it again. The trick is to squeeze hard enough to force the threads to release from the solidified resin, but absolutely not as hard as to damage

the condenser top. Try to release the protective ring with the help of the wide rubber band. It may be necessary to repeat the squeezes a few times.

Figure 8: Indications on the condenser top where to squeeze it in the vise.

c) Apply heat to the thread: Heating with an electric heat gun is a quick and efficient way to release stuck threads but it may damage any sensitive optical parts if not applied precisely and with discrimination. It could work for the protective ring if only you can manage to insulate the top lens to protect it from the hot air. A suggestion is to protect the top lens first with a piece of lens paper and then above that attach a circular piece of cork secured with tape. The hot air should then be directed to blow obliquely from below and from all sides around the top to minimize the air flow over the front lens.

After removal, clean the protective ring and the inside of the condenser's cylindrical top (Figure 9) with pieces of cloth or cotton swabs wetted with white spirit. Make sure that the threads are clean.

Figure 9: Condenser no. 56 with the protective ring removed.

Figure 10: View from the underside of the condenser top.

2. Remove the condenser top.

The condenser top (Figure 8) holds the condenser's both lenses. It is attached with three black M2x4 screws (see Figure 1, where two of the screws are indicated with green circles.) Unscrew the screws and remove the entire top (Figure 10.)

The lower lens' lower surface can now be accessed for cleaning. It is quite well protected from exposure to undesired external influences, so blowing air over it with a camera blower may be sufficient. The inside of the top between the two lenses is even better protected from contamination and should hopefully not need any cleaning at all. However, if required, the inside can be accessed for cleaning, refer to subsection 3 below.

3. Access the inside of the condenser top.

The inside of the condenser top should typically not need to be accessed for cleaning, although there may be exceptional cases when you still will need to clean the inside surfaces of the lenses.

The lower lens in the condenser top must be removed to access the inside of the top. The lens is attached with a black, plastic and threaded locking ring (Figure 12.) The locking ring has two slots to accommodate a camera spanner and is also secured with spots of a blue threadlocker (Figure 11.)

Begin by using a steel needle to scrape off any visible threadlocker from the locking ring. To soften the threadlocker that has penetrated the threads blot the area carefully with a cotton swab well wetted with acetone. Keep the area wet, but avoid flooding, and let the acetone work for a few minutes.

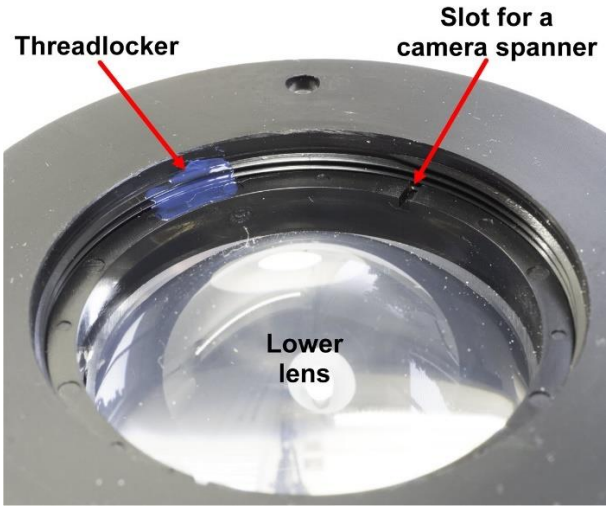

Figure 11: The underside of the condenser top showing the locking ring that holds the lower lens.

Figure 12: The parts of the disassembled condenser top: The top, the lower lens, and the locking ring.

Use a camera lens spanner equipped with screwdriver-like flat tips (Figure 13) to release and unscrew the locking ring. Be careful not to slip with the spanner and avoid scraping the lens with the spanner pins. The lower lens is now loose and can be removed from the condenser top by turning the top upside-down over a soft cloth and shaking it lightly to allow the lens to fall out. The lens (Figure 14) is of a somewhat unusual shape as it is quite thick and has a flat area on its side. It has a mildly convex upper side and a strongly convex bottom side.

Figure 13: A common camera lens spanner with a closeup view of the screwdriver-like tips.

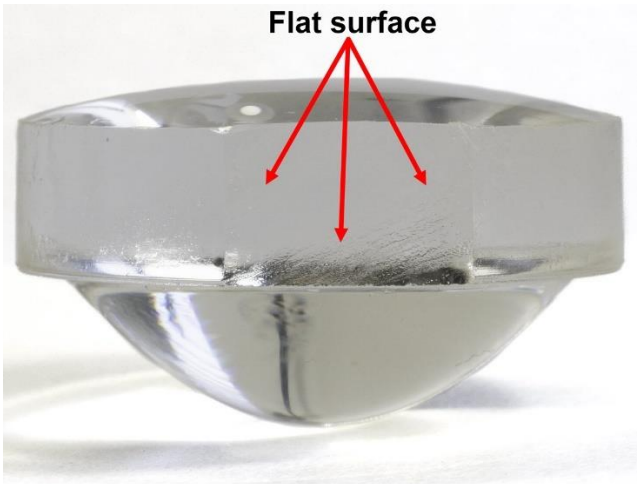

Figure 14: The lower condenser lens.

Clean any dirty lens surfaces with your preferred lens cleaning protocol.

Put back the lower lens into the condenser top. The strongly convex side should face downward (i.e., towards the condenser's aperture diaphragm) and the flat surface on the side of the lens should be turned towards the small vent hole in the side of the condenser top. In this location in the condenser top's inside there are also a few ribs that should face the lens' flat surface (see the orange arrow in Figure 12.)

Once the lens has been properly seated, reattach the plastic locking ring. Tighten the ring only lightly. I choose not to apply any threadlocker to the ring, but feel free to apply some, if you prefer.

4. The filter slide compartment

After the condenser top has been removed from the condenser, we can look down into the condenser's filter slide compartment (Figure 8) and inspect the aperture diaphragm and the locking lever for the filter slide (Figure 15.) The filter slide locking lever with its cantilever spring (Figure 16) can be left where they are unless they need to be cleaned from oil or dirt – they are anyway easy to remove and reattach because they are only loosely attached on the plastic cover.

If required, clean the inside of the filter slide compartment, the locking lever, and the spring with white spirit, but don't yet attempt to clean the sensitive aperture diaphragm blades. The aperture diaphragm shown in Figure 15 is completely soaked with oil, most probably due to an immersion oil accident.

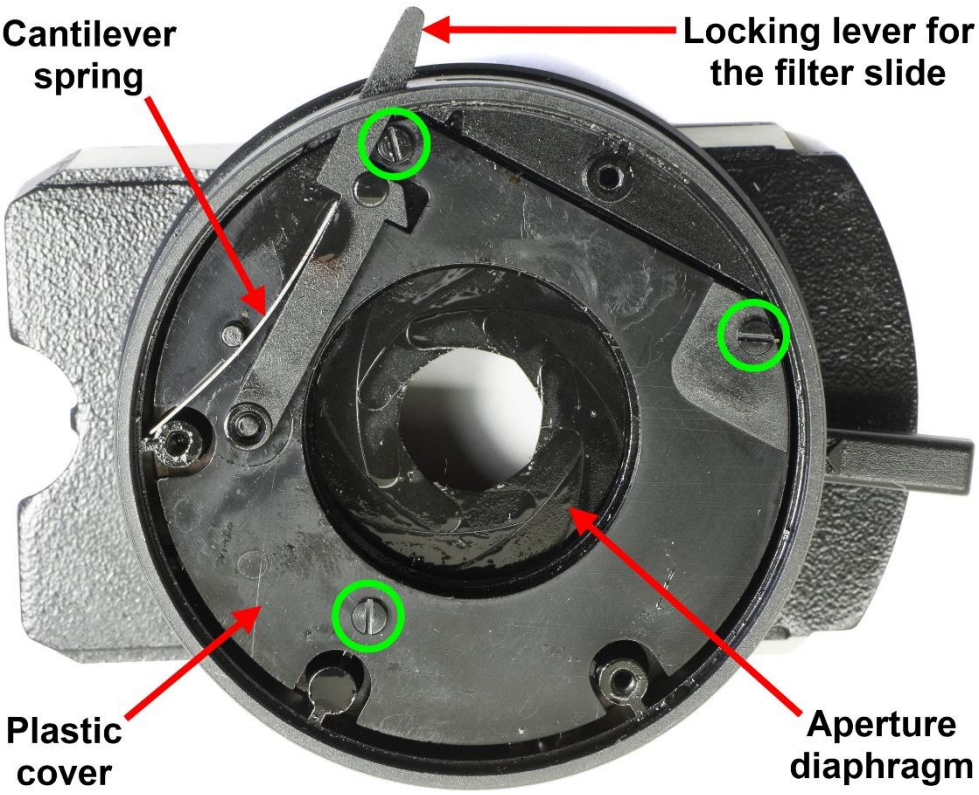

Figure 15: View down into the condenser's filter slide compartment after the cylindrical top has been removed. When inserted, the filter slide will be below the plastic cover.

Figure 16: The filter slide locking lever and its spring.

5. Remove the cover over the filter slide compartment.

The black plastic cover (Figure 15 and Figure 17) over the filter slide compartment is attached with three M1.6x5 screws (with green circles in Figure 15.) If the filter slide is clean and works satisfactory the cover doesn't need to be removed, but if the filter slide compartment needs cleaning or repair, unscrew the screws, remove the plastic cover, and then also remove the roller and the other cantilever spring next to the roller (Figure 17.) The roller (6.0 mm tall and 4.0 mm diameter) and the spring are only loosely attached in the filter slide compartment, so they are easy to put back again after removal. The spring snaps the roller into one of the two notches in the side of the filter slide (Figure 5) thereby holding it fixed, whether it is in its "out" or in its "in" position, refer to Figure 3 and Figure 4, respectively.

If required, clean the filter slide compartment and the parts with white spirit.

Reassemble the parts, after finished work.

Note that the aperture diaphragm can't be disassembled from this side of the condenser.

Figure 17: View down into the condenser's filter slide compartment after the plastic cover has been removed. This is where the filter slide is inserted.

6. Remove the condenser's dovetail mount.

The dovetail mount (Figure 1) must be removed to get access to the aperture diaphragm mechanism. You can skip this subsection if you don't need to clean or repair the aperture diaphragm.

Figure 18: View of the underside of the condenser with its dovetail mount.

Figure 19: The underside of the condenser after the dovetail mount has been removed. This is the underside of the aperture diaphragm base.

The dovetail mount on the underside of the condenser (Figure 18) is attached with four M2.5x6 screws with conical heads. Remove the screws and the mount. (Note how cleverly the screws are asymmetrically spaced to ensure that the mount will be correctly positioned when reattached again.)

Below the mount we can see the screwheads for the three M2x10 screws that hold the aperture diaphragm base (Figure 8 and Figure 19) attached to the condenser.

7. Clean the aperture diaphragm from oil contamination without disassembling it.

This is a simple procedure for cleaning a sluggish or oil contaminated aperture diaphragm by soaking it in solvent. “Simple” means here that you can clean it without taking it apart beforehand. You can skip this subsection if you don’t need to clean the aperture diaphragm.

We start by assuming that you already have done the following:

a) Removed the condenser top (refer to subsection 2 above),

b) removed the filter slide locking lever and its spring (refer to subsection 4 above),

c) removed the plastic cover over the filter slide compartment (refer to subsection 5 above),

d) removed the filter slide roller and its spring (refer to subsection 5 above), and

e) removed the condenser’s dovetail mount (refer to subsection 6 above).

Removal of items b), c), d) and e) are not *strictly* necessary; it is however recommended to remove them to keep the solvent soaking procedure lean, simple and efficient.

Put the stripped-down condenser into a suitable vial and cover it with solvent. White spirit is recommended as the solvent because it has a good oil dissolving capability with low risk for damaging the involved plastic parts and any paint. Avoid solvents like isopropanol or acetone – they quickly dissolve and obliterate the white paint that is used to print the text and markings on the condenser. Leave the condenser submerged for an hour, and then move the aperture diaphragm lever back and forth several times to allow the solvent to penetrate and wash between the diaphragm blades. Repeat moving the lever in this way every few hours. The next day, change to fresh solvent and continue moving the lever. On the third day, remove the condenser from the solvent, shake it lightly and blot it carefully with tissue paper to remove as much of the solvent as possible, and then let it sit to dry in the air. To speed up the drying, distribute the solvent over the diaphragm blade surfaces by moving the aperture diaphragm back and forth every now and then. White spirit has a relatively low volatility, so the drying may take several days.

After all solvent has evaporated (move the aperture diaphragm lever back and forth to check that the diaphragm blades remain completely dry) it is recommended to grease the spring that presses against the side of the aperture diaphragm actuator (Figure 21.) This unfortunately means that you must remove the aperture diaphragm base from the filter slide compartment, but greasing the spring will allow your aperture diaphragm lever to move smoothly and pleasantly. Follow the steps in subsections 8 and 10 below, and make sure to keep the actuator firmly resting on the aperture diaphragm blades all the time.

8. Remove the aperture diaphragm base to access the aperture diaphragm.

Skip this subsection unless you need either to grease the actuator spring or to disassemble the aperture diaphragm for thorough cleaning or repair.

Removing the aperture diaphragm base (Figure 8) provides access to the aperture diaphragm's moving parts. It also leaves the diaphragm and its blades vulnerable to fall apart - reassembling it back into working order can be challenging and time consuming, refer to section About Iris Diaphragms.

We start by assuming that you already have done the following:

f) Removed the condenser top (refer to subsection 2 above),

g) removed the filter slide locking lever and its spring (refer to subsection 4 above),

h) removed the plastic cover over the filter slide compartment (refer to subsection 5 above),

i) removed the filter slide roller and its spring (refer to subsection 5 above), and

j) removed the condenser's dovetail mount (refer to subsection 6 above).

In the stripped-down condenser turn the aperture diaphragm lever (Figure 1) approximately to its middle position. It should now look like in Figure 20 (but with the locking lever removed.) Place the condenser on the table with its underside facing up and remove the three M2x10 screws with conical heads that hold the aperture diaphragm base – the screw heads can be seen in Figure 19. While doing this, take care not to allow the aperture diaphragm base to come off from the rest of the condenser (i.e., from the filter slide compartment), not even by one millimeter - this is to avoid that the diaphragm falls apart. Hold the now liberated aperture diaphragm base snugly attached to the condenser, turn it all upside down (i.e., with the aperture diaphragm base facing down), and put it back on the table.

Figure 20: The aperture diaphragm base still attached to the filter slide compartment.

Now very carefully and without disturbing the diaphragm pull off the filter slide compartment from the aperture diaphragm base that rests on the table. Keep the base steady on the table and also hold on to the aperture diaphragm lever so it remains safely seated on the base covering the diaphragm blades. As the filter slide compartment (on the left side of Figure 21) is pulled off, don't be startled if the spring (Figure 21) that holds the aperture diaphragm actuator (Figure 23) under tension pops out and flies away.

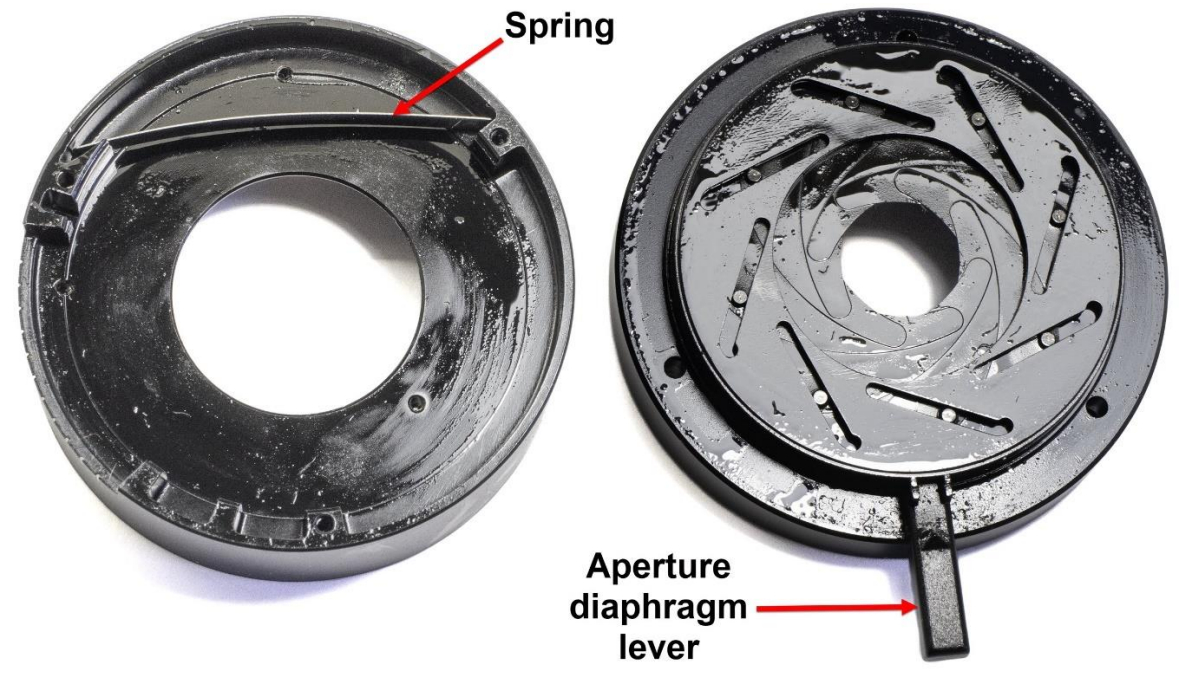

Figure 21: The aperture diaphragm base (right) with the removed filter slide compartment (left.) Everything here is covered with oil, presumably due to an immersion oil accident.

With the filter slide compartment removed you will see the aperture diaphragm covered by the aperture diaphragm actuator (Figure 21, Figure 22 and Figure 23.) The actuator rests loosely on the diaphragm blades with the pin of each blade running in its own slot. For now, leave the actuator where it is - don't remove it from the blades.

Figure 22: The aperture diaphragm base with the aperture diaphragm actuator attached over the aperture diaphragm blades.

9. Disassemble the aperture diaphragm.

Skip this subsection unless you really need to disassemble the aperture diaphragm for thorough cleaning or repair.

Before you remove the actuator put a mark (Figure 22), perhaps a tape strip, on the side of the aperture diaphragm base that shows the position of the lever – this is to be able to correctly put it back later. Remove the actuator (Figure 23) carefully by lifting it straight up from the diaphragm blades without disturbing the blades. You now have access to the diaphragm blades that are only loosely held in the base by their downward pointing pins (Figure 24.) Be aware that if you remove the blades, you will later need to put them back again (refer to section About Iris Diaphragms.) I'm not able to provide any specific guidelines for reassembling the aperture diaphragm because I have

never attempted to do it. General instructions for reassembly of aperture diaphragms can however be found in this article and this video clip.

Figure 23: The aperture diaphragm actuator (and lever.)

Figure 24: The aperture diaphragm after the actuator has been removed.

10. Reattach the aperture diaphragm base to the condenser.

For the reassembly of the aperture diaphragm base, we will start by assuming that you already have successfully reassembled the diaphragm blades on the base and covered the blades with the actuator with its lever pointing in the direction of the mark on the side of the base (Figure 22.)

Put back the spring into the underside of the filter slide compartment as shown in Figure 21. Apply a small amount of grease (for example, Super Lube Multi-Purpose Synthetic Grease with Syncolon, NLGI grade 2) to the side of the spring that faces the actuator. The grease will allow the aperture diaphragm lever to move smoothly; without the grease it would have a hard, scraping feeling.

Holding the actuator by the lever, press it against the aperture blades, and attach the filter slide compartment over the aperture diaphragm base. Attach it from the side so the spring catches the side of the actuator without detaching the actuator from the blades. Also make sure that the scale of the filter slide compartment is just above the aperture diaphragm lever. Holding the parts together with one hand, check that the three screw holes on the underside of the base align with the corresponding screw holes below in the filter slide compartment. If required, turn the parts back and forth against each other for a few millimeters until the screw holes align. Attach the three M2x10 conical head screws. Now the aperture diagram is safe from falling apart. Move the aperture diaphragm back and forth several times to distribute the grease on the spring while also checking that the diaphragm works satisfactory.

11. Reassemble the entire condenser.

If you removed the dovetail mount, attach it now with its four M2.5x6 conical head screws (Figure 18.)

Put back the roller and the corresponding cantilever spring into the filter slide compartment (Figure 17.) Attach the plastic cover over it with its three M1.6x5 screws (Figure 15 and Figure 17.)

Attach the filter slide locking lever and the corresponding cantilever spring into the filter slide compartment (Figure 15 and Figure 16.)

Attach the condenser top to the filter slide compartment with its three black M2x4 screws (see Figure 1, where two of the screws are indicated with green circles.)

Appendix: The n.a. 1.25 oil immersion cap

There is one issue with the oil immersion cap (Figure 2) that I haven't been able to resolve. According to the instructions (Leitz Laborlux S - Instructions) the cap should be attached over the condenser's top lens in the same thread as the protective ring (Figure 1 and Figure 6, after the protective ring has been removed, of course.) Trying to do so, I immediately found out that something is terribly wrong: The oil immersion cap screws down over the top lens only approximately halfway, because before going all the way down, the underside of the cap (Figure 25) hits the surface of the top lens. The correct catalog numbers are printed on both the condenser and the cap, so it doesn't seem that I got the wrong parts, but I just can't bring myself to believe that Leitz meant that a) the cap should not be screwed all the way down (Figure 26), and b) it was OK to let the underside of the cap touch and rub against the top lens' glass surface. Should the top lens be removed before the cap is attached? The instructions don't say that, and anyway it doesn't seem that the top lens is removable at all.

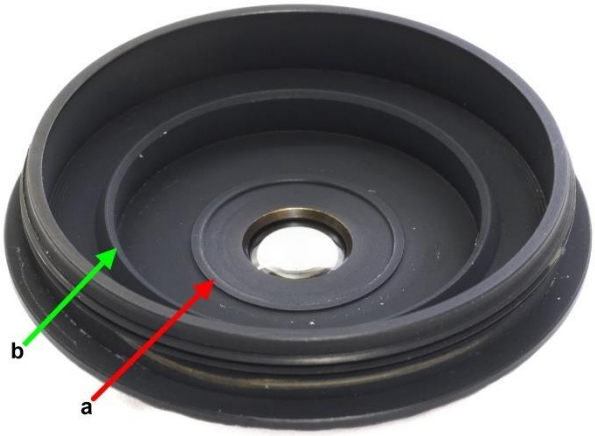

Figure 25: Oil immersion cap n.a. 1.25 viewed from the underside. When attached to the condenser the ring at "a" is touching the surface of the top lens. The ring at "b" goes outside of the top lens and doesn't touch any part of it.

Figure 26: Condenser no. 56 with the immersion oil cap attached over the top lens as far as it goes. The red arrow points to the gap left between the condenser and the cap.

References

Instruction for the Leitz Laborlux S microscope including some information about the no. 56 condenser: Leitz Laborlux S - Instructions

An article describing the function and repair of aperture/field diaphragms: https://www.microscopy-uk.org.uk/mag/artfeb07/pj-iris.html

YouTube movie that illustrates the dexterity and patience needed to reassemble an aperture diaphragm: https://www.youtube.com/watch?v=oH6GfyxpK9o