Leitz Diaplan and Aristoplan Condenser Holder and Condenser Focus Block

Scope

The condenser assembly of the Leitz Diaplan and Aristoplan microscopes has two serviceable parts, the condenser holder and the condenser focus block. Both parts are described in these maintenance notes.

Grease

The condenser holder and focus block functions are non-critical regarding the choice of grease. I have used Super Lube Multi-Purpose Synthetic Grease with Syncolon (NLGI grade 2) throughout. It is an inexpensive and ubiquitous grease.

Maintenance Notes

1. Remove the objectives, the condenser, and the head from the microscope.

To facilitate the work and to avoid contamination of the sensitive optical components, the objectives, the head with the eyepieces, and the condenser should be removed from the microscope and stored protected from dust.

2. Remove the condenser holder and the condenser focus block from the microscope.

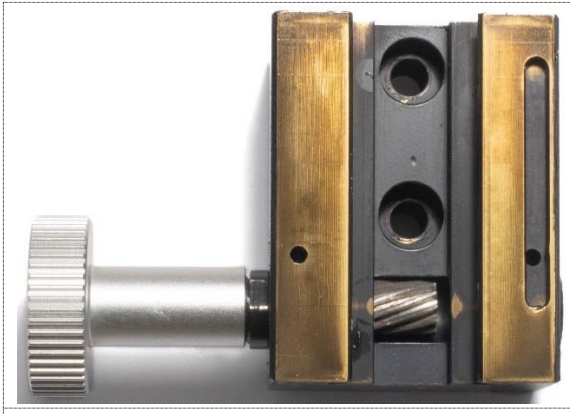

Figure 1: The condenser focus block.

Figure 2: The backside of the condenser holder. The shiny knob to the left is for the adjustable condenser height stop. The top end of the stop rod is sticking up from the top of the holder. The condenser focus rack is the white, striped plastic part in the middle.

Turn the coarse focus control to move the microscope stage to its highest position.

Turn the condenser focus control (a.k.a. the “condenser height adjustment”) to move the condenser holder to its lowest position.

Put the microscope on its back on the table.

Remove the stop screw indicated with a red circle in Figure 3. The tip of this screw fits into a groove (black, on the right side of Figure 1) in the condenser focus block and determines the maximal range of the condenser focus setting.

With the screw out of the way, turn the condenser focus control all the way down and then manually pull the condenser holder further down until it comes off from the dovetail mount.

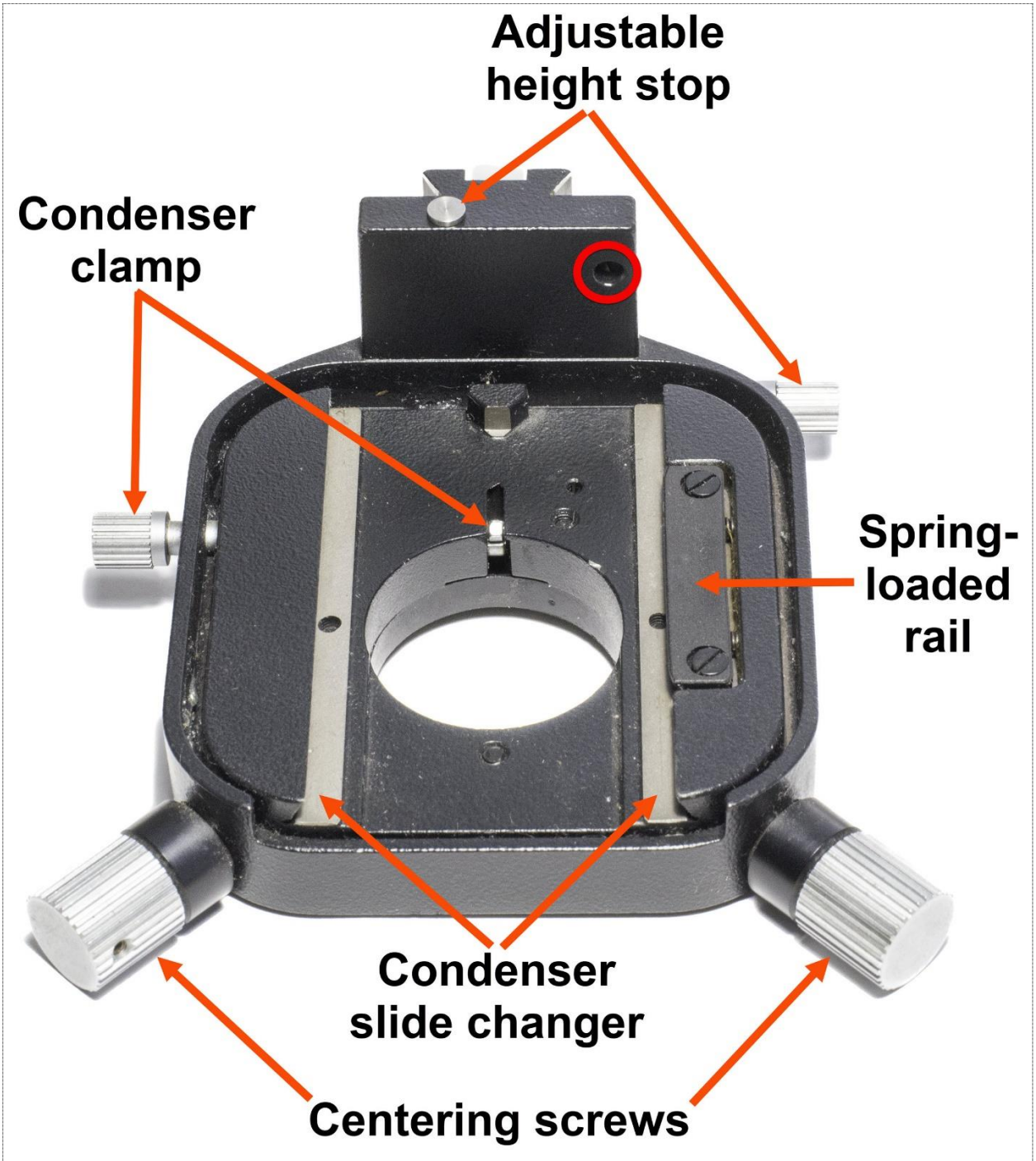

Figure 3: The condenser holder after removal from the microscope. The stop screw that determines the maximal range of the condenser focus is labeled with a red circle.

The knob on the side of the condenser holder's dovetail mount (Figure 2) is part of a simple mechanism, the adjustable height stop, which allows the user to set an upper height limit to the condenser focus control. The idea of the limit is to protect the condenser's top lens from getting scratched by hitting or scraping against the object glass. The knob setting determines how far a steel rod is pushed up (up to 3 mm) from the top of the condenser holder (Figure 2) thereby limiting how high up the condenser is allowed to move.

Remove the height stop knob, clean the threads with solvent, apply some fresh grease to the threads and reattach the knob.

3. Disassemble and clean the condenser holder.

The condenser holder contains a greased slide which allows the condenser to be optically centered with the help of two centering screws. The slide consists of a stationary middle section that is attached to the condenser dovetail mount. The middle section is then sandwiched between a joined upper and bottom shell which together move on the slide according to how the centering knobs are turned. The upper shell has a dovetail slide (the condenser slide changer, Figure 3) for attaching the condenser. A spring-loaded rail along the right side of the condenser slide holds the condenser steady in place. A condenser clamp is used to lock the condenser in its proper position.

The bottom shell is attached to the upper shell by four M3x10 Philips screws (Figure 4.)

Figure 4: The underside of the condenser holder.

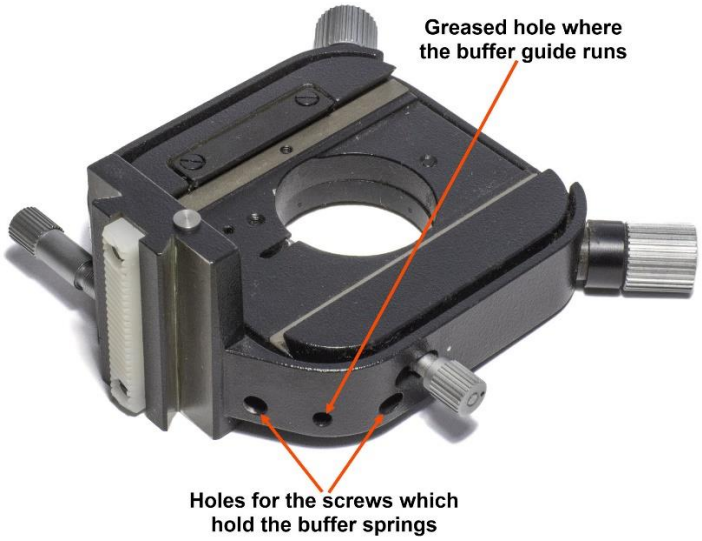

Figure 5: The upper side of the condenser holder.

Begin the disassembly by removing the four short grub screws that cover the buffer springs; you will access the screws from the corners on the backside of the condenser holder (Figure 5.) The screws are securing the buffer springs (Figure 6 and Figure 11) and hold them compressed. Although the width of the screw drive slots is 3 mm, you should use a narrower screwdriver, preferably not more than 2.0 mm wide, to protect the threads in the holes from damage. For the same reason be sure to put the screwdriver centered in the screw slot.

Pull out the buffer springs from the screw holes.

Put the condenser holder upside-down on a suitable support (e.g., a plastic cup with a flat bottom, turned upside-down.) Remove the four Philips screws from the underside of the condenser holder (Figure 4.) and carefully pull off the black, plastic bottom shell. Be careful not to lose any of the small parts now coming loose. You will see (Figure 8) the thoroughly greased (lower) centering slide, the condenser clamp mechanism (knob and pin), two (mechanical) pushers which are moved by the centering knobs, two spring-loaded buffers (each with a linear ball bearing) which push the moving slide against the two centering screws, and on the bottom shell four receivers (Figure 8) that face the buffers (Figure 9) and the pushers (Figure 10.)

Loosen the screw (red circle in Figure 8) that holds the condenser clamp and pull out the axle by the knob (Figure 7.) The small clamp pin will flip up because it is attached to a small spring, but it will remain in place in the condenser holder. With the condenser clamp out of the way, the upper shell (with the condenser slide changer) can also be removed to make the upper centering slide accessible for cleaning and greasing (Figure 6.)

Figure 6: View of the condenser holder from the top and with both the bottom and the upper shells removed.
Note the linear ball bearings on the front ends of the buffers. Each has four stainless steel balls that sit in a brass retainer.

Figure 7: The removed condenser clamp (axle and knob.)

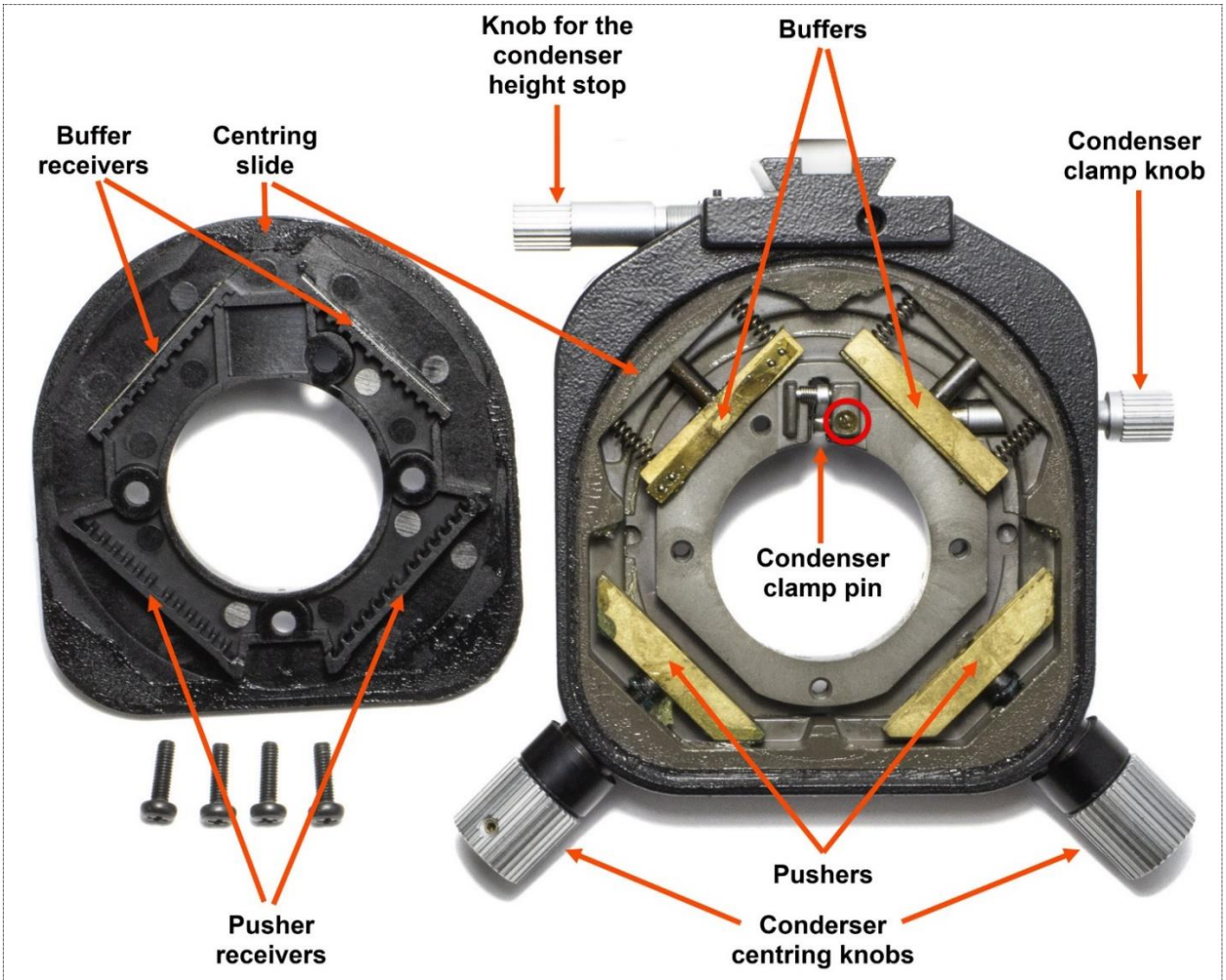

Figure 8: The condenser holder viewed from the underside (to the right) after removal of the bottom shell (to the left.) One of the linear ball bearings that normally sit on the front of the buffers has here been shown placed on top of the left buffer.

Carefully pull out both buffers from the middle section together with their linear ball bearings (Figure 8) that face the buffer receivers on the bottom shell (Figure 9.) Each of the ball bearings has four 1.0 mm balls sitting in a brass retainer.

Remove the pushers (Figure 8) by turning the centering knobs counterclockwise until the pushers release from the threads.

Figure 9: The bottom shell of the condenser holder viewed from the side of the buffer receivers. Note that the surfaces are covered with sheet metal plates that act as races for the buffer ball bearings.

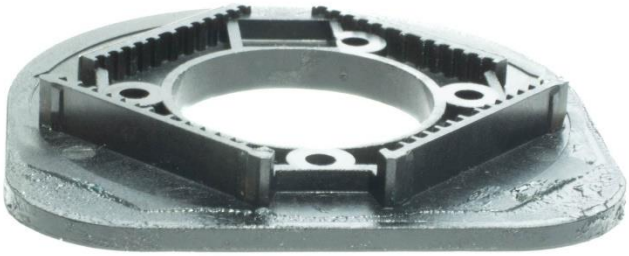

Figure 10: The bottom shell of the condenser holder viewed from the side of the pusher receivers.

Use a 1.3 mm Allen key to loosen (but don't remove) the locking screws on the side of the centering knobs and pull off the knobs. Use an 8 mm open ended wrench to loosen and remove the covers that sit attached on the knob sockets below the knobs. Collect the knob axles (brass, o.d. 5 mm, internal M3 thread), the wave washers (steel, 0.15 mm, i.d. 4.4 mm, o.d. 9.0 mm) and the transparent plastic washers (0.5 mm, i.d. 5.0 mm, o.d. 10.1 mm) which now are accessible. Leave the knob sockets (these are normally hidden under the covers) with the wide external threads where they are attached to the frame of the condenser holder's middle section.

Refer to Figure 11 for all removable parts (except the bearing balls) pertaining to the condenser centering mechanism.

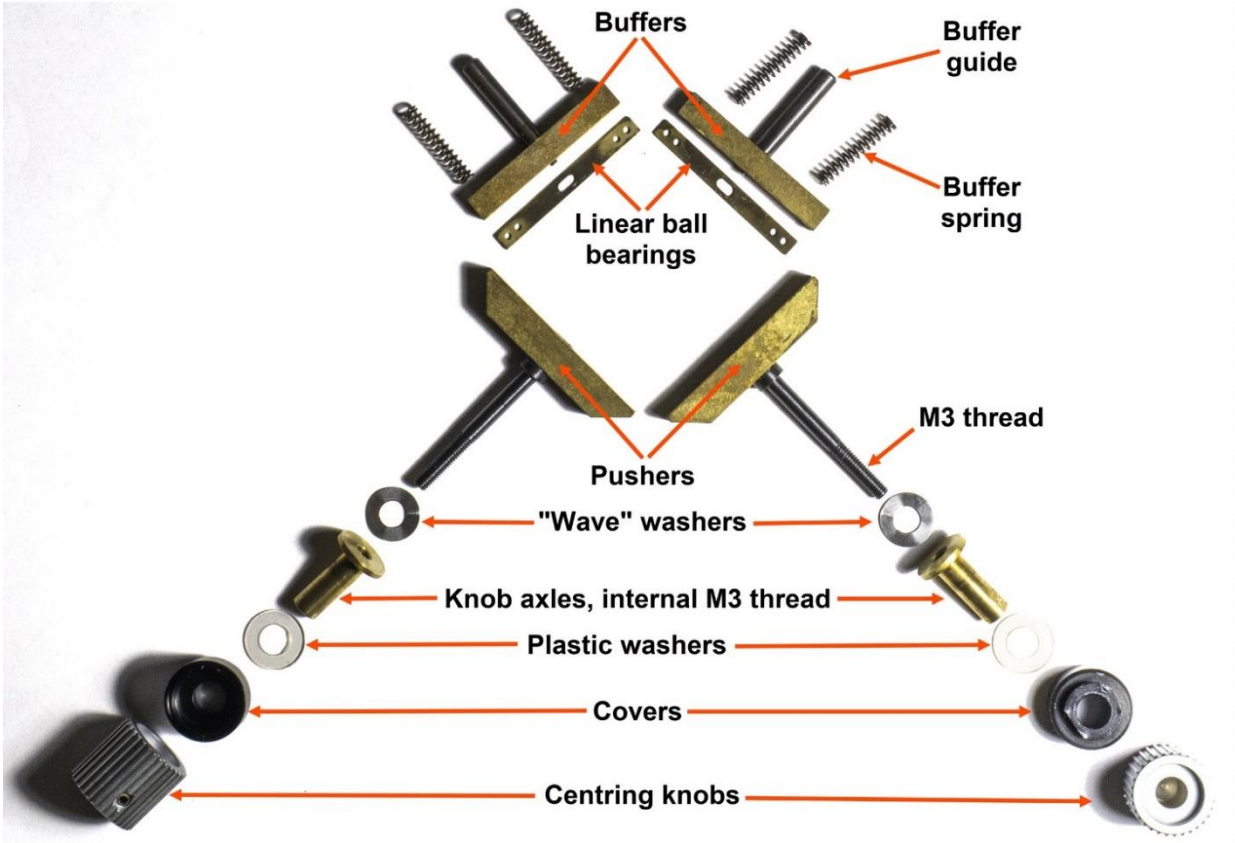

Figure 11: Parts diagram of the pushers and buffers of the condenser centering mechanism. Only the bearing balls are not included in the image.

Use solvent to clean all greased surfaces from old grease. Wipe the bearing balls dry with a microfibre cloth.

The brass surfaces (buffers, bearing retainers, pushers and knob axles) can optionally be cleaned by rubbing with pieces of cloth or cotton swabs wetted with Autosol Metal Polish, or similar. Wash with soap water and an old toothbrush to remove any remaining polish abrasives.

4. Grease and reassemble the condenser holder.

Reassembly of the condenser holder requires some special attention due to the ball bearings on the buffers. Once the greased ball bearing races have been joined (i.e., the buffer receiver placed against the buffer with the bearing retainer and bearing balls properly aligned between) they should not be allowed to separate again. This is because such a separation will likely cause at least one of the bearing balls to dislocate from its hole in the bearing retainer and, if not discovered and corrected, corrupt the function of the ball bearing.

Check if any of the two sheet metal plates on the buffer receivers have come entirely or partly loose from the buffer receivers (Figure 9) on the bottom shell of the condenser holder. If they are loose clean and degrease the surfaces thoroughly with solvent and reattach the receivers with epoxy glue.

Generously grease all four centering slide surfaces (two surfaces on each side of the middle section, one adjacent surface on the bottom shell, and another adjacent surface on the upper shell.)

Grease the bottom shell's buffer receiver surfaces and pusher receiver surfaces (Figure 9 and Figure 10, respectively.)

Place the upper shell on the condenser holder's middle section to join the slide surfaces. Hold the parts together with the fingers and put them on the support (the upside-down cup mentioned previously) with the upper shell facing down.

Grease the condenser clamp axle (Figure 7) and push it into its place in the middle section while holding down the clamp pin against the force of its spring so the pin will end up below the asymmetric tip of the clamp axle. Attach and tighten the screw (red circle in Figure 8) to hold the clamp in the correct axial position without inhibiting its rotation. Make sure that the screw tip reaches down into the groove at the end of the clamp axle but don't tighten the screw so much that it prevents the clamp axle from turning. Check that the clamp can't be pulled out and that the clamp pin moves up and down as the clamp knob is turned.

Grease all surfaces of the pushers including the black threaded guides (Figure 11) and push them into their holes in the condenser holder's middle section (Figure 8.) Grease and attach the wave washers to the threaded ends of the pusher guides that stick out on the outside of the middle section. Grease the threads of the pusher guides and screw on the knob axles (with their flanges facing inward) as far as they go which will keep the pushers maximally retracted. Grease and attach the plastic washers down to the flanges of the knob axles. Attach the black covers and tighten them moderately with an 8 mm open ended wrench. Attach the centering knobs to the axles and tighten the locking screws on the side making sure that the screws reach down on the flat side of the axle ends. Turn the centering knobs to check that they turn freely and that the pushers move properly. Turn the centering knobs clockwise as far as it goes to maximally retract the pushers. This will leave ample space for attaching the bottom shell.

Grease all surfaces of the buffers including the black guides and push them all the way into their holes in the condenser holder's middle section (Figure 5 and Figure 8.) Don't attach the springs yet.

Make sure that the buffer fronts are well greased and attach the bearing retainers to the fronts – the grease will prevent them from falling off. Use a toothpick to slightly move the retainers back and forth to fill the holes for the bearing balls with some of the grease. Use forceps (and perhaps a magnifier) to put the bearing balls into the retainer holes. Push the balls fully down into the holes, they will stick to grease in the holes. Figure 6 illustrates how the bearings should sit on the front of the buffers.

Make sure that the buffers remain pushed as far as possible into their guide holes in the condenser holder's middle section. Push the upper shell (which still should be facing downwards on the support) along the slide as far as it goes towards the pushers and the centering knobs – this will leave maximal space to safely attach the bottom shell without disturbing the bearings.

Now the plastic bottom shell should be attached onto the condenser holder. Hold the bottom shell slanted with the pusher receivers slightly lower than the buffer receivers. Push the pusher receivers against the pushers in the middle section and then carefully lower the other end of the bottom shell into the middle section taking care not to touch or disturb the ball bearings on the buffer fronts. Make sure that the pusher receivers remain sitting tightly on the pushers.

Attach and tighten the four black Philips screws which hold the upper shell and the bottom shell secured around the middle section (Figure 4.)

From the outside of the condenser holder (Figure 5) push with a toothpick the buffer guides down into their holes to move the buffers with their bearings inward until they join the buffer receivers. Don't allow the bearings to separate once they have come together! Put the four buffer springs into their holes from the outside of the condenser holder (Figure 5) and secure them by attaching the short grub screws – make sure again to use a screwdriver with a tip that is maximally 2.0 mm wide. Screw down the screws until the top of their heads is approximately at the same level as where the hole threads begin. With this the centering slide is locked in and the bearings safe from coming apart.

Turn the centering screws back and forth through their entire range to check that they move smoothly, and that the centering mechanism appears to work properly. Turn the condenser clamp to check that the clamp pin moves up and down.

The condenser holder's spring-loaded rail (Figure 3) is usually working fine even with old grease, but if necessary it can be removed, cleaned and re-greased. Remove the two screws on top of the rail to release it but be aware that the rail is under lateral tension from two small springs (and don't lose the springs.) Clean out the old grease with solvent, apply fresh grease, reattach the parts, and tighten the screws. The screws need to be attached while the rail is pressed laterally with the fingers against the springs. As this requires some force and as the rail has a rather sharp edge, it helps to wear a glove to save your fingers.

5. Disassemble, clean, grease and reassemble the condenser focus mechanism.

The condenser holder moves vertically on a greased dovetail slide on the front of the condenser focus block (Figure 12.) The back of the condenser holder has a white plastic rack which is moved by the focus block's steel pinion that is attached to a 4.5 mm steel axle with a focus knob (Figure 13 and Figure 15.) The axle sits in an excentric plain bearing (Figure 16) which allows for adjustment of the tension

between the pinion and the rack. After several years of use (or even worse, inactivity) the condenser focus mechanism may be somewhat stiff or sluggish due to aged, hardened grease on the dovetail mount and in the plain bearing that holds the axle. After cleaning and greasing the control should turn smoothly again.

Remove the two M4x12 screws (with hex drives) and then remove the focus block (Figure 12.) from the microscope stand. There may be one or a few thin metal shims between the focus block and the microscope stand to support condenser alignment. If there are any such shims, make sure to retrieve it/them and make a note of their location. Figure 12 shows a 0.07 mm shim (to the left of the upper screw) which in one case was found sitting with the upper screw. Sometimes the shims fall out before you have had any chance to determine their location; in such cases it may still be possible to infer where they were sitting thanks to the marks left on the metal surfaces (Figure 15.)

Figure 12: The condenser focus mechanism after removal from the microscope.

Next, we will work with the condenser focus control axle (Figure 13.) Remove the chrome plated M3 screw in the center of the condenser focus knob. The inside of the knob has M4 threads reaching a few mm down. Below these threads is the tip of the condenser focus axle. The axle tip has a short internal M3 thread (Figure 14) where the chrome plated M3 screw is attached.

Figure 13: The condenser focus axle with all parts separated.

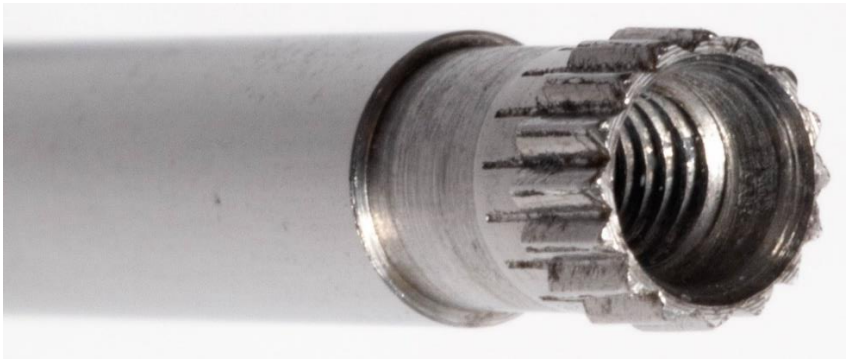

Figure 14: The condenser focus axle end which sits in the knob.

The M4 thread on the inside of the knob was apparently used for knob removal by Leitz technicians. Not knowing about the details of their procedure we will need to resort to a knob removal hack, the "hammer and rod' method. Generally, this hack should only be attempted on knobs attached on very robust mechanisms. Fortunately, the condenser focus control axle is quite robust. We will need a steel rod of carefully selected dimensions: It should be at least 30 mm long, but preferably not much longer. The diameter should be as wide as possible, but not wider than it can freely fit into an M3 nut. This means a maximal diameter of 2.4 mm. The rod must be able to pass through the knob, through the inside M3 threads in the axle tip (Figure 14), and reach the bottom of the axle hole without hurting the threads. I was fortunate enough to find a 0.093" (2.36 mm) steel rod in my toolbox, but the rod could also be made by cutting a piece off from a suitable drill bit or even from a round nail.

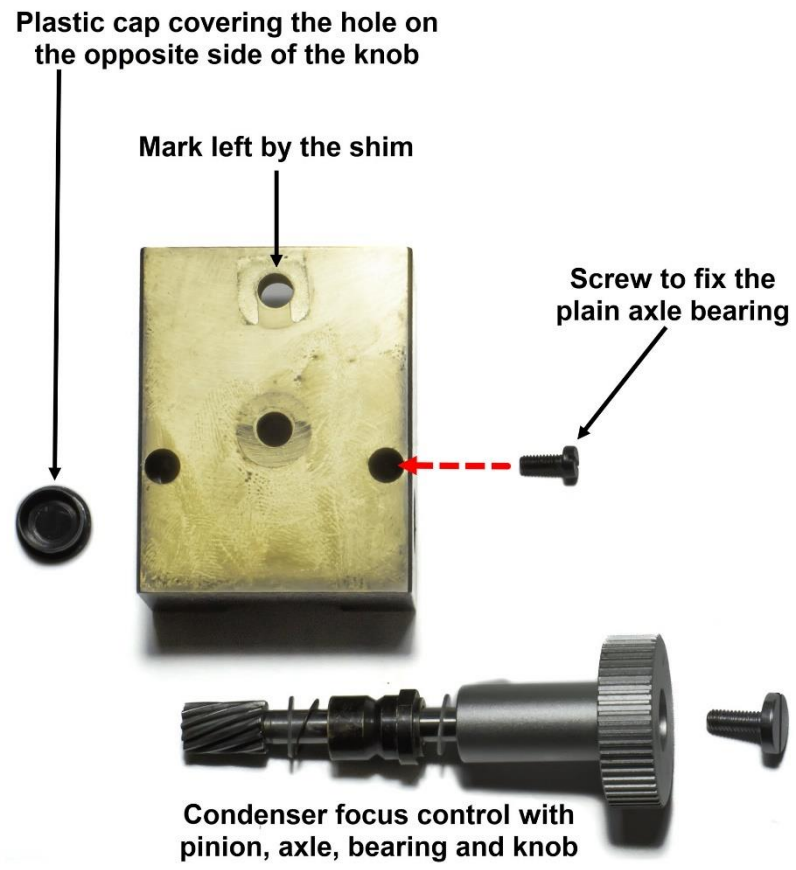

Figure 15: The condenser focus mechanism pulled out of the brass block.

Remove the condenser focus axle from the brass block by releasing the axle bearing's fixing screw (Figure 15) accessible from the condenser focus block's backside. Pull out the knob with the axle, bearing and pinion. The bearing may be somewhat stuck in the block, but usually releases after some pulling and wiggling.

Place the removed knob (with its axle still attached) on a suitable support with the knob facing upwards (e.g., in a vise with plastic jaw pads to protect the axle and knob). The knob should be solidly resting on the vise jaws and the axle while the pinion should freely hang downwards. Put a few drops of penetrating oil (e.g., WD-40) into the empty screw hole in the center of the knob and let it work for one or a few days. Heat the knob with an electric heat gun until it is just too warm to touch (approx. 50-60°C, or 120-140°F), but be careful not to overheat it - heat guns are quite powerful and there are a couple of possibly heat sensitive plastic washers below the knob. After the heating put the axle assembly back on the vise with the knob facing upwards. Put something soft under the vise to catch the axle when it releases from the knob (so it doesn't fall on the floor.) Put the steel rod you manufactured all the way into the knob's screw-opening and down into the axle end, and then tap the rod with a small hammer with a plastic head. Begin with gentle taps, tap many times, and then carefully tap harder and harder, as necessary. It may take several or many taps, but eventually the axle will release from the knob.

The parts are in order from the left to the right (Figure 13 and Figure 15):

- Axle with pinion
- Transparent plastic washer, 0.5 mm thick, i.d. 4.5 mm, o.d. 8.0 mm
- Black conical steel washer, 0.2 mm thick, i.d. 5.1 mm, o.d. 8.0 mm, with the convex side facing the brass bearing
- Plain brass bearing, with the collar facing the knob
- Transparent plastic washer, 0.5 mm thick, i.d. 4.5 mm, o.d. 8.0 mm
- Knob
- Chrome plated screw

(The plastic cap [Figure 15] that covers the hole in the condenser focus block on the opposite side of the knob doesn't need to be removed.)

Use solvent to clean the axle bearing and washers from old grease and let the parts dry.

Clean the slide of the condenser focus block ("condenser slide changer" in Figure 3.)

Grease the washers, the axle, and the inside of the bearing, but don't grease the pinion (the rack and pinion were apparently not greased by Leitz when the microscope was manufactured.) Reattach the washers and the bearing to the axle in the same way as they were before disassembly (Figure 15). Wipe off excess grease from the axle's knob end and attach the knob. Use a vise to carefully press the knob onto the axle. The knob should be pressed down on the axle just enough to prevent any axial play (a minimal play is acceptable), but not as far as to make the axle to move sluggishly in the bearing. If overdone, you can always again use the "hammer and rod" procedure to knock it back ever so slightly. When done, attach the chromium plated screw to the knob and tighten it lightly. Check that the axle still rotates freely in the bearing.

Push the axle with the bearing into the condenser focus block and attach (but don't yet tighten) the fix screw from the backside of the block.

6. Adjust the tightness of the condenser focus control's rack and pinion mechanism.

As indicated above, the tightness or the tension between the rack and the pinion can be adjusted thanks to the excentric hole in the condenser focus axle bearing (Figure 16). A 9 mm open ended wrench can be used to rotate the bearing in its hole in the condenser focus block thereby varying the distance between the rack and the pinion. The access to the two flat sides of the bearing circumference (Figure 16) is however narrow (between the condenser focus block and the condenser focus knob) why a special thin wrench (max. 2.5 mm) is required. If not possible to source, a suitable wrench can quite easily be manufactured by cutting, grinding, and filing a piece of 1.5-2.5 mm aluminum sheet metal or hard plastic. No precision is required, it only needs to have two parallel sides approx. 9.1 mm apart to fit around the bearing collar. The bearing rotates quite easily in its hole, so the wrench doesn't need to be particularly sturdy.

The tightness adjustment must be done before the condenser focus block is attached to the microscope. The reason is that after the bearing adjustment is completed, its fixing screw must be tightened, and that screw is only accessible from the backside of the condenser focus block (Figure 15.)

Use solvent to clean off old grease from the shiny sliding surfaces of the condenser dovetail mount and then apply a new layer of fresh grease on the same surfaces. Use the wrench to turn the bearing into a starting position where the pinion is retracted as deep down as possible into the condenser focus block. Remove the stop screw (with the red circle in Figure 3) from the condenser holder and slide the entire holder carefully down on the dovetail of the condenser focus block* (make sure that neither the condenser holder nor the focus block is upside-down.) When the rack reaches the pinion proceed carefully by turning the control knob so the pinion gently catches the cogs of the rack. Don't force it, the rack is made of plastics and can't take much abuse. Once the holder is vertically level with the focus block attach the stop screw again and tighten it so its tip sticks into the groove in the focus block. Turn the condenser focus knob back and forth through the entire range as allowed by the stop screw. In the starting position the rack and the pinion will be somewhat separated which is apparent by some play when the knob is rotated back and forth. Use the thin 9 mm wrench to slightly rotate the bearing until the knob play just disappears. The knob should still turn easily, but there should not be any play left through the entire condenser focus range. When the adjustment feels satisfactory, fix the bearing by tightening the fixing screw from the backside of the condenser focus block.

Figure 16: The condenser focus axle bearing. The image shows the excentricity of the axle hole and the parallel sides of the collar made to fit a thin wrench.

Loosen the stop screw (with the red circle in Figure 3) and detach the condenser holder from the condenser focus block. Attach the condenser focus block to the microscope stand with the two M4x12 screws (Figure 12), and if applicable, don't forget to put back the shim(s). Attach again the condenser holder to the focus block and tighten the stop screw.

Finally check that the condenser focusing works as desired.

* It can happen that the condenser holder is difficult to slide or even attach to the dovetail mount on the condenser focus block. It may help to carefully sandpaper the front surfaces of the block's dovetail mount to remove surface tarnish. Start by using solvent to remove any grease from the condenser focus block's dovetail mount. Put an extra fine sandpaper (for example, grit size 400) with the grit side up on a flat and even surface. Polish the front of the block's dovetail mount by rubbing it against the sandpaper on the table. After 10-15 strokes check how the condenser holder fits in the dovetail mount. Repeat the sandpapering as necessary, grease the slide when it appears that you may be close to a good fit. Don't overdo the sandpapering and check the fit often – surprisingly little grinding is required to get the slide to move smoothly.