INCOMPLETE INSTRUCTIONS
for
DISASSEMBLY and SOME REPAIR
of
KIRON 70-210mm Zoom Lock Focus Stop f/4 macro 1:4 (62) zoom lens
by Mel Smith mes@bartnet.net

DISCLAIMER AND SOME ADVICE:

My writing is done without malice, but follow these instructions at your own risk. I do not guarantee that there are no errors of omission, commission, opinion, typos, or your interpretation. Changes during manufacture may make your lens different in some ways.

It is assumed that all small pieces and screws are put in a safe place with instructions for their replacement as found. Replacement parts may not be available.

Use proper tools to avoid damage to parts. See Appendix 3.

Do not rotate something newly released by removal of something else without knowing what you are doing.

It is best to read the instructions a couple of times before applying tools to the lens.

Do not take something apart just because you think it can be done--have a reason.

If you repair only the needed you cannot guarantee the rest, but it is easiest

INTRODUCTION:

The subject lens was serial number 36726478 with Pentax K mount (no "A").

The seller wrote: ***It doesn't focus correctly. The front section is supposed to extend when focusing, but it sticks and doesn't move.*** He was correct.

I did not have a service manual or any diagrams showing the construction of this lens. As I worked on the lens I took pictures and kept a diary from which I wrote these instructions. A second disassembly was needed to make some of the photos.

My method was "Make marks, make notes, count turns, make measurements, take photos--and before & after each step think about how it can be put back together and maybe practice that before going on."

Service manuals provide names of parts according to their design and function. Without service manual guidance my first names reflected location and sequence of disassembly. Now that I have uncovered the design and function of the parts I have assigned new names.

Stiff focusing was the only problem. Oily diaphragm and fungus were not present, but access for remedy of these problems is mentioned. The zoom lock and focus limiting features of this lens are uncommon and their construction and operation are described. The focus limiting feature is in the Appendix 1.

Some advantages of the unique focusing system are discussed in Appendix 2.

OVERVIEW:

In this one-touch zoom the glass consists of a front focusing group, two interior zooming groups that move to change the focal length and maintain focus regardless of focal length, and a rear prime group that directs the light to the film.

The focusing mechanism does not rotate the Filter Thread Ring. This is nice for polarizing filters and others that require orientation.

The front lens group moves forward with closer focusing, but the movement is unusual. From infinity to about 5 feet the movement is steady but remarkably slow, then from 5 feet to 1 foot (macro) the advance of the front lens group accelerates rapidly because the focusing is done with cams instead of a helix. See Appendix 2.

NAMES OF THINGS:

Names of specific parts of this particular lens are capitalized as proper nouns.

ring

Any hollow cylinder or sleeve regardless of wall thickness or length relative to diameter. (Read that again. It is not the normal definition of "ring")

Index Ring

The ring with the focal lengths and the distance reference line on it.

Aperture Set Ring

This is the ring the photographer uses to set the aperture.

slot

All the way through. No top or bottom. Some are cams, some are guides. See channel.

channel

Not all the way through. A ditch or trench.

shaft

An axle. Something rolls on it.

screw-shaft

A shaft with screw head and threaded on far end. Service manuals may call it a shaft.

white ring

A plastic ring, a roller or slider. It rides <u>on</u> a screw-shaft and <u>in</u> a slot or channel.

element

A single piece of glass before assembly.

group

Two or more elements cemented face to face.

lens group

Elements and/or groups held together in a sealed unit. The position of elements/groups within the lens group may be critical and disassembly of lens groups is best avoided because proper reassembly may require special equipment.

Focus Group *PHOTO 3.*

The lens group at the front of the lens.

helix

A multiple threaded spiral used for focusing. This lens uses plastic channel followers in six channels instead of the more common helix.

Focus Ring *PHOTO 3.*

This ring holds the front focusing lens group and the filter thread ring.

Grip Ring *PHOTO 4.*

The outer ring with the rubber grip for zooming and focusing.

4.5mm Ring *PHOTO 4.*

A removable shoulder on the Focus Channels Ring. Screw shafts connect it to straight slots in the Grip Ring. Turning the Grip Ring turns the 4.5mm Ring and the Focus Channels Ring for focusing regardless of fore or aft position of the Grip Ring.

Lens Barrel *PHOTO 1.*
The most interior ring. This is the heart of the lens. All other parts control zoom, focus, and interface with the camera. The Focusing Lens Group is at the front of the Lens Barrel. Inside the barrel are lens groups that move on cams to achieve changed focal length and maintain focus. The back end of the Lens Barrel is attached the Camera Mount Module which includes the Prime Lens Group.

Camera Mount Module *PHOTO 2, right item in PHOTO 1.*
On this lens it consists of the diaphragm at the front and the camera mount at the back with a mechanical linkage between them. Also, the prime lens is inside this module.

Distance Scale Ring
The ring with the distance scale on it. See Appendix 1.

Rear Focus Limit Ring
The ring in front of the Distance Scale Ring. See Appendix 1.

Front Focus Limit Ring
The ring in front of the Rear Focus Limit Ring. See Appendix 1.

JIS screw.
A screw with Japanese Industrial Standard cross point head. Usually the screw goes through a bare hole and into a threaded hole and holds these together.

set screw
A screw with a point on the end. They go into a threaded hole and the point digs into something to hold an adjustment in place. Set screws often are very small and short. Often they have a slot head. Sometimes they are called grub screws.

Zoom Lock Ring *PHOTO 5.*
A ring inside the Grip Ring. It has notches for the Zoom Lock Slider.

Zoom Lock Slider
A device on the Grip Ring that locks the zoom focal length in a selected position. It need not be removed.

Outer Zoom Ring and
Inner Zoom Ring *PHOTO 6.*
These rings could be a single unit except that assembly of the lens would be impossible. Fore and aft movement of the Outer Zoom Ring moves the Inner Zoom Ring and that moves, via cam slots, two lens groups inside the Lens Barrel.

Focus Bearing Threads *PHOTO 9.*
These fine threads serve as a bearing for the focusing rotation.

Fat Plastic Set Screw *PHOTO 8.*
Six of these in the Focus Ring fit into six channels in the Focus Channels Ring. Together these serve in place of a helix for focusing action.

Focus Channels Ring *PHOTO 9.*
A ring with six "V" shaped channels that guide the movement of the Focus Ring by the Fat Plastic Set Screws in the Focus Ring.

REMOVAL OF THE RUBBER GRIP:

Unless mount or aperture operation is the only problem, removal of the rubber grip is necessary. Work a bamboo skewer carefully under the rubber grip. It is glued down in places, especially around the Zoom Lock Slider. When off it may be greasy inside and the now-exposed Grip Ring may be greasy outside. It can be cleaned with

camp stove fuel. If there are two smooth channel cover strips inside, do not remove them.

CHOICES:

Next, one can start at either end.

If a sluggish diaphragm or the camera/lens interface is the only problem, start at the rear and remove the Camera Mount Module.

If fungus is the problem, most likely it is most abundant at the front so start at the front by removing the Focus Group and hope that the rest of the lens is clean.

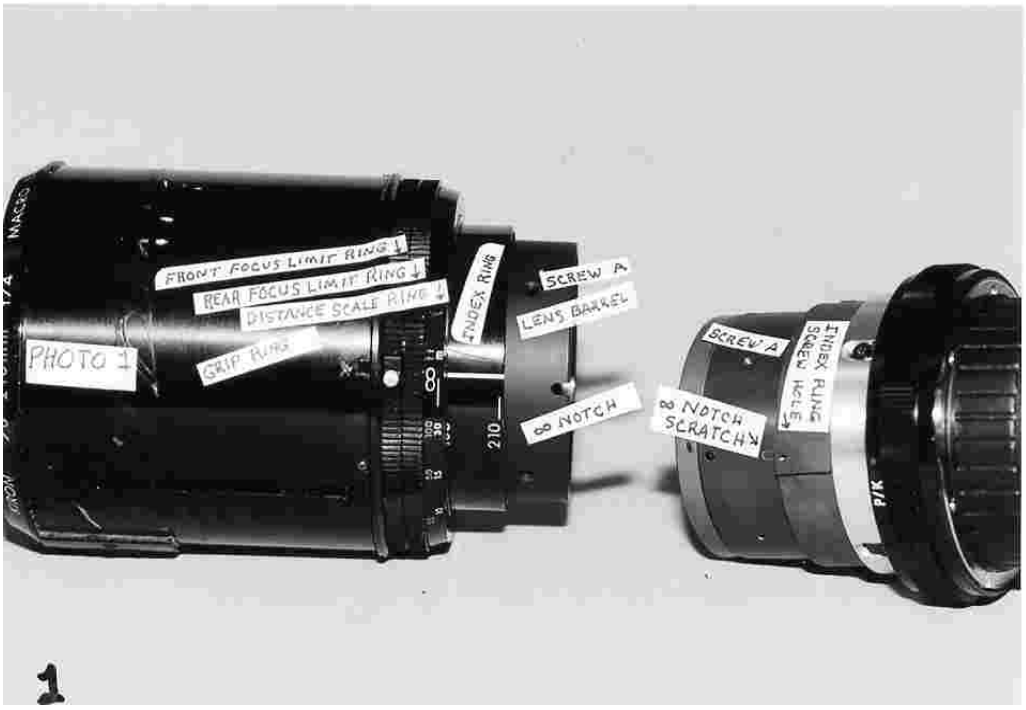
If stiff focus or zoom is the problem both of the above are needed but by removing the Camera Mount Module first you have a smaller, lighter item to work on.

REMOVAL OF THE CAMERA MOUNT MODULE:

Around the Index Ring about half-way between the 100mm and 135mm marks are three small JIS (Japanese Industrial Standard) screws. Remove these. Always use a genuine JIS cross point screwdriver with JIS screws. Phillips cross point screwdrivers are likely to damage the screw heads. See Appendix 3. If thread locker is present, MEK (Methyl Ethyl Ketone) or acetone may soften it, but if the solvent does not penetrate use a red hot soldering gun pressed on the screw head for about 30 seconds to soften the thread locker.

With these three screws removed the Index Ring may be pushed forward over the Lens Barrel. Leave it there. The Index Ring may be rotated, but no need to make marks because when installed it must line up with the infinity mark when the lens focus is turned to infinity.

In *PHOTO 1* the Index Ring has been pushed forward to expose the location of four flush JIS screws that held the Lens Barrel to the end of the Camera Mount Module that fits inside the Lens Barrel. The left label "screw 'A'" is the bare hole and the right label "screw 'A'" is the threaded hole.



There is one "U" shaped notch on the back of the Lens Barrel. Before removing the screws scratch the base of this notch on the Camera Mount Module. When these screws are removed the Camera Mount Module may be removed from the rest of the lens as shown in *PHOTO 1*.

SLUGGISH DIAPHRAGM CLEANING:

The diaphragm is on the front of the Camera Mount Module and the blades are very close to a glass surface. *PHOTO 2.* Despite being close to the glass, such diaphragms have been cleaned by repeated flushing with fresh Coleman brand camp stove fuel. Sluggishness usually is related to oil visible on the leaves, but sometimes the oil cannot be seen. Do not force action of the diaphragm when it is wet with solvent.

Some prefer to remove the diaphragm assembly for cleaning. I have not tried that with this lens so you are on your own if you elect that approach. As stated, these instructions are incomplete.

The subject lens for these pictures is a Pentax K mount. This means that the aperture responds directly to the Aperture Set Ring when off camera, and when on camera the camera holds the lens open until the exposure is made when it is allowed to stop down.

LENS TO CAMERA INTERFACE PROBLEMS:

Complete instructions are beyond the scope of this writing, but for the intrepid reader the following is offered. Proceed at your own risk.

When the rear lens cap is off, usually there are two mechanical devices that interact with the camera for auto diaphragm operation. For the benefit of the light meter, one tells the degree to which the lens will be stopped down for the picture. Normally this device is a lever that responds directly to the aperture setting. On the Pentax K mount this device is down in a slot.

The other lever often is spring loaded and can be moved with your finger. On the Pentax K mount the camera uses this lever to hold the lens open for metering, and releases it to go to the set aperture when exposure is made. The opposite arrangement is used by some cameras. The lens is normally open and the camera body pushes it closed.

First, check that these devices do not appear damaged and that they do align with the mating devices on the camera body.

If the problem is not found here, it may be in the links between these devices and the diaphragm. The first step in this investigation is the removal of the four screws in adjustment slots. This will allow separation of the mount from the diaphragm assembly. Usually the Prime Lens stays with the diaphragm assembly but I have not disassembled this Camera Mount Module.

The reason for the adjustment slots is that shims or some rotary adjustment is used to allow for minor focal length differences in manufacture. On zooms this adjustment usually affects the focus at the short end.

Unless there is an orientation screw like there is on this Pentax K mount, make marks so that the two parts can be reunited as found and leave the adjustment as found.

Reuniting the mount and the diaphragm assembly can be tricky and if done improperly may damage something. A zoom lens that does not change aperture with focal length probably has a cam connection between focal length and aperture..

FOCUS GROUP REMOVAL--going to the front end: *PHOTO 3.*

The Focus Ring is the first ring under the Grip Ring, not counting the Zoom Lock Ring which is best considered an integral part of the Grip Ring. The Focus Ring protrudes from under the Grip Ring at the front of the lens as the lens if focused closer. 8mm from the front of the Focus Ring are three set screws. If the focus is stuck and cannot be moved to expose these screws the Grip Ring must be removed first. Go to GRIP RING REMOVAL, the next heading below, do that, then come back here.

When they can be reached, completely remove the three set screws. Normally, I avoid completely removing set screws because they are tricky to reinstall, but the points of these press into fine threads and if left in place will damage the threads.

The set screws press against threads on the outside of the Filter Thread Ring. With the set screws out, the Filter Thread Ring can be unscrewed. Like all thin rings, squeezing it may cause it to bind. Thread locker may be present.

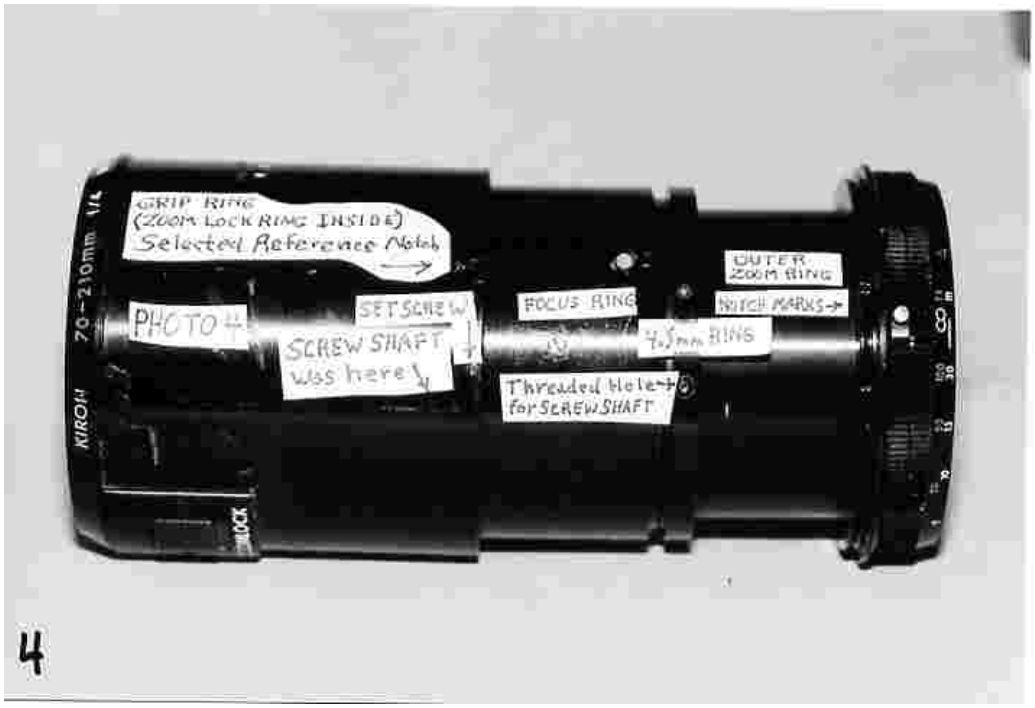
Inside the Filter Thread Ring, and still inside the Focus Ring, is the Focus Group. In *PHOTO 3* it is face down and cannot be seen, but the metal front edge of this group is sloped. Often lens identification is on this ring and it is called the ID ring. There is no writing on this one.

Sometimes ID rings have notches for a spanner wrench. This ring does not. Therefore we need a "friction spanner". I made one out of a plastic pill bottle with a diameter that was a snug fit inside the Focus Ring. With a hot soldering gun I melted most of the bottom out of the pill bottle leaving only a rim. Then I covered the rim with sticky-sided "funky foam" from Hobby Lobby. To protect the glass I put scotch matte finish tape on the glass with one end folded under on itself for easy removal.

IMPORTANT: Before turning anything, use vernier calipers to measure the distance from the front of the Focus Ring to the top of the sloping shoulder of the metal rim on the Focus Group. Measure to 1/10 mm. Next, make a scratch showing the orientation of the sloping edge of the Focus group and the inside of the Focus Ring. When the Focus Group is reinstalled these marks will line up with each turn of the Focus Group, and when they line up at the measured distance it is back as you found it.

I cut a thin strip of funky foam and pressed its sticky side on the ID ring. Then I applied the friction spanner and unscrewed the Focus Group.

If it was necessary to remove the Grip Ring in order to remove the Focus Group, the next step, GRIP RING REMOVAL, has been done so skip to OUTER ZOOM RING REMOVAL. Otherwise, continue.



GRIP RING REMOVAL: (The Zoom Lock Ring stays inside the grip ring.)

It is assumed that the focus is either stuck at an intermediate distance or that it has been set at infinity.

Refer to *PHOTO 4:* Here, with focus stuck but near infinity, the rings have been separated part way after doing the following:

At the back of the Grip Ring are two square notches. Scribe an "X" beside one of them and make two marks on the adjacent shoulder which forms the depression for the rubber grip.

Push the Grip Ring all the way forward, then remove the screw shafts & white rings on either side of the Grip Ring. Do not rotate anything.

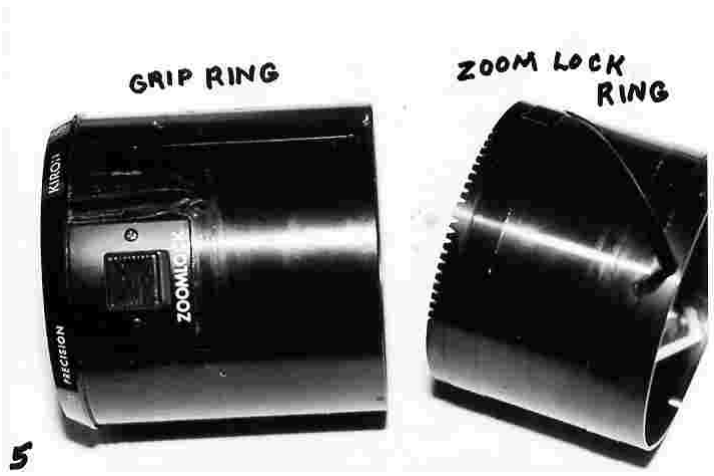
Find three set screws at the rear edge of the Grip Ring. Loosen them, but they need not be removed. When they are loose enough the Grip Ring can be pulled off forward. Do not turn the Grip Ring at this time.

The screw shafts were screwed into a ring that is 4.5mm wide. Immediately mark the position of one of the removed screw shafts and the hole in the 4.5mm Ring from which it was removed. Now if you turn things you know where it goes back.

Unless it is stuck, turning this 4.5mm Ring does the focusing. With the screw shafts and white rings in linear slots and the set screws secure, the Grip Ring turns this 4.5mm Ring from any zoom position when it is assembled.

The Outer Zoom Ring can now be pulled back and the back end of the Focus Ring can be seen under where the Grip Ring had been.

When the Grip Ring is removed the Zoom Lock Ring should remain inside and do not turn it until its orientation can be marked. The back of the Zoom Lock Ring has two notches corresponding to the two notches at the back of the Grip Ring. When the Grip Ring is first removed these two pairs of notches should be aligned or nearly



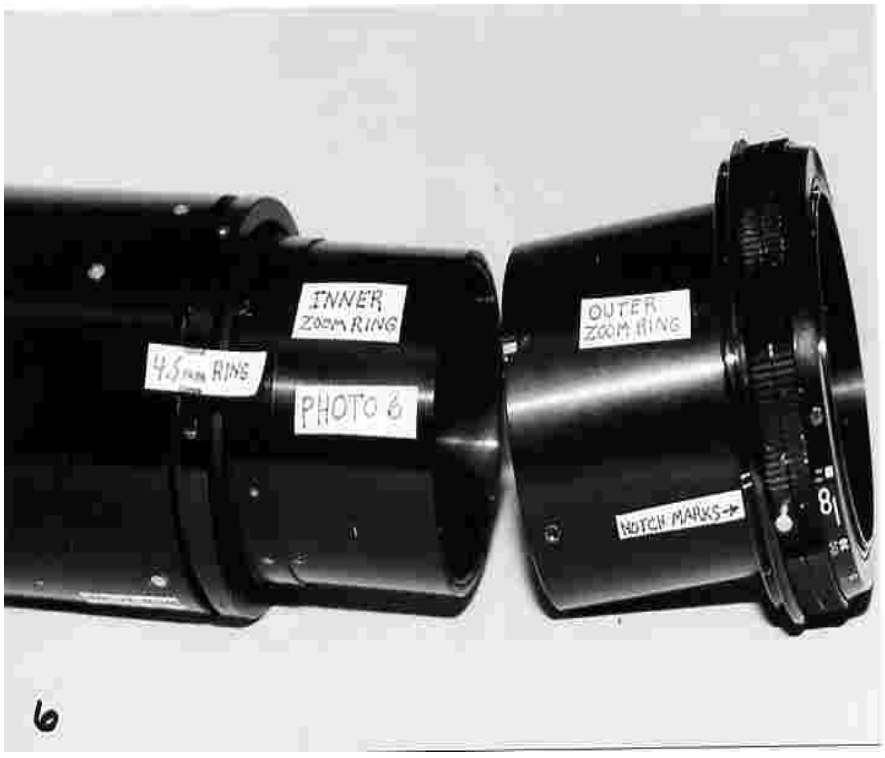
so. Mark the notch on the Zoom Lock Ring that is closest to the marked notch on the Grip Ring. Either at this time or later during reassembly the Zoom Lock Ring may be removed from the Grip Ring (the set screws will interfere if not loosened enough) for cleaning and lubrication. *PHOTO 5* shows the Zoom Lock Ring removed from inside the Grip Ring.

PHOTO 5 shows the Zoom Lock Ring on the right and the Grip Ring on the left. The notches on the front of the Zoom Lock Ring are in only one sector. When the Zoom Lock Slider is moved back it engages one of these notches to lock the zoom in that position. Zoom lock is not infinitely variable. It is limited by the frequency of notches.

If you skipped ahead to this section in order to do the FOCUS GROUP REMOVAL, return to FOCUS GROUP REMOVAL at this time. Otherwise, proceed.

OUTER ZOOM RING REMOVAL:

PHOTO 6: With the screw shafts removed, loosening the set screws at the rear of the Grip Ring allowed the Grip Ring to be pulled off forward and it also released the Outer Zoom Ring to be pulled backward, but not off like it is in PHOTO 6 unless the Camera Mount Module has been removed. The Distance Scale Ring and both Focus Limit Rings are still attached to the Outer Zoom Ring and may remain so. The Focus Limit Rings are discussed in APPENDIX 1.



There is only one square notch on the front of the Outer Zoom Ring. It fits over the only notch in the Inner Zoom Ring which was out of sight under the outer ring in *PHOTO 4*. These notches provide alignment for reassembly.

At the front of the Outer Zoom Ring are three JIS screws. In *PHOTO 6* they have been removed but the hole for one in the outer zoom ring can be seen. It was a snug fit, but the Outer Zoom Ring has been pulled back from

being over the Inner Zoom Ring.

The Inner Zoom Ring slides fore and aft over the Lens Barrel and in doing so moves two lens groups inside the Lens Barrel on cam slots. In *PHOTO 6* the Inner Zoom Ring is back even with the end of the Lens Barrel and the Lens Barrel cannot be seen.

CHOICES AGAIN: Focus or fungus?

If the focus is stuck, continue here. If the focus is smooth and satisfactory but there is fungus, go to PROCEDURE FOR FUNGUS CLEANING.

PROCEDURE ASSUMING A STUCK OR STIFF FOCUS:

PHOTO 7: Look inside the Focus Ring. On the walls are two sets of fine threads, one for the filter thread ring and one for the Focus Group, the former with holes for the removed set screws.

On opposite sides of the walls are channels that cut across these threads. In each channel is a guide that is attached with two JIS screws to a thick ring which is the front end of the Lens Barrel. The guides in these channels direct rotary force into linear motion so that the Focus Ring moves fore and aft without turning. One guide in a slot is shown in *PHOTO 7*.

Examine the guides carefully. Are they the same? I found one bent out away from the slot and not running in the slot because it was too wide. I filed it to correct width and bent it to fit. It was made of brass.

If you suspect a guide problem, one can be removed safely only if the other remains seated well in the slot.

If both are removed things can be turned and the "as found" infinity focus setting can be lost. Read on for information, do not do any of this at this time.

THE FOCUS BEARING THREADS:

A rotary force needs a bearing. This is provided by the Focus Bearing Threads. The female threads are on the inside of a thin ring that is between the Focus Ring and the thick ring to which the guides are attached. The male Focus Bearing Threads are on the thick ring. From the front, only the end of the thin ring can be seen. In *PHOTO 7* it is even with the thick ring and is not evident. However, note that the guides go straight up from the thick ring for about 2mm before bending over to fit in the slot. This allows the thin ring to be up to 2mm forward of the position found in this lens. This would have the effect of moving the Front Focus Group that far and would alter the infinity focus, so it is likely that the degree to which the Focus Bearing Threads are turned is a critical factor in the lens assembly.

It is unlikely, but possible, that the Focus Bearing Threads contribute to stiff focusing and need cleaning and lubrication. Full access to these threads requires more disassembly than I found necessary. However, access to the male threads alone on the Focus Channels Ring occurs when the focus cam system is serviced as described next.

The focus cams servicing probably will require removal of both guides and, if so, inevitably things will be turned. Therefore now is the time to study that turning so the Focus Bearing Threads can be put back as found.

Set the focus to infinity, or note where it is if it is stuck. Mark the end of the thick ring on both sides of one of the guides which is mounted on that ring. Also mark the top of the slot in which the guide rides. Remove both guides and turn the focus ring counterclockwise as viewed from the front and count the turns until it no longer turns easily. Base this count on the marks just made. Mine made 3-1/2 turns before the turning became very stiff. Make a note of the turns for your lens. You will need it later.

If you turn clockwise expect about 11 turns before the threads become disengaged. Pull on the Focus Ring while turning counterclockwise and if you are lucky the threads will engage. It is best to avoid this. The number of turns to disengagement is not needed.

Reinstall the focus guides.

SERVICING THE FOCUS CAMS SYSTEM:

On the outside toward the back of the Focus Ring are the tops of six plastic things about 3mm in diameter. These are exposed even on a fully assembled lens zoomed to 210 and focused to macro. Careful examination may show that there is a slot in the top of most of them, but the slot may be quite shallow. These are best described as Fat Plastic Set Screws.

PHOTO 8 shows them removed--do not remove them yet. The pointed ends of these are in six channels in the underlying Focus Channels Ring, *PHOTO 9*. These channels are "V" shaped in cross section to match the points of the Fat Plastic Set Screws.

All channels have the same cam. Six are used to provide bearing surface and avoid wobble.

Before removing the Fat Plastic Set Screws, note that there is a curved notch at the front of the Focus Ring. Scratch the outline of this notch in Focus Channels Ring that is under it. Do this either with the focus at infinity or at the point where it is stuck, either will do. If all of the Fat Plastic Set Screws are removed, align this notch and mark before replacing the first one.

Now back off each one but do not remove the Fat Plastic Set Screws. Avoid damage to the plastic if possible. Scratch the slots deeper or even drill a hole in the top and press a sharp flat screwdriver a little wider than the hole down into the hole. If any are ruined, it is possible to make replacements. See MAKING REPLACEMENT FAT PLASTIC SET SCREWS.

With the Fat Plastic Set Screws backed off a little, and if the guides move smoothly in their slots, the focus should no longer be stuck. Hold the Outer Focus Ring in one hand and turn the 4.5mm Ring with the other just like the Grip Ring would

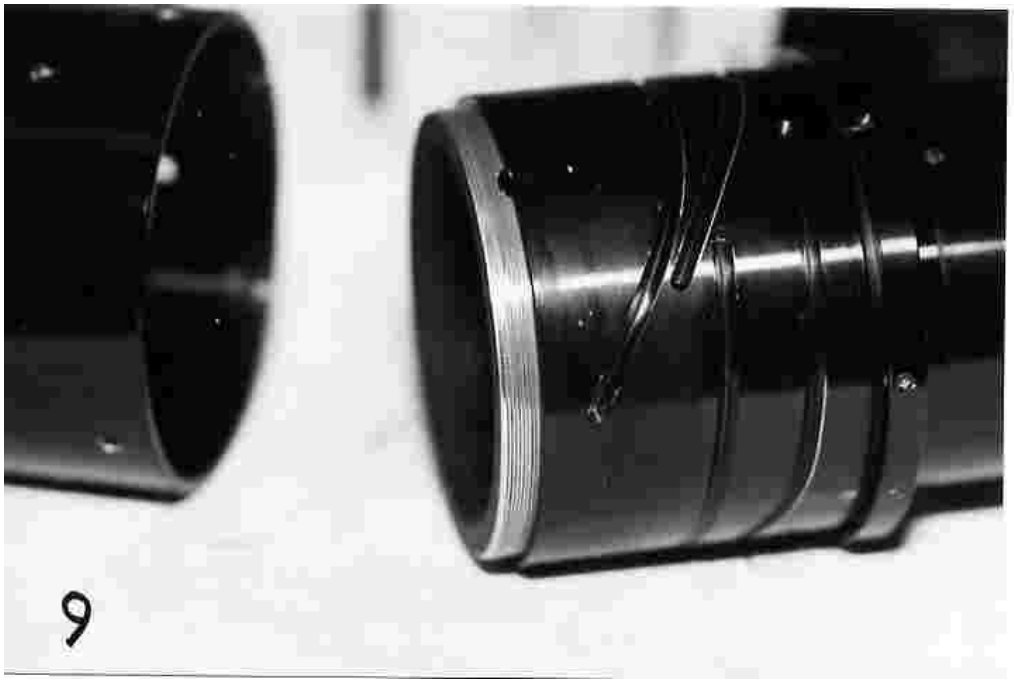
do if its screw shafts were connecting it to the 4.5mm Ring. This should move the Focus Ring forward and expose some of the channels for the Fat Plastic Set Screws.

It may be that over time the lubricant used has caused the Fat Plastic Set Screws to swell and bind. If the focus action is satisfactory with the Fat Plastic Set Screws backed off a little, and if this has not caused any fore and aft play in the Focus Ring, then try fitting the Grip Ring (with Zoom Lock Ring) over the Focus Ring. If necessary, shave the heads of the Fat Plastic Set Screws for clearance.

For the subject lens, backing off the Fat Plastic Set Screws was not satisfactory. The focus action was gritty. Therefore the Fat Plastic Set Screws were removed completely.

If your lens needs the next step it is likely to alter the position of the Focus Bearing Threads because it requires removal of the focus guides. If you have followed the above instructions and have recorded the number of counterclockwise turns you are ready for this.

Remove both guides, then the Focus Ring can be removed from the Focus Channels Ring. *PHOTO 9* shows the Focus Ring on the left separated from over the Focus Channels Ring on the right. This photo also shows some exposed male Focus Bearing Threads. These were cleaned and re-lubed as part of the Focus Cams system servicing,



Some burrs were found on the inner sides of the holes for the Fat Plastic Set Screws and elsewhere some polish of the black anodizing suggested binding. The Inner Zoom Ring was pulled back and taped to the Lens Barrel to keep the glass back. Then the old grease and some aluminum shreds were flushed from the Focus Channels Ring and the Focus Ring with Coleman camp stove fuel. Next, fresh lube was put on the Focus Channels Ring and coated with Bon Ami powder. The Focus Ring was put over the Focus Channels Ring and the two rotated and worked back and forth by hand so that the Bon Ami could polish away the burrs and increase the clearance on the wear places. The Focus Ring was squeezed as this was done.

This did not take long. Next, Coleman camp stove fuel was used to wash away all of the oil and Bon Ami. This resulted in some turning of the Focus Bearing Threads. Therefore the Focus Ring was turned counterclockwise until the resistance was felt and

then turned the 3-1/2 turns clockwise to put the Focus Bearing Threads in their original position. As you have determined, your turns may be different.

The Focus Channels Ring was lubricated with Radio Shack Precision Lubricator #64-2301A and the Fat Plastic Set Screws were reinstalled after the curved notch on the Focus Ring was aligned with the mark made on the Focus Channels Ring. The first Fat Plastic Set Screw was installed little by little until fore and aft play of the Focus Ring ceased and then it was backed off about 1/8 turn. Each of the others were installed until slight resistance to turning the Focus Ring occurred, then they were backed off about 1/8 turn.

MAKING REPLACEMENT FAT PLASTIC SET SCREWS:

One of the Fat Plastic Set Screws was badly damaged so a replacement was made. A plastic rod was found at a hardware store in the form of "Weed Tiger" replacements for a heavy duty "string" weed trimmer. A three inch long piece was used. It was a little large in diameter so the end was shaved to fit close to the roots of the threads in the hole in the Focus Ring and the point was tapered fit the "V" channels. After the other end of the piece of rod was flattened for a grip it was screwed into the hole until there was focus resistance, then backed off a trifle. The excess was shaved off so the Grip Ring could be installed.

A PROCEDURE FOR FUNGUS CLEANING:

I have tested TINACTIN TOLNAFTATE ANTIFUNGAL CREAM, claimed to cure Athlete's foot and ringworm, on several glass surfaces of one zoom lens and found it satisfactory for a light infection of fungus. This is my first choice the next time I have a fungus cleaning job.

Tinactin solubility test results:

WATER: Sort of disperses, leaves a cloudy liquid.

WINDEX: Better dispersion than in water, liquid not very cloudy.

ETHANOL: Dissolves slowly and becomes a clear liquid. I used USP pure ethanol. Vodka might be a good substitute.

A four step cleaning procedure was used.

1. Tinactin was painted on the glass with a soft-bristle artists brush and allowed to stand for at least 30 minutes. The time needed was just a guess.
2. Ethanol was generously painted on the Tinactin with a soft bristle artists brush. The glass was held on a slope and the liquid promptly picked up with a fresh Q-tip cotton swab held at the lower side of the glass. This flushing was repeated with fresh solvent many times until the glass had no visible residue.
3. Windex was used in a similar manner.
4. Water vapor from breath and wiping with a Crizal micro fiber cloth was the last step.

The Crizal micro fiber cloth came with my eye glasses and cannot be purchased separately but similar micro fiber lens cleaning cloths are available. It can be washed in mild soap, rinsed thoroughly, and reused. It is important to have fingers touch the same side of the cloth with each use, and have only the other side touch the lens. Otherwise oil from fingers will transfer to cloth and then to lens.

The procedure used to repair a stuck focus makes available both front and back surfaces of the Focus Group and of the Prime Lens in the Camera Mount Module. Let us hope any fungus inside these groups is only at the edge and not in the light path when stopped down.

One surface of each of the glass groups inside the Lens Barrel also is available for cleaning. If there is need to clean the other side more disassembly is required.

I have not done it, but this is what I would try:

Push the Inner Zoom Ring all the way forward to reveal 1/2 of a screw shaft with white ring on each side. This is the screw shaft that controls the rear group of the two groups in the Lens Barrel.

Scratch the orientation of the square notch in the 4.5mm Ring with the focus at infinity.

Remove the 3 JIS screws that hold the 4.5mm Ring to the Focus Channels Ring. Then remove the 4.5mm Ring to expose all of the screw shaft.

Make a mark on the rim of the rear lens group inside the Lens Barrel. Make this mark opposite the only notch in the Lens Barrel.

Remove the screw shafts that hold the rear group and remove this group.

Now the back side of the front lens group that remains in the Lens Barrel can be reached from the back and the other group is in hand for cleaning both sides.

ASSEMBLY:

The Prime Directive is "Be Clean!". Each glass surface should be cleaned last thing before it is enclosed.

Hopefully, the disassembly has given you an understanding of the design of the lens so that detailed assembly instructions are not necessary.

If the rear zooming lens group in the Lens Barrel was removed as described immediately above, replacing this group must be done first. There may be two ways to replace the rear lens group. Put the mark opposite the notch to replace it as found. Replace the 4.5mm Ring according to the mark.

The Outer Zoom Ring is next, *PHOTO 6*. Align the outer and Inner Zoom Ring notches and install the three JIS screws. With a finger I wiped a thin film of Radio Shack lube on the Inner Zoom Ring to help the Outer Zoom Ring fit in place and align the screw holes.

Adjust the Zoom Lock Ring inside the Grip Ring for installation of the screw shaft and white ring. The screw shaft goes in near the bottom of the long leg of the Zoom Lock Ring slot. Align the marked screw shaft location on the Grip Ring with the marked hole on the 4.5mm Ring.

Install the screw shafts with great care to avoid cross-threading or damaging the white ring. The top of the white ring has flattened sides and must snugly into the slot in the Grip Ring. The bottom is round for fitting the slot in the Zoom Stop Ring.

Next, line up the marks and tighten the set screws at the rear end of the Grip Ring. This secures the Grip Ring to the back of the Outer Zoom Ring just in front of the Focus Limiting Rings. Tighten the set screws evenly or else the zoom action will be stiff.

Slip the front ring of the Lens Mount Module inside the Lens Barrel, align the curved notch mark, and install the four flush JIS screws.

At this point the zoom and focus control should be smooth. The Front Focus Limit Ring button should be at infinity and the rear one at macro for the full range of focus to be checked.

If all is well, fish the Index Ring from its pushed forward position. Align the white line with infinity on the scale and install those three tiny JIS screws. With this Pentax mount turning the Grip Ring all the way counterclockwise as seen from the camera puts focus at infinity. Some other mounts may turn the other way.

Carefully screw the Front Focus Group into the Focus Ring under the Grip Ring. Screw it in the measured distance with the marks aligned. Now check the focus.

ADJUSTING INFINITY FOCUS--one of the last assembly steps.

Zoom lenses often focus by moving the front lens group. For adjusting infinity focus, the lens is mounted on a camera, zoomed to maximum focal length, focused to infinity, and then the Front Focus Group is rotated on its threads until the ground glass shows sharp focus when the distance scale is at infinity. Next, the lens is zoomed to shortest focal length and if not still in focus at infinity an adjustment is made in the Lens Mount Module--either actual shims or a "rotation" that makes the adjustment if shims are not used. The long and short focal lengths are adjusted repeatedly until both focus at infinity.

For this particular lens, the mechanism that achieves the non-rotating Filter Thread Ring has a second means of adjusting the Front Focus Group fore and aft position. This is the position of the Focus Bearing Threads. If the lens was properly adjusted before you took it apart, and if you have put the Focus Bearing Threads in their "as found" position, only the Front Focus Group may need adjusting for infinity focus.

When the Front Focus Group was removed, instructions were:

> IMPORTANT: Next, use vernier calipers to measure the distance from the front of the Focus Ring to the top of the sloping shoulder of the metal rim on the Focus Group. Measure to 1/10 mm. Next, make a scratch showing the orientation of the sloping edge of the Focus group and the inside of the Focus Ring. When the Focus Group is reinstalled these marks will line up with each turn of the Focus Group, and when they line up at the measured distance it is back as you found it.

Now, if these instructions were properly followed, and if the lens was properly focused to begin with, there may be no need to adjust the Front Focus Group. (Once in proper position, a little thread locker is recommended.)

For the subject lens, there were some egg-shaped screw holes in the ring that would take the blow if the lens had been dropped on its nose. Consequently, the front focusing lens group had to be turned a few degrees from the as-found position to achieve sharpest focus. Also it was found that my usual infinity target, a building 0.7 mile away, was difficult to focus with the stretched-out cam focusing mechanism of this lens. I used a measured 100 feet from my back yard wire fence instead, and used the 100 foot index on the lens and a 2.5x magnification on the eyepiece.

When focus adjustment is good, install the Filter Thread Ring. After it is installed remember to install the three tiny set screws that hold it from turning when using filters.

For installing these tiny set screws I use a thin piece of firm foam with a hole in the end that holds the set screw. The pointed end of the set screw helps in finding the hole.

Finally, replace the rubber grip and glue it down with some spots of contact cement. A bamboo skewer is a good tool for administering the glue. The inside of the rubber grip should have strips of smooth plastic that cover the slots in the Grip Ring. Take note of where these are and avoid getting glue in the slots. Except around the Zoom Lock Slider only a few scattered dabs of glue are needed.

APPENDIX 1: THE FOCUS STOP (LIMITING) FEATURE.

When first faced with a stuck focus I thought the problem might be in the unique focus limiting feature. I was wrong and my investigation was a waste of time.

Like other lenses the Distance Ring shows the focus distance against the index line on the Index Ring. The difference with this lens is that in front of the Distance Ring are two other rings called Focus Limit Rings (FLR). Each has a button that when depressed allows the FLR to be moved. Settings occur when fingers on the bottom of the button fit into notches. Choices are frequent but not infinite.

"Home Base" for no focus limiting is:

Button of rear FLR aligned with "macro"

Button of front FLR aligned with infinity.

To apply the focus limit feature, focus on the farther subject. Depress the front FLR button and move it to your chosen focus. It will stop when it reaches the selected distance. Be sure the button pops back up to indicate that the fingers have engaged a notch. After that you can focus anywhere closer but never farther than the selected distance until you move the front FLR button back toward infinity.

If you want a close limit as well as a far limit, set the lens to the close one that you want. Then depress the rear FLR button, turn it to your chosen focus, and be sure the button pops up. This must be 5 feet or more because there are no notches between macro and 5 feet. Then you cannot focus closer than this setting or farther than the other setting.

Now you can zip from one to the other if you have two distances for potential action at a known near and a known far distance. If the action is fast and you do not check focus for each shot be sure to remember which is which.

Disassembly: The Distance Scale Ring is held by two JIS screws into threaded holes. If these screws are removed the Distance Ring and both the Focus Limit Rings can be pulled back toward the mount. Also, both Focus Limit Ring buttons can be removed.

The Focus Limit buttons are hollow on the bottom with a coil spring inside. The shafts of rivet-shaped things depress the springs as they go into the holes. When installed in the Focus Limit Rings the flat head of the rivet-shaped things press against a lower surface and the spring pushes the button up. When disassembled the spring pushes the rivet-shaped things out.

The bottom of each button has three fingers that engage notches. If the button is depressed the fingers may be moved elsewhere along the line of notches.

If the Grip Ring is turned with excessive force against set Focus Limits, bent button fingers or damaged notches might occur. Otherwise it is unlikely that this focus limiting arrangement will be a problem.

If you do take the Focus Limit Rings off don't worry which is which because they are identical. You can try to put them on backward but you will not succeed. Put them on without the buttons first to see how they go, then take them off and try to get them on with the buttons in place. Reassembly is tricky. Those "rivet shaped" spring-follower things are non-magnetic brass and you cannot use a magnet to find one that the spring flipped away. Unless your are a masochist I recommend you leave the focus limiting system alone if at all possible.

APPENDIX 2: SOME THOUGHTS ABOUT THE FOCUS ENGINEERING.

Perhaps I see a reason for the cam focusing mechanism instead of a helix.

Implementation of the Focus Limit idea requires that the distance scale be stretched over a useful range of choices for setting the focus limits because there is a practical limit to the size of the fingers on the Focus Limit Buttons and the notches they fit. The fingers and notches would need to be very tiny, and therefore weak, to accommodate normal helix focusing and the setting of the limits would be hard to see. As an alternative, the helix could have been made with fine threads but that would make excessive turning when focusing close up. Cam focusing was the engineering solution. For long distance focusing, the cam has little curvature and stretches the amount of rotation needed. and then the cam curves more sharply for close distance focusing. The Focus Channels Ring in *PHOTO 9* shows the long distance range of two cam channels on the lower right and the short distance curved cam channels of two others on the upper left.

Even if the focus limiting feature is not in use, the cam focusing makes unusually precise focusing easier at moderate to long distances--20 to 100 feet. Precise focusing with a focusing magnifyier gives maximum sharpness for wide apertures at these distances.

To illustrate, in this table are some measured degrees of rotation comparing this 70-210 lens with a Kiron 80-200 f/4.5 zoom lock lens. The 70-210 turns 75 degrees going from infinity to 7 meters whereas the 80-200 turns only 13 degrees to go from infinity to 7 meters.

rotated degrees from infinity	70-210 distance meters	80-200 distance meters
13		7
15	30	
22		4
30	15	
40		2.5
50	10	
60		1.7
75	7	
80		1.3

This explains why the red line for Infra Red correction is so different on these two lenses.

APPENDIX 3: WHY A PHILLIPS SCREWDRIVER DAMAGES JIS SCREWS.

The Prime Directive for installation of screws, both JIS

and Phillips, appears to be that removal will never be needed.

A JIS screw is made with slots that have straight faces that take the force of the straight faces of a JIS screwdriver. The torque force of a JIS screwdriver on a JIS screw is evenly distributed on the metal from top to bottom of the slots.

Unlike JIS, the slots of a Phillips screw are tapered from top to bottom on the faces that take the torque force. A Phillips screwdriver is tapered to fit and torque force is evenly distributed from top to bottom of the slots in the screw.

When a Phillips screwdriver is applied to a JIS screw the tapered faces put torque force only on the top of the slots in the screw. With sufficient force the metal deforms and this weakens the metal so that added force makes more deformation until the slots merge into one tapered hole.

The design of the JIS screw makes installation with great force possible, and in addition thread sealer often is used. Often the thread sealer is like Pliabond contact cement. Methyl Ethyl Ketone or Acetone or heat will soften it but the screw may still be very tight. Use a steady force as the gooy stuff slowly yields. A jerk my break things.

As force is applied with a Phillips screwdriver to a Phillips screw head the taper causes a force that lifts the screwdriver up out of the slots. This is a cam action and the screwdriver is said to “cam out”. Downward pressure keeps it in for installation of a screw. Downward pressure is needed to turn the screw out and that is a force to keep the screw in. Phillips screws are not designed for removal.

For automatic assembly machines the Phillips screw has an advantage. The machine can be set so the screwdriver to cams out before damaging the screw.