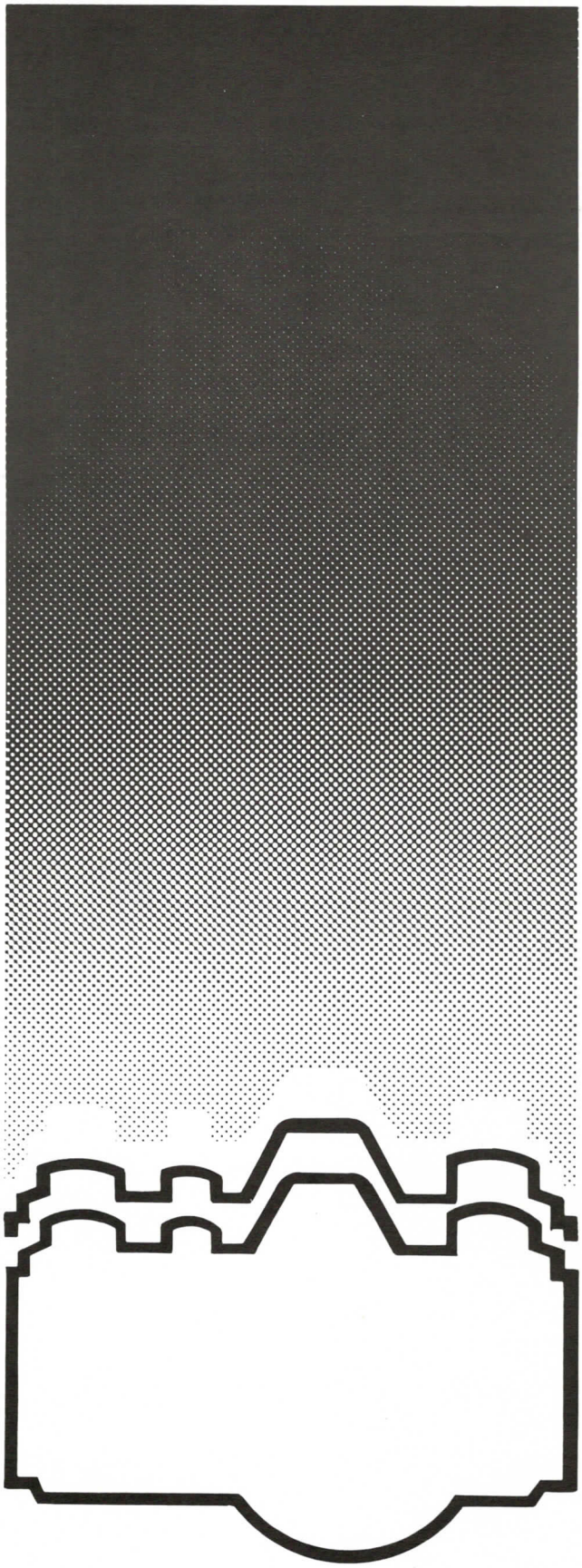

35mm
Disassembly
Technique



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35mm Disassembly Technique

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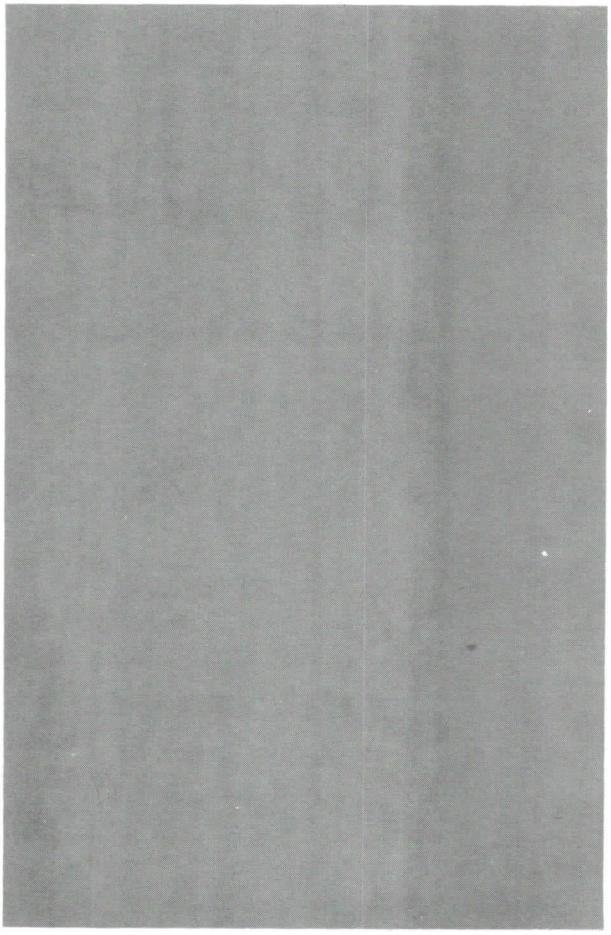

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National Camera, Inc.
Technical Training Division

TIPS FOR A TYPICAL DISASSEMBLY

Some cameras, as you've seen, are very simple in design. But other designs may be complicated and confusing. You then need a broad knowledge of typical disassembly procedures to make your work faster, easier, and safer.

Since the early thirties, the 35mm camera has probably been the most versatile -- and consequently the most popular --type of camera. In this assignment, we'll look at some typical disassembly techniques as they relate primarily to the 35mm camera.

WHERE DO I START?

There's a recommended starting point for the disassembly of an unfamiliar camera -- **remove the bottom cover.** The mechanism you'll then see can provide you with vital information. Plus, you'll rarely disturb any critical timing points or adjustments by just removing the bottom cover.

Two or more screws normally hold the bottom cover to the camera's body casting, Fig. 1. In most cases, you can lift off the bottom cover once you remove the screws. It's common for the rewind button to remain with the bottom mechanism, Fig. 2. But be cautious -- in some designs, the rewind button is loose.

Notice in Fig. 1 that two of the screws are on the bottom; the third screw is on the end of the bottom cover. In this case, the screws at the bottom are countersunk, allowing them to sit flush with the bottom cover. The screw at the end of the bottom cover has a rounded head.

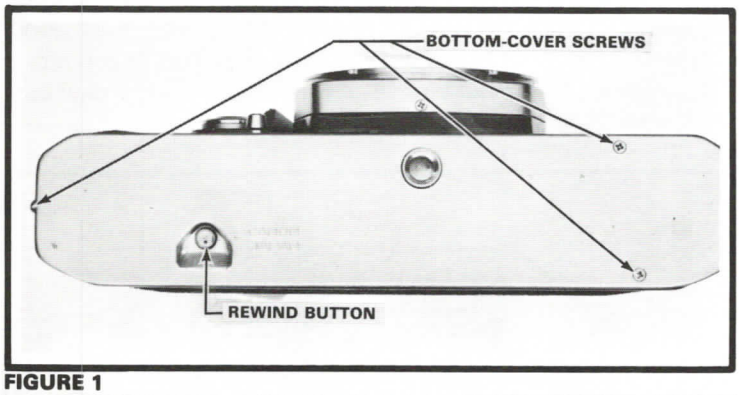


FIGURE 1

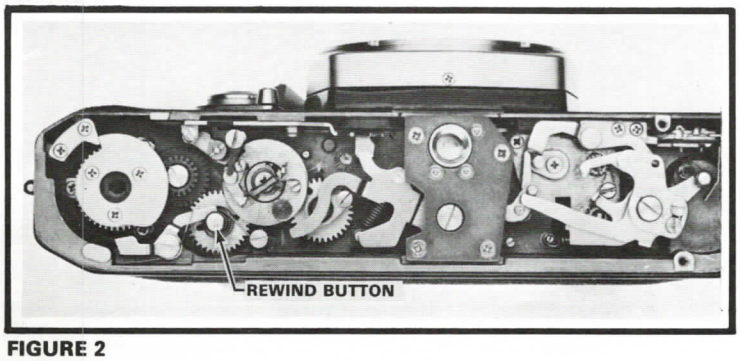


FIGURE 2

The procedure isn't always as simple as just described (for every general rule, you can expect to encounter many exceptions). You may find exterior controls or cosmetic pieces in the way. But they'll become obvious when you can't lift off the bottom cover.

For example, consider the Mamiya 35mm SLR shown in Fig. 3. Once you remove the four screws, you'll discover that the bottom cover catches on the rewind button. You must first remove the rewind button from the rewind shaft.

And here's where you can sometimes get into trouble. Although the rewind button in the Mamiya SLR screws onto its shaft, it has a left-hand thread. Notice the two holes provided in the rewind button for a small spanner wrench, Fig. 3. You can unscrew the rewind button using a stout pair of tweezers or your Multispan wrench.

But remember -- *turn a left-hand screw clockwise to remove it.* Should you try to turn the Mamiya rewind button in the normal direction, chances are you'll break off the head. Then, you'll have to replace the rewind button.

The Mamiya SLR has one other part you should remove before taking off the bottom cover -- the battery-compartment cover. Most of the modern 35mm cameras have built-in exposure meters. And it's very common to find the battery-compartment cover at the bottom of the camera. The Olympus SLR shown in Fig. 4 provides an example.

In many cases, you can remove the bottom cover with the battery-compartment cover still in place. Yet that can be risky -- the battery will be free (and easily lost) once you lift off the bottom cover. So, as a general rule, *remove the battery-compartment cover and the battery as the first step in disassembly.*

We've mentioned a couple of reasons for starting your disassembly with the bottom cover. There's one more good reason. Your disassembly may require that you also remove the camera's front standard. And the bottom cover frequently hides the front-standard retaining screws.

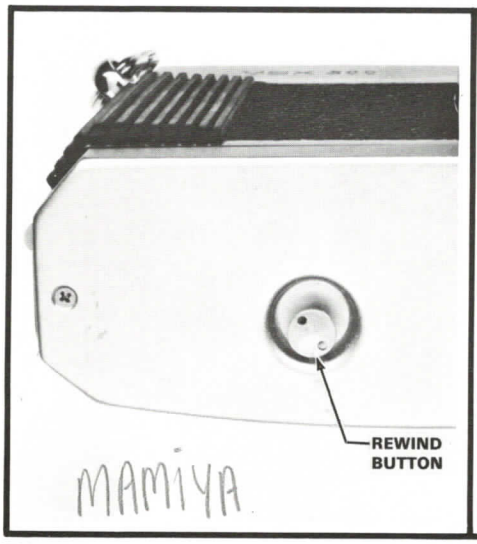


FIGURE 3

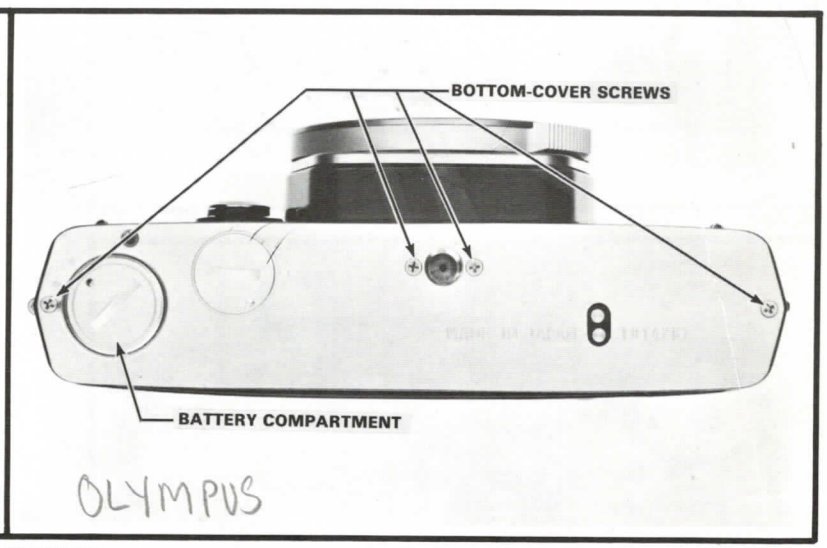


FIGURE 4

REMOVING THE TOP COVER

After removing the bottom cover, study the mechanism at the bottom of the camera. Learn as much as you can about the parts now visible. Then, turn your attention to the top cover.

Remember, you're trying to uncover as much of the camera mechanism as possible -- without disturbing any adjustments. But to remove the top cover, you'll have to get some parts out of your way.

The typical 35mm camera has at least three parts in the way:

1. the wind lever
2. the rewind knob
3. the shutter-speed knob.

The top cover itself, like the bottom cover, is normally held by two or more screws.

REMOVING THE WIND LEVER

A simple cap screw or retaining ring often holds the wind lever. The cap screw or retaining ring normally matches the finish of the top cover. So you must be careful in removing the cap screw -- you don't want to mar the appearance.

Many cap screws, like the one shown in Fig. 5, have two holes for your Multispan wrench. But some cap screws have no holes or dimples. If the cap screw or retaining ring is thick enough, you can then use a Flexiclamp wrench as shown in Fig. 6. However, the cap screw or retaining ring may not have enough of a "lip" to give the Flexiclamp wrench a sufficient grip.

In that case, you can use a chunk of rubber to grip the cap screw. Just cut a square of rubber from an old inner tube. Use the rubber square between your fingers and the cap screw to provide a sufficient grip.

The M-series Leicas provide good examples of tough-to-remove retainers. Here, a retaining ring holds the wind lever, Fig. 7. And there's not enough surface area for a Flexiclamp

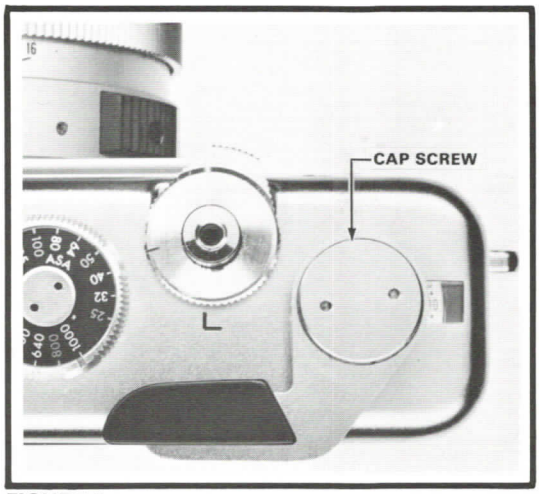


FIGURE 5

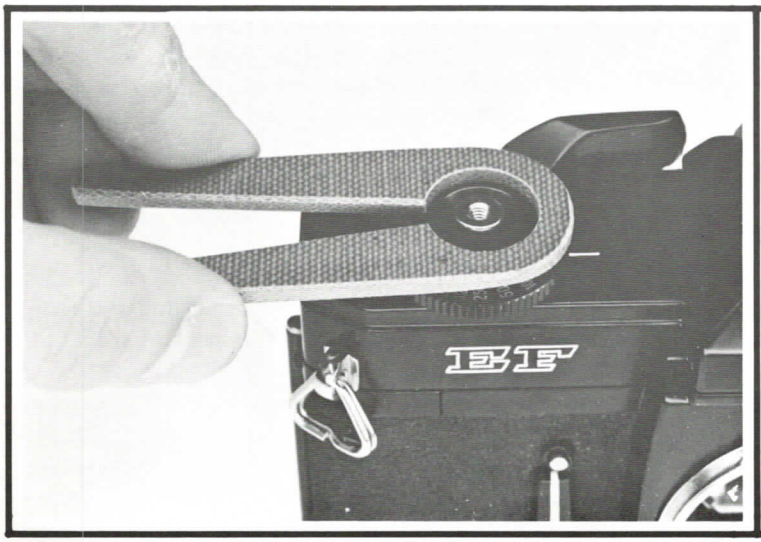


FIGURE 6

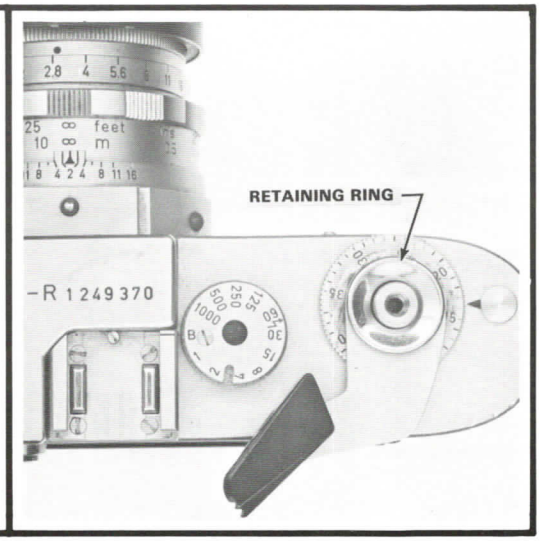


FIGURE 7

wrench. The chunk of rubber often works to remove the retaining ring. But you may find that the retaining ring is too tight -- even the rubber square won't give you a good enough grip.

One technique that works well is to use a 4-jaw independent chuck. Bring each of the four jaws into contact with the outer edge of the retaining ring. Then, use the 4-jaw chuck as a "handle" to unscrew the retaining ring in a counterclockwise direction. If you're careful, you won't mar the retaining ring with the chuck. But if the jaws are too tight, they'll leave four indentations in the retaining ring. If the jaws are too loose, the chuck will probably slip off the retaining ring and damage the appearance.

Sometimes manufacturers make your job tougher by using a locking agent on the threads of a wind-lever cap screw. And those cap screws may not have notches or holes for a spanner-type wrench. It's just about impossible to work a solvent into the threads. However, heat sometimes softens the locking agent. So you might try heating the cap screw with your soldering iron. Then, use your rubber square to unscrew the cap screw.

Even heat won't work on all locking agents. As a last resort, you can drill two holes in the cap screw for a Multispan wrench. It's then best to replace the cap screw with a new one. Your customer probably won't appreciate those holes right above his wind lever.

Also keep in mind that the wind-lever cap screw may have a left-hand thread. If you don't have any success when you first attempt to unscrew the cap screw, try reversing your turning direction.

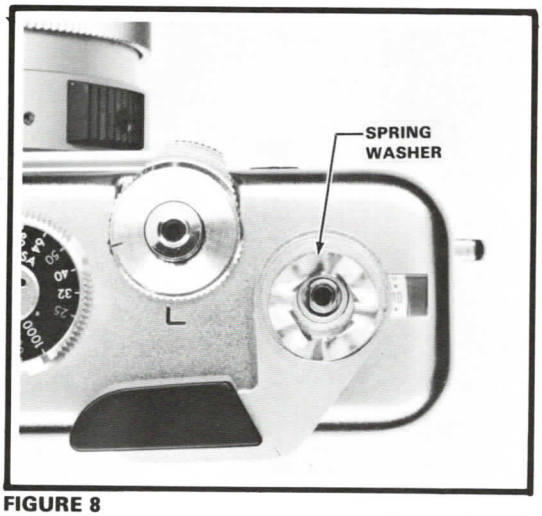


FIGURE 8

Once you remove the cap screw or retaining ring, you'll probably find some loose parts. For example, let's return to the camera shown in Fig. 5. A loose spring washer sits on top of the wind lever, Fig. 8. The spring washer provides the two wind-lever positions -- the "storage" position (with the wind lever against the camera body) and the "ready" position (with the wind lever standing away from the camera body).

There may also be some flat washers under the cap screw. Be careful to keep the washers in their proper sequence for reassembly reference. It may help to line up the washers as you remove them. On reassembly, you can then reverse your disassemby sequence.

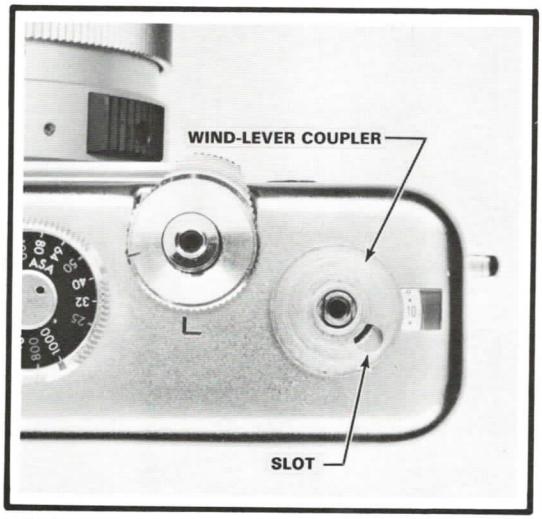


FIGURE 9

Then, lift off the wind lever. Under the wind lever, you'll often find a **wind-lever coupler,** Fig. 9. The wind-lever coupler fits over the two flat sides of the wind shaft.

In Fig. 9, the wind-lever coupler has a slot -- the slot receives a pin on the underside of the wind lever. Advancing the wind lever then turns the wind-lever coupler. And the wind-lever coupler rotates the wind shaft. Other cameras may have a pin on the wind-lever coupler which fits into a slot in the wind lever.

Before lifting off the wind-lever coupler, note the position of the slot or pin. The slot in Fig. 9 goes toward the back of the camera -- that's typical. Since the wind shaft has two flat sides,

it's possible to replace the wind-lever coupler 180° out of position (or upside down).

OTHER VARIATIONS IN WIND-LEVER DISASSEMBLY

The wind lever may simply be held by a screw. But you'll sometimes find that a decorator plate hides the wind-lever retaining screw. The camera shown in Fig. 10 provides an example.

Here, a black decorator plate is cemented on top of the wind lever. You must remove the decorator plate to reach the wind-lever screw, Fig. 11.

It's pretty tricky to remove the thin decorator plate without marring the appearance. Typically, a rubber-base cement holds the decorator plate. So you can use a solvent --either methyl ethyl ketone (MEK) or acetone -- to loosen the cement before prying off the decorator plate.

Use a fine-pointed pair of tweezers (with the points held closed) to pick up a small drop of the solvent. Place several such drops around the edge of the decorator plate. Allow the solvent to seep under the decorator plate and mix with the cement.

Since the solvents evaporate quite rapidly, you may have to repeat the process several times. Enough solvent must get under the decorator plate to loosen the cement. Then, you can pry off the plate without bending or nicking it.

Or you can use heat from your soldering iron, as mentioned earlier. A penny makes a good conductor of heat. So try placing a penny on top of the decorator plate. Then, use your soldering iron to heat the penny.

Before applying heat or a solvent, though, make certain that the decorator plate is indeed cemented. Usually, you can tell at a glance. But there are cases where something appears to be a cemented decorator plate or cap and really isn't. Once again, the Mamiya SLR provides a good example of the exception.

Many of the Mamiya SLR's have the exposure-meter switch built into the wind-lever assembly. Pushing the wind

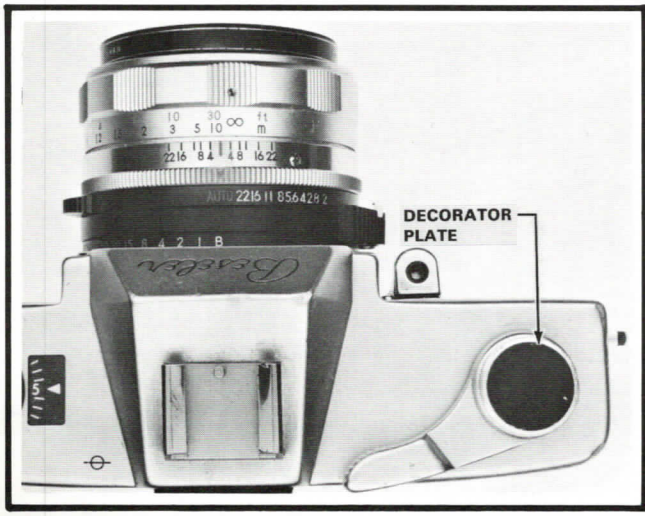


FIGURE 10

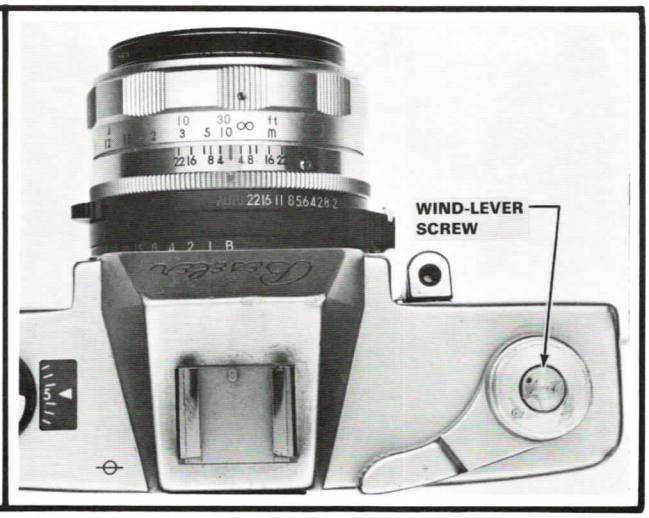


FIGURE 11

lever toward the camera body closes the exposure-meter switch at the bottom of the camera. That simultaneously turns on the exposure meter and stops down the lens.

With the newer Mamiya SLR's, just moving the wind lever to the "ready" position turns on the exposure meter (you don't have to push the wind lever toward the camera body). But, in either type, you can return the wind lever to the storage position without activating the exposure-meter system. Just push down the black cap in the center of the wind lever, Fig. 12. The wind lever then moves to the storage position. And the exposure-meter switch remains open.

Lets repeat the key point here:

NOTE MAMIYA SLR's →

> Pushing the wind lever toward the camera body turns on the meter and stops down the lens. Yet pushing the black cap causes the wind lever to move toward the camera body without actuating either system.

Getting double mileage from the wind lever takes some clever design. It also complicates the disassembly. Try pulling the wind lever away from the camera body to the "ready" position. You'll then see the black cap, Fig. 12, pop up. The black cap looks as though it could be a cap screw. It is indeed a cap. But rather than being threaded on the wind shaft, the cap has a friction fit.

So it may seem you could just lift off the cap. However, the cap sits flush with the wind-lever trim ring. In fact, with the wind lever in the storage position, the cap actually sits below the trim ring. That makes it difficult, if not impossible, to get a grip on the cap. Yet you must remove the cap to take off the wind lever.

There are a couple of techniques you can use. Many technicians use a length of fine nylon thread to pull off the cap. Just double the thread back on itself to form a sort of loop. Then, prod the loop end under and around the cap. A gentle tug on the two loose ends of the thread should lift the cap up and off the wind lever.

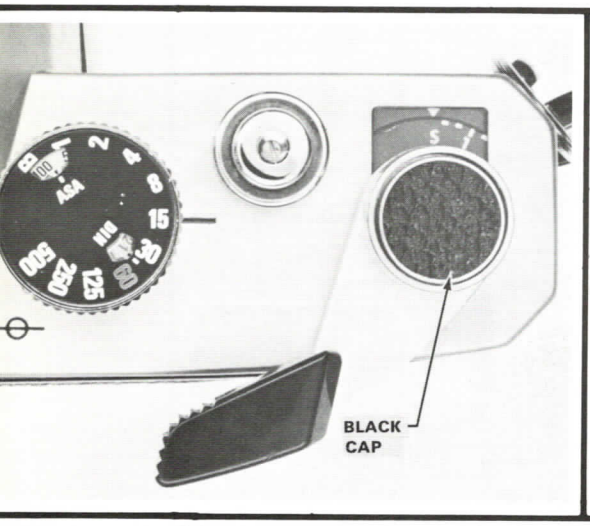


FIGURE 12

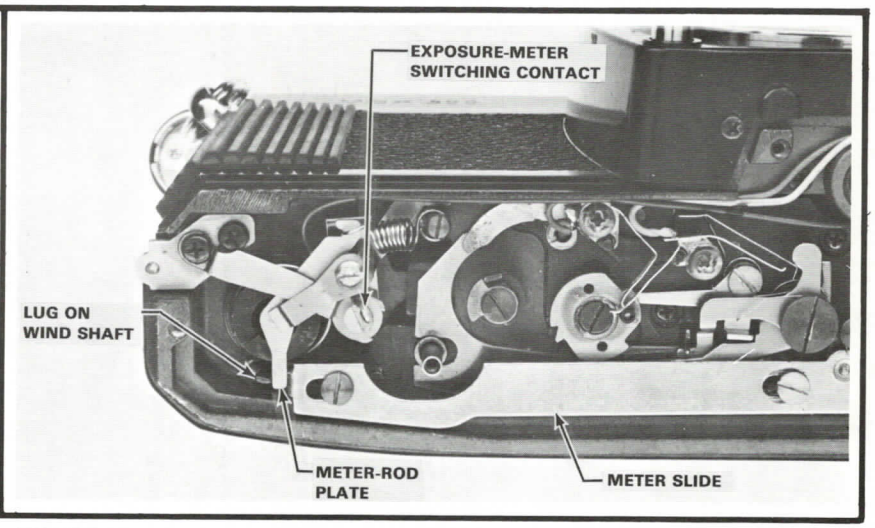


FIGURE 13

But there's another technique that most technicians prefer. Turn over the camera and locate the meter-switch linkage on the bottom of the wind shaft (you should already have removed the bottom cover, remember?). Fig. 13 shows the mechanism from a Mamiya MSX 500. Here, you can see the exposure-meter switch and the meter slide.

In the model shown, the meter turns on when you pull the wind lever away from the camera body. The spring which carries the exposure-meter switching contact drops down. And the switching contact comes against the fixed exposure-meter contact to turn on the meter.

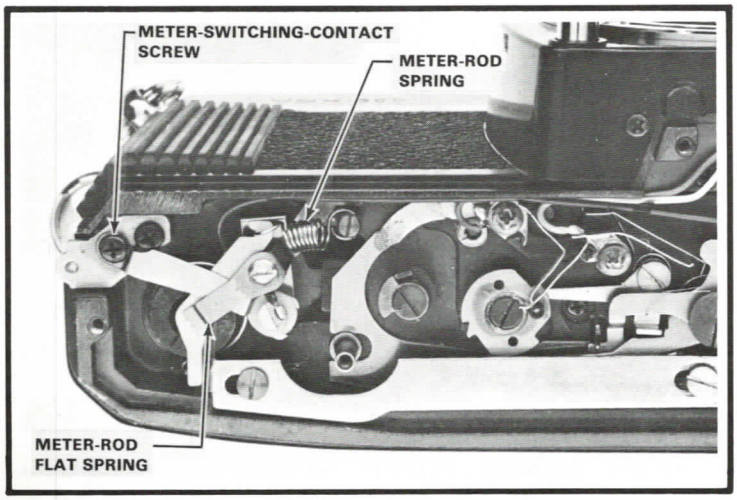
Earlier models use the meter slide, Fig. 13, to turn on the meter. Pushing the wind lever toward the camera body pushes the meter slide from left to right. This movement closes the meter switch. The meter slide in Fig. 13 still stops down the diaphragm for a depth-of-field preview. Pushing the wind lever toward the camera body rotates the wind shaft counterclockwise (as seen from the bottom). A lug on the wind shaft then comes against the meter-rod plate, Fig. 13. And the meter-rod plate pushes the meter slide from left to right.

The meter-rod plate attaches to the end of the meter rod. And the meter rod passes through the center of the wind shaft -- the black cap, Fig. 12, mounts to the upper end of the meter rod. Consequently, pushing down the black cap also moves down the meter-rod plate, Fig. 13.

Now, the wind-shaft lug, Fig. 13, slips under the meter-rod plate, Fig. 14. As a result, the wind lever doesn't actuate the meter slide. Also, the downward movement of the meter-rod plate pushes the exposure-meter switching contact away from the fixed contact. That turns off the exposure-meter system.

Remember, removing the wind lever requires that you lift off the black cap, Fig. 12. Probably the easiest technique is to first remove the parts above the meter-rod plate. Disconnect and remove the meter-rod spring, Fig. 14. Then, remove the screw holding the meter-rod flat spring -- this is the spring that pushes up the meter rod, Fig. 14. Lift out the meter-rod flat spring.

NOTE ON MAMIYA SLRS



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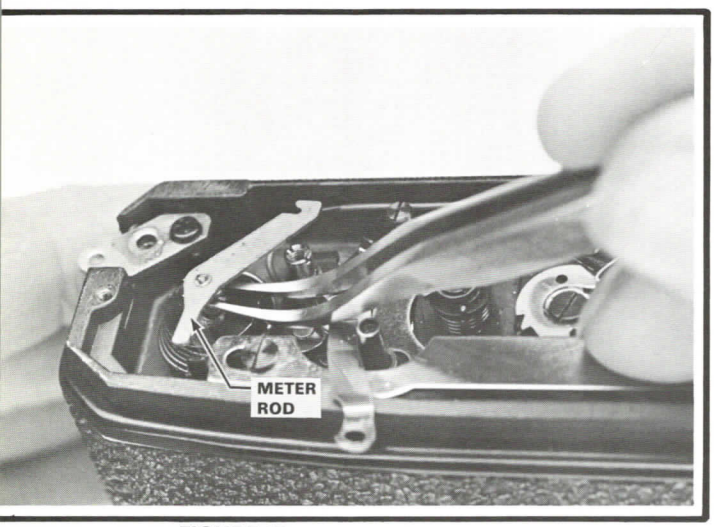


FIGURE 15

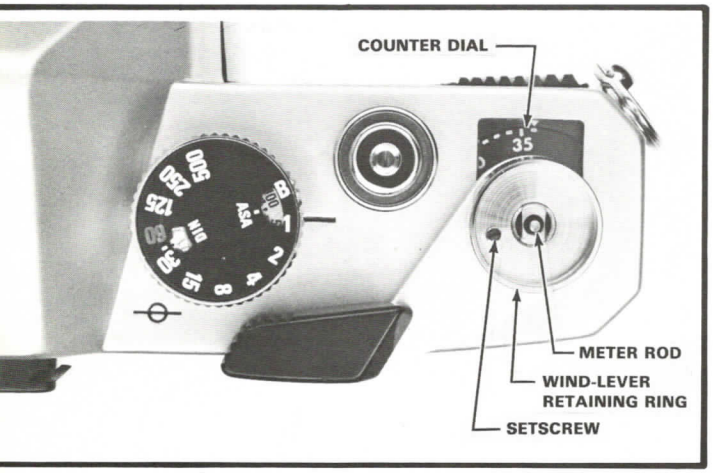


FIGURE 16

If you have the model shown in Fig. 14, also remove the screw holding the meter-switching contact. The earlier models have no contact in this position; the switch is at the other end of the meter slide.

Now, slip the points of your tweezers (curved tips work best) under the meter-rod plate. Gently pull the meter rod toward you, Fig. 15. Once you've pulled the meter rod around 5mm from the camera body, the black cap will pop off the upper end.

Fig. 16 shows the top of the wind lever with the black cap removed. Here, you can see the upper end of the meter rod. You can also see the wind-lever retaining ring. Notice that a setscrew locks the wind-lever retaining ring to the wind lever. That setscrew provides a good example for another general rule in disassembly:

> *Always look for a setscrew before attempting to unscrew an unfamiliar part. Manufacturers frequently use setscrews to lock threaded parts in place. If you attempt to unscrew the part without first loosening the setscrew, you're almost sure to cause damage.*

Also, the wind-lever retaining ring in Fig. 16 has a left-hand thread. First loosen the setscrew. Then, unscrew the retaining ring in a clockwise direction.

TEST-YOURSELF QUIZ #1

1. What is the first plate you should remove in the disassembly of an unfamiliar camera BOTTOM PLATE
2. If a part won't unscrew in the normal direction, it may have a LEFT-HAND thread.
3. If a camera has the battery compartment on the bottom, you should remove the battery before removing the BOTTOM PLATE.
4. In most cameras, you must take off three parts before you can remove the top cover. These major parts are:
   1. WIND LEVER
   2. SPEED KNOB
   3. REWIND KNOB
5. When parts are locked in place, you can often use a solvent to loosen the locking agent. But you can't always work the solvent into the threads of a threaded part. What other technique can you use to soften some adhesives? APPLY HEAT / SOLDER IRON
6. Before using force to unscrew a threaded part, look for SETSCREWS that may be used to lock the part.

FILM-COUNTER DIALS

With the camera shown in Fig. 16, the counter dial sits under the top cover. A window in the top cover allows you to see the film-frame calibrations. That's the common design. Removing the top cover has no effect on the counter-dial timing.

But in some cameras, the location of the film-counter mechanism complicates the removal of the wind lever. A case in point -- the Pentax Spotmatic, Fig. 17. Here, the counter-dial assembly mounts right on top of the wind lever. To remove the wind lever, you must first remove the counter-dial assembly.

The counter cover includes an index for the frame numbers and a plastic window for viewing the dial. Three setscrews hold the counter cover. So all you have to do is remove the three setscrews, right? But hold on. There's an important step you should first take:

> When you open the camera back by lifting the rewind knob, the counter dial returns to its starting position. The index then aligns with the large dot that precedes the "0" calibration, Fig. 18.
>
> Close the camera back and begin advancing the wind lever. Notice that it takes two wind-lever strokes to align the number "0" with the index, Fig. 19. That's an important specification to note before you disassemble an unfamiliar counter mechanism -- the number of strokes required to bring the number "0" into position. Some cameras take two strokes; others may take three.

Make a note of the number of wind-lever strokes required to bring the number "0" into position. Then, loosen the three setscrews and lift off the counter cover. On reassembly, advance the wind lever twice after closing the camera back. Then, install the counter cover and align the index with the "0" calibration, Fig. 19.

Once you've removed the counter cover, you can see the counter dial, Fig. 20. The large screw in the center of the

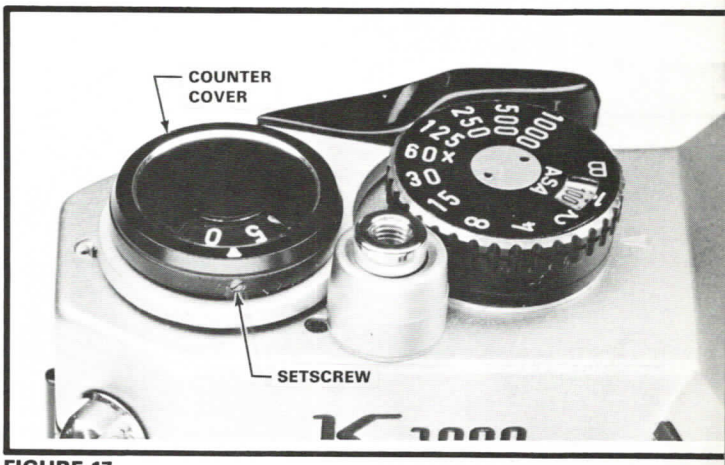


FIGURE 17

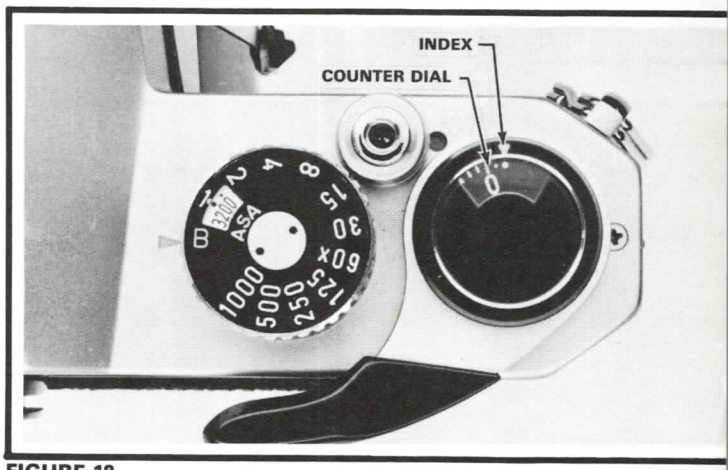


FIGURE 18

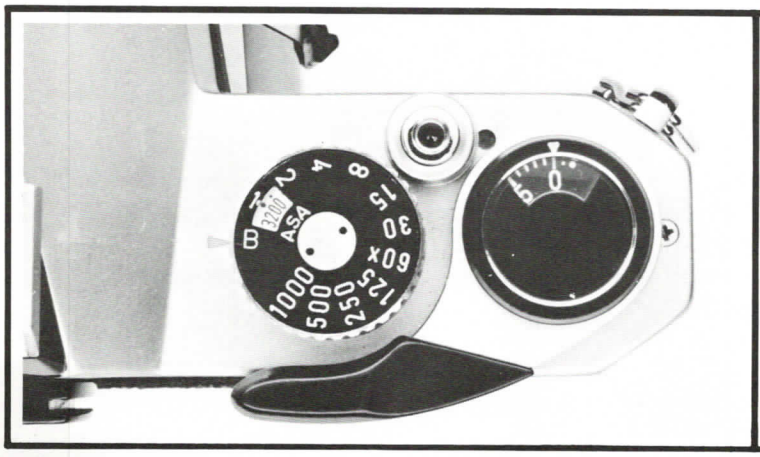


FIGURE 19

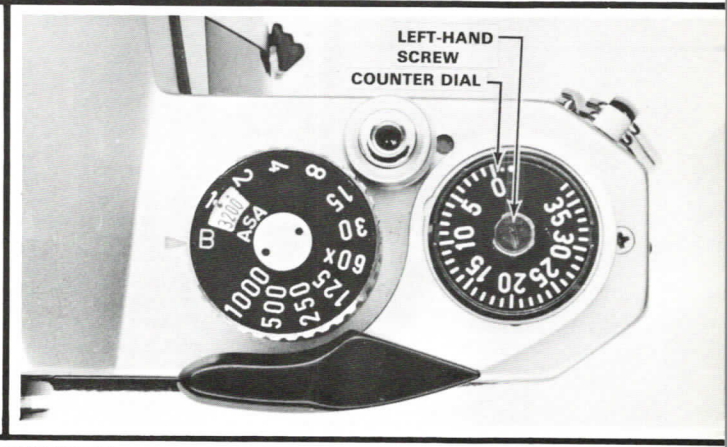


FIGURE 20

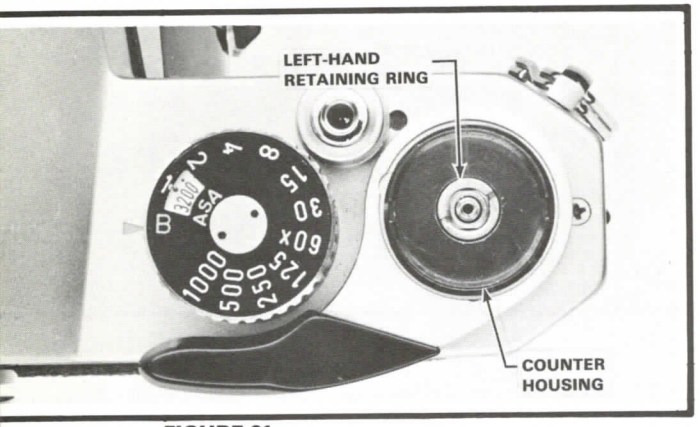


FIGURE 21

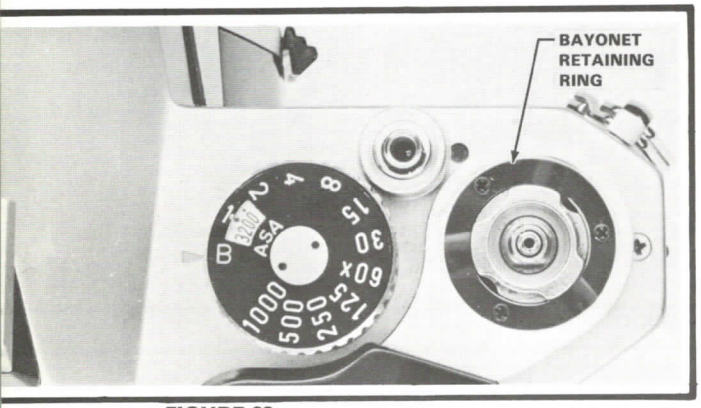


FIGURE 22

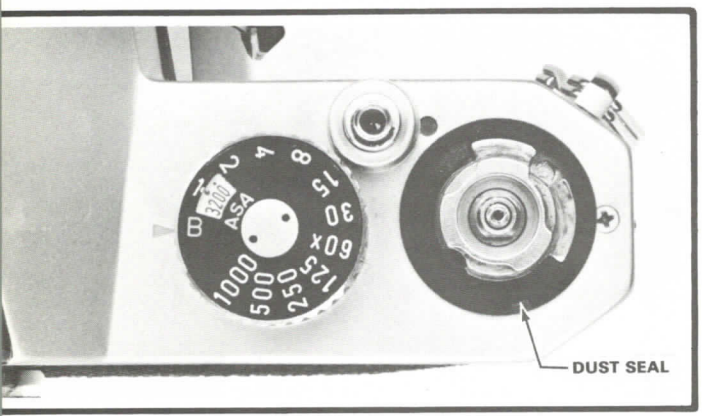


FIGURE 23

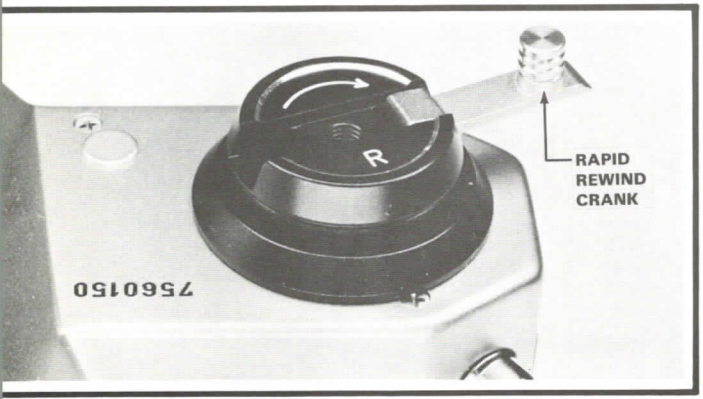


FIGURE 24

counter dial holds the dial to the counter shaft. This screw has a left-hand thread.

Remove the left-hand screw and lift off the counter dial. Then, locate the retaining ring for the counter housing, Fig. 21. Unscrew the retaining ring and lift off the counter housing. In recent Spotmatic models, the counter-housing retaining ring has a left-hand thread.

The three screws now visible hold the bayonet retaining ring to the wind lever, Fig. 22. Three lugs around the center of the bayonet retaining ring slide under corresponding lugs on the wind driver. A pin on the underside of the wind lever couples with a wind-driver notch. So advancing the wind lever turns the wind driver.

Right now, you can't move the bayonet retaining ring to a position where its three lugs will clear the wind driver. You must first remove the three screws shown in Fig. 22. Then, you can rotate the bayonet retaining ring independently of the wind lever. Turn the bayonet retaining ring until you can lift it from the camera. Finally, lift off the wind lever.

Fig. 23 shows the Spotmatic with the wind lever removed. Here, you can see a part that's common in 35mm cameras -- a plastic dust seal. Note the position of the plastic dust seal before lifting it from the camera.

It's a good idea to keep the wind lever and its associated parts handy. You'll probably want to reinstall these parts once you remove the top cover. You can then operate the camera in the normal manner to check the operation and make the adjustments.

REMOVING THE REWIND KNOB

The rewind knob normally sits at the other end of the top cover. Frequently, the rewind knob has a fold-out crank -- the rapid-rewind crank, Fig. 24. Using the rapid-rewind crank, you can conveniently turn the rewind knob when rewinding the film.

A central screw often holds the rapid-rewind crank to the rewind knob. You can see the screw once you've unfolded the crank to the "ready" position. In almost every case, removing that screw results in the same thing -- the rapid-rewind crank falls off the rewind knob, but that does nothing toward helping you remove the rewind knob from the camera. So leave the screw in place until you've exhausted all other possibilities.

In most designs, the rewind knob simply screws onto the end of the rewind shaft. Open the back of the camera. Then, using the butt end of your tweezers, wedge the fork at the end of the rewind shaft, Fig. 25. Since you're holding the forked end, the rewind shaft can't rotate. And you can unscrew the rewind knob.

The rewind shaft may now stay in the camera. Or, depending on the design, it may fall out once you've removed the rewind knob. In either case, you'll frequently find a spacer washer or dust seal between the knob and the shaft. So keep your eyes open for one.

Also, if the rewind shaft stays in the camera body, try to avoid pushing down the rewind shaft. There may be a ball de-

tent that provides two click-stop positions -- the raised position for loading film and the lowered position for engaging the film cassette. That detent ball rides against the side of the rewind shaft. If you push the rewind shaft down and out of the camera, it's possible you'll have a loose detent ball. Replacing the detent ball isn't normally a problem -- but finding that ball inside the camera can be a problem.

Although most rewind knobs use this standard design, there are some variations that can cause problems. You'll sometimes find a setscrew passing through the rewind knob, Fig. 26. The rewind knob still screws onto the rewind shaft -- the setscrew just makes sure the rewind knob won't unscrew on its own. What will happen if you try unscrewing this rewind knob without loosening the setscrew? If you're strong enough to turn the rewind knob, the setscrew will destroy the threads of the rewind shaft.

There aren't too many cameras that use a locking setscrew. But, when working on an unfamiliar camera, be sure to look for a setscrew before trying to unscrew the rewind knob.

Another variation -- in some cameras, the fork at the end of the rewind shaft, Fig. 25, is a separate piece (rather than being formed on the end of the shaft). The fork may screw onto the rewind shaft. Or it may be held by a separate screw.

When you then try to unscrew the rewind knob, you may find that the fork unscrews instead. That's not what you want -- you still must remove the rewind knob to take off the top cover. If the fork unscrews, though, you may have to grip the rewind shaft under the rewind knob. Here, you can use a pair of needle-nose pliers cushioned with tissue to prevent damage. Hold the rewind shaft with the pliers as you unscrew the rewind knob.

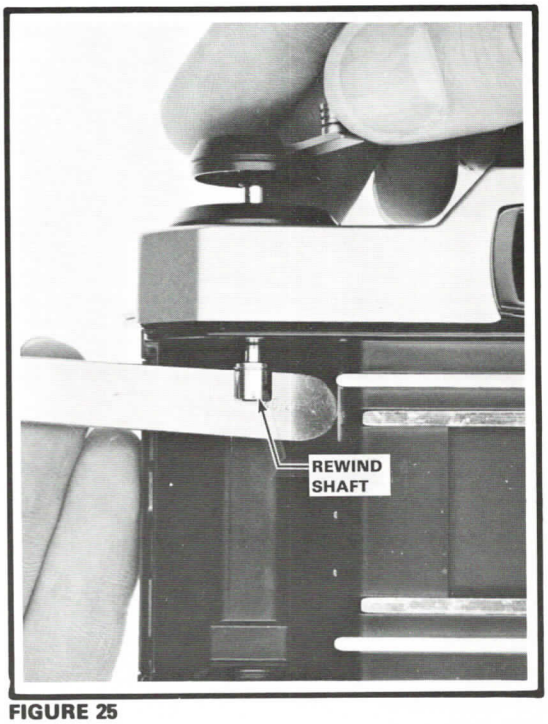


FIGURE 25

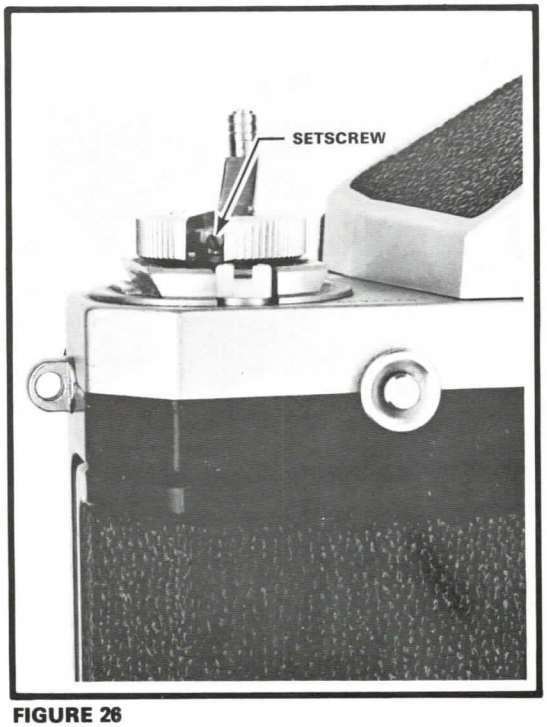
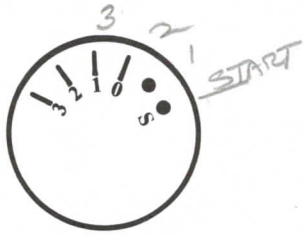


FIGURE 26

TEST-YOURSELF QUIZ #2

1. When you open the camera back, the counter dial shown here should



   A . return to the "0" calibration

   B . return to the "S" calibration

2. How many wind-lever strokes are required to advance the counter dial pictured with question #1 to the first-frame position? _____

3. What is the purpose of the spring washer located under the wind lever? _____

4. Considering a typical 35mm camera, you can remove the rewind knob by _____ it from the rewind shaft.

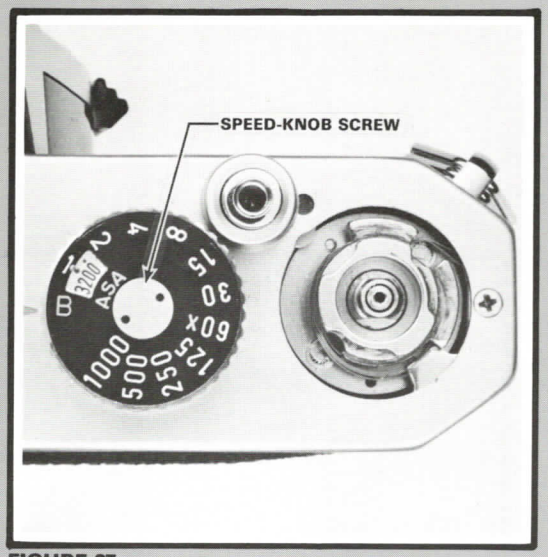


FIGURE 27

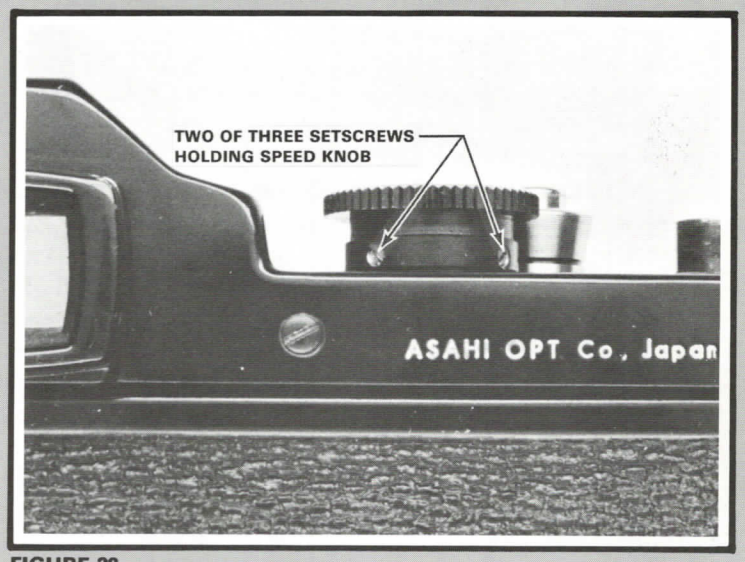


FIGURE 28

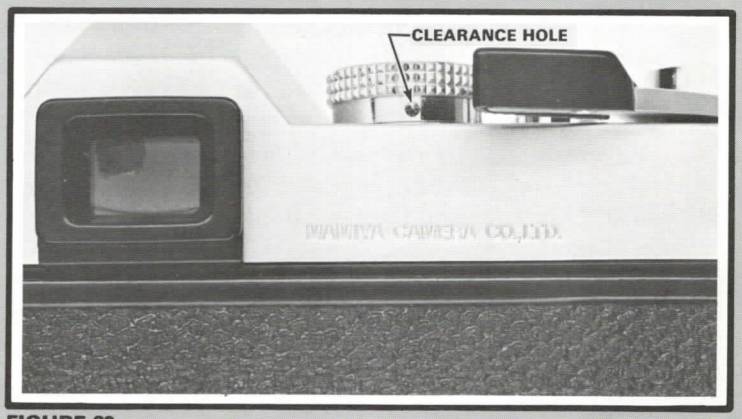


FIGURE 29

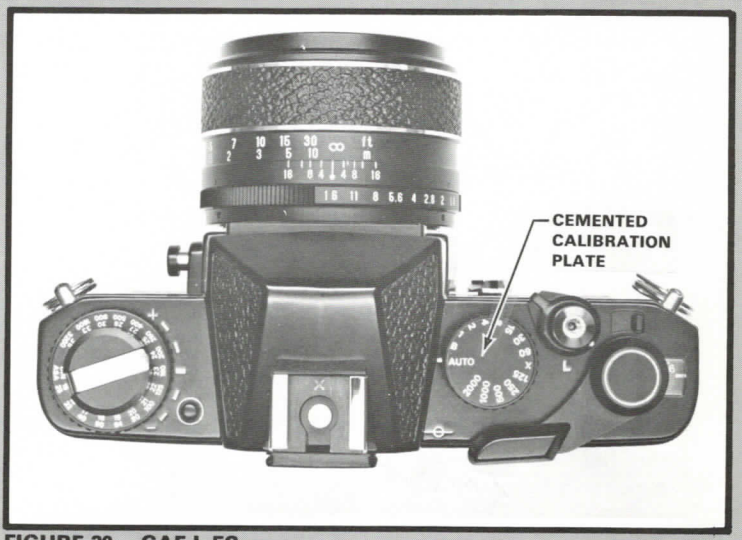


FIGURE 30 GAF L-ES

REMOVING THE SPEED KNOB

The normal position for the shutter-speed knob is on the top of the camera next to the wind lever. But the shutter-speed knob may be on the front standard. Or it may be a ring around the lens opening. If the speed knob sits on the top cover, you'll have to remove it.

Quite often, the speed knob serves double duty -- it serves both as the shutter-speed-setting knob and as the film-speed-setting knob. Turning the speed knob then sets the shutter speed. But lifting and turning the speed knob sets the film speed for a built-in exposure-meter system.

Usually, a center screw holds the double-duty speed knob, Fig. 27. A speed knob that sets the shutter speed only may be held by a center screw or by setscrews on the side, Fig. 28.

It's also possible for a double-duty speed knob to be held by a setscrew. Once again, the Mamiya SLR provides a good example of a somewhat unusual design, Fig. 29. Notice the clearance hole on the side of the speed knob. When you see a clearance hole like this, you know the hole uncovers something at a certain combination of settings.

Setting the Mamiya speed knob to ASA 80 and 1/4 second allows you to reach the setscrew through the clearance hole. Loosen the setscrew to remove the speed knob. What if you don't have the information as to the proper settings? You can then find out. Just keep changing settings until you can see what the clearance hole is intended to uncover.

If there appears to be no way to remove the speed knob, chances are a cemented plate covers the screws. There may just be a decorator plate cemented on top of the speed knob. Or, as shown in Fig. 30, the shutter-speed calibration plate may be cemented in place. Then, you must pry off the cemented plate to reach the screw. Remember to use solvent -- it's tough to remove these thin plates without cosmetic damage.

Speed knobs probably present more variations than do any other conventional parts. In some cases, it makes no difference what settings you use for disassembly. In other cases, the shutter-speed and film-speed settings can make a big difference.

Many cameras mechanically couple the speed knob to a spring-loaded meter movement. Here, it's desirable to set the combination of settings that lets off as much of the spring tension as possible. Otherwise, there may be enough tension to damage the meter needle as soon as you remove the speed knob.

In most designs, you should set the speed knob to bulb and the fastest film speed. This combination normally lets off most of the spring tension. But, as always, there are exceptions. In some cameras, the combination that lets off most of the spring tension is just the opposite -- the slowest film speed and the fastest shutter speed.

With unfamiliar cameras, however, you can follow this general rule:

> Set the shutter speed to bulb before removing the speed knob.

Even if the camera doesn't have a cross-coupled exposure meter, it's desirable to use the bulb setting. Why? Because that's the easiest shutter-speed setting to find with the speed knob removed. On reassembly, just turn the speed-setting mechanism until the shutter delivers bulb operation. Then, seat the speed knob with the "B" calibration aligned properly.

It also helps to make yourself some notes before removing the speed knob. If you have information on the camera -- or if you've worked on the same model before -- you may not need the notes. But on an unfamiliar camera, notes and scribe lines can be great time-savers for reassembly. And save the notes you make for future reference.

For one thing, make a note of the speed-knob settings you use for disassembly. Also, note anything that's unique about the system. As an example, say you're about to remove the speed knob from a Canon FTb. The camera has a mechanically cross-coupled exposure-meter system. At a particular combination of settings -- such as ASA 100 and 1/2 second -- a red warning flag moves into the viewfinder, Fig. 31. The red flag tells you that you're outside the metering range.

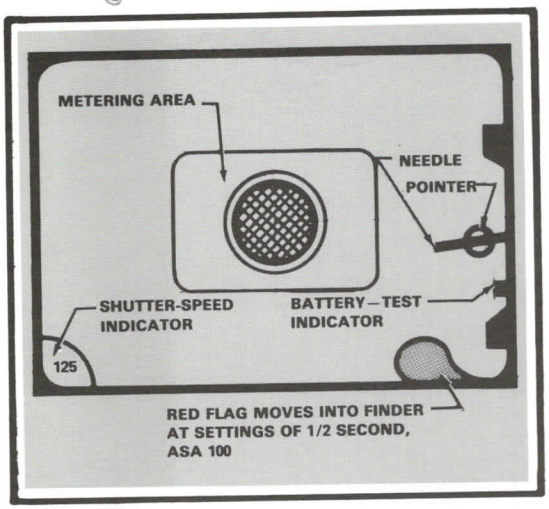


FIGURE 31

That's the type of information you can use in retiming the mechanical linkage system. Plus, it tells you if you've replaced the speed knob properly. As another example, consider again the Mamiya SLR we've been using in the illustrations. This camera uses a center-the-needle system. Looking through the finder, you see the exposure-meter needle as shown in Fig. 32. In use, you just change your diaphragm setting or your shutter-speed setting until the needle centers between the overexposure indication and the underexposure indication.

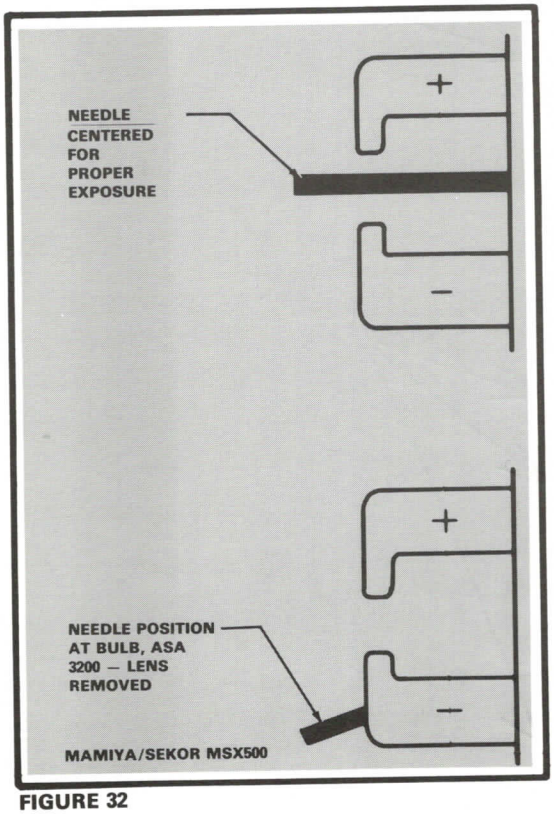


FIGURE 32

A common system. And here, it often helps to note the needle position with the meter turned off and the speed knob at a certain combination of settings. With the Mamiya SLR, you should remove the speed knob at the settings of bulb and ASA 3200. So you might make a sketch of the needle's position at these settings.

Replacing the Mamiya speed knob also illustrates some typical procedures. When you lift off the speed knob, the speed-knob coupler turns as far as it can in a clockwise direction, Fig. 33. The speed-knob coupler is the part that couples the speed knob to the exposure-meter system. In the Mamiya, a chain runs from the speed-knob coupler to the exposure meter. Other cameras may use cords or geared racks for the same purpose.

The post on top of the speed-knob coupler, Fig. 34, must pass into a hole on the underside of the speed knob. However, if you now attempt to seat the speed knob at the bulb setting, you'll find that the post doesn't align with the hole -- you won't be able to seat the speed knob. That's because the spring tension on the exposure-meter system has turned the speed-knob coupler too far in a clockwise direction.

You could rotate the speed-knob coupler a partial turn in a counterclockwise direction. And attempt to hold the speed-knob coupler in position as you replace the speed knob. But an easier technique -- one that works with many systems -- is to first start the speed-knob hole over the speed-knob-coupler

post. Now, turn the speed knob in a counterclockwise direction until the "B" calibration aligns with the index. The speed knob should then drop into place.

Later in your course, we'll cover cross-coupled exposure-meter systems in detail. For now, just be aware that you'll encounter many timing variations. And there's a good chance you'll lose the timing when you remove the speed knob.

LIFTING OFF THE TOP COVER

We mentioned earlier that visible screws normally hold the top cover. It's generally a good idea to *remove the screws first* -- before taking out the wind lever, speed knob, and rewind knob. And replace the screws last. Why? You can then check to make sure everything's working properly before replacing the screws. If something isn't right, you can remove the top cover without taking out all those screws again.

The top cover should now slide off. If it doesn't, take another look at the camera from all sides. You may discover an unusual control or other part that's still preventing you from completely separating the top cover from the camera body. For example, there may be a flashcord terminal that passes through the top cover and screws into the camera body. Or there may be a top-cover retaining ring at either the wind-lever position or the rewind-knob position.

You may also find that you removed a part or an assembly that could have stayed in place -- a part you didn't really need to remove. Replace such a part before proceeding. That'll simplify your reassembly -- and it'll prevent the parts from getting lost by accident.

Once you've freed the top cover, proceed with caution. You might lay the camera on its back as you slide off the top cover. That precaution can prevent loose parts from getting lost. One part that's frequently loose is the **cable-release pin** inside the release button, Fig. 35. An accessory cable release depresses this pin to release the shutter. In some cameras, the entire release button is loose once you pull the top cover.

Also, you may have wires to disconnect. If the flashcord terminal is part of the top cover, you'll normally have to unsolder the sync wire (the wire that runs from the flashcord terminal to the shutter's sync contacts). As you carefully slide off the top cover, watch for any wires you'll have to disconnect.

It's a lot better if you disconnect those top-cover wires yourself (rather than having the wires break or pull loose). You can then make a note as to which wire goes where. Again, simple notes can save you a lot of reassembly time.

Once you've removed the top cover, you may want to replace the wind lever and the speed knob. You can then operate the camera at the various settings to make tests and adjustments.

REMOVING THE LEATHERETTE

Going further in the disassembly normally requires removing the decorative simulated leather at the front of the camera. Very few cameras use genuine leather. Rather, cameras use a simulated leather -- leatherette -- that's made

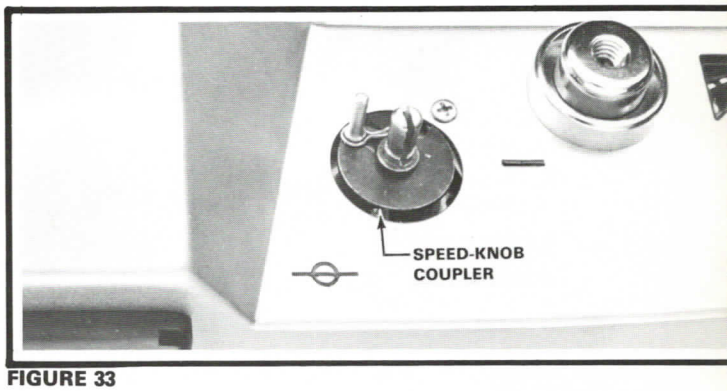


FIGURE 33

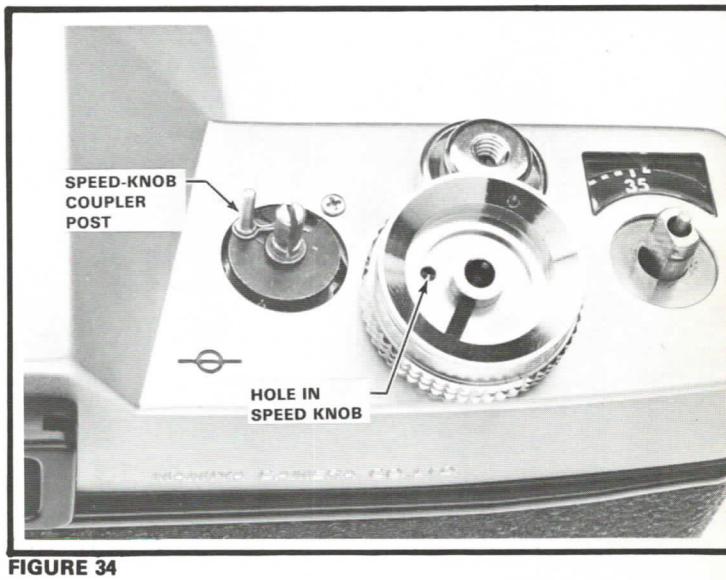


FIGURE 34

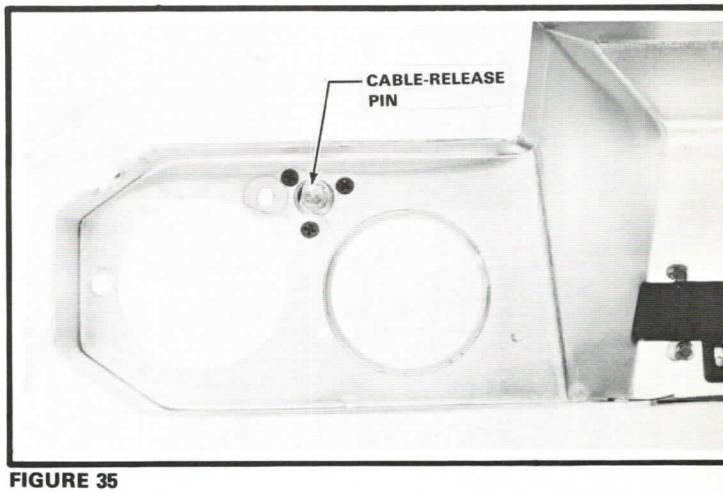


FIGURE 35

FIGURE 36

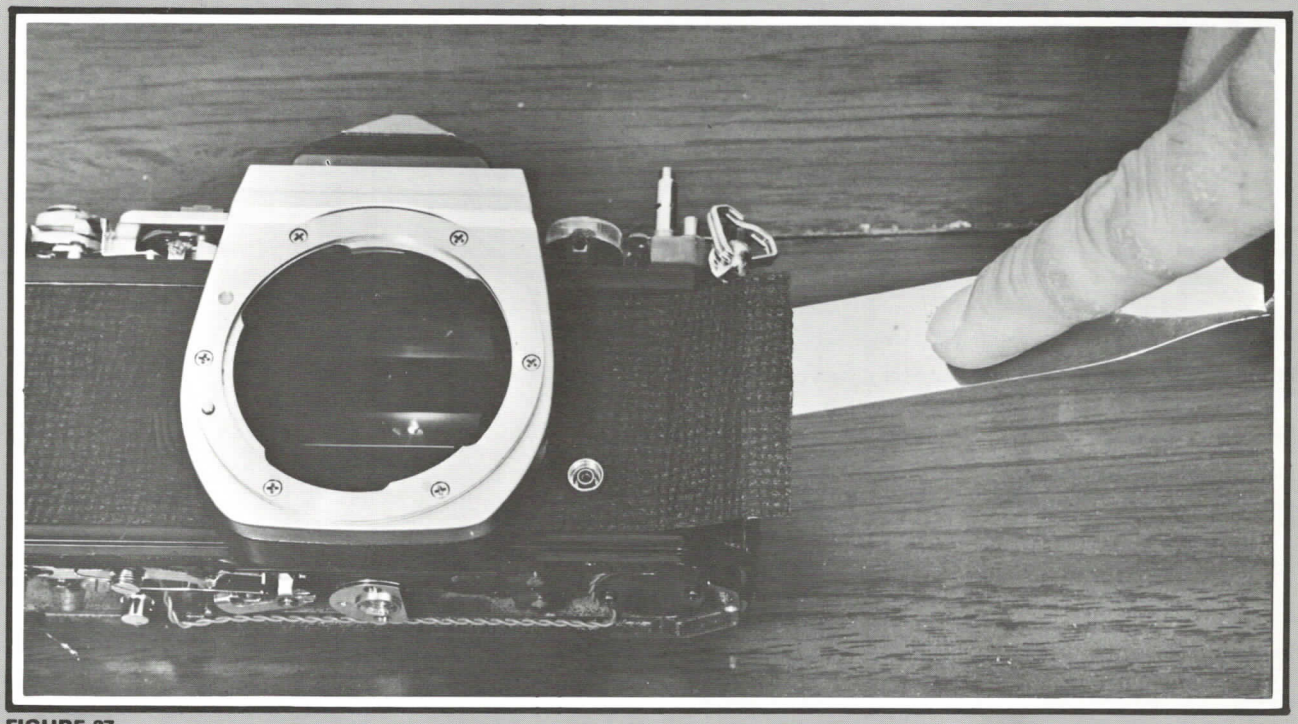


FIGURE 37

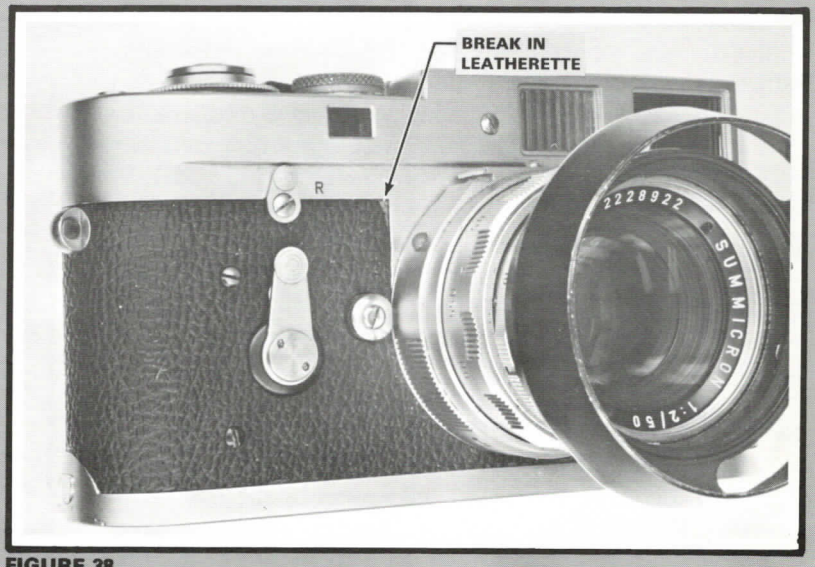


FIGURE 38

from a plastic or cloth material.

Quite often you'll have to remove the camera's front standard. And the front leatherette may cover the front-standard screws. So you'll have to peel off the leatherette to reach the screws. Usually, either shellac or a rubber-base cement (such as Pliobond) holds the leatherette in place.

Some types of leatherette peel off very easily. You may even find that the adhesive on the back of the leatherette remains sticky. You can then replace the leatherette without applying any cement.

But more often, you must recement the leatherette on reassembly. Plus, the leatherette may not be so easy to remove. So here's a basic rule when working on just about any type of camera:

> Replace the leatherette as the very last step in the repair -- after you've completed every other phase of the reassembly and after you've thoroughly checked all the adjustments. That way, you're sure you won't have to remove and replace the leatherette again in correcting a problem. Pulling and replacing the leatherette takes time -- time you don't want to spend more than once

Some leatherettes can be pretty tough to remove without damage. It depends on the type of leatherette and the type of cement the manufacturer (or the last technician) used. You then have to be very careful when you peel off the leatherette. Accidentally stretching or tearing the leatherette spells trouble.

Generally, you can get one side of the leatherette started by using a thin, flat blade. Then, very carefully pull back the leatherette. If the leatherette seems especially stubborn, you can apply a solvent such as alcohol. Use basically the same technique as the one we described for removing cemented decorator plates. However, once you get a section of the leatherette loose, use an air blower to blow off the solvent. If the solvent remains on the leatherette too long, it can damage the appearance.

You might want to make yourself a special tool for removing leatherette. Fig. 36 shows one design made from an artist-type spatula. Grinding a bevel on one side of the blade provides protection. With the beveled side facing up, the blade tends to dig toward the camera body rather than toward the leatherette, Fig. 37.

What if you do damage the leatherette? That depends on the extent of the damage. If you tear the material, it's possible the tear won't show after you replace the leatherette (providing you do a careful, neat job when recementing the leatherette to the camera body).

A frequent problem with the M-series Leicas is that a small chunk of the leatherette breaks away when you pull the top cover. You don't have to remove the leatherette in the Leica camera. But the small break, Fig. 38, does hurt the appearance.

You don't have to replace the complete section of

leatherette to correct the problem shown in Fig. 38. Rather, you can simply "patch" the leatherette -- fill in the break.

The "Monofil" sticks shown in Fig. 39 come in handy for patching small breaks. Patching leatherette isn't the actual purpose of the sticks -- they're for filling in recessed calibrations (such as the shutter-speed calibrations on the speed-setting ring).

To patch the leatherette, just mold a chunk of the Monofil into the break. Then, use a pointed tool to place "dimples" in the shellac -- dimples that match the grain appearance of the original leatherette.

But if you stretch the leatherette during removal, you'll have a problem refitting the leatherette on reassembly. Extensive damage may prevent you from making a satisfactory repair. Remember, customers evaluate your work by appearance as well as by operation. So, if the damage remains noticeable, you should replace the leatherette.

Depending on the camera (whether or not parts are available) you can often buy the leatherette in properly sized sections. And if the leatherette isn't available? Then, you can cut properly shaped sections from bulk leatherette. But custom-fitting a section of leatherette is a time-consuming procedure -- one that you want to avoid if at all possible. It's much better to take a little extra time in removing the original leatherette to avoid damage.

To recement the leatherette, you can use shellac. But leatherette cemented with shellac can be difficult to remove. Most technicians use a rubber-base cement such as Pliobond. Apply a smooth, even coat over the back of the leatherette. Then, give the Pliobond a few seconds to dry. Once the Pliobond becomes "tacky," carefully fit the leatherette to the camera body.

There's a reason for letting the Pliobond dry a little before you seat the leatherette -- you don't have to hold the leatherette in place as the cement dries. Having to sit there, holding the leatherette in place, takes time. And time is one thing you're trying to save.

Also, be careful that you apply a thin, even coat of Pliobond. A glob of cement may flow onto the camera body as you press the leatherette in place. You'll then have to clean off the visible cement (the cement is easier to clean off once it dries). Worse than that, globs of Pliobond can damage certain types of plastic leatherette. The cement actually attacks the plastic, leaving the leatherette with a "mushy" texture.

Rather than Pliobond, you may prefer the glue stick shown in Fig. 40. The glue stick eliminates the mess of Pliobond -- just wipe the glue directly onto the back of the leatherette. Also, the glue stick won't damage the plastic leatherettes.

So the glue stick probably provides the safest, fastest, and cleanest technique for cementing leatherette. Both Pliobond and the glue stick are normally available locally.

In some cases, such as with the Nikkormat EL shown in Fig. 41, you don't even need a cement. All you have to do is moisten the back of the leatherette with acetone. That reac-

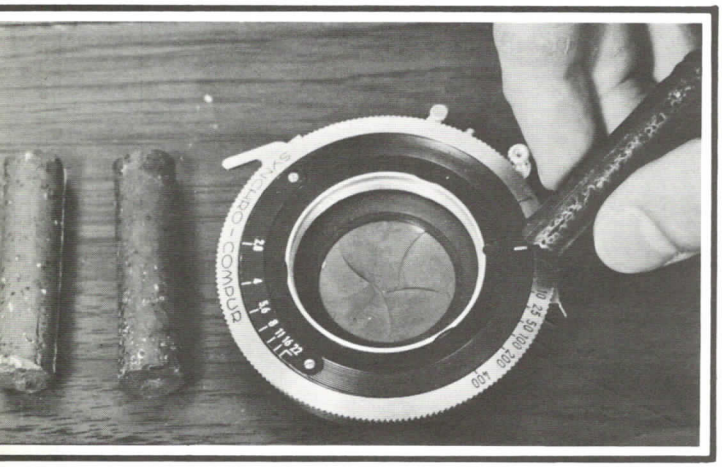


FIGURE 39

"Monofil" sticks for filling in calibrations also work to patch breaks in leatherette.

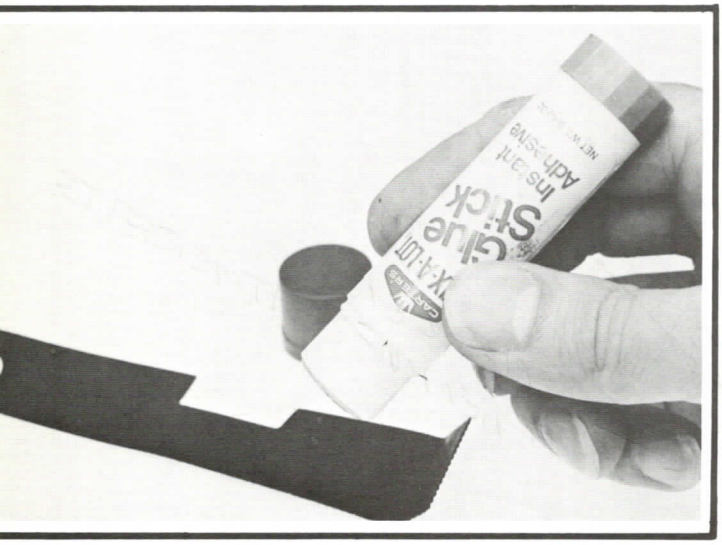


FIGURE 40

tivates the original cement.

Once you're familiar with a particular camera, you can often use shortcuts in removing the leatherette. Many times, it isn't necessary to completely remove the leatherette -- providing you know the locations of the front-standard screws. Just peel back the leatherette far enough to reach the screws, Fig. 41. In Fig. 41, the section of leatherette will stay with the front standard.

The shortcut technique illustrated in Fig. 41 may prevent you from having to remove the self-timer lever. With some cameras, though, the leatherette has a slit to the right of the self timer. So you can then remove the complete section of leatherette with the self-timer lever in place. Most Canon SLR's have this type of leatherette.

Some people prefer to peel back the leatherette from the front standard as shown in Fig. 42. They then leave the leatherette cemented to the camera body (another shortcut technique). Here, it helps to tape the leatherette away from the lens standard, Fig. 43 -- that prevents the leatherette from getting in your way.

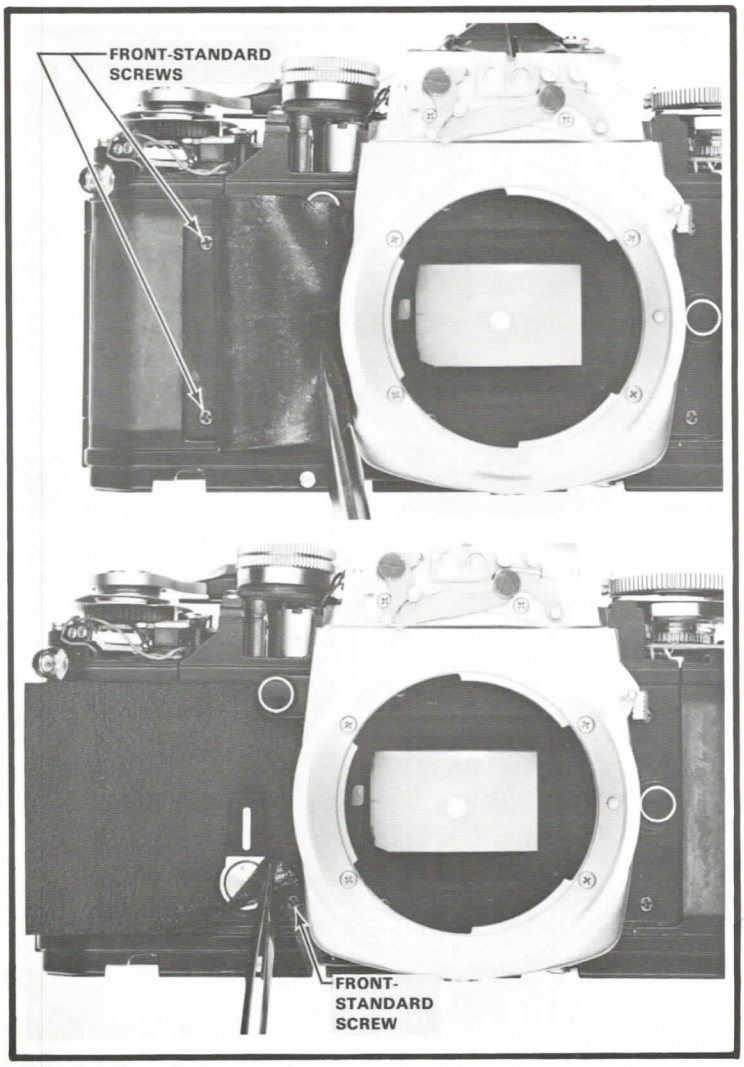


FIGURE 41

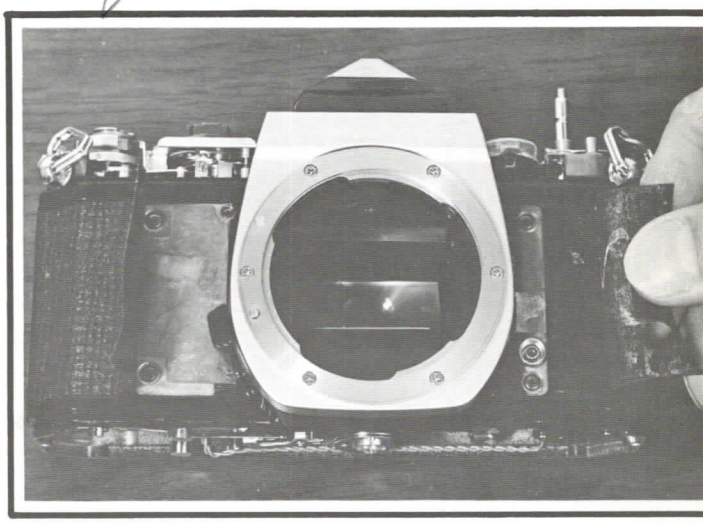


FIGURE 42

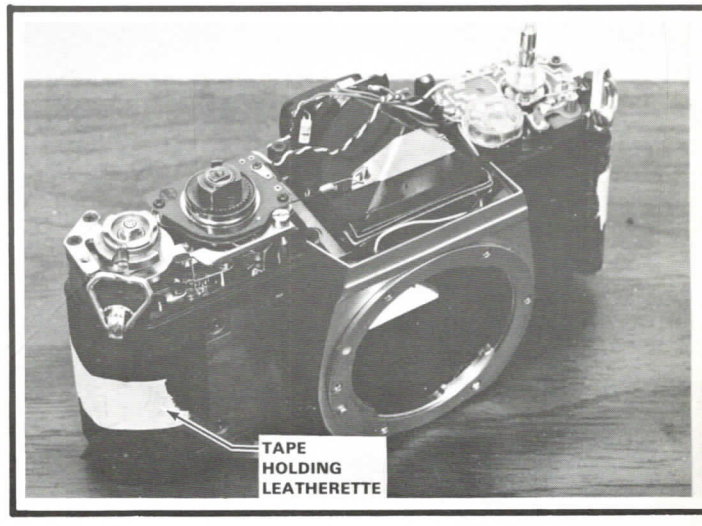


FIGURE 43

TEST-YOURSELF QUIZ #3

1. What is the normal shutter-speed setting you should set before removing a speed knob? BULB @ ASA 3200

2. You've just lifted off the top cover of a 35mm camera. Name two parts you should watch for that may be loose:

   1. CABLE-RELEASE PIN

   2. RELEASE BUTTON

3. Quite often you must unsolder wires to remove the top cover. These wires normally go to the FLASH SYNC terminals.

4. You're removing the front standard of a camera. However, you can't see any screws holding the front standard. The front-standard screws are probably hidden by the LEATHERETTE.

5. Consider that you're in the process of reassembling a 35mm camera which has been completely disassembled. What should be the very last step in the reassembly?

   REPLACING THE LEATHERETTE

REMOVING THE FRONT STANDARD

What's the main reason for removing the front standard? It's normally to gain access to the shutter mechanism -- leaf-type or focal-plane. With a focal-plane shutter, you can plan on removing the front standard. But you can remove some leaf-type shutters without touching the front-standard screws.

For example, consider a bellows-type folding camera. Often, a retaining ring holds the shutter to the front standard. The retaining ring is threaded to the rear lens-mounting flange of the shutter.

Most of these retaining rings have notches or slots. So you can use your Multispan wrench to unscrew the retaining ring. Just insert the Multispan wrench through the back of the focal-plane aperture. Then, unscrew the retaining ring and lift off the shutter mechanism.

Whether you remove the retaining ring with the bellows collapsed or extended depends on the particular camera. Collapsing the front standard places the retaining ring closer to the back of the camera. It's then easier to reach the retaining ring. However, you may find that the retaining ring is partially covered by the bellows. So there's an increased danger that you'll tear the bellows with your Multispan wrench.

Once you remove the retaining ring use caution in lifting off the shutter -- there may be spacers positioned between the shutter housing and the front standard. The spacers serve two basic purposes:

IMPORTANT

1. they provide enough clearance between the shutter housing and the front standard for operation of the cocking and release linkages
2. they position the lens and shutter precisely the correct distance from the film plane.

So the spacers are critical. Make sure you return the spacers to their original positions before reinstalling the shutter assembly.

The procedure for removing a leaf-type shutter from a 35mm rangefinder-type camera is quite similar -- although a little more complicated. A retaining ring still holds the shutter. But, unlike the retaining ring in the folding camera, that retaining ring may not be accessible with the camera fully assembled. Consequently, removing the retaining ring often requires an additional step in disassembly -- removing the front standard to gain access to the retaining ring.

Fig. 44 shows a typical 35mm rangefinder-type camera from the rear. Note the slotted retaining ring that holds the shutter to the front standard. You can actually see two retaining rings in Fig. 44. When you can see more than one ring, *the ring with the largest diameter is the one that holds the shutter.* The smaller retaining ring in Fig. 44 just holds the rear lens element to the rear of the shutter housing.

Also notice the cone-shaped light baffle that prevents you from removing the retaining ring, Fig. 44. The light baffle attaches to the camera's body casting. And there's only one way you can remove the light baffle -- from the front of the camera after removing the front standard.

In Fig. 45, we've removed the leatherette from our representative camera. Locate the four front-standard screws (only two are visible in the illustration). Removing these four screws allows you to lift the entire front standard (with the shutter assembly still attached) from the camera body.

It's normally easy to reach the front-standard screws once you remove the leatherette. But if you can't locate the screws, it's possible they could be hidden by a nameplate or other decorative part. That part may be cemented in place. Or it could have screws of its own.

Here's another variation -- the front-standard screws may thread into the front standard from the back. You'll be able to locate the screws inside the camera. Just open the camera back.

You'll probably find one or more wires attached between the shutter assembly and the camera body. And you'll have to detach these wires before you can completely separate the two assemblies. You can simply unsolder one end of each wire (the end that's easier to reach). Or you can snip the wire at any convenient point along its length. To reconnect the wire, just splice the two wire sections together. Use heat-shrink tubing or plastic tape to insulate your splice.

There's one advantage to snipping the wire. Since you have both ends still attached, you need only line up the two loose ends and make the splice. And, if there's more than one wire, you won't have to note connection points. Just match the color codes and make your splice. The drawback -- it takes more time to strip and splice wires than it does to simply resolder them.

With the front standard now removed, Fig. 46, you can easily reach the retaining ring. Sometimes manufacturers lock the retaining ring with a locking agent. So it often helps to apply a little solvent (or heat) to the retaining-ring threads. But

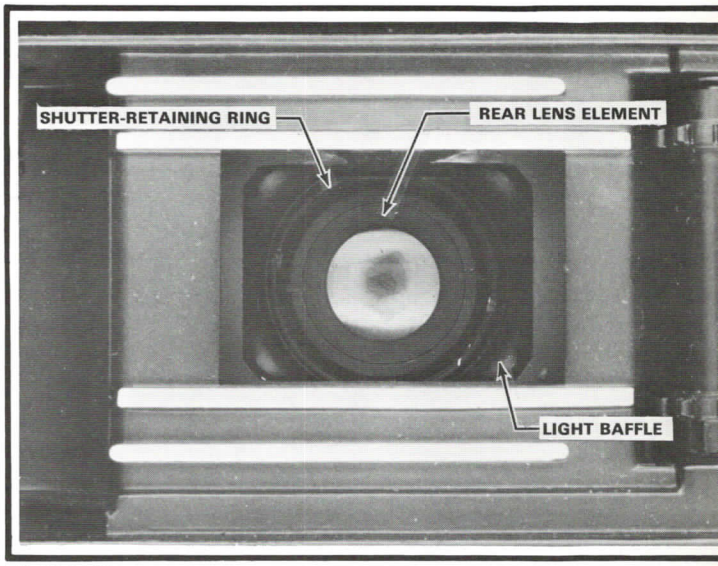


FIGURE 44

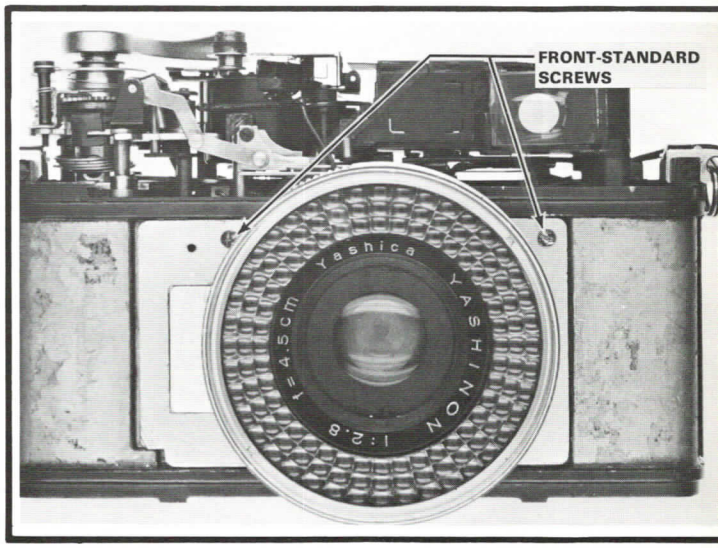


FIGURE 45

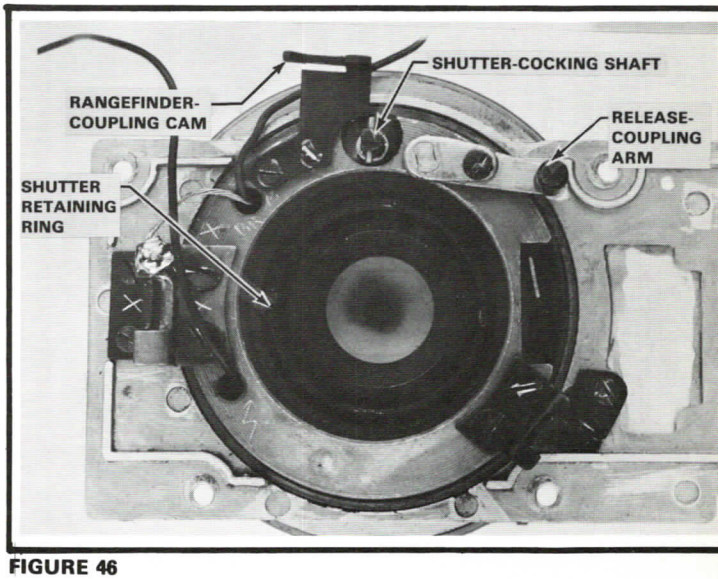


FIGURE 46

before removing the retaining ring, take a look at the camera linkages which cock and release the shutter.

BIG NOTE

CAUTION: Never set the front-standard/shutter assembly on its back. Several parts normally protected by the camera body are now exposed. Resting the entire weight of the shutter assembly on these parts can easily cause damage.
If you wish to work on the front of the shutter assembly at this time, temporarily replace the front standard on the camera body. That protects the parts on the back of the front standard.

On the back of the front standard, locate the shutter-cocking shaft, the release-coupling arm, and the rangefinder-coupling cam, Fig. 46. These parts must align properly with their mating parts in the camera body -- the cocking pinion, the release shaft, and the rangefinder-cam follower, Fig. 47. Also locate the light baffle -- this is the part that prevented your removing the retaining ring with the lens standard in place.

How about aligning those coupling parts? Look first at the cocking pinion, Fig. 47. The two slots in the cocking pinion fit over the two ends of the pin through the cocking shaft, Fig. 46.

With the wind lever in the "ready" position, the cocking-pinion slots are at 12 o'clock and 6 o'clock. And, with the shutter released, the two ends of the pin through the cocking shaft match the cocking-pinion position. So release the shutter before replacing the front standard. Then, as you seat the front standard, watch to make sure the cocking shaft seats properly inside the cocking pinion.

The cocking pinion rotates as you advance the wind lever. So the cocking pinion turns the cocking shaft. And the cocking shaft cocks the shutter through some additional linkage.

Another coupling part, the release-coupling arm, Fig. 46, sits just below a horizontal tab on the release shaft, Fig. 47.

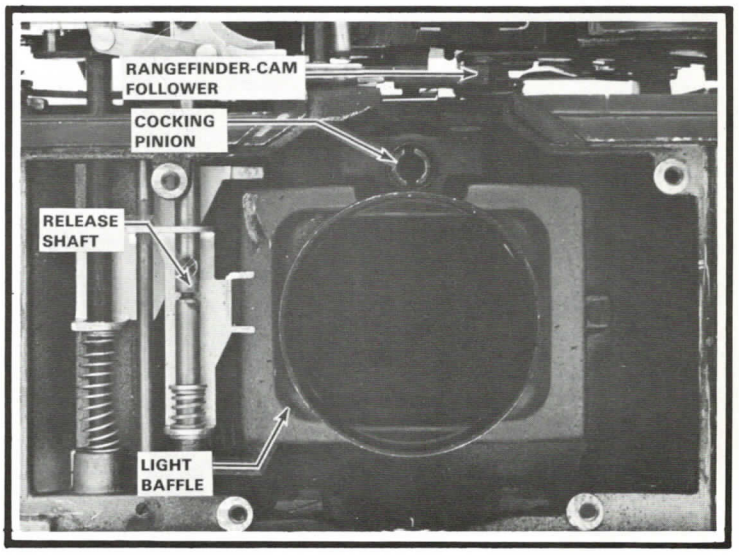


FIGURE 47

Pushing the release button moves down the release shaft. The horizontal tab then pushes down the release-coupling arm. That releases the shutter through linkage on the back of the shutter assembly.

The final coupling part, the spring-loaded rangefinder-cam follower, contacts the rear of the rangefinder-coupling cam. The rangefinder-coupling cam, Fig. 46, attaches to the focusing mount in the front standard. So the rangefinder-coupling cam moves in or out as you focus the camera's lens.

As you replace the front standard, the rangefinder-coupling cam will couple automatically with the rangefinder-cam follower. You'll cover rangefinders and coupled rangefinder systems in a later assignment.

SHUTTER COCKING AND RELEASE LINKAGES

Once you understand the coupling between the front standard and the camera body, you can remove the lens/shutter assembly. Just unscrew the larger of the two retaining rings, Fig. 46.

Fig. 48 shows the back of the shutter assembly. The helical focusing mount and the linkages to the camera body remain with the front standard, Fig. 49.

Locate the round end of the cocking shaft in Fig. 49. The pin shown in Fig. 49 sits just below the end of the cocking lever of the shutter, Fig. 48. As the cocking shaft rotates, the pin pushes up the cocking lever. And, since the cocking lever attaches directly to the shutter's main lever, this action cocks the shutter.

When you allow the wind lever to return, the cocking pinion in the camera body turns clockwise. So the cocking pinion returns the cocking shaft, Fig. 49, to the "ready" position. Now, the cocking-shaft pin is out of the way of the cocking lever, Fig. 48. And the cocking lever can snap back to the released position when you trip the shutter. That readies the whole system for the next cocking cycle.

Fig. 49 also points out the other end of the release-coupling arm. The two ends of the release-coupling arm are staked to a rod running through the front standard. When the release shaft (in the camera body) pushes down the release-coupling arm, Fig. 49, the end shown in Fig. 49 moves down --toward the lens opening.

The end of the release-coupling arm shown in Fig. 49 comes against the pin on the **release-ring lever,** Fig. 48. And one end of the release-ring lever comes against a roller on the **release ring.**

So the release-coupling arm, Fig. 49, pushes down the release-ring lever. In turn, the release-ring lever pushes down the roller on the release ring. That forces the release ring to turn in a clockwise direction, Fig. 48. The tab on the release ring extends into the shutter mechanism -- this is the tab, Fig. 48, that disengages the shutter's inner release lever from the shutter's main lever.

The coupling linkages we've been describing vary from camera to camera. So it's not important for you to try and memorize the actions in our representative camera. The point

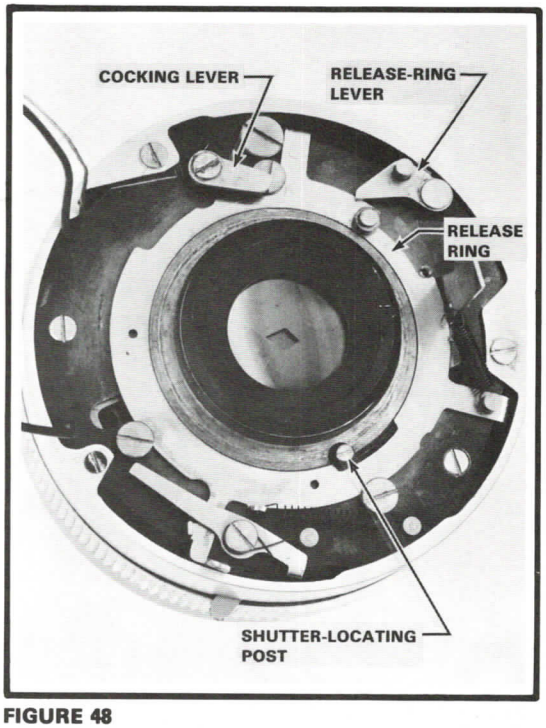


FIGURE 48

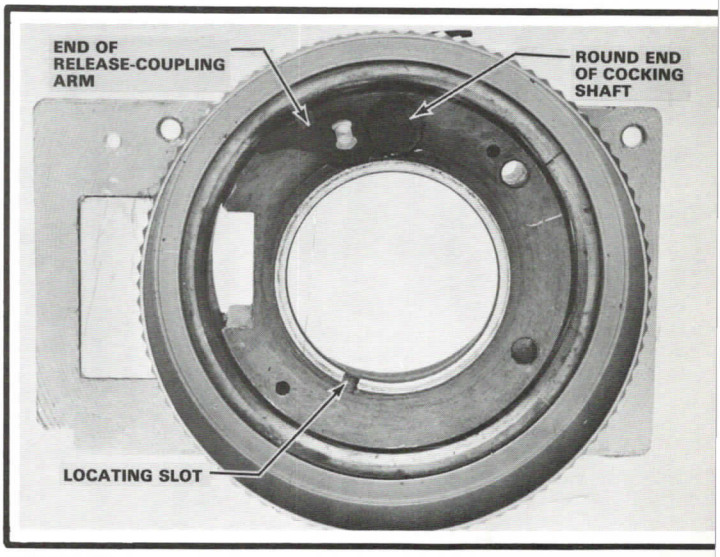


FIGURE 49

is that you should study the parts -- and understand their functions -- before proceeding with the disassembly. Then, you won't lose time on reassembly by having to figure out the operation.

But there's one part pointed out in Fig. 48 that's common to nearly all leaf-type shutters -- the shutter-locating post. The shutter-locating post screws into the rear of the shutter housing.

When you replace the lens/shutter assembly, the shutter-locating post must pass into the locating slot, Fig. 49. Keying the shutter to the front standard assures that the cocking and releasing linkages align properly. So use the locating post and the slot as your guides in replacing the shutter.

There's an additional function of the locating post -- it assures that the cocking and releasing action won't cause the shutter to rotate out of its proper position. In fact, you may encounter a few older cameras that don't use the locating post -- they just rely on the tightness of the retaining ring to hold the shutter properly oriented. And the most common malfunction in these cameras? The shutter rotates slightly through the continued cocking and releasing actions. As a result, you can no longer cock and release the shutter.

OLDER MODELS / SERVICE NOTE

REPLACING THE FRONT STANDARD

The disassembly of the shutter mechanism from this point follows the common leaf-shutter procedures you've already learned. And reinstalling the shutter on the front standard -- as well as reinstalling the front standard on the camera body -- is basically the reverse of the disassembly. But there are some tips that apply to most cameras of this type.

Let's say that you've replaced the front standard. And you've verified that the critical linkages are properly connected. You should now test the operation of the camera as a unit.

It's good practice to replace all of the front-standard screws before testing the operation. Otherwise, the front standard may be shifted by the cocking and releasing actions. With most cameras of this type, the front standard has quite a bit of free movement until you install the screws. Here's the proper method for replacing the screws:

> Position the front standard with the four screw holes aligned. Then, install the four retaining screws one at a time. But just start the screws into the holes -- don't tighten any of the screws fully until you've installed them all. If you tighten one of the screws before replacing the others, the front standard may seat incorrectly. So there'll be unnecessary stress on both the camera body and the front standard.

TEST-YOURSELF QUIZ #4

1. What type of part normally holds a leaf-type shutter to the front standard? RETAINING RING

2. When lifting off the front standard, be on the lookout for loose SPACERS / WASHERS.

3. You want to remove a leaf-type shutter from a camera. But you can't reach the shutter's retaining ring with the camera assembled. What major assembly must you remove before you can reach the retaining ring?
FRONT STANDARD

4. You can see two notched retaining rings at the back of a leaf-type shutter. Which of the two retaining rings actually holds the shutter?

   (A) the larger retaining ring

   B . the smaller retaining ring

5. What does the other retaining ring in question #4 hold?
REAR LENS ELEMENTS

6. You see a fixed post at the back of a leaf-type shutter. On reassembly, key this post to the slot in the FRONT STANDARD SLOT.

ADJUSTING THE TRANSPORT LATCH

Once you've replaced the front standard, install the wind lever to test the operation. Most cameras latch the wind lever at the end of the cocking stroke. Consequently, you can't advance the wind lever a second time -- you must first release the shutter.

Locate the transport latch in Fig. 50. At the end of the wind cycle, the transport latch drops into engagement with a cam on the wind shaft. That latches the wind mechanism.

The transport latch automatically disengages during the release stroke. That means some part of the release linkage

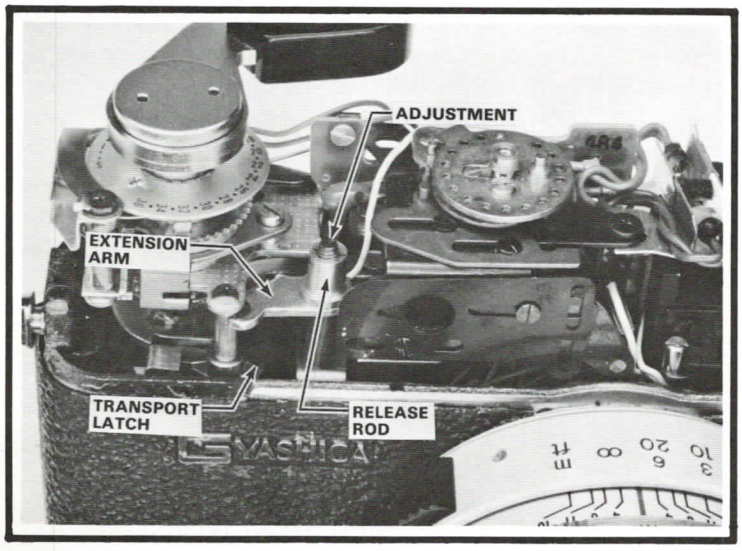


FIGURE 50

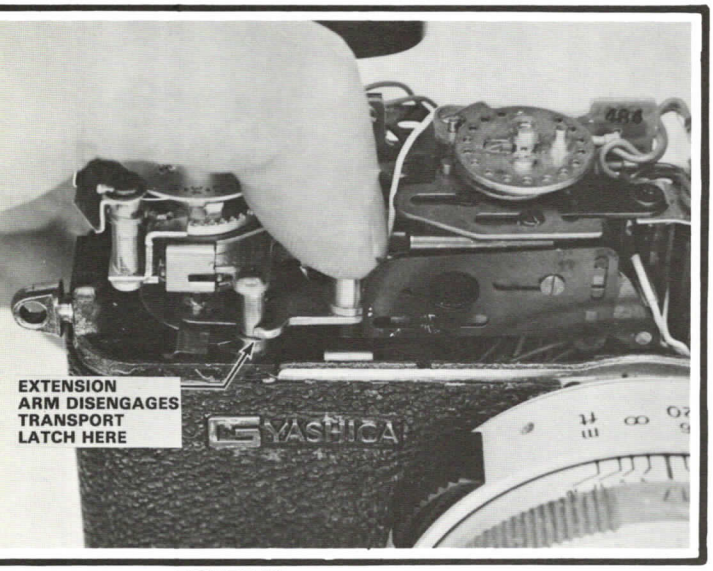


FIGURE 51

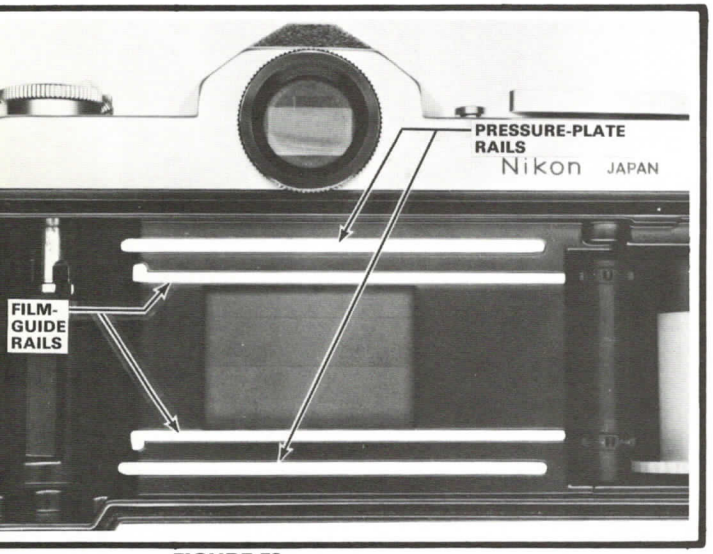


FIGURE 52

FIGURE 53

must disengage the transport latch from the wind mechanism. The camera shown in Fig. 50 has an extension arm connected to the release rod. Depressing the release rod brings the extension arm against the transport latch, Fig. 51. And, as the shutter releases, the extension arm causes the transport latch to swing out of engagement.

There are many variations in the actual latching and releasing linkages -- Fig. 50 and Fig. 51 just show one example. Yet there's one general rule you can apply to all these systems:

The transport latch should disengage at the same time as the shutter release.

Consider what happens when the transport latch disengages after the shutter releases. Maybe the photographer has a light touch on the release button. He then pushes the release button far enough to release the shutter -- but not far enough to disengage the transport latch. And he discovers he can't advance the wind lever for his next exposure.

Or, perhaps the transport latch disengages before the shutter releases. The photographer with a light touch may then push the release button far enough to disengage the transport latch -- but not far enough to release the shutter. He can then wind the film to the next frame without getting an exposure.

Most systems provide an adjustment on the disengaging linkage. Just watch the transport latch as you slowly push down the release rod. See if the transport latch disengages at the same time as the shutter releases.

The adjustment in Fig. 50 is on the release rod. Notice that the release rod has a screwdriver slot in its upper end. Turning the release rod with your screwdriver moves the extension arm up or down. If you move down the extension arm, the transport latch disengages sooner in the release cycle -- the release rod doesn't have to move as far to bring the extension arm against the transport latch.

OTHER FRONT-STANDARD PRECAUTIONS

The camera we disassembled for illustration purposes has a fixed lens -- you can't interchange lenses. But suppose you're working on a more sophisticated camera that does accept interchangeable lenses. There may then be some additional precautions in removing the front standard.

Manufacturers often use spacer washers or shims to control the lens-to-film distance. You may find these spacers under the lens-mounting ring. Or the spacers may be under the front standard.

So, before removing the front standard, keep in mind that you may uncover spacers. The spacers normally go around the screw holes in the camera body. Sometimes, you'll find that cement holds the spacers in position. But more often, the spacers will be loose once you pull the front standard. And the placement of those spacers is critical.

As we mentioned, the spacers control the distance between the lens and the film -- the flange-focal distance. Factory service manuals often specify what the flange-focal distance

should be. However, the manuals don't always tell you the exact points of measurement.

Normally, the flange-focal distance defines the distance between the lens seat (the surface on which the lens sits) and the film-guide rails, Fig. 52. But some manufacturers measure instead to the pressure-plate rails, also pointed out in Fig. 52. It does make a difference. The inner film-guide rails sit slightly lower than do the outer pressure-plate rails. Consequently, the pressure-plate rails hold the pressure plate a slight distance from the film.

Let's take an example. The Canon service manual specifies a flange-focal distance of 42.14mm for SLR's using the FD lenses. However, Canon doesn't mention that they're measuring to the pressure-plate rails. Measuring to the film-guide rails, the flange-focal distance is 41.9mm.

So, even if you have the factory specification, there may be some question as to the proper flange-focal distance. In that case, you might measure the distance prior to disassembly. Here, you need a flat block that fits the film-guide rails, Fig. 53. In Fig. 53, we're using a gage block. However, you can also use a piece of flat glass or any other flat object that fits the film-guide rails.

Then, hold open the shutter on "bulb" or "time." And use a depth micrometer or depth vernier to measure the distance between your focal-plane block and the lens-mounting surface, Fig. 54.

Besides controlling the flange-focal distance, the spacers control the parallelism -- the parallelism between the lens-mounting surface and the film-guide rails. You can also use a depth micrometer to check parallelism. Measure the flange-focal distance at several points around the lens-mounting surface. All your measurements should be within 0.02mm of the specified flange-focal distance.

But there are more precise ways to check parallelism. We'll cover other techniques in your assignments on optics and lens systems. For now, just be aware that the spacer positions are critical. And they vary from camera to camera. So pay close attention to the number, sizes, and locations of any spacers or shims you encounter. Then, replace the spacers the same way you found them. That way, you won't disturb the adjustments.

What would happen if you did disturb the flange-focal adjustment? You may then find that the lens won't focus properly at infinity. It may be possible to adjust the lens to take care of the problem. However, suppose the camera owner installs a different lens. He'll have the same problem again.

Some cameras use a more sophisticated technique for adjusting the front standard. Fig. 55 shows the Minolta SRT-101 with the front standard removed. Note the four screws (one next to each of the threaded holes that accept the front-standard retaining screws).

These four screws provide the support points for the front standard. Rather than using shims or washers, just turn the support screws in or out. That way you can raise or lower the four corners of the front standard independently. Clearance

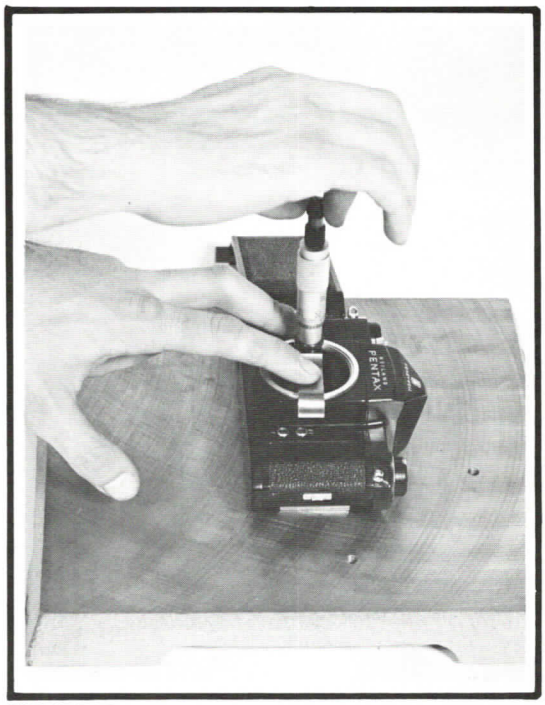


FIGURE 54

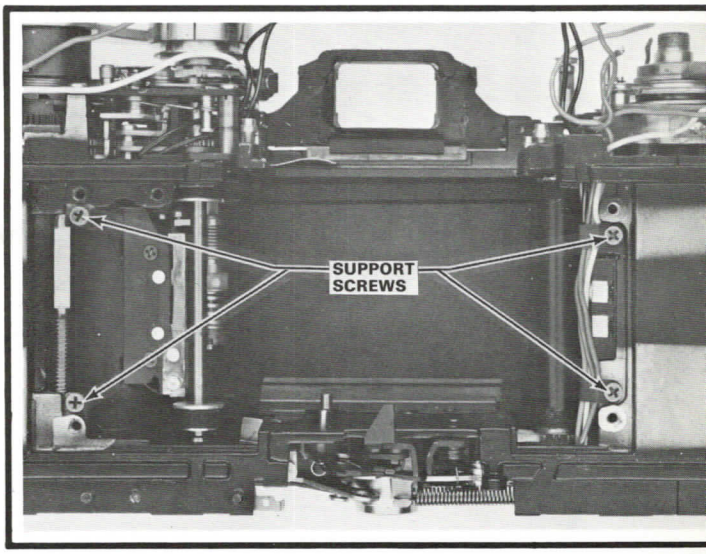


FIGURE 55

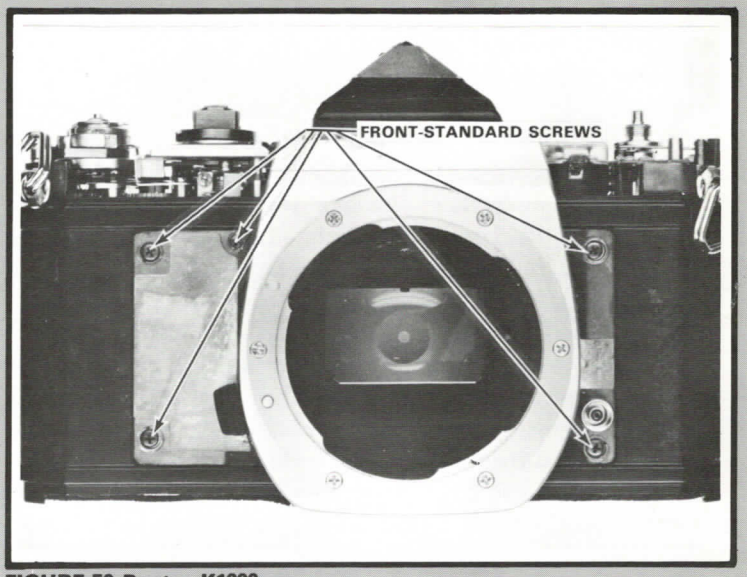


FIGURE 56 Pentax K1000

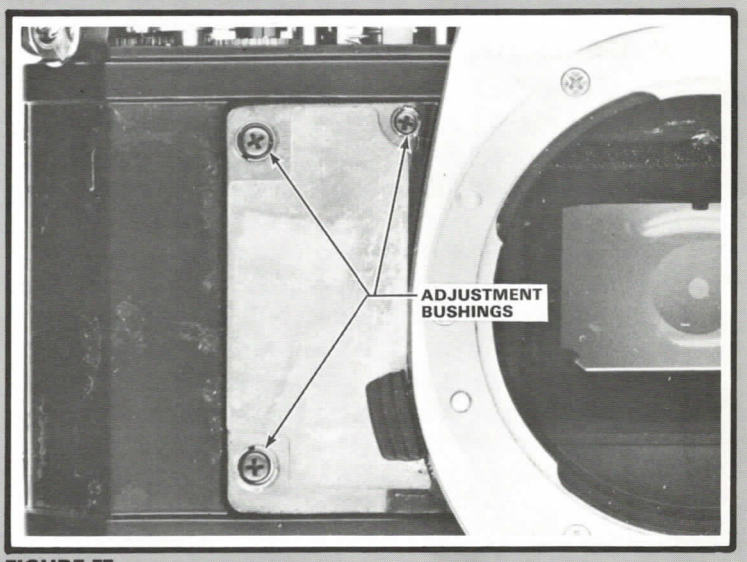


FIGURE 57

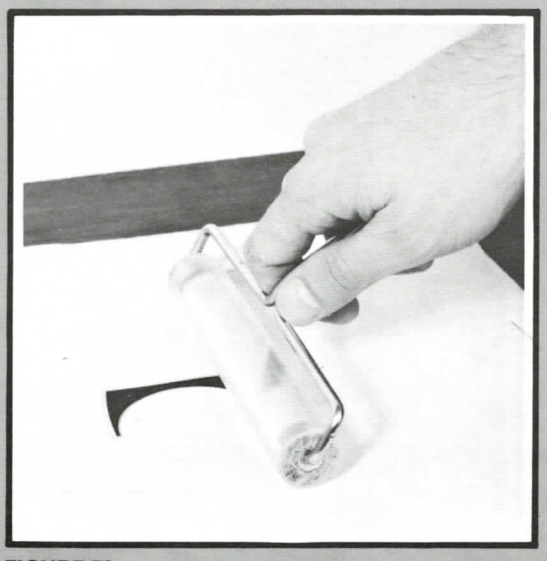


FIGURE 58

FIGURE 59

holes in the front standard allow you to reach the support screws with the front standard installed.

As another example, consider the Pentax shown in Fig. 56. Five screws hold the front standard. And there's a threaded bushing concentric with each screw. To adjust the front standard, first loosen the retaining screws. Then turn the bushings in or out until the flange-focal distance and the parallelism are correct. Finally, tighten the retaining screws to lock the bushings in place.

The Pentax system makes the process of adjusting the front standard relatively easy -- a lot easier than using shims. But there's also a disadvantage. You're likely to turn the bushings when you remove the front-standard retaining screws.

NOTE

So, before removing the retaining screws, you might scribe the position of each bushing with respect to the front standard. Realigning your scribe marks on reassembly puts the bushings in their original positions. That should eliminate -- or at least minimize -- the need for readjustment.

REASSEMBLY TIPS

The appearance of your finished work is vitally important. The customer will judge your efforts by how the camera looks -- as well as by how the camera works.

Be very thorough in your final check-out. Remember to test every function of the camera. How can you be sure you haven't missed anything? You might try putting yourself in the place of the customer. Pretend you're checking your own camera prior to an important picture-taking assignment.

CHECK EVERYTHING

Then, when you're satisfied that the camera is working properly, wipe off all fingerprints from the body. And make sure all the lens surfaces are clean.

How about restoring those nameplates and trimplates? As you've learned, it's pretty tough to remove cemented plates without cosmetic damage. Yet if that nameplate or trimplate doesn't have a like-new appearance, you'll be faced with a most unhappy customer. To many people, a camera is like a piece of jewelry; it has to look perfect.

In some cases, you may have to replace a damaged nameplate with a new part. But you can usually straighten a bent nameplate or trimplate. Fig. 58 shows one technique. Here, we're using a roller (available through artist supplies) to straighten the plate. Also notice that the nameplate is on a cushioned pad. The pad has a foam backing which allows you to "roll out" the bend.

TOOL

And be sure to touch up any defects in painted surfaces --whether or not you're responsible for the chipped paint. You can use a gloss black lacquer for external painted surfaces. Internal surfaces, though should be a dull black -- for example, inside the mirror cage of an SLR. Use dull black brushing lacquer, such as that shown in Fig. 59, to touch up inside surfaces.

TOUCH-UP

For one more touch of professionalism, place the camera in a plastic bag before returning it to the customer. You'll be surprised at how the initial impression pays off!

IMPORTANT

TEST-YOURSELF QUIZ #5

1. The transport latch should disengage

   A . before the shutter releases

   B . after the shutter releases

   (C) . at the same time as the shutter releases

2. The flange-focal distance is the distance between the lens-mounting ring and the FILM.

3. Spacers under the lens-mounting ring or under the front-plate assembly may be used to adjust the flange-focal distance and the PARALLELISM.

4. Some cameras use threaded bushings in the front standard rather than using spacer washers. To save time on reassembly, you want to avoid disturbing the adjustments on the threaded bushings. You could use a locking agent to lock the bushings in position. What is another technique you can use? SCRIBING.

SUMMARY

SUMMARY

In this assignment, you've covered general disassembly techniques that apply to many cameras. You'll put these principles to work as you study specific camera designs.

One of the basic disassembly rules you've learned is to remove the bottom cover first. Normally, you should reassemble in the reverse order of disassembly. However, the last thing you should replace on reassembly is the leatherette -- even though you didn't remove the leatherette first.

Top-cover disassembly usually requires removing the wind lever, the speed knob, and the rewind knob. You've learned that most rewind knobs simply screw onto the rewind shaft. Also remember the "normal" settings for removing the speed knob -- bulb and the fastest film speed. As always, though, there are many exceptions to this general rule.

The techniques and precautions for removing the front standard hold true in most 35mm cameras. You normally have to peel off the leatherette to reach the front-standard screws. And you must watch for loose spacer washers under the front standard.

TEST INSTRUMENT

Those spacer washers control the flange-focal distance and the parallelism. The flange-focal distance is the distance between the lens mount and the film. You've studied one technique for measuring the flange-focal distance. Later in your course, you'll learn how to test for parallelism using optical measurement rather than mechanical measurement. The optical test using an autocollimator is much easier and much more accurate.

Always keep screws and washers with their associated parts during disassembly. If you mix up the screws and washers, you'll waste a lot of reassembly time. And be sure to clean all external parts -- including the carrying case -- before returning the camera to the customer. A "showcase-new" appearance gives the customer a good impression of your work.

ANSWERS TO TEST-YOURSELF QUIZZES

QUIZ #1

1. Remove the **bottom cover** first.
2. The part may have a **left-hand** thread.
3. Remove the battery before removing the **bottom cover.** Otherwise, the battery may fall out and get lost or damaged.
4. The three parts you normally have to remove to take off the top cover are the **wind lever,** the **speed knob,** and the **rewind knob.**
5. **Heat** often works to soften cements.
6. Look for **setscrews** that may be locking a threaded part.

QUIZ #2

1. This counter dial should return to the **"S" calibration** (selection "B"). The "S" indicates "start."
2. It should take **three wind-lever strokes** to reach the "1" position. The first wind-lever stroke advances the counter dial from the "S" position to the first dot. The second wind-lever stroke advances the counter dial to the "0" calibration. The third wind-lever stroke advances the counter dial to "1," the first film-frame position.
3. The spring washer holds the wind lever in the "ready" position (a slight distance from the camera body).
4. Remove the rewind knob by **unscrewing** it from the rewind shaft.

QUIZ #3

1. The speed knob should normally be set to **bulb.**
2. Watch for a loose **cable-release pin** and a loose **release button.**
3. The wires normally go to the **flashcord** terminals.
4. The **leatherette** probably covers the front-standard screws.
5. Replace the **leatherette** (or other cemented parts, such as nameplates) last.

QUIZ #4

1. A **retaining ring** normally holds a leaf-type shutter to the front standard.
2. Watch for loose **washers** as you pull the front standard.
3. You'll probably have to remove the **front standard** to reach the retaining ring.
4. The **larger retaining ring (A)** holds the shutter.

5. The smaller retaining ring holds the **rear lens element.**
6. Key the shutter's locating post to **the slot in the front standard.**

QUIZ #5

1. The transport latch should disengage **at the same time as the shutter releases (C).**
2. The flange-focal distance is the distance between the lens-mounting ring and the **film.**
3. The spacers control the flange-focal distance and the **parallelism.**
4. You can either lock the bushings or **scribe their adjusted positions.**