Section 12—The Screw-Mount Leica

Leica cameras are favorites of collectors. The name "Leica" came by joining the factory name (Leitz) with "camera." Some Leica models are very valuable. But just about all models bring a good price when they are in operating condition.

The first production Leica appeared in 1925 and was supplied in two models—one with a focal-plane shutter and one with a Compur shutter. After that, the drum-type focal-plane shutter became a Leica standard. Very few collectors can boast about having an original production model.

Leica a and b models are also rare—and highly valued. It's unlikely you'll see one for repair. But many collectors do have one or more of the screw-mount Leicas dating from the 1940's—"screw-mount" means the camera has a screw-mount lens rather than the bayonet-mount lens introduced in the M-series Leicas.

The IIIc was introduced in 1940. If you find one of the original IIIc models, it's even more valuable—the original IIIc has a red curtain. The Ic and IIc came slightly later.

But the Leica IIIf may be the screw-mount Leica you see most frequently. Introduced in 1950, the Ill has two variations—the red-dial Leica and the black-dial Leica. The names come from the color of the calibrations on the flash-sync dial under the speed knob.

Moving the flash-sync dial changes the length of the sync delay. In the days of flashbulbs, the Leica photographer could set the sync delay according to the shutter speed and to the type of flashbulb. But these days, you only need the electronic-flash settings. These are:

black-dial Leica—1/30 second, flash-sync setting 2.
red-dial Leica—1/25 second at the flash-sync setting of 0 or 1/50 second at the flash-sync setting of 20.

When you're checking the flash sync with a Leica Ill, set the combination of settings indicated above. You should then get a full aperture with electronic flash.

There's also a difference in the shutter-speed range between the red-dial and black-dial models. With the red-dial Leica, the three slowest slit-width shutter speeds are 1/25 second, 1/50 second, and 1/75 second. The black-dial Leica has more conventional shutter speeds—1/30 second, 1/40 second, and 1/60 second.

Either model may or may not have a built-in self-timer. Models with the self-timer are slightly more valuable to collectors. And, depending on the condition, the red-dial IIIf is slightly more valuable than the black-dial IIIf.

There's also an army version of the IIIf that is all black. But it's unlikely you'll see one. If you do come across a black IIIf, handle it gently—it's worth several times as much as the other versions.

The If and IIf, simplified versions of the III, came a little later. The last of the screw-mount Leicas, the Ill, is very similar to the IIIf, The IIIg has a more sophisticated viewfinder that shows automatic frame lines for 50mm and 90mm lenses. Also, the IIIg has a simplified flash-sync system. There's also a Ig, but this limited-production camera is very rare—and very valuable.

For illustration purposes, we'll use the Leica IIIf. Many of the Leica IIIf features serve to illustrate the fundamentals of 35mm cameras. So, as we go through the Leica IIIf, we'll point out the features that are typical of 35mm design. If you want to learn more about 35mm design features, such as film transport systems, please refer to the Alii companion publication, *Camera Technician's Guide.*

FEATURES OF THE LEICA IIIf

The shutter in the Leica IIIf is similar to the drum-type design discussed earlier. The wind knob at the top of the camera both cocks the shutter and advances the film—just turn the wind knob in its arrowmarked direction. Notice that the speed knob rotates at the same time. The speed knob rotates with the curtain drum.

After cocking the shutter, lift and turn the speed knob to set the shutter speed. The slowest slit-width shutter speed in the black-dial Leica is 1/30 second. But the shutter-speed calibration at. 1/30 second is 30-1. The calibration means that you also leave the speed knob at 30-1 for shutter speeds slower than 1/30 second.

Set the slower shutter speeds with the slow-speed knob at

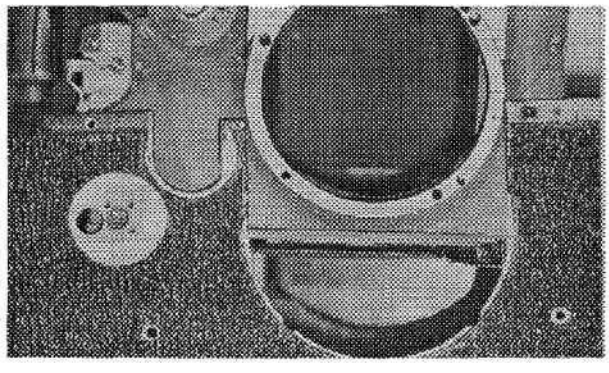

FIG. L1 Removing the body shell.

the front of the camera. The setting on the slow-speed knob determines the amount of retard engagement. The slow-speed knob also controls the pallet in the slow-speed governor.

Check the operation at the slowest shutter speed—1 second. The 2nd curtain should move smoothly through the retard. The operation at 1 second will give you an idea as to the camera's condition. If the shutter hangs open at the 1-second setting—or if the 2nd curtain struggles to get through the retard—the slow-speed governor needs cleaning and lubrication.

Unlike the later Leica M3 described earlier, the IIIf has separate viewing systems for the viewfinder and rangefinder images. There are two eyelenses at the back of the camera. Use the eyelens to the left to focus the lens—turn the focus ring until the rangefinder images superimpose. Use the eyelens to the right to view and compose the picture.

Load film in the camera by first removing the base plate (the plate at the bottom of the camera). Turn the lock lever at the bottom of the camera to the open position. Then lift the lock-lever end of the base plate from the camera body.

Next pull out the take-up spool—the take-up spool has a friction fit over the take-up sleeve. You can now engage the film leader with the take-up spool. Insert the film cartridge and take-up spool into the bottom of the camera.

The "bottom-loading" design makes it difficult to check the shutter operation with the camera assembled. You must first remove the body shell, the black shell that has the leather covering.

REMOVING THE BODY SHELL IN THE IIIf

Notice that the lens-mounting ring has a locating mark at a 9 o'clock position (directly to your left as you're looking at the front of the camera). Remember the position of the locating mark for reassembly reference.

Then remove the four screws that hold the lens-mounting ring. Lift off the lens-mounting ring—but watch for loose shims that may be used for adjustment purposes between the lens-mounting ring and the camera body.

If the camera has a self-timer, remove the self-timer cocking lever and the parts underneath. Fig. L2 shows the sequence.

Now remove the six screws holding the body shell. Four of the screws are at the front of the camera—two on the front of the top cover and two at the front of the body shell. The other two screws are at the back of the top cover.

With the six screws removed, you can slide down the body

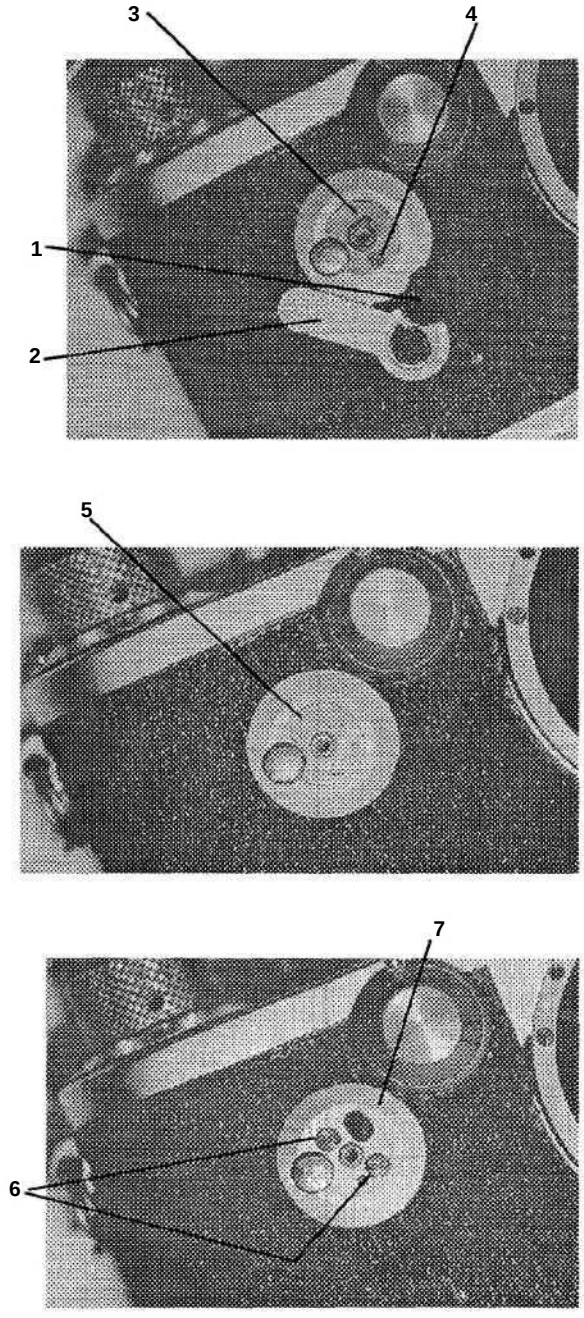

FIG. L2 SEQUENCE TO REMOVE SELF-TIMER PARTS ON BODY SHELL

shell, Fig. L1. The pressure plate and the pressure-plate springs are now loose. Notice that the pressure plate has a beveled edge—since the beveled edge facilitates film loading, it goes toward the bottom of the camera. Lift out the pressure plate and the two flat springs that sit in body-shell recesses. The flat springs provide the tension that pushes the pressure plate toward the film.

You can still cock and release the shutter. Notice the pawl

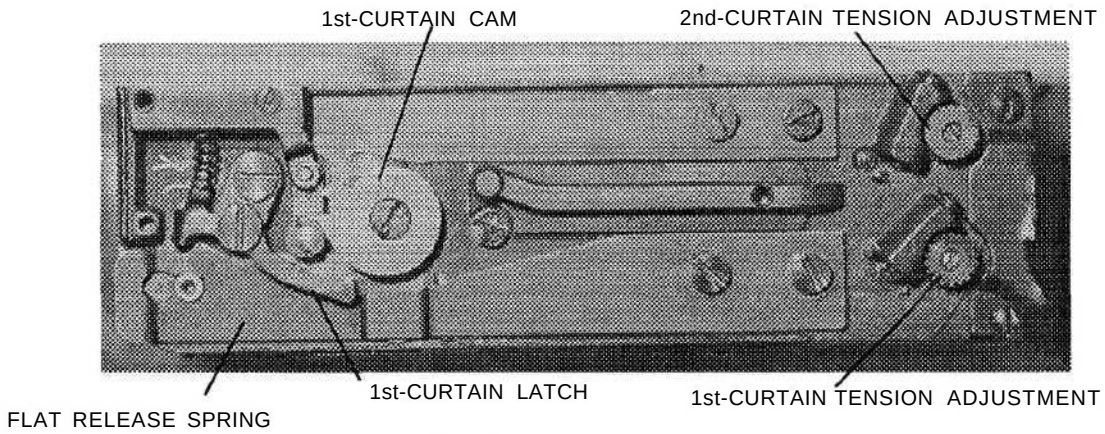

FIG. L3 BOTTOM OF CAMERA, SHUTTER RELEASED

at the top of the take-up sleeve (the shaft from which you removed the take-up spool). The pawl provides the one-way clutch for the cocking action. When you turn the wind knob to cock the shutter, the pawl disengages. Now the gears can turn freely. But when you release the wind knob, the pawl moves into engagement with the gear teeth. So, if you stop turning the wind knob before the shutter is fully cocked, the pawl prevents the curtains from returning to the released position.

From the back of the film aperture, you can now check the shutter curtains. Note the condition of the curtains as you cock and release the shutter. Also check the shutter speeds to see if you're getting a slit all the way across the aperture at 1/1000 second.

The operation at 1/1000 second is your best guide as to the camera's condition. You may find that you get no light at all through the film aperture. Or you may get light at the opening side of the aperture but not at the closing side. In either case, the camera needs cleaning and lubrication—and probably curtain-tension adjustments.

DESIGN AT THE BOTTOM OF THE IIIf

Remove the bottom cover (the plate that shows you how to load the film) by taking out the three screws,—two small screws at the wind-knob end and a larger screw near the center of the camera.

You can now reach the tension-roller adjustments, Fig. L3—the worm-gear design we discussed earlier. Adjust the curtain tensions by turning the screwdriver-slotted ends of the worms—clockwise to increase tension, counterclockwise to decrease tension.

If you find that the slit closes as the curtains cross the aperture, you may only have to add tension to the 1st curtain. Gradually increase the tension until you get light all the way across the film aperture.

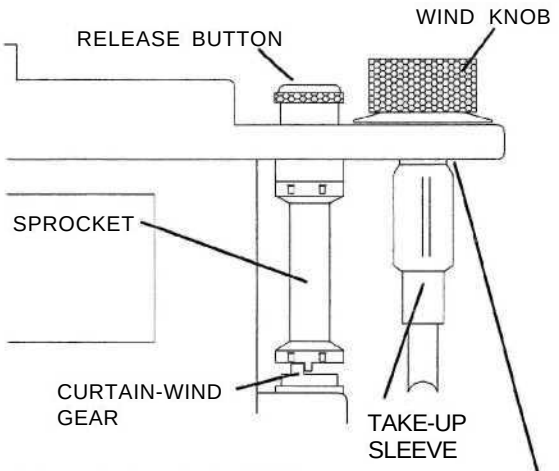

FIG. L4 BACK OF CAMERA, BODY SHELL REMOVED

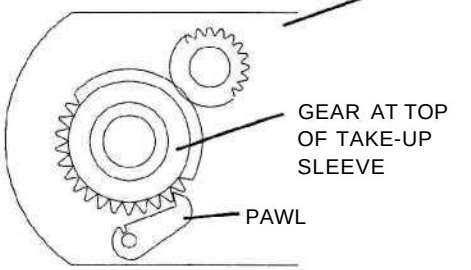

FIG. L5 ONE-WAY CLUTCH AT TOP OF TAKE-UP SLEEVE

You can also observe much of the cocking and releasing operation from the bottom of the camera. As you turn the wind knob, the gears turn the sprocket. A downward-projecting stud at the bottom of the sprocket engages an upward-projecting stud on the curtain-wind gear. Turning the sprocket in the film-advance direction then turns the curtain-wind gear in the same direction.

The curtain-wind gear turns the drum, drawing the curtains to the cocked position. As the drum turns, the lst-curtain cam, Fig. , also turns—the lst-curtain cam turns with the lst-curtain (outer) drum. At the end of the cocking cycle, the lst-curtain latch, Fig. L3, engages a notch in the lst-curtain cam.

Now the curtains can't move in the release direction. The lst-curtain latch engages the lst-curtain drum, and the lst-curtain drum holds the 2nd-curtain drum (the center section of the drum). To release the curtains, two disengaging actions are necessary:

1. the curtain drum must be disengaged from the film-advance gears
2, the lst-curtain latch must be disengaged from the lst-curtain cam.

Both actions take place as you push down the release button. As the release button moves down, the curtain-wind gear also moves down. Remember, the curtain-wind gear is under the sprocket—interlocking studs on the sprocket and curtain-wind gear engage the film-advance gears to the curtain-wind mechanism.

The curtain-wind gear moves down until the interlocking studs disengage, Fig. L7. Now the curtain drum is disengaged from the film-advance gears. But the curtains don't as yet release—the lst-curtain latch still holds the 1 st-curtain cam.

Notice that pushing down the release button also moves the end of the flat release spring, Fig. L3, toward the bottom of the camera. The flat release spring finally pushes the lst-curtain latch out of engagement with the lst-curtain cam. Now the 1st curtain crosses the film aperture.

The 2nd-curtain drum remains held by the 2nd-curtain latch on top of the camera. We'll have to remove the top cover to observe the 2nd-curtain latch. But you've already seen the basic design in your earlier study of focal-plane shutters.

There's one more operation you can see from the bottom of the camera—the curtain brake. The curtain brake goes into action after the 1st curtain has crossed the film aperture.

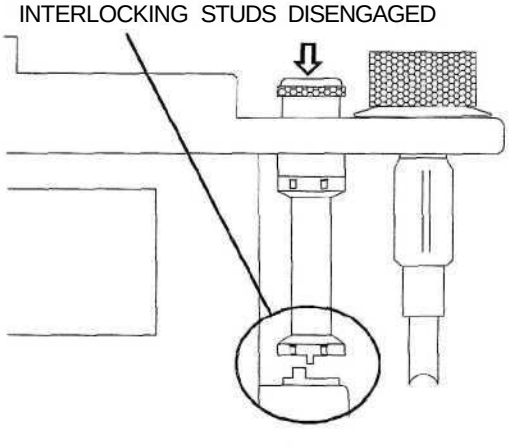

FIG. L7 BACK OF CAMERA, RELEASE BUTTON PUSHED DOWN

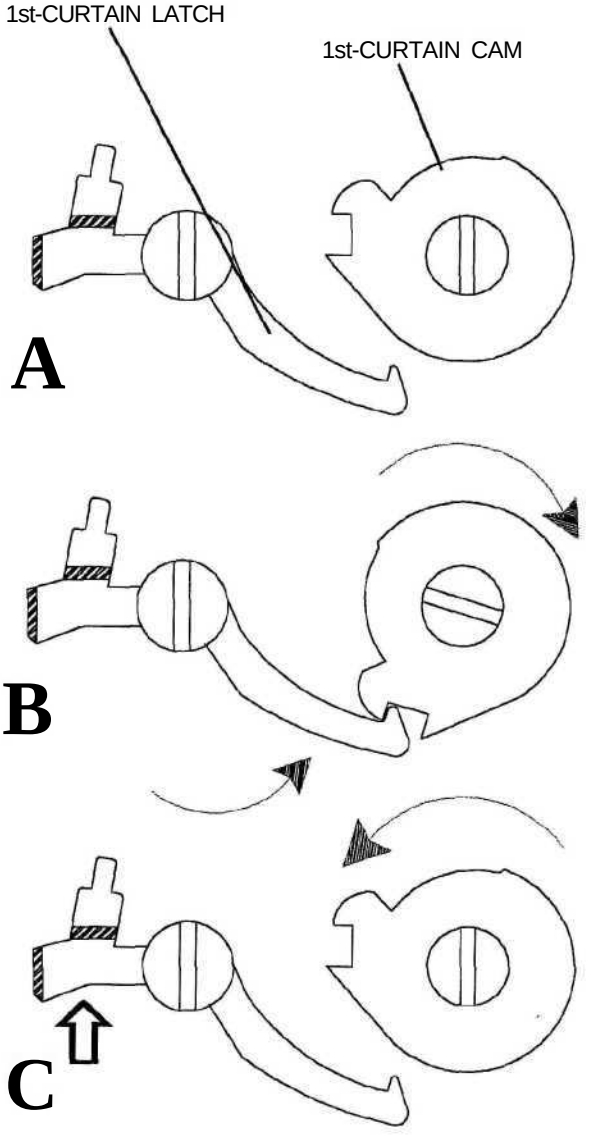

FIG. L6 Sequence of the 1st-curtain release action. In *A,* the shutter is in the released position. As you cock the shutter, the 1st-curtain cam turns clockwise; the 1st-curtain latch then latches the 1st-curtain cam *(B).* In *C,* the flat release spring has disengaged the lst-curtain latch.The 1st-curtain now rotates counterclockwise as the 1st curtain crosses the film aperture.

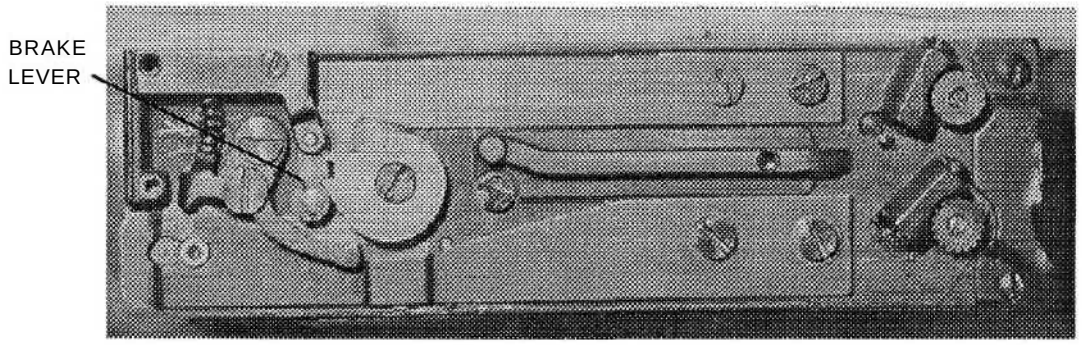

FIG. L8 Bottom of camera, shutter released.

You've seen that the spring-driven 1st curtain fires across the film aperture at a high rate of speed. If the 1st curtain came to a solid stop, it would bounce—the 1 st curtain would re-enter the film aperture. The curtain brake cushions the 1st curtain at the end of the travel. The 1st curtain then comes to a gradual stop to prevent curtain bounce.

As the 1st curtain nears the end of its travel, the lst-curtain cam strikes the brake lever, Fig. L8 and Fig. L9. The brake lever now causes a brake shoe to engage the inside of the brake drum.

You can't as yet see the brake parts—they are on the other side of the bottom plate in Fig. L8. Fig. L10 shows the brake shoe and drum that sit on the inside of the bottom plate. A flatted end of the brake-lever shaft fits in the open area of the brake shoe. When the lst-curtain cam drives the brake lever as shown in Fig. L9, the brake-lever shaft spreads the brake shoe. The brake shoe then comes against the inside of the brake drum.

The brake drum rotates with the lst-curtain curtain drum. So, as the brake shoe slows the rotation of the brake drum, the brake drum slows the rotation of the lst-curtain drum. The 1st curtain comes to a gradual—rather than an abrupt—stop.

How about the 2nd curtain? Some focal-plane shutters also provide a brake for the 2nd curtain. But many focal-plane shutters, like the Leica IIIf, have only a lst-curtain brake. The lst-curtain brake also tends to brake the 2nd curtain.

After the 1st curtain has crossed the aperture, it doesn't move all the way to its stop—the lst-curtain brake prevents the 1st curtain from moving to a solid stop. Now the 2nd curtain fires across the film aperture. As the 2nd-curtain drum nears the released position, it comes against the lst-curtain drum (you saw this operation in your study of drum-type focal-plane shutters). And the 2nd-curtain drum drives the lst-curtain drum a little further in the release direction—against the pressure of the brake. Now the brake cushions the 2nd curtain to prevent bounce.

The end of the brake lever—the end that the lst-curtain cam strikes—is an eccentric, Fig. . The eccentric provides your adjustment for the brake. Later in this section, we'll cover the brake adjustment. The procedure for adjusting curtain brakes applies to all focal-plane shutters.

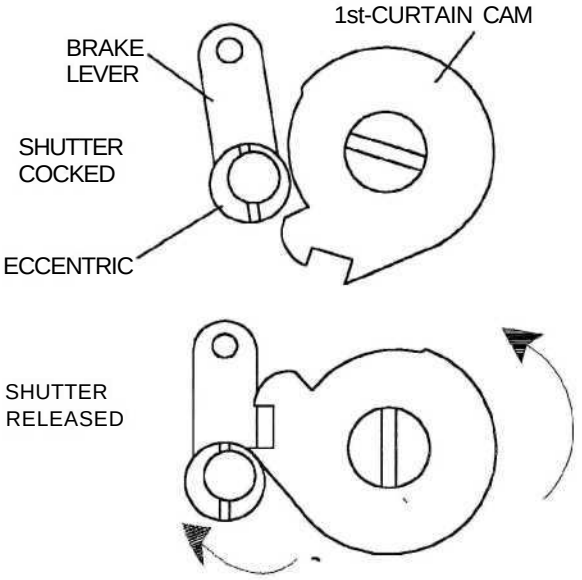

FIG. L9 During the release cycle, the 1st-curtain cam drives the brake lever as shown by the curved arrow.

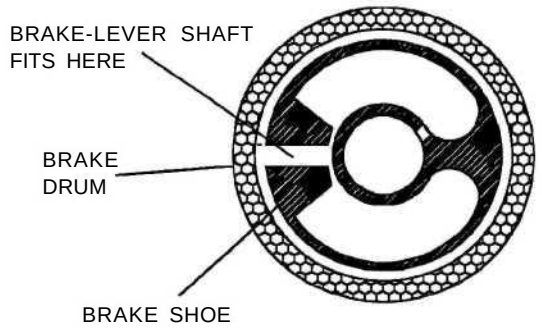

FIG. L10 Brake shoe and brake drum.

REMOVING THE TOP COVER

The speed knob is held to the 2nd-curtain release lever by three setscrews. You can reach the setscrews through clearance holes at the outer circumference of the speed knob. Lift the speed knob against its spring tension. Then, working through the clearance holes, loosen each of the three setscrews. Finally, lift the speed knob straight up and off the shaft of the 2nd-curtain release lever.

On the bottom of the speed knob, you can see the half-moon cutout that operates the sync contacts. The sync contacts, Fig. L14, remain in the center of the sync dial. As the speed knob rotates with the lst-curtain drum, its cutout determines when the sync contacts close.

The movable sync contact is spring loaded—the spring moves the movable sync contact against the fixed sync contact. A solid portion of the cam under the speed knob holds the sync contacts open—the movable sync contact can't move against the fixed sync contact.

As the speed knob rotates during the exposure cycle, the half-moon cutout reaches the movable sync contact, Fig. L15. Now the movable sync contact moves against the fixed sync contact to fire the flash. As you turn the sync dial, you're just setting the starting position of the movable sync contact—the point during the movement of the 1st curtain that the sync contacts close.

It may seem that the sync contacts would also close during the cocking cycle. They do. But, thanks to a safety switch, Fig. L12, the flash doesn't fire.

The use of a safety switch is common in focal-plane shutters. As you cock the shutter, the contacts that fire the flash close. But the safety switch is open, Fig. L12. The open safety switch disconnects the sync contacts from the flashcord terminal.

The safety switch closes during the release cycle. Now the closed safety switch connects the sync contacts to the flashcord terminal. When the sync contacts close, Fig. L13, the flash fires.

In the Leica IIIf, the safety switch is under the 2nd-curtain latch—you'll be able to see the safety switch with the top cover removed.

Set the rewind lever (the lever just in front of the release button) to the advance position. Then remove the screw holding the rewind lever. Lift off the rewind lever and the bushing that fits over the rewind shaft (the shaft from which you removed the rewind lever). Moving the rewind lever to the rewind position disengages the sprocket. The sprocket can then turn in the reverse direction as you rewind the film.

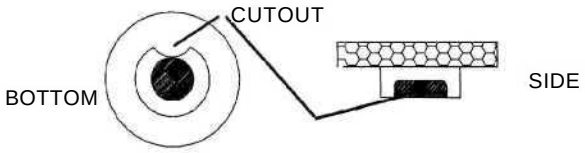

FIG. L11 Speed knob.

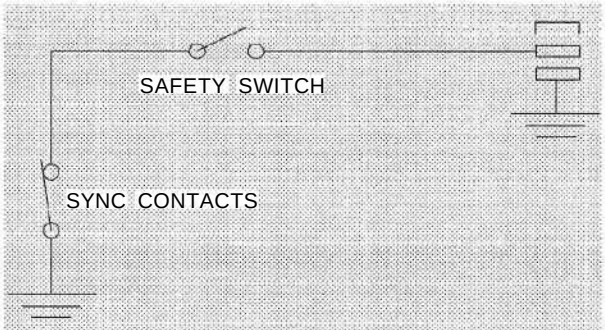

FIG. L12 During cocking cycle.

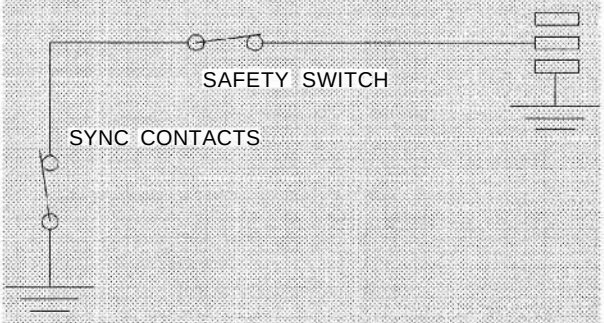

FIG. L13 During release cycle.

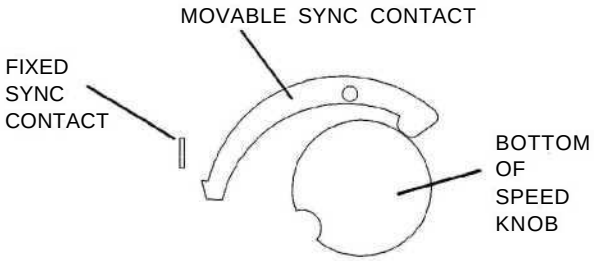

FIG. L14 Shutter cocked.

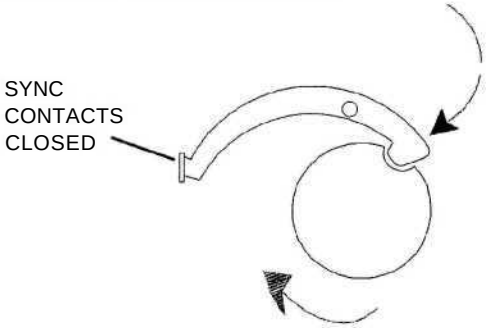

FIG. L15 During release cycle.

Unscrew the knurled shield that fits around the release button, Fig. L16.

The wind knob screws onto the top of the take-up sleeve, Fig. L16. A setscrew locks the wind knob in place. You can reach the setscrew through the hole in the outer circumference of the wind knob, Fig. L17 (you may have to lift and rotate the film-reminder dial to locate the setscrew). Loosen the setscrew around two turns. Then unscrew the wind knob from the take-up sleeve.

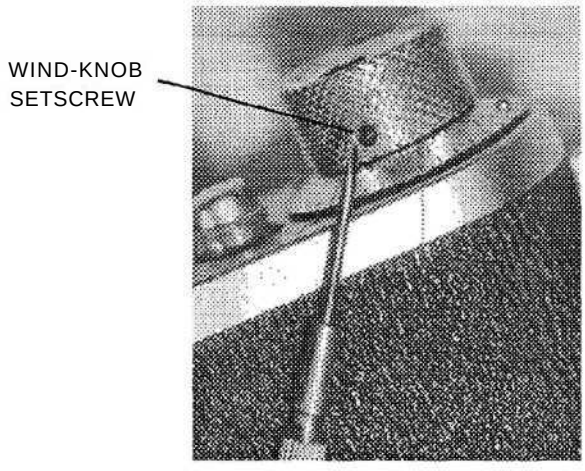

FIG. L17 Side of wind knob.

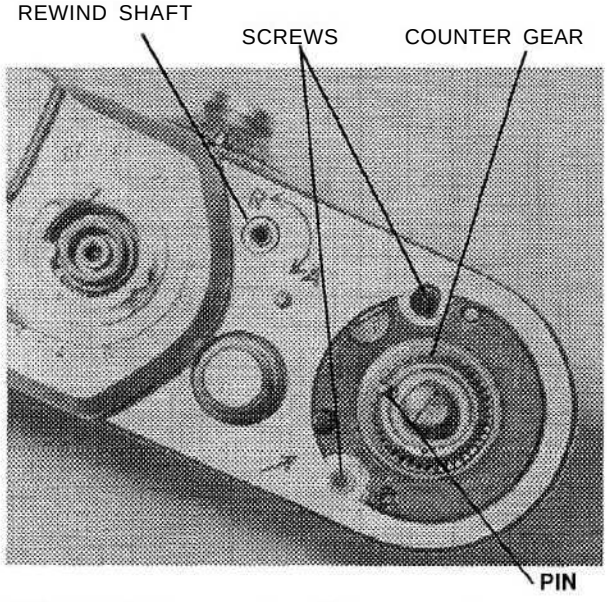

FIG. L19 Top, counter dial removed.

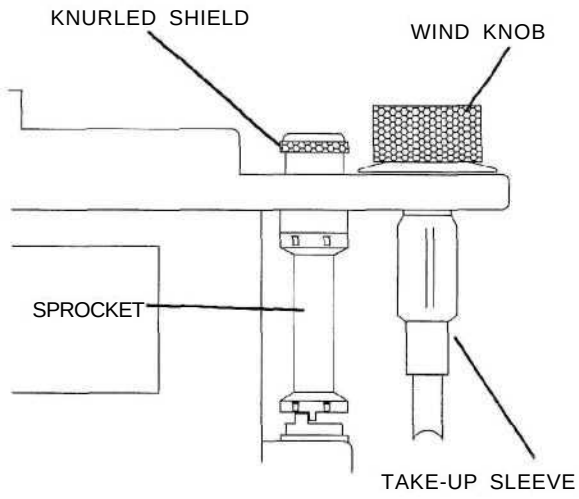

FIG. L16 Back of camera.

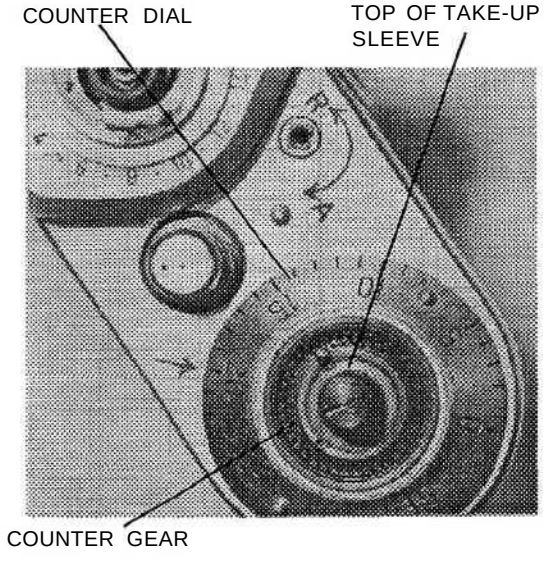

FIG. L18 Top, wind knob removed.

The take-up sleeve and the counter dial arc now loose. But you can hold the take-up sleeve in place to see how the counter dial operates. The top portion of the take-up sleeve is an eccentric that fits in the center of the counter gear, Fig. L18. A slot in the counter gear fits over a pin, Fig. L19. The pin allows the counter gear to slide back and forth. But the pin only allows the counter gear to rotate slightly.

As the take-up sleeve rotates, its eccentric causes the counter gear to slide back and forth—there's enough clearance between the teeth on the counter dial and the teeth on the counter gear to allow the back-and-forth movement. The counter-gear teeth then disengage on one side as the counter gear moves back. Then, as the eccentric shifts the counter

gear, the counter-gear teeth pick up the next tooth on the counter dial. The counter dial advances one frame calibration.

You can now lift out the counter dial, Fig. L18, the counter gear, Fig. L19, and the take-up sleeve. Earlier we described how the gear at the top of the take-up sleeve provides the one-way clutch for the film advance. With the take-up sleeve removed, you can see the pawl spring at its top end, Fig. L21. The end of the pawl spring fits into the notch in the one-way pawl, Fig. L20.

When you turn the wind knob in the advance direction, the pawl spring holds the pawl disengaged as shown in Fig. 20. But when the curtains pull the take-up sleeve in the reverse direction, the pawl spring pulls the pawl into engagement with the take-up-sleeve gear, Fig. L5. The pawl then permits the take-up sleeve to turn in only one direction—the film-advance direction. When you replace the take-up sleeve, fit the end of the pawl spring, Fig. L21, into the pawl notch, Fig. L20.

The large compression spring at the bottom of the take-up sleeve is the slip spring for the film take up. Earlier you removed the take-up spool; the take-up spool fits over the center cylinder of the take-up sleeve, held by the three spring tabs, Fig. L21. The center cylinder of the take-up sleeve is a separate piece.

As the take-up sleeve turns, the compression spring carries the center cylinder. But you can hold the center cylinder and still turn the take-up sleeve—the compression spring now "slips" as the take-up sleeve turns.

Practically all 35mm cameras have such a slipping clutch on the take-up spool or take-up sleeve. As the film wraps around the take-up spool, the diameter of the take-up spool increases. And the larger the diameter, the less the take-up spool must turn to wrap on the same amount of film.

But the wind knob always turns the same amount. The slipping clutch then allows the take-up spool to stop after the correct amount of film has been advanced—yet you can continue turning the wind knob to complete the shutter-cocking cycle.

You can often trace film-advance problems to the slipping clutch on the take-up spool. For example, suspect the slipping clutch if the camera tears the perforation holes in the film. Torn perforation holes indicate that the clutch isn't slipping freely enough.

After the film has advanced the proper amount, the sprocket stops. But the take-up spool keeps turning as you advance the wind knob. If the clutch doesn't slip freely enough, the film will be pulled past the locked sprocket—and perforation holes will tear.

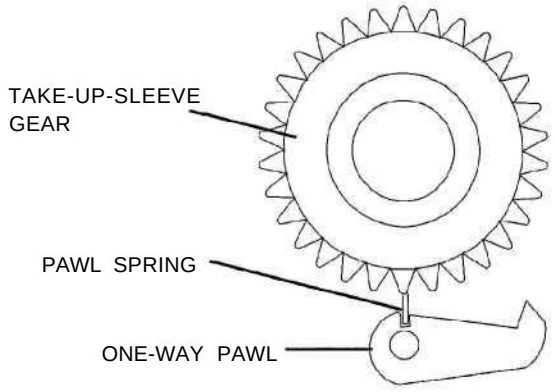

FIG. L20 Take-up sleeve gear as viewed from bottom of take-up sleeve.

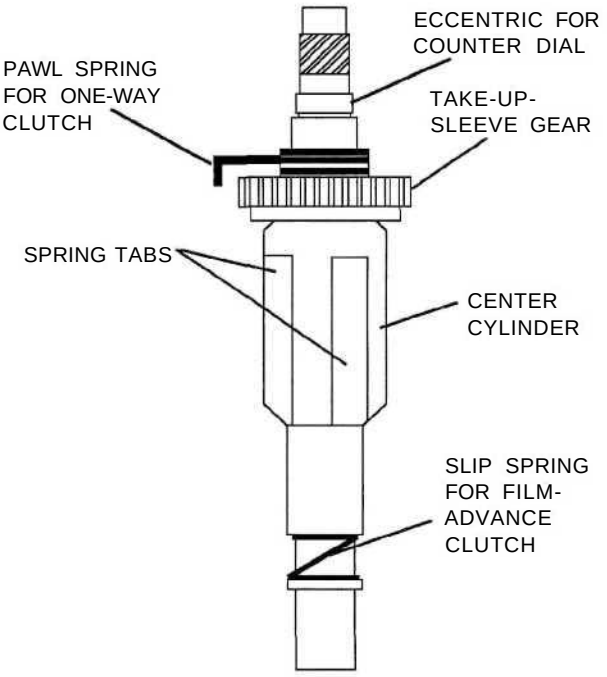

FIG. L21 Take-up sleeve removed from camera.

A clutch that slips too freely causes another problem. The film then isn't wound tightly enough around the take-up spool. The loose film may cause a bind in the film transport.

The slip spring in the film-advance clutch should be clean and normally dry (no lubrication). Lubrication may cause the clutch to slip too freely—dirt may cause the clutch to be too tight. At times it may be necessary to increase the spring tension on the slip spring.

Continuing with the disassembly, you'll see other features that are fairly standard in 35mm cameras. To remove the

IIIf rewind knob, first lift up the rewind knob as shown in Fig. L22. You can now see a collar that's locked by a set-screw, Fig. L22, The setscrew keys to the slot in the rewind shaft.

Remove the setscrew, Fig. L22. You can now lift out the rewind knob and rewind shaft toward the top of the camera. Then push out the rewind fork toward the bottom of the camera. But watch for the compression spring and washer on the shaft of the rewind fork.

You can now reach the rangefinder-focus lever that sits under the rewind knob. The rangefinder-focus lever moves a lens within the rangefinder; use the control to adjust the focus of the rangefinder image.

A notched retaining ring holds the rangefinder-focus lever. Use a spanner wrench with flat tips to unscrew the retaining ring. Then lift out the rangefinder-focus lever. For reassembly reference, note the brass rangefinder-focusing disc under the top cover at the position of the rangefinder-focus lever. The pin on the underside of the rangefinder-focus lever fits into the hole in the rangefinder-focusing disc.

The procedure for removing the rewind knob is a little different in the Leica IIIf than in most 35mm cameras. With most 35mm cameras, the rewind knob screws onto the rewind shaft. Normally you just hold the rewind fork to prevent it from turning—and you then unscrew the rewind knob. But also check for a screw at the top of the rewind knob. If so, the screw may be holding the rewind knob to the rewind shaft. Remove the screw rather than unscrewing the rewind knob.

Remove the eyelens frame, Fig. L22, by taking out its two screws. Also remove the accessory shoe at the top of the top cover—it's held by four screws.

From the front of the camera, note the screw next to the viewfinder—the screw covers a rangefinder adjustment, Fig. L23. Remove the screw. You can then see the accuracy adjustment—a screw accessible through the top-cover opening, Fig. L23. If the only problem is that the rangefinder images don't superimpose at infinity, you need only remove the screw to reach the adjustment.

Now unscrew the bezels around the front rangefinder lenses, Fig. L23. The bezels are thin, metal rings that thread into the rangefinder—Fig. L23 shows the bezels removed. To avoid marring the bezels and the top cover, use a rubber stopper to unscrew the bezels.

The lens for the fixed image, Fig. L23, screws into the rangefinder. But the wedge for the movable image has a friction fit. The movable-image wedge prism provides your alignment rangefinder adjustment. By rotating the wedge, you can align the images vertically.

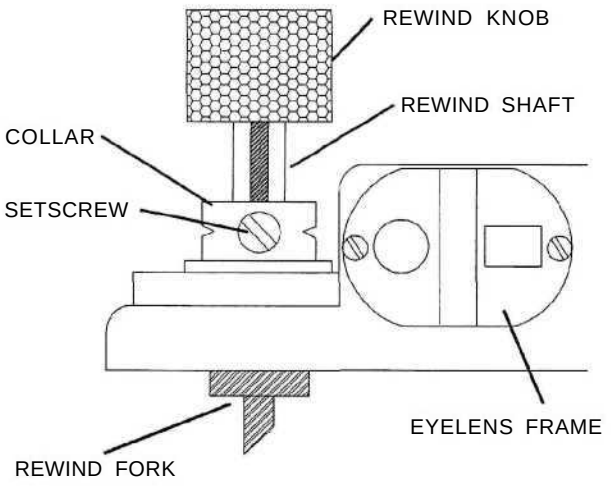

FIG. L22 Back of camera, rewind-knob end.

Some versions have two top-cover screws located under the counter dial, Fig. L19. Remove the two screws if present.The top cover is now free—only the sync wire still attaches the flashcord terminal to the camera. Lift the top cover straight up and off the camera body, Fig. L24—you'll probably have to slightly spring out the front of the top cover to clear the rangefinder assembly. Then unsolder the sync wire from the contact plate, Fig. L24.

Lift out the loose spacer washer that sits on top of the rangefinder-focusing disc at the rewind end of the camera. You might also temporarily replace the eyelens frame, Fig. L22, with its two screws. The eyelens frame then holds the rangefinder eyelenses in place.

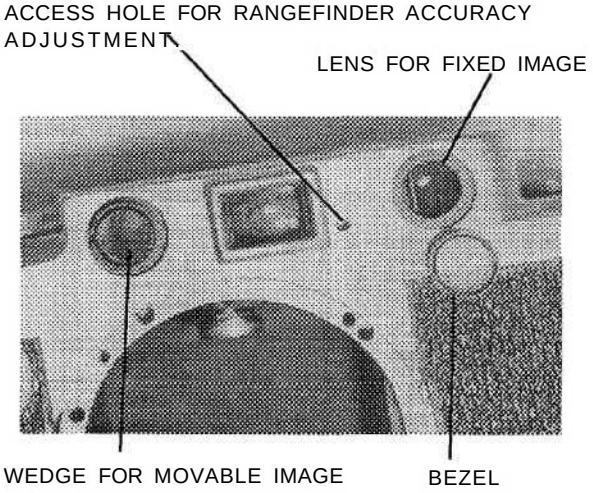

FIG. L23 Front of top cover.

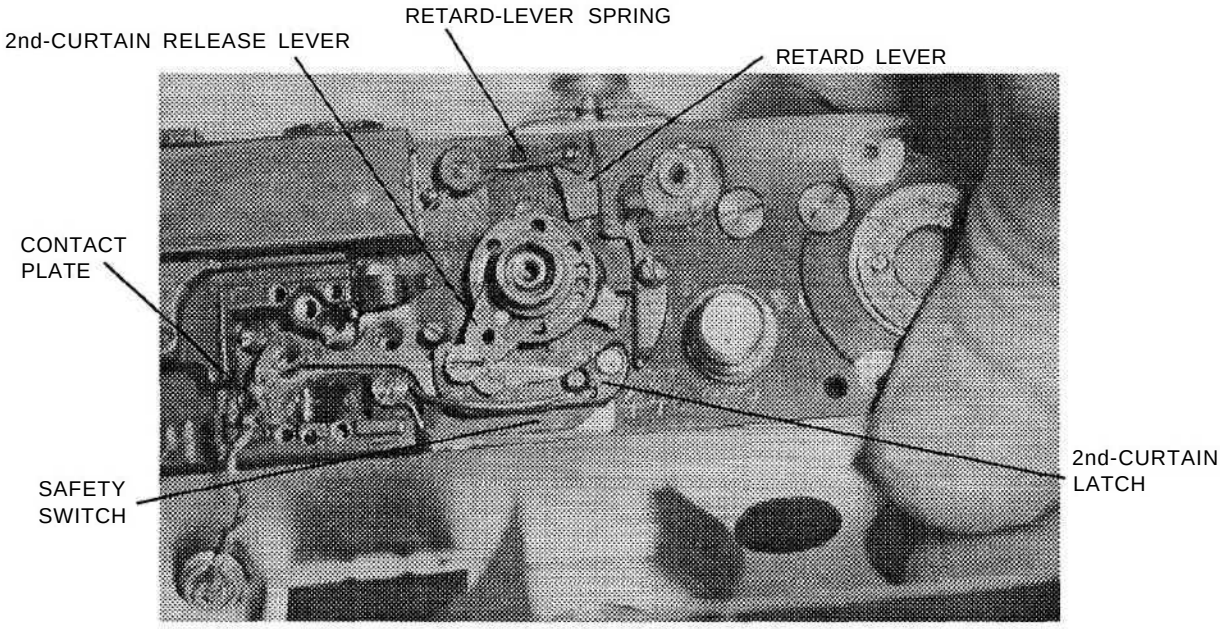

FIG. L24 Top cover removed.

DESIGN AT THE TOP OF THE LEICA IIIf

You should already feel somewhat familiar with the mechanism at the top of the camera. Fig. L24—it's very similar to the drum-type design covered in Section 11.

In Fig. L25, the 2nd-curtain release lever is set to 1/30 second with the shutter cocked. You've seen that the speed-control disc rotates with the lst-curtain drum; the 2nd-curtain cam, Fig. L25, rotates with the 2nd-curtain drum. When you lift the speed knob to set the shutter speed, the speed knob lifts the 2nd-curtain release lever. The shutter-speed setting just determines which speed-control-disc hole is engaged by the pin on the 2nd-curtain release lever.

Right now the 2nd-curtain latch sits slightly above the 2nd-curtain cam. But when you push down the release button, the 2nd-curtain latch moves down—the spring on the 2nd-curtain latch pushes the 2nd-curtain latch both down and toward the 2nd-curtain cam, Fig. L25 . The 2nd-curtain latch attaches to a long rod that runs to the bottom of the camera; the lower end of the rod rests against the flat release spring, Fig. L31. You've already seen how the flat release spring moves down when you push the release button.

You've also seen how the 1st curtain releases. The speed-control disc rotates clockwise, carrying the 2nd-curtain release lever, as (the 1st curtain crosses the aperture. But the 2nd curtain remains held—the 2nd-curtain latch engages the 2nd-curtain cam, Fig. L26.

At 1/30 second, the 1st curtain completely crosses the fo-

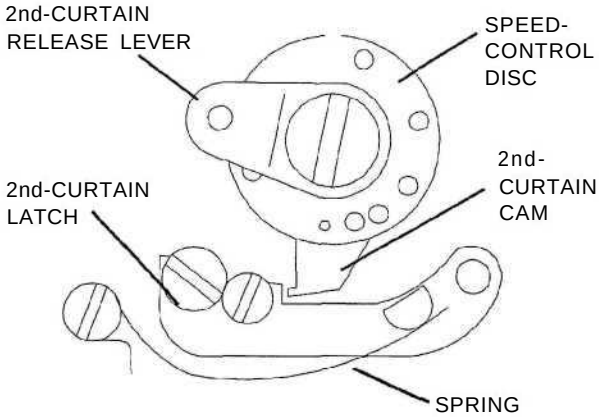

FIG. L25 Shutter cocked, 1/30-second setting.

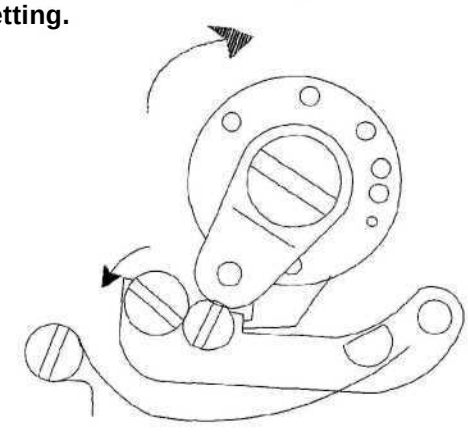

FIG. L26 2nd-curtain release lever striking 2nd-curtain latch.

cal-plane aperture before disengaging the 2nd-curtain latch. The end of the 2nd-curtain release lever then strikes a post on the 2nd-curtain latch. Now the 2nd-curtain release lever drives the 2nd-curtain latch out of engagement with the 2nd-curtain cam. Disengaging the 2nd-curtain latch frees the 2nd curtain.

To observe the operation, cock the shutter by rotating the sprocket, Fig. L16, in the film-advance direction. Lift and turn the 2nd-curtain release lever until it's in the 1/30-second position, Fig. L25. Now push the release button to release the shutter.

Also note the operation when the 2nd-curtain release lever is in the bulb hole, Fig. L27. Here, the 2nd-curtain release lever can't rotate far enough to release the 2nd curtain. The 2nd curtain remains latched until you let up the release button. The flat release spring then pushes up the 2nd-curtain latch to free the 2nd curtain.

Notice that the 2nd-curtain latch in the Leica IIIf actually has two posts. The higher post is only used at 1/1000 second. At 1/1000 second, the 2nd-curtain release lever sits in the small hole of the speed-control disc. The small hole raises the 2nd-curtain release lever.

When you now release the shutter, the 2nd-curtain release lever passes over the top of the lower post, Fig. L27. The 2nd-curtain release lever then strikes the higher post to release the 2nd curtain.

Both of the posts on the 2nd-curtain latch are eccentrics—you can turn the eccentric posts to adjust the shutter speeds. Since the higher post is only used at 1/1000 second, it provides your 1/1000-second adjustment. The lower post provides your adjustment for the shutter speeds of 1/30 second through 1/500 second.

You've seen that the slow-speed governor comes into play at shutter speeds slower than 1/30 second. Leave the 2nd-curtain release lever at the 1/30-second setting. Then set the slow-speed knob at the front of the camera to a slow speed. Notice that setting a slow speed moves the retard lever, Fig. L24 and Fig. L27, toward the center of the camera.

Fig. L28 and Fig. L29 show the 2nd-curtain cam as if you could see through the 2nd-curtain release lever and the speed-control disc. The retard lever moves into the path of the 2nd-curtain cam. After the 2nd-curtain release lever disengages the 2nd-curtain latch, the 2nd-curtain cam can only move a slight distance before it strikes the retard lever, Fig. L29. The 2nd curtain moves slightly in the release direction—but not far enough to enter the film aperture.

Now the 2nd-curtain cam must push aside the retard lever—against the opposition of the slow-speed governor. The

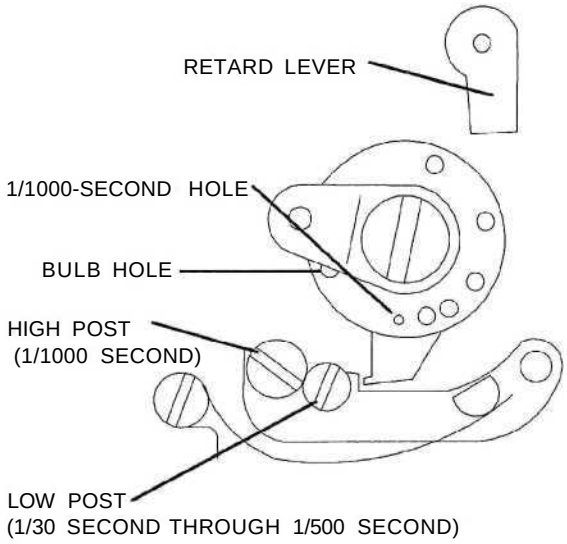

FIG. L27

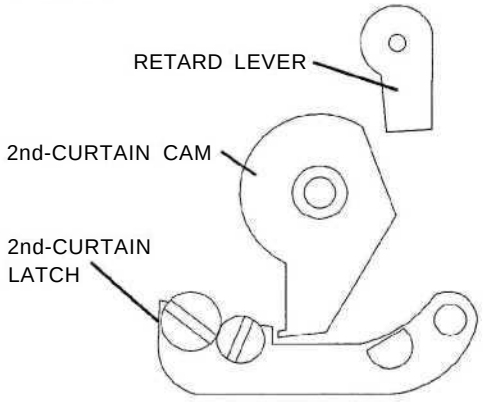

FIG. L28 2nd-curtain cam with 2nd-curtain release lever and speed-control disc removed.

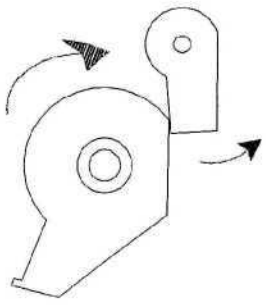

FIG. L29 On slow speeds, the 2nd-curtain cam must push aside the retard lever.

deeper the engagement between the retard lever and the 2nd-curtain cam, the longer it takes for the 2nd-curtain cam to push aside the retard lever.

As the 2nd-curtain cam is pushing aside the retard lever, the 2nd curtain is creeping toward the film aperture. Finally the 2nd-curtain cam gets past the retard lever. And the 2nd curtain fires across the film aperture to end the exposure.

As you cock the shutter for the next exposure, the 2nd-curtain cam rotates counterclockwise. Now it appears that the retard lever is in the way of the 2nd-curtain cam. But,until you release the shutter, the retard lever sits below the plane of the 2nd-curtain cam. The 2nd-curtain cam then passes above the retard lever. Then, when the 1st curtain crosses the film aperture, the retard lever moves up—into position to catch the 2nd-curtain cam.

The part that moves up the retard lever is the retard-rod spring at the bottom of the camera, Fig. L31. The lower end of the retard rod sits on the top of the retard-rod spring; the retard lever attaches to the upper end of the retard rod.

A pin on the underside of the lst-curtain cam operates the retard-rod spring. With the shutter cocked, the end of the retard-rod spring moves down—toward the bottom of the camera. The retard-lever spring, Fig. L24, then pushes down the retard rod. Now the retard lever sits below the plane of the 2nd-curtain cam.

But when the lst-curtain cam reaches the released position, Fig. L31, its downward-projecting pin pushes up the end of the retard-rod spring. The retard-rod spring pushes up the retard rod. And the retard lever moves into the plane of the 2nd-curtain cam.

The slow-speed knob also has a time setting. At time, the retard lever moves its maximum distance toward the 2nd-curtain cam. Here the time plate, Fig. L30, blocks the movement of the retard lever. The 2nd-curtain cam can't push the retard lever aside. And the shutter stays open until you turn the slow-speed knob to another setting.

The time plate has an adjustment—after loosening the screw,

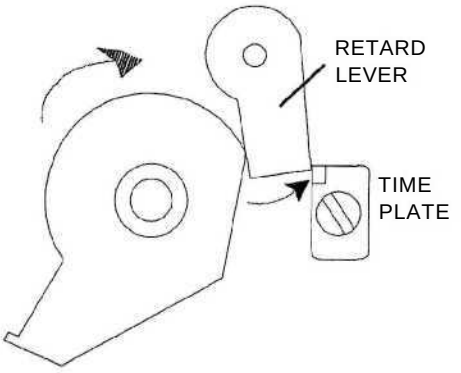

FIG. L30 Time action.

you can slide the time plate closer to or further from the retard lever. Adjust the position of the time plate for proper time operation. If the time plate doesn't catch the retard lever at the time setting, slide the time plate closer to the retard lever. If the time plate catches the retard lever at the 1-second setting, slide the time plate away from the retard lever.

REMOVING THE SPEED-CONTROL PARTS

You may wish to disassembly the speed-control parts for cleaning and lubrication. It's especially critical that the 2nd-curtain latch is clean and properly lubricated.

To remove the 2nd-curtain release lever, take out its center screw. Careful—there's a loose compression spring under the screw. The compression spring holds the 2nd-curtain release lever against the speed-control disc. Remove the compression spring and lift off the 2nd-curtain release lever.

Next remove the screw on the outer circumference of the speed-control disc—the screw holds the speed-control disc to the shaft of the lst-curtain drum. Lift off the speed-control disc.

You can now reach the 2nd-curtain cam, Fig. L28. If you cock

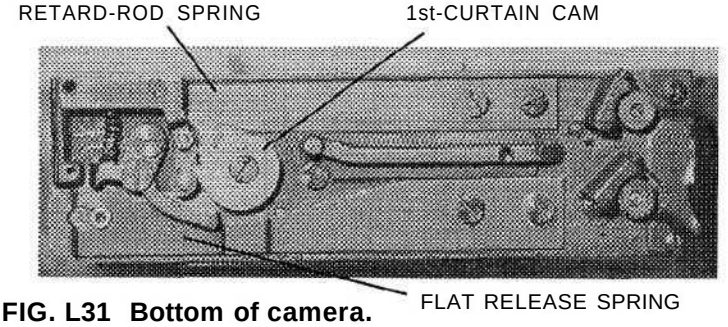

FIG. L31 Bottom of camera.

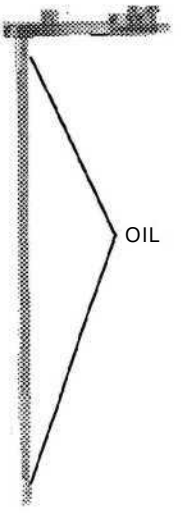

FIG. L32 2nd-curtain latch.

and release the shutter, you'll get bulb operation. There's nothing to disengage the 2nd-curtain latch. The 2nd-curtain latch then continues to hold the 2nd-curtain cam until you let up the release button.

Disconnect the spring from the post on the 2nd-curtain latch, Fig. L25. Then remove the shoulder screw that holds the spring. Lift the 2nd-curtain latch up and out of the camera body, Fig. L32.

LUBRICATING THE SPEED-CONTROL PARTS

After you've cleaned the parts just removed, you can apply lubrication. Lightly grease the two cam lobes on the 2nd-curtain cam—the cam lobe that comes against the retard lever, Fig. L29, and the surface that's engaged by the 2nd-curtain latch, Fig. L28.

The 2nd-curtain latch must move freely up and down—down when you depress the release button and up when you let up the release button. Use shutter oil to lubricate the shaft of the 2nd-curtain latch—the areas that come against the bearings in the camera body, Fig. L32.

Lubricate the latching surface of the 2nd-curtain latch with grease. Also use grease to lubricate the posts of the 2nd-curtain latch—the posts that the 2nd-curtain release lever strikes to release the 2nd curtain.

With the 2nd-curtain latch removed, you can more clearly see the safety switch, Fig. L24. Remember, the safety switch completes the circuit to the sync contacts during (he release cycle. As the 2nd-curtain latch moves down, it closes the safety switch.

You can now replace the 2nd-curtain latch and connect the spring, Fig. L25. Make sure the 2nd-curtain latch moves down freely when you push the release button.

Then replace the speed-control disc with its screw. Install the 2nd-curtain release lever on top of the speed-control disc.

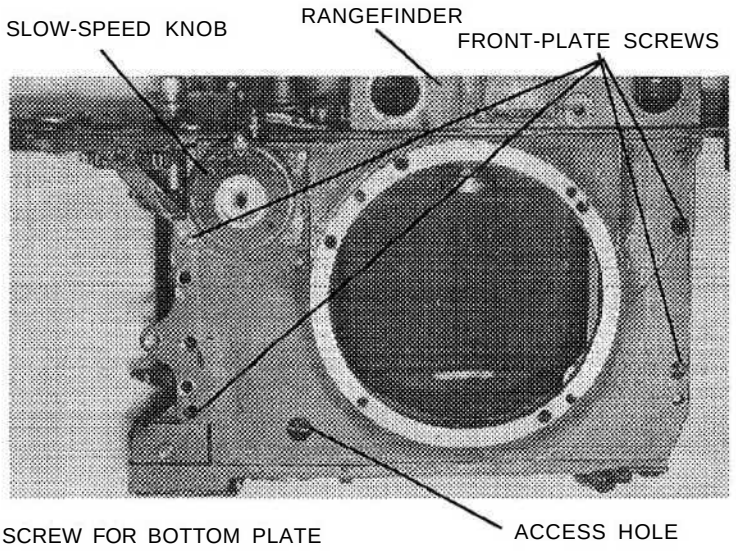

FIG. L33

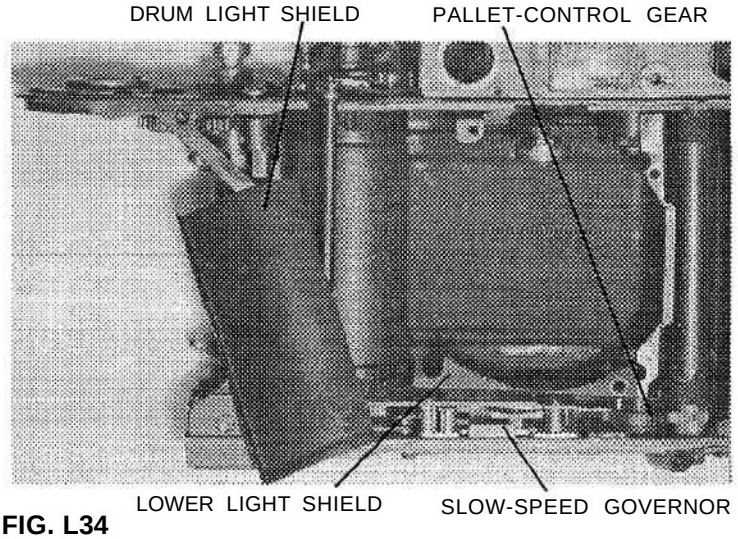

FIG. L34

Seat the compression spring at the top of the 2nd-curtain release lever and replace the screw.

REMOVING THE FRONT PLATE

You can clean and lubricate the curtain rollers after removing the front plate, Fig. L33. Removing the front plate also allows you to reach the slow-speed governor.

If the camera has a self-timer, remove the complete self-timer mechanism. Two screws at the front of the front plate hold the self-timer.

Now remove the four screws around the lens opening and the screws around the edge of the front plate. Depending on the version of the camera, there may be a short front-plate screw at the bottom front—also remove this screw if it's present. Do not remove the bottom-plate screw indicated in

Fig. L33. Lift off the front plate together with the slow-speed knob.

Two of the three light shields within the focal plane are now loose—these two light shields were held by the screws around the lens opening.

Carefully note the position of the light shield around the curtain drum and the light shield above the slow-speed governor. Fig. L34 shows the drum light shield lifted out—the drum light shield passes to the inside of the upturned tab on the lower light shield (the light shield above the slow-speed governor).

The light shield next to the tension rollers also passes to the inside of the upturned tab on the lower light shield. You can't as yet remove the light shield next to the tension rollers. But you can remove the lower light shield, Fig. L35.

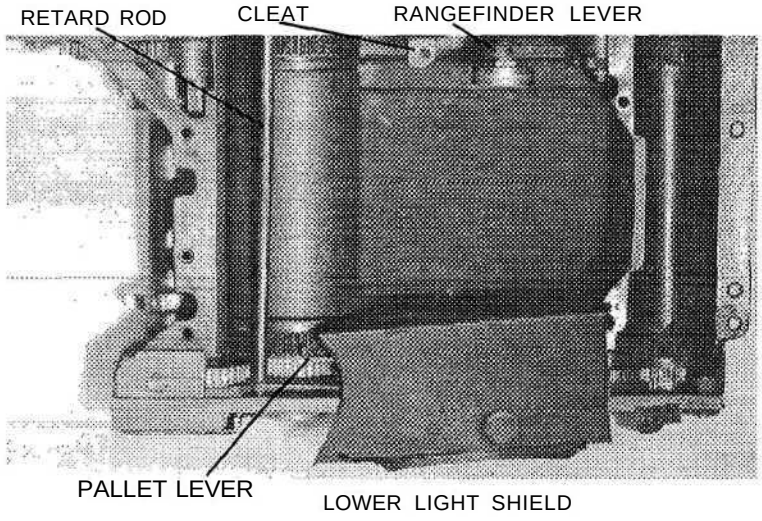

FIG. L35

REMOVING THE SLOW-SPEED GOVERNOR

There's one more part you would normally remove for a routine cleaning and lubrication—the slow-speed governor, Fig. L34. For reassembly reference, you might first take a moment to study the operation.

The retard rod, Fig. L35, connects the slow-speed governor to the retard lever. Notice that, with the front plate removed, the retard-lever spring pushes out the retard rod—toward the front of the camera.

If you push in the top of the retard rod, you can see how the retard lever moves in—toward the 2nd-curtain cam for deeper engagement. The part that controls the position of the retard rod is the slow-speed cam at the back of the speed knob. You can see the slow-speed cam by looking at the back of the front plate, Fig. L36.

The slow-speed cam has two cam surfaces. The cam face of the slow-speed cam positions the retard rod—for deeper retard-lever engagement, the slow-speed cam pushes the retard rod toward the camera body. The cam edge of the slow-speed cam controls the pallet in the slow-speed governor.

At the three slowest shutter speeds—1 second, 1/2 second, and 1/4 second—the pallet engages the star wheel in the slow-speed governor. The slow-speed cam disengages the pallet for the rest of the slow speeds. The pallet-cam follower, Fig. L36, connects the slow-speed cam to the slow-speed governor.

The upper end of the pallet-cam follower rides against the outer cam surface of the slow-speed cam, Fig. L36. The lower end of the pallet-cam follower couples to the upturned tab on the pallet lever in the slow-speed governor, Fig. L35.

A spring on the slow-speed governor moves the pallet into engagement with the star wheel. To disengage the pallet, the slow-speed cam pushes the pallet-cam follower in a counterclockwise direction, Fig. L36. The lower end of the pallet-cam follower then pulls the pallet lever from right to left in Fig. L35 . The pallet lever now moves the pallet out of engagement with the star wheel.

As you replace the front plate, you'll have to couple the pallet-cam follower to the pallet lever. A hole in the front plate provides access to the lower end of the pallet-cam follower. Working through the access hole, Fig. L33 and Fig. 36, you can couple the pallet-cam follower to the right of the pallet-lever tab, Fig. L35.

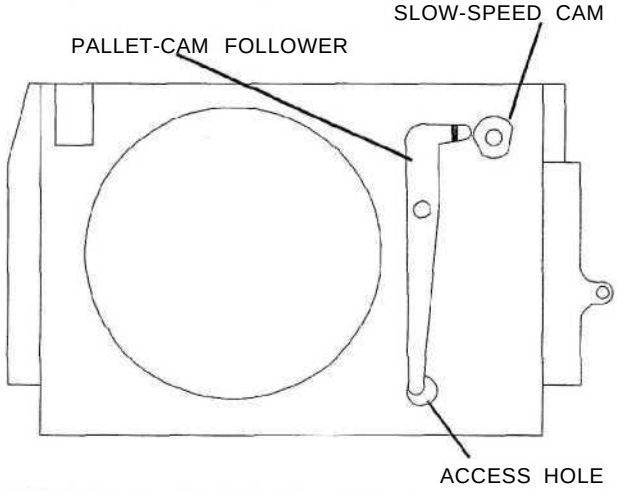

FIG. L36 Back of the front plate.

Also note the other end of the pallet lever—the right-hand end of the pallet lever comes against a pin on the pallet-control gear, Fig. L34 and Fig. L37.

The pallet-control gear engages the 2nd-curtain tension roller. As the 2nd curtain crosses the film aperture, the pallet-control gear rotates as shown in Fig. L38. The pin on the pallet-control gear drives the pallet lever, Fig. L38, from right to left—the direction that disengages the pallet.

Disengaging the pallet after every exposure allows the retard lever to return easily to the ready position. Say, for example, that you shoot a 1-second exposure. You've seen how the 2nd-curtain cam drives the retard lever from left to right in Fig. L29.

The retard lever must now return to the ready position—from left to right in Fig. L29—in preparation for the next exposure. A spring on the first-gear segment in the slow-speed governor returns the retard lever. Since the 2nd curtain has disengaged the pallet, the retard lever can move easily to the ready position—the spring-loaded first-gear segment doesn't have to move against the opposing action of the pallet.

Two screws hold the slow-speed governor, Fig, L39—one of the screws also helps secure the retard rod spring. Remove the two screws and lift out the slow-speed governor.

You may also want to remove the pallet-control gear for cleaning and lubrication. Since the pallet-control gear rotates with the 2nd curtain, it must be clean and properly lubricated. Remove the shoulder screw that holds the pallet-control gear.

FLUSH CLEANING THE SHUTTER

You can now clean the slow-speed governor as described in Section 3, *Cleaning & Lubrication.* Lubricate the gear pivots of the slow-speed governor with oil.

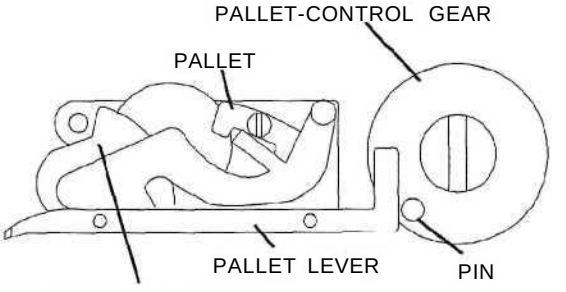

FIG. L37 Slow-speed governor, shutter cocked.

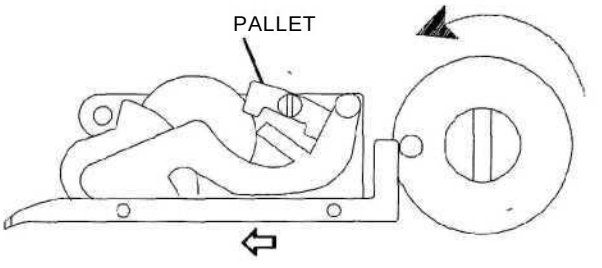

FIG. L38 Slow-speed governor, shutter released.

But with the Leica IIIf—and, as a general rule with other focal-plane shutters as well—you don't want to remove the curtains for cleaning. Removing the curtains is very time-consuming—and reassembly can be difficult.

Fortunately, it's rarely necessary to remove the curtain rollers. You can even replace the curtains without further disassembly—we described the technique in *Making and Replacing Shutter Curtains* (Section 10).

Flush cleaning is the technique for cleaning with mini-

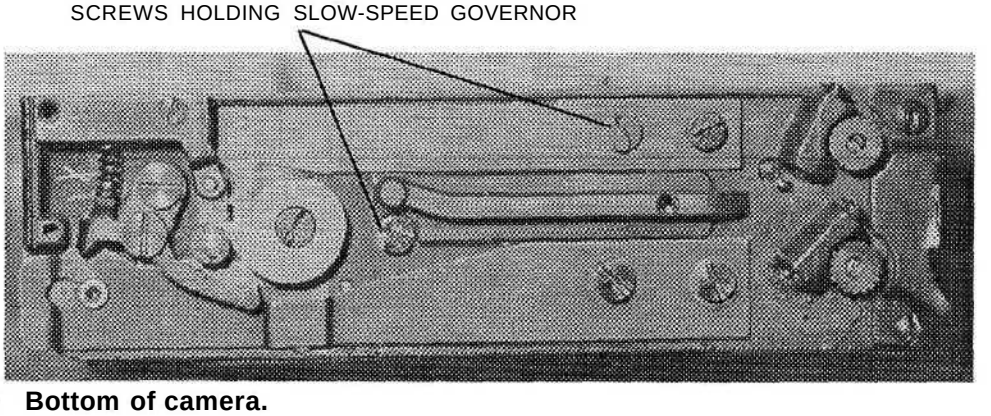

FIG. L39 Bottom of camera.

mum disassembly. To flush clean a mechanism, work in the cleaning solution to the bearing surfaces. Then blow out the cleaning solution. Compressed air works best. But you can also use your hand blower.

With a focal-plane shutter, you can use a small brush—such as an artist's brush. Use the brush to deposit the cleaning solution into a bearing. For example, say you're cleaning the tension rollers. Deposit the cleaning solution between the central shaft and the outer shell at the top of one tension roller.

Use your thumb to rotate the tension roller back and forth. And slide the tension roller up and down, working in the cleaning solution. Then blow out the cleaning solution. The cleaning solution carries out the dirt and dry lubrication. Repeat the procedure a couple of times to make sure the bearing is clean. Then proceed to the next bearing surface-

Make sure you clean all four bearing surfaces for the tension roller (two tension rollers, top and bottom). Also clean both ends of the curtain drum. Reach under the 2nd-curtain cam to clean the upper bearing of the 2nd-curtain drum. And reach under the lst-curtain cam to clean the lower bearing of the lst-curtain drum.

Remember to repeat the cleaning procedure for each bearing. The process may seem slow. But it's a lot faster than removing and replacing the curtain rollers. After cleaning the shutter, lubricate each bearing with a tiny drop of oil.

You may prefer to remove the pallet-control gear, Fig. L34, for cleaning and lubrication. Since the pallet-control gear turns with the 2nd curtain, it must be very clean and properly lubricated. Lubricate the shoulder of the shoulder screw that holds the pallet-control gear with shutter (clock) oil.

REPLACING THE PALLET-CONTROL GEAR AND SLOW-SPEED GOVERNOR

Remember that all parts that rotate with the curtains should be lubricated with shutter oil—that includes the pallet-control gear. Lightly lubricate the inside of the pallet-control-gear center hole.

When you replace the pallet-control gear, note the timing—the pin on the pallet-control gear must point to the slow-speed governor with the shutter released. Fig. L38 shows the timing.

Replace the slow-speed governor with the shutter in the cocked position. The pin on the pallet-control gear, Fig. L37, then clears the pallet lever. Or, if the shutter is released, you can push the pallet lever against its spring tension as you scat the slow-speed governor—make sure the pallet lever sits alongside the pin on the pallet-control gear, Fig. L38.

REMOVING THE RANGEFINDER

For most repairs, it isn't necessary to remove the rangefinder assembly, Fig. L40. But you can remove the rangefinder after taking off the front plate.

The roller on the rangefinder lever, Fig. L35, rides against a cam formed at the back of the lens. The rangefinder lever then moves a prism in the rangefinder. And the prism moves the movable rangefinder image.

A screw holds the rangefinder lever to the rangefinder. Working from inside the shutter opening, Fig. L35, remove the screw and washer at the end of the rangefinder lever. Lift out the rangefinder lever.

Three screws hold the complete rangefinder assembly—two are under the rangefinder lever you just removed. The third is next to the flange for the rewind shaft. Remove the three screws and lift out the rangefinder assembly.

Looking at the underside of the rangefinder assembly, you can see a screwhead extending from the eyelens tube—the screw provides the coupling for the eyelens-focus adjustment. Remember that you can adjust the focus of the rangefinder image for your own eyesight. Moving the screwhead slides a lens within the eyelens tube.

The screwhead fits in the slot of a coupling lever at the top of the camera body. A fork at the end of the coupling lever straddles a projection on the rangefinder-focusing disc (the disc around the rewind flange that's engaged by the rangefinder-focus lever). When you replace the rangefinder assembly, fit the screwhead in the slot of the coupling lever. Fig. L40.

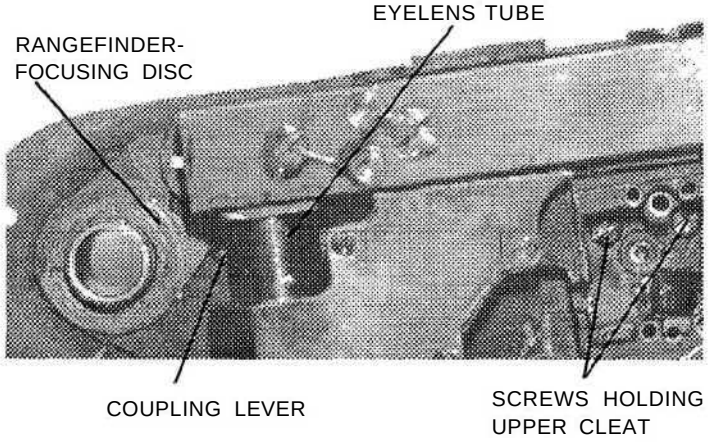

FIG. L40 Top view, rewind end.

REPLACING THE FRONT PLATE

Install the light shields, Fig. L35 and Fig. L34. Remember the positions of the drum light shield and the light shield by the tension rollers—both light shields pass to the insides of the upturned edges of the lower light shield, Fig. L41.

As you seat the front plate, couple the pallet-cam follower to the retard lever—work through the access hole in the front plate to couple the pallet-cam follower, Fig. L42.

Now replace four of the front-plate retaining screws—two at each side. If the camera has the fifth front-plate screw at the bottom front, Fig. L41, the screw is slightly shorter in length. And the screw threads into a cleat mounted to the inside of the camera.

One of the screws around the lens mount also passes into a threaded cleat, Fig. L41. The cleats are separate parts held to the camera body by screws. You can see one of the threaded cleats in Fig. L35—this is the cleat for the screw around the lens mount.

It's possible that the threaded cleats may have shifted out of position. The screw hole in the cleat won't then align with the screw hole in the front plate.

The cleat shown in Fig. L35 is held by two screws within the accessory-shoe cavity, Fig. L40. Loosen the two screws. You can then work through the screw hole by the lens opening, Fig. L42, to align the screw hole in the cleat. Replace the screw by the lens opening. Then tighten the two screws in the accessory-shoe cavity.

If the camera has a screw at the front bottom of the front plate, Fig. L42, the cleat is held by the screw shown in Fig. L44—one of the screws holding the retard-rod spring. Loosen the screw at the end of the retard-rod spring. Then align the cleat and replace the front-plate screw. Tighten the screw at the end of the retard-rod spring.

ADJUSTING THE CURTAIN TENSIONS

You can adjust the curtain tensions and the shutter speeds before replacing the top cover. The top cover must be removed to adjust the slit-width shutter speeds. But you can temporarily replace the take-up sleeve, the counter gear, the counter dial, and the wind knob. You can then cock the shutter with the wind knob rather than trying to rotate the sprocket.

Also replace the speed knob. Seat the 2nd~curtain release lever in the bulb hole, Fig. L43. Then replace the speed knob with its "B" calibration pointing to the center of the camera.

Replacing the speed knob serves two purposes. For one, it's

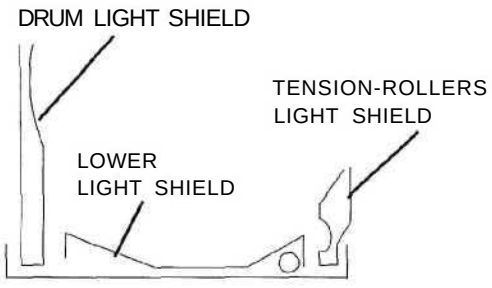

FIG. L41

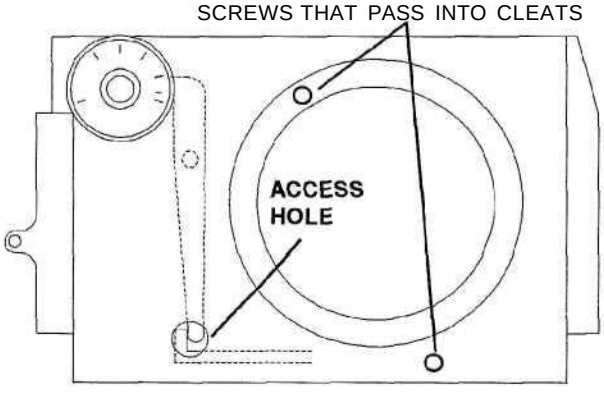

FIG. L42 Connection between the pallet-cam follower and the pallet lever.

easier to set the desired shutter speed. Just cock the shutter. Then lift and turn the speed knob until the desired shutter-speed calibration points to the center of the camera. The second purpose is to add the weight of the speed knob to the lst-curtain drum. Remember that the speed knob rotates with the 1st curtain. The additional weight of the speed knob then has a slight effect on the lst-curtain travel time.

Precise adjustments require proper testing equipment. But you can visually adjust for proper operation. Set the shutter speed to 1/1000 second. Then check to see if you're getting a slit all the way across the film aperture. Remember that you can use a florescent lamp to get an indication as to the accuracy of the shutter speed and the uniformity of the shutter speed across the aperture.

If you only get light at the opening side of the aperture, the 2nd-curtain is catching the 1st curtain. You then know you have to add tension to the 1st curtain.

But what if you get no light at all through the aperture? Change the shutter-speed setting to 1/500 second. Then recheck the operation. If you now gel light at the opening side—but not at the closing side—increase the lst-curtain

tension. Adjust the lst-curtain tension until you get light all the way across the aperture.

Again set 1/1000 second. And recheck the operation. You should now be getting light through the opening side of the aperture. But the 2nd curtain may still be catching the 1st curtain, cutting off exposure at the closing side of the aperture. Increase the tension on the 1st curtain until you get exposure all the way across the aperture.

If you get no exposure at 1/500, however, check 1/250. And adjust the lst-curtain tension until you get exposure all the way across the aperture. Repeat the adjustment to get exposure all the way across the aperture at 1/500 second. And finally repeat the adjustment at 1/1000 second.

In some cases—for example, if you replaced the shutter curtains—you may be setting up the tensions from scratch. You can then start with a certain number of turns on each tension roller.

Start with the curtains in the released positions. Then turn the lst-curtain worm, Fig. L44, until the lst-curtain worm gear has turned **three full turns.** Next turn the 2nd-curtain worm, Fig. L44, until the 2nd-curtain worm gear has turned 1 3/4 **turns.**

The shutter should now operate. From here, make all your tension adjustments on the 1st curtain as previously described.

ADJUSTING THE SHUTTER SPEEDS IN THE LEICA IIIf

Once the exposure appears uniform across the film aperture at 1/1000, you can check the accuracy of the shutter speeds. Again, precision requires test equipment. But you can use the florescent lamp to set 1/500 and 1/1000 as described in *Checking and Adjusting Shutter Speeds with a Focal-PlaneShutter,*

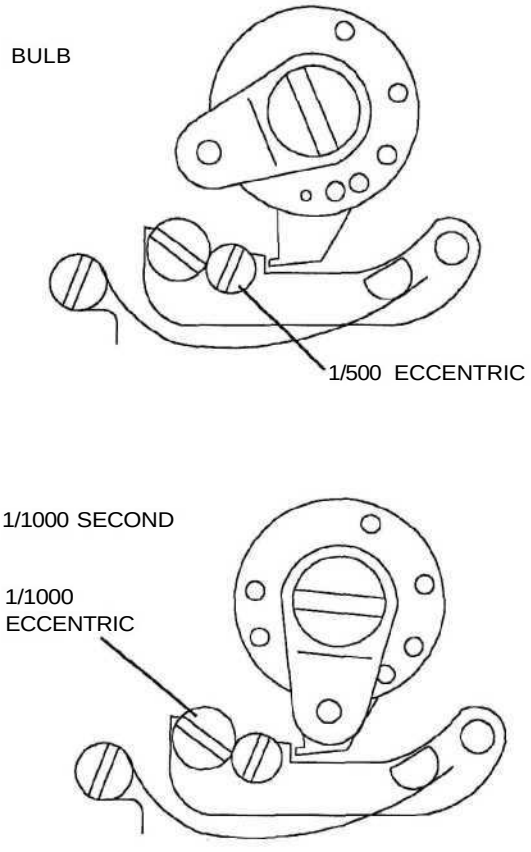

FIG. L43 2nd-curtain release lever at bulb (top) and at 1/1000 second (bottom), shutter cocked.

Start with 1/500 second. Adjust the 1/500 eccentric, Fig. L43. for an accurate exposure. For a faster exposure time, turn the eccentric in the direction that will disengage the 2nd-curtain latch sooner. Then set 1/1000 second. Adjust the 1/1000 eccentric for an accurate exposure.

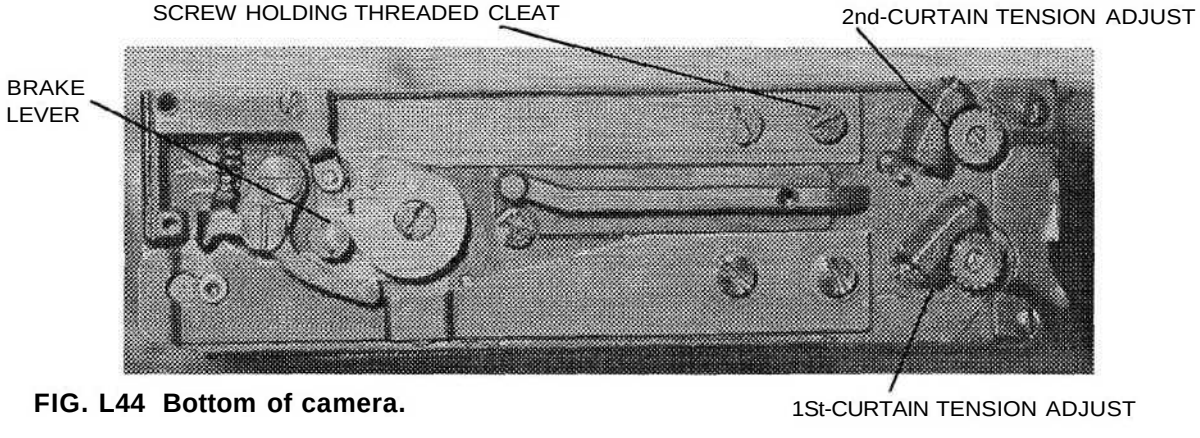

FIG. L44 Bottom of camera.

The slit-width shutter speeds—1/1000 through 1/30—should now be correct. Set the speed knob to 1/30 second. And set the slow-speed knob to 1 second. Check the 1-second exposure.

Adjusting the slow speeds requires repositioning the slow-speed cam. The adjustment moves the retard lever either closer to or further from the 2nd-curtain cam. If you move the retard lever closer to the 2nd-curtain cam, you increase the depth of engagement. The result—a slower shutter speed.

To reach the slow-speed adjustment, first loosen the set-screw on the outer circumference of the knurled slow-speed knob. Now unscrew the knurled knob. Removing the knurled knob from the slow-speed knob uncovers the adjusting collar, Fig. L45.

The adjusting collar screws into the slow-speed knob. And the locking screw, Fig. L45, screws into the back of the slow-speed cam, Fig. L36. By changing the relationship between the adjusting collar and the locking screw, you move the slow-speed cam in or out. Moving in the slow-speed cam increases the depth of retard-lever engagement.

To adjust at 1 second, unscrew the locking screw a partial turn. Then screw the adjusting collar in or out. When you retighten the locking screw, the slow-speed cam sits at a new position. Turn the adjusting collar clockwise for a slower shutter speed or counterclockwise for a faster shutter speed.

CHECKING AND ADJUSTING CURTAIN BOUNCE

Earlier we mentioned the purpose of the brake lever, Fig. L44—the brake, you'll recall, prevents the curtains from bouncing into the aperture after the exposure. Curtain bounce may not be a major concern in an antique—unless you're going to use the camera photographically.

You can check for curtain bounce by setting the full-aperture shutter speed (1/30 second in the black-dial IIIf, 1/25 second in the red-dial IIIf). Watch through the back of the film aperture and hold the camera to a light source. With some practice, you can detect the curtain bounce when you release the shutter.

Curtain bounce shows at the closing side of the film aperture. If the 1st curtain bounces, the shutter briefly reopens at the closing side. You'll see a slit of light—a strip of white running down the closing side of the film aperture.

If the 2nd curtain re-enters the film aperture, you'll see the opposite effect—a dark-colored strip running down the closing side of the film aperture.

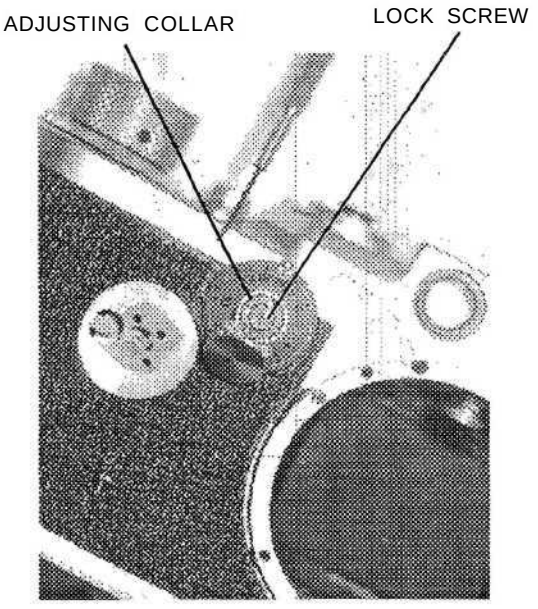

FIG. L45 Knurled knob removed from slow-speed knob.

Either lst-curtain or 2nd-curtain bounce means that the brake action is insufficient. Increase the brake pressure. In the Leica IIIf, you can increase the brake pressure by turning the brake-lever eccentric toward the lst-curtain cam.

What if there's too much brake action? Try holding open the shutter on bulb. If there's excessive braking action on the 1st curtain, the lst-curtain bar may still be visible from the back of the film aperture. But the same symptom will result from insufficient tension on the lst-curtain tension roller—or from a dirty shutter.

Then let the shutter close at the bulb setting. Can you still see the 2nd-curtain bar in the film aperture? If so, the brake may again be too tight. The 1st curtain hasn't sufficiently overcome the brake, causing the 2nd-curtain bar to remain in the film aperture.

You've seen that the lst-curtain brake also serves as a brake for the 2nd curtain. But the 2nd-curtain has additional braking action—as the pallet-control gear strikes the pallet lever, it helps brake the 2nd curtain, lst-curtain bounce is generally more common than 2nd-curtain bounce.

Many focal-plane shutters do have separate brakes for each curtain. For examples of brakes in modern focal-plane shutters, please refer to the *Camera Technician's Guide* published by Alii Service Notes.

Repair Tips for Unfamiliar Cameras

Before starting on an unfamiliar camera, gather all the repair information you can get—especially if the camera has value. The sheet Sources for Assistance includes suppliers of repair information on specific cameras.

Unfortunately, it's not always possible to find information on the older cameras. If there's no information available—and if you can't find a "junker" for practice—you may have to prepare your own repair manual as you go. But again—if the camera has value, don't attempt repairs until you've gained proficiency.

You might make a photo record of your disassembly. The photos you take will provide invaluable reassembly reference. Or make sketches to show spring positions, wire connections and routing, timing points, etc. The better your sketches and photos, the more useful your repair information will be.

Here are some tips you can apply when working on an unfamiliar camera:

DISASSEMBLY SEQUENCE WITH A 35mm CAMERA

With a 35mm camera, you should generally start your disassembly by removing the bottom cover. It's normally fairly easy to remove the bottom cover. And it's usually safe. Removing the bottom cover, as you've seen in the Leica, rarely disturbs timing points.

Then study as much of the operation as you can. With a focal-plane shutter, you can often learn quite a bit from the bottom of the camera. But if the camera has a blade-type shutter, there may be very little at the bottom.

Remember to keep screws with the associated parts. Compare screws as you remove them to see if they are the same. If the cover plate has different types of screws, make notes or sketches to show where each type of screw goes.

REMOVING THE TOP COVER

Removing the top cover may disturb timing points—especially if the camera has a cross-coupled exposure meter. As mentioned in the section *Exposure Meters*, the old cameras use mechanical linkage.

The linkage couples the ammeter to the camera controls. Frequently the ammeter housing rotates as you change the shutter-speed or aperture controls. Rotating the ammeter housing puts the needle in a different position for the same amount of light. Or the linkage may move the pointer or doughnut above the exposure-meter needle.

If the ammeter housing rotates, there's another danger—the housing is probably spring-loaded. The linkage then moves the housing in one direction; the spring moves the housing in the other direction.

You can determine what part is moving before disassembly. Change the shutter speed. Is the exposure-meter needle moving? Or is a doughnut moving? Also check the operation while you're changing the diaphragm setting and the film-speed setting.

To prevent damage—and to give you a chance to note timing points—it's desirable to let off as much tension as possible from the ammeter spring. Usually, the shutter-speed and film-speed controls rotate the ammeter housing. And in most cases, you can let off the maximum amount of spring tension by the following settings:

1. Set the shutter speed to bulb.
2. Set the film speed to the highest ASA setting.

There are exceptions—and that's why it helps to gather specific repair information. But the combination of bulb and the fastest film speed generally rotates the ammeter housing in the direction that lets off spring tension.

Then determine what parts must be removed to take off the top cover. With a 35mm camera, you'll usually have to remove the wind lever and the rewind knob. You've seen that the rewind knob normally screws onto the rewind shaft—by holding the rewind shaft, you can unscrew the rewind knob. But also check for a screw at the top of the rewind knob. If the screw holds a rapid-rewind crank, it should normally be left in place. However, the screw may be holding the rewind knob to the rewind shaft.

Removing the wind lever may lose spring tension—the tension on the spring that returns the wind lever after the cocking stroke. Usually, though, the return spring is on the wind shaft.

You may also lose, spring tension when you remove the counter dial. A spring may return the counter dial to the start position when you open the back cover. When the counter dial reaches the start position, it comes against a stop. Here, there's still some tension remaining on the counter-dial spring-that's the initial tension. You'll lose the initial tension when you remove the counter dial.