Nat Cam **Manual**

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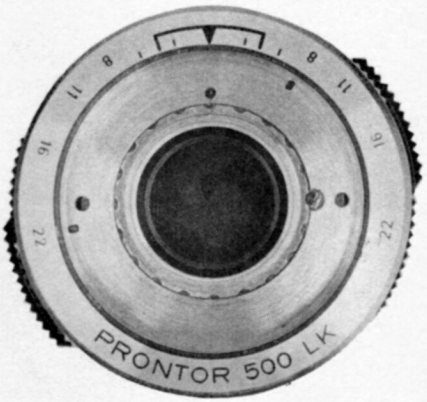

The Prontor 500LK Programmed Shutter

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NATIONAL CAMERA
TECHNICAL TRAINING DIVISION

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THE PRONTOR 500 LK PROGRAMMED SHUTTER

Although increasing the speed range made shutters more versatile, it also made the cameras more difficult to use. The semi-automatic camera resulted from the desire to produce a high quality instrument which would approach the box camera in operating simplicity.

With this system, the shutter's diaphragm and speed controls are coupled to an indicator pointer which is visible to the operator. Changing either the aperture or the shutter speed moves the indicator in relation to the needle of a built-in exposure meter. When the pointer and needle are aligned, the camera controls are correctly set to the existing light conditions.

Besides the coupling system, the semi-automatic camera required a shutter in which equal amounts of diaphragm control ring and speed cam movement would result in equal amounts of indicator pointer movement. The shutter's controls could then be programmed to the exposure meter. Although you will find many versions of this principle, the shutters themselves normally follow standard designs. A good example is the Prontor 500 LK, a programmed shutter which is basically similar to the Vario you have already studied. An adjustable pallet for a greater speed range, a delayed-action escapement, and the programmed feature are just added to the basic Gauthier design.

The exposure meter coupling system of the Prontor 500 LK consists of a cam within the shutter itself and a pin-type cam follower contained in the camera body. Changing the film speed setting, the shutter speed, or the f/stop moves this shutter cam in accordance. The spring-loaded cam follower, which is linked to a pointer visible in the camera viewfinder or through a separate window, follows the movement of the cam. Once the operator has selected the correct film speed he can set the exposure by changing the shutter speed or aperture until the pointer is aligned over the exposure meter needle. The result is a semi-automatic camera, one in which the user must still set the shutter controls, but has a built-in guide to minimize error and simplify operation.

For instance, the operator may need a fast shutter speed for an action shot. Once he has set this speed, he can find the correct aperture by turning the diaphragm control until the pointer is aligned with the exposure meter needle. If he then needs a small aperture for greater depth of field, he can select the desired f/stop and turn the speed control until the pointer and needle are once again aligned.

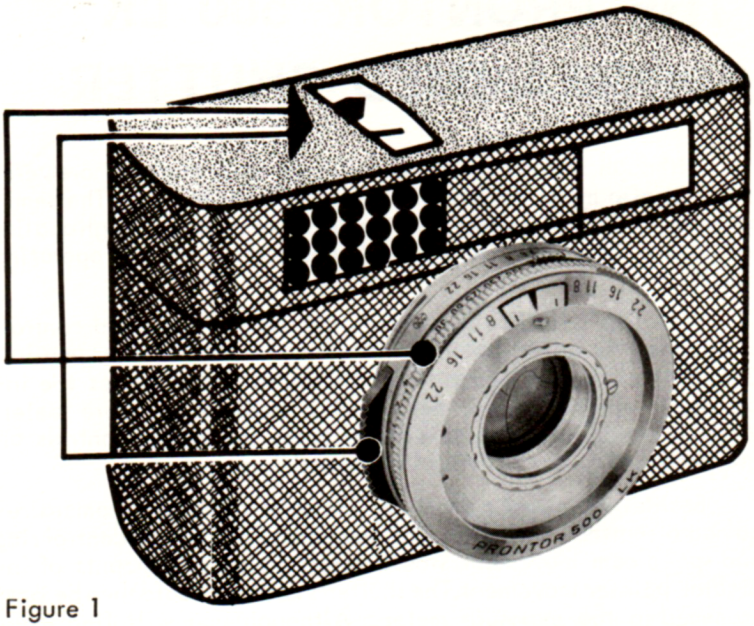


Figure 1
Changing Shutter Speed and/or Diaphragm Setting Alters Position of Pointer.

One problem this programmed feature presented to the designers was that, in order for the aperture setting and the speed setting to have the same effect on the pointer position, the respective control rings would have to move exactly the same amount for each setting change. That is, the diaphragm control ring must have the same amount of physical rotation to effect each change in aperture so it can be correlated to the speed cam movement. However, the existing diaphragms did not move in equal increments over the entire range of adjustment. For example, it required twice as much diaphragm control ring movement to change from f/8 to f/11 as to change from f/11 to f/16, even though the relative aperture in each case changes only one f/stop. This would mean that the change in cam and pointer movement would not correspond to the change in aperture.

The problem was solved by a newly designed diaphragm leaf, Figure 2. A diaphragm using five of these leaves moves exactly the same amount for each change in aperture. Note the long "tail" (which forms the aperture with the programmed style) and the two pins on the same end of the leaf.

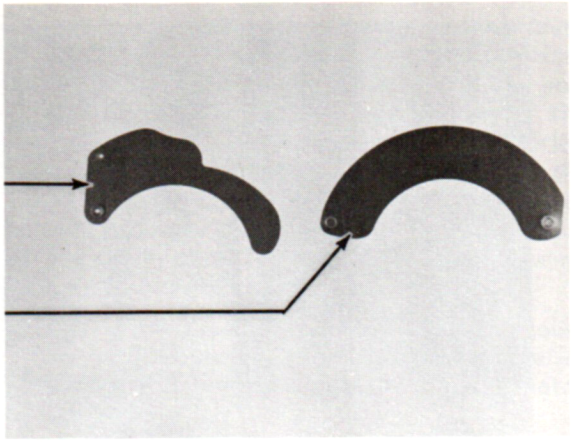


Figure 2

Before you begin your disassembly of the Prontor 500 LK, you can observe several of the shutter's characteristics. Both the shutter speed and diaphragm calibration scales are on the side of the shutter, Figure 3. If the shutter were mounted on the camera, these scales would face the top where they would be convenient to the operator. The f/stop calibrations are contained on the diaphragm control plate which can easily be turned by two plastic handpieces on its outer circumference. The shutter speeds, indicated on the side of the speed cam, can be changed by rotating the knurled ring, Figure 4. (Note: When the shutter is removed from the camera it will be necessary to hold the rear lens flange while changing shutter speeds.) Although an index for setting the f/stop and the shutter speeds would normally be provided on the camera body, you can use the index on the cover plate (the center of the depth-of-field scale, Figure 5) for reference when the shutter is removed.

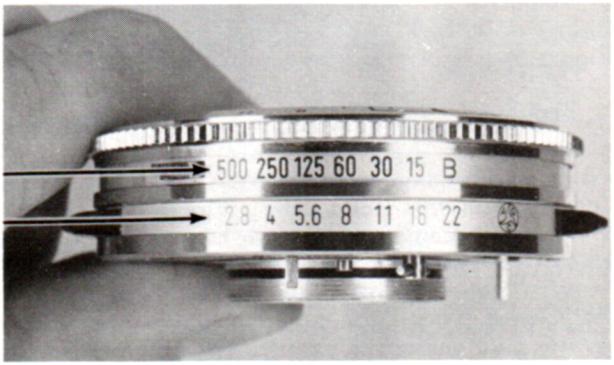


Figure 3

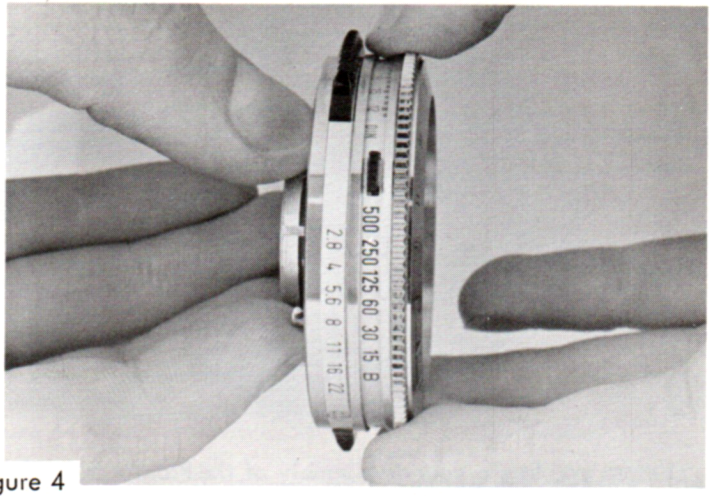


Figure 4

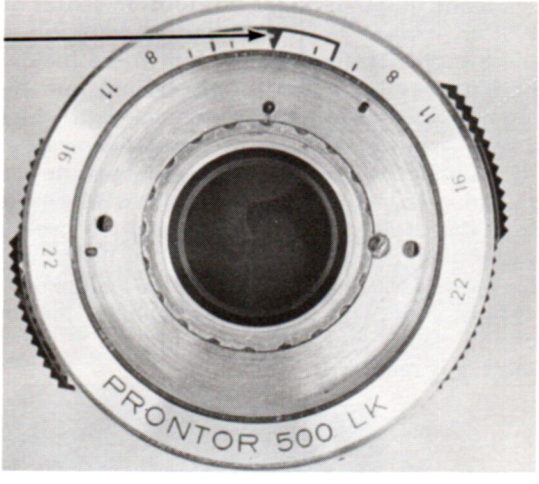


Figure 5

The knurled ring which is turned to change shutter speeds is actually the ASA (film speed) setting ring. Locate the two scales - corresponding to the ASA and DIN ratings - on either side of the shutter speed scale. Either scale can be used by the operator, depending on whether his particular film is rated as to ASA (American Standards Association) now the United States of America Standards Institute, or as to DIN (Deutsche Industrie Norm, the German standards organization). Film instruction sheets usually give one or the other (or both) of these ratings. In order to set the correct film speed, the plastic button on the side of the speed cam, Figure 6, must be depressed. While the plastic button is held in against the shutter, the ASA setting ring can be

turned until one of the red dots on the ring is over the appropriate film speed calibration on the scale. When the plastic button is released, the ASA setting ring will be latched to the particular setting. Thereafter, the ASA setting ring and the speed cam will be physically coupled, turning together when the speeds are changed. You will discover on disassembly that, while the speed cam effects the change in shutter speeds, it is the ASA setting ring that actually determines the position of the exposure meter control cam.

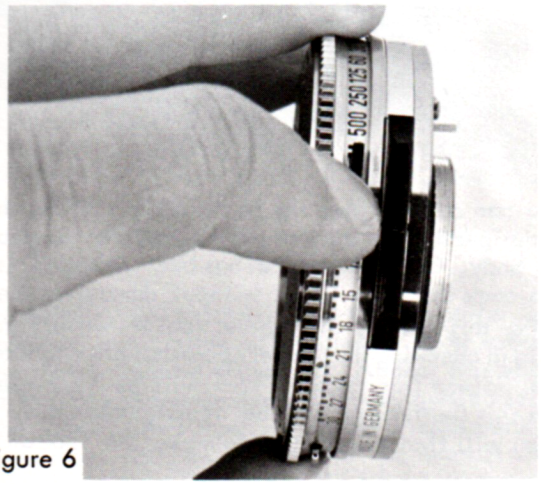


Figure 6

A retaining ring usually holds the shutter to the camera. However, before the shutter can be completely removed, the two wire leads from the sync nipple in the camera to the shutter contacts must be unsoldered. You can see the two contacts - an insulated hot contact and a flat ground wire - from the back of the shutter near the main lever shaft, Figure 7. (Whenever wires must be disconnected, make a note of the color coding and position to assure correct replacement. This will eliminate the time-consuming necessity of having to trace the circuit.)

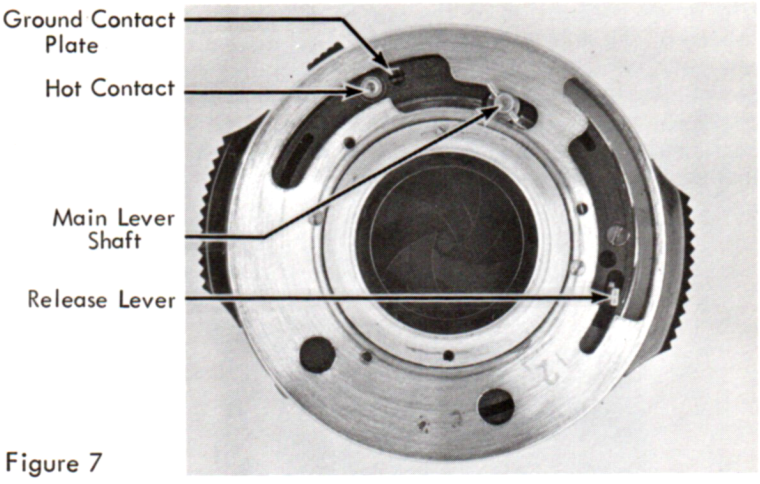
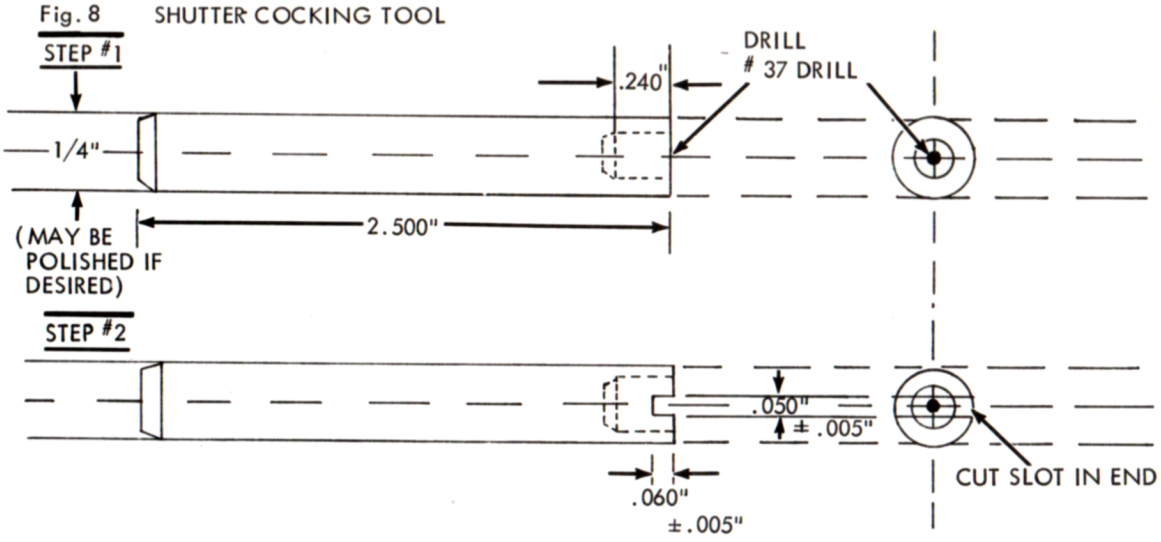


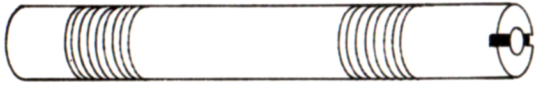
Figure 7

As you can observe from the back of the shutter, the Prontor 500 LK is designed to be cocked and released by controls within the camera body. Once the shutter has been removed, it is rather difficult to cock the main lever without damaging the shaft or housing. For this reason, the special tool shown in figure 8 is a valuable aid in checking the shutter operation prior to mounting on the camera. Since this cocking tool will be very useful when working on this shutter and will be needed frequently in future repairs, you will find it desirable to make the tool at this time.

Fig. 8 SHUTTER COCKING TOOL



MAKE FROM 1/4" ROUND BRASS STOCK
(DRAWING IS NOT ACTUAL SIZE)



SHAFT MAY BE GROOVED, KNURLED OR
FIT WITH A "T" HANDLE IF DESIRED

Using the special cocking tool, cock the shutter by turning the main lever shaft in a clockwise direction, Figure 9. Trip the shutter by depressing the release lever, Figure 7.

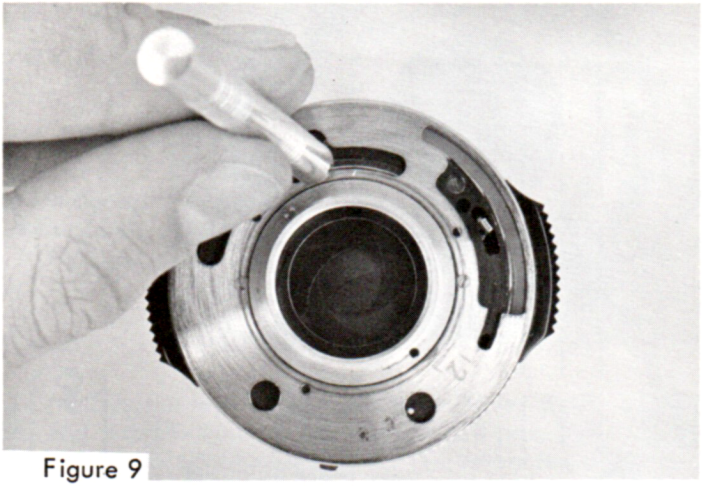


Figure 9

When you were studying the calibration scales, you probably also noticed a red-tipped lever extending through the side of the shutter, Figure 10. This is the delayed-action setting lever, the lever which cocks the delayed-action escapement to provide a ten-second delay in blade opening. You will find two basic delayed-action designs in Gauthier shutters - one in which the delayed action is cocked automatically when the shutter is set and the other which requires manual cocking as in the Prontor 500 L K. Although you have already studied delayed-action designs in other shutters, you will soon discover that the Gauthier design is quite different in operating principle.

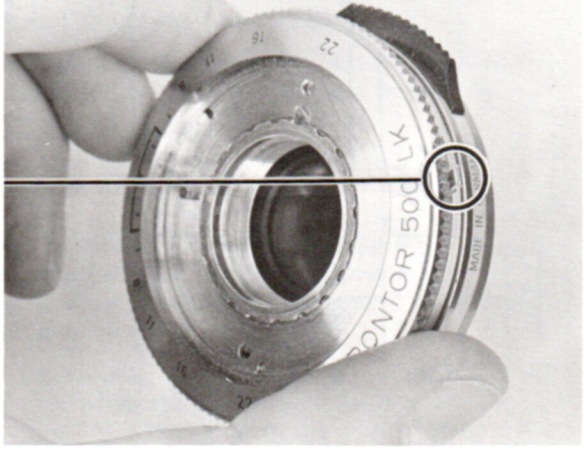


Figure 10

As was previously mentioned, the Prontor 500 LK is a programmed shutter designed to be coupled to a pointer over the exposure meter. In order to thoroughly analyze the coupling parts within the shutter, the speed cam must be removed. You can at this time, however, observe the section of the cam which operates the spring-loaded cam follower in the camera body. From the back of the shutter, note the white nylon linkage control cam which can be seen through the cutout near the release lever, Figure 11. If the shutter were mounted on the camera, the cam follower would pass through this cutout.

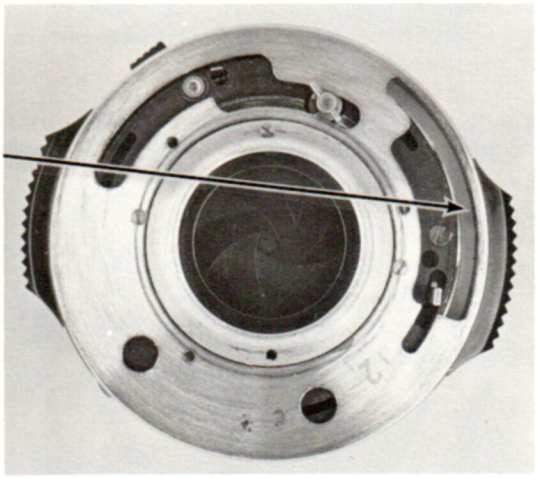


Figure 11

Since the linkage control cam is linked to the diaphragm control plate, turning the plate will impart the same rotational movement to the cam. Because the cam's face is inclined, the spring-loaded cam follower will move in or out accordingly. Changing the shutter speed (or the ASA) moves the entire linkage control cam vertically along the threaded shutter housing without changing the cam's rotational position. The effects on the cam follower of the rotational and vertical movements of the linkage control cam will cancel each other out if the shutter speed and aperture are changed together. For now, just observe the movement of the linkage control cam while you are changing the shutter speeds and the f/stops - how this movement is accomplished will become clear after you have removed the speed cam.

DISASSEMBLY OF THE PRONTOR 500 LK

NOTICE: Of all the practice shutters you have encountered thus far in your course, the Prontor 500 LK is the most delicate. Although not unusually complex or difficult, extreme care must be exercised to avoid damaging the fragile and precise parts of the shutter. Work slowly and carefully until you get the feel of the various assemblies, paying particular attention to the cautions as they appear in the text.

As is typical of Gauthier design, the cover plate is held by a scalloped retaining ring, Figure 12. Before you turn the lock nut 180°and unscrew this ring, rotate the speed cam back and forth a few times to get the "feel" of the operation. On reassembly, the scalloped retaining ring should be tightened until the speed cam has the same tension. Since the customer is very familiar with the use of his camera, he will notice any difference in the tightness of the speed cam.

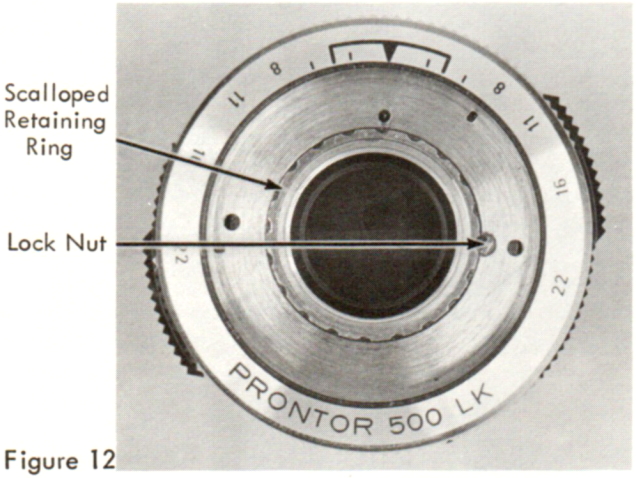


Figure 12

With the retaining ring removed, the knurled ASA setting ring and the cover plate can be lifted off together, Figure 13. Set the cover plate aside and note the design of the ASA setting ring. The row of teeth on the inner circumference, Figure 14, corresponds to the film speed range. A spring-loaded coupling latch on the speed cam, Figure 15, engages in one of the slots depending on the film speed selected. It is this coupling latch that connects the ASA setting ring and the speed cam, allowing the two to be turned simultaneously.

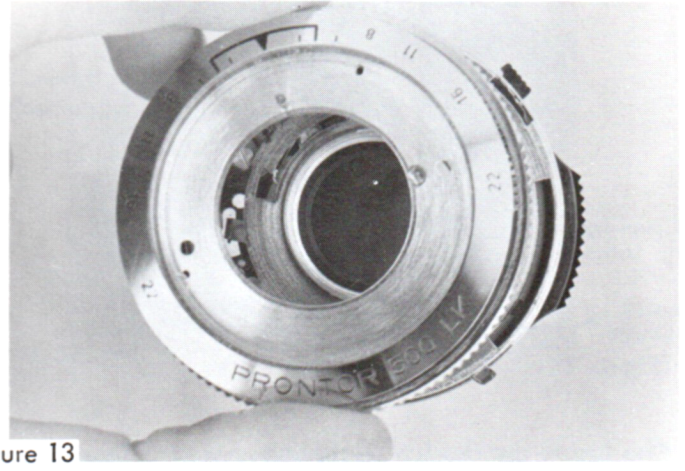


Figure 13

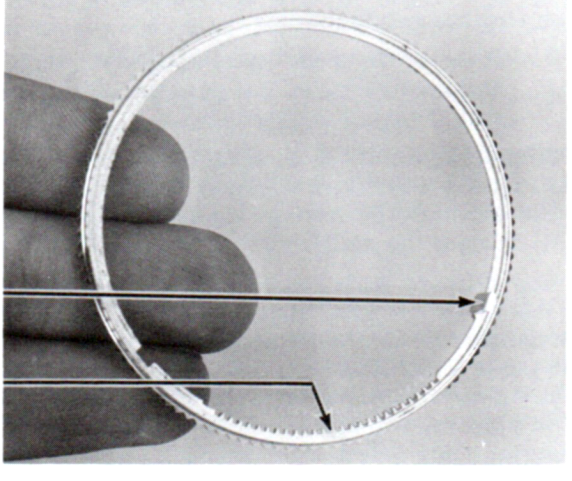


Figure 14

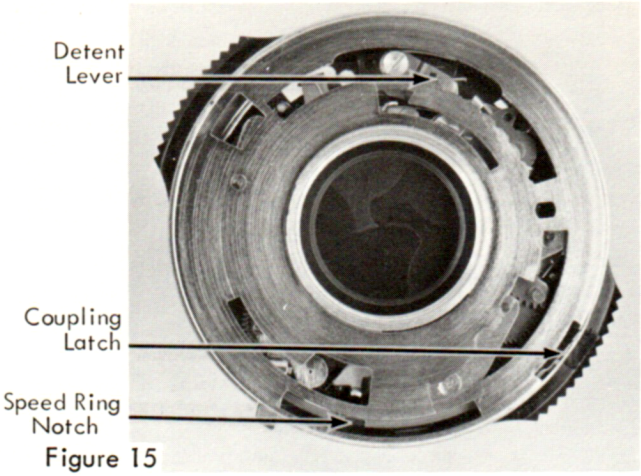


Figure 15

Also locate the flat lug on the bottom of the ASA setting ring, Figure 14. This is the means by which the setting ring controls the vertical position of the linkage control cam. The lug engages a notch in a threaded brass ring, the speed ring, which completely encircles the shutter housing. (This notch in the speed ring can be seen by looking through the slot in the top of the speed cam, Figure 15.)

Because of these two design features, it follows that the ASA setting ring has two functions:

1. It moves the speed cam through the coupling latch.
2. It controls the vertical position of the linkage control cam through the speed ring.

Both of these actions occur as a result of changing the shutter speed. Setting a different film speed merely changes the relationship between the ASA setting ring and the speed cam and, as a result, changes the position of the linkage control cam.

You will now notice that the speed cam is somewhat different from the others you have studied in that it extends part of the way down the side of the shutter housing. The shutter speed and film speed scales which you have already observed are printed on a separate plate which encircles the side of the speed cam and is held in place by two screws. (It is never necessary to remove this calibration plate unless replacement is required.) Another characteristic is that the speed cam has "click-stops" to provide precise positioning at the speed settings. Locate the spring-loaded detent lever which rides against a row of notches on the speed cam, Figure 15, corresponding to the shutter speed range.

Despite its differences in design, the speed cam controls the shutter speeds in basically the same manner as did the other shutters in this lesson. Cutouts in the top of the speed cam, Figure 16, govern the action of the bulb lever, the length of retard lever stroke and the pallet engagement. (Although the Prontor 500 LK does not have the truly slow speeds - the slowest is 1/15 sec. - it still uses an adjustable pallet to obtain two speed ranges. The pallet is engaged at "bulb," 1/15 sec. and 1/30 sec., and is held out of engagement at the other speed settings.)

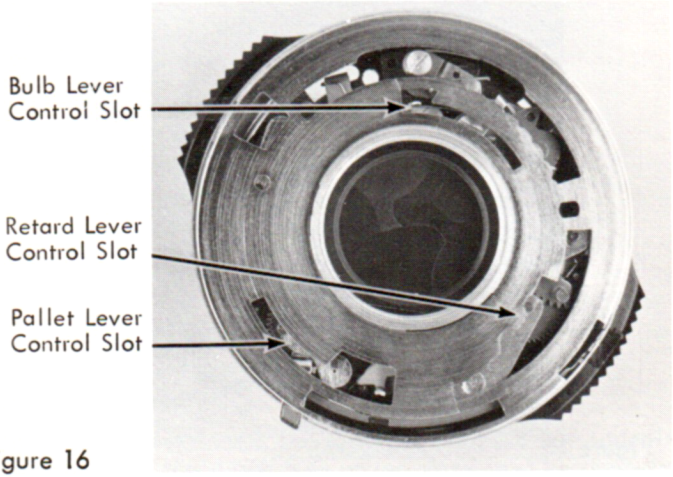


Figure 16

To remove the speed cam, there are two important design features which must be considered: the pressure maintained by the detent lever and the position of the delayed-action setting lever

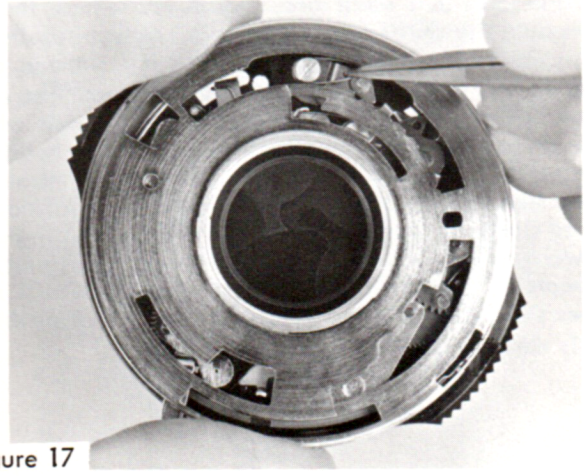


Figure 17

which passes through a slot in the side of the speed cam. First, disconnect the detent lever by inserting a pointed tool, such as a closed tweezer, into the hole provided in the lever for this purpose, Figure 17. While holding the detent lever against its spring tension (toward the outside of the shutter), lift the side of the speed cam slightly. Allow the detent lever to return, passing under the speed cam. Now, with a gentle twisting motion to clear the delayed-action setting lever, Figure 18, separate the speed cam from the shutter.

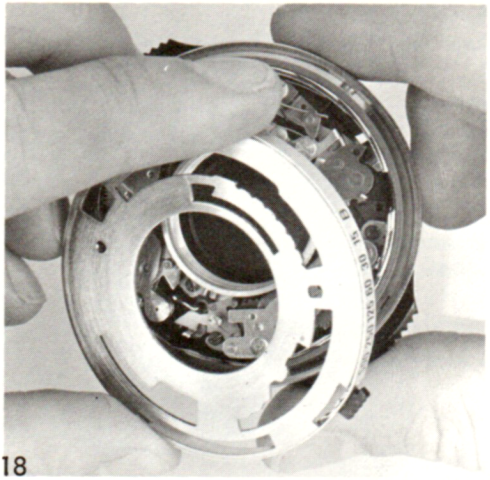


Figure 18

With the speed cam removed, the actions of the speed ring and of the linkage control cam can be clearly observed. Insert a small screwdriver into the notch in the speed ring (the notch which is normally engaged by the ASA setting ring) and turn the speed ring back and forth in a small arc, Figure 19. Since the speed ring screws onto the shutter housing, a spiral motion results which will in turn impart a vertical movement to the linkage control cam riding on this ring. As the speed ring is turned, the linkage control cam slides up or down, guided by a brass stud which is part of the diaphragm control plate, Figure 19. By holding the speed ring stationary and turning the diaphragm control plate, you can see that the linkage control cam and the spiral movement of the speed ring will determine the position of the spring-loaded cam follower in the camera. The two actions are so calibrated that equal amounts of horizontal and vertical movement will nullify one another's effects, as when the aperture is halved and the shutter speed is doubled at the same time.

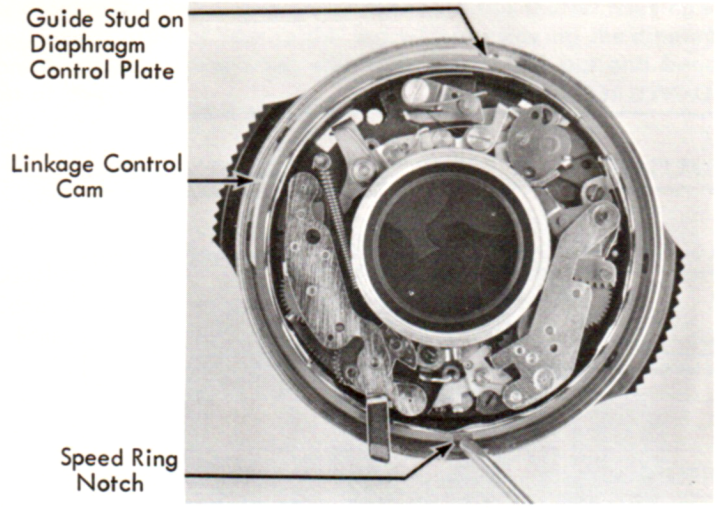


Figure 19

For example, selecting a smaller aperture will force the cam follower (in the camera) to move inward (toward the camera) against its spring tension. Setting a slower shutter speed will allow the cam follower to move out (toward the shutter). If these two movements are in equal amounts resulting in the same exposure- such as stopping the diaphragm down one stop and selecting the next slower shutter speed - the inward and outward movements of the cam follower will also be equal. Therefore, since the exposure has not been changed by the new settings, the pointer visible to the operator will be in the same position. Of course, when another exposure (combination of f/stop and shutter speed) is selected - or a different ASA film speed - the pointer will move accordingly.

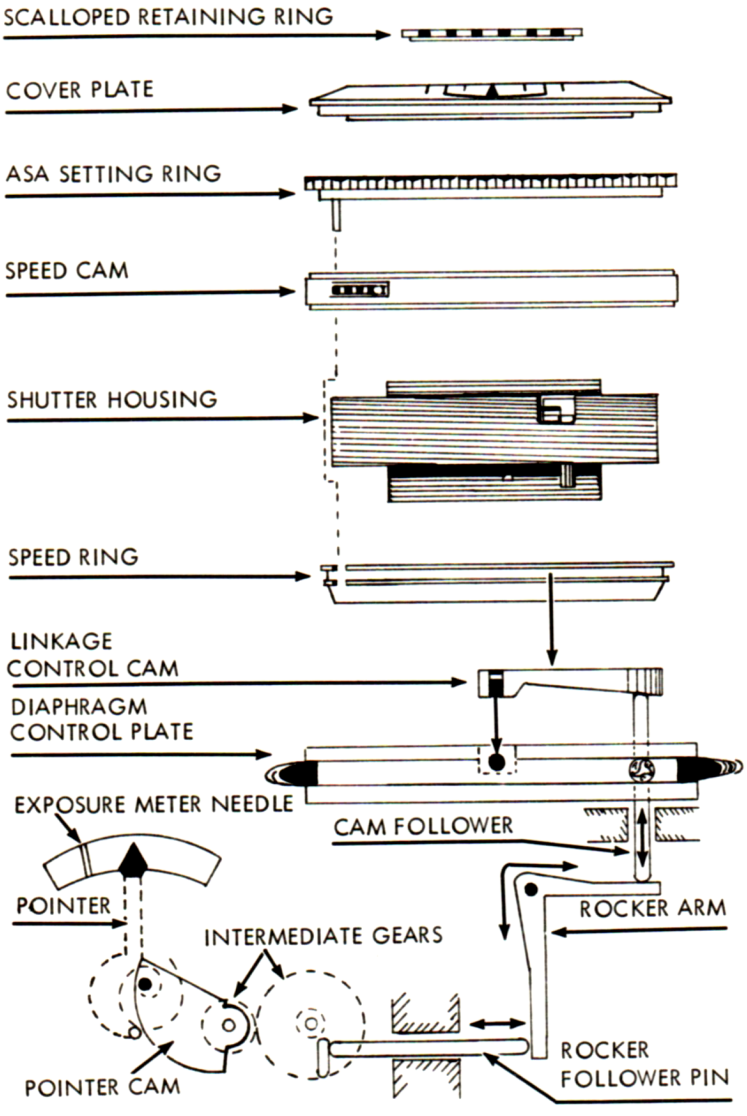


Figure 20 Exploded Diagram of Prontor 500 LK Shutter With One Possible Linkage Connection to Pointer and Exposure Meter.

Although the shutter mechanism may at first appear complex, you are already familiar with the basic operation. The outer release lever, the inner release lever, the bulb lever, the main lever and the leaf lever differ slightly in shape from their Vario counterparts, but the operation is exactly the same. Since these parts can normally be left in place, and since both escapements are sub-assemblies which are removed as complete units, disassembly is greatly simplified. There are, however, several areas which will require dexterity and patience.

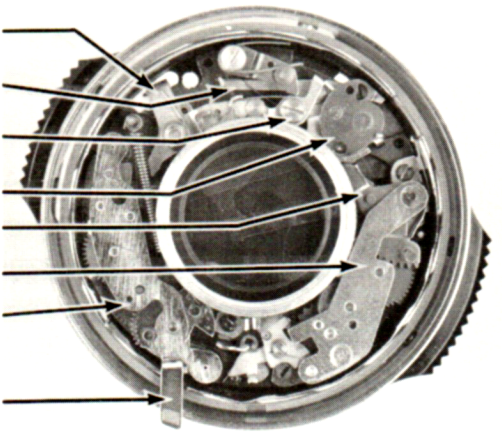


Figure 21

Before proceeding with the disassembly, operate the shutter several times while observing the familiar Gauthier design (the shutter will yield "bulb" action with full retard). You will notice that, unlike the Vario model previously described, this Prontor does not use a lock lever under the bulb lever - so the release lever can be actuated whether or not the shutter is cocked. Since the Prontor 500 LK is designed to be set and released by the camera, the double exposure prevention mechanism is also contained within the camera body. This eliminates the need for such a mechanism within the shutter itself.

When the shutter is cocked, the main lever is latched by the inner release lever. Pressing the outer release lever moves the inner release lever out of engagement with the main lever, allowing the main lever to move under the tension of the mainspring. The leaf lever, riveted to the main lever, then opens the shutter blades. As the blades reach the full-open position, the main lever is arrested by the bulb lever (note that both the inner release lever and the bulb lever contact, in turn, the same latching point on the main lever). The shutter blades are held in the open position until the outer release lever is allowed to return, forcing the bulb lever out of engagement with the main lever. The shutter can

now complete its cycle to close the blades. Although this is basic Gauthier design common to Vario and Prontor models, you should carefully examine the parts and their spring locations.

Locate the vertical lug on the main lever that contacts the retard lever in the speeds escapement (the escapement that controls the shutter speeds). With the speed cam removed, the retard lever is allowed a full stroke. The pallet, however, is in the disengaged position and will not contact the star wheel until the shutter is tripped.

As with most complex escapements, the pallet is engaged only when the shutter is tripped at slow speeds. You will recall that the main lever in the Compur-Rapid disengaged the pallet on the setting stroke, while the same function was performed in the Supermatic (except in the flash model) by the setting lever. In the Prontor, however, the pallet is always held in the disengaged position - until the shutter is tripped. This action is provided by the blade operating ring.

Note: There are three studs on the blade operating ring which extend through the mechanism plate. Each one has its important and distinct function(s) in the shutter operation. To avoid confusion, identify each stud with its individual purpose, as:

A. The stud situated between the two escapements which (1) contacts the pallet control lever to hold the pallet disengaged, and (2) contacts the first gear segment of the delayed action to prevent the blades from opening when the delay is used.

B. The stud under the retard lever which (1) is moved by the leaf lever to open and close the blades, and (2) carries the contact closing lever.

C. The stud under the speeds escapement pallet which is contacted by the blade operating ring spring to prevent the blades from opening on the setting stroke of the main lever.

Locate the blade operating ring stud which extends through the mechanism plate between the two escapements, Figure 22. A curved "wing"on the stud holds the pallet control lever toward the outside of the shutter, keeping the pallet disengaged from the star wheel. Using the special tool you made for cocking the shutter, restrain the main lever and allow the shutter to release slowly. As the blade operating ring turns to open the blades, observe the pallet moving toward the star wheel. By the time the main lever has contacted the retard lever, the pallet will be fully engaged with the star wheel. As soon as the blades begin to close, the blade operating ring stud will again press the pallet control lever

back until the curved section in the pallet is against the head of the escapement mechanism retaining screw, Figure 22. This screw serves to position the pallet, preventing any chance of contact with the star wheel.

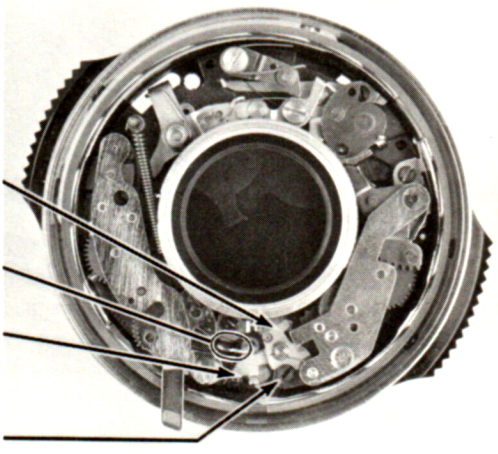


Figure 22

Besides determining the position of the pallet control lever, this stud on the blade operating ring has another important duty in the shutter operation - it is responsible for holding the blades in the closed position when the delayed action (self-timer) is used. You have seen one delayed-action design in the Supermatic (in which the mechanism actually trips the shutter), and another in the Compur (in which the mechanism retards the main lever). In the Prontor, the shutter is set and released normally, the delayed-action escapement merely blocking the blade operating ring for the necessary duration.

To cock the delayed-action escapement, move the delayed-action setting lever as far as it will go in a clockwise direction, Figure 23. This setting lever is an extension of the first gear segment which turns against a one-way clutch (similar in this respect to the Supermatic) to tension the return spring. At the same time, the delayed-action setting lever releases a locking lever, Figure 23, which is moved by its spring into engagement with the pinion of the third escapement gear. This locks the gear train, holding the return spring in the "set" position.

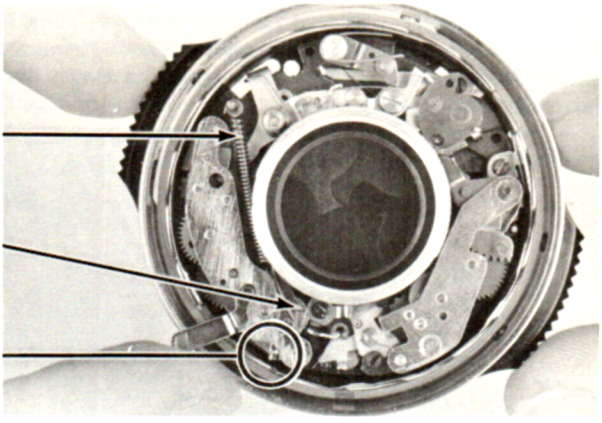


Figure 23

While one end of the locking lever was moving toward the pinion, the other end was moving into the path of the blade operating ring stud. Note the curved lever under the first gear segment which is now nearly touching the stud. You can see that if the blade operating ring stud were traveling toward the delayed-action escapement, it would contact first the locking lever and then the curved surface of the first gear segment.

With both the shutter and the delayed action cocked, you can follow the sequence of events when the shutter is released. As soon as the main lever is tripped, the blade operating ring stud will begin its movement toward the delayed-action escapement. At the start of its travel, the stud kicks the locking lever and holds it out of engagement with the third gear pinion. Now the return spring can turn the first gear segment against the retarding action of the escapement. Before the blade operating ring has moved far enough to open the blades, its stud strikes the curved surface of the first gear segment, arresting the shutter action. The main lever and the blade operating ring are held in this position until the escapement has run down, allowing the blade operating ring to drop into a slot in the gear segment. At this point, the main lever can complete its movement and the blades will open and close normally.

Removing the delayed-action return spring is a tricky operation, requiring both patience and practice. The first gear segment should be in the released position so there is a minimum amount of tension on the spring. The coiled end of the return spring hooks in the groove around a post on the mechanism plate (the top section of this post serves as a locating pin for the cover plate). Slip one point of your tweezers into the loop, Figure 24, pulling the spring away from the post while lifting the loop out of the groove. When the coiled end is free, slide the spring toward the first gear segment and disconnect the hooked end, Figure 25.

Now, with both ends loose, move the entire return spring back toward the pallet end of the delayed-action escapement until you can manipulate the spring out of the shutter.

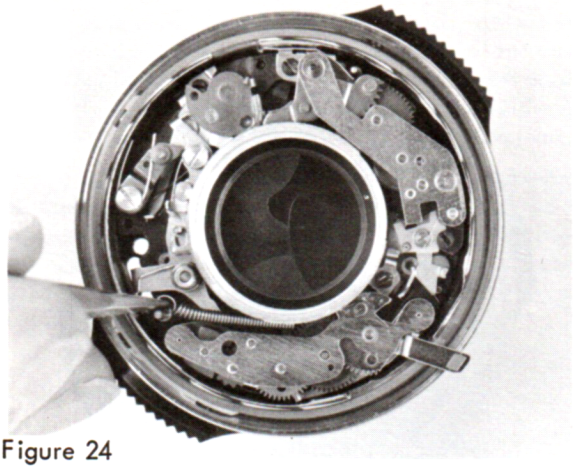


Figure 24

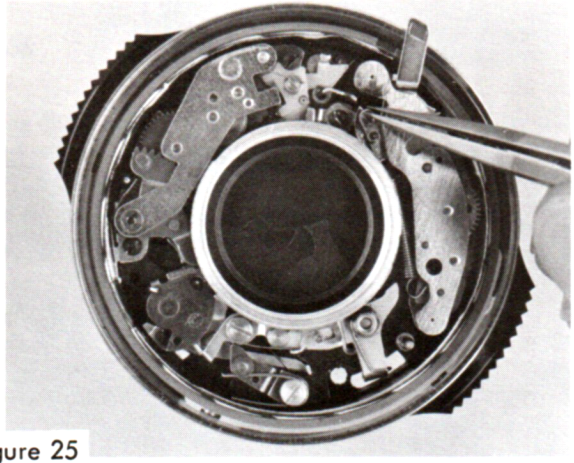


Figure 25

Next, turn the delayed-action setting lever until the flat side of the first gear segment faces the lens barrel, Figure 26. In this position, the complete escapement can be lifted straight up and off of its locating post. If the first gear segment catches on the lens barrel during this process, turn the delayed-action setting

lever in one direction or the other until there is sufficient clearance (in order to turn this lever toward the released position, the locking lever must be depressed, Figure 27).

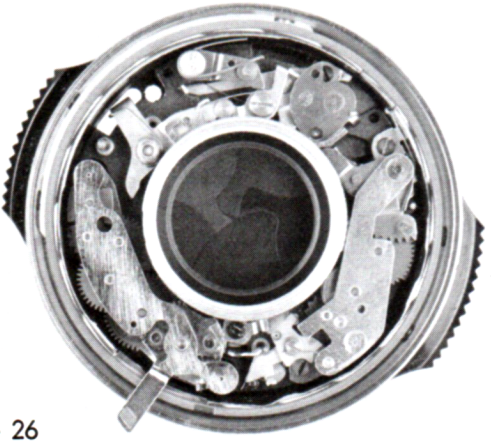


Figure 26

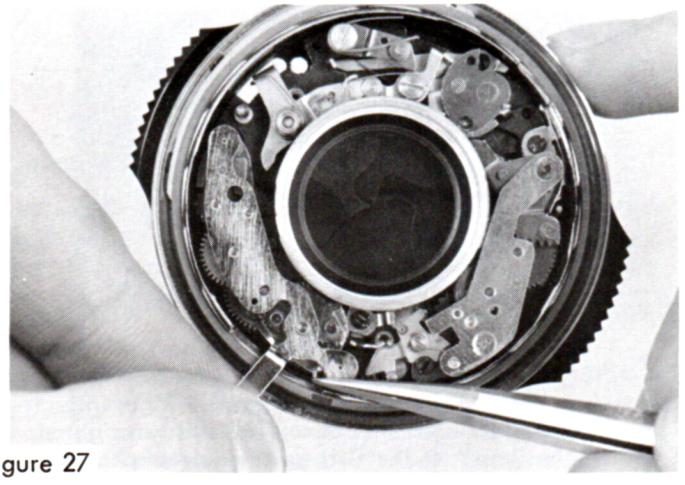


Figure 27

After taking out the delayed-action escapement, turn it over and locate the locking lever, Figure 28. You can now clearly see the curved end which is actuated by the blade operating ring stud and the pawl end which engages the third gear pinion. Further disassembly of the delayed-action escapement is not necessary.

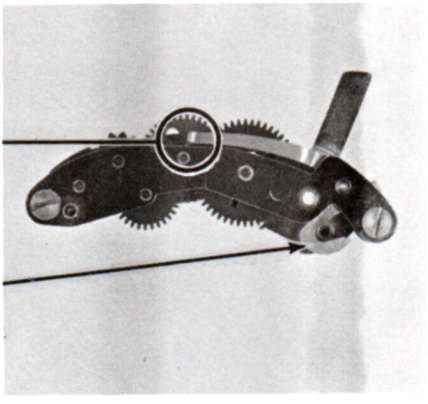


Figure 28

Before removing the speeds escapement, direct your attention to the top contact plate and the contact closing lever which are visible beneath the retard lever, Figure 29. The contact closing lever, pivoting around the retard lever post, hooks in a notch on the blade operating ring stud (the stud which is moved by the leaf lever). Although this much of the operation is difficult to examine because of the retard lever, you can observe the closing of the shutter contacts.

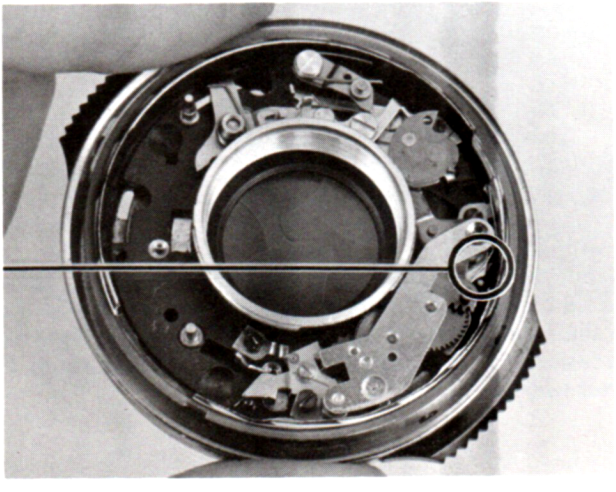


Figure 29

Set and release the shutter several times while watching the action of the contact closing lever. When the blades have reached the full-open position, the contact closing lever will have moved far enough to press the "tail" of the top contact plate against the sync post, Figure 30. If the shutter were mounted in the camera, this post would be wired to the insulated terminal of the sync nipple, while the lower contact plate (directly under the top contact plate) would be wired to the ground terminal. Since the circuit is complete when the blades are fully open, "X" synchronization is provided.

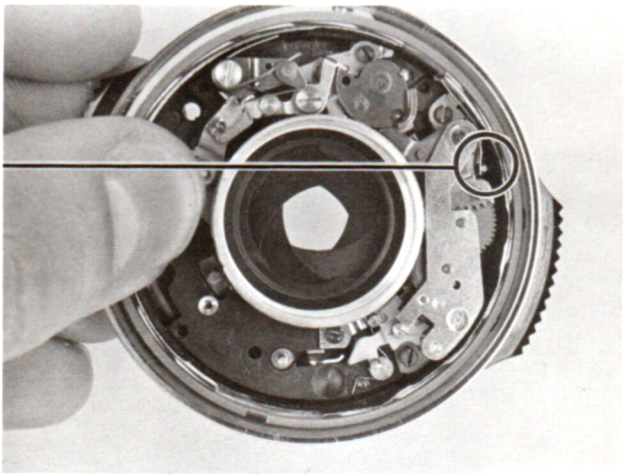


Figure 30

Cock the shutter and remove the two retaining screws, Figure 31. After you have taken out the screw at the retard lever end, carefully lift out the two contact plates, Figures 32, 33 & 34. Using your tweezers, grasp the retard lever control stud and move it to the outside of the shutter housing, Figure 35. Now, lift the escapement straight up until it clears the lens barrel. (Note: a stud on the bottom of the escapement mechanism fits into a hole in the mechanism plate. Since this is often a tight fit, it may be necessary to gently pry the escapement loose using the blade of a screwdriver.)

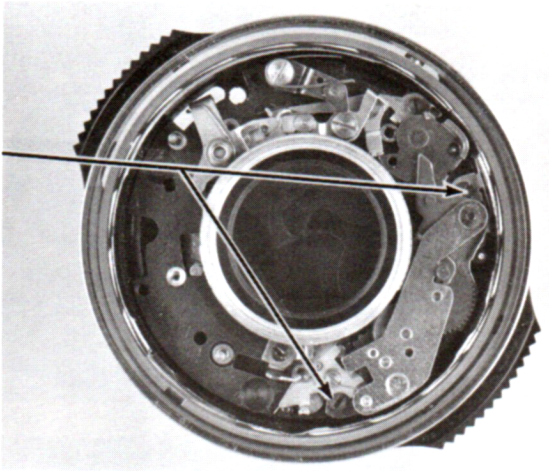


Figure 31

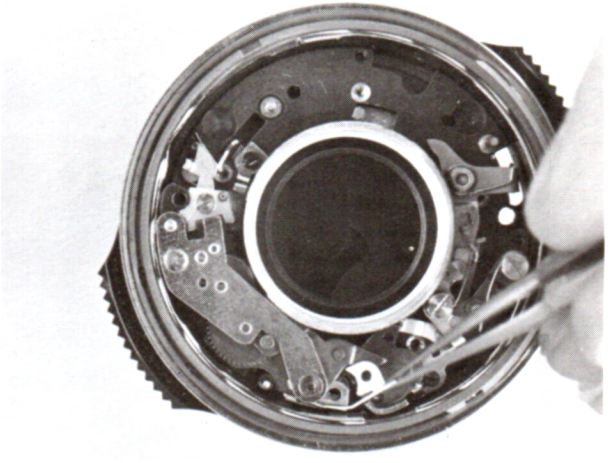


Figure 32

Removing Lower Contact Plate

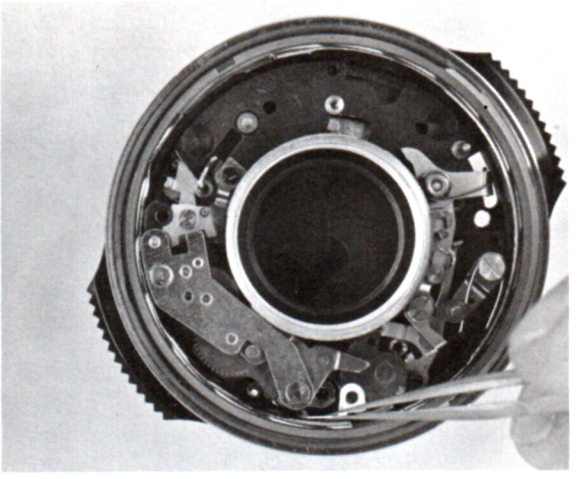


Figure 33

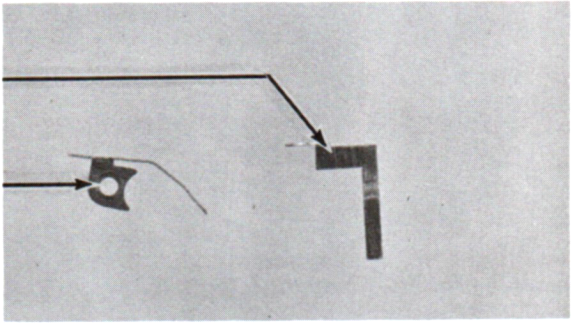


Figure 34

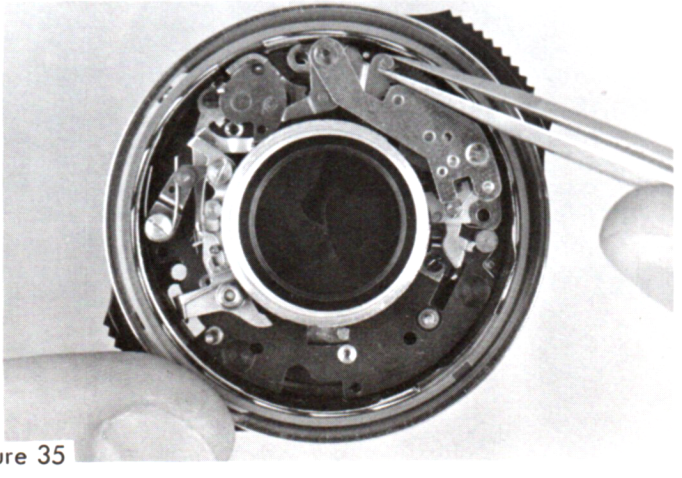


Figure 35

With the escapement mechanism out of the shutter, you can see some rather unique characteristics. For one thing, there is no spring on the retard lever. Instead, a hairspring, similar in appearance to the one in the Compur, serves to move the retard lever through the gear train. (Unlike the Compur, however, the timing of this hairspring cannot be lost.) Also, note that there is only a slight resistance when the retard lever is actuated - even though the pallet is fully engaged. Since the slowest shutter speed is 1/15 second, a short gear train and a light, nylon pallet are all that are necessary for the required retarding action.

From the bottom of the escapement, you can now more clearly see the contact closing lever, Figure 36. Note the long, thin section which fits into the notch in the blade operating ring stud, Figure 37. Like the delayed-action mechanism, the speeds escapement should not be taken apart. When a part is defective, the entire unit is replaced.

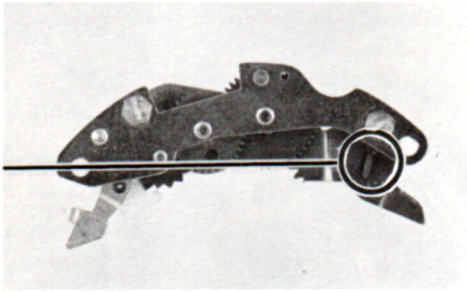


Figure 36

Since the blade operating ring spring is held by a shouldered brass stud rather than a screw, care is required to avoid distorting the spring during removal. Disconnect the long end of the spring first. Then, using a small screwdriver blade, gently work the coil up and around the stud, Figure 37.

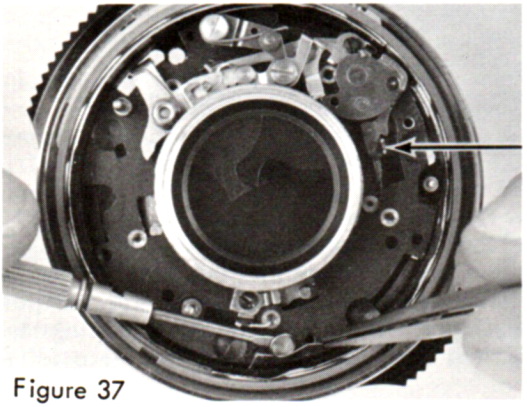


Figure 37

Disconnect the speed cam detent lever spring and take out the shouldered screw, spring and lever.

It is not normally necessary to remove the parts remaining on the mechanism plate (there is one possible exception - the ring stop, Figure 38, which must be taken out in order to remove the blade operating ring as you will soon see). However, if further disassembly is required, such as when replacement is indicated, be sure to note spring positions. The mainspring is of special importance, both in type and location.

In Prontor shutters designed to operate at 1/500 second, the mainspring wire is rectangular in section rather than round. This enables the spring to deliver more tension to accommodate the faster speed. Whereas the long end of the Vario mainspring hooks on a brass bushing under the inner release lever, a special plate serves the same purpose in this Prontor model, Figure 38. If it were necessary to replace the mainspring, however, the same installation procedure described for the Vario would apply.

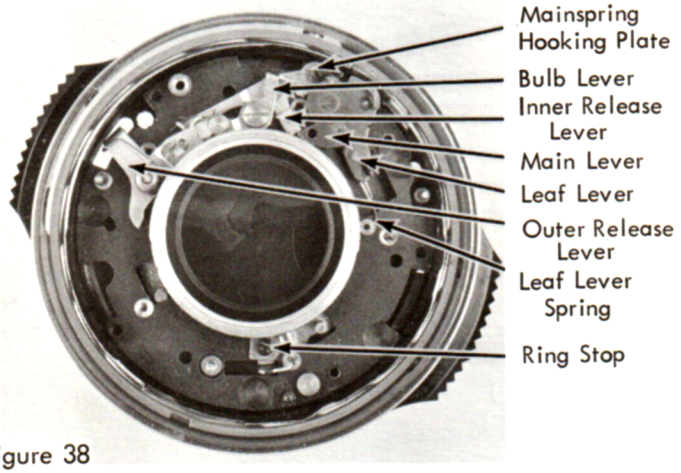


Figure 38

Before the mechanism plate can be taken out, the taper pin which passes through the main lever shaft must be removed. Because of the tight fit of the pin, this operation requires a combination of firm pressure and caution to avoid marring the shaft, pin or housing. Place one tip of your chain nose plier against the shaft and the other tip against the pin as shown in Figure 39. Now, by firmly closing the plier, press the pin toward the outside of the shutter. When one end of the pin is flush with the main lever shaft, grasp the other end with your plier and pull the pin out the rest of the way, Figure 40. Caution: avoid twisting the pin excessively at this final step, the result of which is usually breakage.

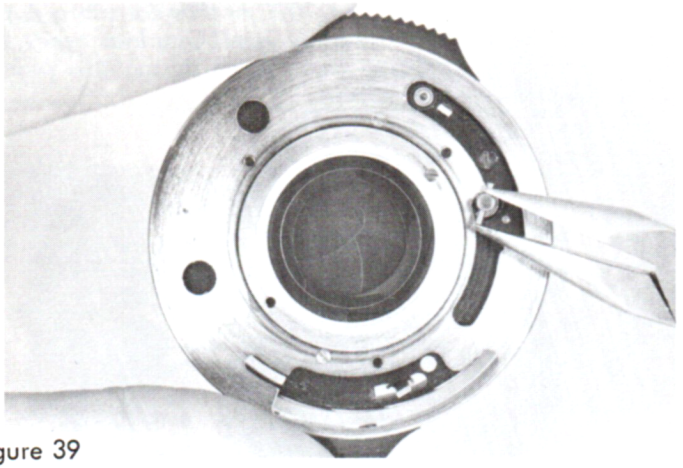


Figure 39

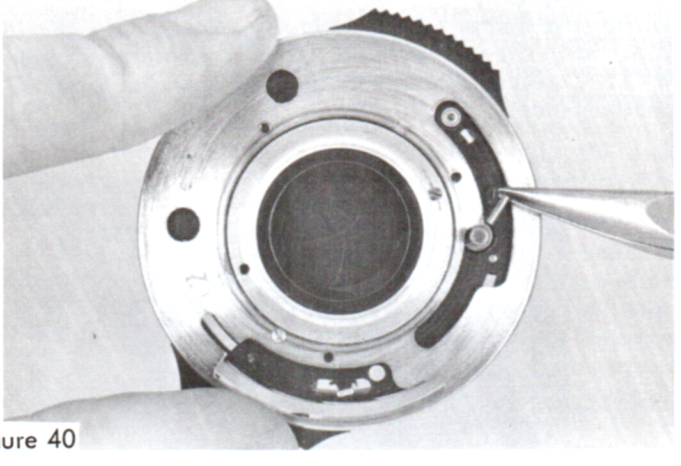


Figure 40

When the two round holes in the back of the diaphragm control plate are aligned over two of the mechanism plate screw heads, Figure 41, all four screws can be reached for removal. Once the four screws have been taken out, the mechanism plate can be separated from the shutter housing. As in all Gauthier types, hold the shutter with the mechanism plate down during this process, being careful of the shutter blades.

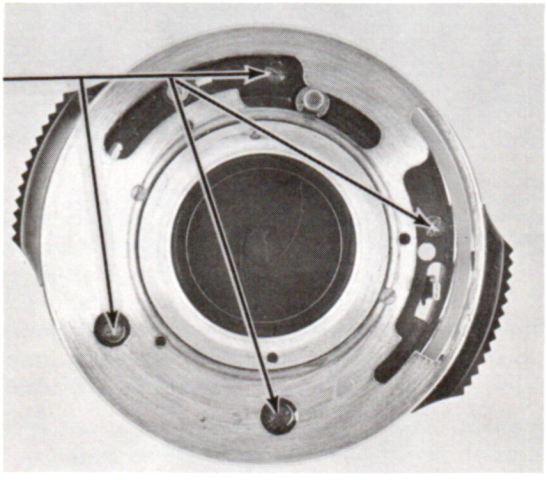


Figure 41

Lift off the shutter blades carefully, particularly the blade that is partially situated within a slot in the main lever bushing, Figure 42. Careless disassembly here will inevitably result in a bent shutter blade.

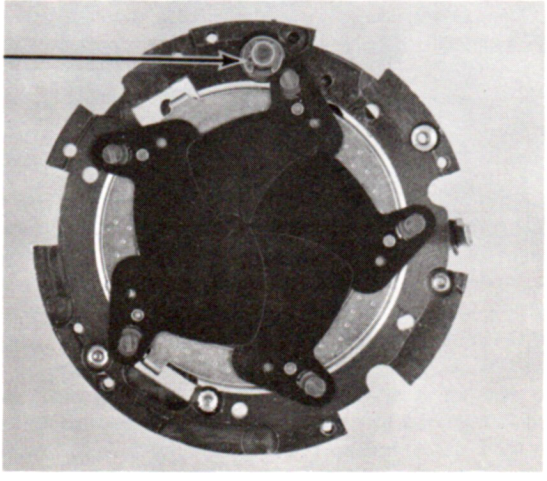


Figure 42

You will now find a variation in the design of the blade operating ring retaining screws and washers. Note that the slots in the screw heads are only indicated, making it impossible to remove the screws without cutting sufficient slots. However, the blade operating ring can be taken out with the screws and washers left in place.

Locate the cutouts on the outer circumference of the blade operating ring, Figure 43. If these cutouts were aligned with the washers, the blade operating ring could be lifted straight up from the mechanism plate. The additional movement necessary to effect such alignment is prevented by the previously mentioned ring stop, Figure 38.

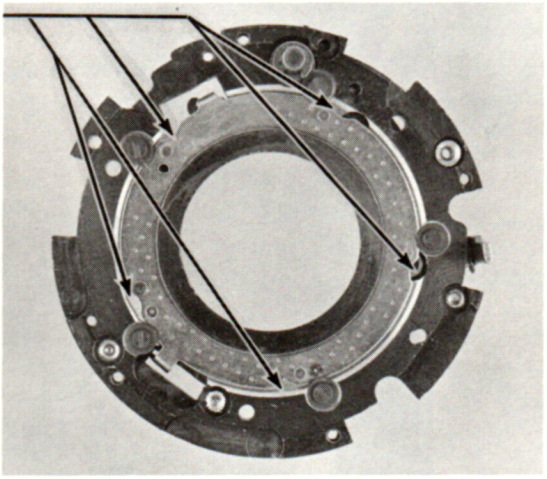


Figure 43

Turn the mechanism plate over and take out the ring stop. (Note: check to assure that the main lever is still in the cocked position - if it is not, insert a pointed tool into the taper pin hole in the main lever shaft and cock the shutter.) Rotate the blade operating ring as far as it will go in a counterclockwise direction, aligning the ring cutouts with the retaining washers, Figure 44. In this position, the blade operating ring can be lifted from the mechanism plate.

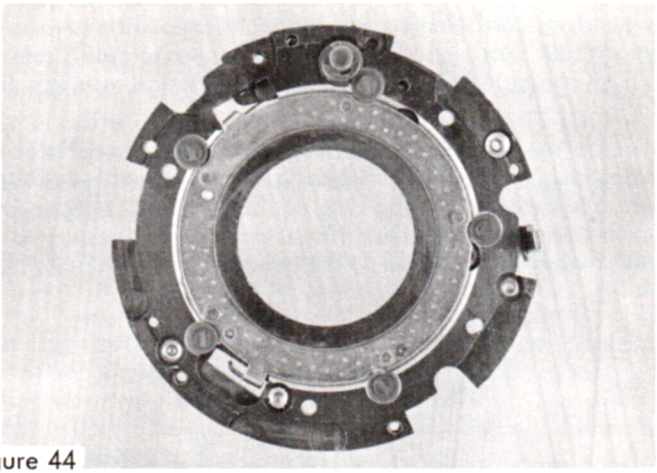


Figure 44

After removing the blade operating ring, identify the three studs which normally extend through the mechanism plate, Figure 45.

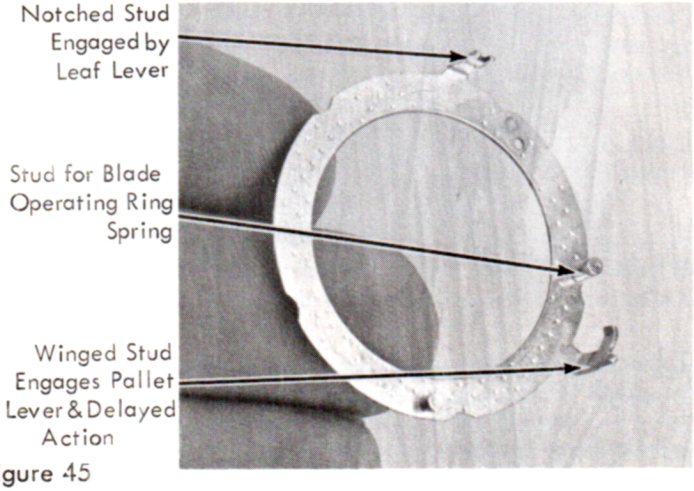


Figure 45

Although it is not necessary to take out the diaphragm leaves for cleaning, the diaphragm control plate should always be removed - especially when using a commercial cleaning machine. The two plastic handpieces on the outer circumference of the plate can be damaged by cleaning solution and by the heat of the dryer.

Two screws, Figure 46, hold the diaphragm control plate to the diaphragm control ring. Caution: hold the shutter housing with the linkage control cam to the top while removing the diaphragm control plate. Otherwise, the cam could fall out and become lost or damaged.

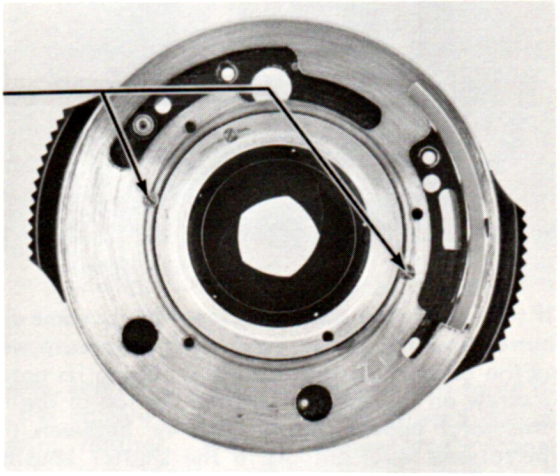


Figure 46

IMPORTANT: NEVER remove the speed ring, Figure 47, unless it is imperative to do so. The housing has a multiple thread, allowing several starting positions for the speed ring. Removal could result in time-consuming readjustment for correct placement. (If for any reason the speed ring must be removed, both the ring and the shutter housing should be marked so they can be reassembled in exactly the same position. Scribe the speed ring and the housing at the point of disengagement.)

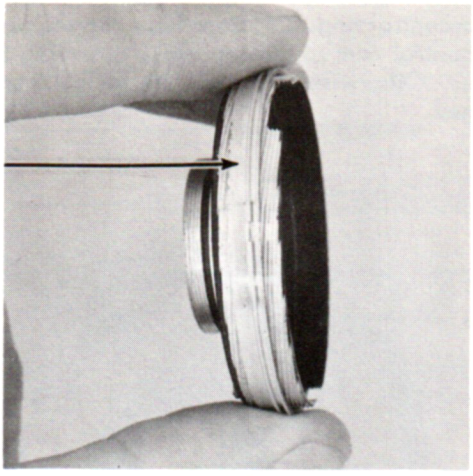


Figure 47

If the speed ring should accidentally become disengaged from the shutter housing, a trial-and-error procedure will be required to find the correct starting position. Using its notch as a reference, screw on the speed ring from the top of the housing. Start with this notch approximately halfway between the main lever and the release lever cutouts in the shutter housing, Figure 48. (To locate a starting thread, it may be necessary to turn the speed ring slightly in a clockwise direction until a "click" is heard - the speed ring can then be screwed on by turning it in a counterclockwise direction - this requires a delicate "feel" to avoid cross-threading.)

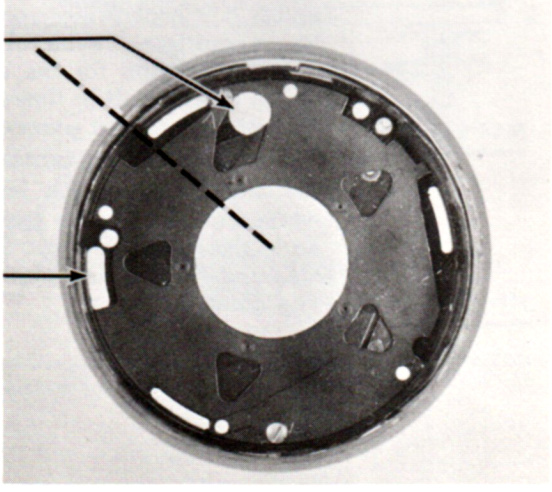


Figure 48

Now, screw the speed ring onto the housing until the bottom edge of the speed ring is flush with the back of the shutter housing, Figure 49. In this position, the notch in the speed ring should align approximately with the hole for the lower contact plate in the shutter housing. If this alignment is incorrect, it will be necessary to remove the speed ring and try another starting thread. Change the starting place one thread at a time until the speed ring will screw on to the position shown in figure 49.

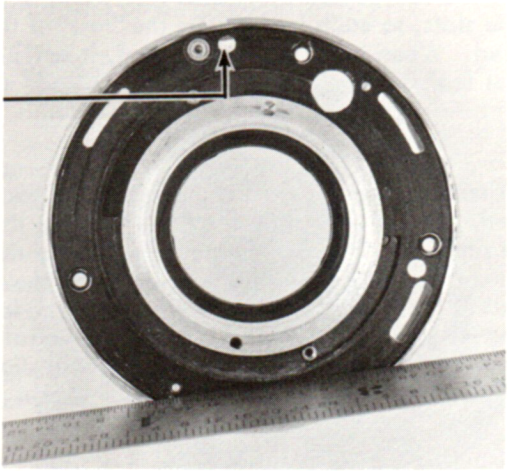


Figure 49

As previously mentioned, the diaphragm should not normally be disassembled. If the diaphragm cover plate must be removed, such as when leaf repair or replacement is required, first scribe the position of this plate in relation to the housing and the positions of the retaining screws, Figure 50. The cover plate has a confusing array of holes so the reference scribe marks will greatly facilitate reassembly.

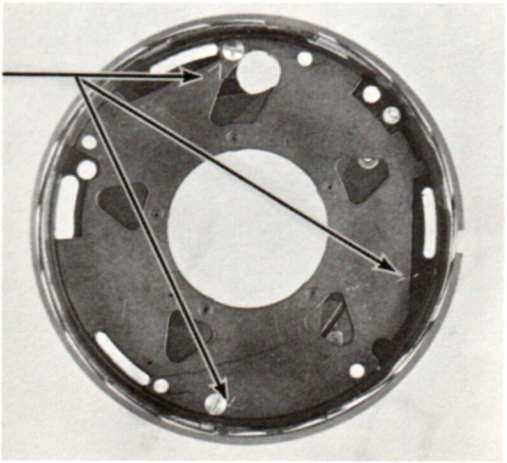


Figure 50

Installing the five programmed-style diaphragm leaves is quite easy in comparison with the conventional design you have already studied. (This procedure is applicable to any programmed shutter with a linear diaphragm scale.) After replacing the diaphragm control ring, turn it as far as it will go in a counterclockwise direction - this is the full aperture position. Orient each leaf with the pin nearest the end up, the "tail" to your right. Now replace the leaves in a clockwise rotation, the lower pins fitting into the slots, so each leaf covers the "tail" of the one previously installed. When inserting the last leaf, it will be necessary to lift the first leaf slightly in order to slip the "tail" underneath.

When the five leaves are in position, each "tail" will be covered, passing to the inside of the pin on the adjacent leaf. Before replacing the cover plate, manipulate the leaves to form a full round aperture and test to assure that the pins are properly located in their slots. Finally, lower the cover plate into the housing with reference to the scribe lines and align the upper pins in the same manner as with the conventional diaphragm. Test the operation before and after replacing the screws.

One Leaf in Position

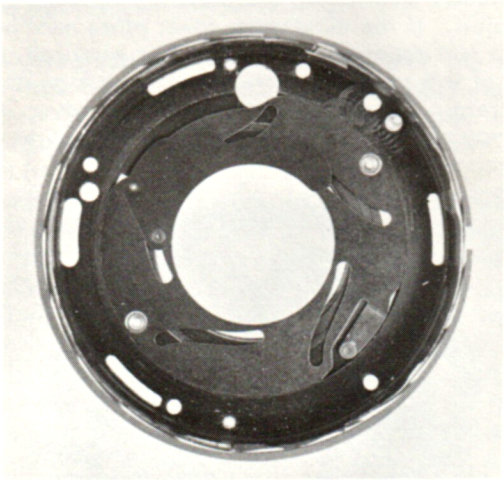


Figure 51

All Leaves in Position

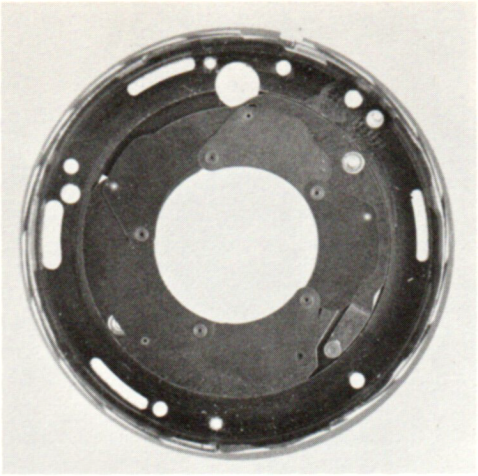


Figure 52

REASSEMBLY OF THE PRONTOR 500 LK

Since the speed ring was not removed on disassembly, there are no timing considerations in replacing the linkage control cam and diaphragm plate. As long as the parts are installed correctly, the timing with the exposure meter will be correct. (If for some reason you did remove the speed ring, such as to repair damaged threads, be sure to replace it with reference to your scribed lines.)

Note the two ridges around the outer circumference of the speed ring. These ridges serve as guides for the linkage control cam, a "track" upon which the cam slides when the aperture is changed and a coupling to lift and lower the cam when the speeds are changed. When the cam is in place, its top edge will ride between the two ridges on the speed ring.

To replace the linkage control cam and diaphragm control plate, turn the diaphragm control ring from the back of the shutter housing to about the midpoint of its travel, at approximately half aperture, Figure 53. Next, position the speed ring at or near the middle of the shutter housing. As you will discover, these starting positions are unimportant, but will serve as reference points.

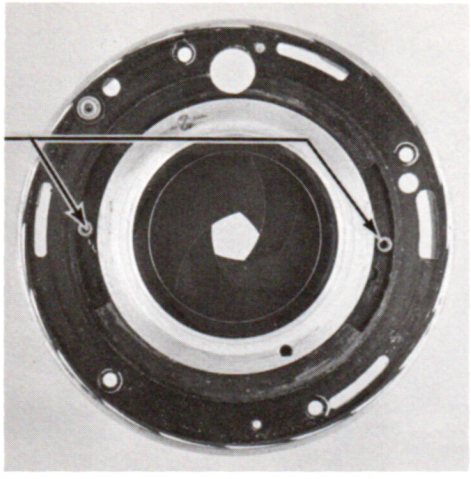


Figure 53

Seat the linkage control cam on the speed ring making sure that the inclined face of the cam is toward the back of the shutter, Figure 54. (Note that one of the two ridges on the speed ring is slightly smaller in diameter than the other - the smaller ridge rests in the groove of the linkage control cam.) Now, slide the linkage control cam around the ring until the notch in the cam and the notch in the ring are positioned 180° opposite each other on the shutter housing, Figure 55.

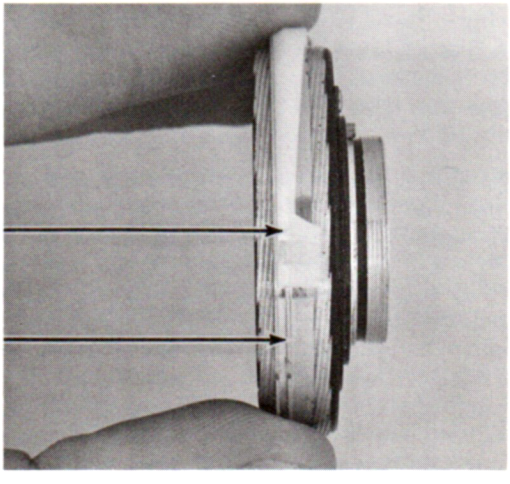


Figure 54

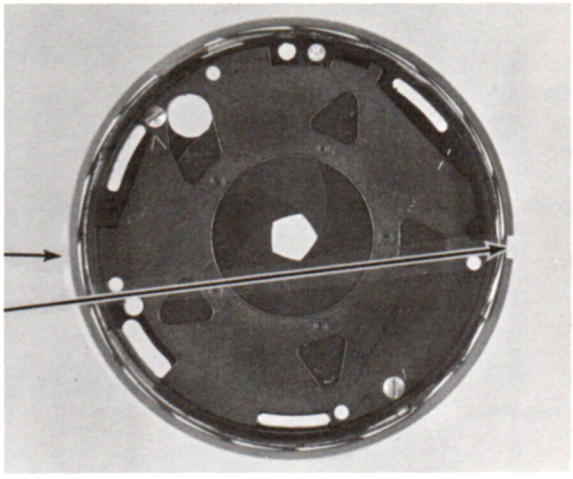


Figure 55

Hold this assembly in one hand with the linkage control cam toward the top. Next, pick up the diaphragm control plate and locate the brass stud on its inner circumference, Figure 56. Making sure that the brass stud is positioned within the notch in the linkage control cam, slide the diaphragm control plate onto the shutter housing, Figure 57. While holding the assembly together, turn the diaphragm control plate counterclockwise until the two screw holes in the plate are aligned with the threaded holes in the diaphragm control ring. Finally, replace the two screws.

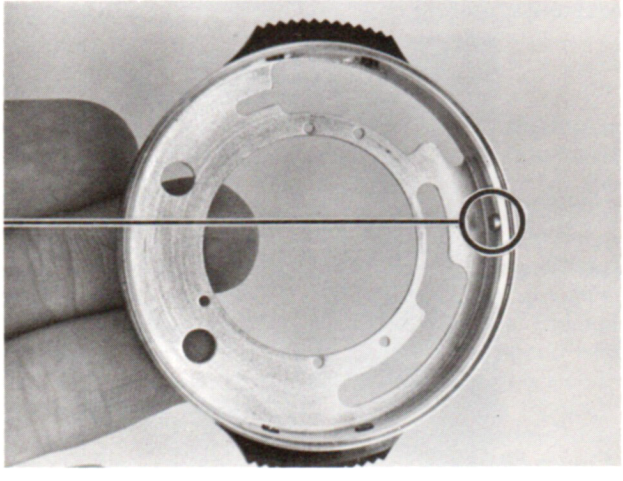


Figure 56

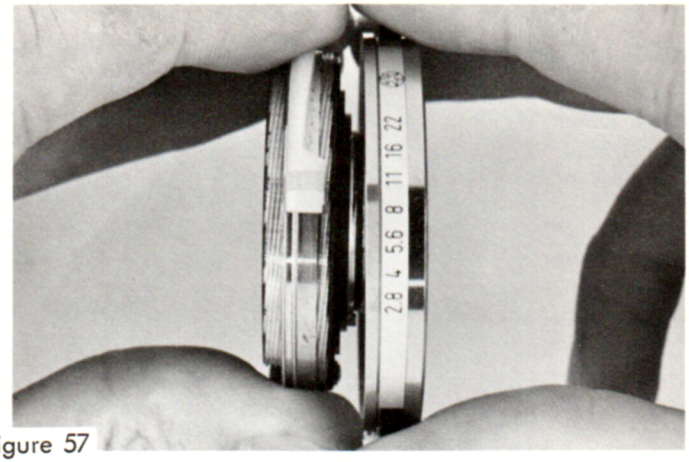


Figure 57

With the assembly of the shutter housing complete, the next step is to replace the blade operating ring. Start with the main lever in the cocked position. Now, place the blade operating ring on the mechanism plate with the notched stud, Figure 58, passing through the cutout at the leaf lever position. Be certain that this stud is located to the outside of the leaf lever spring, that is, between the spring and the outer edge of the mechanism plate. When the blade operating ring is turned as far as it will go in a counter-clockwise direction, the cutouts will be aligned with retaining washers. After checking to assure that the blade operating ring is fully seated in its track, hold the leaf lever against the lens barrel and turn the blade operating ring clockwise. Since the blade operating ring is now secured by the retaining washers, the mechanism plate can be turned over to replace the ring stop. (Note: one side of the ring stop is serrated - this side goes next to the mechanism plate.)

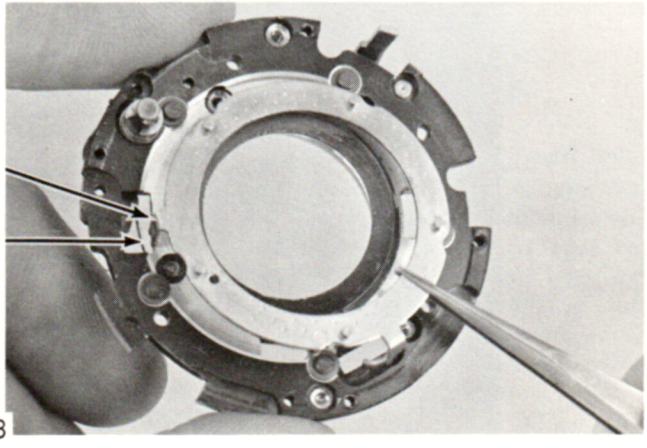


Figure 58

Test your assembly at this stage by cocking and releasing the main lever several times. After tripping the shutter, hold the release lever depressed, arresting the main lever for "bulb" operation. In this position, there should be a visual clearance between the ring stop and the round blade operating ring stud. If necessary, loosen the screw and move the ring stop. (This is to prevent the blade operating ring stud from contacting the ring stop on the opening cycle. Insufficient clearance here could cause the shutter to "hang up" with the blades partially open.) When you are sure that the blade operating ring is functioning properly, proceed with the installation of the shutter blades.

Starting at the pin position nearest the leaf lever, replace the five shutter blades in clockwise rotation. (Note: the blade next to the main lever must be tilted slightly during installation to fit into the slot in the brass bushing.)

You are now ready to replace the mechanism plate in the shutter housing. This is a delicate operation, where carelessness or force could result in damage to the shutter blades. First, locate the two cutouts in the shutter housing - the round hole for the main lever shaft and the slot for the release lever. (The diaphragm plate should be turned slightly to clear the round hole, Figure 59.) Next, aligning the respective cutouts over the main lever shaft and the release lever, carefully lower the shutter housing over the mechanism plate. When you are certain that the mechanism plate is fully seated, replace the four screws (remember, the long screw goes near the blade operating ring spring position, Figure 60). Be sure to test the shutter operation at this stage.

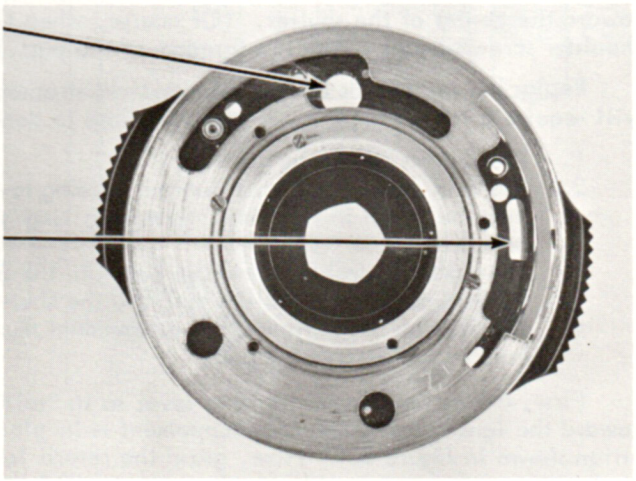


Figure 59

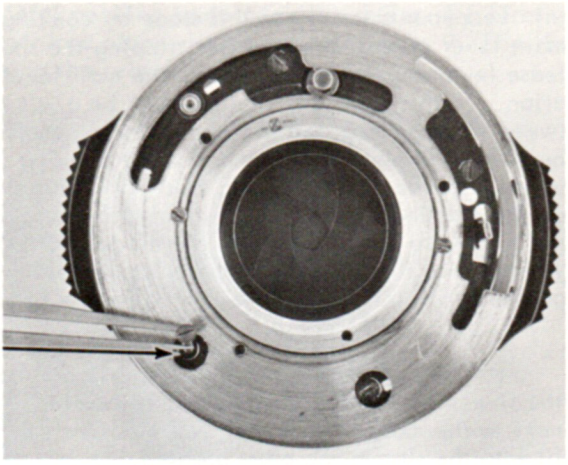


Figure 60

To replace the taper pin in the main lever shaft, start the smaller end into the hole so that the pin will pass from the outside of the shutter toward the center. (To determine which is the smaller end of the pin, try both ends in the hole using your plier - you should be able to press only one end into a good starting position.) Then, using your plier in the same manner described for pin removal, press the pin firmly into the shaft. The taper pin should now be tight within the main lever shaft, extending equally on either side.

Turn the shutter over and replace the blade operating ring spring. Be sure that the spring loop is completely seated around the brass stud before hooking the two ends. The speed cam detent lever with its spring and shoulder screw can also be installed at this time. When the spring is hooked, the detent lever will be forced toward the center of the shutter. (Of course, when tightening a shoulder screw always check the freedom of the part.)

Replacing the speeds escapement is a ticklish operation which will require a little practice. The precautions to consider are:

1. The shutter should be cocked.
2. The thin extension of the contact closing lever must fit into the notch in the blade operating ring stud by the retard lever.
3. The pallet control lever must be between the blade operating ring stud (at the pallet end) and the shutter housing.
4. The stud on the bottom of the escapement must fit into a hole in the mechanism plate.

First, orient the contact closing lever so its "tail" will point toward the lens barrel when the escapement is in place (the position shown in figure 36). Now, grasp the retard lever control stud with your tweezer and lower the escapement into the shutter,

Figure 61, turning the retard lever slightly to clear the lens barrel.

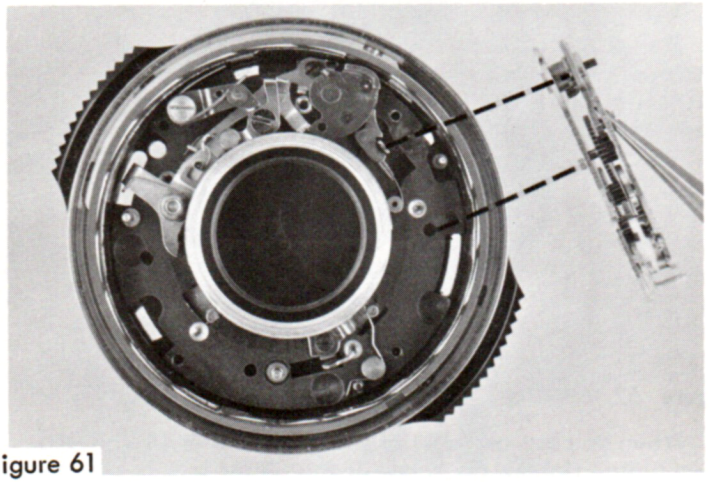


Figure 61

With the two screw holes aligned, seat the pallet lever end of the escapement, moving the pallet control lever toward the outside of the shutter housing, Figure 62. Anchor this end of the escapement in place by barely starting the long-head screw - do not tighten the screw at this time. With the escapement lightly secured in position, you can manipulate the contact closing lever until its "tail" is within the notch in the blade operating ring stud. Work under the retard lever with your tweezer, slightly lifting the end of the escapement, if necessary, to turn the contact closing lever (the contact closing lever can be most conveniently manipulated from the end nearest the outside of the shutter until the opposite end, the "tail," is correctly positioned). When the "tail" is in place, the contact closing lever will not move in either direction. Finally, actuate the retard lever to assure its freedom, indicating that the escapement is fully seated. (If more than a very slight amount of pressure is needed to seat the escapement, either the bottom locating pin or the pallet lever is not properly positioned - recheck each of the previously noted precautions, and do not attempt to force the escapement in place.)

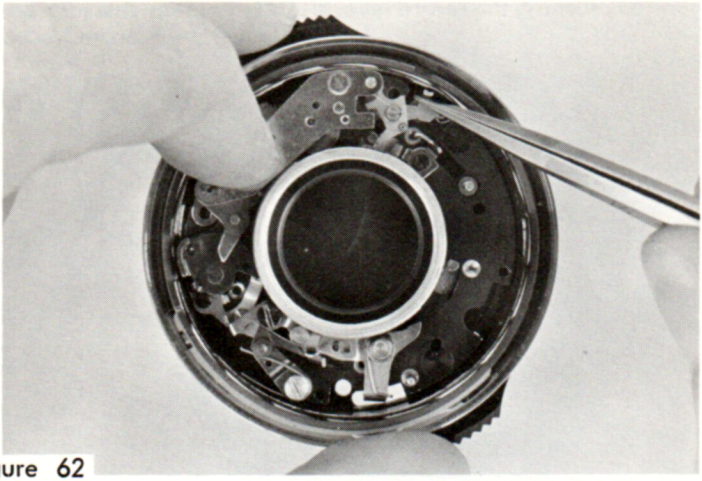


Figure 62

When you are certain the escapement is flush with the mechanism plate, tighten the screw at the pallet lever end. You are now ready to install the contact plates, a procedure which requires dexterity and patience. Replace the lower contact plate (the ground) first, feeding its long tail through the hole in the mechanism plate. Then install the top contact plate, inserting its tail through from the end of the escapement (not over the top). Be certain that the top contact plate is to the inside of the sync post. Align the holes in the two contact plates with the hole in the lower plate of the escapement and the screw hole in the mechanism plate.

Before replacing the screw at the retard lever end of the escapement, check to see that the contact closing lever is still within the notch in the blade operating ring stud. If the lever can be moved, it will be necessary to loosen the escapement retaining screw at the pallet end to work the contact closing lever back in place. When a subsequent check reveals that the escapement is correctly positioned, insert the screw at the retard lever end, passing this screw through both contact plates and the lower plate of the escapement. Tighten both screws and test the operation.

At this stage, the shutter should deliver "bulb" action (providing the bulb lever was not removed) with full retard. When the blades are held open on "bulb," the tail of the top contact plate should be touching the sync post.

All that remains to be replaced on the mechanism plate is the delayed-action escapement. Turn the first gear segment to the same position required for removal. Holding the mechanism by its setting lever, lower the escapement into position over the post. During this installation, subsequent adjustment of the first gear segment may be necessary for clearance with the lens barrel.

Before hooking the return spring, depress the locking lever and move the first gear segment to the fully released position. Seat the coiled end of the spring over the mechanism plate post with the loop to the bottom. With the coils passing under the top plate of the escapement, pull the hooked end of the spring to its latching stud on the first gear segment. Check that the straight section of the spring is against the lens barrel and that both spring ends are within the grooves around their respective posts. Finally, test the operation of the delayed action, assuring that the escapement runs smoothly and properly.

Relocate the notch in the speed ring around the shutter housing, and turn the ring until the notch is adjacent to the pallet lever, Figure 63. This position will allow you to see the notch when the speed cam is installed.

Speed Ring Notch Aligned with Pallet Lever

Figure 63

To replace the speed cam, orient the side slot with the delayed-action setting lever. Tilt the speed cam slightly, allowing the delayed-action setting lever to pass through this slot. Now, with the speed cam resting on top of the shutter, turn the cam clockwise until it is blocked by the mechanism plate post, Figure 64. Since this is the "bulb"position, seating the speed cam will not damage the bulb lever control stud.

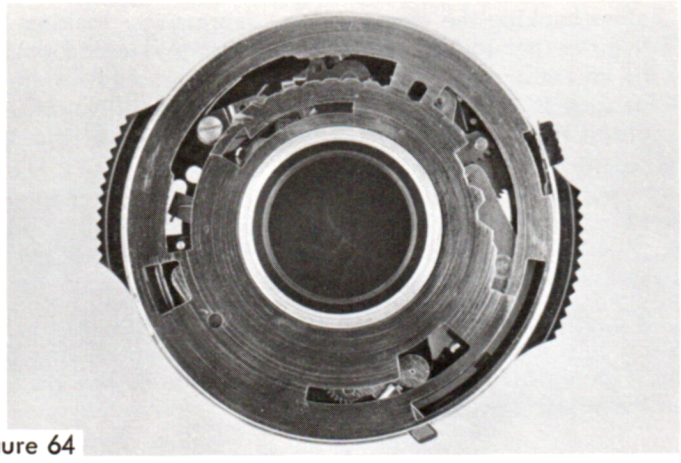


Figure 64

Working through the top of the speed cam, insert a closed tweezer into the hole in the detent lever. Pull the detent lever toward the outside of the shutter housing until the detent stud is seated in the first speed cam notch.

Even though there is no speed setting index at this stage of assembly, the shutter speeds could be conveniently checked for accuracy by using an electronic tester. It would only be necessary to note which notch in the speed cam (for the detent lever) corresponds to the calibrated speed being tested.

Since the speed ring was positioned with reference to the pallet lever, the notch will now be visible through the slot on top of the speed cam. When installing the ASA setting ring, Figure 65, be sure the stud passes into this notch. Depress the coupling latch on the side of the speed cam to seat the ASA setting ring.

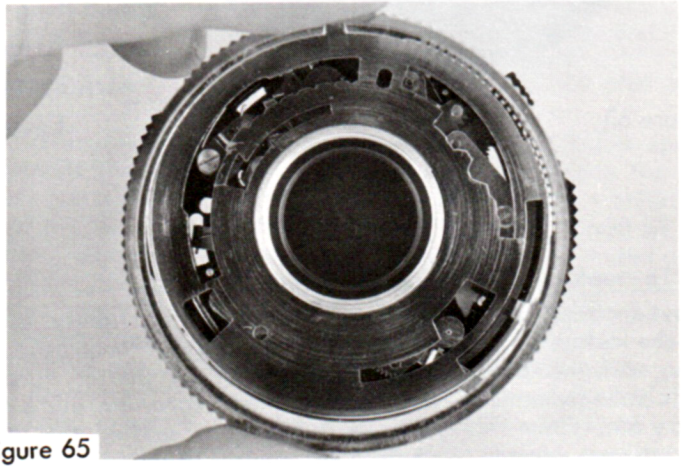


Figure 65

Two locating studs within the shutter (the post which also secures the delayed-action return spring and the stud at the retard lever end of the speeds escapement, are responsible for the precise alignment of the cover plate. These studs pass through two oblong holes in the cover plate, Figure 66.

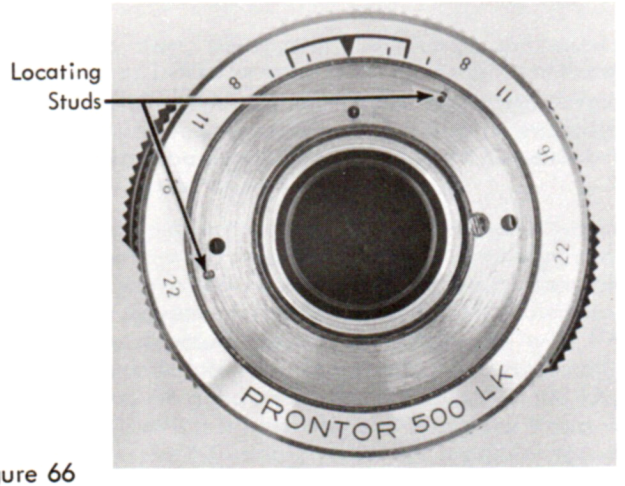


Figure 66

With the cover plate positioned over the locating studs, replace the scalloped retaining ring. (Note: although the scalloped retaining ring can be screwed on in either position, it must be located with its shoulder down - the shoulder passes into the opening in the cover plate.) Tighten the scalloped retaining ring until the speed cam has the proper tension. Finally, turn the lock nut to hold this adjustment, completing the reassembly.

NATIONAL CAMERA, INC.

Technical Training Division

(National Camera Repair School)