

## part 1

# Record changer workshop

By Forest H. Belt, CET

No one knows for sure why most technicians hate to tackle a record changer or automatic turntable. Perhaps it's because they lack training in how to repair them; most schools neglect this particular subject.

Some technicians say they just don't have the "knack" for troubleshooting mechanical equipment. Not true! You don't need any special talent or energy to repair hi-fi turntables successfully. You do need two things: some knowledge of what all those gears, wheels, bars, and slides are doing, and a fundamental servicing approach that adapts to any mechanism. With this basic understanding, no record-changing device can stump you for long. Let's discuss an "approach" first.

Efficient technicians divide their initial troubleshooting into five facets: cleanup, inspection, testing, adjustments, and diagnosis. This Workshop session covers the first three. You'll see exactly what constitutes a thorough cleaning. Lubrication can be part of cleanup, but something you do sparingly. The cleaning process often cures certain faults without you even bothering to test for them.

Inspection leads you to other faults. So do specific

tests, also described in this session. Part 2 shows you how adjustments ascertain proper changer/turntable operation. And then, two more Workshops take you inside a typical changer and turntable mechanisms. That's what you need for intelligent overall diagnosis.

Now, follow the various steps and see, in sharp closeup photos, how you can profitably approach automatic-changer servicing.

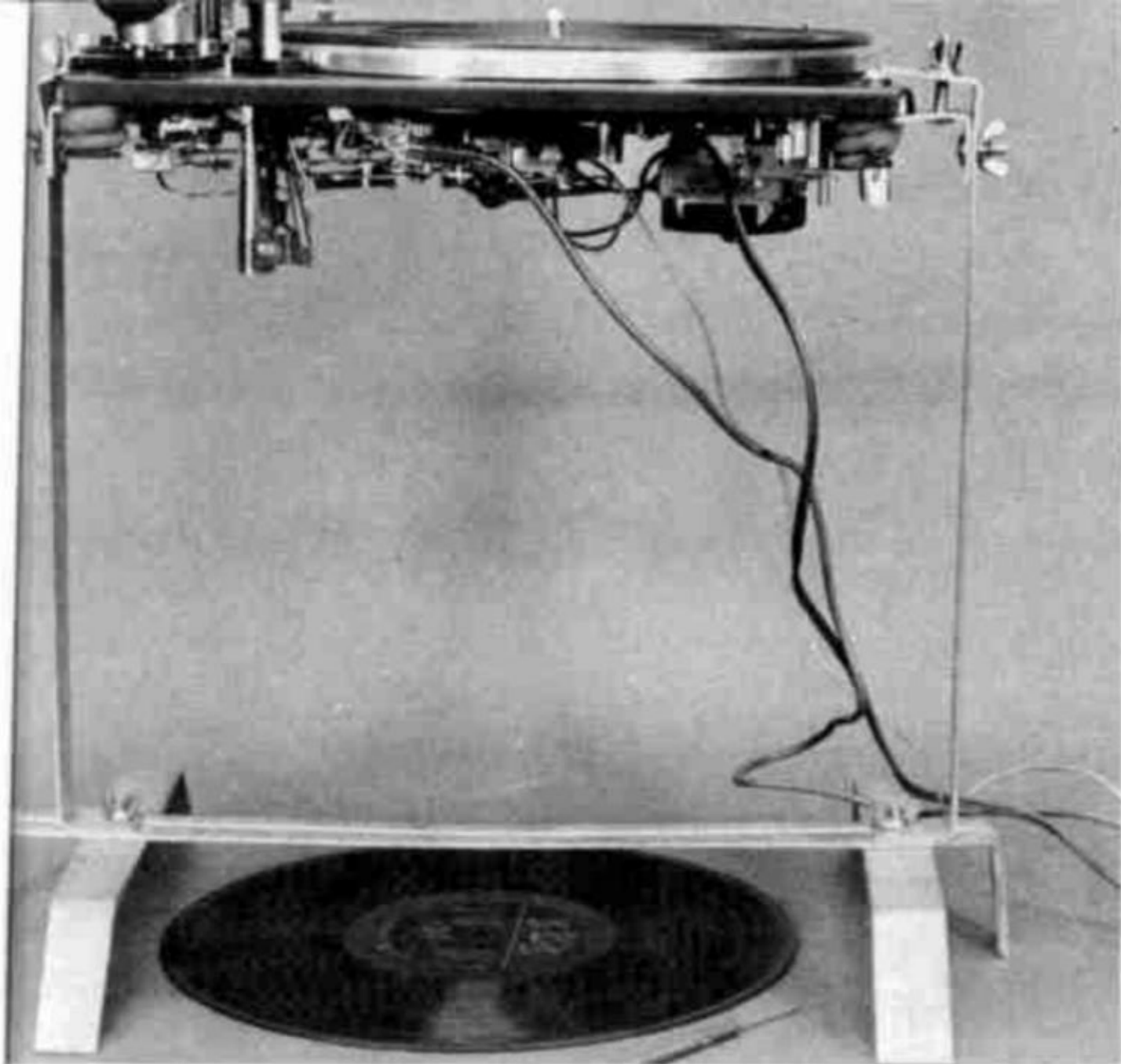
---

*The well-known author/photographer of this new series, Forest H. Belt, is a former editor of Electronic Servicing, and has written several Howard W. Sam's books. For some of these books, he and his associates have spent many hours lab-testing new repair methods and taking detailed photographs of the latest equipment.*

*From this advance service information. Mr. Belt will present a series of "direct-view" workshops [next best to hands-on study].*

*If you like coverage of this type, let us know, and the series can be extended to other types of equipment.*

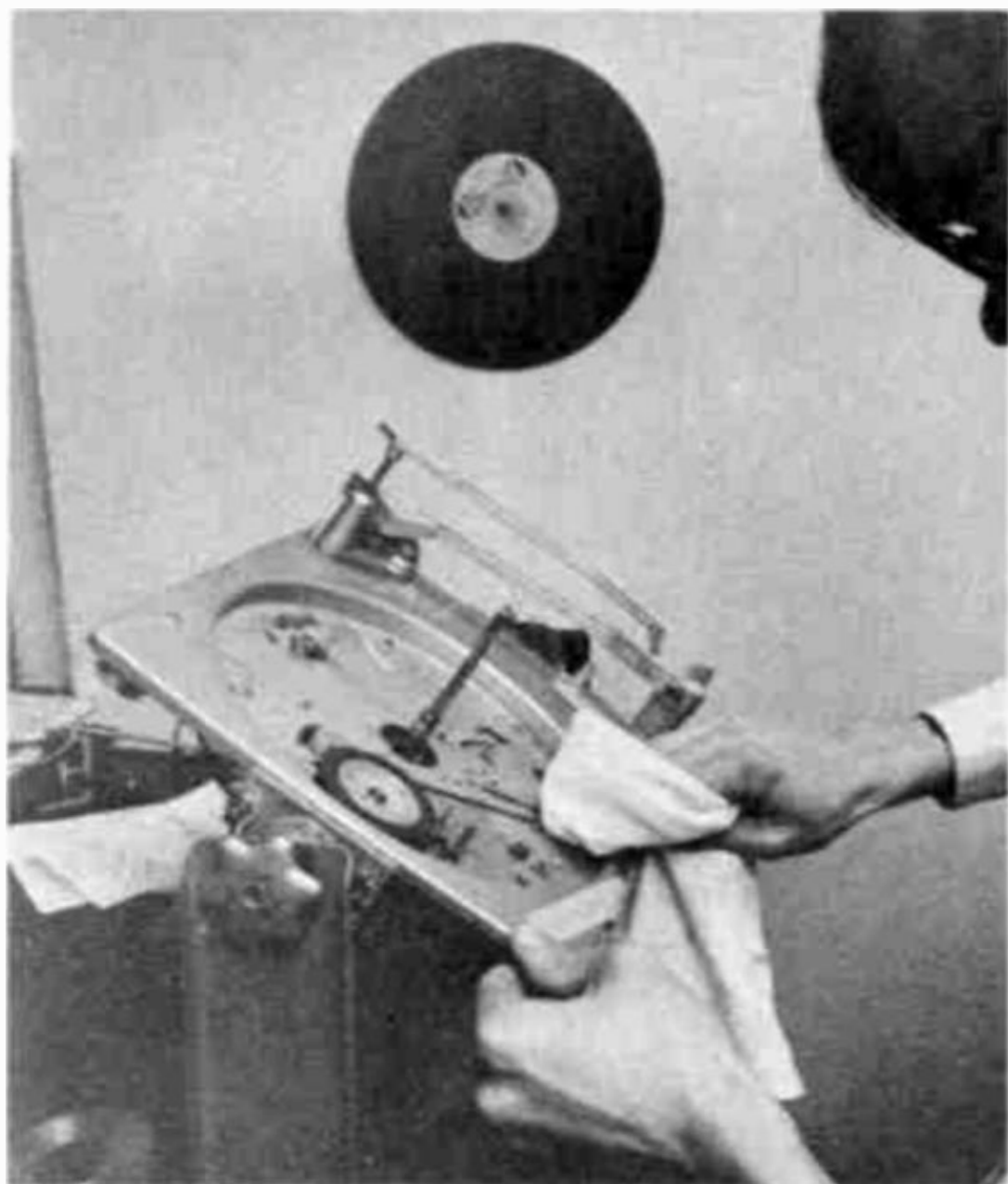
---



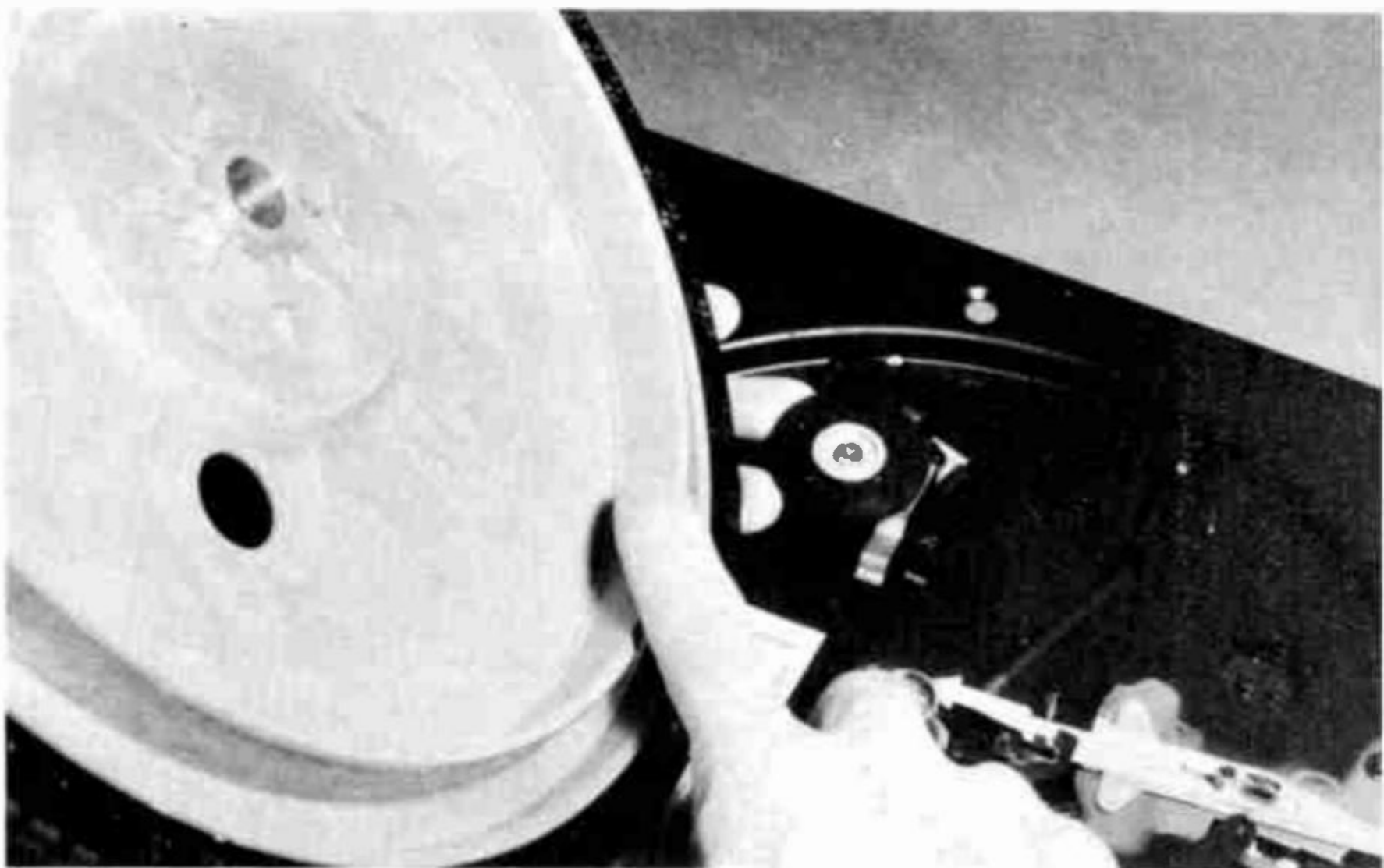
A servicing rack brings several advantages. You can watch changer operations easily. Parts and assemblies are accessible for repair and replacement. Your parts distributor carries these repair stands in stock or can order one for you. Caution: Use soft padding between the clamps and the turntable baseplate, to prevent scratches (you can glue automobile gasket material to the clamp faces).



**Step 1.** Cleaning comes first. Most record changers and hi-fi turntables are grimy inside. Remove the turntable platter. A clip may hold it in place, or a rubber or plastic O-ring. Top-line automatic and manual turntables might not have a clip, with the platter held in place only by its own weight and bulk. Remove the spindle before you lift any platter, if you can. When replacing the platter over a fixed spindle, lift the guide tab to let the platter hole past the spindle offset.



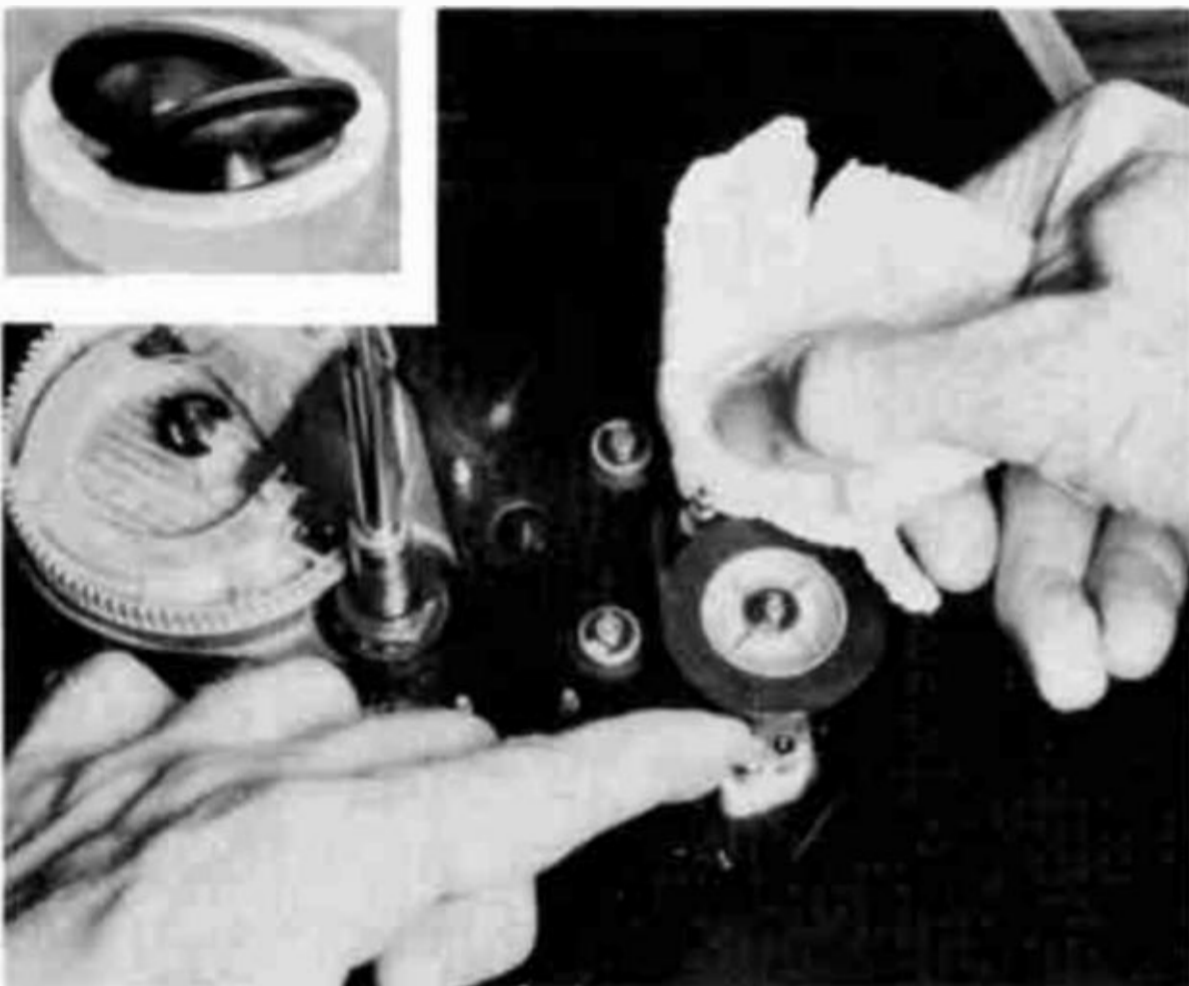
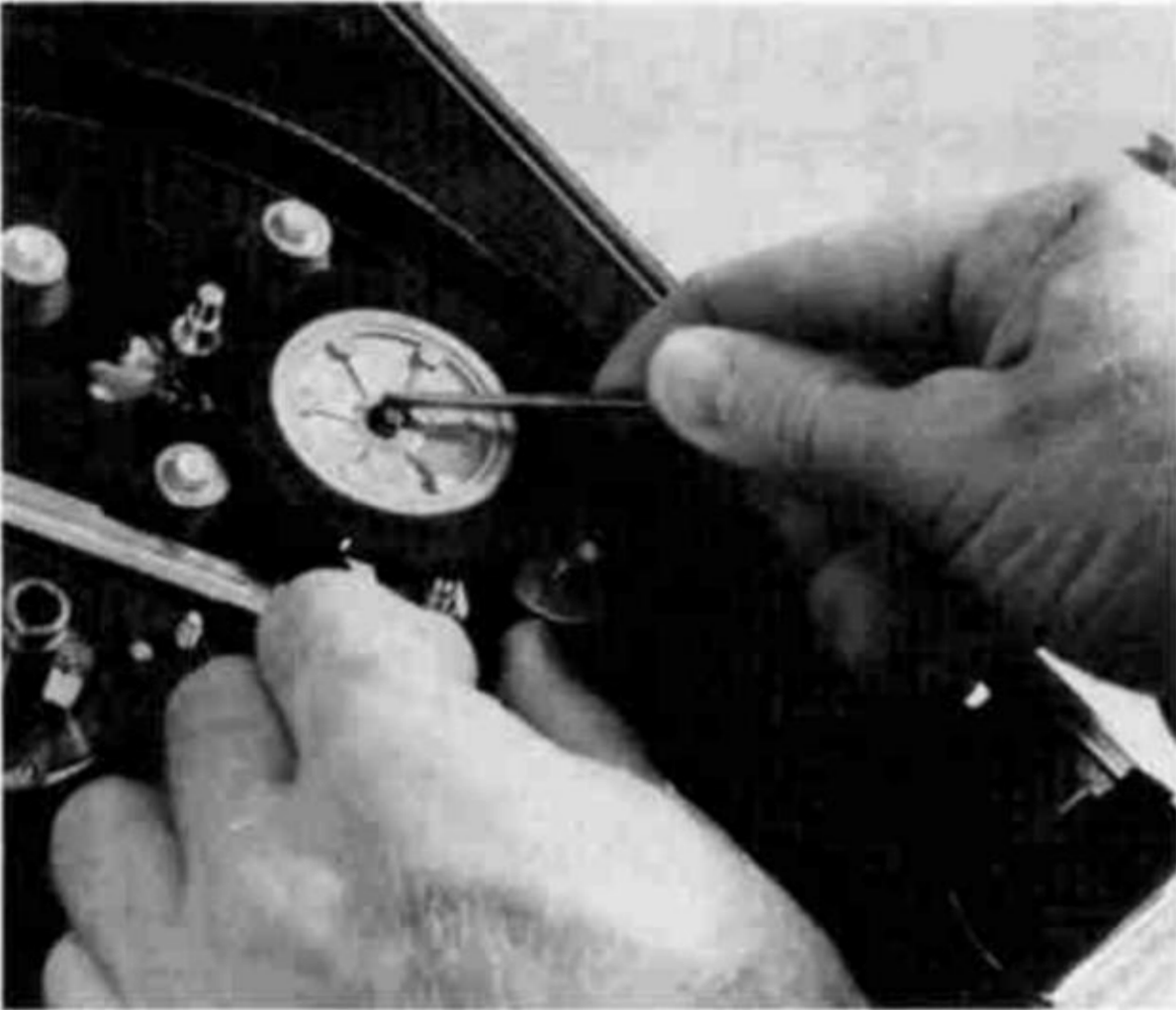
**Step 2.** Wipe out the dust and accumulated dirt above and below the baseplate. It often is caked; evaporating oil mixes with dust to form a scum. Use alcohol to help cut the layer. Don't use carbon tetrachloride. Clean each machine thoroughly before you even begin to service it. Don't do any lubricating at this point.



**Step 3.** The platter rim must be cleaned with alcohol repeatedly until a drying cloth comes away without any trace of dirt. Even "invisible" residue here, such as left by your fingers, can introduce slippage that causes wow or lets the changer stall in-cycle. ALWAYS clean this surface before you begin other servicing. Then clean it again the last thing before you finish the job.

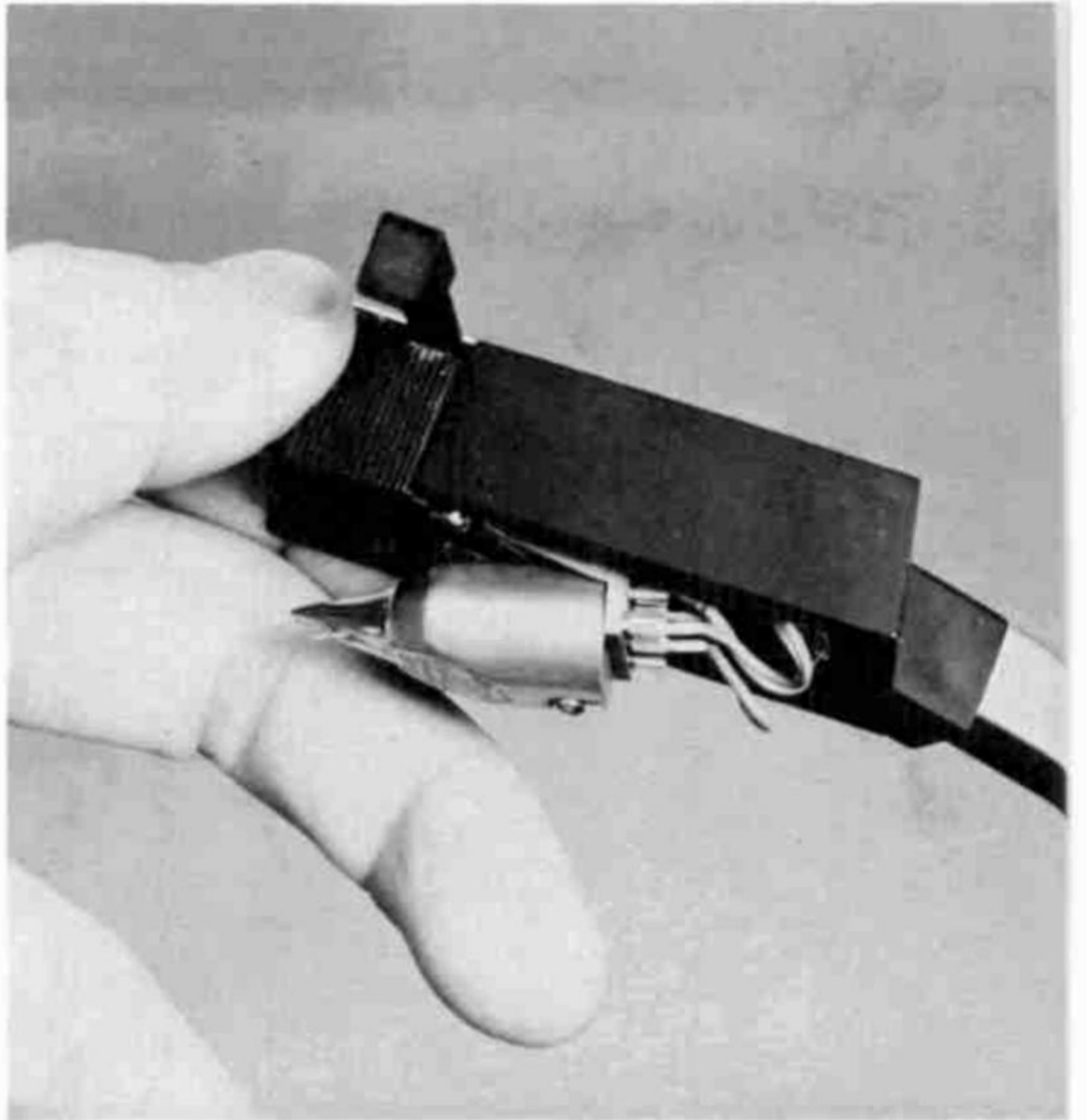
*(Continued on page 20)*

(Continued from page 15)

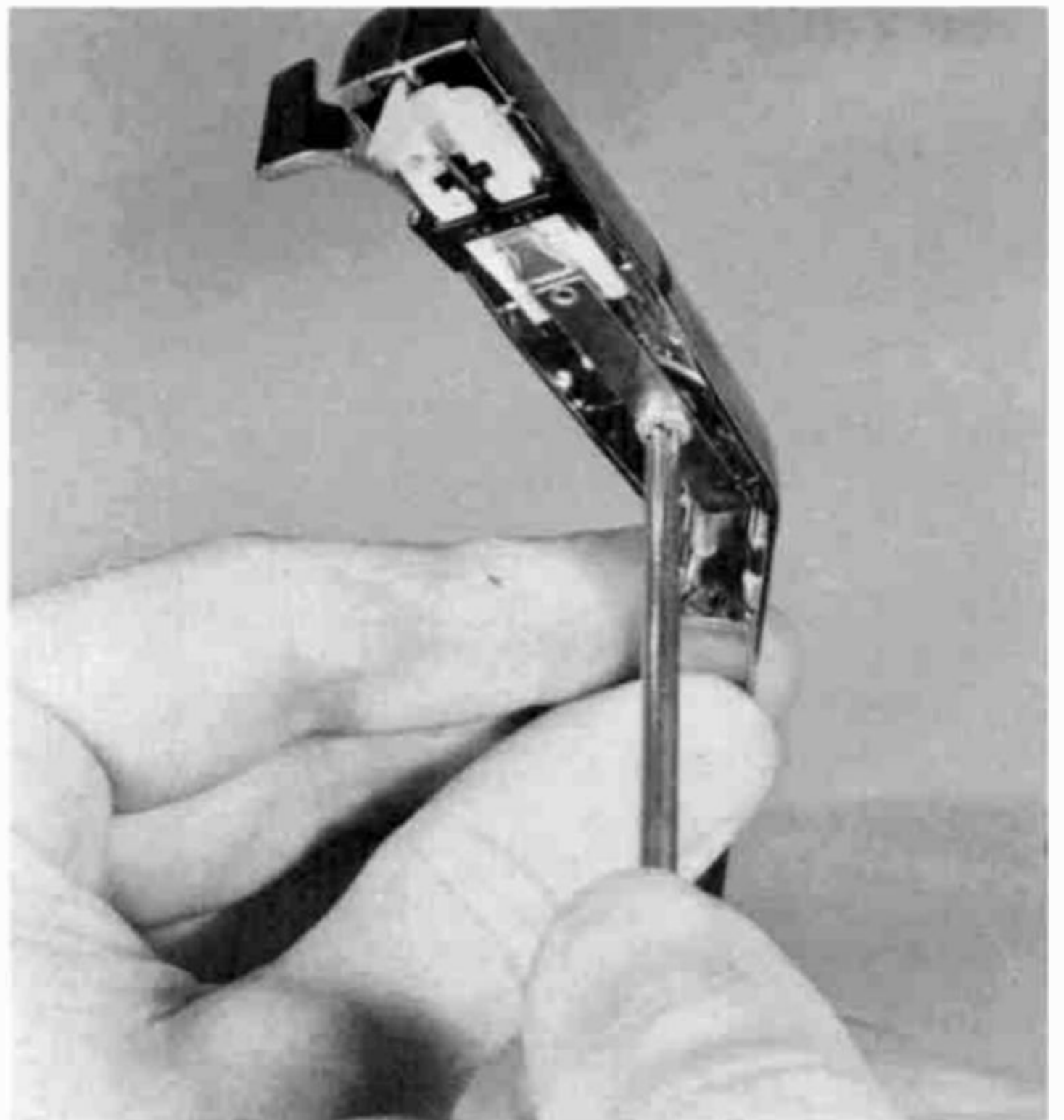


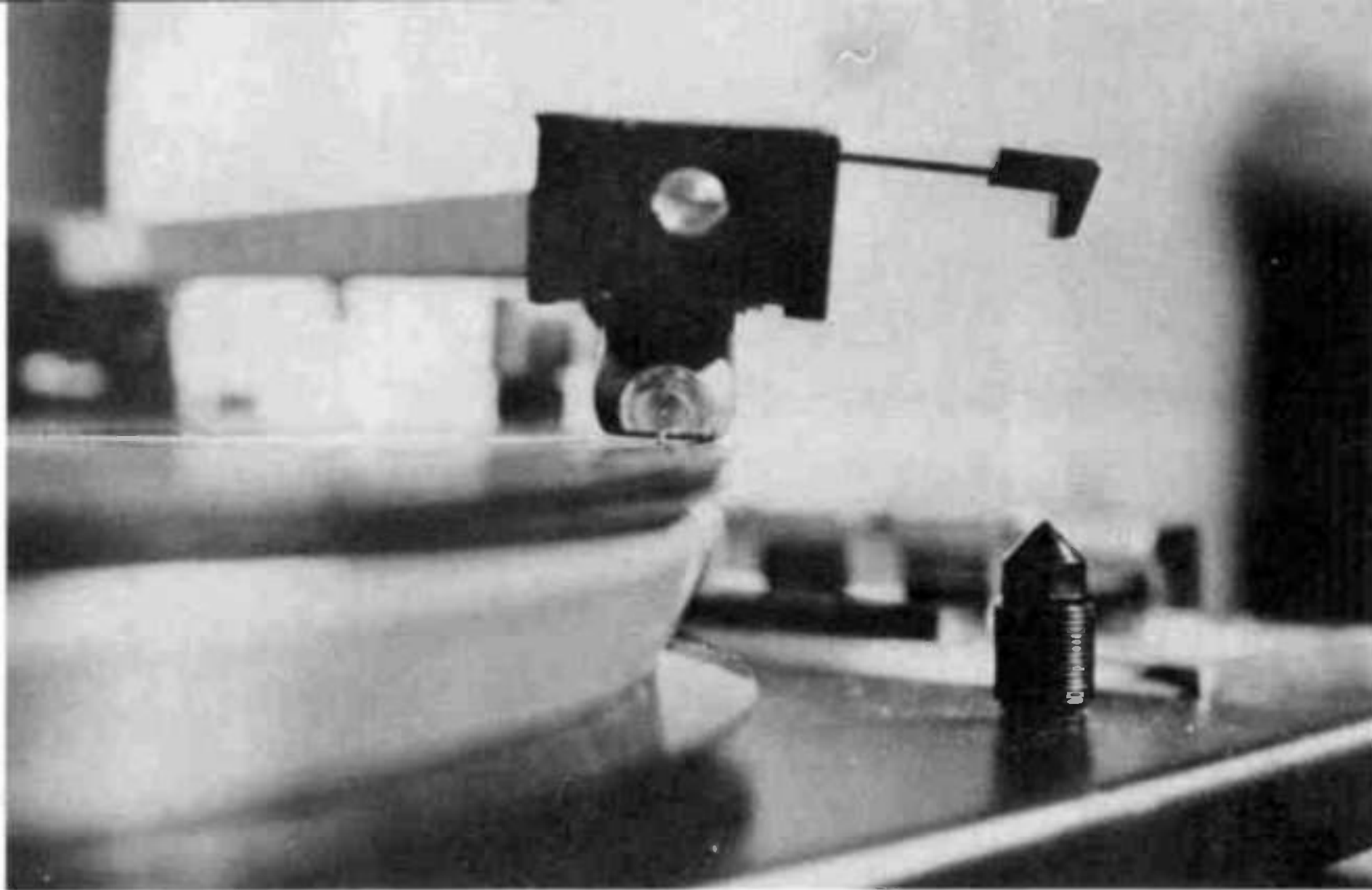
**Step 4.** An equally-important cleaning job involves the pulley on the motor and the rubber-tired drive idler. Hold an alcohol-soaked wiper in contact with the spinning motor pulley. Be sure you get into the crevices on each step of the pulley. Don't clean the idler that way, though. Remove it and wipe thoroughly with alcohol, keeping fingers away from the drive rubber. Take a close look at the surface of the tire. Any almost invisible lump can cause thumping and wow in sound from a record. If the rubber surface has a glazed or "shadowed" look, replace the idler (it costs less than a callback). Don't touch the rubber surface or let it touch anything as you replace the idler on its mounting.

**Step 6.** Make sure the cartridge mounting is tight. Complaints of an erratic channel originate often from faulty cartridge mounting. Particularly suspect the kind that "snap" into the end of the tone arm; the leaf-spring metal contactors notoriously make poor contact. Before you take a cartridge loose, check the wiring at the rear; sketch a diagram to prevent miswiring in case wires slip off or break.

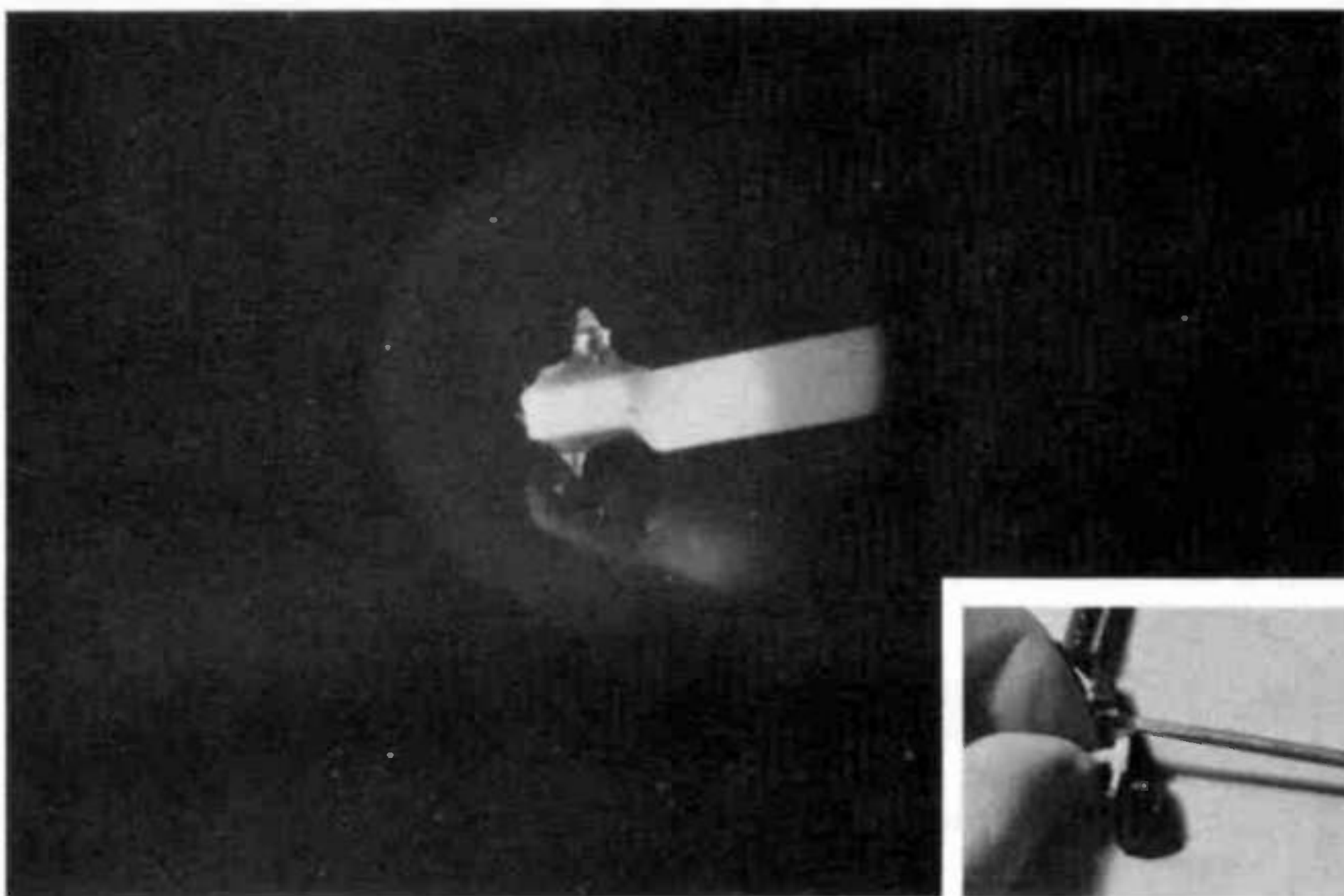


**Step 5.** Make some preliminary tests before checking out the mechanism. The "scrape" test verifies that the cartridge works. With stereo cartridges, listen to both channels. Scrape the ridges of your fingertip **LIGHTLY** across the stylus tip; carelessness could damage cartridge and stylus.

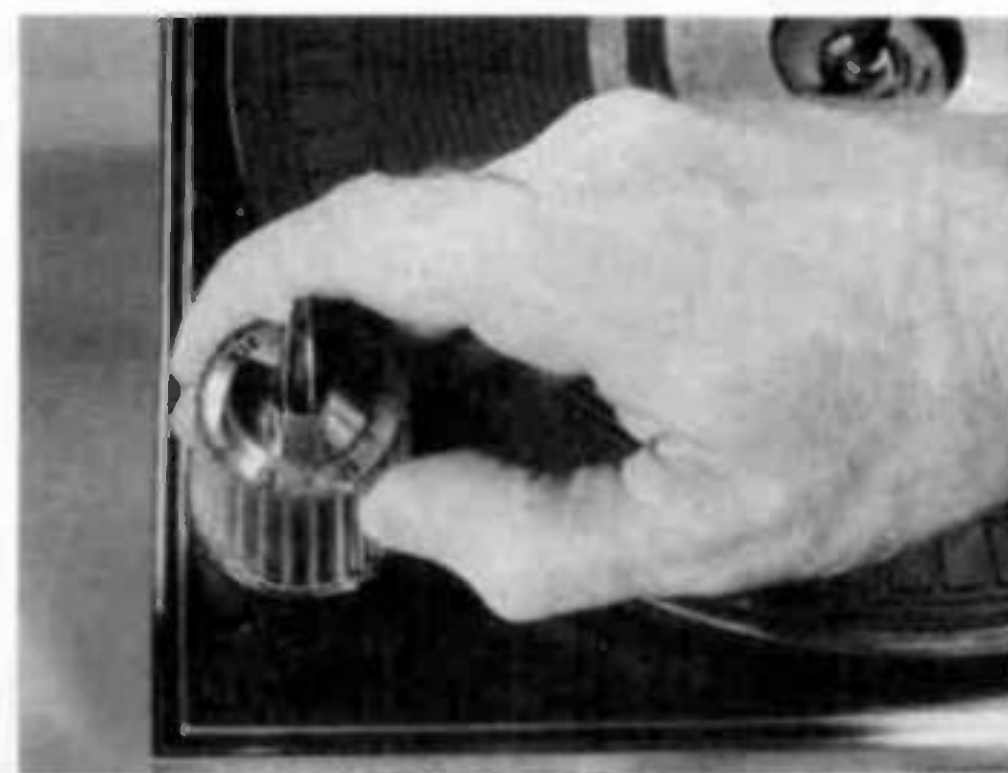
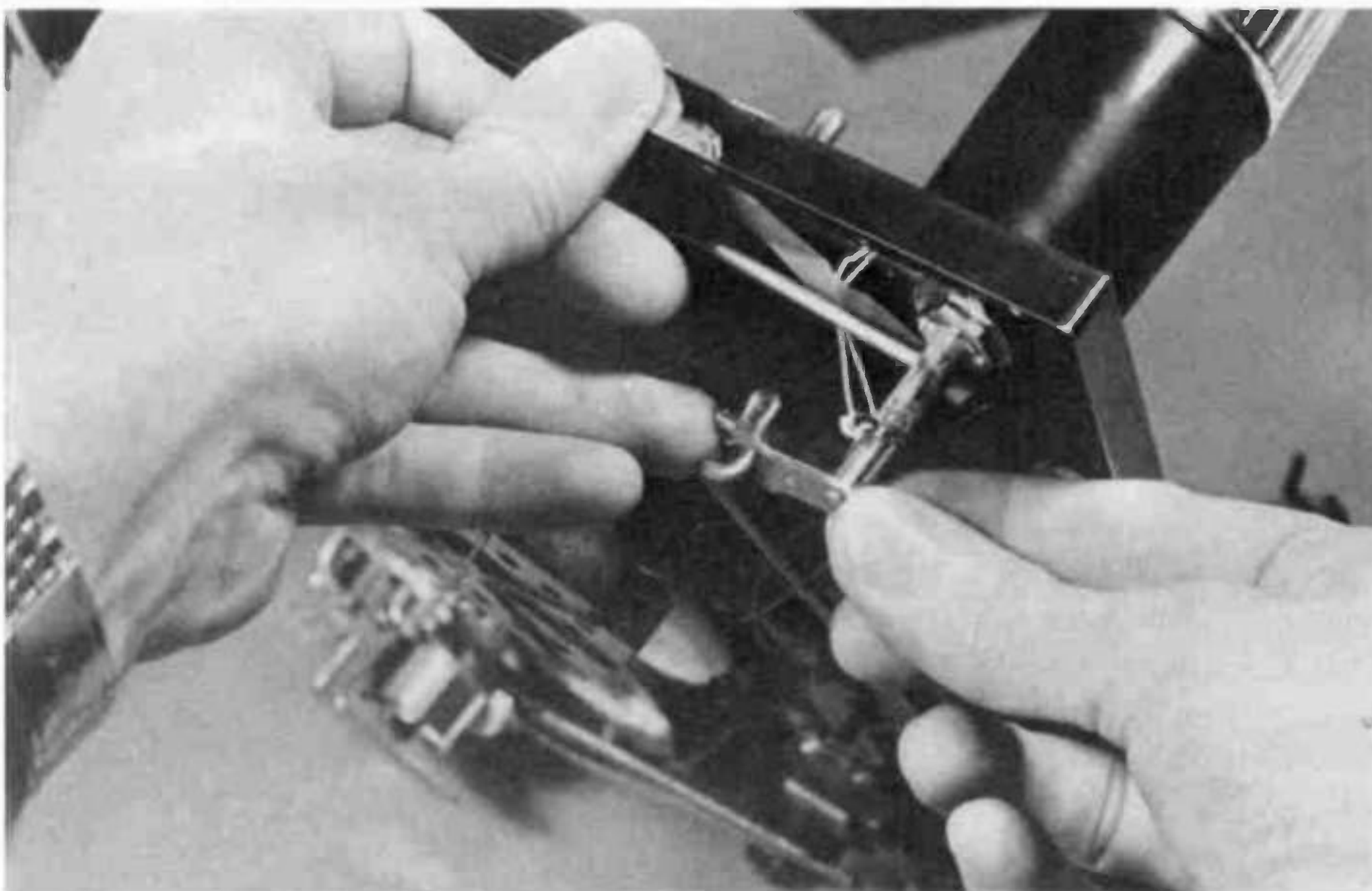




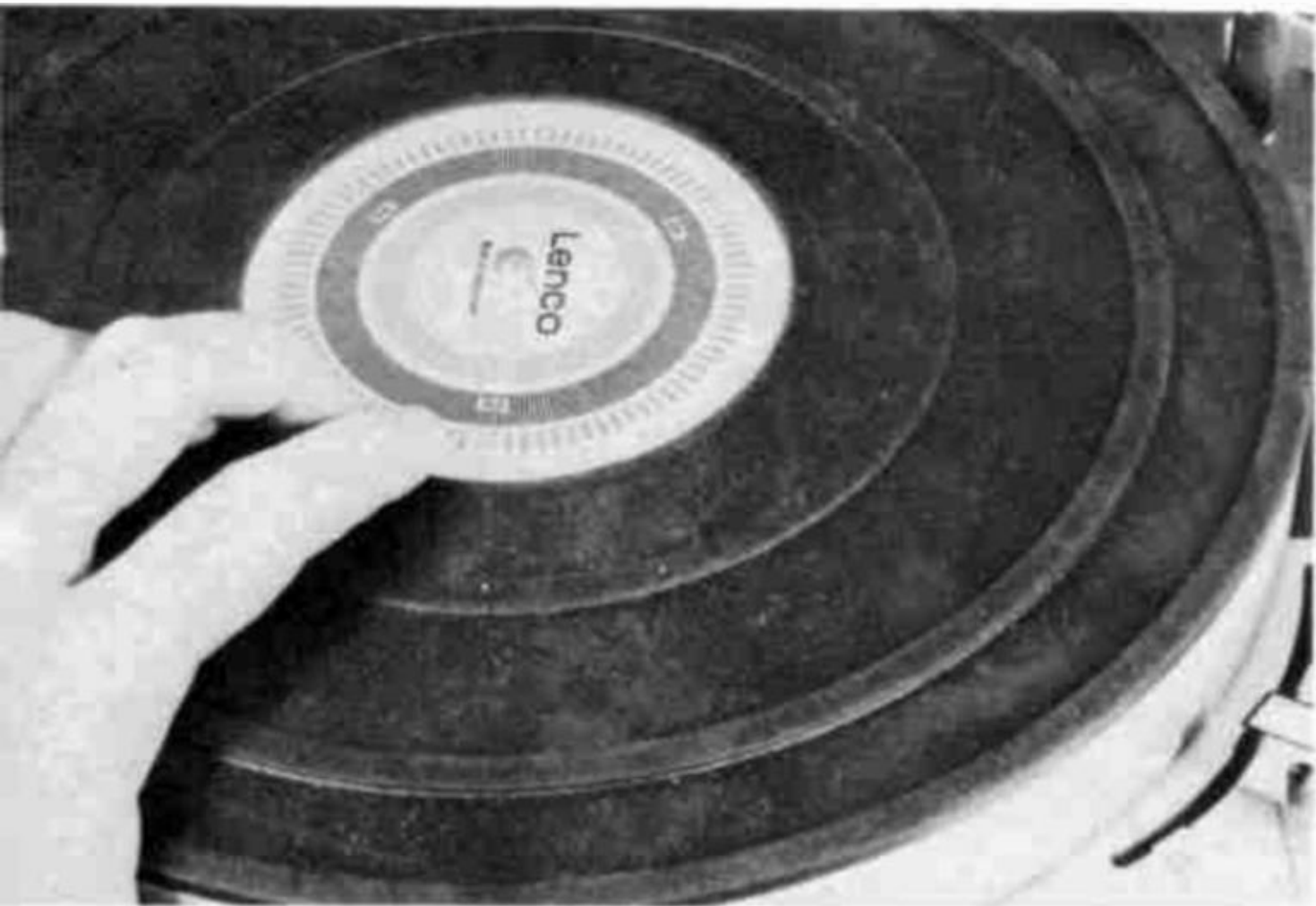
**Step 7.** Inspect the cartridge mounting for vertical tracking error. The bottom of the cartridge should be precisely parallel with the platter (or record) surface. In some high-quality turntables, this is adjustable. Where it isn't, find a way to correct any error. The needle rides poorly in the record groove if you leave it slanting, and distortion and record wear are high.



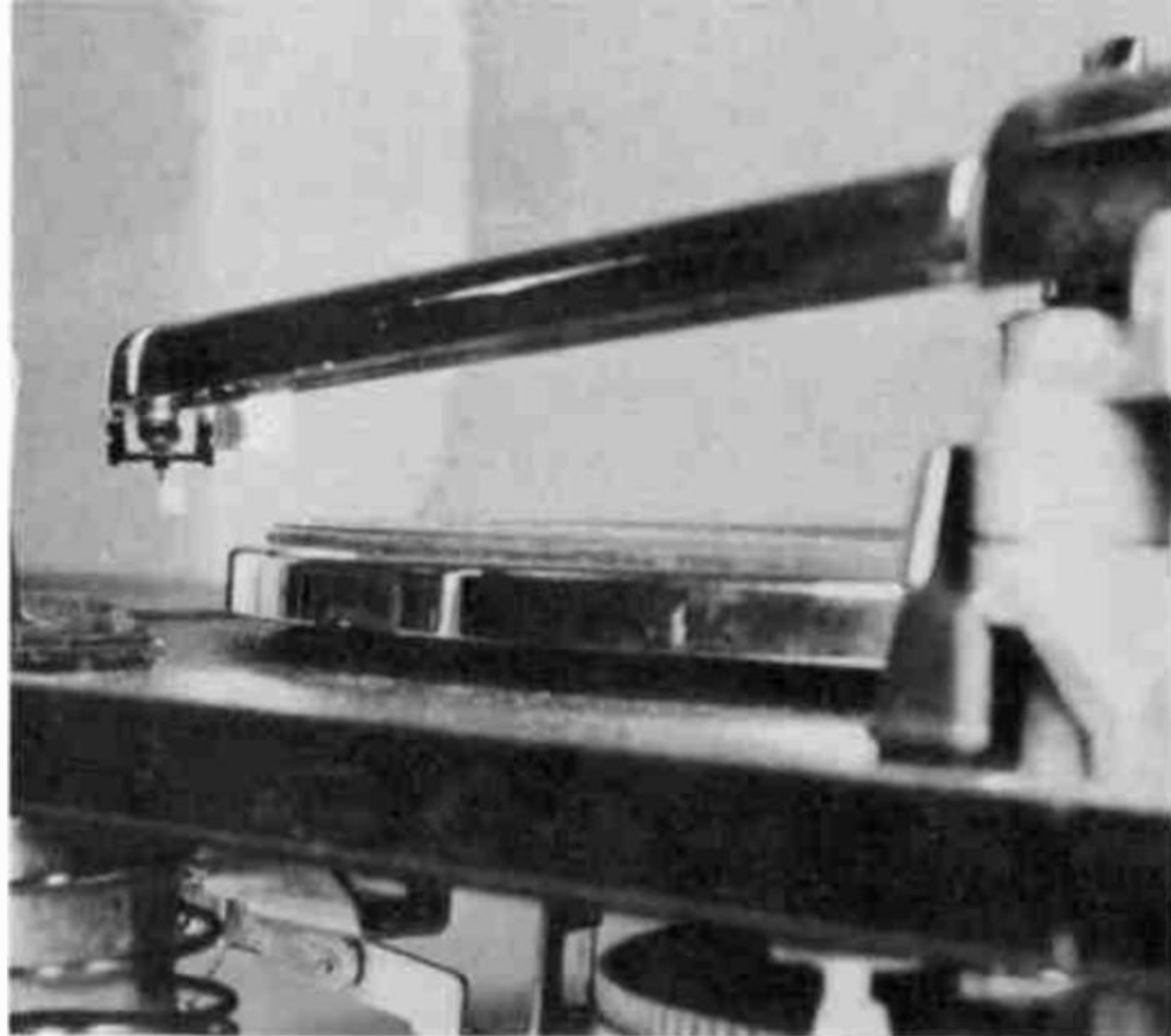
**Step 8.** The "scrape" test tells nothing about stylus quality. In fact, your ear can't be trusted either. Inspect the stylus tip under a microscope. You can buy a small hand-held microscope for this inspection. Sapphire tips can be expected to cause record wear after 25 hours of playing. Diamonds are okay to 500 hours, but should be inspected every 100 hours after that.



**Step 9.** As part of your inspection, try all controls. Check their freedom of action. Inspect underneath; make sure no linkages or springs are off. Usually, the above-deck controls include on-off-reject and speed, sometimes size indexing and cueing. In your first operational tryout of the machine, see if they do what they're supposed to.

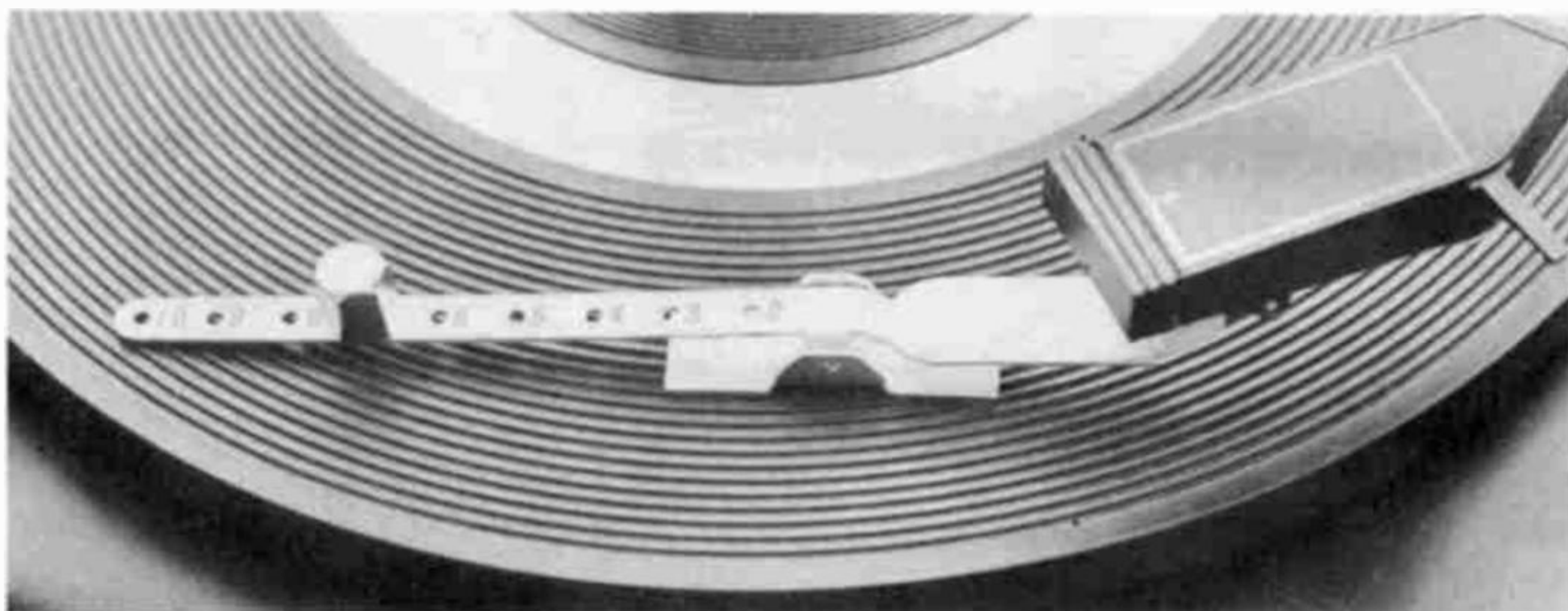


**Step 10.** Verify accuracy of the speeds. Strobe discs are inexpensive. Under 60-Hz light, the marks "stand still" if speed is accurate. Constancy of speed is more important than accuracy. If the marks appear to move erratically or with a swinging motion, the machine cannot deliver hi-fi sound. The cure may lie in the drive system, the platter may have become unbalanced, or hub bearings may need replacing.

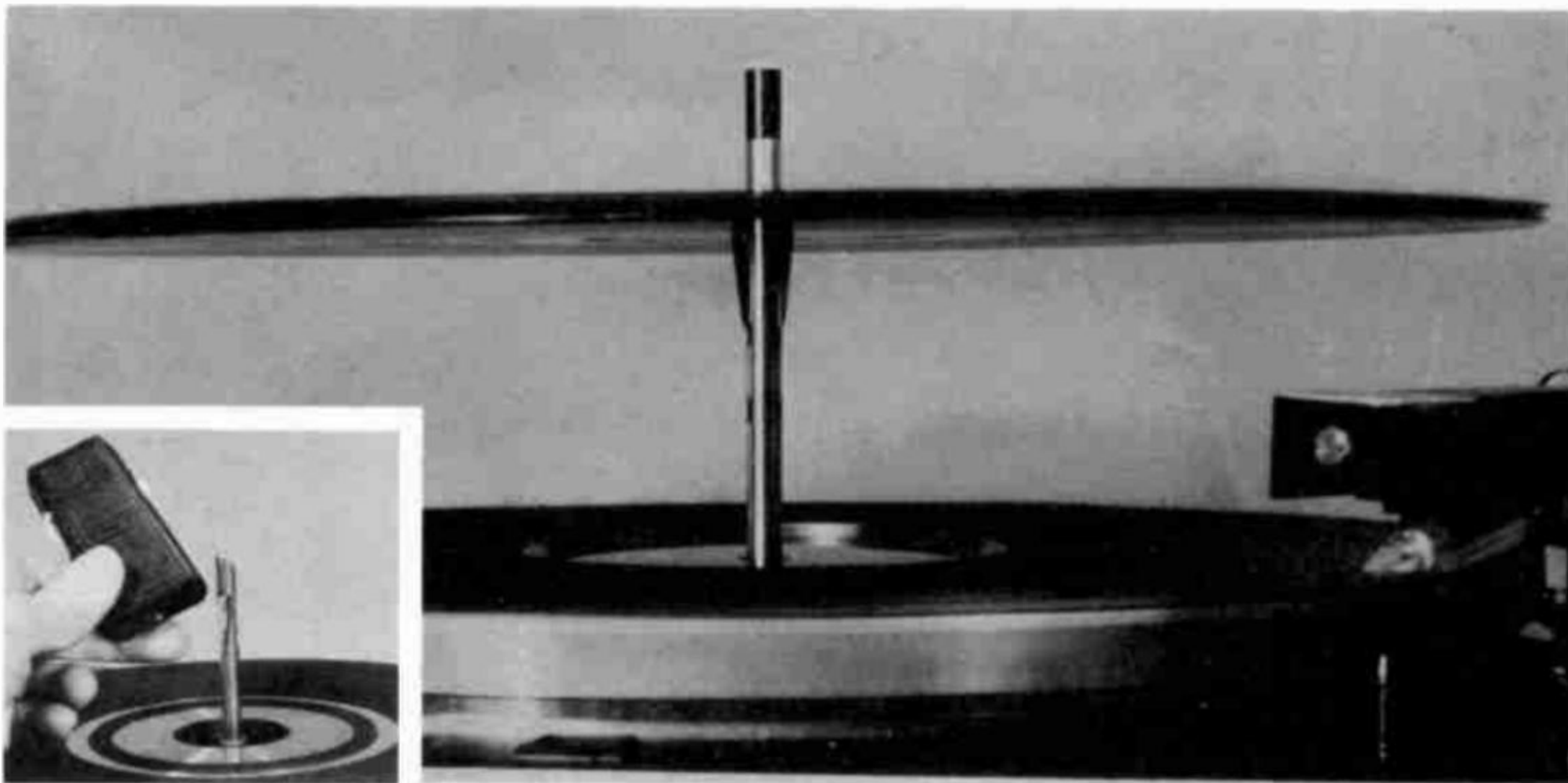


Tone arm balance is important, because that's the starting point for setting grams of stylus pressure. As you'll see in the next Workshop session, you begin at zero grams, the balance point. Then you test to verify what the pressure knob says.

**Step 11.** Inexpensive changers don't have a stylus-pressure knob. Instead, you set pressure with an adjustable spring, and use a scale for "weighing" the tone arm at the stylus. Some experts prefer the gram gauge down beside the platter, others insist it's more accurate with the tone arm up where it plays.

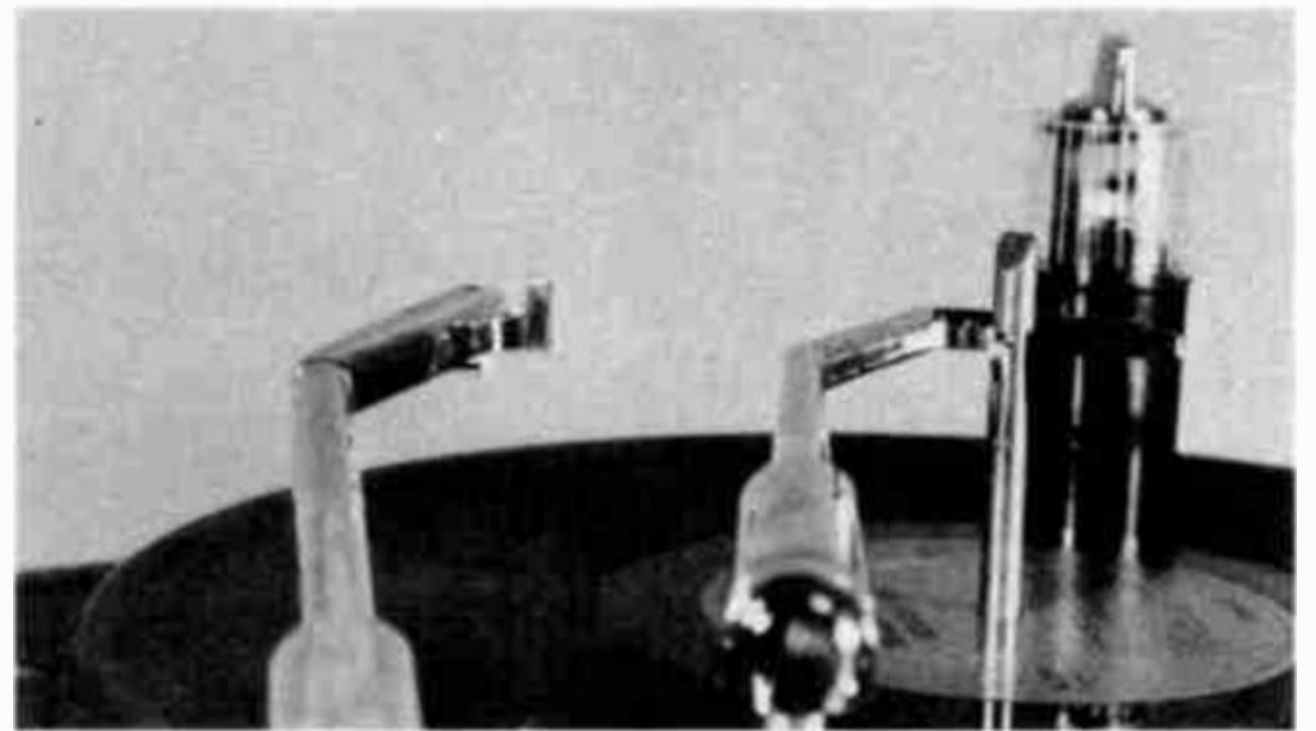


**Step 12.** Test record dropping, with regular spindle and with 45-RPM. Pay particular attention to how far the pushoff tab moves out and back. In some automatic turntables, this has an extra purpose: sensing when there's no record left, to trigger automatic shutoff. Spindles for changers or turntables should be replaced when one doesn't function right, as long as you're sure the fault isn't down below in the slide mechanism.

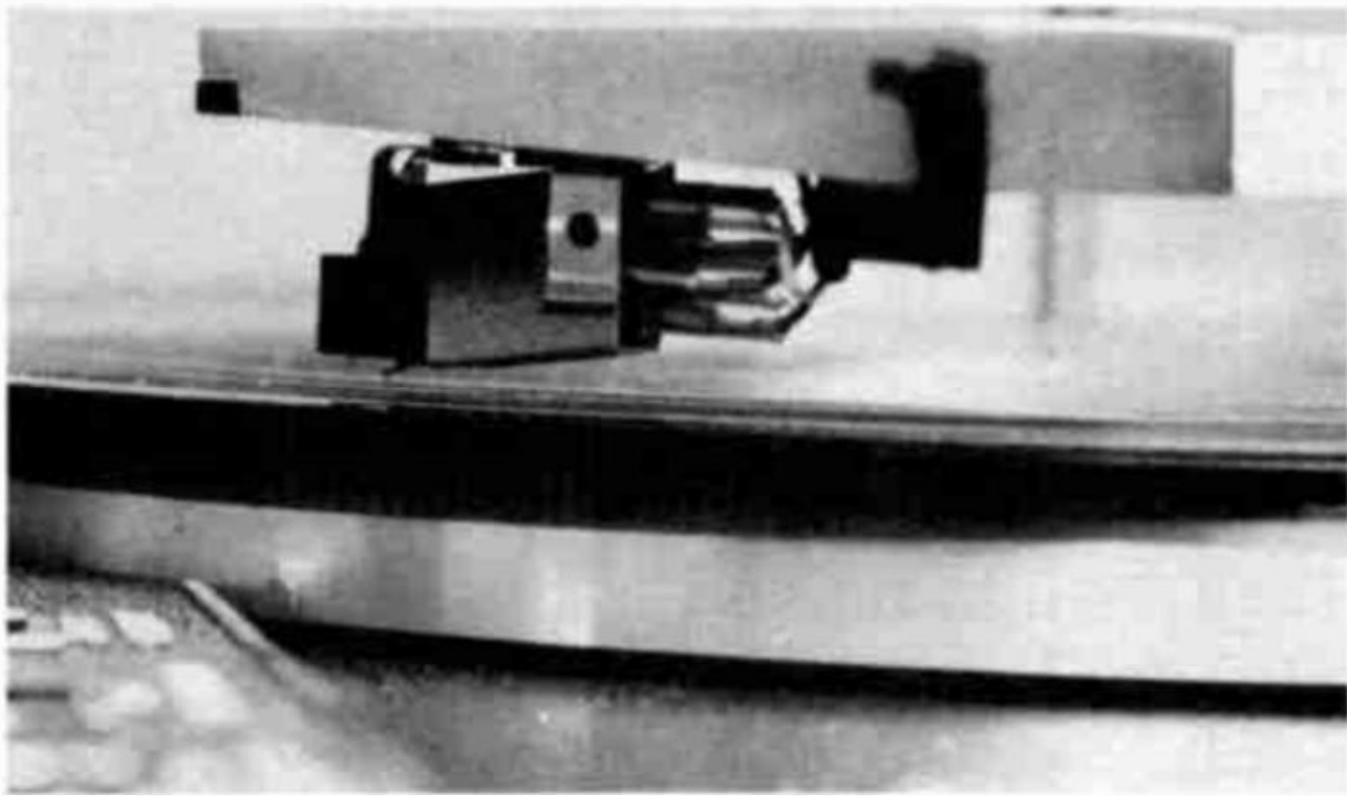




**Step 13.** Test the lift height. The tone arm must raise high enough to clear a sensible number of records on the platter—no more than six for best fidelity. The arm must also NOT go so high as to bump the record stack on the spindle. Check both heights.



**Step 14.** Test automatic tripping. That is, put the stylus down near the center, carefully. Let the record play out and see if the change cycle initiates as it should. One mechanism underneath lets the tone arm trip the cycle from the lead-out groove; another is for "reject" or initiating the cycle manually.



**Step 15.** Test setdown. Though indexing may be correct, stopping the tone arm at approximately the right diameter, you might have to refine the setdown adjustment to hit the first groove exactly. At best, this may involve a compromise among the three record sizes. If a compromise won't work, chances are the indexing system is worn and needs repair or parts replacement.



**Step 16.** Test cue damping, if the turntable you're servicing has it. Damping lets the tone arm lower gently, even though you pull the cue lever down quickly. A mechanism underneath slows the descent, usually by friction. Too quick or too slow means you'll have to check the mechanism.

### Next Month

As I promised at the beginning of this session, you've been exposed to those parts of a record changer or automatic turntable you need to check first, before you proceed with diagnosis. You've learned a general, basic approach to servicing a changer or turntable.

The next session takes you further, to the next major step in your approach. You'll see how to set most of the adjustments on major brands of changers and hi-fi turntables. There are variations, and several are shown. Then, in two later Workshop sessions, I'll explain the intricacies of mechanisms and of diagnosis.

# Record changer workshop part 2



By Forest H. Belt

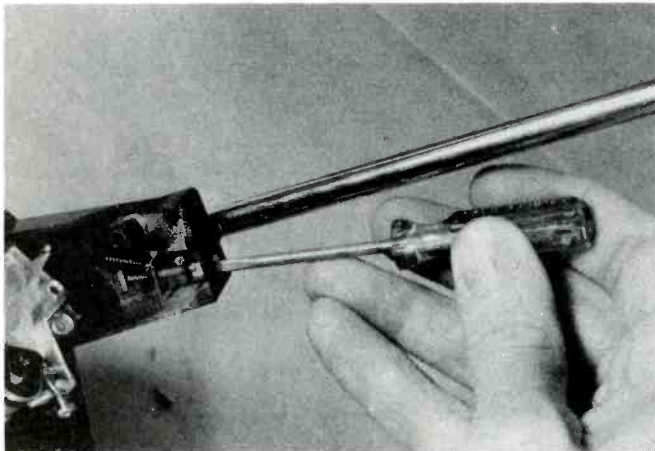
In our first Workshop session you found out the best way to approach record changers and automatic turntables for servicing. A thorough cleaning starts the procedure. Then comes inspection and testing, both of which lead toward diagnosis.

But they aren't the only steps. Another, and an important one, is **adjustment**. That's what this session covers.

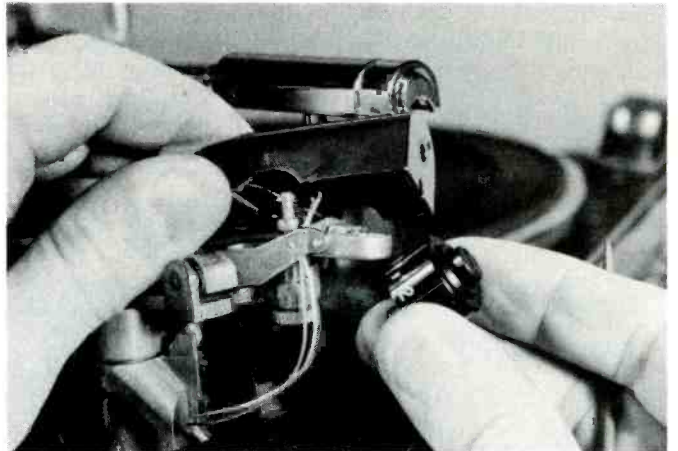
One fact becomes apparent as you study through the photos in

this session. Inexpensive record changers differ from automatic turntables more than just in price. Once you discover the main differences, something else becomes obvious: costly machines actually are easier to repair. You find more adjustments, but that saves you "bending" parts to make them perform within acceptable limits.

Certainly, not every make or model appears in this session. But enough adjustments are pictured, and sufficient information supplied, to help you adapt your knowledge easily to other versions. Make adjustment an early part of your diagnosis and repair procedure. And give then a final check before you hand the unit back to your customer.

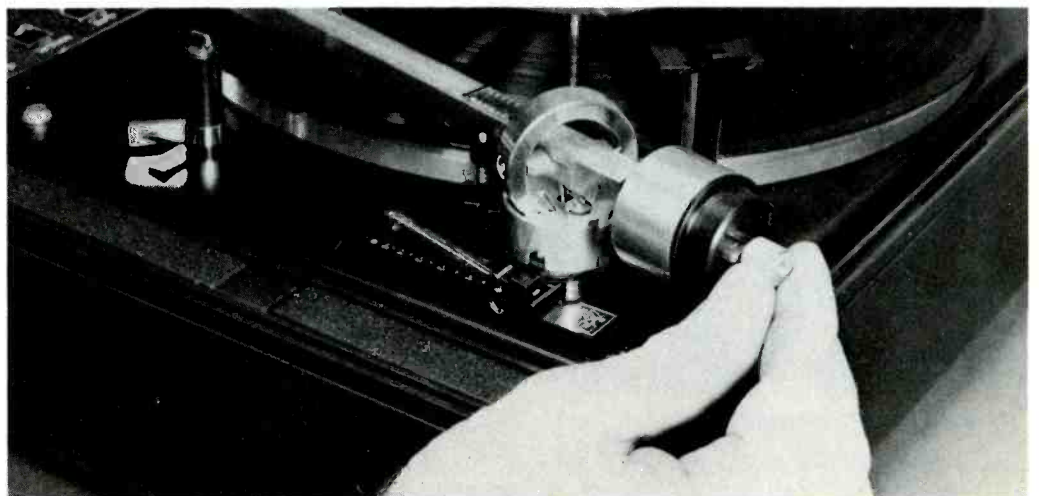


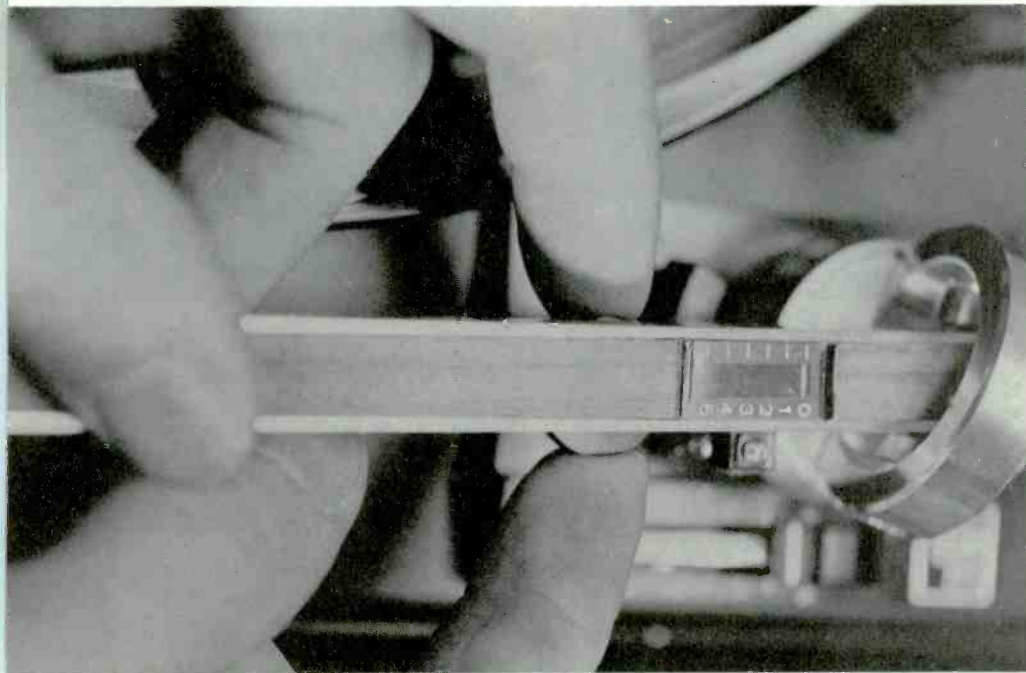
**Step 1** To adjust pressure that tone arm of record changer puts on stylus, you alter spring tension at vertical pivot. Inexpensive models have only rough adjustment—you shift the spring anchor point.



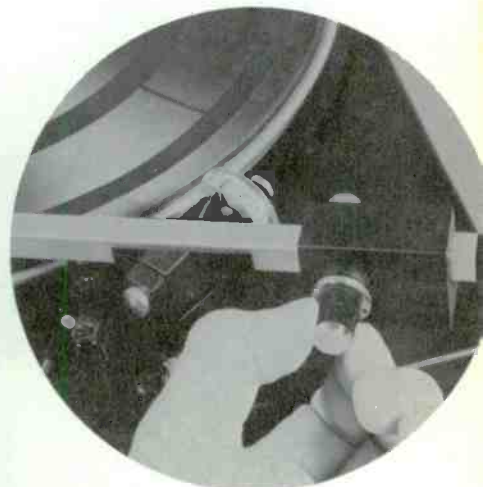
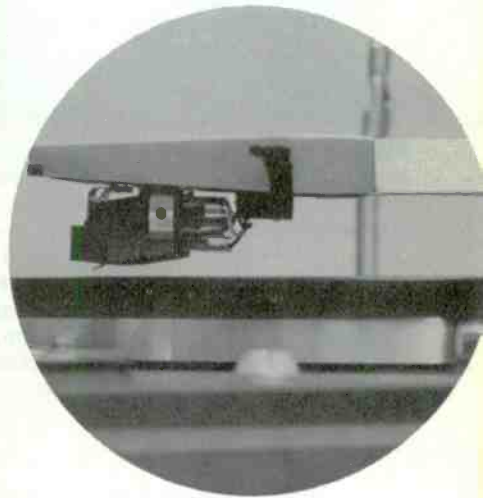
**Step 2** Many costly changers, and most hi-fi turntables, have knob for setting exact stylus pressure. This one, not the most expensive, uses spring tension to counterbalance weight of arm and cartridge.

**Step 3** Better automatic and manual turntables use a counterweight method of controlling stylus pressure. A weight at the back end of the tone arm balances out the weight of the arm and cartridge.

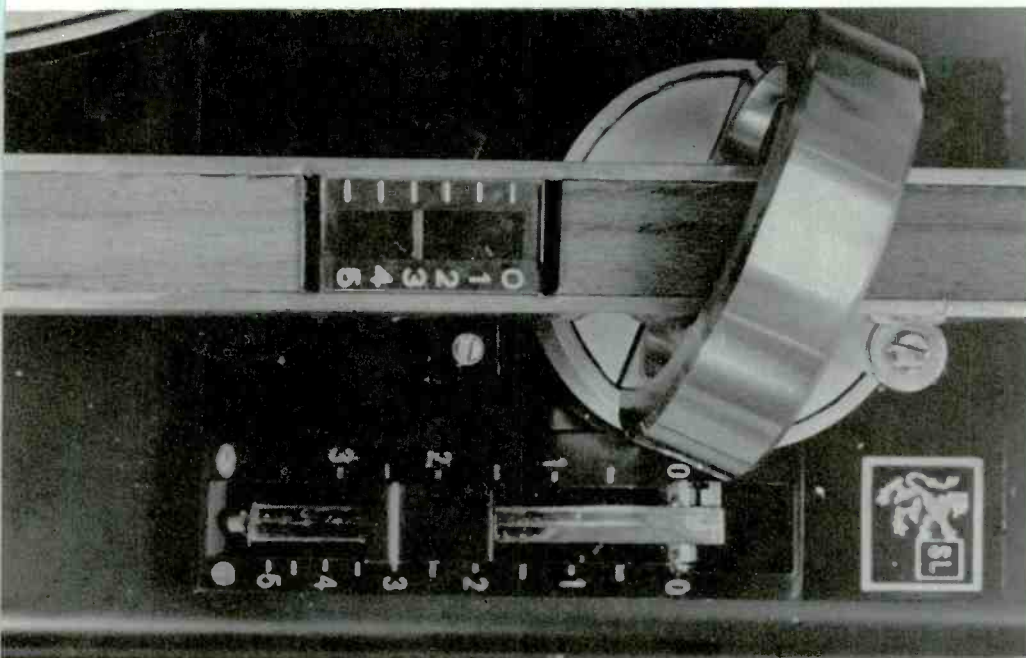




**Step 4** To begin adjustment, you first set the grams-scale knob to zero. This calibrates the knob to deliver exactly the indicated grams of weight at the stylus tip, but only after the arm is balanced.

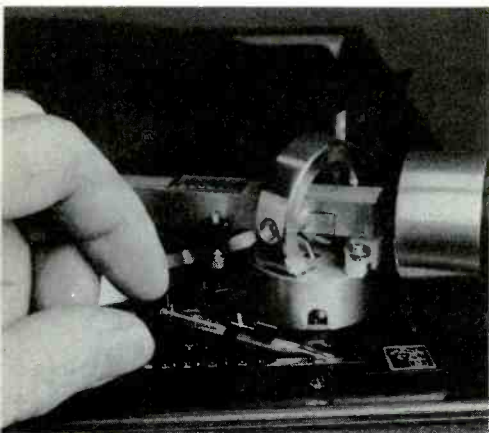


**Step 7** The tone arm shown here has a sliding counterweight moved by a friction knob. The grams knob, the white one on the other side of the mounting post, is typical of medium-price automatics.

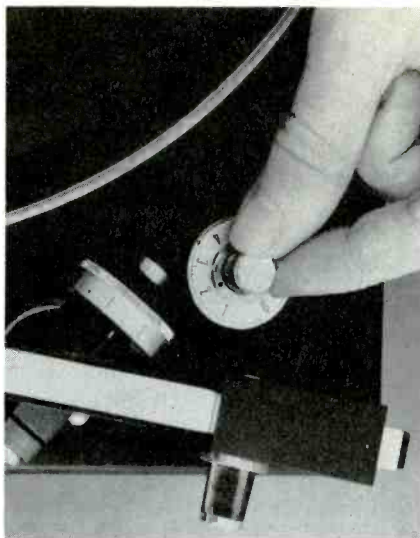


**Step 6** After the tone arm is balanced, the grams scale is accurate. You dial in the stylus pressure recommended for the cartridge being used. If the cartridge is changed, the tone arm must be rebalanced at zero, and the new stylus pressure then set on the dial.





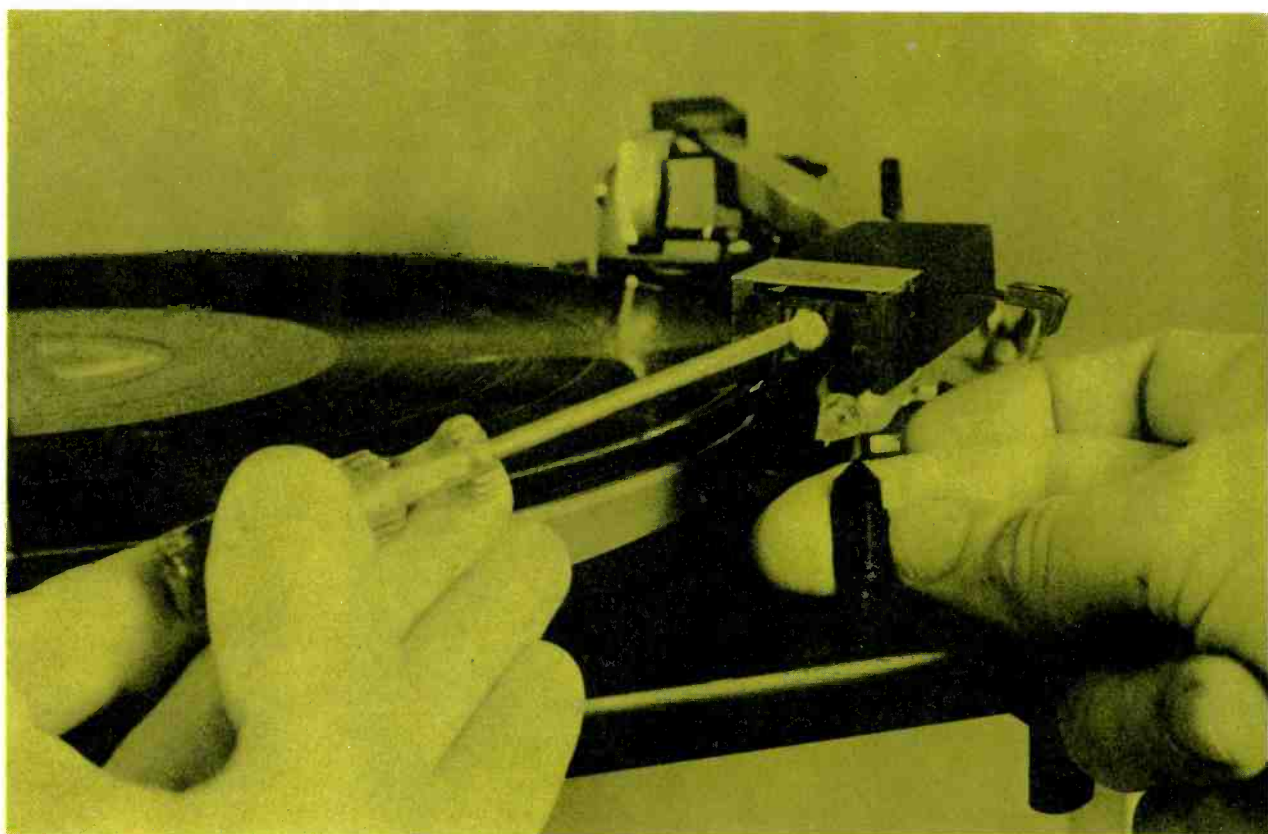
**Step 8** Sideways movement of tone arm across record grooves towards the center is called skating. To minimize this unwanted effect, designers include some means of countering it. The feature goes by the name **anti-skate**. This one, consisting of a bar connected by a cord to the tone arm, has a sliding weight that determines how much anti-skate pressure is applied.



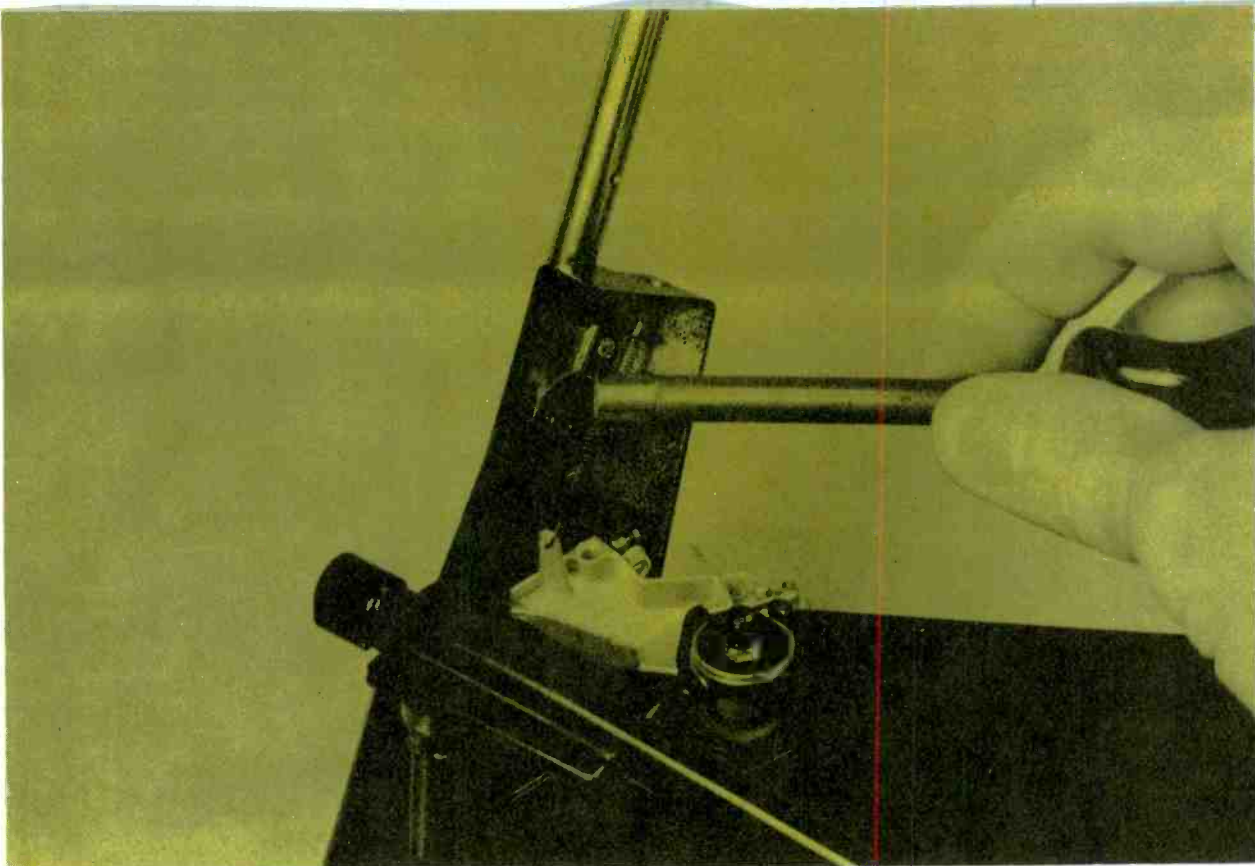
**Step 9** This alternate anti-skate system incorporates springs underneath the baseboard. They apply sideways pressure to the tone arm to counter any skating tendency. Ordinary adjustment calls for anti-skate pressure equal to stylus pressure. When done right, the anti-skate adjustment "balances" the tone arm in the lateral plane.



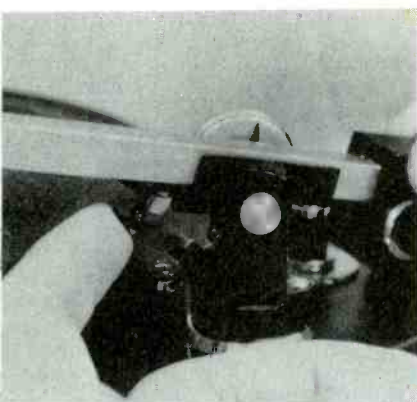
**Step 10** This is the vertical tracking adjustment on a high-quality turntable. You saw a cartridge in Session 1 that needed this adjustment corrected. It looked sideways in its mounting, viewed from the front. The stylus can't seat properly in the groove unless this is right.



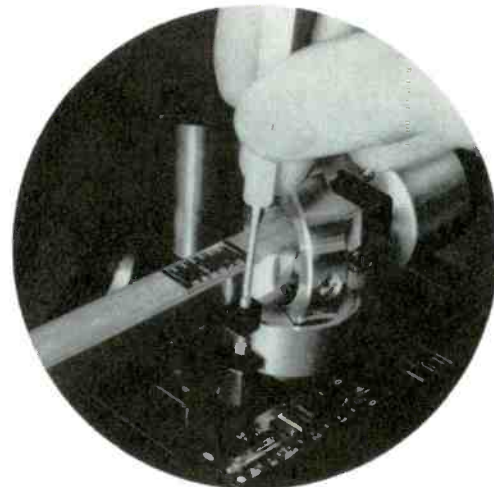
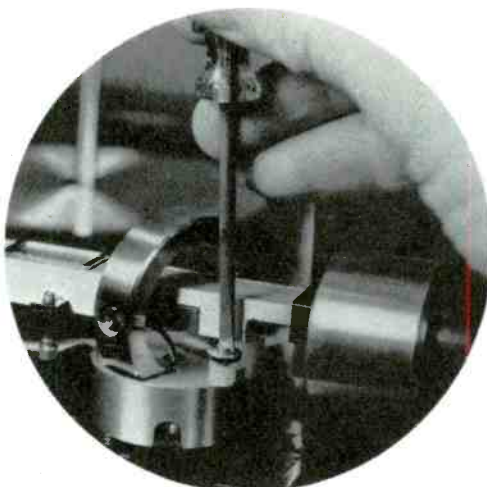
**Step 11** The lateral tracking adjustment puts the tone arm at the stylus on precisely the right tangent to the circle formed by the record grooves. This introduces the least possible tracking distortion. On the machine illustrated here, a guide post lets you determine where the exact tangent is; you align the stylus tip with the apex of the post.



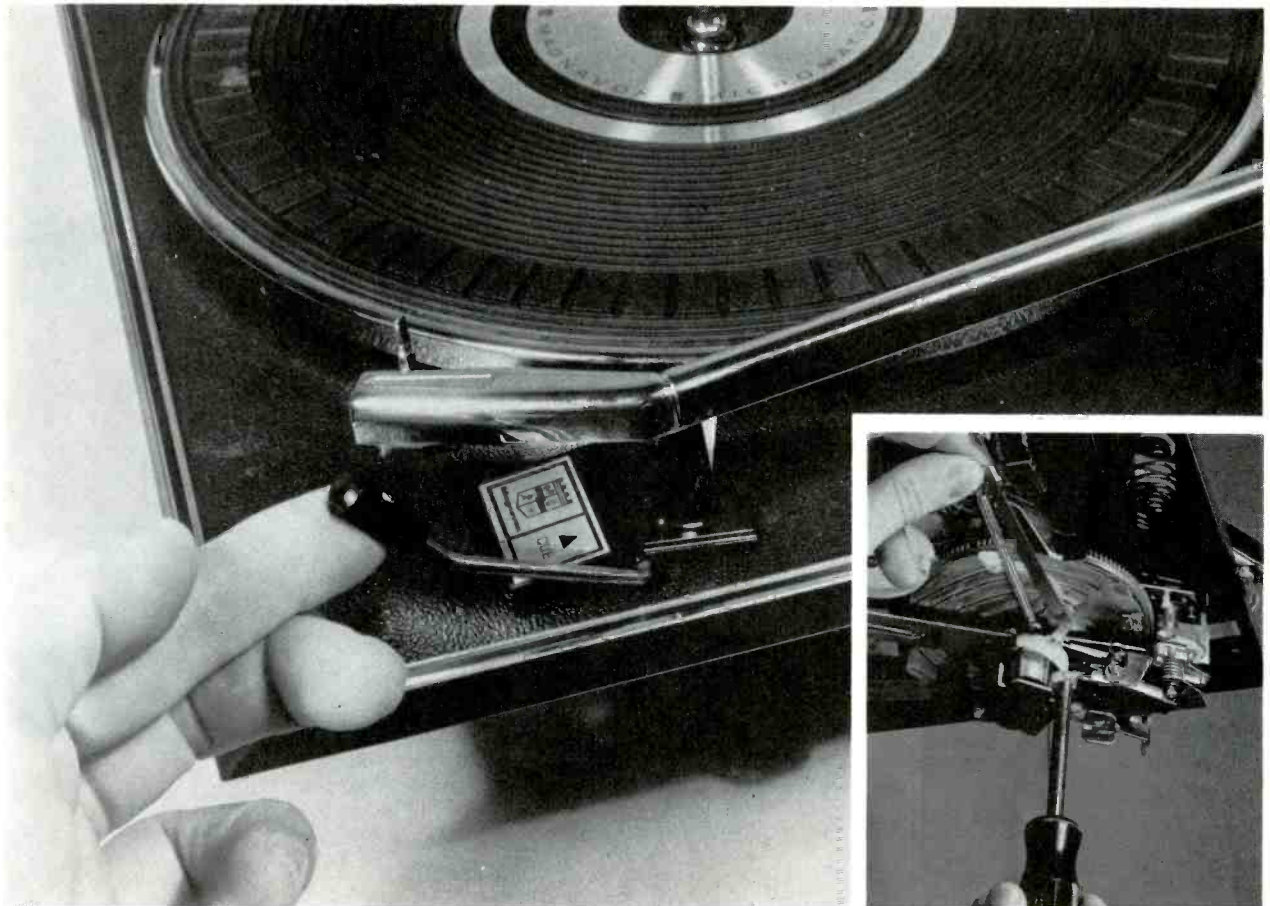
**Step 12** How high the tone arm lifts is determined by a screw underneath the tone arm, on this record changer. Might take a nutdriver, a Phillips, or regular screwdriver.



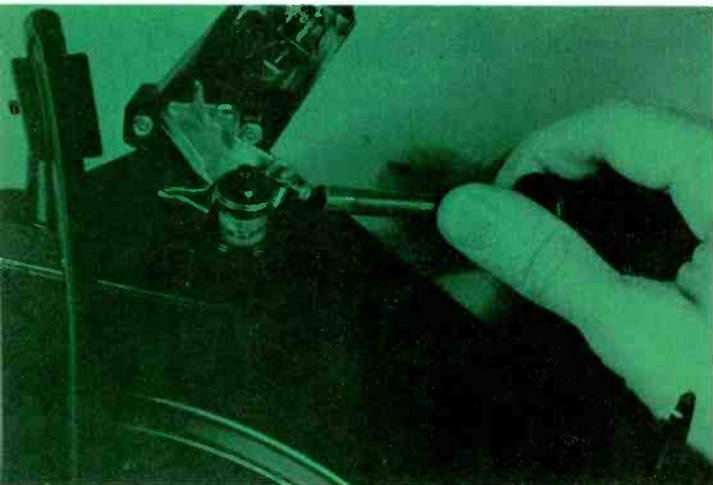
**Step 13** Thumbwheel rides on lift bar of this automatic turntable. Fingertip adjustment is easy. The arm shouldn't be raised any higher than necessary to clear records on platter.



**Step 14** The tone arm, when it lifts during the change cycle, must raise high enough to clear records on the platter but not high enough to bump those stacked on the spindle. Above and to the left, respectively, are adjustments that control these limits.

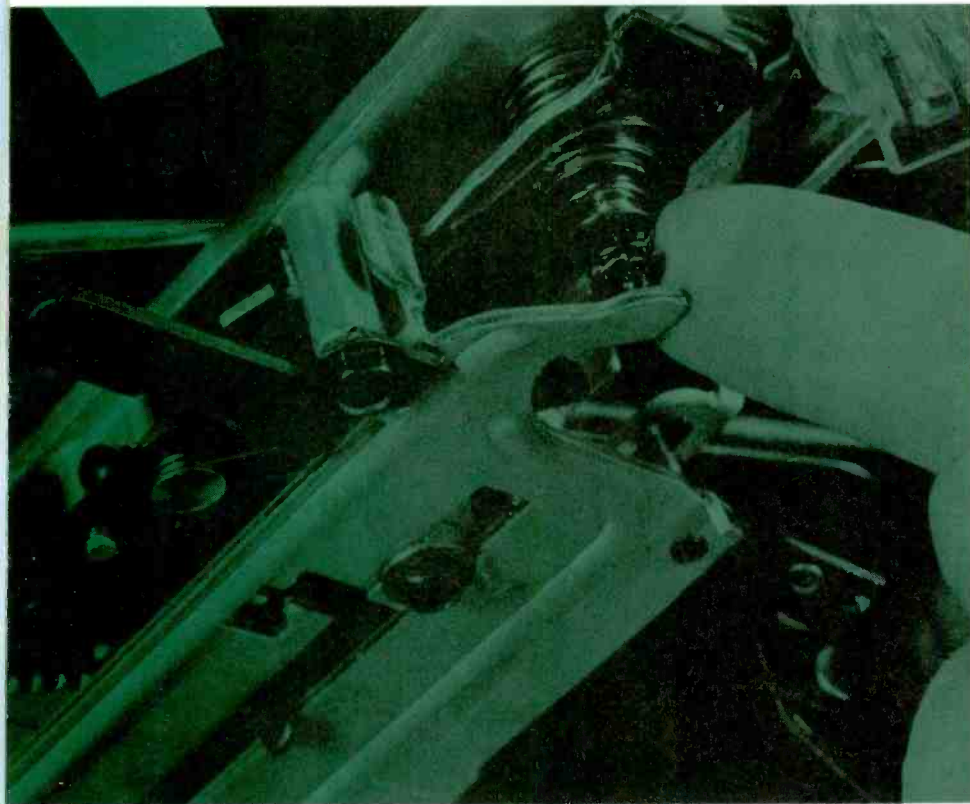


**Step 15** Where cueing is a part of an automatic turntable, damping often is provided to keep the tone arm from dropping abruptly and damaging the stylus tip or the record. Below, the cue handle. At right, adjusting limit of cue lift, so arm doesn't go too high.



**Step 16** Indexing picks the size of record the tone arm sets down on, but a finer adjustment puts the stylus right in the lead-in groove. The above photo shows the setdown screw on a popular record changer; use a nutdriver. Above right, the setdown adjustment is almost hidden at the base of the tone arm mounting. Likewise in the photo at right; screw is nearly out of sight in lower gimbal ring.

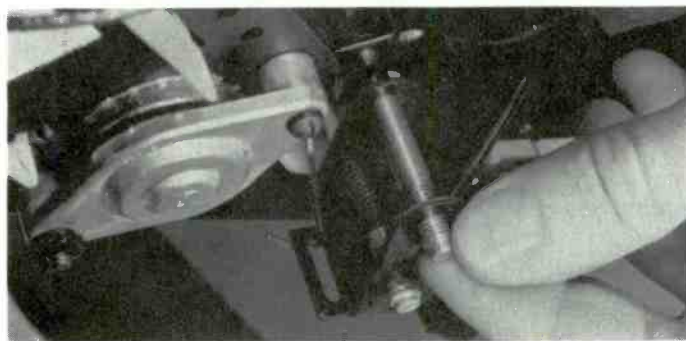
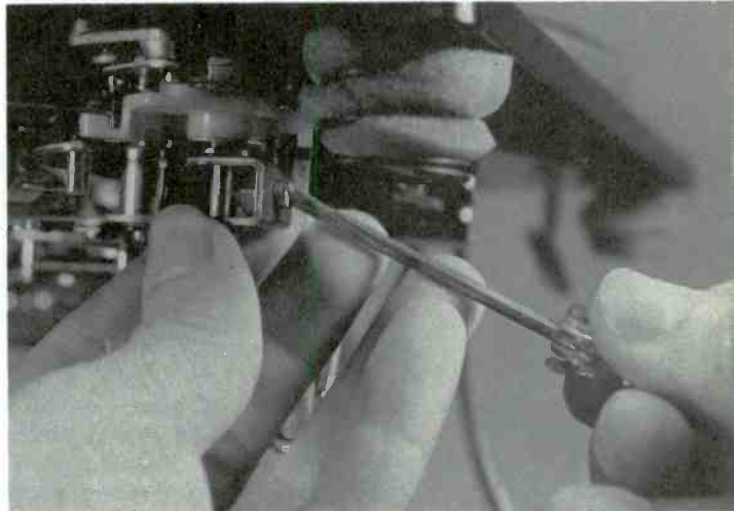
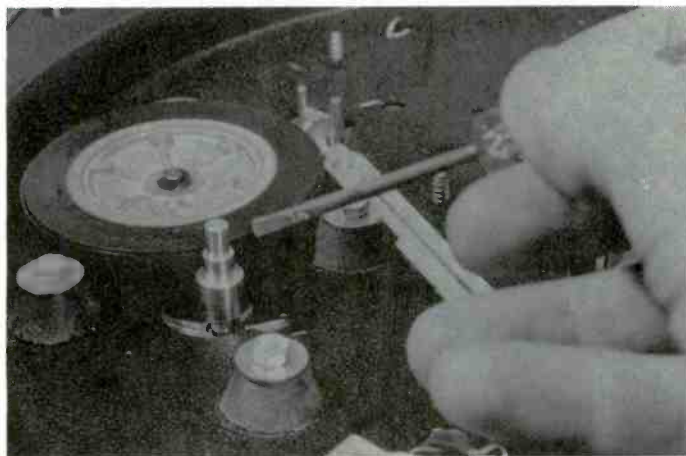




**Step 17** Dropping the record is a function of the spindle. But down underneath, something does the pushing. Here, it's a projection on the cycling slide. Usually, there's some adjustment to make sure the lift rod shoves the pushoff tab out far enough, but not too far.

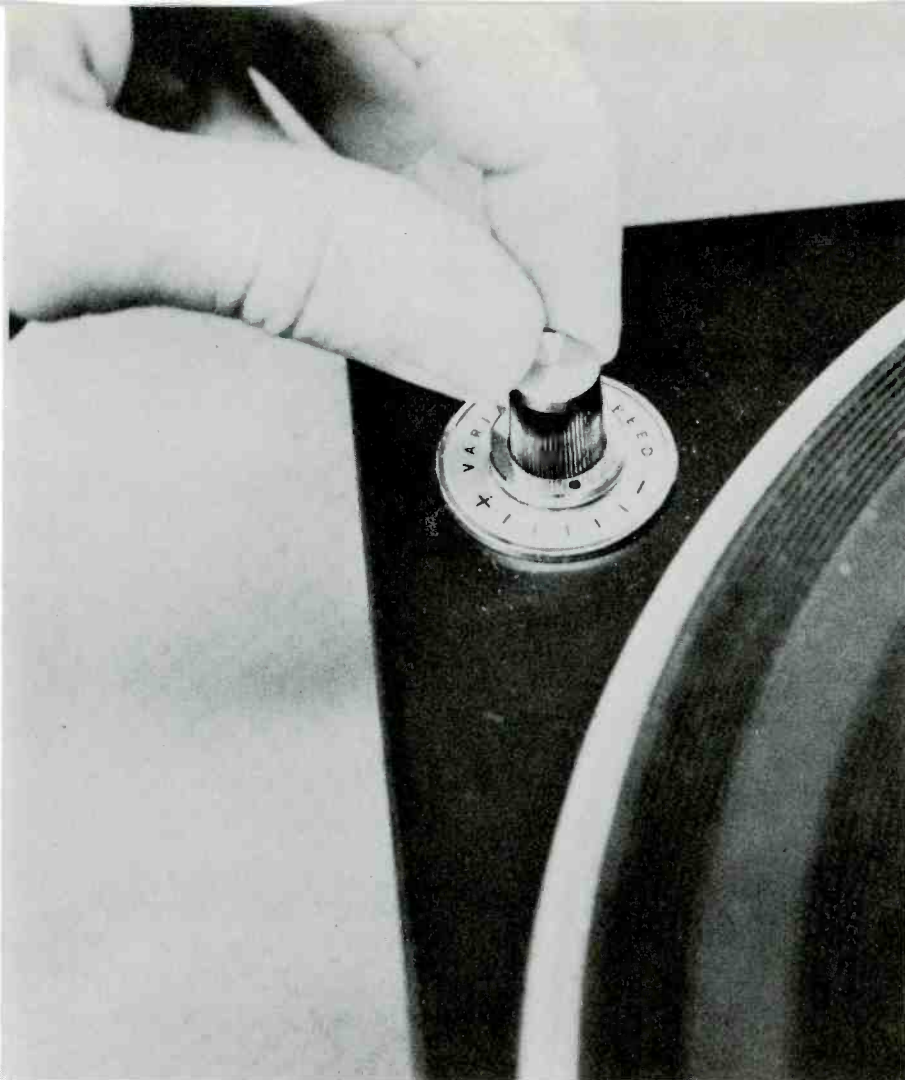
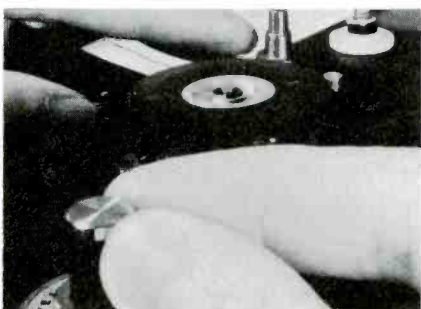
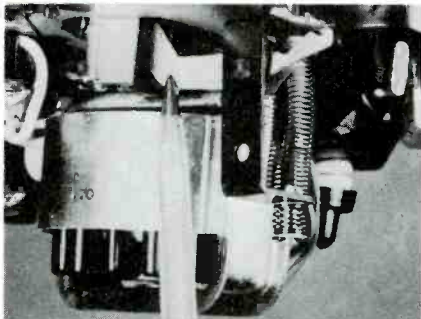


**Step 18** In one automatic turntable, the pushoff adjustment is part of the spindle. A fork is part of the cycling mechanism. At the right time, the fork pulls downward on the bottom of this spindle, pulling rods inside it and dropping the record. The same pulling action causes the spindle to sense whether to shut off after the record plays.



**Step 19** In the ordinary record changer and in most hi-fi turntables, there is no provision for fine speed variation. There are two, three, or four speeds, set by the diameter of a pulley on the motor shaft. The drive idler rides on one of the diameters. If it rides too high or too low, it can cause wow and/or abnormal wear. The adjustments at right are typical of those provided for keeping the idlers at an even height. You may have to compromise a bit, or replace the mounting the idler fits on.

**Step 20** Here's one that does have variable speeds, brought about by a tapered pulley on the motor shaft (below, right) against which the idler rolls. Speed changes (78, 45, 33) are as usual. The Variable knob at left moves a lever (below, left) that slips the idler up and down on whichever step the speed selector has placed it.



### Summary

*Every adjustment of any record changer or turntable you have in for service should be checked before you begin diagnosis. And, once the repair job is done, another quick run-through can head off unsatisfactory operation.*

*Actually, you'll find that a careful analysis of the results of each adjustment gives you a pretty good idea where any mechanical difficulty might be. From there, diagnosis of a specific faulty operation is but a short step.*

*For that, you do need a rather complete understanding of how the machine works. You might be able to figure out the mechanism by watching its attempts to operate correctly. To aid you in that analysis, our next session shows you the key operations inside a typical record player. □*

# Record changer workshop <sup>part 3</sup>

By Forest H. Belt, CET

Record changers usually cost less than high-fidelity turntables and you'd expect they might be simpler. Not necessarily so. Often you'll find just the opposite; a turntable can be deceptively simple. Only the troubles they develop seem complicated.

Operating principles are nearly the same for both kinds of machine. Certain basic functions must take place in either one. These consist of tripping (initiating

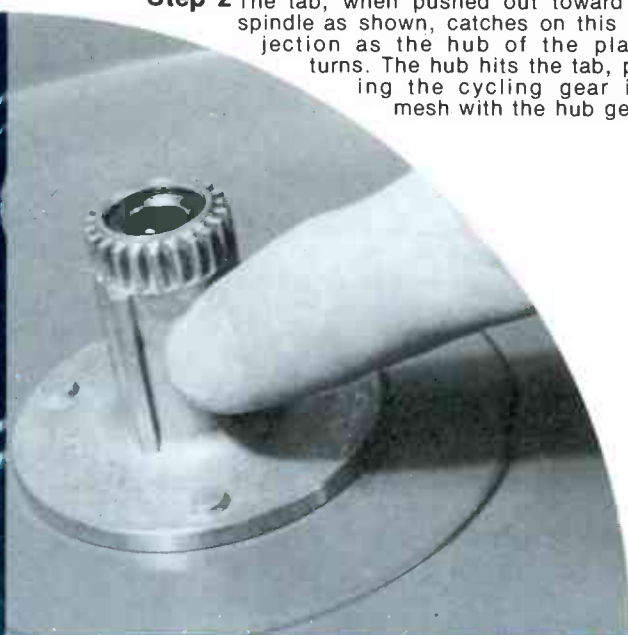
the cycle), driving the cycling mechanism, lifting the arm, swinging it, dropping the record, swinging back the arm and lowering it in the right place (indexing). Most also shut off automatically.

Of course, there are some variations of design. But learn how these basic operations are performed, and you know the secrets of any machine. In this session, you see the functions of an ordinary record changer. Next month, a hi-fi turntable is the subject.

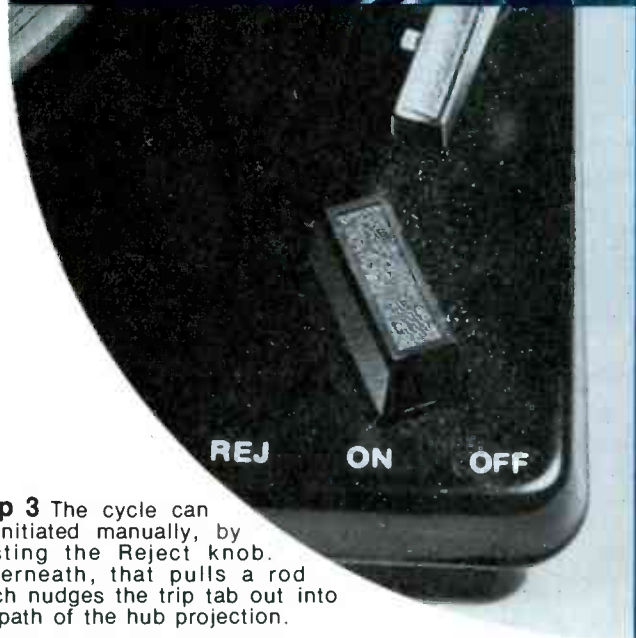
**Step 1** Let's start with tripping. The key part is the trip tab, a little metal piece on the cycling cam. You can see it here, as it appears when tripped. Normally, it's back out of sight.



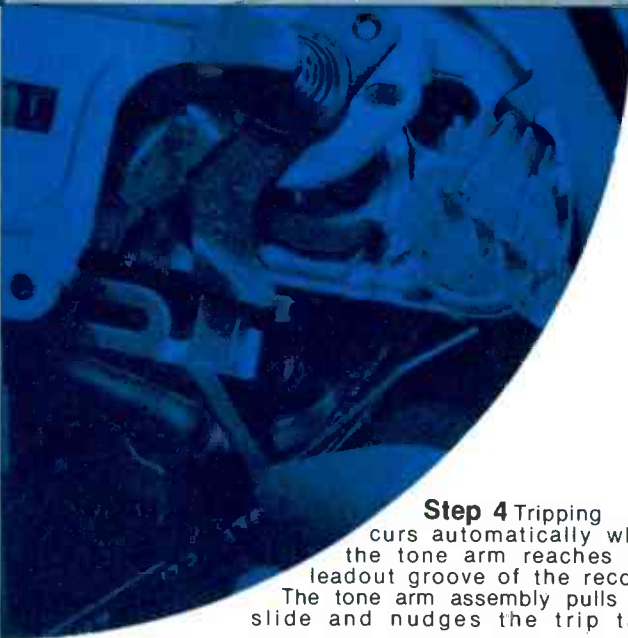
**Step 2** The tab, when pushed out toward the spindle as shown, catches on this projection as the hub of the platter turns. The hub hits the tab, pulling the cycling gear into mesh with the hub gears.

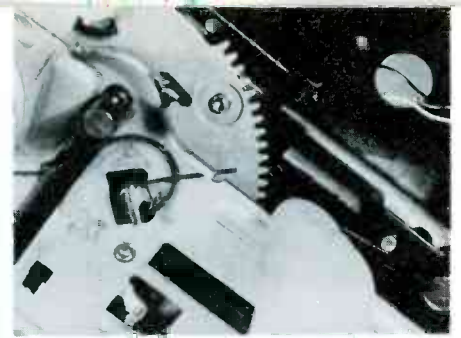
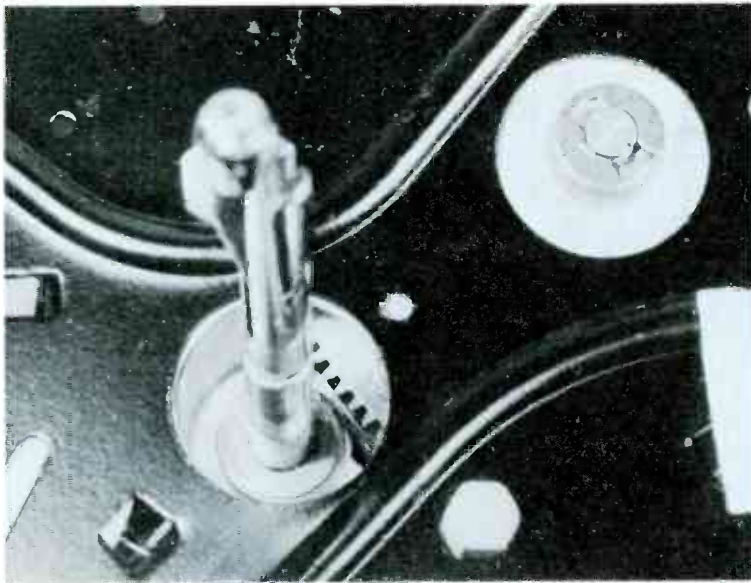


**Step 3** The cycle can be initiated manually, by twisting the Reject knob. Underneath, that pulls a rod which nudges the trip tab out into the path of the hub projection.

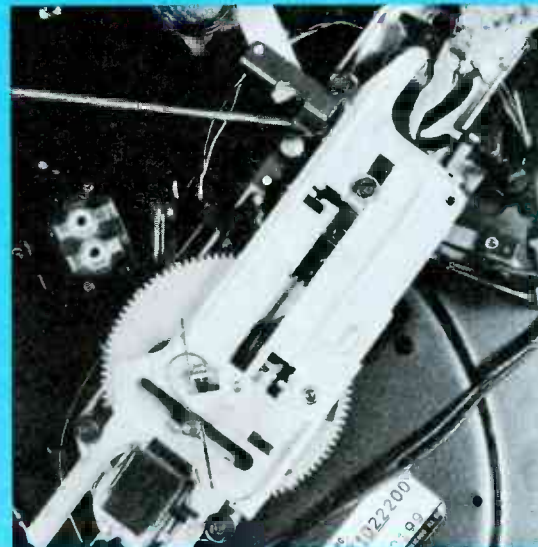
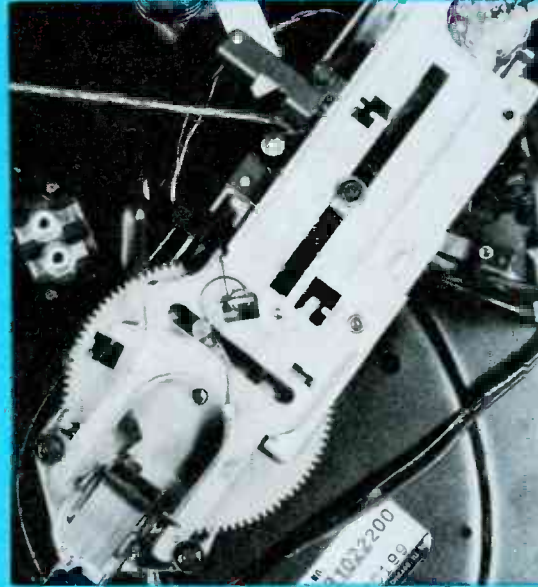
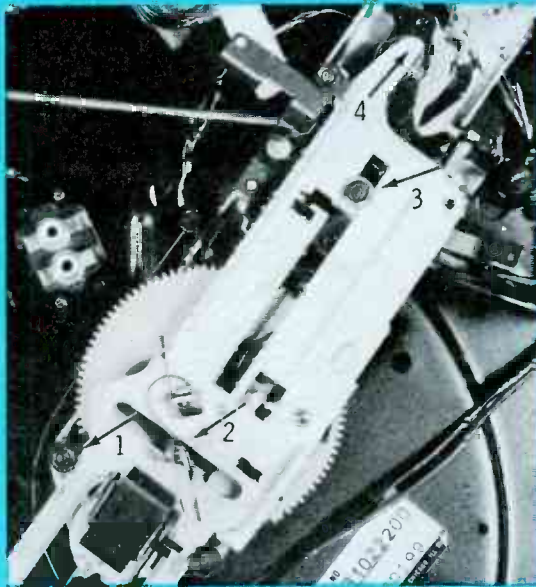


**Step 4** Tripping occurs automatically when the tone arm reaches the leadout groove of the record. The tone arm assembly pulls the slide and nudges the trip tab.

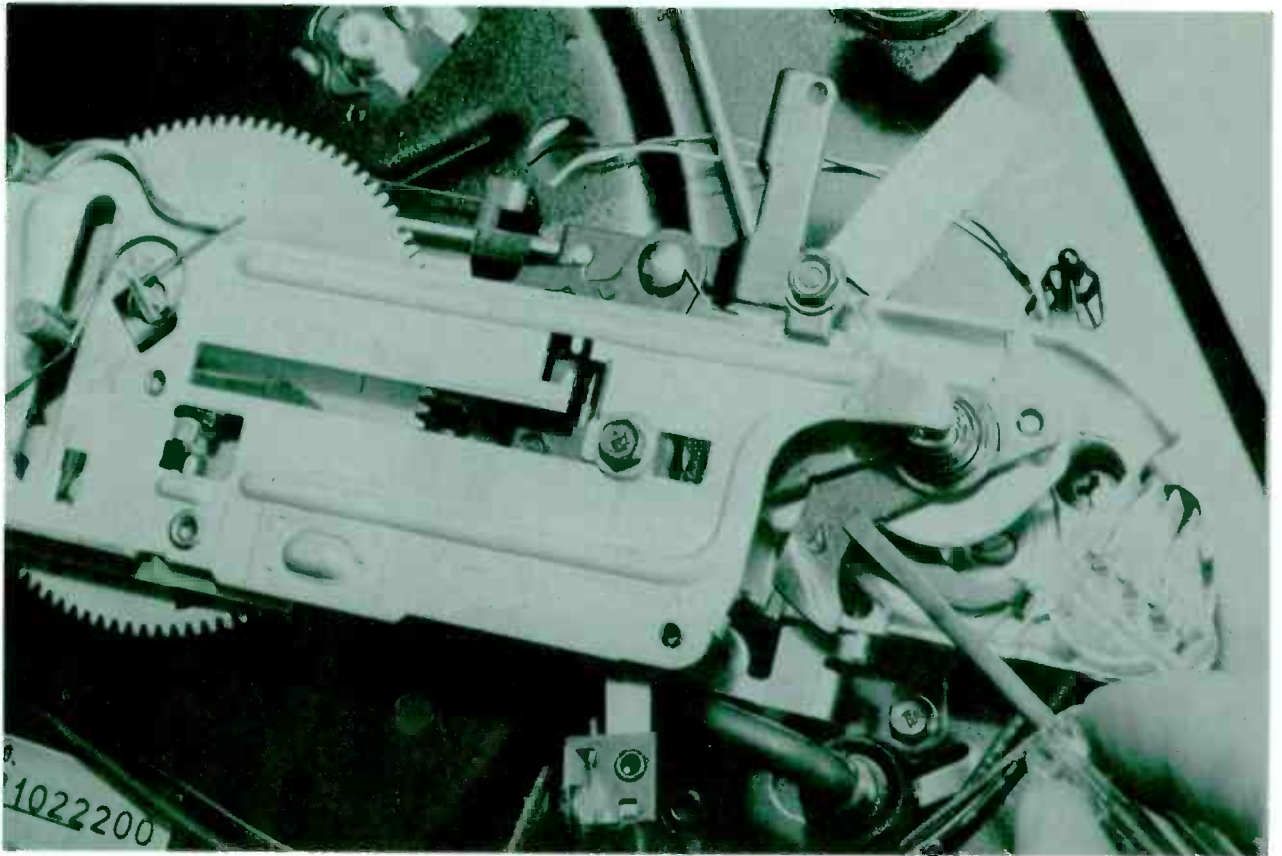




**Step 5** In the top view, you can see the teeth of the cycling gear after the tab has pulled it into mesh with the hub (platter removed for this photo). View of the bottom of the changer shows the gear from the underside, with the Teflon detent pawl visible coming out from behind the cycling slide. The gap you see in the teeth is the same one as in Step 1.



**Step 6** The white rectangular-shaped part is the cycling slide, and the round part with the teeth is the cycling gear. Revolutions of the cycling cam gear drive the cycling slide sideways by means of a post mounted off-center on the cycling cam (arrow #2). It is visible in the cross-slot of the slide. As the cam gear turns, the post moves the slide (to the right and up in the photo). To prevent movement of the slide towards or away from the base, it is held in three places, the screw at #1, plus another at the opposite side of the slide, and one at #3. Movement of the slide is clear when compared to these three points. As the slide moves fully to the right and back, it initiates the record drop (parts near the left end of the slide), arm lift (ramp portion near #4), arm swing and backswing (parts between the slide and the baseplate), and arm lowering (ramp at #4). Notice the position of the post and slide in each photo in turn.



**Step 7** This photo shows the arm that fastens to the bottom of the tone-arm lateral-pivot spindle. It has two jobs. It operates the trip slide (already explained) as the tone arm travels in the lead-out groove. And, during the cycle, the cycling slide catches the other end (opposite the screwdriver) and swings the tone arm laterally. It's sometimes called the lateral arm.

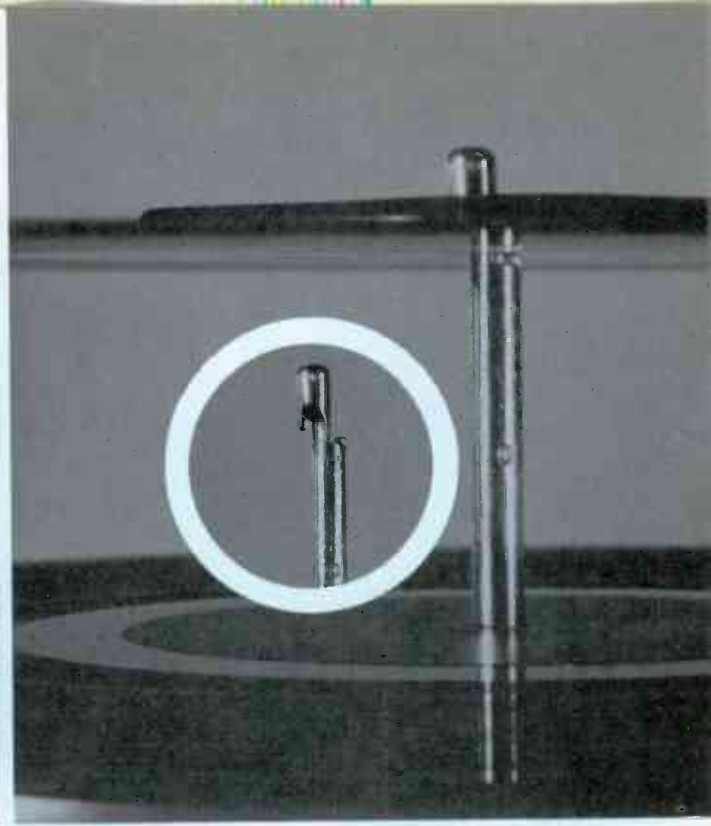
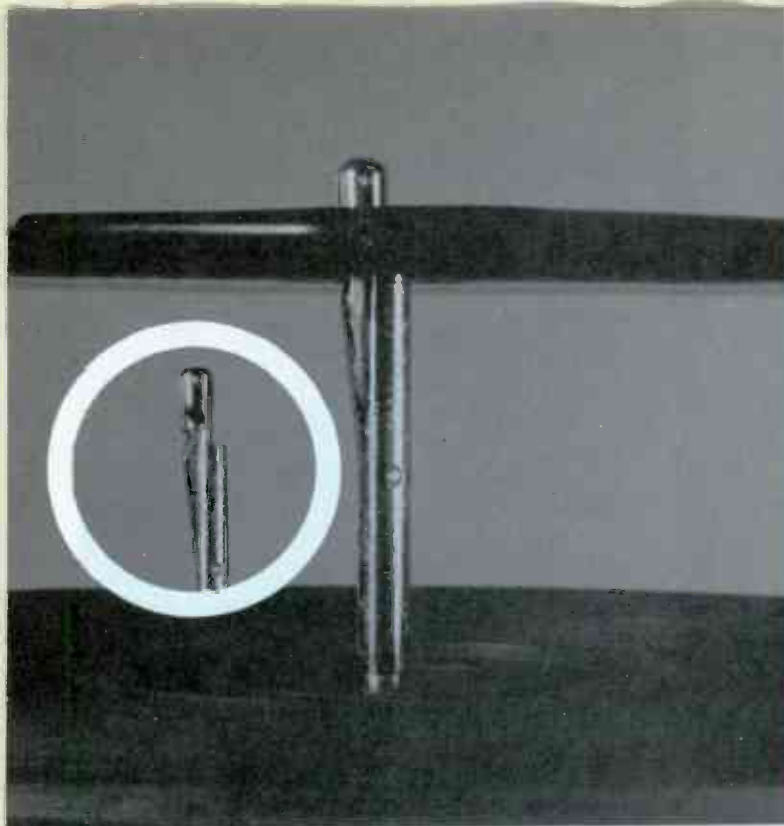


**Step 8** These photos show the mechanics of the tone-arm lift. In the below-deck view, the ramp part of the cycling slide is raising the lift rod. In the top view, the upper end of the lift rod (arm moved out of the way for photo) is shown at the top of its travel.



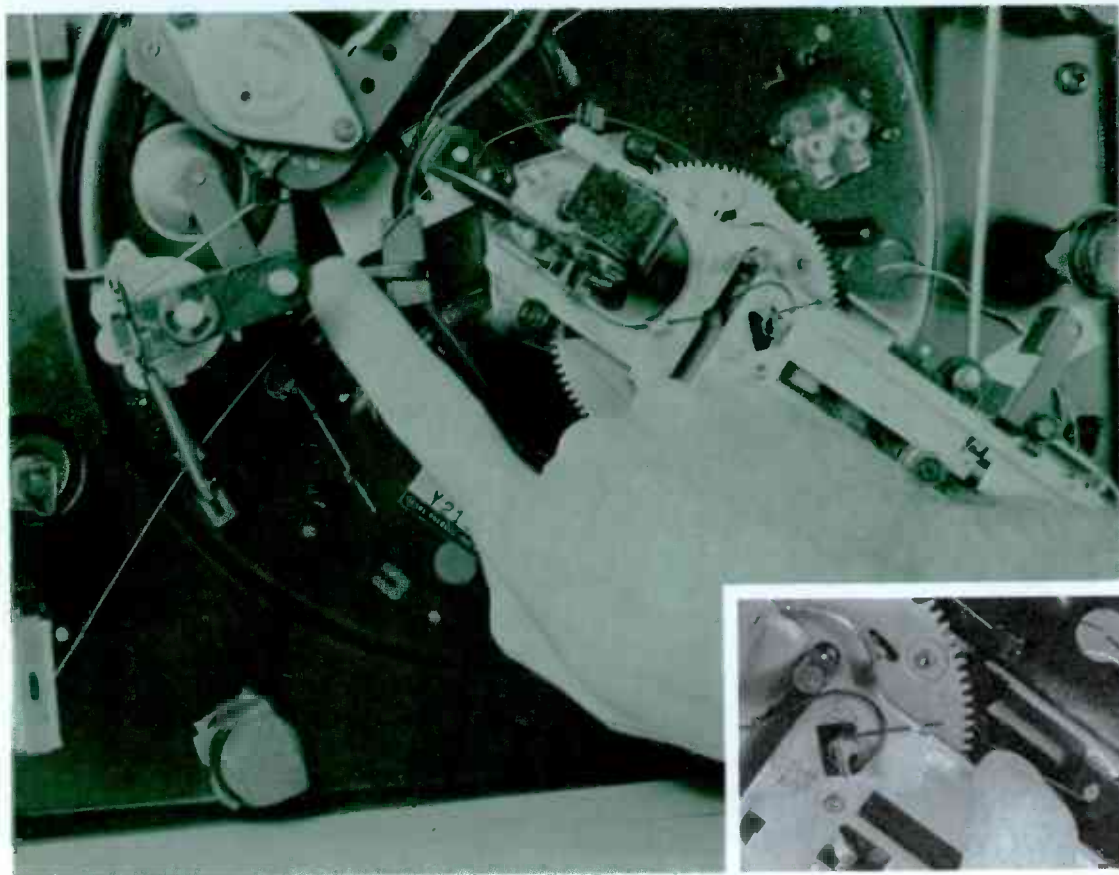
**Step 9** The spindle in most record changers can't easily be removed as it can from automatic turntables, for it has more to do with record dropping. The cycling slide, as it reaches almost the half-cycle position, encounters a rocker-type pawl. That lifts the center rod of the spindle, operating the pushoff tab and dropping the record.



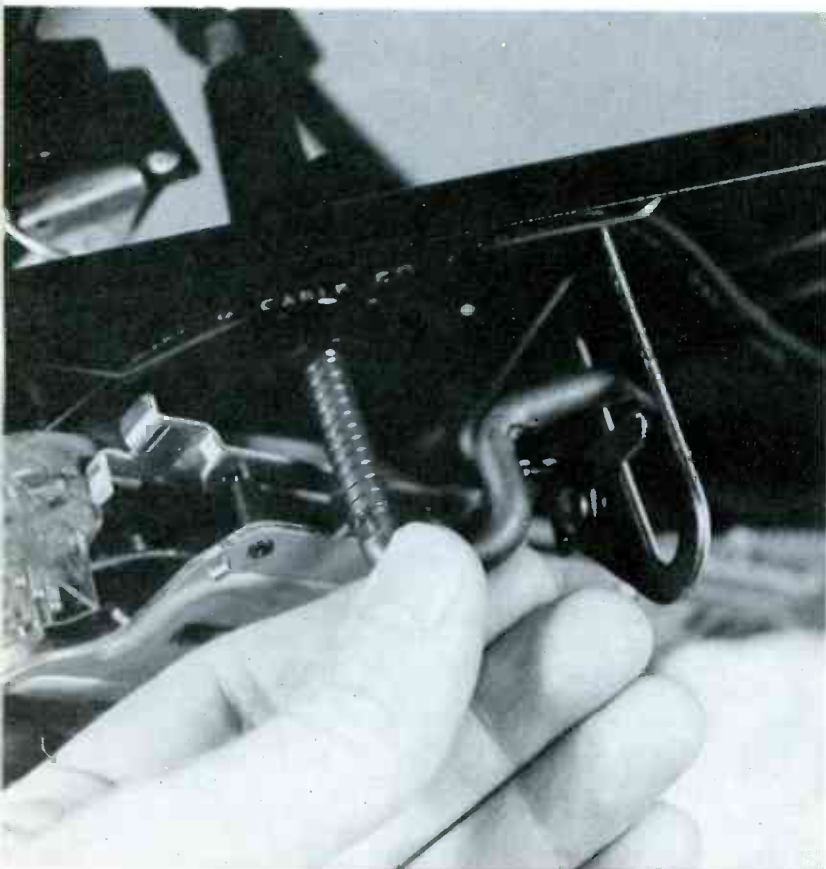


**Step 10** Sequence of record dropping by the spindle is as follows: the records are placed on the spindle (inset of photo one shows how the pushoff tab does not permit the record to move sideways and fall down accidentally). The stabilizer arm is brought into position over the records to keep them level; now the action of the cycling slide moves the pushoff tab sideways inside the spindle, pushing off the lower record (photo two) which falls to the platter for

playing; the next record settles to the offset notch of the spindle while the pushoff tab is still over; then the pushoff tab is returned to its normal exposed position. Notice the small sliding part at the top of the spindle. Its only function is to move upward out of the way when the records are removed. But if it sticks at the top of its travel, records often drop at the wrong time.



**Step 11** Record-size indexing in this model changer is set by movement of a top-of-the-plate knob (near left hand). In turn, the wire (near right-hand index finger) moves the indexing latch bar (other photo) so the tone arm assembly is stopped in its swing-back movement by one of a series of "stair-steps".



**Step 12** Automatic shutoff usually is triggered by the vertical position of the shaft of the stabilizer arm, the one placed on top of the records to steady them. When the last record has dropped, the stabilizer shaft drops well below the normal operating level. Underneath, the shaft tilts a lever which intercepts the lateral movement of the arm so it cannot reach the record. The same lever also initiates a movement that shuts off the on-off switch after the arm sets down on the rest post.

There you have the main working mechanisms of a typical record changer. The motor and platter drive have been omitted because they are easy to figure out. Besides, you saw them in earlier sessions when I described cleaning and adjusting. Armed with this general understanding of record-changing mechanisms, you should have little difficulty working out how any particular brand or model works.

In the next session, the last of a series of four, I'll show and explain the insides of an automatic turntable. □

# Record changer workshop part 4



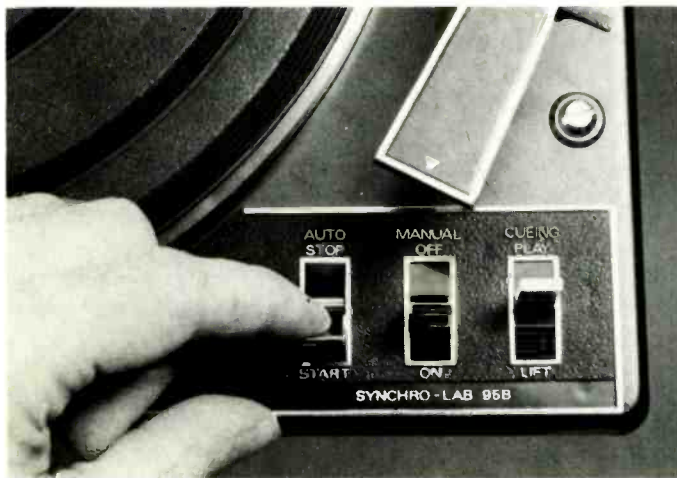
Forest H. Belt,  
CET

An automatic turntable is the higher-priced, more versatile version of a record changer. The extra cost covers more than just profit, though. The buyer of an automatic turntable expects a platter that weighs more and therefore offers smoother performance, a delicately balanced tone arm that "tracks" with feather pressure on the stylus tip, perhaps a more powerful and steady motor, and the capability of playing single recordings without the change cycle. An automatic turntable, or for that matter a manual one, offers playing quality a record changer can't have.

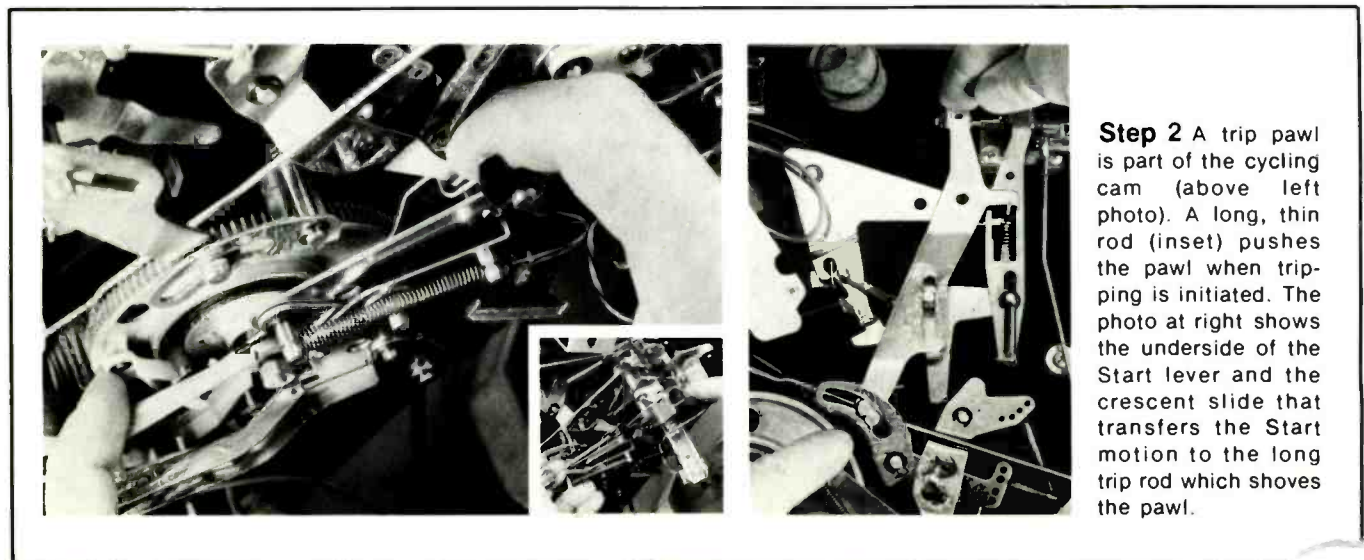
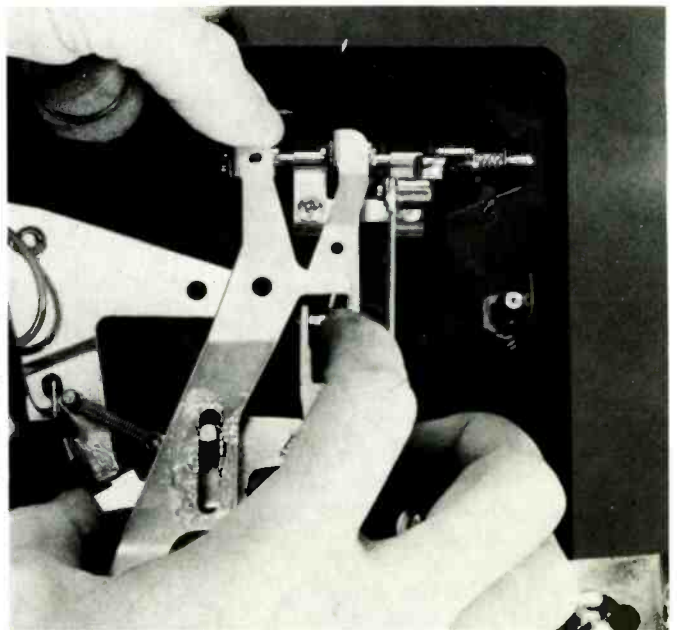
But servicing doesn't change much. As

you saw in earlier Workshop sessions, the turntable might have more adjustments. They permit careful alignment of the precision movements. That can actually make the turntable the easier of the two to troubleshoot and repair.

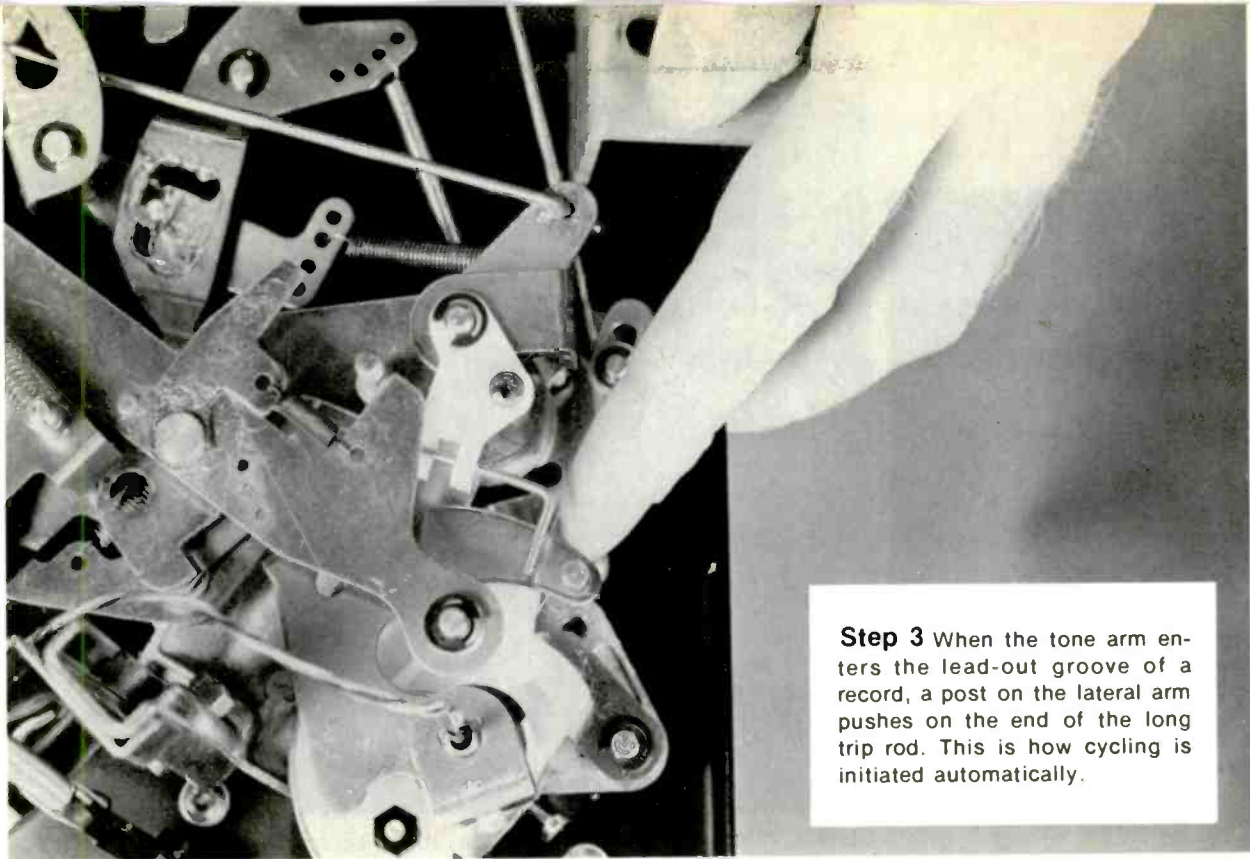
Inside, the automatic mechanisms perform the same tasks: spinning the record, playing it, swinging the arm up and out of the way and dropping the next record, then returning the arm to the playing position (or to a position for shutoff), and shutting the machine off after the last record is done. This final Workshop session on Record Changers and Turntables details the workings in a precision turntable.



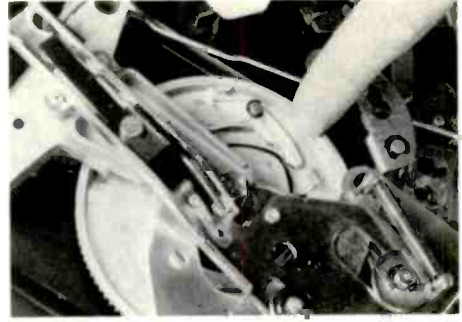
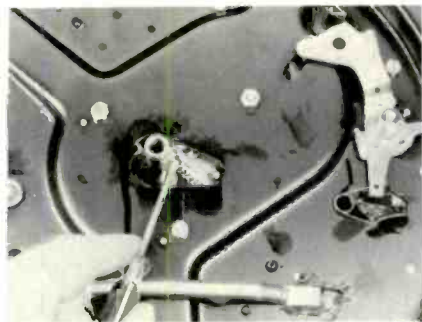
**Step 1** Tripping (initiating the change cycle) happens manually when the Start lever is pulled. It interlocks with the Manual lever, and also pulls in to On. Underneath, you can see the interlocking parts, and the long slide that operates the tripping mechanism.



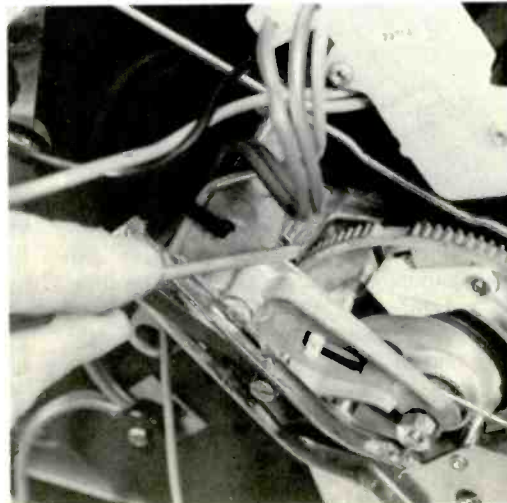
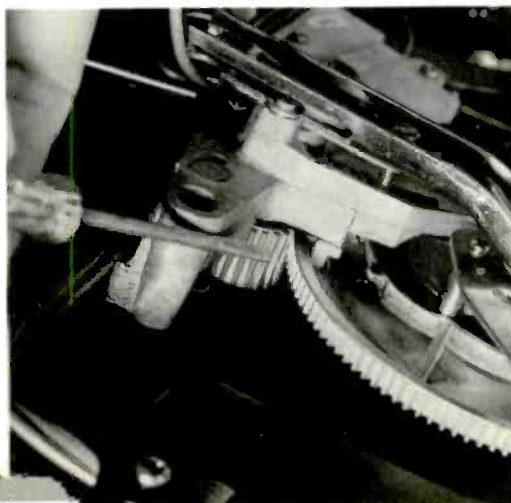
**Step 2** A trip pawl is part of the cycling cam (above left photo). A long, thin rod (inset) pushes the pawl when tripping is initiated. The photo at right shows the underside of the Start lever and the crescent slide that transfers the Start motion to the long trip rod which shoves the pawl.



**Step 3** When the tone arm enters the lead-out groove of a record, a post on the lateral arm pushes on the end of the long trip rod. This is how cycling is initiated automatically.



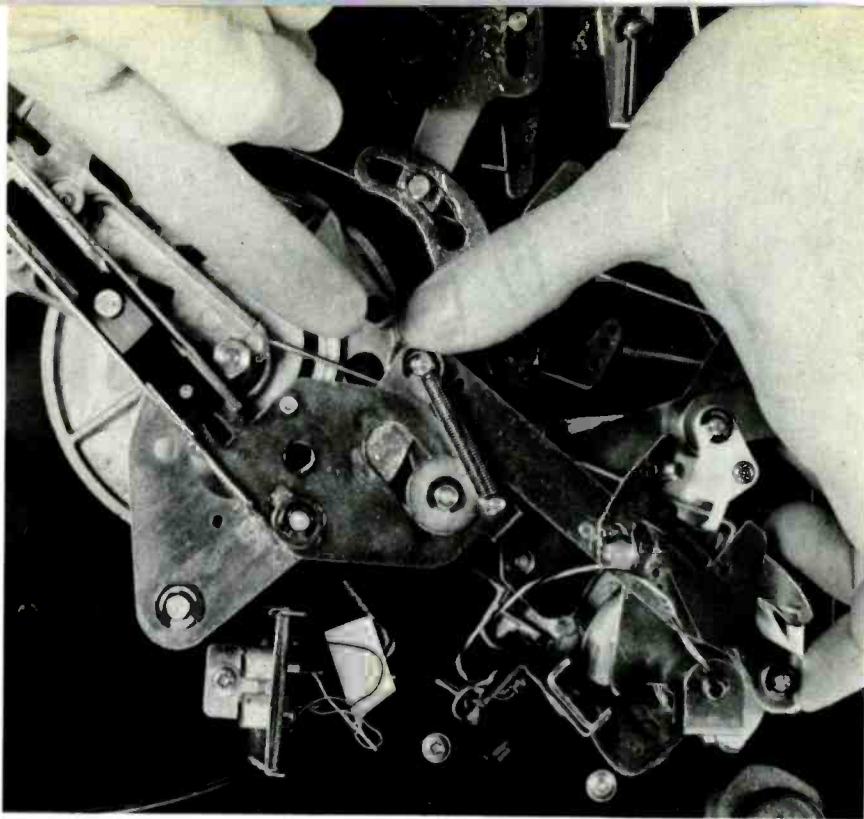
**Step 4** In the photo at left is a view of the trip pawl in the tripped position. The turntable platter is off, but you can see its hub in the inset photo. The projection catches on the pawl, dragging the cycling cam into mesh with the gear teeth of the platter hub. You can see, in the photo on the right, the detent lock that holds the cycling cam in place while the record plays; the tug of the trip pawl moves the cam off that detent and into cycle.



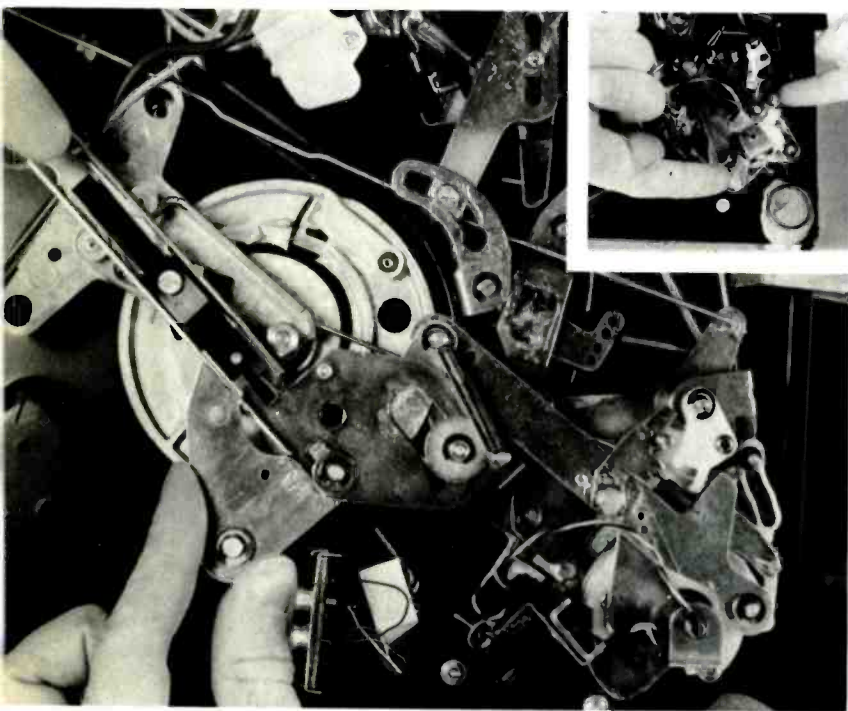
**Step 5** These below-deck pictures show the two sides of the cycling cam when it is being driven by the turntable-platter hub. The photo at the right also gives you a good look at the underside of the cam, with the trip-pawl body. The tab that the platter hub catches is above the cam, but this view shows the pivot and the portion of the pawl the long trip rod pushes.



**Step 6** From a groove in the cam, the cycling cam drives several cycling slides. The groove engages a post that is part of the main cycling slide.



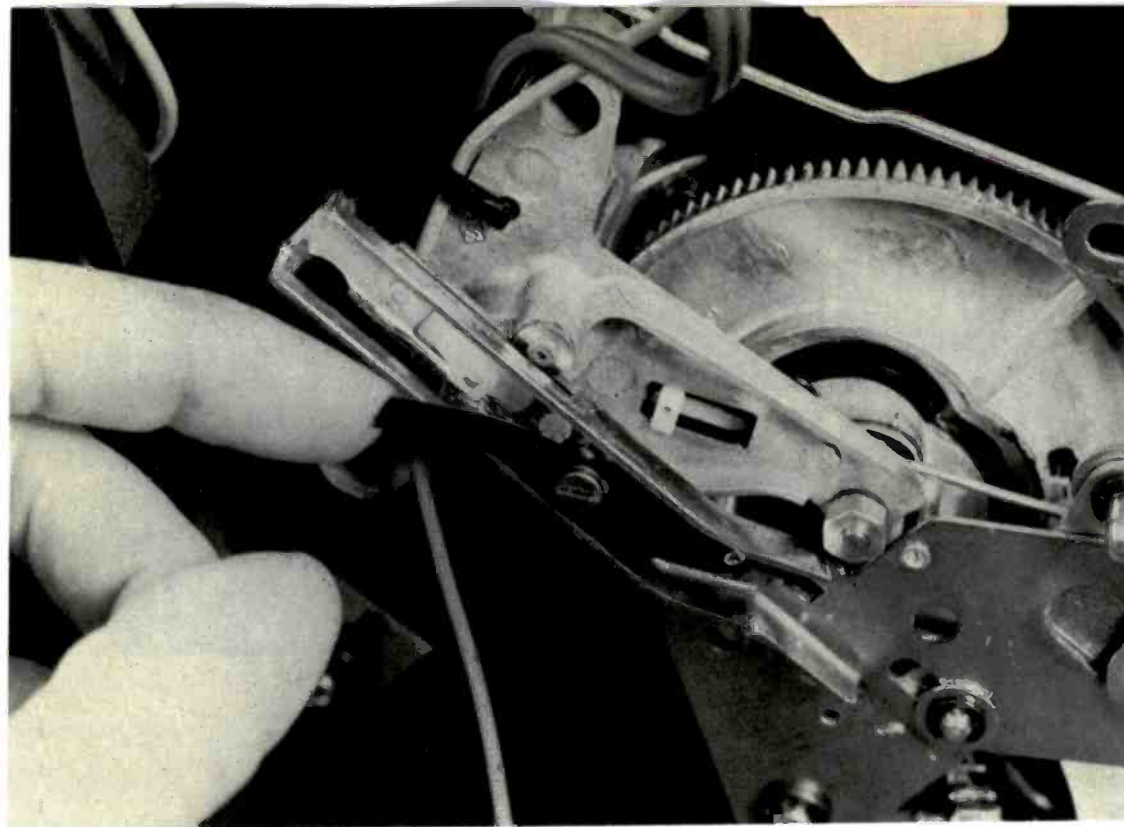
**Step 7** This slide takes care of the lifting action of the tone arm. If you encounter faulty lifting, carry your diagnosis to this slide and its associated assemblies. Watch for springs that might have dropped out of place or might be stretched.



**Step 8** Lateral motion (swinging out and back) of the tone arm mainly is accomplished by the triangular-shaped slide lever. The inset photo shows the assemblies it acts upon. The post, indicated by forefinger at the right, is part of the tone-arm lateral-movement arm; it's what hits the trip rod at the end of the record.



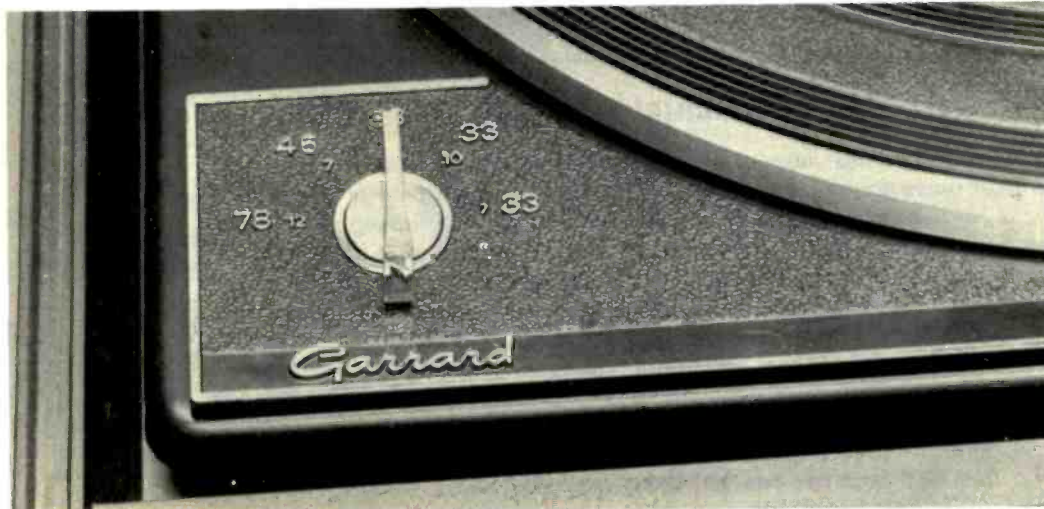
**Step 9** This spindle is removable—as are most turntable spindles—and has a long activator rod. Movement of the activator rod is sideways, moving the pushoff tab out and back, and then a little further until it protrudes in the other direction. This far-forward motion senses any more records on the stack; if none, the machine shuts off after the record that just dropped has played.



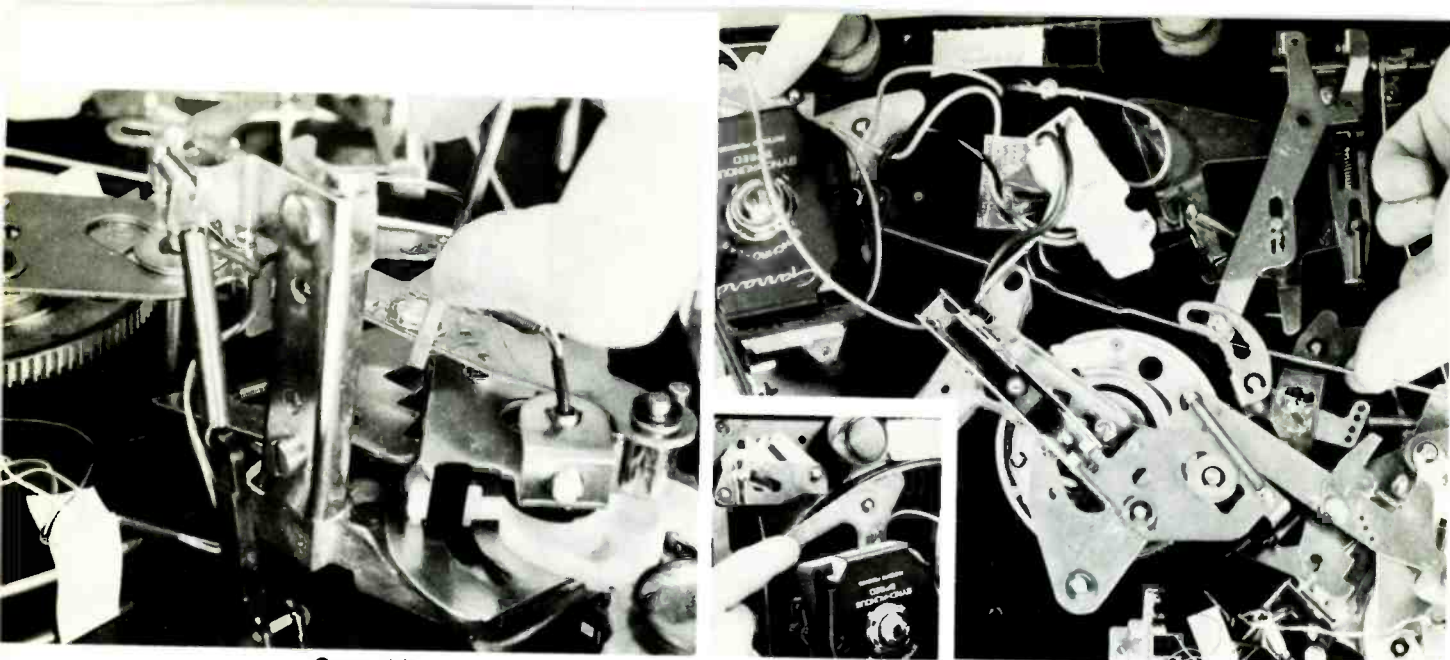
**Step 10** A Teflon fitting holds the bottom end of the spindle lever into the cycling slide. This slide senses for shutoff. When the pushoff tab encounters the hole of a record still on the spindle platform, it prevents the slide moving back quite so far. That signals the shutoff mechanisms not to shut off until that final record has dropped and been played.



**Step 11** Here you see the spindle actions during record-dropping, but without the records. In the left photo, the cycling slide has moved the lever inside the spindle slightly to the left; the record moves over and drops. The record (in the center photo) has dropped, and the guide tab positions the stack of records. The cycling slide moves far forward after dropping, and carries the lever and tab to the extreme position shown. But any record still on the spindle blocks the tab (and thus the slide below) so the shutoff mechanism doesn't operate. If there's no record to block the tab, the shutoff mechanism is allowed to operate. In the picture at right, the tab has returned to normal, ready to pushoff the next record.

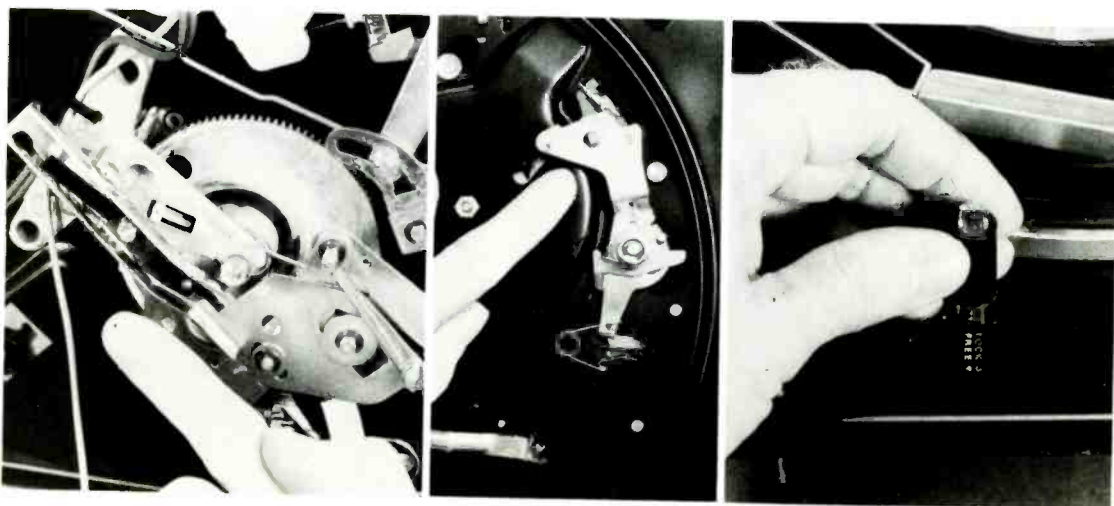


**Step 12** Very few automatic turntables or record changers today do the indexing automatically. Instead, a size-selector knob chooses the desired set-down indexing. The one shown here combines size selection with speed change.



**Step 13** Here's how indexing occurs. The photo at left shows a notched indexing block; the lateral-slide mechanism moves it into position and starts to pull it back. Connected to the block is a long rod (photo at right) that connects to a lever (inset photo) near the indexing-knob understructure. As the indexing block tries to move back, so does the long rod and indexing lever. The knob understructure stops it at the position selected by the knob. That prevents further motion and the indexing block is held at that position to stop the tone-arm lateral movement at the right diameter for setdown.

**Step 14** I already have described the sensing step of automatic shutoff in conjunction with the spindle photos (Step 11). After the record plays, the main slide does not catch the shutoff mechanism and the machine cycles toward shutoff. An extra notch on the index block stops the tone arm before it moves inward. The turn-on mechanism (above-deck parts in center photo) turns off the switch after the tone arm has settled to its rest post (photo at right).



## Conclusion

*These past four sessions have given you a fairly thorough understanding of the mechanical operations in typical record changers and automatic turntables. If you use a logical approach—cleaning, inspecting, adjusting, and then diagnosing from your study of the machine in operation—you should become an expert in a short time. You have seen from the photos and explanations in these Workshop sessions that various machines have operations in common. Knowing how key operations work, you can adapt that knowledge to any brand or model.*

*This concludes my Workshop on record changers and hi-fi turntables. If these sessions have suited your need for help with mechanical units, I'll put together others. The next ones could explain eight-track tape mechanisms. With the new two-channel/four-channel machines, you probably wonder what the insides look like and how you can go about troubleshooting them. Watch for the next Forest H. Belt Workshop.*