

*Record
changers
aren't so tough
—if you
know what
to look
for*

Servicing Record Changers Faster



By P. SHENEMAN

ALL automatic record changers are mechanically different, but some service problems are common to all. A technician who has some mechanical ability, a stroboscope and a lot of patience can solve most of them—often right in the customer's home.

The first common fault is caused by a speed change within a single revolution of the turntable and is called wow. This change in speed produces a wavering tonal effect which is much more pronounced on a 33 $\frac{1}{3}$ -rpm disc than on its 78-rpm brother.

A stroboscope placed on the turntable will display a pattern that systematically advances and retreats. (A heavy turntable acts as a flywheel and tends to damp out and smooth such speed changes, especially at the higher record speed.)

When wow is the problem, check for:

- Center hole in records too large.
- Warped records.
- Bent idler wheel.
- Tire on idler wheel out of round.
- Bent pulley shaft.
- Warped turntable.
- Defective turntable bearings.
- Pulley(s) not seated correctly.
- Motor not balanced.
- Bent motor mounting plate.
- Bent motor armature.
- Defective motor bearings.

Change in musical pitch

A changer can play a single record at the correct musical pitch, yet have the pitch become lower as additional records are placed on it. With a full stack of records on the turntable, the last record may be as much as a half a tone flat. This change in pitch may be unnoticed by some, but to others it is very annoying.

To locate this trouble, check turntable speed with a stroboscope when one or several records are on the turntable and when the turntable is fully loaded.

When change in musical pitch is the problem, check for:

- Motor overheating caused by poor ventilation, bad bearings or shorted windings.
- Lack of friction in the turntable driving mechanism.

Slow turntable

Another common problem is the turntable that runs slow. A stroboscope placed on such a turntable will produce a pattern that seems to crawl backward. Like most speed-regulation troubles in record changers, it will be most noticeable on long-playing records.

When slow turntable speed is the problem, check for:

- A pulley binding on its shaft.
 - Because of condensation, rust often forms on the pulley shaft. This acts as a parasitic drag and can slow the turntable down by several rpm. To check, remove the pulley by pressing upward at its base with a screwdriver. If the shaft is rusted, sand with very fine emery cloth and lubricate.
- Motor armature bearings that need lubrication.
- Too strong a tension spring on idler wheel.
 - The original spring may have been replaced with one with more tension or shortened.
- Worn turntable bearings.
- Low line voltage.
- Defective motor.

Stalls, won't complete change cycle

This is by far the most common trouble. While the record is playing, the phono motor has to oppose only the force of the needle in the record groove and the friction of the tone-arm support. During the change cycle, the motor must provide enough torque to operate all the mechanical parts needed to complete the change cycle. In most rim-drive turntables, the torque is applied

by friction. Any loss in friction results in failure of the change cycle.

If the turntable stalls and won't complete the change cycle, check for:

- Grease or oil on turntable rim.
- Grease or oil on idler wheel or pulleys.
- Worn pulley(s), too small in circumference.
- Pulley(s) not seated on pulley shaft.
 - Often when pulleys are removed for cleaning or replacement, too much lubricant is placed on the shaft. When the pulley is replaced, air is trapped between the shaft and the pulley hub. The trapped air prevents the pulley from seating firmly. The pulley should be pressed until it snaps into the seating ring.
- Pulleys or idler-wheel rubber impregnated with dirt.
 - When dirt is in the pores of the rubber, the pulley has a glossy appearance. To remove the gloss, hold fine sandpaper lightly against the pulley while it is turning. Motors using drive belts to turn the pulleys can have friction restored by turning the belts inside out.

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- Weak motor.
- Weak idler wheel spring.

Tracking-error distortion

Correct positioning of the pickup arm and cartridge is essential to minimize tracking-error distortion. Tracking error is the deviation from tangency of the needle in the record grooves as the stylus moves across the record. [For more detailed information on this subject see "Record Tracking," by Norman Crowhurst, (October, 1957, page 40) and "The Record Skips," by Charles W. Farrington, (April, 1959, page 61).]

Since record changers use a relatively short pickup arm, tracking error is much greater in record changers than in single-record turntables. In addition to tracking error, compensation must be designed into the pickup arm to

AUDIO—HIGH FIDELITY

allow for the change in tangency of the stylus to the record relative to the size of the stack of records. Ideally, the stylus should be perpendicular to the record. This condition is satisfied when a single record is on the turntable. However, as more and more records are placed on the turntable, the stylus assumes an angle to the record. This consideration is a major factor in pickup arm design.

If tracking-error distortion is the problem, check:

- **Pickup-arm mounting.**

The arm should mount in its pivots without binding or excessive play.

- **Stylus replacement.**

The length and angle of offset of the pickup arm was designed by the manufacturer in conjunction with a certain stylus design. Using a different replacement stylus often increases tracking-error distortion. Also true of a cartridge in which stylus position differs from original.

- **Vertical tracking force.**

Vertical tracking force is the pressure the stylus exerts in the record groove. The average is 5 to 9 grams. This tracking force is adjusted by spring tension or a counterbalance. For accurate tracking force, the weight should be adjusted with scales made for this purpose.

- **Worn or dirty stylus.**

A worn stylus produces distorted sound and causes excessive wear. Dust and dirt that have collected on the stylus can attenuate the sound pickup and, in severe cases, prevent any pickup at all.

- **Loose cartridge.**

A loose cartridge can increase tracking error and cause distortion.

Rumble

Low-frequency noise produced by mechanical vibrations of the phonograph motor is called rumble. Since the pickup arm in an automatic record changer is part of the changing mechanism, these mechanical vibrations can be picked up by the arm and sometimes modulate the recorded signals.

When rumble is the problem, check for:

- **Worn motor mounts.**

Motor mounts that have lost their elasticity.

- **Poor changer mountings.**

The changer is designed to rest on springs and should not rest on any part of the cabinet.

- **Old idler wheel.**

If the rubber tire on the idler wheel is old and hard, noise will be transferred to the tone arm and cartridge via the turntable.

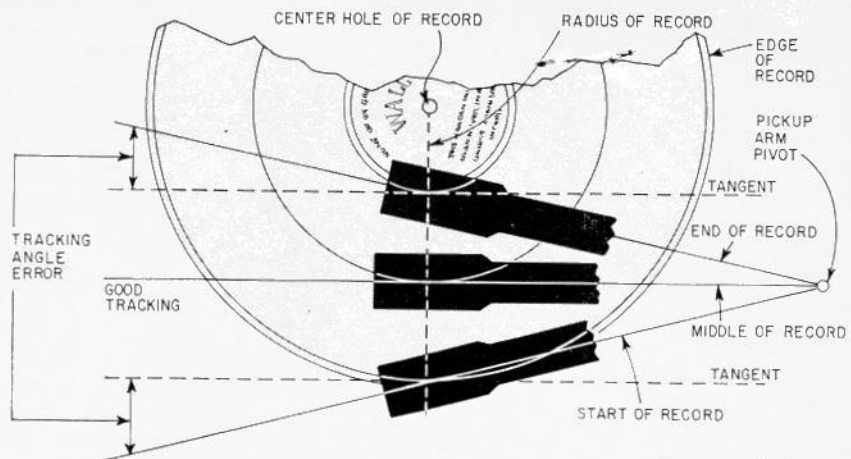
- **Bent armature shaft of motor.**

- **Motor out of balance.**

- **Worn turntable bearings.**

Stylus replacement

The assortment of styli runs from the steel stylus, good for a few plays, to the diamond, good for 10,000 or more plays. However, life cannot be judged by the number of times a record has



How tracking error is measured

been played. The record's condition is a predominant factor in stylus life. Even more than the number of plays, worn or dirty records, incorrect vertical tracking force and binding of the tone-arm mechanism, all shorten stylus life.

When needle replacement is necessary, check:

- **Record condition.** Discard worn records.

Correct stylus pressure (vertical tracking force). Too light a pressure causes skidding. Too heavy a pressure speeds both stylus and record wear.

Trip-reject cycle

Tripping, generally referred to as rejecting, is the mechanical action which results in applying power to the record-changing mechanism. In most record changers, this is done by the lateral motion of the tone arm caused by the stylus riding in the concentric groove in the center of the record.

Generally, tripping problems can be separated into three distinct conditions:

1. Won't trip.
2. Trip is activated and change cycle begins but is not completed.
3. Trips continuously.

If the changer won't trip, check:

- **Pickup-arm follower.**

The pickup-arm follower follows the pickup-arm movement to activate the trip mechanism. The pickup-arm follower may be caught in a position where it cannot activate the trip mechanism, or may not be following the tone arm.

Follower may not have enough friction to activate the trip mechanism.

The pickup-arm follower as a rule

is not connected to the pickup arm directly, but usually follows the movement of the pickup arm because of friction between the follower and pickup-arm mounting arrangement. Friction is generally applied by a coil or arched spring. However, sometimes it might be done by cork or fiber washers between the follower and pickup-arm mounting arrangement.

In many changers, friction can be increased by an adjustment which compresses the spring. With changers using cork or fiber washers, lack of friction can be caused by smooth washers or grease or oil on washer surfaces. Cleaning will often restore the original operation.

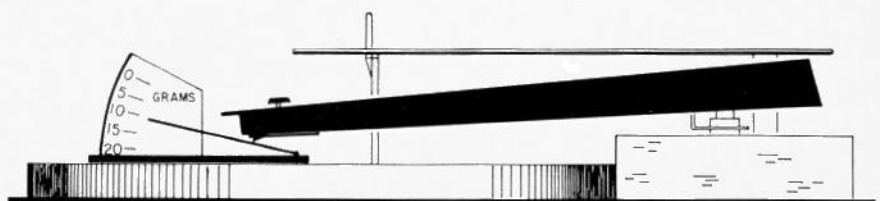
- **Trip mechanism binding.**

The trip mechanism may be jammed, broken or binding, so the pressure from the pickup-arm follower cannot activate it.

If the changer trips and starts the change cycle but the change cycle is not completed check:

- **Binding in the record-changing mechanism.**

The changer may have been



How to measure stylus pressure.

SERVICING RECORD CHANGERS FASTER (Continued)

dropped or worked on by its owner so that a part or parts of the mechanism are damaged.

- Loss of friction between the motor and turntable.

If the changer trips continuously, check:

- Pressure applied to the trip mechanism from the pickup-arm follower.

Very little pressure is needed to trip the change mechanism. Too much pressure may be the result of incorrect adjustment of the friction between the pickup arm and follower. Excessive friction also can be the result of corrosion, rust and the accumulation of dirt.

- Trip mechanism itself.

It may be jammed in a position permitting constant tripping.

Record drop

There are several systems for making a record changer drop the next disc. Zenith uses an ejector finger that swings out from a flush position in the spindle and rotates 180° to drop the record. In the VM and many other changers, an ejector lever, normally flush with the spindle, moves forward to drop the record. With many Philco changers, the spindle itself moves forward or

“nods” to do the same job. Many models by Motorola had an ejector lever, or tongue, in the record support shelf to push the bottom record from the stack of records. As another example, Webcor used the record support shelf itself, nodding or moving forward, to dislodge the record to be played.

No matter which system is used, there are adjustments for controlling the record dropping action.

- Zenith: The ejector finger must be straight and timed correctly.
- VM: Ejector lever in the spindle, the amount of travel of the lever is variable.
- Philco: The movement of the spindle can be controlled for more or less “nodding.”
- Ejector lever within the record support shelf: The movement of the ejector lever can be regulated.
- Webcor: Record support shelf moves forward, amount of record shelf movement can be adjusted.

When it comes to record drop, all record changers have one thing in common—a spindle cap, spindle slider, or the angle at the top of the spindle, which prevents more than one record from dropping at a time.

For record-drop problems, check:

- Thickness of records.

Records that are too thick will not drop correctly. Also applies to records that are too thin.

- Size of center hole.

Worn or chipped center hole affects record drop.

- Spindle cap or slider.

If bent, more than one record will drop. Perhaps several.

- Angle at top of spindle.

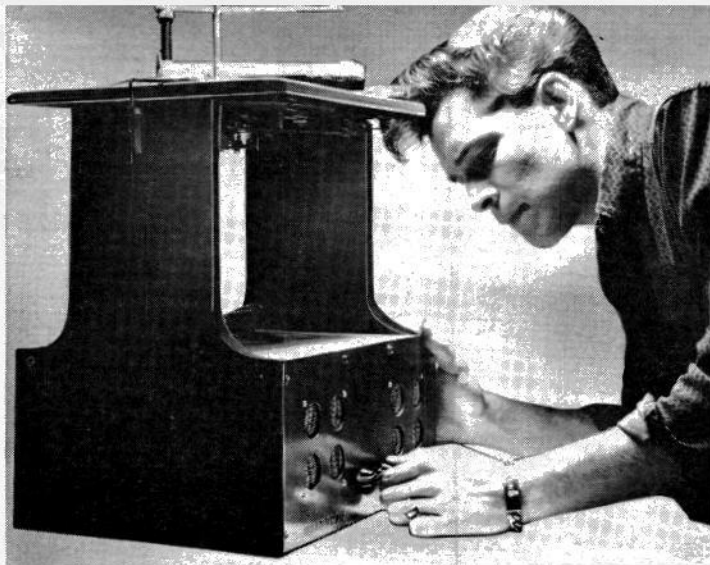
In spindles not using a spindle cap or slider, the angle at the top of the spindle prevents more than one record from dropping at once. If the angle has been changed, several records may drop simultaneously.

(RCA makes a series of records for checking record changers. Among the tests they will aid in making are: landing and tripping, pickup sensitivity, turntable rumble and flutter, and record tracking at various recording levels and stylus pressures. These discs are available from the RCA Victor Custom Record Department, 155 East 24th Street, New York 10, N. Y. Write to the attention of the Sales Service Section. Walsco Electronic Products also makes a series of these discs. For information write to Walter L. Schott Co., 100 West Green St., Rockford, Ill.—Editor) END

REPAIRING RECORD CHANGERS

This second half of the story details speed troubles and some adjustments you can make

By HOMER L. DAVIDSON



ONE OF THE MOST FREQUENT RECORD changer complaints is about speed: "My changer runs too slow" or "My changer plays one record and then slows down and stops." Trouble like that can be caused by slippage (too little friction where it's needed), dry bearings (too much friction, where it isn't) or a defective motor.

Take a look at the motor assembly (Fig. 1). The ac motor turns the idler wheel and turntable. (Most of these changer motors are ac, and only a few are ac-dc types.)

A burned-out motor is easy to spot. The field winding will be charred and you will smell "burned transformer". The whole motor assembly must be re-

placed after a few hours in operation. This is normal.

Misalignment between motor shafts and bearings will freeze them together. A fine cutting oil can be used to loosen up the shaft bearings. If the motor is full of dirt and grease, take it apart. Clean the bearings, armature and assembly with cleaning fluid. Mark one side of the motor field assembly so you will know which side goes next to the mounting frame. The sides of the field assembly look the same and it is very easy to reverse it when the motor is completely apart. If the field assembly is turned over, the motor will run backward. Oil the motor bearing felts with light machine oil. If the changer motor

cause too much trouble. If it is properly cleaned and greased when the changer is in for repair, it will last for a long time.

The speed of a changer turntable must be checked with some type of speed indicator. Use a strobe disc and light to check for correct speed (Fig. 2). These discs can be picked up at the local wholesale house. A fluorescent or neon light will show if the turntable is running at the correct speed. Fig. 3 shows a strobe light you can build. (Several firms supply small neon strobe lamps with their strobe discs.) Most record changers run slow, almost never too fast.

If the large turntable drive idler wheel is dented or a piece of the rubber is dug out of it, the turntable will thump when this spot comes around. The rubber on these wheels becomes worn, smooth and cracked. Replace the wheel if it looks defective. If the tension spring from idler wheel assembly to the base is loose, tighten it. A couple of turns can be snipped off and the spring fastened back into its original position.

The turntable may be slow for 33 $\frac{1}{3}$ rpm and OK on all other speeds. If this is the case, check the 33 $\frac{1}{3}$ idler wheel. Many times shafts become dry or the rubber smooth, reducing the speed. Pull off all three rubber wheels and clean them thoroughly. Use a match or toothpick and place a small amount of petroleum jelly inside the bearing. Do not use too much grease; it will cause slippage. (Many times a customer will oil everything under the turntable to try to gain speed.) Be careful that no oil or grease gets on the turntable drive, rubber idler drives or motor drive shaft.

One of the biggest causes of slow speed is the slipping of the idler wheel on the drive rim of the turntable. Clean the drive rim and use a turntable dressing such as Phono-Magic. This dressing will dry rapidly when the turntable is placed under a shop light. Fig. 4 shows

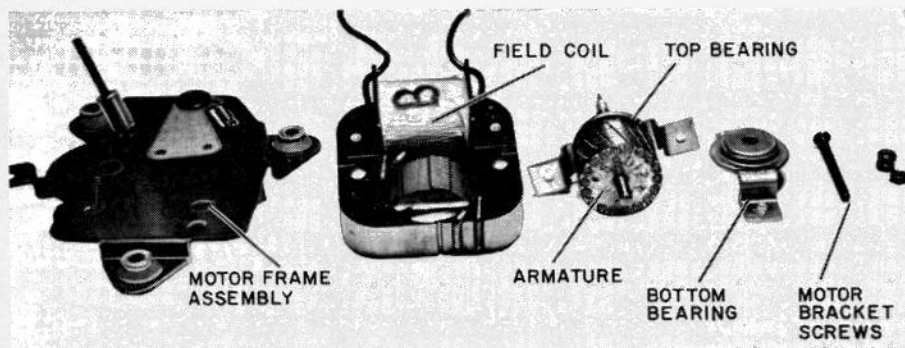


Fig. 1—Major motor parts.

placed. If the motor has a shorted field, it and the whole motor will become very warm in a few minutes.

Even new motors can have stuck or tight bearings. If the motor and turntable have been completely greased within the last month, and the customer complains that the turntable does not rotate, the motor is stuck again and should be replaced.

Field-coil resistance ratings are not usually available from manufacturers. Of course, if an ohmmeter check shows that the field coil is open, the motor is defective. Most motors do run warm

in a small tight compartment, use petroleum jelly as lubrication.

The motor bearing may loosen in the bolted assembly. Sometimes the whole bearing assembly drops down, jamming the motor. A noisy motor indicates lack of oil or really bad bearings.

If there is too much play in the bearings, replace the whole motor assembly. A motor will freeze when the changer jams in operation and is left on, or when the worn rubber drive wheel jams between motor and turntable. The phono motor, though, generally doesn't

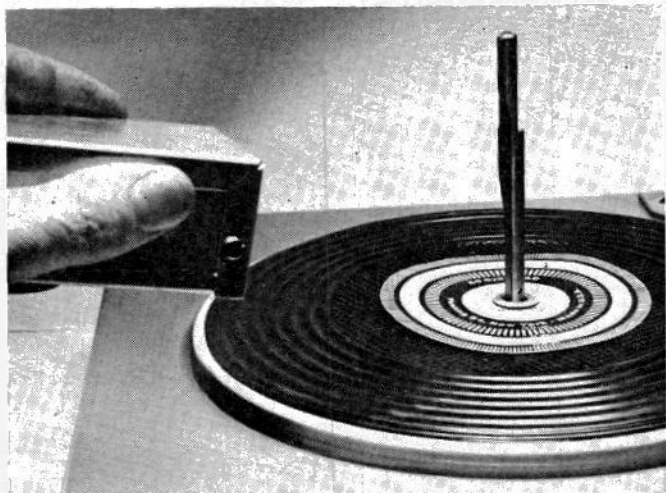


Fig. 2—Simple cardboard stroboscopic disc, viewed under 60-cycle neon light source, gives accurate check of speed.

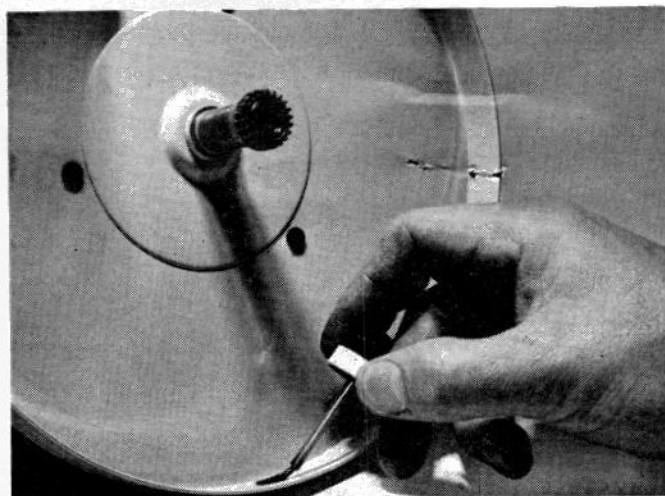


Fig. 4—Friction dressing applied to turntable's inside rim often cures slippage and slow speed.

how to apply dressing to the turntable. If the changer is old and you cannot get the speed up to normal as described so far, take a small spring, a little larger in diameter than the spring on the motor drive spindle, and install it over the old one. File and smooth down any rough ends and, generally, the changer will run a little faster than before. Fig. 5 shows a defective rubber cam drive on an older type of changer. Idler wheels and parts are available at local radio and TV parts distributors or wholesale set distributors.

Adjustments

The landing position of the pickup arm is adjusted with a screw (Fig. 6). It should be set for all three record sizes. Some changers have a hole for this in the top of the turntable base and also on the pickup arm assembly. Make

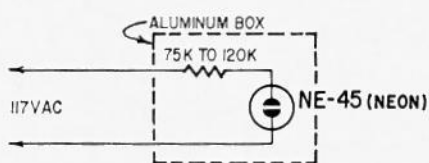


Fig. 3—Hand strobe light source is neon lamp powered from ac line through current-limiting resistor.

the setting so the stylus falls on the record midway between the outer edge and the beginning of the recorded portion.

Rotate the turntable until the pickup arm is at its highest position. Set the height adjustment screw so there is enough clearance under the next record to drop and enough also above the height of a ten-record stack on the

turntable. Some manufacturers provide two height adjustments, to prevent the needle from landing on the motor board out of cycle, and still let it land properly on a stack of records. Most height adjustment screws are located under the pickup arm and between the lift pins. Some changers have a pickup arm tracking force adjustment—a tension spring in the arm itself.

Check the stylus for wear and chipping. Be careful when replacing a needle in a crystal cartridge—crystals are easily damaged. A defective crystal cartridge will have no sound, distorted sound or intermittent sound.

Some service technicians set the changer on ordinary paint cans for repair. The photo at the head of this article shows a homemade stand with a self-contained amplifier for checking out the repaired record changer. END

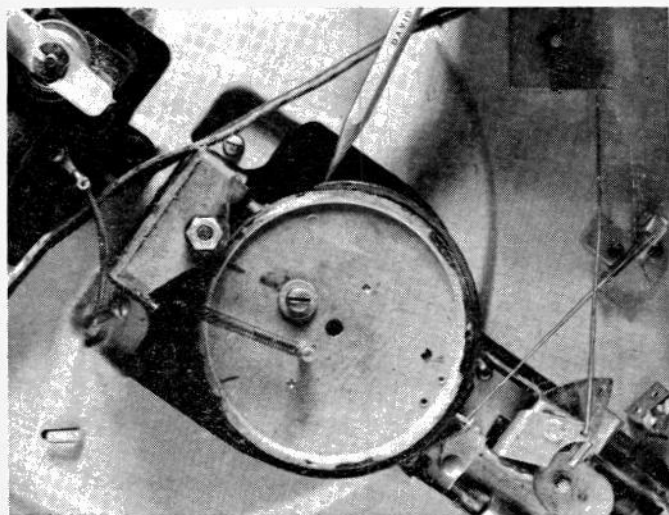


Fig. 5—Old tire on idler must be replaced; this one caused irregular speed and thumping noise.

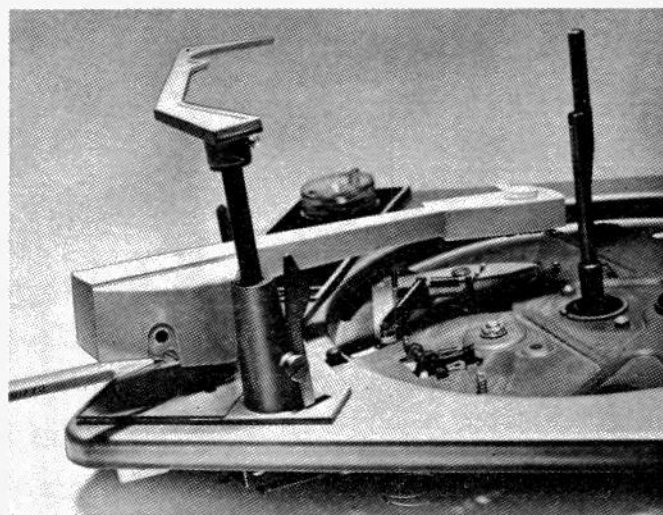
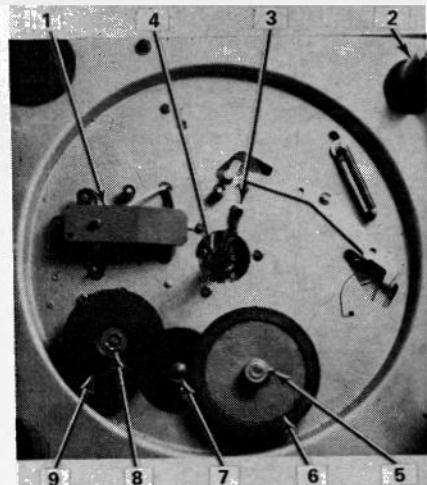


Fig. 6—Landing position screw sets diameter at which stylus comes down and starts to play record.

Servicing Record Changers- 21 basic steps

*Record changers can be a problem to repair.
Try the procedure spelled out in this
article and eliminate the headaches*

by **ELLIOT S. KANTER**



1. A.C. SWITCH
2. OVER ARM SHAFT
3. SPINDLE
4. PLATTER BEARINGS
5. DRIVE WHEEL SET SCREW
6. DRIVE WHEEL
(NOT ON ALL TURNTABLES)
7. MOTOR SHAFT & PULLEY
8. IDLER WHEEL RETAINING SCREW
(MIGHT ALSO BE "C" CLIP)
9. IDLER WHEEL

ACCORDING TO THE LATEST STATISTICS, home entertainment systems (stereo-hi-fi) represent a major portion of the average consumer's electronic investment. Stereos come in all sizes, shapes and prices from a budget-stretching portable to the most elaborate custom-installed system imaginable.

Basically, each system consists of some source or sources (tuners, tape players or record-players) an amplifier and speakers. It would be safe to say, that everyone reading this article has at least one record player or changer in his home, and frequently it needs repair or adjustment. Fortunately, the electro-mechanical record changer can

be serviced quite adequately if you have the proper tools and know the proper techniques.

We will examine and repair a typical record changer and completely service it to the extent of rebuilding its motor. The techniques described in the motor disassembly portion are applicable to any small motor (drill, kitchen appliance, hair dryer, etc.) and will prove a useful aid in their repair.

Before we can begin to service the record changer, we must make sure we have the proper tools. A suggested list of tools and materials are in Table I. These items represent a maximum investment of about \$15.00, depending on how many of them you already have. Very few items are critical and a multitude of substitutes and sources are listed.

Figure 1 shows a common auto-

matic turntable used by a great many manufacturers of home stereo systems. All systems, with only one or two exceptions will have the components described in this article and can be serviced in the same manner. Before we can service the system, we must first remove the platter to get at the various mechanisms. Using a screwdriver (Fig. 1) pry loose the C clip which holds the platter in place and remove the platter by lifting straight up. If the platter fails to lift freely, spray a little degreaser to free the main shaft and permit easy removal.

**TABLE I
BASIC TOOLS & MATERIALS**

ITEM AND ACCEPTABLE SUBSTITUTE

- 1/8-inch screwdriver
- 1/4, 3/8, 7/32-inch wrench or Socket wrenches
- Q-Tips or cotton swabs
- Rubber Magic or denatured alcohol
- Phono-Lube (GC1223) or General purpose oiler
- Paper toweling (kitchen)
- Degreaser (spray) or Tune-O-Wash

OTHER TOOLS NOT REQUIRED BUT HANDY

- Universal changer power cord
- 4-lengths (approx 3-inch each) 1/2-inch wood dowel
- Strobe-disc
- Chain-nose pliers
- Spray cleaner, Windex, 409
- Spray wax



FIG. 1—TYPICAL RECORD CHANGER. Note that there is usually only a single C-clip holding the platter in place.

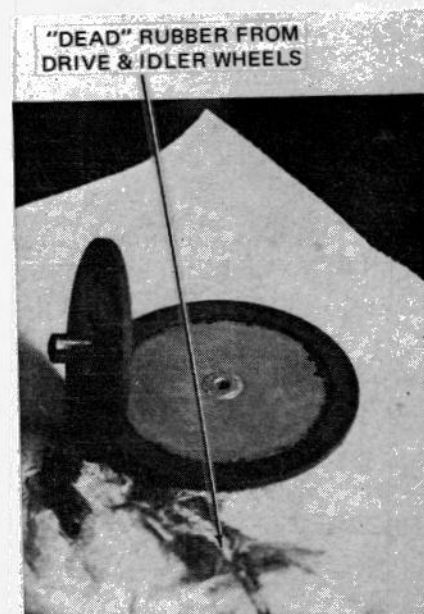


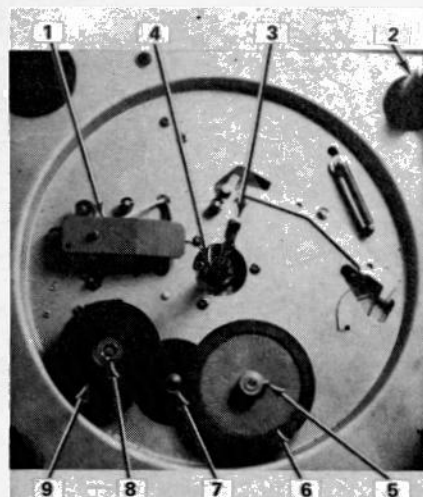
FIG. 2—DEAD RUBBER from idler wheels is a frequent troublemaker. Careful cleanup offers the best solution.

Figs. 2 and 3 are closeups of the inner mechanism of the typical record changer. Basically, most problems center around the idler wheel (Fig. 2) and the motor bearings (Figs. 6 and 7).

The idler wheel and the drive wheel (if the unit has one) are made of a rubber-type material and have a tendency to become brittle with age or develop a film which tends to cause slippage.

The motor shaft and bearings are subjected to dirt, grease build-up and a condition referred to as bearing freeze-up. This particular problem is a result of accumulated dirt, hair and grease which results in the bearing(s) becoming frozen or locked and the motor then overheats with absolutely no platter movement. In other cases, it creates a low-torque condition.

The cam-assembly identified in Fig. 5 is not usually a problem causer.



1. A.C. SWITCH
2. OVER ARM SHAFT
3. SPINDLE
4. PLATTER BEARINGS
5. DRIVE WHEEL SET SCREW
6. DRIVE WHEEL (NOT ON ALL TURNTABLES)
7. MOTOR SHAFT & PULLEY
8. IDLER WHEEL RETAINING SCREW (MIGHT ALSO BE "C" CLIP)
9. IDLER WHEEL

FIG. 3—WITH THE PLATTER OFF here's what you are likely to see. All important parts are identified.

unless the turntable has been rotated counter-clockwise. If this is the case, it is best to secure a replacement assembly as there are a number of tiny pins and levers which have been damaged beyond repair. The newer free-wheeling turntables are not subject to this kind of damage.

The actual overhaul of the record changer goes like this.

1. Remove the idler wheel and the drive wheel (if the unit has one) by loosening the screw(s) or removing the

C clips holding it in place.

2. Saturate a piece of towelling with Rubber Magic and rub the edges of both wheels to remove the dead rubber and all traces of film (Fig. 4).



FIG. 4—CLEAN IDLER AND DRIVE wheels thoroughly. Dry with a separate piece of clean towelling.

After thoroughly rubbing the edge(s), go over it again with a clean towel to remove all traces of residue.

3. Completely clean the shaft the idler wheel was mounted on and also the motor pulley. A cotton swab moistened with Rubber Magic will facilitate a thorough cleaning.

4. After the idler wheel shaft has been cleaned apply a drop of lubricant (oil or Phono-Lube) and allow it to drip down the shaft.

5. Remove the C clips (Fig. 6) holding the motor to the bottom of the record changer.

6. Scribe (scratch) a mark on the motor housing (Fig. 8) for alignment purposes.

7. Remove the motor from the base and disassemble by removing the screws.

8. Refer to Fig. 11, and liberally spray the upper motor bearing and shaft with the degreaser. Then, apply a drop of lubricant to the shaft and work it (the shaft) in and out of the top bearing. Continue adding lubri-

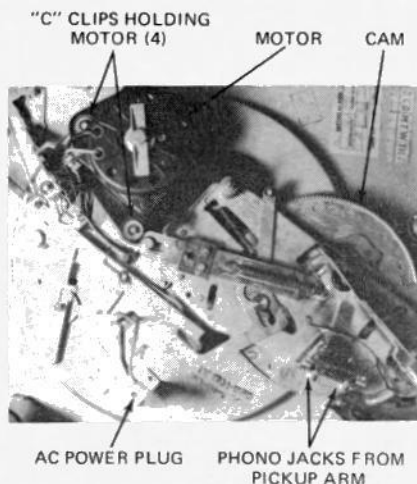


FIG. 5—CAM ASSEMBLY is usually not a problem unless turntable has been accidentally rotated backwards.



FIG. 6—C CLIPS hold the motor in place. Remove them, then the motor, to get at the upper motor bearings.

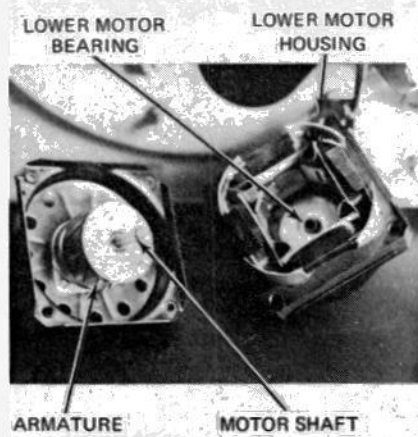


FIG. 7—CHECK THE LOWER BEARING for traces of dirt or other foreign matter. Clean with cotton swab.

cant a drop at a time until the shaft shows no trace of dirty oil deposits or grease and spins freely. At this point apply a single drop of lubricant to the top bearing and set the assembly aside.

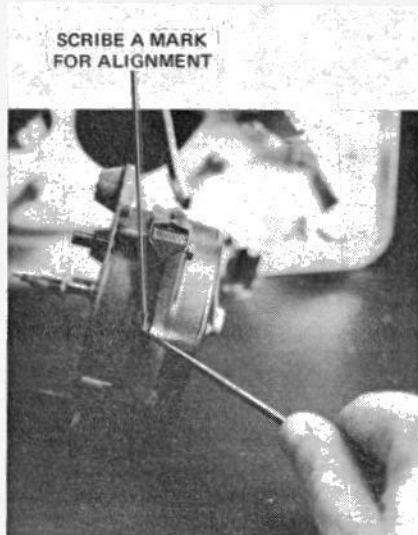
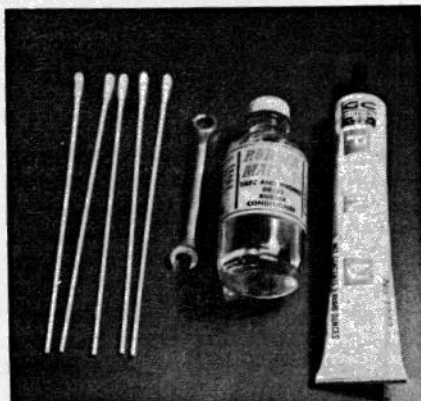


FIG. 8—SCRIBE A MARK on the motor housing to insure proper replacement positioning when you finish.

9. Examine the lower bearing (Fig. 7) for any traces of dirt or foreign matter. Spray it completely with the degreaser. Saturate a swab with oil and clean the inner surfaces of the bearing. Rotate the swab in the bearing opening while adding a drop or two of oil to clean the side surfaces.



TURNTABLE CLEAN-UP KIT consists of cotton swabs, hypodermic-type oiler, solvent, and lubricant.

10. After cleaning and freeing the lower bearing, apply a single drop of lubricant to the bearing opening and set it aside.

11. Reassemble the motor, line up the mark made in step 6. Before tightening the screws down, tap (lightly) the lower bearing housing with a screwdriver handle while spinning the shaft. This balances the motor shaft and insures that it is correctly seated in both the upper and lower bearings. Now tighten the screws completely. At this point you could utilize the 'universal' power cord to check motor operation, this is not necessary.

12. Replace the motor and secure it with the four C clips removed in step 5.

13. Using a saturated towel (Rubber-Magic), wipe the inside rim of the platter clean of rubber residue (Fig. 9).

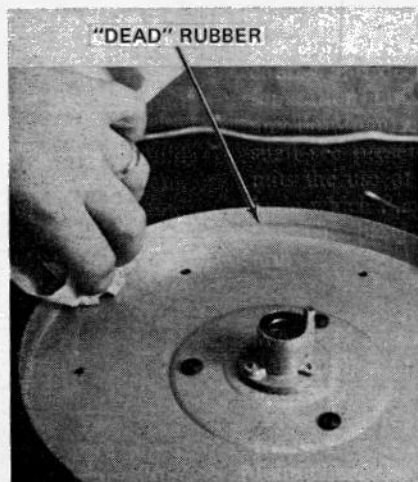


FIG. 9—WIPE THE INSIDE RIM of the platter clean of rubber residue. Use a towel saturated with solvent.

14. Refer to Fig. 3 and remove the platter bearings. Clean and lightly lubricate them and replace in same order removed.

15. Lightly apply a tiny amount of Phono-Lube to moving parts located on the underside of the changer. Too little lubricant is much better

than too much!

16. Carefully replace the cleaned idler wheel and the drive wheel on their respective shafts, and secure. Manually operate the speed selector and observe the relative position the idler wheel takes in respect to the motor pulley. It should be approximately

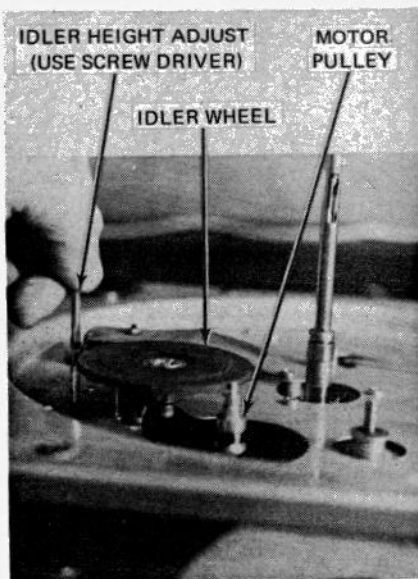


FIG. 10—IDLER WHEEL HEIGHT must be set properly to insure that the motor pulley mates properly.

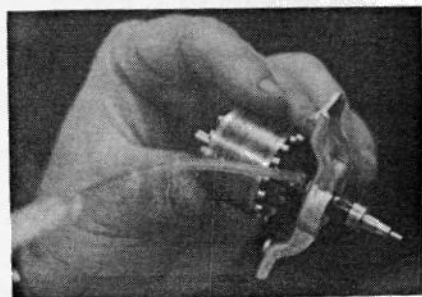


FIG. 11—DEGREASE, THEN LUBE the upper motor bearing before replacing the motor on the turntable.

centered in each of the increments of the pulley (16-33-45-78). If it is not centered use the idler wheel height adjustment (Fig. 10) to raise or lower the wheel as required.

17. Replace the platter with a slight spinning (clockwise) motion to seat the platter and position the idler wheel (continued on page 71)

TABLE II—TROUBLESHOOTING CHART

SYMPTOM	CAUSE & CURE
Audio:	
1. Buzz in output one or both channels	Poor ground connection to cartridge, turntable, bad connection to cartridge, check and correct.
2. One channel dead, phono only	Shielded cable open, or bad wire in pickup arm, test cable by substitution, repair or replace.
3. Muddy sound, distortion	Glob of dust/dirt on stylus, or worn stylus; remove dirt or replace stylus.
4. Intermittent sound, low output	Test cartridge by lightly applying pressure to pickup arm while playing <i>OLD</i> record, if pressure corrects problem, replace cartridge.
Mechanical:	
1. Arm slides across record	Bad stylus, replace.
2. Arm sets down too soon/late	Readjust set-down, adjustment screw located in rear of pickup arm assembly, turn as required.
3. Won't auto-cycle	Check overarm, must be free, clean and oil, if bent, straighten, check, clean idler wheel.
4. Arm sets down in middle of record	Check to see size is set for 12-inch, or speed for 33 $\frac{1}{3}$ rpm.
5. Won't turn	Motor frozen, clean, free bearings, oil as described in text.
6. Slows in cycle or erratic speed	Clean and reface idler wheel, oil upper motor bearings (1-2 drops) check idler wheel height.
7. Won't cycle 45's	Check speed, idler wheel height, replace 45 adapter.

wheel. Replace the retaining C clip and any trim you might have had to remove to gain access to the clip.

18. Refer to Fig. 2 and apply a single drop of lubricant to the over-arm shaft assembly. Work the arm up and down to insure proper lubrication.

OPTIONAL STEPS

19. Place 4 dowels, one under each corner to support the changer slightly off the bench. Connect the universal power cord to the changer and plug into an ac outlet. Place a strobe disc on the turntable and test for correct speed. The pattern should appear stationary.

20. Thoroughly clean the changer using a liquid spray cleaner for metal surfaces, and spray wax for the wooden surfaces.

21. Replace the changer in the unit and performance test. If any problems are noted consult trouble chart (Table II).

The complete changer just described requires about 45-minutes. While these simple overhaul techniques will solve about 80% of your record-changer problems, Table II gives you additional hints for servicing



Stereo Scene

By J. Gordon Holt

THE AVERAGE non-audiophile is often taken aback by the audiophile's constant state of frustration with his hi-fi system. "Why," the former asks, "would anyone pay \$800 or more for a music system and then moan about its imperfections?" Said non-audiophile doesn't know the rules of the game. High fidelity is frequently a state of dissatisfaction. It was (and is) a pursuit of reproduced perfection; and, with some people, it doesn't exist without dissatisfaction about the state of the art or the state of one's own hi-fi rig.

For example, state-of-the-art disc reproduction is extraordinarily good—the next best thing, according to some perfectionists, to hearing an original master tape. But most of us own phono units which display some shortcomings. This is often the result of fairly simple malfunctions which can be remedied at little or no cost. Here's a listing of some of the problems, and what you can do about them.

Wow. Wow is defined as "cyclical speed variation occurring at a slow repetition rate." One thing on a turntable that can cause slow-speed variations is the platter bearing. Wow is not, however, as widespread a problem as many think, for there is a common belief that you can see turntable wow as shifting bars on a strobe disc pattern. However, you frequently can't.

What *looks* like wow on a strobe pattern may be due, not to turntable irregularities, but to imperfections and imperfect centering of the strobe pattern itself. The illuminated strobe patterns on some turntables, and the strobe discs sold by accessory manufacturers, like Robins and Audiotex, are for determining whether the *average* platter speed is correct. They are not intended for any other purpose and should not be so used.

A strobe must, incidentally, be viewed under illumination that is flickering at the ac line frequency, which means daylight illumination is out. An incandescent lamp will suffice if the strobe is shielded from natural light, but the best viewing source is a fluorescent lamp or one of those little neon lamps sold specifically for the purpose, usually by the same firms that supply strobes.

Okay then, how *do* we test for wow? Since few of us own wow and flutter meters, our best approach is to play a disc with some sustained piano chords, and listen for once-per-revolution pitch changes. Or, we can use an even more critical listening test, a recording of a high-frequency tone. Whatever you use, the grooves *must* be precisely concentric or you'll have the same problem as with a strobe: an indication of wow where none exists.

If the pickup, viewed from directly above, shows *any* visible side-to-side swing, you'll hear wow from even the most constant-speed turntable. Warp of the test disc can cause audible wow from some tone-arm designs, although it generally takes much more warp than eccentricity to be audible. The listening test, in other words, is valid in one direction only. If you hear *no* wow from it, the turntable (and test disc) is perfect; if you *do* hear some wow,

Record Player Trouble- Shooting

it could be the fault of the table or of the test disc.

If you suspect a turntable-wow problem, remove the platter and clean the bearing and its well with a lintless cloth (push it into the well with the eraser end of a pencil), being careful not to lose the ball bearing that some models have at the bottom of the well. Then relubricate as recommended. If you still have wow, let the manufacturer or a service technician cope with it.

Flutter. This is "cyclical pitch variation occurring at a rapid repetition rate." It is best detected by ear via the same signal sources used for checking for wow, but there's no need to worry about record concentricity when listening for flutter. As before, though, the test is valid in one direction only. If no flutter is audible, the turntable is perfect. If some is audible, it could be the turntable or it *could* be the disc, since some test discs are cut from a master tape which may introduce more flutter than your turntable. So if your turntable flunks the flutter test, try a sampling of other discs with sustained piano tones on them. If they all flutter, and the flutter always has the same repetition rate, it's the fault of your turntable.

The probable site of the flutter is usually indicated by its repetition rate. Extremely high-speed flutter, with a rate equivalent to the vibrations of a bumblebee's "Zzzzz" sound, may be due to very severe platter spindle problems (in which case it is always accompanied by a bad case of rumble) or to a frayed or stretched drive belt. High-speed flutter, with a repetition rate of a rolled-on-the-tongue "Brrrr," generally indicates dirt or wear on the drive-motor pulley, dry or worn motor bearings, or a bent pulley shaft. Dirt can be seen as black patches, bearing problems can usually be felt as vibration of the motor, and a fingernail placed against the pulley surface (with motor running) will reveal any eccentricity.

Rumble. Most good turntables are so designed that the majority of their rumble occurs at a subsonic frequency, which is a mixed blessing. The good news is that it is rarely audible as rumble. The bad news is that, although generally inaudible, it can cause other system problems which *are* audible but which don't sound like rumble and are thus harder to diagnose. True rumble is more often seen than heard, as fluttery

pumping motions of a woofer speaker cone.

If the speaker has pronounced low-frequency distortion, the rumble may be audible as a breathy fluttering sound. More often, though, the only audible effect is a subtle muddying of bass reproduction, plus a failure of the amplifier to put out as much signal power as it *should* be able to (because of the power wasted in driving the woofer at subsonic frequencies). Usually, it takes a spectacularly poor turntable to produce this much rumble, although one thing that can help to magnify the problem is the (mis)mating of an arm and pickup which happen to resonate at the same frequency at which the turntable's rumble occurs. Changing either the arm or the cart-ridge will usually kill that proclivity.

A pulsating, booming rumble, usually recurring once or twice per platter revolution, is often due to a bad platter bearing or a slipping or rubbing drive belt. In most belt-driven turntables, proper centering of the belt in the motor pulley depends on the alignment of the motor as well as on the correct positioning of one or more belt-guide yokes. If the motor is crookedly mounted or a guide is misplaced, the belt will rub on the guide, causing rumble. Fortunately, many belt-driven turntables have an outer platter which can be turned over and placed upside-down on their inner platter, thus allowing you to observe the alignment of the belt while the turntable is running. If the drive belt is not centered on the motor pulley when the table is running, the motor is probably crookedly mounted, and you should check for a loose mounting screw or for tension on one of the wires going to the motor. If the belt is centered on the pulley but rubbing on the guide yoke, bend the guide until it just clears the belt. Don't try to center the belt in the guide, as some clearance at the other edge may be necessary to accommodate position changes for speed switching.

In the vast majority of cases, rumble problems are *not* the fault of the turntable, but are the result of incipient acoustic feedback, which has several identifying characteristics. First, it seems to appear suddenly when the listening volume is advanced to a certain point, and then increases in volume *more rapidly* than the music when the volume is advanced further. Second, it tends to make the bass in the program material sound boomy, and the higher the listening level, the boomier the bass. And third, the

dead giveaway is that, when the volume is advanced to a certain point, feedback rumble will start to become self-sustaining, sometimes continuing to build in intensity until the entire program is submerged in a room-shaking boom or shudder.

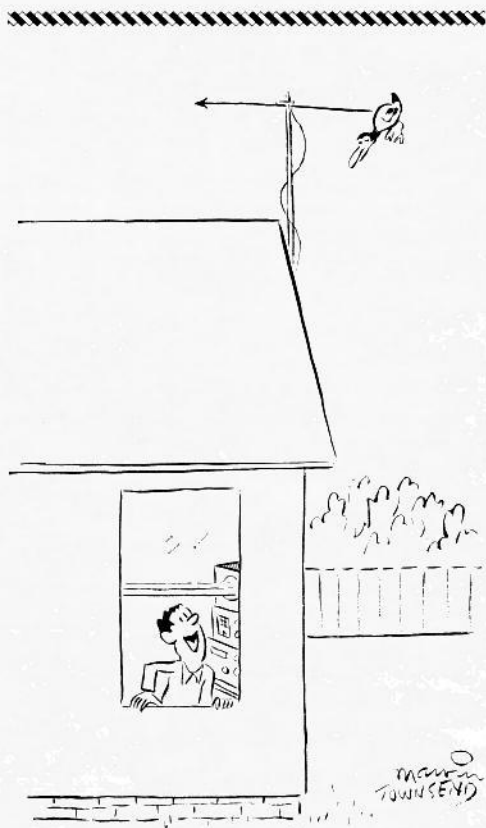
It should be noted that virtually *all* phono systems can be persuaded to produce acoustic feedback if there is enough available reserve range on the volume control, just as you can get audible hum, hiss or burbling noises from most phono preamps by turning the gain up way past the normal listening range. For practical purposes, your concern is whether or not there is audible indication of incipient feedback at the volume-control settings at which you normally listen. If there is, don't blame rumble on the turntable drive; it is due to feedback.

There are two paths by which acoustic feedback from a loudspeaker can reach the phono pickup. One, against which most turntables are adequately protected, is by way of the room's floor and thus up into the cabinet or the shelf housing the phono unit. The other, which few turntables are designed to resist, is vibration of the entire "floating" platter-and-motor-board assembly by *airborne* sound waves. A clue to which path is causing a feedback problem is provided by the frequency at which the feedback occurs. Very low-frequency feedback, characterized by fluttering or shuddering rumbles, is generally floor-borne. Higher-pitched booming or grumbling noises are generally the result of airborne feedback. Another check on the source of feedback involves pressing down on the suspended system until it bottoms on the turntable base. If the problem is floorborne, this will make the feedback worse. If it is airborne, this will *reduce* the feedback. And that suggests the solution to either one.

If the feedback is floorborne, it can be reduced or eliminated by providing additional vibration-isolation for the phono unit, via one or two layers of foam rubber between it and the surface it is mounted on. (If you're raising an entire phono player with base, put a sheet of masonite or plywood between it and the underlying isolation layers to avoid closing off the ventilating holes in its bottom panel.) If the problem is airborne, you may be in trouble. Sometimes, screwing down the isolating springs until the floating suspension is bottomed on the base will alleviate the problem, as the mass of the base is then added

to that of the suspended system, changing the resonance of the vibrating system. Sometimes, moving the phono unit to another part of the room (for instance, a part where the bass sounds weakest) will do the trick. Occasionally, it may be necessary to replace either the phono pickup or the tone arm, in order to change the system resonance to a frequency where "reception" of the loudspeaker output is less efficient.

A viscous-damped tonearm may be the best solution to a knotty airborne-feedback problem, for it prevents the resonance between the stylus compliance and the tone-arm mass from developing the sharp peak which invites feedback problems. And if you must listen to a phono system at very high levels, it may even be necessary to remove the entire phono unit (and the pre-amp, because you can't run long cables between them) to another room of the house. ♦



"Get out the wild rice, Mary!
Another one just came in on the beam."