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CD Player and CD-ROM Drive Maintenance

WHILE IT IS TEMPTING TO SUSPECT THE MOST EXPENSIVE COMPONENT (LIKE THE LASER) WHEN YOUR TRUSTY CD PLAYER OR CD-ROM DRIVE REFUSES TO COOPERATE, THE MOST COMMON CAUSE IS ACTUALLY A DIRTY LENS, WITH THE next most likely causes being simple mechanical problems like a bad belt, dirt, and gummed-up lubrication. This month we are going to cover general inspection, cleaning, and lubrication. After all, a little tender loving care may be all that is needed to get your unit up and running.

Inside A CD Player or CD-ROM Drive

Before we begin, it would be useful to familiarize ourselves with the insides of some typical units. We'll also define some terms to minimize any chances of confusion as we proceed with the rest of our discussions on CD player/CD-ROM-drive repairs.

Let's begin by taking a look at a couple of typical mechanisms: An RCA RP7903A portable CD player with the top cover removed is shown in Fig. 1. Note how everything is squeezed into a package only slightly larger than the CD itself. When a CD is loaded, it conveniently blocks access to everything below it—which is a real pain when it comes time for servicing!

Figure 2 shows a Teac CD-532S CD-ROM Drive, a popular design used in late model (1998) low-cost high spin-rate units. This one is a 32× model with a SCSI interface. It is interesting to note that the 32× rating really means that it spins at constant speed roughly equivalent to a 13× rate, and the 32× transfer rate is only achieved for data located near the outer edge of the disc.

Although there are many variations on the basic theme, every CD player or CD-ROM drive has a power supply, logic/control board or boards, and an optical deck—which is the heart of the unit. The optical deck includes all those components directly associated with loading, spinning, and reading the disc.

An optical deck from a Sony D2 portable CD player is shown in Fig. 3. This is very typical of what is found in a variety of consumer-grade portable as well as full-size CD players and older CD-ROM drives. It uses a gear mechanism for moving the pickup.

Figure 4 shows the very simple optical deck from a Philips CD-206 CD-ROM drive. It uses the less-common rotary type positioner (more on that later).

The optical decks in changers are similar but there will be an additional mechanism for selecting the discs from the carousel or cartridge.

The following summary identifies the major parts of the optical deck. Note, however, that not all models will have all of these items.

Loading Drawer: Most portable and many lower cost CD players or CD-ROM drives do not include this convenient feature. Of the ones that do, most are motor driven; however, some must be pushed in or pulled out by hand. One common problem with the loading-drawer mechanism is loose or oily belts that result in the drawer either not opening or closing at all, or opening or closing only partially. There also might be mechanical damage such as worn or fractured gears or broken parts. Another possibility is that the drawer switch might be dirty, causing the drawer to decide to open or close on its own. Finally, the motor might be shorted, have open or shorted windings, or even have a dry or worn bearing.

Spindle Table or Platform: When the disc is loaded, it rests on this platform, which is designed to automatically center the disc and minimize runout and wobble. Common problems here include dirt on the surface, a bent spindle, or dry or worn motor bearings.

Spindle Motor: This is the motor that spins the disc. Most often, the spindle platform is a press fit onto the spindle motor. There are two common types: a miniature DC motor that uses brushes similar to the motors found in toys and other battery-operated devices, and a brushless DC motor that uses Hall-effect devices for commutation. Common problems with these motors include a partially shorted commutator (brush type), a shorted or open winding, and dry or worn bearings.

Clamper: The clamper is usually a magnet on the opposite side of the disc from the spindle motor that prevents slippage between the disc and the spindle platform. The clamper is lifted off the disc when the lid or drawer is opened. Alternatively, the spindle may be lowered to free the disc. A common problem here is the clamper not engaging fully, thus permitting the disc to slip on the spindle because of a mechanical problem in the drawer-closing mechanism.

Sled: This is the mechanism that the optical pickup is mounted upon. The sled provides the means for moving the optical pickup across the disc during

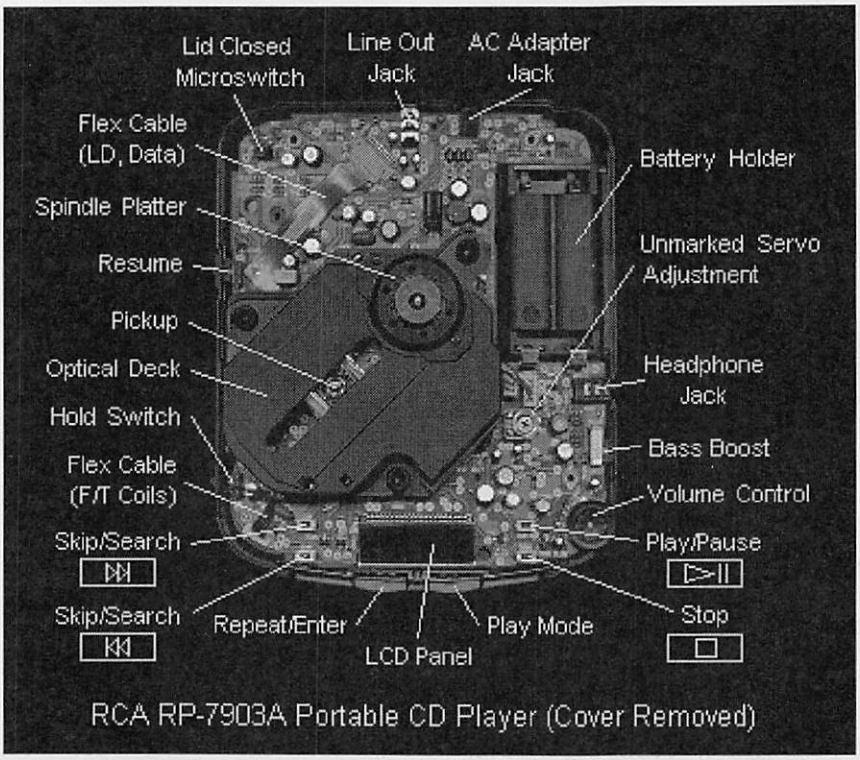

FIG. 1—LIKE MOST MODERN PORTABLES, there's not a lot of room inside this RCA RP7903A.

normal play or to locate a specific track or piece of data. The sled is supported on guide rails and/or bearings and is moved by either a worm or ball gear, a rack-and-pinion gear, a linear motor, or rotary positioner similar to what is found in a modern hard-disk drive. Common problems include dirt, gummed up or no lubrication, and damaged gears.

Pickup Motor: The entire pickup moves during normal play or for rapid access to musical selections or CD-ROM data. The motor is either a conventional miniature permanent-magnet DC motor (with belt or gear with worm, ball, or rack-and-pinion mechanisms) or a direct-drive linear motor or rotary positioner (with no gears or belts). Common problems include a partially-shorted motor, shorted or open winding, and dry or worn bearings.

The Optical Pickup

Next, let's turn our attention to the optical pickup, which is usually a self-contained and replaceable (though generally very expensive) subassembly. The good news is that, despite the fact that it is a precision opto-mechanical device, optical pickups are remarkably robust and are not that easily susceptible to mechanical damage.

Laser Diode: This is a near infrared (IR) emitting device that usually operates at 780 nm, which is just outside the visible range of 400 to 700 nm. The power output is no more than a few milliwatts, and is further reduced to 0.25 to 1.2 mW at the output of the objective lens. A photodiode inside the laser-diode case monitors optical power directly and is part of a feedback loop that maintains the laser output at a constant and extremely stable value. Common problems here include a bad laser diode or sensing photodiode, causing a reduction or loss of the laser output.

Fixed Optics: These consist of the collimating lens, diffraction grating (only found in three-beam pickup), cylindrical lens, beam splitter, and turning mirror. Note that not all of these will necessarily be present in a given pickup; the functions of these components were discussed in a previous installment of this series. The good news here is that, outside of damage caused by a serious fall, there is little to go bad. Actually, that is very good news as it is usually very difficult to access any of the fixed-optics components, and even if you could, there is no easy way to realign them. Fortunately, except for the turning mirror, it is unlikely that they would ever need cleaning, and even the turning mirror is usually fairly well protected and remains clean.

Objective Lens: This is a high-quality plastic focusing lens, very similar to a good microscope objective with a focal length of 4 mm. Common problems with it include dirty lens, dirt in the lens mechanism, and damage from improper cleaning or excessive mechanical shock.

Photodiode Array: This is the sensor that is used to read back data and control beams. Common problems are bad photodiode(s) resulting in improper focus or absence of focus and weak or missing RF signal.

Focus Actuator: Since focus must be accurate to 1 micron (1 μm), a focus servo is used to keep it on target. The actuator is actually a coil of wire in a permanent magnetic field much like the voice coil of a loudspeaker. The focus actuator can move the objective lens up and down (closer or farther from the disc) as needed based on-focus information taken from the photodiode array. Common problems here are a broken coil or damaged suspension (caused by mechanical shock or improper cleaning techniques).

Tracking Actuator: Like focus, tracking must also be accurate to 1-μm or better. A similar voice-coil-type actuator moves the objective lens from side to side, based on tracking feedback information taken from the photodiode array. Note: On pickups that have rotary positioners, there may be no separate tracking coil as its function is taken care of by the positioner servo.

Common CD-Player Problems

While there are an almost infinite number of distinct things that can go wrong with a CD player, any set of symptoms can be classified as either a hard failure or a soft failure. A hard failure includes such things as door opening/closing problems, discs not being recognized, no sound, unit totally dead, etc. Soft failures include skips, continuous or repetitive audio noise, search or track-seek problems, and random behavior.

Both types of problems are common. The causes in both cases are often very simple, easy to locate, and quick and inexpensive to repair. Here is a short list of the most common causes for a variety of tracking and audio or data readout symptoms:

- Dirty optics—lens, prism, or turning mirror.
- Drawer loading belts—worn, oily, flabby, or tired.

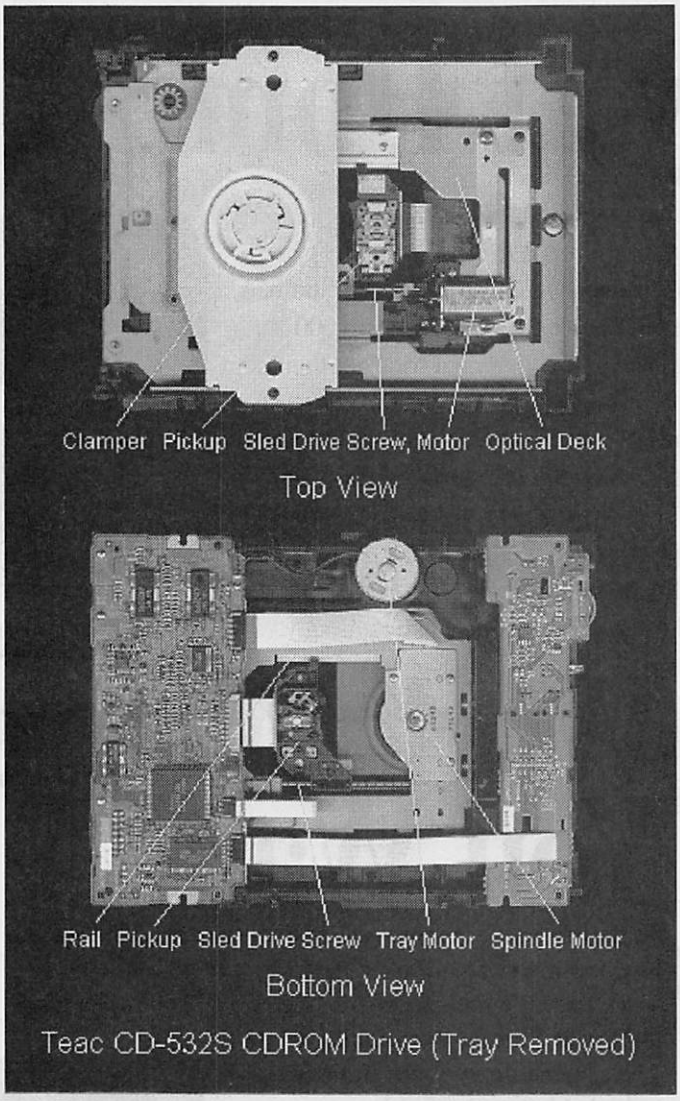

FIG. 2—THIS TEAC CD-532S is a modern, 323 CD-ROM drive, though that maximum transfer rate is only reached for data located at the edge of the disc.

- Sticky mechanism—dirt, dried up/lack of lubrication, dog hair, sand, etc.
- Broken (plastic) parts—gear teeth, brackets, or mountings.
- Electronic servo adjustments needed—focus, tracking, or PLL.
- Intermittent limit or interlock switches—worn or dirty.
- Bad connections—solder joints, connectors, or cracked flex-cable traces.
- Motors—electrical (shorted, dead spot) or mechanical (dry/worn bearings).
- Laser—dead or weak laser diode or laser-drive (power) problems.
- Photodiode array—bad, weak, or shorted segments, or no power.
- Bad heat-sensitive electronic components.
- Bad or missing optical pickup shield ground.

The following two areas cover the most common types of problems you are likely to encounter. Consider them first in any situation where operation is intermittent; if audio output is noisy, skips or gets stuck; or if some discs play and others have noise or are not even recognized consistently:

The first is a dirty lens, which is particularly likely if the house the drive came from is dusty, if the player was located in a greasy area like a kitchen, or if there are heavy smokers around. Cleaning the lens is relatively easy and may have a dramatic effect on player performance.

The second thing to look at is a mechanical problem. Dirt, dried up lubrication, and damaged parts often cause erratic problems or total failure. One typical symptom is that the first part of a CD may play, but then get stuck at about the same time location.

Luckily, both of these can be taken care of easily.

General Inspection, Cleaning, and Lubrication

The following should be performed as general preventive maintenance or when erratic behavior is detected. The lens and its suspension, turning mirror, drawer mechanism, spindle, and sled drive should be checked, cleaned, and/or lubricated if necessary and appropriate (but read our comments on the lubrication of CD players, which follow shortly, before drowning your unit in motor oil or WD40!).

You will have to get under the clamp to access the lens and spindle on drawer loading models, but the lens and its suspension, at least, should be readily accessible on portable CD players with pop-up doors. These types can collect a lot of dust, dirt, and even fingerprints! Realistically, you probably won't do any of this for component CD players, CD-ROM drives, or other drawer loading models until something goes wrong! (I don't blame you—getting one of those out from the tangle of entertainment-center wiring, dusting it off, removing the cover, disassembling the unit to whatever level is needed, and so forth can be a royal pain.)

Cleaning the objective lens and turning mirror (if accessible) are the most important general maintenance tasks that can be done. Even minor contamination of their optical surfaces can easily result in 50% reduction in the returned signal—and all sorts of problems.

When cleaning the objective-lens assembly, be careful and gentle. The lens is suspended by a voice-coil actuated positioner that is relatively delicate. A CD-lens cleaning disc is nearly worthless except for the most minor dust as it will not completely remove grease, grime, and condensed tobacco smoke products (yet another reason not to smoke!), and could make matters worse by just moving the crud around.

First, gently blow out any dust or dirt that might have collected inside the lens assembly. A photographic type of air bulb is fine, but be extremely careful using any kind of compressed-air source. Next, clean the lens itself. It is made of plastic, so don't use strong solvents. There are special cleaners, but isopropyl alcohol is usually all that is needed for CD players and VCRs. (91% medicinal alcohol is acceptable, but pure isopropyl is better. Avoid rubbing alcohol, especially if it contains any additives.) Sometimes, a drop of water will be need-

ed to dissolve sugar-based crud. There should be no problems as long as you dry everything off (gently!) reasonably quickly. DO NOT LUBRICATE! You wouldn't oil a loudspeaker, would you?

You generally cannot get to the bottom surface of the lens, but this isn't nearly as exposed as the top surface, so that usually isn't a problem. Do not use strong solvents or anything with abrasives—you will destroy the lens surface rendering the entire pickup worthless.

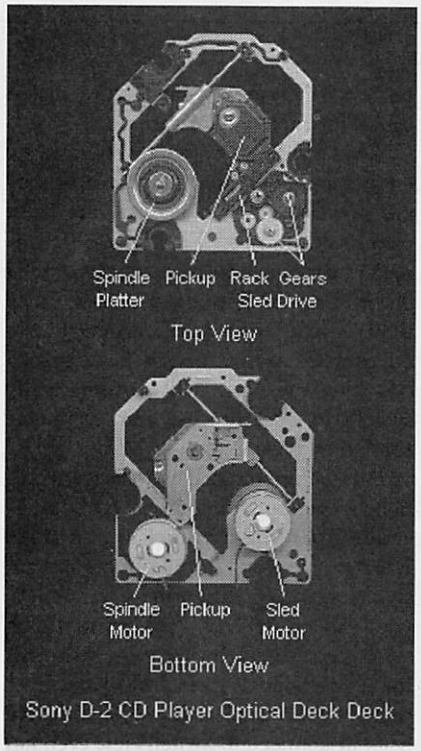

FIG. 3—A GEAR MECHANISM is used to move the optical pickup in this Sony D2 portable player. The pickup itself is typical of what you'll find in consumer units.

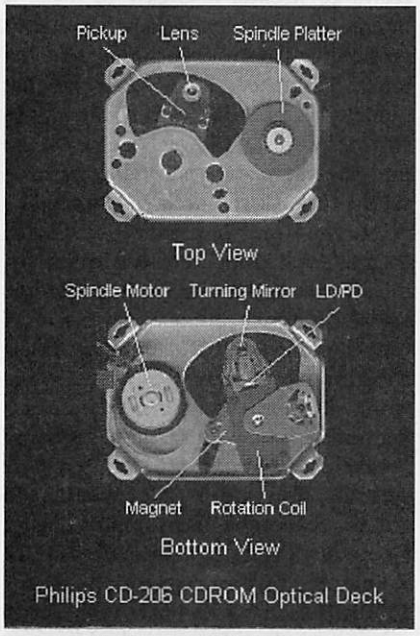

FIG. 4—HERE'S THE VERY SIMPLE optical deck used in a Philips CD-206 CD-ROM drive. This unit uses a rotary-type positioner.

Now, inspect the lens. When clean, the lens should be perfectly shiny with a blue tinge uniform over the central surface. Minor (barely visible) scratches will probably cause no harm, but any major scratches might result in erratic tracking or total inability to even read the disc directory. The pickup (or lens assembly) will need to be replaced in such cases.

Next we'll deal with the turning mirror or prism. If you can get to it under the lens without disturbing anything, clean it as well using the same procedure. Cleaning this might be at least as important as the lens. Unfortunately, the turning mirror may not be accessible without major (and difficult) disassembly. However, for Sony pickups (also used in Aiwa and some other brand players), it can be accomplished relatively easily.

Note: The turning mirror is not silvered so don't expect a normal mirror appearance—it looks just like a piece of glass. However, it is coated to be an excellent reflector for the 780 nm IR laser light.

Next, check the lens suspension for free movement and damage. Then check the spindle bearing (this is primarily likely to cause problems with repetitive noise). There should be no detectable side to side play. A seriously worn bearing will require replacement of the spindle motor.

To access the drawer mechanism and sled drive in component units, you will probably need to remove the optical deck from the chassis. It is usually mounted by 3 long screws (one of which may have a grounding lug—don't lose it). In portables and CD-ROMs, the bottom panel of the unit will need to be removed. Try not to let any of the tiny screws escape! A good set of jeweler's screwdrivers is a must for portables.

Check the drawer mechanism (if present) for free movement. Test the belt for life—it should be firm, reasonably tight, and should return to its original length instantly if stretched by 25% or so. If the belt fails any of those criteria, it will need to be replaced eventually, though a thorough cleaning of the belt and pulleys with isopropyl alcohol (dry quickly to avoid damaging the rubber) or soap and water may give it a temporary reprieve. Also, check the gears and motor for lubrication and damage and correct as necessary.

Next up is the sled drive. Check the components that move the pickup including (depending on what kind of sled drive your unit has) the belt, worm or other gears, or slide bearings. These should all move freely (one exception here: if there is a lock to prevent accidental damage while the unit is being transported, the pickup might not move freely or very far). Inspect for damage to any of components that might impede free movement. Lubricate, repair, or replace as appropriate.

Finally, before going any farther, try to play a disc to assess the results of your efforts thus far.

Lubrication

The short recommendation here is to NOT add any oil or grease unless you are positively sure it is needed. Most moving parts are lubricated at the factory and do not need any further lubrication over their lifetime. Too much lubrication is worse than too little. It is easy to add a drop of oil but difficult and time consuming to restore an optical pickup that has taken a bath.

Never, ever, use WD40 or anything similar! Despite claims to the contrary, WD40 is not a good lubricant. Legend has it that the WD stands for Water Displacer—which is one of the functions of WD40 when used to coat tools for rust prevention. WD40 is much too thin to do any good as a general lubricant and will quickly collect dirt and dry up.

A light machine oil like electric-motor or sewing-machine oil should be used for gear or wheel shafts. A plastic-safe grease like silicone grease or Molylube is suitable for gears, cams, or mechanical (piano-key) mode selectors. Never use oil or grease on electrical contacts.

Unless the unit was not properly lubricated at the factory (which is quite possible), don't add any unless your inspection reveals the specific need. In a CD player or CD-ROM drive, there are a very limited number of failures specifically due to lubrication.

Note that in most cases, oil is for plain bearings (not ball or roller) and pivots while grease is used on sliding parts and gear teeth. If the old lubricant is gummed up, remove it, and clean the affected parts thoroughly before adding new oil or grease.

(Continued on page 30)

SERVICE CLINIC

continued from page 23

In general, do not lubricate anything unless you know there is a need. Never 'shotgun' a problem by lubricating everything in sight! Considering the damage you might do, you might as well literally use a shotgun on the equipment!

Wrap Up

That's all for now. The general maintenance procedures we've outlined here should actually cover the majority of CD player and CD-ROM drive problems you will encounter. Next time we will get into some specific electronic problems (such as what to do if your CD player does a credible impersonation of a brick!).

In the meantime, if you have any specific problems or questions, you can reach me by e-mail at sam@stdavids.picker.com. For general information on electronics troubleshooting and repair visit my Web site at http:// www.repairfaq.org/ or go direct to: http://www.repairfaq.org/REPAIR/ F_Repair.html for a new, expanded, and greatly enhanced set of repair guides and other electronics troubleshooting and design information. EN