

Going in Circles

Time: Monday, 10:00 a.m.

Place: General Manager's office

People present: GM, Program Director, Music Director, News Director, and yourself - Chief Engineer

General Manager: "We need to do something to get more older listeners. Our latest book shows that almost no one over 30 is listening to us. Our under 30 book is good, but we need to appeal to older people. Any ideas?"

Program Director: "Our programming mix should be working for us. We are doing a mix of contemporary and 'oldies' that should be getting these people for us. Maybe if we played more 'oldies' it would help."

Music Director: "That's a good idea, but we have a problem. We have quite a few older LP's and 45's, but we have been playing all CD's on the air. All the oldies we play have been re-released on CD, so we took all the turntables out of the on-air control room. We only have one production room with a turntable in it, and we only use that for spot production."

Chief Engineer: "Yeah, the music sounds so much better when we play it from the CD's."

Music Director: "But we need the greater variety that the LP's give us to attract the audience. I have a stack of letters from people complaining about us not playing music by so-and-so. We have the LP's, but they aren't real popular now so no one has put their stuff on CD."

General Manager: "Don't we still have the turntables we took out of the main control room last year? Why not put them back?"

Chief Engineer: "But the CD players are so big they took up the space where we had the turntables. We just don't have room for the CD players and the turntables in that room."

Program Director: "What about putting them into a production room and dubbing the music to cart for air play. Those cart machines really sound

good after you tuned them up last month. They probably would sound good enough for most of the old stuff."

Chief Engineer: "Well, I guess we could put them in Production Two. There is some room in there. We still have all the parts, but it will take some work to get it all going."

General Manager: "Good! Let's see if we can do this by the end of next week. We'll coordinate this with a new promotion for more oldies. Maybe we can even give away some of the duplicate records we picked up when our retired morning drive man gave us his collection last month."

Everyone leaves the meeting smiling, except you. Those turntables are old and haven't been used in almost a year. Besides, you've forgotten almost everything you knew about turntables and tone arms, which wasn't much. You don't have any books in your library about them, either. The only thing you even remember reading about turntables was in an old hi-fi magazine about five years ago, and that was about some \$10,000 super rig. Now what?

Let's look at the two main parts of a record playing system. You have the turntable and the tone arm/cartridge combination. They don't look like much in most systems, and their functions are fairly simple. The turntable's primary function is to rotate the record at a constant speed while holding it in the proper position for the cartridge to play it. The tone arm's function is to hold the cartridge in the proper position relative to the record while the cartridge converts the mechanical impulses on the record to electrical impulses. The basic concept has not changed much from the day Edison recorded "Mary Had a Little Lamb" on his cylinder, but the details have.

Most turntables consist of a motor, a means of conveying the rotation of the motor to the platter, and the platter itself. At one time it was good enough to use a synchronous motor whose

speed was dependent on the AC line frequency for this job, but as newer technology came along, the motors evolved into servo-controlled systems for very accurate speed control.

There are only a few ways to transmit the rotation from the motor to the platter. The two earliest were belt drives and puck drives. Belt drives used a belt turning on a pulley fastened to the motor shaft and turning around a pulley surface on the underside of the platter. The puck or rim drives used a rubber tired idler pulley between the motor shaft and the rim of the turntable. Both systems worked well, with a few cautions. If the belts, pulleys, or tire surfaces became dirty or oily, the turntable would run off speed or wow. Depending on the design of the turntable, some of these systems were dependent on the amount of pressure or belt tension for proper speed. I even knew of one type of turntable that you had to keep a supply of selected belts on hand to make work. The belts actually had a bump where the ends were joined to make a loop, and you had to select the best compromise between the "thump" generated by the belts, the speed of the turntable, and the pick-up (acceleration) of the turntable.

The platter (the device on which the record rests) is usually quite heavy and serves as a flywheel for the system. If you remember your high school physics classes, you will recall that a flywheel serves to smooth out the small speed variations in a rotating system. Many turntable platters may weigh ten pounds or more. If you look closely at the platter, usually on the underside, you will see some holes or weights that have been added to balance it. Proper balance of a platter means that it will perform up to expectations.

As technology has advanced, some of the newer turntables have used a direct drive system. With a direct drive system, the belts and pulleys have been eliminated, and the platter actually

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becomes a part of the motor. These systems are always electronically controlled and driven due to the very low speed of rotation required.

When installing or maintaining a turntable, a number of considerations must be observed. The surface of the platter must be perfectly level in all directions. If it is not, the motor will have an uneven and excessive load placed on it and may run off speed. If you look around, you can still find a few places that sell turntable levels. A turntable level is a small bubble level that you place on the center spindle of the platter. There is a circle on the top of the level and you adjust the levelers on the turntable until the bubble is centered in the circle. If you do not have a turntable level available, a small torpedo level (available in most hardware stores) can be used, just be sure to check in all directions.

In addition to being level, the turntable must be stable. It cannot rock, even with large amounts of pressure, or the tone arm will tend to skip. If possible, the turntable should be isolated from the floor or surrounding furniture. Remember that any vibrations picked up by the turntable will be translated into noise while listening to a record. Also, make sure the turntable is not too close to speakers. The vibrations from the speakers can actually set up a feedback loop through the turntable system.

As we mentioned before, the belts, pulleys, and rubber tires must be kept clean. Also, the bearing surface at the center of the platter must be kept clean. Lubrication in these systems is equally important, since the steadiness of rotation is dependent on the free movement of all parts. Be sure to only lubricate those areas that should be lubricated, and use only the lubricant recommended by the manufacturer. If you no longer have any service information on your turntables, lubricate only the center of any idlers and the bearing surface of the platter. Use a light, non-gumming oil such as that used for model trains. A good hobby

shop will have a selection of lubricants that will be usable for this purpose.

While the turntable is usually a simple electronic system, especially the older ones that used synchronous motors, some maintenance is required. Switches must be kept clean to work reliably. I have seen some turntables that have a pushbutton start and stop that become very flaky. While the switch contacts are sealed, the problem with these is that the actuator becomes sticky and will not move freely, causing the switch contacts to not open and close fully.

The motors on most turntables require only that they be kept free of dirt. Many of these motors were not to be oiled (according to original instructions), but if the turntable is old and the motor is not moving freely, that may be your only hope. The electronics in the servo controlled and direct drive turntables are fairly reliable, but sometimes a transistor or integrated circuit will fail in these. If it does, good luck finding the proper replacement parts. There are very few turntables still being manufactured, and parts (even replacement parts) may be hard to find. To make this more complicated, many of the integrated circuits used in these turntables are special-purpose ones that were even hard to find when they were new. A service manual will help some, but can't do a thing about the parts problem. A caution about servicing direct drive turntables -- NEVER turn on power to a direct drive turntable with the platter removed. You can cause permanent damage to the motor and the driving transistors.

As we mentioned before, the purpose of the tone arm is to hold the cartridge in the proper position to play the record. That sounds simple enough until you remember that the proper position is constantly changing as the record plays. Every tone arm is a little different in the adjustments available and the way they are executed, but the principles are the same with all of them. (We will not discuss the straight-line tracking tone arm, since this is not really a practical product for broadcast-

ing.) Usually the adjustments are made with the aid of some simple gauges and templates. Many times they will come with the cartridge, but they are easy to lose, especially if you have an older system that has not been used for some time. However, there are some simple ways to work around these.

The first thing you have to be concerned with is the height of the tone arm. The height of the arm at the pivot actually determines the "rake angle" of the stylus. With most modern cartridges, the stylus tip should be vertical with respect to the record surface. This is usually achieved when the tone arm is parallel to the record surface with the stylus resting in a groove. Careful measuring and a "calibrated eyeball" will help with this. Make sure the stylus is vertical when viewed from the front as well as from the sides.

The second factor in adjusting the tone arm is tangency. When a record is mastered, it is done with the cutting stylus perfectly tangent to the groove. When playing back the record, if the stylus is not tangent to the record, you will get excessive wear on the sides of the stylus and the groove walls. However, since the stylus is pivoted from a point at the end of the tone arm, it is only possible to have it perfectly tangent to the grooves at one point. This is usually chosen for the best compromise at the center of the playing surface of the record. You can make a simple gauge to check this by gluing a piece of graph paper on a 3 x 5 file card. Using a hole punch, punch a hole at the center of one end of the card at a point where two lines cross. Using a straight pin poke a small hole 2-3/8 inches away from the center of the other hole on the same grid line. You can then place this gauge over the spindle on the turntable and set the stylus tip in the pin hole. Adjust the position of the base of the tone arm and the mounting position of the cartridge so that the edges of the cartridge are parallel with the grid lines.

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When the height and tangency are correct, you can then set the tracking weight of the cartridge. This is usually done with a counterweight on the back end of the tone arm, but some arms use a spring arrangement to achieve the same results. Some tone arms have calibrated markings on them to assist with this adjustment, but many do not. Those that do are sometimes wrong. The best way to make this adjustment is with a stylus pressure gauge. If you do not have one, try to find one. The proper tracking pressure will save your records and your stylus life. If the arm is calibrated, set the counterweight so the arm is balanced. Then set the reference marker and adjust until the desired weight shows on the weight.

The final mechanical adjustment of the tone arm is the anti-skating. This adjustment is not included on some arms, but is helpful to reduce wear and to make life easier. The best way to adjust this is to use a record with no grooves in it and place the stylus on the record with the turntable turning. When the anti-skating is properly adjusted, the stylus will not move toward or away from the edge of the record. I like to set for a very slight amount of skating toward the edge of the record. In this way if the stylus skips it will not slide across the surface of the record.

After you have gone through all of this mechanical set-up, you may want to check out the electronics of your system. The output of the cartridge should be properly terminated, since the cartridge is usually an inductive device. The cables going to the pre-amp provide some of this termination, but the pre-amp provides most of it. Most broadcast pre-amps have a fixed termination that seems to work well with a variety of cartridges. The data sheet for the cartridge will tell you the proper termination to use.

Before attempting to play a record, be sure to check the stylus on the cartridge. Make sure it is not bent or excessively worn, either of which may damage the records played with the stylus. You can check for any bending of the

stylus by visually comparing it to a known good stylus. If you do not have one available, look to be sure that the shank, from the cartridge to the stylus tip, is straight. There may be a slight bend at the very tip to allow the stylus to be vertical to the record, but there should be no other bends on the shank. Stylus wear is usually checked using a special microscope. These are a bit difficult to obtain, as well as being expensive, so you may have to use a good magnifying glass. The tip should be round or elliptical (depending upon the type of stylus), with no flat spots. If you see any signs of damage, the stylus should be replaced.

To check the frequency response of the system, use a special test record and measure at the output of the pre-amp. At one time these test records were made by a number of companies, but the increasing popularity of the compact disc has made them hard to find. If you have a friend who is seriously into stereo, he may have one. If you find the frequency response is not correct, check the equalization adjustment of your pre-amp and the termination of the cartridge.

While you are checking things you may want to check the speed of your turntable. Some turntables have a strobe system built in to check their speed. If yours does, use it. If not, you will need a strobe disk. This is a special disk, usually made of cardboard, that has lines on it. When the turntable is operating at the correct speed, holding a neon or fluorescent light over the disk will make the lines appear to stand still. Most broadcasters are not that concerned about the absolute speed of the turntable, but any errors will make a difference in the timing of the music. On the other hand, some classical radio stations (yes there are a few of them left) may have some listeners who will call to complain that the turntable is "off pitch". They may describe it in musical terms, such as sharp or flat, but it is a direct result of the turntable running at the wrong speed. Some turntables provide speed adjustments, but many of the older ones do not.

Another speed related problem is wow. If you listen to a steady tone being played on the turntable, you may hear a variation in the pitch of the tone. This is usually due to some problem with lubrication or cleanliness in the mechanical system of the table.

Finally, a few thoughts about the records themselves. Records must be kept clean, and the best way to keep a record clean is to store and handle it properly. Records should be stored on edge in a proper inner sleeve in their jacket. Some of the broadcast equipment suppliers still sell replacement sleeves and jackets for records. They should be supported so that all records on a shelf are vertical, none of them should lean. Records should be handled by their edges and center only. Fingerprints on the grooves can be more deadly than fingerprints on CD's, and harder to remove.

Static electricity is also a problem with records. The vinyl in the records builds up a static charge and attracts dust like a magnet. While there are many ways to deal with this, I have found the most convenient is a specially treated brush that should be used to wipe the record before each play. You can still find these in better stereo stores. Try to avoid the sprays that you apply to the record. Some of these can do more harm than good, and some can actually damage your records, especially if they are not used strictly according to the instructions.

Yes, many radio stations have retired their turntables and tone arms in favor of CD's, DAT, or carts. However, not all music is available in these newer formats, especially some classical music and obscure "oldies." Your station may not be using them now, but the day may come when, like the engineer at the beginning, you are faced with having to make a turntable work. If you are still using turntables, perhaps this will take some of the mystery out of it for you. Who knows, in a few more years broadcast engineers and dyed-in-the-wool analog nuts may be the only ones left who know how to set up a tone arm.