AUDIO TOPICS

SCRATCH FILTERS: A MYTH THAT LINGERS ON

"Would you please supply me with a circuit for a scratch filter to suit my record player?" Every letter of this kind which arrives in our mail is evidence that a myth lives on. Let's make one more attempt to despatch it.

by Neville Williams

Most readers with a long enough memory will recall the circumstances which nutured the myth, when it was much younger — circumstances involving 78rpm shellac records and early vintage magnetic pickups.

In those days, record "scratch," as it was most commonly called, was a very real problem. Behind the sound reproduced from every standard disc was a continuous frying noise or crackle. Listeners, perforce, had to put up with it and accept it as philosophically as they could, as a characteristic of reproduction from mass-produced discs. They listened rather enviously to the almost silent acetate transcription discs used by broadcast stations, and to sound-on-film reproduction, which might hiss but at least it didn't crackle!

The noise from the old 78rpm discs — frying, crackling, scratching — resulted primarily from the granular nature of the material from which they were pressed. Writing in "Wireless World" in November, 1939, well-known engineer and author M. G. Scroggie had this to say:

"What is heard is due mainly to the material of which the record is composed. At one time abrasive material was intentionally included in the mixture with the object of quickly grinding the playing needle to the contour of the groove.

"The choice of materials now is determined chiefly by a balance between economy and physical properties such as hardness, durability, uniformity and so forth."

The reference to hardness may sound rather strange to modern ears but it must be remembered that, up to that time, the idea of lightweight pickups, in the real sense of the term, had not emerged.

Pickup design proceeded from the assumption that a standard interchangeable needle had to be used. This involved a needle chuck with a set screw to hold the needle in place; attached to the chuck, there had to be the internal mechanism of the pickup, which generated the actual audio signal.

It added up to quite a large mass, which needed to be wiggled by the groove, and the playing weight on the needle point had to be quite high to make sure that it stayed in the groove during heavily modulated passages. Playing weight on the needle point ranged from 3 to 7 or more ounces compared with modern standard lightweight pickups, which have a playing weight of as many grams — or less! (There are approximately 28 grams to one ounce.)

A typical formulation for shellac records was given as:

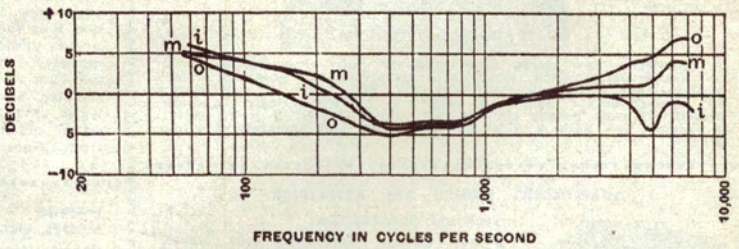
Slate dust	56 p.c.
Orange lac	22 p.c.
T.N. shellac	16 p.c.
Rosin	4 p.c.
Lamp black	1.5 p.c.
Cotton flock	0.5 p.c.

It is apparent that slate dust made up more than half of such a mixture and, however finely it was ground, the dust constituted hard, discrete particles protruding from the surface of the bonding material. These discrete particles, striking the tip of the playing needle, were responsible for the scratch.

Not surprisingly, perhaps, consideration of the problem led to speculation as to whether the scratch tended to concentrate in a particular frequency region. If such turned out to be the case, it was reasonable to assume that a filter, tuned to this region, would markedly reduce the intensity of the scratch, without affecting too much the overall sound reproduction.

As early as 1931, Buchmann and Meyer (E.N.T., May, 1931) published curves which are reproduced herewith. They indicate the relative intensity of total record surface noise plotted on a decibel scale against frequency. It is seen to distribute across the whole audio spectrum from 60Hz to 7KHz, which probably represented the limits of measurement then possible. The effect of lineal groove speed is apparent, in that the high frequency components are emphasised in the outer grooves — something that could logically be expected.

Buchmann and Meyer's findings were lost, however, on a great many record enthusiasts. They observed that scratch could often be reduced markedly by connecting a filter to the output of the pickup tuned to attenuate frequencies in the region of 3.5KHz.



Buchmann and Meyer's frequency-analysis of record surface noise. Tests made on outer, middle and inner grooves are distinguished by o, m and i respectively. The decibel zero is arbitrary.

It was a case of believing ears rather than curves and a whole generation of experimenters fiddled with resonant circuits in series or in parallel with the pickup output leads, seeking to tune out the troublesome scratch.

In fact, neither curves nor ears were wrong, only the assumption of what was going on.

Surface noise did, in fact, appear to concentrate in the 3.5KHz region but not because of any characteristic of the surface itself. It was simply due to the fact that, by reason of their construction, most of the pickups of

the day had a marked resonance in this region. So also did many loudspeakers. The noise itself was distributed over the whole spectrum but it seemed loudest in the region where the system gain was highest.

What the experimenters of the day were doing was to provide not scratch filters, but pickup filters. In fiddling with the attenuation characteristic, they were fitting it not to the record, but to the pickup.

In the article referred to earlier, M. G. Scroggie related how he quite independently verified the findings of Buchmann and Meyer, using silent grooves on shellac pressings and a G.R. wave analyser, an instrument capable of measuring selectively signal components anywhere in the audio band.

With a wide-range professional Telefunken pickup, the surface noise was found to distribute over the whole audio spectrum. With a typical needle-holder type pickup, a sharp peak was evident at 4KHz, some 5dB above the adjacent plateau area. This latter pickup would have been an obvious candidate for an attenuation filter tuned to this frequency.

Relative to 1969, the matter can be re-stated thus:

(1) Record scratch never did peak at a particular frequency and the time-honoured concept of a scratch filter is erroneous.

(2) Modern vinyl records contain no particle-type fillers and do not suffer from "in-built" scratch.

(3) Even if the facts of (1) and (2) were otherwise, the filters devised for old-style magnetic cartridges would be quite inappropriate for modern crystal and ceramic cartridges.

Compared with the surface noise of the old style 78 rpm shellac pressings, that produced by modern L.P.s is very small indeed — or at least it should be.

Modern records do have the characteristic, however, that the plastic materials from which they are pressed can acquire a surface electrostatic charge, which will attract particles of dust and lint. Interposed in the path of the tiny, jewelled stylus, such particles can produce noticeable clicks and pops.

Some records contain an inhibiting dopant (e.g. "Catenac" supplied by Dow Chemical) which renders the disc less prone to picking up dust and lint.

It is also possible to buy anti-static fluids which are supposed to achieve a similar effect, although not everyone agrees with the idea of a surface film on a disc, no matter how thin the film may be.

But dopants or fluids notwithstanding, the golden rule for modern discs is to expose them as little as possible to dust and lint.

Before each playing session clean off the turntable platter with a brush, a lint-free duster or a damp rag.

Transfer the discs direct from their sleeves to the platter and back again, handling them only by the edge and the label area.

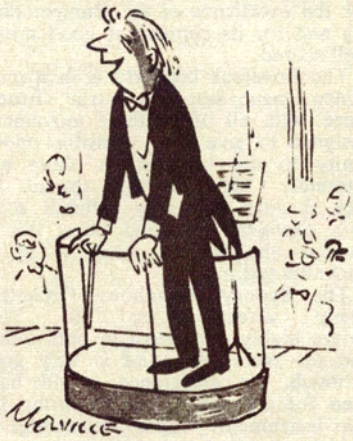
Never lay them flat on a table, a lounge or anywhere else, while you look for the jacket.

These are very simple precautions which involve no effort, only care by all those handling your records.

It is possible, of course, to go to greater lengths, as by the use of a "Dust-Bug" or other such device. Go the "extra mile" if you wish but care is the major part of the battle.

Not suprisingly, the observations made earlier in the article about old-fashioned scratch apply in general to the odd crackle and pop which may be heard from a modern record system. The audio spectrum of such noises will tend to peak where the gain of the system is highest, notably on a response peak of the cartridge or loudspeaker.

Whereas old-fashioned pickups used to peak at about 3 to 4KHz, modern cartridges tend to peak at about double this frequency, or beyond. If the peak is a prominent one and the loudspeaker also has a strong response in this region, clicks will tend to be exaggerated. The simplest cure in such a case is to turn down the treble tone control until surface clicks are attenuated without — one would hope — too great a loss in the high frequency content of the program material.



And now we would like to play a little number that has been climbing up the charts for the last 200 years. ("TV Times").

Fortunately, with a response peak at 7KHz or above, a good deal of rolling off is possible before the balance is compromised below ordinary medium fidelity standards.

Some amplifiers intended for the hi-fi market have a control to attenuate high frequency components, variously marked "High Filter," "Noise," "Scratch," or some other such term. In some cases, it merely provides extra treble cut and is little more than a gimmick. In other cases it gives a sharp roll-off above some selected frequency and is a useful facility for records with a particularly noisy surface.

In this connection, it should be noted that the severity of surface noises can be aggravated by excessive bass boost and any tendency to low frequency feedback. Over-emphasised bass can easily turn a "click" into a "bong."

The best approach, undoubtedly, is to select a cartridge and a loudspeaker system which is as free as possible of peaks within the audible range. Used with records which are properly cared for, such a system will suffer so little from surface clicks and pops, that it will disturb no one but a zealot. ■