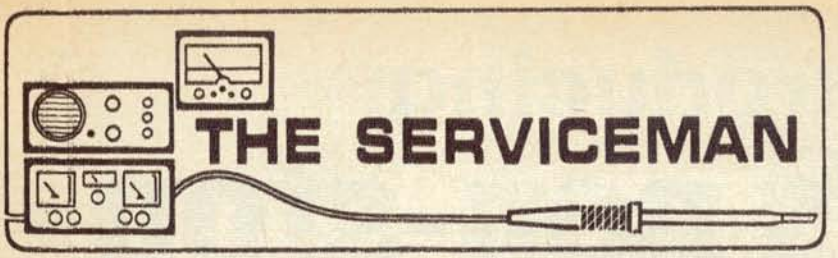


# *Acoustic feedback problem that wasn't*

Any good detective story will confuse the trail to the culprit by one or more false leads. The format isn't quite as rigid with serviceman stories but they do occasionally turn out that way.

This particular story concerns a former client who moved into another suburb, rather off my usual beaten track. Over the years, I had looked after his radio and later his television problems but, some time ago, he retired and bought another, smaller, home more suited to his declining years. In the normal way, I imagine that I'd have forgotten all about him.

Recently, however, he rang and reintroduced himself—complete with a new problem.

I gather that, when he moved into the new house, he indulged a long-standing ambition and bought a quite expensive stereo amplifier system with, he explained, "a special cabinet for the amplifier and radio and two separate loudspeakers."

The equipment had performed well for two or three years but now it was giving trouble.

"What kind of trouble?"

The conversation that followed was fairly typical of the efforts one has to make to piece together a story that makes technical sense from the observations of a strictly non-technical person. Sparing you the details, however, it appeared that the amplifier would be playing along quite normally when, all of a sudden, the music would get louder and the whole thing would break into a violent rumble.

He had to race over and turn down the volume and lift the pickup off the record. He could then start it playing again and everything would be normal —until next time!

At first, the equipment misbehaved only on isolated occasions but now the trouble was recurring more frequently, so that he could count on it happening at least once during an evening's listening.

"Can you possibly come over and have a look at it for me?"

Frankly, I wasn't keen to get involved. To trace and fix a fault is one thing but to wait around somebody's place until a fault showed up was quite another. And there certainly wouldn't be much point in taking the whole thing into my shop for listening tests.

From the description, the trouble sounded very much as if it had something to do with acoustic feedback: Sound waves from the loudspeaker agitate the air in the room and may also vibrate the floor. Some of this energy may reach the pickup stylus, causing it to vibrate and generate a spurious signal which drives the amplifier. This drives the loudspeaker harder, which vibrates the pickup stylus and so on, in a vicious circle. The end result, as often as not, is a rumble which builds in violence till it threatens the eardrums, if not the equipment itself.

Most hi-fi equipment in ordinary home situations suffers from the effect to some degree, some energy from the loudspeaker making its presence felt at the pickup.

The effect may be so slight as to be unnoticeable. It may, on the other hand, tend to make the bass sound a little "drummy" or cause the system to emit a dull "bong" when equipment is bumped or somebody walks too heavily across the floor. Turning up the volume or the bass control tends to make it worse.

And, of course, there are the cases where the equipment will break into active oscillation, even before the volume and/or bass controls have been advanced to a desired playing level. This is where the situation really gets sticky.

Being basically an acoustic problem, there isn't much point in diving in with a soldering iron and multimeter. One may have to start moving the furniture round, or looking for a too-springy floor, or experimenting with the suspension of the record playing deck. It can be a fiddling, time-consuming business in which one seldom comes up with a complete cure. As often as not, one succeeds only in reducing the magnitude of the trouble.

If the problem is going to show up, it normally does so at the time the equipment is installed. There is no special reason to expect it to show up later or to be intermittent and, in this respect, the present complaint didn't quite add up to expectations.

However, a few things can happen which might turn a potential trouble into a real one. For example, the rubber or spring cushioning below the playing deck may gradually subside or distort, allowing the deck to rest against the cabinet work; this may be all that is necessary to transmit vibrations to the pickup and stylus, or the stylus suspension may change its characteristics slightly.

Quite differently, a pier beneath the house may subside enough in a dry spell to allow the floor to vibrate!

Inside the amplifier, gradual loss of capacitance in the filter and decoupling components may aggravate potential oscillatory condition involving acoustic feedback.

As for the allegedly intermittent nature of the trouble, I was inclined to put it down to the possibility that the equipment was on the verge of instability, requiring only a sustained loud passage or a heavy footfall to start it going. This would be aggravated if the nature of an individual recording required the volume or bass controls to be advanced slightly beyond their accustomed settings.

With these rather speculative thoughts in mind, I said that I'd call in some time, if I was over that way, and at least see if I could pick out any tendency, even if I didn't get to hearing the actual "performance."

About a week later, another telephone call advised me that the amplifier had now become so unreliable that it would only run for a few minutes without misbehaving. Couldn't I please call in today, tomorrow or at least before the weekend?

There was nothing for it but to go!

When I duly made the call, I had only listened to the system for about three minutes when it "took off" quite violently. Immediately it did, I turned the volume control down, perhaps rather more hurriedly than the owner had been used to doing. The volume went down, then jumped up again, complete with rumbling, as the potentiometer hit the stop.

What was this? A faulty control?

I left the control where it was and hurriedly lifted the pickup off the record. In the comparative silence that followed, I could hear a gentle hiss and hum. Walking across, I ascertained that it was coming from one channel only, just as if the volume were turned right up on that channel. Yet I had turned the volume right off.

Gently working the control and listening to the hum confirmed the observation. There was an intermittent, presumably between the volume control resistance element and the earthy side of the circuit. When the intermittent opened, the channel was turned virtually full on, irrespective of where the control happened to be set.

No wonder the system—or at least that particular channel—took off in acoustic oscillation. In the confusion that followed, the owner could hardly have been expected to notice that one channel only was involved.

Sliding the amplifier out, I removed the top cover and felt the lugs of the potentiometer. I can't say that I was impressed by the rigidity of any of them and it seemed highly likely that faulty assembly was to blame. Short of completely disassembling the control, however, there was no way of attempting any kind of a repair and I certainly didn't have a suitable replacement with me. So I wobbled the lugs, re-soldered the connections to them and sprayed them with degreasing fluid, all with the idea that the fouling would be dispelled that had apparently built up between the earthy end of the element and the connecting lug.

Fortunately, luck was with me and, when the equipment was switched on again, I couldn't make it misbehave. I didn't regard the fault as being genuinely fixed and I arranged to drop in some time later when I had obtained a suitable replacement component. But, in the meantime, the old couple would be able to listen to their stereo music without having to jump and down like Jack (and Jill) in the box.

This story reminds me of another one about an amplifier which I had to cope with a couple of weeks back and which I roughed out at the time. It seems appropriate to include it here, just as I wrote it.

"Listen mate, would you have a look at this (adjectival) amplifier. It'd fair drive you up the wall."

In this uninhibited and distinctly Australian fashion, I was invited to service a small P.A. amplifier which was dumped on the shop counter.

I knew, without being told, that the amplifier belonged to a local social group. The man who delivered it went on to explain that it couldn't be relied upon. Sometimes it was "strong"; sometimes it was "weak."

"Sometimes it varies all over the flamin' shop!"

I gathered from this that the amplifier varied considerably in terms of gain and it was my job to find out why.

Lifting off the top and bottom covers, next morning, revealed it as a fairly typical small public address amplifier: An EF86 microphone preamp. stage, feeding a volume control/mixer arrangement; then came a 6BL8 wired as a pentode amplifier and triode phase-splitter, feeding a couple of EL84 output valves.

As I normally do with equipment suffering an intermittent condition, I left everything severely alone, until I had connected it up and switched it on. The proper time to push and prod amongst the components in such a case is when you're able to observe any effects of such pushing and probing.

Having connected the amplifier to a test loudspeaker and switched it on, I turned up the microphone gain control and, as I had expected, was greeted with enough hum and hiss to know that everything was working, apparently normally.

Then with an ear cocked to the sound in the loudspeaker, I clipped the earthy probe of the VTVM to the chassis, set the instrument to the 300V DC range and read off the HT supply voltages, then the plate and screen voltages of the EF86 mic. preamplifier; this followed by the cathode, on the 3V range. The HT voltage read around 260, the decoupled supply around 230, the plate and screen voltages around 70 and the cathode about 1.5. They all seemed normal enough but one thing I did notice: clicks through the amplifier, caused by the meter prod, seemed to disturb the gain slightly, as evidenced by the level of hiss and hum from the loudspeaker.

Next step was to measure around the 6BL8 pentode. Touching the meter prod on the grid produced the kind of buzz one expects from so doing, but showed no sign of any voltage which one might have expected if the preceding coupling capacitor had been leaky. The plate voltage was normal, likewise the screen . . .

Oops!

As I broke the connection between test prod and screen, there was a sudden silence, as hum and hiss disappeared. Very obviously, the gain had dropped by lots of decibels. By touching the prod on to the screen pin again, I found that I could induce a change of gain more or less randomly. What was no less significant, when the amplifier was in the low gain condition, touching the test prod on to the grid produced very little hum. The change was occurring from the 6BL8 onwards.

Another significant point was that the change in gain was apparently not reflected anywhere in a change of operating voltage. It seemed rather unlikely, therefore, that it was being caused either by a resistor or a valve.

The obvious component to suspect was the 6BL8 screen bypass, mounted rigidly on a tagboard and remote from the socket. A bit of prodding here produced the low-gain condition as an apparently permanent one. It seemed as though I had struck oil.

With hot iron and pointed pliers, I very carefully eased the suspect capacitor off the tagboard and clipped it on to the R/C bridge. More or less as I had suspected, it read open-circuit. In position, and while undisturbed, it had been alternatively bypassing the screen and leaving it float, partially or completely unbypassed. No wonder the gain had been "all over the flamin' shop."


*"How about that: Four dollars for one home service call!" ("PF Reporter").*

Needless to say, it didn't take long to install a new capacitor and put the amplifier aside as "fixed." I had every reason to hope that the members of the club could henceforth come down from their positions "up the wall."

Here is another story demonstrating the value of the "canned cold" technique. This was one of those "off the record" jobs undertaken out of working hours to assist a friend. However, it is none the less interesting technically for that.

My friend is a keen and fairly experienced electronics enthusiast. In the early days of TV he constructed his own TV receiver—a 17in type—which served him faithfully for many years. Then he took the opportunity to update it to a 21in type, using as a guide the circuit of the 1964 23in Television Receiver described in this magazine.

This had worked out quite well initially but, over the last few months he had become aware of a temperature sensitive defect. This involved the vertical deflection system. If, when the set was first switched on, the picture height and linearity were correctly adjusted, the gradual warming up of the set would, after about an hour, result in the bottom of the picture shrinking by up to an inch. This produced marked cramping in this part of the picture so that all the cowboys and their horses were running around on dachshund-like legs.

The problem was, where to look. My friend had tried to reason out which component would most likely cause this effect, but without much success. He wasn't even sure whether the trouble was in the oscillator or the output stage.

In fact, it was on this point that he approached me, hoping that I could at least narrow down the number of likely components. Otherwise he felt that he might have to change all the components in this section before he found the culprit. Since there was a considerable number involved, some of them fairly expensive, and a considerable amount of work involved in changing them, he wasn't particularly keen on this idea.

Unfortunately, I didn't feel much more confident about such a prediction than he did. For one thing the circuit was a fairly complex one employing, among other features, a feedback loop around the output stage to control height and linearity. And, while this is an excellent idea and produces very good results, it just isn't the kind of circuit which lends itself to speculation when something goes wrong.

As far as that goes, such circuits are not the easiest to service even when one has them on the bench. Even assuming that one can check the performance, i.e., waveform, with a CRO and recognises that it is not as it should be, it is another thing again to nominate the cause. Because of the feedback network the faulty waveform is likely to appear anywhere inside the feedback loop, making it almost im-

possible to determine at what point it is originating.

Of course, one can always disconnect the feedback loop. But where, as in this case, the loop contributes a significant amount to the final waveform, it may be difficult to predict how the circuit should behave without it. And if, as is quite likely, the fault is in the loop itself, how is one to find it, short of replacing each component in the loop. Which is more or less where we came in.

By the time I had discussed all these points with my friend he was feeling — and looking — pretty discouraged. Little did he realise that I was setting the scene for a dramatic revelation.

"It just so happens," I explained, when he had just about reached his lowest ebb, "That I have here the very thing to solve this otherwise insurmountable problem." (Well, perhaps "insurmountable" was going a bit far, but I couldn't resist a little dramatic licence.) At the same time I picked up my little aerosol freezer can and swept it on to the counter in front of him with a dramatic gesture.

"What is it?" he asked.

"I call it canned cold," I replied, "and it has already solved some otherwise very sticky problems for me." Then I went on to explain how it was used.

"Quite seriously," I concluded, "I think this is by far the simplest approach. We could try swapping likely components, or we could try to work out which component is most likely to cause the precise symptoms you describe, but I think this will do the job in a fraction of the time, with a minimum of effort."

As it happened Mrs Serviceman and I were due to pay a social call on my friend in a few days time, so we decided that this would present a good opportunity to put my theory to the test. I advised my friend how to set things up in advance, and we left it at that.

Thus it was that, accompanied by Mrs Serviceman, I arrived at my friend's place a couple of days later, armed with my can of cold and a lot of confidence. Acting on my suggestion my friend had switched the set on about two hours previously, carefully adjusted the vertical controls to just fill the screen, then let it run. By the time I arrived the bottom of the picture had shrunk exactly as he had described it. So, while Mrs Serviceman and my friend's wife went off prattling about such trivia as "pearl," "plain," "basques," and other incomprehensible things, my friend and I got down to the important business of the evening.

Fortunately, the underside of the chassis was easy to get at. The chassis was mounted vertically on one side of the cabinet, its flanges running in grooves cut in wooden strips mounted inside the top and bottom of the cabinet. It was thus possible to gain access to the underside of the chassis by removing the knobs and sliding the chassis backwards until it was about half out of the cabinet. The leads to the picture tube were long enough to permit this while the set was running.

This done my friend pointed to a moderate size resistor strip and explained that it supported most of the vertical oscillator and output stage

components. I noticed with satisfaction that the layout was a good deal more open that most of the previous devices on which I had used the freezer making it relatively easy to treat each component separately.

So, without more ado, and without bothering to identify the individual components, I started at the top and squirted each component in turn. At the same time my friend watched the screen, although we had also rigged a mirror so that I could watch it as well.

The first half dozen components I sprayed produced some unexpected side effects, and there were also a couple of false alarms. One side effect, caused by spraying a particular resistor, produced shrinkage at the top of the picture. Perhaps this wasn't surprising, seeing that the resistor had a crop of frost on it which would have done justice to a Christmas tree.

The false alarm was caused by the fact that most vertical scanning systems vary their scan slightly with changes in picture brightness. And, while this circuit is remarkably stable in this regard, there is still enough shift to be noticable when one is concentrating on a visible edge. Thus it was that, at the precise moment I sprayed a particular component, there was a change from a very dark picture to a very light one. My friend's immediate reaction was that we had found something, but a more critical look soon revealed the mistake.

To avoid this kind of confusion, it would be better to conduct such a test while a test pattern was available, although it is not a serious problem once the possibility is appreciated.

Finally, I had sprayed all the components on the panel, with one exception, without any real indication that any of them were faulty. The exception was a paper capacitor located behind the panel and not very easy to get at. So I twisted the spout of the freezer can as best I could to reach it, pressed the button, and gave it a good squirt.

I glanced at the mirror. The picture was the same as before. My friend looked at me and we shrugged our shoulders. It seemed my idea hadn't worked out. Then we both looked back at the screen and, lo and behold, the picture now filled the screen with something to spare. Nor was there any doubt about it, even the darkest picture filled the screen.

To make quite sure we let the set run while we had a cup of tea, by which time the picture had started to shrink again. We left it a little while longer until we were quite sure, then I gave the capacitor another squirt. Once again nothing happened for a few seconds, presumably the time needed for the cold to penetrate to the "innards" of the capacitor, then the picture expanded to normal size.

This seemed to put the matter beyond doubt. The capacitor was the .012uF sawtooth capacitor in the oscillater circuit, and was one of the old paper type. We found and fitted a modern plastic type, and reset the height and linearity controls. The picture remained stable for the rest of the evening and subsequent reports from my friend indicate that the trouble has been completely cured.

Another victory for the "canned cold" technique! ■