The Serviceman

TIME TO STUDY TRANSISTORS

The winds of change are blowing for servicemen and it won't be long before the trickle of transistorised equipment calling for attention becomes a flood. A mixed metaphor, maybe, but that shouldn't prevent you from getting the message — while there is still time!

To date, the average serviceman has not had to deal with overmuch transistorised equipment. His daily round is still largely occupied, as it has been for the past 10 years, correcting faults in valve-type television receivers, valve-type radios and valve-type stereograms. Transistor portables and the occasional transistor TV set, which look at all difficult, can still be shunted back to the shop specialists, who have the circuits, the spare parts and the know-how to cope with them.

But this procedure shouldn't be allowed to become routine, otherwise a lot of servicemen are going to find themselves acting as pickup and delivery men, while somebody else solves the technical problems—and both paid accordingly! The wise serviceman should, I think, be burning some midnight oil in the face of this changing situation, finding out a few things about transistors and the equipment in which they are being used.

And what better way of backing up such study than by tackling a few repair jobs—not with the idea of being paid on a per-hour basis, but simply with a view to gaining experience.

As you have no doubt guessed, these thoughts were prompted by an actual situation encountered, not by myself as it happens, but by a friend who is also in the servicing game. He is on the service staff of a large organisation which sells and services a wide range of electronic and electrical goods, including a few electronic organs, imported musicians' amplifiers and so on.

My friend's activities are normally confined to television sets and stereograms but a staff crisis, a few weeks back, projected him into the situation where he had to handle a couple of urgent jobs in the music field—if he could! His superiors happened to know that he was a proficient pianist and this, with his knowledge of electronics, made him the most likely recruit to fill the empty shoes.

The first job involved a guitar-cum-microphone amplifier that belonged to a professional musician. My friend picked it up in the course of his normal "television" rounds and took it home to work on that night—preferring to work quietly in his own time rather than display to the client his lack of experience with the particular equipment. The complaint was very bad noise on the microphone channel.

My friend soon established that the noise depended on the microphone volume setting, so that it was apparently in the microphone preamplifier stage. So, rather painstakingly, he traced out the circuitry on the wiring board, identified the collector, base and emitter components and, of course, the transistor itself. A check with ohmmeter and voltmeter showed nothing obviously amiss and led him to the idea that the transistor itself might have been the source of the noise.

The question was how to prove it.

With no circuit and no clear marking on the transistor, he could only assume that it was a PNP type, probably germanium, operating from a negative supply line. It so happened that he had a few such transistors among oddments in a screw-top jar and, wtihout further ado, he carefully removed the suspect transistor from the amplifier and wired in one of his own oddments.

Result? Plenty of gain and no noise to speak of.

Rather encouraged by how easily it had worked out, he returned the amplifier next morning, promising to return at the first opportunity with an "official" replacement transistor. In the meantime . . ."The one I put in will see you through. . ." (Here the client is supposed to express grateful thanks).

What I've recounted to this point I pieced together from a conversation when my friend rang me one evening in anything but a happy frame of mind. His next job had turned out to be much more sticky and this was the real reason for his pessimistic note — and his call!

It involved an electronic organ which exhibited a very strange fault. It would be behaving quite normally when, for no apparent reason, every B-flat note on the manual would sound an octave above normal.

And here's where my friend's musical background did, in fact, help. He could play the organ, he did verify that every B-flat was affected and he confirmed that the notes were perfectly on pitch, though an octave high. Since it had (mercifully) been late in the day, he explained to the client that he would prefer not to get too deeply involved just then. Having heard the trouble for himself he would see if he could rectify it. . . "probably tomorrow."

What he did, in fact, was to go home and ring yours truly, having recalled that I had exhibited some interest in electronic organs through the years. I might even be able to suggest where to begin looking for such a crazy fault!

I probably didn't sound too helpful at first. I knew nothing at all about the particular brand of organ — a Japanese make — and while the one book I had contained a few details of American designs, it had been written long before the Japanese entered the field on the present scale.

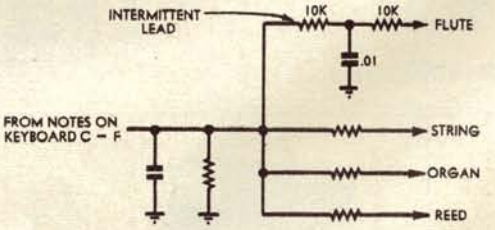
However, I was able to explain to him that most electronic organs had a set of twelve master oscillators providing signals for the topmost octave on the keyboards, or even an octave above that again. The frequencies provided by these master oscillators were passed through a series of 2:1 dividers, so that each oscillator, with its train of dividers, would provide signals for all notes of a particular name.

Since the trouble had to do with the B-flats in the organ, it would obviously be in the oscillator-divider chain providing these notes.

And, since the pitch of the notes remained true, I didn't think that the oscillator would be at fault. But, since all the notes jumped an octave, I felt that the trouble would be in the first divider. For some reason or other it was apparently intermittent; sometimes it did the right thing and divided the oscillator frequency by two at other times it was apparently passing on the same number of pulses that the oscillator was feeding to it. This caused it to produce twice its normal output frequency, the other dividers fed from it doing likewise.

"Why would it do this?" my friend asked. Not being an expert in transistor dividers, I could only hazard a guess that one of the components in the stage was intermittent or, perhaps, the transistor itself. It would be up to my friend to find which; but first he had to locate the suspect stage in a completely unfamiliar and apparently rather complex instrument.

As it turned out, knowing what to look for, he located the twelve master oscillators readily enough, and the sets of frequency dividers (or flip-flops)



An intermittent 10K resistor silenced one of the basic voices in an electronic organ.

associated with each. Then, with the organ switched on but not being played, he went over the twelve first dividers taking comparative voltage readings at corresponding points in the circuit assembly.

In his own words: "I checked them several ways and each time it was that B-flat divider that turned out to be the odd one out." This much established he switched off and tested the components as best he could, without finding anything amiss.

Could it be the transistor?

Once again, the screw-top jar yielded a transistor which seemed like a reasonable substitute for the original one and this was duly installed "pro tem" — which is a flash way of saying "until he could get the right one."

In fact, the substitute transistor worked perfectly and the organ showed no further inclination to switch octaves —which is always an advantage!

As they used to say when I was a boy: Another redskin had "bit the dust!"

The next story comes almost as a postscript and, in fact, was related to me by the same budding organ serviceman, just after I had finished writing up the other two. It concerned a fault in a single manual Japanese organ, which had the nasty habit of dropping completely the top six notes—C to F inclusive—when using the "Flute" voice.

Emboldened—and enlightened — by his previous experience, my friend worked out that, since the Flute voice only was affected, the trouble would not be in the oscillator or divider systems. It would almost certainly be in the signal distribution system — the control tabs, key contacts or the associated wiring.

Aided, on this occasion, by a circuit in the owner's manual, he found that the five suspect notes were passed as a group through a simple filter system, the Flute filter being two 10K resistors in series with the junction bypassed to chassis through a .01uF capacitor, as shown in the accompanying circuit. Since the String, Organ and Reed voices were not subject to the fault, the trouble more or less had to be in this Flute network.

A little manipulation with pointed pliers quickly revealed that the circuit through the first 10K resistor was intermittent, although the exact reason was not clear. However, once the resistor had been removed from the assembly board, it was apparent that the lead wire was floating loose in the resistor body. Whoever had bent the leads for insertion into the board had been more willing than wise!

It was only a few minutes' work to locate and instal another 10K resistor and to assure the owner that the trouble had been positively located and positively fixed.

If there is a moral to these stories it surely must be that, whether in radio or TV sets, guitar amplifiers, organs or other items of electronic equipment, the failure pattern of components is a fairly routine one. Servicemen proficient with one class of equipment should not find it too difficult to adapt to another—given some re-training and the willingness to burn a little midnight oil!

Having had so much to say about solid-state devices, it may be appropriate to squeeze in a couple of items which involved me personally.

The first one had to do with a transistor receiver which was being used by a patient in a hospital. His wife rang to say that he had accidentally knocked the set off his locker and that it didn't seem to go very well any more. She explained:

"It only gets the stations weakly, and they sound harsh. And there's a knob thing that doesn't seem to work."

Could she drop it in next day for me to have a look at?

I'm afraid I had a mental picture of some of the wrecked receivers I have seen in the past—receivers that have literally had to be brought in in a plastic bag: bits of moulded case, bits of dial, batteries and other gadgetry hanging at the end of wires and so on. I pointed out to the lady involved that I might have to send the receiver back to the distributor, if sections of it were broken for which only the distributor would have replacements.

What could be worse, if parts were not available, it might not be practical to repair it economically.

When the set was finally put on my counter, I was rather surprised to find that it was of local manufacture, secure in a protective leather case and free from any visible signs of damage. The sound from it was weak and distorted, to be sure, but I recognised immediately that the "knob thing that doesn't seem to work" was a fine tune roller intended to operate on the short-wave band only.

At the first opportunity I checked the batteries and found them to be be about as flat as any I've ever taken from a "still working" set. New batteries restored it to normal operation on broadcast and short-wave bands alike. In fact, there was just nothing wrong with the set.

Fairly obviously, the owner had been using it for long periods in the hospital but at very low volume, to avoid annoying other patients. This being so, he was quite unaware that the batteries had run right down to the point where they would have been quite unable to run the set at normal volume.

When he dropped the set, the owner naturally feared the worst and when, by way of test, he tried vainly to play all the stations at normal volume, his fears seemed to be well founded. Hence the report that the set was quite okay until it was dropped.

As for the fine-tune knob, my tip is that the owner either never knew or had forgotten what it was for and, when it didn't have any effect on the broadcast stations, he assumed that it, too, was broken.

Naturally, it was a very relieved wife who learned next day that the set was back to its old self, for little more than the cost of new batteries.

Another "I dropped it" tale which followed hard on the heels of this one concerned an imported battery-operated cassette type tape recorder. After being dropped, it still seemed to replay normally but would not record.

Again, I had to explain to the owner about special components that might have been damaged in the fall—internal projections from the case, printed wiring boards, integral switching levers and so on. However, I promised to have a look at it, in case it turned

out to be something that could be fixed simply.

Later, on gaining access to the "works," it was immediately apparent that the printed wiring board, on which most of the circuitry was mounted, was quite loose. It certainly did look as though it had been torn adrift from its mountings by the fall.

As a next step, I manipulated the switches on the front panel while peering under the board to see what they did—or were supposed to do. A couple of minutes of peering and pushing were sufficient to establish that the "Record" switch did not work because a small nylon collett was out of position. Once having spotted the trouble, it was only a matter of seconds to re-engage it.

It further became apparent that the collett had disengaged when the board jumped out of position — apparently when the recorder hit the floor. But how was I going to hold the board firmly to its mounting again?

Very simply — by tightening the mounting screws!

Nothing was broken; none of them was stripped.

In fact, the board had apparently been loose on its mountings for a long time; it may never have been tightened before it left the factory!

As long as the recorder was treated with the care that a proud owner lavishes on something new, all was well. But a drop to the floor was a different matter.

If the screws had been tight, the drop would almost certainly not have affected the recorder and the owner would have had not more than a few moments of dismay. As it was, he had to wait till he phoned me next day to learn that everything was "jake"—again at the cost of a modest service fee.

And now some comments regarding a couple of points raised in the January and March articles. First, the matter of incorrect polarity markings on batteries. One reader writes:

Dear Sir,

In response to your request for experience concerning incorrectly marked batteries, I would like to record a recent case. It was a (brand) type (number) cell, with the label upside down.

A simple, and what should be a very obvious fault like this can cause a surprising amount of trouble. In this case, the cell was purchased along with three others by a young lady who was quite inexperienced in electrical matters. She fitted the cells to her Japanese portable radio herself.

When the set (almost new) performed poorly, she took it to a serviceman, who reported there was nothing wrong with it, and who returned it, no charge.

I saw the set a week or two later and confirmed that its performance was down. It had the poor volume and high distortion charactertistic of low batteries. I did what the serviceman had probably done—checked each cell for voltage, and then checked them under load. They were all O.K., so I turned to the set itself. It operated perfectly from a power supply, so, puzzled, I replaced the batteries. They were replaced according to the shape of the cells rather than according to label. It was then obvious that one cell was "upside down," and a second look showed that the label on the cell was indeed reversed.

I thought at the time that such a fault must be very rare, mentally kicked myself for not noticing it immediately, and promptly forgot about it.

If your reader from Orange has had two examples, it is possible that it is not so uncommon. I expect there have been quite a few who, like me, have had the experience, and let it go at that. I would be very interested to see the response to your request for similar experiences. Yours faithfully,

K. E. H. (Cremorne, N.S.W.).

The interesting point about this letter, I feel, is not so much that it reports another battery wrongly marked, but rather that it describes, as an actual happening, the kind of inconvenience which this kind of thing can cause. On the other hand, with typical production running into millions of cells per year, the number of cases reported so far can only be regarded as a negligible percentage.

The second comment concerns the story in the January issue about the premature demise of a couple of portable radios while in the vicinity of an amateur transmitter. Our correspondent is a radio operator who gives his address as one of the coastal vessels operating off Western Australia. He writes:

Dear Sir,

Reference your correspondent's story about mobile transmissions doing in the front end of transistorised noise producers. This tallies with what I used to think what would happen, but experience has shown otherwise, in my case anyway.

I am a marine radio op., and since transistor radios became common nearly every crew member has his own in his cabin and, in non-Pantenna equipped ships, every one has his own aerial. (Observe the display of wire on most Australian ships.)

On this vessel there are six crew aerials on the bridge alone, each about 40ft vertical length, approx, parallel to my main aerial and emergency aerial down leads, within 10-15ft of them. My Transmissions range from 410KHz to 22MHz on spot frequencies at approx 300 watts up the spout.

I used to warn people not to put aerials anywhere near my gear (to keep them clear of DF loops, and to protect the front end of their radios). However experience has shown them it doesn't matter, as far as damage to their noise boxes goes, and so every ship is cluttered up with bits and lengths of wire close to transmitting gear. I think the only way to permanently mute these sets is to hook the main transmitter on to their aerials.

In fact, I have usually one or two of these boxes in the radio shack for repair, etc, and they are usually within 10 feet of my transmitter aerial leads (copper tubing on stand-off insulators). I use the transmitter as required, and the only effect, I can detect, is to mute them, or splatter their output, or produce Morse only interference, depending on mode (CW, MCW or R-T) and frequency in use. They recover almost immediately on transmission ceasing. I had put it down to AVC-AGC action, on overload,

This should start some argument.

Best regards, W.B.

Well, so much for that reader's observation. Any comments? ■