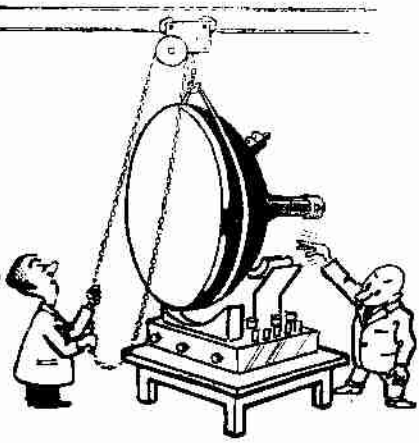
In your Workshop



This month Smithy the Serviceman takes advantage of a quiet period to discuss, with his able assistant, Dick, topics ranging from intermittent connections to frame buzz

"Do *what?*"

"Polish the bench tops", repeated Smithy.

The Serviceman gazed unemotionally at his outraged assistant.

"But they've never been polished before", protested Dick. "*Ever.*"

"All the more reason", commented Smithy, "for starting now."

The Workshop was going through one of its periodic quiet spells. Whilst plenty of work had been coming in for repair, faults were of a simple order and required little diagnostic skill on the part of either Smithy or Dick. In consequence, the pair had found that they had an unusually large amount of spare time on their hands. Smithy, philosophic as ever, had taken advantage of the situation to catch up on his paperwork, and to force his rebellious assistant into spring-cleaning the Workshop.

However, even Smithy was a little taken aback at Dick's reception of his polishing suggestion. He decided to change his tactics slightly.

"You'll be amazed", he remarked mildly, "at the difference a bit of polish makes to the benches. There's something psychological about it."

"Schizophrenic is the word *I'd* use," said Dick bitterly. "And it applies to split-personality Servicemen who get Service-minded!"

Coil Formers

With much grumbling Dick set about his task; and he reluctantly rubbed polish into the linoleum-topped benches. It was his own inventiveness which, fortunately, prevented a complete rupture in Workshop relations. After having applied the polish Dick set himself to the manufacture of a buffing-wheel from old rags fitted to the hand electric drill. This turned out to be quite successful, and he was able to bring up a shine in not much more than twice the time it would have taken to do the job by hand.

"There you are, Smithy," he remarked proudly, as the overloaded hand drill finally screamed its way into silence. "Operation Bullshine is now complete!"

"Good," said Smithy approvingly. "And I think you'll agree that a bit of polish does make the place a bit more cheerful."

"I suppose it does," commented Dick, grudgingly. "At least it will be easier to spot elusive nuts and bolts against the shiny surface. But, please, Smithy, let's give this spring-cleaning a rest! Why don't we face up to the fact that things are quiet and relax for a bit? It's a long time since we had a gen session, and I'm bursting with queries."

Smithy looked at his papers. He disliked quiet periods just as much as his assistant.

"Fair enough," he said. "You get the kettle going whilst I finish off what I'm doing here. Then we can have a nice cosy rag-chew."

Dick needed no second bidding, and it wasn't long before he and Smithy were comfortably settled with cups of tea in their hands.

"The first question", said Dick, wasting no time, "has to do with coil formers. As you know, we've had quite a few television tuner units in recently with very thin-wall s.r.b.p. formers. When you try to adjust the oscillator cores in these formers you sometimes push them right in. What's the cure for that?"

"Well," said Smithy. "Let's begin at the beginning. The type of tuner you're talking about has its coils mounted radially on a disc rather than in a drum. Right?" Dick nodded an assent. "Now the formers in these tuners have indentations along their length which interfere with the core threads, so that the latter can be screwed in and out. These formers also have very thin walls, and the indentations tend to be somewhat weak in consequence. Before going any further, I think I should make the point that you shouldn't, in any case, apply too much pressure to such cores."

"The indentation strength seems to vary from former to former," Dick volunteered.

"That may well be the case," confirmed Smithy, "and I have little doubt that the formers are very tricky to manufacture. Now, let's get down to the instance where you've been unlucky enough to push the core right in, whilst attempting to adjust it, and you want to get it out again. When this happens, the indentations in the former are usually sufficiently wrecked for it to be impossible to screw out the core, even with the lightest of pressures. What I always do then is to find the approximate position of the core by feeling for it with a screwdriver, and then lightly press the blade of another screwdriver on to the outside of the former at that spot. (Fig. 1 (*a*).) The second screwdriver slightly distorts the former and gives the core a purchase. I then unscrew the core until it has passed the distortion given by the second screwdriver, and re-apply the latter over the new position of the core. Three or four operations of this nature are usually enough to unwinkle the core."

"What about a pair of taper-nosed pliers instead of the second screwdriver?"

"Not so good," said Smithy. "The screwdriver blade takes up much less room on the former, and you can insert it between the turns of Band III coils, if necessary, without disturbing them."

"That seems fair enough," remarked Dick. "How about re-fitting the core again?"

"Well, you can't just re-insert it, of course, or it will slip down all over again! What I do myself is to pop a bit of cigarette paper in the former before re-inserting the core. A double thickness about an eighth of an

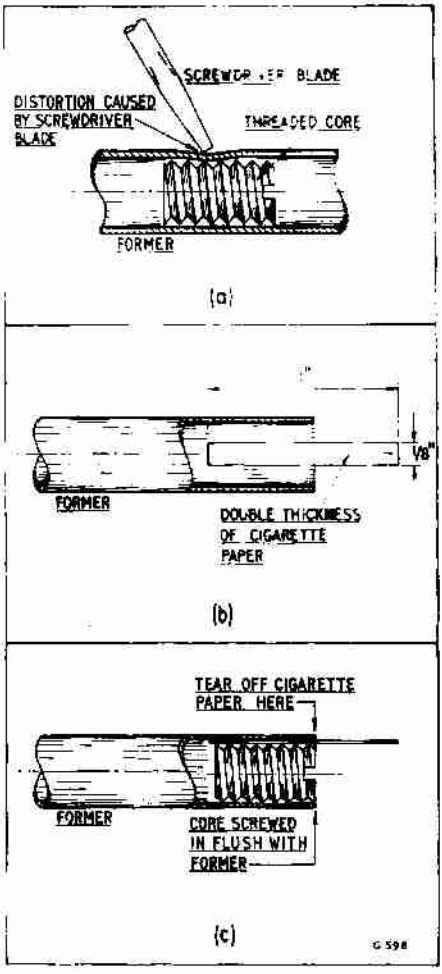


Fig. 1 (a) The cores in thin-wall television tuner formers occasionally become pushed down and cannot readily be removed. If the former is distorted by light pressure from a screwdriver, as shown in this cross-sectional view, sufficient interference is provided to enable the core to be unscrewed. (b) Before the core is re-fitted it is advisable to lay a small piece of cigarette paper inside the former. (c) The bulk of the cigarette paper provides added interference, and ensures that the core does not slip again. When the core has been screwed in flush with the end of the former, the excess paper should be torn off

[1] S.R.B.P. is an abbreviation for "synthetic resin bonded paper". This material is more commonly known under trade names such as Paxolin.

inch wide and an inch or so long popped in for two-thirds of its length usually does the trick. (Fig. 1 (*b*).) The extra bulk provided by the cigarette paper causes adequate interference with the core over the distance through which it normally has to travel, and you can adjust it with no further trouble. I should mention that, after you've screwed the core in flush with the end of the former, you should tear away the protruding cigarette paper. (Fig. 1 (*c*).) You may occasionally find that you only need one thickness of paper, or that you need more than two, but the first few turns of the core will soon tell you whether it's too tight or too loose."

"Any special type of cigarette paper?"

"Nothing particular. The ordinary white paper you buy in packets at the tobacconist's for rolling your own cigarettes is quite adequate."

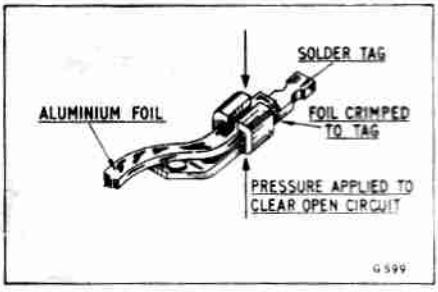


Fig. 2. The lead-out connection shown here, whereby a length of aluminium foil from the inside of an electrolytic condenser was crimped to the solder tag, caused an intermittent open-circuit. The fault was cleared by applying light pressure to the crimp in the direction indicated by the arrows with a pair of side cutters

"Hmm," said Dick. "Does this cigarette paper idea clear loose cores in the heftier sort of former you find in i.f. transformers and the like?"

"It does sometimes," said Smithy, "but you have to be careful not to use too much or you may jam the core and break it. It is worth mentioning that there are several highly viscous lubricants on the market which are ideal for application to loose cores, a well-known example being Kilopoise 0868G.[2] These lubricants are more useful to the professional service engineer, of course. Application is dead simple: you just smear the stuff on the core or on the inside of the former. The lubricant then holds the core in position without stopping you from adjusting it. Ordinary soft soap works pretty well on a job of this nature, too!"

"*You* should know about soft soap!"

Smithy ignored the interruption.

"Any other queries?"

Intermittents

"Oh yes," said Dick. "I bumped into rather a queer sort of intermittent the other day. It was a t.v. receiver and its line blocking oscillator just refused to work. I broke its h.t. supply whilst searching for the fault, and then re-connected it whilst the set was on. And, blow me, if the oscillator didn't go like a bomb! And it's never stopped since!"

"The basic fault there", remarked Smithy, "is an oldie which has plagued service engineers ever since the radio game started, well-nigh. What probably happened in your case was that you had a dicey connection somewhere in the oscillator circuit, and the pulse of current given by the sudden application of h.t. welded it over and made it good. Normally, the relatively slow rise in h.t. given by switching on the receiver wouldn't give the connection the pulse it needed. I would guess that, in your instance, the ropey joint was in the blocking oscillator transformer itself.

"The first time," continued the Serviceman, "I bumped into something like this was before the war. I had a sound receiver which gave a thin and reedy output until, with the volume turned up, it reproduced a loud burst of music. It then cleared itself and the receiver gave correct reproduction. However, if the set was switched off for a few hours the reedy reproduction would return once more, only to be cleared by another heavy burst of sound."

"Where was the snag?" asked Dick.

"So far as I could tell", said Smithy cautiously, "it was in one of those intervalve a.f. transformers that we used in those days. At any event, the trouble disappeared when I fitted a new component. The infuriating thing was that the old tranny showed perfectly good when tested with an ohmmeter. I must admit, of course, that the ohmmeters we had in those days passed a fair old current, and this may have been enough to bridge the gap, as it were."

"Have you encountered this snag recently?"

"Now and again," said Smithy. "It's like a No. 11 bus: you don't see one for ages, and then you get a lot in a rush. In a recent case I had an a.f. coupling condenser which gave the same symptoms as my old transformer set. That is, reedy reproduction until a thump of music made the set work O.K. again. I suppose that there was an internal

[2] Kilopoise Lubricants are manufactured by Rocol Ltd., Rocol House, Swillington, Leeds.

intermittent in the condenser and that, in its faulty condition, it exhibited a low capacity only. Another recent instance concerned a cathode bypass electrolytic. In this receiver, though, the fault didn't affect frequency response. What happened, instead, was merely that the gain was rather low until a loud pulse of a.f. came along; whereupon the receiver provided full amplification. I located the fault to the cathode bypass condenser, and I assumed that this was open circuit during the low-gain periods. The particular component fitted had strips of ali foil coming out of the innards, these being crimped to the solder tags. (Fig. 2.) The bad connection was at the crimp, and I made it good again by applying light pressure to it with a pair of side cutters. Due to their small contact area the cutters applied quite a high pressure to the junction of ali foil and solder tag material, thereby breaking through any oxides that might have formed on either surface. This process cured the intermittent altogether."

Frame Buzz

"Another fault that's come my way", remarked Dick, "is frame buzz in t.v. receivers."

"Another cup of tea, please."

Dick got up and replenished Smithy's cup.

"I was saying, "he repeated, "that I've been getting quite a few cases of frame buzz recently."

"Ah, yes," said Smithy, sipping his tea appreciatively. "What you mean is the audible buzzing in a television receiver which occurs at frame frequency and which is quite distinct from mains hum. Even though the frame frequency is the same, at 50 c/s, as that of the mains."

"That's right," Dick remarked, "so what I'd like to . . ."

"Some people", continued Smithy, completely ignoring his assistant, "refer to it, fairly obviously, as frame 'tick'. The first thing to remember is that frame buzz may come either from the loudspeaker or from the frame output transformer, or both. It *could* come from the frame deflection coils as well, but I've never met such a case myself, and I don't intend to give it serious consideration at the moment."

"Yes," put in Dick. "Well, what I was about . . ."

"An important thing to bear in mind", Smithy sailed on, "is that what appears to be a trifling case of frame buzz in a service workshop may be absolutely infuriating to the viewer at home. The reason for this is that the ambient background noise level in the average workshop is surprisingly high, much higher than exists in many customers' houses. So always treat a complaint of frame buzz with respect, even if it does seem to be insignificant when you get the set on the bench. I don't know what you've done this morning, Dick, but this tea is almost acceptable for human consumption. I'm certain that the County Veterinary Officer would say that the horse was fit for work."

The Serviceman smacked his lips approvingly.

"You *always* come out with that corny old gag," remarked Dick bitterly. "Anyway, to get back to the buzz. I was first of all going to ask you about possible sources and whether low-level cases should be considered."

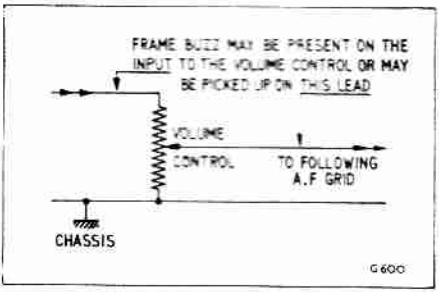


Fig. 3. If adjustment of the volume control varies frame buzz level, the buzz may be picked up in the circuitry and wiring preceding the volume control, or on the lead connecting to its slider

"But I've already answered those questions."

"Yes, I know," continued Dick patiently. "So let's get on to the next step. What's your usual procedure for curing frame buzz?"

"Ah," said Smithy. "Well, the first thing I do is to switch on the set, putting it on to a dead channel if necessary, listen for the buzz, and try to localise its source. That is, try to see whether it comes from the speaker or the frame output tranny. It's a funny thing, but frame buzz is of such a nature that it is sometimes quite difficult to determine which of these two things it comes from, particularly when the cabinet is still on the chassis. Should I feel at all doubtful I normally give the volume control a waggle. If buzz reduces to zero, or very nearly to zero, as the volume control is set to minimum, then I'm certain that the buzz is coming from the speaker and that it is being picked up either before the volume control or on the lead connected to its slider. (Fig. 3.) The possibility of pick-up before the volume control represents an obvious diagnosis. The idea of pick-up by the lead connected to the volume control slider may not be quite

so obvious, until you remember that the slider short-circuits this lead to chassis when it is set to minimum.

"Very often there isn't any noticeable change in buzz level as you adjust the volume control. This does not mean, though, that the buzz is not coming from the loudspeaker, as it could still be picked up in the a.f. stages after the volume control. So, if the source of buzz is still doubtful, the next step is to short-circuit the speaker. If the buzz then stops, it is obviously coming from the speaker. If it remains, it is obviously coming from the frame output tranny. You may notice, incidentally, that so far it hasn't been necessary to remove the cabinet, if the set is at all conventional."

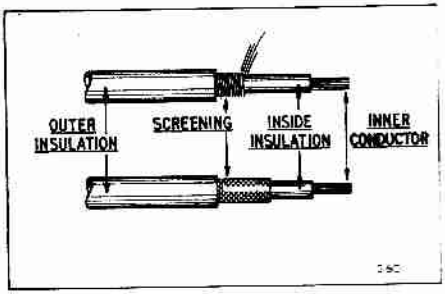


Fig. 4. The screened wire employed in many present-day receivers has an outer conductor consisting of several strands of wire wound spirally around the insulation of the inner wire. Such wire is shown in the upper diagram, conventional braided screening being illustrated below

"Suppose the buzz *does* stop when you short out the speaker?"

"You proceed", said Smithy, "to find out where the buzz is getting into the receiver a.f. stages. The buzz can be picked up from any part of the frame circuits; from the sync separator feed into the frame oscillator to the output leads to the frame deflector coils. The most common snag is poor dressing (or positioning) of leads in the frame circuits. Particularly suspect here are the usually long leads which travel to the frame hold and linearity controls, and to the frame deflector coils. The set is almost bound to have frame flyback suppression and any lead which carries the suppression pulses to the tube base also becomes suspect. Should any of these leads approach the a.f. wiring, the a.f. components, or the a.f. amplifying valve or valves, then you may well get sufficient cross-coupling to cause frame buzz from the speaker. In practice, it's usually pretty easy to sort out bad dressing, as all you have to do is to move the appropriate leads around gently with an insulated rod and listen to the buzz. When you move a lead which is causing trouble, the consequent change in buzz level normally sticks out a mile. I might add, incidentally, that I've been able to cure quite a few cases of bad dressing without having to take the cabinet off at all."

"What about the earlier instance where buzz level changed as you adjusted the volume control?"

"More or less the same rules apply. With the exception that you know that the buzz is being picked up in the volume control circuit or in the circuits immediately before it. It's fairly usual to have long screened leads running to the volume control, and these may quite possibly run close to frame circuits. You should check that the screening on these leads is reliably earthed. Also that all the metalwork of the volume control *and* the metal bracket on which it is mounted, if any, is also correctly connected to chassis in the manner intended by the manufacturer. In tough cases I've once or twice had to earth the screening of screened leads to the volume control at both ends, the manufacturer having earthed it at one end only. And don't raise your eyebrows and mutter about 'hum loops', Dick my boy! There isn't usually enough gain in a t.v. a.f. amplifier to give trouble on *that* score. Another point is that you shouldn't rely too much on the screening of the screened leads, either! Very often, the outer conductor of the screened leads used by manufacturers these days consists of a spiral of wire around the centre conductor instead of the braided arrangement you get in coaxial cable. (Fig. 4.) The spiral outer conductor may occasionally 'let in' a bit of frame buzz if it is *very* close to high amplitude frame points.

"If the buzz is being picked up before the volume control you may have to look at quite an extensive bit of receiver a.f. circuitry to find the pick-up point. Starting at the sound detector you may, for instance, have to pass through an interference limiter diode as well as a choke or two before the volume control even hovers into view. Plenty of high-impedance points there to pick up buzz!"

"Hmm," grunted Dick. "Not so easy. Any other route via which frame buzz can get into the a.f. stages?"

"Very occasionally", replied Smithy, "it gets in along the h.t. line. Some sets decouple either the sound stages (Fig. 5 (*a*)) or the frame output stage (Fig. 5 (*b*)) to overcome this risk. If such decoupling exists you can, of course, always check it by popping another condenser across that already in circuit. If both the frame output and the a.f. stages are run direct from the h.t. line you *could* decouple the latter from h.t. with the aid of

an additional resistor and condenser. Something like 500Ω and 32μF should meet the bill there. However, this is a real Custer's Last Stand remedy."

he could quite possibly wreck the transformer."

"The inexperienced types have got to start somewhere," said Dick, reasonably.

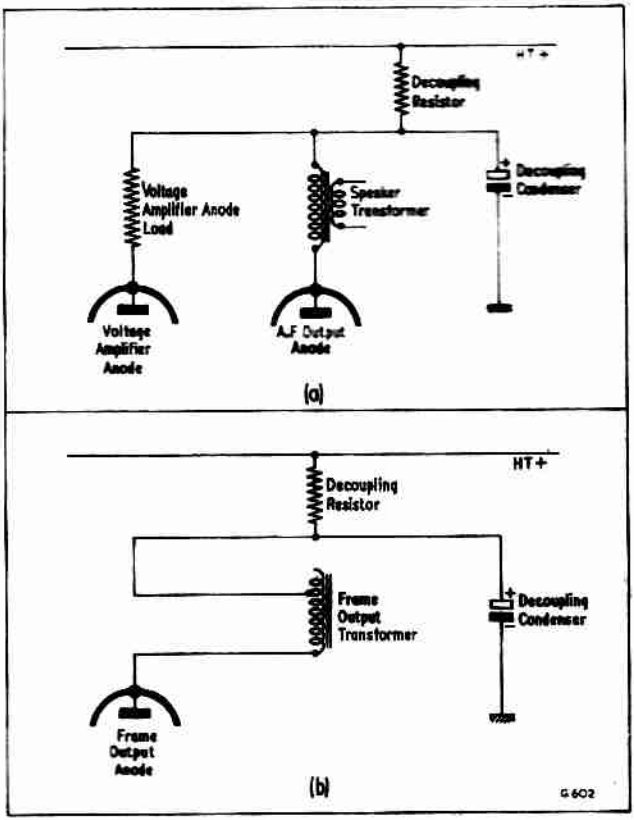


Fig. 5. In order to prevent frame buzz being passed via the h.t. positive rail, some receivers provide additional decoupling for the a.f. stages, as in (a), or for the frame output stage, as in (b)

Lamination Buzz

"What's the remedy if the buzz comes from the frame output tranny?"

Smithy looked a little cautious.

"Well", he replied eventually, "the obvious answer to a frame output transformer which buzzes too much is to swop it for a new one."

"You don't sound very sure," commented Dick.

"That's because I'm in a bit of a quandary," confessed Smithy. "You see, there is very often a simple basic fault in a buzzing frame output transformer which can be cured by any knowledgeable sort of geyser with very little fuss at all. The trouble is that if an inexperienced chap attempts the same repair

"That's true enough, I suppose," conceded Smithy. "So I might as well pass on the necessary information. But I'm going to make the point here and now that anyone who attempts some of the more difficult repairs I mention must take upon himself the full responsibility for any accidental damage he does to the transformer."

Smithy walked over to the spares cupboard and rummaged around.

"O.K. then!" he remarked briskly, returning to his seat. "Now the frame output transformers you're liable to meet in the average t.v. receiver will be simple butt-laminated jobs like one of these two." As he spoke, Smithy showed Dick the two trans-

formers he had taken from the cupboard. (Fig. 6 (*a*)). "By butt-laminated I mean that the E and I laminations with which the tranny is made, (Fig. 6 (*b*)), are not interleaved, but are all put in one way round with a piece of gapping paper between them."

"Wouldn't you get more efficiency with interleaved laminations?"

"Not in this instance. Interleaved laminations—that is, alternate Es and Is like you get in a mains transformer—would saturate at the higher frame output currents, and the iron wouldn't truthfully follow the sawtooth in the primary winding. If you put a break in the magnetic circuit—as you do with the butt-lamination arrangement saturation occurs at a much higher primary current.

"Now, the gap at the butt-joint is extremely important in frame output transformer design. It is normally provided by a piece of tough paper of selected thickness, the lams being pressed up against it on either side. If you play around with a frame output transformer you must take great care not to accidentally increase the gap, or you may get what might well be incurable non-linearity. Also, the reduced primary inductance resulting from the increased gap may cause the frame output valve to draw increased current at the end of the scanning stroke at the bottom of the picture. Since most frame output valves are already straining their guts at the end of the scanning stroke this extra current is quite liable to seriously reduce their useful life."

"What happens if you reduce the gap?"

"You may run into non-linearity again due to the increased inductance, together with the possible risk of incipient lam saturation. The increased inductance may also, in a marginally-designed frame output stage, increase flyback time. With the result that you get frame foldover."

"The frame output tranny appears to be a touchy bit of goods," remarked Dick.

"It is certainly touchier," said Smithy, "than most people imagine. Right! Now that I've delivered my Awful Warning about the gap, let's get down to the buzz.

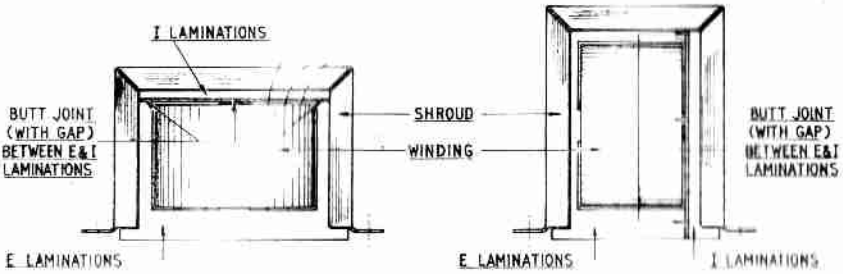
"If the frame output transformer causes buzz, this can come either from the gap, because the Es and Is are not held securely against each other, or, more frequently, by vibration from the Is or the limbs of the Es. The first cause of buzz is obvious enough, and is usually the result of previous maltreatment of the transformer. Someone has probably bashed it around a bit and loosened the lams. If such is *obviously* the case it may be worth while trying to tighten things up mechanically by bolting the shroud down more tightly to the chassis, or by attempting a cure of the type I'm going to discuss in a moment.

"The second and more prevalent cause of buzz, where the individual lams vibrate, is pretty easy to understand. All the lams are magnetised in the same way so, as the current through the primary increases during the frame cycle, the mutual repulsion they suffer goes up. It may happen that, with certain types of shroud, part of an outside lamination is not held down at all, and that it is free to vibrate as much as it likes. If this is the case just bend it out and cut it off. There's no point in attempting to clamp down just one part of one lam.

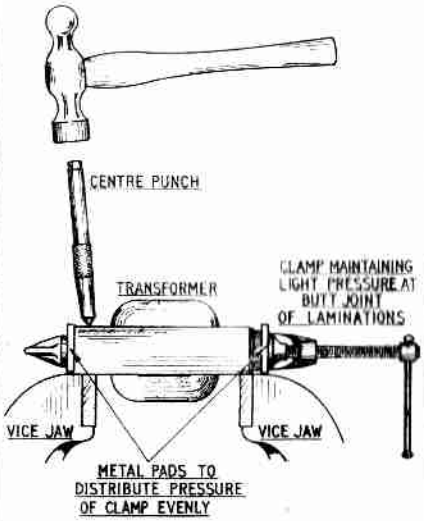
"Usually, however, the lams are loose within the shroud. And now we come to the dicey bit! You can often clear such trannys by primarily fitting a clamp to keep the Es and Is together and then putting small dimples into the shroud with the aid of a fairly blunt centre-punch and hammer, the underside of the shroud being supported by the open jaws of the vice. (Fig. 6 (*c*)). Don't tighten up the clamp too much; just give it enough to feel that pressure is being exerted. And there must always be a supporting vice jaw underneath the particular dimples you're making. Half-a-dozen dimples spaced around the shroud are all you need normally. (Fig. 6 (*d*)). Then you turn the tranny over and repeat the dimpling process on the other side of the shroud."

"What happens if tag-boards or terminals get in the way of the clamp or the vice jaws?"

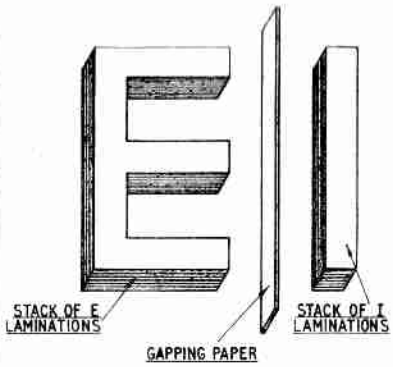
Fig. 6 (a) Two conventional frame output transformer assemblies. It should be noted that, whereas bolting the left-hand assembly to a heavy chassis ensures that pressure at the gap between the E and I laminations is maintained, the right-hand assembly does not provide this facility. (b) Showing graphically the manner in which the laminations are brought together in a butt-laminated transformer. When the transformer is assembled the two stacks of laminations are pressed together, the only separation being provided by the gapping paper. The latter, shown rather thick here for purposes of illustration, normally has a thickness lying between 0.01 and 0.001 inches. (c) Tightening up laminations. The E and I laminations are held together securely with the aid of a clamp, whilst dimples are put into the shroud with the aid of a centre-punch and hammer. The underside of the shroud is supported on the open jaws of a vice. (d) Six dimples on either side of the shroud, spaced as shown here, should be sufficient to clear most cases of lamination buzz


I LAMINATIONS
BUTT JOINT (WITH GAP) BETWEEN E&I LAMINATIONS
SHROUD
WINDING
BUTT JOINT (WITH GAP) BETWEEN E&I LAMINATIONS
E LAMINATIONS
E LAMINATIONS
I LAMINATIONS

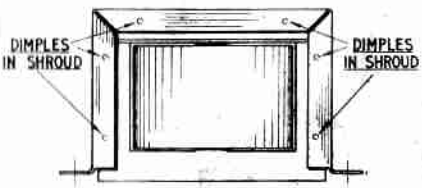
(a)


CENTRE PUNCH
TRANSFORMER
CLAMP MAINTAINING LIGHT PRESSURE AT BUTT JOINT OF LAMINATIONS
VICE JAW
VICE JAW
METAL PADS TO DISTRIBUTE PRESSURE OF CLAMP EVENLY

(c)


STACK OF E LAMINATIONS
GAPPING PAPER
STACK OF I LAMINATIONS

(b)


DIMPLES IN SHROUD
DIMPLES IN SHROUD

(d)

G 603

"You have to dream up suitable spacers to prevent damage to them", replied Smithy. "But these should not be beyond normal ingenuity. As I said before, the process is a piece of cake for those who've had plenty of experience, but it may have disastrous consequences in the hands of the unpractical."

"That's fair enough," commented Dick. "Are *all* frame output transformers laminated in the same way as the ones we've just discussed?"

"Nearly all of them are," said Smithy. "Although there are a few filtering on to the market now with C-cores, and things like that. However, these tend to be semi-potted in encapsulating material. If any of *those* should buzz, and I think it's extremely unlikely, I think you'd be forced to swop it."

A Clear Outlook

"Well," said Dick reluctantly, "that seems to be it. The teapot's empty, the kettle's empty, and I've run out of questions!"

"You could", said Smithy, rising from his chair, "do a little more cleaning up, you know. The windows are getting a bit murky, for instance."

One glance at his assistant's horrified expression was sufficient for Smithy.

"O.K., O.K.", he chuckled. "I'll forget it for now. The only other practical idea I have to offer is that you take the rest of the day off."

This particular suggestion was by far the most popular mooted by Smithy that day; and it was put into immediate effect with such a flurry of coat-changing and such a slamming of the door that even that imperturbable gentleman was mildly surprised.