

In this third & final article, we conclude the assembly procedure for these wide range electrostatic speakers & give some hints & tips on obtaining the optimum sound quality.

By ROB McKINLAY

Wide range electrostatic loudspeakers; Pt.3

Last month, we finished assembly of the half panels of which there are 12. One of each pair of half panels was fitted with the diaphragm which was tensioned and painted with a conductive coating. The next task is to assemble the pairs of half panels together. The result will be four complete bass panels and the two central treble panels.

Before assembly takes place, wires should be attached to the panels for the audio drive signal. The half panels which have the diaphragm attached should have a red wire connected to the metal grid. The match-

ing half panels should have a black wire attached to their metal grids. The panels which have red wires attached are mounted at the front of the finished speaker system. This procedure ensures that all panels are in phase when they are connected together.

The two matching half panels are placed face to face with the diaphragm in the middle. Using the channel section supplied, clip the two halves together. A small cutout will need to be made in one long channel section to allow for exit of the EHT wire. Mark the channel section where the cutout is to be made. Drill a 10mm hole

through the flange close to the channel web, then use side cutters to cut the flange out to make a 'U' shaped cutout.

Clip the channel over the two half panels starting at the EHT terminal end and push it firmly towards the centre. Ensure that the two panel halves line up with each other.

The front panel wire (the red one) is passed under the panel before the bottom channel is clipped on. It will be necessary to break out some small pieces of plastic matrix to allow easy exit. Solder the red wire to an eye terminal. Screw a brass nut onto the

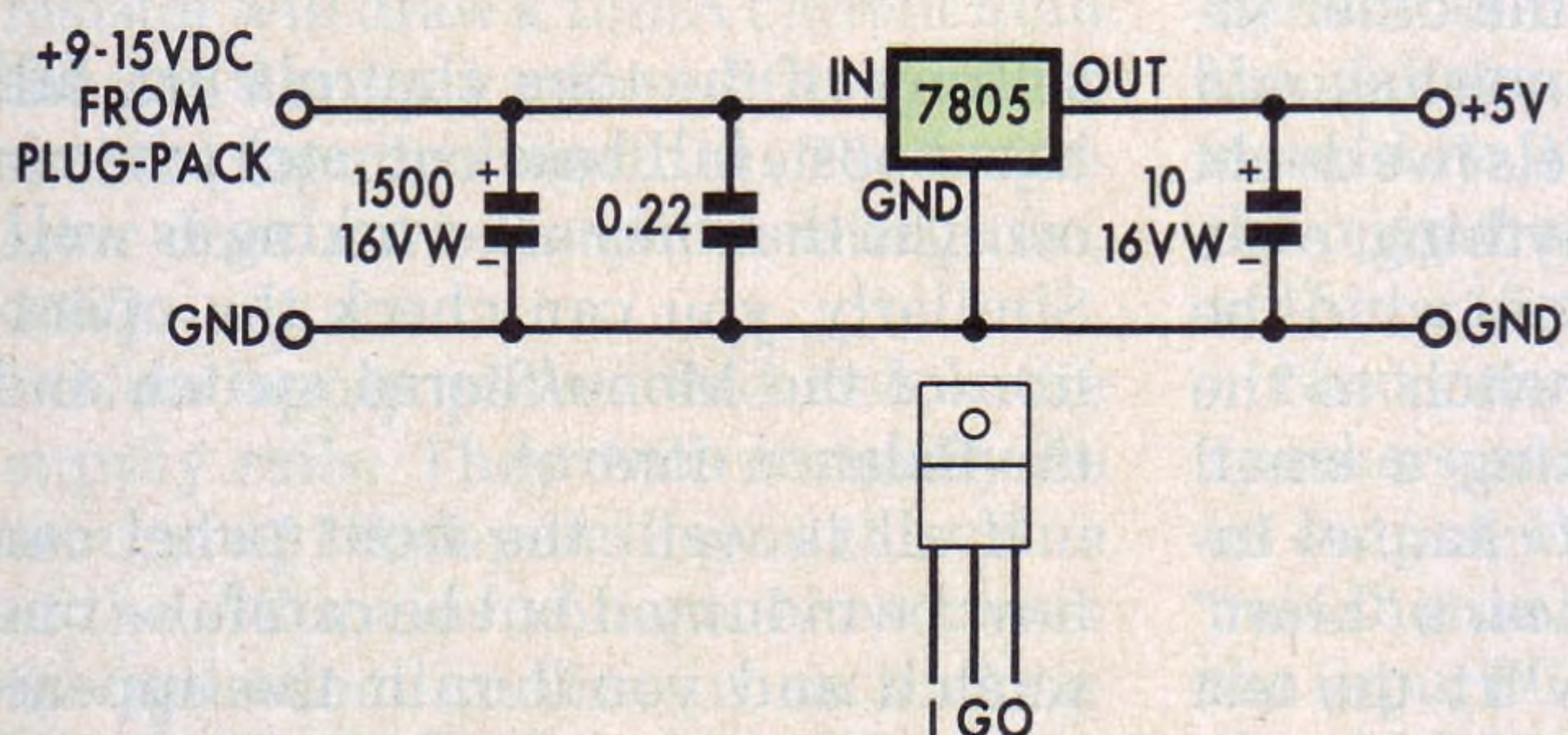
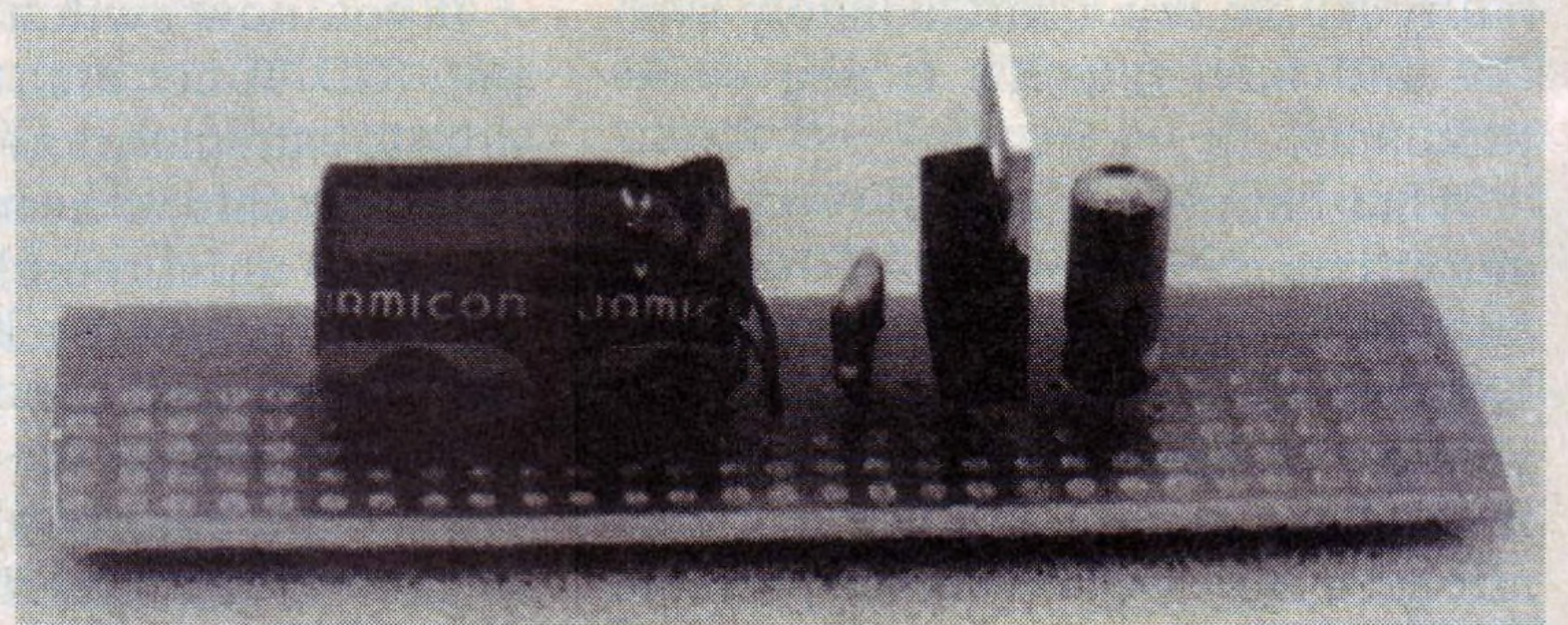


Fig.1: this circuit provides 5V DC to the EHT inverter in both electrostatic loudspeakers.



The 5V regulator is supplied pre-assembled on a piece of Vero-board but the wiring must be completed before it can be used.

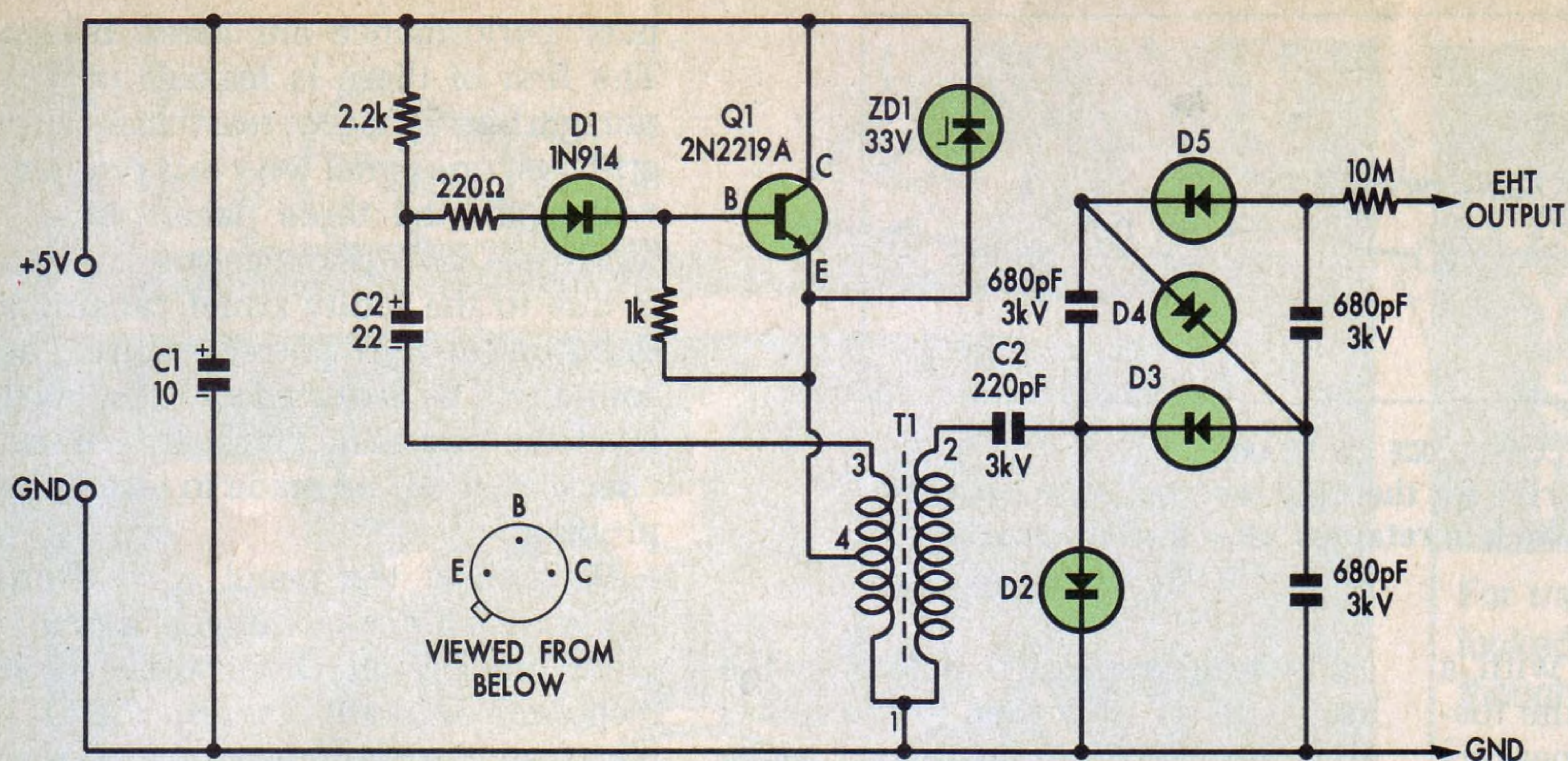


Fig.2: the EHT inverter is a 1-transistor blocking oscillator feeding a 2-stage Cockcroft-Walton voltage multiplier. It generates about 3kV to provide the polarising voltage for the three electrostatic panels in each speaker.

terminal screw. Do not overtighten. Place a brass washer on the connection. Break out sufficient matrix toward the bottom of the panel, to allow the eye terminal to sit flush on the connection allowing the wire to pass underneath the completed panel.

Now clip on the bottom channel section. The black audio wire should be soldered to an eye terminal which is then bent through 90° to allow connection to the rear grid through the plastic matrix segment. Fit a 3mm brass nut onto the connection screw and tighten it but do not overtighten it.

Place a 3mm brass washer on the connection followed by the eye terminal, another washer and a brass nut. Tighten carefully.

It may be necessary to break out some small pieces of matrix to provide sufficient clearance for the terminal. This procedure is carried out on all panels.

The three panels are installed in the speaker frame with the treble panel in the centre. There are two pairs of bass panels with left hand connections and two with right. One of each is used per finished loudspeaker.

The three panels are connected in parallel; ie, all three red audio wires connected together, all three black audio wires connected together and all three EHT wires connected together.

Electronic assembly

Three electronic modules need to be put together to provide the EHT supply for the speakers. Briefly, a 9V

DC plugpack feeds a 5V regulator module which is mounted in its own small plastic case. The 5V DC from the module then supplies a DC-to-EHT inverter in each loudspeaker cabinet.

Fig.1 shows the 5V regulator circuit which is quite standard. This is supplied in the kit pre-assembled on a small piece of Veroboard. It needs to be soldered and assembled into its plastic box. The two sets of output leads are wired to 3.5mm jack plugs. These plug into 3.5mm sockets on the rear of the loudspeaker cabinets.

The DC-to-EHT inverter circuit is shown in Fig.2. This is essentially a 1-transistor blocking oscillator driving a 2-stage Cockcroft-Walton multiplier.

WARNING!

The voltages generated by the EHT supply and the step-up audio transformer are very high. **Never touch the output cables or terminals from the audio transformer with the amplifier running.** The high voltage output from the transformer, depending on the amplifier used, could reach 5kVAC. **This is a lethal voltage.**

The EHT supply operates at about 3kV with very low current. The high voltage capacitors used will retain a charge for some time after switch off. Always discharge the EHT cable to ground before making any connections or doing any work on the speakers.

It produces an output of close to 3kV with a 5V DC input.

The circuit is wired onto a small PC board, using the component layout shown in Fig.3. One of these boards is required for each complete electrostatic loudspeaker. Each board is mounted in its own plastic box which is itself mounted in the base of the speaker cabinet.

Final wiring

The photo of Fig.5 shows the details of the wiring. At left is the audio transformer which is driven from one channel

of a stereo amplifier. The transformer has two primary windings and these are connected in parallel but with a 1.2Ω 10-watt wirewound resistor in series with each winding. The high voltage side of the transformer has three connections. The centre tap is connected to the 0V connection of the EHT board. The two other terminals are connected to the paralleled red and black wires from the three electrostatic panels. Finally, the EHT output from the inverter board is connected to the paralleled EHT wires from the three panels.

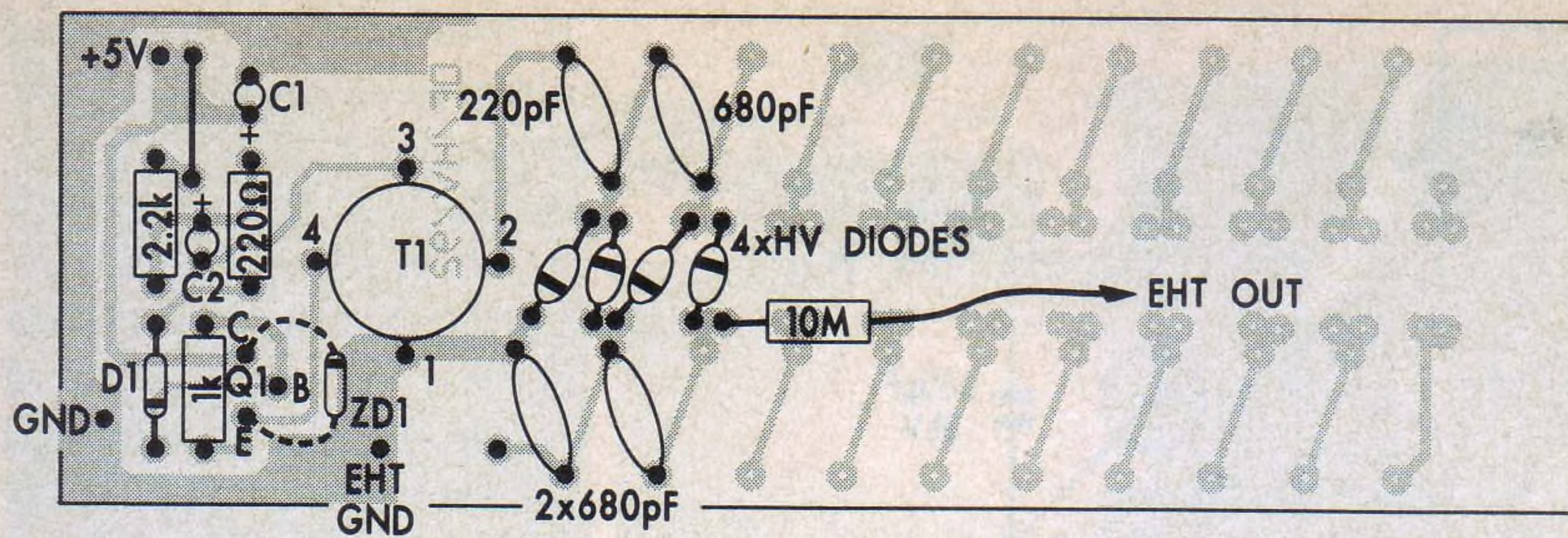
All of this high voltage wiring should be terminated in an insulated terminal block, as shown in the photo of Fig.6.

When all the wiring is complete, the back panels should be installed so that listening tests can begin.

Operating the electrostatics

The loudspeakers will take two or more hours to reach their optimum state of charge. When reached it will be maintained by the internal electronics. The plugpack power supply should be permanently connected and switched on. Its power connection is quite small (less than five watts).

Optimum loudspeaker placement is dependent on room size and shape. The following suggestions are guidelines to achieve the best performance from the ESL III's. Start with the loudspeakers about one metre from the rear wall and, in a 3.5-5 metre wide room, about half a metre from the side walls. Toe the speakers in towards the listening position.



MOUNT ZD1 ON COPPER SIDE OF BOARD

Fig.3: this is the component overlay for the EHT inverter. Note that it generates a very high voltage which is retained after switch-off (see warning panel).

Play some familiar music with a centre stage vocalist. Adjust the toe-in on one or both of the loudspeakers to make the vocalist appear centrally located. Room interference effects may cause one loudspeaker to be toed in more or less than the other. It may be necessary to toe-in the speakers until they are pointing directly at the listening position. The speakers may now be moved either closer to or away from the rear and side walls to achieve the best bass response.

The loudspeaker panel is designed as a symmetrical vertical array. This produces the best sound quality at ear level when seated. To reduce tonal variation when standing, tilting back the loudspeaker may be desirable in some rooms. The spikes supplied will provide the necessary adjustment. It is advisable to fit the spikes after the best position has been found for the speakers. This will avoid damage to floors and toes!

Use some packing to determine the best angle of lean, then fit the spikes and carry out fine adjustments. Make small adjustments to toe-in and lean; they can make big differences to the sound quality.

These loudspeakers radiate sound from the rear as well as the front. To avoid adverse effects on the imaging, it may be necessary to have some sound absorbent material such as heavy curtains on the rear wall or in the rear wall corners. You can expect to devote a few hours of "tweaking" to achieve the best results.

Like most high quality loudspeakers, the ESL III's will need running in. It will take two to three weeks of normal use before the diaphragms reach maximum compliance. You will notice better bass and improved treble after this period.

Troubleshooting

Some common problems causing

poor performance are listed below. The first of these is leakage of diaphragm bias voltage to rear (black wire) grid. Just one panel with this problem will cause the three panels in one loudspeaker to perform poorly. This is due to the faulty panel causing a drain on the EHT power supply. The sound will be distorted and at a lower level than normal. There are several checks that can be made to locate the problem.

Disconnect the panel wires from the terminal blocks. Connect a multi-meter on a high Ohms range (200 megohms or more) between the EHT wire from the diaphragm and the rear grid audio wire (the black one). The reading should be "open circuit".

If a finite reading is obtained, there is a conductive path between the diaphragm and its connections to the grid. To check this, split the panel into its halves and use your multi-meter to check both half panels. If a finite reading is again obtained, the problem lies on the relevant half panel. The cause is likely to be some conductive material which has been caught between the foil tape or the connection point and the grid.

If no reading is obtained when the panel is disassembled, the problem will be between the diaphragm and the grid. Look for conductive material between the grid and diaphragm: hair, lint, fine wire and insects can all cause problems. Absolute cleanliness during construction pays off. During each stage of construction, vacuum any dirt or grit from the panels.

Flakes of dry conductive coating can cause problems if they get in the wrong places. Always remove your gloves away from the construction area. If the conductive coating is being applied in more than one session, wear new gloves.

Other causes can be: the centre tap of the audio transformer not connected to 0V on the EHT supply or one grid wire not making a good connection; EHT supply not working properly; the conductive coating on the diaphragm applied incorrectly (ie, patchy, too light or not making contact with the EHT foil tape); and finally, the diaphragm tension may be too low.

Care of your speakers

The timber cabinets should be oiled occasionally. Grille cloths should be lightly vacuumed from time to time to

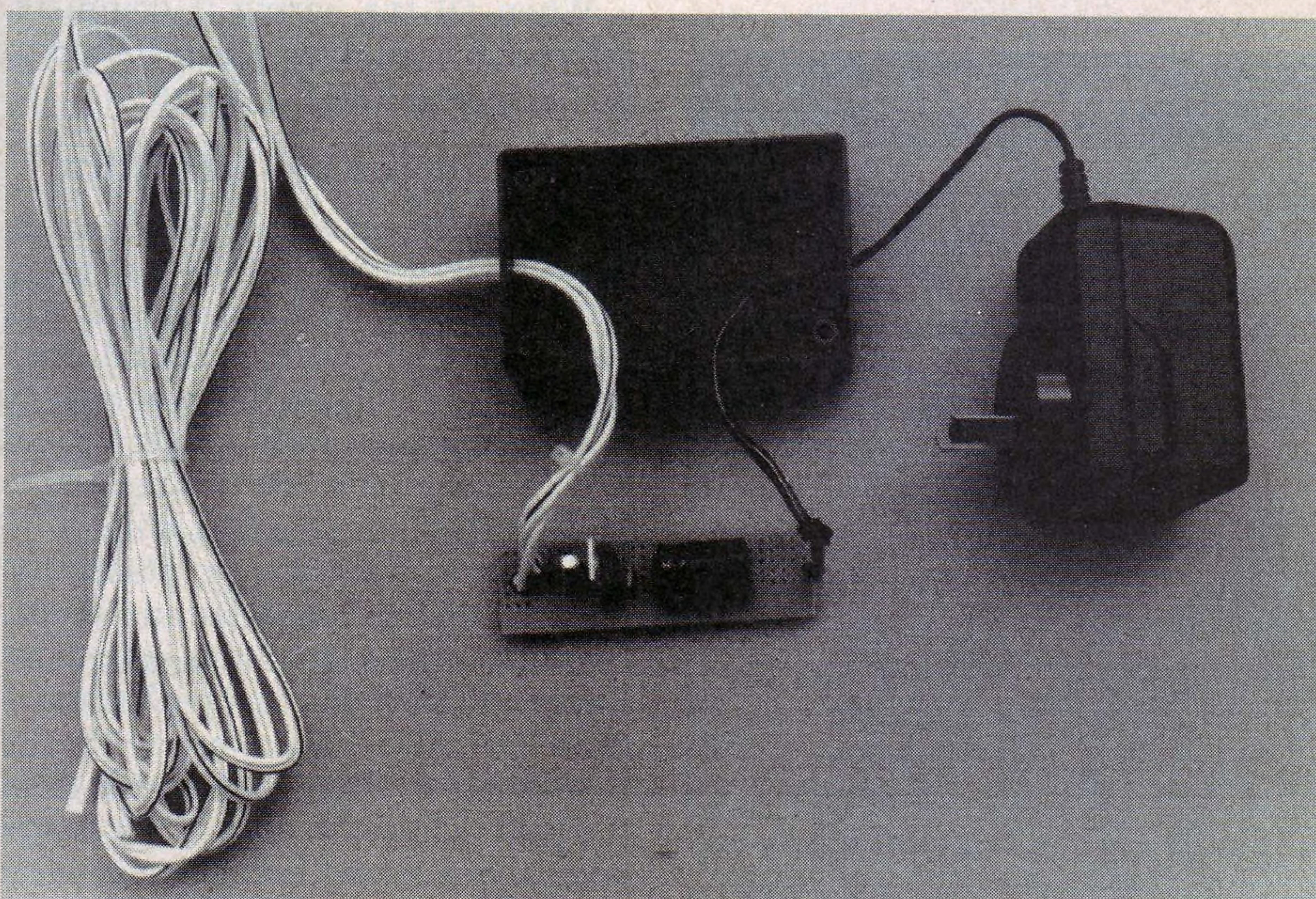


Fig.4: the finished 5V regulator is installed in a plastic box. It has two separate leads to supply the EHT inverter in each electrostatic loudspeaker.

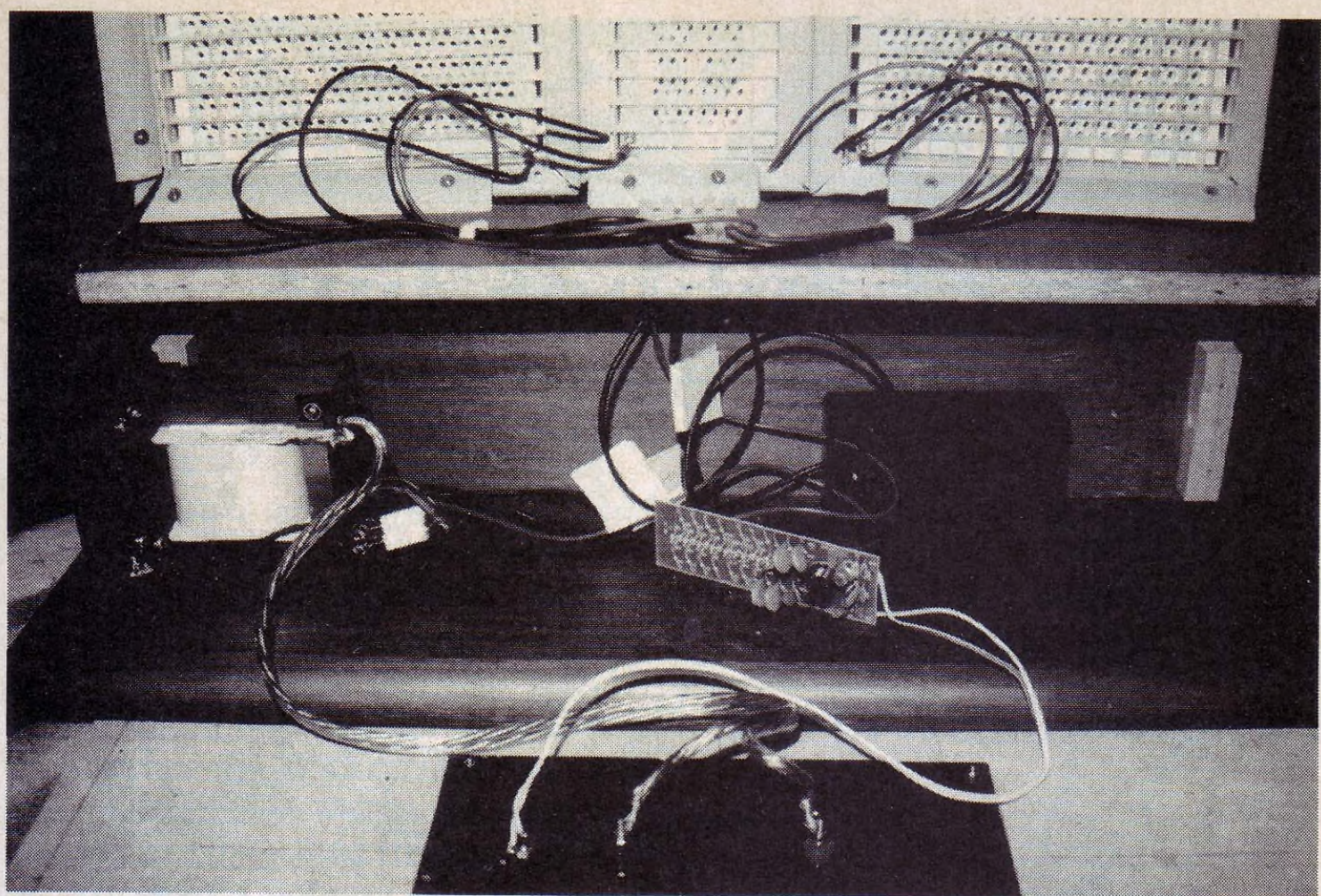


Fig.5: the compartment at the base of the speaker houses the audio step-up transformer and the EHT inverter. Note the wirewound resistors connected in series with the transformer primary windings. The inverter is normally housed in the plastic box at the rear, for safety's sake.

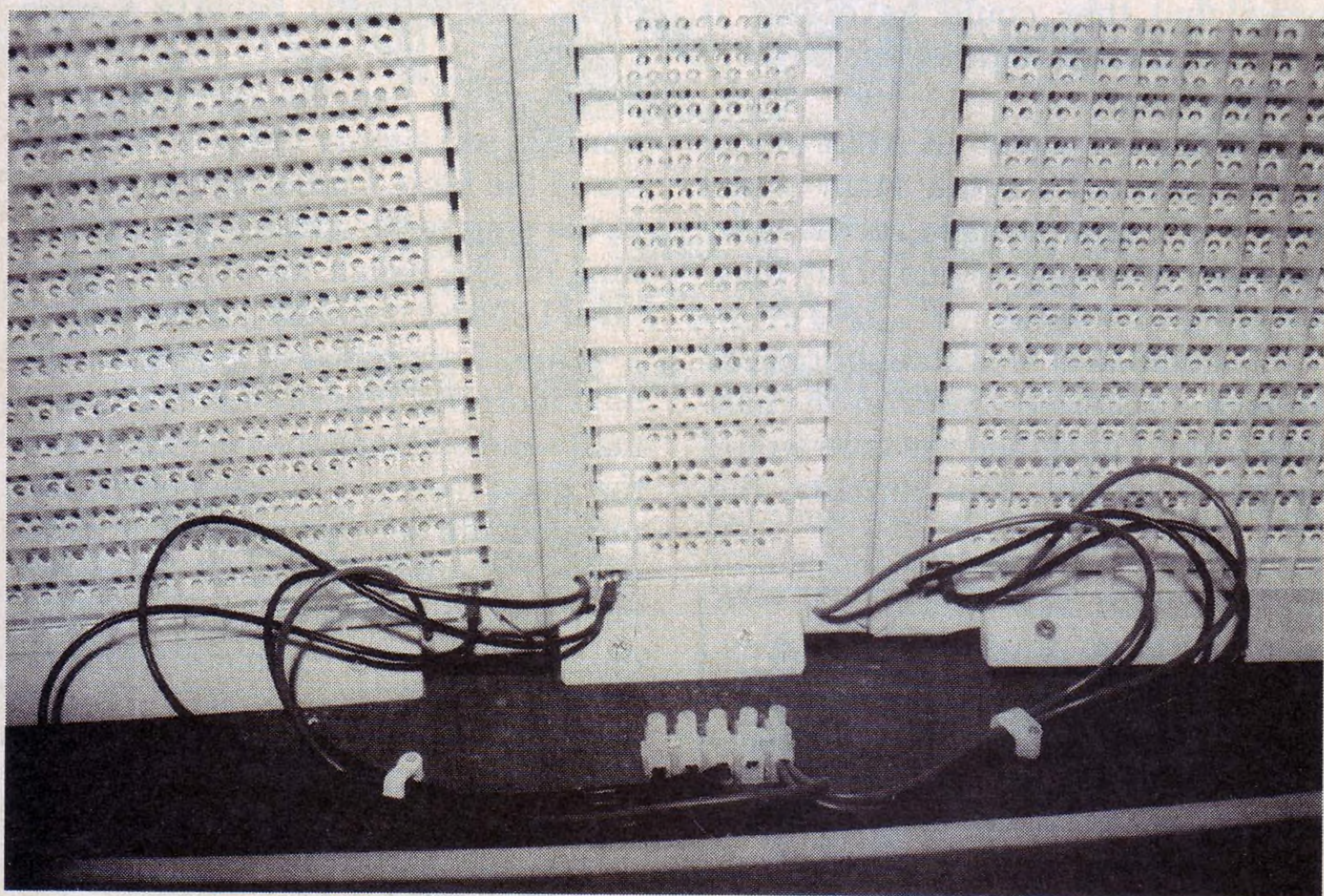


Fig.6: this close-up view shows the wiring connections to the three panels.

remove dust. Care must be taken with the front grille as the speaker diaphragm is only a few millimetres from the grille cloth. Always use the "partial suction" position on the vacuum cleaner.

Avoid exposure to direct sunlight, moisture or temperature extremes. Avoid overdriving the loudspeakers too. Power limits will be apparent by a "snap" (high voltage flashover) followed by a temporary loss of volume. Continued use under these conditions may cause damage.

SC

Kit Availability

The ESL III electrostatic loudspeakers are available in kit form at \$1199 a pair plus an extra \$499 for the two ready-built timber enclosures. Freight, packaging and insurance will vary from state to state. For further information, contact Rob McKinlay, E. R. Audio, 119 Brookton Highway, Roleystone, WA 6111. Phone (09) 397 6212 or fax (09) 496 1546.