DOUBLE QUAD

A step closer to the ultimate sound, by Dr. T. Farrimond, Electronics Today International, Feb 1975

One has only to listen to music through a pair of good quality electrostatic headphones to realise that the auditory performance of most loudspeakers leaves a lot to be desired. Good quality headphones are, of course, easier to build. Low mass distortion-free units can be built at moderate cost since the physical size of the moving parts is relatively small. The close coupling between the earpiece and ear enables adequate sound-energy to be made available, hence realistic levels of loudness may be achieved without the need for large diaphragm displacements.

Full-range electrostatic loudspeakers are particularly difficult to build-in fact very few are available. The British Quad is probably the most familiar example of this type of speaker since it has been in existence for many years, but other brands are now appearing which tackle the problems in different ways and by so doing, generate a new range of subsidiary complications.

The Quad is a push-pull system in which a lightweight diaphragm is free to move in an air-gap between perforated static plates - so producing sound.

A limitation of such a speaker is that low frequencies (below 50 Hertz) may be restricted, since the large excursions of the diaphragm required for significant acoustic output may not be physically

achievable.

In the United States, the Dayton Wright full-range electrostatic loudspeaker uses a system in which the charged plates are sealed in an atmosphere of sulphur hexafluoride. This confers two advantages over an air-spaced system: it gives a higher loading to the moving membrane - because of the density of sulphur hexafluoride relative to air; it also enables the voltages of the static plates to be increased because of the better electrical insulation properties of the gas. This in turn enables the spacing between plates to be increased, so allowing the diaphragm to be driven harder when reproducing low frequencies.

In general, a full-range electrostatic loudspeaker has certain merits relative to the majority of moving coil designs. It has low colouration since it is of doublet design and has no cabinet resonances. It has a lightweight diaphragm which is driven uniformly across the whole of its surface rather than from one small area, which minimises unwanted diaphragm flexing.

SPEAKERS IN PARALLEL

The advantages of driving two moving-coil speakers in parallel has been often stressed, for example by Gilbert Briggs, ('Loudspeakers', Wharfedale Wireless Works Ltd) but little has been written concerning the possible advantages of driving two full-range electrostatic speakers in parallel. One advantage in the case of the Quad electrostatic would be to double the amount of air acted upon. Also if the speakers were mounted vertically one above the other, high frequency dispersion would be improved. Because of the shape of the high frequency transducer of the Quad (which is a long narrow vertical element) the horizontal dispersion is approximately 70°. However the vertical dispersion is only 15° and this produces a beaming effect which results in changes in loudness of high frequencies when the listener moves his head. Such effects can be tiring and this is one of the reasons why "reflected sound" loudspeakers are preferred by many audiophiles. The construction of the double Quad system was undertaken with the aim of bringing about these improvements.

HOW THEY WERE MADE

Constructing double Quad speakers is quite straightforward. The wooden side pieces are removed and two extended wooden arcs screwed in their place. The arcs are constructed to continue the line of curvature of the front of the speaker grille. The angle of tilt of the complete assembly is then adjusted so that the uppermost speaker retains the same angle of inclination as a single unit mounted on the floor. The three feet of the Quad speaker are replaced by two parallel wooden extensions projected fore and aft from the speaker assembly. Four castors enable the unit to be moved quite easily and since the centre of gravity is well within the base, it is completely stable.

The complete double speaker construction is much more easily moved than the single Quad with its rather unstable tripod leg arrangement. This feature of the standard Quad is something which the manufacturers could well improve since even an obstreperous cat has on occasion tipped ours over!

A danger to be avoided when loudspeakers are run in parallel results from the excessively low impedance which may be created; this may produce undesirable effects upon the amplifier. Modern

direct-coupledamplifiers can supply large amounts of subsonic energy and therefore may damage a speaker if its impedance is very low. The Acoustical Quad amplifier has a capacitor output which blocks direct current and on-frequency signals and it is for this reason that the manufacturers of other amplifiers (for example Amcron, who produce the D-60 amplifier), recommended that a capacitor, in parallel with a four ohm resistor, be inserted between the amplifier and an electrostatic loudspeaker load when the direct current resistance of the input transformer of the loudspeaker is less than three ohms, (which it is in the case of the Quad speakers).

When driving Quad electrostatic speakers in parallel, the impedance of the double unit falls to three ohms at frequencies above 8 kHz, but this is not too bad compared with some electrostatic systems in which impedances may fall even lower than this.

It may perhaps be asked why one should go to all this trouble with electrostatic speakers when the problems could be solved by using moving-coil units which in general do not have the limitations of full-range electrostatic speakers. However in lengthy listening sessions involving moving-coil, hybrid and full-range electrostatics, full-range electrostatics seemed the most 'transparent'. Although at the extremes of frequency response some roll-off occurs, the detailed and accurate mid-range reproduction combined with an absence of bass colouration makes them difficult to beat.

STEP BY STEP INSTRUCTIONS

SIGNAL INPUT:

(a) Remove rear wire mesh cover of lower speaker.
(b) Loosen the four retaining bolts on the signal input transformer and displace slightly to one side so that the wooden speaker base is exposed.
(c) Cut hole in exposed speaker base to take DIN socket.
(d) Wire DIN socket to shanks of transformer signal input sockets, observing polarity.
(e) Replace transformer.
(f) Staple signal leads carrying a DIN plug to speaker framework to carry signal to uppermost speaker.

MAINS INPUT:

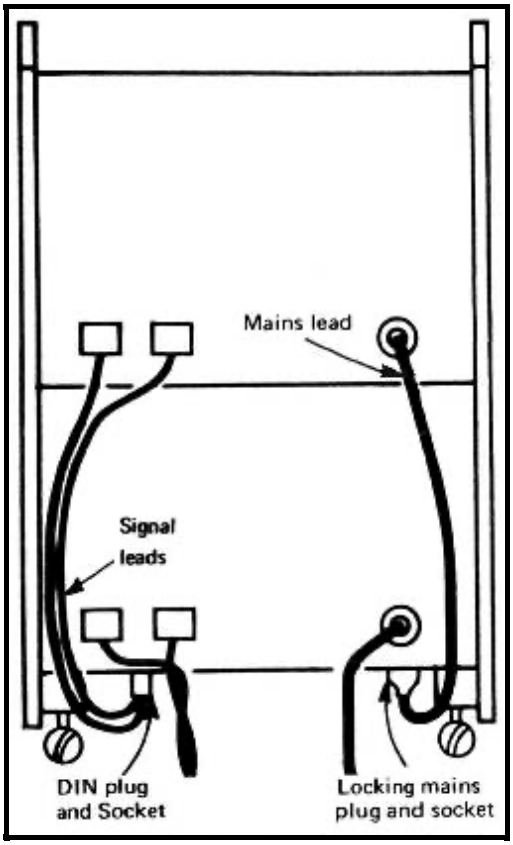
(a) Cut hole in wooden speaker base near the mains input transformer to take three pin socket with locking collar.
(b) Connect three wires between the pins of the socket and

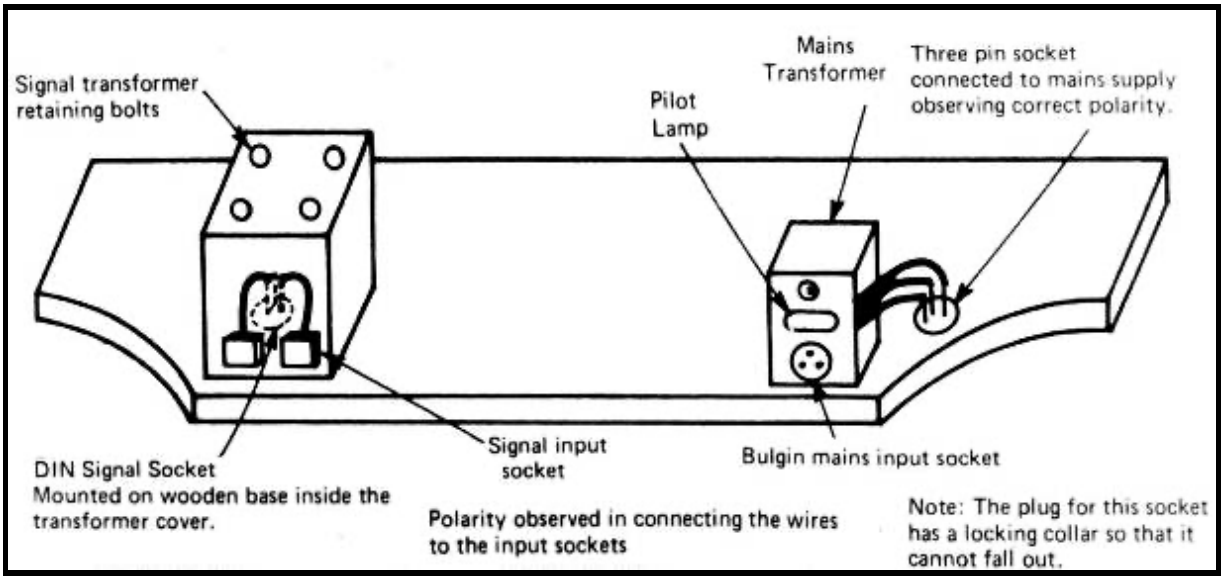
the Bulgin socket mounted in the mains transformer corner (or to other appropriate wiring points which preserve the correct polarity).

(c) Replace the lower speaker rear mesh.

(d) Staple mains cable to edge of wooden framework.

(e) Terminate mains cable with Bulgin plug to energise uppermost speaker.





Note, my personal opinion is that the method of connection used in this article is not the best. Further, if at a later stage you wish to sell the speakers (god forbid!) you will have at least one pair with extra holes in the base. My solution was more eligant if a bit more involved (*Double Quad Connections*).

Brian Lenharth brianl@lsid.hp.com supplied the following information about the Dayton-Wright speaker:
"The Dayton-Wright speaker was Canadian made, not USA made."
"I believe that you were supposed to have a little tank of the gas around in order to keep your cell pumped up, but I don't know how you were to keep normal air from diffusing into the cell." (ref. sulphur hexafluoride gas)

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