By Ralph West

how to build the DECCA

★ Originally designed by Mr. Ralph West for the Decca Record Company in 1949, this speaker enjoyed a period of popularity for some few years. Interest has re-awakened of late, probably due to the introduction of new and better driving units. The Decca Company have agreed to let us publish the details of this design. They also agree to waive their patent rights as far as the individual home construction is concerned, but only on the strict understanding that it is for the personal use of the constructor, and cannot be sold or otherwise exchanged. Anyone wishing to make such speakers for sale would have to make his own arrangements with Decca, who alone can grant a licence. The following article by Ralph West describes the speaker in constructional details. **Editor.**

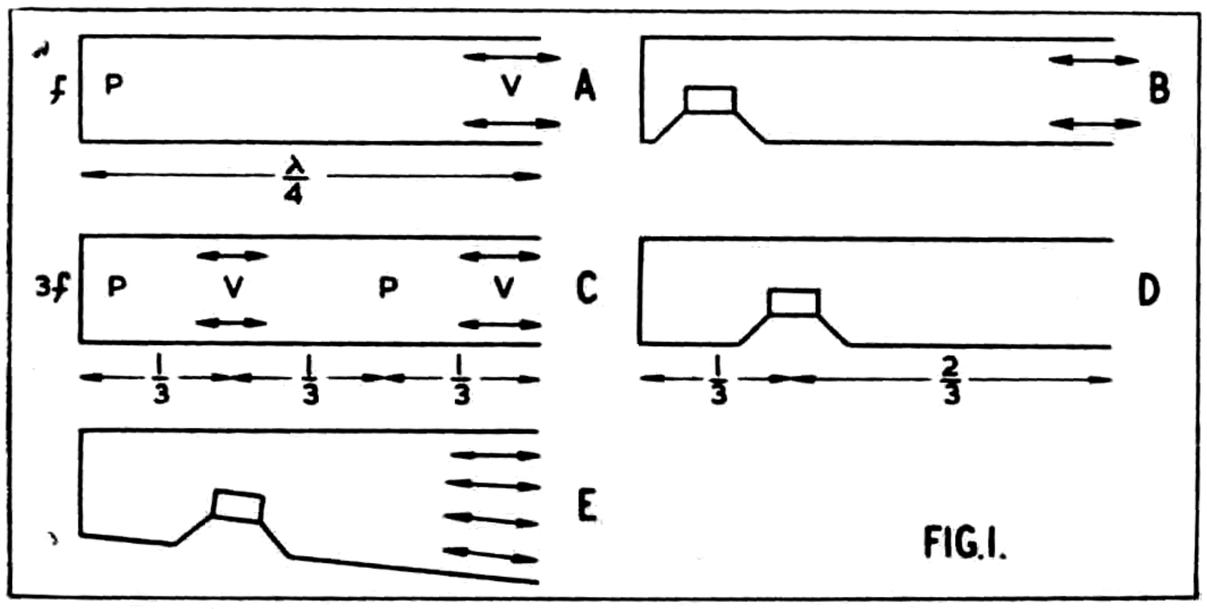


FIG.1.

Historical Note: This speaker owes its inspiration to Voigt, and is based mainly on the quarter wave loading originally proposed by him in patent No. 447749. Further inspiration came from Voigt in the manner of distribution. Few people who have enjoyed the reproduction from his domestic corner horn, with its lovely wide window effect, could ever go back to a small hole in the side of a box. The writer was one of these, and eventually evolved the corner reflection scheme. This is embodied in patent No. 673009, which eventually proceeded in the name of The Decca Record Co. Ltd. It was originally fitted with the Wharfedale Super 8 unit, which had just appeared on the market. FFRR and many other familiar Hi-Fi names were still young in those days.

Acknowledgments to Voigt

Theory. While an ordinary moving coil loudspeaker works fairly well at the higher frequencies, it becomes very inefficient at low frequencies, unless aided by some cabinet or enclosure. Below the frequency where its diameter is about half a wavelength, efficiency tends to fall, because the cone has very little to push against. Open air offers quite a large resistance to rapid movements, but very little to slow ones. A correctly proportioned horn offers about the best possible solution, but is too large for domestic use unless cut down somewhat. Voigt's quarter wave loading, in its final form, produces an efficiency comparable with a cut-down horn of similar proportions. It is in fact so much like a horn that it would very well be called one.

A closed organ pipe **(fig. 1A)** will resonate at such a frequency that its length is one quarter of a wavelength of that sound. There is considerable air movement (velocity) at the open end, and quite high alternating air pressures at and near the closed end. If a loudspeaker unit is placed there **(fig. 1B),** it will operate with very high efficiency and low distortion at that frequency. The cone hardly moves, and the sound comes mainly from the large air movements at the open end. Two things remain to be tidied up.

First, as the pipe will also resonate fairly well at three times the first frequency, it is necessary to put the speaker about one third of the way along the pipe. This drops efficiency at this frequency, which is desirable, since the normal forward radiation from the front of the cone is adequate. Its efficiency at the original fundamental frequency is hardly reduced since the pressure falls off very slowly near the closed end. This move is shown in **fig. 1D.** The finite size of the driving unit prevents trouble at higher harmonics.

Resonance Damping

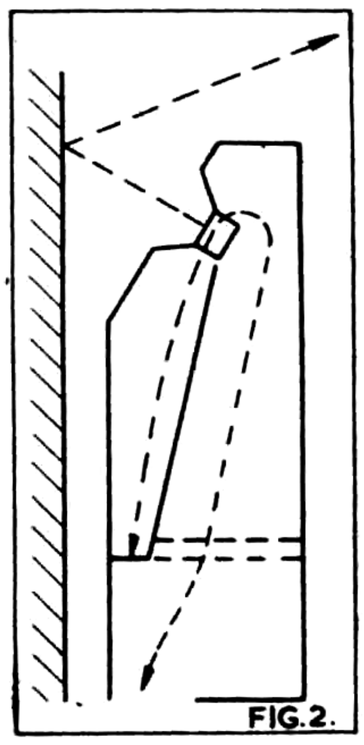


FIG.2.

Next, the main resonance must be damped considerably, so as to avoid hangover and to spread its effect over as wide a frequency range as possible. This, Voigt very wisely did by tapering the pipe. The very wide open end damps the system by turning energy into sound. This is better than merely wasting the energy with layers of felt. With all but the largest reflex cabinets and many other enclosure systems, definite energy loss in felt, etc., may well be a necessary part of the system.

This speaker uses no lagging whatsoever and its introduction definitely spoils the result. **Fig. 2** shows the general layout. The pipe is folded to get it into an overall size that is not out of place in the home, and to radiate the high frequencies from a suitable height. A length of approximately 5 feet gives a nominal column resonance of just under 50 c/s. The unit is tilted slightly to allow most of the reflected sound to clear the cabinet top.

In the last few years, the very large part played by flexure of cabinet walls has come to be more widely realised. Most readers will be familiar with Mr. A. R. Neve's (CQ) work in this direction. Ten years ago, little was known, apart from Voigt's pointing out that flexible walls helped to damp air column resonances inside cabinets.

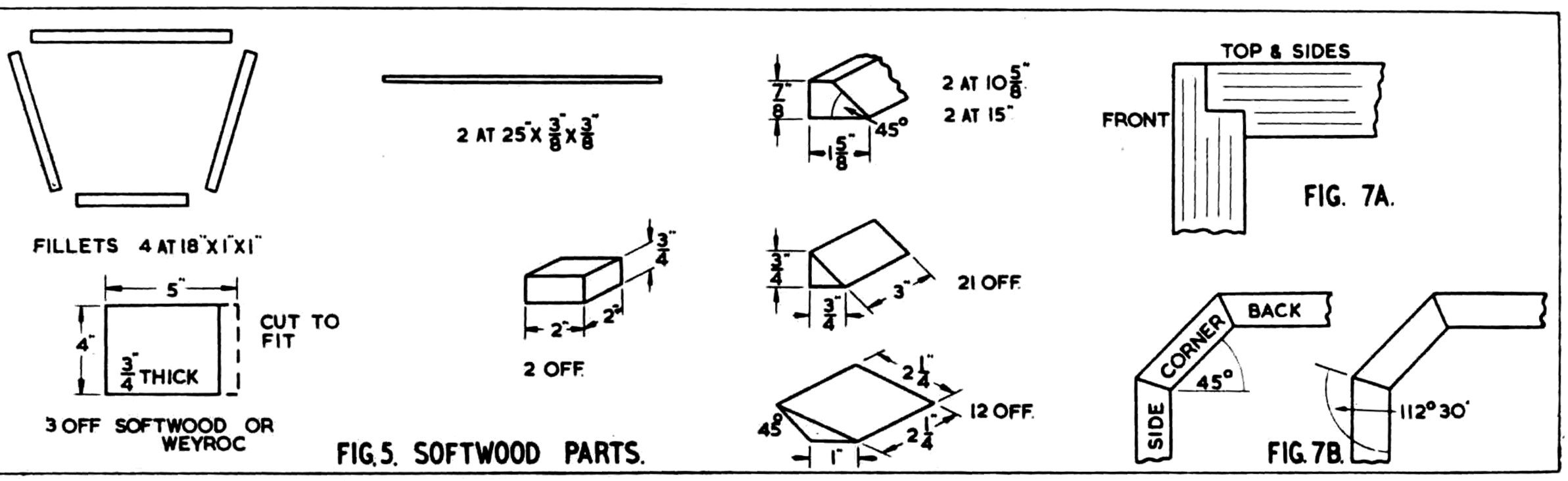


FIG.5. SOFTWOOD PARTS.

CORNER SPEAKER

By sheer fortuitous choice of materials, dimensions, and method of construction, this speaker design happens to be a happy choice.

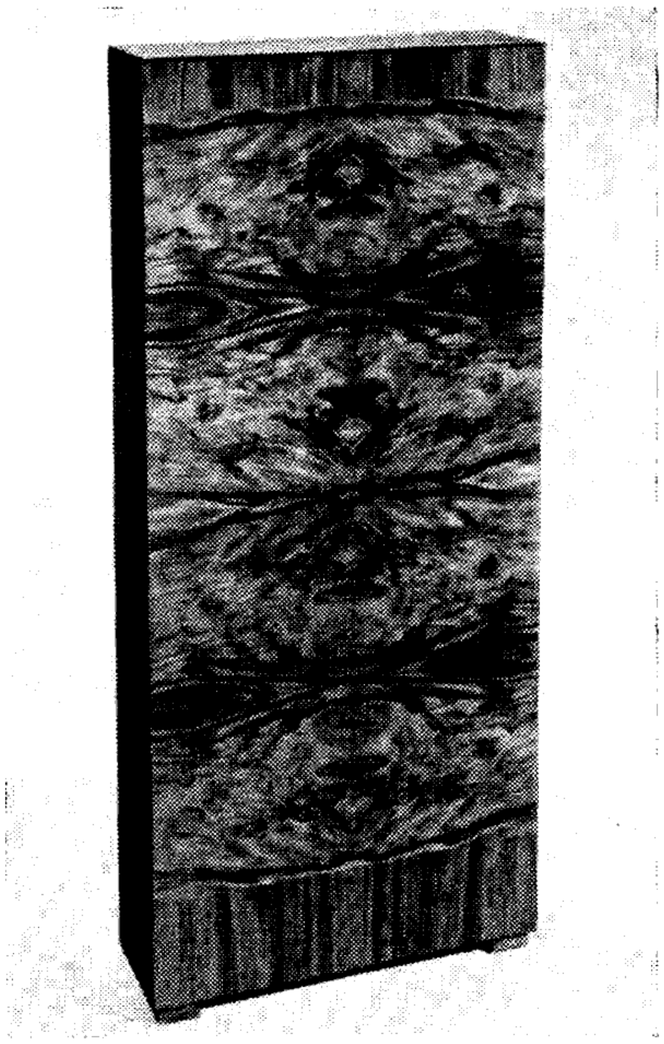


Fig. 8. *The completed loudspeaker. You may employ the particularly handsome finish shown here, or any one of the veneers which are available. Alternatively, plain plywood may be used and painted to match the existing colour scheme.*

Accuracy Essential

The writer must impress on the constructor the need to follow the design most carefully. Materials and construction are most important, a quarter of an inch dimension variation here and there does not matter as long as the parts meet! Only one real modification to the original design giving any improvement, has so far come to light. That is the removal of the bottom front stiffener from existing models —the one that goes between front panel and inner closed end—shown dotted in **fig. 2.** This increases the output slightly around 100 c/s, and produces a slightly rounder tone from the larger stringed instruments.

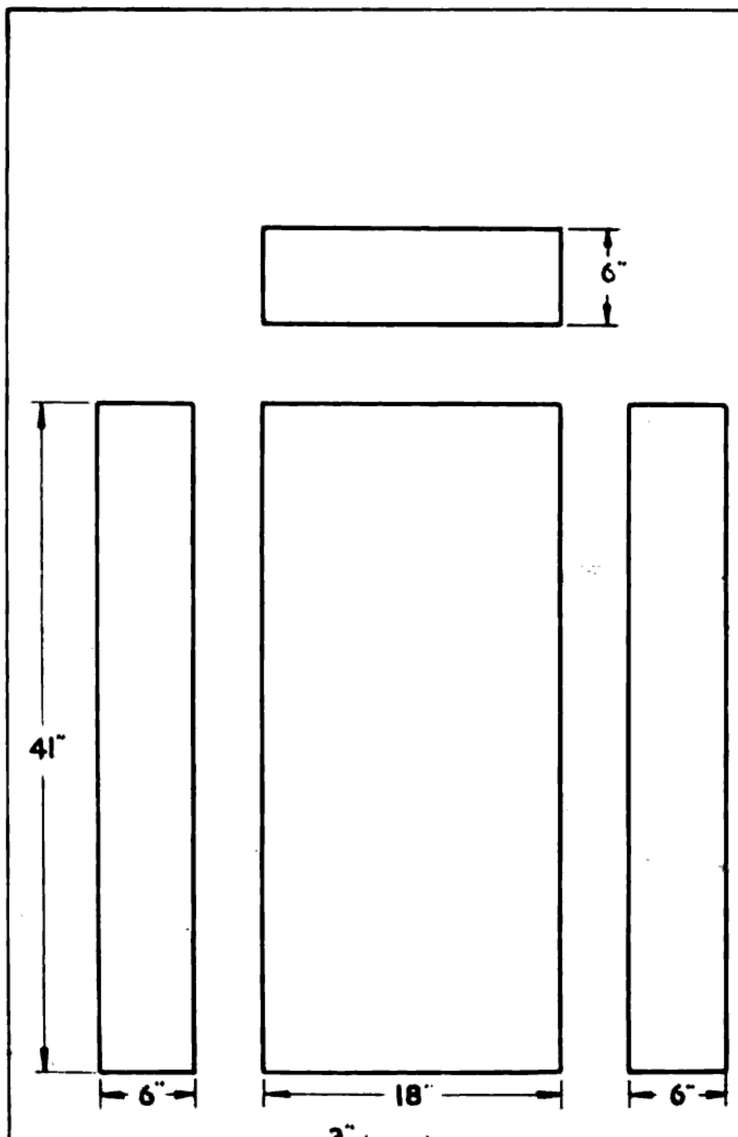
While the original choice of unit was quite acceptable in 1949, many people may now prefer more output at the higher frequencies, in order to enjoy to the full signals from the best modern pickup and FM radio. A small tweeter could be added, mounted more or less coaxially with the main unit. The new *Wharfedale column* 8/145 has been developed for a design with a similar very wide high note distribution. This suits it very well and a tweeter is then unnecessary. The *Lowther PM6* is also very successful.

The cabinet loading is comparable to that given by a horn and is therefore suitable for such a unit. Several other Lowther units (PM2 and PM4) have been tried and seem to work quite well at domestic levels. In any case, like column type loudspeakers, it does need a unit with a very good high frequency output. The cone resonance is not critical but should not be above 60 c/s. The distance it is placed from the corner is a matter for experiment. For monaural work, up to 3 feet can be very pleasant. For stereo use, the writer finds his best results when the centre of the speaker aperture is about 15 in. from the corner.

In ideal conditions in the home, it is possible to hear a genuine 30 c/s (at low level) free from harmonics. Forty cycles per second, at a level able to make odd windows and panels rattle, yet still free from noticeable harmonics should be possible in almost any surroundings. It should be able to handle the full power down to 40–45 c/s.

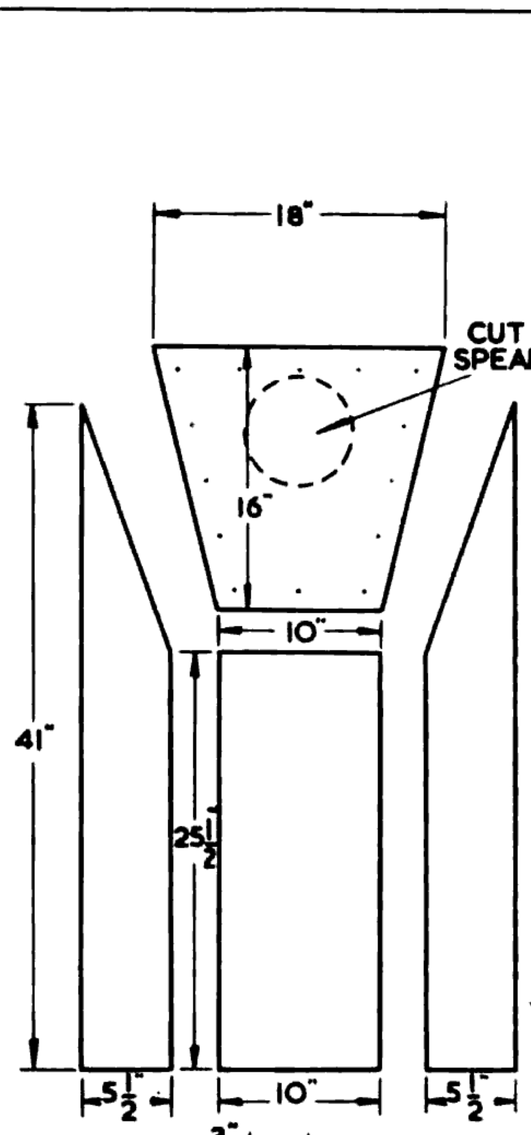
The Materials

Figs. 3, 4 and **5** show the materials roughly cut to shape. Veneered timber can be used, better still, the front, top and sides can be veneered afterwards. Not shown will be sundry small items: about 5–6 feet of $\frac{3}{4}$ in. wide thin plastic foam to make an airtight seal for the removeable speaker panel; a dozen or more $1\frac{1}{2}$ in. × 4 in. *brass* screws and cups (need not be brass) to fix this panel. Four 4BA *brass* bolts (1 in.) nuts and washers to fix the speaker unit. It is always risky handling (chewing up!) steel screw heads near loudspeaker magnets. A small two-way terminal block. A small square of very thin material—muslin will do—to cover the speaker aperture. Thicker materials like Tygan, etc., absorb noticeable amounts of high frequency energy. Four small Domes of Silence (about $\frac{5}{8}$ in. diam.) to finish off the feet. A supply of thin panel pins (or veneer pins).



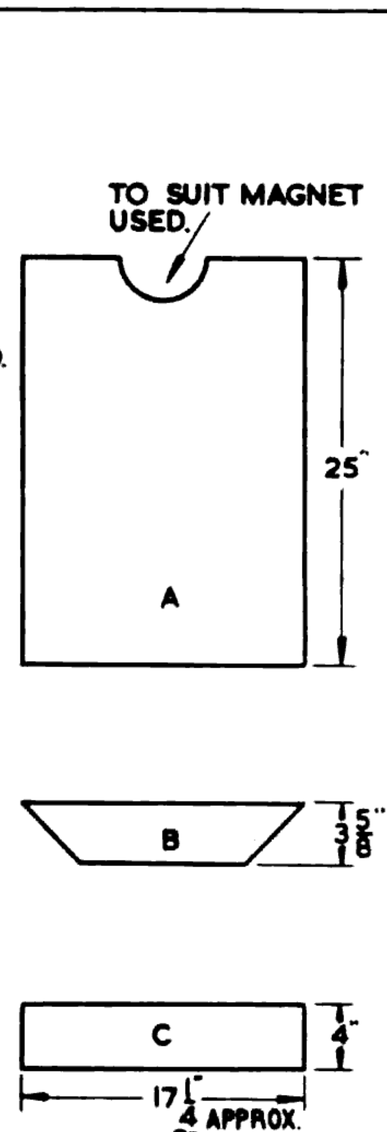
FRONT, $\frac{3}{8}$" (9MM.) VENEERED PLY.

FIG. 3.

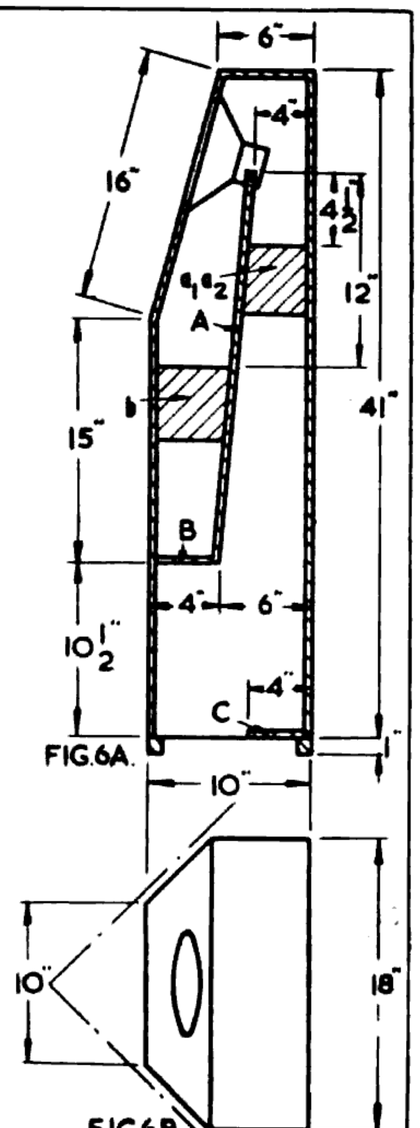


REAR, $\frac{3}{8}$" (9MM.) PLAIN PLY.

FIG. 4.



BAFFLES $\frac{3}{8}$" (9MM.) PLY.



Construction

Figs. 6A and **6B** show the general construction. External dimensions are exact, some slight adjustment of size here and there inside, will not upset the performance. Modern waterproof glues (e.g. Casco) are recommended, as they are easy to use and very strong when set. One thing is vital; all parts must fit snugly. Any errors necessitating straining the wood, use of cramps, etc., is fatal.

The best sequence to follow will probably be this:—Mark out and prepare the front, top, sides and bottom panels, and the 25 in. bearer rails for inner panel **(fig. 7A).** Glue and pin these rails in position on the insides of the side panels. When these have set, assemble front, sides, top and bottom and add the corner fillets:—Four along the top-front edge, one each between top and sides, eight between each side and front, three between bottom and front, and one each between sides and bottom. This is all square work and it should be left a few hours or till next day to harden, having checked that the rear edges of the sides really are pointing in the right direction! Two or three odd strips of wood could be laid across and pinned temporarily to hold the sides square. Next the inner panel can be fitted accurately and then glued and pinned to the narrow bearer rails.

When this assembly has become strong it is then safe to add more to it. Two ways of "turning the corner" are shown **(Fig. 7B).** The one with 112½ degree edges is, of course, the better, and the sides are best prepared before assembly. The internal closing panel and corner panels are next prepared, and fitted. The closing panel gives them something to lean on, but temporary bracing is advised.

When all the angles are correct—before the glue has set—the six 135 degree fillets can be adjusted if necessary, and fitted. Two should go each side below the closing panel, one almost touching it and the other within 1 in. of the bottom. Four go above this panel and the lowest on each side will need trimming a bit on one side to clear the inner panel. Give this time to solidify. Prepare the four 135 degree strips, glue and pin on the free edges of the corner strips. Hold a heavy weight or something behind these when hammering in the pins OR the corner joints may be damaged. The bottom pair of strips must project ¾ in. and form two of its feet. Two small square blocks, ¾ in. high are glued and pinned to the front corners of the bottom panel to form the other two feet. Fix the domes of silence straight away; it saves the floor and the wooden feet.

The rear panel can now be fitted snugly and fixed. The last two corner fillets go between the closing panel and the rear panel, underneath. Next prepare the internal bracing pieces. One goes inside the narrow end of the pipe, between the rear panel and the inner panel. Its vertical position is shown on the diagram, and it should be about ½ in. to one side of central. This is to "split" the panels into uneven areas and so avoid coincidence of any resonant frequencies. The other two go between the front panel and inner panel and divide the width into three slightly different parts. They are best inserted from the top by turning sideways, squaring up, and then pulling upwards into position. None of the bracing pieces must be fitted too tightly, for reasons already given.

The speaker aperture battens are an awkward shape, but great care must be taken to ensure a very good fit. The top batten should be kept very narrow, or better, thinned off in the middle so that the loudspeaker unit can be mounted as high up as possible. The loudspeaker hole must be the full width of the cone plus its surround or audible coloration may result.

The piece cut from the inner panel can be done after the speaker is mounted. It must completely clear the magnet, but should not be larger than that. Clear it, and then take out another ⅛ in. all round. When fixing the speaker panel use four or five screws at the top, three each side and two or three at the bottom. Drill the battens with small holes so that the screws may be run in and out many times before tearing themselves loose—unless you are quite certain you never want to see inside it again! Fix the terminal block fairly close to the unit and bring the wires out through a suitable hole. With a 1½v cell, find the terminal which, when connected to the positive of the cell (centre) causes the cone to move outwards. Mark it with a spot of red paint.

All joints in the cabinet must be mechanically sound so as not to buzz or rattle and they must also be airtight. The usual test is to feed in a 50 c/s tone—say 3 volts from the heater winding of a mains transformer. Any leaks will blow the flame of a lighted taper. Now, cross your fingers, and good luck! **R.L.W.**

CONSTRUCTIONAL POSTSCRIPTS

I. DECCA CORNER SPEAKER — By RALPH WEST

● **From experience gained from recent Home Constructors' Features, we have decided to pass on to the authors all remarks, queries and criticisms from readers . . . and to call for postscripts to tidy things up.**

QUITE a number of readers have written in to ask whether a 12 inch unit can be used instead of an 8 inch. The main fear seems to be that the 8 in. will not handle enough power to satisfy their requirements. If any 8 inch unit, unmounted, is hung up say, by a piece of wire, the maximum amount of noise it can produce is not very large. It is, of course, also a most unpleasant sound as it can radiate efficiently only at the higher frequencies. If the volume control is turned up very far, the cone merely flaps and rattles against the stops, as it has nothing much to push against.

Put it in a small open-backed cabinet, say the size of a table model receiver, then, not only is the sound less unpleasant, (as somewhat lower frequencies are now being radiated), but the total amount of sound it can produce without rattling is much increased. Mount it in a small reflex cabinet and it will handle much larger signals without overloading and the maximum sound possible is much larger. A larger reflex would probably raise it slightly higher still. Now, if it

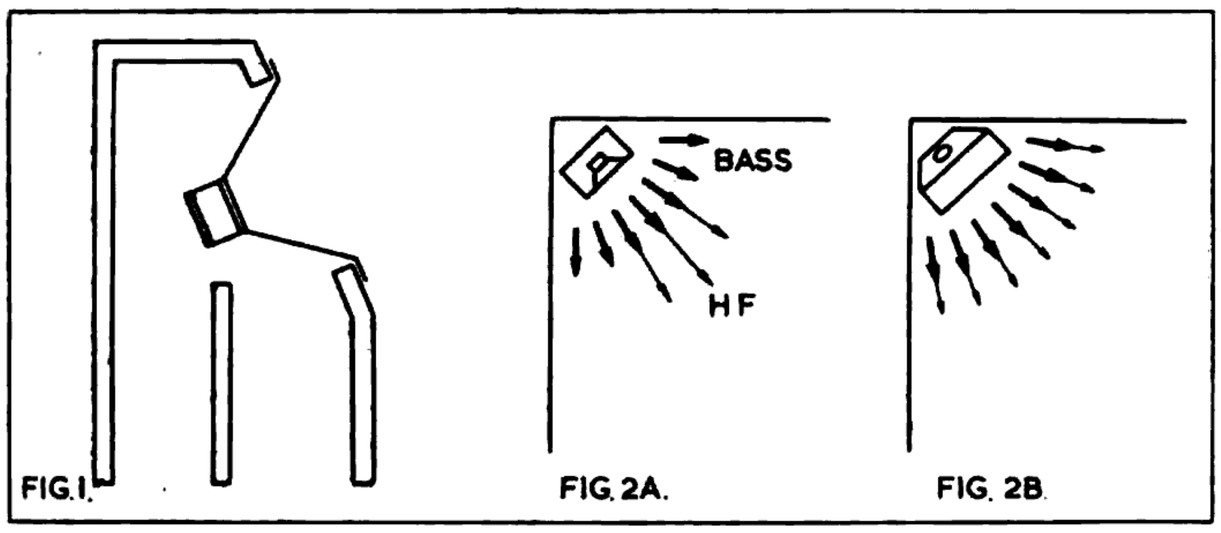


FIG. 1. FIG. 2A. FIG. 2B.

could be put on the narrow end of a huge horn—about 4 in. diameter, increasing to 10 or 15 feet and of length 10 to 15 feet, the sound output for the *same* input would be really startling. It would also handle much more input power before starting to rattle, and the total output from that would be truly impressive.

Well, the Decca Corner horn, using Voigt's Quarter-Wave design has an efficiency and performance short of this but well above that of a reflex cabinet. It is quite safe to say that any 8 inch unit of reasonable design will produce far more sound when in this cabinet than can be tolerated in domestic surroundings. With a high flux type of unit (generally more efficient), even more sound is produced for the same input. Thus the maker's power handling rating of say only 6 watts maximum need not be considered a limitation. Anyway, the power handling capacity is raised by this form of loading, so unless someone wishes to fill a very large hall for dancing, it is quite adequate.

Experiments for 12-inch Units

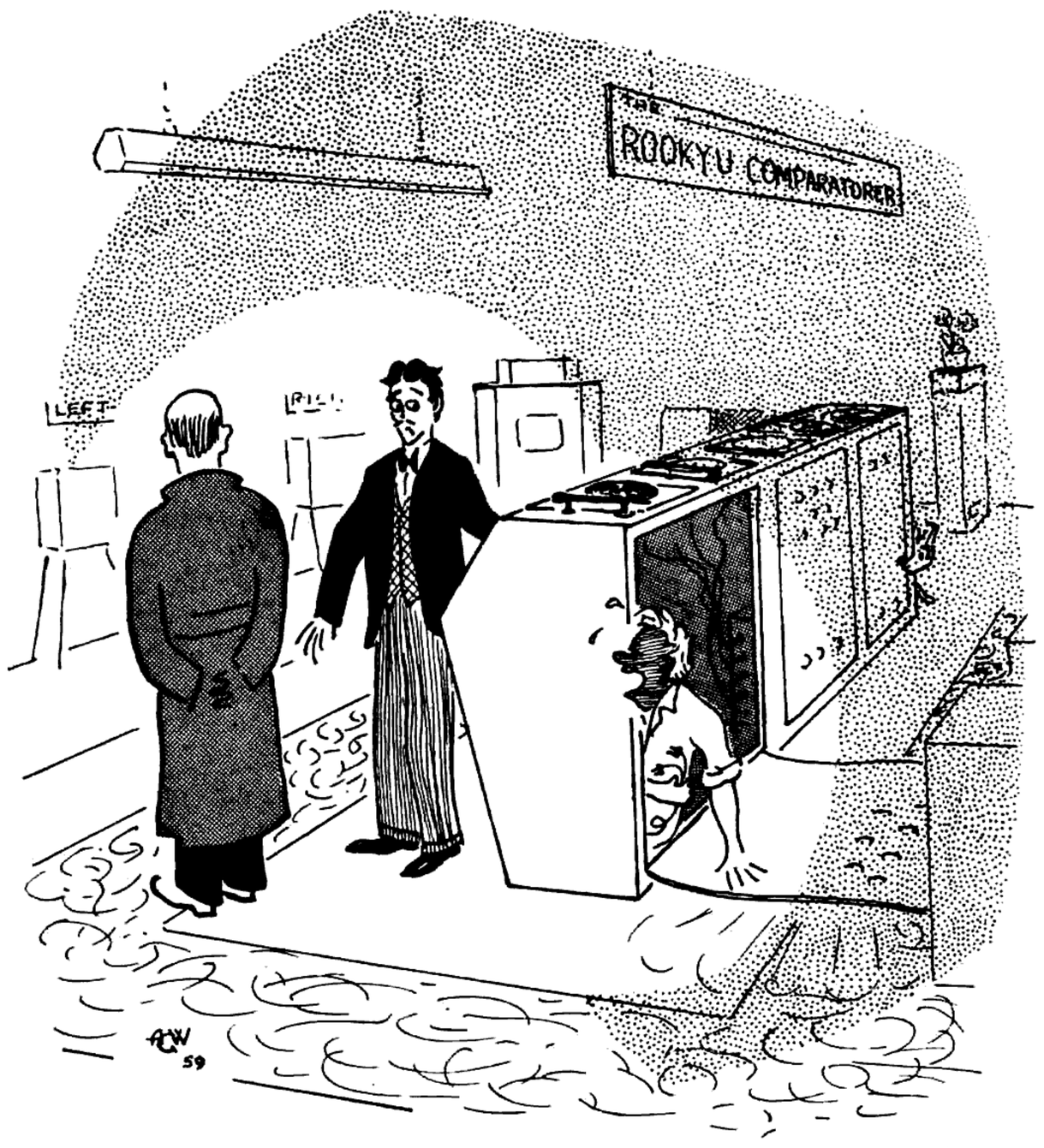
For those who still want to try a 12 in. unit, the writer would suggest two sloping rear panels are cut and fitted when building the cabinet. Experiments can then be performed without spoiling anything. A little space will be gained by mounting the unit *outside* instead of inside the panel (**fig. 1**). This is indeed a good thing with cabinets generally, expecially those with thick panels. Whatever speakers are considered for use in this cabinet, they should be high flux types. These not only have a higher efficiency, but give better bass damping. The bass response is not increased but it is much smoother.

Going back to 8 in. units versus 12 in. units, most authorities would agree it is easier to design a good 8 in. unit and that in general 8 in. units produce better and smoother middle and top. They would also point out that the 12 in. unit produces a better bass. That last statement is, of course, generally true when using reflex cabinets, especially the smaller ones, but not for this quarter wave design. Another feature is the smaller dependence on cone resonance frequency. The writer has had satisfactory bass from units with cone resonances ranging from 40 c/s—80 c/s. Above 90 c/s would not be satisfactory—in general, the lower the better. As stated in the original article, a better-than-usual top response is needed. Most loudspeakers are designed to give the right bass-HF balance on the axis. Moving off axis, the top response falls, slowly for the better units and rapidly for the cheaper, i.e. wide beams and narrow beams respectively. The bass output is evenly distributed anyhow (**Fig. 2A**). With the Decca corner reflection, the *whole* of the HF response is also evenly distributed—spread more thinly as it were (**Fig. 2B**). Many loudspeaker units will thus be deficient in HF response for this type of distribution. The result often gives a somewhat hollow sound which at first hearing suggests bad resonances. Put the same speaker on a flat baffle and sit in front of it and there is no hollowness. Put a unit with adequate top into the Decca and again there is no hollowness.

The writer's first choice is the Lowther PM6, expensive but lovely. It was designed originally to have a very good HF response to match an equally large bass output when used with horn loading. Also considered perfectly satisfactory is the Wharfedale column 8/145. This, too, was designed to have higher-than-usual efficiency at the top end. It has not quite the attack and sparkle of the PM6—14,500 gauss against 17,500 gauss *and* a twin cone—but it takes an A–B test to show very much difference. There are many other 8 in. units that will give quite pleasant results. The writer has not had opportunity to try them all, so it is handed back to the reader at this point.

* * *

(**Note:** As there are many readers who already have 12 inch units and would like to use them in a similar system, Mr. West has been prevailed on to prepare a " Big Brother " to the Decca design. He warns, however, that it is not as good as the smaller one (with suitable unit), but it will do any high flux 12 inch unit full credit.—EDITOR.)



" *You pressed '78' and 'Stereo'—what am I supposed to do?* "