first, the exponential column having over twice as many in a given frequency range as the cylinder. Although more numerous, the peaks using the exponential column are much less severe. For other columns in the same "family" as exponential, such as catenoidal, hyperbolic, tractrix, etc., similar results are obtained, the principal differences being in the frequency range below the first peak.

Compromise choice

For the application in mind the cylindrical column is obviously unsuitable, unless filters are used to suppress the unwanted peaks and even then the first peak is not spread over sufficient frequency range. The exponential column appears the most attractive but even at a point

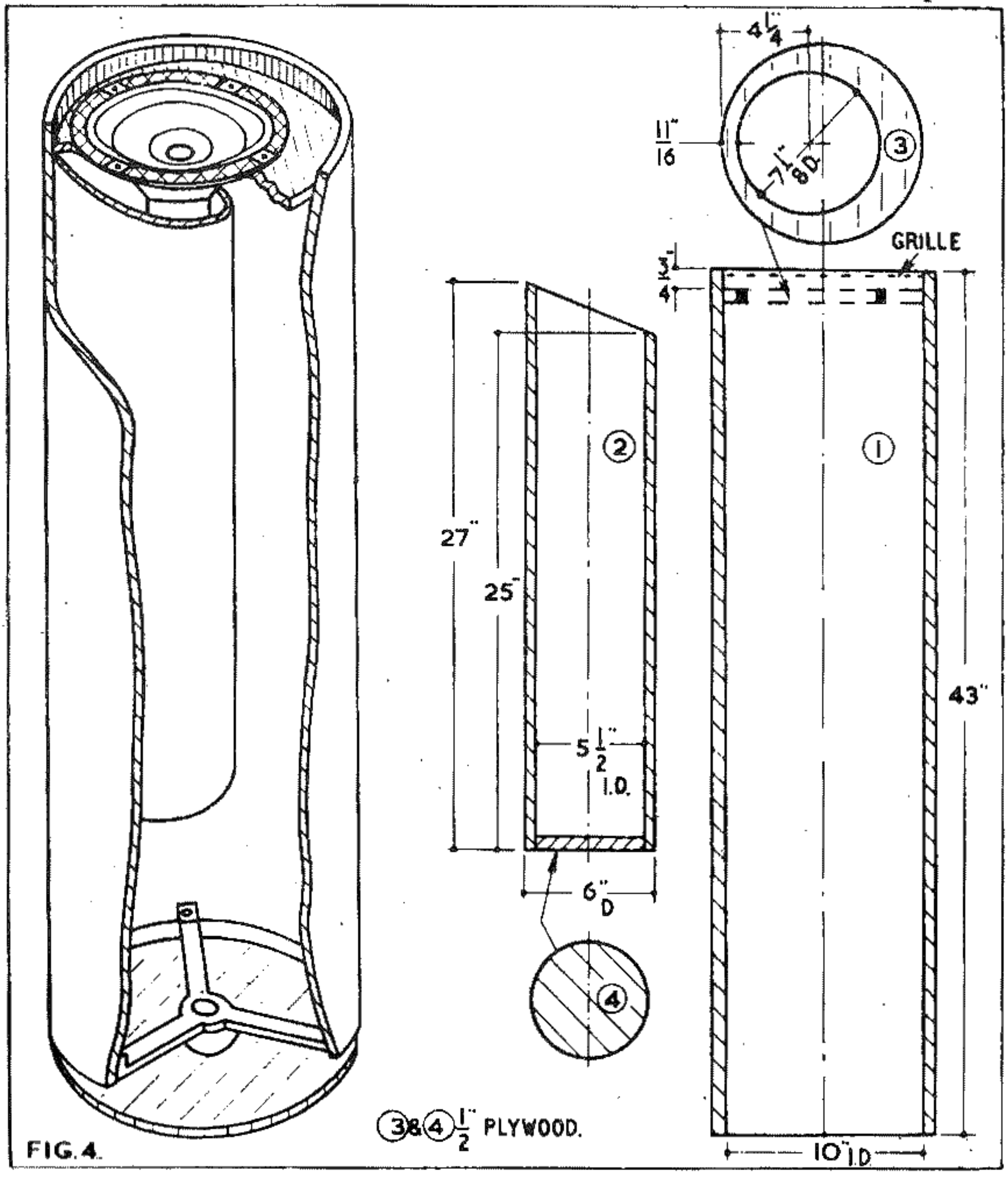


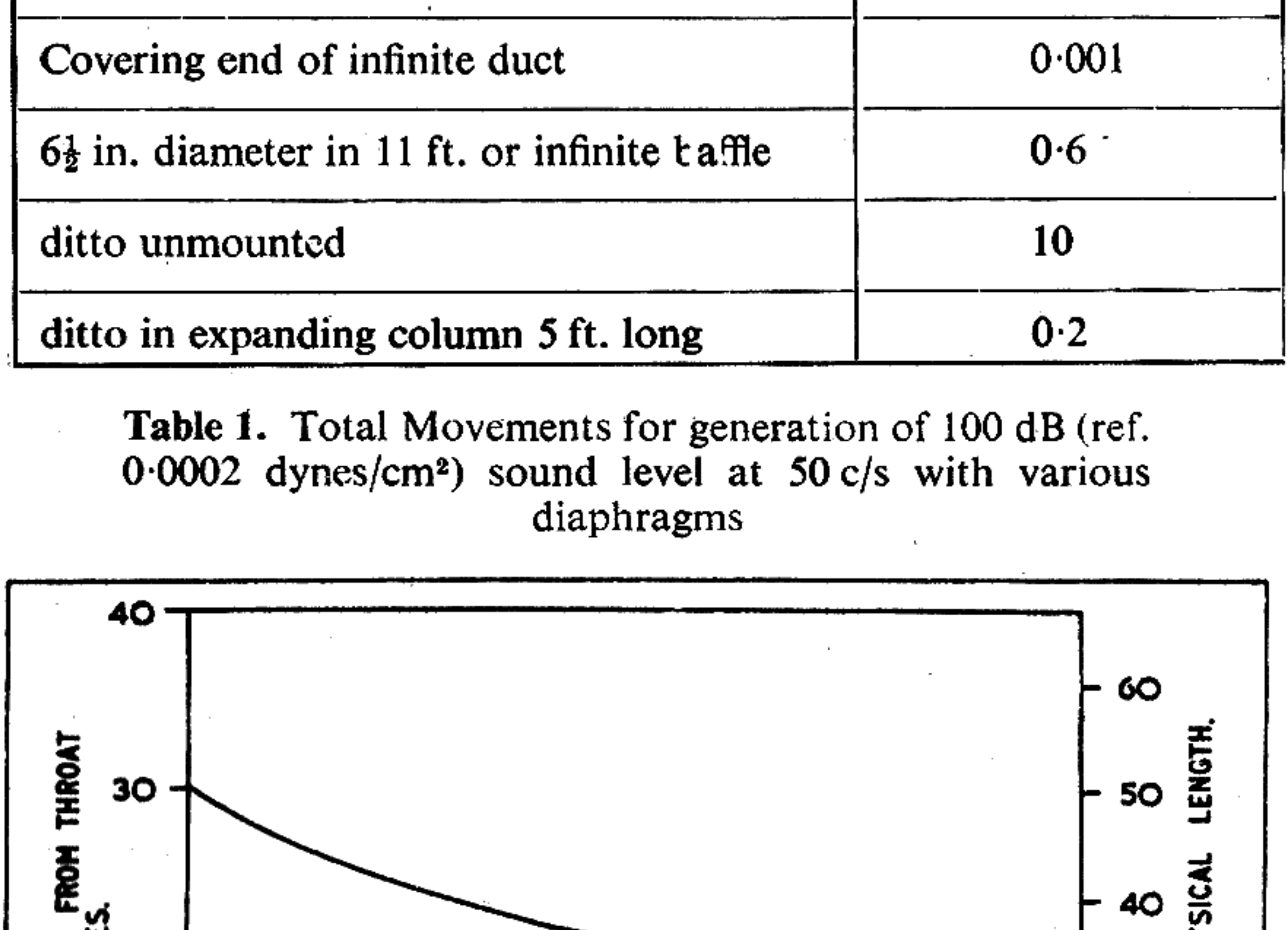
FIG. 4.

Cutaway view of tricolumn and basic parts.

mid-way along, the cross-sectional area is much smaller than the proposed diaphragm area. Unless a special unit is used, distortion is likely to occur and, in addition, at least three folds will have to be employed to obtain the required height. An exponential column also exhibits a "flare" cut off frequency below which little fundamental frequency power is generated, being 36 c/s in the above case. It is desirable to extend the enclosure output down to 32·7 c/s (CCC), the lowest frequency at which considerable *continuous* power is generated by musical instruments (with the exception of pipe organs containing

Diaphragm	*Total Movement Reqd.* ins., pk. to pk.
Covering end of infinite duct	0·001
6½ in. diameter in 11 ft. or infinite baffle	0·6
ditto unmounted	10
ditto in expanding column 5 ft. long	0·2

Table 1. Total Movements for generation of 100 dB (ref. 0·0002 dynes/cm²) sound level at 50 c/s with various diaphragms



Optimum driving point for parabolic columns.

substantial for these screws to bite into. If necessary, felt or plastic sponge sealing strips can also be added.

The hole for the unit should be as large as possible to avoid " boxing it in ", especially with the thicker panel materials. With thicker material it is even worthwhile to bevel or chamfer the edge of the hole. Keen ears can hear the difference. With the thicker panel materials, internal bracing should not be necessary, but the thinner materials may well benefit from some assistance. Two suitable positions are shown dotted in **fig. 3B.** The upper one is level with the top of the internal panel, and is thus set somewhat to one side—a good thing as it divides the front panel into two dissimilar sections. Any bracing can be added after the speaker is complete, but care must be taken to avoid forcing it in.

Finishing off

It is advisable to finish off the bottom with four large domes of silence, as, apart from being kinder to floors and carpets, it avoids putting unnecessary strain on the lower panel joints.

Some fabric protection over the speaker hole is desirable, but this should be as thin and light as possible. Some of the heavier fabrics show appreciable high note absorption, and some have been found to produce a little inter-modulation distortion as well.

When complete, test with a torch battery for polarity, and mark with red the terminal that makes the cone jump towards the hole, i.e. outwards. This will save a lot of trouble when connecting up the second one for stereo!

R. L. W.

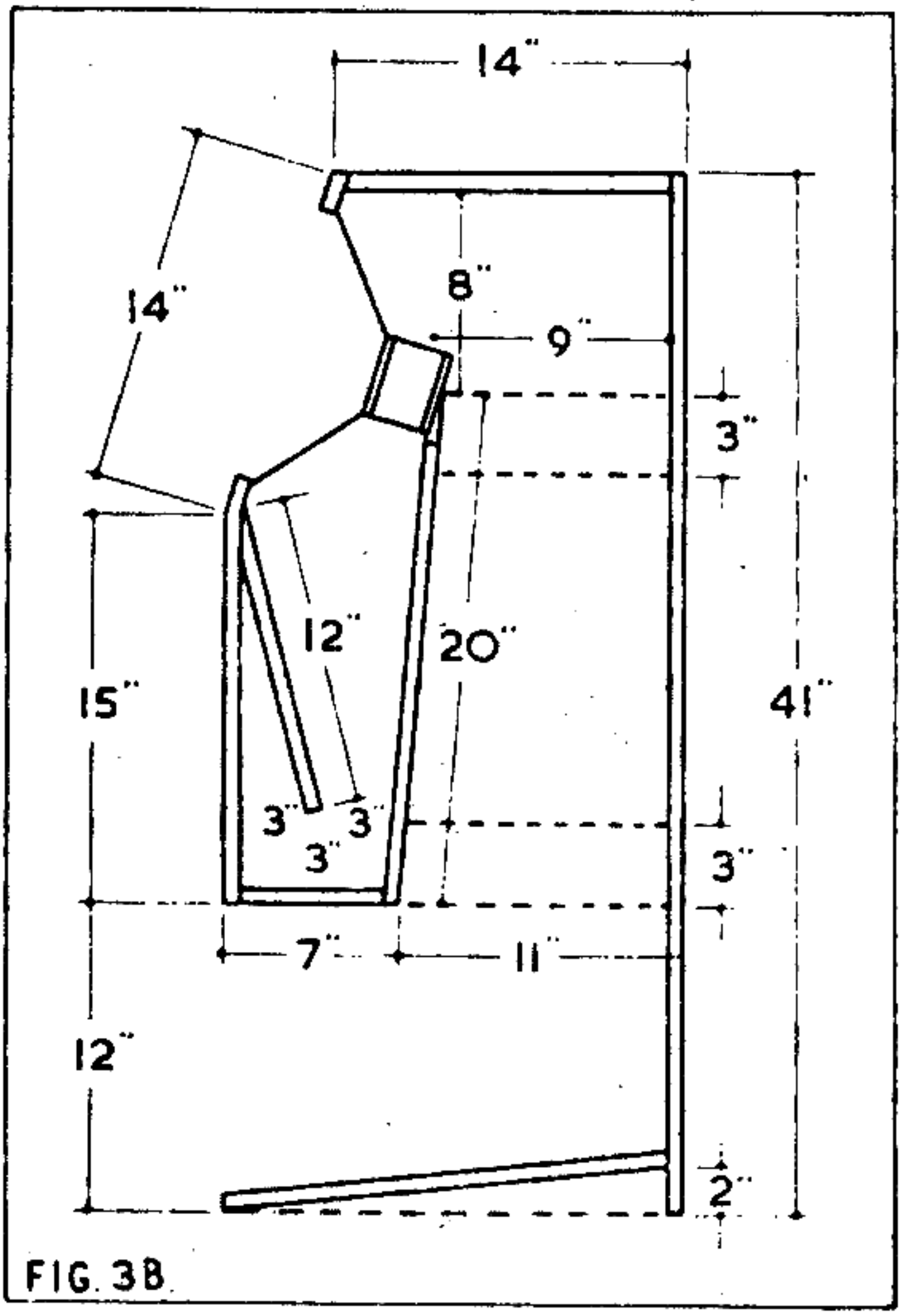


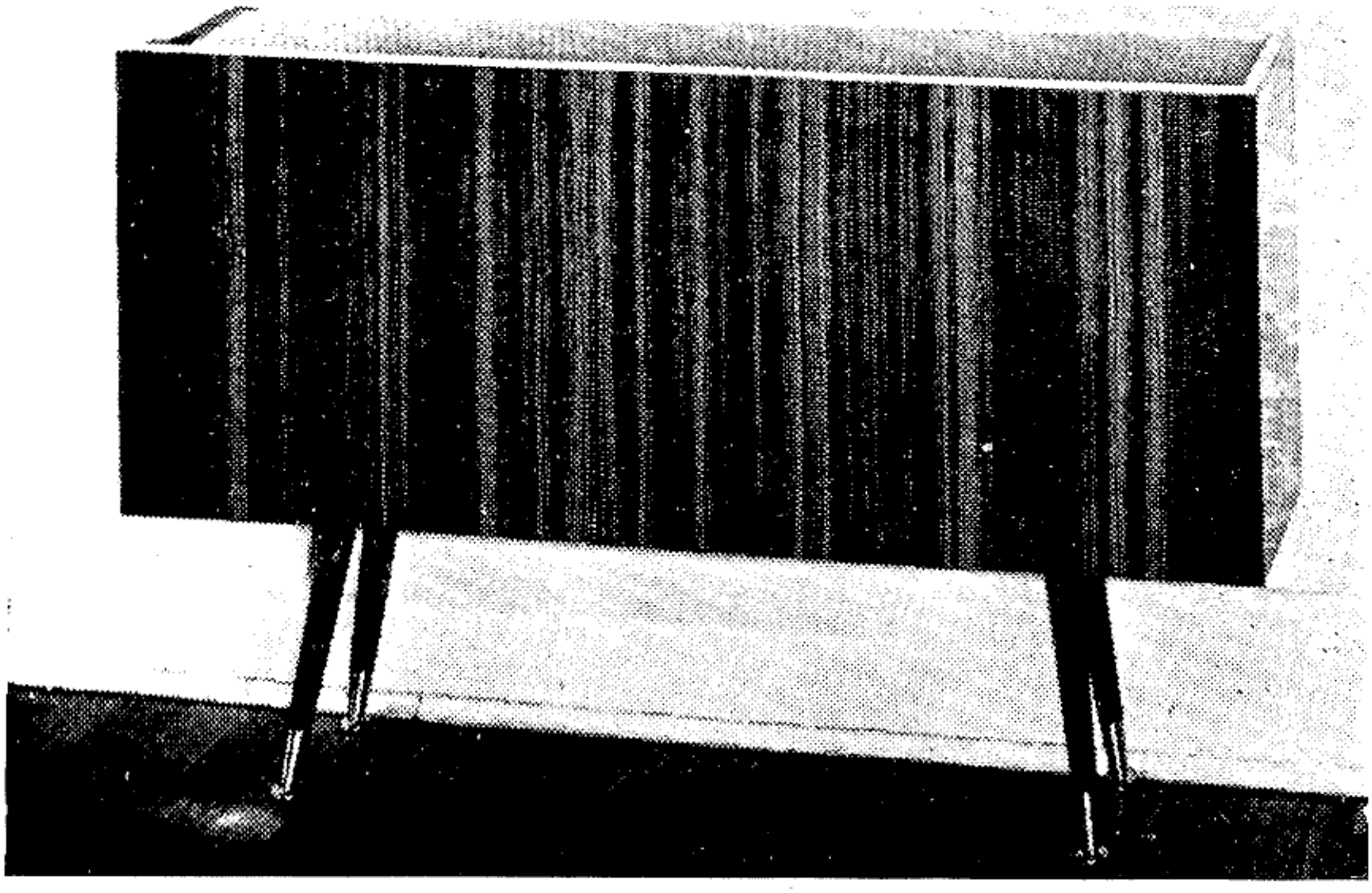
FIG. 3B

In this diagram, no allowance has been made for panel thicknesses (see also fig. 3A).

the PARALINE SPEAKER

OVER the last few years the trend in furniture design has been towards a long, low and slim appearance, and this has influenced the shape of radiograms and separate loudspeaker enclosures. In the stereogram field, very few models have the loudspeakers situated so that satisfactory results are achieved at a comfortable listening distance. Also, because of the requirement of housing turntables, etc., such units cannot be truly slim in the modern sense of not intruding appreciably into living space. Designers of high quality loudspeaker enclosures have now succeeded in reducing their depth to around 6 in., but the overall appearance is not always in accordance with the intended setting.

It occurred to the writer that it might be possible to combine the undoubtedly attractive frontal appearance of many stereograms with the slimness and excellent acoustic performance of separate enclosures. The outcome is the ' Paraline ', a versatile design whose name is derived from para (meaning beside), parallel, parabolic, parity and transmission line, all of which have associations with the operation or usage. Right- or left-handed versions, designated respectively PaRaline or ParaLine, may be built for monophonic



applications. For stereophonic use a pair may be either spaced apart as required or clamped together to form the PaRaLine illustrated in the photograph.

The major design requirements were thought to be:

1. Acoustical

(*a*) Well balanced performance with useful frequency range better than 50c/s–10 Kc/s. Efficiency such that maximum inputs of 5–10 watts per channel are adequate under domestic conditions.

(*b*) Bass output to be sufficient without use of room corners. Advantage to be taken of lowest parallel mode of room resonance, usually 35–50c/s.

(*c*) Freedom from fatiguing coloration and pronounced directionality.

(*d*) Acoustic image spacing and height to be suitable for stereo; minima of, say, 5 ft. and 2 ft. respectively. Results not to be marred by adjacent furniture.

2. Visual

(*a*) Not to look like a loudspeaker. (But what does a loudspeaker look like? The writer's definition: a small cubic box with

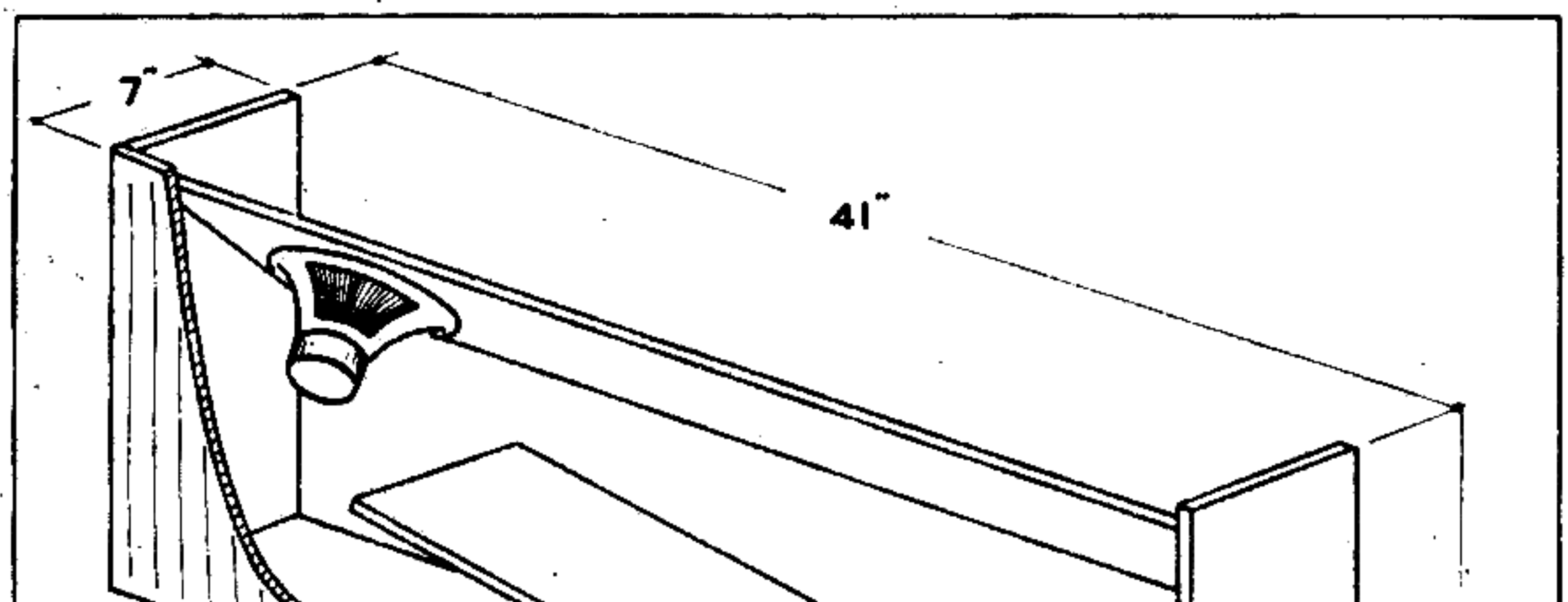


Fig. 1. *Cut-away view of the left-hand Paraline showing basic dimensions*

the unit facing the listener through a visible round hole; a constant reminder that the sound is not live!)

(*b*) Attractive appearance and compatibility with modern decor.

(*c*) Enclosure proportions to be acceptable whether used separately or combined to form a single unit.

(*d*) Suitability for mounting adjacent to a wall. Total projection to be less than 10 in.

3. Mechanical

(*a*) Easy construction for the amateur. No difficult joints or non-standard parts.

(*b*) Total construction cost for stereo to be less than £20.

(*c*) Design to be such that operation in the accepted stereo configurations is possible with only minor modifications.

(*d*) Dimensions and weight to be consistent with portability and easy movement for cleaning, etc.

Taking the acoustical conditions first, it was decided that they could best be met using a suitable 8 in. loudspeaker unit, back-loaded by a tapered air column, with front radiation reflected from an adjacent wall. This, of course, stems from the work of Paul Voigt on his Domestic Corner Horn in the 1930s, that of Ralph

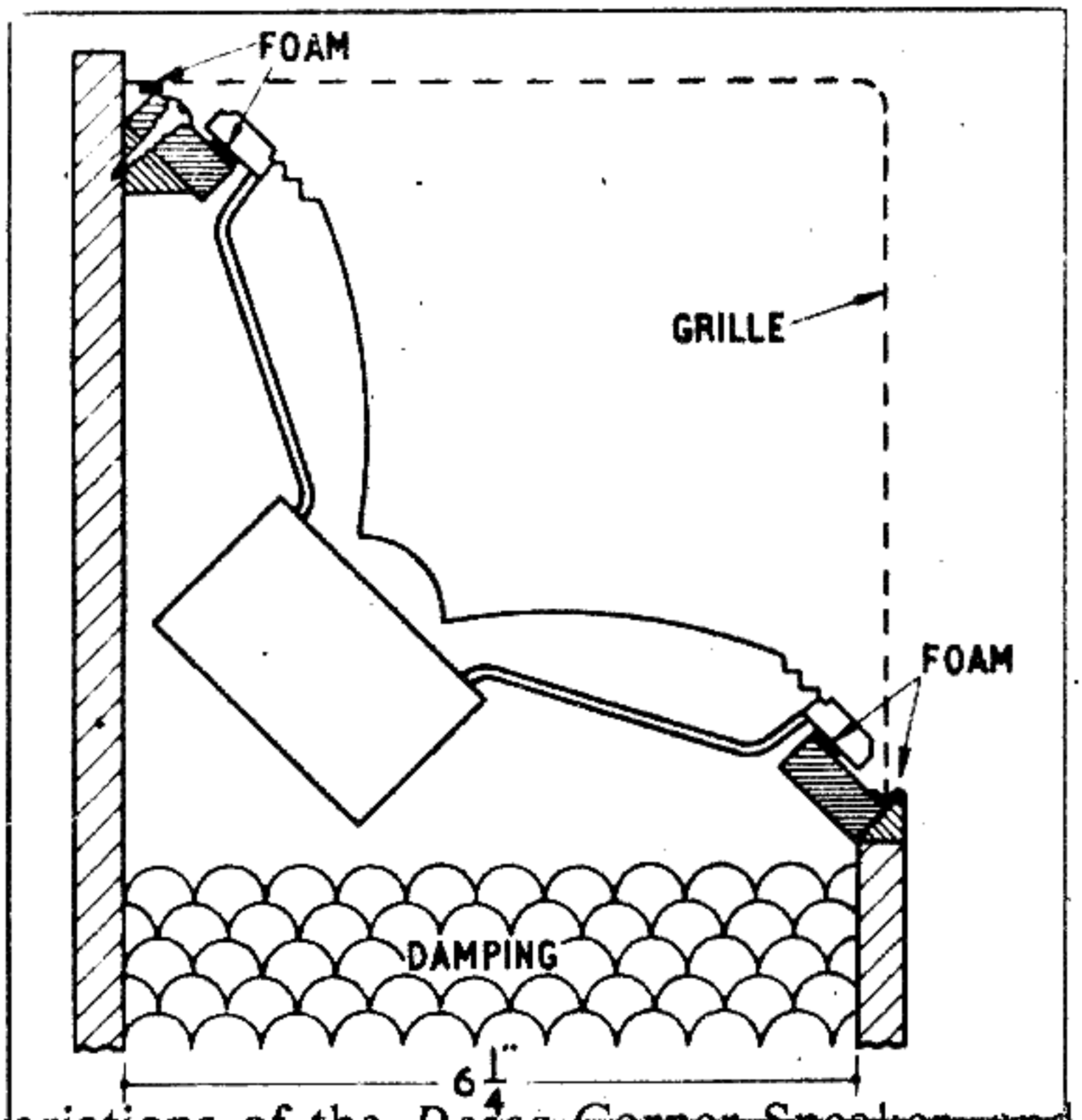


Fig. 2. *The speaker unit is fixed from the outside, using foam plastic strip to ensure a proper seal. The dotted line represents the decorative grille, which also sits in foam to prevent unwanted rattles.*

West since 1949 with variations of the *Decca* Corner Speaker, and the writer's own development, the Tricolumn (see *Hi-Fi News*, April and May 1961 and January 1962; also available as a reprint). In passing, it should be noted that the Paraline does not displace the Tricolumn for simplicity of construction, cheapness or port-

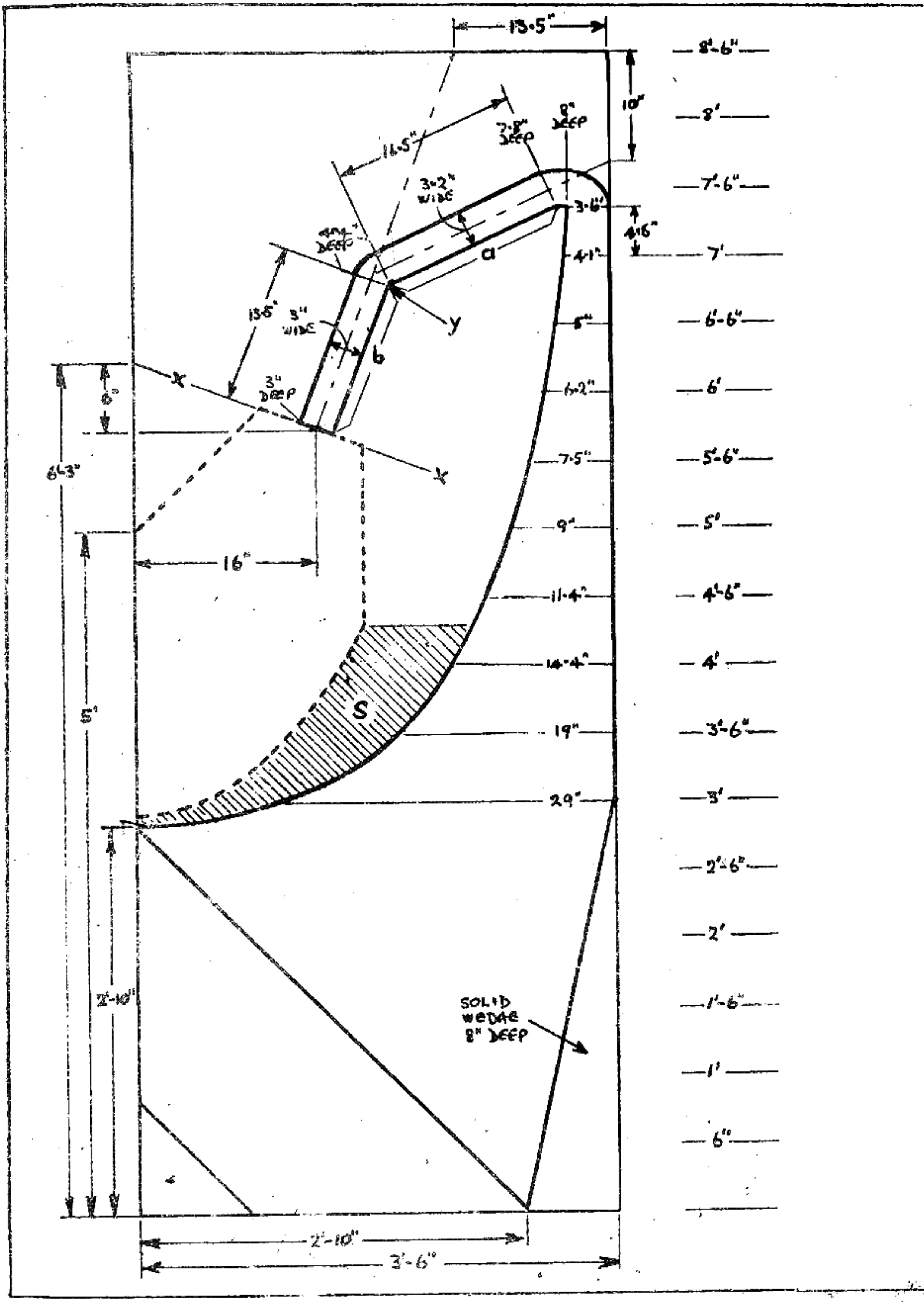
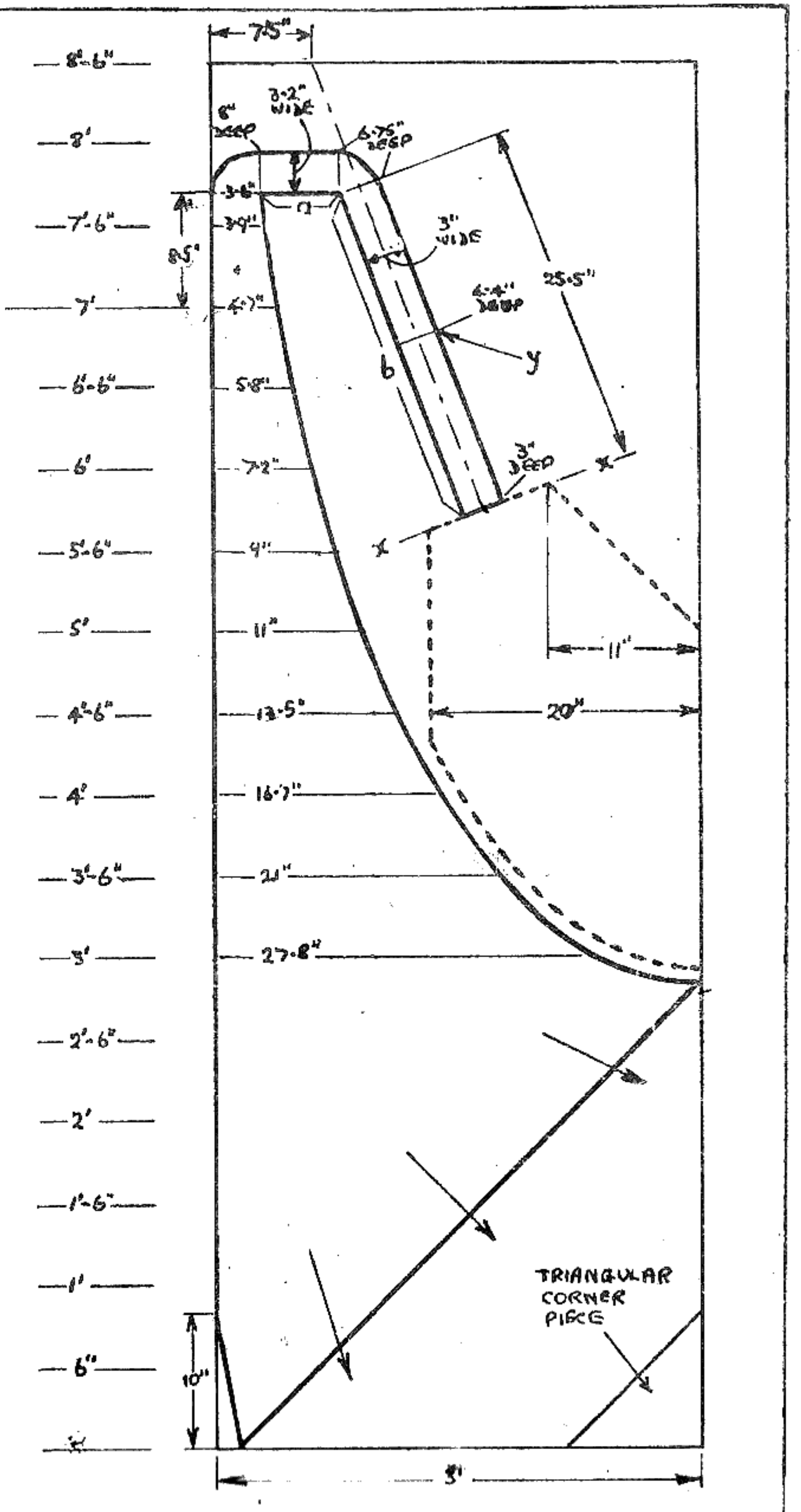


Fig. 1. *Dimensions of two bass horns with identical performance, but designed to fit different recess widths. The depth from*



front to back is 8 in. right up to the first bend. Where a dimension is the same on both horns it is given once only.