

## INTRODUCTION

by G. A. BRIGGS

The enormous demand for this C.C.S. seems to prove that readers obtain good results and save quite a bit of money by following its precepts and instructions.

No doubt stereo is responsible for a growing interest in speaker problems, but statistics show that the demand for radio sets is also on the up-grade, due to some extent to the excellent quality now available from good FM receivers which fully justify the use of wide range speaker systems.

My own bedroom installation consists of a commercial VHF set connected to a 10" unit in the reflex cabinet of Fig. 2, plus Super 3 tweeter, and I am often agreeably surprised at the capabilities of the set in the reproduction of music, with its own speaker switched off.

The following diagrams show the essential features of enclosures which give optimum results (in relation to size) with Wharfedale free suspension speakers. Other units can be used in these cabinets provided the cone resonance is not higher than the equivalent Wharfedale speaker.

### Size

The larger enclosures always give more output at low frequencies, but the smaller designs described give a satisfactory response consistent with their size. Outside dimensions are given, together with constructional specifications and recommended materials. Plywood thinner than that specified should not be used unless lined with Celotex. The shape of any model may be changed slightly without affecting the low frequency performance, provided the total volume does not vary by more than 10 per cent.

It is usually satisfactory to mount a speaker in an enclosure designed for a larger unit. It is, however, quite wrong to reverse the procedure and fit, say a 10" unit in one designed for an 8" model.

### Openings

Loudspeaker and port apertures should be left open or covered with an open mesh. For this purpose Wharfedale anodised aluminium mesh is available in gold or bronze finish. The placing of such openings is not critical.

### Lining

Where absorbent lining is specified this should consist of bonded acetate fibre, cellulose wadding, fibre glass, cotton wool or cheap carpet felt, up to about 1" thick. One of the best of these is the bonded acetate fibre as it is clean, non-irritant and easily cut and glued to woodwork. It is made in thicknesses up to 1½" by Southalls (Birmingham) Ltd., Industrial Division, Charford Mills, Saltley, Birmingham 8.

### Dust Exclusion

It is important that no foreign matter or dust from fibre glass should be allowed to enter the magnet gap; the cotton bags fitted to the open voice coil speakers should therefore be permanently retained.

### Walls

The corner walls of a room, if brick built, form an ideal backing for a corner reflex enclosure, and are superior to any cabinet. The front and top panels should make an airtight fit to the walls; gaps are easily filled up by glueing layers of cloth or felt to the edge of panels.

### Sand-filling

Next to concrete or bricks, a sand-filled panel gives the least resonance. Two sheets of plywood are spaced ½" or 1" apart—the larger the area the wider the spacing—and the cavity is filled with dry sand, which adds weight and absorbs vibration. Ordinary builder's sand is satisfactory.

### Tweeters

The 8" and 3" units should not be placed in the bass enclosure without being surrounded by absorbent material and carefully boxed in, because they are fitted with open chassis and the cones would be affected by the L.F. sound waves, thus offsetting one of the benefits of the crossover network.

External mounting for middle and treble units is recommended to avoid enclosure resonances. Directional effects are avoided by facing the speakers upwards or towards a wall or corner at a suitable angle.

### Acoustic Filter

When an acoustic filter is placed inside a cabinet it should form an airtight fit to the front, sides and back, so that the only air path from the upper compartment to the lower one is through the slits which permit the required transmission of low frequencies only.

### Stereo

Where a good, omni-directional corner speaker or SFB/3 system is already in use, the addition of a column type, or a reflex enclosure plus Super 3 tweeter facing upwards, will give excellent results on stereo because treble dispersion will be similar. If economy in space and financial outlay enforces the use of a small model as the second speaker, this should be tilted or orientated so that directional effects are not too pronounced, and are similar to those of the other speaker. Treble volume controls assist in obtaining reasonable balance.

Carefully matched speakers are not essential because room acoustics often vary from side to side and pickups have been known to do likewise.

Excellent stereo is also possible with more directional speakers—say 8" or 10" unit, Super 12 or Coaxial 12—in cabinets of Figs. 1, 2, 4 and 11, but the optimum listening area is more restricted than with omni-directional types.

A high-class speaker system of any make should never be discarded in favour of a pair of so-called matched but cheap specimens, because stereo *per se* can never replace good quality of reproduction.



## DESIGN DETAILS

**Fig. 1.** This small enclosure is simple in design and gives optimum results with the Super 8/FS/AL, the new Column 8/145 unit or the 8" Bronze FS/AL.

The sub-baffle is spaced  $\frac{3}{4}$ " away from the front panel, and the rest of the cabinet is totally enclosed as advocated in the first edition of LOUDSPEAKERS ten years ago. Volume 1 cu. ft.

**Fig. 2.** Excellent results with only 2 cu. ft. of volume. The rectangular opening improves diffusion in the upper register, but may be omitted if the speaker is used for bass only. The round opening would then be  $8\frac{1}{2}$ " diameter. The vent is tuned to about 40 c/s and will blow out a lighted match at this frequency with about 3 watts input to the 10" Bronze/FSB or about 2 watts to the Golden/FSB or W10/FSB. The Wharfedale acoustic filter improves the power handling capacity at low frequencies and reduces standing wave effects.

**Fig. 3.** Where a corner is available, this design will give the best cost-performance ratio that is possible, because full use of the room walls is made. Dimensions suitable for 8", 10" and 12" speakers are given.

**Fig. 4.** This 5 cu. ft. reflex enclosure with acoustic filter suits the Super 12/FS/AL, a unit which has attained a world-wide reputation. It also gives good results with the Coaxial 12 loud-speaker.

**Fig. 5.** The 9 cu. ft. corner system with sand-filled panel needs no introduction, as it has been demonstrated by us in concert halls in Bradford,

Leeds, Liverpool, Birmingham, Bristol, London, New York and Toronto; also in lecture and concert halls by our agents in Lisbon, Cape Town, Singapore, Hong Kong, Tokyo, Sydney and various South American cities whose names all sound alike to the writer.

**Fig. 6.** The brick enclosure is even better than Fig. 5 and actually costs less to build, but is of course a fixture.

**Fig. 7.** Large free standing cabinet for 3-speaker system. Withdrawn from leaflet. Design available on request.

**Fig. 8.** For domestic use the twin treble cabinet is normally faced upwards, but in large halls or heavily furnished rooms it may be desirable to tilt the speakers to an angle of about 45 degrees.

**Fig. 11.** This is a new adaptation of a 2 cu. ft. cabinet tuned to give good results with any 12" speaker with a cone resonance not higher than 35 c/s, thus providing economy of space where two speakers are required for stereo.

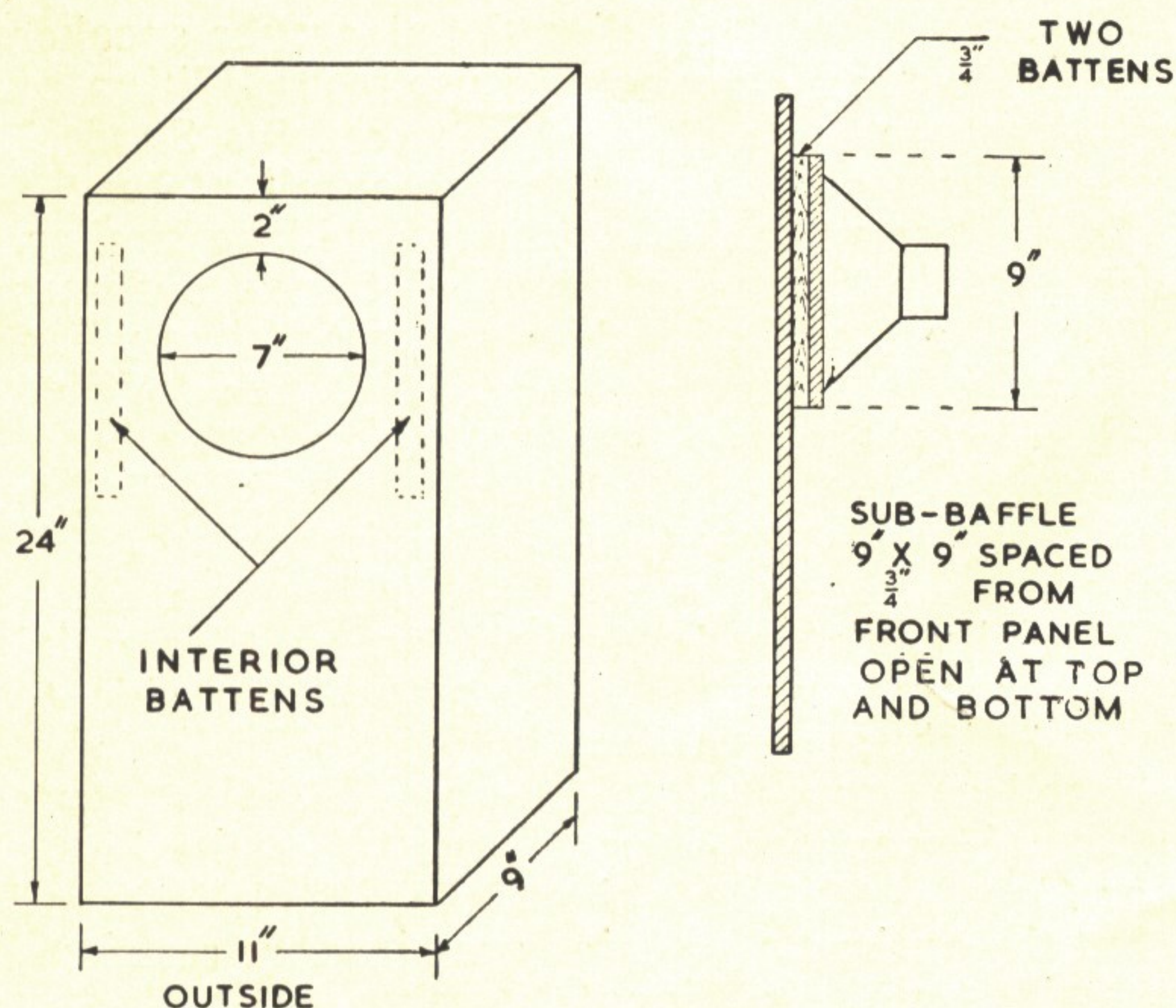
### COLUMNS

**Figs. 9, 10 12 and 13** give full details of a range of designs suitable for 8" and 10" speakers.

A COLUMN SPEAKER with good diffusion above chairs and furniture is very successful on stereo.

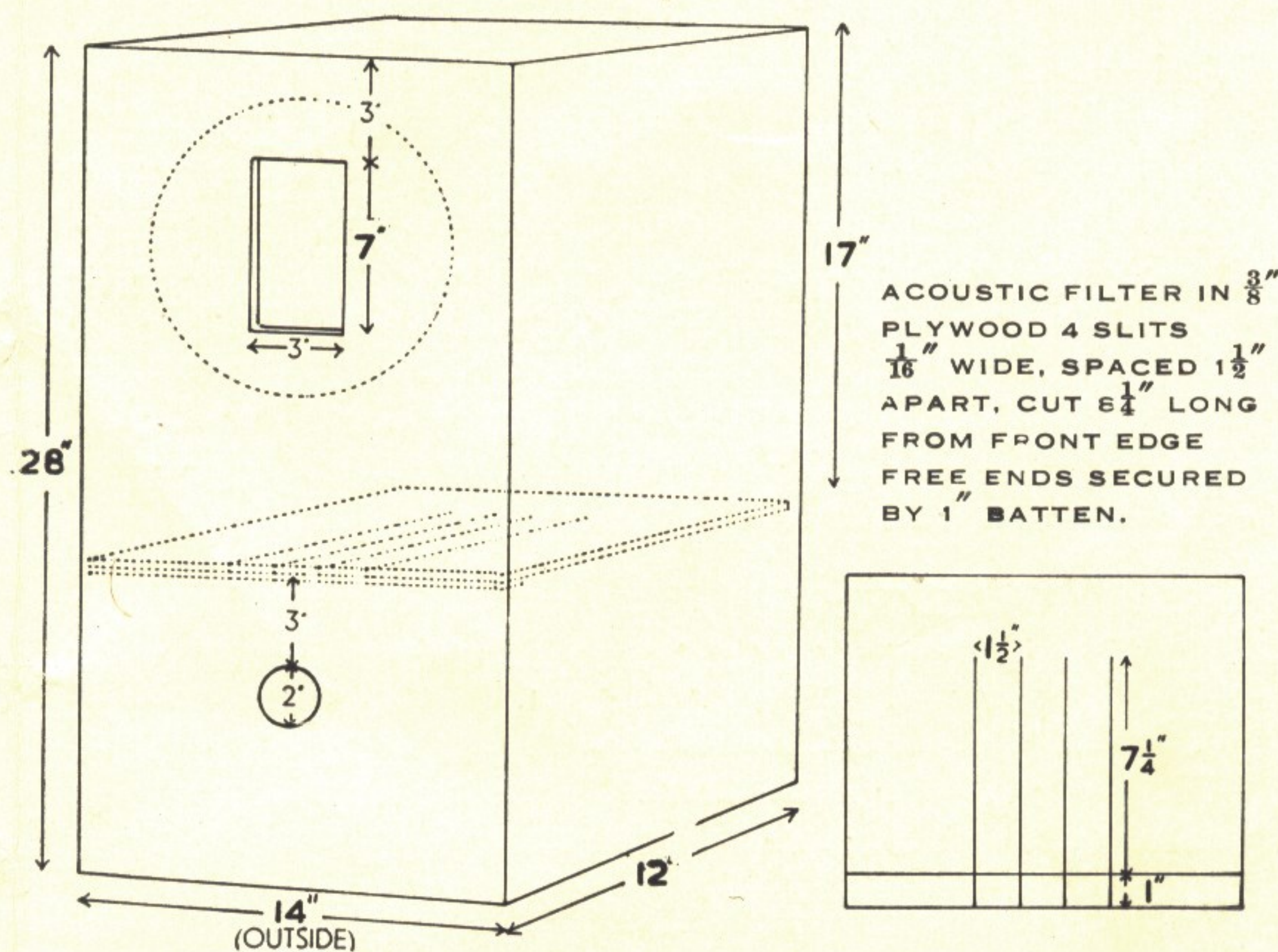
Judged on a cost v. performance v. room space, the concrete types are hard to beat.

**Fig. 1. TOTALLY ENCLOSED CABINET FOR 8" UNIT with spacing to replace tuned vent. Volume 1 cu. ft.**



MATERIALS:  $\frac{1}{2}$ " PLYWOOD, LINED 1" ABSORBENT ON TWO SIDES, TOP AND BACK

**Fig. 2. 10" REFLEX CABINET with Wharfedale Acoustic Filter.\* Volume 2 cu. ft.**



MATERIALS:  $\frac{3}{8}$ " PLYWOOD LINED WITH  $\frac{1}{2}$ " CELOTEX THE COMPARTMENT ABOVE THE FILTER SHOULD ALSO BE LINED WITH ABSORBENT MATERIAL, TWO SIDES, TOP AND BACK ONLY. WEIGHT 30LB. APPROX.

\*(Patent applied for No. 4483/56)



### Fig. 3. FLAT CORNER PANEL - SAND FILLED - WITH TOP

These enclosures are simple to construct and give very good results.

	Height inside	Width inside	Distance along wall inside	Approx. Volume	Sand Thickness	Total Port Area
	in.	in.	in.	cu. ft.	in.	sq. in.
8" units	31	30	21 $\frac{1}{4}$	4	$\frac{3}{4}$	10
10" units	38 $\frac{1}{2}$	30	21 $\frac{1}{4}$	5	$\frac{3}{4}$	14
12" units	40	32 $\frac{1}{4}$	22 $\frac{3}{4}$	6	1	20

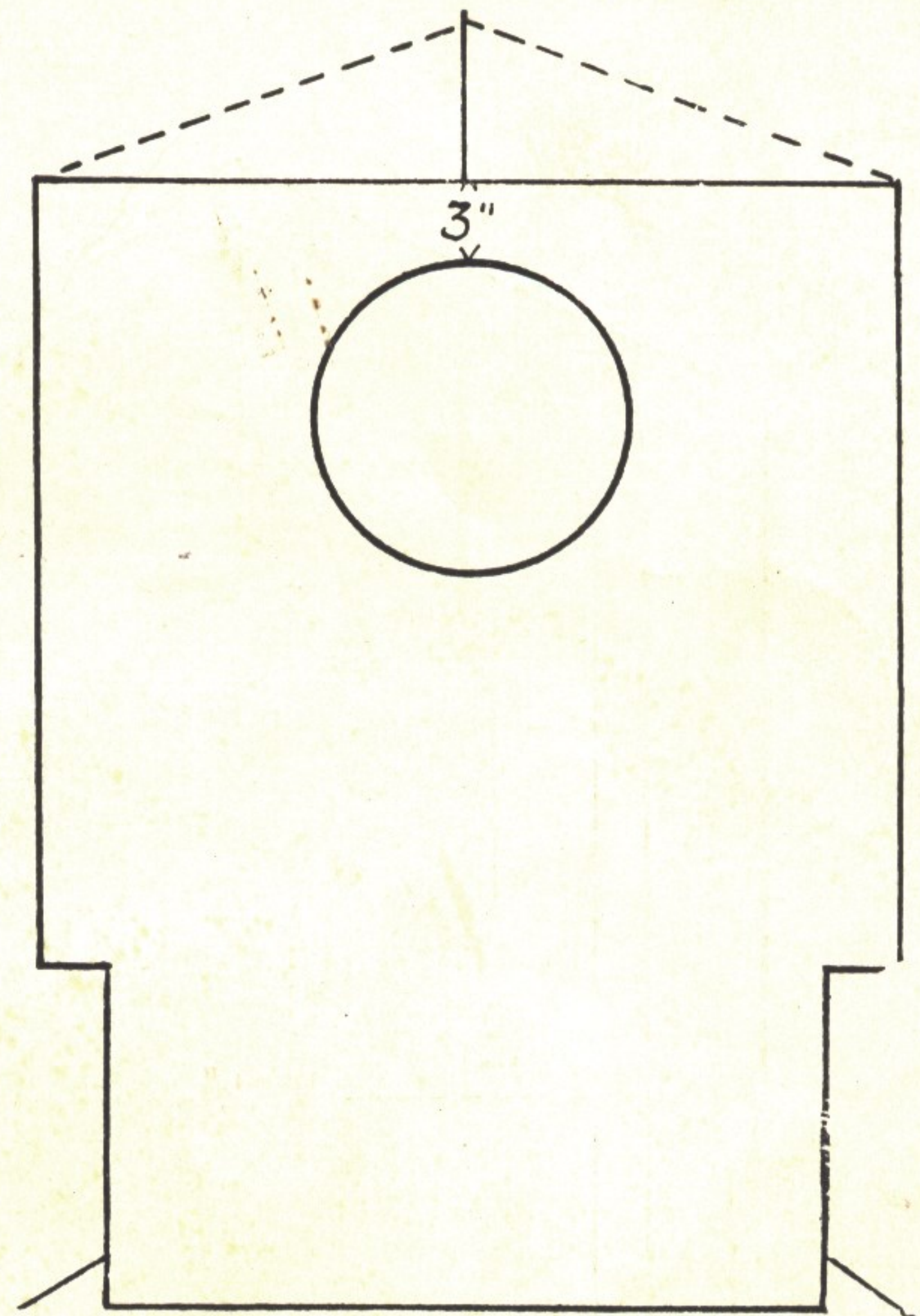
#### Materials

Solid wood frame of thickness to give required sand filling, faced both sides with  $\frac{3}{8}$ " plywood. Top in  $\frac{3}{4}$ " plywood. For maximum bass response an airtight fit to walls should be ensured by fitting strips of felt or Bostik white sealing strip.

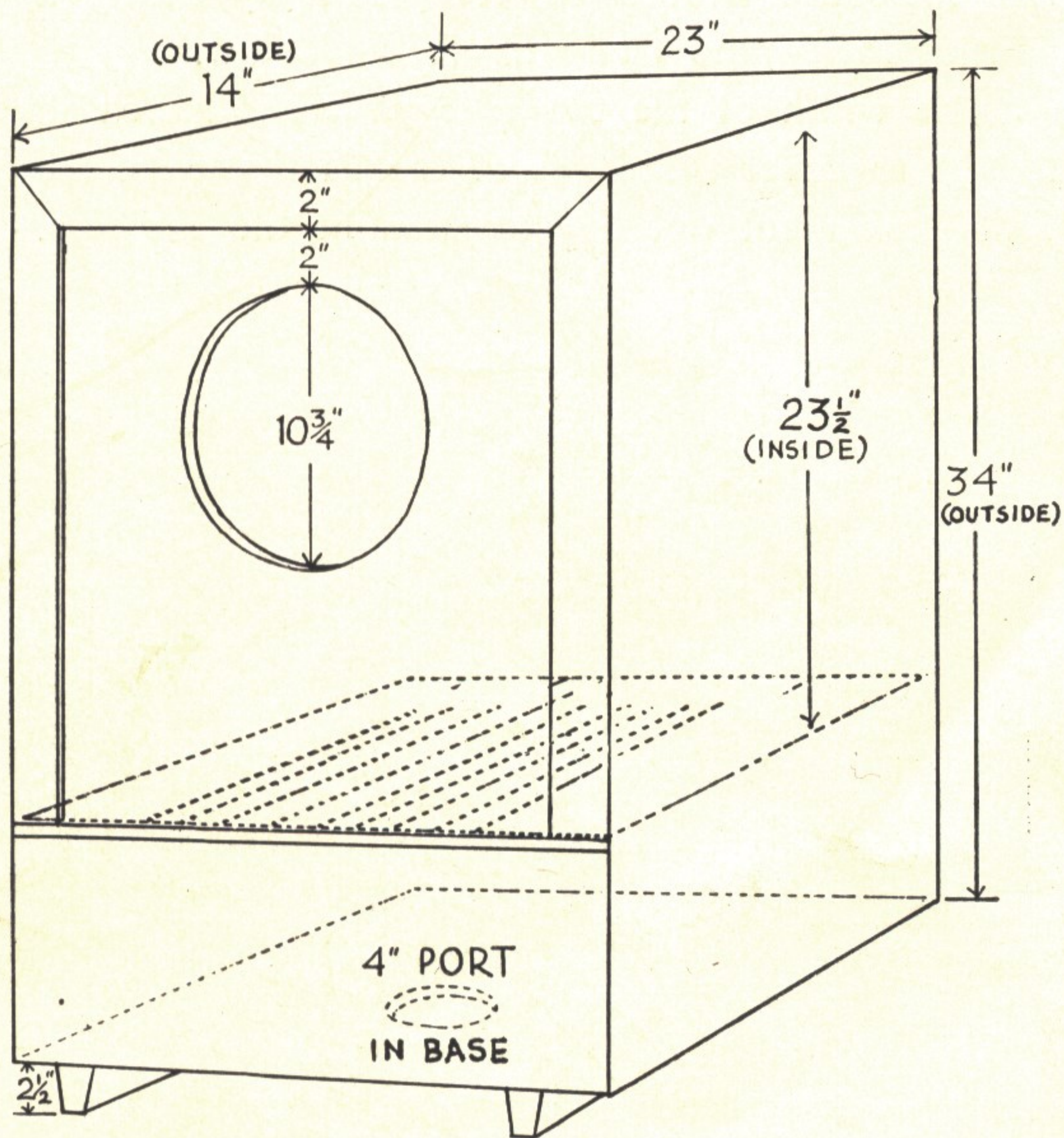
#### Note

It is convenient to use side ports to clear the skirting-board. The area of each port should then be half the specified total area after allowing for the space taken up by the skirting-board. The unobstructed section of the port should preferably be not less than 1" wide.

With the small corner panels of Fig. 3 it is



recommended that the cross sectional area of the skirting-board be taken into account, because the total port area is small and skirting-boards differ widely. Such measures are unnecessary with the 9 cu. ft. corner panel of Fig. 5 because the large volume ensures broad tuning and makes the port area much less critical.



### Fig. 4. AF 12 REFLEX CABINET

#### Materials

$\frac{3}{4}$ " plywood or  $\frac{3}{8}$ " ply lined  $\frac{1}{2}$ " Celotex. The compartment containing the loudspeaker (excluding partition) should be lined with absorbent material. The back must make an air-tight fit to sides of cabinet.

Weight: 64 lb. approx.

#### Recommended Units

Coaxial 12 (full range), Super 12/FS/AL (full range), W12/FS (bass only).

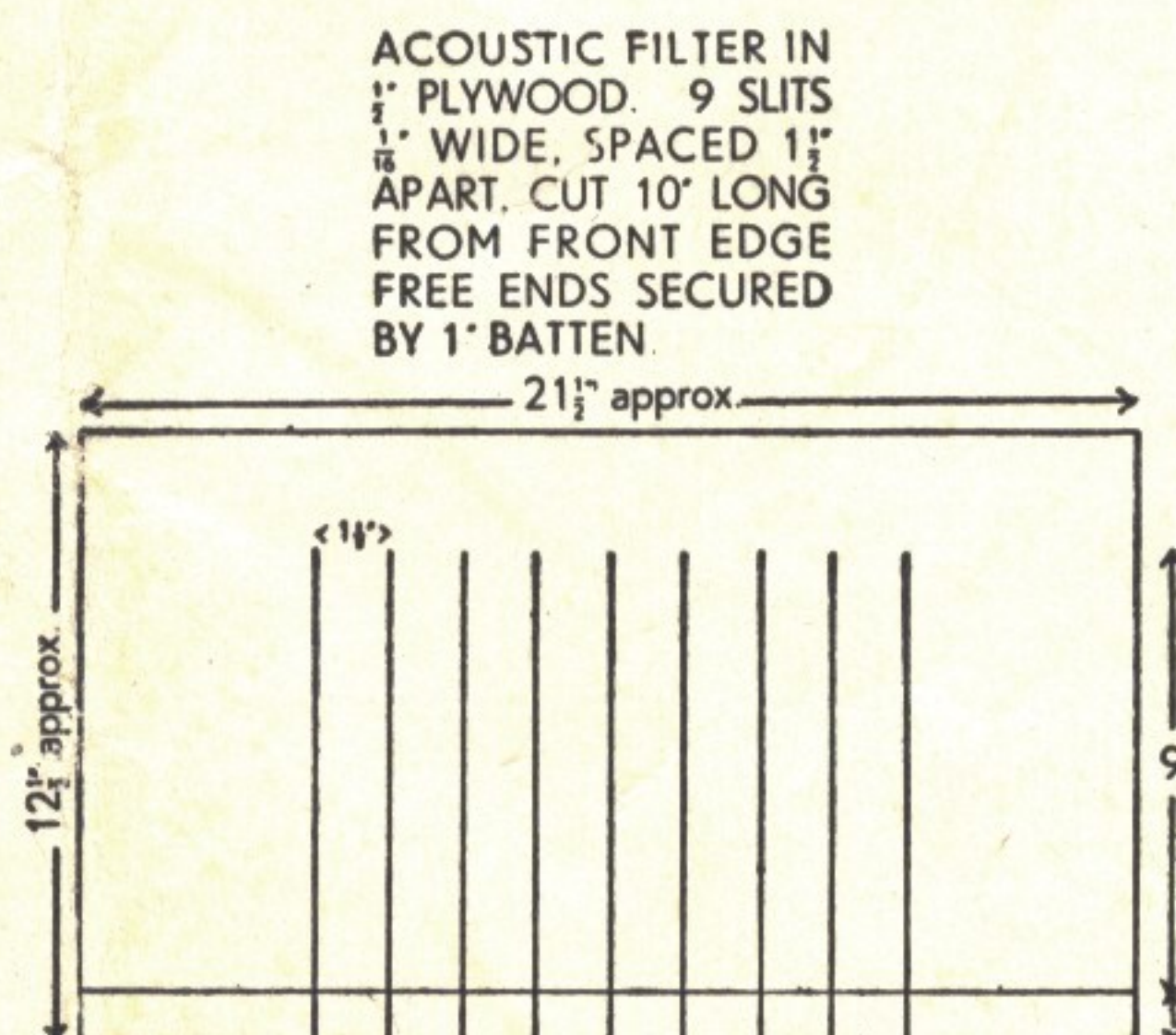
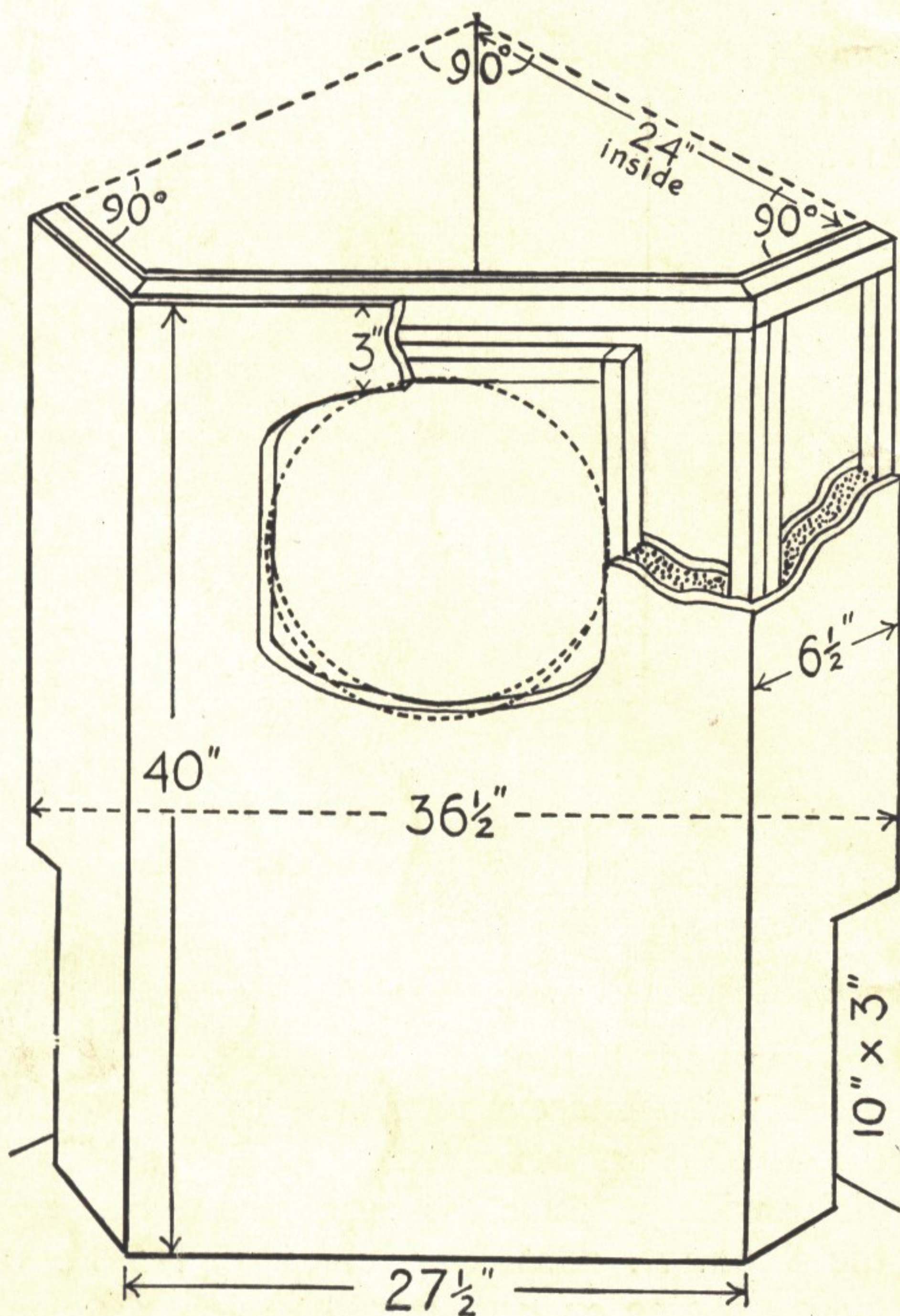




Fig. 5. 9 cu. ft. SAND-FILLED CORNER PANEL



Distance along wall from corner to front of lid is  $26\frac{1}{4}$ ". Weight of front panel 124 lb.

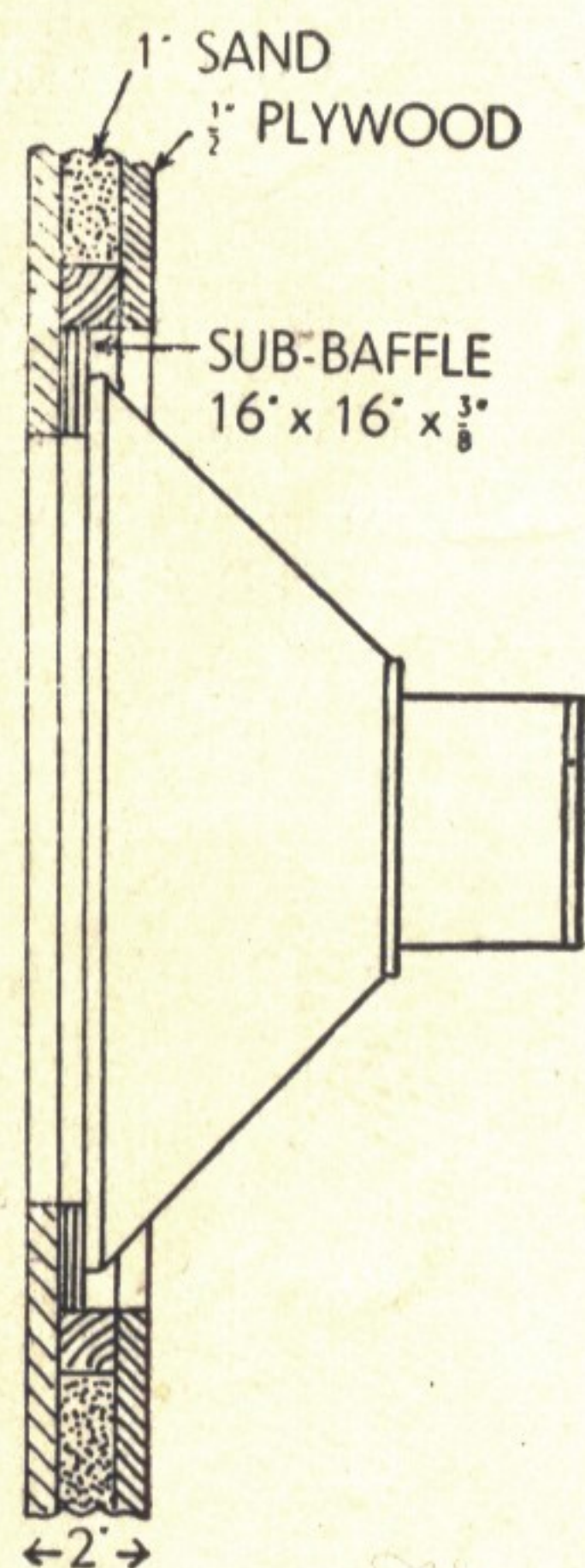


Diagram to show method of fitting sub-baffle to sand-filled panel.

### Recommended Units

W15/FS (bass only), Coaxial 12, Super 12/FS/AL.

This enclosure also gives excellent results with the W12/FS in a budget three-speaker system. The free surround 10" units also perform well here, but with 8" units the new concrete column gives a better balance.

### Materials

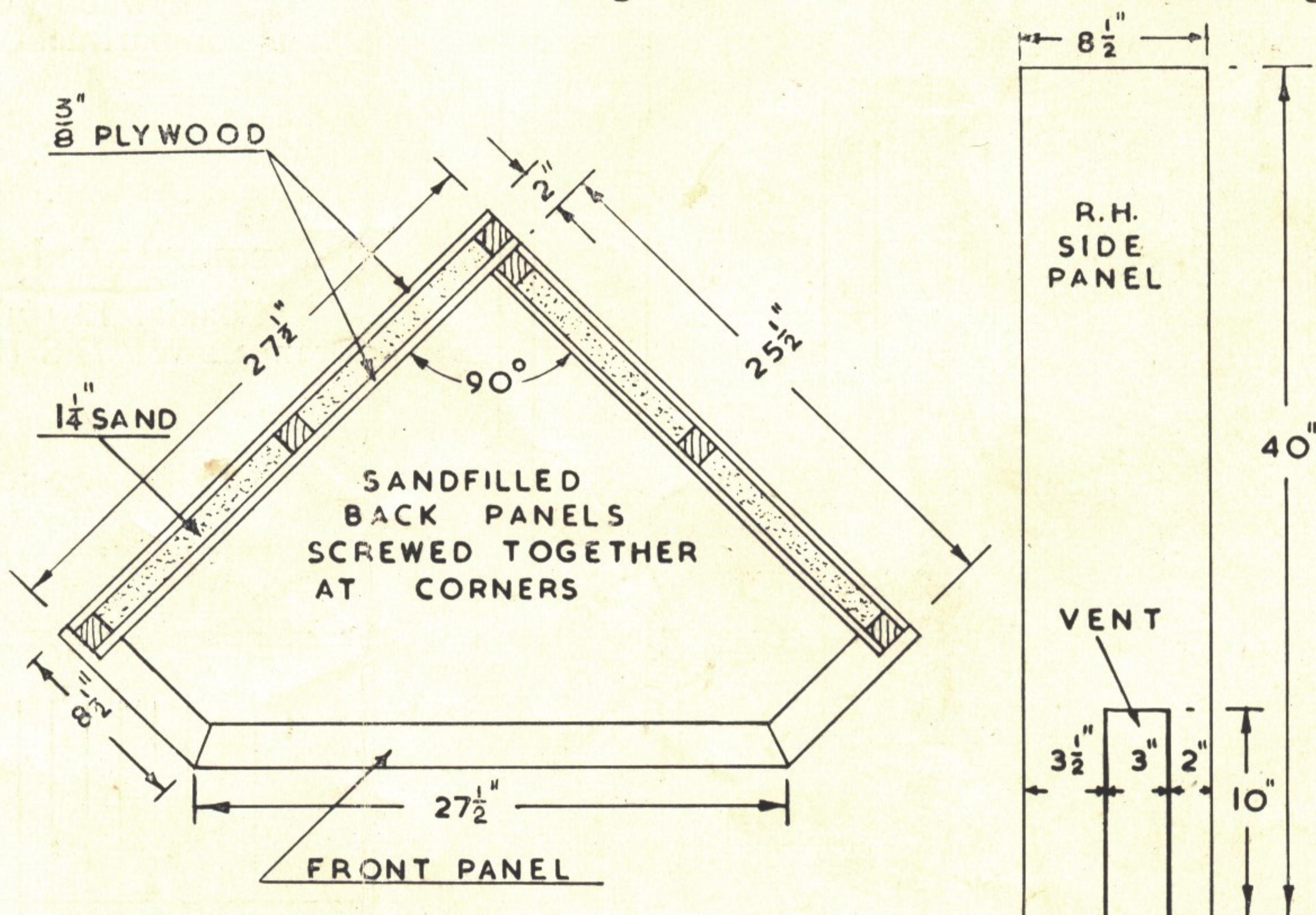
Solid wood frame 1" thick, faced on both sides with sheets of  $\frac{1}{2}$ " plywood. Space between plywood filled with tightly-packed dry sand. Top in 1" plywood or blockboard. For maximum bass response an air-tight fit to walls must be ensured.

Sub-baffle about 16" x 16" in  $\frac{3}{8}$ " plywood should be fitted up to the rear side of the front plywood panel, inside the frame shown in drawings, to avoid a cavity in front of the cone.

### SAND-FILLED BACKS

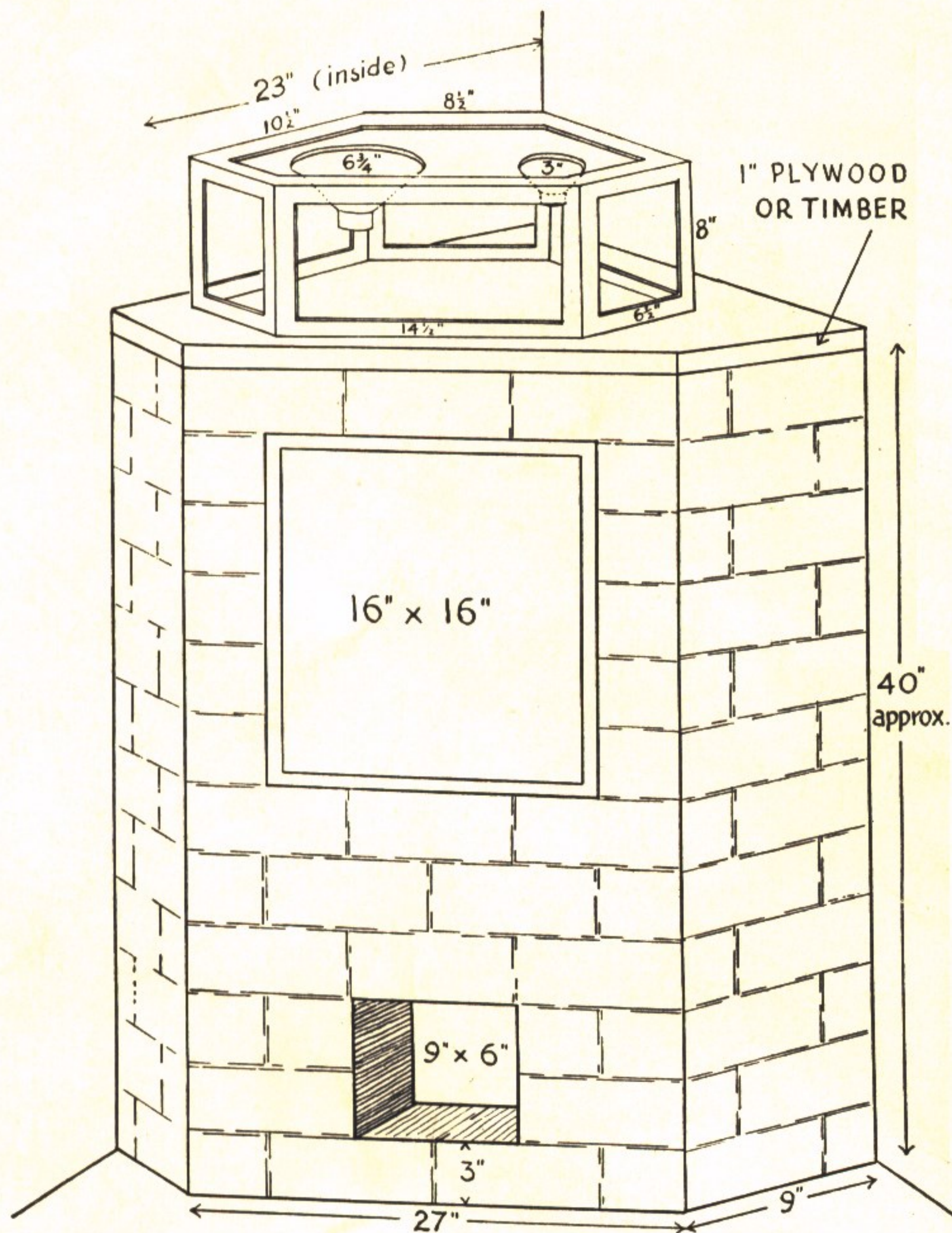
Where a solidly built corner is not available, the enclosure should be completed by fitting a pair of sand-filled backs as shown below.

The width of the two side panels is increased to  $8\frac{1}{2}$ " to cover the edges of the back panels, the vents being cut out as indicated in the drawing.





## Fig. 6. BRICK REFLEX



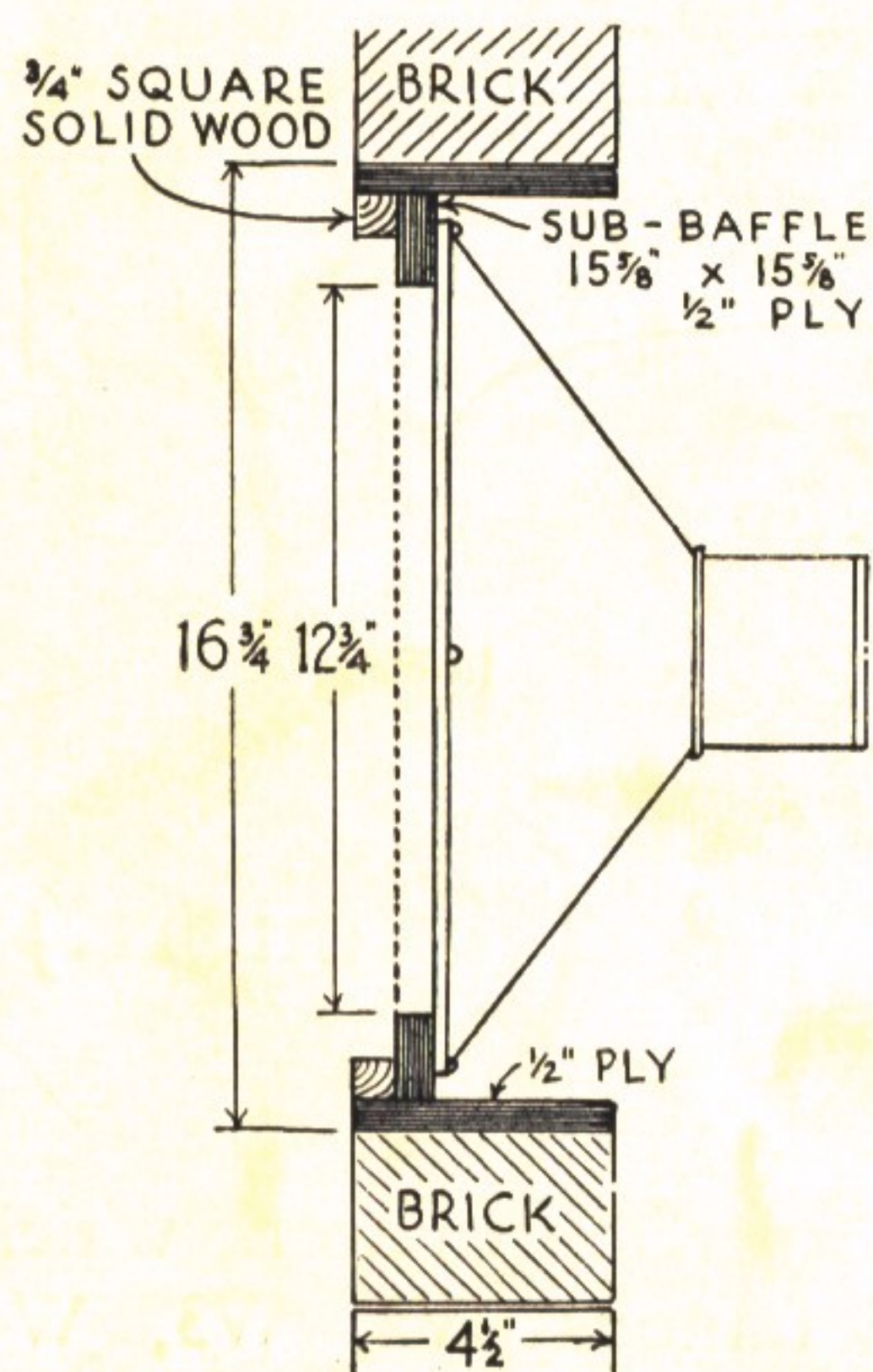
Brick structure for 9 cu. ft. reflex loading.

Readers who may be removing, redecorating, or building a house are strongly advised to construct a brick enclosure along the lines of this drawing. The cost is low, but the results are superb.

The wooden frame is recessed to take a sub-baffle with bass unit. This baffle should be fixed as near as possible to the front of the structure, and may be  $\frac{1}{2}$ " plywood.

The distance along the wall inside the enclosure is 23", and along the front is 27" outside. The W15/FS is the ideal bass speaker, with a treble unit or middle and top units, mounted as shown in Fig. 8.

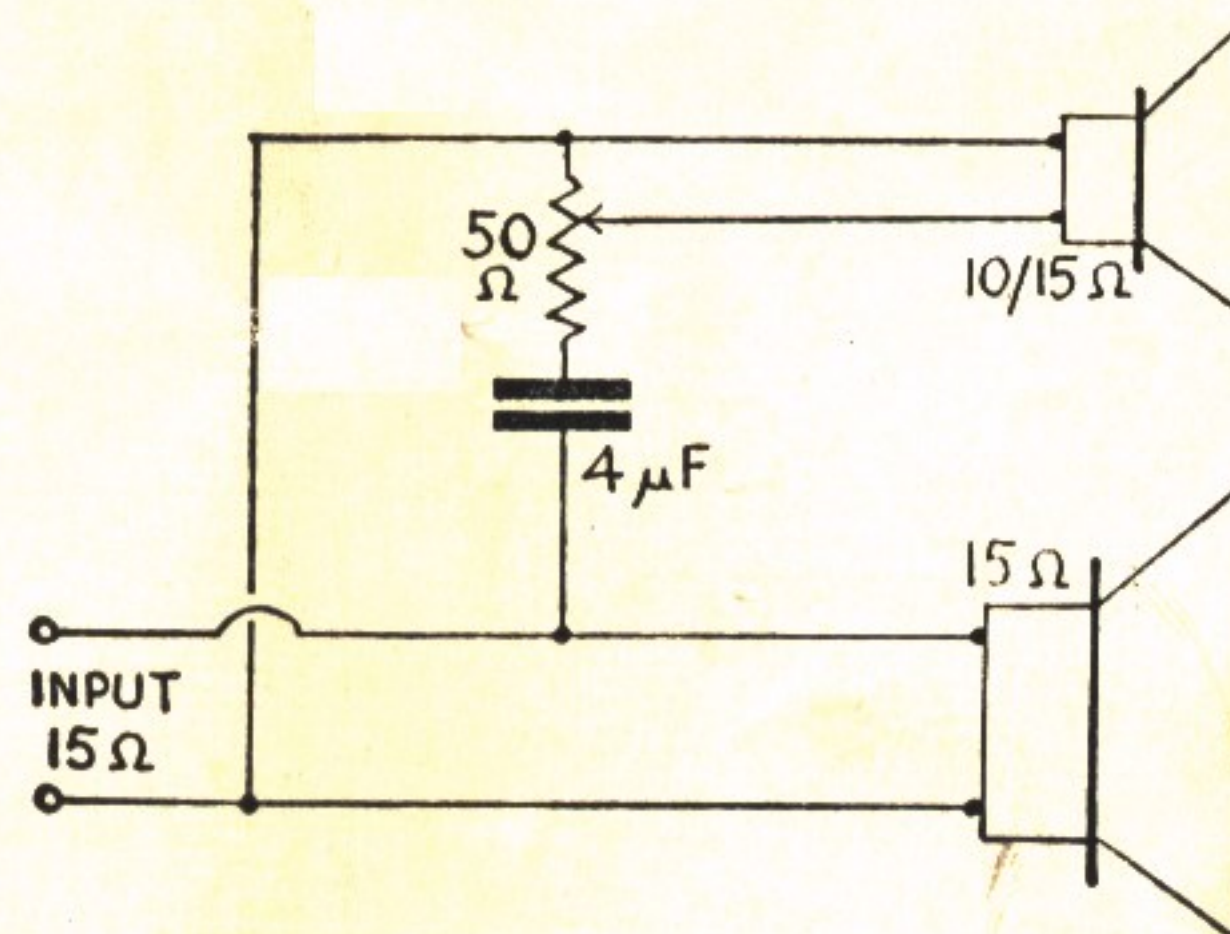
Alternatively, the Coaxial 12, Super 12/FS/AL, W12/FS, W10/FSB and even smaller speakers give a good account of themselves in brick surroundings, but the improved bass response may call for the addition of a tweeter to preserve a good tonal balance, except when the Coaxial 12 is fitted.



Side view of brick panel showing method of fixing sub-baffle.

### ADDING A TWEETER

A Super 3 Unit may easily be added to any existing loudspeaker system. The unit should be mounted on a small open baffle 6" x 4" facing upwards and connected as shown in diagram.



Tweeter with volume control. If the impedance of the main loudspeaker is  $\frac{2}{3}$  ohms, the filter capacitor and V.C. should then be 12 Mfd and 20 ohms respectively.

## TWO-SPEAKER SYSTEM

Where two speakers are used with crossover network, the treble unit should be mounted on an open baffle placed above the reflex cabinet. Plywood  $\frac{3}{8}$ " thick is satisfactory and a crossover at 1,000 c/s. is correct with the following sizes:

8" Treble unit baffle 14" x 12" approx.

10" " " " 16" x 14" "

Under these conditions a quarter section series network gives excellent results.

If a 400 c/s. crossover is used the baffle should be 3 or 4 inches bigger. This lower frequency is recommended for stereo, because most of the

stereo information is found in the range above 400 c/s.

With a 3" treble unit, the baffle size may be reduced to about 6" x 4" and the crossover frequency should not be lower than 2,000 c/s.

### BEAM EFFECT

To reduce directional effect and spread the H.F. beam, the treble unit in all the above cases may be mounted horizontally with the cone facing upwards, or at an angle of 45° facing into the corner of the room for good reflection effects.



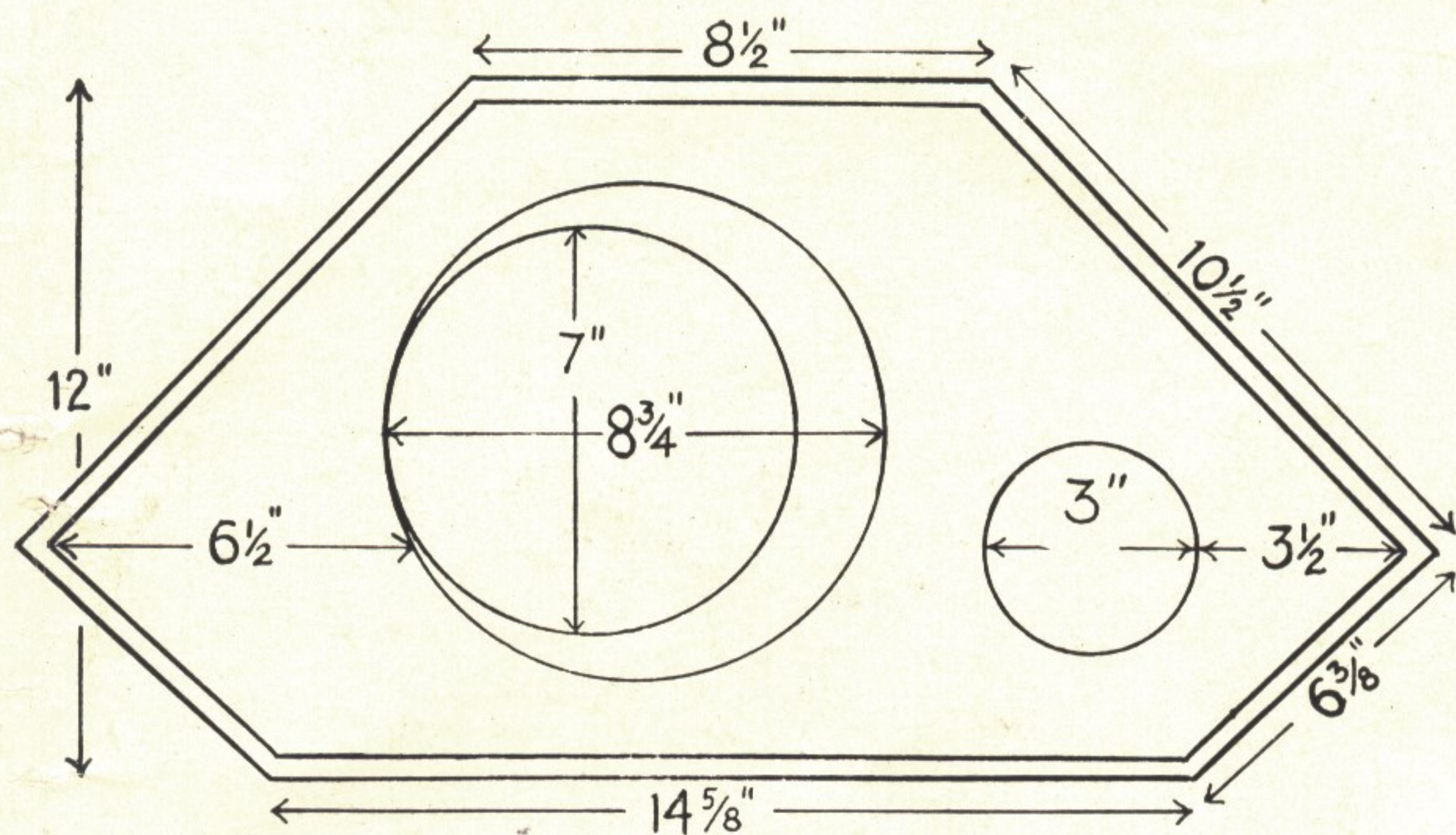
## Fig. 8. TWIN TREBLE ASSEMBLY FOR THREE-SPEAKER SYSTEM

A crossover between 400 and 1,000 c/s. is satisfactory with a 10" or 8" unit for the middle and upper registers plus a 3" to improve the extreme top. The third speaker is connected in parallel with the middle speaker with capacitor of 4 Mfd. in series with the voice coil of the small unit (10-15 ohms). (With 2-3 ohm speakers the value of the capacitor would be 12 Mfd.)

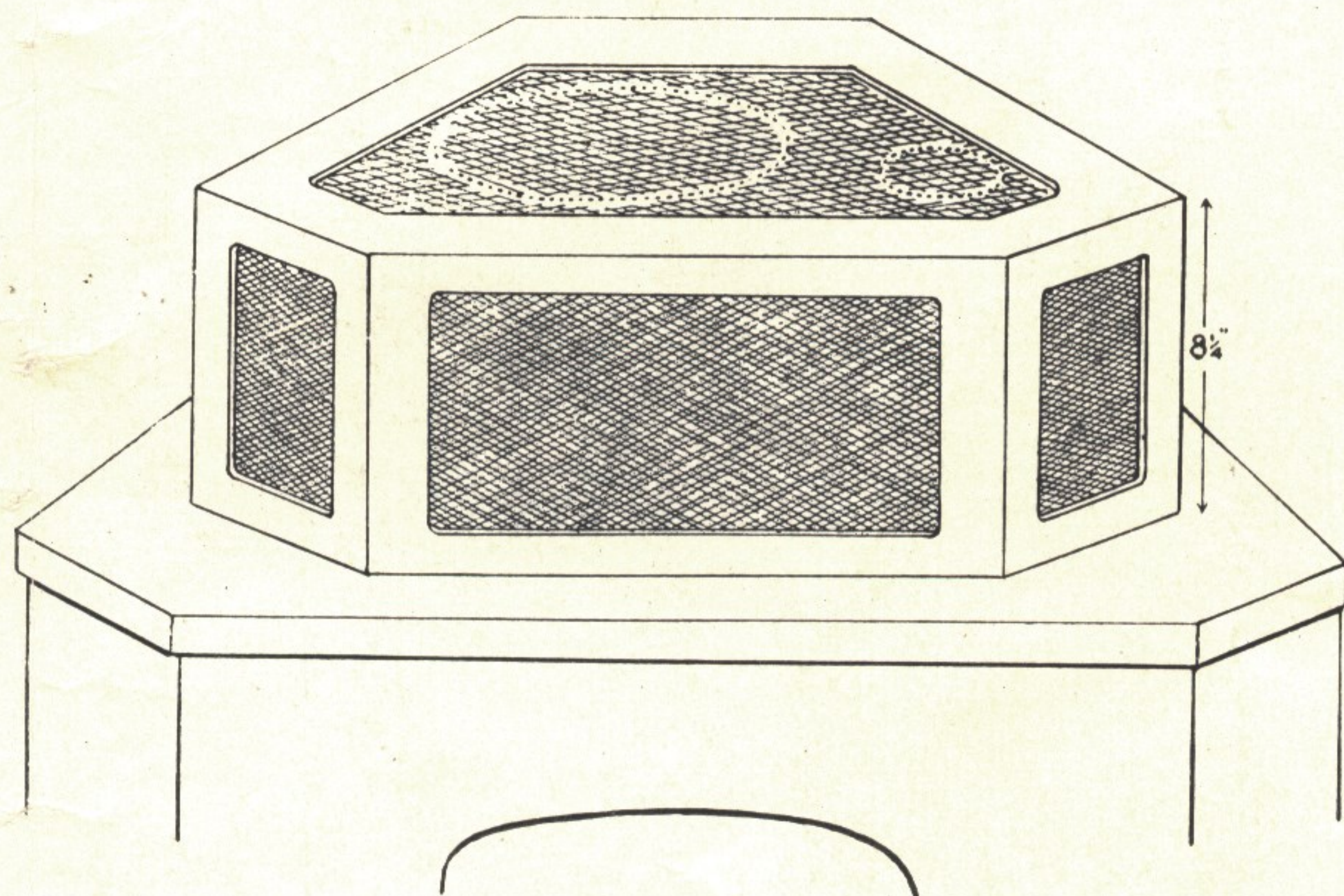
Wharfedale 8" or 10" FS units are suitable for use as middle speakers. The Super 3 gives good results as the third speaker.

Non-directional and natural results are achieved by horizontal mounting on the lines of the diagrams shown. Both units face upwards and dust should be excluded by a layer of fine cotton or muslin. The baffle openings shown will suit 8" or 10" middle speakers and 3" tweeters.

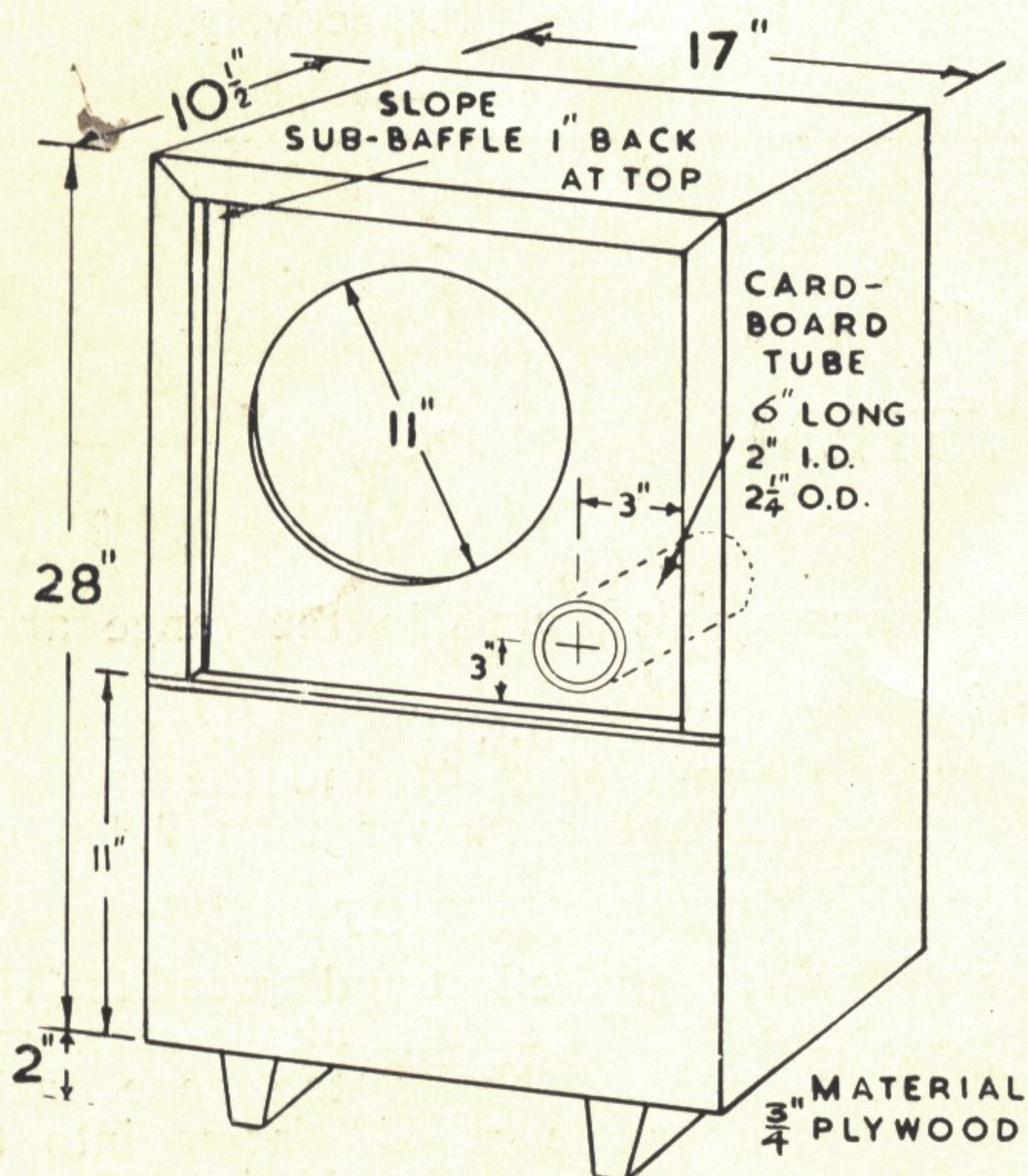
The sides and back of the cabinet must be left as open as possible. Anodised aluminium mesh is a suitable covering.



Plan view of Baffle



## Fig. 11. TUNED ENCLOSURE FOR 12" UNIT (Vol. 2 cu. ft.)



As a result of months of research work which culminated in the now famous W2, W3, W4 range of speakers, we are able to offer a design which gives good results in 2 cu. ft. with a 12" speaker with cone resonance not higher than 35 c/s. The normal acoustic filter and vent are replaced by the pipe, which we can supply at 2s. 6d. postage paid. As the pipe tunes the enclosure, the rest of the cabinet assembly must be airtight, with no air leak around back, sub-baffle or the pipe itself. NB: Pipe = Tube.

The enclosure suits the Coaxial 12, Super 12/FS/AL and W12/FS. The sub-baffle is shown tilted for use with a full-range speaker. For bass only, such tilting is unnecessary. (The Super 12/FS/AL is improved by the addition of a Super 3).

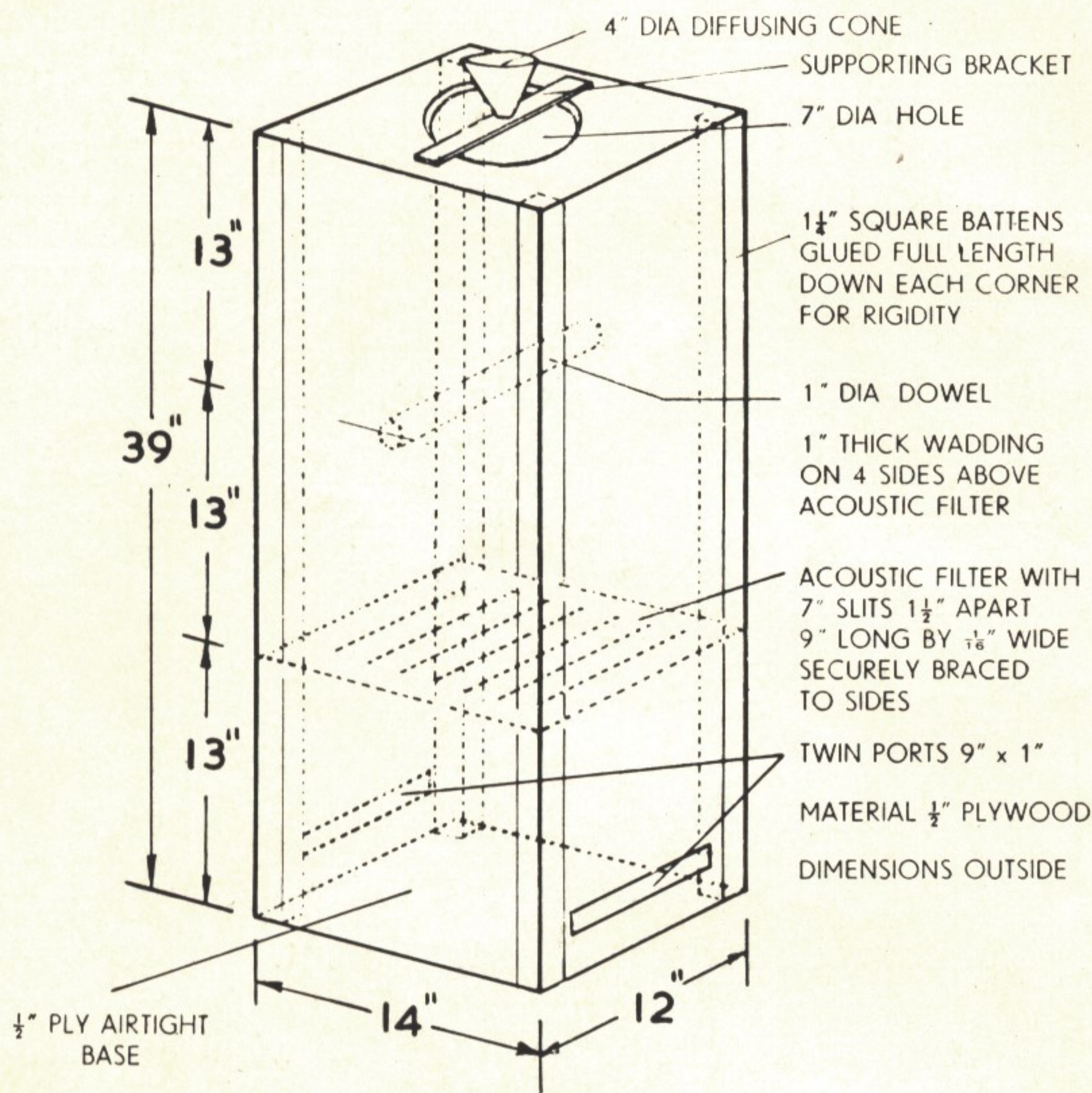
Although not equal to the AF12 model, the size/performance ratio of Fig. 11 is very good.

Lining: 1" absorbent material.

Weight: 35 lb. approx.



**Fig. 9. COLUMN SPEAKER**



Column speakers seem to be ideally suited to stereo, either in pairs or on one channel with a different type on the other. The omni-directional treble diffusion renders the listening position relatively uncritical.

The column must be sturdily built to reduce resonance; this model weighs over 30 lb. The bass is outstanding for an 8" speaker. The acoustic filter reduces column resonance, especially third harmonic, and the diffuser gives excellent high note dispersion.

In the new design given here, the height of the column has been reduced to about 3' 4" and the shape is made oblong instead of square for acoustic reasons.

The assembly suits the 8/145 unit and the Super 8/FS/AL. The 8" Bronze FS/AL can also be used with good results; the cost is lower but there is a drop in sensitivity and a slight loss in transient attack.

We can supply diffusing cones at 7s. 6d. each.

**Fig. 10. CONCRETE COLUMN**

For the floor space used and low financial outlay involved, we have never heard more impressive sound than comes from this concrete column. There are, of course, solid reasons why these rigid enclosures give such excellent results.

The absence of panel and structural resonance avoids absorption of energy at very low frequencies and therefore improves bass response; it avoids mid-frequency coloration, which in turn improves transient response and allows the HF end to come through clearly. These benefits accrue at the sacrifice of mobility, but they apply with equal force to single channel and stereo reproduction.

The column illustrated was built in the Wharfedale laboratory in half a day and takes the 8" units specified in Fig. 9.

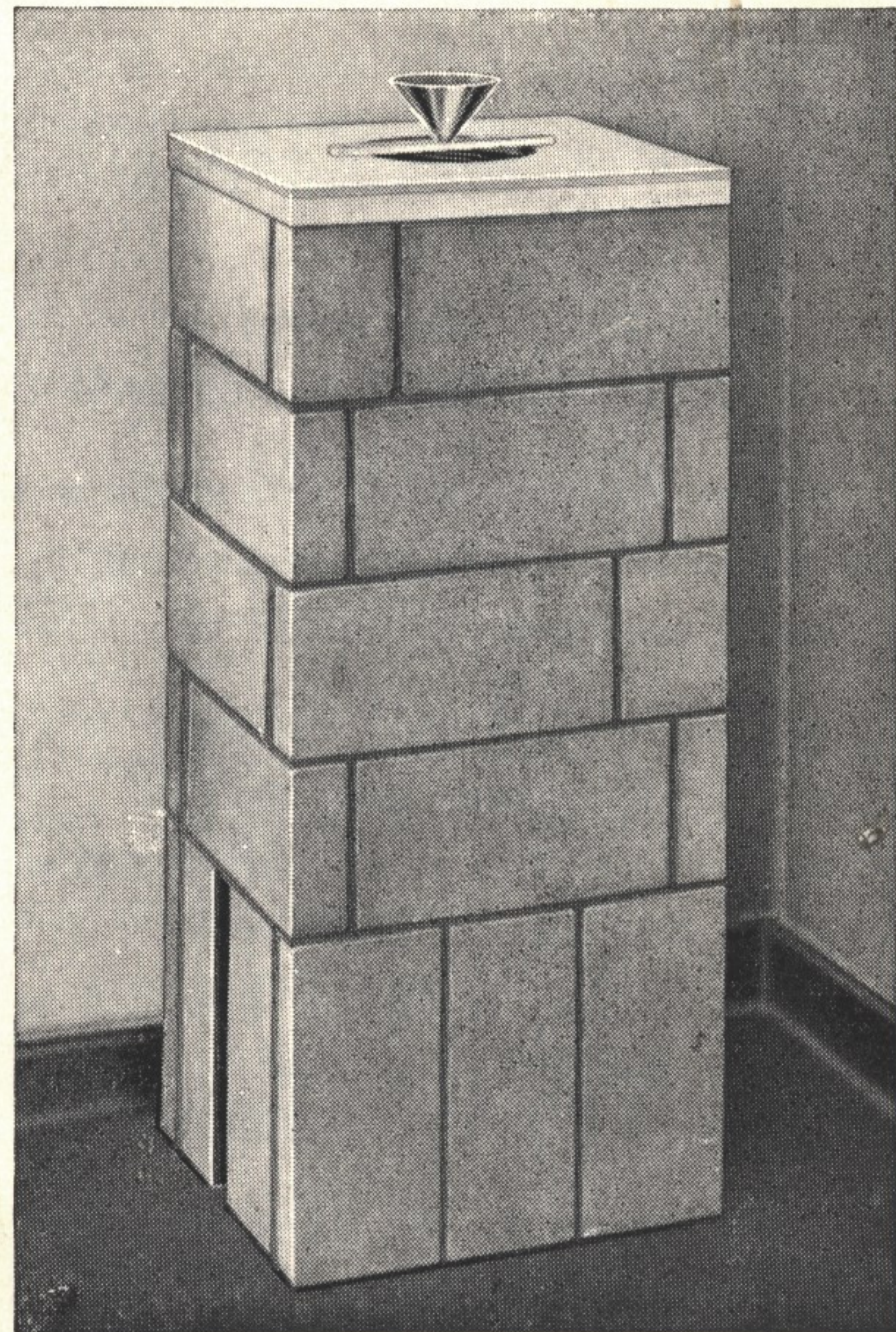
The coloured concrete blocks measure 12" x 6" x 2", weigh 10 1/2 lb. each, and are easily obtainable from builders' merchants. The entire structure weighs about 2 1/2 cwt.; but if fitted to brick wall or corner up to 50% of the blocks can be omitted and the twin ports arranged to clear the skirting-board.

A column 36" high is satisfactory with an acoustic filter inserted one-third of the way up.

The acoustic filter should be as specified for Figure 9.

The baffle on which the speaker is mounted must make an air-tight fit to the top of the column, which is lined with 1" absorbent material above the filter.

The finished column is easily painted or papered to match the walls of the room, or may be covered by thin plywood panels.



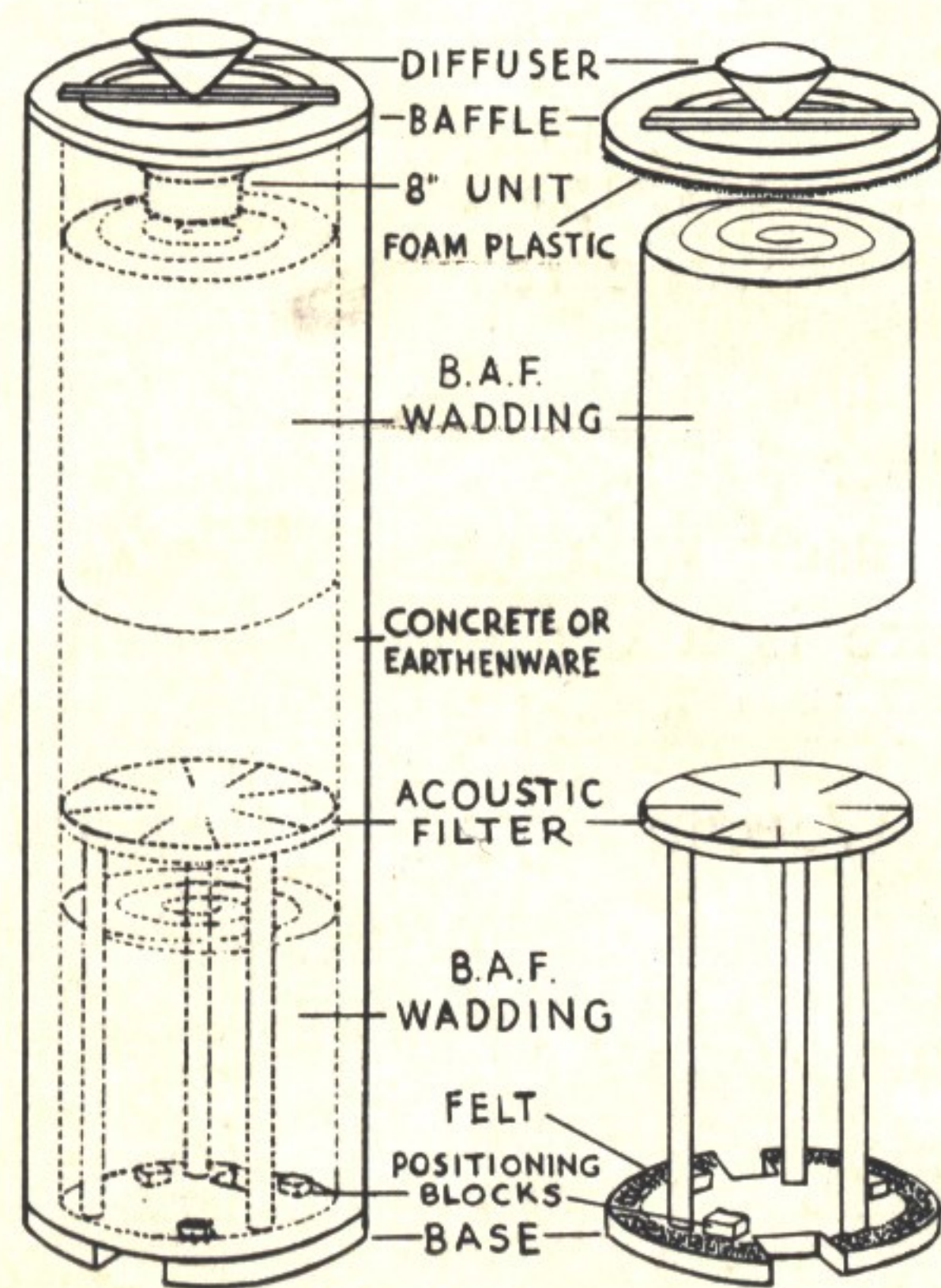
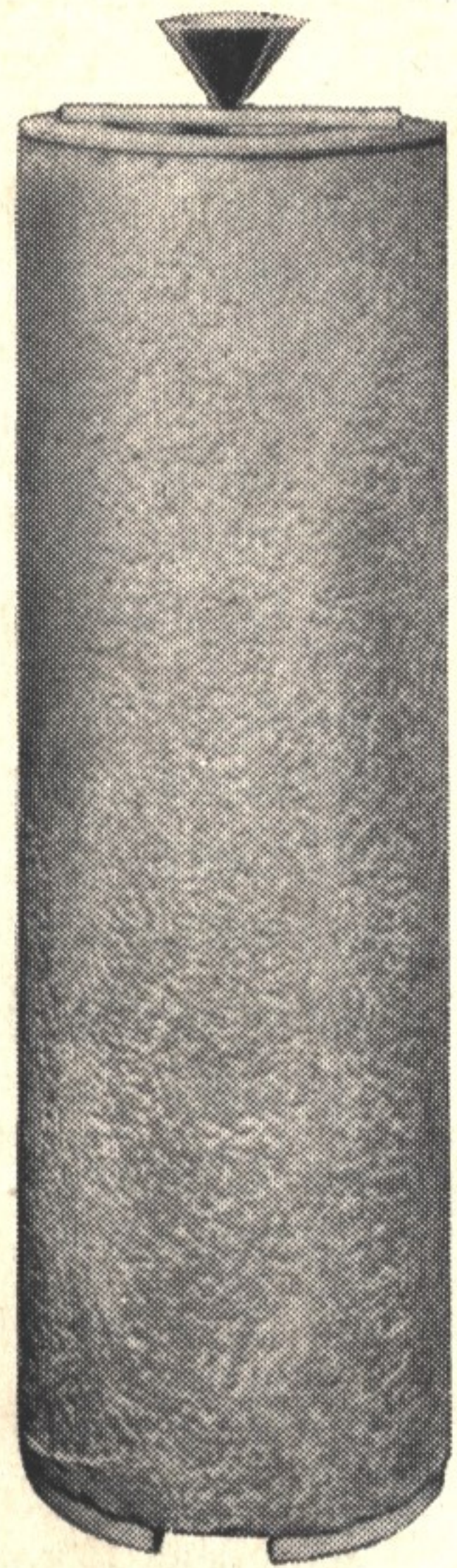
Concrete column 3 cu. ft.  
Twin ports 12" x 1". Outside  
dimensions, 17" x 15" x 36".

It is impossible to use this type of column, or the brick assembly of Fig. 6 on one channel of a good stereo system without hearing the benefits of the sound acoustic principles inherent in their conception.



## Fig. 12. CIRCULAR COLUMN for 8" UNIT

Recommended unit: 8/145.  
Price £6-19-11, (inc. P.T.)



Cheaper, lighter, smaller and easier to install than Fig. 10, this model is movable but results are not quite so good. The pipe costs about 12/6 from builders' merchants. The acoustic filter and two rolls of wadding are essential to counteract the small volume and circular shape.

Length of pipe 3 ft. Weight 106 lb. Diameter 9" inside, 11" outside. Internal volume 1.3 cu. ft. The pipe shown is in porous concrete and it was necessary to use some plaster on each end of the pipe in order to obtain a level surface for an airtight fit. (Plasticine could also be used for this purpose.) Pipes of glazed earthenware or spun concrete would require less treatment.

There is a circular baffle at the top with diffuser, and a wooden base with suitable vent openings. The underside of the baffle is fitted with a layer of foam plastic, and the circular base has a layer of felt on which the pipe rests.

## Fig. 13. CIRCULAR COLUMN for 10" UNIT

This drain pipe costs about 25/- and gives excellent results with a suitable 10" unit and the same internal treatment as above.

Turned upside down, a 12" unit can be fitted, but this is not recommended as results are most unsatisfactory. (A large sewer pipe with 14" or 15" inside diameter would be the minimum size here.)

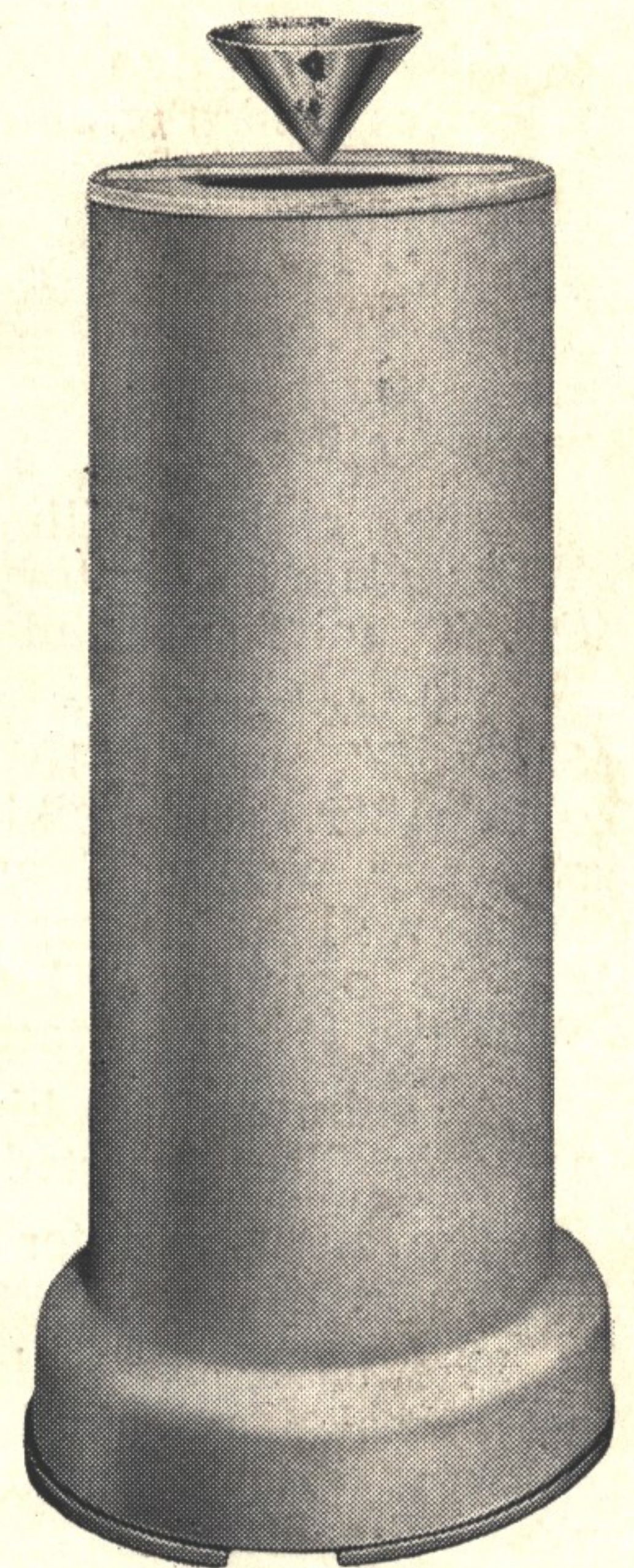
Length of pipe 3' 3". Weight 145 lb. Diameter 12" inside, 14½" outside. Internal volume 2.5 cu. ft.

Recommended units: W10/FSB, £12-9-10; Golden/FSB £8-6-7; 10" Bronze/FSB, £5-5-11; in that order. Prices include P.T.

### COMPONENTS

We do not supply the pipe, but the other components are available as follows:—

	8" Type	10" Type
Wooden base, acoustic filter, circular baffle and strut for diffuser	£2 - 15 - 0	£3 - 5 - 0
Two rolls of B.A.F. wadding	12 - 6	£1 - 2 - 6
Aluminium Diffuser	7 - 6	10 - 6



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