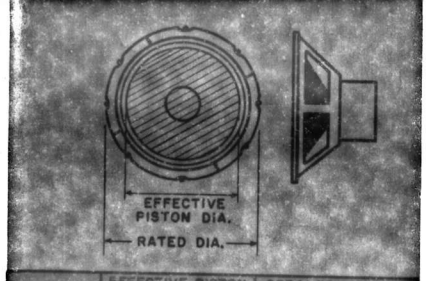
BASS-REFLE

-Including Ducted-F



RATED DIA.	EFFECTIVE PISTON AREA	SPEAKER VOLUME DISPLACEMENT
5"	12 SQ. IN.	.05 CU. FT.
4"X 6"	12 "	.05 "
6"	18 "	.10 "
5"X 7"	18 "	.10 "
8"	28 "	.15 "
7"X 9"	28 "	.15 "
10"	50 "	.25 "
12"	78 "	.40 "
15"	133 "	.75 "
18"	200 "	1.50 "

Fig. 1. Effective piston area and speaker volume displacements for typical speakers.

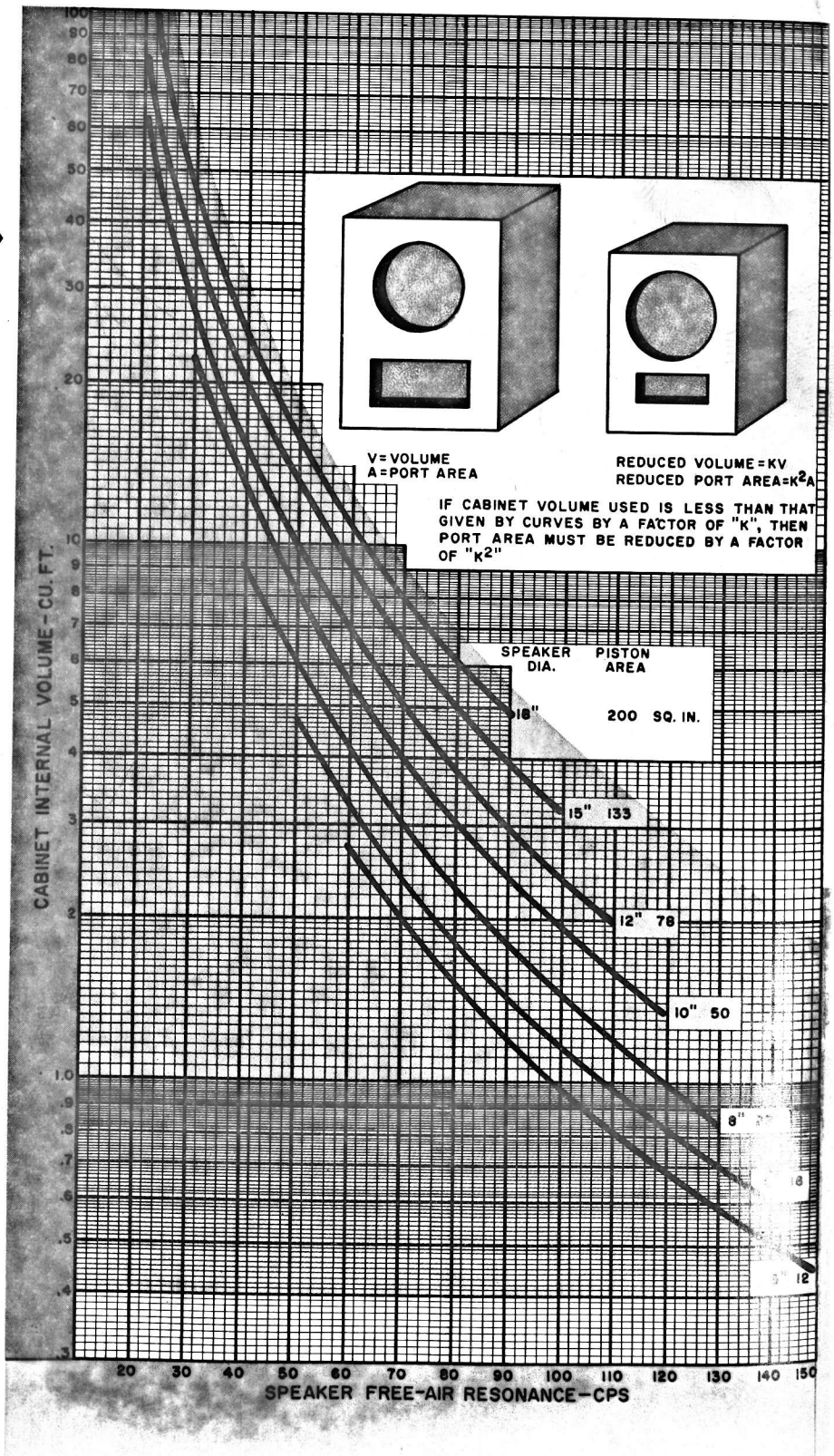
Fig. 2. Internal cabinet volume necessary for a given resonance for port area equal to full equivalent piston area of speaker. If smaller volume is used, port size is reduced as indicated in the illustration.

THE MATCHED BASS-REFLEX ENCLOSURE is a very effective means of loading a cone-type loudspeaker so that the speaker and enclosure combination reproduce smooth low-frequency response well below the original free-air resonance of the speaker, with excellent damping, and with approximately twice the acoustic output of that of a closed box for the same speaker.

By means of a resonance condition set up by the volume of the box and the front opening (the port), the backwave from the speaker is reversed in phase, and radiates from the port in-phase with the front wave. The close coupling of the enclosure to the speaker, where both are tuned to the same resonant frequency, sharply attenuates the excessive original resonant peak of the speaker and substitutes for it two damped resonant peaks on either side of the original resonance. By this method, low frequencies are obtained below the original free-air resonance of the speaker.

In designing the bass-reflex enclosure, an enclosure volume and port opening are chosen so that the enclosure resonates at the same frequency as the speaker alone in free air. The enclosure consists of an internal box volume with a port or vent on the panel side of the enclosure which holds the speaker. Since this opening will radiate low frequencies comparable to those radiated directly from the speaker piston, port area should approximate the effective size of the piston. The effective piston area of a speaker is always less than that determined by its rated diameter. (See Fig. 1)

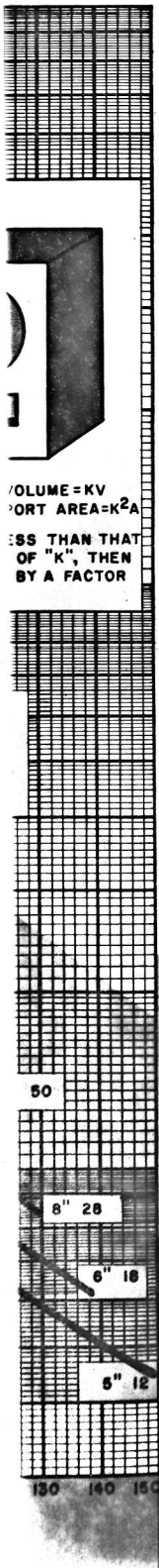
Fig. 2 gives the necessary internal volume of an enclosure to resonate at a given frequency for popular-sized speakers. Curves are based on a port opening equivalent to the effective piston area of the speaker being used. When the actual volume of the cabinet is chosen to be less than that given by the curves by a factor of "k", then the port area must be reduced by a factor of k^2 in order to maintain the original resonance condition. For example, if volume is reduced to .866V, then the port must be reduced to .75A, or if the volume is reduced to .707V, then the port must be reduced to .5A. As the port area is reduced, however, it may impede effective bass radiation due to viscous losses and there may be a rise in low-frequency distortion. Rather than use a very small port then, a somewhat larger area in conjuction with a duct may be preferred.



.EX DESIGN CHARTS

d-Port Type

ELECTRONICS WORLD



Enclosure volume may be reduced by the use of a ducted port. Fig. 3 shows a family of curves correlating cabinet volume as it is affected by introducing a length of duct for various resonances of the popular-sized speakers. For a given speaker size and resonance, a duct length may be chosen so that the volume of the cabinet is reduced to the desired size. These curves are based on a duct cross-sectional area equivalent to the effective piston area.

Where it is necessary to use a cabinet of smaller dimensions than given by these standard curves, it is possible to lay out an alternate arrangement. The piston areas of Fig. 3 may also be considered to be the duct cross-sectional area irrespective of speaker size. Even if the speaker being used is a 15" type, the curves for the 8" effective piston area (in this case, duct area) may be used to choose a duct length and cabinet volume to resonate at the original 15" speaker resonance. The internal end of the duct should not be closer to the rear wall of the cabinet than one-half the effective speaker piston diameter. These values for cabinet volume include the volume occupied by the duct.

The curves give the free internal volume of the structure. The actual physical dimensions will be larger by a factor determined by the amount and density of sound-absorbing material used to line the internal faces of the structure. (It is desirable to line all faces, but if at least two-thirds of the surfaces are lined, satisfactory results will be obtained.) A rule of thumb to determine volume of the sound-absorbing material is to multiply the area of the material by its hand-compressed thickness. This total volume should be added to the free volume figure. Also, the volume displaced by the speaker itself, from Fig. 1, should be added to the free volume figure. From the total internal volume thus obtained, Fig. 4 will give the final internal dimensions of the panels. The constructor will add to these dimensions sufficient overlap areas of these panels depending on their thickness and the method of assembly. Fig. 4 also provides a very close figure for the total area of lumber (and sound-absorbent material) required to construct the enclosure for the size chosen. The construction should be of a good grade ¾-inch plywood or solid wood, with all wood mating surfaces, except for the back panel, thoroughly glued. The panels should be screwed together after the glue is applied, to insure maximum rigidity of the completed enclosure.

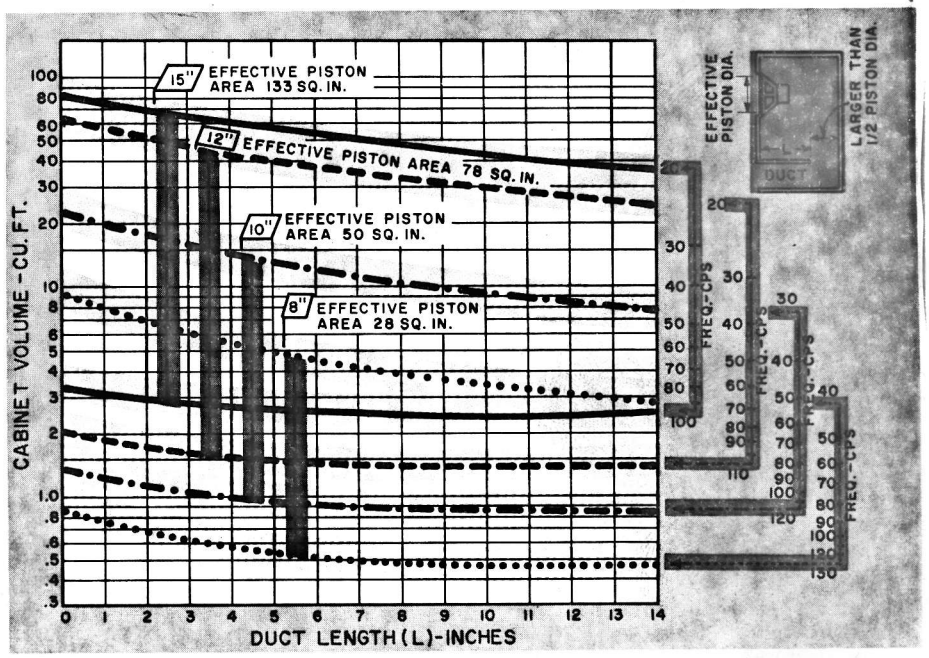


Fig. 3. Internal cabinet volume necessary for a given resonance for a ducted-port area equal to full equivalent piston area of speaker. Volume includes space used up by duct. If smaller size is desired, choose set of curves for smaller piston area, maintaining original resonance frequency of larger speaker. Refer to the text.

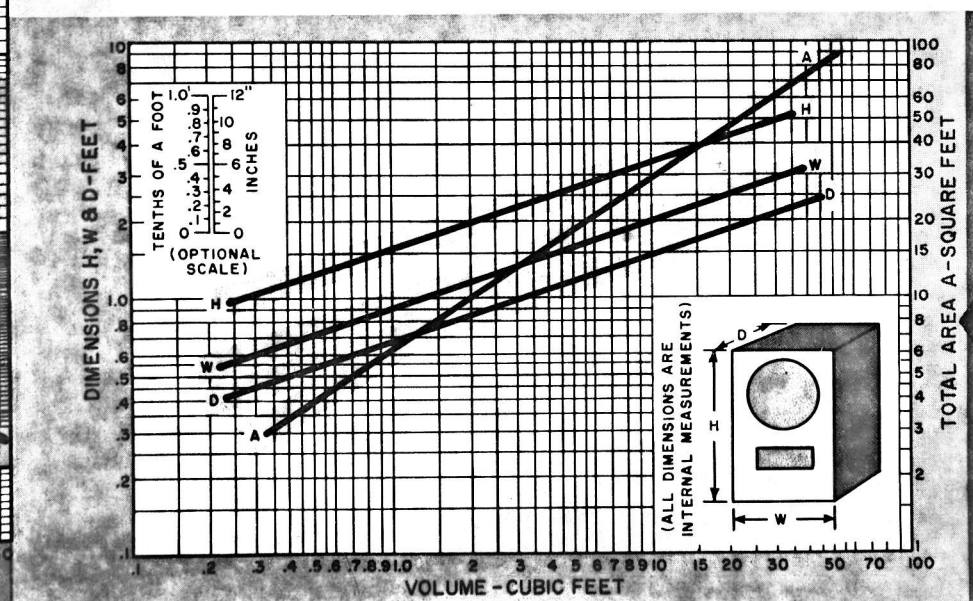


Fig. 4. Internal dimensions and total internal area of panelling required for total volume of enclosure as determined from the previous curves.