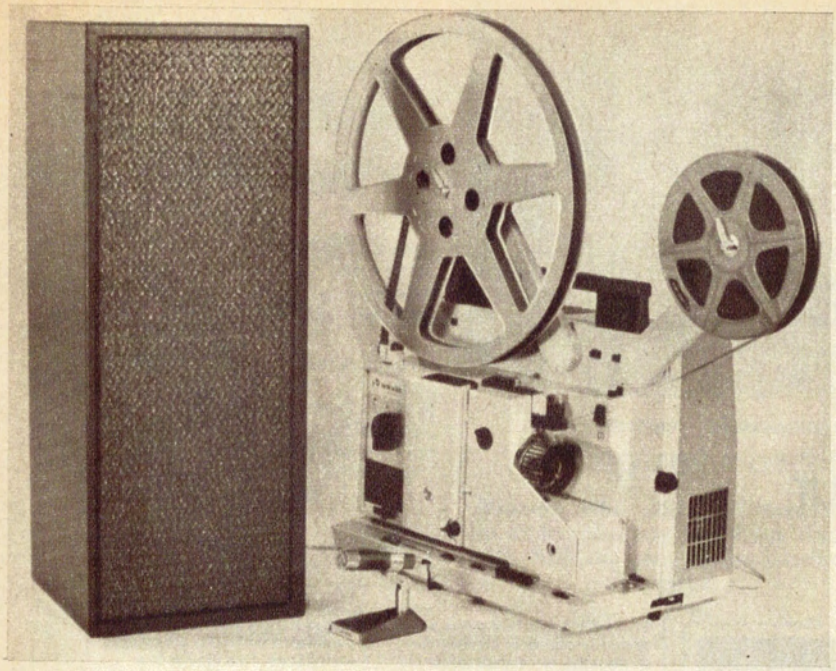


For projectors, tape recorders, small P.A.

ECONOMY LINE SOURCE LOUDSPEAKER

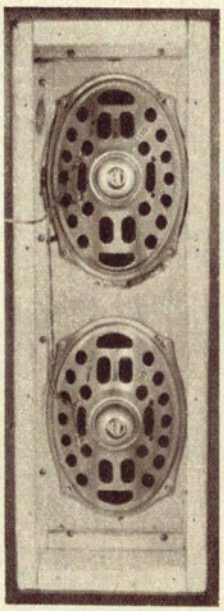
Recently, we had occasion to make up this loudspeaker system to satisfy a need in our Parent Company. It worked so well for such a reasonable outlay we felt it would be worthwhile passing the details on to readers. It contains two 9" x 6" twin-cone loudspeakers and will handle the output of amplifiers up to 15 watts.

The project began with a request for a suitable loud-speaker and microphone to be used in conjunction with the 16mm film projector shown in the accompanying illustration. This would allow the projector to double as a public address system at meetings and getherings which inevitably occur in any large business organisation. The projector was fitted with an internal loudspeaker but this was inappropriate for a large audience and useless if the projector was in an enclosed projection booth.

More often than not, auxiliary loudspeaker systems which somebody "knocks together" for use with film projectors and modest public address systems are 12-inch units in a minimum sized, open-back enclosure. While it is true that 12-inch loudspeakers, as a class, are efficient, the radiation pattern from the single loudspeaker is far from optimum for the purpose.

A single, round loudspeaker radiates sound energy in something approaching a spherical pattern, the energy being distributed in all directions. While this pattern may be acceptable in a small room, it may not be so with a large group of people in a hall. The ideal pattern is a wide flat beam rather like that from the latest rectangular, "asymmetric" auto headlights. This would be aimed obliquely down over the heads of the listeners to give maximum coverage.

The type of loudspeaker which best approximates the above radiation pattern is commonly referred to as a "line-source" or "column" system. This consists of a number of moderately-sized loudspeakers arranged in a tall, narrow cabinet. This can be mounted at a suitable height above the listeners' heads and aimed towards the rear of the hall so that most of sound passes over those at the front, becoming progressively more effective towards the rear. In this way, those at the rear may be given adequate level without "blasting" those in the front. In short, the result is a substantially even level of sound along the entire hall. And, by selecting efficient loudspeakers, the overall system can be very efficient.



An inside view of the enclosure, minus the acoustic filling. Two 33-ohm units were used to produce an approximate 16-ohm system.

While we have published details of column P.A. speakers in the past, these generally used a minimum of four loudspeakers and were intended as a more less permanent installation. The present loudspeaker was required to be light and portable. For this purpose we felt that four loudspeakers were not justified but we still wanted the advantages of the "line source."

We decided to use two 9 x 6in elliptical units, mounted vertically to obtain the beam effect. Our further requirements were good sensitivity, to ensure acoustic efficiency, a reasonably low free-air cone resonance and a tweeter cont to make use of any high frequencies that might be available.

The loudspeakers which came to our notice at the time were type 96S1X, produced by Magnavox. While these were used in the prototype, other loudspeakers which would meet the specifications could be substituted. If the upper treble response is not considered vital for particular applications, loudspeakers without tweeter cones could be used.

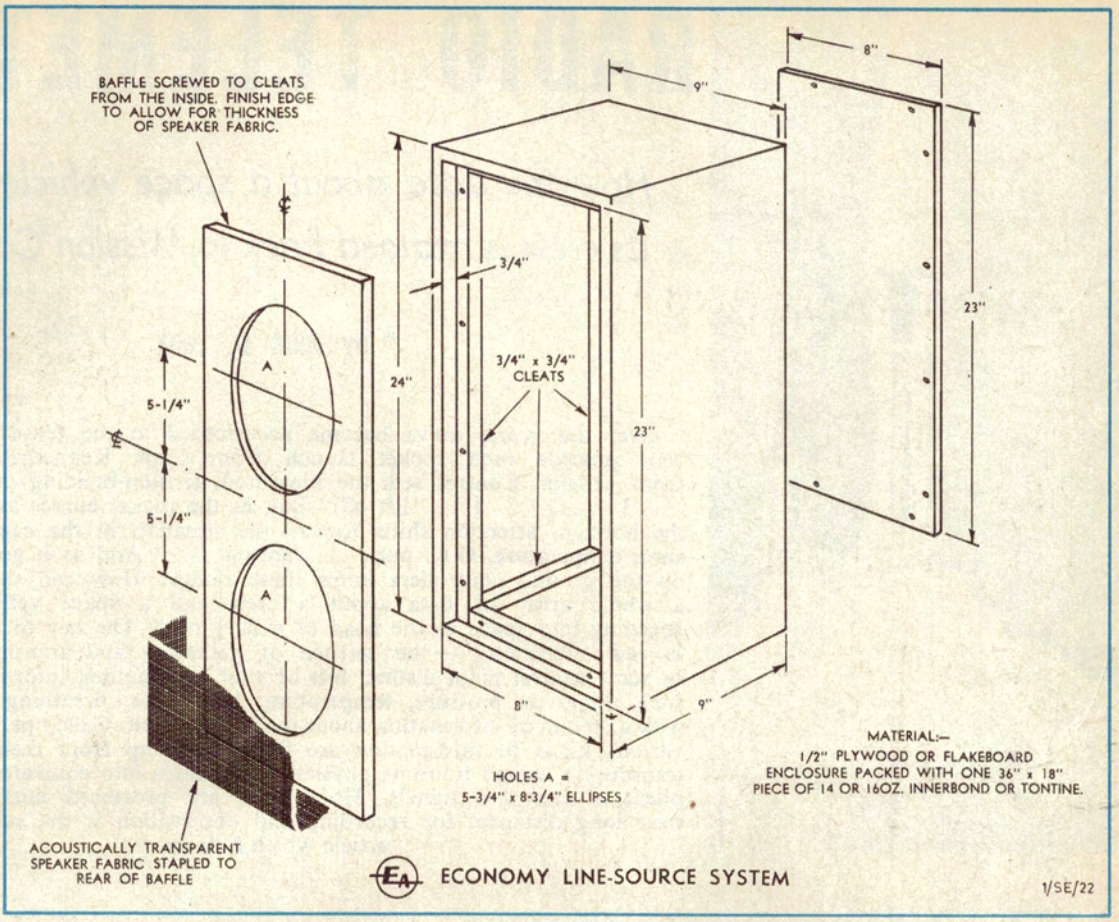
The loudspeaker were mounted in an enclosure 24 x 9 x 9 inches which was made of ½-inch thick particle board covered in black vinyl. The grille cloth was black with a gold fleck dispersed through it, making an attractive but unobtrusive enclosure. For a start, we decided to try the system with a closed back and to sort out any problems from there.

The main problem we expected was the inevitable rise in cone resonance which results when a loudspeaker is installed in a small, completely sealed enclosure. The Magnavox 96S1X and other equivalent speakers have a free air cone resonance of around 75Hz. Placing two of these speakers in an enclosure with a volume of approx. 0.8 cubic feet would probably cause the resonance of the cones to rise to we'l over 120Hz, being prominent not only in frequency but in amplitude. This would give an unnatural "chestiness" on speech and a pronounced "one note bass" effect on music. In this direction, our fears were certainly confirmed. The system resonance was up around 150Hz and the system was anything but good on music signal. Plainly, the resonance would have to be damped down to a large degree before the system could be pronounced satisfactory.

A common approach to the above problem is to provide some sort of venting to dissipate the "back pressure" which is the reason for the greatly increased cone resonance figure. This can take the form of a distributed port, a vent with a tuned tunnel or simply a hole in the form of a handhold in the rear of the cabinet. While all these ideas can be satisfactory, if one particular loudspeaker is used, the results can be rather indeterminate if a variety of loudspeakers are envisaged.

Of the methods mentioned, perhaps the one most assured of giving good results with a variety of loudspeakers is the distributed port, which involves drilling an array of holes of deliberate number and size, preferably around the edge of the baffle.

However, in trying to keep the



dimensions of the enclosure to a minimum we found there was not much room in the front baffle to drill holes. Added to this, it poses problems for factory production.

So we reverted to what we had found to be successful with systems in the past: a completely airtight enclosure substantially filled with acoustic absorbent material such as Innerbond, Bonded Courtelle or Tontine, to lower and damp the system resonance. Subsequent tests showed that the resonance was substantially reduced by filling the enclosure with one piece of 16oz material 36 x 18 inches rolled loosely to fill the space around the speakers. The overall result would probably not satisfy the critical "hifi" enthusiast but it is eminently suitable for the intended application.

With the projector shown, the loudspeaker was a great improvement over the internal unit. Efficiency showed a marked increase and, as could be expected, frequency response at both ends of spectrum was considerably extended. In modest P.A. applications when teamed with a 10-watt amplifier, the system would work very well. The amplifier could be a compact, solid-state unit sitting on top of the enclosure.

Having explained at length how the new unit came into being, we must discuss some of the details of construction. The prototype enclosure was a very well finished unit supplied by courtesy of Beech Electronics, P.O. Box 160, Kogarah, N.S.W. This firm can supply ready-built loudspeaker units to those who do not wish to build their own.

The exploded diagram shown gives the essential dimensions and shows details of cleats to hold it firmly together. The dimensions can be varied somewhat to suit individual needs provided the internal volume is not decreased. It may be increased to advantage, if overall size is no problem.

With the relatively small panel sizes used in the enclosure, ½-inch think material is adequate. It may be made thicker but not thinner, to avoid panel resonances. If the enclosure is made of particle board, the cleats should, for best results, be made of timber, as particle board is not very satisfactory if screws have to be wound in and out several times. The cleats for the front baffle will have to be "relieved" slightly to clear the speaker chassis.

Make sure that the enclosure is, in fact, airtight. Joints at the four corners should be snugly glued and all cleats accurately fitted and glued in position. The baffle of the prototype was recessed about ¼ inch to lessen the possibility of the grille cloth being damaged when in transit. If the front and rear panel are dressed to a close push-fit there should be no problem obtaining an airtight cabinet, especially if it has been trimmed in vinyl.

Do not spoil all the good work by merely passing the leads out through oversize holes. Fit connectors or screw terminals or plug the holes with a non-hardening compound.

The system may be built with a nominal 16 or 8-ohm impedance by connecting two 33-ohm or 16-ohm units in parallel. Ensure that the loudspeakers are correctly phased. While manufacturers generally code one of the terminals with a red dot or other

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LOUDSPEAKER—cont.

sign, phasing can be checked simply by connecting a torch cell across the voice coils and noting that both speaker cones move in the same direction. If not, reverse the leads to one voice coil. Note that we bolted the loudspeakers in, for strength, rather than relying on screws.

So there it is, a compact, easily portable loudspeaker system which can fill a need in many small P.A. situations in halls at slide or movie shows or at a party to keep the guests under control. ■