A Full-Range Electrostatic Speaker

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D.c.-coupling the electrostatic loudspeaker to the amplifier, and including the speaker in the feedback path, takes full advantage of the unique capabilities of this type of loudspeaker. You can build both the speaker and the amplifier by following the instructions carefully.

THE DYNAMIC SPEAKER has been developed to a high degree of perfection, some say to the point where it can no longer be improved considerably. Although dynamic speakers can be designed to have a frequency coverage well above and below the audible frequency spectrum, phase differences between the inner and outer radiating part of the cone tends to make good transient response difficult to achieve. However, good transient response seems to be an exceedingly important factor for naturalness in sound reproduction. Also, crossover networks used with the multiple-way systems necessary with most dynamic speakers introduce some phase error, at least near the crossover frequency.

The well-constructed electrostatic speaker is able to overcome most of these difficulties, and in the past it had only one drawback: it needed rather high audio feed voltage, which, for full-range units, usually had to be supplied by a step-up transformer. As the secondary of that transformer couldn't be included in the feedback loop, the result was the same old harmonic and phase distortion. The present speaker-amplifier combination solves these difficulties by d.c.-coupling the speaker to the amplifier and including the speaker in the negative feedback loop.

In the construction data you will find dimensions for the speaker. They should all be closely observed, except for the length. For reasons which would lead us too far afield, it is desirable to make the speaker as long as possible for maximum low-frequency response. As this unit is only about 6-in. wide and 1½-in. deep (including its protective envelope), it can be hung a few inches off the wall, thus taking much less space than even a "compact." This means that the speaker should be one narrow strip, beginning at the floor and extending from three to nine feet in height.

The author's speaker is composed of three sections, each three-feet long, mounted one over the other. They are light and suspended like a picture, or curtain, five inches off the wall.

The audio voltage from the amplifier is applied in push-pull to the electrodes, e_1 and e_2 (the copper layer on a printed-circuit board). For better isolation and linearity, the electrodes are on the outside of the electrode-supports, E_1 and E_2. As the efficiency rises geometrically with the applied bias voltage, the membrane gets a high negative bias (minus 3500 volts) which is produced, at rather low cost, by a doubler using diodes. The use of such high voltage is made possible because of a special insulating lacquer on the copper electrodes. Lower bias will result in lower efficiency. If all values are observed, the efficiency of the speaker-amplifier is many times better than that of a good dynamic cone speaker. The membrane is made of very thin (0.25 mil) metalized elastic polyester foil. The foil itself is glued to spacer S_1 and on the opposite side, to spacer S_{11}. By slightly pulling spacer S_{11} out, the membrane is stretched and then fast-

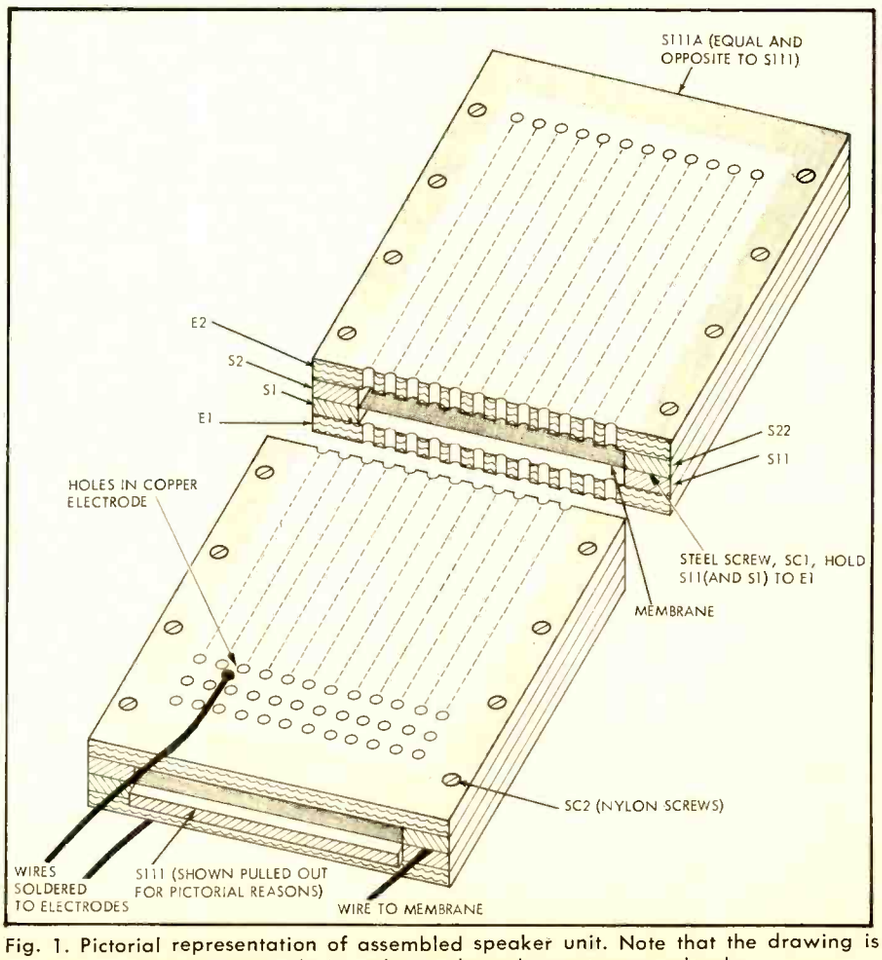

Fig. 1. Pictorial representation of assembled speaker unit. Note that the drawing is not to exact scale in order to show the parts more clearly.