

# THE RADIO RECORD

Published Weekly  
REGISTERED G.P.O., WELLINGTON, N.Z., AS A NEWSPAPER.

Price 3d.

VOL. I, No. 49

WELLINGTON, FRIDAY, JUNE 29, 1928.

## The Exponential Horn for Perfect Reproduction

**I**N this article by "Switch" there is given a brief outline of the evolution of the radio loudspeaker, supplemented by constructional details for an easy method of building an exponential horn which type marks a big advance in loudspeaker efficiency. The materials are easily procurable in New Zealand, and the method of construction is so simple as to be possible for anyone with the slightest mechanical skill. The exponential horn has been developed along scientific lines, and its success has been acclaimed far and wide.

**W**HILE radio engineers had wrought wonderful improvements in the components and design of broadcast receiving equipment the problem which proved one of the most baffling was loudspeaker efficiency. The old type of horn loudspeaker was universally adopted in the genesis of the broadcasting era, and it still maintains a prominent position in popularity the world over. The old horn-type loudspeaker possesses inherent infirmities which no amount of scientific application has been able to completely cure. The radio technicians of the world long since realised that while efficiency in transmission and radio receiving equipment had progressed to well nigh perfection the efficiency of the loudspeaker had lagged badly. In the United States more than in Great Britain the horn type loudspeaker had failed to keep pace with radio advancement. In the Homeland the horn-type loudspeaker manufacturers had certainly made far more progress than in America. This was so manifest that one of the biggest loudspeaker manufacturers in England invaded the United States and by setting up a factory there and capturing a large market demonstrated the superiority of the English article over the considerable majority of American loudspeakers.

### ARRIVAL OF THE CONE SPEAKER.

**T**HEN came the cone loudspeaker which the Americans evolved with considerable ingenuity and not a little success. Without going into the scientific deficiencies of the average horn-type loudspeaker, and even the best plain cone-type, it can be stated that these individual types failed, generally speaking, to reproduce the high and low pitched notes with equal efficiency. That is to say, one type would give emphasis to the bass notes and fail in its treatment of the higher treble register, and vice-versa. The position was promptly realised by the American manufacturers who then applied the cone principle to the moving coil or electro-dynamic mechanism. The cone was then much reduced in size as the pitch was then obtainable by the amplitude of the vibrations of the cone which is mechanically restricted in the small diaphragm of the original horn-type loudspeaker and the mechanism of the original cone-type.

### A NEARLY PERFECT LOUDSPEAKER.

**T**HIS marked a striking advancement in loudspeaker efficiency, and it may be reasonably claimed that the electro-dynamic cone loudspeaker is as near perfection in tonal qualities as can be reasonably expected for some years to come. But an inherent disadvantage of the cone-type electro-dynamic loudspeaker is its cost, and in this respect, so far as the general body of the public is concerned, has not seriously menaced the popularity of the less-costly original horn-type and cone-type loudspeaker. Still, those who could afford to purchase the electro-dynamic loudspeaker of the cone-type enjoy a quality of reproduction incomparably in advance of the older and more popular types of speakers. In order to capture that section of the public who can afford to pay a substantial sum for a loudspeaker, some of the American manufacturers have contrived to reduce the cost of the electro-dynamic cone-type to a more reasonable figure than originally. Still, the vast majority find the cost of this article above their means.

### IMPROVING HORN LOUDSPEAKER.

**W**ITH characteristic resourcefulness the American radio manufacturing companies turned their attention to improving the original horn-type speaker so that its tonal qualities would be more efficient, and its cost could still remain within the reach of a large proportion of the general public. The services of scientific men were requisitioned and the science of acoustics was delved into. Sound responds or conforms to well-recognised laws. For example, sound is reflected in a manner analogous to the reflection of light. When it is reflected from a plane surface the reflected sound comes as though it was propagated from a point beyond the surface at a distance equal to the distance of the real point of propagation from the surface. Sound is produced by certain vibrations in the air or other matter in contact with our organs of hearing and it is through the column of the vibrating medium, air, within the horn of a loudspeaker or surrounding the surface of a cone loudspeaker that the original vibrations of the horn diaphragm or cone are reproduced in the drums of our ears and made audible through the connecting nerves to our brains.

### INVESTIGATIONS BY SCIENTISTS.

**S**CIENTISTS investigated the relation between the number of vibrations per second of the horn speaker diaphragm and the length and shape of the column of air contained within the horn. The vibrations of the horn diaphragm create waves in the air

readily procurable and with a little mechanical skill the horn can be built so as to reproduce tone of such superior quality and fidelity as to afford the listeners an entirely new pleasure in listening to broadcast entertainment. To facilitate its construction by an amateur the horn can be made with a square cross-section, for it has been found that the shape of the cross-section is not a critical factor as square horns have been found to give excellent results.

### METHOD OF CONSTRUCTION.

**T**HE inside dimensions, from the 5-in throat to the 20-inch mouth of the bell, are shown in Fig. 1. Dimensions are given for every six inches up to four feet from the throat, and for every three inches thereafter, because of the more rapid increase of the curve. After the points have been laid off, they may be joined by freely-drawn lines, if no suitable curve is at hand. If you have not a straight-edge sufficiently long, a chalk-line may be used for the centre.

A single sheet of beaver or wall board contains enough material to make one horn; it is eight feet long, four feet wide, and 3/16-inch thick. It is divided into four pieces, as shown in Fig. 2, as a preliminary step. The pattern, laid out as shown in Fig. 1, is then applied to each piece in succession; a strip equal to the thickness of the material being added to one side, on each strip. All four pieces may then be cut out; they are exactly alike.

### MOUNTING THE SIDES.

**T**HE next move is to shellac each piece on the face which will be inside. They are then put together, as shown in Fig. 3, overlapping on successive sides. All are fastened partly by small brads. (It is well to drill the wall board for the brads, as otherwise they are apt to split it.) In this operation, two pairs of hands, though not absolutely necessary, are better than one.

The wall board is sufficiently flexible to accommodate itself to the curve desired, under pressure; and the outside edges are fastened with gummed mending tape, 1 1/2 inches wide. This tape should be creased down the centre before it is applied. A ten-yard box, costing about half a crown or less, is ample for one horn.

When everything is in place and dry, a very neat fillet can be made in the inside corners, by carefully running a good glue down each in turn, catching the excess at the bottom. One corner, of course, must dry before work is undertaken on the next. This will prevent pinhole leaks at the corners.

Before finishing the horn on the outside, try it with your set at full volume. If the bell develops a vibration, due to the thinness of the material, reinforce it with panelling of the same material. After that, the horn may be decorated to suit your fancy.

Although this horn is large, it is easy to handle if it is mounted on a suitable base. The results are so satisfying as to encourage experiment to find a more compact form, which can be mounted in a cabinet, with no sacrifice of efficiency.

The horn may be connected to the unit of your loudspeaker after removing its original horn.

A small piece of heavy rubber tubing can be used to connect the exponential horn to your loudspeaker unit. Loudspeaker units can be purchased separately, and it would be greatly advantageous to purchase the best procurable, for one cannot expect good tone even from an exponential horn if a cheap loudspeaker unit is used.

### FOR ILLUSTRATIONS SEE PAGE 2

of a certain length just as there are various wavelengths in radio transmission. The deep notes of the bass produce longer waves than the shrill notes of the treble. To faithfully control the longer waves of the bass before they progressed beyond the control of the loudspeaker horn scientists agreed that the loudspeaker horn would have to be lengthened. Next a relation between the gradual widening of the horn and its length was found necessary by a scientific process which need not be detailed here. Exhaustive experimentation was finally rewarded by the evolution of the successful exponential horn loudspeaker.

### EXCELLENT TONE AND VOLUME.

**B**ESIDES its tonal excellence, the new speaker, through its admirable control of the air column within the horn, has remarkable volume and some striking open-air demonstrations of this were given by one of the American companies which devoted a considerable sum of money to its development. The success of the exponential horn was acclaimed by the American radio press, and in very short time the market was well supplied with the new speaker. A substantial advantage of the best exponential horn is that it can be sold at only a trifle higher price than the average high-priced old-type horn loudspeaker.

New Zealand ever eager to keep pace with the world's progress has already had some very excellent exponential horns on the market and these have been purchased with avidity by the radio public.

### EASY TO CONSTRUCT.

**T**HE construction of an exponential horn is within the capabilities of anyone possessed of the slightest ability in handicraft. The main thing to be considered is that the measurements must be strictly adhered to in order to preserve the remarkable characteristics of the speaker. The materials are