

(limited to the elasticity of the diaphragm) was so small as to render the output of a 210 type valve inaudible at five feet. Somewhat better results were obtained by stretching the diaphragm a millimetre or so distant from the back plate, but here again there were two factors which militated against success. The first was that the dimensions of the unit had to be kept very small or the diaphragm touched the back plate. An additional inducement toward small dimensions was introduced by the necessity of drilling countless holes in the back plate to provide the now essential ventilation.

The second factor was the distance and appreciable air space between the back plate and the flexible conductor (which, by the way, consisted of a smooth sheet of tinfoil solutioned to the rubber sheet). The electrostatic force existing between the two plates of a condenser varies inversely as the square of the distance between them, and directly as the square of the dielectric constant of the insulator separating them. Now in the present case not only were the plates necessarily separated by a substantial distance, but the greater part of the dielectric consisted of air, which, of course, has the very low dielectric constant of 1. So one more disappointed experimenter temporarily abandoned the condenser speaker.

Design Considerations.

THE corrugated back plate overcomes the difficulties mentioned in a most ingenious manner. The portions of the diaphragm which bridge the depressions in the back plate are practically unrestricted as to movement and can readily accommodate themselves to the large amplitude of motion necessary for realistic reproduction of bass notes. Also, a considerable electrostatic force is exerted on those portions of the flexible conductor where the diaphragm is in contact or nearly in contact with the back plate. It is the portions of the diaphragm which are nearly in contact with the back plate which are most useful.

As the diaphragm is attracted under the influence of the electrostatic force the area of contact is increased and the diaphragm rolls down the slopes of the depressions. A wedge-edged air space is still maintained adjacent to the point of contact so that the attracted area moves down the slope too. The modern condenser reproducer owes its efficiency almost entirely to this wedge-shaped air space which permits a large force to be exerted and at the same time allows a considerable movement of the diaphragm.

The depth of the corrugations or undulations in the back plate should preferably not be too great, as the efficiency is higher when the depressions are shallow. It is necessary, however, that there shall be sufficient depth to accommodate a fairly considerable movement of the diaphragm. Ventilation must be provided in the depressions of the plate so that trapped air will not restrict the movement of the diaphragm. Commercial speakers usually provide the ventilation in the form of narrow milled slots running at right angles to the corrugations. Drilled holes, provided there are enough of them, would be just as effective.

The back plate must be fairly stiff or there is danger of it resonating and "buzzing" against the diaphragm. The same "buzzing" sometimes arises through the diaphragm not being in close contact with the back plate

throughout its area. This condition is usually remedied by making the plate slightly convex toward the diaphragm. Any metal may be used for the plate, perhaps the best material for the purpose being the corrugated aluminium used for airplane construction.

The Diaphragm.

THE material used for the flexible diaphragm of the commercial condenser speakers is one known as "Kylite" and has been specially developed for the purpose. If any misguided experimenter feels disposed to tread the fields of endeavour which the writer has explored with doubtful success, he will find, as has been previously mentioned, thin sheet rubber of the "toy balloon" variety the best available material. "Kylite" is used in a thickness of five thousandths of an inch, but it is doubtful whether rubber can be obtained as thin as this, or, if it can, whether it will stand the application of the polarising voltage.

The flexible metal coating on the front surface of the diaphragm presents another difficulty to the experimenter. However, thin and uncreased tinfoil can quite well be used for experimental purposes, although beaten leaf or a sprayed metal coating is necessary where greater permanency is desired.

Fitting a Baffle.

LIKE any other speaker, for best results the condenser reproducer demands some form of baffle. However, since the considerable area of the speaker itself acts as a partial baffle, it is permissible to reduce the baffle proper to such a size as to add a margin of 10 inches round the edge of the reproducing unit. The baffle may either be in the same plane as the reproducing unit or, more conveniently perhaps, it may take the form of a rectangular box of which the speaker forms the front. The space at the rear of the speaker is then available for a radio receiver and power pack, although it must not be filled in so solidly as to interfere with the free passage of air currents.

It is very necessary with this type of speaker that nothing in the baffle or speaker mounting (e.g., wood or sheet metal panels) resonates appreciably at any frequency within the audible range. One particular form of resonance is apt to be troublesome. Speakers of this type are almost invariably built up of small units having dimensions about eight inches by twelve inches; when such a multi-unit speaker is solidly supported all round its periphery, the whole assembly sometimes vibrates as a single diaphragm, and with sufficient amplitude to separate the diaphragm from the back plate and produce a buzzing sound. The remedy is to divide the speaker by a stiffening member or to attach a brace to its centre; the speaker may also be mounted in damping material—felt or rubber—at the edges.

The necessity for a source of polarising or biasing voltage to maintain a potential difference between the two plates of the condenser speaker has already been touched upon. It is interesting to note that it is a condition for freedom from harmonic or wave-form distortion that the alternating or speech voltages shall be small compared with the polarising voltage. This calls for a high polarising or biasing voltage, as does the fact that the force exerted on the diaphragm varies as the square of the biasing voltage. Nevertheless, there is nothing to be gained by in-

creasing the biasing voltage above about 600 volts, as the diaphragm will be drawn tightly against the back plate and a loss of efficiency result. Between 500 and 600 volts is the best biasing voltage. There is, by the way, no danger of shock from this source, as there is practically no current available.

Owing to limitation of space available, the conclusion of this article and the illustrations must be held over till next week.

Trade Notes

A New Valve

THE "Osram" Valve Department of the British General Electric Company announces the arrival of a new type of 4v. super power valve, which

will be known as the "Osram" P.X4. The characteristics have been developed specially with the idea of its employment in the last stage of A.C. sets using indirectly heated cathode valves in the early stages.

In order to furnish the required emission for a large power output, the P.X4 is fitted with a heavy filament consuming 0.6 amps. The current is negligible when drawn from the main. The valve provides a power output between P.625A and the L.85A power valves. It can be allowed to dissipate 10 watts at its maximum plate voltage of 200. The P.X4 completes a very useful range of 4v. indirectly heated A.C. valves.

Radio Listeners' Guide, 1930 Edition. Dealers and Booksellers 2/6, posted 2/9. P.O. Box 1032, Wellington. Now Available.



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