New Type of Speaker Appears

The Inductor Dynamic has Interesting Features

(By CATHODE)

A NEW type of speaker has appeared. It is known as the inductor dynamic, and while in some respects it resembles a magnetic speaker, it is more like a moving coil without field current and large pot magnet. But there is no moving coil.

The feature of the dynamic speaker which has particularly fitted it for reproducing the elusive low tones at considerable volume is that the movement of the coil within the magnetic field is in a direction parallel to the surface of the pole pieces. Thus the movement of the coil is not limited to the inconsiderable space between pole pieces; provided the movement is truly parallel to the pole pieces the moving coil and the attached cone could move in and out half an inch or more if necessary. In the magnetic type of speaker (including those referred to as "balanced armature" speakers, the direction of movement is at right angles to the surface of the pole pieces. Thus the maximum movement permissible is determined by the space by which the armature clears the pole pieces; the fact that the sensitivity of the unit depends on having this space as small as possible so as to secure a reasonable flux density renders the magnetic speaker uneconomical for large inputs—it will be obvious that every increase in input power means increasing the space available for movement and correspondingly decreasing the efficiency.

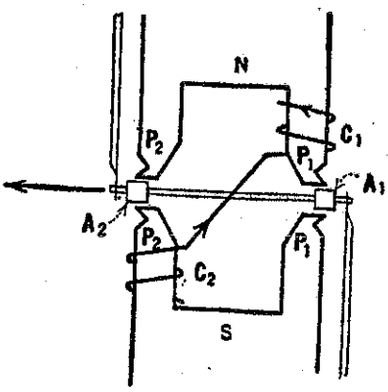
A further advantage which a parallel motion unit has over the magnetic type is that the force applied to the armature is nearly proportional to the current through the speaker coils. It will be no news to readers that the force which a magnet will exert on an iron armature or "keeper" becomes very much greater as the armature approaches the magnet. Consequently the driving force applied to a magnetic speaker increases out of all proportion to the increases in current occasioned by low notes or high volume simply because the greater movement brings the armature nearer the pole pieces. This is the principal cause of the distressing rattle noticed when a magnetic speaker is "overdriven."

The last disadvantages of the magnetic speaker to which reference is to be made is not shared by all speakers of this type; many, however, have an unbalanced armature which is prevented from "flopping" on to the pole-pieces only by the inherent stiffness of a reed or strong spring, which is also instrumental in driving the diaphragm. Not only is this reed a serious factor in curtailing the amplitude of movement, but it introduces resonances, frequently so marked as to become irritating. A balanced system such as the "inductor dynamic" employs obviously needs no restoring force to be supplied by springs, and while these still provide a convenient means of locating the armature centrally in the gap, yet permitting free movement, their strength may be so reduced and their damping made so effective that any resonances introduced are unimportant; commercial models are claimed to have no measurable resonances higher in frequency than 60 cycles.

HAVING now discussed the principal advantages which the "inductor dynamic" and "moving coil" speakers share to the exclusion of the magnetic type, it remains to be seen what advantages, if any, the "inductor" has over the "moving coil." It has only one, but it is important. It is no longer necessary to provide a considerable gap in the iron circuit to accommodate a bulky moving coil; all that is necessary is a bare clearance for the iron armature. Clearly the magnetising force necessary to maintain a satisfactory flux will be very much less, and, in point of fact, a horseshoe permanent magnet of fair dimensions is sufficient and is used commercially with success.

In principle the new unit depends on the well-known fact that a magnet will produce a torque—or force—in such a direction as to reduce the length or reluctance of the path of the magnetic flux. Diagram 1 shows in section the two armature bars (A1 and A2) connected by tie rods, the lengths of which are so adjusted that the armature bars, when symmetrically disposed, lie partially outside their respective pole faces; in other words, each pole face is only partially covered by its appropriate armature bar. It will be noted that each armature bar has acting upon it a torque tending to bring it opposite the corresponding pole face (so as to reduce the reluctance of the flux path) but that by virtue of the tie rods the force acting on one armature bar opposes that acting on the other; the result is that the assembly will take up a position in which the magnetic pull on both bars is equal and opposite, and this may be termed the magnetic centre.

Consider now the effect of passing a current through the series-connected coils C1 and C2. A current flowing



Illustrating the movement of the new Inductor Dynamic Speaker, fully described in the text.

in the direction indicated will increase the flux through the pole legs P1 and decrease the flux through the pole legs P2. The major flux, seeking the path of least reluctance, exerts a greater force on the armature bar A1 than is exerted on the armature bar A2, thus moving the whole armature assembly from right to left. On the reverse of the cycle, the armature moves in the opposite direction in the same manner.

Expressed a little differently, it might be said that the flow of voice current in the coils causes the magnetic centre to shift and the armature assembly moves along with the magnetic centre. The pole legs are cut to the shape indicated to reduce the leakage flux and to bring the greatest flux density to the desired points. A suitable extension of the central tie rod to one side or other of the assembly illustrated provides a driving pin for a freely mounted cone; the driving pin is, of course, mounted in the opposite direction to that in which the permanent magnets, of which there may be two or more, mounted side by side, project.

In the commercial product, the springs which hold the gap constant, are of very thin stock (.008in.) and the entire armature assembly, including springs, weighs but 4.5 grams as compared with the 8 to 15 grams of representative moving coils. It is claimed that with an input of 15 db. at 30 cycles, the unit moves a 10-inch cone one-eighth inch; if this is true, the efficiency is strictly comparable with a moving coil speaker using twelve watts or so to provide the field. Certainly this movement could be accommodated for the very light springs restrict motion in the desired direction scarcely at all, although they render it quite impossible for the armature to touch the pole pieces. The springs are of channel section, the channel being filled with soft rubber to provide damping.

IT is doubted whether this speaker unit is suitable for amateur construction, even in a modified form. The shaping of the pole pieces is of some importance, and while those fortunate persons who have access to a machine shop might be able to achieve success, shaping by chisel and file is altogether too laborious. Any machinists contemplating construction will, of course, be guided as to dimensions by the type of magnet they chance to procure; this must be fairly powerful, and a disused magneto might provide suitable material. 1000 turns or so of very fine wire (44 or 46 s.w.g. enamelled) must be accommodated on each of two bobbins made of varnished and baked paper for C1 and C2, unless a step-down output transformer is used when the turns may be reduced roughly according to the ratio of the transformer, the size of the wire being suitably increased to fill the bobbin. Strictly speaking, the number of turns should be determined by the type of output valve employed, but the number given should not be far out for any of the modern fairly low-impedance power valves, even if these are used in push-pull.

It is essential that some type of output device, either an output transformer or a choke-condenser output unit, should be used with this speaker unit. The only circumstance under which this may be dispensed with is when a push-pull final stage is used; the junction between the two coils may then be connected to B + the other ends of the coils being connected to the plates of the output valves, one to each. As with the ordinary dynamic speaker, a baffle-board of fairly large dimensions must surround the freely-mounted cone driven by the unit if the latter is to do itself justice on the lower tones.

The writer has been doing a little experimenting with condenser speakers, and while results are not yet such as to justify a constructional article, they are distinctly interesting.