Goodmans

Notes On
The
AXIOM 80

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INTRODUCTION

The basic functional requirements governing the design of an outstanding loudspeaker are simple.

It must be as critical of its input as a trained human ear is of its output.

The " Axiom 80 " is designed to rise as close as possible to this ideal in both its frequency coverage and low distortion characteristics.

DESIGN, CRITERIA & DETAILS

The human ear, in youth, is capable of detecting audio signals having a periodicity of up to 20,000 c/s. This limit figure decreases somewhat with increasing age. At the other end of the scale there is virtually no limit to what the ear can detect ; but it is generally accepted that only those sounds having a rate of vibration of 20 c/s or over may be classified as musical notes.

Both these facts played an important part in the design of the " Axiom 80 ". It was considered essential that the frequency coverage of this special transducer should be at least comparable to that possessed by the listener. This has been achieved, and in the interests of minimum distortion and maximum efficiency has been carried out by dividing the radiating portion into two separate concentrically mounted diaphragms, each designed to give optimum performance in its own part of the total range. By correct apportioning of mass to each of the moving parts, and by careful selection of furnishes used in the manufacture of each diaphragm, the

" change over " between the two has been made so smooth as to be undetectable. It should be clearly understood that this change-over of drive is entirely mechanical and requires no adjustment whatsoever. The high frequency radiator is of necessity extremely light ; and by the adoption of a special profile and very high pressure forming and impregnation, exceptionally rigid.

The main diaphragm is unorthodox in its conception. In order to minimise constraint on piston action movement, the edge of the cone, after stiffening, terminates in free air.

The moving assembly is radially constrained by two triple sets of paired double-acting cantilevers. The opposing bias on each member of each pair produces an extremely low and linear resultant axial stiffness, at the same time providing a powerful radial centering action. Three pairs of cantilevers are located in the frontal plane of the main diaphragm, and three pairs at its apex.

This high value of suspension compliance is adjusted to bring the fundamental resonance of the system to 20 c/s.

Two rings are cast into the main frame around the periphery of the main diaphragm to act as stops to reduce the risk of damage due to excessive amplitude caused by overloading, or by insufficient acoustic loading. Control of the coil movement is essential to prevent distortion. When a loudspeaker is, for example, shock excited, there are three main factors which will control its subsequent behaviour. These are :—

(1) The mechanical (frictional) resistance offered by the diaphragm suspension ;

(2) The control exerted by the resistive portion of the air load on each side of the diaphragm, and

(3) The damping action at the coil itself, caused by the generation of back E.M.F. in the coil (due to its motion in the magnetic field) which creates a current flow round the closed circuit consisting of the voice coil and the impedance presented by the output transformer. This current tends to produce a motor force on the coil acting in a direction opposite to the motion causing the back E.M.F. The value of back E.M.F. generated is naturally dependent on the strength of the magnetic field embracing the turns of the coil.

The control offered by factors (1) and (2) is normally insufficient to prevent the diaphragm " overshooting ", or continuing its excursion (due to its inertia) after the cyclic peak is passed, and " hangover ", or the continuance of diaphragm vibration after the cessation of the signal. However, strong electro-magnetic control, as described above, can provide excellent control.

For this reason, the " Axiom 80 " is equipped with a magnet system producing a gap flux density of 17,000 gauss, an exceptionally high figure for a unit of this size.

NOTES ON USE

Nearly always, the Axiom 80 itself will indicate when it is being incorrectly used, and in no uncertain terms. We deal first with those features of operation which although often overlooked on conventional high fidelity loudspeakers *must not be ignored* on the Axiom 80.

1. Correct Mounting

Details of specially designed enclosures are supplied with every

Axiom 80. On no account must the Axiom 80 be operated without any baffling, even for quick test purposes. In spite of the mechanical stops, a local line surge (e.g. caused by switching) could cause damage. The enclosures published by Goodmans are designed to utilise the potential bass capabilities of the Axiom 80, without being unconventionally large.

For some applications a greater power will be required than can be obtained from one Axiom 80. For these cases, two or four units should be used. Mounting details for such arrangements are also supplied with each instrument.

2. Signal Source and Amplifiers

Since the Axiom 80 is intended for professional use, it is assumed that it will only be used in conjunction with equipment of the very highest order. It is most important that the feeding amplifier should have sufficient negative feed-back to ensure a substantially constant voltage (very low source impedance) output. Naturally, any economy on the output transformer would be false economy. It can be taken for granted, also, that any amplifier used will have negligibly low distortion, and will have a very low hum level.

The Axiom 80 will probably be used mainly with inputs from disc, tape, and frequency modulated broadcasts.

When reproducing disc recordings through the Axiom 80, a pick-up should be chosen which has a treble resonance which is either—

(a) well above the limit of the audio range, or
(b) sufficiently well damped to remove all trace of its presence.

Further, the resonance which takes place when the mechanical reactance of the inertia of the pick-up arm equals that of the stylus suspension should be as low as possible and well damped.

A loudspeaker with a more limited frequency coverage than the Axiom 80 might not be unduly troubled by these resonances ; but it must be remembered that the Axiom 80 is as critical as the ear itself, and its whole performance can be upset by uncontrolled resonances falling within its operating range.

It is frequently forgotten that " surface noise " on a disc is composed of frequencies from all parts of the audio scale ; and consequently the greater the " band-width " of the loudspeaker, the greater will be the range of surface noise reproduced, and the amount of this noise will appear greater. This is in no way a fault of the loudspeaker. Naturally, if the compensation network for the recording characteristic is incorrect, resulting in (say) an emphasis of all frequencies above 1 Kc/s, then the surface noise will be accentuated ; but an error of this sort should make itself evident by producing bad tonal balance. (*N.B.* Any loudspeaker which has an appreciable " peak " at any point in its response will naturally reproduce more of the surface noise that falls into the region of the peak, as well as more of the signal that falls into that region. This brings us to one of the best tests of loudspeaker characteristics, the " white noise " test. White noise is sound composed of frequencies from every part of the audio spectrum, in equal amounts. If " white noise " is fed to an Axiom 80 which is being operated correctly, the resulting sound has no obstrusive character but is smooth and even, and completely devoid of any pitch.)

When the Axiom 80 is used to reproduce a frequency modulated broadcast source, or material recorded on magnetic tape, performance of the first order can be obtained without difficulty provided that the signal material and driving equipment are of top quality.

3. Monitoring

It has already been mentioned that the Axiom 80 is as critical as the ear itself. It is also quite as critical as *any* single loudspeaker through which any material being monitored will eventually be reproduced. This means that the Axiom 80 can be used with full confidence as a standard ; and any signal which is capable of doing full justice to the Axiom 80 will stand the closest investigation by any other reproducing system.

4. High Power Systems

There are various special applications where High Fidelity reproduction is required at very high power ; and although the combination of four Axiom 80s can handle a maximum input power of over 20 watts, it may be required to exceed this figure in certain cases.

On such occasions it is recommended that the Axiom 80 be used to handle the upper middle, top, and extreme top registers only ; and that a heavy duty " woofer " be employed in the lower registers.

The choice of crossover frequency will depend upon the performance of the " woofer " and upon the power distribution of the material being reproduced.

It may be found that the sensitivity of the Axiom 80 is too great for correct balance with the woofer. If this is so, it should be fed through a variable constant impedance attenuator, which can be varied until balance is achieved.

It is quite permissible to use more than one Axiom 80 in conjunction with suitable woofers ; in this way it is possible to create a system with extremely high power rating ; and of any desired angular coverage, by suitable disposition of the units.