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TUBULAR LOUDSPEAKER CONES

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INTRODUCTION

It is generally accepted that bass is a dimension that is missing from most high fidelity loudspeakers and it was recognised by the author that there was a need to redefine this dimension.

Four years of research and development have produced a tubular loudspeaker cone which is made up of a helical tube that ports into the cabinet at its centre. The tube can be closed or open to the atmosphere on its circumference. Effectively the new design can give portless loudspeakers a degree of reflexivity and greatly increase both surface area and rigidity, the sonic effect is to increase power handling and bass extension below $50H_z$.

BACKGROUND

It is not normally possible to improve bass response below $40H_z$ without increasing cabinet size or drive unit size.

A bass output increase of 10dB at $30H_z$ has been measured in anechoic conditions using a tubular component in comparative tests.

Drive units and ABR's (auxiliary bass resonators) have been fitted with the new tubular cones and found to be more than 200% more effective at increasing bass extension. A six dB increase at frequencies of $40H_z$ is double the volume. Increases of 10dB at $30H_z$ have been measured on separate occasions using various different design formats at the anechoic chamber belonging to the Building Research Establishment at Watford using B+K spectrum analysis equipment graphs of which are enclosed.

Loudspeaker cones because of their shape have a degree of gyroscopic stability but the vibrating air mass within a new tube cone adds far greater axial stability. The rigidity also extends high frequency output being less prone to break up than conventional speaker cones. It is possible to increase power input and volume without distortion because of this type of stabilisation. The whole excursion and return of a tubular diaphragm is cushioned by the contained mass of the vibrated column of air within the conduit. On many recordings which I have heard through tubular cones, low frequency colouration such as trucks or generator engine noise can be very noticeable and probably the engineers who have made such recordings were not aware of the subsonics since conventional cones do not normally reproduce these frequencies very well during playback.

The device combines two effects, those of an organ pipe with a diaphragm attached to it and vice versa. The tube absorbs vibrations from the diaphragm and vice versa. The structure is self damping and being an extension of the enclosure wall it also damps cabinet resonance very effectively.

TUBULAR LOUDSPEAKER CONES

This device which won a gold medal in the electronics section of the 20th International Salon of Inventions in Geneva last year provides an effective means of condensing a larger compressed active surface area into a given diameter.

It is interesting to note that although the conventional cone is excellent on mid-range applications, the tubular version can simplify many of the complex equations governing loudspeaker cone behaviour and loudspeaker design.

Some of the benefits are:-

1. Reduce distortion particularly at high volumes.

2. Feedback is substantially reduced.

3. The component reduces structural resonance.

4. It improves clarity therefore.

5. The structure improves percussion. Attached to a drum diaphragm it will double the output volume and bass extension (see note 1).

6. It is a way of adding structure to a cone improving low frequency performance without the penalty of reduced sensitivity.

7. Every note has an infinite number of octaves above and below and by restoring low frequency definition balance and fidelity are also achieved with the result being a more rounded and physiologically felt acoustical effect.

NOTE 1
The technology also applies to a drum giving similar results.

DRUM COMPRESSOR

Herewith brief details of the way in which the compressor works which I hope you will find of interest.

The vacuum formed ducting baffles are fitted centrally with adhesive to a drum head which has been perforated at its centre. The air is ducted through and around the spiral which can be open at both its centre on one side and the periphery on the reverse side, connecting the interior with the exterior atmosphere. This configuration has been found to be a little more effective than porting the tube into the drum at the centre only.

The compressor rotates and vibrates the contained air mass every time the diaphragm is struck. This acts as a gyroscopic and pneumatic shock absorber providing a more dynamic point of contact between mechanical energy and air pressure through gyroscopics which actually stabilise oscillation in the drum. This method of increasing bass response improves a wider frequency range by a greater margin than by simply adding a static mass loading to the resonator head.

Along with increasing surface area of the volume of air contained, the device acts as an oscillator/resonator and organ pipe in one.

CURRENT SYSTEMS

High quality multidriver HiFi loudspeakers have been successfully converted to use the new component where injection moulded cones have been perforated and fitted with ducting baffles back and front as illustrated in figure 1.

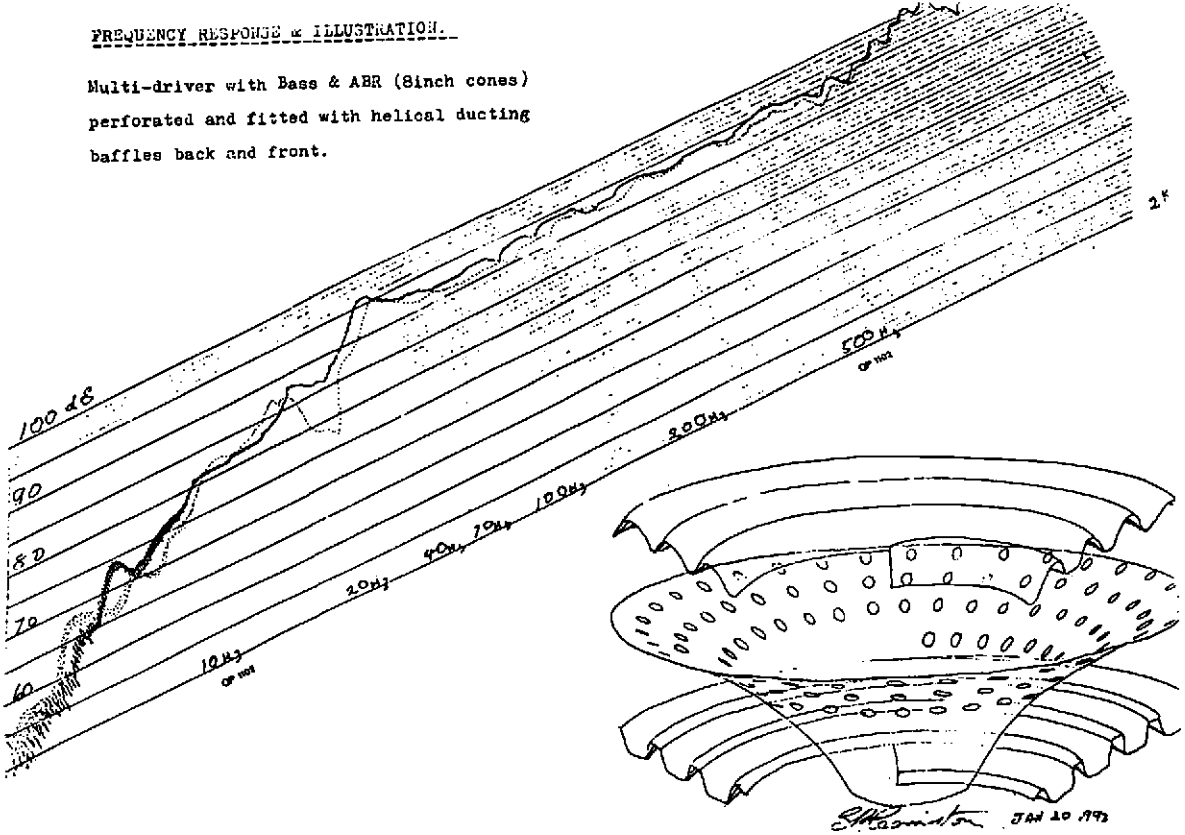
Recording studio monitor speakers are now being converted to evaluate the tubular technology in the form of testing stick-on ducting baffles for the monitors hemispherical woofer drive unit cones, these should enable the studio to accurately define sub $40H_z$ frequencies.

Interest has been expressed in the concept by receiver manufacturers and it is hoped that the miniaturised version of the component will be of value in hearing aid applications.

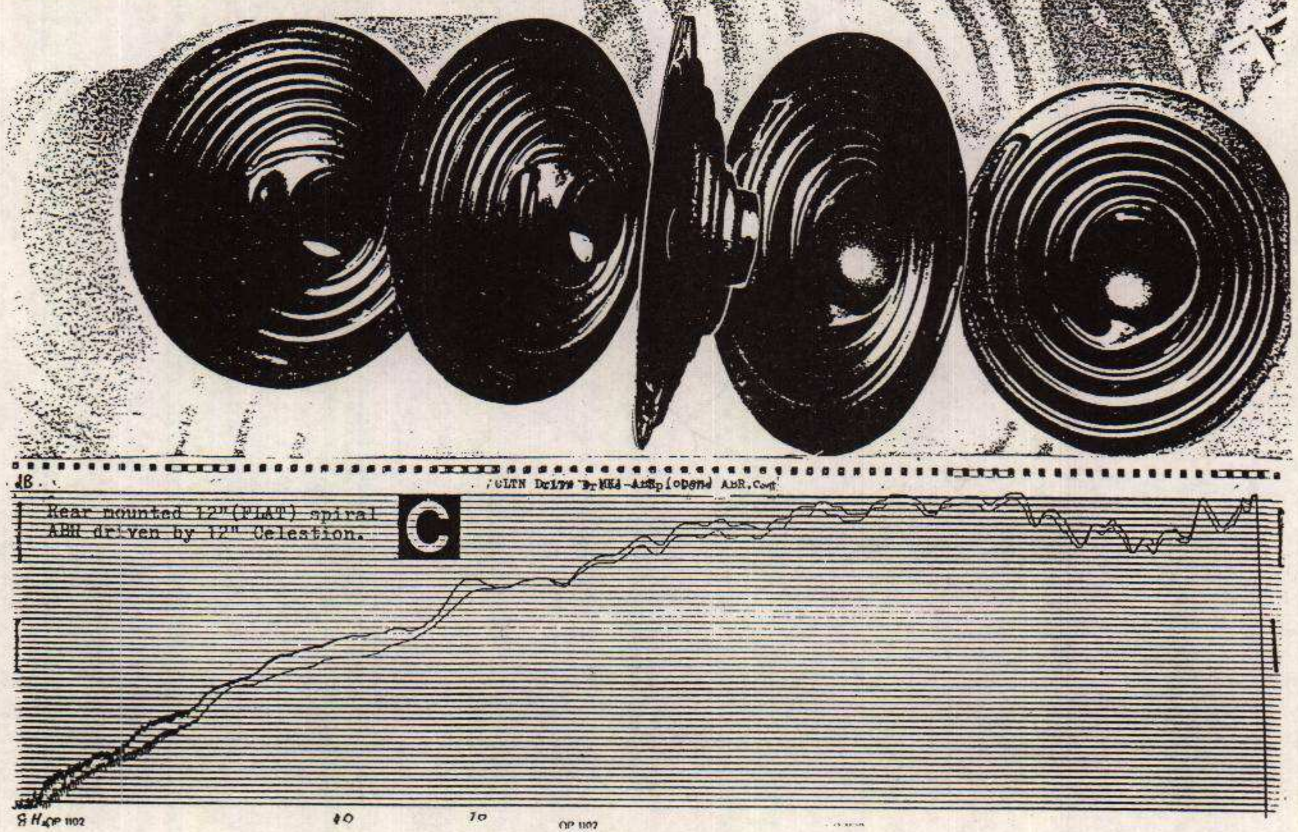
The principle has been tested in the bass unit of an AKG microphone with promising results, again it improves percussion.

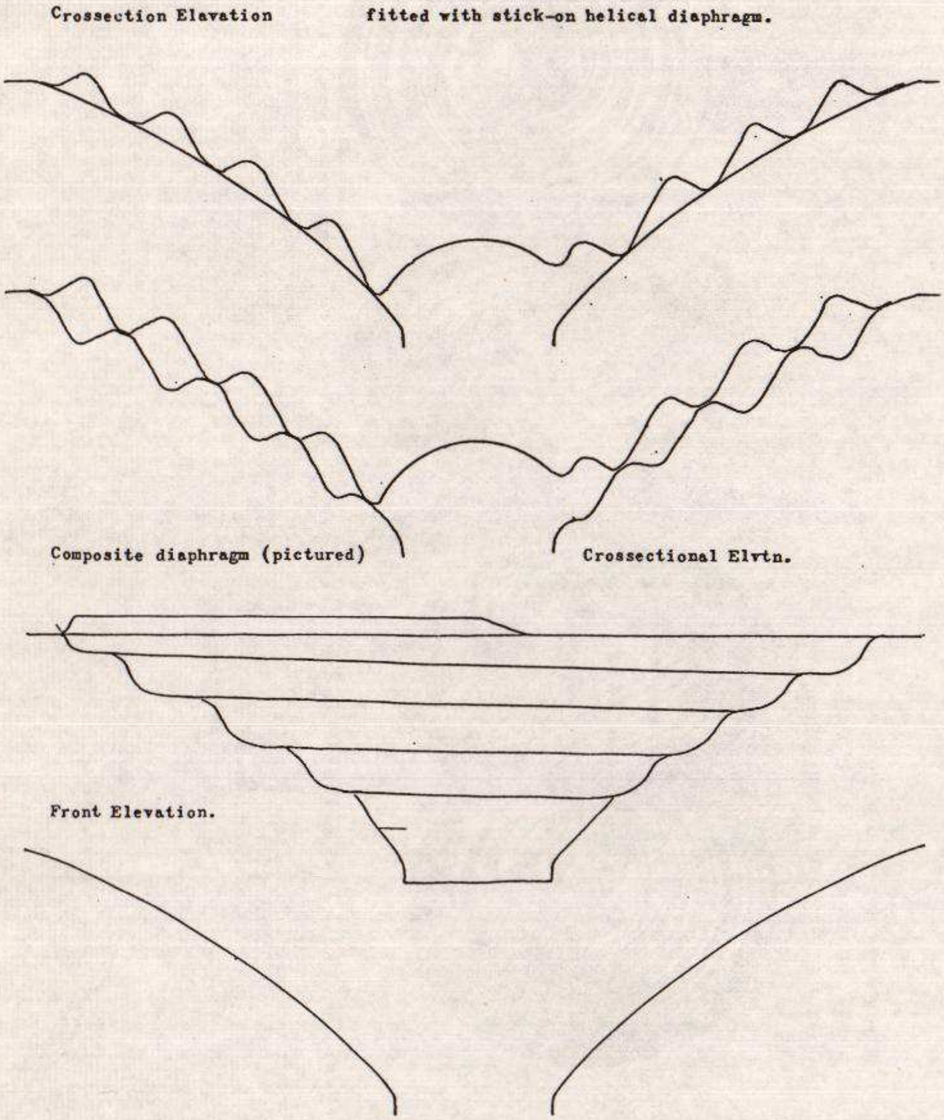
FREQUENCY RESPONSE & ILLUSTRATION.

Multi-driver with Bass & ABR (8inch cones) perforated and fitted with helical ducting baffles back and front.

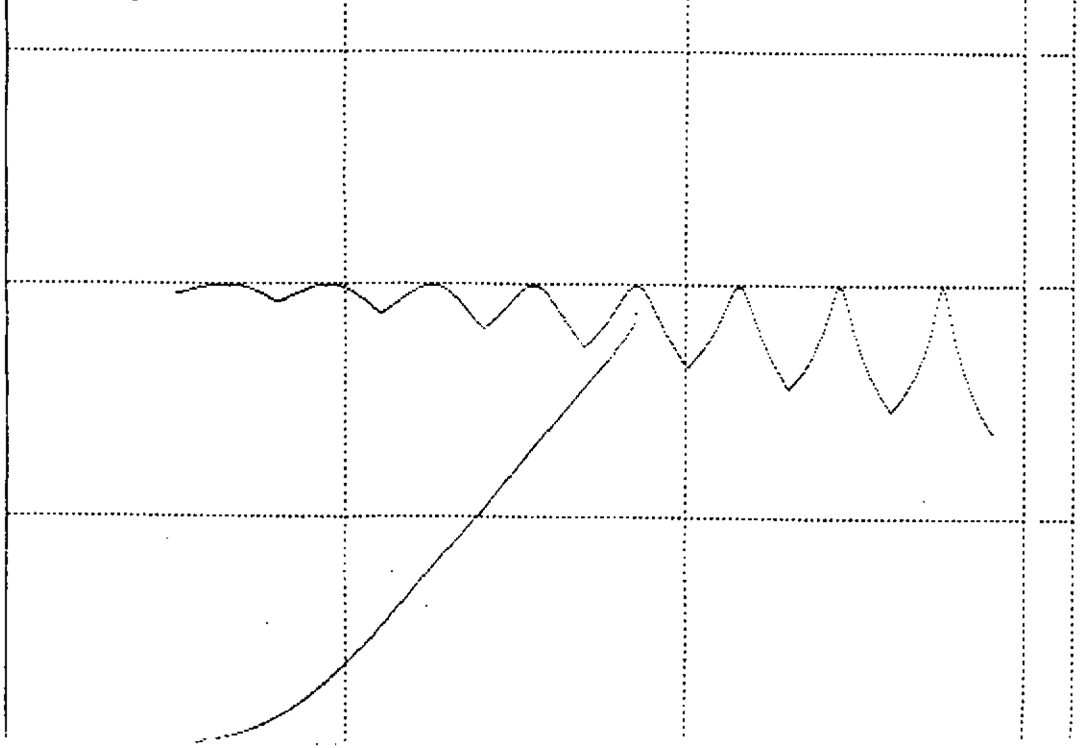


Composite diaphragm & graph showing
ABR application - improving output 8Hz to 2KHz.
Topline 2-3 dB increase in output using tubular ABR

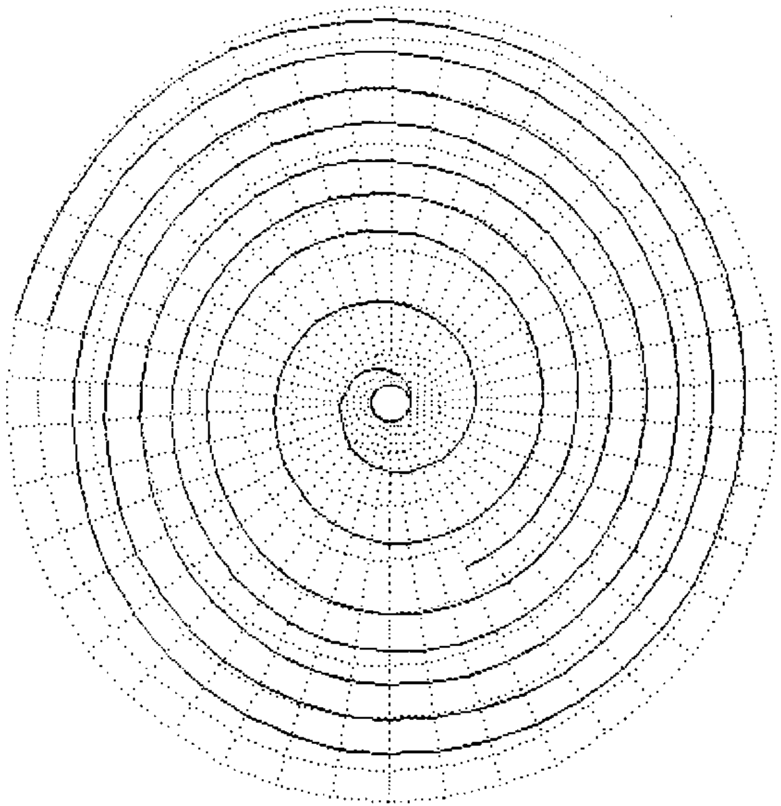


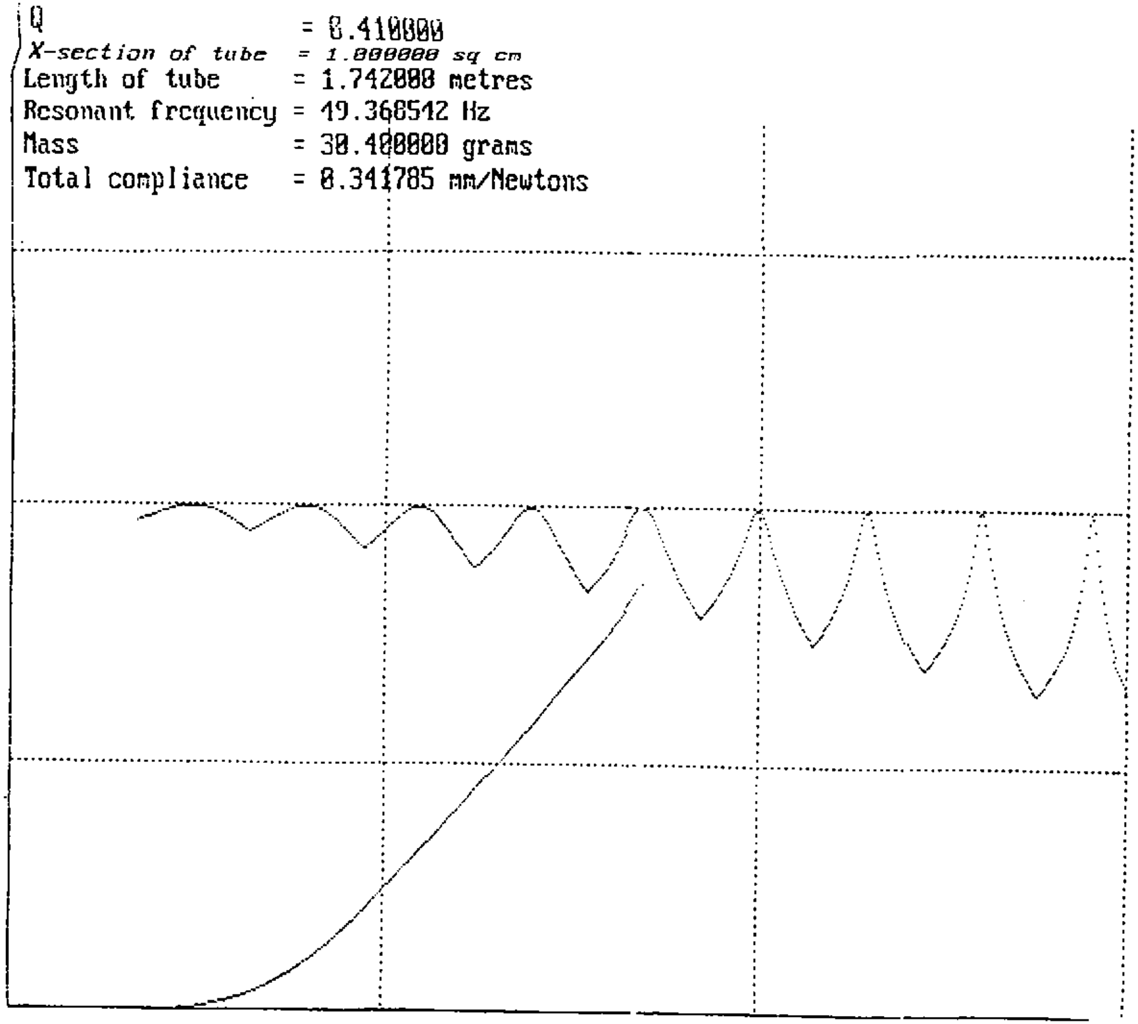

Crossection Elavation
fitted with stick-on helical diaphragm.
Composite diaphragm (pictured)
Crossectional Elvtn.
Front Elevation.

```
Q                    = 0.707000
X-section of tube    = 0.250000 sq cm
Length of tube       = 1.200000 metres
Resonant frequency   = 71.666664 Hz
Mass                 = 50.000000 grams
Total compliance     = 0.098611 mm/Newtons
```



```
Radius of diaphram (cm)    ==> 7.620000
Prime frequency (Hz)       ==> 63   Length of prime spiral (cm)     ==> 136
Secondary frequency (Hz) ==> 100   Length of secondary spiral (cm) ==> 86
Reservoir radius (cm)      ==> 0.399778
done...
```




Q = 0.410000
X-section of tube = 1.000000 sq cm
Length of tube = 1.742000 metres
Resonant frequency = 19.368542 Hz
Mass = 30.400000 grams
Total compliance = 0.341785 mm/Newtons

```
Total Q              = 0.340000
Speaker resonance    = 71.000000 Hz
Mass                 = 17.059999 grams
Total compliance     = 0.294464 mm/Neutons
, pf=286, t=1920, k=860
```