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(54) **Apparatus for generating noise.**

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**GB-A-1 171 728**
**US-A-3 713 417**
**US-A-3 835 810**

**JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA, vol. 63, no. 3, March 1978, pages 687-693, Acoustical Society of America, New York, US; D.A. WEBSTER et al.: "Collinear interaction of noise with a finite-amplitude tone"**

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Courier Press, Leamington Spa, England.

## Description

The present invention relates to apparatus for generating high frequency high level noise fields.

High intensity noise fields of specified spectral shapes are required for a number of industrial and technical testing purposes an example of which is the provision of a high level noise field to excite and test aerospace structures in a simulated noise environment of rocket, jet engine and propeller noise. The production of such noise fields in the frequency range above 1.25 KHz has been found to be either impractical or expensive. Certain acoustic test facilities have been using commercially available low or medium frequency noise generators. These generators suffer from high-frequency roll-off above about 500 Hz. A few test facilities have been using aeroacoustic noise sources such as impingement jets, shock cell noise, Hartmann generators or modified Hartmann generators in place of conventional "high" frequency noise generators. The Hartmann generator produces narrow band high level tones and if it is detuned could, less effectively, produce broad band tones. In order to fill up the width of the frequency spectrum with noise, many Hartmann generators would have to be added. However this solution is impractical insofar as the cost of operating multiple Hartmann generators makes the solution uneconomical and further the interaction of the Hartmann signals does not always produce the desired spectrum, as tests have shown.

For a background on the noise testing of articles reference is made to the paper entitled The Use of Hartmann Generators at Sources of High Intensity Sound in a Large Absorption Flow Duct Facility, D. L. Martlew of the National Gas Turbine Establishment at Farnborough, Hants, United Kingdom (published in A.I.A.A. Paper 75—529 March 1975, Aeroacoustics Conference, Hampden, Virginia, U.S.A., 24—26 March 1975). The paper discusses a large scale noise test facility used in an aeroengine reduction noise program. Another paper of interest is that of D. A. Webster and D. T. Blackstock, Journal of the Acoustic Society of America 63(3), March 1978, pages 687—693 which discusses the interaction of high level high frequency tones with low level broad band noise by collinear propagation.

The problem facing the test facilities is to fill up the produced noise spectrum between 500 Hz and say, 10 KHz in an economical practical fashion.

According to the present invention there is provided apparatus for producing noise as defined in claim 1.

The low frequency high-level noise source may be a broad band or a narrow band low-frequency noise generator. For sonic testing of an article in a reverberation chamber, the tube may include an acoustic horn adapted for connection to the low-frequency source at its small end and for connection to the reverberation chamber at its large end.

Other advantageous features of the apparatus are defined in dependent claims 2 to 8.

The invention extends also to use of the claimed apparatus for sonic testing of an article, more especially sonic testing of an article in a reverberation chamber.

The invention is further concerned with an improved Hartmann type noise generator. A known generator is disclosed in GB—A—1 171 728. The improved generator is defined in claims 9 and 11 and advantageous developments are set forth in dependent claims 10 and 12 and 13.

The following is a description by way of example of certain embodiments of the present invention reference being had to the accompanying drawings in which:

Figure 1 is a schematic representation of an application of the invention to the testing of an article in a reverberation chamber;

Figure 2 is the acoustic spectrum propagated into a test chamber from a Hartmann-type generator, operated alone;

Figure 3 is the acoustic spectrum propagated into the same chamber from a low frequency high-intensity tonal noise source, operating alone;

Figure 4 is the acoustic spectrum propagated into the same test chamber when the functioning of the Hartmann type generator is modified by a high intensity tone from the low frequency source;

Figure 5 is the wide broad band spectra propagated in the chamber and using a logarithmic frequency scale, when the functioning of two differently tuned Hartmann-type generators is modified by a low frequency broad band noise source;

Figure 6 is a detail of a tube modified to accept a plurality of aeroacoustic noise sources;

Figure 7 is a section along the lines 7—7 of Figure 6 showing an aeroacoustic generator of the Hartmann type;

Figure 8 is a cross-section similar to Figure 6 and showing a rectangular tube means;

Figure 9 is a detail of a tuning arrangement for the aeroacoustic noise generator of Figure 7; and

Figure 10 is a detail of a second form of aeroacoustic noise generator.

Turning now to the drawings. In Figure 1 a pair of broad-band (or tonal) low-frequency high level noise sources 10 and 11 are operatively connected through a Tee-piece with a tube means 14 having a tubular section 15 which may be of circular cross-section, or rectangular cross-section as seen in Figures 7 and 8 respectively. The noise sources may conveniently be Wyle broad-band devices of the type known as WAS 3000. Equally well, the noise sources could be of the Ling type, such as sold by Ling Altec Limited under the model no. EPT—200, electro-pneumatic transducer. In noise sources of this type, compressed air at up to about 0.2 MPa (30 PSIG) is blown into a chamber where slotted sleeves slide axially under the action of an electrodynamic coil. The soundwaves thus generated are propagated through the Tee-piece and into the tube means 14.

The tube means 14 may include an acoustic horn 17 connected at its broad end to a reverberation chamber 18.

Arranged at, say, four separate places along the length of the tubular section 15, are receiving apertures (see also Figures 6, 7 and 8) for an aeroacoustic noise generator, or generators, such as Hartmann type generators 20. Hartmann type generators are well known in the art and do not require detailed explanation here but generally speaking air is delivered at high speeds through a converging nozzle 21 and impinges directly into the open end of a resonance cup 23. The shock wave created responds to the acoustic pressure waves in the resonance cup 23 and a high intensity sound is emitted. This sound has a spectrum consisting of a fundamental tone 30 (Figure 2) and harmonics 32, 33. The fundamental tone is related to the depth of the resonance cup which may be tuned by moving a plug 25 (Figures 7, 8 and 9) longitudinally within the resonance tube, as will be explained more fully hereinafter.

For the sake of simplicity of understanding, consideration should be given to the interaction between a single low frequency source 10, or 11, controlled to emit a tonal sound spectrum somewhat similar to that shown in Figure 3 with a single Hartmann type aeroacoustic noise generator 20 producing a sound spectrum similar to that shown in Figure 2. The noise from the sound source 10 interacts with, and excites, the natural unsteady oscillatory aerodynamic flow in the Hartmann type generator 20 to produce noise output which is a non-linear modulation (see Figure 4) of the normal noise generation of the Hartmann generator 20. It will be noted that the Hartmann type device, or devices 20 are preferably positioned along the tubular section 15 so as to be close to the high noise levels generated by the sources 10, 11. However, it is to be understood that if desired, the tube means 14 could have provision made in its horn section 17 to receive one or more noise generators 20.

The propagated sound precedes along the horn 17 into a reverberation chamber 18, in which the air is preferably kept dry, and acts upon a test piece 19 suspended in the reverberation chamber 18.

Depending upon the nature of the sound envelope which it is desired to generate, and this of course will be dictated by the nature of the test or function which is to be conducted, one or more Hartmann-type generators 20 may be positioned along the tubular section 15 and one or more Wyle, or the like, sources may be operated. Where it is desired to produce a broad spectrum flat envelope, a Wyle WAS 3000 type device may be combined with two Hartmann-type generators 20 tuned to different frequencies to produce the sound spectrum seen in Figure 5. Such a sound envelope, because of its high intensity over a wide spectrum, is particularly useful for testing of aerospace equipment, satellites and the like.

The curve 5a in Figure 5, is that of a WAS 3000 alone tuned to provide a broad band, low frequency, high intensity noise and the curves 5b—5e are of two Hartmann-type generators 20 modulated by the WAS 3000 and operated at different supply pressures. The peak 5p may be adjusted to higher or lower frequencies depending on the tunings of the Hartmann generators 20 and can be shifted to the left (as seen in Figure 5) to merge with the WAS 3000 broadband noise.

Turning now particularly to Figures 6 through 9, the novel Hartmann-type generator shown differs from the standard Hartmann-type acoustic generator in that it does not comprise a separate nozzle and resonator cup section. Rather a tube member 26 is provided with a slot 27 which is cut into the tube member wall. In the rectangular cross-section tube 26 shown, the slot is cut into three adjacent side walls leaving a top uncut wall section 28 to span the slot. The tube member 26 is provided with a flange 26f which is bolted to a flange 21f (Figure 7) of a converging nozzle section 21 which connects to an air source. On the left of the gap 27 is the nozzle section 26n of the tube and on the right hand side of the air gap 27 (as seen in Figure 7) is the resonator cup 23. The tuning of the generator is accomplished by moving the plug 25 forwards or backwards in the cup 23 longitudinally of the tube 26. The movement of the plug 25 can be accomplished in any desired fashion.

In Figure 9 there is shown a simple form or adjustment in which a series of holes 30 are drilled in line in the top wall of the tube member 26 and a series of co-operating tapped holes are provided in the plug. The plug is moved backwards and forwards in the tube 26 and positioned by inserting a cap screw or screws into the appropriate holes in the tube 26 and into the corresponding threaded holes in the plug 25 to anchor it. Obviously a more elaborate or even automatic system could be provided in which hydraulic or pneumatic cylinders, or the like, could be provided to push or pull the plug, within the tube 26, to position it. Thus the plug position, and consequently the tuning of the generator, could be remotely controlled. In tubes with short resonant cavities, the tube cross-sectional area and shape may often prove to be an important factor in tuning the generator to the desired frequency. Thus, rectangular, square, triangular, semi-circular, or other suitable cross-sectional shape may be selected to produce the desired frequency for a given air flow.

In the inventive configuration shown, at least two advantages accrue. First the wall 28 serves to combine the cavity 23 and nozzle 26n in accurate alignment and as a unitary structure. Second, the aerodynamic and acoustic frequency performances are virtually that of a tube of twice the cross-sectional area, additionally the aerodynamic boundary layer on the wall 28 may allow operation of the generator to be extended from supercritical nozzle pressure ratio down to subcritical nozzle pressure ratios, thereby providing a greater range of selectable spectrum shapes and noise levels.

In order to attach the Hartmann-type generator in position on the tube section 15, one of the blanking yokes 29 (see Figure 6) is simply

unbolted from its ledge 29l and the tube 26 of the generator 20 is bolted on that ledge 29l.

Figure 10 shows a second form of modified Hartmann-type generator in which a circular section nozzle 40 is aligned with an acoustic tube 41 in the mouth of which 42 is formed a reverberation cup 43. An air gap 44 separates the nozzle 40 from the tube 41, in normal fashion. The gap 44 may be varied to accommodate different noise generation conditions and suitable clamping means may be provided to connect nozzle 40 and tube 41 for relative movement and to permit them to be clamped in a variety of spacings.

A bridge member 45 spans the air gap 44 and is slidingly engaged within the nozzle 40 and the tube 41, resting on aligned sections of the peripheral walls 46, 47 of nozzle and tube respectively. The bridge section is of semi-circular cross-section where it spans the air gap and has a flat 48 machined on its top side. At the nozzle end of the bridge member, the flat 48 is curved away at 49 towards the nozzle to provide for smooth passage of air from the nozzle. At the other end of the bridge member 45 is a plug 50 formed integrally with the bridge member 45 and being of circular section to fit snugly within tube 41. A series of holes 52 in the upper section of the peripheral wall 47 accommodates a threaded screw member 53 which can be engaged in a selected one of a series of threaded holes 54 in the circular plug 50 when the bridge member is moved backwards and forwards within the tube 41 and nozzle 40 to vary the depth of the reverberation cup 43, between the mouth of the tube 41 and the flat face 55 formed on the plug at the point where it meets with the flat 48 on the bridge member. It will be understood that any other suitable mechanism may be provided for sliding and fixing the plug 50 in the tube 41.

As has been indicated, if desired suitable means may be provided to clamp the bridge 45 to the nozzle 40, for example a series of holes similar to 52 may be provided in the lower section of peripheral wall 46 of nozzle 40, to accommodate a threaded screw member 53b which can engage in one of a series of threaded holes, similar to holes 54, provided in the underside of bridge 45 where it enters nozzle 40.

By sliding the bridge 45 with its plug 50 within the tube 41 so as to vary the depth of the reverberation cup 43, the Hartmann-type generator may be tuned to different frequencies.

This novel version of generator has the advantages of that described above with references to Figures 7, 8 and 9 and additionally provides for a variable air gap. Where a variable air gap is not desired, the bottom segment of the peripheral walls 46, 47 may be left integral, that is to say as with the generator shown in Figures 7, 8 and 9, the gap 44 may be cut as a slot and a wall, like 28, left in place.

Although the invention has been described with reference to the operation of the generated noise being used to sonic test a piece of space equipment, it will be understood that noise generated in the tube and passed either directly from the tube section, or through the acoustic horn, or some other suitable tubular arrangement, may be used to shake dust particles from an environment, or to generate sonic waves in a fluid, or the like, in order to accomplish a desired purpose.

## Claims

1. Apparatus for producing noise comprising a tube (14), an aeroacoustic type high-frequency high-level acoustic noise generator (20) coupled to the tube, a low frequency high-level acoustic noise generator (10) coupled to the tube whereby, in operation, the noise from said low frequency high-level acoustic noise generator interacts with and excites the natural unsteady oscillatory aerodynamic flow in the aeroacoustic type generator to provide an output of non-linearly modulated noise.

2. Apparatus according to claim 1, characterized in that the tube (14) is adapted for communication with the inside of a reverberation chamber (18).

3. Apparatus according to claim 2, characterized in that the tube (14) includes an acoustic horn (15, 17) adapted for connection to the low frequency generator (10) at its small end and for connection to the reverberation chamber (18) at its large end.

4. Apparatus according to claim 1, 2 or 3, characterized in that the low frequency generator (10) is a broad band, low-frequency, high level noise source.

5. Apparatus according to claim 1, 2 or 3, characterized in that the low frequency generator (10) is a narrow band, low-frequency, high level noise source.

6. Apparatus according to any of claims 1 to 5, characterized in that there is a plurality of high frequency noise generators (20) spaced along the tube (14) and tuned to different frequencies.

7. Apparatus according to any of claims 1 to 6, characterized in that the or each high frequency generator (20) is a Hartmann-type noise generator.

8. Apparatus according to any of claims 1 to 7, characterized in that the low frequency generator comprises at least one electropneumatic transducer (10, 11).

9. A Hartmann-type noise generator comprising a tube (26), a slot (27) cut out of the tube wall to provide an air gap between a nozzle section (26n) of the tube and a reverberation cup (23) formed in the tube, the nozzle section and cup being joined by an uncut portion (28) of the tube wall spanning the slot, and an adjustable tuning plug (25) in the cup.

10. A noise generator according to claim 9, characterized in that the tube (26) is rectangular in cross-section and the slot (27) is cut in three of the four wall sides.

11. A Hartmann-type noise generator comprising a nozzle (40), an aligned acoustic tube (41) spaced therefrom by an air gap (44), a reverberation cup (43) formed in the mouth of the tube facing the nozzle, a bridge (45) extending into the

nozzle and into the tube and spanning the air gap and being in contact with a section of a peripheral wall of the nozzle and an aligned section of a peripheral wall of the tube, and means (50) for varying the depth of the reverberation cup, wherein the nozzle (40) and tube (41) are of circular section and the bridge (45) is a member of semi-circular section where it spans the air gap.

12. A noise generator according to claim 11, characterized in that the means for varying the depth of the reverberation cup (43) is a circular plug (50) formed integrally with the end of the bridge (45) and located within the reverberation cup, and position adjusting means (52—54) to positively locate the plug within the acoustic tube (41).

13. A noise generator according to claim 12, characterized by means (53) for securing the bridge (45) to the nozzle (40) and to the tube (41) to permit relative movement between the nozzle and tube to vary the air gap (44).

14. Use of apparatus according to any of claims 1 to 8 for sonic testing of an article.

15. Use of apparatus according to any of claims 1 to 8 for sonic testing of an article in a reverberation chamber.

**Patentansprüche**

1. Vorrichtung zur Lärm(Schall)erzeugung mit einem Rohr (14), einem an das Rohr angekoppelten aeroakustischen Hochfrequenz-Hochleistungs-Akustik-Lärm(schall)generator (20), einem an das Rohr angekoppelten Niederfrequenz-Hochleistungs-Akustik-Lärmgenerator (10), bei dem im Betrieb der Lärm des Niederfrequenz-Hochleistungs-Akustik-Lärm(schall)generators mit der natürlichen unstetigen oszillierenden aerodynamischen Strömung in dem aeroakustischen Generator in Wechselwirkung tritt und diese erregt, um einen nicht linear modulierten Lärmausgang zu erzeugen.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Rohr (14) zur Kommunikation mit dem Innenraum einer Nach- bzw. Wiederhallkammer (18) ausgebildet ist.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß das Rohr (14) ein akustisches Horn (15, 17) umfaßt, das zur Verbindung mit dem Niederfrequenzgenerator (10) an dessen weitem Ende und zur Verbindung mit der Nachhallkammer (18) an seinem engen Ende gegeignet ist.

4. Vorrichtung nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß der Niederfrequenzgenerator (10) eine Breitband-Niederfrequenz-Starklärmquelle ist.

5. Vorrichtung nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß der Niederfrequenzgenerator (10) eine Schmalband-Niederfrequenz-Starklärmquelle ist.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß entlang des Rohres (14) eine Mehrzahl von Hochfrequenz-Lärmgeneratoren (20) vorgesehen ist, die auf unterschiedliche Frequenzen abgestimmt sind.

7. Vorrichtung nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß der oder jeder Hochfrequenzgenerator (20) ein Hartmann-Lärm-(schall)generator ist.

8. Vorrichtung nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß der Niederfrequenzgenerator wenigstens einen elektropneumatischen Transducer (10, 11) umfaßt.

9. Hartmann-Lärm(schall)generator mit einem Rohr (26), einem aus der Rohrwand ausgeschnittenen Schlitz (27) zur Bildung eines Luftspalts zwischen einem Düsenabschnitt (26n) des Rohrs und einer in dem Rohr ausgebildeten Nachhallschüssel (23), wobei der Düsenabschnitt und die Schüssel mittels eines nicht eingeschnittenen Abschnitts (28) der den Schlitz überspannenden Rohrwand miteinander verbunden sind, und einem einstellbaren Abstimmtstopfen (25) in der Schüssel.

10. Lärmgenerator nach Anspruch 9, dadurch gekennzeichnet, daß das Rohr einen rechteckigen Querschnitt hat und der Schlitz (27) in drei der vier Seitenwände eingeschnitten ist.

11. Hartmann-Lärm(schall)generator mit einer Düse (40), einem mit dieser fluchtenden akustischen Rohr (41), das durch einen Luftspalt (44) von diesem getrennt ist, einer in dem der Düse zugewandten Mund des Rohrs ausgebildeten Nachhallschüssel (23), einer in die Düse und in das Rohr reichenden und den Luftspalt überspannenden Brücke (45), die in Kontakt mit einem Abschnitt einer Umfangswand der Düse und mit einem fluchtenden Abschnitt einer Umfangswand des Rohrs steht, und mit Mitteln (50) zur Veränderung der Tiefe der Nachhallschüssel (43), wobei die Düse (40) und das Rohr (41) kreisförmigen Querschnitt haben und die Brücke ein halbkreisförmiger Abschnitt im Bereich der Überbrückung des Luftspalts ist.

12. Lärmgenerator nach Anspruch 11, dadurch gekennzeichnet, daß das Mittel zur Veränderung der Tiefe der Nachhallkammer ein einstückig mit dem Ende der Brücke (45) geformter und innerhalb der Nachhallschüssel angeordneter kreisförmiger Stopfen (50) ist, und daß ein Lageeinstellmittel (52—54) zur positiven Anordnung des Stopfens innerhalb des akustischen Rohrs (41) vorgesehen ist.

13. Lärmgenerator nach Anspruch 12, gekennzeichnet durch Mittel (53) zur Verbindung der Brücke (45) mit der Düse (40) und zum Rohr (41) zur Ermöglichung einer Relativbewegung zwischen der Düse und dem Rohr zur Veränderung des Luftspalts (44).

14. Verwendung der Vorrichtung nach einem der Ansprüche 1 bis 8 zur Schalluntersuchung eines Gegenstands.

15. Verwendung der Vorrichtung nach einem der Ansprüche 1 bis 8 zur Schalluntersuchung eines Gegenstands in einer Reverberationkammer.

**Revendications**

1. Appareil pour produire du bruit comportant un tube (14), un générateur (20) de bruit acoustique de haut niveau et de haute fréquence du type aéroacoustique couplé au tube, un générateur (10) de bruit acoustique de haut niveau et de basse fréquence couplé au tube et grâce auquel, en fonctionnement, le bruit provenant dudit générateur de bruit acoustique de haut niveau et de basse fréquence interagit avec l'écoulement aérodynamique oscillatoire non stationnaire et l'excite dans le générateur du type aéroacoustique pour fournir en sortie un bruit modulé non linéaire.

2. Appareil selon la revendication 1, caractérisé en ce que le tube (14) est adapté à communiquer avec la partie intérieure d'une chambre (18) de réverbération.

3. Appareil selon la revendication 2, caractérisé en ce que le tube (14) comporte un cornet acoustique (15, 17) adapté à être connecté au générateur à basse fréquence (10) à sa petite extrémité et à être connecté à la chambre de réverbération (18) à sa grande extrémité.

4. Appareil selon les revendications 1, 2 ou 3, caractérisé en ce que le générateur à basse fréquence (10) est une source de bruit de haut niveau, de basse fréquence et de bande large.

5. Appareil selon les revendications 1, 2 ou 3, caractérisé en ce que le générateur à basse fréquence (10) est une source de bruit de haut niveau, de basse fréquence et de bande étroite.

6. Appareil selon l'une quelconque des revendications 1 à 5, caractérisé en ce qu'il est prévu une pluralité de générateurs de bruit (20) à haute fréquence situés à intervalles le long du tube (14) et accordés à différentes fréquences.

7. Appareil selon l'une quelconque des revendications 1 à 6, caractérisé en ce que le générateur à haute fréquence (20), ou chacun d'entre eux, est un générateur de bruit du type Hartmann.

8. Appareil selon l'une quelconque des revendications 1 à 7, caractérisé en ce que le générateur à basse fréquence comporte au moins un transducteur (10, 11) électro-pneumatique.

9. Générateur de bruit du type de Hartmann comportant un tube (26), une fente (27) découpée dans la paroi du tube pour fournir un espace entre une section de buse (26n) du tube et une coupelle de réverbération (23) formée dans le tube, la section de buse et la calotte étant jointes par une partie non découpée (28) de la paroi du tube qui enjambe la fente, et un tampon d'accord (25) réglable dans la calotte.

10. Générateur de bruit selon la revendication 9, caractérisé en ce que le tube (26) a une section droite rectangulaire et la fente (27) est découpée sur trois des quatre côtés de la paroi.

11. Générateur de bruit du type de hartmann comportant une buse (40), un tube acoustique aligné (41) écarté de celle-ci par un espace (44), une coupelle de réverbération (43) formée dans l'embouchure du tube qui fait face à la buse, un pont (45) qui pénètre à l'intérieur de la buse et à l'intérieur du tube et qui enjambe l'espace en étant en contact avec une section d'une paroi périphérique de la buse et une section alignée d'une paroi périphérique du tube, et des moyens (50) pour faire varier la profondeur de la coupelle de réverbération, dans lequel la buse (40) et le tube (41) ont une section circulaire, le pont (45) étant un élément de section semi-circulaire à l'endroit où il enjambe l'espace.

12. Générateur de bruit selon la revendication 11, caractérisé en ce que les moyens pour faire varier la profondeur de la coupelle de réverbération (43) sont un tampon circulaire (50) faisant partie intégrante de l'extrémité du pont (45) et situé à l'intérieur de la coupelle de réverbération, et des moyens de réglage de position (52—54) pour placer de façon positive le tampon à l'intérieur du tube acoustique (41).

13. Générateur de bruit selon la revendication 12, caractérisé par des moyens (53) pour fixer le pont (45) à la buse (40) et au tube (41) en permettant un déplacement relatif entre la buse et le tube pour faire varier l'espace (44).

14. Utilisation de l'appareil selon l'une quelconque des revendications 1 à 8, pour effectuer des essais acoustiques d'un objet.

15. Utilisation de l'appareil selon l'une quelconque des revendications 1 à 8, pour effectuer des essais acoustiques d'un objet dans une chambre de réverbération.

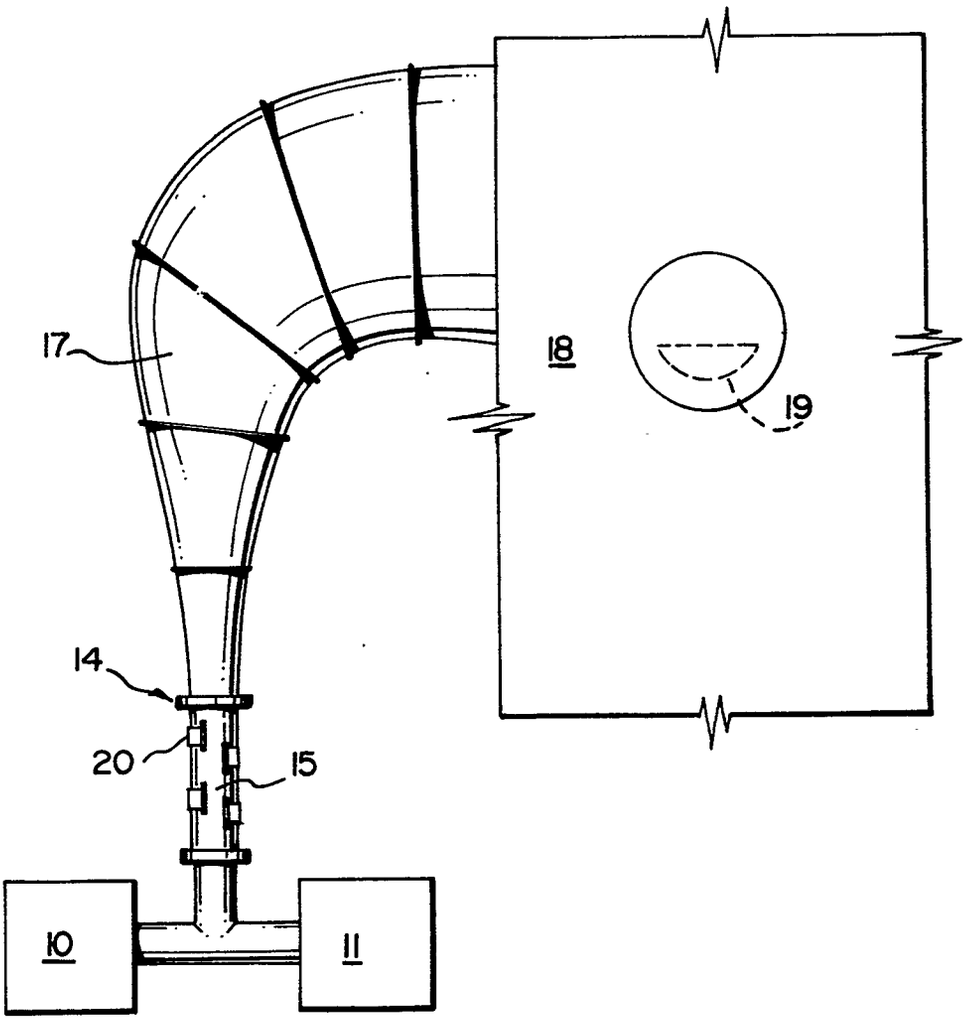



FIG. 1

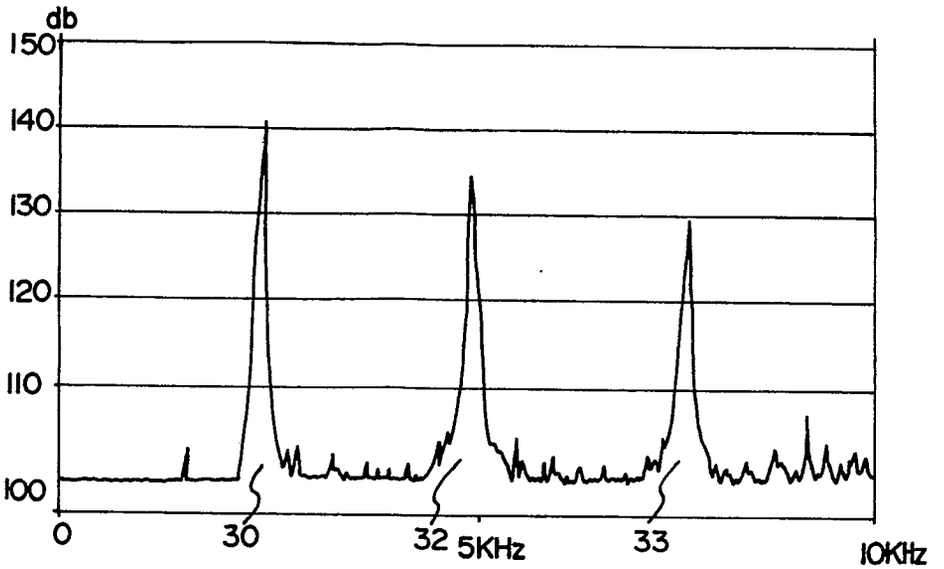

db
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120
110
100
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30
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5KHz
33
10KHz

FIG. 2

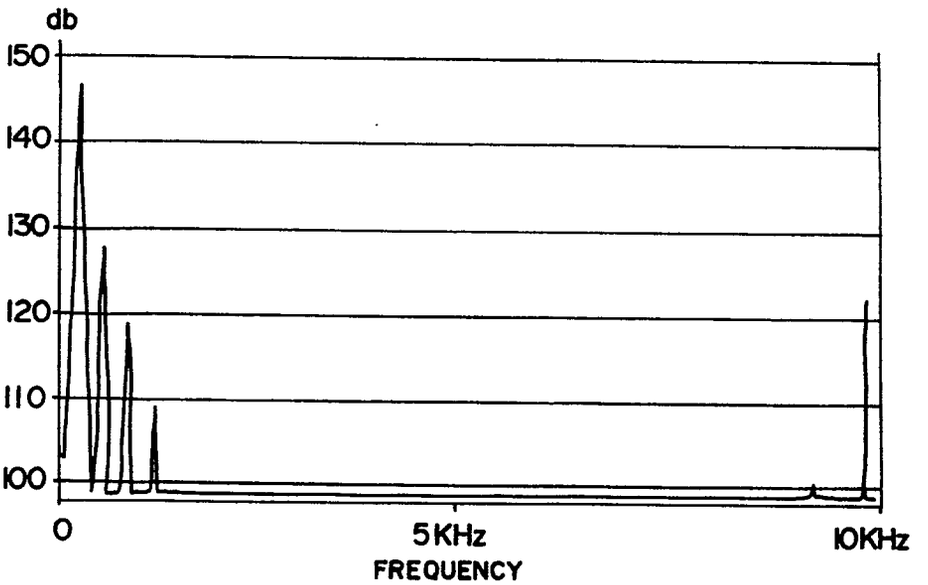

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120
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100
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5KHz
10KHz
FREQUENCY

FIG.3

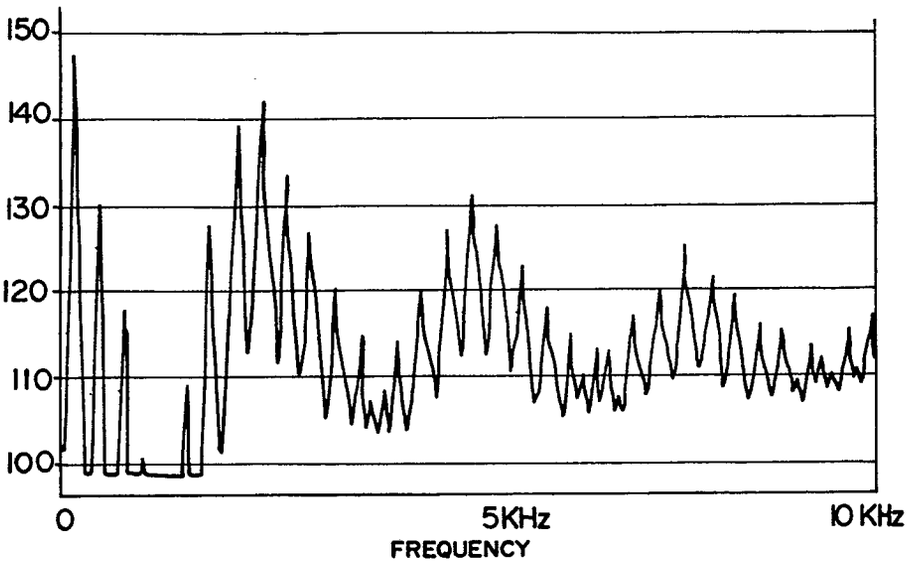

150
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130
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110
100
0
5KHz
10 KHz
FREQUENCY

FIG. 4

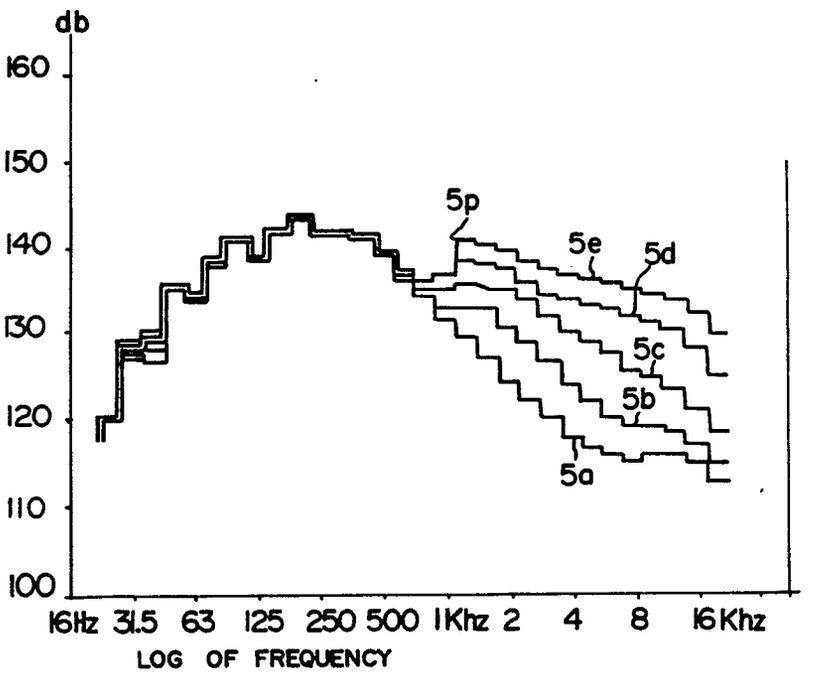

db
160
150
140
130
120
110
100
5p
5e
5d
5c
5b
5a
16Hz 31.5 63 125 250 500 1Khz 2 4 8 16Khz
LOG OF FREQUENCY

FIG.5

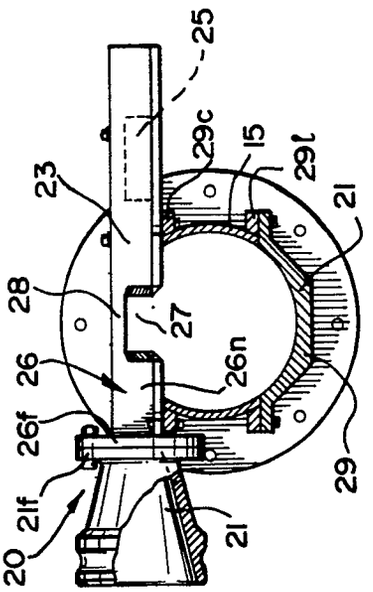

25
29c
15
29t
23
21
28
27
26
26n
26f
29
21f
20
21

FIG.7

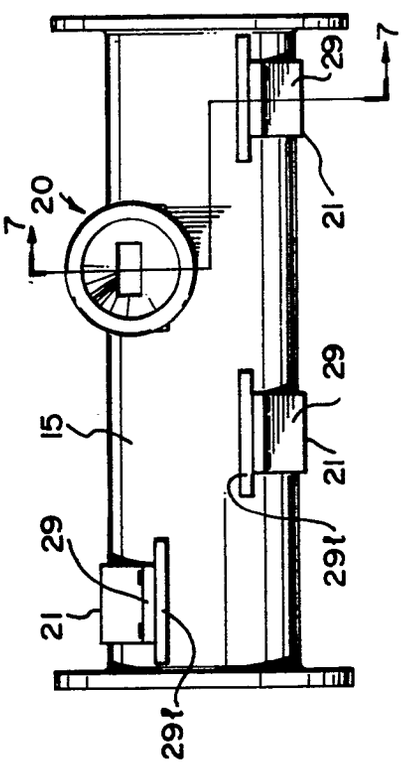

29
7
20
21
7
29
15
21
29
29t

FIG.6

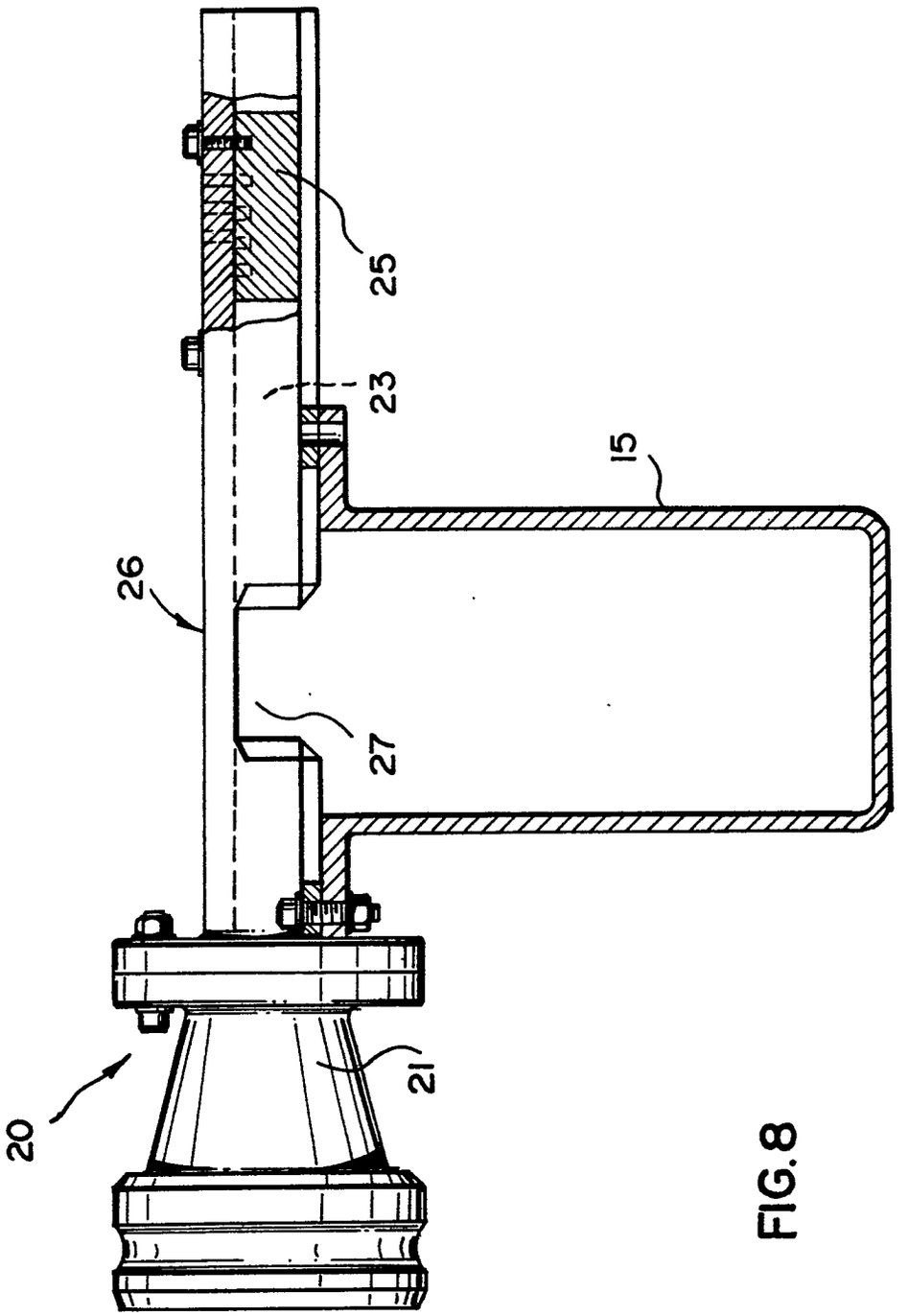



FIG.8

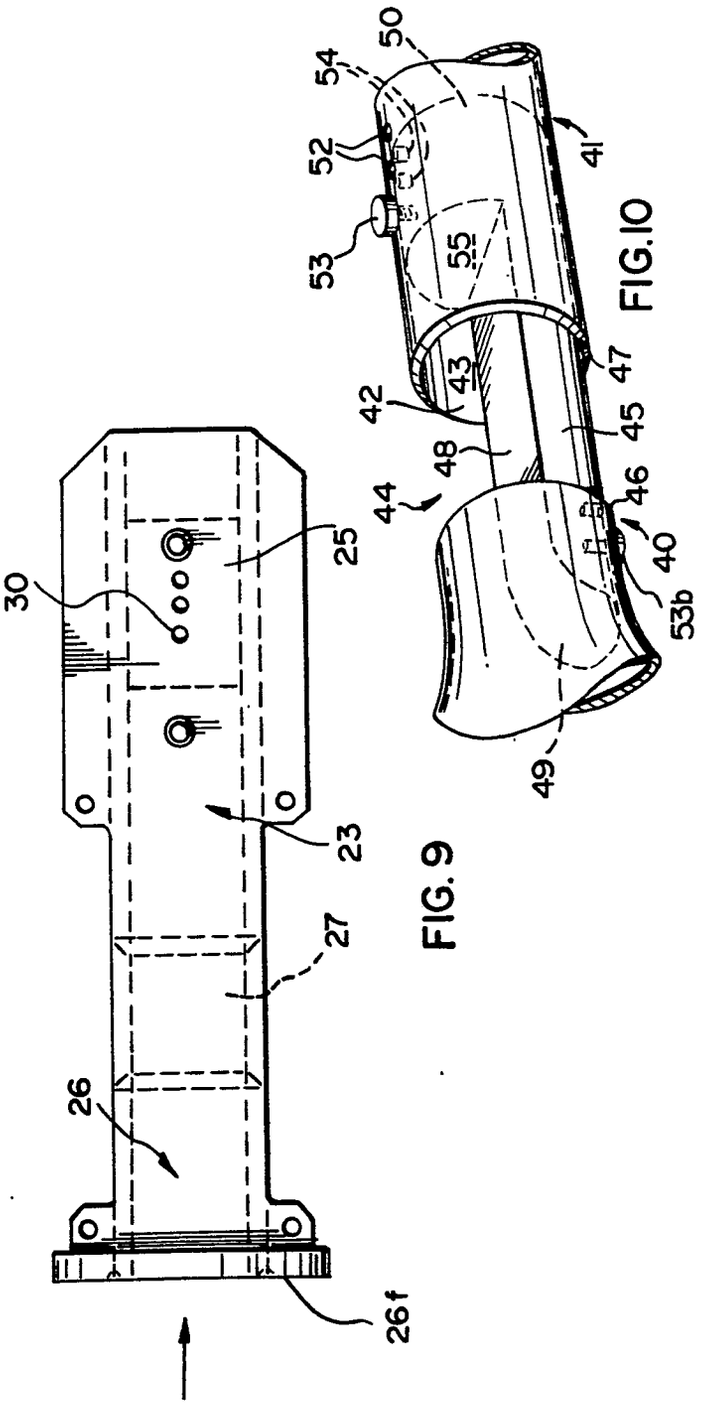



FIG. 9

FIG. 10