

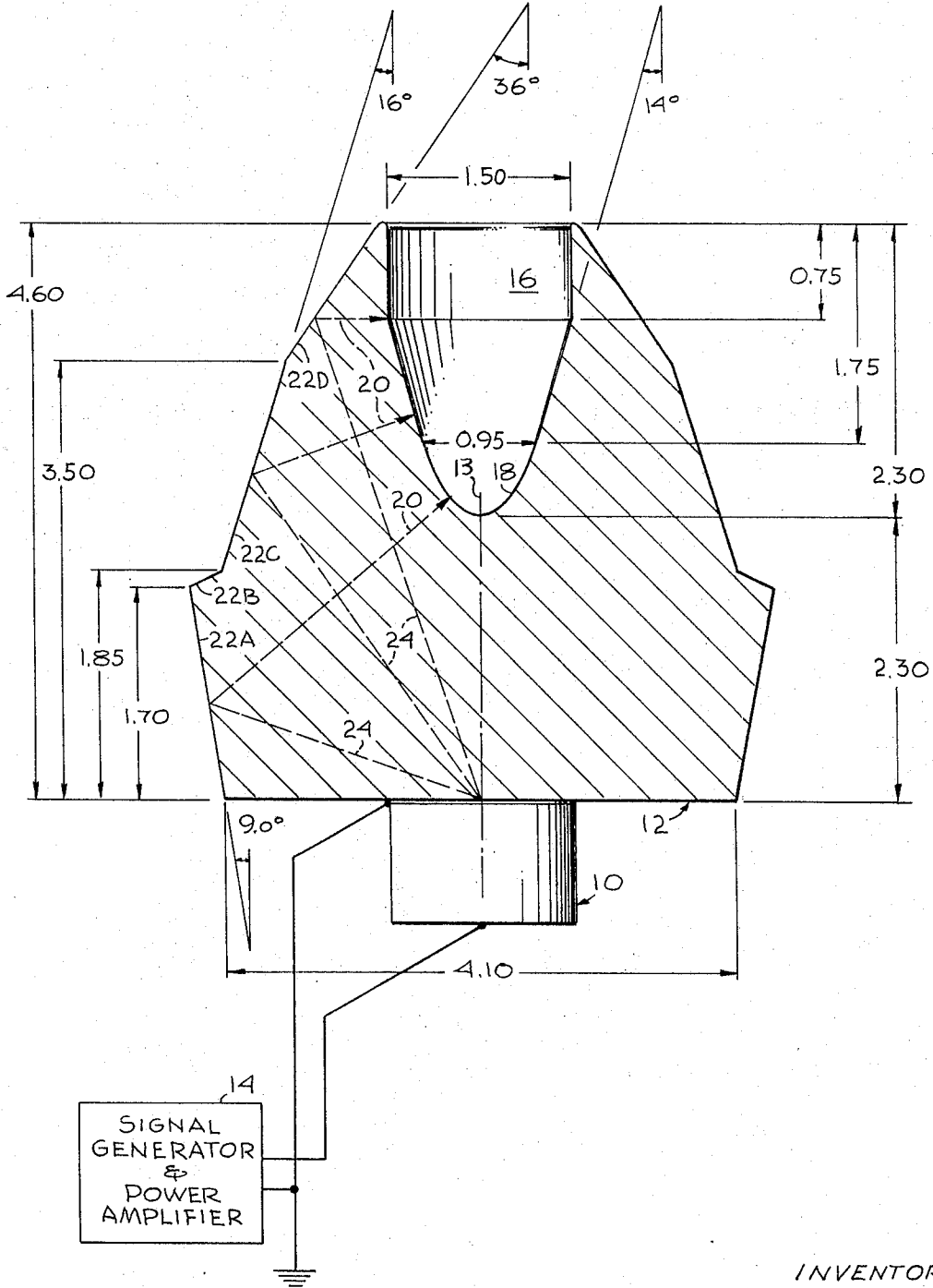
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ULTRASONIC CONCENTRATOR

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1

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ULTRASONIC CONCENTRATOR

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3 Claims. (Cl. 259-72)

This invention relates to apparatus for concentrating ultrasonic vibrations and more particularly to improvements therein.

An ultrasonic concentrator usually comprises a crystal which is driven with an electrical signal at an ultrasonic frequency, and which crystal is attached to a device employed for focusing the mechanical vibrations of the crystal at a region at which there is an interface with the atmosphere. Liquids or solid particles which it is desired to convert into a spray are fed to the region of the interface. Thus, an ultrasonic concentrator may be used for the dissemination of aerosols from liquids or solids, the generation of an intense ultrasonic energy for chemical or biological application, or by the generation of inflammable sprays for burners.

An object of this invention is the provision of a novel and useful arrangement for an ultrasonic concentrator.

Another object of this invention is the provision of an ultrasonic concentrator which is more efficient than those which have been employed heretofore.

These and other objects of the present invention are achieved in an arrangement wherein an electromechanical transducer is bonded to the bottom of a metal body that constitutes the concentrator. The concentrator has a cavity at the end opposite the side to which the transducer is bonded. The cavity walls form a resonating cavity to the impinging ultrasonic rays. The walls of the metal body are shaped so that the ultrasonic rays which are internally reflected from the walls reach the walls of the cavity in phase with the rays arriving directly from the transducer. In this manner, the energy transferred into the resonant cavity is made optimum.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawing, which is a cross-section of an embodiment of the invention.

The drawing shows a cross-section of the concentrator, in accordance with this invention, and the driving transducer which is bonded thereto. The concentrator is made of suitable metal, such as aluminum, and is symmetrical about the axis. The driving transducer 10 which may be suitable ferro-electric material is bonded to the base 12 of the concentrator. This base is flat. The concentrator is symmetrical about the axis 13. The purpose of the concentrator is to focus the sonic energy which is emitted by the transducer 10 when it is driven from the signal generator and power source 14, into a cavity 16, that is located at the apex of the concentrator. The cavity is defined by the walls 18 such that it forms a resonating cavity in response to the impinging ultrasonic rays represented by the arrows 20.

A number of considerations enter into the determination of the shape to be given to the walls 22 of the concentrator. The surface motion of the driving transducer 10 is made such that radial and axial components are

2

present at each point of the interface surface. The concentrator walls 22 must be located at a distance from the axis of the concentrator such that the total travel distance between a surface point of the driving transducer, to the reflecting wall, and then to the resonant cavity wall is exactly one or more full wavelengths. The walls 22 are divided into Fresnel segments; that is, the successive segments 22A, 22B, 22C, 22D of the surfaces are directed so that the angles of incidence and reflection to and from those surfaces of the ultrasonic respective rays 24, 20 must be equal to one another.

The total length of the concentrator and transducer is made of a whole multiple of the wavelength which is applied to drive the transducer from the source 14. The distance from the bottom of the cavity to the surface of the transducer is made such that an antinode is generated at said surface. An antinode is a point at which vibration is in phase and maximum.

The dimensions given in the drawing are those of a concentrator which was built in accordance with the teachings of this invention and was successfully operated. The dimensions are to be construed as illustrative, and not as limiting.

There has accordingly been described and shown herein a novel, useful and efficient arrangement for concentrating the mechanical vibrations derived from an electromechanical transducer.

What is claimed is:

1. A body for concentrating the output of an electromechanical transducer comprising a symmetrical metal body having walls defining a resonant cavity at one end of its axis of symmetry and a flat surface at the other end of the axis of symmetry to which surface the working face of said electrochemical transducer is bonded, said body and cavity having side walls which are spaced from the axis of symmetry a distance to provide a total travel distance for ultrasonic energy directed from said transducer to the side walls of the body and then reflected to the wall of said resonant cavity, equal to a multiple of a whole wavelength, and said side walls of the body being divided into a plurality of Fresnel segments.

2. An ultrasonic concentrator comprising an electromechanical transducer, a concentrator body which is symmetrical about an axis therethrough, said body having a flat surface at one end of said axis, to which surface the working face of the transducer is bonded, walls forming a resonant cavity at the other end of said axis, and side walls therebetween, the said side walls of said concentrator being divided into successive angulated segments having angles such that the angle of incidence of ultrasonic energy impinging thereon from said driving transducer is equal to the angle of reflection, the total length of said concentrator and transducer being made a multiple of half the wavelength of vibration of said transducer, and the distance between the bottom of said resonant cavity and the surface of said transducer along said axis of symmetry being such that an antinode is present at the bottom of said cavity.

3. An ultrasonic concentrator comprising an electromechanical transducer, a concentrator body which is symmetrical about an axis therethrough, said body having a flat surface, at one end of said axis, to which surface the working face of the transducer is bonded, walls forming a resonant cavity at the other end of said axis, and side walls therebetween, the side walls of said concentrator being divided into angular segments having angles such that the angle of incidence of ultrasonic energy impinging

3

thereon from said driving transducer is equal to the angle of reflection, the total length of said concentrator and transducer being made a multiple of half the wavelength of vibration of said transducer, the distance between the bottom of said resonant cavity and the surface of said transducer along said axis of symmetry being made such that an antinode is present at the bottom of the cavity, the distance of each angular segment and the cavity walls from said axis of symmetry being made such that the total travel distance of a ray of ultrasonic energy directed from a point on the surface of said transducer to said segment

5

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4

and then reflected to said resonant cavity walls is a multiple of a full wavelength.

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