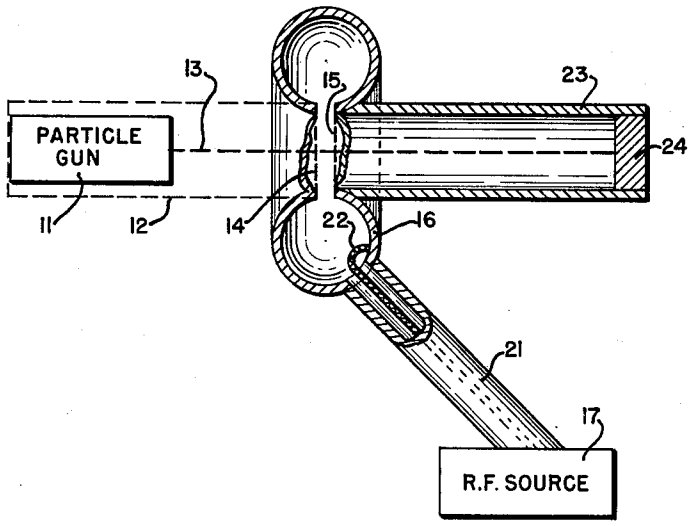
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VELOCITY MODULATED ELECTRONIC SUPERSONIC GENERATOR

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VELOCITY MODULATED ELECTRONIC SUPERSONIC GENERATOR

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9 Claims. (Cl. 340—384)

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This invention relates in general to electro-acoustical systems, and more particularly to a source of supersonic compressional waves of ultra high frequency.

Supersonic signals at ultra high frequencies are of considerable value in the study of the structure of fluids, solids, colloidal suspensions and the like. Such signals are also of assistance in obtaining information concerning electrical problems involving crystal detectors and delay lines, and may be applied to study various biological effects.

The present invention contemplates and has as a primary object the provision of a supersonic signal generator capable of operation at high frequencies.

Another object of this invention is the provision of a supersonic signal generator which utilizes a mechanically resonant element energized by a velocity modulated beam of electrically charged particles.

A further object of this invention is to provide means for utilizing the kinetic energy of a bunched beam of electrically charged particles to establish mechanical vibrations in a resonant element.

These and other objects of the present invention will now become apparent from the following detailed specification when taken in connection with the accompanying drawing which illustrates diagrammatically an embodiment of the present supersonic generator.

With reference to the drawing, there is illustrated apparatus for generating and directing a beam of electrically charged particles. This beam generator, shown as particle gun 11, is suitably supported within a tube structure outlined by broken line 12. The details of the gun and the supporting tube have been omitted as these form no part of the present invention. The particle gun 11 may be of the form used in conventional cathode ray tubes and thereby provide an electron beam, or may be so constructed as to provide a beam of ions. An ion beam is advantageous in the present system in that the particles thereof are of comparatively high mass.

The particle beam 13 leaving the gun 11 is directed through the grids 14 and 15 of a resonant cavity 16. Cavity 16 is electrically energized at its resonant frequency from a source 17 of radio frequency signals by means of a suitable transmission line, as for example, coaxial line 21 and loop coupler 22. As is well known in connection with the theory of operation of the klystron tube, the electrically charged particle beam 13 will be velocity modulated, or varied in density, while traversing cavity 16 in the region between grids 14 and 15. The velocity modulated beam thus generated is directed through a drift tube 23, secured in a suitable manner to cavity 16, wherein the beam particles are separated into bunches. It will thus be apparent that cavity 16 is in effect equivalent to the buncher cavity of a klystron tube.

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Secured to the end of drift tube 23 remote from cavity 16 is a plate 24, mechanically resonant at the electrical frequency applied to the system. As shown in the drawing, the bunched beam is caused to impinge upon plate 24, where a portion of its kinetic energy is imparted, establishing mechanical vibrations in the plate. These mechanical, or supersonic vibrations extend throughout plate 24 and may be transferred to test samples by suitable mechanical coupling.

Plate 24 may be made of a metal, or any other substance in which supersonic waves of the desired frequency may be established. The design of plate 24 such that resonance is established at the operating frequency is determined by acoustical considerations which are not herein presented. As the energy of beam 13 is dissipated, in part, in the form of heat, plate 24 must be suitably cooled.

As previously mentioned an ion beam is preferable to an electron beam since a larger percentage of the kinetic energy of the beam is transferred to the resonant plate, providing stronger mechanical oscillation. The intensity of the mechanical oscillation is of course a function of the beam current.

Since various modifications and extensions of the principles of the present supersonic signal generator may now, in view of the above disclosure, become apparent to those skilled in the art, it is preferred that the spirit and scope of this invention be limited solely by the appended claims.

What is claimed is:

1. A supersonic signal generator comprising within an envelope, means for generating a beam of charged particles, a plate resonant at a predetermined supersonic frequency, means for directing said beam to impinge upon said resonant plate, and means for density modulating said beam at said predetermined supersonic frequency.

2. Apparatus as in claim 1 wherein said last-mentioned means comprises a cavity resonator disposed in the path of said beam between said beam generating means and said resonant plate, and means for electrically energizing said resonator at said predetermined frequency.

3. A supersonic signal generator comprising within an envelope, means for generating a beam of charged particles, a resonant plate, said beam generating means being arranged whereby said beam is directed axially of said envelope toward said resonant plate, beam modulating means disposed in the path of said beam intermediate said generating means and said resonant plate, said modulating means including a cavity resonator electrically resonant at the mechanically resonant frequency of said plate and means for electrically energizing said cavity resonator at said frequency, whereby said particle beam is density modulated at said frequency and impinges upon said plate to establish resonant mechanical vibrations therein.

4. A compressional wave signal generator comprising a cavity resonator having first and second adjacent modulating grids, an envelope extending outwardly of the first of said grids and enclosing means for generating a beam of charged particles, means for directing said beam through the modulating grids of said cavity resonator, a drift tube extending outwardly of the second of said grids and arranged coaxially of said particle beam, a resonant plate sealing the end of said drift tube opposite said second modulating grid, and means for energizing said cavity resonator to establish an oscillating electric field between said modulating grids at the mechanically resonant frequency of said resonant plate.

5. A supersonic signal generator comprising within an envelope, means for generating an electron beam, a plate resonant at a predetermined supersonic frequency, means for directing said beam to impinge upon said resonant plate, and means for density modulating said beam at said predetermined supersonic frequency.

6. Apparatus as in claim 5 wherein said last-mentioned means comprises a cavity resonator disposed in the path of said beam between said beam generating means and said resonant plate,

and means for electrically energizing said resonator at said predetermined frequency.

7. A supersonic signal generator comprising within an envelope, means for generating a beam of ions, a plate resonant at a predetermined supersonic frequency, means for directing said beam to impinge upon said resonant plate, and means for density modulating said beam at said predetermined supersonic frequency.

8. Apparatus as in claim 6 wherein said last-mentioned means comprises a cavity resonator disposed in the path of said beam between said beam generating means and said resonant plate, and means for electrically energizing said resonator at said predetermined frequency.

9. A supersonic signal generator comprising, a cavity resonator having first and second adjacent modulating grids, a plate having a compressional wave resonant frequency substantially equal to the resonant frequency of the cavity resonator, means for securing said plate to said cavity resonator, means for generating a beam of charged particles and directing said beam through the grids of said cavity resonator, and means for electrically energizing said cavity resonator whereby the density of the beam is modulated and resonant mechanical vibrations are established within the plate.

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