

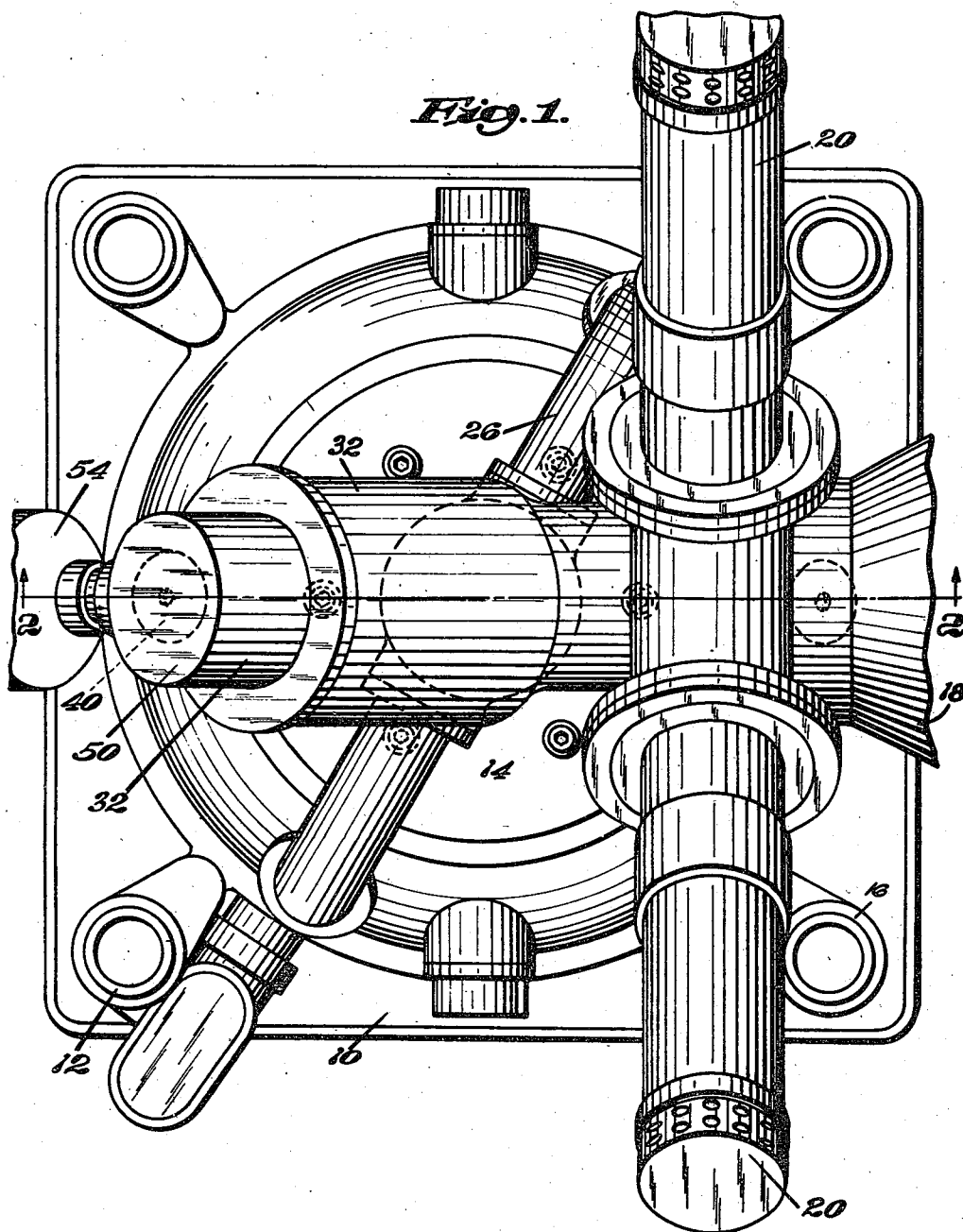
July 22, 1947.

W. A. VAN ALLEN
MODULATOR FOR SOUND WAVES

2,424,375

Filed Feb. 21, 1946

2 Sheets-Sheet 1



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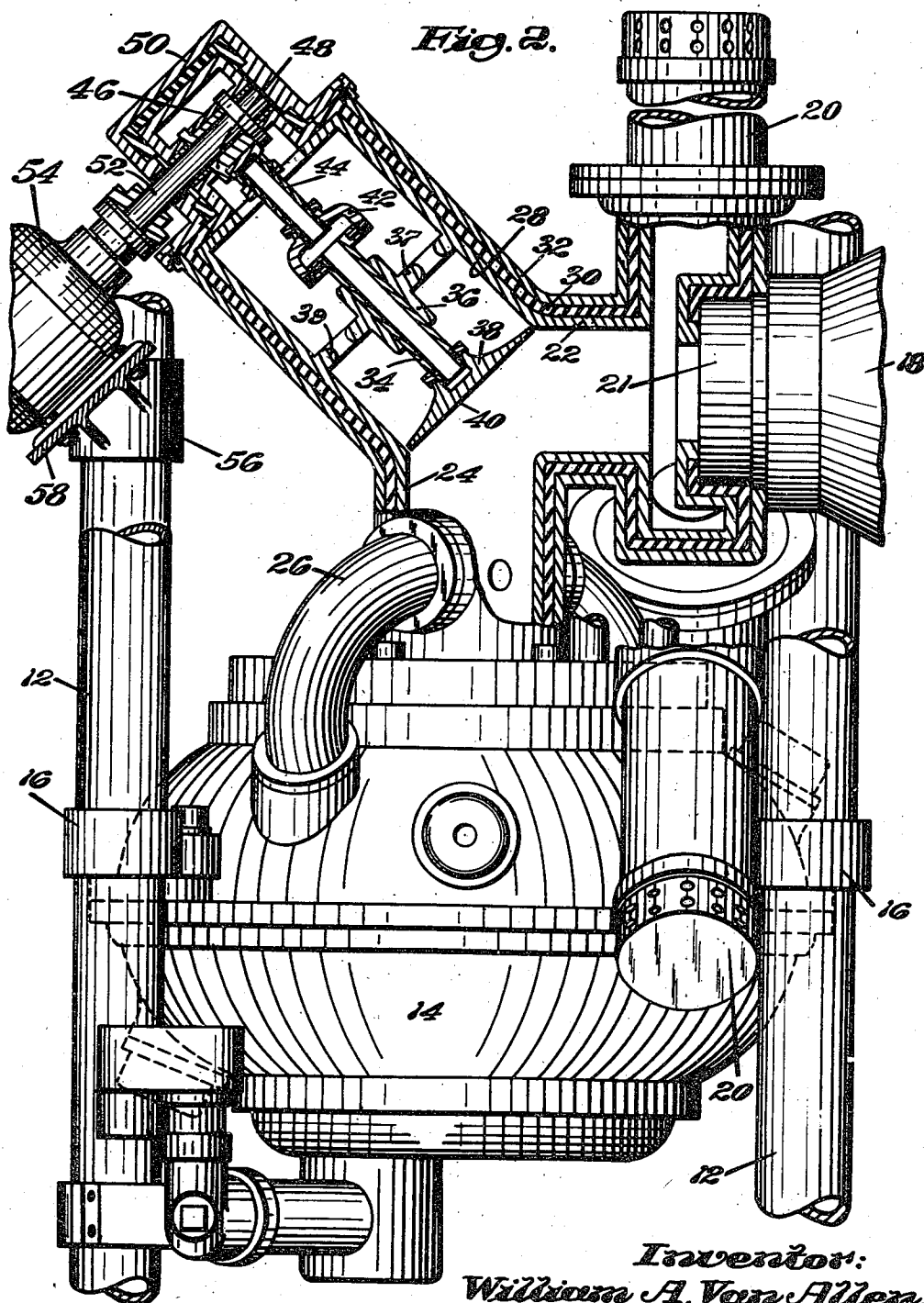
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UNITED STATES PATENT OFFICE

2,424,375

MODULATOR FOR SOUND WAVES

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Application February 21, 1946, Serial No. 649,255

5 Claims. (Cl. 116-137)

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My invention relates to apparatus useful in various processes for treating materials with compression waves. In one aspect my invention consists in an improved frequency modulator by means of which compression waves projected from a generator may be modulated over a wide range of frequencies and directed into a suitable treating chamber.

The general background for the present invention is discussed in considerable detail in the copending applications of Caperton B. Horsley, Ser. No. 624,504, filed October 25, 1945; Ser. No. 645,224, filed February 2, 1946; and Ser. No. 646,178, filed February 7, 1946. Accordingly, reference is made to the said copending applications for a fuller treatment of the general subject than will be found herein. In a sense the present invention consists in certain modifications and improvements upon the apparatus disclosed in those applications.

Before proceeding further I believe it desirable to define the term "compression waves." Briefly speaking, compression waves are any series of alternately positive and negative pressure regions travelling through a medium. The term includes audible waves as well as ultrasonic frequencies, and a device useful for generating and utilizing compression waves may for convenience sake be referred to as "an acoustic device," although such apparatus is by no means limited to use with waves of audible frequency.

The most important object of my invention is to increase the efficiency and facility with which compression waves may be modulated over desired frequency ranges.

An important feature of my invention resides in the combination of a pair of compression wave conducting tubes with a reflecting surface capable of rapid reciprocation and disposed at the junction of the conducting tubes at such an angle that waves projected through one of the tubes will be reflected through the other tube. The effect of reciprocating the reflecting surface is to modulate the frequency of the compression waves in accordance with the principle of the Doppler effect.

These and other objects and features of the invention will be more readily understood and appreciated from the following detailed description of a preferred embodiment thereof selected for purposes of illustration and shown in the accompanying drawing, in which:

Fig. 1 is a plan view of a device embodying the invention, and

Fig. 2 is a view partly in side elevation and

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partly in cross section along the line 2-2 of Fig. 1.

The apparatus shown in the drawings is organized about a heavy rectangular metal base 10 and four vertical standards 12. Located over the base 10 and centrally disposed among the standards 12 is an acoustic treating chamber 14 secured to the standards 12 by four straps 16. The details of the acoustic treating chamber 14 are not shown or described herein but will be found in the copending application of Caperton B. Horsley, Ser. No. 645,224, filed February 2, 1946. A compression wave generator 18 is supported horizontally above and slightly to one side of the acoustic chamber 14. Here again the details of the generator 18 form no part of my invention and are to be found in the copending application of Caperton B. Horsley and Richard E. Young, Ser. No. 624,504, filed October 25, 1945.

A substantially Y-shaped tubular casting of stainless steel or other suitable material has a horizontal cylindrical leg 22 connected to the output end 21 of the generator 18 and to four mufflers 20 disposed radially about the end of the tubular member 22 to permit air or other gas coming from the generator 18 to be exhausted. The Y-shaped member also has a vertically disposed cylindrical leg 24 which is connected to the acoustic chamber 14. Two pressure-equalizing conduits 26 lead from intermediate points in the member 24 to the interior of the chamber 14. The Y-shaped member has a cylindrical main portion 28 the axis of which is disposed at an angle of 135° with respect to the axes of the tubular conduits 22 and 24 and is covered throughout with a layer 30 of sponge rubber, fiber glass, or other suitable sound absorbing material. The rubber layer 30 is in turn confined by an outer metal casing 32, to form a sandwich type of construction which effectively prevents the emission of compression waves into the atmosphere surrounding the apparatus. Within the cylinder 28 there is disposed a shaft 34 working in a bearing 36 formed in a transverse wall or partition 37 provided with a series of through-and-through apertures 39 to equalize the pressure on both sides of the wall 37. At its inner end the shaft 34 is threaded into a disk or piston 38 having on its inner face a circular polished reflecting surface 40. At its outer end the shaft 34 is threaded into a cup-shaped union 42 mounted on the end of a short shaft 44 which in turn is threaded into a socket carried by a crank 46, surrounding an eccentric 48 secured to a shaft 52. The crank, eccentric, and shaft are disposed

in a well or cup 50 secured to the outer end of the cylinder 28 and the casing 32, and the shaft extends through the wall of the cup 50 to a motor 54 secured to two of the standards 12 by means of a pair of straps 56 and an inclined bracket 58.

Compression waves which leave the generator 18 travel through the conduit 22 and strike the reflecting surface 40 at an angle which results in their reflection from the surface 40 down through the conduit 24 and into the acoustic chamber 14. In the construction shown in the drawings the angle between the tubes 22 and 24 is 90°, and the angle of incidence of compression waves on the piston 40 is therefore 45°. It is obvious, however, that the angles may be changed without affecting the functioning of the device, provided the surface 40 is disposed at an angle which will result in the proper angle of reflection to direct the waves through the tube 24.

When the motor 54 is energized, the piston 38 is reciprocated in the cylinder 28 and the frequency of the compression waves will be varied up and down over a selected range. The modulation is the result of Doppler effect; that is to say, the frequency of compression waves will be lowered if they strike the reflecting surface 40 while it is travelling away from the generator 18. Conversely when the surface 40 is moving toward the generator 18, the frequency of the compression waves will be increased. The base frequency about which modulation takes place is of course determined by the frequency imparted to the waves in the generator 18. The extent of the modulation is determined by the maximum speed of the piston 38, and the time required for a complete cycle of modulation will, of course, depend upon the R. P. M. of the shaft 52. All of these factors may be varied in accordance with the requirements of the specific process to be carried out in the acoustic chamber 14.

It is to be remembered that I have described and illustrated herein one preferred embodiment of the invention. There are many modifications of the apparatus shown which will be apparent to those skilled in the art, and the scope of the invention is to be measured by the appended claims rather than by the specific description contained herein.

Having thus disclosed my invention what I

claim as new and desire to secure by Letters Patent of the United States is:

1. Modulator for compression waves, which comprises a pair of tubes disposed with their axes intersecting at an angle, a piston disposed substantially at the intersection of the said axes and so disposed as to intercept compression waves travelling down one tube and reflect them through the other tube, and means for reciprocating said piston to present to oncoming compression waves a surface alternately receding and approaching.

2. Modulator for compression waves, which comprises a first conduit for compression waves, a member providing a reflecting surface disposed adjacent one end of said conduit, a second conduit connected to said first conduit and disposed at an angle thereto to receive waves reflected from said surface, and means for reciprocating said surface so that it alternately recedes from and approaches toward oncoming waves.

3. Acoustic device which comprises means for projecting compression waves, walls forming a chamber, a member presenting reflecting surface disposed to reflect compression waves from said projecting means into said chamber at a predetermined angle, and means for reciprocating said member so that said surface alternately recedes from and approaches oncoming waves.

4. A device of the class described, which comprises a compression wave generator, a first conduit connected to the output of said generator, walls forming a treating chamber, a conduit connected to said chamber and connected at a predetermined angle to said first conduit, a housing secured to both conduits at the intersection thereof, a piston mounted in said housing at an angle to reflect waves from said first conduit through the second conduit, and means for reciprocating said piston in said housing.

5. A device of the class described, which comprises a pair of conduits connected at an angle, a compression wave generator connected to one of said conduits, a piston disposed at the intersection of said conduits at an angle to reflect waves from said generator through the other conduit, and means for reciprocating the piston toward and from the generator.

WILLIAM A. VAN ALLEN.