

Dec. 26, 1950

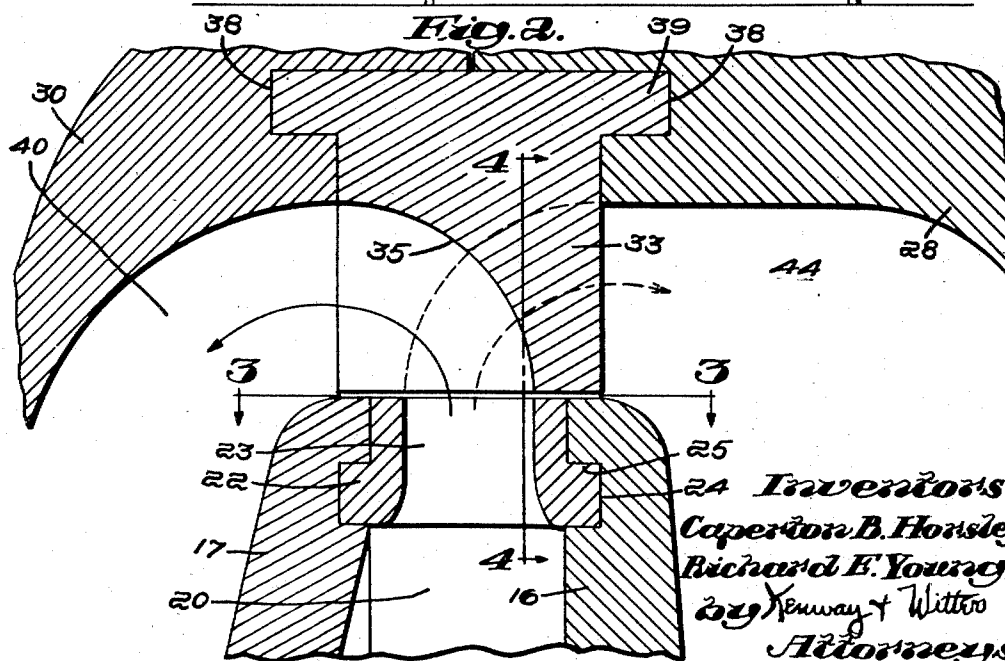
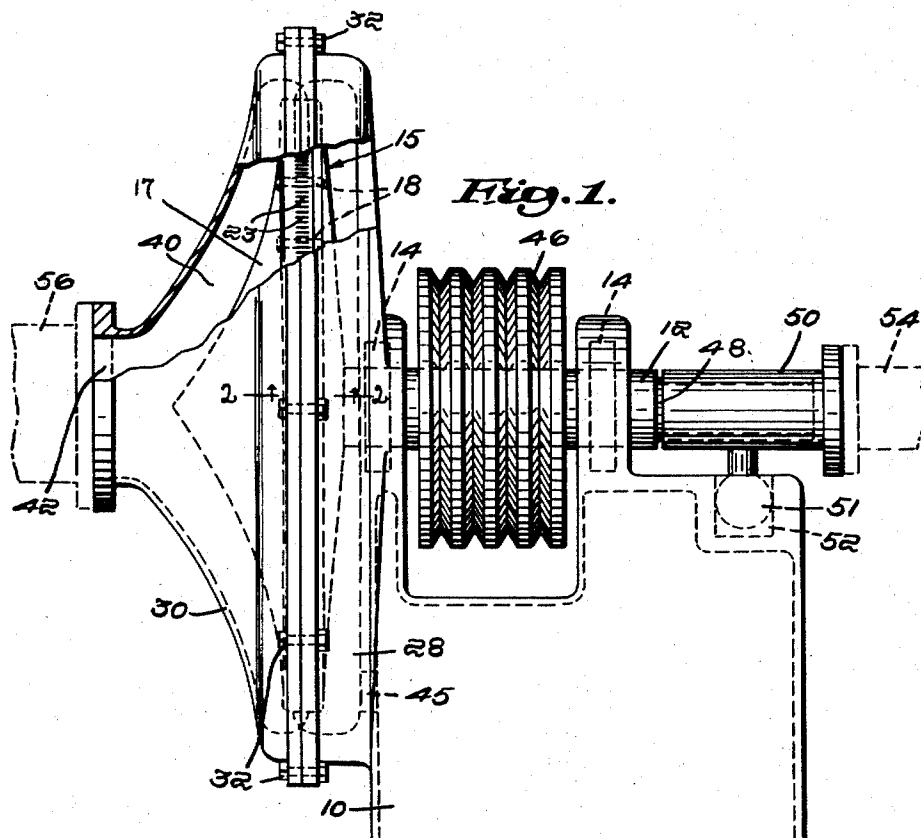
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METHOD AND APPARATUS FOR GENERATING SOUND WAVES

Filed Jan. 15, 1947

2 Sheets-Sheet 1



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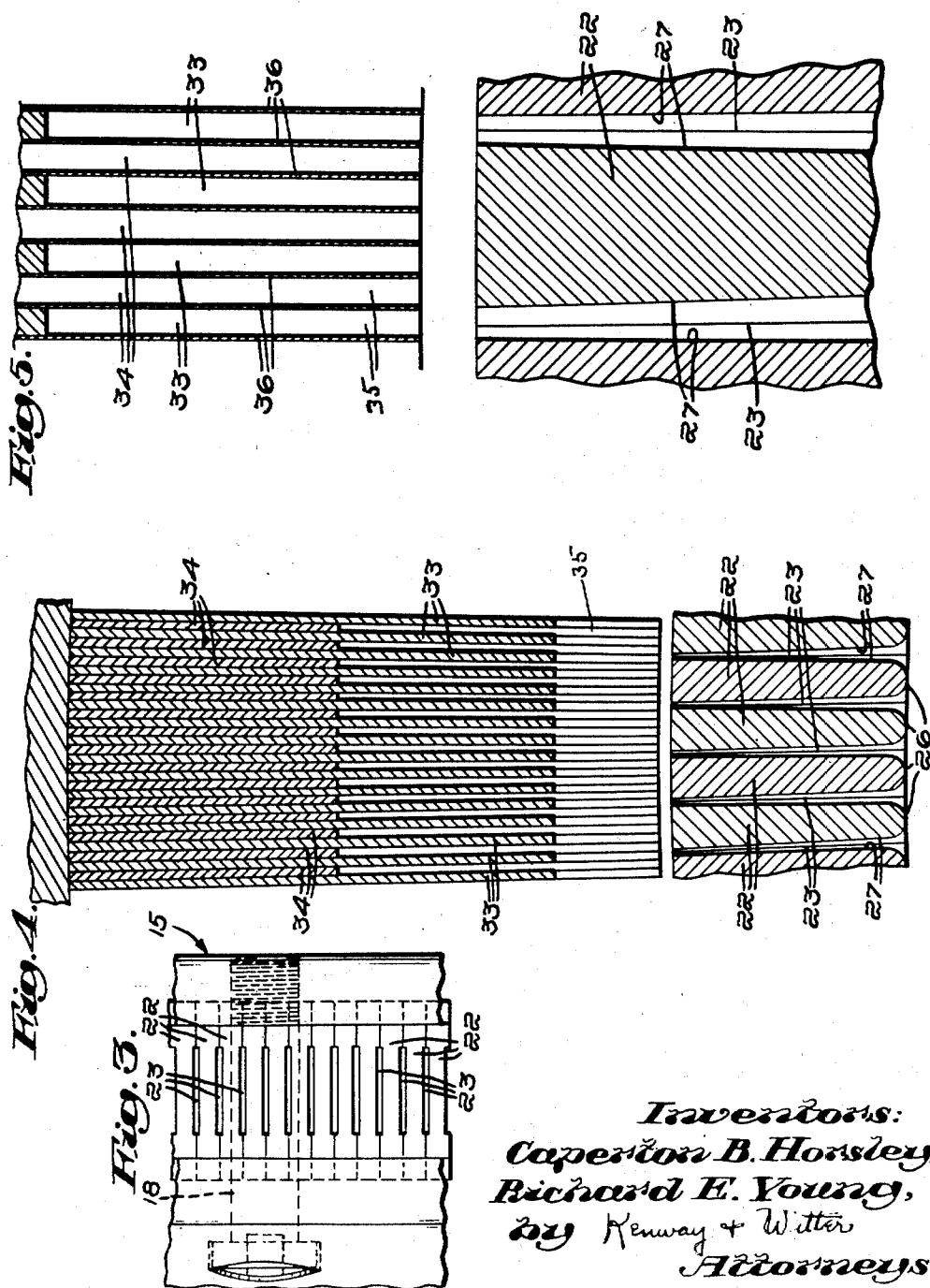
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UNITED STATES PATENT OFFICE

2,535,680

METHOD AND APPARATUS FOR GENERATING SOUND WAVES

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Application January 15, 1947, Serial No. 722,240

7 Claims. (Cl. 116-137)

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This invention relates to a new method of and apparatus for generating sound waves at supersonic frequencies wholly by mechanical action, as distinguished from the electronic type of supersonic generator employing piezoelectric crystals or magnetostriction, and especially contemplates a more effective and direct generation of sound waves at supersonic frequencies over a wide range and at acoustic intensities heretofore impossible. The present invention is a continuation in part of my prior and copending applications Serial Nos. 624,504, filed October 25, 1945 (now abandoned), and 636,038, filed December 19, 1945, now United States Patent No. 2,424,357, dated July 22, 1947.

Sound waves at various frequencies have been employed for many purposes including the homogenizing and emulsifying of liquids, the determining of flaws in castings or other solids, the sterilizing of foods, etc., and much experimental work has been carried out in connection therewith. The results produced however have been limited due to the functional limitations of the apparatus employed. The primary object of our invention resides in the production of a new and improved method and apparatus which will function mechanically and more effectively in the production of sound waves at various frequencies than have methods and apparatus heretofore known.

Our invention more particularly concerns the generating of sound waves for industrial purposes and contemplates a method and apparatus capable of producing with maximum economy and effectiveness a very high output level and volume and requiring a minimum amount of auxiliary equipment, service or maintenance and technical knowledge or skill to operate, all of which are particularly desirable for such purposes.

An important feature of the invention consists in converting or transforming a continuously moving current of air or fluid into intermittent jets or waves without arresting or interrupting the movement of the current. As herein shown this is effected by flowing fluid into a chamber having a plurality of openings, discharging the fluid continuously from the chamber into a member having two separate systems of passages, and valving the fluid first through one of said systems and then through the other with the result that in each system there is set up a series of compression waves, the flow of fluid through and from the member not being interrupted and the waves in one system being out of phase with those in the other.

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The method and apparatus comprising our invention includes the continuous discharging of a stream of fluid outwardly through a chambered member through a series of spaced and relatively adjacent jet openings and the collecting of such fluid in spaced impulses of predetermined frequency from the openings by a ported member located adjacent to and exteriorly of the chamber and while effecting relative movement of the members along a path common to said openings and the ports in the ported member.

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

Fig. 1 is a front elevation of an apparatus embodying our invention,

Fig. 2 is an enlarged fragmentary sectional view taken on line 2-2 of Fig. 1,

Fig. 3 is a fragmentary plan view of the rotary member 16,

Fig. 4 is an enlarged sectional view taken on line 4-4 of Fig. 2,

Fig. 5 is a portion of Fig. 4 on a greatly enlarged scale.

The apparatus illustrated in Figs. 1-4 of the drawings comprises a base 10 on which a tubular horizontal shaft 12 is mounted to rotate in bearings 14. Carried on one end of the shaft is a chambered member 15 embodying a disk 16 secured directly to the shaft and a second disk 17 secured to the disk 16 by bolts 18. The two disks are in spaced relation providing a chamber 20 therebetween and in direct communication through the tubular opening in the shaft.

Carried by and between the two disks 16 and 17 at their periphery are a plurality of blocks 22 in face to face contact at their ends and recessed immediately therebetween to form outwardly directed jet openings 23. The inner faces of the disks are annularly grooved at 24 and the blocks are provided with end flanges 25 fitting within such grooves. The intermediate portions of the blocks are ground to provide inner rounded ends 26 and walls 27 converging radially outward, thereby forming relatively wide inner mouths adjacent to the chamber 20 and outwardly converging jet openings as illustrated in Fig. 4. The blocks are held tightly in place by and between the disks by the bolts 18, and the chamber 20 is closed except for the inlet through the shaft 12 and the outlet passages 23.

Supported by and preferably integral with the base 10 is a housing 28 disposed about the disk

16, and cooperating therewith and disposed about the disk 17 is a housing 30. The two housings are secured together in face to face contact at their periphery by bolts 32. Disposed between and carried by the two housings directly adjacent to and outwardly of the blocks 22 are a plurality of plates 33 and 34 in alternate and juxtaposed relation. The plates 33 and 34 are of identical and symmetrical construction, each being cut away or slotted at one corner portion 35, but the plates 33 are mounted with their slots directed forwardly into the housing 30 and plates 34 are disposed 180° therefrom with their slots directed rearwardly into the housing 28. Each two adjacent plates 33 and 34 are separated by a relatively thin separator plate 36 of a configuration corresponding to the overall shape thereof and separating their slots 35 into independent passages.

The plates 33, 34 and 36 are of T shape configuration (Fig. 2) and the housings 28 and 30 are annularly grooved at 38 to receive the T end portions 39 of the plates, the bolts 32 serving to bind and hold the plates securely in place. As illustrated in Fig. 2, the inner end of the plates are disposed closely adjacent to the periphery of the member 15 with the slots 35 arranged consecutively to align with the jet openings 23 as the member 15 is rotated, the curved wall of each slot 35 being arranged to coincide with one end wall of the jet opening. The housing 30 is of conical configuration and embodies a chamber 40 therein with a single outlet 42 located at the axis of rotation of the member 15. The housing 28 embodies a chamber 44 having one or more outlets 45 therefrom.

The shaft 12 and member 15 can be rotated by any suitable means, as the V belt pulley 46. The outer end 48 of this shaft is of reduced diameter and telescopically mounted thereon and thereover is a sleeve 50. The sleeve is non-rotatably supported on a ball 51 seated in a recess 52 in the base 10 and having a stem attached to the sleeve. Air is conducted to the sleeve through a tubular connection at 54 and air is likewise conducted from the outlet 42 through a tubular connection at 56.

The jet openings 23 and passages 35 are so arranged that the jet openings consecutively align with the passages as the member 15 is rotated. Furthermore, the arrangement illustrated is such that all the jet openings align alternately first with the passages in the plates 33 and then with the passages in the plates 34, thereby directing air alternatively into the chambers 40 and 44. Thus as the member 15 is rotated air delivered into the member will be discharged into the chamber 40 in a sinuous variation and into the chamber 44 in a like variation but 180° out of phase therewith. The number of passages 35 will preferably exceed the number of jet openings and will always be a multiple thereof.

The operation of the generator can best be appreciated by examining Fig. 5 which shows, on a greatly enlarged scale, the relative dispositions of the jets 23 and the slots 35. As heretofore explained, alternate slots are curved in opposite directions. In the position shown in Fig. 5 two jet openings are shown in position to discharge into oppositely disposed slots 35 both of which lead to the same outlet and which form, in effect, one exit system. If the rotor now be considered as moved slightly upward on the sheet of drawings, it will reach the position where each jet opening is discharging into two adjacent slots.

This result is obtained by reason of the fact that the separator plates 36 are much thinner than the width of either of the jets 23 or the slots 35. In other words, the flow of air through the jet openings is continuous, because at no time during the cycle are the jet openings appreciably blocked. It will therefore be seen that the flow of air or other fluid into one set of slots 35 does not stop until the flow through the other set has begun.

It will be noted that the outlet 42 from the chamber 40 is disposed centrally and symmetrically of all the port openings 35 leading thereinto from the plates 33 and, in the apparatus illustrated, it is contemplated to use only the air pressure waves from this chamber. The air discharged into the chamber 44 can be muffled and permitted to escape to the atmosphere through a plurality of openings 45 or it is possible and may be desirable in some cases to capture and utilize these waves from a single outlet 45. It will be apparent that the frequencies in cycles per second of the air waves delivered at the outlet 42 will be the product of the R. P. M. of member 15 and the number of plates 33. For example, when employing 2500 plates 33 and rotating the member 15 at 1200 R. P. M. (20 R. P. S.) the sound wave frequency delivered will be 50,000 C. P. S.

While we have herein illustrated and described a preferred form of apparatus embodying a rotary chambered member constructed to discharge air outwardly to a collecting stator, it will be readily apparent that our invention broadly contemplates the discharging of air from a plurality of jet openings and the collecting of air therefrom through an adjacent ported member while effecting a relative rotation of the two members. The air or other fluid leaving the jet openings flows through two exit systems the inlets to which are alternately presented to the jet openings but in overlapping arrangement so that the flow through one system does not stop before flow through the other system has begun, thus resulting in a smooth continuous flow of air or other fluid through the entire device. Various modifications within the scope of the invention are possible as will be understood.

Having now disclosed our invention what we claim as new and desire to secure by Letters Patent of the United States is:

1. An apparatus for generating sound waves, comprising a member mounted for rotation about a fixed axis, a second member disposed adjacent to and annularly about the first named member and said axis, means carried by one of the members providing spaced air jet openings therefrom disposed annularly about said axis, means providing a plurality of spaced ports in the other member having open ends disposed adjacent to and in position to align with the jet openings consecutive as the member is rotated the spaces between adjacent ports being less than the width of one of said jet openings in the direction of movement of the rotated member, whereby the overall air flow is never completely blocked, and means providing a common exit passage for certain of the ports.

2. An apparatus for generating sound waves, comprising a hollow rotor having spaced peripheral jet openings, a stator surrounding said rotor and formed to provide a series of ports separated by knife edges and arranged to be opened and closed as said rotor turns presenting to each stator port first a jet opening and then a wall separating adjacent jet openings, the arrangement of ports and jets being such that as one

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group of stator ports is opened to communicate with said jet openings, the remainder of the ports is being closed, whereby fluid may be discharged from said rotor through said jet openings as said rotor turns, at a substantially constant rate.

3. An apparatus for generating sound waves, comprising a hollow member mounted for rotation about a fixed axis, means associated with said member to provide a series of jet openings from said member adjacent the periphery thereof, all of said series of jet openings being substantially spaced from said axis and equidistant therefrom, an annular stator disposed about the periphery of said member and provided with a series of ports disposed closely opposite said jet openings, and walls forming a pair of separate and distinct exit passages, each passage serving one half of the series of ports but in alternation and itself being alternately closed and opened in opposite phase to the other passage, the disposition of said jet openings and ports being such that the flow of fluid from the member is deflected alternately through said passages without interruption of the flow through the jet openings.

4. The method of generating sound waves comprising continuously flowing a stream of fluid under pressure into a chamber, and jetting fluid from the chamber alternately in two different directions, and in opposite phase each jetting in one direction beginning before the preceding jetting in the opposite direction has stopped, whereby there is caused to travel in each direction alternate and successive zones of compression and rarefaction.

5. An apparatus for generating sound waves comprising a hollow rotor having spaced peripheral jet openings, a stator surrounding the said rotor and having a series of radial ports, walls forming a pair of separate and independent exit passages for fluid flowing out of the jet openings and through the radial ports, walls disposed adjacent each of said jet openings in position to block alternate ones of said series of stator ports from communication with one of said exit passages and to afford communication with the other exit passage, whereby each of the said exit passages communicates with alternate and different ones of said series of ports of the stator, means for rotating the rotor at a predetermined rate, and means for forcing fluid through the rotor and out through the stator, the said jet openings being spaced around the periphery of the rotor further apart than the width of the radial ports, and the radial ports being spaced closer

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together than the width of the jet openings, whereby alternate radial ports will be intermittently completely closed but fluid will then continue to pass through the jet openings into the other radial ports.

6. An apparatus for generating sound waves comprising a hollow rotor having peripheral jet openings, a stator surrounding the said rotor and having a series of radial ports, walls forming a pair of separate and independent exit passages for fluid flowing out of the jet openings and through the radial ports, walls disposed adjacent each of said jet openings in position to block alternate ones of said series of stator ports from communication with one of said exit passages and to afford communication with the other exit passage, whereby the said exit passages communicate with alternate ports of the stator, means for rotating the rotor at a predetermined rate, and means for forcing fluid through the rotor and out through the stator, the said jet openings and radial ports being constructed and arranged as follows: the rotor jet openings are spaced to coincide with radial stator ports leading to a common exit passage, and the said radial ports being spaced closer together than the width of the jet openings whereby the flow of fluid out of the jet openings will never be completely interrupted, but the jet openings of the rotor being spaced farther apart than the width of the stator ports whereby the passage of fluid through each of said stator port is intermittent.

7. The method of generating sound waves comprising flowing fluid into a chamber having a plurality of openings, discharging the fluid continuously from the chamber into a member having two separate systems of passages, and valving the fluid first through one of said systems and then through the other to set up in each system a series of compression waves without interrupting the flow of fluid through and from said member, the waves in one system being out of phase with those in the other system.

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