Jan. 6, 1948. K. V. OZOLS 2,434,175

STEAM OPERATED HORN

Filed Nov. 10, 1944 4 Sheets-Sheet 1

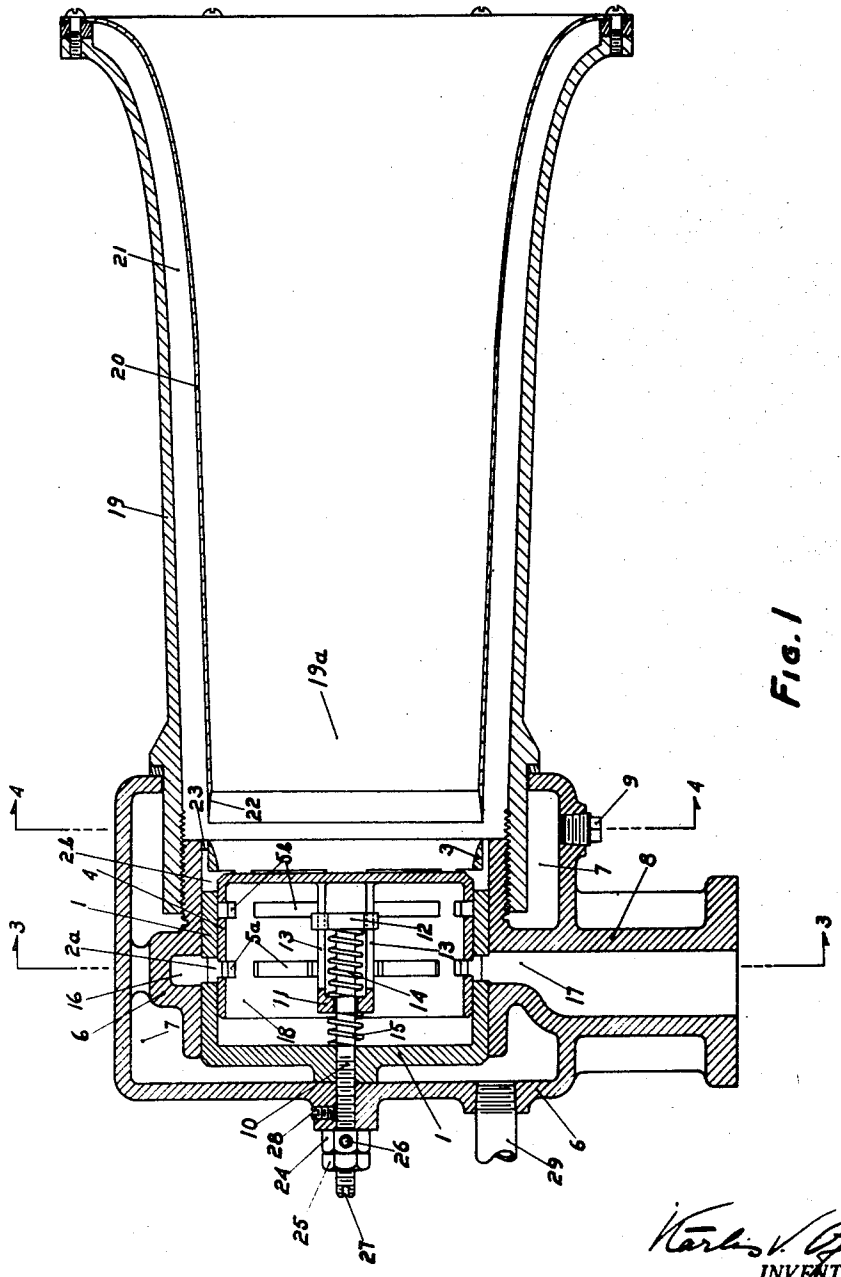



FIG. 1

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STEAM OPERATED HORN

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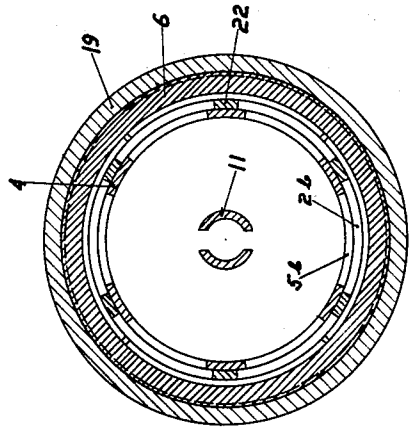



FIG. 5

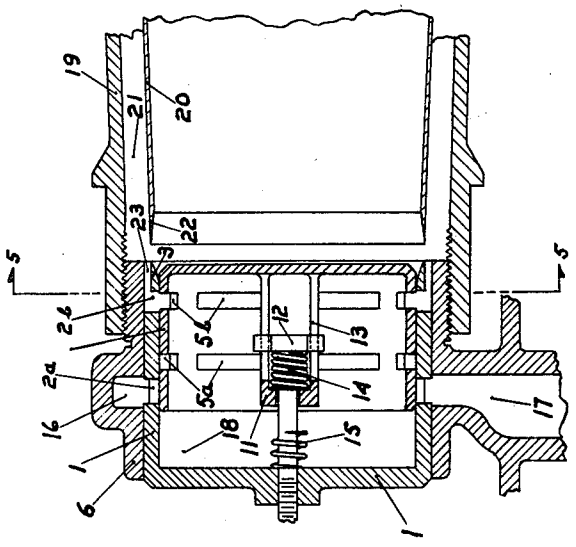



FIG. 2

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STEAM OPERATED HORN

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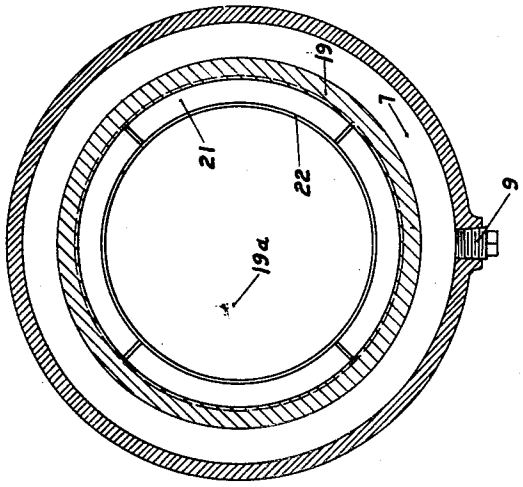



FIG. 4

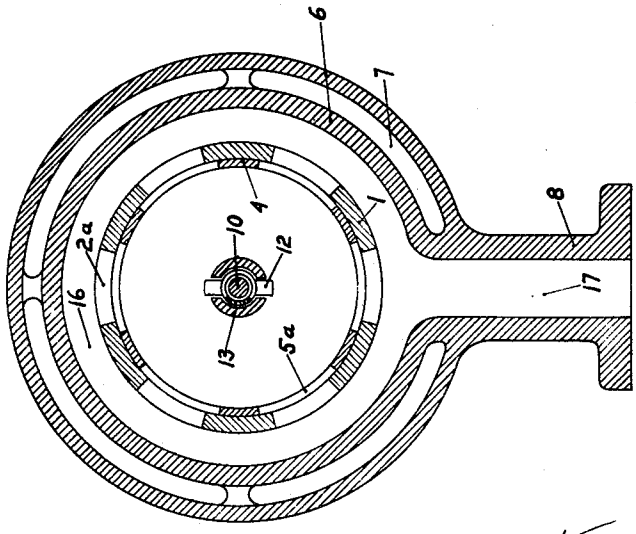



FIG. 3

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STEAM OPERATED HORN

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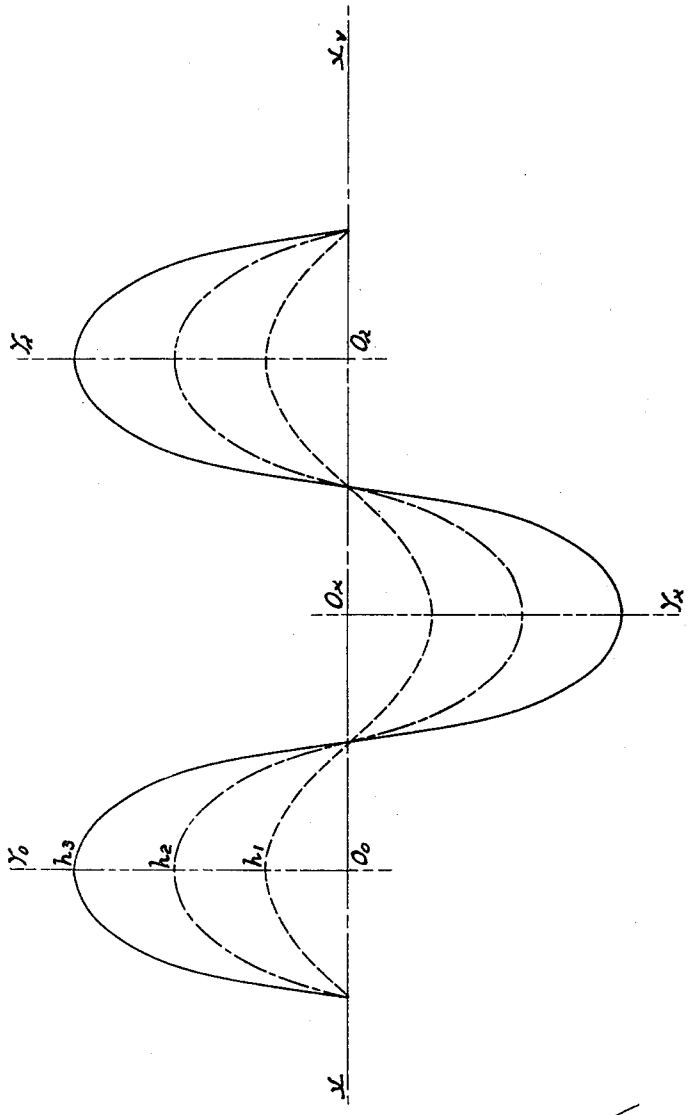



FIG. 6

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Patented Jan. 6, 1948 2,434,175

# UNITED STATES PATENT OFFICE

2,434,175

## STEAM OPERATED HORN

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Application November 10, 1944, Serial No. 562,893

6 Claims. (Cl. 116—147)

1

The invention relates to sound producing devices, for instance horns for fog signaling, for code signaling or position locating and similar purposes.

In devices of this type the sound is frequently produced by rapid successive blasts of a pressure medium; these blasts are created by a circumferentially perforated sleeve or piston oscillated in a likewise perforated cylinder; the oscillating sleeve interrupts the passage of the pressure medium which enters the inner space of the cylinder through the perforations so that a series of consecutive quick impulses of the pressure medium is produced which upon discharge from the cylinder into a resonator create corresponding sound waves.

The main disadvantage of the hitherto known sound producing devices of this type consists therein that their sound intensity is poor, which is mainly due to the fact that they are operated with a single sound producing source; therefore, the amplitude of the created sound waves is restricted and especially the low frequency range is limited.

It is the primary object of the invention to devise a sound producing device which is adapted to produce an unusually strong sound intensity and an unlimited frequency range.

It is another object of the invention to create for a given energy or pressure medium input a maximum sound wave amplitude.

With these and other objects in view which will become apparent as this specification proceeds, the invention is based on the recognition that in order to produce a maximum sound intensity for a given energy input, for instance a given quantity of pressure medium, it is necessary to increase the number of the sound producing elements or sources of a horn and the like, and at the same time to maintain the sound waves produced by these various sound producing elements in phase and in synchronism.

The synchronism of the various sound waves produced by the individual sound producing elements or sources is essential, as thereby the frequencies of all the sound waves which are held in phase and in identity are summarized to produce a corresponding sound augmentation.

The sound producing sources or elements utilized to carry out the invention are the following:

1. The periodic displacement of an air volume resulting from the movement of an oscillating piston, whereby periodic air pressure variations are created in the horn;

2

2. The periodic blasts of an operating pressure medium emitted through the slots of the piston oscillatingly displaced within a slotted cylinder;

3. The combination of a lip and of a resonance chamber into which the pressure medium blasts are emitted; these blasts strike the edge or lip provided at the inside end of the resonator or resonance chamber, thus setting up vibrations which are synchronized with the natural frequency of the chamber. The length of this chamber and thereby of the column of the operating medium determines the frequency of the sound waves by forcing the blasts to vibrate synchronously with this column. The frequency of the periodic blasts of the operating medium produced by the vibrating piston is in this manner maintained in phase with the natural frequency of the resonating chamber, whereby the sound volume is reinforced accordingly.

Some of the above sound producing elements are, as previously stated, known as such. The invention is based on the adjusted combined effect of all the sound producing elements herein described.

The sound amplitude is further increased by the air volume displacements resulting from the oscillation of the piston creating periodic air pressure variations in the resonance chamber and by the blasts of the pressure medium which in turn is additionally amplified by the passage through the horn.

The sound producing device forming the subject matter of my invention is illustrated by way of example in the attached drawings of which

Fig. 1 is a sectional elevation of the same in its initial operating position,

Fig. 2 is a sectional elevation in a second operating position,

Fig. 3 is a sectional elevation on line 3—3 of Fig. 1,

Fig. 4 is a sectional elevation on line 4—4 of Fig. 1,

Fig. 5 is a sectional elevation on line 5—5 of Fig. 2,

Fig. 6 is a graphical illustration of the summation of the various synchronized wave amplitudes utilized in the performance of the invention.

Referring particularly to the figures, 1 is a cylinder or jacket which is closed at its one end; the cylinder is provided with circumferential slots 2a, 2b; the end portion 3 of cylinder 1 has a reduced wall thickness to effect a turbulence-free passage of the operating medium. A piston 4 which is closed at the one end opposite to the

closed end of cylinder 1 is mounted therein for reciprocative displacement; piston 4 is provided with circumferential slots 5a, 5b.

Cylinder 1 is located in an outer casing 6 which accommodates a steam jacket 7 surrounding the cylinder; the casing is provided with a supply tube 8; the heating jacket has a drain plug 9 for condensed water.

A shaft 10 is mounted in cylinder 1 and casing 6; the shaft protrudes into cage 11 carried by piston 4; cage 11 is provided with longitudinal slots 13; it accommodates a spring 14 which abuts against head 12 fastened to shaft 10 and the inner wall of cage 11; a second spring 15 is located on rod or shaft 10 between cylinder 1 and cage 11. A circumferential channel 16 surrounds cylinder 1; a supply tube 17 for the pressure medium is attached to casing 6; the pressure medium entering through tube 17 passes through circumferential channel 16 and slots 2a, 5a into inner chamber 18 formed by cylinder 1 and piston 4.

An outer horn 19 which preferably has a parabolic form is attached to casing 6; an insert or inner horn 20 having the same form as outer horn 19 is concentrically located in the latter; a resonating chamber 21 is created by the two horns; this chamber is shown as being closed, but it may be left open.

The inside end of the inner horn 20 is shaped to form a vibrator lip 22.

The operation of the device is as follows:

A suitable operating medium, for instance steam or compressed air, is supplied through channel 17 into a circumferential channel 16, and from there through slots 2a and 5a into chamber 18, Fig. 1.

By the pressure thus created in the closed chamber the piston 4 is forced in its outer operating position, shown in Fig. 2; spring 14 is compressed thereby.

As soon as this position is reached and a connection is produced through slots 5b and 2b between chamber 18 and the atmosphere, the pressure is reduced and the compression spring 14 forces piston 4 back in its former position; hereupon the operating medium is again supplied to chamber 18 and forces the sleeve in its outer position.

In this manner a rapid oscillation of the piston is maintained during the supply of the pressure medium and a longitudinal sound wave is created in the resonating chamber and in the throat 19a of horn 19.

The jets of the operating medium which escape through slots 5b, 2b pass through circumferential passage 23 located between reduced end 3 of cylinder 1 and casing 6. The jets hit upon the edge of lip 22 and are set into rapid vibrations in the manner which is known from the blowing of a whistle.

The operating medium at the same time passes into the circumferential resonator chamber 21 where it creates stationary sound waves.

For the same reason of maintaining the various sound creating elements in phase the natural frequency of the compression spring 14 should coincide with the operating frequency of the horn; this is, for instance, achieved by adjusting nut 24 and lock nut 25 which is held by set screw 26 to avoid its loosening by the vibrations of piston 4; spring 15 prevents undesired excessive displacement of piston 4.

By regulating the pressure supply of the operating medium in accordance with the length of the horn, the oscillation frequency produced by the oscillating piston is synchronized with the stationary waves produced in chamber 21.

In order to regulate the flow rate of the operating medium into chamber 18 the size of the slot openings may be varied by axial displacement of the piston 4. This displacement may be effected by insertion of a suitable tool in slot 27 of shaft 10. The shaft is then secured by set screw 28 and prevented from further axial rotation.

The steam jacket 7 into which steam is supplied through pipe 29 prevents freezing of the working parts of the horn.

Fig. 6 illustrates the summation of the various above described individual wave amplitudes in accordance with the invention.

Horizontal line, or ordinate of time, X—Xv indicates the center line of the sound wave amplitude summarizing system.

Vertical lines or abscissae of pressure, Oo—Yo, Ox—Yx and Oλ—Yλ are the center lines of the summarized wave amplitudes. $h_1$—Oo denominates the wave amplitude produced by the oscillating displacement of piston 4; $h_2$—Oo results from the summation of amplitude $h_1$ and of the amplitude created by the periodic blasts of the operating pressure medium expelled through the slots of piston 4; $h_3$—Oo signifies the total sum of the three sound amplitudes produced in the horn and is obtained by adding sound amplitude $h_2$—Oo to the amplitude produced by the sympathetic vibrations of the jet of the operating medium striking against lip 22.

It is to be understood that the construction of the horn, as described above and illustrated in the drawings, may be varied without departing from the invention.

I claim:

1. A sound producing device comprising a cylinder closed at its one end, a hollow piston in said cylinder, said piston being closed at the end opposite of the closed end of said cylinder, an inner chamber formed by said cylinder and said piston, a group of slots in the contacting walls of said cylinder and said piston, means to admit a pressure medium through said slots into said chamber and to displace said piston from its one end position into a second end position, a second group of slots in said contacting walls so arranged as to connect said chamber in the second end position of the piston with the atmosphere and to simultaneously interrupt the admission of the pressure medium through said first group of slots, a compression spring to return said piston into its first operating position and to reestablish the connection with said pressure medium to thereby produce a periodic reciprocation of said piston in said cylinder, periodic air pressure variations creating sound waves and periodic pressure blasts producing sound waves, a resonating chamber adjacent to said cylinder and a lip integral with said resonating chamber, means to pass the periodic blasts of said pressure medium onto said lip and into said resonating chamber to produce thereby vibrations of the pressure medium creating sound waves and to summarize said various sound waves.

2. In a sound producing device according to claim 1 means for varying the natural frequency of the compression spring in accordance with the length of the resonating chamber.

3. A sound producing device comprising a cylinder closed at its one end, a horn attached to said cylinder, a closed resonating chamber circumferentially surrounding said horn, a hollow

piston in said cylinder, said piston being closed at the end opposite of the closed end of said cylinder, a closed chamber formed by said cylinder and said piston, means to reciprocate said piston in said cylinder and to produce by the vibrating action of the closed end of the piston periodic pressure variations in said horn creating sound waves, means to emit by the reciprocation of said piston, periodic blasts of a pressure medium from said closed chamber into said closed resonating chamber and to thereby create stationary rebounding sound waves and means to conduct said rebounding sound waves into the path of the closed end of said reciprocating piston to produce in said horn a corresponding sound augmentation.

4. In a sound producing device according to claim 3, means for synchronizing the frequencies of the various produced sound waves, said means including a device to adjust the number of successive reciprocations of the piston.

5. A sound producing device comprising a cylinder closed at its one end, a horn attached to said cylinder, a closed resonating chamber circumferentially surrounding said horn, a hollow piston in said cylinder, said piston being closed at the end opposite of the closed end of said piston, a closed chamber formed by said cylinder and said piston, means to reciprocate said piston in said cylinder and to produce by the vibrations in said horn thereby creating sound waves, means to connect said chamber alternatively with a high and a low pressure medium to create periodic pressure blasts producing sound waves, means to emit said periodic blasts from said chamber, means to convert said periodic pressure medium blasts into vibrations producing around waves and means to synchronize and to summarize the frequencies of the various sound



waves in said sound producing device and to thereby augment the sound intensity.

6. A sound producing device comprising a cylinder closed at its one end, a horn attached to said cylinder, a closed resonating chamber circumferentially surrounding said horn, a hollow piston in said cylinder, said piston being closed at the end opposite of the closed end of said cylinder, a closed chamber formed by said cylinder and said piston, a fluid pressure medium and a spring to reciprocate said piston in said cylinder and to produce by the vibrating action of the closed end of the piston periodic pressure variations in said horn thereby creating sound waves, means to emit by the reciprocation of said piston from said closed chamber periodic blasts of a pressure medium into said closed resonating chamber and to thereby create stationary rebounding sound waves and means to conduct said rebounding sound waves into the path of the closed end of said reciprocating piston to produce in said horn a corresponding sound augmentation.

KARLIS V. OZOLS.

## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS


| Number | Name | Date |
|---|---|---|
| 606,668 | Hunter | July 5, 1898 |
| 1,844,226 | Northey | Feb. 9, 1932 |
| 1,624,873 | Landis | Apr. 12, 1927 |
| 1,289,065 | Wolff | Dec. 24, 1918 |
| 1,522,095 | Booty | Jan. 6, 1925 |
| 1,486,650 | Foley | Mar. 11, 1924 |
| 2,019,596 | Broden | Nov. 5, 1935 |
| 1,653,119 | Perrin et al. | Dec. 20, 1927 |