United States Patent [19]

Ueda

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[54] **ELECTRIC HORN**

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[52] **U.S. Cl.** **340/388**; 340/393; 181/.5

[51] **Int. Cl.** **G10k 9/00**; G08b 3/00

[58] **Field of Search** ..... 340/388, 392, 393, 401, 340/402, 404; 166/137 R, 137 A, 142 R; 181/.5 AG

[56] **References Cited**

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Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

An electric horn is provided which comprises a vortical acoustic transformer having a sound inlet port, an electromagnetic vibrating mechanism disposed at a central portion of the transformer and having an armature, a diaphragm mounted, along with the armature, on the transformer so as to enclose the sound inlet port, and a vibrator fixed to the diaphragm at a position opposite to the transformer.

3 Claims, 6 Drawing Figures

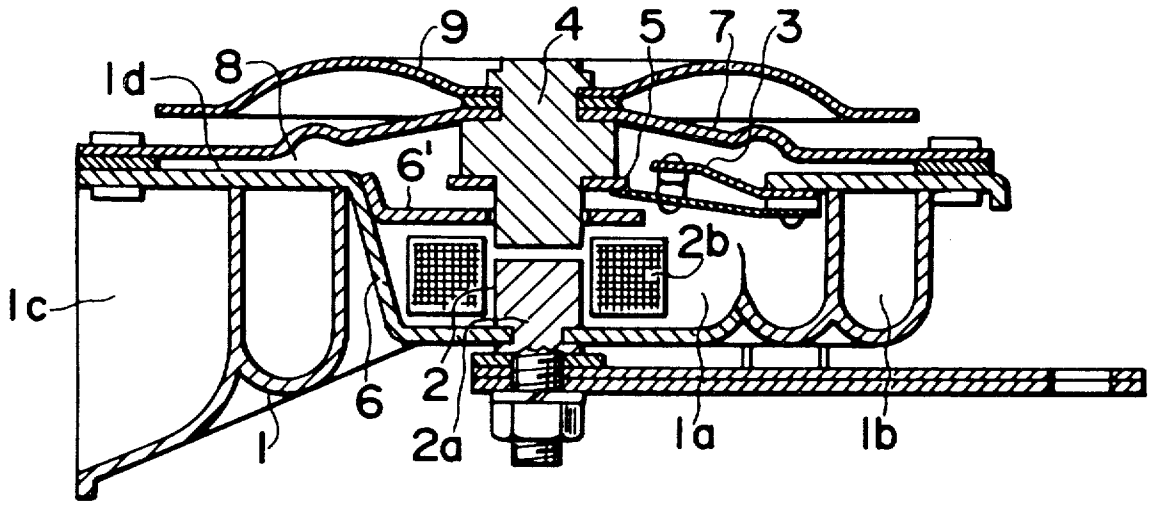


FIG. 1
PRIOR ART

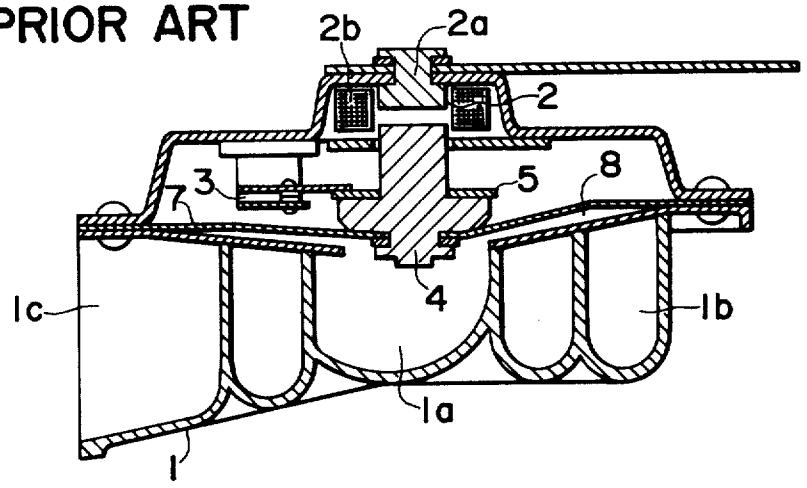


FIG. 2
PRIOR ART

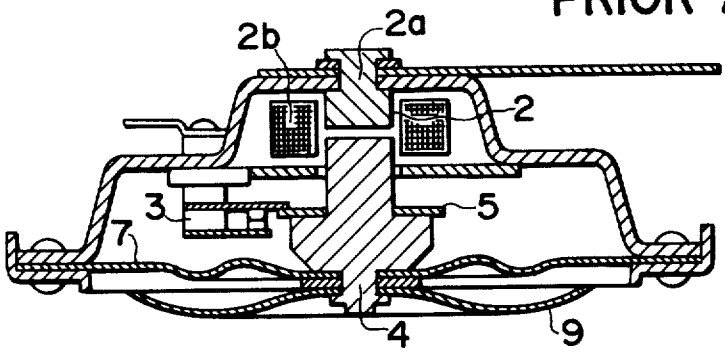


FIG. 3

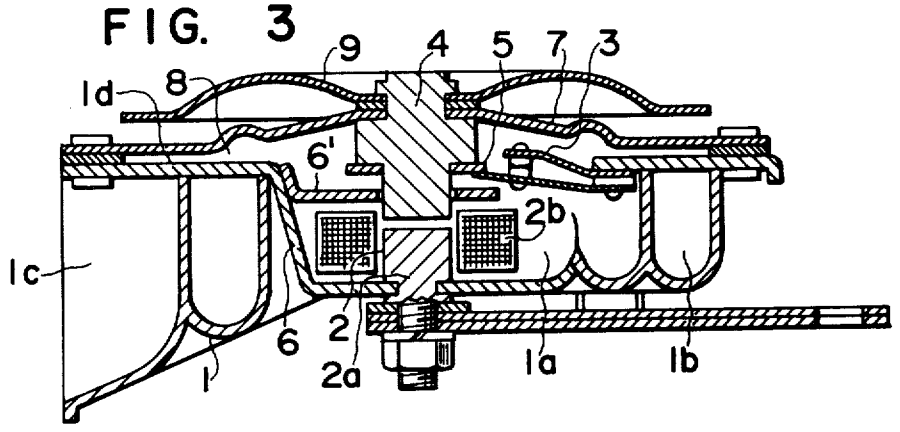


FIG. 4
PRIOR ART

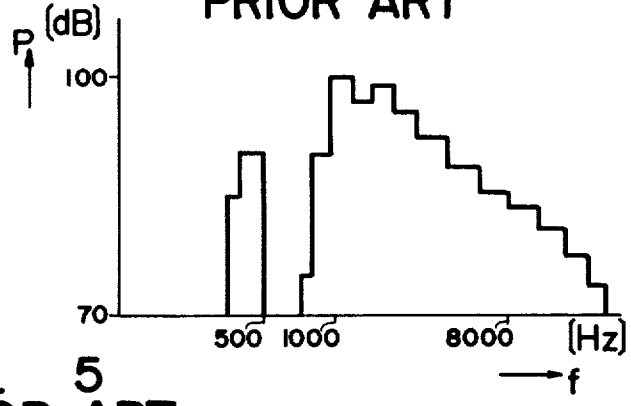


FIG. 5
PRIOR ART

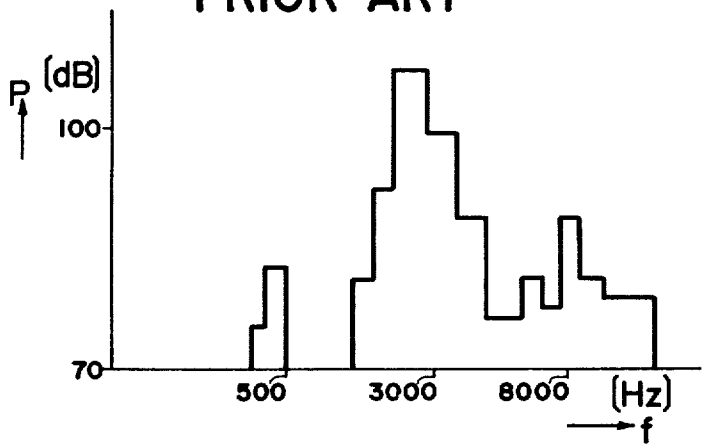
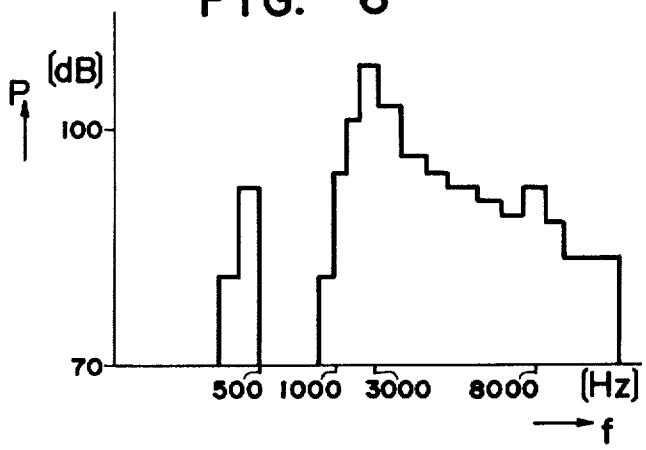


FIG. 6



ELECTRIC HORN

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to improvements in the tone quality and acoustic efficiency of an electric horn used primarily on a motor vehicle.

2. Description of the Prior Art

Electric horns heretofore used extensively include the vortex type horn shown in FIG. 1 of the accompanying drawings and the flat type horn shown in FIG. 2. However, these two types are contrary in their characteristics. In other words, with respect to the tone, the former, i.e., the vortex type horn has characteristics such that, as will be seen from FIG. 4 showing a spectrum diagram of the sound pressure p (dB) plotted against the frequency f (Hz), the level of the fundamental frequency corresponding to the number of vibrations of a diaphragm 7 is prominent, the maximum harmonic level appears between 1000 and 2000 Hz and is gradually decreases as the frequency increases, thus providing a tone which is soft and mellow on the whole. On the other hand, the latter, i.e., the flat type horn has characteristics such that, as will be seen from the spectrum diagram shown in FIG. 5, the level of the fundamental frequency is relatively low, the sound pressure main component having a very high level appears in the vicinity of 2000 to 3000 Hz and it rapidly decreases as the frequency increases with a higher harmonic level reappearing in the vicinity of 8000 Hz, thus providing a tone which is materially monotonous and highly jarring on the whole. Further, the former vortex type horn has a drawback in that since the sound produced by the vibrations of the diaphram 7 is indirectly emitted through a vortical acoustic transformer 1 (hereinafter referred to as a trumpet), the propagation directivity of the sound is poor. In contrast, while the latter flat type horn has a remarkable directivity and high acoustic efficiency owing to the fact that the sound produced by the vibrations of a resonant vibrator 9 (hereinafter simply referred to as a vibrator) is directly emitted to the atmosphere in the form of a plane wave, it has a drawback in that since the sound produced by this horn is highly jarring as previously mentioned, it causes a feeling of unpleasantness on the part of the people.

SUMMARY OF THE INVENTION

It is the object of the present invention to provide an electric horn which overcomes the foregoing difficulty and which comprises an electromagnetic vibrating mechanism disposed at the central portion of a vortical trumpet, a diaphragm mounted to the armature of the vibrating mechanism to enclose the sound inlet port of the trumpet, and a vibrator mounted to the armature on the outside of the diaphragm in direct contact with the atmosphere, whereby the desired characteristic of the vortex type horn and the flat type horn are combined to produce an entirely new tone and maintain the emission efficiency of the sound to the atmosphere at a high level.

According to the present invention, an electromagnetic vibrating mechanism is disposed at the central portion of a vortical acoustic transformer with a diaphragm mounted to the armature of the vibrating mechanism to enclose the sound inlet port of the acoustic transformer, and a vibrator is mounted to the armature on the outside of the diaphragm in direct contact with the atmosphere, whereby the independent vibrating motions of the diaphragm and the vibrator are caused to act in the same dimension, that is, the same effect as would be obtained by the simultaneous operation of the vortex type horn and the flat type horn is ensured by the single horn. Thus, there is a great advantage in that the present invention provides a highly efficient novel horn which is of simple structure and inexpensive to manufacture and in which inferior performance of the vortex type horn in respect of the acoustic efficiency and emission directivity is compensated by the acoustic characteristic of the vibrator and moreover the highly jarring tone of the flat type horn is mitigated by the acoustic characteristic of the acoustic transformer to thereby produce an entirely new tone.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal side sectional view of a conventional vortical electric horn;

FIG. 2 is a longitudinal side sectional view of a conventional flat electric horn;

FIG. 3 is a longitudinal side sectional view showing an embodiment of an electric horn according to the present invention;

FIG. 4 is a frequency spectrum diagram showing the tone components of the vertical electric horn shown in FIG. 1;

FIG. 5 is a frequency spectrum diagram showing the tone components of the flat electric horn shown in FIG. 2; and

FIG. 6 is a frequency spectrum diagram showing the tone components of the electric horn according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein the same reference numerals refer to the same or equivalent component parts, the preferred embodiment of the invention will be explained. In FIG. 3, numeral 1 designates a vortical trumpet with numeral 1*a* designating its sound inlet port, 1*b* its sound path, 1*c* its mouth and 1*d* its shell flat portion. Numeral 2 designates an electromagnet disposed at the central portion of the trumpet 1, 2*a* its iron core, 2*b* an energizing winding wound on the core 2*a*. Numeral 3 designates an interrupter for interrupting the supply of current to the energizing winding 2*b*, 4 an armature disposed at a position opposite to the core 2*a*, 5 an interrupter actuator for controlling opening and closing of the interrupter 3 in accordance with the reciprocating movement of the armature 4. Numerals 6 and 6′ designate magnetic path members for providing a magnetic path between the electromagnet 2 and the armature 4. The electromagnet 2, the interrupter 3, the armature 4 and so on constitute an electromagnetic vibrating mechanism. Numeral 7 designates a diaphragm securely mounted at the central portion thereof on the armature 4 and clamped at the peripheral edges thereof on the peripheral portions of the shell flat portion 1*d* to enclose the sound inlet port 1*a* of the trumpet 1 and define a narrow air chamber 8 between the diaphragm 7 and the shell flat portion 1*d*. Numeral 9 designates a vibrator securely mounted to the armature 4 on the outside of the diaphragm 7 in direct contact with the atmosphere.

With the construction described above, the electric horn according to the present invention operates as follows: When a current is supplied to the energizing winding 2*b*, the diaphragm 7 vibrates rapidly by virtue of the provision of the interrupter 3 and thus the air within the air chamber 8 is rapidly compressed and expanded in response to the vibrations of the diaphragm 7, thereby producing an impulsive sound. Consequently, this sound is emitted into the sound inlet port 1*a* of the trumpet 1, so that sound is propagated through the sound path 1*b* to the mouth 1*c* from which the sound is emitted to the atmosphere.

On the other hand, since the vibrator 9 is securely mounted to the diaphragm 7 on the side thereof where it comes into direct contact with the atmosphere, a so-called resonant state is caused by the natural vibrations of the vibrator 9 which are so related as to produce harmonics and consequently the amplified sound output is emitted directly to the atmosphere.

As a result, the tone emitted from the mouth 1*c* of the trumpet 1 and having a low acoustic efficiency and inferior emission directivity is compensated by the acoustic characteristic of the vibrator 9, while the highly jarring sound produced by the vibrator 9 is softened by the sound produced by the trumpet 1.

Further, since the vortical trumpet 1 serves concurrently as an acoustic transformer and as a resonant tube for the air column vibrations, its resonant frequency is approximately in the order of 1000 Hz and it does not change much depending on the length and dimension of the trumpet 1. However, there are a number of factors, such as the shape, dimension, weight, material and so on which affect the resonant frequency, the resonant frequency of the vibrator 9 may be selected as desired to some extent. Furthermore, since the trumpet 1 and the vibrator 9 are quite independent of each other, when considered primarily on the basis of the emitting sound pressure, it is sufficient if the natural frequency of the vibrator 9 is set to a so-called resonant frequency which corresponds to the resonance frequency of the trumpet 1. In addition, there is a great convenience in that by intentionally deviating the frequency of the vibrator, it is possible to produce a unique tone. The spectrum diagram of FIG. 6 showing the relationship between the frequency f (Hz) and the sound pressure p (dB) represents the case of the horn according to the embodiment described hereinbefore and it is approximately the same with the spectrum diagrams of FIGS. 4 and 5 combined together.

I claim:

1. An electric horn comprising a vortical acoustic transformer having a sound inlet port, an electromagnet fixedly secured on said transformer at the center thereof, means for energizing said electromagnet, interrupting means for interrupting the energizing current to said electromagnet, a movable armature disposed proximate said electromagnet, said armature being attracted to said electromagnet when energized by said energizing current, a diaphragm having a portion thereof fixedly secured to said transformer and having another portion thereof fixedly secured to said armature, said diaphragm being moved in accordance with the movement of said armature, said diaphragm enclosing the sound inlet port of said transformer, and a vibrator fixedly secured to said diaphragm and said armature on the side of said diaphragm opposite said transformer.

2. The electric horn of claim 1 wherein said interrupter means includes at least one movable contact, said contact being separated from another stationary contact by the movement of said armature toward said electromagnet, said contacts being closed when said armature moves away from said electromagnet.

3. An electric horn comprising

a vortical acoustic transformer having a sound inlet port proximate a central portion thereof,

an electromagnet fixedly secured to the central portion of said transformer within said sound inlet port,

a diaphragm fixedly secured to said transformer and extending over said sound inlet port,

an armature fixedly secured to a central portion of said diaphragm and being positioned in proximity to and in reciprocating relationship with said electromagnet, said diaphragm and said armature enclosing said inlet port,

means for energizing said electromagnet,

an interrupter means for intermittently interrupting the energization of said electromagnet, and

a vibrator fixedly secured to said diaphragm on the side of said diaphragm opposite to said transformer.

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