

April 13, 1926.

1,580,112

E. P. BONE

SOUND PRODUCER

Filed May 17, 1922

2 Sheets-Sheet 1

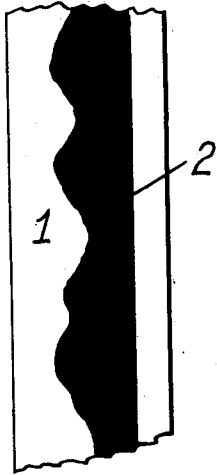


Fig. 1.

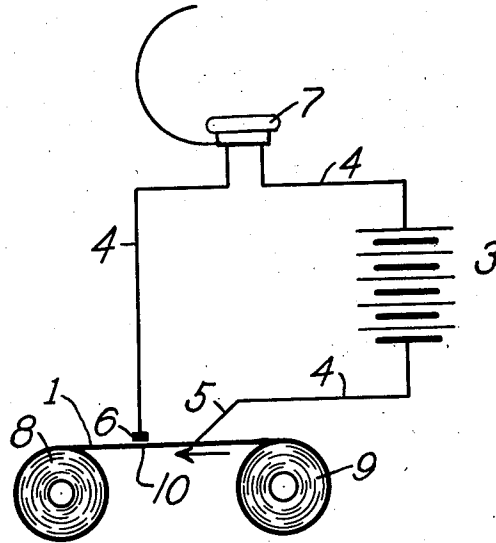


Fig. 2.

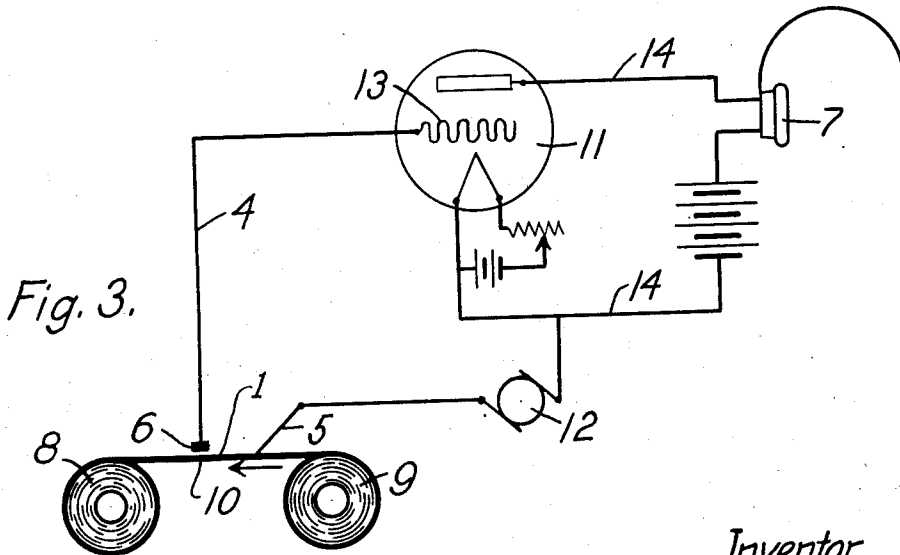


Fig. 3.

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2 Sheets-Sheet 2

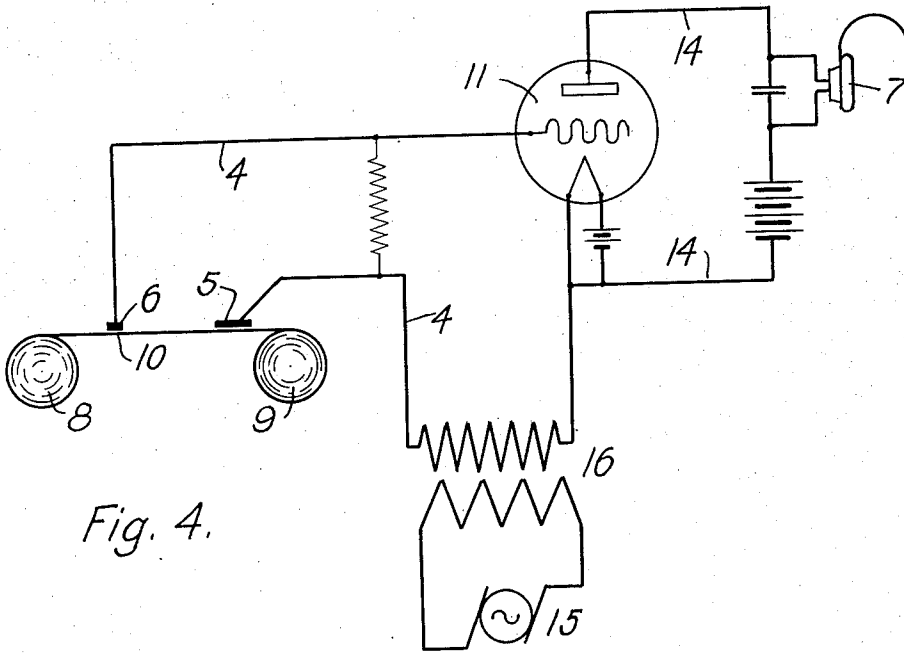


Fig. 4.

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# UNITED STATES PATENT OFFICE.

EVAN P. BONE, OF CINCINNATI, OHIO.

SOUND PRODUCER.

Application filed May 17, 1922. Serial No. 561,740.

*To all whom it may concern:*

Be it known that I, EVAN P. BONE, a citizen of the United States, and a resident of Cincinnati, in the county of Hamilton and State of Ohio, have invented new and useful Improvements in Sound Producers, of which the following is a specification.

My invention relates to sound producing devices and has for its object, the provision of means for producing music or other sounds of improved purity of tone and of any desired quality.

The sounds are produced by electrical means and the qualities of the sounds are governed by the modulations of characters printed in an ink, which is a conductor of electricity, upon a sheet of paper or other suitable material. The characters may be in the form of a line of appreciable width, having wavy edges. The paper is made to move in such a manner that successive parts of the ink line pass in close proximity to some part of an electrical circuit, changing the electrical capacity of said circuit in accordance with changes in the character of the ink line. The changes in capacity cause a correspondingly changing current to flow in the circuit, when the circuit is under the influence of a suitable electro-motive force. This changing current, which is similar to the current in a telephone circuit, is transformed into audible sound waves by a telephone receiver, or the like, connected in the circuit. However, the changing current is preferably amplified by one or more vacuum tubes before it is converted into audible waves. By virtue of said amplification, an ink line of small dimensions on a compact sheet or roll of paper is possible. As no moving mechanical contacts are required, pure tones are produced.

In the particular embodiments of my invention selected for illustration—

Fig. 1 is a plan view of a broken off part of the sheet of paper with the ink characters.

Fig. 2 is a diagram of a simple circuit for producing sound from the inked paper sheet.

Fig. 3 shows a sound producing circuit with a vacuum tube amplifier.

Fig. 4 shows a vacuum tube sound producing circuit charged by an alternating source of electro-motive force.

In Figure 1, the numeral 1 represents a sheet of paper or other relatively non-conducting material and the black area 2 a wide line of conducting material such as metallic

ink, carbon ink, a lead pencil mark or the like. The sheet with its figured line corresponds to the wax record of the phonograph or the magnetized steel wire of the telegraph. It is to be understood, however, that the sheet may not only function as a record for the reproduction of sound but as a producer of sound. The waves of the ink line correspond to the sound waves to be produced and any shading in the quality of the tones is accomplished by changing the shape of the ink waves. Any combination of tones of any pitch and with any combination of harmonics or overtones with any amplitude can be graphically designed. The design can be made photographically to reproduce sounds from other musical instruments, or means may be used to form waves of original character. The chief purpose of the paper is to carry the wave shaped conducting film of ink.

In the circuit shown in Fig. 2, the battery 3, is connected in the circuit 10, 5, 4, 4, 6, which circuit also includes the telephone receiver 7. The paper sheet 1 is shown as viewed from the side showing only its edge. In producing sound the sheet is wound upon reel 8 from reel 9. The brush 5 is in contact with the ink portion 2 of the sheet. The battery 3 charges the conductor 6 with a certain quantity of electricity and also the ink line adjacent thereto (represented by 10) with a like quantity of electricity of opposite polarity. The quantity of electricity is proportional to the width of the line at 10, because the capacity of a condenser is proportional to the area of its plates. Now, as the sheet 1 moves to bring another portion of the ink line having, say, a greater width, to the point 10, additional quantities of electricity will flow from the battery to 6 and to 10. And as the paper moves, the current of electricity will fluctuate in accordance with the waves on the moving ink line, which fluctuations of current are formed into sound waves by the telephone receiver 7. The function of the battery 3, which may be any suitable source of electro-motive force, is to give the conductors 10 and 6 an initial charge. It is not necessary that the battery be in the circuit 4, 4, as it may be connected in various ways to influence the conductors 6 and 10 as desired. It is the relative motion between the wave shaped conductor and the conductor 10 which generates the alternating electro-motive force to produce the sound waves.

Inasmuch as it is not necessary for the conductor 6 to come into mechanical contact with the sheet, the sounds are of pure tone. The brush 5 need not have mechanical connection with the sheet but can be placed near the ink line at the side or part where there are no fluctuations and no changes in influence.

Figure 3 shows a connection with a vacuum tube amplifier 11. Here the generator 12 furnishes the electro-motive force to charge the conductors 10 and 6. The conductor 6 is connected to the grid 13 of the vacuum tube. The fluctuations in the width of the ink line at 10, of the moving sheet 1, cause a varying electrical influence on conductor 6, which in turn affects the grid 13, thru the conductor 4. Thus, by causing the potential of the grid to fluctuate in harmony with the waves on the ink line, an amplified pulsating current is correspondingly created in the plate circuit 14, 14 including the telephone receiver 7.

The term "telephone receiver" herein is intended in the general sense, to define an instrument which changes electrical pulsations or alternations into audible sound waves. It is preferably of a type now known as a "loud speaker" but it might be actuated electrostatically, electro-thermally or the like, as well as electro-magnetically.

The "vacuum tube amplifier" used herein is intended to include the vacuum tube with its appurtenances such as the battery for heating the filament, the battery for adjusting the potential of the plate or grid and various well known coils, condensers and conductors.

The sources of electro-motive force designated at 3 and 12 may be any suitable form. An alternating current generator may be used whereby the potential of the grid can be made more effective by using a transformer or induction coil to step up the voltage as shown in Fig. 4. The alternating current generator is shown at 15 and the step up transformer at 16. Such alternating current can be made inaudible by using a high frequency above the range of hearing and the rectifying property of a vacuum tube. When alternating current is used to excite the conductors 6 and 10, their charges alternate but this fact does not interfere with the generation of audio frequency pulsations as above described.

Numerous arrangements of circuits will be evident to accomplish the object and to make several steps of amplification, and I do not confine my invention to the particular diagrams shown herein.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A sound producer comprising, a paper sheet upon which are printed sound wave characters, of an electrically conducting ink, capacitively connected in a circuit, said circuit being electrically connected to a source of electro-motive force and to a telephone receiver, and means for moving said paper sheet.

2. A sound producer comprising, a paper sheet upon which sound wave characters of an electrically conducting ink are printed, means for moving said sheet relative to a conductor, to bring successive parts of the conducting wave characters near without touching said conductor, means for electrically charging said conductor and adjacent wave characters, and a telephone receiver electrically connected to said conductor and wave characters.

3. A sound producer comprising, a sheet of comparatively non-conducting material upon which sound wave characters composed of a film of electrically conducting material are superimposed, means for moving said sheet relative to a conductor, to bring successive parts of the conducting wave characters near without touching said conductor, a source of electro-motive force for charging said conductors and adjacent wave characters, and a telephone receiver electrically connected to said conductor and wave characters.

4. A sound producer comprising, a paper sheet upon which sound wave characters of an electrically conducting ink are printed, means for moving said sheet relative to a conductor, to bring successive parts of the wave characters near without touching said conductor, a source of electro-motive force for charging said conductor and adjacent wave characters, and a telephone receiver, electrically connected, thru a vacuum tube amplifier, to said conductor and conducting ink.

5. A sound producer comprising, a paper sheet upon which sound wave characters of an electrically conducting ink are printed, means for moving said sheet relative to a conductor, to bring successive parts of the wave characters near without touching said conductor, means for electrically charging said conductor and adjacent wave characters, and a vacuum tube amplifier, including said conductor and conducting ink in a grid circuit, and including a telephone receiver in a plate circuit.

EVAN P. BONE.