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AUDIBLE SIGNAL APPARATUS

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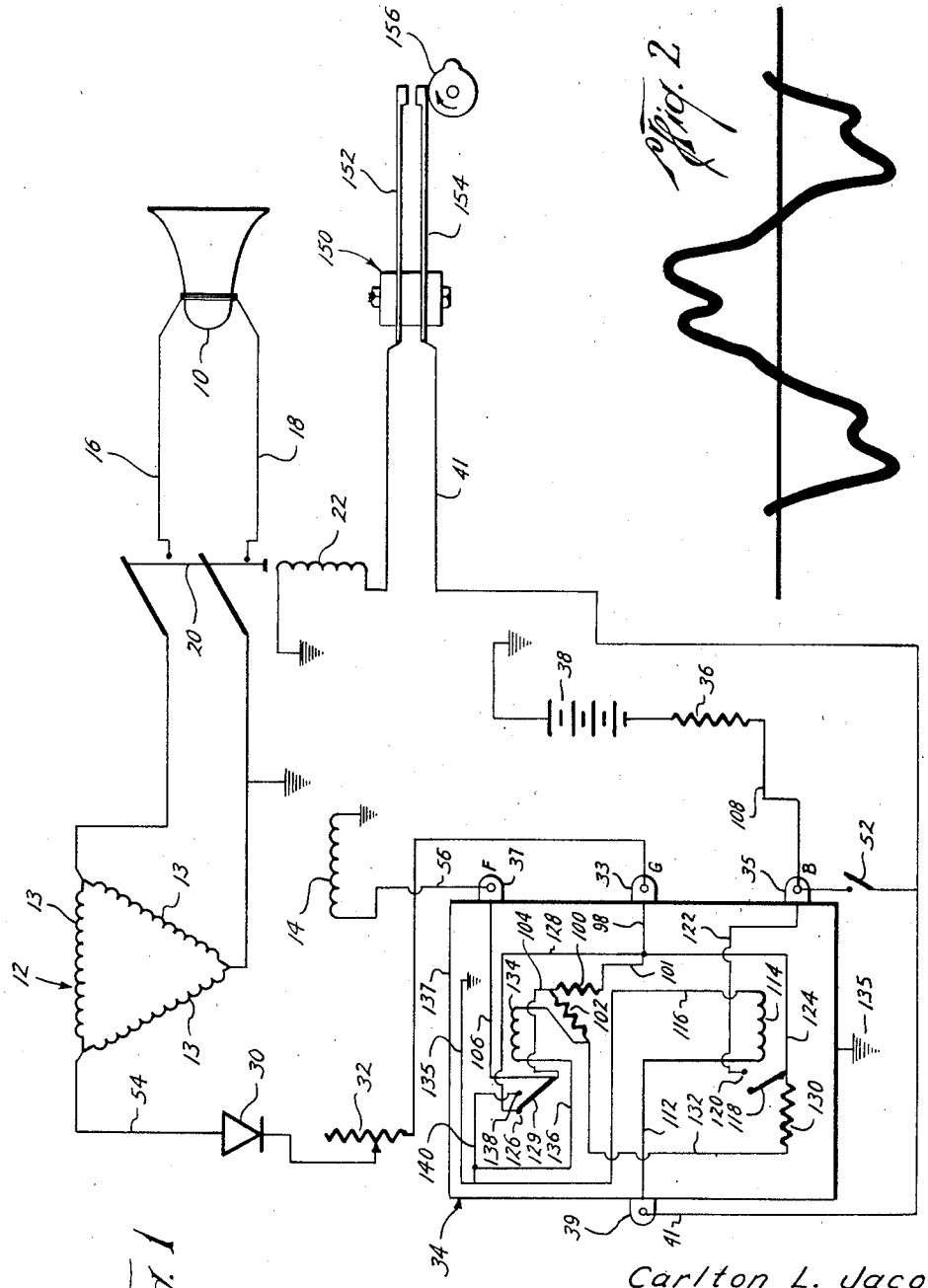


Fig. 1

Fig. 2

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AUDIBLE SIGNAL APPARATUS

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This invention relates to audible signal apparatus, and more particularly to electrical sound producing equipment.

While not limited to such use, the invention finds particular application in connection with audible alarm and warning equipment such as fog horns and the like.

In the development of audible signal apparatus it has long been known that distance and direction are recognized by the harmonic content of the sound, the lower harmonics being first heard and the higher harmonics becoming recognizable as the source is approached. Thus, the fundamental is the first tone heard in approaching an audible signal and the higher harmonics are heard in the increasing order of their frequencies. Audible signal apparatus, for use under conditions in which the indication of distance and direction of the sound source as the same is approached is of importance, must therefore, be capable of producing a number of harmonics. This is especially true in the case of fog horns, or the like, which must operate effectively under greatly varying atmospheric conditions adversely affecting the transmission of sound.

Heretofore various methods have been proposed for the production of audible signals making use of high and low harmonics, such as by the use of air actuated whistles, or electrical sound equipment in which alternating current is separately generated at a number of different frequencies and the frequencies blended to provide mixed harmonics. Devices of this character have, however, not proved to be entirely satisfactory, because of the relative complexity of the apparatus required or because of the large amount of power which must be expended in the operation of the same. No satisfactory equipment of this character has heretofore been available for the production of signals containing a number of harmonics by which direction and distance could be effectively recognized.

The present invention has for an important object the provision of audible signal apparatus which is capable of producing signals having improved characteristics whereby the distance and direction of the sound source may be more easily recognized.

Another object of the invention is to provide audible signal apparatus whereby signals of improved characteristics of recognizability as to direction and distance may be produced with a minimum expenditure of power and cost of equipment.

A further object of the invention is the provision of audible signal apparatus making use of an electrically driven loud speaker receiving current from an alternating current generator, having means for furnishing current to the field thereof which is of greater value during one half of the cycle than during the other half thereof, whereby distortion is produced in the output of the generator, which in turn produces harmonics in the sound produced by the speaker, resulting in a sound whose tonal quality makes it possible to easily recognize the distance and direction of the sound source.

Another object of the invention is to provide audible signal apparatus of the kind referred to which is adjustable to permit the frequencies of the alternating current produced by the generator to be altered, whereby the quality of the sound produced by the speaker may be regulated to improve the distance and direction recognition characteristics of the signals.

A further object of the invention is the provision of audible signal apparatus having means whereby the frequencies of the sound produced may be adjusted as desired.

Another object of the invention is to provide audible signal apparatus of the type referred to which embodies improved electrically operated timing mechanism whereby the duration and frequency of the signals may be adjusted as desired.

A still further object of the invention is to provide audible signal apparatus which is of simple design and economical to manufacture and which may be economically operated and maintained.

The above and other important objects and advantages of the invention may best be understood from the following detailed description, constituting a specification of the same, when considered in conjunction with the annexed drawings, wherein—

Figure 1 is a circuit diagram, illustrating electrical circuits embodying the invention;

Figure 2 is a diagrammatic view showing the form of wave produced by the alternator of the invention and by which the sound producing means is operated.

Referring now to the drawings in greater detail, the invention is illustrated in connection with its use in fog horn equipment including one or more electrically operated horns such as that indicated at **10**, of conventional design, such as a loud speaker of the dynamic type, which is connected to receive current from the stator **12** of an alternating current generator of usual construction having a field coil **14** which is rotatable relative to the stator. For the purpose of illustration, the stator may be constructed with three coils **13**, and the horn **10** may be connected by the conductors **16** and **18** across one of these coils. Means is provided for controlling the supply of current to the horn, which may take the form of a relay having an armature **20** and a coil **22**, the armature being arranged to open and close the circuit through the conductors **16** and **18**. Conductor **18** is also connected to ground.

Suitable timing mechanism, described in detail hereinafter, is provided for controlling the operation of the relay.

As ordinarily operated, the field coil **14** of the generator is supplied with direct current from a source such as the battery **38**, in order to produce alternating current whose instantaneous values are represented by a sine curve.

The operation of a horn of this type, however, from a source of current whose instantaneous values may be represented by a sine curve, does not prove satisfactory, because a sound wave of sine shape is not easily recognizable by the human ear, and does not give a sense of distance and direction. In order to overcome this difficulty, and to provide current which will operate the horn in a manner to produce a sound having improved characteristics of distance and direction recognizability, means is provided for distorting the shape of the curve representing the instantaneous values of the current from the generator. This may be accomplished by altering the characteristics of the current supplied to the field coil **14**.

For this purpose a half-wave rectifier **30** is provided which is connected to the stator **12** and to a resistor **32**, which is also connected to a terminal **33** of a voltage regulator, indicated generally at **34**, hereinafter described in greater detail. From the voltage regulator current is conducted through a conductor **108**, connected to the terminal **35**, to a resistor **36** which is in turn connected

to one side of the battery 38. The battery 38 has its other side connected to ground.

The regulator 34 also has a terminal 39, which is connected to the terminal 35, through a conductor 41, into which a switch 52 is connected whereby this connection may be opened or closed. The voltage regulator is contained in a casing 137 of conventional type, which may be of metal construction carrying the terminals 33, 35, 37 and 39 which are insulated from the casing and the casing may also be connected to the ground 135 and to conductors 116, 136 and 140 to ground the same.

By this arrangement the voltage across the field coil, during one half cycle of the output across one of the coils of the stator, will be the voltage of the battery plus the voltage drop across the resistor 36, and during the other half cycle of the output of the same stator coil, will be the voltage of the battery minus the voltage drop across the resistor 36.

The instantaneous value of the current generated by the generator operated in this manner will be represented by a distorted curve and the current so produced will contain a fundamental frequency and a number of harmonics, and the horn, when operated by such current will produce sound having improved characteristics which make it possible to easily recognize the distance and direction of the source.

The voltage regulator may be of usual construction, a preferred form of which is illustrated in Figure 2. The regulator has an on-and-off relay having a coil 114 and an armature 118, which moves into and out of contact with a stationary contact 120. A voltage regulating relay is also provided, having a coil 134, which is connected to the armature 118 through a resistor 130 and conductor 132, and which is also connected to the ground as indicated at 135, through conductor 136, so that when the armature 118 is in contact with the contact 120, current may flow from the battery 38 through resistor 36, conductor 108, terminal 35, conductor 122, armature 118, resistor 130, conductor 132, to coil 134 and thence to ground through conductor 136, to actuate the voltage control relay upon an increase in the voltage across the battery.

A stationary contact 126 is provided for the armature 129, which contact is connected to the armature 118 through conductor 128 and conductor 124, and armature 129 is also connected to the field coil 14 through conductor 106, terminal 37, and conductor 56, whereby the field coil 14 is connected to the battery and the resistor 36. Thus, the voltage on the field coil 14 will, under these conditions, be the battery voltage plus the voltage drop across the resistor 36, when the armature 129 is in contact with the contact 126.

Another stationary contact 138 is provided for the armature 129, which contact is connected to ground through conductor 140.

The terminal 33 is connected to the conductors 124 and 128 by a conductor 98, which is also connected to the armature 129 through a conductor 101, resistor 100 and conductor 104.

Current from the stator 12 may flow through conductor 54, rectifier 30, resistor 32, terminal 33, conductor 98, conductor 124, armature 118, conductor 122, terminal 35, conductor 108 and resistor 36 to battery 38, to charge the battery. In the event that the voltage from the generator exceeds a predetermined limit, the current through the coil 134 of the regulating relay will increase sufficiently to move the armature 129 out of contact with the contact 126 and into contact with contact 138, thus short circuiting the field coil 14 through conductor 56, terminal 37, conductor 106, armature 129 and conductor 140. The generator voltage will thereupon diminish.

It will be seen that with this arrangement the output voltage from the generator to the horn may be regulated by adjusting the resistor 32.

The current to the relay coil 22 may be controlled by any desired type of timing mechanism such as the cam operated switch indicated at 150 having the switch blades 152 and 154 each provided with contact points and arranged to be operated by the cam 156 which may be mounted on a shaft 158 for rotation by any suitable means, as by means of a driving connection not shown, with the generator shaft. Switch blade 152 is connected to the coil 22 and switch blade 154 is connected to the conductor 41. Upon rotation of the cam 56 the switch 150 will be closed by the projection 160 of the cam to permit current to flow to the coil 22 whereby the armature 20 will be moved to close the circuit to the horn through conductors 16 and 18.

While the invention is disclosed herein in connection with certain specific embodiments of the same, it will be understood that this is intended by way of illustration only and that numerous changes can be made in the character and arrangement of the various parts without departing from the spirit of the invention and within the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. Audible signal apparatus comprising electrically operable sound producing means of the magnetically operable vibrating diaphragm type responsive to an alternating electrical current to produce an audible signal, an alternating current generator having a stator winding and a field coil, a first electrical circuit including said means and said stator winding, a source of direct current, a second electrical circuit including said stator winding, said source and said field coil for supplying direct current to said field coil, and means in said second circuit for continuously varying the voltage of the current supplied to said field coil to cause variations in the wave form of the current supplied to said sound producing means.

2. Audible signal apparatus comprising electrically operable sound producing means of the magnetically operated vibrating diaphragm type responsive to an alternating electrical current to produce an audible signal, an alternating current generator having a stator winding and a field coil, a first electrical circuit including said stator winding and said means for supplying alternating current to said means, a source of direct current, a second electrical circuit including said field coil and said source, and means forming an electrical connection between said stator winding and said second circuit and responsive to the current in said stator winding to continuously vary the voltage of the current supplied to said field coil to cause variations in the wave form of the current supplied to said sound producing means.

3. Audible signal apparatus comprising electrically operable sound producing means of the magnetically operated vibrating diaphragm type responsive to an alternating electrical current to produce an audible signal, an alternating current generator having a stator winding and a field coil, a first electrical circuit including said winding and said means to supply alternating current to said means, a source of direct current, a second electrical circuit including said source and said coil for supplying direct current to the coil, means forming an electrical connection between said second circuit and said winding and responsive to the flow of current in one direction through said winding to cause a flow of direct current of continuously varying voltage from said winding through said second circuit to cause a variation in the wave form of the current supplied to said sound producing means, and voltage regulating means in said second circuit operable to limit the voltage applied to said sound producing means.

4. Audible signal apparatus comprising electrically operable sound producing means of the magnetically operated vibrating diaphragm type responsive to an alternating current to produce an audible signal, an alternating

current generator having a stator winding and a field coil, a first electrical circuit including said winding and said means for supplying alternating current to said means, a source of direct current, a second electrical circuit including said source and said coil for supplying direct current to the coil, means forming an electrical connection between said winding and said second circuit and responsive to the flow of current in one direction through said winding to cause a continuous variation in the voltage of the current in said second circuit during one-half cycle of the alternating current from said generator to cause a variation in the wave form of the current supplied to said sound producing means.

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