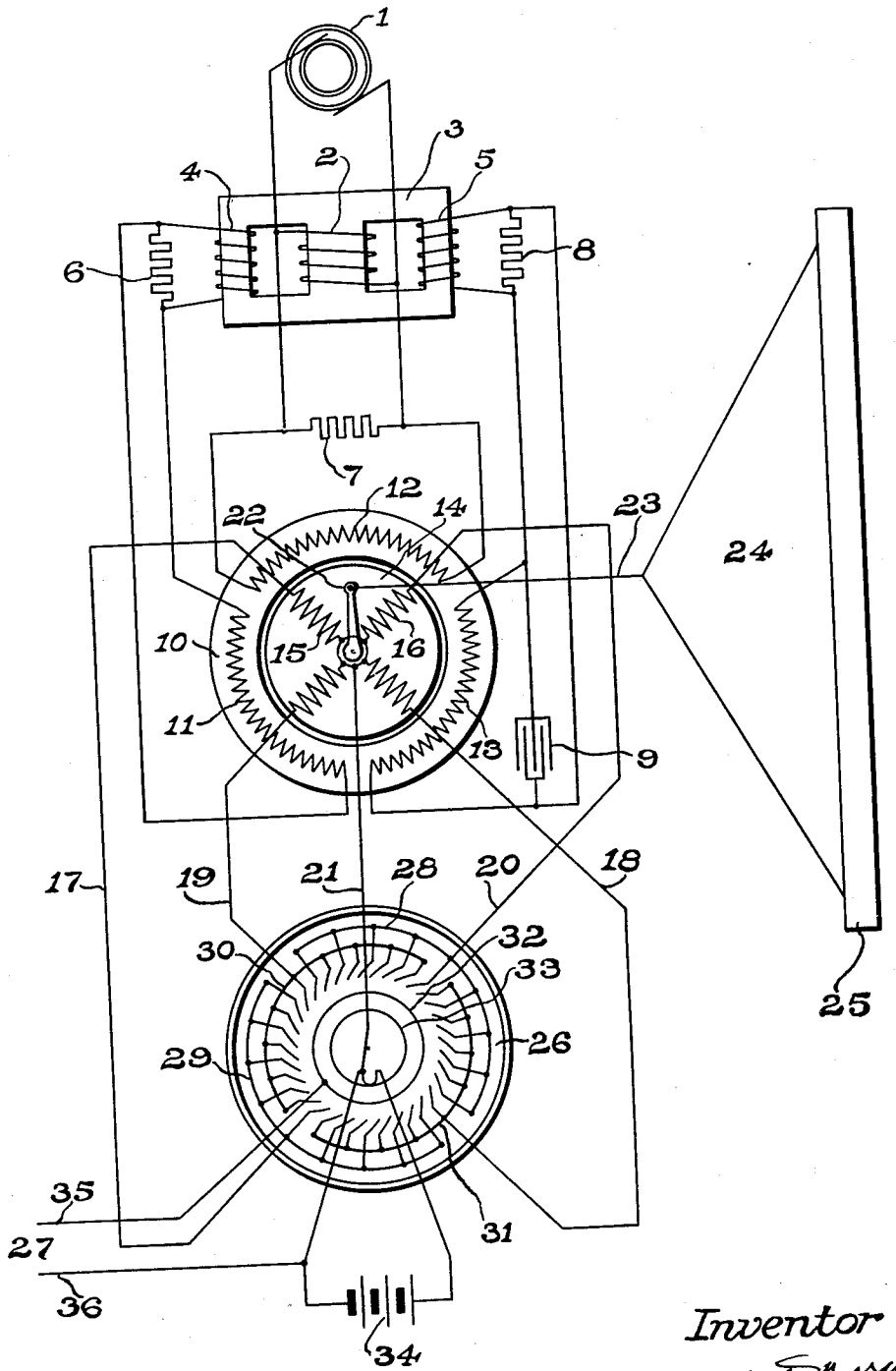
Feb. 6, 1934. M. MORRISON 1,946,098

SOUND WAVE PRODUCING DEVICE

Filed Sept. 19, 1931



Inventor.

Montford Morrison

Patented Feb. 6, 1934

1,946,098

UNITED STATES PATENT OFFICE

1,946,098

SOUND WAVE PRODUCING DEVICE

Montford Morrison, Long Island City, N. Y.

Application September 19, 1931
Serial No. 563,803

10 Claims. (Cl. 179—115.5)

This invention relates to a class of devices commonly known as loud speakers and is applicable to all classes of signaling and to other related art, and relates specifically to means and methods of producing sound waves from electric currents by electrically excited magnetic fields co-operating with movable armatures without the employment of direct-current-excited magnetic fields and without the use of permanent magnets.

Among the objects of this invention are to provide means for producing sound waves from electric currents in a device having all the desirable characteristics of an "electrodynamic" loud speaker without the necessity of employing direct current for the magnetic field excitation; to provide a device of the class described to which alternating current commonly found on power lines in practice may be used directly for providing the necessary magnetic field excitation; and, further, to provide a device in which the energy consumed in producing the sound waves is largely drawn from the said magnetic field circuit with its attendant advantages. Further and other objects will be apparent and pointed out in the specification.

The structure herein disclosed for converting single phase alternating currents to polyphase alternating currents is claimed in my co-pending application Serial No. 656,295, filed February 11, 1933.

In the prior art devices of the class herein described have employed either permanent field magnets or electro-magnets requiring direct current for their excitation. Difficulty in obtaining the desired results with permanent field magnetic devices has directed the development of the art toward electro-magnetically excited field devices. Such devices require considerable field energy for excitation and, further, require the conversion of the usual alternating current supply into direct current before being used to excite the fields. This makes a bulky, heavy and expensive device for the purpose.

In the present invention the applicant employs polyphase alternating currents which are so combined as to produce a revolving field having a constant amplitude. The constant amplitude of this field takes the place of the constant field of the prior art devices and the structure involved in the use of this field is so arranged that its revolving plays no detrimental role in the operation of the device, the only requirement being that the armature structure be of such form that the torque of the armature is proportional to the currents therein as the value of the armature torque determines the pull on the sound producing diaphragm or its equivalent.

Many simple and different embodiments may be made of this invention. In fact, simpler embodiments may be made than the one to be hereinafter described, but the one hereinafter described, it is believed, is best suited for purposes of understanding the invention.

In the figure, 1 is a single phase alternating current generator supplying a primary 2 of a three legged transformer 3 with input electrical energy. Transformer 3 has a secondary 4 and a tertiary 5.

For clearness in understanding the theory involved, the three coils are associated by three resistors, 6, 7 and 8, each of which constitute the predominating loading characteristic in each of the individual three circuits. That is, these resistors are sufficiently heavy, as compared with any other loading to substantially determine the character of the loading on the transformer 3. Under these conditions, the voltage across the resistor 7 is in phase with the line voltage. The leakage reactance of the transformer 3 is such that the voltage across the resistor 6 lags 60° behind the primary voltage. The voltage across resistor 8 would also lag in phase position except for the condenser 9, which is shunted across it. The condenser 9 is of such value as to make the resultant voltage across it and the resistor 8 lead the primary voltage by 60°.

By reversing the assumed polarity of coils 4 and 5 their phase relation is changed by 180° which results in the voltage across resistors 6, 7 and 8 being 120° apart, or giving a true three-phase voltage across these resistors.

As will be appreciated by those skilled in the art upon further reading of this specification, the number of phases is not important in embodying my invention and any properly poly-phased current may be used.

10 is the stator of a common induction motor, which, in the figure, is illustrated as a three-phase machine. The voltage of resistor 6 is applied to stator winding 11. The voltage across resistor 7 is applied to stator winding 12 and the voltage across resistor 8 and condenser 9 is applied to stator winding 13. The windings as illustrated herein are merely diagrammatic and insulated for the sake of clearness and are not indicative of any particular type of winding used or preferred. The stator windings 11, 12 and 13 may be of the type commonly found in induction motors and, as illustrated herein, represent the windings of a two-pole machine. 14 represents the com-

monly called rotor of the diagrammatic induction motor illustrated but may or may not rotate in the present invention, depending upon the specific design employed.

That is, the lever arm 22 may be fixed to the windings 15 and 16 so as to oscillate as a whole with the windings under operation, or the lever arm 22 may not be fixed to the said windings but provided with sufficient looseness to slip in the manner of the prony brake, as will be understood in the art. The actual rotor windings may be fixed in slots in the rotor, in which case the rotor will tend to turn. In some cases the windings will not be fixed to the rotor proper but free to move either in the slots themselves or in the air gap of the machine, which greatly reduces the moment of inertia of the moving parts, which allows the natural period of the rotating member to have a very high value, which is desirable as will be hereinafter pointed out. In this case the torque is taken by mechanical connection to the windings and the iron core is fixed.

For clearness in the present diagrammatic embodiment in the rotor, 14 is a two phase diametrical winding, indicated by crossed coils 15 and 16, the winding is fixed to the iron core and the integral mass rotates as is common in the induction motor art.

The number of phases in the rotor is not material to the invention and two phase has been used to simplify the diagram. The terminals of coil 15 are indicated by leads 17 and 18 and terminals of coil 16 are indicated by leads 19 and 20. 21 is a center connection for the rotor coils. The rotor shaft is provided with a lever arm 22, which is tied by means of a connecting link 23 to a sound producing diaphragm 24, affixed by frame 25 with respect to the axis of the rotor so that, when the rotor 14 tends to rotate in a counter-clockwise direction, the pull on the link 23 deflects the diaphragm, the deflection being proportional to some extent upon the torque on the rotor. The restoring force of the rotor in the diagram is illustrated as being the elasticity in the diagram.

Under these conditions variations in the stalled torque of the rotor 14 produces the sound waves in diaphragm 24, as will be readily appreciated by those skilled in the art.

26 is a loading device for coils 15 and 16 and may be any device in which the loading produced in the rotor coils is proportional to the currents or voltages of the input leads 27, which represents leads from an input circuit supplying currents or voltages having instantaneous values proportional to the desired instantaneous deflection of the cone or other sound wave producing device 24.

In the present embodiment the loading device 26 is represented diagrammatically as being an electron discharge device of the class described in co-pending application Serial No. 421,790, filed January 18, 1930, and which, in the figure, comprises a two-phase electron discharge tube having lead 20 connected to a segmental squirrel cage anode 28 and lead 17 connected to an opposite segmental squirrel cage anode 29. Lead 19 is connected to a segmental intermeshed anode 30 and lead 18 is connected to the corresponding opposite intermeshed anode 31. 32 is the control grid of the device and 33 represents the filament thereof which is connected to lead 21 and to a source of heating current 34, which is illustrated in the figure as being better for clearness in showing the invention, though, in practice, a different heating means is usually employed.

35 and 36 are the leads for the input circuit which may be taken as coming from any circuit in which the current form therein represents the wave form of the sound waves to be produced on 24 and, by way of example, may be considered as coming from the amplifier circuit of, for instance, a radio receiving set.

Lead 35 is connected to grid 32 and lead 36 to the filament 33. The filament 33, being illustrated as looped, is merely indicative of its having no interruptions in its electron emitting service, adjacent to the grid, due to filament supporting members. With the described tube in conjunction with input circuit 27, it is assumed that the drop in potential around the filament 33 produces no variation in instantaneous electron emission due to change in position of the electrostatic field of the anodes with respect to the filament. This assumption is made for clearness in teaching the present invention.

As more fully disclosed in the aforementioned copending application, tube 26 produces a revolving polyphase field which is constant in form and, therefore, draws from a supply line a constant amount of electric energy, the amount of which is controlled by grid 32. That is, the energy draw of tube 26 from the rotor coils 15 and 16 is instantaneously proportional to the potential of the grid 32 under proper operating conditions.

In a high resistance wound rotor circuit the stalled torque bears a close relation to the energy consumption in the rotor circuit. Under these conditions the torque of the lever arm 22 is closely proportional to the instantaneous value of the potential of the grid 32 so that the pull on the link 23 is instantaneously proportional to the potential value of the grid 32.

It will be observed by those skilled in the art that the energy for operating sound producing diaphragm 24 comes largely from the stator exciting circuit of the polyphase motor 10, depending largely upon the design of the tube 26, and the characteristics of the circuit 27, it being possible to design a device such that substantially all of the sound producing energy is provided from the alternating current circuit instead of being supplied by the amplifier circuit as will be understood by those skilled in the art.

It will be appreciated that such a device in a sense acts as an amplifier itself and, therefore, can be made with proper design to function with fewer stages of audio frequency amplification for the same sound volume than can the devices of the prior art.

The present invention is not limited to conical, flat or any other specific form of sound wave producing member and is not limited to any specific structure of device for the element 10, the invention being, broadly, an alternating-current-field-excited sound wave producing device in which the pull on the sound producing member is instantaneously proportional to the currents representing the sound waves and independent of the alternations of the field.

The invention is further not limited to the class of device illustrated by 26, which is merely shown as illustrative of one embodiment of my invention.

It will be obvious to those skilled in the art that this invention also constitutes a novel general translating device subject to, for instance, embodiment as a recorder by the substitution of

a recording element for the sound wave producing cone in the figure.

The patentable novelty disclosed in the single phase to polyphase transformer apparatus herein described forms the subject matter of a separate application, and, therefore, the claims hereof are directed to other elements of the invention herein set forth.

The above specification being directed to the teaching of the present invention, the nature thereof is pointed out in greater particularity in the claims hereunder.

I claim:

1. A sound wave producing device comprising a polyphased alternating-current-field winding and an armature continuously responsive to sound modulated currents and mechanically associated with a sound wave generating surface.

2. In a sound wave producing device, means for producing an alternating field, and means magnetically associated with said field for producing sound waves responsive to sound modulated currents and independent of the point to point variations in the said field.

3. A sound wave producing device, comprising a polyphased alternating-current field-winding, an armature winding magnetically associated therewith and mechanically associated with a sound wave generating surface and adapted to react under a predetermined current excitation in proportion to the amplitude of said polyphased currents and to the amplitude thereof only at any fixed frequency thereof.

4. A sound wave producing device, comprising a polyphased alternating-current field-winding, a movable armature winding magnetically associated therewith and mechanically associated with a sound wave generating surface and a loading device electrically associated with said armature winding and adapted to load the said armature winding in accordance with instantaneous variations in a sound wave modulated current.

5. A sound wave producing device, comprising a polyphased alternating-current field winding, a movable armature having a winding magnetically associated therewith, a movable member having a sound wave producing surface and mechanically associated with said armature and means adapted to actuate said armature in accordance with variations in sound modulated currents.

6. A sound wave producing device, comprising a polyphased induction motor provided with stator excitation, a rotor having a winding thereon and a lever arm fixed thereto and mechanically linked to an element having a sound producing surface and a loading device electrically connected to said rotor winding and adapted to load the said rotor electrically in accordance with a predetermined manner, whereby sound waves are produced.

7. A sound wave producing device, comprising a rotatable member, subject to oscillation about an axis thereof, motionally responsive under said oscillation to sound modulated currents, and means for converting said rotary oscillations into corresponding approximately linear motion, said means actuating a member having a surface suitable for generating sound waves.

8. The method of producing sound waves which comprises creating an alternating electromagnetic field and causing a second electro-magnetic field inter-linked with aforesaid field to react therewith in response to currents in the latter said field and independent of the point to point variations in the first said field, and the said reactions providing energy for the production of sound waves.

9. The method of producing sound waves which comprises creating an alternating electro-magnetic field and causing a second electro-magnetic field to react with aforesaid field and with a sound wave producing member, whereby the sound waves produced are responsive to current variations in the latter said field and independent of the point to point variations in the first said field.

10. The method of producing sound waves which comprises creating a rotating electromagnetic field of constant amplitude, creating a second electro-magnetic field responsive to sound wave modulated currents and reactive with first said field, and then utilizing the physical effect of the said reaction in the production of sound waves.

MONTFORD MORRISON.