Nov. 30, 1954 W. GODAERT 2,695,606

DEVICE FOR COMPARING THE PHYSIOLOGICAL ACTIVITY OF AN ORGAN TO A STANDARD

Filed Dec. 18, 1951

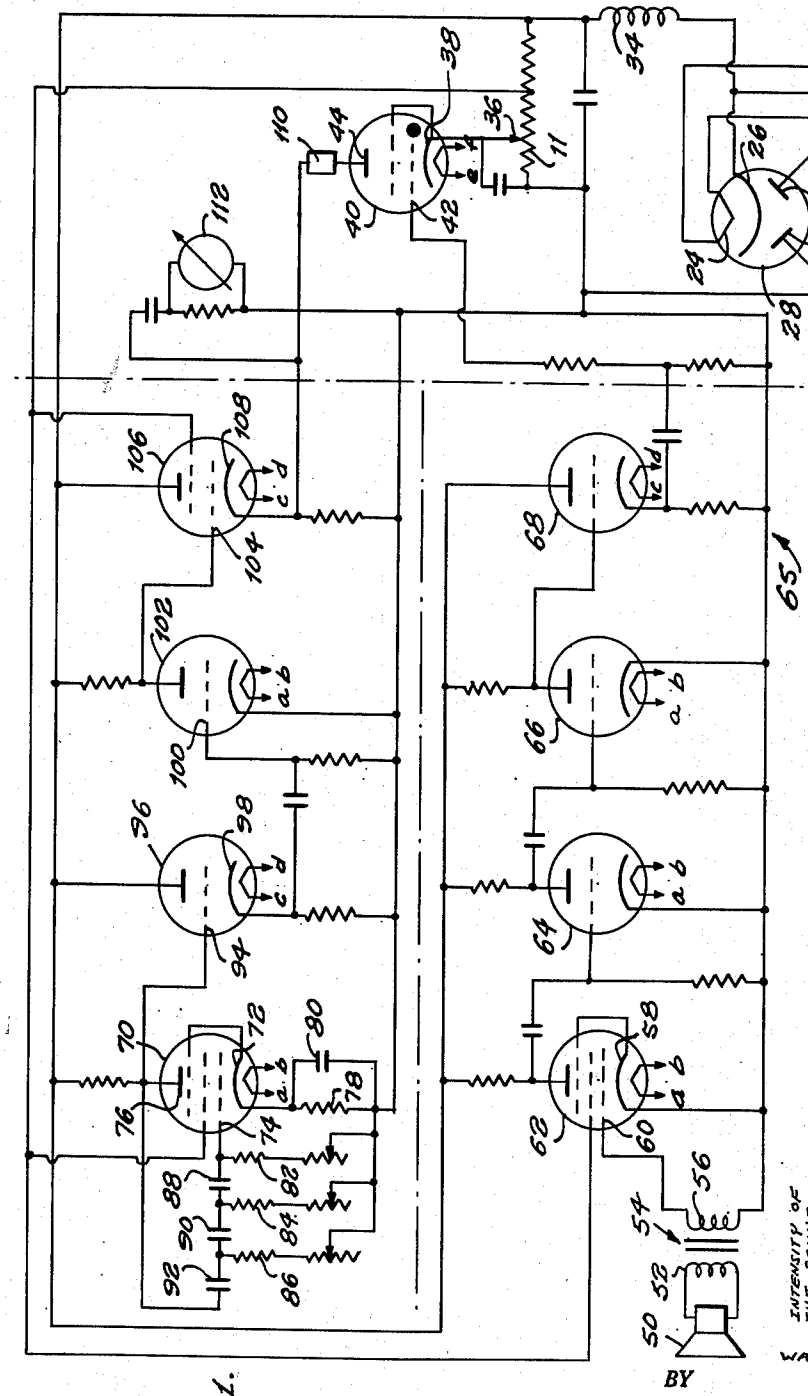


FIG. 1.

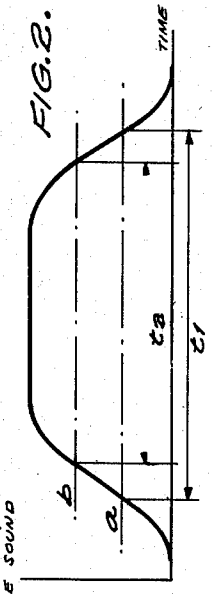


FIG. 2.

INVENTOR.

WALTER GODAERT

BY:

BY:

United States Patent Office

2,695,606

Patented Nov. 30, 1954

2,695,606

DEVICE FOR COMPARING THE PHYSIOLOGICAL ACTIVITY OF AN ORGAN TO A STANDARD

Walter Godaert, Brussels, Belgium

Application December 18, 1951, Serial No. 262,243

Claims priority, application Belgium December 29, 1948

20 Claims. (Cl. 128—2)

The present invention relates to a device for comparing the physiological activity of an organ to a standard, and more particularly to a device for comparing the noise produced by the physiological activity of an organ, such as the lungs of a patient to a standard.

The present appplication is a continuation-in-part of the co-pending application Serial No. 134,252, filed December 21, 1949, for "Electro-Acoustical and Bio-Chemical Method for the Measure of Nervous Tension (Vaso-Constriction) as Well as the Estimation of the Bio-Chemical Dosing of Blood."

As more fully explained in my co-pending application, this method consists in observing the periodical sound produced by the physiological activity of an organ such as the lungs, the so-called breathing cycle and comparing the same for instance, by a graphical recording with the sound produced by the corresponding organ, for instance, the lungs of a normal person. From the curves recorded in this way medical conclusions with respect to the state of health of the person whose breathing cycle is examined can be drawn.

It is an object of the present invention to provide a device for comparing the physiological activity of an organ, and particularly the sound produced by the lungs of a patient, to a standard.

It is another object of the present invention to provide an electro-acoustical device for the same purpose.

It is a further object of the present invention to provide a device which allows a change of the standard within certain limits.

It is a still further object of the present invention to provide an electro-acoustical instrument which can be operated by the average physician without special knowledge of the electrical principle involved.

A device according to the present invention comprises in its broadest aspects a thyratron having a control grid and an anode, means connected to the anode of the thyratron for imparting to the anode oscillations having a predetermined frequency depending on the standard, means for generating oscillations in dependency on the activity to be compared, means for imparting to the control grid of the thyratron a potential controlled by the generating means, and recording means connected to the anode of the thyratron whereby the thyratron is started in a rhythm dependent on the activity to be compared and extinguished in the rhythm of the oscillations having a predetermined frequency so that the recording means is actuated rhythmically in dependency on the activity to be compared.

Preferably a microphone is actuated by the sound produced by the physiological activity to be compared, and an electric circuit is connected to the microphone and generates a potential controlled by the microphone, means being provided for imparting to the control grid of the thyratron, the potential generated in the electric circuit.

In a preferred embodiment of the present invention an amplifier is connected to the microphone and a cathode follower having the input thereof connected to the amplifier and an output being connected to the control grid of the thyratron.

Preferably, the oscillating stage includes an oscillating tube having a cathode connected to an oscillating circuit including a resistor and a capacity connected and parallel with each other, the oscillating stage being connected to the anode of the thyratron.

Preferably, a tuning circuit including a plurality of variable resistors is connected with one end thereof to the oscillating circuit, the tuning circuit being connected to the grid of the oscillating tube.

In a preferred embodiment of the present invention the oscillating stage comprises in addition an amplifying tube having a control grid fed with the oscillations generated by the oscillating tube, the amplifying tube being biased so as to generate substantially square output oscillations which are supplied to the control grid of a cathode follower the output of which is connected with the anode of the thyratron.

Preferably a frequency meter is provided for measuring the frequency of the oscillating stage.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a wiring diagram of a device according to the present invention; and

Fig. 2 is a diagram for explaining the operation of the device shown in Fig. 1.

Referring now to the drawings and first to Fig. 1 the apparatus according to the invention comprises a main transformer **10** having a primary **12** connected to the line (not shown) and five secondaries **14**, **16**, **18**, **20** and **22**. The secondaries **14**, **16** and **18** supply the heating currents for the cathodes of the tubes more fully described hereinafter. The secondary **20** supplies the current for the heating winding **24** of the cathode **26** of a rectifying tube **28** the anodes **30** of which are joined by the secondary **22** having a mid-point **32** which is connected to one end of a potentiometer **11** the other end of which is connected over a choke **34** to the cathode **26**. In consequence thereof the potentiometer **11** is imparted a smooth direct current setting up in the same a substantially constant direct voltage of which a part is taken off by the tap **36** and fed to the cathode **38** of a thyratron **40** having a control grid **42** and an anode **44** which are connected, respectively, to the parts more described in detail hereinafter.

A microphone **50** is connected to the primary **52** of transformer **54** the secondary **56** of which is connected between the cathode **58** and the control grid **60** of a vacuum tube **62** forming the first stage of a three-stage amplifier **65** comprising in addition two more stages consisting of the vacuum tubes **64** and **66**. The vacuum tubes **62**, **64** and **66** are resistance-capacitance coupled with one another. The vacuum tube **66** is coupled to a vacuum tube **68** designed as a cathode follower (termed hereinafter the second cathode follower) connected to the control grid **42** of the thyratron **40**. It should be understood that the control grid **42** is negatively biased with respect to the cathode **38** of the thyratron **40** and changes its potential under the influence of the sound waves taken up by the microphone **50** which produces electrical voltages amplified by the amplifier **64** and transmitted through the cathode follower **68** to the control grid **42** of the thyratron **40** so that the latter is fired. The connection between the microphone **50** and the control grid **42** of the thyratron **40** is referred to hereinafter as "the electric circuit."

The oscillating stage comprises a vacuum tube **70** acting as an oscillating tube and having a cathode **72**, a control grid **74** and an anode **76**. The cathode **72** is connected to an oscillating circuit consisting of a resistor **78** and condenser **80** in parallel. The control grid **74** of the oscillating tube **70** is connected to one end of the resistor **78** by means of a tuning circuit including three variable resistors **82**, **84**, **86** and condensers **88**, **90** and **92**, the condenser **92** connecting the variable resistor **86** with the control grid **94** of a vacuum tube **96** to be described in detail hereinafter. By a suitable adjusting of the resistors **82**, **84**, **86**, the oscillating tube **70** can be made to generate oscillations having a predetermined frequency such as 24 cycles per second half of which is called a biocycle for reasons given hereinafter. It is, however, to be understood that the predetermined frequency gener-

ated by the oscillating tube **70** can be changed within certain limits by an adjustment of the variable resistors **82, 84, 86.**

The vacuum tube **96** following the oscillating tube **70** is connected as a cathode follower the cathode **98** of which is connected to the control grid **100** of a vacuum tube **102** being an amplifying tube which is so biased that the tube **102** produces substantially square waves.

The square waves poduced by the amplifier **102** are fed to the control grid **104** of a vacuum tube **106** designed as a cathode follower (termed hereinafter "the first cathode follower") the cathode **108** of which is connected to the anode **44** of the thyratron through a recording device **110.**

The heating currents of the tubes **62, 64, 66, 70** and **102** are supplied by the secondary **14,** the heating currents of the tubes **68, 96, 106** are supplied by the secondary **16** and the heating current of the cathode **38** of the thyratron **40** is supplied by the secondary **18,** the letters *a, b, c, d, e, f,* being added to the terminals of the secondaries **14, 16** and **18** and the heating windings of the tubes **62, 64, 66, 68, 70, 96, 102, 106** and **40,** respectively.

A frequency meter **112** is connected so as to allow to measure the predetermined frequency of the oscillations generated by the oscillating tube **70** and fed to the anode **44** of the thyratron **40.**

The operation of this device is as follows:

The oscillator connected to the anode **44** of the thyratron is tuned to a predetermined frequency depending on the standard such as the respiration cycle of a normal person. The normal period of inhalation of a normal man has been determined to be three seconds. It has also been determined by way of experiment, that in order to most readily understand the measure of the difference between the period of inhalation of a subject as compared to a normal man a period of time such as one twelfth of a second is most suitable, and is known as biocycle. The oscillator is designed to oscillate at twenty-four cycles per second, twice the biocycle.

The microphone **50** is applied to the organ the physiological activity, for instance the sound, of which is to be compared to the standard. As a rule this sound will be produced by the lungs of a patient so that the control grid **42** of the thyratron **40** is biased positively in the rhythm of the sound to be compared. The thyratron **40** prevents the registration or the measuring of the square waves produced by the amplifier **102** during the period of silence. The square waves are recorded or measured as soon as the respiratory noises begin and can be heard. In the absence of respiratory noises the square waves are prevented from being recorded by the negative difference of potential between the grid and the cathode of the thyratron sufficient to cut off electron emission in the thyratron. The amplified respiratory noises picked up by the microphone **50** which are fed to the control grid of the thyratron, result in an output which is recorded by the recording device connected in the thyratron circuit each time the poetntial of the control electrode is driven in positive direction beyond the cut off potential. The thyratron permits the registration or measuring of the square waves at one half the oscillatory frequency, namely, twelve cycles per second (the thyratron acting as a rectifier). The number of registered or measured square waves permits the determination of the extent of inhalation or expiration stated in biocycles. It is apparent that such a determination can be made since, as has been stated, the normal extent of inhalation of a normal man is determined to be three seconds. Inasmuch as the biocycle is one twelfth of a second it is apparent that it is possible to obtain a maximum of thirty-six square wave pulses for each inhalation or exhalation cycle. By counting the number of the square wave pulses and comparing them to the number obtained when examining a normal man the condition of the examined subject may be readily determined. Figure 2 of the accompanying drawings is a diagram of the intensity of sounds plotted against time as taken by the recording device **110** and it will be clear from Fig. 2 that the thyratron **40** is fired during the time interval t_1 or t_2 according as the cathode voltage of the thyratron is adjusted by the adjustment of the tap **36** of the potentiometer **11.** Thus it will be clear that the number of standard cycles during which the thyratron **40** is fired can be easily ascertained with the apparatus, this number depending on the sound received by the microphone **50.** The curves taken by the recording device **110** allow to draw important conclusions with respect to the condition of the patient from the number of cycles during which the thyratron is fired and from the shape of the curves as more fully explained in my co-pending application Serial No. 134,252.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of devices for comparing the physiological activity to a standard differing from the types described above.

While the invention has been illustrated and described as embodied in a device for comparing the noise produced by the lungs of a patient to a standard, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; means connected to said anode of said thyratron for imparting to said anode oscillations having a predetermined frequency; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

2. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; means connected to said anode of said thyratron for imparting to said anode oscillations having a predetermined frequency; means for generating oscillations in electrical potentials in dependency on the activity to be compared, said means including a cathode follower; means for imparting to said control grid of said thyratron a potential controlled by said cathode follower; and recording means connected to said anode of said thyratron.

3. A device for comparing the sound produced by the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; means connected to said anode of said thyratron for imparting to said anode oscillations having a predetermined frequency; means for generating oscillations in electrical potentials in dependency on the sound produced by the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

4. A device for comparing the sound produced by the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; means connected to said anode of said thyratron for imparting to said anode oscillations having a predetermined frequency; means for generating oscillations in electrical potentials in dependency on the sound produced by the activity to be compared, said means including a cathode follower; means for imparting to said control grid of said thyratron a potential controlled by said cathode follower; and recording means connected to said anode of said thyratron.

5. A device for comparing the sound produced by the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; means connected to said anode of said thyratron for imparting to said anode oscillations having a predetermined frequency; a microphone actuated by the sound produced by the physiological activity to be compared; an electric circuit connected to said microphone, said electric circuit generating a potential controlled by said microphone; means for imparting to said control grid of said thyratron the potential generated in said electric circuit; and recording means connected to said anode of said thyratron.

6. A device for comparing the sound produced by the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; means connected to said anode of said thyratron for imparting to said anode oscillations having a predetermined frequency; a microphone actuated by the sound produced by the physiological activity to be compared; an electric circuit connected to said microphone and including a cathode follower, said electric circuit generating a potential controlled by said microphone; a connection between said cathode follower and said control grid of said thyratron so as to impart to the same the potential generated in said electric circuit; and recording means connected to said anode of said thyratron.

7. A device for comparing the sound produced by the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; means connected to said anode of said thyratron for imparting to said anode oscillations having a predetermined frequency; a microphone actuated by the sound produced by the physiological activity to be compared; an amplifier connected to said microphone; a cathode follower having the input thereof connected to said amplifier, the output of said cathode follower being connected to the control grid of said thyratron so as to impart to the same potentials dependent on the sound produced by the physiological activity to be compared; and recording means connected to said anode of said thyratron.

8. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; means including a cathode follower connected to said anode of said thyratron for imparting to said anode oscillations having a predetermined frequency; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

9. A device fore comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube generating oscillations having a predetermined frequency; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

10. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube having a cathode; an oscillating circuit including a resistor and a capacity connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube, said oscillating stage generating oscillations having a predetermined frequency; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

11. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron said oscillating stage including an oscillating tube having a cathode, a grid and an anode; an oscillating circuit including a constant resistor and a capacity connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube; a tuning circuit including a plurality of variable resistors connected with one end thereof to said oscillating circuit, said tuning circuit being connected to said grid of said oscillating tube, said oscillating stage generating oscillations having a predetermined frequency; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

12. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a predetermined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations, said substantially square output oscillations of said amplifying tube being supplied to said anode of said thyratron; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

13. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a predetermined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations; a cathode follower having a control grid connected to the output of said amplifying tube, the output of said cathode follower being connected with said anode of said thyratron so as to impart to the same potentials corresponding to said substantially square output oscillations of said amplifier; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

14. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube having a cathode, a grid and an anode; an oscillating circuit including a constant resistor and a capacitor connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube; a tuning circuit including a plurality of variable resistors connected with one end thereof to said oscillating circuit, said tuning circuit being connected to said grid of said oscillating tube, said oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a predetermined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations, said substantially square output oscillations of said amplifying tube being supplied to said anode of said thyratron; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

15. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube having a cathode, a grid and an anode; an oscillating circuit including a constant resistor and a capacity connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube; a tuning circuit including a plurality of variable resistors connected with one end thereof to said oscillating circuit, said tuning circuit being connected to said grid of said oscillating tube, said oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a prede-

termined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations; means for generating oscillations in electrical potentials in dependency on the activity to be compared; means for imparting to said control grid of said thyratron a potential controlled by said generating means; and recording means connected to said anode of said thyratron.

16. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube having a cathode, a grid and an anode; an oscillating circuit including a constant resistor and a capacity connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube; a tuning circuit including a plurality of variable resistors connected with one end thereof to said oscillating circuit, said tuning circuit being connected to said grid of said oscillating tube, said oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a predetermined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations said substantially square output oscillations of said amplifying tube being supplied to said anode of said thyratron; a microphone actuated by the sound produced by the physiological activity to be compared; an electric circuit connected to said microphone, said electric circuit generating a potential controlled by said microphone; means for imparting to said control grid of said thyratron the potential generated in said electric circuit; and recording means connected to said anode of said thyratron.

17. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube having a cathode, a grid and an anode; an oscillating circuit including a constant resistor and a capacity connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube; a tuning circuit including a plurality of variable resistors connected with one end thereof to said oscillating circuit, said tuning circuit being connected to said grid of said oscillating tube, said oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a predetermined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations said subtsantially square output oscillations of said amplifying tube being supplied to said anode of said thyratron; a microphone actuated by the sound produced by the physiological activity to be compared; an electric circuit connected to said microphone and including a first cathode follower, said electric circuit generating a potential controlled by said microphone; a connection between said second cathode follower and said control grid of said thyratron so as to impart to the same the potential generated in said electric circuit; and recording means connected to said anode of said thyratron.

18. A device for comparing the physiological activity of an organ to a standard, comprising in combination, a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube having a cathode, a grid and an anode; an oscillating circuit including a constant resistor and a capacity connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube; a tuning circuit including a plurality of variable resistors connected with one end thereof to said oscillating circuit, said tuning circuit being connected to said grid of said oscillating tube, said oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a predetermined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations, said substantially square output oscillations of said amplifying tube being supplied to said anode of said thyratron; a mircophone actuated by the sound produced by the physiological activity to be compared; an amplifier connected to said microphone; a second cathode follower having the input thereof connected to said amplifier, the output of said second cathode follower being connected to the control grid of said thyratron so as to impart to the same potentials dependent on the sound produced by the physiological activity to be compared; and recording means connected to said anode of said thyratron.

19. A device for comparing the physiological activity of an organ to a standard, comprising in combination a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube having a cathode, a grid and an anode; an oscillating circuit including a constant resistor and a capacity connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube; a tuning circuit including a plurality of variable resistors connected with one end thereof to said oscillating circuit, said tuning circuit being connected to said grid of said oscillating tube, said oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a predetermined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations, said substantially square output oscillations of said amplifying tube being supplied to said anode of said thyratron; a microphone actuated by the sound produced by the physiological activity to be compared; an amplifier connected to said microphone; a second cathode follower having the input thereof connected to said amplifier, the output of said second cathode follower being connected to the control grid of said thyratron so as to impart to the same potentials dependent on the sound produced by the physiological activity to be compared; and recording means inserted between the cathode of said cathode follower and said anode of said thyratron.

20. A device for comparing the physiological activity of an organ to a standard, comprising in combination a thyratron having a control grid and an anode; an oscillating stage connected to said anode of said thyratron, said oscillating stage including an oscillating tube having a cathode, a grid and an anode; an oscillating circuit including a constant resistor and a capacity connected in parallel with each other, said oscillating circuit being connected to said cathode of said oscillating tube; a tuning circuit including a plurality of variable resistors connected with one end thereof to said oscillating circuit, said tuning circuit being connected to said grid of said oscillating tube, said oscillating tube generating oscillations having a predetermined frequency; an amplifying tube forming part of said oscillating stage and having a control grid fed with the oscillations having a predetermined frequency and generated by said oscillating tube, said amplifying tube being biased so as to generate substantially square output oscillations, said substantially square output oscillations of said amplifying tube being supplied to said anode of said thyratron; a microphone actuated by the sound produced by the physiological activity to be compared; an amplifier connected to said microphone; a second cathode follower having the input thereof connected to said amplifier, the output of said second cathode follower being connected to the control grid of said thyratron so as to impart to the same potentials dependent on the sound produced by the physiological activity to be compared; a frequency meter connected to said first cathode follower; and recording means inserted between the cathode of said cathode follower and said anode of said thyratron.

No references cited.