

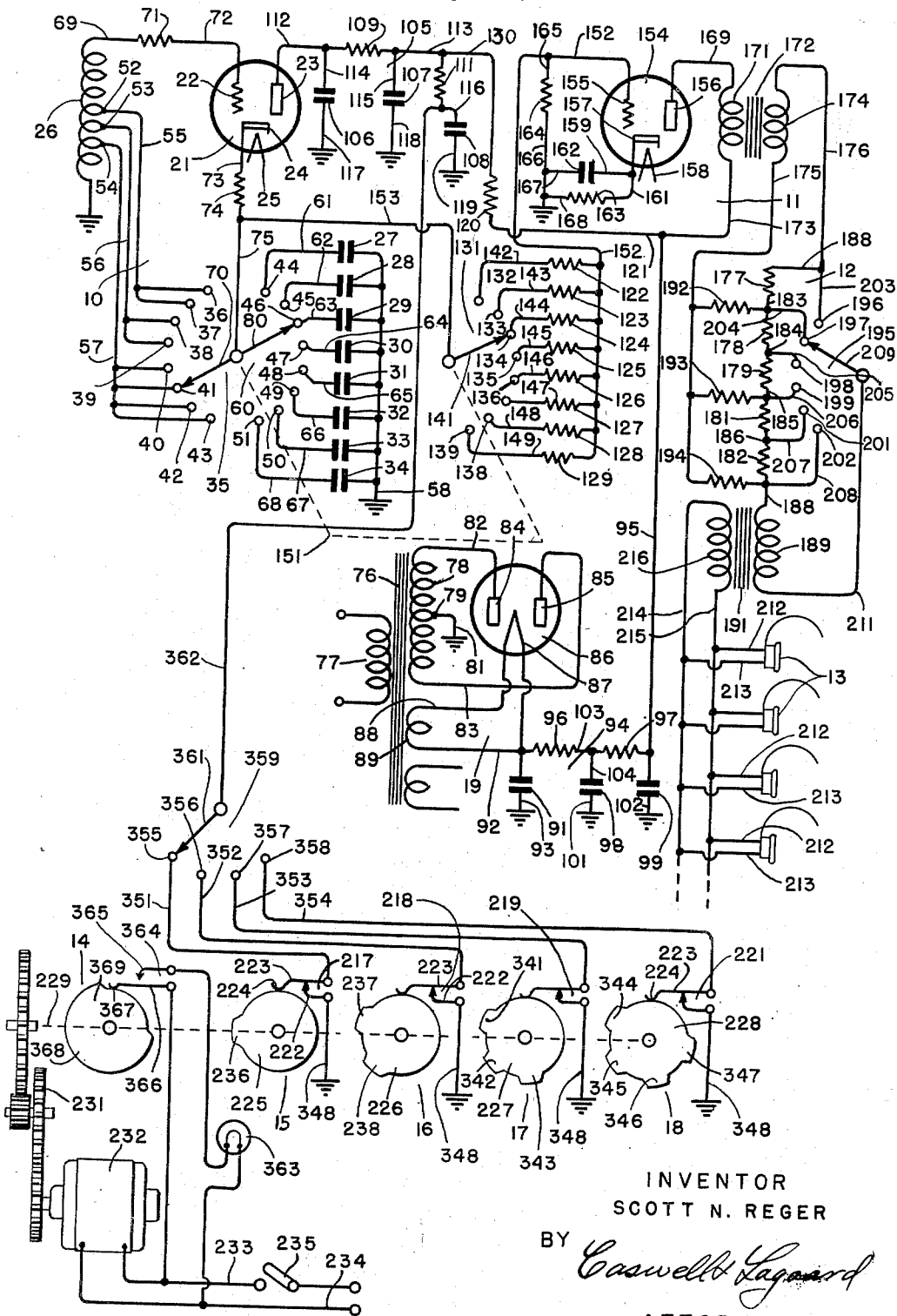
Jan. 9, 1951

S. N. REGER

2,537,911

AUDIOMETER

Filed Sept. 18, 1946



INVENTOR
SCOTT N. REGER

BY *Caswell Lazard*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,537,911

AUDIOMETER

Scott N. Reger, Iowa City, Iowa, assignor to Patent Management, Incorporated, Minneapolis, Minn., a corporation of Minnesota

Application September 18, 1946, Serial No. 697,822

17 Claims. (Cl. 179—1)

My invention relates to audiometers and has for an object to provide an audiometer by means of which a number of patients may be simultaneously examined.

Another object of the invention resides in providing an audiometer having a number of outlets from which the same sounds may emanate, and in modifying the sounds without changing their frequency so that the patient may differentiate the different sounds and designate the same without knowing the frequency or intensity of said sounds.

A still further object of the invention resides in providing an audiometer having a generator adapted to produce a continuous audible sound and in further providing a control device adapted to initiate said sound and to terminate said sound after a predetermined period.

An object of the invention resides in providing an audiometer in which the continuity of the sound may be varied in accordance with different predetermined sound patterns to produce one or more sound pulses of varying duration, number or arrangement.

A feature of the invention resides in providing a plurality of control devices for controlling the effectiveness of said generator, each adapted to produce a different sound pattern, and in providing selector means for selectively rendering any one of said control devices effective.

An object of the invention resides in utilizing in said generator, a thermionic oscillator and in providing means for making and breaking one of the circuits associated therewith in accordance with predetermined sound patterns.

Other objects of the invention reside in the novel combination and arrangement of parts and in the details of construction hereinafter illustrated and/or described.

In the drawing, the figure is a wiring diagram of an audiometer illustrating an embodiment of my invention.

In the operation of my invention, a generator is employed which is adapted to produce continuous audible sounds of different frequencies and intensities. These sounds are interrupted in a manner to give individual sounds of definite duration and separated by dwell periods of predetermined length. These individual sounds have been referred to in the specification and claims as sound pulses to distinguish from the resultant sound which has merely been designated as a sound and which may consist of one or more pulses.

The invention consists of an oscillator 10 which

produces an alternating or pulsating electric current. This current passes through an amplifier 11 and through an attenuator 12 from which the same is directed into a number of sound producing devices 13. The sound producing devices 13 convert the alternating current into audible sounds which may be discerned by the patients being examined. The oscillator 10 and the sound producing devices 13 constitute a generator for the sounds utilized in the invention. The current produced by the generator is controlled by a number of control devices 15, 16, 17 and 18 which interrupt or vary the current in different ways so as to enable the patient to distinguish the different sounds produced by means other than by the frequency or intensity of the sound. Each control device interrupts the sound in a different predetermined manner which I have referred to as a sound pattern, the said sound patterns depending upon the form and construction of the particular control device. In addition, a signaling device 14 informs the patient when the device is in operation. A power supply unit 19 furnishes suitable current for operating the invention. These parts of the invention will now be described in detail.

The oscillator 10 consists of a thermionic tube 21 having a grid 22, a plate 23, a cathode 24 and a heater 25 for said cathode. The tube 21 is coupled with a portion of an inductance 26 and any of a number of condensers 27, 28, 29, 30, 31, 32, 33 and 34, which are connected in series to form a resonant circuit. This construction provides an oscillator which produces an alternating or pulsating current whose frequency depends upon the relation between the inductance and condenser connected in the circuit. For connecting a certain portion of the inductance 26 and any one of the various condensers in the circuit, two multiple contact switches 35 and 36 are employed. The switch 35 has a number of fixed contacts, 36, 37, 38, 39, 40, 41, 42 and 43 and a movable switch arm 70. The switch 36 has a number of fixed contacts, 44, 45, 46, 47, 48, 49, 50 and 51 and a movable switch arm 80. Both of the switch arms 70 and 80 are mounted on the same shaft, which is diagrammatically indicated at 151 in the drawing, and travel in unison so that certain of the sections of the inductance 26 are always connected to certain of the condensers 27 to 34 inclusive. The inductance 26 is provided with three taps 52, 53 and 54. A conductor 55 is connected to the tap 52 and also to both of the contacts 36 and 37. Another conductor 56 is connected to the tap 53 and to both

of the contacts 38 and 39. While another conductor 57 is connected to the tap 54 and to all of the contacts 40, 41, 42 and 43. One side of each of the condensers 27 to 34 inclusive is connected to a conductor 53 which is grounded. The other sides of these condensers are connected by means of conductors 61, 62, 63, 64, 65, 66, 67 and 68 to the respective contacts 44 to 51 inclusive. The inductance 26 is connected by means of a conductor 69 with a resistor 71 which, in turn, is connected by means of a conductor 72 with the grid 22 of tube 21. The cathode 24 of this tube is connected by means of a conductor 73 with a resistor 74 which, in turn, is connected by means of a conductor 75 with both of the switch arms 79 and 80. It will thus be seen that one of the condensers 27 to 34 inclusive and a portion of the inductance 26 are connected in series in the grid circuit of the tube 21.

For the purpose of providing current for operating the invention, the power supply 19 is employed. This power supply includes a transformer 76 having a primary 77 adapted to be connected to a suitable source of alternating current. This transformer also has a secondary 78 which is provided with a center tap 79 and which is connected to ground by means of a conductor 81. The ends of this secondary are connected by means of conductors 92 and 93 to the plates 84 and 85 of a rectifier tube 86. The filament 87 of this tube is connected by means of a conductor 88 to a secondary winding 89 on the transformer 76. This winding is connected to a condenser 91 by means of a conductor 92. Condenser 91 is grounded through a conductor 93. Another conductor 96 connects the other side of the filament 87 to conductor 92. The output of the tube 86 is directed through a filter system 94 and from which direct current is furnished to the audiometer by means of a conductor 95. The filter system 94 includes two resistances 98 and 97 and in addition to the condenser 91, two other condensers 99 and 99. Both the condensers 98 and 99 are grounded through conductors 101 and 102. The resistance 98 is connected to the conductor 92 and by means of conductor 103, to the resistance 97. This resistance is, in turn, connected to the conductor 95. Condenser 99 is connected by means of a conductor 104 with the conductor 103 while condenser 99 is directly connected to the conductor 95.

The plate 23 of tube 21 is connected to a filter system 105 which consists of three condensers 106, 107 and 108 and two resistors 109 and 111. The plate 23 is connected by means of a conductor 112 to the resistor 109 which is connected by means of a conductor 113 to the resistor 111. A conductor 114 connects the conductor 112 with condenser 106 and another conductor 115 connects the conductor 113 with condenser 107. In a similar manner, a conductor 116 connects the resistor 111 with the condenser 108. All three condensers 106, 107 and 108 are grounded through conductors 117, 118 and 119. Plate voltage is procured for the tube 21 from the conductor 95. A branch conductor 121 is connected to the conductor 95 and to a resistance 129. This resistance is connected by means of a conductor 130 to conductor 113.

Due to the fact that certain frequencies are more audible to the human ear than other frequencies, it becomes necessary to equalize the output of the oscillator 19 in accordance with the frequencies of the currents produced thereby. For this purpose, a series of equalizing resistors

122, 123, 124, 125, 126, 127, 128 and 129 are employed. Also, an additional multiple contact switch 131 is used. This switch has a number of contacts 132 to 139 inclusive which are connected to the various resistors 122 to 129 by means of conductors 142 to 149 inclusive. Switch 131 also includes a switch arm 141 which is adapted to make contact with any of said contacts. The three switches 35, 60 and 131 are all ganged and the switch arms 79, 80 and 141 of the same are all connected to the common shaft 151, previously referred to. By the selection of suitable values for the resistors 122 to 129 inclusive, the output from the oscillator 19 can be so regulated that the sounds produced by the sound producing devices 13 are comparable. All of the resistors 122 to 129 inclusive are connected to a common conductor 152 which will be subsequently referred to. The switch arm 141 is connected by means of a conductor 153 with the conductor 75 which is associated with switch 25 and 60.

The amplifier 11 is merely shown diagrammatically and a single stage has been illustrated. It can, however, be readily comprehended that any type of amplifier may be employed and as many stages as found necessary utilized. The amplifier 11 includes a thermionic tube 154 having a grid 155, a plate 156, a cathode 157 and a heater 158 for the same. The conductor 152 previously referred to, is connected directly to the grid 155 of the tube 154. A resistor 164 is connected by means of a conductor 165 to the conductor 152. Said resistor is further connected by means of a conductor 166 to ground. The cathode 157 of this tube is connected by means of conductors 159 and 161 to a condenser 162 and a resistor 163. This condenser and resistor are in turn connected by means of conductors 167 and 168 to the conductor 166 and thus grounded. The plate 156 of the tube 154 is connected by means of a conductor 169 with one side of the primary 171 of an output transformer 172. The other side of this primary is connected by means of a conductor 173 with the conductors 121 and 95. Thus, plate voltage is furnished through the primary of this transformer to the plate 156 of the tube 154. The secondary 174 of the transformer 172 is connected to conductors 175 and 176 which impresses the amplified voltage upon the attenuator 12.

The attenuator 12 comprises five resistors 177, 178, 179, 181 and 182 which are connected in series by means of conductors 183, 184, 185 and 186. The resistor 177 is further connected by means of a conductor 187 with the conductor 176. Resistor 182 is connected by means of a conductor 188 with the primary 189 of a transformer 191. In addition to the five resistors 177, 178, 179, 181 and 182, three other resistors 192, 193 and 194 are employed. These resistors are all connected at one end to the conductor 175 from the secondary 174 of transformer 172. The other ends of these resistors are connected to the conductors 183, 185 and 188 previously referred to. The attenuator 12 also includes a selector switch 195 which comprises a number of contacts 196, 197, 198, 199, 201 and 202. These contacts are connected by means of conductors 203, 204, 205, 206, 207 and 208 to the various conductors 183, 184, 185, 186 and 188 respectively. Said switch includes a switch arm 209 which is adapted to make contact with any of the said contacts. This switch arm is connected by means of a conductor 211 with the primary 189 of transformer 191.

The sound producing devices 13 may be of any suitable character or construction. For the purpose of illustration, ear phones have been shown, there being as many of the said ear phones as there are patients to be examined. Each of the ear phones 13 is connected by means of conductors 212 and 213 to two other conductors 214 and 215. These latter conductors are, in turn, connected to the secondary 216 of the transformer 191.

The control devices 15, 16, 17 and 18 include switches 217, 218, 219 and 221. These switches each have a fixed contact 222 and a movable contact 223. The contact 223 has a lug 224 adapted to engage one of a corresponding number of cams 225, 226, 227 and 228. All of these cams are mounted on a single shaft 229 which is connected to a system of reduction gearing which is diagrammatically indicated at 231. This gearing is operated by an electric motor 232. Motor 232 has connected to it, conductors 233 and 234 which, in turn, are connected to a suitable source of electric energy such as the line used for energizing transformer 76. A manually operated switch 235 is disposed in the conductor 233 and serves to actuate or shut off the motor 232. The cam 225 has a single hump 236 on the same which is adapted to engage the lug 224 of switch arm 223 and to open the switch 217 once for every revolution of the shaft 229. The cam 226 has two humps 237 and 238 which are successively adapted to engage the lug 224 of switch arm 223 of switch 218 and open said switch, twice in succession. In a similar manner, cam 227 has three humps 341, 342 and 343 which similarly open the switch 219 three times during each revolution of shaft 229. Cam 228 has four humps 344, 345, 346 and 347 which operate in the same manner and which serve to open the switch 221 four times during each revolution of the shaft 229. All of the contacts 222 are connected by means of conductors 348 to ground. The movable contacts 223 of the switches 217, 218, 219 and 221 are connected by means of conductors 351, 352, 353 and 354 to the contacts 355, 356, 357 and 358 of a selector switch 359. This switch also includes a movable arm 361 which is connected by means of a conductor 362 to the conductor 116 previously referred to.

In conjunction with the sound generator used in the audiometer, the visible signaling device 14 is employed which includes a lamp 363. This lamp is controlled by means of a switch 364 similar to switch 217. The switch 217 is normally open and has a fixed contact 365 and a movable contact 366. The latter contact has a hump 367 which is adapted to be engaged by a raised portion 368 of a cam 369. The raised portion 368 is co-extensive with the circumferential extent of all the humps 344, 345, 346 and 347 of cam 228. By means of this construction, the light 363 is turned on during such portion of the cycle of operation of the shaft 229 in which the various sound pulses are given.

The operation of the invention is as follows: When the switch 235 is closed, a circuit is established through the motor 232 which drives the shaft 229. When the hump 367 of switch arm 366 of switch 364 engages the raised portion 368 of cam 369, the light 363 becomes illuminated. At the same time, a circuit is established through one of the switches 217, 218, 219 or 221 depending upon the position of the switch arm 361 of switch 359. If the said switch arm engages contact 355, the circuit is established through

switch 217. This circuit includes conductor 362 which is connected with the plate of tube 21. This circuit, when closed, reduces the potential to the plate 23 of said tube and renders the oscillator 10 inoperative. As soon as hump 224 of switch arm 223 engages the raised portion 236 of cam 225, the said switch is opened and the oscillator 10 allowed to function for the period determined by the circumferential extent of the raised portion 236 of said cam. This produces one pulse by the oscillator 10 which, in turn, is converted into one sound pulse in each of the ear phones 13. The output of tube 21 is taken from the cathode 24 of said tube and passes through the equalizing resistors 122 to 129 inclusive and to the grid 155 of tube 154. The output of the tube 154 is delivered to the attenuator 12 which delivers the energy to the ear phones 13 by means of which the same is converted into sounds.

The device is so constructed, that the oscillator 10 can be caused to operate at any of a certain number of frequencies which are determined by the values of the condensers 27 to 34 inclusive and the portions of the inductance 56 connected in series therewith. The switch 131, being connected to the shaft 151 which also operates switches 35 and 60, causes the oscillator to deliver comparable alternating currents of predetermined frequency depending upon the setting of the said shaft and switches.

The attenuator 12 operates to vary the intensity of the alternating current from the output transformer 172 and delivers the same to the transformer 191. The ear phones 13 are fed from the secondary 216 of this transformer.

When the operator is about to test a number of patients, the procedure is as follows: Each of the patients to be examined is given one of the ear phones 13 and instructed to watch the light 363. He is told when the light goes on, to listen and count the number of sound pulses he hears. He is then required to note on a suitable record, the number of sound pulses he heard and if he heard no sounds whatsoever, to so note. The operator first sets the shaft 151 to the proper position to cause the oscillator 10, when energized, to generate the desired frequency on which the test is to be made. He usually starts at one end or the other of the audible frequency range. The contact arms 70, 80 and 141 of the three switches 35, 60 and 131 are brought to the proper contacts to give the desired frequency. Attenuator 195 is then set by moving the switch arm 201 to the desired contact giving the greatest intensity of the sound. The operator then selects by means of switch 359, the particular pattern of the sound to be given. In the particular device shown, the sound may be interrupted so as to produce one, two, three or four successive pulses. If the switch arm 361 is positioned as indicated in the drawing, the circuit through the switch 217 is closed and the device gives a single pulse. Switch 235 is then closed and the motor 232 actuated. When the cam 369 comes around the proper position, switch contact 366 is caused to ride on the raised portion 368 of cam 369 which closes switch 364. This causes the light 363 to become illuminated and the patients all listen for the sound. As the shaft 229 continues to rotate, the raised portion 236 of cam 225 opens switch 217 and breaks the circuit through the conductor 362 which is connected to the plate circuit of the tube 21. When the said switch is open, full plate voltage is applied to the plate 33 and the oscillator op-

erates. The output from the oscillator feeds through the equalizing resistors 122 to 129 inclusive and to the amplifier 11. The output of the amplifier 11 is delivered to the attenuator 12 which delivers the energy to the ear phones 13 by means of which the same is converted into audible sounds. While the light 363 is lit, the single hump 236 of cam 225 causes a single pulse to be heard in the ear phones. The operator then changes the position of the selector switch 359, maintains the frequency of the generator the same and changes the intensity of the sound. If the maximum intensity was produced on the first test, the successive tests will be for lesser intensities. When the operator has gone through the various intensities for one frequency, he changes and does the same for another frequency. The number of pulses heard each time is dependent upon the will of the operator and the listener never knows how many pulses he is about to hear. It therefore becomes impossible for the patient to falsify and claim he heard sounds which he was unable to hear since he has to mark down the number of pulses heard and he would be unable to guess at the right number of pulses. While the operator usually gives the tests with the different frequencies and intensities in succession, it can be readily comprehended that these may be mixed up and the patients still further put off guard.

In the form of the invention illustrated, the sounds have been broken up into a number of successive pulses of equal duration, and with equal dwells between the same. It may, however, be readily comprehended that other sound patterns may be employed. For example, the sound pattern may consist of pulses of different duration. It is also possible to vary the pattern by varying the dwell between the pulses. Likewise, any combination of sound patterns may be employed.

My invention is highly advantageous in that it is possible to test numerous patients at the same time. With my invention, it becomes practically impossible for the patient to falsify due to the fact that he has to note the number or character of the pulses heard. An audiometer constructed in accordance with my invention, can be constructed at a cost not greatly exceeding that of the ordinary audiometer. The audiometer may also be used in the conventional manner. My invention is simple in construction and practical in operation.

Changes in the specific form of my invention, as herein described, may be made within the scope of what is claimed without departing from the spirit of my invention.

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

1. In an audiometer for simultaneously testing a number of persons, an oscillator for producing a continuous alternating current, sound producing means actuated thereby, means including an attenuator for varying the intensity of said sound, a cyclically operable control device including means to interrupt the continuity of the alternating current flow according to a predetermined sound pattern during each cycle and visual means for indicating the beginning of the cycle during which the control device is functioning and operating concurrently with said control device.

2. In an audiometer, an oscillator for producing a continuous alternating current, sound producing means actuated thereby, means including

an attenuator for varying the intensity of said sound, a plurality of cyclically operated control devices each including means to successively interrupt the continuity of said current according to a different predetermined sound pattern during each cycle and means for selectively rendering any of said control devices effective.

3. In an audiometer, a generator for producing a continuous alternating current, sound producing means actuated thereby, means including and electric circuit, an attenuator for varying the intensity of said sound and a cyclically operated control device for successively interrupting the alternating current flow in said circuit in accordance with a predetermined sound pattern during each cycle.

4. In an audiometer, an oscillator for producing a continuous varying current, sound producing means actuated thereby, means including an electric control circuit for controlling the production of the sound, and a plurality of branch circuits connected thereto, a switch in each of said branch circuits for rendering said control circuit operative to control the production of the sound, a plurality of cyclically operated cams each operating one of said switches to control the sound in accordance with a predetermined sound pattern, selector means for connecting any of said branch circuits with said control circuit, a signal for indicating the beginning of the cycle during which said branch circuit switches are operated and means for simultaneously operating all of said cams and said signal.

5. In an audiometer, an adjustable oscillator, means including a sound producing device energized by said oscillator, means including an attenuator for varying the intensity of the sound produced by said sound producing device, means including a plurality of control devices for controlling the initiation and termination of the sound produced by said sound producing device said control devices each operating in accordance with a different sound pattern, selector means for selecting the frequency at which said oscillator operates, selector means for varying the intensity of the sound produced by said sound producing device and selector means for selecting the particular control device to control said oscillator.

6. In an audiometer, an oscillator for producing a continuous alternating current, sound producing means actuated thereby, means including an attenuator for varying the intensity of said sound and means including a cyclically operated control device adapted to convert said continuous sound into a number of separate sound pulses during each cycle.

7. In an audiometer, generating means for producing alternating current and including a plurality of thermionic tubes, sound producing means actuated thereby, means including a control circuit connected to one of said tubes for controlling the conductivity of said tube, a plurality of branch circuits connected thereto, a switch in each of said branch circuits for causing said control circuit to function, a plurality of cyclically operated cams each of different form, each operating one of said switches, each of said cams causing said sound producing means to produce a series of sound pulses of a differing predetermined sound pattern and selector means for connecting any of said branch circuits to said control circuit.

8. In an audiometer, generating means for producing alternating current and including a plurality of thermionic tubes, sound producing

means actuated thereby, means including a control circuit connected to one of said tubes for controlling the conductivity of said tube, a plurality of branch circuits connected thereto, a switch in each of said branch circuits for causing said control circuit to function, a plurality of cyclically operated cams each of different form, each operating one of said switches, each of said cams causing said sound producing means to produce a series of sound pulses of a differing predetermined sound pattern, selector means for connecting any of said branch circuits to said control circuit, a signal for indicating the beginning of the cycle during which said branch circuit switches are operated and means for simultaneously operating all of said cams and said signal.

9. In an audiometer, generating means for producing alternating current and including a plurality of thermionic tubes, sound producing means actuated thereby, means including a control circuit connected to one of said tubes for controlling the conductivity of said tube, a plurality of branch circuits connected thereto, a switch in each of said branch circuits for causing said control circuit to function, a plurality of cyclically operated cams each of different form, each operating one of said switches, each of said cams causing said sound producing means to produce a series of sound pulses of a differing predetermined sound pattern, selector means for connecting any of said branch circuits to said control circuit, a signal for indicating the beginning of the cycle during which said branch circuit switches are operated, a cam for operating said signal and means for simultaneously operating all of said cams.

10. In an audiometer, generating means for producing alternating current and including a plurality of thermionic tubes, sound producing means actuated thereby, means including a control circuit connected to one of said tubes for controlling the conductivity of said tube, a plurality of branch circuits connected thereto, a switch in each of said branch circuits for causing said control circuit to function, cam means for operating said switches to produce with each branch circuit a number of sound pulses differing according to predetermined sound patterns and means for selectively connecting any of said branch circuits to said control circuit.

11. In an audiometer for simultaneously testing a number of persons, an electrical generator including an adjustable oscillator, means whereby energization of said oscillator produces alternating currents of various frequencies, means including a plurality of sound producing devices having substantially identical sound producing characteristics, one for each person in the group, means whereby said sound producing devices are simultaneously actuated by said oscillator, means including an attenuator for simultaneously regulating in each of said sound producing devices the intensities of the sounds, a time controlled mechanism, oscillator energizing means, a control circuit connected thereto and including switch means operated by said time controlled mechanism for intermittently actuating said oscillator energizing means to energize said oscillator to cause said sound producing devices to produce a certain sound pattern, a second control circuit connected to said oscillator energizing means and including switch means operated by said time controlled mechanism for intermittently actuating said oscillator energizing

means to energize said oscillator to cause said sound producing devices to produce a second sound pattern, and visual indicating means actuated by said time controlled mechanism for indicating the listening period and operative during actuation of either of said control circuits.

12. In an audiometer for simultaneously testing a number of persons, an electrical generator including an adjustable oscillator, means whereby energization of said oscillator produces alternating currents of various frequencies, means including a plurality of sound producing devices having substantially identical sound producing characteristics, one for each person in the group, means whereby said sound producing devices are simultaneously actuated by said oscillator, means including an attenuator for simultaneously regulating in each of said sound producing devices the intensities of the sounds, a time controlled mechanism, visual indicating means actuated thereby for indicating the listening period and operable for a definite time period, oscillator energizing means, a normally inactive control circuit connected thereto and including switch means operated by said time controlled mechanism, said circuit upon actuation intermittently actuating said oscillator energizing means to energize said oscillator to cause said sound producing device to produce a certain sound pattern, a second normally inactive control circuit connected to said oscillator energizing means and including switch means operated by said time controlled mechanism, said second circuit upon actuation intermittently actuating said oscillator energizing means to energize said oscillator to cause said sound producing device to produce a second sound pattern, the switch means of both of said control circuits being operated during said period, and means for selectively actuating either of said control circuits.

13. In an audiometer for simultaneously testing a number of persons, an electrical generator including an adjustable oscillator, means whereby energization of said oscillator produces alternating currents of various frequencies, means including a plurality of sound producing devices having substantially identical sound producing characteristics, one for each person in the group, means whereby said sound producing devices are simultaneously actuated by said oscillator, means including an attenuator for simultaneously regulating in each of said sound producing devices the intensities of the sounds, a time controlled mechanism, including a rotating shaft, visual indicating means actuated by said shaft for indicating the listening period and operable for a definite period, oscillator energizing means, a normally inactive control circuit connected to said oscillator energizing means and including switch means, means on said shaft for successively operating said switch means to cause said circuit upon actuation to intermittently energize said oscillator and cause said sound producing device to produce a number of sound pulses, a second normally inactive control circuit connected to said oscillator energizing means and including switch means operated by said shaft, means on said shaft for successively operating said second named switch means to cause said circuit upon actuation to intermittently actuate said oscillator energizing means to energize said oscillator and cause said sound producing device to produce a different number

11

of sound pulses, the switch means of both of said control circuits being operated during said period, and means for selectively actuating either of said control circuits.

14. In an audiometer, an oscillator for producing a continuous varying current, sound producing means actuated thereby, means including an electric control circuit for controlling the production of the sound, and a plurality of branch circuits connected thereto, a switch in each of said branch circuits for rendering said control circuit operative to control the production of the sound, a plurality of cyclically operated cams each of different form for operating one of said switches to control the sound in accordance with a predetermined sound pattern and selector means for connecting any of said branch circuits with said control circuit.

15. In an audiometer, an oscillator for producing a continuous varying current, sound producing means actuated thereby, means including an electric control circuit for controlling the production of the sound, and a plurality of branch circuits associated therewith, a switch in each of said branch circuits for rendering said control circuit operative to control the production of the sound, a plurality of cyclically operated cams each operating one of said switches to control the sound in accordance with a predetermined sound pattern, selector means for connecting any of said branch circuits with said control circuit and means for simultaneously operating all of said cams.

16. In an audiometer, an oscillator for producing a continuous varying current, sound producing means actuated thereby, means including an electric control circuit for controlling the

12

production of the sound, and a plurality of branch circuits connected thereto, a switch in each of said branch circuits for rendering said control circuit operative to control the production of the sound, a plurality of cyclically operated cams each operating one of said switches to control the sound in accordance with a predetermined sound pattern, selector means for connecting any of said branch circuits with said control circuit, a signal for indicating the beginning of a cycle during which said branch circuit switches are operated, a cam for operating said signal and means for simultaneously operating all of said cams.

17. In an audiometer, an oscillator for producing a continuous alternating current, sound producing means actuated thereby, and producing a continuous sound, means including an attenuator for varying the intensity of said sound, means including a plurality of cyclically operated control devices each converting said continuous sound into a different predetermined number of separate sound pulses during each cycle.

SCOTT N. REGER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 21,735	Huth et al.	Mar. 4, 1941
2,052,167	Coyne	Aug. 25, 1936
2,072,705	Bloomheart	Mar. 2, 1937
2,257,262	Koren	Sept. 30, 1941
2,257,263	Koren	Sept. 30, 1941
2,394,569	Strommen	Feb. 12, 1946