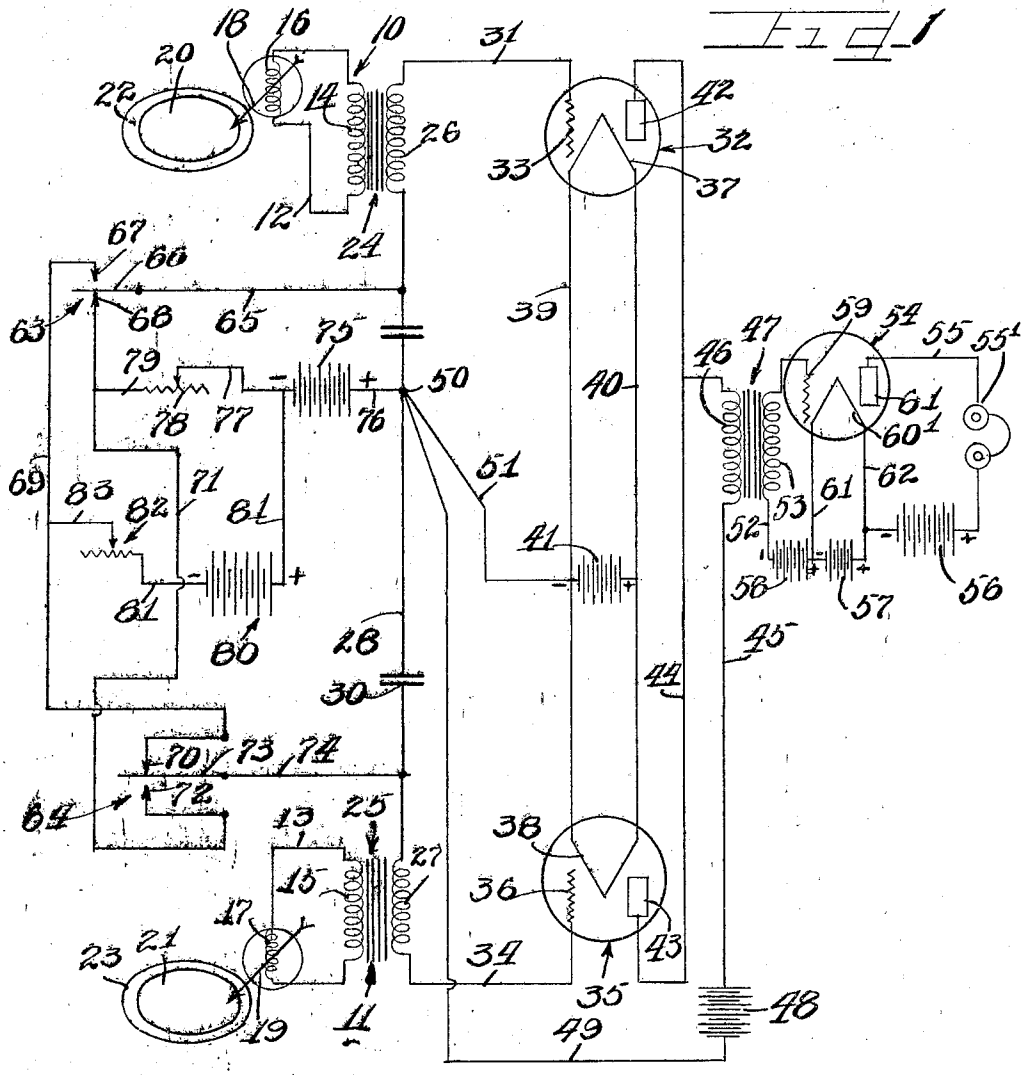
June 28, 1932. R. T. CLOUD 1,864,890

ELECTRICAL REPRODUCER

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Fig. 1



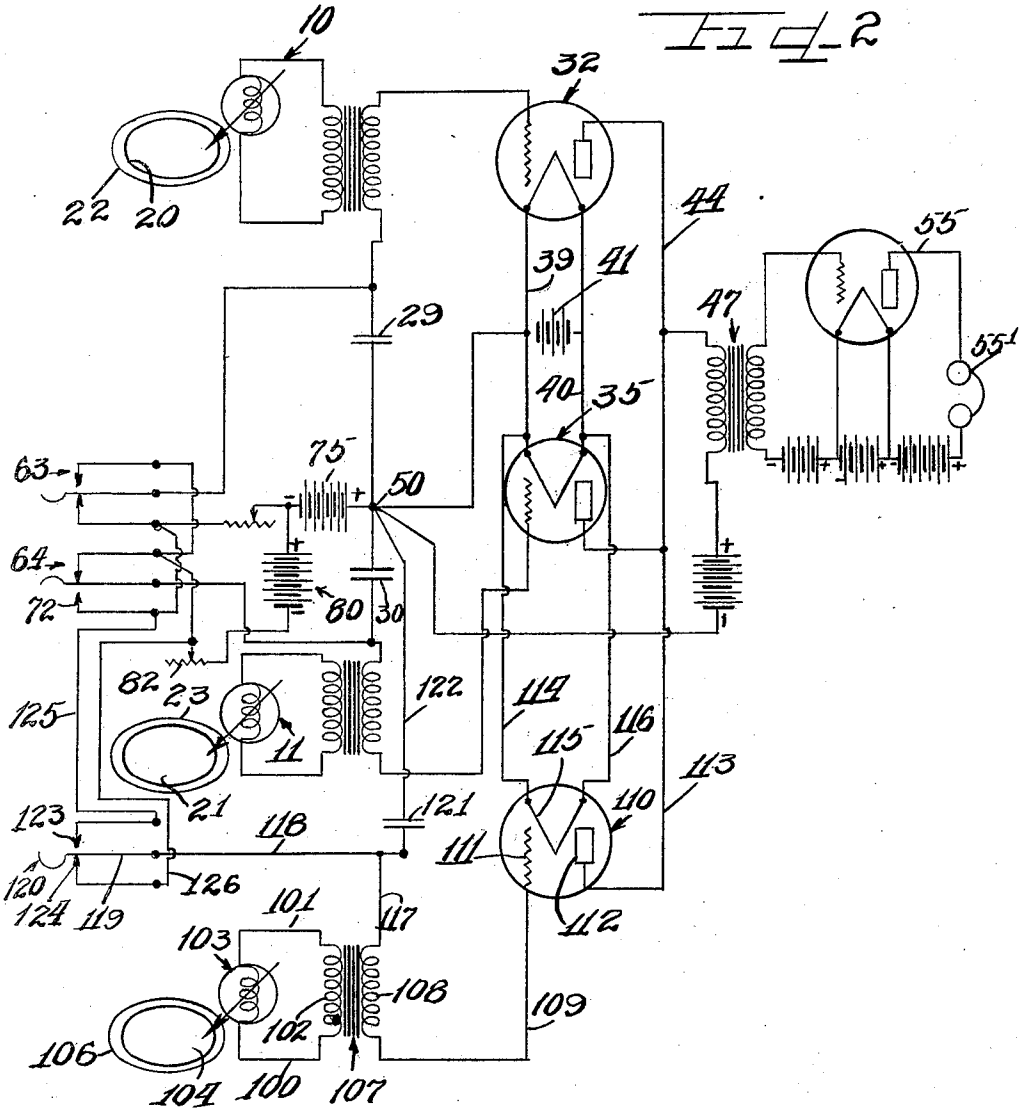
Inventor
Raymond T. Cloud
Charles W. Hills
by Attys

June 28, 1932. R. T. CLOUD 1,864,890

ELECTRICAL REPRODUCER

Filed Nov. 19, 1927 2 Sheets-Sheet 2

Fig. 2



Inventor

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Patented June 28, 1932 1,864,890

UNITED STATES PATENT OFFICE

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ELECTRICAL REPRODUCER

Application filed November 19, 1927. Serial No. 234,447.

My present invention pertains to electrical reproducing apparatus, and more particularly to a method of and an apparatus for contemporaneously reproducing, in a single reproducing unit, the electrical impulses from a plurality of different sources. More specifically, the invention relates to a method of and an apparatus for controlling the reproduction of music or other sound waves in a single reproducing unit from a plurality of records, in such a manner that even though the records might be at all times in contact with the respective electrical pick-ups, still music may be reproduced selectively from any one or more of the records as desired, and not from the others.

An object of my invention resides in the provision of a method of and an apparatus for electrically reproducing the waves recorded on records in such a manner that any one of the records may be alternately and selectively reproduced as desired.

Another object of my invention is the provision of a method of and an apparatus for controlling the reproduction of waves from a plurality of records in such a manner that the impulses from one record can be caused to gradually decrease in volume, whereas the impulses from the other record can be contemporaneously gradually increased in volume, thus enabling the reproduction of an electrical wave which is the resultant wave of the different sets of impulses.

Still another object of my invention has to do with the provision of a method of and an apparatus for electrically reproducing the waves recorded on a plurality of records in such a way that these records can be alternately reproduced without the detection of the change from one record to the other.

A further object of my invention is the provision of a method of and an apparatus for electrically reproducing the waves recorded on a plurality of records in such a manner that the reproduction is a resultant wave in which the components are overlapping impulses from the different records.

A still further object of my invention is the provision of a method of and an apparatus for electrically reproducing the music recorded on a plurality of different records in such a manner that the music produced consists of overlapping waves from the different records, thus enabling the alternate reproduction of each of the records without the listener being ordinarily able to detect when the change is made from one record to another.

Another and further object of my invention resides in the provision of a method of and an apparatus for controlling or delaying the action of a thermionic valve in such a manner that it does not become fully operative or inoperative until a predetermined period of time has elapsed.

A still further object of my invention has to do with the provision of a method of and an apparatus for exponentially varying the electron emission in a thermionic valve.

A further object of the invention is the provision of a method of and an apparatus for reproducing sound from a plurality of phonograph records in a single sound reproducing unit, in such a way that the intensity of the sound from each of the several records may be varied, while the intensity, of the sound emitted by the single reproducing unit remains substantially constant.

Another important object of my invention is the provision of a method of and an apparatus for electrically reproducing musical waves from records as well as the reproduction of the illusion of approaching and receding bodies so that while one record is providing the music, another may be brought into play to reproduce the whistling of a locomotive, the ringing of bells and the like.

A still further object of the invention resides in the provision of a method of and an apparatus for controlling the transfer of power from two different electrical sources, each capable of a relatively constant input, to a common receiver through two thermionic tubes in such a manner that the electronic emission in one of the tubes may be increased, while the electronic emission in the other of the tubes is being decreased and yet at the same time enable the total output of the tubes to the common receiver to remain substantially constant in volume while

one of the sources is being switched into operative association with the receiver and the other of the sources is being switched out of operative association with the receiver.

In accordance with the general features of the present invention, I provide a sound reproducer having two record turntables with a record on each, electrical pick-up means in operative association with the records, electrical sound transmitting means connected to a reproducing unit, and means including an electrical circuit for controlling the sound output of the pick-ups and for increasing the output of one pick-up while decreasing the output of the other pick-up to electrically produce sound in the reproducing unit from either record as desired.

Other objects and advantages of my invention will more fully appear from the following detailed description taken in connection with the accompanying drawings, which illustrate several embodiments thereof and in which:

Figure 1 is a diagrammatic view illustrating a novel electrical circuit embodying the features of my invention, and

Figure 2 is a diagrammatic view similar to Figure 1 illustrating the circuit as being provided with an additional input device adapted to be operated when it is desired to reproduce the illusion of an approaching or receding train or the like by the whistling of a locomotive.

It is thought that my novel method of electrically reproducing waves will be evident from a description of an apparatus by which the process may be practiced.

In the drawings:

Like reference characters designate similar parts throughout the several views.

The reference characters 10 and 11 designate generally the input devices of my novel electrical circuit. Each of these devices comprises a circuit 12—13, which includes a primary transformer winding 14—15, and a pick-up resistance 16—17. The two resistances 16 and 17 comprise parts of electrical pick-ups designated generally by the reference characters 18 and 19.

These electrical pick-ups may be of any conventional construction. These devices 18 and 19 are operatively associated with the records to be electrically reproduced. In accordance with the features of a preferred embodiment of my invention, I have illustrated these pick-ups as being operatively associated with phonograph records 20 and 21. These phonograph records are mounted on turntables 22 and 23, which may be rotated by any suitable means, such, for example, as electrical motors (not shown), as is well known in the art. Also it is to be noted that my invention permits of both of these turntables rotating contemporaneously throughout the period of time that music is being reproduced. As will be more fully explained hereinafter, when one record is being reproduced, another record may be placed on the other rotating table in a condition ready to be reproduced when the pick-up associated with the former record is rendered ineffective.

The primary windings 14 and 15 comprise parts of transformers designated generally by the reference characters 24 and 25. The secondary windings 26 and 27 of these two transformers 24 and 25 are connected by a common lead wire 28, in which is interposed a pair of fixed condensers 29 and 30, the purpose of which will be more fully described in connection with the operation of my circuit. It will also be noted that the transformer winding 26 is connected by a conductor 31 with the grid 33 of a thermionic tube 32, and that the winding 27 is connected by a conductor 34 to the grid 36 of another thermionic tube 35. The filaments 37 and 38 of the two tubes 32 and 35, respectively, are connected together by conductors 39 and 40. Connected in parallel to the conductors 39 and 40 is an A battery 41.

The plates 42 and 43 of the two tubes 32 and 35, respectively, are connected by means of a common lead 44. Connected to this lead 44 between its ends is one end of a conductor 45, including the primary winding 46 of an output transformer 47. The other end of the conductor 45 is connected to one side of a battery 48. The other side of the battery is connected by a conductor 49 to a point 50 in lead wire 28. It will also be noted that a conductor 51 connects this point 50 with the negative side of A battery 41.

The secondary winding 52 of output transformer 47 comprises part of an electrical reproducing or receiving circuit 53, which includes an amplifier tube 54, a head set or loud speaker 55 and A, B and C batteries 56, 57 and 58. The tube 54 is a conventional three element tube and includes a grid 59, a filament 60′ and a plate 60. The filament 60′ is connected by leads 61 and 62 to A battery 57.

I shall now proceed to describe in detail the control mechanism, including the switches, for controlling the electron emission in tubes 32 and 35, whereby the music reproduced in the circuit 55 may be selectively controlled. The lead 28 has connected to it, adjacent condenser 29, one end of a conductor 65, the other end of which is connected to a switch element 66 adapted to cooperate with switch points 67 and 68. The switch point 67 is connected to one end of a conductor 69, the other end of which terminates in a switch contact point 70 of another switch. The switch point 68 is connected by a conductor 71 to the switch point 72 of said other switch. These switch points 70 and 72 are adapted to cooperate with a

switch element 73 connected by a conductor 74 to circuit lead 28. I have designated generally the two switches above described by the reference characters 63 and 64.

A bias battery 75 is connected on one side by a conductor 76 to point 50, previously described, in lead 28. The other side of battery 75 is connected by a conductor 77 to a variable resistance 78, which is connected by a conductor 79 to an intermediate part of conductor 71. The conductor 77 has secured to it one end of conductor 81, which is electrically connected to one side of a C bias battery 80, which I shall hereinafter refer to as a blocking battery. The other side of this battery is connected by a conductor 81 to a variable resistance 82 connected by a conductor 83 to an intermediate point in lead 69.

From the foregoing, it will be evident that there are two C bias batteries adapted to be electrically connected to the grids 33 and 36 of tubes 32 and 35. The C battery 75 is adapted to be connected to either of these grids for the normal operation of the associated tube, whereas the C battery 80 is adapted to be connected to either of these grids for the purpose of blocking the action of the associated tube or valve. Attention is also directed to the fact that the switches 63 and 64 are adapted to be operated, as will be more fully explained hereinafter, to control the selective operation of thermionic tubes 32 and 35, so that these tubes may be alternately connected to the reproducing or receiver circuit 55.

The resistances or resistors 78 and 82 are designed to control the rate that condensers 29 and 30 are charged and discharged, so as to enable the selective control of the blocking out of the tubes 32 or 35, as well as the setting into action of these tubes.

The C bias battery 75 is intended to be of such capacity as to provide the normal amount of voltage needed to charge the grids 33 and 36 of tubes 32 and 35 without overloading or blocking them, whereas the C bias battery 80 is of such a capacity as to be capable of providing sufficient voltage to these grids as to overload them and thus prevent their normal operation.

The operation of my novel circuit is briefly as follows:

When the switches 63 and 64 are in the positions shown in Figure 1, the blocking battery 80 will be connected so as to charge condenser 30, and the normal battery 75 will be connected to the grid 33 of tube 32. It will be evident that the blocking battery 80 will charge the condenser 30 and give the grid 36 of tube 35 a charge of the proper intensity to block the emission of electrons from the filament 38 to the plate 43 of tube 35, thus rendering this tube inoperative as an amplifier or relay. Of course, it is to be understood that the rate at which the potential of grid 36 is built up depends upon the rate at which condenser 30 is charged. This rate, of course, will be controlled by the position of the resistor 82. That is to say, upon the initial connection of blocking battery 80 to condenser 30 and grid 36, the resistor 82 will serve as a means to delay the building up of the overloading potential of grid 36. In other words, the resistor 82 permits of the tube 35 being gradually rendered inoperative by the building up of the potential on grid 36 from battery 80. However, it is to be remembered that this feature would not be possible if it were not for the condenser 30, which is charged at a predetermined rate depending upon the position of resistor 82. Furthermore, I find that the rate at which the potential on grid 36 is built up may be plotted graphically, and that the resultant curve takes the form of an exponential curve.

Obviously by gradually building up the potential of grid 36, it is possible to gradually decrease the electronic emission in the tube 35 between the plate and the grid thereof. In fact, this electronic emission decreases exponentially.

In Figure 1 it will also be observed that the battery 75 is connected through switch 63 to the grid 33 of tube 32. This battery serves to supply a voltage sufficient for the normal operation of tube 32.

It will also be evident from Figure 1 that when tube 32 is operative, the waves entering the transformer 10 from the pick-up device 18 will be amplified and reproduced in the receiver or reproducing circuit 55. On the other hand, the rendering inoperative of the tube 35 will prevent any reproduction of the waves entering transformer 11 from pick-up device 19.

When the record 20 on turntable 22 has been substantially reproduced in the receiver circuit 55, or when it is desired to change from the record 20 to the record 21 on turntable 23, it will be necessary to operate switches 63 and 64, so as to move contact element 66 into cooperation with switch point 67 and contact element 73 into cooperation with switch point 72. It will, of course, be evident that the operation of these two switches 63 and 64 may be accomplished contemporaneously by the means of a suitable cam key or the like, such as is well known in the art. In any event, it is desirable to operate these two switches at the same time, and hence the switch arms or elements 66 and 73 should be mechanically connected together.

This operation of the switches 63 and 64 will result in the blocking battery 80 being connected to condenser 29 and grid 33 of tube or valve 32, and the normal battery 75 being connected to grid 36 of tube or valve 35. Also it will be evident that the condenser 30 will no longer be charged by the overload

battery 80 and hence will begin to discharge through the resistor 78. The rate at which this condenser discharges can be controlled exponentially by the resistor 78. Obviously by gradually causing the condenser 30 to discharge, the overload potential on grid 36 will gradually decrease, thus allowing the tube 35 to be gradually brought into operation. When the condenser 30 has become discharged to such an extent that the grid 36 has a normal potential, the normal battery 75 will function to maintain this normal potential in this grid.

By connecting the overload C bias battery 80 to the condenser 29, the potential on grid 33 of tube 32 will be gradually increased, thus causing the amplifying action of this tube to be proportionately diminished. In other words, the electronic emission in the tube 32 can be gradually decreased, thus decreasing the intensity of the waves reaching the receiving circuit 55 from the pick-up 18. When the condenser 29 has become fully charged by the blocking battery 80, the tube 32 will have been rendered completely inoperative.

From the foregoing, it will be evident that one tube can be gradually brought into operation, and the other tube can be gradually rendered inoperative. This means that the electrical waves reaching the circuit 55 from one pick-up will gradually decrease in intensity, while the electrical waves from the other pick-up will gradually increase in intensity. The wave reproduced in the loud speaker or head set 55′ will be a resultant of these two sets of varying waves or impulses. Thus, it will be evident that when one record is brought into play, the music reproduced therefrom will overlap the impulses coming from the tube which is gradually being blocked by battery 80. This overlapping feature is desirable for the reason that it prevents the listener from being ordinarily able to detect when the change is made from one record to another. That is to say, the records 20 and 21 can be alternately reproduced in the receiving circuit 55 without the detection of the change from one record to the other. As previously pointed out, at the time this change is made the music emanating from the head set 55′ will comprise a resultant wave, in which the components are the overlapping impulses from the two amplifying tubes 32 and 35.

It is evident from the foregoing, that as soon as a record has been blocked out so that reproduction from this record has ceased, the pick-up may be removed from contact with that record and another record may be substituted for it, and the pick-up may be placed in contact with the substituted record. Each of the pick-ups is so arranged that it may be removed from contact with the associated record at any time and moreover this may be accomplished either manually or automatically as desired by the operator.

The records 20 and 21 are illustrated as being of the ordinary disc type, which may be rotated with the turntables 22 and 23 by any suitable means such, for example, as the conventional electric motor. It is, of course, apparent that the present invention is not to be limited in its application to the use of such disc records, for obviously the invention may be employed in connection with cylinder records or to any records upon which sound waves or other waves to be reproduced have been recorded, irrespective of the manner in which these waves are recorded. As previously pointed out, the pick-ups 18 and 19 may be of any suitable type adapted to receive the recorded impulse and to transform it into an electrical impulse.

In Figure 2 I have illustrated a modification of my invention, wherein an additional input device 100 is connected so as to modulate the electrical current flowing in the amplifying circuit. Inasmuch as the circuit associated with the other two input units shown in Figure 2 operates in identically the same way as that shown in Figure 1, the same reference characters will be applied to the elements comprising this circuit as were used in connection with Figure 1. Different reference characters will be applied to the parts of the circuit shown in Figure 2 used to couple the third input device 100 to the other circuit. The input device 100 comprises a circuit 101 including a primary transformer winding 102 and a resistance 103 comprising part of an electrical pick-up device 104. The pick-up device is operatively associated with a disc record 105 of the phonograph type disposed on a rotatable turntable 106.

The winding 102 constitutes part of a transformer 107, which also includes a secondary winding 108. One end of this winding 108 is connected by a conductor 109 to the grid 111 of an amplifying tube or valve 110. The plate 112 of this tube is connected by a conductor 113 to conductor 44 connected to the plates of the other two tubes 32 and 35. The filament 115 of this tube is connected by conductors 114 and 116 to the leads 39 and 40 connecting the filaments of the tubes 32 and 35. In other words, the filament 115 is so connected as to receive current from the A battery 41 common to filaments of tubes 32 and 35.

The other end of transformer 108 is connected by a short length of wire 117 to a conductor 118. One end of this conductor 118 is secured to a switch element or arm 119 of a switch 120. The other end of this wire 118 is connected to a fixed condenser 121 which is connected by wire 122 to point 50 of the main circuit.

The switch 120 includes a pair of oppositely disposed contacts 123 and 124 cooperable with

switch element 119. One of these contacts 123 is connected by a conductor 125 to switch contact 72 of switch 64. The other switch contact 124 is connected by a conductor 126 to resistor 82.

The operation of this additional input device 100 and the associated amplifying tube 110 is briefly as follows:

The switch element or arm 119 is shown in a position (Figure 2) wherein it is in engagement with contact 124 and hence results in the grid 111 of tube 110 being connected to the overload C battery 80 through the resistor 82. This means that the grid 111 is provided such a high potential that the action of tube 110 is blocked. When it is desired to render the tube 110 operative so as to enable the reproduction of the music on record 105 in the receiving circuit 55, the same may be accomplished by moving switch element 119 out of cooperation with contact 124 and into engagement with contact 123. This will result in the grid 111 being disconnected from the blocking battery 80 and being connected to the normal C bias battery 75. Of course, it is to be understood that the minute switch arm 119 has moved out of cooperation with contact 124, the condenser 121 will begin to discharge. As the condenser 121 discharges, the potential on grid 111 is gradually decreased, thus resulting in the tube 110 gradually becoming operative. In fact, the rate of the electronic discharge in the tube between the plate 112 and the filament 115 will follow substantially an exponential curve. After the condenser 121 has discharged to a sufficient extent to cause grid 111 to have a normal potential, the tube 110 will become fully operative.

Thereafter, when it is desired to render the tube 110 inoperative, the same may be accomplished by moving switch arm 119 back into engagement with contact 124 of switch 120. This will mean that the blocking battery 80 will being to gradually charge condenser 121 through resistor 82. Obviously since the condenser 121 is in conductive connection with the grid 111, it necessarily follows that the condenser 121 and the grid 111 will have the same potential when the blocking battery 80 is connected thereto. As the charge in the condenser 121 gradually builds up, the potential of grid 111 will also gradually increase, thus resulting in a gradual decrease in the electronic activity of the tube. In other words, the tube 110 will be gradually rendered inoperative. Moreover, by diminishing the electronic emission in tube 110, the intensity of the impulses from pick-up device 104, transmitted to the receiving circuit 55 by this tube, will be gradually diminished. Thus, the music reproduced in the receiving circuit 55, from disc 105, will gradually die out until the tube 110 is rendered completely inoperative.

This third input device 100 can be utilized to musically produce the illusion of approaching and receding bodies. For example, the record 105 may have recorded thereon impulses corresponding to the whistling of a locomotive, the hoofbeats of a horse, the ringing of bells and the like, all of which may be reproduced to produce a given illusion. That is to say, while one of the records 20 or 21 is providing the music, such as is required in connection with a given scene of a moving picture, the record 105 can be gradually reproduced in the receiving circuit 55 to produce an illusion in connection with the music being heard.

Now, of course, it is to be understood that although I have illustrated and described in detail the preferred forms of my invention, the invention is not to be thus limited, but only in so far as defined by the scope and spirit of the appended claims.

I claim as my invention:

1. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of input devices connected to said unit by said circuit adapted to each set up electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for automatically causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, said latter means including a plurality of amplifying elements and means for simultaneously increasing the output of one of said elements and decreasing the output of another element.

2. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of input devices connected to said unit by said circuit adapted to each set up electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and electronic means controlled by said selective means and connected to said circuit for causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, said latter means including a plurality of electrical valves receiving energy from said input devices and electrical means for decreasing the electron emission in one of said valves and for increasing the electron emission in another of said valves.

3. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of input devices connected to said unit by said circuit adapted to each set up electrical impulses in said circuit, means con-

nected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, said latter means including a plurality of amplifying tubes adapted to receive energy from said input devices and electrical means including condensers adapted to contemporaneously increase the electron emission in one of said tubes and to decrease the electron emission in another of said tubes.

4. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, said latter means including a plurality of electron tubes, energy storing means connecting said tubes to said input devices and energy dissipating means connected to said tubes for contemporaneously increasing the electron emission in one of said tubes and for decreasing the electron emission in another of said tubes.

5. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, and means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation.

6. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation, and means for controlling this gradual blocking of the tubes.

7. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, and means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation, said tubes each including a grid, said latter means including a plurality of condensers, there being one connected to each tube grid.

8. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation, and means for controlling this gradual blocking of the tubes, said blocking means including a plurality of condensers connected to the tubes and said last mentioned control means including a plurality of resistors for controlling the action of the condensers.

9. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation, said latter means including a plurality of condensers, battery means for charging these condensers adapted to supply the necessary voltage for overloading the tubes, and resistors for controlling the charging of the condensers by said battery means.

10. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for automatically causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, each of said input devices including a record to be reproduced and pick-up means electrically connected to said circuit and at all times in operative association with the record.

11. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for automatically causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, each of said input devices including a record turntable, a record on the table and electrical pick-up means connected to the circuit and at all times in operative association with the record on the turntable.

12. In an electrical circuit a thermionic tube including a grid, an electrical pick-up connected to said grid, a source of energy, energy storing means, and energy flow resisting means adapted to exponentially increase an electric charge on the grid of the tube to gradually block out the transmission of wave impulses from said pick-up.

13. In an electrical circuit a thermionic tube including a grid, an electrical pick-up connected to said grid, a source of energy, energy storing means, and energy flow resisting means adapted to exponentially decrease an electric charge on the grid of the tube to gradually cause said tube to transmit wave impulses from said pick-up.

14. In an electrical circuit a thermionic tube, an electrical pick-up connected to said tube, a source of energy, condenser means connected to said source, and resistance means connected to said condenser means adapted to exponentially vary the electron emission in the tube so as to vary the transmission of wave impulses from said pick-up through said tube.

15. In combination, a thermionic tube including a grid, an electrical pick-up connected to said grid, and means connected to said grid for gradually energizing said grid beyond the operable capacity of said tube, whereby the action of said tube is gradually blocked to prevent transmission of electrical waves from said pick-up.

16. In combination, a plurality of means adapted to receive and transmit electrical impulses, means for transforming said electrical impulses into audible sound waves, an electrical circuit connecting said receiving means to said transforming means, and means connected to said circuit and acting between said receiving means and said transforming means for automatically and selectively increasing the intensity of the impulses from one receiving means and simultaneously decreasing the intensity of the impulses from another of said receiving means, whereby said transforming means may be subjected to an electrical resultant wave, in which wave the impulses from each of said receiving means are the components.

17. In a record playing machine having two record turntables and a record on each of the said turntables, two oscillable arms, an electric pick-up connected to each of the said arms in operative association with a record, a tone chamber, electric sound transmitting means connected to the tone chamber, means to rotate the said turntables, an electric circuit operatively connecting both of the pick-ups, and means in the said circuit automatically operable upon the closing of the circuit for controlling the sound output of the said pick-ups, and for automatically increasing the output of one pick-up while decreasing the output of the other pick-up to electrically produce sound in said tone chamber from either record as desired.

18. The combination of music synchronizing means for phonographs with two record tables, a record on each of the tables, arms including electric pick-ups in operative association with the said records, and two thermionic amplifiers in a circuit with the said pick-ups, the said means being automatically operable upon the closing of the circuit to gradually increase the electron emission in one of the said amplifiers while gradually decreasing the electron emission in the other of the said amplifiers so as to gradually increase the volume of sound transmitted to a tone chamber from one of the pick-ups and to decrease the volume of sound transmitted to a tone chamber from the other of the pick-ups.

19. In combination, a plurality of records, a plurality of thermionic tubes having grids therein, pick-up means in operative association with the said records and the said tubes, electrical storing means and electrical dissipating means cooperating with a grid in one tube to exponentially increase the electron emission in the said tube, and cooperating with a grid in another tube to exponentially decrease the electron emission in the latter named tube so that the emission in the first named tube is increasing while that in the latter named tube is decreasing.

20. In combination, a plurality of records, thermionic tubes having grids therein, pick-up means in operative association with the said records and the said tubes, electrical storing means and electrical dissipating means cooperating with a grid in one tube to increase the electron emission in the tube, and cooperating with a grid in another tube to decrease the electron emission in the latter named tube while the electron emission in the first named tube is increasing so that the total output of the tubes may be maintained substantially constant while the energy input to the tubes from the pick-up means remains constant.

21. An energy transfer device of the class described, comprising a plurality of thermionic tubes, each having a grid therein, electrical input means in operative association with the said tubes, a source of electrical power, energy storing means connected thereto, energy dissipating means, and switch means adapted to connect the said energy source, and the said energy storing means and the said energy dissipating means in operative association with the said grids to exponentially increase an electric charge on the grid of one tube while exponentially decreasing an electric charge on the grid of another tube.

22. The method of electrically modulating recorded impulses in a reproducing circuit, which consists upon the closing of the circuit in automatically increasing the intensity of one impulse, decreasing the intensity of another impulse, combining the impulses and transforming the resultant impulses into audible sound.

23. The method of automatically and electrically modulating a plurality of different sources of impulses upon the closing of a reproducing circuit, which consists in varying electrical currents by said impulses, amplifying the resulting currents, automatically increasing the intensity of one of said amplified currents, automatically decreasing the intensity of another of said amplified currents and combining said latter currents for reproduction.

24. The method of automatically and electrically modulating a plurality of different sources of impulses upon the closing of a reproducing circuit, which consists in varying electrical currents by said impulses, amplifying the resulting currents, automatically increasing the intensity of one of said amplified currents, automatically decreasing the intensity of another of said amplified currents and causing said varying currents to overlap each other as they are transmitted into audible sound.

25. The method of maintaining a substantially constant total output to a common receiver from two thermionic amplifying tubes cooperating with two pick-up means in operative association with phonograph records, which consists in exponentially decreasing the electron emission in one tube receiving energy impulses from one record through a pick-up while exponentially increasing the electron emission in the other tube receiving energy impulses from a record through the other pick-up.

26. The method of maintaining a substantially constant output from a plurality of amplifying means, which consists in exponentially decreasing the output of one of the said amplifying means while exponentially increasing the output of the other of the said amplifying means.

27. The method of varying the output of a plurality of thermionic amplifying tubes supplying energy to a common receiver, which consists in exponentially increasing the electron emission in one of the said tubes while exponentially decreasing the electron emission in the other of the said tubes and combining the resultant outputs of the tubes.

28. The method of automatically and electrically modulating impulses from a plurality of different records in a reproducing circuit when the circuit is closed, which consists in varying electrical currents by the recorded impulses, amplifying the resulting electrical currents, automatically controlling the amplification of said currents so as to enable the intensity of certain of said currents to be increased and the intensity of other currents to be contemporaneously decreased, combining said amplified currents of varying intensity and transmitting the resultant current into audible sound of comparatively constant volume.

29. The method of automatically and electrically modulating impulses from a plurality of different records in a reproducing circuit upon the closing of the circuit, which consists in contemporaneously varying electrical currents by the recorded impulses from independent sources, amplifying the resulting electrical currents so as to enable the intensity of one of said currents to be increased and the intensity of another of said currents to be decreased, automatically controlling the amplification of said currents so as to enable the impulses recorded on either of said records to be reproduced when desired, and transmitting the amplified currents into audible sound in such a manner that the change from one record to another cannot be ordinarily detected by the listener.

In testimony whereof I have hereunto subscribed my name at Chicago, Cook County, Illinois.

RAYMOND T. CLOUD.