Aug. 21, 1951 P. M. G. TOULON 2,565,103

SWITCHING TUBE

Filed Dec. 19, 1950 2 Sheets-Sheet 1

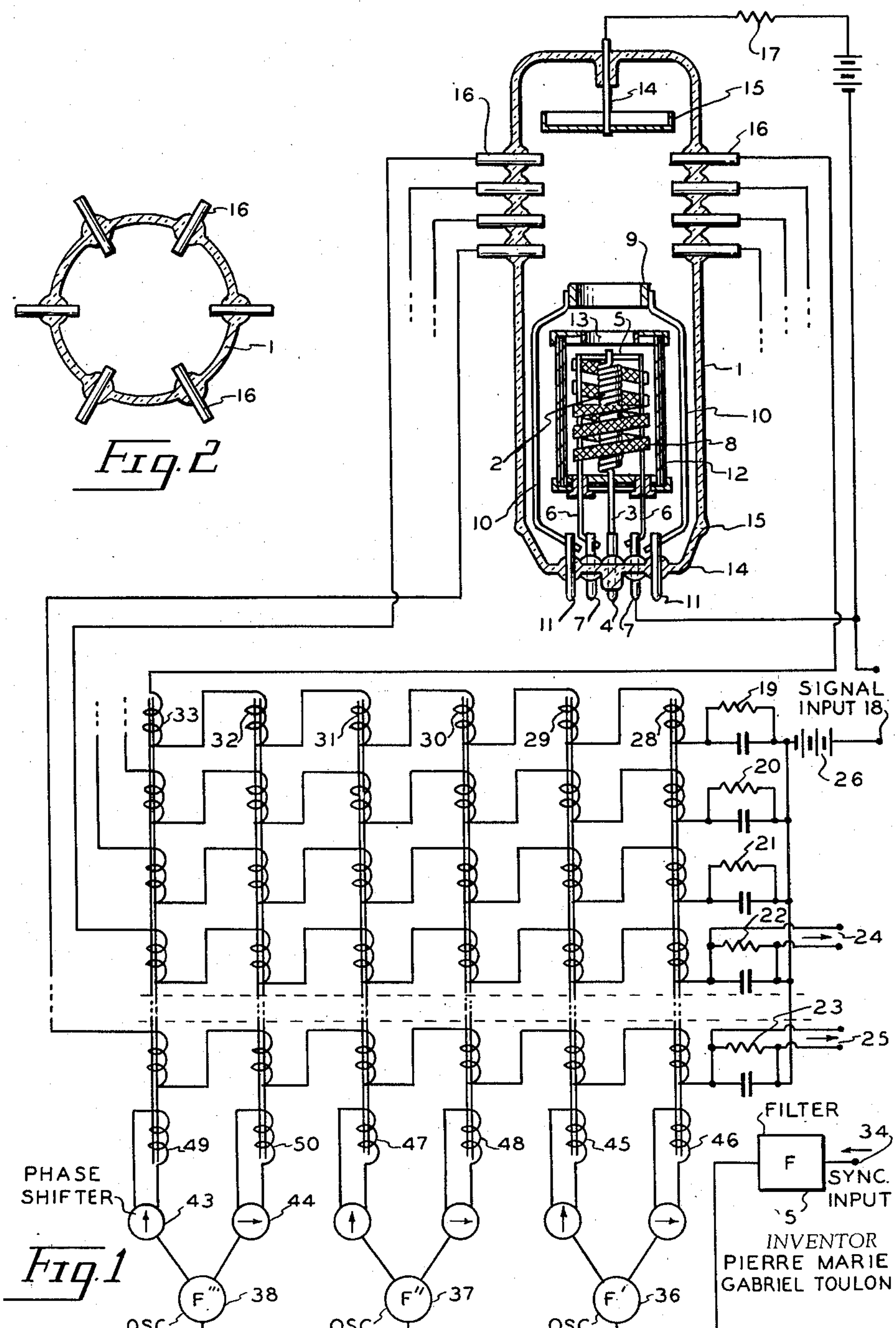

Fig. 2

Fig. 1

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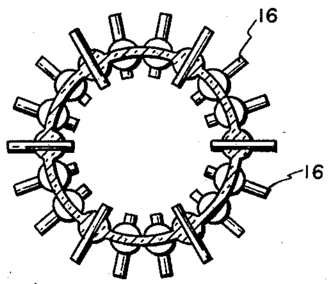

Fig. 3

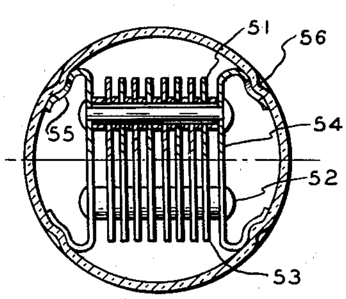

Fig. 5

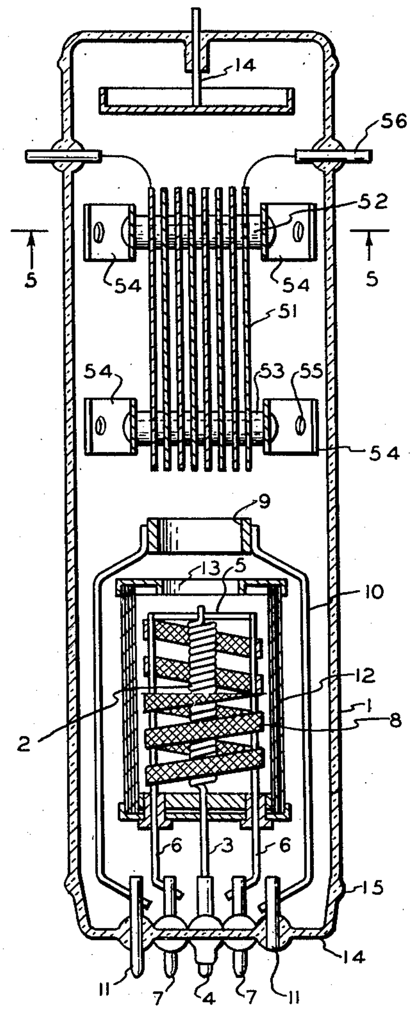

Fig. 4

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SWITCHING TUBE

Pierre M. G. Toulon, New York, N. Y.

Application December 19, 1950, Serial No. 201,601

27 Claims. (Cl. 315—334)

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This application is a continuation in part of my prior application for U. S. Patent Serial No. 739,019, filed April 2, 1947, entitled "Electrical Transmission Systems."

The present invention relates generally to gaseous conduction devices and to circuits containing such devices, and more particularly to gaseous conduction devices comprising a large number of anodes, immersed in ionized gaseous plasma, and which may be selectively rendered conductive in order to effect control and switching of electric currents.

The gaseous conduction device in accordance with the invention is a tube comprising essentially an indirectly heated cathode, located adjacent to the base of the tube, a single continually energized anode, which in conjunction with the cathode produces gaseous ionized plasma within the tube, and a large number of auxiliary anodes which are disposed within the ionized gaseous plasma, which normally are maintained negatively polarized with respect to the cathode, in order to prevent current flow, and which may be selectively positively polarized, to accomplish selective control or switching of electric currents.

The cathode is surrounded by a conducting metallic sheet, the upper end of which is provided with a large aperture centered on the axis of the tube, and through which ionization or ionized plasma may expand over the entire volume of the tube. The auxiliary anodes, which are mutually electrically isolated, may be distributed longitudinally and circularly about the wall of the tube, in a regular geometrical pattern, or dispersed within the confines of the tube. The auxiliary anodes should each have a considerable surface, in order to be capable of dissipating appreciable quantities of heat, and may be of cylindrical form, if dispersed about the wall of the tube, or constituted of metallic sheets arranged parallel to one another, if located within the confines of the tube.

In a preferred embodiment of the invention, the tube may be filled with a gas having highly mobile ions, and consequently great speed of de-ionization. Examples of such gases are helium and hydrogen, at appropriately low pressure, for example, of the order of a tenth of a millimeter of mercury. If required, the tube may be cooled by externally applied ventilation, or by means of a shirting through which runs a refrigerant.

The invention involves not only the structure of the tube per se, but, in addition, circuits connected with the tube, whereby the tube may be utilized.

In accordance with a modification of the invention, the tube and its circuits may be utilized for accomplishing timed circuit selection. In particular the invention may be utilized for

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switching among a large number of independent channels, of impulses which arrive in succession, and at a regular periodicity, via a single channel.

In accordance with a further modification of the invention, tubes constructed in accordance with the invention may be utilized to accomplish remote switching of any one of a large number of independent devices. Specifically, the devices may be selected in response to two or more stimuli, which may consist of voltages applied to appropriate points of the system.

As many different tubes may be utilized in a system as there are different possible values of one of the stimuli, and in each of the tubes may be provided as many anodes as there are possible values of the other stimulus. The number of devices which may be selected then corresponds with the product of the total number of tubes by the total number of anodes.

The principles of the invention may be extended beyond the case where two stimuli are selected, in order selectively to switch into a circuit a single device, since the principle involved may be generalized to any number of stimuli.

Specifically, the invention may be utilized to enable selective actuation of the levers of a calculating machine, to the automatic connection remotely of electric circuits in telephone central stations, and to the control of machines intended for sorting or classifying. More generally stated, the invention is applicable to the spatial selection of objects or indications.

The invention finds particular application in multiplex communication, and particularly multiplex telephony, whether by wire or radio. The invention is further applicable to systems of television, for transferring signals in succession to the different horizontal and vertical points of a televised image. Since the applications of the invention extend to the problem of controlled energization and de-energization of any desired electrical signal responsive device, it may be particularly applied to the energization of ionic tubes such as ignitrons, and to the ignition of explosion motors.

It is accordingly a broad object of the invention to provide a novel ionic gaseous conduction device.

It is a further object of the invention to provide a novel gaseous ionic conduction device having facilities for providing continuously ionized plasma, and a pluralty of anodes immersed in the plasma, and which may be selectively energized.

A further object of the invention resides in the provision of electrical circuits in conjunction with an ionic conduction device of the above character, for accomplishing sequential energization of the auxiliary anodes, and thereby switching electrical signals from a single channel into a plurality of channels in succession, or vice versa.

The above and still further features, objects and advantages of the invention will become apparent upon consideration of the following detailed description of specific embodiments thereof, especially when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a schematic circuit diagram of a circuit including a gaseous conduction device, and view in longitudinal section taken through the gaseous conduction device, in accordance with the invention;

Figure 2 is a transvers sectional view taken through the tube of Figure 1, on the line **2—2**, and illustrating the arrangements of certain anodes thereof;

Figure 3 is a transverse section taken through the tube of Figure 1, and showing a further arrangement of certain anodes thereof, and representing a modification of the structure of Figure 2;

Figure 4 is a longitudinal section of a gaseous conduction device, constructed broadly in accordance with the principles of the gaseous conduction device of Figure 1, and having a different anode structure; and,

Figure 5 is a transverse section taken on the line **5—5** of Figure 4.

Referring now particularly to Figure 1 of the accompanying drawings, the novel gaseous conduction device of the invention comprises a cylindrical glass envelope, fabricated of glass having a very high melting point, and which has been carefully evacuated and sealed, and filled with an inert gas at low pressure. The gas utilized may preferably be hydrogen or helium, but it is also feasible to utilize krypton, xenon, etc., or metallic vapor, in accordance with the de-ionization time required for a particular application. The pressure used may generally be of the order of $\frac{1}{10}$ of a millimeter of mercury, but this pressure may also be varied within extremely wide limits, according to the purposes for which the tube is to be utilized. A cathode heater, in the form of a spiral of tungsten **2**, is provided within the cylindrical envelope **1**, secured at one end to a lead **3**, which acts as a support, and which is connected with a heater terminal **4**. The other end of the tungsten filament is secured to a supporting structure **5**, from which extend downwardly two metallic rods **6**, which are connected to cathode leads **7**. The rods **6** then form an armature for supporting an indirectly heated cathode **8**, comprising a very fine conductive grating of nickel, to which has been affixed the active matter of the cathode, generally constituted of carbonate of barium, or strontium, etc., finely ground and diluted in an organic colloidal solution. The latter is dissociated by heat when the tube is evacuated, leaving the active coating.

Above the indirectly heated cathode **8** is provided a grid structure **9**, constituted of a small carbon cylinder, which is suspended by means of a pair of rods **10**, the lower ends of which are secured to terminals **11**.

The grid **9** may be employed, if desired, in a manner known per se, or, if desired, need not be employed at all, in a circuit utilizing the tube.

The cathode **8** is located within heat insulating enclosure **12**, which may generally be of cylindrical shape, and which is insulatedly mounted with respect to the various supports, terminals and structures of the tube, hereinabove specifically described. The enclosure **12** is provided at its upper end with a large aperture **13**, aligned with the longitudinal axis of the envelope **1**, through which gaseous plasma formed in the interior of the enclosure **12** may spread throughout the envelope **1**. Use of the enclsoure **12** enables heating of the cathode with a minimum of electrical energy.

There is further provided at the upper end of the envelope **1**, and suspended from a lead **14** extending through the upper end of the envelope **1** in sealed relation, a main anode **15**, which may be fabricated of carbon-nickel.

In accordance with the invention, I provide a plurality of tungsten rods **16**, disposed about the cylindrical wall of the envelope **1**, and extending therethrough, at positions intermediate the grid **9** and the anode **15**, and which are consequently immersed in the gaseous plasma contained in the envelope **1**, when the device is suitably energized. The tungsten rods **16** may be arranged in various ways, without departing from the principles of the present invention. Specifically, and in accordance with the structure illustrated in Figure 2 of the drawings, four groups of anodes **16**, each group consisting of six anode rods, may be provided, each group being at a different level longitudinally of the envelope **1**, and the anodes of any group being equally spaced about the circumference of the envelope **1**. In accordance with a modification of the arrangement of Figure 2, as illustrated in Figure 3 of the accompanying drawings, the successive anodes of each successive group may be angularly displaced slightly with respect to corresponding anodes of preceding and succeeding groups. Thereby in Figure 2 anodes of different groups are superposed directly above one another, while in the system of Figure 3 an angular displacement occurs in going from an anode in one group to an anode in another group.

It will be noted, nevertheless, that the arrangement of the anodes, in accordance with either Figure 2 or Figure 3, provides for a regular geometric arrangement, and a relatively uniform spacing between anodes.

There may be applied between the terminal **7** and the support **14**, a source of potential **16** in series with a load resistance **17**, whereby the anode **15** is maintained positively polarized with respect to the cathode **8**, at some relatively stable value, say 20 volts. The resistance **17** acts as a current limiting and voltage dropping resistor, and the potential existing in the space between the anode **15** and the cathode **8**, by virtue of the source of potential **16**, results in the production along the interior of the envelope **1** of a positive ionized column of gas in which the auxiliary anodes **16** are immersed. It has been noted experimentally that any one of the auxiliary anodes **16** is capable of transferring an extremely large instantaneous current, when positively polarized to a voltage above that of the anode, and passes no current when negatively polarized. If the duration of the passage of current to any one anode is short, and if the time between successive current passages is sufficiently long so that the anode does not over-heat, and so that the gaseous plasma within the envelope **1** has had time to reconstruct itself, the structure as described is found capable of providing an average current of the order of 10 amperes, and a very much greater instantaneous current.

It has been found feasible experimentally to cause any selected one of the auxiliary anodes **16** to pass the total current provided by the cathode **8**, by rendering the selected auxiliary anode positive while maintaining the remaining auxiliary anodes, negative. Where the anodes are required to pass current in sequence, and at a regular fairly high periodicity, the average value of the current flowing remains fairly small, since the anodes are numerous. Although the anodes, considered each by itself, are relatively small in size, they do not over-heat, since the current flow is switched from one to another of the anodes rapidly in turn, despite the fact that each anode is found to operate substantially at the full instantaneous power capabilities of the tube, while it is passing current.

The novel ionic conduction tube above specifically described finds particular application to the distribution among a plurality of independent channels, of signals arriving in succession, and in regular periodicity, via a single input channel. The problem of signal distribution of this nature arises particularly in multiplex telephony, where it may be required to distribute among 24 independent channels, signals repeated at the frequency of 8,000 per second in each one of the channels.

In the system of Figure 1, the input channel may be denoted by the reference numeral 18. It may be assumed that multiplex telephone signals are applied to this channel, and are to be sequentially divided on a time division basis, to a plurality of loads represented by the resistances 19, 20, 21, 22, 23, thereby to be made available for transfer into output channels such as 24 and 25.

A source of bias voltage 26 is provided, the positive terminal of which is connected with the cathode 8, and the negative terminal of which is connected via a line 27 to one end of each of the resistances 19, 20, 21, 22 . . . 23. The other end of the reistance 19 is then connected in series through a plurality of windings as 28, 29, 30, 31, 32, 33 with one of the anodes 16. Similarly, each of the remaining load resistors, as 20, 21 . . . 23 is connected via similar windings to other ones of the auxiliary anodes 16. Accordingly, each one of the load resistances 19, 20, 21, 22 . . . 23 is connected in series with a different one of the anodes 16, and all these anodes are normally maintained negatively polarized with respect to the cathode 8, by means of the voltage source 26. The windings 28 to 33, inclusive, are utilized for deriving a positive peaked voltage, at controlled times, periodically, for overcoming the negative bias provided by the voltage source 26, and accordingly for causing current transfer through the series connected auxiliary anode 16. The corresponding windings in series with the load resistances 20, 21 . . . 23, are similarly utilized. The manner of generation of the peak voltage at controlled times, in series with the load resistances 19, 20, 21, 22 . . . 23, is described as follows.

A source of synchronizing signals 34 is provided, which may be assumed to occur in synchronism with signals incoming on the input channel 18. These synchronizing signals are separated from the signals in the input channel by means of a filter 35, and then utilized to control the frequency of three oscillators 36, 37 and 38, oscillating at frequencies F′, F′′, F′′′, which are harmonically related, and which have as the lowest common multiple of their frequencies, the frequency of recurrence F of the synchronizing signals selected by the filter 35 and supplied over the line 34. The output of the oscillators 36, 37, 38 respectively are each applied to pairs of phase shifting circuits, as 39, 40—41, 42—43, 44, respectively. One of the phase shift

circuits of each pair, as 39, serves to delay the phase of the signal output of the oscillator 36 by 45°, while the other, as 40, serves to advance the phase by 45°, so that at the output of the phase shift pairs is present two signals at the frequency of the driving oscillator, and in 90° phase relationship. For purposes of convenience then, the output of the phase shifter 39 may be denominated an in phase current at frequency F′, while the output of the phase shifter 40 may be denominated a quadrature current at frequency F′. Similar relationships occur at the output of the phase shifters 41, and 42, of which the former provides in phase current at frequency F′′ and the latter quadrature current at frequency F′′. Still further, the output of the phase shifter 43 is in phase at frequency F′′′ and the output of the phase shifter 44 in quadrature at the frequency F′′′.

The outputs of the phase shifters 39 to 44, inclusive, are connected to windings 45, 50, inclusive, respectively, and these later windings are coupled one-for-one with the windings 28 to 33, inclusive, respectively. The number of turns and the direction of winding of each one of the windings 28 to 33, inclusive, which form secondary windings of transformers, of which the primary windings are 45 to 50, inclusive respectively, enable control of the amplitude and the phase of the voltage induced in the separate windings 28 to 33 respectively at each one of the frequencies F′, F′′, F′′′. The total number of turns of each winding may be so selected that peaks of voltage occur, resulting from the superposition of the six inducing voltages, and these peaks may be caused to occur at any desired times relative to the times of occurrence of the sync signals provided over the line 34. Accordingly, by suitably designing the windings connected in series with the load resistances 19, 20, 21 . . . 23, positive peaks of voltage may be caused to occur on separate ones of the 24 anodes 16, in sequence, and with such time spacings as to complete a cycle of energization of all the anodes between each pair of synchronizing signals. Since the anodes 16 are energized in sequence, signals provided in the input channel 18 are cause to flow in separate ones of the load resistances as 19, 20, 21, 22 . . . 23, in sequence. Thereby is accomplished a multiplex distribution of signals on a time division basis among the separate output channels.

It will be clear that instead of effecting a distribution of signals among a plurality of channels, these signals all deriving from a single channel, that the reverse operation may be effected, i. e., that of combining impulses arriving over separate channels on a time division basis, into a single or common output channel.

I have noted during experimentation with tubes of the character disclosed herein, if a plurality of auxiliary anodes are employed in the tube, either in the form of concentric cages or in the form of parallel planes, that so long as the auxiliary anodes are maintained below a minimum positive value, or negative, that extreme difficulty is experienced in extending ionized plasma throughout the tube. Once the auxiliary anodes have been brought above the minimum positive value, even for an instant, the positive column or gaseous plasma readily expands throughout the tube. If, thereafter, the main anode is maintained positively polarized the positive column or gaseous plasma is maintained throughout the tube, regardless of the potential of the auxiliary anodes, or any of them, and even if the latter be so arranged as to intercept the positive column, or to intervene between the main anode and the cathode. When any auxiliary anode which is bathed in the gaseous plasma is made sufficiently positive, on the other hand, it is capable of passing an intense current, and this is true almost no matter what form the anode takes, or what its position in the envelope.

The auxiliary anode structure and arrangement as illustrated in Figures 1–3, inclusive, may be departed from, without departing from the spirit of the invention. One possible modification of anode structure is that illustrated in Figures 5 and 6 of the accompanying drawings. Those features of tube arrangement and construction, in Figures 5 and 6, which do not relate to auxiliary anode structure, arrangement and mounting, are identical in all the figures and the identical numerals of reference are accordingly applied to the same parts of the structure.

In Figures 5 and 6, the auxiliary anodes are constituted of a pile of mutually insulated plates **51**, fabricated of nickel.

The plates **51** are mounted on rods **52** which are each covered with an insulating bushing **53**, passing through suitable apertures in the plates. The insulating bushings may be arranged to act as spacers for the separate plates **51**.

The rods **52** are secured to supports **54**, one at each end of each rod, and the spacing between the supports **54** is such as to enable the supports to be in contact with the inner surface of the envelope **1**. Each support **54** is provided with small apertures or indentations **55**, which coacts with properly positioned bosses **56** on the inner surface of the envelope **1**. When the apertures **55** are in engagement with the bosses, the pile of plates **51** are securely supported, and solidly moored, against the wall of the envelope.

Each separate plate **51** is provided with a lead, as **56**, which extends externally of the envelope **1**, and thereby enables the application of voltage to the plate **51**, and the flow of current.

If a tube in accordance with the invention is required to have extremely high current capacity, or power handling capacity, the indirectly heated cathode **8** and its heater **2** may be supplanted by a mercury pool. In the latter case an arc may be struck, and thereafter maintained by maintaining anode **15** continuously energized. The arc may then be diverted to any one of a plurality of normally negatively polarized auxiliary anodes, by selectively bringing the anodes to positive potential.

While I have described and illustrated specific forms of the invention it will be clear that variations thereof may be resorted to without departing from the true scope of the invention as defined in the appended claims.

What I claim and desire to secure by Letters Patent of the United States is:

1. In a gaseous conduction device, a gas filled container having internally thereof a cathode, indirect heating means for said cathode, an insulating chamber substantially enclosing said cathode and having an aperture, an anode externally of said chamber and in alignment with said aperture, and a plurality of further anodes extending through the walls of said container and supported by said walls.

2. In a gaseous conduction device, a gas filled container of electrical insulating material having internally thereof a cathode and a main anode in alignment, and a plurality of further anodes located in said container symmetrically with respect to a line joining said cathode and main anode and intermediate said cathode and main anode, means maintaining said main anode continuously at positive ionizing potential with respect to said cathode, and inductive means for maintaining said further anodes selectively positive and negative with respect to said cathode.

3. In a gaseous conduction device, an eclosure, a cathode and an anode in said enclosure, means for establishing between said cathode and anode and in the vicinities thereof an ionized gaseous plasma, said means comprising a source of voltage continuously connected between said anode and cathode, a plurality of further anodes located in said gaseous plasma, means for maintaining said further anodes normally at negative potential with respect to said cathode, and inductive means for applying positive potentials with respect to said cathode selectively to said further anodes.

4. The combination in accordance with claim 3 wherein said further anodes are unitary electrically conducting structures extending through the walls of said enclosure.

5. The combination in accordance with claim 3 wherein is provided means secured to an inside wall of said enclosure for supporting said further anodes.

6. In a gaseous conduction device, an enclosure for a gaseous medium, a cathode, a first anode spaced from said cathode, means for energizing said first anode and cathode to generate an ionized gaseous plasma in said enclosure in the space intermediate said first anode and cathode, a plurality of additional anodes located in said ionized gaseous plasma intermediate said first anode and cathode, means normally maintaining said additional anodes all at a negative potential with respect to said cathode, and inductive means for selectively raising the potentials of said additional anodes to a value positive with respect to the potential of said cathode.

7. In a switching circuit, a gaseous conduction switching device comprising, an enclosure for a gaseous medium, a cathode, a first anode spaced from said cathode, means for continuously energizing said first anode and cathode to generate continuously an ionized gaseous plasma in said enclosure in the space intermediate said first anode and cathode, a plurality of additional anodes located in said gaseous plasma intermediate said first anode and cathode, a first information bearing channel, means for connecting said first information bearing channel in parallel to said additional anodes, means normally biasing said additional anodes all negatively with respect to said cathode, and inductive means for unbiasing said additional anodes in time sequence.

8. In a switching circuit, a gaseous conduction switching device comprising, an enclosure for a gaseous medium, a cathode, a first anode spaced from said cathode, means for continuously energizing said first anode and cathode to generate continuously an ionized gaseous plasma in said enclosure, a plurality of additional anodes located in said gaseous plasma, a first information bearing channel, means connecting said first information bearing channel via parallel second information bearing channels to said additional anodes, a bias source normally biasing said additional anodes all negatively with respect to said cathode, a signal circuit in each of said second information bearing channels, and inductive means for applying in said second information

bearing channels selectively an unbiasing voltage for said additional anodes to complete said second information bearing channels selectively through said switching device.

9. In a gaseous conduction device, a gas filled vitreous container having internally thereof a cathode, an ionizing anode and a plurality of load anodes, a source of D.-C. voltage and a voltage dropping resistance connected in series between said ionizing anode and said cathode to maintain said gas in a continuously ionized state, each of said load anodes constituted of a solid conductive rod extending through a wall of said container and sealed to said wall.

10. The combination in accordance with claim 9 wherein said load anodes are distributed in symmetrical fashion about said vitreous container.

11. In a gaseous conduction device, a gas filled vitreous container having internally thereof a cathode, an ionizing anode, and a plurality of load anodes, a source of D.-C. voltage and a voltage dropping resistance connected in series between said ionizing anode and said cathode to maintain said gas in a continuously ionized state, each of said load anodes comprising a plate, said plates arranged in parallel planes within said container, and a support means for commonly supporting all said plates from an interior wall of said container.

12. The combination in accordance with claim 11 wherein said support means comprises at least one rod extending between and supported between portions of a wall of said container, said at least one rod extending through apertures provided in said plates.

13. In a gaseous conduction device, a gas filled container having internally thereof a cathode and an ionized anode and a plurality of load anodes, means comprising said energy anode and said cathode for maintaining said gas continuously ionized, and means for energizing said load anodes selectively in current conducting relation to said cathode, said load anodes located intermediate said cathode and ionizing anode, and consisting of parallel plates, in planes substantially parallel to a line joining said cathode and ionizing anode.

14. The combination in accordance with claim 13 wherein said plates are suspended solely from an inner wall of said container.

15. The combination in accordance with claim 7 wherein said means for unbiasing said additional anodes in time sequence comprises a separate plurality of transformer windings connected in series with each of said additional anodes, and means for inducing a component of unbiasing voltages in each of said transformer windings.

16. The combination in accordance with claim 8 wherein said means for applying in said second information bearing channels selectively an unbiasing voltage for said additional anodes comprises, at least one transformer secondary winding connected in series in each of said second information bearing channels, and means for inductively transferring voltage to each at least one transformer secondary winding.

17. The combination in accordance with claim 8 wherein said means for applying in said second information bearing channels selectively an unbiasing voltage for said additional anodes comprises, a separate plurality of transformer secondary windings connected in series in each of said information bearing channels, and means for inducing in each of said separate plurality of transformer secondary windings a different combination of harmonically related voltages.

18. The combination in accordance with claim 8 wherein said means for applying in said second information bearing channels selectively an unbiasing voltage for said additional anodes comprises, a separate plurality of transformer secondary winding pairs connected in series in each of said information bearing channels, and means for inducing in each of said pairs an alternating voltage of different frequency, said voltages in the windings of any pair being of the same frequency and of different phase.

19. In combination, a gaseous conducting device having an enclosure and means for maintaining in said enclosure continuously an ionized gaseous plasma, a plurality of anodes and a cathode in said enclosure, said plurality of anodes located in said gaseous plasma, a first information bearing channel having two terminals, one of said terminals connected to said cathode, a plurality of parallel circuits connected each between the other of said two terminals and one of said anodes, a load device in each of said parallel circuits, and a plurality n of transformer secondary windings in series in each of said parallel circuits, a plurality n of primary windings, each of said primary windings coupled with a plurality of said secondary windings selected one from each of said parallel circuits and means for causing alternating currents of predetermined phases and frequencies to flow in said primary windings.

20. The combination in accordance with claim 19 wherein n is an even number, and wherein said alternating currents in each $n/2$ of said primary windings are of harmonically related frequencies

21. The combination in accordance with claim 19 wherein each plurality n of primary windings is arranged in pairs, n being even, and wherein said alternating currents in each of said pairs is of the same frequency but of 90° phase separation in the separate windings of the pair, and wherein in the currents of separate pairs are harmonically related in frequency.

22. In combination, a gaseous conduction device having an enclosure, and means for maintaining in said enclosure continuously an ionized gaseous plasma, a plurality of anodes and a cathode in said enclosure, said plurality of anodes located in said gaseous plasma, a first information bearing channel comprising two terminals, one of said terminals connected to said cathode, a plurality of parallel connected channels connected each from the other of said terminals to separate ones of said anodes, means for biasing said anodes normally all negatively with respect to said cathode, and means for selectively unbiasing said anodes in sequence, said last means comprising a plurality of windings connected in each of said parallel connected channels, and means for inducing in said plurality of windings selectively voltages of magnitude, phase and frequency arranged to provide periodic peaks of resultant positive voltages of predetermined time positions.

23. A signal distribution system, comprising, a gaseous conduction device having a container, means comprising a single cathode for maintaining continuously within said container an ionized gaseous plasma, a plurality of anodes extending into said ionized gaseous plasma, a separate external circuit between each of said anodes and said cathode, a source of successively occurring signals, means for simultaneously applying said

successively occurring signals in each of said separate external circuits, said successively occurring signals of variable magnitude insufficient to establish current flow in said external circuits, and means for electro-magnetically superimposing on said signals in said separate external circuits in succession voltage pulses of magnitude sufficient to establish current flow in said separate external circuits and through said ionized gaseous plasma.

24. The combination in accordance with claim 23 wherein said last means comprises a plurality of transformers having secondary windings in series in each of said external circuits, and means for inducing polyphase voltage pairs of harmonically related frequencies in said secondary windings.

25. A signal distribution system, comprising, a gaseous conduction device having a container, means comprising a cathode for maintaining continuously within said container an ionized gaseous plasma, a plurality of anodes extending within said container, distinct external circuits between each of said anodes and said cathode comprising transformer means for applying to said anodes in succession positive voltage pulses of magnitude sufficient to establish current flow in said external circuits through said ionized gaseous plasma.

26. In combination, a plurality of rectifiers each having an anode, a common cathode circuit for said rectifiers, a pair of signal input terminals, means connecting one of said signal input terminals to said common cathode circuit, a negative bias voltage source, having a positive and negative terminal, means connecting said positive terminal to the other of said signal input terminals, a plurality of signal output circuits connected in parallel each between said negative terminal and one of said anodes, a separate similar group of transformer secondary windings connected in series in each of said plurality of signal output circuits, a plurality of transformer cores, means for coupling magnetically one transformer secondary winding from each of said groups with one only of said cores, a separate transformer primary winding magnetically coupled with each of said cores, and means for driving harmonically related currents in selected pairs of said primary windings, the phases of currents in the windings of each of said pairs being different.

27. A system for sampling a signal at periodic intervals, comprising, a rectifier, a source of said signal, means connecting said source of said signal and said rectifier in series, means biasing said rectifier normally in non-conductive relation to said signal, and means for periodically unbiasing said rectifier comprising a plurality of transformer secondary windings in series with said source of signal and said rectifier, and means for inducing in said transformer secondary windings by pairs signal of separated phase and identical frequency, said frequency different in different ones of said pairs.

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No references cited.