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ARC HASH ANALYZER BY CATHODE-RAY TUBE

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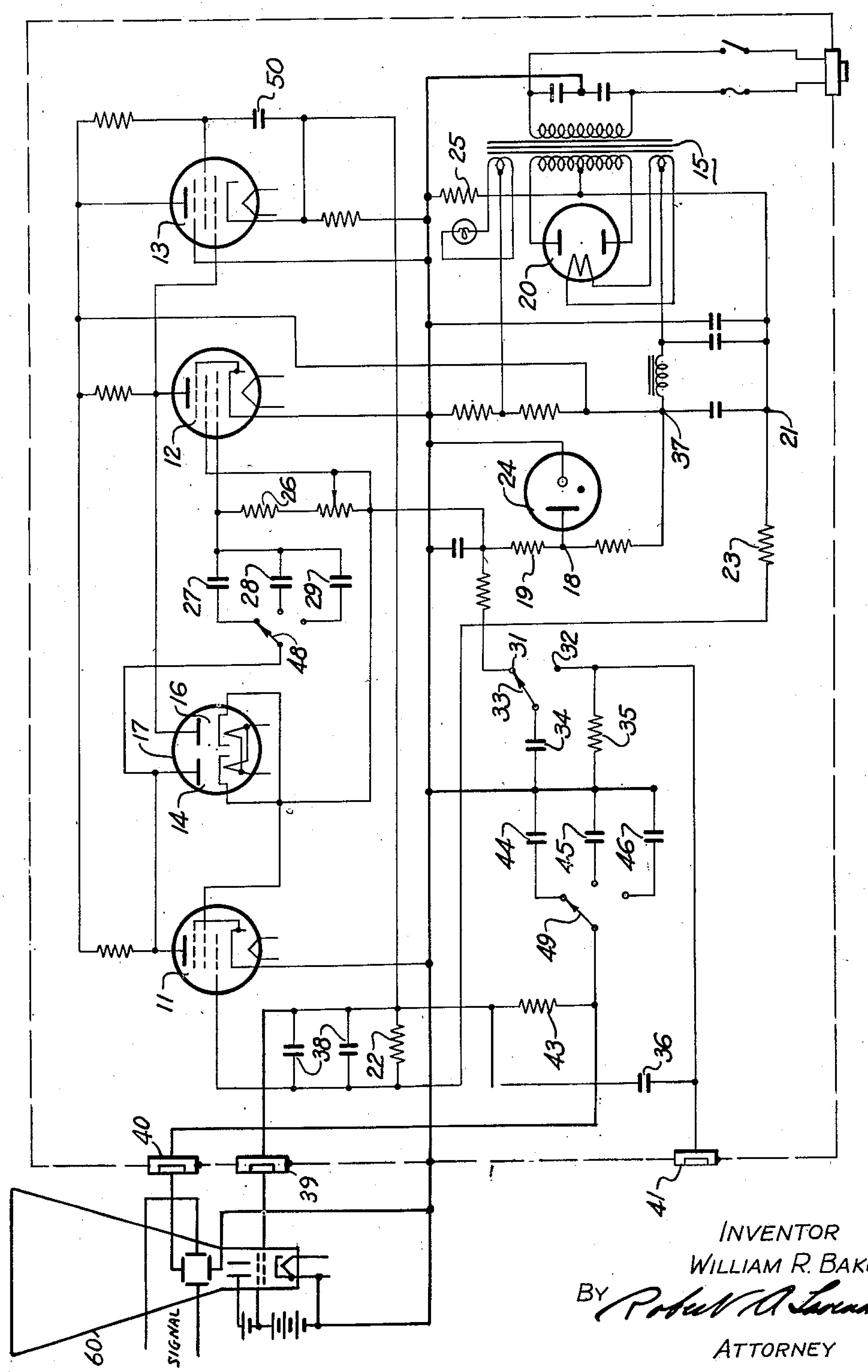

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ARC HASH ANALYZER BY CATHODE-RAY TUBE

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4 Claims. (Cl. 315—22)

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This invention relates to an electrical signal analyzer functioning to present visually on the screen of a cathode ray tube wave forms over a selected short time interval, said interval being capable of adjustment to portray any portion of an electrical signal.

In a calutron, high-frequency oscillations occurring in the arc or in the ion beam are denoted as hash. Arc hash is conducive to poor ion production while ion beam hash results in poor isotopic separation. This invention provides an analytical means for studying hash phenomena in the calutron with a view to its elimination. Although the invention has been evolved particularly for the purpose described, it is not intended that it be limited thereto inasmuch as it has broader applications for use in the study of any noisy electrical signal.

It is therefore an object of the invention to provide a hash analyzer which presents visually on the screen of a cathode ray tube the wave form existing during a selected time interval of any section of an electrical signal.

Another object of the invention is to provide a control circuit including a locked multi-vibrator the operation of which can be initiated by a microswitch or by other electrical means such as a starting signal voltage from an external source.

Another object of the invention is to generate a pulse of rectangular wave form responsive to the control circuit and of selective duration and predetermined strength for controlling the intensity of the cathode ray beam whereby said beam excites the oscilloscope screen only for the interval of said pulse.

A further object of the invention is to coordinate the pulse intensifying the cathode ray beam with means for deflecting said beam in one direction over the same time interval of said pulse and means adapted to deflect said beam in another direction in accordance with the signal to be analyzed.

Other objects and advantages of the invention will be apparent in the following description and claims considered together with the accompanying drawing in which there is illustrated a schematic representation of the circuit elements embodying the invention.

Referring to the drawing, it will be noted that the locked-multivibrator circuit includes amplifier tubes 11 and 12, voltage limiting duo-diode tube 17, and a cathode follower tube 13; a timing circuit comprising resistor 26 and condenser 27; an integrator circuit comprising resistor 43 and condenser 44; a starting circuit comprising a microswitch 33, a condenser 34, a resistor 35, and a condenser 36; an alternate starting circuit comprising terminal 41, and a condenser 36; and a voltage regulated power supply 15 comprising duo-diode rectifier tube 20, and voltage regulator tube 24. The power supply is arranged to produce a high positive voltage at point 37 and a lower regulated voltage at point 18 and a negative voltage at point 21, the point 21 being maintained negative by means of resistor 25.

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When the control circuit including the multivibrator is in its normal condition, no signal appears on the viewing screen of the cathode ray tube 60. And when it is operated the cathode ray beam sweeps across the screen once and a signal appears on the screen representing the wave form of the signal during a selected time interval.

In the normal condition of the control circuit, tube 11 is nonconducting, tube 12 is conducting and the current through tube 13 is small. Also at this time section 14 of duo-diode tube 17 is conducting, thereby limiting the voltage on the plate of tube 11 to a predetermined value of about 108 volts. This predetermined value is equal to the voltage (of 105 volts) at point 18 plus a small drop of a few volts through resistor 19 and section 14 of the duo-diode 17. Also in the normal condition the voltage on the signal grid of tube 11 is established at a negative value determined by the positive potential at the cathode of tube 13, the negative potential at the point 21 and the relative value of the resistors 22 and 23. Thus, in the normal condition of the circuit the signal grid of tube 11 is biased negative, maintaining this tube non-conducting. Also in the normal condition, the positive potential supplied from point 18 of the power supply 15 through the resistors 19 and 26, causes the grid of tube 12 to be maintained slightly positive thus drawing grid current and maintaining tube 12 conducting. As a result the condenser 27 is charged to a relatively high voltage of about 110 volts. Inasmuch as tube 12 is conducting at this time, the potential of its plate is at a very low value and section 16 of the duo-diode 17 is nonconducting. Also at this time a large bias is applied to the control grid of tube 13.

In the normal condition the microswitch 33 remains closed in position 31 thus charging condenser 34 to the voltage of the point 18 of the power supply. To initiate operation of the control circuit, switch 33 is moved from position 31 to position 32 thus causing the condenser 34 to discharge through resistor 35 and to transmit a positive pulse through condensers 36 and 33 to the signal grid of tube 11. As the negative bias on the signal grid of tube 11 is reduced by this positive pulse, the current through the tube 11 increases thus reducing the voltage on the plate of this tube. As the voltage on the plate of tube 11 drops, the grid of tube 12 is driven negative by virtue of the voltage held across the condenser 27 by the charge thereon thus driving the tube 12 toward cut-off and raising the potential on its plate. During the transitory stage the rate of change of voltage across the condenser 27 is less than the rate of change of voltage at the plate of tube 11. As the potential on the plate of tube 12 increases, the grid of tube 13 is driven positive and by virtue of the cathode-follower action, the cathode of tube 13 is likewise driven more positive. This positive cathode signal is applied to the signal grid of tube 11 supporting the original positive pulse applied thereto and accelerating its effect. As this transitory process continues, section 14 of the duo-diode tube 17 is cut off and when the potential at the plate of tube 12 reaches about 105 volts, section 16 of the duo-diode tube 17 starts to conduct, thereby limiting the potential on the plate of tube 12. As condenser 27 continues to discharge through the resistor 26, the potential on the signal grid of tube 12 is driven toward the potential of point 18 of the power supply. As soon as the tube 12 starts to conduct, the potential at its plate is reduced and a negative pulse is transmitted through the cathode follower tube 13 to the signal grid of tube 11, thus restoring the multivibrator circuit to its normal locked condition.

During the time that the cathode of tube 13 is maintained at its relatively high positive value, a positive rectangular pulse is applied to the output terminal 39 which is connected to the control grid of the cathode ray tube 60 and serves to intensify the cathode ray beam. Also in the same time interval a gradually increasing positive signal is applied to the second output terminal 40 which is connected to the horizontal deflection plates of the cathode ray tube 60 and serves to sweep the cathode ray beam horizontally by virtue of the action of the integrator circuit comprising resistor 43 and condenser 44. The duration of this rectangular pulse is determined by the values of the timing circuit and the range of the sweep on the cathode ray tube 60 is determined by the time constant of the integrator circuit. In practice, the time constant of the timing circuit including the resistor 26 and one of the condensers 27, 28 and 29, is so coordinated with the time constant of the integrating circuit, comprising resistor 43 and one of the condensers 44, 45 and 46 by means of the ganged switches 48 and 49, that the triangular wave appearing at point 40 always reaches the same peak value during the time interval during which the rectangular pulse exists. Thus by means of this arrangement the cathode ray beam sweeps across the same horizontal range of the screen regardless of the length of the time interval selected for observing the noise or other signal.

The cathode follower circuit utilized here operates to sharpen the rectangular wave by virtue of the fact that the signal pulse applied to the control grid of tube 11 is applied thereto from the low impedance output circuit of the cathode follower. Thus by using a cathode follower the time constant which controls the operation of the circuit during the transitory stage is shorter than it would otherwise be if the signal were applied from the plate circuit of tube 12 to the control grid of tube 11. Also in connection with the cathode follower circuit, it is to be noted that because the signal grid and the cathode of this tube 13 will change potential by substantially equal amounts, the effective capacitance in the plate circuit of tube 13 is very low, there thus being substantially no Miller effect.

Microswitch 33, condenser 34, and resistor 35 comprise a series circuit. The time constant of the circuit including condenser 34 and resistor 35 is by design made very low in comparison to 500 microseconds which is the approximate interval between successive bounce contacts on switch position 32 and is characteristic of the initial operation of the microswitch 33. The inclusion of condenser 34 and resistor 35 results in only one pulse on contact and precludes the tendency of the microswitch 33 to transmit a succession of positive pulses to the signal grid of tube 11.

The inclusion of a condenser 53 between the screen grid and the cathode of the tube 13 tends to maintain a substantially constant geometry in the region between the screen and the cathode during the transition period.

The terminal 41 is utilized for applying, initiating, or starting signals to the control circuit from an external source.

Although this invention has been described with reference to a particular embodiment thereof, it is not limited to this embodiment nor otherwise except by the terms of the following claims.

What is claimed is:

1. In a pulse generator, the combination comprising a first tube, voltage means connected to said first tube for normally rendering said tube nonconductive, means connected to said first tube for recurrently rendering the tube conductive, a second tube, voltage means connected to said second tube for rendering the tube normally conductive, a condenser and resistor circuit connected between said first and second tubes, the values of said condenser and resistor being such that said condenser becomes charged when said first tube conducts to change the condition of said second tube for a period equal to the time constant of said circuit, a cathode follower tube connected to said second tube, means connected between the cathode of said cathode follower and said first tube to accelerate the conduction of said first tube whereby a rectangular voltage wave is generated at said cathode follower having a duration equivalent to the discharge time of said condenser.

2. In a signal analyzer, the combination comprising a first and a second vacum tube each having at least an anode, a control grid, and a cathode, voltage means connected to the anodes and cathodes of said first and second tubes for impressing operating voltages, means connected to the control grids of said first and second tubes for rendering said first tube nonconductive and said second tube conductive, a condenser connected between the anode of said first tube and the control grid of said second tube for storing energy when said first tube conducts, a resistor connected to the control grid of said second tube to provide a discharge path for said condenser, the values of said condenser and resistor being such that said second tube is rendered noncon-

ductive for an interval equivalent to the time constant of the combination of said condenser and resistor, a cathode follower tube having at least an anode, a control grid, and a cathode, the anode of said second tube being connected to the control grid of said cathode follower, the cathode of said cathode follower being connected to the control grid of said first tube to accelerate the action thereof, a cathode ray tube having an electron gun, deflecting plates, and a viewing screen, the cathode of said cathode follower being connected to said electron gun for producing an electron beam during the interval said second tube is nonconductive, a resistor connected between the cathode of said cathode follower and one of said deflecting plates, a condenser connected between said one deflecting plate and the opposing plate to deflect said beam, the values of the last referenced resistor and condenser combination being such that the condenser is charged at a rate proportional to the voltage at the cathode of said cathode follower and coordinated with the values of said first referenced resistor and condenser so that each successive time said electron gun operates said beam is deflected the same horizontal distance across said viewing screen, and means for varying the time constants of said resistor and condenser combinations in unison.

3. In a signal analyzer, the combination comprising a first and second vacuum tube each having at least an anode, a control grid, and a cathode, voltage means connected to said first and second tubes for rendering said first tube nonconductive and said second tube conductive, means connected to the control grid of said first tube for recurrently rendering such tube conductive, means connected between the anode of said first tube and the control grid of said second tube responsive to conductance of said first tube to render said second tube nonconductive for a predetermined time, an output circuit responsive to voltage changes at the anode of said second tube, a cathode ray tube having an electron gun, deflecting plates, and a viewing screen, said output circuit being connected to said electron gun for producing an electron beam during said predetermined time, a resistor and capacitor circuit connected across said output circuit and one set of said deflecting plates for impressing a sawtooth voltage thereacross during said predetermined time, means for connecting a signal voltage across the second set of said deflecting plates, and means connected between said output circuit and the control grid of said first tube for impressing a portion of the voltage of said output circuit to accelerate conduction thereof.

4. In a pulse generator, the combination comprising a first and a second vacuum tube each having at least an anode, a control grid, and a cathode, voltage means connected to the anodes and cathodes of said first and second tubes for impressing operating voltages, means connected to the control grids of said first and second tubes for rendering said first tube nonconductive and said second tube conductive, a variable condenser and resistor circuit connected between the anode of said first tube and the control grid of said second tube for rendering said second tube nonconductive for a period equivalent to the time constant of such circuit, a cathode follower tube having at least an anode, a control grid, and a cathode, the anode of said second tube being connected to the control grid of said cathode follower tube, the cathode of said cathode follower tube being coupled to the control grid of said first tube to provide positive feedback to accelerate the conduction of said first tube whereby a rectangular voltage wave is generated at the cathode of said cathode follower having a duration equivalent to the time constant of said variable condenser and resistor circuit.

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