

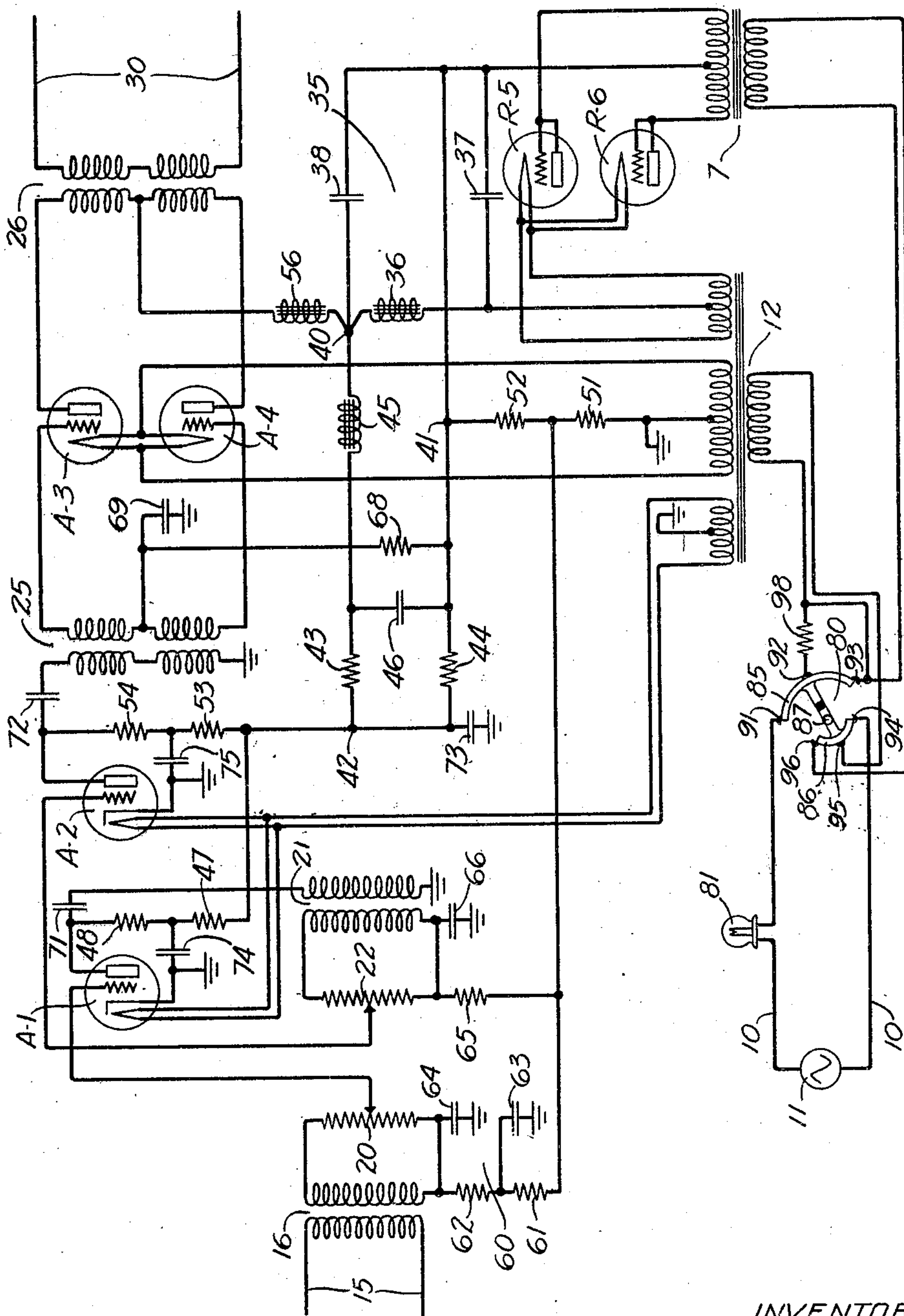
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VAN METER COUSINS

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VACUUM TUBE CIRCUITS

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VACUUM-TUBE CIRCUITS

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This invention relates to energization of electric space discharge devices.

An object of the invention is to regulate cathode heating current and space discharge current for such devices.

5 In one specific aspect the invention is an electric space discharge amplifier having a cathode heating circuit and a plate current supply circuit energized from a power circuit through a three-position switch and a ballast lamp or resistance for maintaining the current supplied by the power circuit constant. When the switch is in its off position the power circuit is open or disconnected from the heating circuit and the space current circuit. When the switch is operated from its off position to its first operating position the heating circuit is connected to the power circuit through the ballast lamp and a protective resistor, but the space current circuit is not closed. If the space current circuit were closed in this position of the switch, the potential applied to the plates might be excessive, since the impedances of the space paths are high when the cathodes are cold. If the protective resistor were omitted, the heating current might be excessive in this position of the switch, since the ballast lamp tends to maintain its current at a given value corresponding to the proper value of the sum of the heating current and the normal space current, and the space current is zero instead of normal in this position of the switch. When the switch is operated from its first operating position to its other operating position, it closes the space current circuit and short circuits the protective resistor.

40 The protection of the space discharge devices in accordance with the invention is of especial utility in the case of uni-potential cathode tubes which have cathodes that heat slowly and more especially in the case of such tubes that have heating elements of filamentary or other form rendering the elements likely to be damaged by excessive current.

50 Other objects and features of the invention will be apparent from the following description and claims.

The single figure of the drawing shows schematically the specific form of the invention referred to above.

The amplifier is a three stage amplifier. The first two stages comprise uni-potential cathode tubes A^1 and A^2 respectively and the third stage comprises two tubes A^3 and A^4 in push-pull connection. Two tubes R^5 and R^6 are used for rectifying current obtained through a voltage step-up transformer 7 from a 110 volt, 60 cycle power supply circuit 10 fed from generator 11. The rectified current is used to supply the grid and plate potentials for all stages. The currents for heating the filaments of all five of the tubes are alternating currents obtained from power supply circuit 10 through voltage step-down transformer 12. The tubes A^1 and A^2 may be, for example, of the heater type disclosed in French Patent 593,321, May 22, 1925, or the type disclosed in U. S. patent to M. J. Kelly, 1,678,145, July 24, 1928.

Waves to be amplified are impressed on input transformer 16 from amplifier input circuit 15. They are transmitted through that transformer to an amplifier input potentiometer or adjustable gain controlling attenuator 20 in the input circuit of tube A^1 , thence through that tube and an interstage transformer 21 to an interstage potentiometer 22, and thence through tube A^2 , interstage transformer 25, tubes A^3 and A^4 , and output transformer 26 to amplifier output circuit 30.

The currents rectified by tubes R^5 and R^6 pass through a filter 35, comprising inductance coil 36 as a series arm and condensers 37 and 38 as shunt arms, for suppressing voltage and current fluctuations. Points 40 and 41 may be regarded as the positive and negative output terminals respectively of the filter 35.

A potential from which plate potential for tubes A^1 and A^2 is obtained is derived from the junction point 42 of voltage dividing resistances 43 and 44, which are connected across points 40 and 41 by a filter consisting of an inductance coil 45 as a series arm and a condenser 46 as a shunt arm. This filter assists the filter 35 in suppressing voltage and current fluctuations. The steady plate

current for tube A^1 passes from point 42 through resistances 47 and 47 to the plate of the tube, thence to the grounded cathode of the tube, and thence through resistances 51 and 52 to point 41. The steady plate current for tube A^2 passes from point 42 through resistances 53 and 54 to the plate of the tube, thence to the grounded cathode, and thence through the resistances 51 and 52 to the point 41.

The steady plate current for tubes A^3 and A^4 passes from the point 40 through a choke coil 56 for suppressing current fluctuations, the primary windings of transformer 26, the tubes A^3 and A^4 , the middle pair of secondary windings of the transformer 12, and resistances 51 and 52, to the point 41.

Negative grid biasing potential for the tubes A^1 and A^2 is obtained from the voltage drop in resistance 51. The biasing potential for the grid of tube A^1 is applied from the junction of resistances 51 and 52 through a resistance and condenser filter 60 and the secondary winding of transformer 16 and the potentiometer 20. The filter 60 consists of resistances 61 and 62 as series arms and condensers 63 and 64 as shunt arms.

The biasing potential for the grid of tube A^2 is applied from the junction of resistances 51 and 52 through a filtering series resistance and shunt condenser 65 and 66 and the secondary winding of transformer 21 and the potentiometer 22.

Negative grid biasing potential for the tubes A^3 and A^4 is obtained from the voltage drop in resistances 51 and 52. The biasing potential is applied from point 41 through a filtering series resistance 68 and shunt condenser 69 and the secondary windings of transformer 25.

Condensers 71 and 72 are the usual stopping condensers, of negligibly low reactance for the frequencies of the wave to be amplified, for blocking passage of direct current.

Fluctuations of the plate current supply for tube A^1 are further prevented by a filter consisting of the resistances 47 and 48 as series arms and condensers 73 and 74 as shunt arms. Fluctuations of the plate current supply for tube A^2 are further prevented by a filter consisting of the resistances 53 and 54 as series arms and condensers 73 and 75 as shunt arms.

The transformers 7 and 12 are energized from the circuit 10 through a three position switch 80 and a ballast lamp 81 for regulating the voltage delivered by circuit 10 to maintain that voltage substantially constant. The ballast lamp may be of the usual type comprising a resistance element having a high positive temperature coefficient of resistance.

The switch comprises two arcuate conducting plates 85 and 86 insulated from each

other and rotatable in a clockwise direction by shaft 87, and comprises six stationary contacts 91 to 96. The switch has a first or off position, a second or starting position and a third position which is the normal operating position. It is shown in its third position, in which the plate 85 connects contacts 91, 92 and 93 and the plate 86 connects contacts 94, 95 and 96. In the first position of the switch the plates 85 and 86 do not touch any of the stationary contacts, and windings 7 and 12 therefore are disconnected from source 11. In conditioning the amplifier for operation, the filaments are energized by rotating the switch to its second position, in which plate 85 connects contacts 91 and 92 and plate 86 connects contacts 94 and 95, so that transformer 12 is connected to source 11 and lamp 81 through a resistance 98. This resistance prevents the voltage applied to transformer 12 from being so great as to result in injury to the filaments energized by the transformer; for in this position of the switch the transformer 7 is not drawing current and the current through the ballast lamp is therefore not sufficient to cause the voltage drop in the ballast lamp to have a value substantially as great as when both of the transformers 12 and 7 draw current. To supply plate potential to the tubes, the switch is moved from its second position to its third position, in which the resistance 98 is short circuited and both transformers are connected to source 11 through lamp 81. The delay in the connection of transformer 7 to the source 11 until the cathodes of the tubes have become energized is desirable in order to prevent application of excessive plate potentials, as pointed out, for example, in Ryan Patent 1,565,505, and Kishpaugh Patents 1,601,075 and 1,473,433.

What is claimed is:

1. A wave transmission system comprising electric space discharge means having cathode means, a power supply circuit, current regulating means in said circuit, a cathode energizing circuit for said cathode means, a space current circuit for said electric space discharge means, protective means for said cathode energizing circuit, and means operable to connect said cathode energizing circuit to said power supply circuit, said regulating means and said protective means, and at the same time to maintain said space current circuit disconnected from said power supply circuit, and operable also to connect said space current circuit to said power supply circuit and said regulating means and disable said protective means.

2. A wave transmission system comprising electric space discharge means having cathodes means, a power supply circuit, a ballast resistance in series in said circuit, a cathode heating circuit for said cathode means, a heating current transformer in said heating cir-

5 cuit, a space current circuit for said electric
space discharge means, a space current trans-
former for the latter circuit, a protective re-
sistor for said heating circuit, and a switch
10 having one position in which it disconnects
said power supply source from said trans-
formers, a second position in which it dis-
connects said power supply circuit from said
space current transformer but connects said
15 power supply circuit to said heating current
transformer with said ballast resistance and
said protective resistor in series with said
heating current transformer, and a third posi-
tion in which it short circuits said protective
20 resistor and connects said power supply cir-
cuit to said transformers in parallel, with
said ballast resistance in series with the par-
allel connected transformers.

3. In a circuit for a vacuum tube having
25 cathode and anode, an energizing circuit for
supplying cathode heating and space current
to said tube, a regulator in said energizing
circuit, and a switch movable through dif-
ferent positions in sequence, in one position
30 disabling said energizing circuit, in another
position energizing said cathode at no higher
than normal operating level and keeping said
anode circuit unenergized, and in the next
sequential position energizing both said cath-
ode and said anode circuit under control of
said regulator.

In witness whereof, I hereunto subscribe
my name this 21st day of June, 1929.

VAN METER COUSINS.

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