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IMPULSE AMPLIFIER

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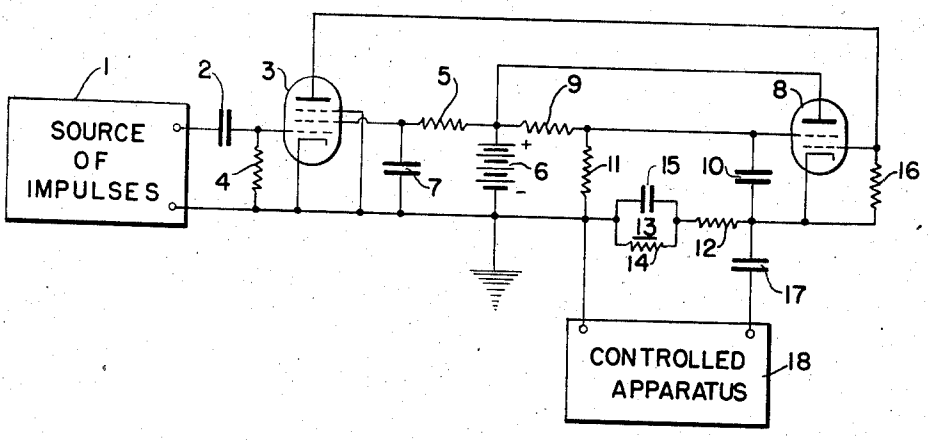

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IMPULSE AMPLIFIER

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This invention relates to electronic amplifiers and particularly to apparatus adapted to amplify unidirectional impulses such as those employed in television systems.

According to conventional practice in television systems, unidirectional impulses are used for a number of different purposes. Typical uses for such impulses are for effecting synchronism and for blanking the reproducing apparatus during the retrace period. Such impulses must be supplied at suitable voltage and power levels before they can be used for their intended purpose. Also, at the receiver the synchronizing impulses must be separated from the video signals of a composite television signal including both types of signals. Frequently the separating and amplifying functions are performed by the same apparatus.

As is well understood in the art, however, where a relatively high overall amplification of the impulses is required, several amplifying stages may be needed. When high level positive output pulses are required the efficiency of such apparatus from a power consumption standpoint is quite low.

An object of the present invention therefore, is to provide a novel multi-stage amplifier which is capable of a large output and which has a high overall power efficiency.

Another object of the invention is to provide novel means for separating the synchronizing impulses from the video signal portion of a composite television signal.

A further object of the invention is to provide a source of polarizing potential to be applied to the anode circuit of a driving stage and derivable from an electrode of the driven stage.

In accordance with the present invention, there is provided a multi-stage amplifier. Each amplifier stage includes an electronic device having an input and an output circuit. The impulses to be amplified are impressed upon the input circuit of the first amplifier stage and the amplified impulses are derived from a load impedance included in the output circuit of a succeeding stage.

There is provided as part of the load impedance, an integrating circuit which is adapted to translate the impulsive energy applied thereto from the output circuit of the succeeding stage into a substantially constant unidirectional voltage. This voltage is applied as a polarizing potential to the output electrode of the first stage. For this purpose a conductive coupling is provided between the integrating network and the output electrode of the first amplifier stage.

There are developed, in the coupling, voltages varying in response to current changes in the output circuit of the first stage. These current changes result from the impedance variation of the electronic device under the control of the impulses applied to the input circuit thereof. These developed voltages are applied to the input circuit of the succeeding stage to effect a control thereof, whereby amplified impulses are produced in the output circuit of this stage. A portion of the energy of the amplified impulses is used to maintain the voltage developed by the integrating circuit and the remainder may be used for a control purpose.

The connection between the conductive coupling and the input circuit of the succeeding stage is such that this stage functions as a class C amplifier; that is, the control grid potential of the electronic device with respect to its associated cathode potential normally is sufficiently negative to effect cut-off of anode current. The currents representing the impulses in the ouput circuit of the first stage effect the development in the coupling of voltages which, when applied to the input circuit of the succeeding stage, render the electronic device thereof conducting. Thus, if a composite television signal including video signals and synchronizing impulses is impressed upon the input circuit of the first stage, the electronic device of the succeeding stage is rendered unresponsive to signals having the relatively small voltage amplitudes of the video signals. It is only when the signal amplitude increases to represent a synchronizing impulse that the electronic device of the second stage responds to amplify such a signal. Thus, the device in accordance with the instant invention not only operates as a more efficient amplifier but also may serve as a means for separating the synchronizing impulses from the video signals in a television system.

For a better understanding of the invention together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing, the single figure is a circuit diagram of an amplifier embodying the instant invention in what at present is considered a preferred form.

Referring now more particularly to the drawing, there is shown a source of impulses 1. This source may be a generator of periodic impulses or it may be the detector of a television receiver circuit. The output circuit of the source 1 is coupled by a condenser 2 to the control grid of an input or driving vacuum tube 3 included in the

first stage of the amplifier. The input circuit of the tube is shunted by a grid leak resistor 4. The screen grid of the tube 3 is connected through a resistor 5 to a source of positive direct current voltage, such as a battery 6, and is bypassed to ground through a condenser 7. The suppressor grid of the tube is connected directly to ground so that it is maintained at the cathode potential. The anode of the tube 3 is connected to a source of positive potential which will be described more fully hereinafter.

The second stage of the amplifier includes an output or driven vacuum tube 8, the anode of which is connected directly to the positive terminal of the battery 6. The screen grid of the tube 8 is connected through a resistor 9 to the battery 6 and is also bypassed to the cathode through a condenser 10. There is also provided a resistor 11 for establishing a desired potential on the screen grid of vacuum tube 8. The cathode of the tube 8 is connected to a load impedance which includes a resistor 12 and an integrating or energy storage network 13. The integrating network comprises the parallel arrangement of a resistor 14 and a condenser 15 and is connected between the resistor 12 and ground. The cathode of the tube 8 is also connected through a coupling resistor 16 to the anode of the tube 3. The coupling resistor also serves as the load for the output circuit of the tube 3. The control grid of the tube 8 is connected to the anode end of the coupling resistor 16.

The output circuit for the amplified impulses is derived from the terminals of the load impedance of the tube 8. This circuit is coupled by a condenser 17 to the apparatus 18 which is to be controlled by the impulses.

Referring now to the operation of the system, assume that there is applied to the input circuit of the tube 3 a series of unidirectional impulses of such polarity that the grid-to-cathode potential of this tube is decreased thereby. As a result of the repetition of these impulses in the output circuit of the tube 8 impulsive energy is applied to the integrating network 13. The time constant of this circuit is such that there is maintained at the terminals thereof a substantially constant unidirectional voltage. This voltage maintains the cathode of the tube 8 at a relatively high positive value with respect to ground.

During the intervals between impulses, when the output circuit of the tube 3 is drawing an appreciable current, there is developed across the coupling resistor 16 a relatively high voltage. The polarity of this voltage is such that the control grid of the tube 8 is at a negative potential with respect to its associated cathode such that anode current in the tube is cut off.

When an impulse is applied to the input circuit of the tube 3, the anode current in this tube decreases. The resultant decrease of the voltage drop across the coupling resistor 16 is sufficient to raise the grid-to-cathode potential of the tube 8 to the point where this tube becomes conducting. Thus, it is seen that there is repeated in the output circuit of the tube 8 the signal which exists in the input circuit of the tube 3. Each of the amplified impulses repeated in the output circuit of the tube 8 produces sufficient energy to restore the integrating circuit to its maximum voltage and also produces impulsive energy for use by the controlled apparatus 18.

Where the source of impulses is the detector circuit of a television receiver, the video signals applied to the input circuit of the tube 3, are of insufficient amplitude to cause the anode current in this tube to approach cutoff, thus tube 8 remains biased to or beyond cutoff and no variations in the output current of tube 8 occur. Video signals, therefore, are not repeated into the output circuit of the second amplifier stage. However, the amplitude of the synchronizing signals is sufficient to reduce the anode current of the tube 3 to the point where the tube 8 becomes conducting. The synchronizing signals then are repeated in the output circuit of the second amplifier stage. Consequently, it is seen that the apparatus in accordance with the present invention will function as a separator of the synchronizing signals from the video signals in a television system.

While it will be understood that the circuit specifications of the amplifier may vary according to the design for any particular application, the following circuit specifications for an amplifier employed for either of the applications described are included by way of example only:

Input impulses—5 volts negative
Condenser 2—0.25 microfarad
Vacuum tube 3—6AC7
Resistor 4—470,000 ohms
Resistor 5—100,000 ohms
Battery 6—700 volts—0.40 amperes
Condenser 7—10 microfarads
Vacuum tube 8—6Y6G
Resistor 9—20,000 ohms
Condenser 10—40 microfarads
Resistor 11—100,000 ohms
Resistor 12—4,700 ohms
Resistor 14—10,000 ohms
Condenser 15—40 microfarads
Resistor 16—4,700 ohms
Condenser 17—1 microfarad
Output impulses—550 volts positive

The amplifier in accordance with the instant invention has a number of desirable and advantageous features. The output voltage supply for the first amplifier stage which is taken from energy stored in the output circuit of the second stage results in a substantial increase in the overall efficiency of the amplifier from the standpoint of power consumption. The derivation of the control voltages for the input circuit of the second stage from the conductive coupling element between the output circuit of the first tube and its energy source provides a class C operation of the second stage, whereby to produce an effective signal separator adaptable for use in television receiving systems. Another advantageous characteristic of the amplifier is its capability of producing a relatively large output.

While there has been described what, at present, is considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and therefore, it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In an electronic amplifier, a first stage having input and output circuits, a second stage having input and output circuits, an energy storage circuit including an integrating network connected in the output circuit of said second stage, means for energizing the output circuit of said first stage from said storage circuit, and means for deriving from said energizing means a control

voltage for the input circuit of said second stage, whereby to reproduce in the output circuit of said second stage signals impressed upon the input circuit of said first stage.

2. In an electronic amplifier, an output electronic device having input and output circuits, a primary source of substantially constant unidirectional energy connected in said output circuit, a secondary source of substantially constant unidirectional energy including an integrating network connected in said output circuit, an input electronic device having input and output circuits, means for impressing signals to be amplified upon the input circuit of said input electronic device, means for coupling said secondary source of unidirectional energy to the output circuit of said input electronic device, and means including said coupling means for impressing control voltages upon said input circuit of said output electronic device, whereby said signals are reproduced in the output circuit of said output electronic device to energize said storage network.

3. In a two-stage amplifier, a coupling arrangement between the stages comprising a load for the output circuit of the second stage including an integrating circuit, means for deriving from said integrating circuit a substantially constant unidirectional voltage, means for coupling said unidirectional voltage to supply the output circuit of the first stage, and means for deriving from said coupling means a control voltage for the input circuit of said second stage.

4. An impulse amplifier comprising, an input vacuum tube having a control grid and an anode, means for impressing impulse voltages upon said grid to produce related impulse voltages at said anode, an output vacuum tube having a control grid and a cathode, a load impedance including an integrating network, means including said network for maintaining said cathode at a substantially constant unidirectional potential, means including a conductive coupling to impress said unidirectional potential upon the anode of said input tube, and means for deriving from said coupling a control voltage for the grid of said output tube, said control voltage varying in accordance with variations of the anode voltage of said input tube in a manner to effect the repetition by said output tube of impulses to said network.

5. Apparatus for amplifying signal impulses comprising, a driving vacuum tube having input and output circuits, said output circuit including an anode, a driven vacuum tube having input and output circuits, said input circuit including a cathode and a control grid, a load impedance for the output circuit of said driven tube including an integrating network connected to said cathode, a load impedance for the output circuit of said driving tube including a resistor connected between said cathode and said anode, means for coupling said grid to said anode, means for impressing voltage impulses of negative polarity upon the input circuit of said driving tube, whereby to produce amplified voltage impulses of positive polarity in the output circuit of said driven tube, said integrating network utilizing said positive impulses to produce a substantially constant supply voltage for the output circuit of said driving tube.

6. Apparatus for separating synchronizing impulses from a composite television signal including video signals and synchronizing impulses comprising, a vacuum tube having input and output circuits and arranged to reproduce in said output circuit a composite television signal impressed upon said input circuit, a second vacuum tube having input and output circuits, said second tube output circuit including a series arrangement of a source of unidirectional energy and an energy storage network, an impedance element connected to the input circuit of said second tube, said impedance element also serving to couple said energy storage circuit to the output circuit of said first tube, whereby said reproduced composite television signal develops corresponding voltages in said impedance element, and means including said impedance element for biasing the input circuit of said second tube so as to render the output circuit thereof responsive only to the developed voltage representing the synchronizing impulses.

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