

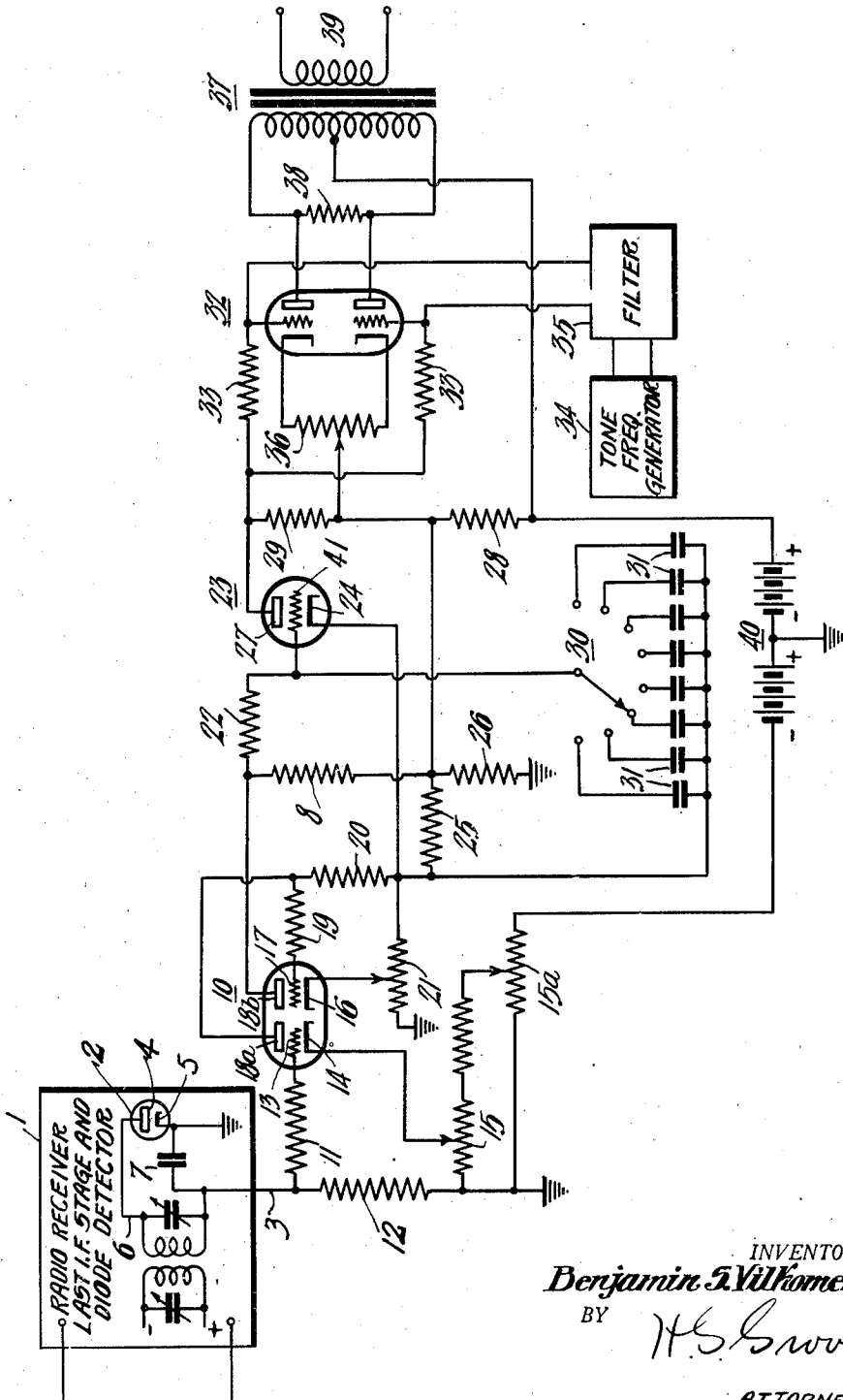
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RECEIVING SYSTEM FOR CODE SIGNALS

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## UNITED STATES PATENT OFFICE

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## RECEIVING SYSTEM FOR CODE SIGNALS

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This invention relates to receiving systems for code signals and more particularly to apparatus for reducing the effects of interference when receiving code signals by radio.

In order to reduce interference effects, such as random noise peaks, key clicks of stations on adjacent channels, and other adverse effects, it is important that the received signals should be regenerated before application to a telegraph signal recorder or printer. This is preferably done in such a way that a substantially rectangular wave is produced representing the marking and spacing elements of the signals. Various limiting devices are known in the art which aid in accomplishing this purpose. Insofar as I know, however, it is a novel technique to use in combination an amplitude limiter and a time integrator to discriminate against pulses of shorter duration than the signaling dots which are used in the composition of the code signals.

Accordingly, it is an object of my invention to provide a translating circuit arrangement for suppressing the effects of short pulses having their origin in noise and other interference effects and to feed the wanted pulses of dot and dash duration directing to the responsive device which may be used for relaying, recording or printing the intelligence.

It is another object of my invention to provide an adjustable resistance-capacitance integrator stage following an amplitude limiter in a receiving circuit for code signals, this integrator being so adjusted that pulses of the duration of a dot at the keying speed in use will build up sufficient voltage on the grid of an amplifier tube so as to unlock this stage, allowing locally generated tone voltage to go through, while pulses of shorter duration than the duration of a dot, such as noise peaks or key clicks, since they cannot be of greater amplitude than the signals, due to limiter action, do not build up sufficient voltage to open the audio channel.

My invention will now be described in more detail, reference being made to the accompanying drawing, the sole figure of which shows diagrammatically a preferred circuit arrangement.

Referring to the drawing, I show therein a radio receiver 1, the intermediate frequency output from which may be fed to a diode rectifier tube 2, wherein rectification of the intermediate frequency signals is obtained. The last I. F. amplifier transformer of the receiver is connected to anode 4 of diode rectifier tube 2 by lead wire 6, and by means of condenser 7 to cathode 5 which is grounded. (This diode is

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usually inside the receiver.) The rectified code signals which appear as negative voltages to ground across condenser 7 are conducted by lead 3 to resistor 12 through which the D. C. circuit to ground is completed.

The rectified signal potentials are caused to control one of the grids 13 in a D. C. amplifier tube 10 which is of the twin triode high mu type. The electronic path shown in the left section of this tube has an input circuit which includes resistors 11 and 12 leading from the grid 13 to ground. This section of the tube is normally maintained in a saturated state, but is biased to plate current cut-off by a rectified signal potential of sufficient negative value applied to the grid 13. The cathode 14 is, therefore, maintained normally at such a value of negative bias with respect to the grid 13 as to ensure operation at signal amplitudes, and not by weaker spurious pulses, this being accomplished by proper setting of a movable tap on a potentiometer 15 in the circuit between a source of negative voltage 40 and ground. One end of the potentiometer 15 is connected to a tap on a second potentiometer 15a which is connected between ground and the negative terminal of the source 40. The use of two potentiometers 15 and 15a is found advantageous for fine and coarse setting of the threshold bias.

The right hand section of tube 10 contains an independent cathode 16, a control grid 17, and an anode 18b. The grid 17 is connected by a resistor 19 to the anode 18a in the left hand section of tube 10. Anode potential is fed from source 40 through resistors 28, 25, and 20 to the anode 18a in the left section of the tube 10. Resistor 20, however, is common to the output circuit of the left hand section and the input circuit of the right hand section. The junction between resistors 20 and 25 is connected to ground through a potentiometer 21, to a tap on which cathode 16 is connected. A resistor 26 also connects the junction between the resistors 25 and 38 to ground.

The input circuit for tube 23 includes a filter network consisting of resistor 22 and a selected one of a number of capacitors 31 of different ratings which may be adjustably inserted in circuit between resistor 22 and the cathode 24. A selector switch 30 is used to determine which of the capacitors 31 shall be used in this filter. If desired, the switch 30 may be so constructed as to insert one or more of the capacitors 31 in the circuit. The choice of these capacitors 31 is determined by the keying speed, by the operating

characteristics of the circuit as a whole and by the prevailing character of the noise effects which are to be eliminated.

In operation, the threshold bias potentiometers 15 and 15a are adjusted according to the signal strength, so that the cathode 14 is somewhat less negative in respect to ground than the grid 13 as biased by rectified signals. This means that interfering signals, or noise of a grid voltage which has less amplitude than the desired signal, will result in lower negative relative to ground than the cathode so that the grid 13 remains positive in respect to the cathode, and the voltage on anode 18a remains low—about +10 volts. It should be noted that resistor 11 which is of the order of 1 megohm is in series with the grid 13 and limits the flow of grid current to a few micro-amperes as long as the grid is positive by any ordinary amount. Very nearly all of the positive voltage applied appears across this resistor, so that the grid actually goes only very slightly positive with any applied positive voltage. When the grid 13 goes negative, due to rectified signal voltages of larger negative magnitude than the negative bias on cathode 14 being applied, the grid current stops and, there being no voltage drop across resistor 11, the full negative voltage is applied to the grid 13. This reduces or cuts off the current flowing in circuit with anode 18a. The anode voltage rises to a more positive value due to a reduction of the voltage drop across resistor 20. Cathode 16 having been set to such a positive voltage by potentiometer 21 as to make grid 17 negative in respect to it in the absence of signal, when anode 18a goes more positive, due to a signal being impressed, grid 17 goes positive also (limited by resistor 19), thereby reducing the positive voltage on anode 18b and on grid 41 of tube 23. This increases the positive voltage on anode 27 which, being connected through resistors 33 to the grids of tube 32, changes the potential of these grids in respect to their cathodes from a negative value corresponding to plate current cut-off to a normal amplifier bias. The locally generated tone frequency voltage applied to the grids of tube 32 is thus stopped or passed on to transformer 37 in accordance with the presence or absence of signal voltage on grid 13. The sensitivity of the device is such that complete switching on and off of the local tone source can be accomplished with a differential voltage of as little as 0.2 volt on grid 13 above the adjustable threshold bias voltage on cathode 14. Any value of signal above this, up to 75 volts or more, has exactly the same effect on the voltage of anode 18b, so that the effect of tube 10 is to make all signals that pass through it have exactly the same amplitude. Being all of the same amplitude the voltage impressed on grid 41 will be a function of the time during which current flows through resistor 22 to charge condenser 31. By proper selection of values, pulses of shorter duration than the dot of the keying speed in use will not build up sufficient voltage to cause tube 23 to switch on the local tone voltage. In this way noise pulses of short duration can be completely eliminated from the output of transformer 37 even when their original amplitude (on grid 13) is many times greater than that of the desired signal.

The setting of switch 30 should be such as to eliminate pulses of shorter duration than any which are used as signaling dots at a given keying speed. In an embodiment of my invention which has been constructed and successfully operated,

there were eight different condensers 31 connected to different points on the selector switch 30, and the values of the respective condensers were as follows:

M. F. D.

0.1  
.05  
.03  
.015  
.006  
.003  
.0018  
.00082

15 The output circuit of the D. C. amplifier 23 includes resistor 29 serving as a load. Utilization, however, is obtained by connection of the anode 27 to the grids in a push-pull twin triode amplifier tube 32. Grid resistors 33 are used in this connection.

20 A tone signal from a local source 34 is applied in a push-pull manner to the grids of tube 32 through a filter network 35. The two cathodes in tube 32 are interconnected by a potentiometer 36 having a tap connected to ground through resistor 26. The tap is movable in order to equalize the positive and negative peaks in tube 32. Anode potential is applied to the anodes in tube 32 by connection from the direct current source 40 to a midtap on the primary winding of the output transformer 37. The secondary winding of this transformer is suitably connected to terminals 39 of a line which may be used, if desired, for transmission of signals to a commercial receiving station.

35 In utilizing my invention it will be apparent that the characteristic of the received signals is usually one wherein the intelligence signals are accompanied by unwanted interference effects. The operation of the limiting devices including tubes 10 and 23 in combination with the filter system composed of resistor 22 and a selected one of the condensers 31 is such as to remove substantially the greater part of the interference effects and to deliver a noise-free signal wave.

40 The choice of suitable values for the resistances and capacitances of the network depends on keying speed only and can be and were calculated to accommodate the speeds in use. The lowest speed naturally gives the highest amount of noise rejection, as noise pulses of longer duration can be rejected without losing dots. The combination of resistive and capacitive components covers a range of time constants of from .0004 second to .05 second when using a resistor 22 having a value of 470,000 ohms and when using the capacitive values given in the above table. This is roughly equivalent to dots of keying speeds of from 20 words per minute to the highest speeds used with automatic transmitters.

45 It will, of course, be understood by those skilled in the art that various modifications of the invention may be made without departing from the spirit thereof. I do not wish to be restricted, therefore, to the precise circuit arrangement illustratively shown herein, nor do I feel restricted to the choice of components having the values illustratively stated.

I claim:

50 1. In a signal receiving system, a multi-stage amplifier including at least one stage which is biased to be un-responsive to input voltages of less than an adjustable predetermined amplitude, and to pass on to succeeding stages voltage pulses of constant amplitude whenever the said input

voltage exceeds, by either a relatively small or a large amount, the aforesaid predetermined amplitude, said one stage being followed by a first amplifier stage having an input circuit which includes resistance and capacitance, means for adjusting the value of said capacitance so as to integrate pulses of energy derived from the said one stage and thereby to differentiate between such pulses as constitute intelligence signals and pulses caused by random noise peaks, key clicks and the like, a local source of low frequency energy, and a second amplifier stage having an input circuit which is subject to joint control by said local source and by the output from said first amplifier stage, said second amplifier being thus rendered responsive only to signal pulses representing said intelligence signals.

2. A system in accordance with claim 1 in which said means for adjusting the value of the capacitance includes a multi-position switch having selective contacts each connectable to a respective one of a plurality of differently rated capacitors.

3. A signal translating arrangement comprising two amplifier stages biased to be un-responsive to input voltages below an adjustable threshold value which amplifier stages are operated to produce voltage pulses of equal constant amplitude for input signals of all amplitudes above the threshold value, followed by a resistance capacitance integrator stage and a push-pull amplifier stage in cascade in the order recited, means for constantly applying tone frequency energy to be keyed on and off in accordance with the marking and spacing conditions of an incoming train of code signals to said last amplifier stage, said first amplifier stages being operative to deliver substantially rectangular waves to said integrator stage, said integrator stage possessing a time constant circuit the parameters of which are so chosen as to nullify the effects of random noise peaks, key clicks and similar interference the persistence of which is of shorter duration than that of a signaling dot, and said integrator stage having its output circuit coupled to the input side of said tone frequency amplifier stage, whereby the keying of said tone frequency energy is effected.

4. A receiving circuit for discriminating between intelligence signals and noise signals, comprising direct current amplifier means for level-

ing the signal wave peaks to a limiting value, a direct current amplifier stage having an input coupled to said amplifier means and having output electrodes, said last stage having a device in its input circuit for integrating energy pulses which constitute signal components derived from said limiting amplifier means, such device being effective to dissipate the energy components of noise signals whenever they persist for a shorter time than the duration of a signaling dot, another amplifier having a tone frequency source connected to its input circuit, and means for keying the output of this amplifier by the signal energy derived from said energy-integrating amplifier.

5. A circuit arrangement for the reception and translation of code signals comprising a plurality of cascaded amplifier stages, at least one of said stages being operable as a minimum input and maximum output amplitude limiter, a following stage having an energy integrating device associated with its input circuit, said device including a time constant circuit at least one of the components of which is adjustable to produce discrimination between the signal dots of code reception at a predetermined keying speed and noise pulses of shorter duration than said signal dots, said discrimination being thus effective to cause the output of said following stage to be substantially noise free, a source of tone frequency energy, a push-pull amplifier stage having its input circuit subjected to push-pull control by said source, and means under control of code signal potentials in the output of said following stage for keying said push-pull amplifier stage on and off.

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