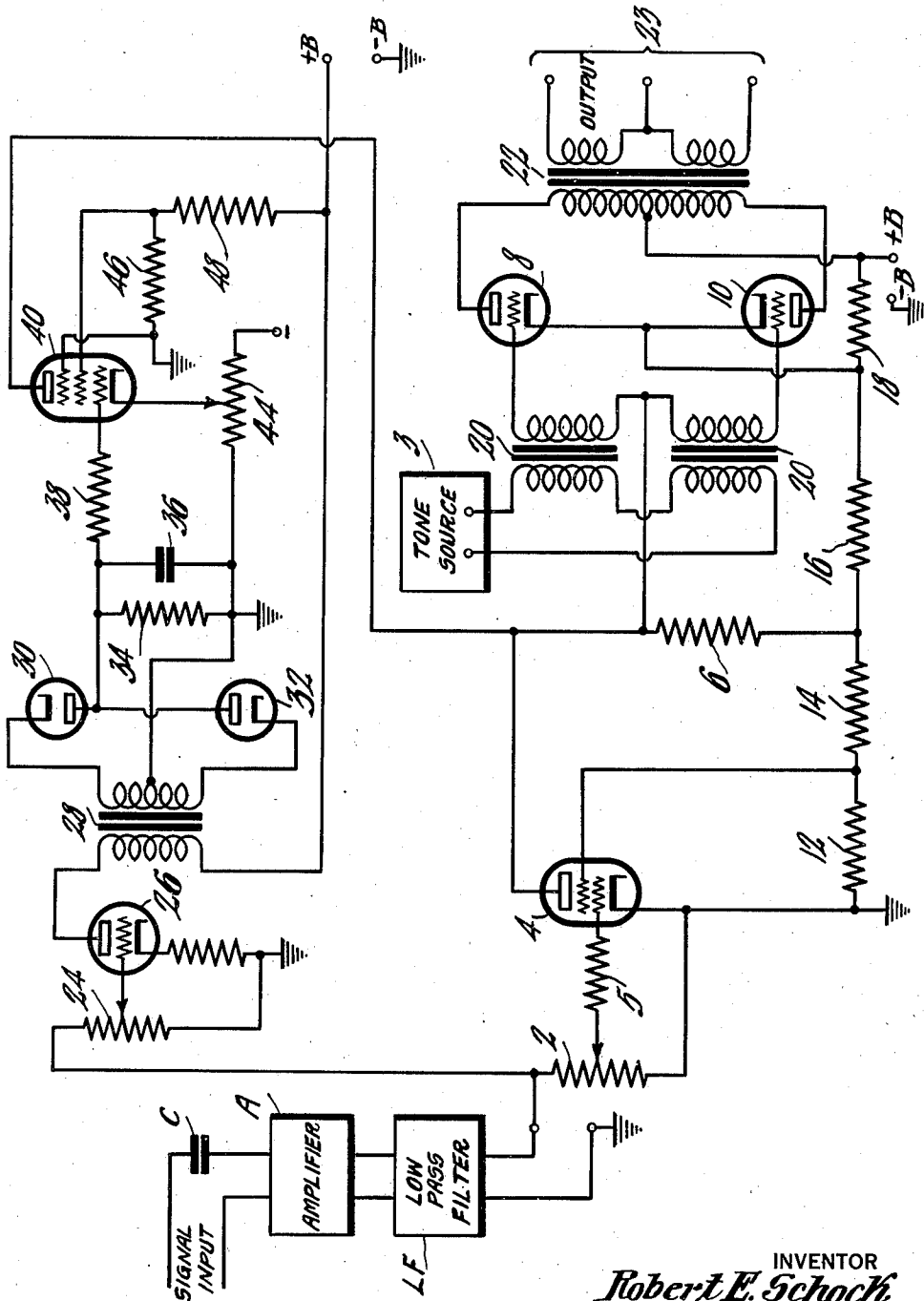


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SQUELCH CIRCUIT FOR SUPPRESSING
NOISE COMPONENTS
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SQUELCH CIRCUIT FOR SUPPRESSING
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In telegraph signal systems when the signals stop, noise in the system often excites the tube stages, thereby operating the recording apparatus to cause the same to print gibberish.

The primary object of my invention is an improved signal relaying and amplifying system for the signals to be recorded including improved means for inhibiting or squelching operation of the tube stages in the absence of signals to thereby prevent improper operation of the recording apparatus.

In describing my invention, reference will be made to the drawings wherein the single figure illustrates signal amplifying and recording apparatus control circuits arranged in accordance with my invention.

To simplify the description of my invention, it has been applied to a recorder of signals such as are derived at the output of a frequency shift receiver as disclosed in Schock et al. application Serial Number 632,978, filed December 5, 1945. The signals at the discriminator and detector output in this receiver swing above and below (+ and -) about zero potential. It will be understood that the invention is equally applicable to "on-off" telegraph systems of the type wherein the signal is varied in a like manner and to F. S. and "on-off" systems of the type wherein the signal is varied from some high negative value representing, say, mark, to about zero value representing, say, space.

In the system being described, the numerals 1 to 22 inclusive designate the essential circuit elements of a tone keyer as used by my assignee, the Radio Corporation of America, except for the grid limiting resistor 5. The circuits, including elements designated by numerals 24-48 inclusive, constitute the squelch circuit or inhibiting means which blocks output from the tone keyer when no signals are supplied to the control grid of tube 4.

The input to condenser C might be taken at the output of the gate tubes in said Schock et al. application and these signal potentials which swing plus and minus with respect to zero are amplified in A and filtered in LF and applied to the tube 4. To limit the grid current of the tone keyer input on positive swings of the signal characters derived from the frequency shift detector, the resistor 5 is inserted. When cur-

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rent flows in the grid circuit of tube 4 the potential drop in 5 tends to limit such current flow. The tube 4 is fully conductive when zero bias is applied to its grid and the positive swings of the applied potential, which may represent space characters, do not change this condition, but the negative swings, which may represent mark characters, bias the tube 4 to cut-off. When the tube 4 is conductive the plate current drop through resistor 6 is fed to the grids of the tone keyer stage tubes 8 and 10 through the secondary windings of the transformers 20 coupled with the tone source 3. This potential drop which makes the grids of tubes 8 and 10 less positive drives tubes 8 and 10 to cut-off so that the tone applied from source 3 to the grids of the amplifiers 8 and 10 through transformer 20 is not passed to the tone keyer output transformer 22 and thence to the lines 23 which may go to recording apparatus such as a teletypewriter. When the potential at the grid of tube 4 swings negative in, say, mark condition, the tube 4 is cut-off so that its plate current falls and the potential at the tube 4 anode rises. This swing in the positive direction of the biasing potential on the grids of tubes 8 and 10 causes the same to become conductive to amplify the tone from source 3 and feed it to the output transformer 22 and thence to the recording apparatus connected with the lines 23.

Potentials for the anodes and screen grids of tubes 4, 8 and 10 are supplied from appropriate points on a potentiometer including resistors 12, 14, 16 and 18 shunting a direct current source. The tone keyer including tubes 4, 8 and 10 may be substantially as disclosed in Peterson Patent 2,237,631 dated April 8, 1941.

The purpose of the invention is to block off tubes 8 and 10 when signals no longer appear across resistor 2, and my improved means to do this will now be described. The signal potentials at 2 are also applied across the potentiometer resistor 24 a point on which is coupled to the grid of an amplifier tube 26 which in turn feeds the primary winding of a transformer 28 the secondary winding of which is coupled in push-pull by diode rectifiers 30 and 32. The rectifier circuits are completed by resistor 34 connecting the anodes of the diodes 30 and 32 to a point intermediate the terminals of the transformer

28 secondary winding. The rectified output of rectifiers 30 and 32 appears as a negative voltage across the rectifier load resistor 34 and condenser 36. The negative voltage appearing across the resistor 34 is applied through a grid limiting resistor 38 to the control grid of the tube 40 whose plate circuit is connected in parallel with the plate circuit of the control tube 4 in the tone keyer. The tube 40 is herein designated as a squelch tube and it derives its plate current through the load impedance 6 just as does tube 4. A negative bias is supplied to the cathode of the squelch tube 40 through potentiometer 44.

In operation, potentiometer 24 is adjusted so that when a signal is present the magnitude of the negative voltage developed across the rectifier load resistor 34 will be such as to cut-off squelch tube 40. When the squelch tube 40 is cut-off, that is when signals are present, only the tube 4 is drawing current through the load resistor 6 and it operates in its normal manner as described above to key the output of tone source 3 in accordance with the signals to supply keyed tone output at the lines 23. When there is no signal present, the full wave rectifier output approaches zero and the negative potential across the condenser 36 leaks off through resistor 34 so that the grid of tube 40 is no longer biased to cut off and tube 40 becomes conductive. Now since the plate of tube 40 is in parallel with the plate of tube 4 through resistor 6 of the tone keyer the current of tube 40 flowing in resistor 6 supplies a voltage drop which cuts off tubes 8 and 10 to stop or block output from the tone source 3. When squelch tube 40 is conductive the tone keyer is rendered inoperative and when squelch tube 40 is cut off the tone keyer is free to operate normally. The time constant of the network including resistors 34 and 36 is as described above and is large enough to insure that discharge into the region where the tube 40 is turned on does not take place in normal signaling. The time constant is, however, small enough so that it will discharge into that region after the loss of a number of signal elements, for example, those of a 5 letter word. Since the tube 40 becomes conductive only in the absence of signal its action on the tone keyer is that of a squelch circuit.

Of course noise on the circuit input, in the absence of signal, will be rectified and appear as a negative voltage on the grid of the squelch tube thus cutting it off and allowing the tone keyer to become operative. This would defeat the purpose of the squelch since the noise would then be able to operate the tone keyer in the absence of signal. To obviate this possibility, a negative voltage is supplied to the cathode of tube 40 through potentiometer 44. (This is, of course, equivalent to applying a positive bias on the grid. In fact if the cathode of tube 40 were grounded and a positive bias placed in series with the grid circuit it would accomplish the same end.) With a negative potential on the cathode (positive grid bias) the noise must now be of much greater amplitude before it can generate enough negative potential in the rectifier output to overcome the positive bias on the squelch tube grid. Therefore it is possible to adjust the bias applied by potentiometer 44 so that noise cannot render the squelch inoperative unless its amplitude is almost as great as that attained by the signal when the signal is present. As an example, suppose the signal when present generates 10 volts negative potential across resistor 34. Since tube 40 would nor-

mally best be a sharp cutoff tube which would cut off at about 1 volt bias, only a volt or two of this signal is needed for cutting the tube 40 off. If the cathode of tube 40 is made 8 volts negative it will require 9 volts of rectified signal to shut it off. Since 10 volts of rectified signal is available, when the signal is on, the signal will cut off the squelch with a margin of one volt. In the absence of signal, however, the noise now has to have an amplitude which will give 9 volts of rectified output across resistor 34 before it can stop the squelch action. Therefore the tone keyer remains squelched in the event of no signal even though the noise is eight tenths as strong as the signal used. That is, the noise will have to generate more than 8 volts across resistor 34 before it begins to cut tube 40 off and actually will have to generate 9 volts before it can completely cut tube 40 off.

The potentiometer 24 is used to adjust the level of the signal in the squelch circuit to a magnitude which will insure that the squelch tube 40 is cut off in the presence of signal. The tube 26, rectifiers 30, 32, load 34 and 36, etc. are such as to generate at the grid of tube 40 a negative voltage from the incoming signal sufficient to cut off the tube 40. Since the tubes 30 and 32 form a full wave rectifier circuit both sides of the signal wave get rectified and the same voltage is generated from the signal regardless of whether the keying is light or heavy. The potentiometer 44 sets the threshold below which noise will be unable to operate the squelch.

What is claimed is:

1. In a system for relaying telegraphy signals and for preventing relaying of noise components in the absence of signals, a first control tube having input electrodes excited by said signals and noise and having output electrodes in circuit with an impedor wherein a potential is developed which may be used, a rectifier excited by said signals, said rectifier having an output impedor wherein a potential is developed which is negative in the presence of signals, a second tube having a control grid coupled to said rectifier and excited by said last named potential and having an anode circuit including the impedor in the output circuit of said first tube, and means for biasing said second tube by a potential such that the same is cut off in the presence of signals at the input of said rectifier.

2. In a system for relaying telegraphy signals and for preventing relaying of noise components in the absence of signals, a first control tube having input electrodes excited by said signals and noise and having output electrodes in circuit with an impedor wherein a potential is developed which may be used, a rectifier excited by said signals, said rectifier having an output impedor wherein a potential is developed which is negative in the presence of signals and less negative in the absence of signals, a relatively large capacitor in shunt to said impedor, a second tube having a control grid coupled to said last named impedor and excited by said last named potential and having an anode circuit including the first named impedor in the output circuit of said first tube, and means for biasing said second tube by a potential such that the same is cut off in the presence of signals and is conductive in the presence of noise components which are materially less in magnitude than the signals.

3. In a telegraph system a tone source and apparatus for keying said tone source in accordance with signals represented by potentials of varying

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magnitude and for preventing keying of said tone source by noise components in the absence of signals comprising, a first control tube excited by said signals and noise, an output resistor wherein a potential is developed which keys said tone source, a full wave rectifier circuit excited by said signals and noise, said full wave rectifier circuit including an output impedor wherein a potential is developed which is negative in the presence of signals and less negative in the absence of signals, a relatively large capacitor in shunt to said impedor, a second control tube having a control grid coupled to said impedor and excited by said potential, and having an anode circuit including the resistor in the output circuit of said first control tube, and means for bias-

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ing said second control tube by a potential such that the same is cut off in the presence of signals and is conductive in the presence of noise at the input of said full wave rectifier the magnitude of which does not exceed the magnitude of the signal.

ROBERT E. SCHOCK.

REFERENCES CITED

- 10 The following references are of record in the file of this patent:

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Number	Name	Date
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