May 19, 1942. V. J. COOPER 2,283,724

KEYING CIRCUIT

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Fig. 1

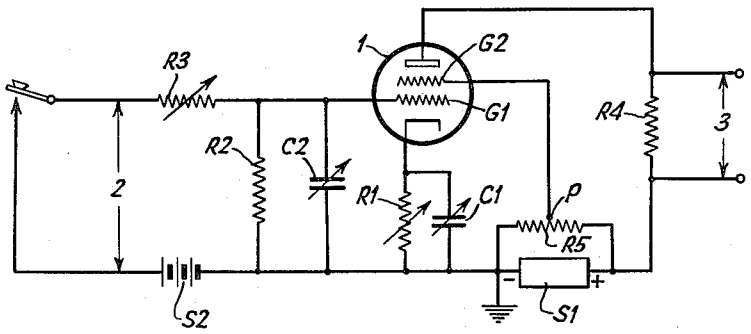
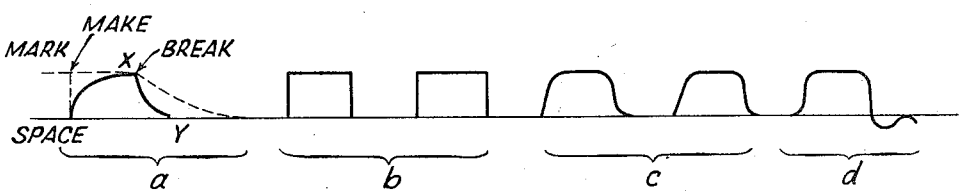


Fig. 2



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KEYING CIRCUIT

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2 Claims. (Cl. 178—66)

This invention relates to keying arrangements for radio and like systems and provides what may be referred to as "softening" whereby to prevent key-clicks.

A complete description of the invention follows, wherein reference is made to the accompanying drawing showing,

Figure 1 which represents a circuit arrangement for shaping the voltage wave form suitably to avoid key-clicks; and

Fig. 2 shows graphically various wave form representations.

Softening by the usual CR circuits produces a voltage wave form such as is illustrated in Fig. 2 of the accompanying drawings, at *a*. This wave form exhibits an exponential rise and fall of voltage on "make" and "break" respectively for "mark" and "space," and it will be seen that there exists a very high rate of change at the point X at which point the level of the keyed signal is high. This tends to produce an undesirable click which can be reduced or minimized only by reducing the initial slope of the curve X, Y. Such reduction has the disadvantage, however, that it produces a long "tail" which either reduces intelligibility or speed, since dots tend to run together.

According to the invention a keying circuit arrangement for radio or like transmitters includes a valve having at least a cathode, a control grid, and an anode; an input network connected between said control grid and cathode, said input network including a resistance-shunted capacity; a keying circuit including keying contacts, a series impedance and a source of potential connected across said input network, and an output circuit connected between said anode and cathode, said output circuit including a source of anode potential and an impedance.

Preferably there is included in the cathode leg of said valve a bias resistance and, if desired, this reactance may be capacity shunted.

Referring now to Fig. 1, a circuit arrangement is illustrated including a variable-mu discharge tube 1, such as that known commercially as an RCA type 35 tube. Between the source S1 and the cathode of this tube is connected a self-bias resistance R1, and in shunt therewith an adjustable capacitor C1. The control grid is connected to a resistance-shunted capacity network R2, C2 and also through resistance R3 to a keying circuit 2 which includes a source of keying potential S2. The negative terminal of source S1 is also connected to R2 and C2. The anode and screen grid circuits are connected to the positive terminal of source S1. The keying source S2, if independent of the source S1 (as shown), has its positive terminal connected to the cathode of the tube 1. The anode circuit includes a resistance R4 and from across this last mentioned resistance (or part thereof) amplified keying potentials may be derived at terminals 3 for impress upon the carrier energy of a radio transmitter. Across the source of anode potential S1 there is connected a potential-dividing resistance R5 from which positive potential for the screening grid G2 of the valve is taken at point P.

With this arrangement softening of the beginning and end of the keying output impulses from the valve is effected without, as is the case with the usual CR circuits, the disadvantage of producing a high rate of change of the slope of the wave form at the point where the carrier, at a maximum, is cut off. Wave forms for the input and output voltages 2 and 3 are shown at *b* and *c* in Fig. 2.

If desired, a condenser C1 may be connected across the cathode-leg bias resistance R1.

Circuit values are so chosen that, when the keying contacts are closed, the valve is biased to cut-off, and no difference of potential appears across the terminals of the output resistance R4. In this condition a potential difference exists across the resistance-shunted capacity input network R2, C2. Furthermore, when the valve is biased to cut-off, and when the screen grid current is negligible in relation to the current through R5, then there will be substantially no potential difference across the cathode-leg bias resistance R1. Thus, the screen grid G2 can be maintained at a substantially constant potential determined by the potential of the source S1 and the position of the tapping point P on the potential divider R5. When the keying contacts are opened the condenser C2 in the input network will discharge through the resistance R2 in that network, and the till then existing negative potential component on the control grid G1 due to the source of keying potential will decrease in accordance with an exponential law. This has the effect of permitting anode current to flow through the valve 1 and a gradually increasing potential component will appear across the cathode leg bias-resistance R1. This latter potential component will tend to delay the growth of current in the valve, and these two effects produce the desired "softening" in the rise of anode current.

If a condenser C1 is connected across the cathode-leg bias-resistance R1, when the voltage is

building up across this resistance the shunting condenser will charge up at a rate dependent on the voltage across the resistance R1, the rate of change of current in the anode circuit, and the value of the capacity C1. If the condenser is large, until a steady state is reached, the self-bias will be less than the bias would be if the condenser were absent. This condenser thus provides, after the softening following the opening of the keying contacts, a transitory state during which the anode current is in excess of the steady state anode current and thereby a momentary peak of excess voltage which corresponds to a "curbing" voltage which can be utilized to improve the intelligibility of high speed keying, firstly, by reducing the "tail" of the "break" curve to zero and, secondly, by improving the ratio of mark time to space time. The wave form for this condition is shown at *d* in Fig. 2.

When the keying contacts are again closed, the condenser C2 in the input network will again charge according to an exponential law, so that the negative grid potential will increase accordingly, and the anode current fall. The fall of anode current will be opposed by the potential across the self-bias resistance R1 so that a delay, with consequent softening of the "make" of the output impulse, will be effected.

Suitable values for the various components are as follows: keying voltage 100 volts, keying resistance 80,000 ohms, condenser in the input network ½ microfarad, resistance in that network 55,000 ohms, cathode-leg resistance 5,000 ohms, anode potential 215 volts and screening grid potential 100 volts (all potentials being referred to the potential of the cathode) and anode resistance 25,000 ohms.

A further degree of "softening" can be achieved if desired by making R5 a high resistance potentiometer or by omitting the part of the resistance R5 connected between the tapping point P and the negative terminal of the source of supply S1 so that the screening grid S2 of the valve is maintained at a potential dependent upon the current taken by the screening grid.

I claim:

1. In a keying circuit for a radio transmitter, an electron discharge tube having at least a cathode, an anode, a control grid and a screen grid, keying means connected through an adjustable resistor to the control grid, also through a source of keying potential equivalent to a cut-off bias, and through a second resistor to said cathode, an adjustable capacitor in shunt with said second resistor, an output circuit which includes said second resistor, a source of anode potential, and a load impedance, a voltage divider connected across the terminals of said anode potential source, a connection from a suitable point on said voltage divider to said screen grid, and a capacity shunted grid leak resistor connected between said control grid and the terminal of said second resistor remote from the cathode.

2. The combination according to claim 1 and further characterized in that the parameters of each said resistor, each said capacitor, and the said potential sources are so determined as to produce keying impulses in the output circuit which possess a substantially round cornered and flat-topped wave formation.

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