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KEYING SYSTEM

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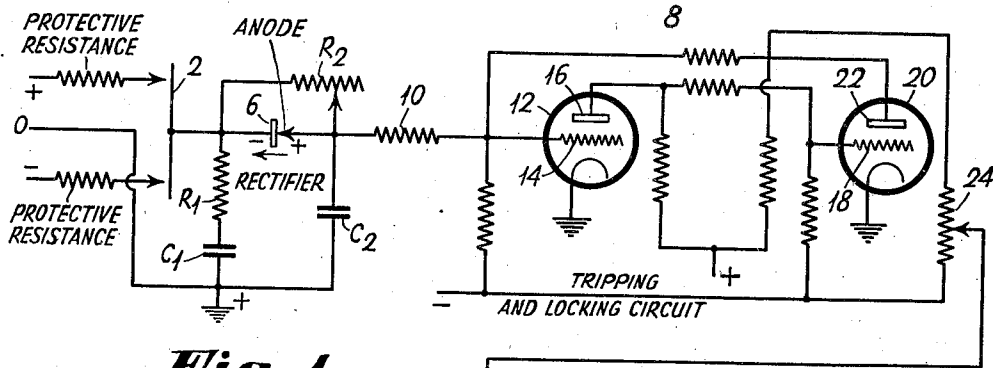


Fig. 1

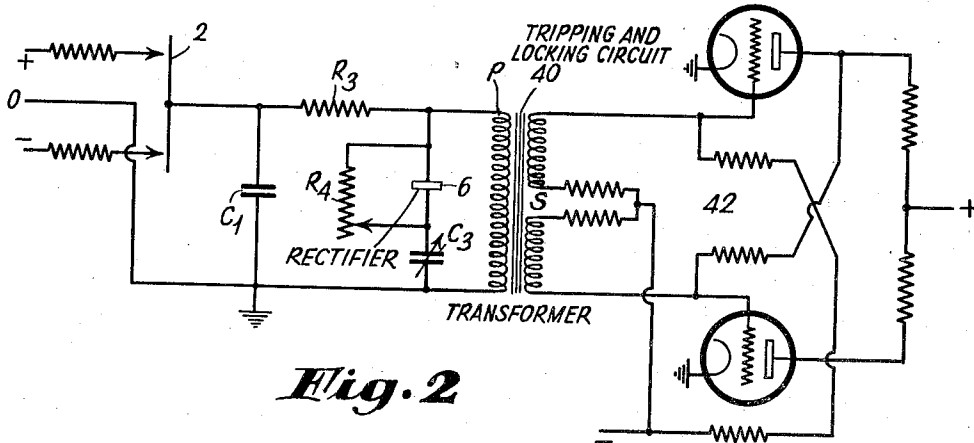
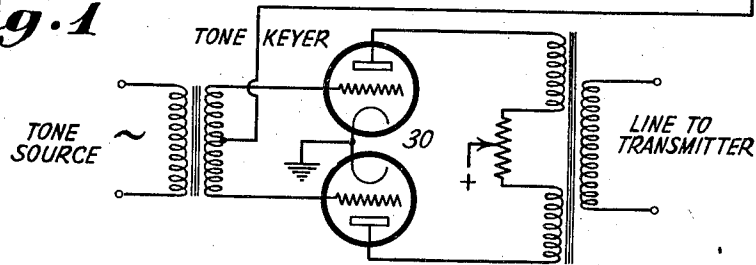
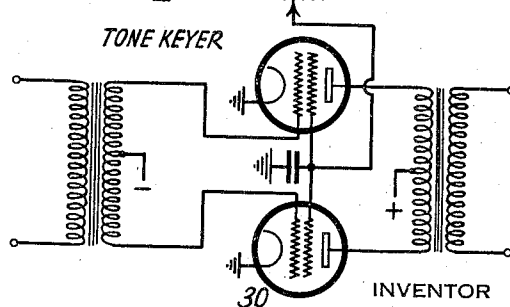


Fig. 2



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KEYING SYSTEM

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8 Claims. (Cl. 178—66)

In describing this invention which concerns keying systems for high frequency transmitters, reference will be made to the attached drawing wherein the two figures illustrate automatic keying means, including means for regulating the heaviness of keying, in combination with a tripping circuit or locking circuit which supplies keyed tone impulses of controllable character to a transmitter. The arrangements of Figures 1 and 2 are similar in principle. In Figure 1, the coupling between the keying weight regulating means and the tripping circuit is resistive whereas a transformer coupling is used at this point in Figure 2. The positioning of the keying weight regulating elements is somewhat different in each figure.

In the operation of high frequency telegraph transmitters for long distance service multi-path transmission causes several rays of transmitted radiation to reach the receiver with different over-lapping arrival times. The effect at the receiver is to increase the marking periods and decrease the spacing periods so that they are not reproduced in correct proportion at the receiving end. The result is frequently a pronounced decrease in readability of the received signals, particularly at high keying speeds. A similar effect occurs in the operation of carrier telegraph wire line circuits where reflections at various places along the line, and in filters or other circuits, frequently cause elongations of the carrier current pulses.

This source of signal distortion, to a very large extent, has been overcome by means of the keying system disclosed in my United States Patent #1,808,220 wherein the keying circuits were so arranged that the time of travel of an electro-mechanical relay armature was subtracted from the marking time. In commercial practice the relay was adjusted so that the time of its travel was approximately equal to the signal elongation caused by multi-path transmission. With this arrangement there were practically no complaints of "heavy" keying from the receiving end of the circuit but under similar conditions prior to the use of my said system, when transmitters were keyed perfectly to give equal dots and spaces complaints of "heavy" keying were frequent and sometimes bitter.

In order to overcome the above difficulties provision should be made in all keying circuits and in particular in keying circuits for short-wave transmitters used over long distances to subtract a definite and controllable amount of time from each dot and dash and add this time to the

spaces. At present in some cases provision is made for adjusting the "weight" of keying to some extent by means of volume control in vacuum tube keyers and by means of relay adjustments. However, as the art develops toward more nearly 100% electrical and vacuum tube devices keying speeds increase and performance requirements become more rigid, some definite electrical method must be made available by means of which equal time intervals may be subtracted from dots and dashes and added to the spaces. This provision should be made for all services employing keying of direct or alternating signalling currents, such as ordinary telegraph, time division multiplex telegraph, facsimile, etc. In telegraph service one method for carrying out the marking time subtraction idea discussed above while still retaining positive off-keying without amplitude dribbling is to take the reversing direct current signal from the automatic keying heads or auto heads and apply the said reversible impulses to a tripping circuit of the Finch type, described in United States Patents #1,948,103 and #1,844,950, through a special time biasing circuit, such as shown in Figures 1 and 2 of the drawing.

In the arrangement of Figure 1 an automatic transmitter mechanism shown diagrammatically at 2, actuated in any manner such as for example by an automatic typewriter mechanism, or a perforated paper tape, not shown, applies reverse current pulses to a condenser C_1 through a current limiting and anti-sparking resistor R_1 . The automatic transmitting or keying means may be of any type. For example, take transmitters as illustrated in Mathes' United States Patent #1,979,484 or Callahan et al.'s United States Patent #2,010,505, or keying means as in Callahan's United States Patent #2,086,351 or typewriter mechanism as shown in Brady's United States Reissue Patent #16,485 and Patent #1,523,337. In practice, the reverse current pulses may be obtained from plus and minus power sources at 100 to 150 volts through short circuit protective resistances which are low in value compared with other resistances in the keying circuits. The condenser C_1 serves as a charge accumulator to permit operation of the keying system following the regulator even when the transmitter mechanism shown diagrammatically at 2 supplies only short momentary contacts. The charge built up in condenser C_1 of a polarity determined by the last contact made by the transmitter mechanism 2 passes through resistor R_2 and (if of proper polarity) through the rec-

tifier 6 in parallel with R_2 to condenser C_2 . The rectifier 6 being a unilateral device passes a substantial current only in the event the impulse applied to R_1 and C_1 is negative so that current flows through 6. In the event the last contact is positive current cannot pass through 6 in material amounts and reaches C_2 only through R_2 . Thus, the rate of charging of condenser C_2 is greater for impulses of negative polarity than it is for impulses of positive polarity because of the action of the rectifier 6. This time difference is substantially proportional to the difference in time constant of the resistor condenser circuit for the two directions of current flow and is also substantially independent of the keying speed. In practice, the charge carried over to condenser C_2 has an opportunity to reach a steady state value, or nearly a steady state value, for each pulse of current delivered to the condenser for all keying speeds up to the maximum which can be used safely over the long distance wire or radio circuit with which the keyer may be associated. The time constants of the resistance condenser circuit is adjustable in accordance with ordinary operating requirements at R_2 and appropriate values of R_1 , C_1 , C_2 and R_2 are chosen so that the impulses representative of dots and dashes may be made lighter or foreshortened to suit the needs of the particular transmission used. In the particular application the marking impulses, i. e., dots and dashes, are thereby shortened or made lighter an amount sufficient to subtract from the keying impulses an amount of time equal to that added to the keyed impulses at the receiver by multi-path transmission.

The keying impulses as regulated are supplied through a resistance 10 to a tripping and locking circuit of the Finch type shown in general at 8. This tripping and locking circuit comprises an electron discharge tube 12 having its control grid 14 connected to 10 and its cathode grounded, being thereby connected to the common point of the regulating circuit. The anode 16 of 12 is connected to the grid 18 of tube 20, the anode 22 of the latter tube being connected back to the grid 14 of tube 12. A change of potential in one direction on grid 14 amplified in 12 acts on 18 to produce a corresponding change in potential at 22 which is fed back to the grid 14 of 12 to produce a blocking or tripping action in the tube. This operation has been described in greater detail in Finch's United States Patents #1,844,950 and #1,948,103. Thus, positive and negative impulses on the grid of 14 produce positive reversing of current in the anode circuit of 20 and this reversing of current produces in the potentiometer 24, grid biasing potentials, or blocking potentials, for the grids of the tubes in unit 30, the input of which is connected to a tone source and the output of which is connected to a line for transmission to a distant point. The line may extend to the receiving point in which case my signal correcting circuit will compensate for signal elongation due to the effect of line reflections, filter sections, etc., or it may extend to a radio transmitter through which connection is made to a distant receiver in which case my circuit may be used to correct elongations in both wire and radio circuits.

Various modifications may be made in the circuits without destroying the results I wish to obtain. For example, resistance R_2 may have substituted therefore an inductance, or a combination of resistance and inductance. The polar-

ity of output may be reversed by connecting the potentiometer 24 to the anode 16 instead of to anode 22. Likewise the polarity of the time biasing may be reversed by reversing the polarity of the rectifier 6 or by reversing the polarities of currents supplied to the transmitter mechanism 2 and at the same time moving the potentiometer 24 from anode 22 to anode 16.

In the arrangement of Figure 2 an automatic reverse current transmitter mechanism 2 supplies currents to charge the condenser C_1 positively and negatively in accordance with the telegraph, printer, or facsimile signals which are to be transmitted. Current from the condenser C_1 passes through a resistance R_3 to a condenser C_3 through the parallel combination of an adjustable resistance R_4 and a rectifier 6. In parallel with the combination of condenser C_3 , resistance R_4 and the rectifier 6, as shown, is the primary P of a transformer 40. The transformer has two secondary windings S, one in series with the lead to the grid of each tube in the Finch tripping and locking circuit 42. The anodes and grids of the tubes in 42 are cross connected as shown by resistances so that a potential change on one grid produces through the tubes and circuits a positive tripping action. By means of pulses delivered to the Finch tripping and locking circuit the circuit is caused to turn on and off a tone keyer for the transmission of a keyed carrier telegraph, printer, or facsimile signal. The action of the tripping circuit and tone keyer is substantially identical with that described for Figure 2. A difference resides in the use of multi-grid vacuum tubes in the tone keyer of Figure 1 and the use of transformer coupling to the tripping circuit.

To explain the action of the keyer system of Figure 2 in shortening (or lengthening if desired) the signalling pulses it will be noted that the potential across the primary winding P of the transformer 40 and therefore across the secondary windings S also, is dependent upon the potential across condenser C_3 plus the potential drop in the parallel combination of the resistance R_4 and the rectifier 6.

When the potential across condenser C_1 is reversed by the transmitter mechanism 2 the condenser C_3 tends to delay the rise of potential across the primary winding of the transformer. When the potential reverses to one potential polarity, or direction, current flows easily through the rectifier and due to voltage drop in resistance R_3 considerably delays the application of potential to the transformer primary winding while the condenser is being charged through R_3 . When the potential reverses to the other potential polarity or direction, current can not flow in substantial amount through the rectifier 6 there is little voltage drop in resistance R_3 and nearly full potential is applied almost instantly to the primary winding of the transformer. Thus, with equal time intervals of reversing potentials across condenser C_1 , there will exist unequal time intervals of reversing potentials across the primary winding of the transformer. Therefore, the output from the Finch tripping circuit 42 and from the tone signal keyer 30 will have an altered relation between on and off time periods. If the on periods have been shortened and the off periods lengthened, by a correct amount, then signal elongation in transmission may be overcome.

Practical experience indicates that, for ordinary purposes, a fixed amount of time may be

subtracted from each marking or on period and added to the spacing or off period. Preferably the time subtracted should just balance or even a little more than balance the signal elongation between transmitter and receiver terminal mechanisms. When the receiver mechanism is a recorder which writes a record of the message on a moving tape, in the form of an undulating line drawn on the tape, the message is more readable if something has been subtracted from the marking time periods to compensate for the effect of the width of line drawn by the recorder. Therefore, my invention may be applied to compensate for the recorder characteristics as well as for intervening circuit characteristics.

Although I have described my invention as applied to the transmitter it will be evident that I may also apply it in radio receivers, especially in those systems where the receivers are used to key a carrier wave for transmission over a wire line to a central traffic office. Such receiving systems have been used in the communications art for the past fifteen years or more and have been described by H. H. Beverage, H. O. Peterson, J. B. Moore and others. See Beverage et al. United States Patent #1,874,866 dated August 30, 1932 and Moore United States Patent #2,089,568 dated August 10, 1937.

In practice, I may so design my system that any of the circuit elements used are variable either at the time of installation or during ordinary operation. The degree of flexibility of circuit elements will in each case be governed by the requirements of the service, cost, reliability, etc.

The rectifier shown in the two figures may be any of the well known types including vacuum tubes, gas or vapor glow discharge tubes, oxide rectifiers, etc. In practice cuprous oxide film rectifiers of the kind commonly used for small storage battery charger rectifiers, small direct current power supplies, etc., are recommended. Such rectifiers with any reasonable range of voltage, current carrying capacity, etc., are readily available commercially and can be recommended.

I claim:

1. A keying system including means for controlling the weight of keying comprising, means for producing positive and negative impulses characteristic of signals, a condenser and a resistance in series, means for impressing said impulses on said condenser, a storing device, and uni-directional means connecting said resistance and condenser to said storing device, whereby energy from said condenser and resistance is stored up in said device at different rates by the positive and negative impulses respectively.

2. A keying system including means for controlling the weight of keying comprising, means for producing positive and negative impulses characteristic of signals, a condenser and a resistance in series connected with said means to be energized by said impulse, a second condenser, and a rectifier connecting said resistance and first condenser to said second condenser, whereby energy from said first resistance and first condenser is stored up in said second condenser at different rates by said positive and negative impulses respectively.

3. A keying system including means for controlling the weight of keying comprising, means for producing positive and negative impulses

characteristic of signals, a condenser and a resistance in series connected with said means, a rectifier and a condenser in series, means connecting said series rectifier and condenser in shunt to said resistance and first condenser, a resistance in shunt to said rectifier, and a utilization circuit connected in shunt to said second condenser.

4. In a signalling system means for producing impulses the polarity of which relative to a fixed potential are characteristic of marking periods and spacing periods, means for keying a transmitter of carrier waves in accordance with said impulses and means to compensate for elongation of carrier wave signals by multi-path transmission comprising means interposed between said first and second means for automatically reducing the time length of marking periods and increasing the time length of spacing periods.

5. In a signalling system, means for producing impulses the polarity of which relating to a fixed potential are characteristic of marking periods and spacing periods, means for keying a transmitter of carrier waves in accordance with said impulses and means to compensate for elongation of carrier wave signals by multi-path transmission comprising, an electrical circuit interposed between said first and second means said electrical circuit being energized by said impulses, a condenser in said electrical circuit and a unilateral, conductive device in shunt to said condenser whereby said potentials of different polarity charge said condenser at different rates.

6. In a keying system to be used with radio telegraphy transmitter systems wherein signals are distorted in length during transmission, an electrical circuit including, means for applying changing potentials or currents thereto, a keying circuit adapted to be connected to said transmitter and means to alter the relative time period lengths of the interrupted carrier current signals comprising a rectifier for providing different time constants of response in said electrical circuits for said potential or current changes of different polarity.

7. In a keying system to be used with radio telegraphy transmitter systems wherein signals are effected by two path transmission, means for producing current pulses of polarity relative to a fixed polarity characteristic of signals and spaces, circuits having a different time constant of response for potential or current changes in one direction as compared with the time constant of response for potential or current changes in the opposite direction, means for applying said pulses to said circuits, and means connected with said circuits for keying a telegraphy transmitter.

8. In a telegraphy system means for producing potentials the value of which relative to a fixed potential are characteristic of signals and spaces, a relay connected to said means to be excited by said potentials to produce current flow characteristic of said signals and spaces and means for adjusting the relative lengths of said signals and spaces comprising a current storing condenser in said connection to be charged by said potential and means in said connection for lowering the rate at which said condenser is charged by certain of said potentials.

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