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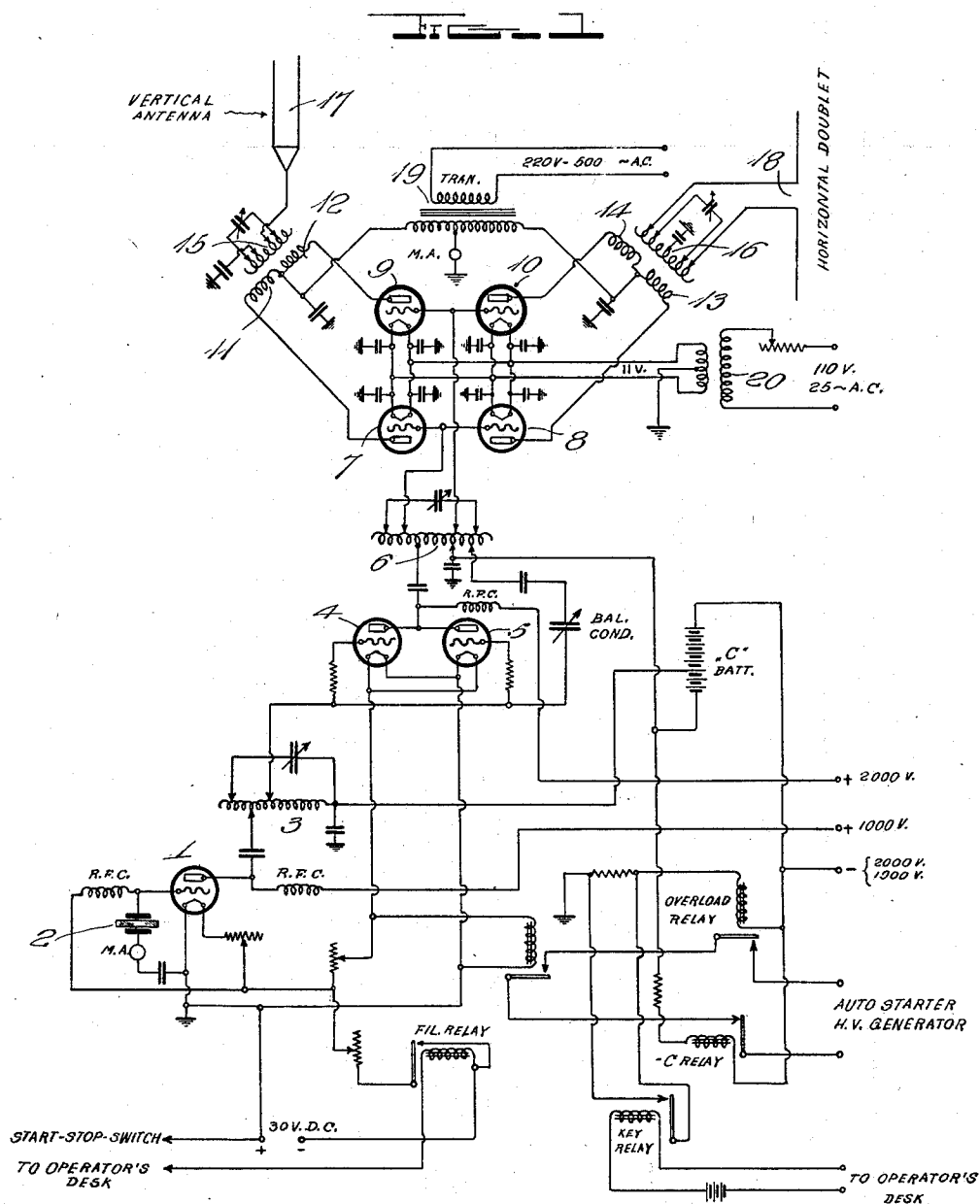
L. C. YOUNG

1,863,518

SYSTEM FOR REDUCING FADING EFFECTS IN RADIO COMMUNICATION

Filed March 29, 1927

3 Sheets-Sheet 1



INVENTOR.
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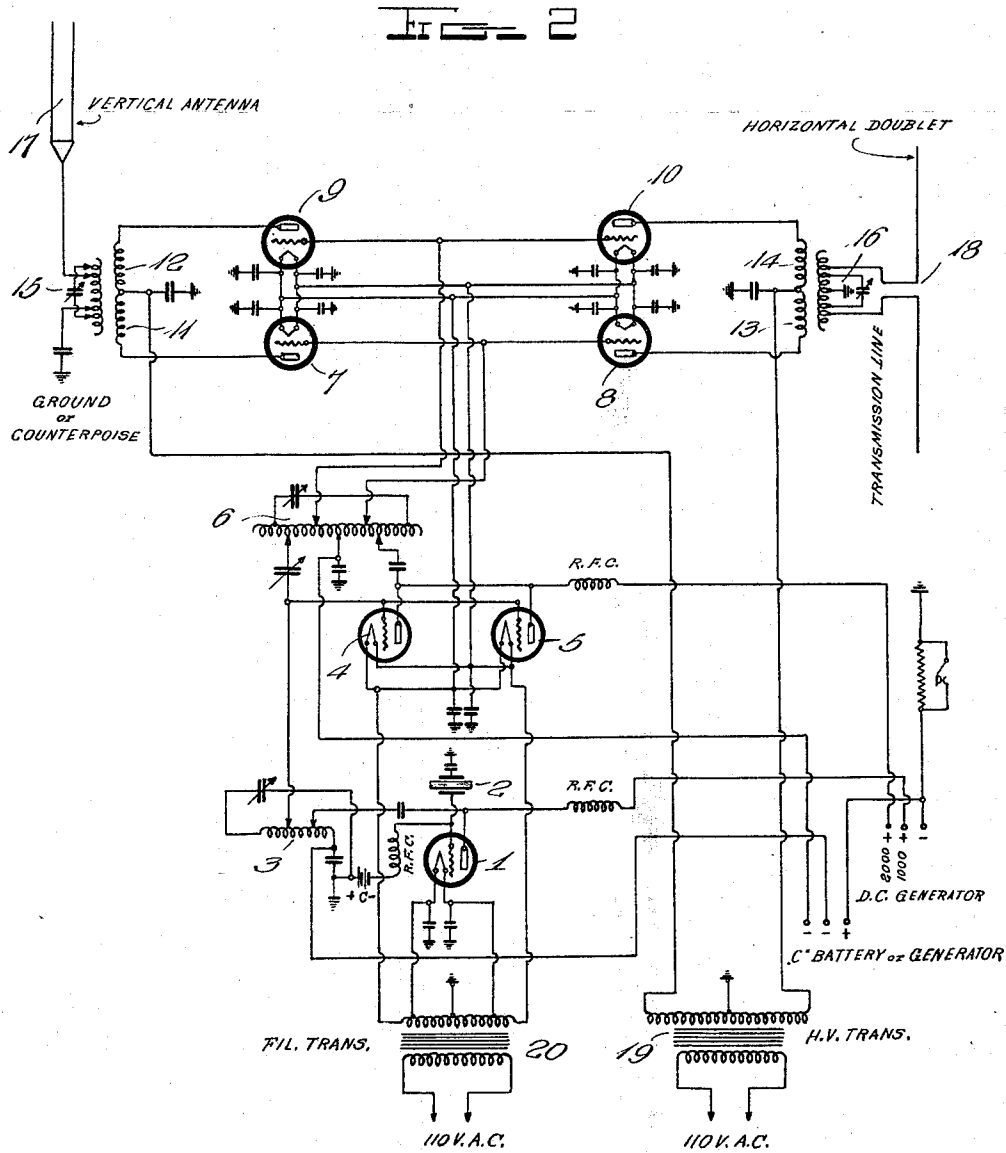
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SYSTEM FOR REDUCING FADING EFFECTS IN RADIO COMMUNICATION

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3 Sheets-Sheet 2



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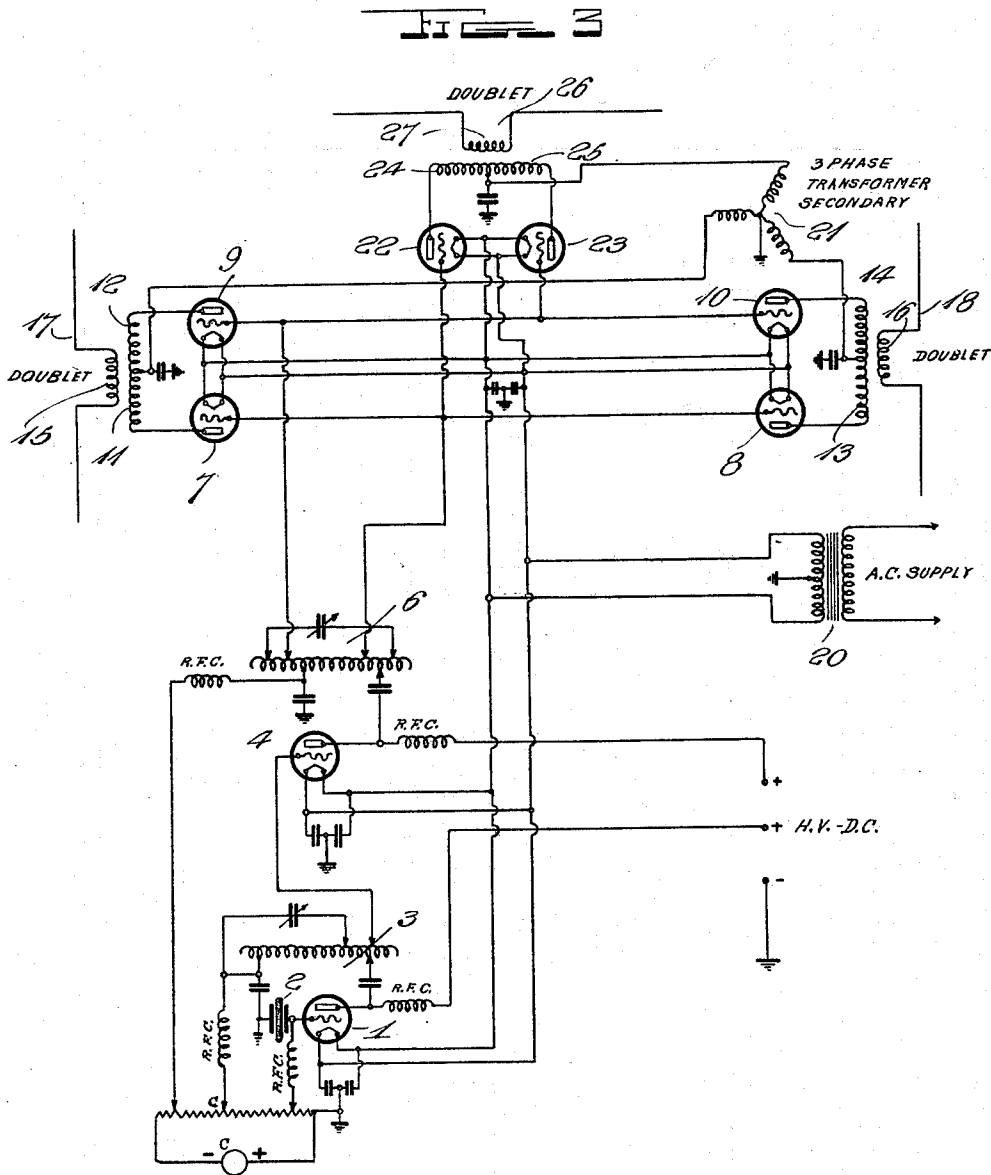
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SYSTEM FOR REDUCING FADING EFFECTS IN RADIO COMMUNICATION

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

LEO C. YOUNG, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WIRED RADIO, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

SYSTEM FOR REDUCING FADING EFFECTS IN RADIO COMMUNICATION

Application filed March 29, 1927. Serial No. 179,348.

My invention relates broadly to a system of radio transmission for reducing the effects of fading and more particularly to a circuit arrangement for effecting radiation on a plurality of differently polarized wave components for compensating for the effects of static.

The object of my invention is to provide a circuit arrangement for a transmission system in which a plurality of antennae are alternately energized by the transmission system for radiating signaling energy on differentially polarized waves for minimizing the effects of fading at a distant receiver.

Another object of my invention is to provide a polyphase high frequency signal transmission system with a plurality of independent antennae systems arranged to be alternately energized by said transmission system for effecting transmission of a plurality of different polarized wave components for compensating for the effects of fading at a distant receiving system.

It has been found that a considerable amount of fading encountered in high frequency reception is due to the rotation of polarization of the transmission wave. The circuits of this invention were developed to minimize fading effects by starting out from a transmitter, a plurality of waves differently polarized and in such a manner that the different components do not arrive at a receiving station in such phase relations as to cancel each other.

The circuit arrangement of my invention has proven highly successful in operation and has given remarkably good results in long distance transmission. The transmission system comprises a crystal control circuit and intermediate amplifier operating on direct current with a third stage working as a bilateral, push-pull amplifier and frequency doubler; that is, the plate circuit is fed with alternating current and the tubes work alternately as the plate voltage changes polarity. At the same time the grids of each set of tubes are connected to opposite ends of the excitation coil so that they are 180° out of phase, giving a push-pull radio frequency amplifier. This push-pull feature

puts the capacity of tube elements in series which gives better efficiency and allows a greater number of tubes to be used in high power transmission. The bilateral feature permits putting one pair of tubes on one form of antenna and the other pair on another form of antenna, so as to send out two waves of different polarization, changing from one radiating system to the other as many times per second as the frequency of the generator supplying the plate power to the last amplifier. I have obtained particularly desirable results by employing a combined antenna system of a horizontal doublet on one side and a vertical antenna on the other side of the transmission.

My invention will be more fully understood from the specification hereinafter following by reference to the accompanying drawings wherein:

Figure 1 shows the circuit arrangement of the transmitter of my invention; Fig. 2 shows a simplified circuit arrangement embodying my invention; and Fig. 3 shows a circuit using a three phase alternating current supply to the output amplifier of the transmitter.

Referring to the drawings in detail reference character 1 indicates an electron tube arranged as a generator of high frequency oscillations sustaining the oscillations of piezo-electric crystal element 2. The output circuit of the oscillator 1 includes the tuned system 3 upon which the high frequency oscillations are impressed. The high frequency oscillations developed by the circuit system of electron tube 1 are impressed upon the input circuits of electron tubes 4 and 5 connected in parallel for impressing oscillations at increased amplitude on the output circuit 6. Separate sets or pairs of bi-lateral electron tubes are arranged with their input circuits excited from the output circuit 6. One pair of cooperating tubes in bi-lateral relation have been indicated at 7 and 9. Another pair of electron tubes in bi-lateral relation have been indicated at 8 and 10 working in balanced order. The output circuits of electron tubes 7 and 9 include windings 11 and 12 which are inductively coupled through winding 15 with vertical antenna system 17. The

output circuits of tubes 8 and 10 include windings 13 and 14 which are coupled through inductance 16 with the horizontal doublet 18. The plate circuits of the several tubes are supplied with power from an alternating current source through a transformer system represented at 19. The filament circuits of each of the electron tubes are excited from transformer system 20 with alternating current. It will be observed that the sets of electron tubes work alternately as the plate voltage changes polarity. By reason of the alternate operation of the tubes in each set, high frequency energy is radiated by waves of different polarization changing from the radiating system 17 to the radiating system 18 as many times per second as the frequency of the generator supplying the plate power to the amplifier system.

In Fig. 2 the wiring arrangement has been simplified in order that the operation of the circuit may be more clearly understood. It will be observed that all of the electron tubes, that is, the oscillator indicated by reference character 1 and the intermediate amplifier including tubes 4 and 5 and electron tubes 7—9 and 8—10 may all be operated from the same filament transformer 20.

In Fig. 3 I have illustrated a polyphase transmission system embodying the principles of my invention where a polyphase supply source is coupled to the secondary system of a transformer represented at 21 for supplying power to the plate circuits of a number of bi-laterally arranged amplifier systems, the number of amplifier systems corresponding to the number of phases of the polyphase supply source. I have illustrated a three phase source for the purpose of describing my invention, but I desire that it be understood that a two phase source or any desired number of phases may be employed in carrying out the principles of my invention. I have shown three separate radiating systems at 17, 18 and 26. For the purpose of illustration, these radiating systems are indicated as doublets. The doublet 17 corresponds to the antenna 17 of Figs. 1 and 2 and is coupled in a similar manner as in the previous figures to the output circuits of tubes 7 and 9 through windings 11 and 12 which are coupled with the secondary winding 15. The doublet 18 couples through winding 16 with windings 13 and 14 in the output circuits of tubes 8 and 10. A bi-laterally arranged amplifier system constituted by tubes 22 and 23 is connected to supply high frequency energy to the radiating system 26 through windings 24 and 25 and coupling coil 25. Filament heating current is supplied to all of the tubes through transformer system 20 while plate potential is alternately applied to the output circuits of the pairs of electron tubes constituting the high frequency amplifiers.

In the drawings the tubes 4 and 5 are con-

nected in parallel and function as one tube. The two tubes are used here in order to increase the radio frequency output and give a greater radio frequency voltage to the grids of the output amplifiers. A bi-lateral arrangement may be used in this stage, but in the drawings the arrangement of the two tubes is a parallel connection.

The crystal and intermediate amplifier tubes 1—4—5 are supplied with a D. C. plate source so that a continuous radio frequency voltage is obtained in circuit 6 as long as the key is depressed by exciting all the grids of the output amplifier continuously with a radio frequency voltage so long as the key is held down.

The tubes 7 and 9 form one unit and tubes 8 and 10 another unit, the plates of which are supplied from an A. C. source, connected bi-laterally so that first one unit and then the other unit is supplied with a positive plate potential. But each unit is connected bi-laterally for the radio frequency component of the circuit. That is, the grid of the tubes 7 and 9 are connected to opposite ends of coil 6 so that they are excited with a radio frequency voltage 180° out of phase so that when the plate current is rising in 7 it is falling in 9 and vice versa. As the plate supply to these tubes is A. C. the plate will have a positive potential for a small fraction of a second or equal to one-half cycle of the A. C. source, while the grids will reverse many times during the fraction of a second as they are excited by a radio frequency source of as much as 20,000 kcs. or more thus causing the plate current to rise and fall correspondingly, giving a pulse of radio frequency energy to antenna 17. Thus during a half cycle of the A. C. both tubes 7 and 9 work into antenna 7 and send out a pulse of radio frequency energy, then as the A. C. reverses, tubes 7 and 9 have a negative potential on the plates and are therefore dead and 8 and 10 go through the same process as described above sending out a pulse on the other antenna, which is out of phase with the first pulse and can not cancel the antenna current at the receiving end.

By this arrangement of circuits, waves in different planes of polarization may be started out of phase. One pair of electron tubes is always functioning while the other pair of electron tubes is not functioning. The alternate switching from one pair of electron tubes to another effects radiation from the separate antennae in different planes of polarization for compensating for the effects of fading at distant receiving stations.

The system of transmission disclosed, herein has been found to be very practical in operation and has functioned efficiently in long distant communication.

While I have described my invention in certain of its preferred embodiments, I desire it to be understood that modifications may be

made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A high frequency signaling transmission system, comprising a plurality of independent antennae, a circuit for generating high frequency oscillations, bi-laterally arranged amplifiers between each of said antennae and said circuit and a source of alternating current for alternately energizing the plate circuits of each of the bi-laterally arranged amplifiers for periodically rendering said amplifiers operative in successive order for causing high frequency oscillations to be impressed upon said antennae alternately from said circuit

2. A high frequency signaling transmission system comprising a plurality of independent antennae each arranged to successively radiate waves in different planes of polarization, a source of high frequency signaling energy, a balanced amplifier system connected between each of said antennae and said source, and a power supply circuit for alternately energizing parts of each of said balanced amplifier circuits for automatically impressing high frequency signaling energy upon each of said antennae alternately from said source.

3. A high frequency signaling transmission system comprising a plurality of antennae arranged to successively radiate signaling energy in different planes of polarization, a source of high frequency oscillations, balanced amplifier circuits connected between each of said antennae and said source of said high frequency oscillations, a power source of alternating current for periodically exciting said balanced amplifier circuits in successive order and connections between said power source and the output circuits of said balanced amplifier circuits for successively energizing said output circuits and effecting radiation of high frequency signaling energy from said antenna alternately in different planes of polarization.

4. A high frequency signaling transmission system comprising a plurality of independent antennae connected to successively radiate energy in different planes of polarization, a generator of high frequency oscillations and pairs of balanced electron tube circuits connected between each of said antennae and said generator of high frequency oscillations, a power supply system connected with said electron tube circuits for independently and automatically energizing the electron tube circuits of each of said pairs of balanced electron tube circuits in succession for effecting the transmission of high frequency signaling energy in different planes of polarization successively from said independent antennae.

5. A high frequency signaling transmission system comprising a plurality of independent antennae connected to successively radiate energy in different planes of polarization, a generator of high frequency oscillations, sets of electron tube circuits each including a balanced pair of electron tubes having input and output circuits, each set of electron tubes having their input circuits excited from said generator of high frequency oscillations with the output circuits thereof connected to said independent antennae systems and a power source of alternating current connected with said output circuits for energizing each set of electron tubes in succession for effecting the alternate radiation of high frequency signaling energy in different planes of polarization from said independent antennae.

6. A high frequency signaling transmission system comprising a plurality of antennae connected to radiate signaling energy successively in different planes of polarization, a generator of high frequency oscillations, a set of balanced electron tube amplifiers interposed between said source and each of said antennae, and a source of polyphase power for successively energizing each of said sets of balanced electron tube amplifiers for alternately and automatically effecting radiation of signaling energy in different planes of polarization from said antennae.

7. A high frequency signaling transmission system comprising a plurality of independent antennae, a circuit for generating high frequency oscillations, sets of balanced amplifiers each having input and output circuits with the input circuit thereof connected with said first mentioned circuit and with the output circuits thereof connected with said antennae and a polyphase power source having a number of phases corresponding with the number of said sets of balanced amplifiers and connections between said polyphase power source and the output circuits of said balanced amplifiers for energizing one-half of each of said balanced amplifiers in succession whereby signaling energy in different planes of polarization may be alternately and automatically transmitted from said independent antennae in successive order.

8. Apparatus for radiating signal-bearing carrier waves comprising an oscillator network, an amplifier network including a plurality of bi-laterally paired thermionic tubes having alternating current plate supply, a plurality of antennae having different wave-polarization characteristics, and means to impress the output of said amplifier network successively and cyclically upon said antennae so as to continuously vary the plane of polarization of the resultant energy radiation.

LEO C. YOUNG.

CERTIFICATE OF CORRECTION.

Patent No. 1,863,518.

June 14, 1932.

LEO C. YOUNG.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, lines 10 and 11, claim 1, strike out the word "ar-laterally"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of April, A. D. 1933.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.

CERTIFICATE OF CORRECTION.

Patent No. 1,863,518.

June 14, 1932.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, lines 10 and 11, claim 1, strike out the word "ar-laterally"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 16th day of April, A. D. 1933.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.