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TELAUTOGRAPH SYSTEM

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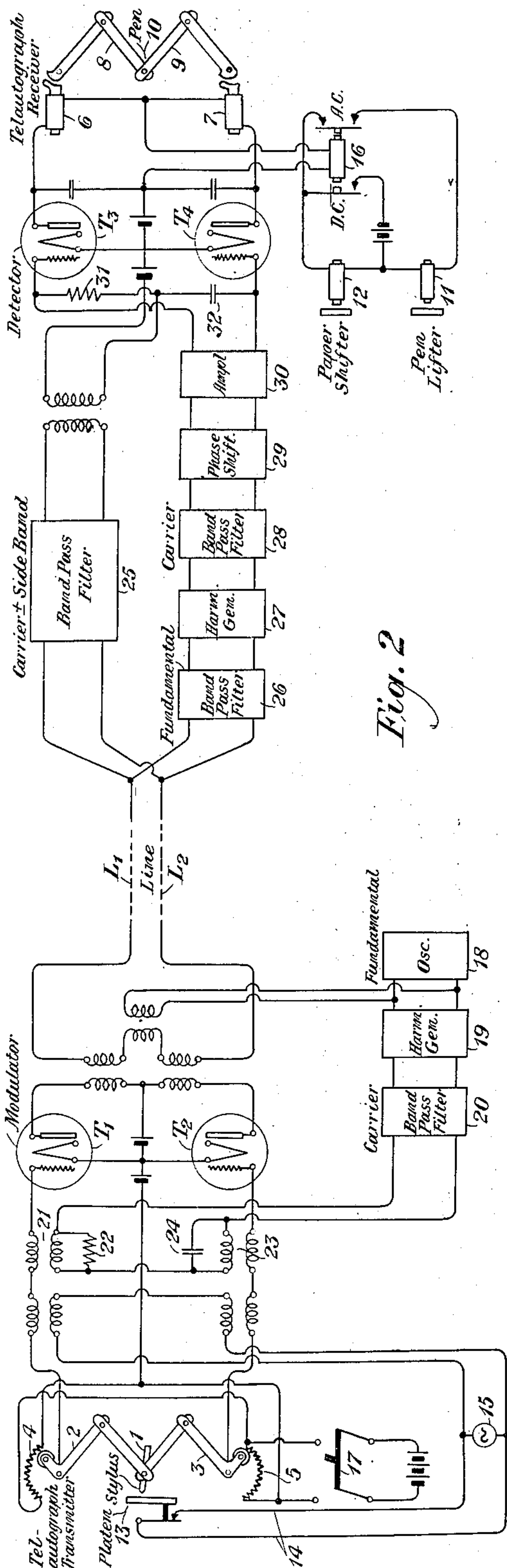


Fig. 2

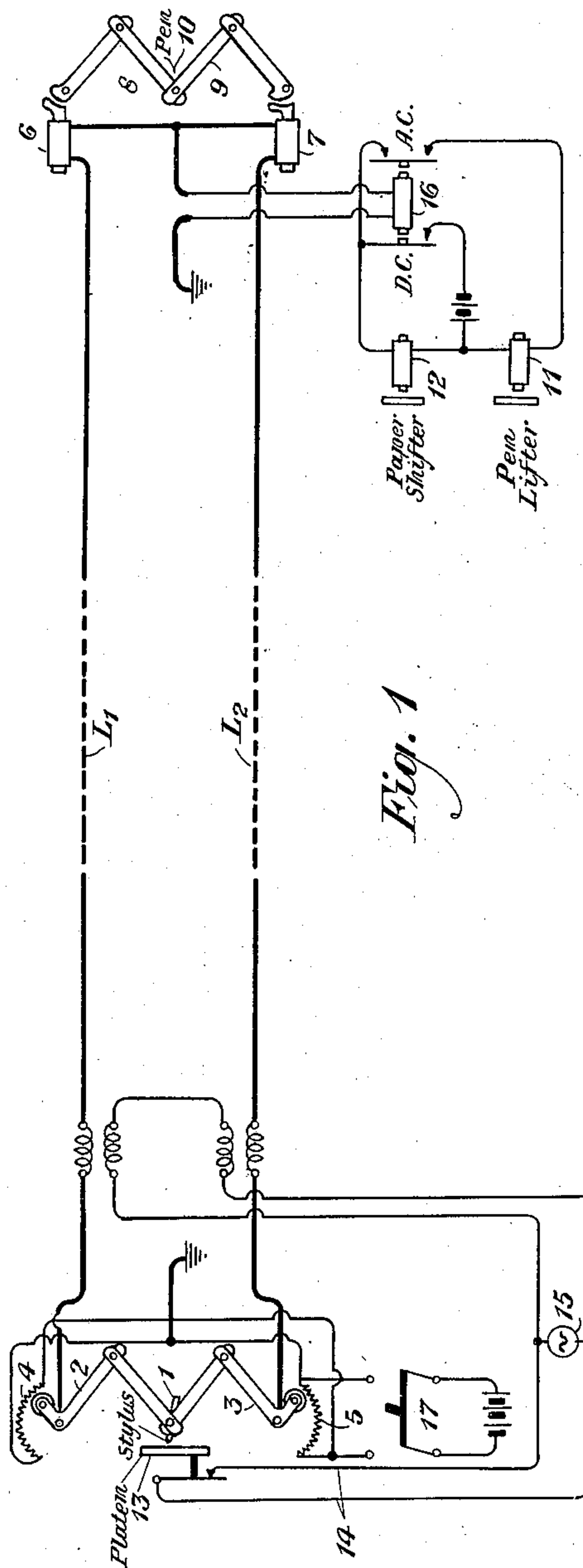


Fig. 1

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TELAUTOGRAPH SYSTEM.

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This invention relates to improvements in telautograph systems, and more particularly relates to the application to such systems of the principles of phase discrimination where-
5 by the two necessary operating channels are obtained on the same carrier frequency on an alternating current circuit.

The use in general of an alternating current circuit for the telautograph has the advantage that the system may be multiplexed
10 on the same line with other telautograph or with telegraph circuits. The arrangements of this invention present the further advantage that the two operating channels are
15 obtained from the same carrier frequency by the use of phase discrimination, thus affording further economy in the use of line facilities. The principles of obtaining two operating channels in communication systems
20 from one carrier frequency are well known in the art. The present invention applies these principles to advantageous use in the operation of telautograph systems. Other features and purposes of the invention will
25 appear more fully from the detailed description hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawing, in Figures
30 1 and 2 of which the invention is illustrated. In Fig. 1 is shown a circuit diagram illustrating the principles of operation of a telautograph system. In Fig. 2 is shown the telautograph system of the invention. Similar reference characters have been utilized
35 to denote like parts in both figures of the drawing.

In Fig. 1 there is shown, for purposes of illustration, a circuit diagram outlining one
40 of the various types of telautograph systems, the general method of operation of which is as follows:

An operating stylus 1 is connected to a linkage system 2 and 3 having two degrees of
45 freedom. The movements of the linkage arms 2 and 3 control two rheostats 4 and 5, one for each degree of freedom, which in turn vary the direct current potential applied to two separate circuit L_1 and L_2 . At the receiving
50 end the currents operate two magnets 6 and 7, respectively, which actuate the members 8 and 9 of a linkage system similar to that used for sending, and cause a pen 10 to execute a motion reproducing that of the sending

stylus. The apparatus includes mechanism 55 to touch the pen to the paper and lift it off, following a similar motion on the part of the sending stylus. This mechanism is controlled by the pressure of the stylus on a platen 13. In writing, this pressure disconnects a short circuit across an alternating current channel from source 15, which is superimposed on the two direct current channels from line L and L_2 . A receiving alternating current relay 16 controls a circuit through
60 a pen-lifting magnet 11, which effects the operation. When the stylus is lifted the alternating current from source 15 is cut off and the pen-lifting magnet 11 operates. There is also a paper-feeding mechanism 12, 70 operated by the switch 17, which disconnects the current entirely at the sending station. At the receiving station a normally closed direct current relay, which is combined with the alternating current relay 16, mentioned
75 above, controls the paper-feeding mechanism 12.

The method of utilizing phase discrimination to obtain two channels from one carrier frequency in a communication system is as
80 follows:

Two carrier waves of the same frequency but 90° out of phase with each other (i. e., a sine and a cosine wave, such as the two phases of a 2-phase alternating current supply) are
85 each modulated by independent signal waves, say $f(t)$ and $g(t)$, and superimposed on the line, giving a voltage across it of

$$v = f(t) \sin wt + g(t) \cos wt \quad 90$$

At the receiving end there is superimposed upon this voltage (which has been attenuated) the voltage $A \sin wt$ for one channel, and $A \cos wt$ for the other channel. The amplitudes which are in phase will add directly, while those in quadrature will add as the square root of the sum of the squares. Consequently in the one receiving channel the variations in the cosine term will be largely suppressed as compared with the
100 variations in the sine term. When the modulated wave is rectified the original signal wave, $f(t)$ will be substantially reproduced on this channel. Similarly in the other receiving channel the signal wave $g(t)$ will be
105 reproduced. This method thus allows of two independent channels of communication on one line at one carrier frequency.

As has been pointed out, one of the essential features of the invention consists in applying the principles of phase discrimination for obtaining two channels out of a single carrier, as heretofore described, and utilizing the two channels so obtained as the two necessary operating channels for a telautograph system. Such an arrangement is illustrated in detail in the circuit diagram of Fig. 2. Similar reference characters have been utilized to denote like parts with respect to Fig. 1. In the arrangements of the invention the sending output potentials from the telautograph machine, instead of being directly impressed on the line as for the direct current transmission, are applied to the grids of two vacuum tubes T_1 and T_2 , which modulate two phases, respectively, of the carrier current. To obtain these two carriers of the same frequency of different phase, an oscillator 18 is provided to generate a fundamental frequency. A harmonic generator 19 is connected thereto. A filter 20 is provided to select a suitable carrier frequency. This carrier is transmitted through the windings of the transformers 21 and 23. By means of the resistance 22 in parallel with the primary winding of transformer 21 and by means of the condenser 24 in parallel with the primary winding of transformer 23, the carrier voltages applied to the modulator tubes T_1 and T_2 , respectively, from the single source may be made to be the desired degree out of phase with each other. These two phases are then transmitted out over the circuit L_1 , L_2 . At the receiving end the modulated wave is detected by modulating with more carrier current having the correct phase by means of the detector tubes T_3 and T_4 . The rectified current in each channel will be approximately proportional to the direct current through the sending rheostat of the corresponding channel, and can, therefore, be used to operate the magnets 6 and 7 to move the arms 8 and 9 of the receiving linkage system, which, in turn, will impart to the pen 10 a movement similar to that of the stylus 1. The required constant phase relations between the carrier current used for detecting at the receiving end and that which is modulated at the sending end may be obtained in various ways well known in the art. The particular method herein illustrated consists of making the carrier current some harmonic (say the second) of a fundamental frequency, which latter is superimposed over the modulated carrier on the line. At the receiving end the fundamental is selected by means of a narrow band-pass filter 26 and fed into a harmonic generator 27, from which the carrier frequency (second harmonic in this case) is selected by means of another band-pass filter 28. This is then passed through a phase shifter 29 and amplifier 30 to the detector tubes T_3 and T_4 for phase discrimination purposes,

as is well known in the art. In order to prevent interference of the fundamental current with the modulated carrier current at the receiving end, it is necessary to provide there a band-pass filter 25 passing only the carrier and its two side-bands in the main message-carrying circuit.

The pen-lifting and paper-shifting mechanisms are controlled in exactly the same way as for the direct current telautograph system described in Fig. 1, i. e., the first by the use of a superposed alternating current wave (of say 20 cycles), and the second by removing the current connected to the sending rheostats. The latter action diminishes to zero the additional potential imposed on the grids, thus reducing the output of carrier current on the line. At the receiving end the direct current relay 16, operating on the rectified current from both channels, is released and opens the circuit to operate the paper shift mechanism. The direct current relay 16 may be combined with the alternating current relay for the pen-lifting mechanism 11 in exactly the same manner as in the direct current telautograph system of Fig. 1.

While the arrangements of the invention have been disclosed in certain specific arrangements which are deemed desirable, it is to be understood that they are capable of embodiment in many and other widely varied forms, without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A telautograph system utilizing two operating channels of the same carrier frequency but of different phase.
2. A communication system comprising a telautograph sending station wherein two operating potentials are developed, a carrier circuit wherein two separate channels are developed from one frequency by means of phase discrimination, and means for modulating said two separate carrier channels by the operating potentials of said telautograph sending station.
3. A communication system comprising a telautograph sending station wherein two operating potentials are developed, a carrier circuit wherein two separate channels are developed from one frequency by means of phase discrimination, means for modulating said two separate carrier channels by the operating potentials of said telautograph sending station, a receiving station including demodulating and rectifying means whereby there may be produced from said two carrier channels direct currents having potentials proportional to said aforementioned two operating potentials, and a telautograph receiver device operated by said direct currents.
4. The method of transmitting telautograph messages which comprises providing two separate operating channels from a sin-

gle carrier frequency by means of phase discrimination, and modulating said channels separately with the operating potentials of a telautograph sender.

- 5 5. The method of transmitting telautograph messages which comprises providing two separate channels from a single carrier frequency by means of phase discrimination, modulating said channels separately with the
10 operating potentials of a telautograph sender,

transmitting said channels thus modulated to a receiving station, demodulating and rectifying said channels thereat, and utilizing the currents thus produced to operate a telautograph receiver.

In testimony whereof, we have signed our names to this specification this 20th day of October, 1927.

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