Aug. 19, 1924.

1,505,158

DE LOSS K. MARTIN

FREQUENCY CONTROL SYSTEM

Filed Nov. 23, 1921

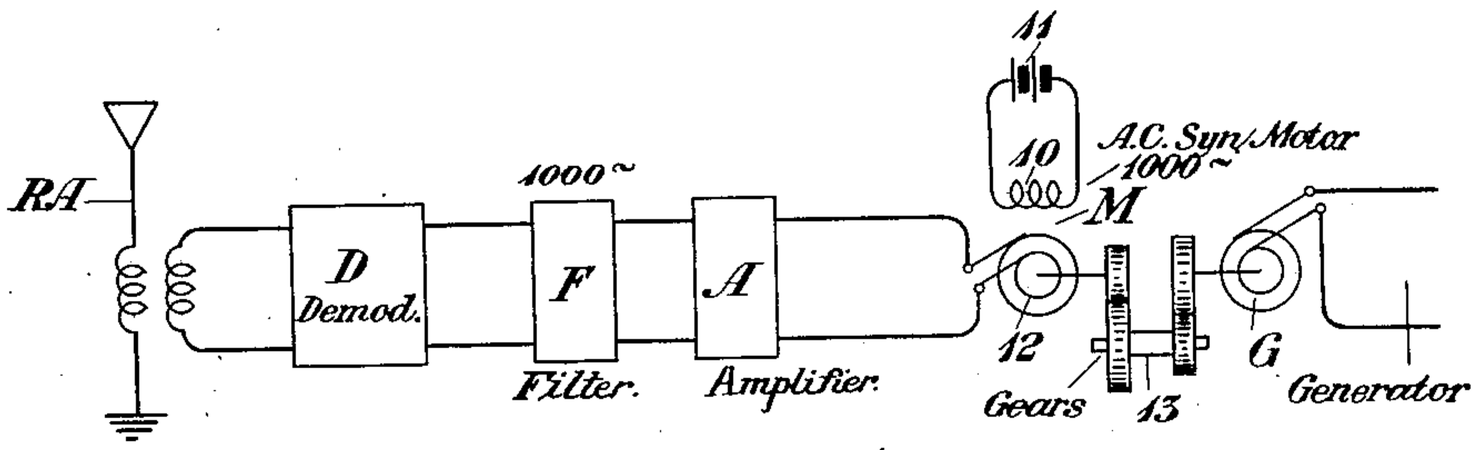

Fig. 1

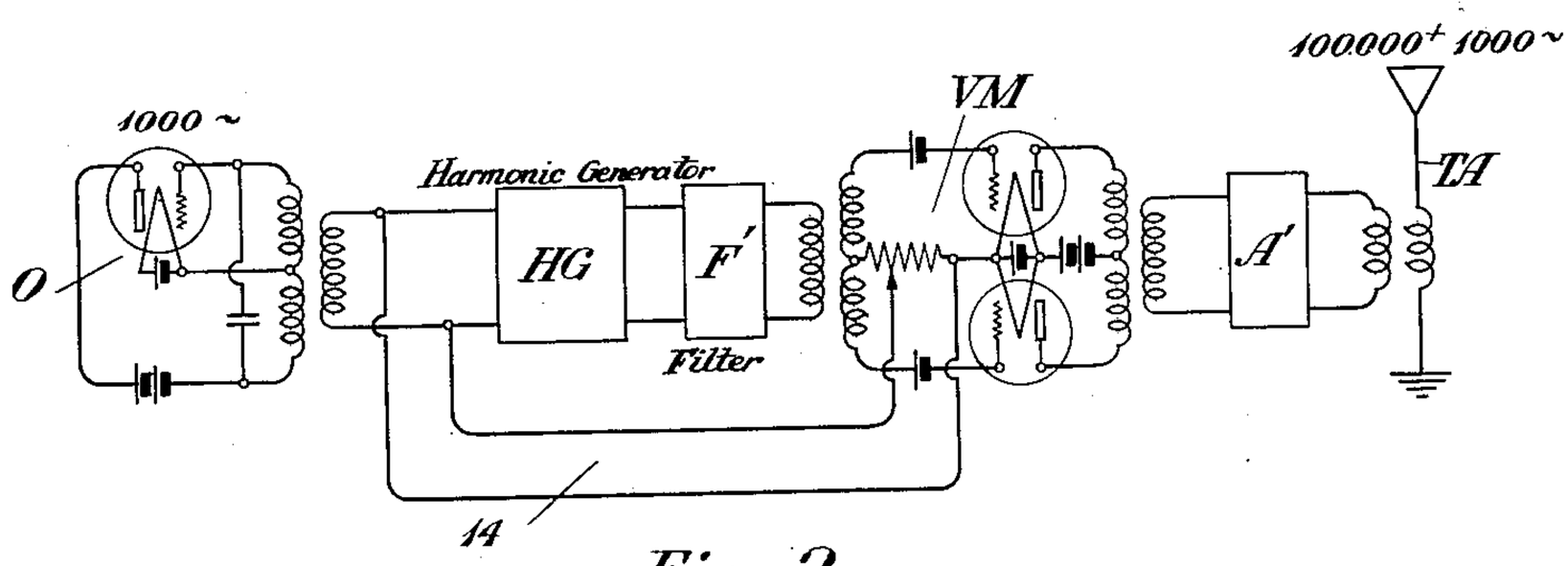

Fig. 2

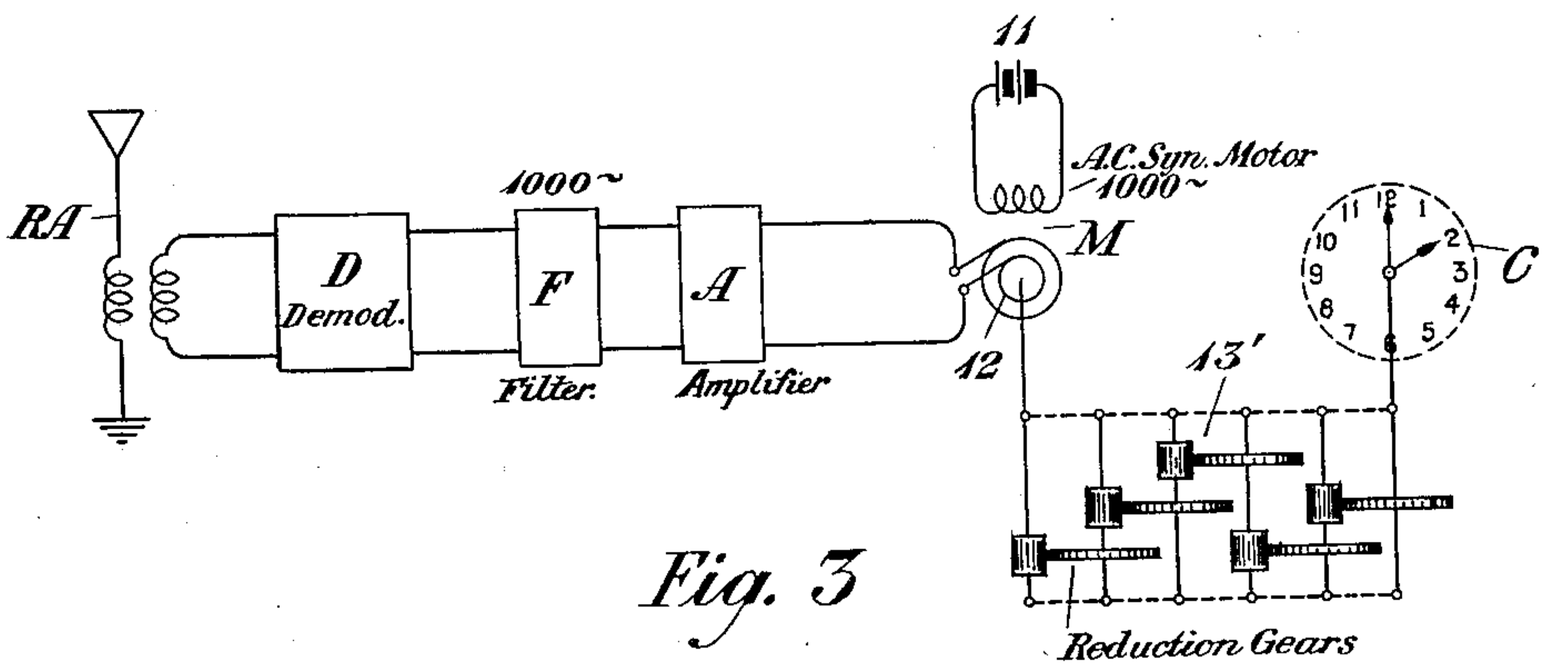

Fig. 3

INVENTOR
D. K. Martin
BY
ATTORNEY

Patented Aug. 19, 1924. 1,505,158

UNITED STATES PATENT OFFICE.

DE LOSS K. MARTIN, OF ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

FREQUENCY-CONTROL SYSTEM.

Application filed November 23, 1921. Serial No. 517,336.

To all whom it may concern:

Be it known that I, DE LOSS K. MARTIN, residing at Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Frequency-Control Systems, of which the following is a specification.

This invention relates to distant control and more particularly to an arrangement for controlling from a distance the carrier frequency to be used for signaling.

In a system, either wire or radio, employing carrier currents for transmission purposes, it is frequently desirable that some method be available for controlling the carrier frequency at one station from a distant station. In a wire carrier system, for example, it is necessary, where the homodyne method of receiving is employed, to properly synchronize the frequencies used for receiving with the frequencies used for transmitting at the distant station, and it is also desirable that the spacing of the carrier frequencies employed by the various channels be maintained in the same relation. In a radio system the same situation arises, and, in addition, it is desirable that the frequencies assigned to different stations and to groups of stations belonging to different systems be maintained in proper spacial relation. This is necessary in the one case to prevent interference between different signaling stations of the same system and in the other case to prevent interference between stations of different systems. In either case it is desirable to transmit from some controlling station a master frequency and to provide at each signaling station arrangements whereby the carrier frequencies employed may be determined by the master frequency.

All of these situations call for an arrangement whereby a frequency at one station may be controlled from a distant station. In accordance with the present invention it is proposed to accomplish this result by transmitting a controlling frequency from a distant station to the station at which the signaling frequency is to be produced. At the latter station the transmitted frequency or a frequency derived therefrom may be amplified, and in its amplified form employed for driving a synchronous motor. The synchronous motor will in turn drive an alternating current generator of any desired frequency. It is thus possible to produce locally an alternating current of any frequency while at the same time maintaining a desired frequency relation with the controlling current whose frequency may be widely different from the controlled frequency.

While one of the principal uses of the principle above described is in the control of a signaling frequency from a distant point, the invention is also applicable to other uses. In fact, the synchronous motor may be used to operate any mechanism where synchronism is of importance. It might be used, for example, to operate a clock through a suitable reduction gearing, and many other applications of the idea will readily suggest themselves.

The invention may now be more fully understood from the following description when read in connection with the accompanying drawing, Figure 1 of which illustrated the apparatus utilized at a signaling station in connection with the production of a signaling frequency under the control of a distant master station, Fig. 2 of which illustrates a form of apparatus which may be used at the master station, and Fig. 3 of which illustrates the invention as applied to the control of a clock.

Referring to Fig. 1, RA is a receiving antenna by means of which the master controlling frequency may be received from the master station at which it is radiated. The controlling frequency may be a high frequency carrier modulated by a relatively low frequency, and in order to detect the low frequency a demodulator D is associated with the antenna RA. The demodulator D may be of any well-known type, such, for example, as the duplex vacuum tube modulator illustrated and described in Carson Patent 1,343,308 of June 15, 1920. In order to select the detected low frequency from the radio frequency a filter F is provided in the output circuit of the demodulator. This filter may be either a simple tuned circuit or a band selecting filter of the Campbell type. An amplifier A is also provided which may be of any desired form, such, for example, as a vacuum tube amplifier.

M designates a synchronous motor hav-

ing a field winding 10 associated with a suitable D. C. source 11 and armature windings 12 connected to the output circuit of the amplifier A. In order to generate the local frequency to be used for signaling purposes an alternating current generator G is provided. This generator is adapted to be rotated by means of the synchronous motor M, a suitable intermediate gearing 13 being provided for the purpose of enabling the generator G to be rotated at any desired speed with respect to the speed of rotation of the synchronous motor. This permits of the maintenance of any desired relation between the frequency of the generator G and the controlling frequency.

The apparatus for radiating the controlling frequency is illustrated in Fig. 2 and comprises an oscillator O for generating the fundamental controlling frequency, this oscillator being associated with a harmonic generator HG of a well-known type. This harmonic generator may be, for example, a vacuum tube arrangement, it being well known that the distorting action, due to operating upon the curved portion of the characteristic of the vacuum tube, will result in the production of harmonics. A filter F′ is placed on the output side of the harmonic generator HG for the purpose of selecting the desired harmonic. This filter may be of any desired type, such as a simple tuned circuit or a sharply selected band filter of the Campbell type.

A modulating device VM is provided for modulating the selected harmonic in accordance with the fundamental frequency. This modulator may be a vacuum tube modulator of the type shown in Carson Patent 1,343,307 of June 15, 1920, for example, although it may in some instances be preferable to use a simple vacuum tube modulator. In case a duplex modulator is used, the circuit is arranged so that the harmonic frequency is impressed in series upon the two tubes while the fundamental is impressed differentially upon the tubes through the common branch of the input circuit, a special connection 14 being provided between the common branch and the output circuit of the oscillator O for supplying the fundamental to modulator. This circuit results in modulating the harmonic frequency by the fundamental and suppressing the fundamental so that the harmonic frequency will be transmitted as a carrier together with the side frequencies resulting from modulation. A suitable amplifier A′ is provided in the output circuit of the modulator for amplifying the modulated frequencies. This amplifier may be of any well-known type, such as a vacuum tube amplifier. The output circuit of the amplifier is associated with a transmitting antenna TA for radiating the frequencies to be used for distant control.

Assuming that the oscillator O is arranged to generate a fundamental frequency of 1,000 cycles per second, this frequency is impressed upon the harmonic generator HG to produce harmonics, and the filter F′ may be arranged to select, for example, the hundredth harmonic, so that the carrier frequency applied to the modulating device VM may correspond to a frequency of 100,000 cycles. This frequency is modulated by the fundamental frequency of 1,000 cycles, so that the antenna TA radiates frequencies of 101,000, 100,000 and 99,000 cycles.

These frequencies, when impressed upon the receiving antenna RA, react in the demodulator D to produce, among other components, a difference frequency of 1,000 cycles. In order that this frequency of 1,000 cycles may be used exclusively as the controlling frequency, the filter F is arranged to select this frequency and discriminate against the other components. The selected controlling frequency of 1,000 cycles is then amplified by the amplifier A and is impressed upon the synchronous motor M which is arranged to operate in response to current having a frequency of 1,000 cycles. The synchronous motor M then rotates the generator G which generates a frequency depending upon the construction of the generator and the ratio of the gearing interconnecting the synchronous motor and the generator.

An arrangement embodying a similar principle is illustrated in Fig. 3 in which the synchronous motor M operates through a suitable reduction gearing 13′ to rotate a clock mechanism schematically indicated at C.

It will be obvious that the general principles herein disclosed may be employed in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. A system of distant control which comprises means for transmitting a controlling frequency of small energy, means for amplifying said energy, a synchronous motor responsive to the amplified controlling frequency and a synchronous device operated by the synchronous motor.

2. A system of distant control comprising means to transmit a controlling frequency of small energy, means for amplifying said energy, a synchronous motor responsive to the amplified controlling frequency and an alternating current generator operated by the synchronous motor.

3. A system of distant control comprising means to transmit a controlling frequency of small energy, means for amplifying said energy, a synchronous motor responsive to the amplified controlling frequency, a syn-

chronous device operated by the synchronous motor and gearing means whereby the synchronous device may be operated by the motor at any desired ratio of speed.

4. A system of distant control comprising means for transmitting frequencies from which a relatively low frequency may be detected, means for detecting the low frequency, a synchronous motor responsive to the low frequency and a synchronous device operated by the synchronous motor.

5. A system of distant control comprising means for transmitting frequencies from which a relatively low frequency may be detected, means for detecting the low frequency from the transmitted frequencies, a synchronous motor responsive to the detected frequency and an alternating current generator operated by the synchronous motor.

6. A system of distant control comprising means for modulating a carrier frequency in accordance with a relatively low frequency, means to transmit the resultant frequencies, means for detecting the low frequency from the transmitted frequencies, a synchronous motor responsive to the detected low frequency and a synchronous device operated by the synchronous motor.

7. A system of distant control comprising means for modulating a carrier frequency in accordance with a relatively low frequency, means to transmit the resultant frequencies, means for detecting the low frequency from the transmitted frequencies, a synchronous motor responsive to the detected low frequency and an alternating current generator operated by the synchronous motor.

8. A system of distant control comprising means for producing a fundamental controlling frequency, means for producing harmonics of a fundamental frequency, means for selecting a desired harmonic, a modulator for modulating the selected harmonic in accordance with the fundamental frequency, transmitting apparatus for transmitting the resultant frequencies, detecting apparatus for detecting the fundamental frequency from the transmitted frequencies, a synchronous motor responsive to the detected fundamental frequency and a synchronous device operated by the synchronous motor.

9. A system of distant control comprising means for producing a fundamental controlling frequency, means for producing harmonics of a fundamental frequency, means for selecting a desired harmonic, a modulator for modulating the selected harmonic in accordance with the fundamental frequency, transmitting apparatus for transmitting the resultant frequencies, detecting apparatus for detecting the fundamental frequency from the transmitted frequencies, a synchronous motor responsive to the detected fundamental frequency and an alternating current generator operated by the synchronous motor.

In testimony whereof, I have signed my name to this specification this 17th day of November 1921.

DE LOSS K. MARTIN.