Nov. 1, 1938. M. BAESECKE 2,134,850

SIGNAL TRANSMISSION

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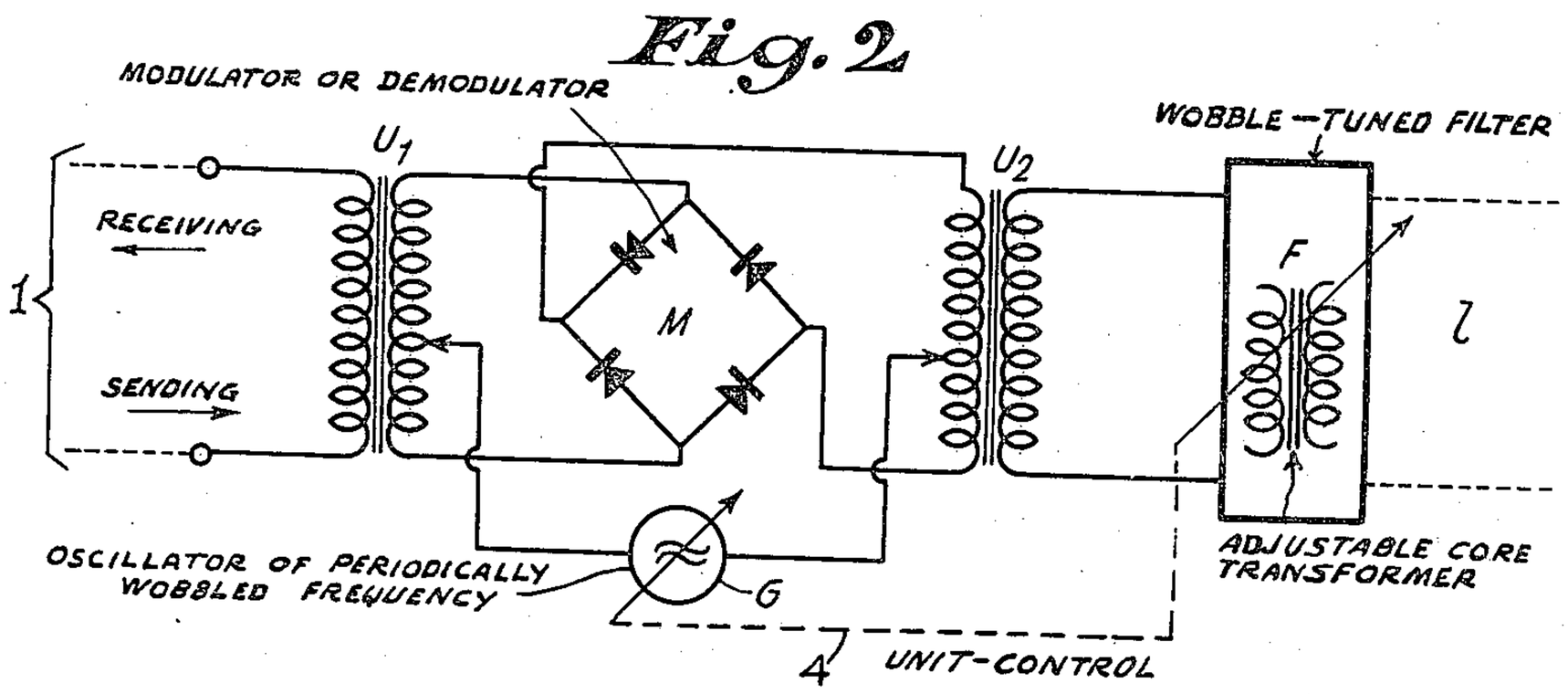

Fig. 1

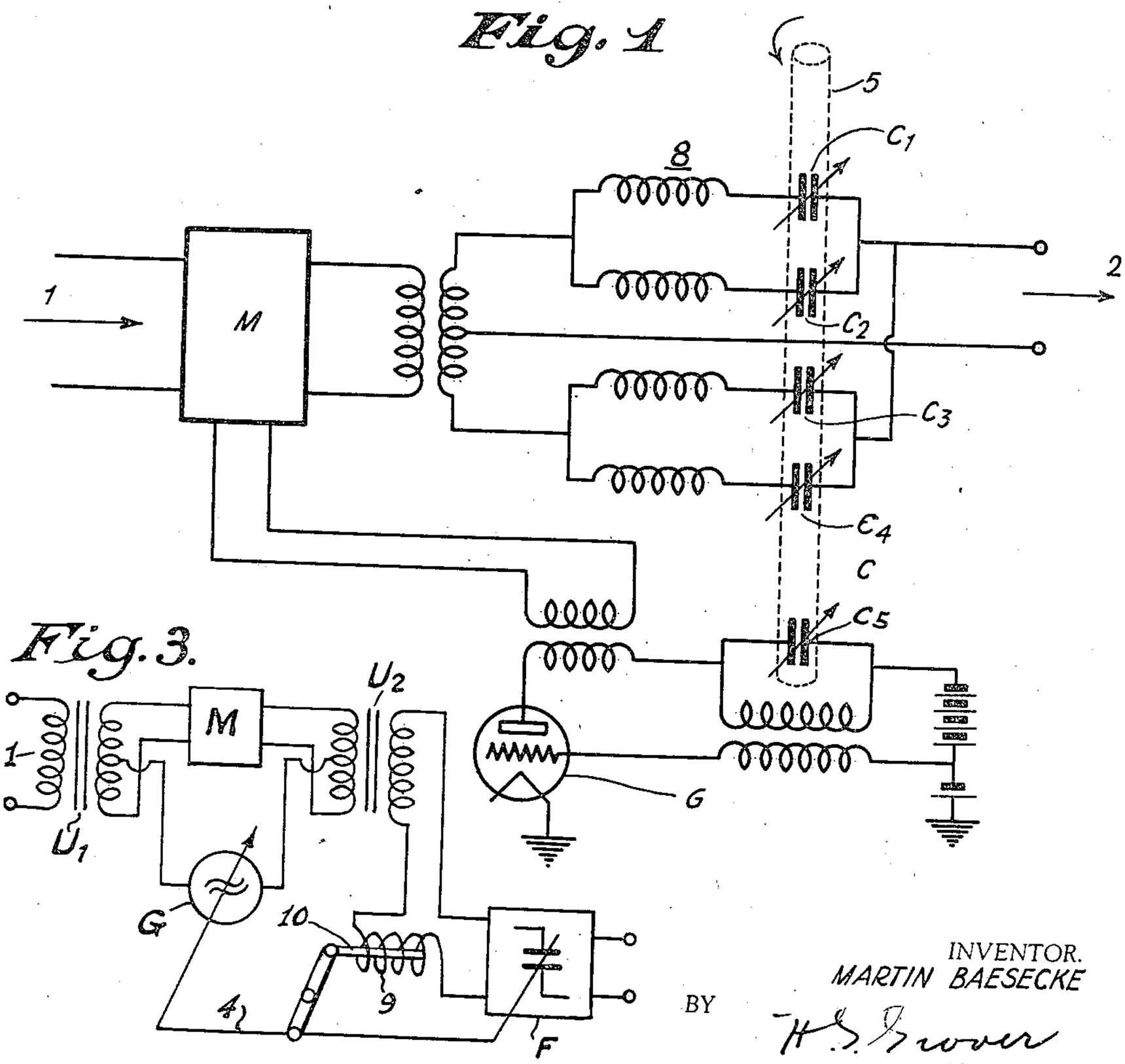

Fig. 3.

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SIGNAL TRANSMISSION

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1 Claim. (Cl. 250—6)

This invention relates to a new method of intelligence or signal transmission by means of carrier currents subject to time-variation or wobbling.

A number of methods have been disclosed in the prior art designed to transmit intelligence and news by the aid of a carrier current subject to periodic frequency-variations. Most of these methods had the object to insure secrecy, especially in radio telephonic communication. Variation of the carrier current known in the art as "wobbling" was preferably effected periodically, and after modulation with signal currents there resulted two side-bands the frequencies of which were shifted in unison with the variation of the carrier frequency. Methods of this kind are known both for single side-band as well as for full side-band transmission work in simplex and multiplex systems. One difficulty inhering in these methods is that after conversion and prior to reconversion, only selective means presenting a large transmission range could be employed in order that the signal band or bands enlarged by the wobbling may be transmitted or passed.

According to this invention, intelligence transmission by the aid of carrier-frequencies subject to periodic frequency variation is improved by providing filters for the signal wave-band or bands, and by providing means for changing the transmission range of the filters in consonance with the variation of the carrier frequency in such a way that at least one of the limiting or cut-off frequencies of the filter presents a constant frequency difference relative to the variable or wobbled carrier frequency.

This method will be found particularly advantageous if, for the transmission of intelligence or signals, only one of the side bands of the wobbled carrier frequency is to be transmitted. Such methods in contrast with full side-band transmission, in case of carrier suppression desirable for insuring secrecy of communication, prove especially advantageous inasmuch as the normal decoding or decyphering work becomes simplified. Since in side-band transmission the carrier current must be added not only with the proper frequency, but also under correct phase relations the problem of supplying carrier current of proper phase plays no part at all. So far as the wobble frequency is concerned, equality or synchronism must, of course, prevail at the sending and receiving ends.

In the use of radio-telephony on a single side-band, arrangements have been made in the prior art so that the voice-frequency band to be transmitted was first shifted upwards followed by modulation with a wobbled carrier frequency. By the aid of a low-pass filter, the upper side-band, in wobbled form, was then transmitted. In this mode of transmission, by the action of side bands of a higher order, the transmission medium was liable to be vitiated by frequencies falling inside the transmission range or pass of the low-pass filter. Moreover, at the receiving end it was essential to use selectve means having a broad tuning characteristic, and hence a correspondingly low selectivity. By the employment of selective means designed to pass substantially the width of the signal-wave band, though changing in consonance with the frequencies of the signal wave-band, the said difficulties may be obviated, both at the sending as well as at the receiving ends.

The change in the tuning of the transmitter or the receiver filter may be secured, as fundamentally known in the prior art, preferably by the aid of condensers of the variable type, the regulator means being in mechanical coupling relationship with the oscillation circuit governing the carrier frequency.

The method here disclosed may be applied for insuring secrecy of communication within widely different frequency ranges. As a general rule, band-pass filters may be used as the selective means. If the voice-frequency band is to be wobbled inside the audio-frequency range, e. g., inside the normal range of audibility, recourse could be had to a low-pass filter whose upper cut-off frequency is varied at the rhythm of the wobble frequency, and this simplifies the problem of choosing the proper dimensions for the filter.

In order to make the filters of the desired variable band-position, recourse could be had to different methods. The variable elements of the filter, as above indicated, may be adjusted in mechanical dependence upon and in synchronism with the frequency-determining condenser of the oscillator generating the carrier frequency. In this connection, particularly favorable forms of construction result in combination with the employment of bridge or differential-type filters known in the prior art in that the condensers of the oscillatory circuits included in the bridge arms are made variable and are adjusted conjointly with the condenser of the carrier-wave generator by the agency of a common drive mechanism. Another embodiment would consist in adjusting the elements, especially condensers, which govern the frequency transmitted through the filters, in electric dependence upon the frequency furnished from the generator. With this

end in view I prefer to use a frequency demodulator or a rectifier which is brought to act upon an electromagnetically actuated device which, in turn, results in mechanical changes in the filter tuning or adjusting means, more particularly condensers. A preferable and particularly advantageous method resides in the use of filters comprising coils having magnetizable cores whose saturation is subject to the control action of a rectifier which is fed with the wobbled carrier frequency.

Other ways and means are predicated upon the variation of coupling, stray leakage, and resistance, for instance, by the aid of controlled dry (copper-oxide) types of rectifiers or tubes designed to influence the frequency-governing elements of the filters.

My invention will now be described in more detail, reference being made to the accompanying drawing, in which:

Fig. 1 shows an exemplified embodiment of this invention in connection with a transmitter equipment.

Fig. 2 shows how my invention may be applied to receiving as well as sending apparatus, and Fig. 3 illustrates one detail of a signal responsive means for jointly controlling the frequency generated by an oscillator, and the band pass characteristic of a filter.

Referring, first, to Fig. 1, the voice frequencies to be coded or garbled, and applied at 1, are fed to the modulator M which is fed from the generator G producing the carrier current. From the output end of the said modulator, signalling currents of the upper or the lower or both side-bands of the modulated carrier wave are fed to the transmitter filter 3 whereby one side-band is suppressed. The transmitting filter, as known in the art, consists of a transformer or repeater-coil with four oscillatory circuits which act differentially upon the output. The condensers C1—C4 which govern the transmitted frequency band, are in mechanical coupling relationship with the condenser C5 which governs the frequency of the generator. The mechanical coupling device is indicated in Fig. 1 by a broken line representation of a rotatable shaft 5. The output frequencies appearing at 2, therefore, represent a coded band of constant width and presenting a constant distance or difference relative to the prevailing carrier frequency. A plurality of such assemblies could be connected in parallel at 2, either for the transmission of useful bands in a multiplex system, or else interfering bands. In either case any unauthorized person attempting to listen in will be unable to decode the signals or to understand the transmitted voice or communication as long as he has no receiving filter regulated in synchronism.

As previously stated, a receiving filter is employed at the receiving station to which the wobbled frequency band is fed. The arrangements could be substantially similar to the sending equipment illustrated in Fig. 1, though 2 would then be the input end and 1 the output end. The adjustment of the range of transmission of the receiving filter is effected simultaneously with the regulation of the generator provided at the receiving end.

Fig. 2 shows an exemplified embodiment in which the modulator M, generator G, and band-pass filter F are jointly used for sending and receiving. The conversion assembly comprising the said units is connected at 1 with a subscriber's line, a local line or a long-distance line. The currents flowing in the sending direction are fed through the repeater coil U1 to the modulator M where they modulate the wobbled carrier current (a frequency of, say, from 3000 to 6000 cycles per second being used. By way of the repeater coil U2 the two side-bands are fed into the filter F presenting a range of transmission (pass) which is shifted at the rhythm of the wobble frequency, and from which, say, the lower side-band is put on the line or circuit 1. As shown schematically in Fig. 3, I may, if desired, adopt a frequency control device which is rendered operable by the incoming signal energy for controlling the frequency of the oscillator G. The arrangement shown includes a magnetizing coil 9 having an adjustable iron core 10 which is suitably connected mechanically with a frequency controlling member 4 which corresponds with the unit control member 4 shown in Fig. 2. The other portions of the circuit of Fig. 3 are preferably in conformity with the showing in Fig. 2. It will be seen from this Fig. 3, therefore, that it is possible to carry out my invention by rendering the tuning of the filter and of the oscillator jointly controllable by the frequency of the incoming carrier wave which, in this case, is shown to be a wobbled carrier wave and, hence, one which would produce a wobbled frequency response in the receiver.

Means are known in the art for varying the frequency of an oscillator under control of a condenser whose capacitive value is periodically wobbled in any suitable manner. For example, United States Patent No. 1,450,966 to Affel and United States Patent 1,645,850 to Bernhard show such devices.

Referring, again, to Fig. 2, the incoming (wobbled) voice-frequency band is impressed upon the receiving filter F. M acts as the demodulator, while 1 is the output end. The same method will be applicable also in connection with a plurality of modulator stages, and in this instance several assemblies of the kind shown in Figs. 1 or 2 must be used in cascade.

The method here disclosed is useful not only for coded or garbled communication work, but also, for instance, for the purpose of obviating fading actions, for wobble communications are less sensitive to these actions.

Having thus described my invention, what I claim is:

In a radio signaling system, means for transmitting a carrier wave of periodically wobbled frequency, means for modulating said carrier wave with signals, a receiving apparatus having filtering means, a Wheatstone bridge network, an oscillator connected across the bridge arms of said network, a frequency demodulator, and means for varying the frequency of said oscillator and said filter under control of variations in the balance of said frequency demodulator due to frequency variations of the received carrier frequency.

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