

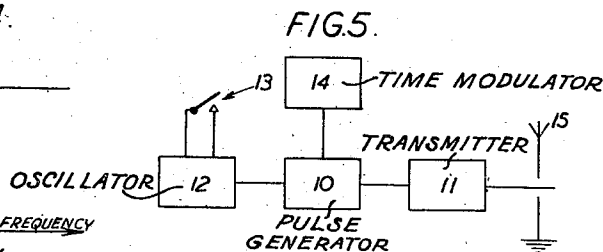
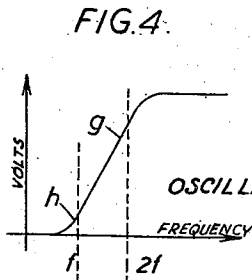
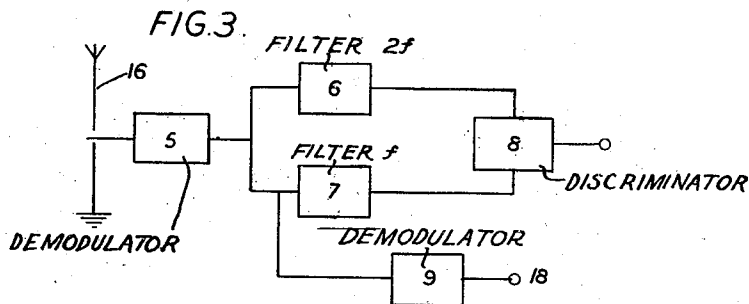
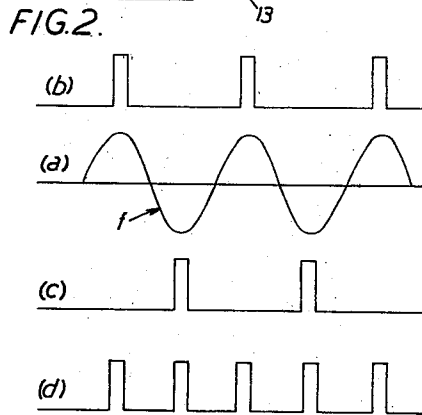
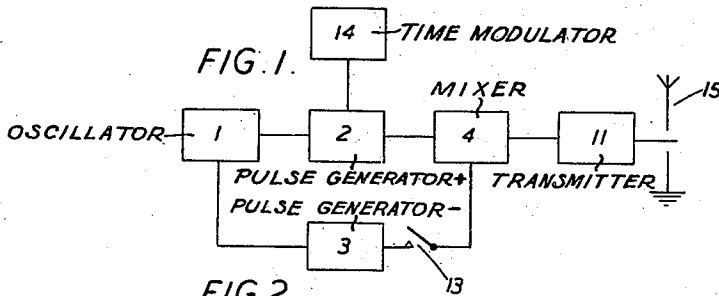
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P. K. CHATTERJEA ET AL

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SINGLE CARRIER TELEPHONE AND TELEGRAPH PULSE MULTIPLEX SYSTEM

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Inventors
P. K. Chatterjea
L. W. Houghton
By J. D. Fearing
Attorney

UNITED STATES PATENT OFFICE

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SINGLE CARRIER TELEPHONE AND TELEGRAPH PULSE MULTIPLEX SYSTEM

Prafulla Kumar Chatterjea and Leslie Wilfred Houghton, London W. C. 2, England, assignors, by mesne assignments, to International Standard Electric Corporation, New York, N. Y., a corporation of Delaware

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The present invention relates to electrical pulse transmission systems, and in particular to those used for telegraphic communication.

In pulse transmission systems which have been used hitherto, the signals are usually conveyed by generating a train of pulses regularly repeated at a high frequency, and time modulating them with the signals to be transmitted. As is well known, considerable advantage is derived from the use of pulses of very short duration, but in this case, the energy of the modulation components is small compared with the energy of the pulses. The study of the frequency spectrum of a time modulated pulse train shows that the component of maximum energy is always the one whose frequency is the same as the repetition frequency of the pulses.

In the system described in this specification, instead of time modulating the pulse train as in the well known arrangements, the frequency of repetition of the pulses is varied in accordance with the signals, for example, by a Morse key, and in this way an efficient telegraph link will be obtained.

An important advantage of the system of the present invention is that it is relatively insensitive to interference. Even if the amplitude of the disturbing signals or atmospherics exceeds that of the pulses, the intelligence can be extracted so long as the frequency components of the interference do not swamp those conveying the information.

According to the invention, there is provided an electric telegraph system for operation over a communication path comprising means for transmitting a train of short unidirectional pulses repeated at one given frequency to serve for the marking condition of a channel, and means for transmitting another train of short unidirectional pulses at another given frequency to serve for the spacing condition thereof.

According to another aspect, the invention comprises an electrical communication system comprising a telegraph system in which means is provided for transmitting regularly repeated impulses of short duration, the marking and spacing conditions of a channel being characterised by different impulse repetition frequencies, and means for obtaining a second simultaneously operable communication channel comprising means for time modulating the impulses.

The invention will be more clearly understood by reference to the following detailed description, and to the accompanying drawing, in which—

Figs. 1 and 3 show block schematic circuits of

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a transmitting and receiving system, respectively, according to the invention;

Fig. 5 shows a modification of Fig. 1; and

Figs. 2 and 4 show diagrams used in the explanation of the invention.

A system for the radio-transmission of telegraph signals is shown in block schematic form in Fig. 1. An oscillator 1 generating waves having a frequency f is connected to two pulse generators 2 and 3 so designed that one of them produces a pulse corresponding to each positive half wave of the oscillator output, and the other produces one corresponding to each negative half wave. Thus referring to Fig. 2, if curve a represents the output wave of the oscillator, then curves b and c represent respectively the pulses produced by generators 2 and 3. The generator 2 is directly connected to a mixing circuit 4, and 3 may be also connected thereto by closing the telegraph key 13. The mixing circuit 4 is in turn connected to the radio transmitter 11 and thence to the aerial 15. The block 11 is intended to include the amplifiers, modulator and other equipment usually provided for the transmission, and may be of any known type.

During the periods when the key 13 is open, a train of pulses depicted by curve b of Fig. 2 will be continuously transmitted. When the key is closed, the b and c pulses will be combined in the mixing circuit 4 and a train of pulses repeated at a frequency of $2f$ as shown by curve d of Fig. 2 will be transmitted. Thus the telegraph marking and spacing conditions are denoted by the trains of pulses repeated at frequency f and $2f$, respectively, (or the reverse, if desired).

In Fig. 1, the key 13 need not necessarily be a manually operated Morse key or the like. It is intended to represent also any machine-operated transmitting contact, for example, that of a teleprinter or other apparatus working with a marking and spacing condition on the telegraph channel.

Fig. 3 shows a block schematic circuit of the corresponding receiver. The receiving aerial 16 is connected to an amplifier 5 which leads to a pair of selective filters 6 and 7 arranged in parallel, and designed respectively to pass frequencies $2f$ and f . The output sides of these filters are connected to a discriminating circuit 8 which differentiates between the two frequencies, giving for example, a larger output voltage for $2f$ than for f . The circuit 8 might comprise a network having greater attenuation at frequency f than at $2f$, and a suitable detector, so that an output voltage similar to the curve shown in

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Fig. 4 is obtained. A relay adjusted to operate at point *g* in Fig. 4 but not at point *h* could be connected to the output of the discriminator 8. This is only one possible means for distinguishing the marking and spacing signals, and other suitable arrangements will occur to those skilled in the art.

In Fig. 5 there is shown an alternative means of transmitting the signals according to the invention. In this circuit, 11 and 15 represent the radio transmitter and aerial as in Fig. 1. The pulse generator is represented by 10, and 12 is the oscillator corresponding to 1 in Fig. 1. The key (or machine-operated contacts) 13 is connected to the oscillator 12, and when closed is designed to change the oscillation frequency, as by adding a suitable condenser to the oscillating circuit, or otherwise. It will be understood that any convenient auxiliary means, including relays, for instance, may be associated with the key for this purpose. This arrangement enables any desired frequency change to be made, and is not restricted to doubling the frequency as is the circuit of Fig. 1. The receiving circuit of Fig. 3 can be used with Fig. 5, if the units 6, 7 and 8 are designed accordingly.

It is possible to add to the telegraph channel just described another channel, which may be a telephone or a telegraph channel, by providing means for time modulating the pulses. Thus in Figs. 1 and 5, 14 represents any suitable equipment of known type for time modulating the pulses generated by the device 2 or 13 with speech or other signal waves before they are applied to the radio transmitter 11. At the receiving end Fig. 3, the pulses obtained from 5 are fed direct to the translating device 9 where they are demodulated, and the original signals are obtained at the output 18.

It will be clear that the operation of the telegraph channel will not be appreciably affected by the modulation of the pulses, since the received components at the pulse repetition frequency will be very little changed in amplitude by the modulation.

It will be evident that in Fig. 1, only the pulses at frequency *f* which are transmitted during the marking period will be time modulated. During the spacing periods additional pulses not time modulated will be transmitted. It will be unnecessary specially to select the time modulated pulses at the receiving end, and they may be passed together with the extra pulses through a low pass filter in the translation circuit 9 and demodulated according to well known practice.

In Fig. 5 all the pulses are time modulated, but the fact that the repetition frequency varies when the telegraph channel is operated has little effect on the modulation components, and demodulation occurs in the device 9 in the usual ways.

The second channel can clearly be applied to any communication purpose, but if used for a speech channel, the pulse repetition frequency must be high enough to allow of satisfactory time modulation. On the other hand, the frequency should be kept as low as possible in order to occupy the minimum band width.

It may be pointed out, also, that the invention may be applied to an existing or contemplated time modulation pulse system to obtain therefrom an additional telegraph channel, by providing means for generating the second train of pulses, and also providing the other components which have been described. In any system in-

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volving a speech channel, it would, of course, be necessary to take care that frequency components obtained from the speech modulation do not interfere with the pulse train which provides the spacing signal in the telegraph channel.

While the invention is of principal application to radio communication systems, such as the example described above, it is not restricted to such systems, and could be applied to transmission over other known types of communication path. Although it has been explained in terms of a particular arrangement, it is not intended to be limited thereto, and various modifications in accordance with the principles explained will occur to those skilled in the art.

What is claimed is:

1. In an electric telegraph system for the communication of marking and spacing conditions, means for transmitting a train of short unidirectional electric wave pulses repeated at one given frequency to serve for the marking condition of said system, and means for transmitting another train of short unidirectional electric wave pulses at another given frequency to serve for the spacing condition thereof, said transmitting means including means for producing a single carrier wave of a given frequency and means for modulating said carrier wave with said trains of pulses.

2. A system according to claim 1 and the means for receiving the two trains of short electric wave pulses including a pair of parallel connected selective filters each designed to pass one electric wave component in one of the said trains wherein said component is that of the same frequency as the frequency of repetition of the pulses of said train, and to exclude the corresponding component in the other said train that is passed by the other filter.

3. A system according to claim 1 wherein said transmitting means comprise means for time modulating at least one of said trains of pulses in accordance with additional signals to be transmitted simultaneously with said marking and spacing conditions.

4. A system according to claim 1 wherein said transmitting means comprise means for generating two trains of pulses at substantially the same given frequency including means for shifting the phase of the pulses of one of said last mentioned trains with respect to that of the pulses of the other of said last mentioned trains.

5. A system according to claim 1 wherein said transmitting means comprise means for generating two trains of pulses at substantially the same given frequency including means for shifting by a half period the phase of the pulses of one of said last mentioned trains with respect to that of the pulses of the other of said last mentioned trains, said transmitting means further comprising means for mixing said last mentioned two trains of pulses to produce one train of pulses repeating at double of said given frequency wherein said train of pulses repeating at double said given frequency rate and the train of pulses repeating at said given frequency rate constitute the two trains of pulses which serve for the marking and spacing conditions.

6. A system according to claim 1 wherein said transmitting means comprise an oscillator for producing electric waves of a given frequency including means for changing said given frequency to another given frequency, a pulse generator controlled by said oscillator, and switching means controlling the frequency changing means to produce selectively two trains of pulses, one repeated

at said one given frequency and another repeated at said other given frequency.

7. In an electric telegraph system for the communication of marking and spacing conditions, means for transmitting a train of short unidirectional electric wave pulses repeated at one given frequency to serve for the marking condition of said system, means for transmitting another train of short unidirectional electric wave pulses at another given frequency to serve for the spacing condition thereof, said transmitting means including means for producing a single carrier wave of constant frequency and means for modulating said carrier wave with said trains of pulses, and means for receiving the two trains of short pulses including a pair of parallel connected selective filters each designed to pass one electric wave component in one of the said trains wherein said component is that of the same frequency as the frequency of repetition of the pulses of said train and to exclude the corresponding component in the other said train that is passed by the other filter.

8. A system according to claim 1 wherein said transmitting means comprise an oscillator generating alternating waves at a given frequency, two pulse generators controlled by negative and positive half portions respectively of said alternating waves, each pulse generator producing pulses repeated at said given frequency, the pulses of the generators having a relative phase difference of half a period of the said waves, a mixing device, one of said pulse generators being permanently connected thereto, and switching means for connecting the other of said pulse generators to the said mixing device in accordance with signals to be transmitted.

9. In an electric telegraph system for the communication of marking and spacing conditions, means for transmitting a train of short unidirectional electric wave pulses repeated at one given frequency to serve for the marking condition of said system, means for transmitting another train of short unidirectional electric wave pulses at another given frequency to serve for the spacing condition thereof, said transmitting means including means for producing a single carrier wave of a constant frequency, means for modulating said carrier wave with said trains of pulses, and means for time modulating at least one of said trains of pulses in accordance with additional signals to be transmitted during said marking and spacing conditions, means for receiving the pulse modulated carrier wave including a pair of parallel connected selective filters each designed to pass one electric wave component in one of the said trains wherein said component is that of the same frequency as the frequency of repetition of the pulses of said train and to exclude the corresponding component in the other said train that is passed by the other filter, and a discriminator to which the output sides of said two filters are connected in parallel, said discriminator providing a low voltage output when the said electric wave component of one train of pulses is transmitted and a high voltage output when the said corresponding component in the other train is transmitted.

10. A system according to claim 1 wherein said transmitting means comprise an oscillator gener-

ating full waves at a given frequency, two pulse generators controlled by negative and positive half portions respectively of said full waves, each pulse generator producing pulses at said given frequency, the pulses of the pulse generators having a relative phase difference of half a period of the said waves, a mixing device, one of said pulse generators being permanently connected thereto, switching means for connecting the other of said pulse generators to said mixing device in accordance with signals to be transmitted, said transmitting means further including means for time modulating the pulses from the first mentioned pulse generator in accordance with additional signals to be transmitted through said first train of pulses.

11. In an electric telegraph system for the communication of marking and spacing conditions, means for transmitting a train of short unidirectional electric wave pulses repeated at one given frequency to serve for the marking condition of said system, means for transmitting another train of short unidirectional electric wave pulses at another given frequency to serve for the spacing condition thereof, said transmitting means including means for producing a single carrier wave of constant frequency means for modulating said carrier wave with said trains of pulses, and means for time modulating at least one of said trains of pulses in accordance with additional signals to be transmitted during said marking and spacing conditions, means for receiving the pulse modulated carrier wave including a pair of parallel connected filters each designed to pass pulses repeated at one of the given frequencies and to exclude pulses repeated at the frequency passed by the other filter, and translating means connected in parallel with the input circuits of the filters for obtaining said additional signals from the time modulated pulses.

PRAFULLA KUMAR CHATTERJEA.
LESLIE WILFRED HOUGHTON.

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