Dec. 12, 1944. G. T. BAKER 2,364,685

TELEPHONE SYSTEM

Filed Feb. 6, 1943

Fig. 1

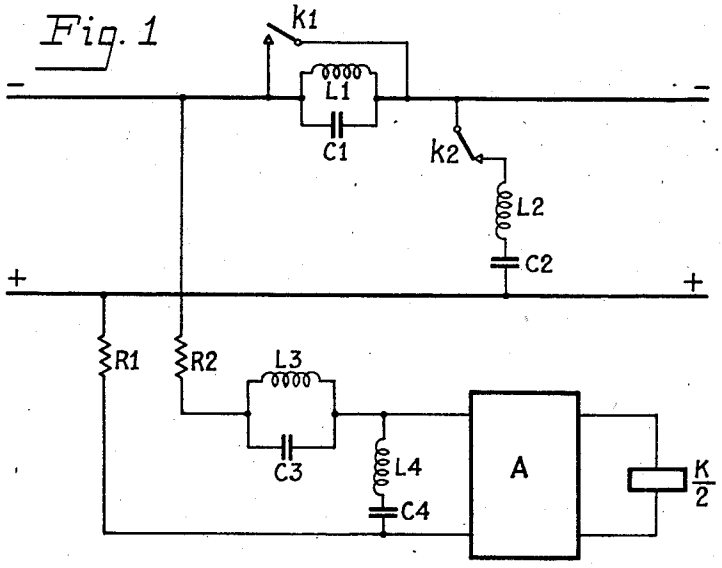


Fig. 2

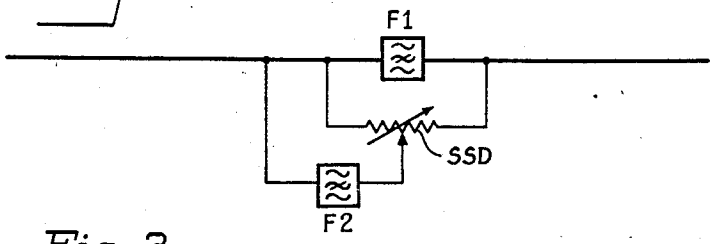


Fig. 3

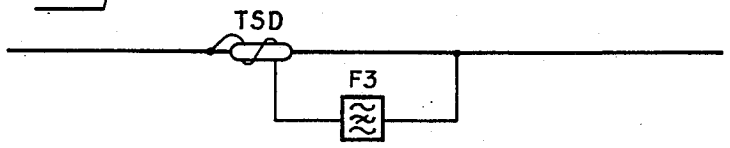
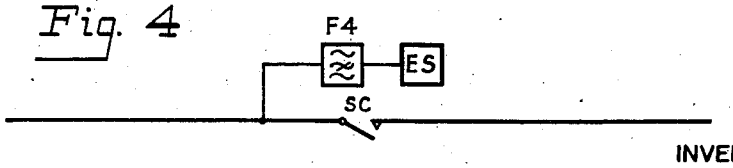


Fig. 4



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TELEPHONE SYSTEM

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In Great Britain April 28, 1942

10 Claims. (Cl. 179—84)

The present invention relates to telephone systems and is more particularly concerned with telephone systems of the type employing, for signalling purposes, alternating currents of a frequency within the voice spectrum.

In such systems account must be taken of the likelihood that currents of signalling frequency will be present in the currents representing speech and known means for distinguishing between signalling frequencies and the same frequencies when occurring as part of a speech passage generally depend on the fact that in the latter case if the frequency or frequencies allocated for signalling are present, they will be accompanied by other frequencies. The presence of these other frequencies serves to render inoperative the receiving device which responds to currents of signalling frequencies.

In some circumstances it is found desirable to arrange that signals shall not pass a particular point in a transmission line while speech, including the signalling frequencies, shall be enabled to pass without hindrance. Arrangements have already been proposed for meeting this requirement and the chief object of the invention is to provide improved arrangements for permitting speech to pass without interference or alteration while barring the passage of signalling frequencies.

According to one feature of the invention, in a telephone system employing voice frequency currents for the transmission of signals incidental to the setting up and supervision of a connection, blocking means normally effective to obstruct the passage over the line of currents of one or more frequencies in the voice frequency range are arranged to be controlled in response to currents of non-signalling frequencies to have their blocking effect neutralised.

According to another feature of the invention, in a telephone system employing voice frequency currents for the transmission of signals incidental to the setting up and supervision of a connection, the line circuit includes a filter device adapted to obstruct the passage of currents of the signalling frequency or frequencies and to be rendered inoperative in response to the reception of currents of non-signalling frequencies.

According to a further feature of the invention, in a telephone system employing voice frequency currents for the transmission of signals incidental to the setting up and supervision of a connection, the line circuit is normally blocked to currents of all frequencies and means responsive to currents of non-signalling frequency are arranged to remove the blocking effect.

The invention will be better understood from the following description of four methods of carrying it into effect, reference being had to the accompanying drawing comprising Figs. 1–4.

Fig. 1 shows a line circuit for a voice frequency signalling system, using a filter in the line for blocking the signalling frequencies, and having an amplifier controlled relay in a branch of the line for removing the blocking effect.

Fig. 2 shows schematically an alternate form of the invention using a variable attenuation network in combination with filters.

Fig. 3 shows still another method of operation by the use of a thermal switching device in conjunction with a filter.

Fig. 4 shows a modification of the invention using an echo suppressor in circuit with a filter controlling the operation of the line disabling feature,

In the arrangements of all the figures it is assumed that one frequency only is employed for signalling purposes and it will be understood that in Figs. 1–3 the line is normally blocked as regards this frequency only but offers no appreciable hindrance to other frequencies. In Fig. 4 the line is normally blocked as regards all frequencies and this blocking is rendered ineffective in response to the reception of non-signalling frequencies either with or without the selected signalling frequency.

Referring now to Fig. 1, the combination of inductances and capacitances L1, C1 and L2, C2, represents in simple form a filter of the type necessary to provide high attentuation to a signalling frequency so that the line is in effect blocked to such frequency. Connected across the line by way of a pair of load limiting resistances R1 and R2 is an amplifier A, in the input circuit of which a similar filter circuit represented by L3, L4, C3, C4 is inserted so as to bar the signalling frequency. The output circuit of the amplifier is connected to a relay K.

The reception of a signalling frequency unaccompanied by other frequencies is without effect on the amplifier so that relay K does not operate and the line effectively remains blocked as far as this frequency is concerned. If however it is accompanied by other frequencies, then such frequencies will be amplified to operate relay K whereupon at contacts *k*1 and *k*2 the filter is cut out so that the line is switched through for all frequencies. In order to ensure that the line filter will remain disabled during a con-

tinuous speech passage even though at any one time the speech frequency component may only consist of current of the signalling frequency, relay K may conveniently be provided with a delayed release time so that the filter disabling means comprised by its contacts will remain effective during the speech passage.

Assuming the device is to operate on a one-way basis only, i. e., with the input on the left-hand side and the output on the right-hand side, it might be arranged to connect the amplifier A on the outgoing side of the line filter, in which case it would be unnecessary to employ the additional filter in circuit therewith as shown, since discrimination against a signalling frequency will be effected by the line filter.

Instead of the mechanical switching arrangement shown, it would be possible to employ a static switching device comprising for instance dry plate rectifiers or other units the impedance of which can be varied to produce the switching effect brought about by the contacts of relay K.

This is diagrammatically shown in Fig. 2 where the filters F1 and F2 are each arranged to offer high impedance to the signalling frequency, while the static switching device SSD which is connected across the line filter F1 and which may comprise a variable attenuation network, normally has a high impedance so that the line is normally blocked to the signalling frequency. If a non-signalling frequency is received either alone or in combination with a signalling frequency, it will pass through filter F1 and also by way of filter F2 and the static switching device SSD. The potential change involved in the latter path is used to bias back the switching device SSD so that it now becomes of low impedance and serves to pass all frequencies.

In the arrangement of Fig. 3 there is connected in the line a small bead of known material such as uranium oxide or silver sulphide which has a non-linear negative temperature coefficient, that is to say its resistance decreases rapidly from its normal high value with increase of temperature: this will be referred to as a thermal switching device and is designated TSD. The filter F3 which is arranged to offer high impedance to the signalling frequency is connected in series with the heater winding for this device, and hence if a signalling frequency alone is received it will be unable to pass through since one path therefor is interrupted by the high resistance of the bead TSD, while the other path is interrupted by virtue of the action of the filter F3. If, on the other hand, a non-signalling frequency alone or accompanied by the signalling frequency is received, it will be able to find a path by way of the filter F3. Hence the current flow through the heater winding of the device TSD although small will be such as to heat up this device, whereupon its resistance will rapidly decrease and a low resistance path by way of the transmission line will be offered to all frequencies.

Referring now to Fig. 4, use is made in this instance of an echo suppresser ES which is connected to the line in circuit with the filter F4 which serves to bar the signal frequency. If a signal frequency only is received, the equipment ES will not come into operation and the line will remain blocked, while if a non-signalling frequency is received the echo suppressor comes into operation and either statically or by a relay operation as indicated by contacts *sc*, extends the line through for all frequencies.

An advantage of the above-described arrangements is that since the line is normally blocked to signal frequencies it is impossible for unwanted pips of signal tone to get through to another circuit where trouble might be caused. Furthermore, in the cases described in connection with Figs. 1–3 it will be seen that the line is never blocked to frequencies other than those selected for signalling purposes and hence even if the signal barring device should fail to come into operation, a speech passage could be transmitted through without more interference than would be caused by the suppression of frequencies which correspond to those used for signalling purposes.

What I claim as new and desire to secure by Letters Patent is:

1. In a telephone system employing voice frequency currents for the transmission of signals, a line for the setting up and supervision of a signalling and talking connection, means normally effective to obstruct the passage over said line of currents of one or more frequencies in the voice frequency range, and means responsive to currents of non-signalling frequencies to remove said obstruction to allow transmission of said frequencies over the line.

2. In a telephone system in which there is means for transmitting currents of voice frequency over a line to transmit signals incidental to the setting up and supervising a signalling and talking connection over the line, a filter tuned to normally obstruct the passage over said line of said currents of the signalling frequency or frequencies, and means for removing said filter obstruction responsive to the transmission of currents of non-signalling frequencies over said line.

3. In a telephone system, a line circuit over which voice frequency signalling currents are transmitted during the setting up of a connection over the line, an amplifier associated with said line, a filter in the input of said amplifier tuned to make the amplifier unresponsive to said signalling currents but responsive to currents of other frequencies, and means in the output of said amplifier for controlling said line circuit when said other frequencies are received.

4. A system as claimed in claim 3, in which said last means comprises a relay connected to the output terminals of said amplifier, and adjusted to operate on the transmission of currents of frequencies receptive to said amplifier over said line.

5. In a telephone system employing voice frequency currents for the transmission of signals, a line for the setting up and supervision of a signalling and talking connection, means including a line filter and a shunt normally blocking said line to currents of a signalling frequency or frequencies, an amplifier, a slow to release relay, said relay operating during transmission of non-signalling currents through said amplifier to disable and cause said blocking means to remain disabled during transmission of speech currents over said line, even though the speech frequency component consists of currents of the signalling frequency or frequencies.

6. In a signalling system, a line circuit over which speech currents are to be transmitted, and over which certain control frequencies are also transmitted, a filter in the line circuit tuned to block the control frequencies from passing over the line, a device associated with the line and responsive to frequencies of current other

than the control frequencies to render the filter in the line circuit ineffective.

7. A system such as claimed in claim 6, in which said device includes a variable attenuation network in shunt of the line circuit filter, and means for varying the attenuation of the network to vary its shunt effect.

8. A system such as claimed in claim 6, in which said filter comprises an element of resistance material having a high negative coefficient of resistance change with temperature, and means consisting of a heating coil in series with a second filter to render said first filter ineffective.

9. In a telephone system, a line circuit over which voice frequency signalling currents are transmitted incidental to the setting up of a connection over the line, means normally operative to obstruct the passage over said line of all frequency currents, and means responsive to the transmission of non-signalling frequencies over the line for removing the obstruction.

10. In a telephone system, a line circuit over which voice frequency signalling currents are transmitted during the setting up of a connection over the line, means blocking said line to all frequency currents, a control branch of said line circuit, a filter in said control branch, a device operating over said control branch in response to the transmission over the line circuit of currents of non-signalling frequencies for removing the blocking means to permit the transmission of all frequency currents over the line.

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