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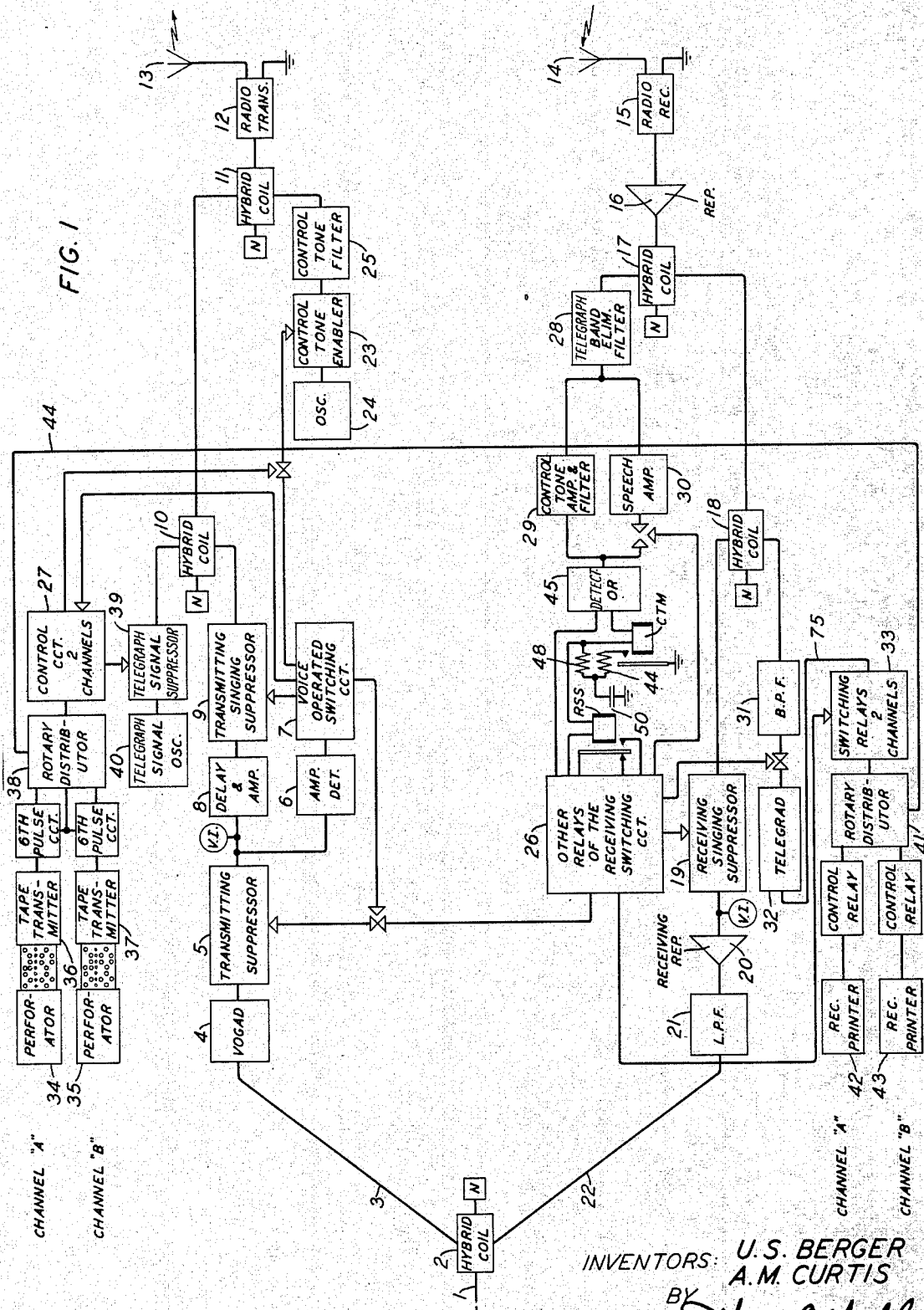
U. S. BERGER ET AL

2,220,883

CIRCUIT CONTROLLER

Filed July 8, 1939

2 Sheets-Sheet 1



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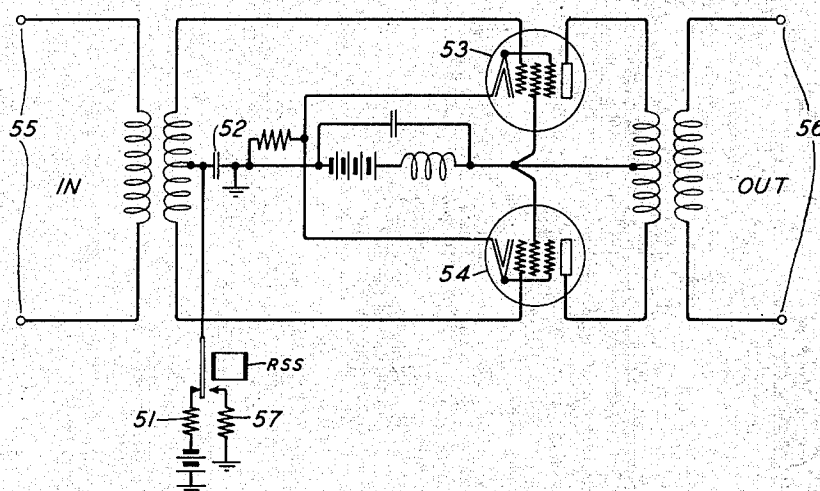
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2 Sheets-Sheet 2

FIG. 2



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CIRCUIT CONTROLLER

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6 Claims. (Cl. 179-4)

This invention relates to communication systems and particularly to telephone systems wherein the speech channels are used during lulls in speech and during other intervals when not being used for speech, for other purposes, such as the transmission of telegraph signals.

The object of the invention is to render the switching which necessarily takes place each time a speech channel is converted from a telephone channel to a telegraph channel, or vice versa, unnoticeable to a listener. Where such switching is controlled by the use of a control tone which precedes speech, there is always a short interval just before the speech begins or just after it ends when the channel is in a different condition. The transition from the normal condition to said different condition, or vice versa, may, if made suddenly, as by the opening or closing of a relay contact, manifest itself to a listener as a noise or a thump or a click.

Another object of the invention is to render switching operations unnoticeable in a voice controlled circuit in which the voice is delayed so that a control tone may precede the voice to cause such switching operations prior to the arrival of the voice.

A feature of the invention is means in a communication system to minimize the effect of switching operations caused by voice operated devices.

Heretofore, switching operations have been carried out by the use of the crossed coil transmission loss unit disclosed in Patent No. 1,749,851, granted March 11, 1930, to H. C. Silent. Its use in a system of the present type is shown in Patent No. 2,207,720, granted July 16, 1940, to Cole et al. and the present invention may be considered an improvement over the Cole et al. invention.

A feature of the present invention is the use of a slow operating and slow releasing variable transmission loss element in a voice frequency channel under control of a control tone transmitted over such channel in response to the action of voice operated devices at the transmitting end of the channel. This and other features will appear as the description proceeds.

Another feature of the invention is the use of a slow operating channel switching means responsive to a control current, whereby positive action is insured and clipping of speech heretofore an annoying feature of voice controlled switching means is either prevented or greatly reduced and its effect on the subscriber is made entirely negligible.

The drawings consist of two sheets, the first containing Fig. 1 in the form of a block diagram showing a general schematic of a system in which the present invention may be used and the second containing Fig. 2 in the form of a circuit diagram showing the details of the present invention.

Fig. 1 is a general schematic of the system in which the circuit controller, subject of the present invention, is employed. A speech path 1 leads to a hybrid coil 2 from which a path 3 for outgoing speech leads to a vocoder 4. The outgoing speech then passes through a transmitting suppressor 5 and by means of an amplifier-detector 6 operates a chain of relays 7 here labeled as "voice operated switching circuit." This voice operated switching circuit controls a transmitting singing suppressor 9; so that the outgoing speech can pass from the transmitting suppressor 5 through the delay and amplifier 8 and the transmitting singing suppressor 9 to the hybrid coil 10. From the hybrid coil 10 the speech reaches another hybrid coil 11 and thence goes through the radio transmitter 12 to an antenna 13. Through radio transmission the speech will be received at some distant point and for purposes of explanation it will be assumed that the distant point has a receiving circuit similar in all respect to the lower part of Fig. 1. The speech therefore enters antenna 14, passes through a radio receiver 15 and a repeater 16 to a hybrid coil 17. From the hybrid coil 17 the speech goes into hybrid coil 18, thence through the receiving singing suppressor 19, the receiving repeater 20, a low-pass filter 21 and a path 22 to a hybrid coil, such as 2, whence it goes to the receiving subscriber over a line, such as 1.

The receiving singing suppressor 19 is shown in detail in Fig. 2 and its particular operation will be described hereinafter.

The voice operated switching circuit 7 controls a control tone enabler 23, so that a source of control tone 24 is passed through the control tone filter 25 to the hybrid coil 11 and thus accompanies speech. The voice operated switching circuit 7 also controls a switching point leading from the receiving switching circuit 26 at the same terminal to the transmitting suppressor 5 so as to open this circuit during the periods speech is going out from line 1 to antenna 13. During this time, the voice operated switching circuit 7 also controls the telegraph control circuit 27 to stop the action of the telegraph transmitting circuit.

At the receiving end, the control tone coming in over antenna 14 passes through hybrid coil 17

and thence through telegraph band elimination filter 28 and into a control tone amplifier and filter 29 and thence into detector 45. This operates relays CTM and RSS and other relays of the receiving switching circuit 26. The relay CTM is known as the control tone master relay and its contacts operate through a hang-over circuit comprising resistances 48, 49 and a condenser 50 to provide a slow release operation for relay RSS. The other relays of the receiving switching circuit perform several functions as follows. First, the circuit 26 controls a normally open circuit between the telegraph band elimination filter 28 and the detector 45 including a speech amplifier 30. This is provided so that when control tone is first received, the receiving switching circuit 26 will be operated thereby and then held operated thereafter by speech currents flowing through the amplifier 30.

The receiving switching circuit also controls the receiving singing suppressor 19 to open up the speech path. The receiving switching circuit 26 also controls a normally closed path between the band-pass filter 31 and the telegrad 32 so that while speech is being received the telegrad 32 will be disabled. At the same time, the receiving switching circuit 26 controls the switching relays for two telegraph channels 33.

During pauses in the speech, either when the subscriber at the distant end is talking into channel 1 or during the time when the subscriber on channel 1 pauses during his talk out over the antenna 13, the telegraph apparatus shown in the upper part of the figure is in operation. This comprises perforators 34 and 35 working respectively into tape transmitters 36 and 37 and thence into rotary distributor 38. Rotary distributor 38 works through the control circuit 27, which in turn exercises control over the telegraph signal suppressor 39. A source of telegraph signal tone is supplied by the telegraph signal oscillator 40 and through the action of the telegraph signal suppressor 39 under the control of the control circuit 27 sends telegraph signals into the hybrid coil 10, thence through the hybrid coil 11 and the radio transmitter 12, and out over the radio path from antenna 13.

At the distance end these telegraph signals in the form of spurts of alternating current are received over antenna 14 and radio receiver 15 and thence pass through the hybrid coils 17 and 18 to the band-pass filter 31. Thereafter the signals enter the telegrad 32 and are converted from varying strength alternating current signals to uniform strength direct current signals of practically the same length at which they were received over the antenna 14. These direct current signals then pass through the switching relay circuit 33 and the rotary distributor 41 to the two printers 42 and 43. During the reception of telegraph signals the receiving switching circuit 26 is unoperated and the speech path is blocked off by the receiving singing suppressor 19.

A line 44 schematically represents the means for keeping the rotary distributor 38 in exact synchronism with the distant rotary distributor 41. The rotary distributor 38 and the rotary distributor 41 at the same terminal may or may not be kept in synchronism. In actual practice they generally are kept in synchronism for reasons having to do with the cost of synchronizing apparatus, but from an operating standpoint it is only necessary that the rotary dis-

tributors forming part of the same channel be kept in synchronism.

The receiving singing suppressor 19 is a circuit controller and is shown in detail in Fig. 2. The relay RSS, which is one of the relays of the receiving switching circuit operated by the detector 45, is provided with an armature and a front and a back contact. When the relay is in its idle condition a connection is made from a negative battery through a resistance 51, the back contact and armature of relay RSS to charge a condenser 52 negatively. This condenser whose other terminal is grounded, controls the grids of two vacuum tubes 53 and 54. When the condenser 52 is charged negatively, the vacuum tubes 53 and 54 are conditioned to prevent the flow of voice currents from the in terminals 55 to the out terminals 56. When the relay RSS is operated and the condenser 52 is short-circuited through the front contact and armature of relay RSS and the resistance 57 to ground, the vacuum tubes 53 and 54 are conditioned to allow free passage of voice currents from the in terminals 55 to the out terminals 56.

Since the armature of relay RSS therefore controls a circuit which results in one case in the building up of a charge on condenser 52 and in the other case in the dissipating of a charge on condenser 52, and since the charging and discharging of this condenser takes a finite time, the result will be that the circuit controller opens and closes the speech path from the hybrid coil 18 to the receiving repeater 20 slowly.

This finite time may be fixed by adjusting the values of the condenser 52 and the resistances 51 and 57. By way of example the charge and the discharge of condenser 52 may be made to occur in thirty milliseconds or practically the time comparable to that taken for the envelope of a spoken syllable to reach its crest.

Thus when control tone first comes in over antenna 14 and results in the operation of relay RSS, the speech path through the receiving singing suppressor 19 is operated slowly so that the listening subscriber will not be annoyed by the clicks caused by the sudden change in circuit conditions. Likewise, at the end of a period of speech and after the hang-over period provided by the circuit controlled by relay CTM when relay RSS releases, there will be a slow transition from the open to closed condition of the receiving singing suppressor 19.

An additional advantage of this method of operation is in the "noise suppression" which it affords. In the intervals between received words, or in brief pauses in speech which are not long enough to cause the listener to take control of the circuit, the receiving singing suppressor 19 disables the path to the listener, preventing him from being disturbed by noise or cross-talk. This results in a distinct improvement in circuit utilization, permitting the use on traffic of noisy circuits which without the "noise suppression" would be uncommercial.

That part of the circuit between and including the radio transmitter 12 and the radio receiver 15 is spoken of as a mutable link since it comprises a signaling channel capable of or liable to change from internal or external cause which may give rise to interfering energy or more specifically, subject to noise, fading or change of attenuation. It is to be understood, however, that the present showing is by way of example and that the term "mutable link" does not necessarily mean that a space radio link is in-

variably involved but that the term is broader in its meaning and includes any channel liable to change from internal or external change.

What is claimed is:

5 1. In a communication system, a voice frequency channel including a mutable link, means for normally employing said channel for a first type of communication, switching means at the transmitting end and at the receiving end of said channel responsive to a second type of communication for halting said first type of communication and conditioning said channel for said second type of communication, said switching means including at said receiving end a variable impedance device in the circuit beyond said channel for employment in said second type of communication and means for slowly operating said variable impedance device.

2. In a communication system, a voice frequency channel including a mutable link, means for normally employing said channel for telegraph communication, switching means at the transmitting end and at the receiving end of said channel responsive to voice currents for halting said telegraph communication and for conditioning said channel for telephone communication, said switching means including at said receiving end a variable transmission loss element in a telephone communication circuit and means for slowly operating said variable transmission loss element.

3. In a communication system, a voice frequency channel including a mutable link, means for normally employing said channel for telegraph communication, switching means at the transmitting end and at the receiving end of said channel for halting said telegraph communication and for conditioning said channel for telephone communication, said switching means at said transmitting end being responsive to voice currents, means also responsive to voice currents for transmitting a control current over said channel for operating said switching means at the receiving end of said channel, said switching means at the receiving end of said channel including a variable transmission loss element for rendering the telephone circuits at said receiving end opaque to voice frequency currents during telegraph transmission and transparent to voice frequency currents during transmission of said control current and means for slowly and gradually operating said variable transmission loss element.

4. In a communication system, a voice frequency channel including a mutable link, telegraph circuits and telephone circuits associated with both ends of said channel, means for normally employing said channel for telegraph communication, switching means for disconnecting said telegraph circuits from said channel and connecting in place thereof said telephone circuits, voice operated means at the transmitting end of said channel for operating the said switching means thereat, for connecting a source of control current to said channel and for delaying the transmission of said voice currents over said channel, control current operated means at the

receiving end of said channel for operating said switching means thereat including a variable transmission loss element in the telephone circuit thereat for slowly and gradually changing said telephone circuit from one opaque to voice frequency currents to one transparent to voice frequency currents and vice versa, whereby during the interval between the application of control current to said channel and the beginning of transmission of voice currents thereover the transition from and to a connection including said mutable link will be rendered unnoticeable to a listener.

5. In a communication system, a voice frequency channel including a mutable link, telegraph circuits and telephone circuits associated with both ends of said channel, means for normally employing said channel for telegraph communication, switching means for disconnecting the said telegraph circuits from said channel and connecting in place thereof said telephone circuits, voice operated means at the transmitting end of said channel for operating the said switching means thereat, for connecting a source of control current to said channel and for delaying the transmission of said voice currents over said channel, control current operated means at the receiving end of said channel for operating said switching means thereat, a variable transmission loss element in the telephone circuit at the receiving end of said channel, a relay operated by said control current operated means, a condenser connected to said variable loss element for regulating the loss thereof and charging and discharging circuits for said condenser controlled by said relay, said charging and discharging circuits being constructed and arranged to function in a time comparable to that taken for the envelope of a spoken syllable to reach its crest.

6. In a communication system, a voice frequency channel including a mutable link, telegraph circuits and telephone circuits associated with both ends of said channel, means for normally employing said channel for telegraph communication, switching means for disconnecting the said telegraph circuits from said channel and connecting in place thereof said telephone circuits, voice operated means at the transmitting end of said channel for operating the said switching means thereat, for connecting a source of control current to said channel and for delaying the transmission of said voice currents over said channel, control current operated means at the receiving end of said channel for operating said switching means thereat, a variable transmission loss element in the telephone circuit at the receiving end of said channel, a relay operated by said control current operated means, a condenser connected to said variable loss element for regulating the loss thereof and charging and discharging circuits for said condenser controlled by said relay, said charging and discharging circuits being constructed and arranged to function in a period of the order of thirty milliseconds.

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