July 16, 1940. U. S. BERGER ET AL 2,207,711

CONVOY CURRENT TIMING ARRANGEMENT

Filed July 8, 1939 4 Sheets-Sheet 1

FIG. 1

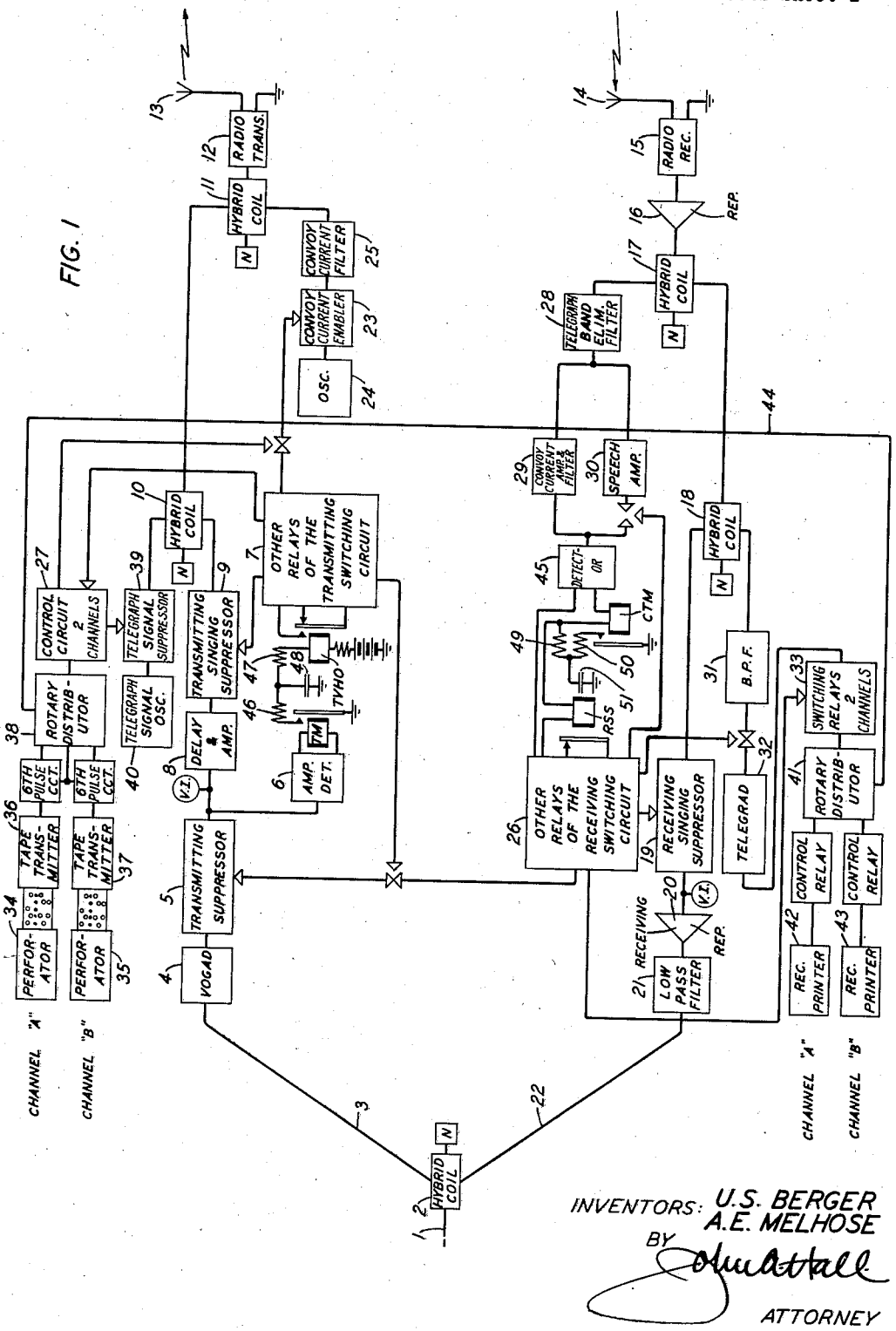

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FIG. 2

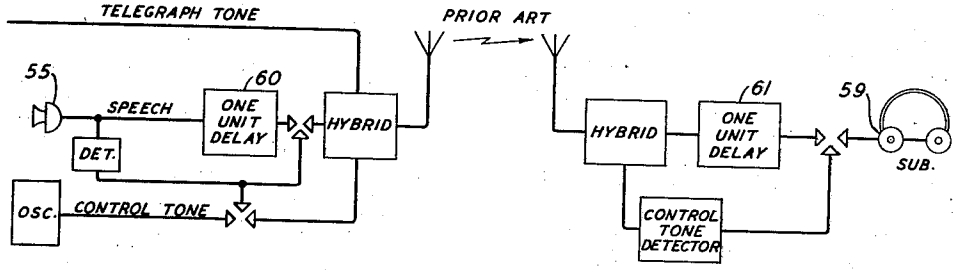


FIG. 3

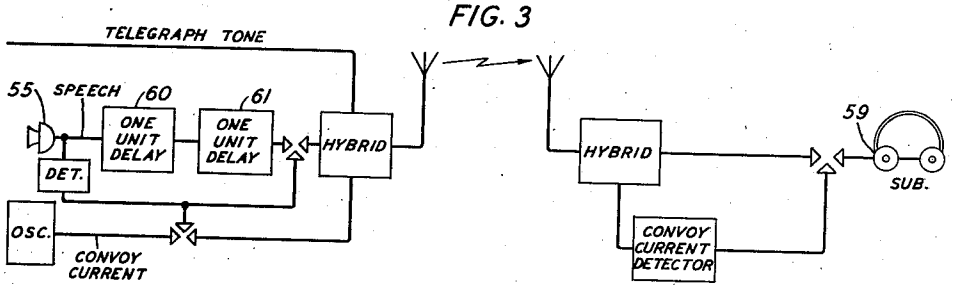


FIG. 4

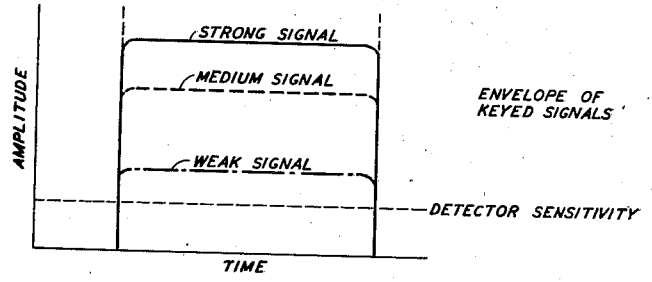
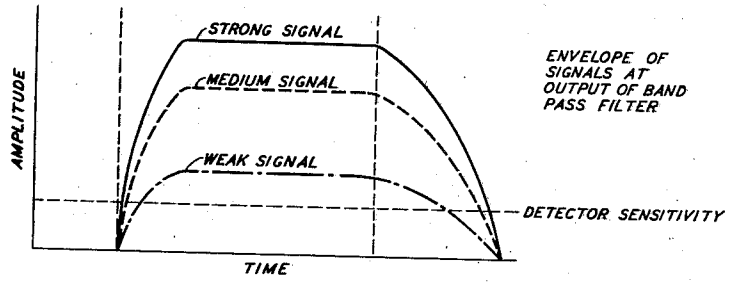


FIG. 5



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CONVOY CURRENT TIMING ARRANGEMENT

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FIG. 6

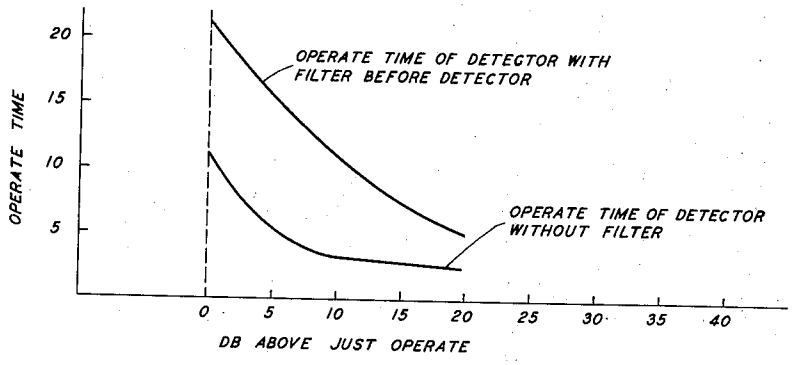
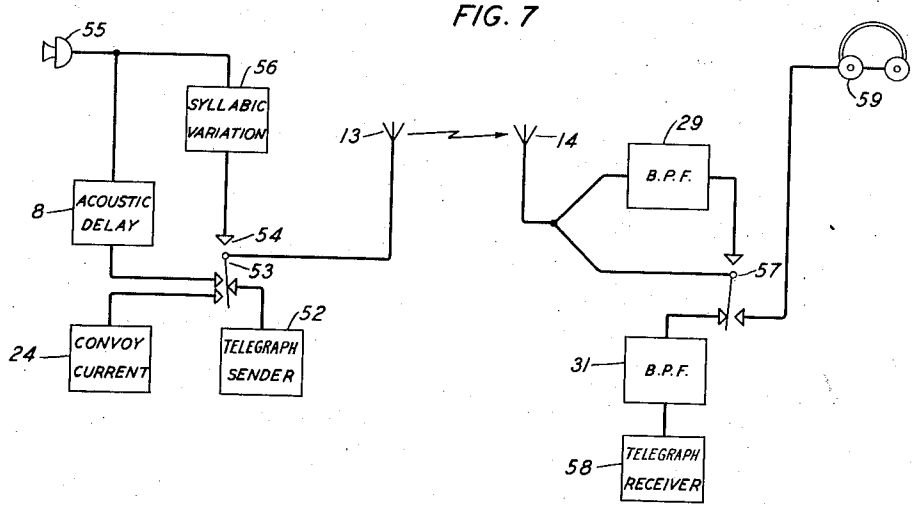


FIG. 7



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CONVOY CURRENT TIMING ARRANGEMENT

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FIG. 8

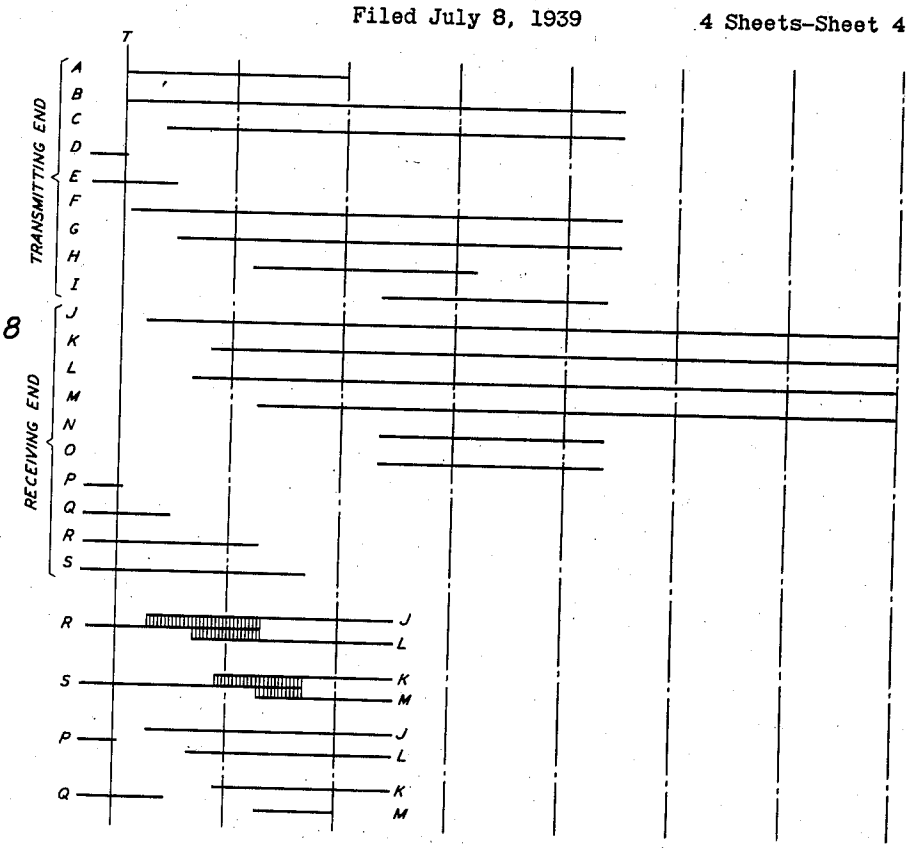
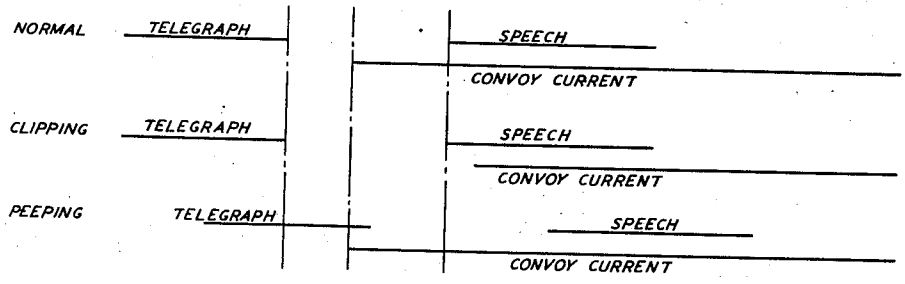


FIG. 9



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Patented July 16, 1940 2,207,711

UNITED STATES PATENT OFFICE

2,207,711

CONVOY CURRENT TIMING ARRANGEMENT

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Application July 8, 1939, Serial No. 283,369

6 Claims. (Cl. 179—4)

This invention relates to communication systems and particularly to systems wherein telegraph signals are interpolated in telephone conversations. The invention is an improvement in the system disclosed in application Serial No. 219,964, filed on July 19, 1938, by I. E. Cole and A. E. Melhose.

The object of the invention is to provide a novel circuit arrangement which will insure against mutilation of speech or the intermixture of telephone and telegraph signals. It is important in a system of this nature that the telephone transmission shall approach perfection so that nothing should occur to disturb or annoy a listener. Insurance against disturbing occurrences must be positive and extreme, otherwise the usefulness of the system fails, not in accordance with the frequency of interference but more nearly in totality where such interference first begins to occur. It will, of course, be understood that this is based in large measure on the general expectation of the public that they will be given as nearly perfect telephone service as it is possible to provide.

According to the present invention a channel, including a mutable link or 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 impedance, is employed normally for sending telegraph signals in the form of voice frequency alternating current signals. Telephone facilities are also provided at each end of this channel. At the transmitting end there is a voice operated means for switching off the telegraph circuit and switching on the telephone circuit. Also responsive to this switching device there is a means for transmitting over the channel a convoy current in the form of an alternating current of a predetermined and definite frequency just beyond the voice frequency range. Means are provided at the transmitting end for delaying the voice currents until the convoy current has been transmitted for a period long enough to prevent the occurrence of certain annoying phenomena which will be described presently. At the receiving end, the normal arrangement is a path through a switching point thence through a band-pass filter tuned to the frequency of the alternating current telegraph signals to the telegraph receiving apparatus. There is also a branch circuit leading into a band-pass filter tuned to the frequency of the convoy current. When the convoy current is transmitted, it goes through this branch path and causes the operation of the switching means which thereupon cuts off the telegraph receiving circuit and switches on the telephone receiving circuit.

In the operation of circuits of this nature, certain annoying phenomena have been noted. First, there is the phenomenon known as "clipping." This manifests itself to the listener as the loss of a syllable or a small portion of a syllable at the beginning of each period of conversation. Another annoying phenomenon is known as "peeping," so called because it manifests itself to the listener as a short application of telegraph frequency signal at the beginning of each period of conversation.

Clipping is caused by the overlapping in time of the arrival of speech currents at the receiving switching point and the operation of the switching means thereat. Peeping is caused by the overlapping in time of the arrival of telegraph signal current at the receiving switching point and the operation of the switching means thereat. If this switching means is too late in operating clipping will result; if this relay is too early in operating peeping will result. In order to prevent the too late operatng of the switching means sufficient delay of speech currents somewhere between transmission and reception must be provided to overcome delay in the operation of this means caused by such factors as syllabic variation and the adverse effect of the mutable link on the convoy current after it has passed through delaying circuits such as band-pass filters. In order to prevent the too early operation of the receiving switching means, the exact time relation between the telegraph signal and the convoy current must be maintained from the point of transmission into the mutable link up to the receiving switching point. In other words, where a fading mutable link is the transmitting medium, all the delay must be at the transmitting end because any difference in delay in the different paths traversed by the currents going into the speech path on the one hand and the switching path on the other hand will upset the relation between telegraph signal current and convoy current. If there is any delay at the receiving end, such delay does not affect the operation of the switching means but does affect the timing of the telegraph signal, and hence the relative effective timing pattern is upset with the result that the switching may take place before the telegraph signal has ceased to flow to the switching point.

Heretofore various terms have been used to

designate that current which is used before or with the transmission of speech to effect the switching at the distant end. In the present case, since this current completely blankets the speech overlapping it at both the head and rear, it may appropriately be termed the convoy current. This is especially so since the relationship of convoy current and speech is maintained in its transmission over the mutable link and through the receiving circuit up to the point where these currents are separated.

The drawings consist of four sheets and contain nine figures.

Fig. 1 is a block diagram illustrating by general schematic the manner in which the present invention operates.

Fig. 2 is a fundamental circuit diagram illustrating prior art.

Fig. 3 is a fundamental circuit diagram illustrating the present invention.

Fig. 4 is a nest of graphs showing the form of varying strength signals at the transmission point.

Fig. 5 is a nest of graphs showing the form of varying strength signals at the receiving point, after they have passed through certain delaying networks, such as band-pass filters.

Fig. 6 is a pair of graphs illustrating the effect on the timing of certain relays caused by the use of band-pass filters.

Fig. 7 is a fundamental circuit diagram illustrating the invention in more detail than in Fig. 3 above.

Fig. 8 is a timing chart used to explain the action of the component parts of the invention, and

Fig. 9 is another chart illustrating the phenomena of clipping and peeping.

Fig. 1 is a general schematic of the system of the present invention. A speech path 1 leads to a hybrid coil 2 from which a path 3 for outgoing speech leads to a vogad 4. The outgoing speech then passes through a transmitting suppressor 5 and by means of an amplifier-detector 6 operates a chain of relays TM (transmitting master relay), TVHO (transmitting voice hangover relay) and other relays 7, herein labeled as "other relays of the transmitting 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 respects to the lower part of Fig. 1. The speech, therefore, enters antenna 14, passes through a radio receiver 15 including a detector and a vodas repeater 16 to a hybrid coil 17. That part of the circuit from radio transmitter 12 to radio receiver 15 is termed 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 impedance. From the hybrid coil 17 the speech goes into a 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 voice operated switching circuit 7 controls a convoy current enabler so that the source of current 24 is passed through the convoy current filter 25 to the hybrid coil 11 and thus acompanies 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 enable this circuit during the period that 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 convoy current coming in over antenna 14 passes through hybrid coil 17 and thence through a telegraph band elimination filter 28 into a convoy current amplifier and filter 29. This operates the receiving switching circuit 26, through a detector 45 and relays CTM (master relay) and RSS (receiving singing suppressor relay). The circuit represented by the rectangle 26 here labeled "other relays of the receiving switching circuit" performs several functions as follows: one, the receiving switching 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 convoy current 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 the speech path. In practice the receiving singing suppressor 19 is operated directly by the relay RSS which is part of the receiving switching circuit. This switching circuit 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 controls the receiving 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 over the antenna 13, the telegraph apparatus shown in the upper part of the figure is on 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 exercises control over the telegraph signal suppressor 39. A source of telegraph signal tone is supplied by the telegraph 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 a hybrid coil 11 and out over the radio transmitter 13.

At the distant end these telegraph signals in the form of spurts of alternating current are received over antenna 14 by the 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 a means for keeping the 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 distributors forming part of the same channel be kept in synchronism.

In Fig. 1 the amplified-detector 6 works into a relay TM, known as the transmitting master. This relay is shown in some detail in order to illustrate the action of the following relay TVHO. When the subscriber on line 1 begins to talk, speech currents through the amplifier-detector 6 operate the TM relay and close a circuit from ground through the armature and right contact of relay TM, resistance 46, resistance 47 to the winding of relay TVHO and thence to battery. A condenser 48 connected between resistances 46 and 47 comprises a hang-over circuit so that when speech ends and relay TM moves back to normal position, the charging of condenser 48 will maintain TVHO operated for a predetermined period. Relay TVHO therefore does not immediately release the other relays of the transmitting switching circuit but maintains them operated for a short period known as the hang-over period after speech has ended.

In the same manner and in the receiving circuit the master relay CTM is operated from the detector 45 and causes the operation of relay RSS through the resistances 49 and 50 and the condenser 51. Relay RSS is caused to be slow to release so that another hang-over period is provided at the receiving end to hold the other relays of the receiving switching circuit operated after the convoy current has ceased to operate the master relay CTM.

Going now to the fundamental circuit in Fig. 7, this will be related to the circuit in Fig. 1. 52 represents the telegraph sending apparatus in the upper part of Fig. 1. 53 represents a switching point for normally connecting the antenna 13 to the telegraph sender 52. In Fig. 1 this switching point comprises the action of the transmitting switching circuit 7 through the control circuit 27 and through that the control of the telegraph signal suppressor 39. The switching point 53 in its alternate position in Fig. 7 is designed to indicate connection to antenna 13 of the convoy current 24 and the delay 8. An arrowhead 54 indicates the control of the operation of the switching point 53 by the voice coming from the telephone transmitting point 55 through a rectangle 56, here labeled "syllabic variation." This fundamental circuit, therefore, indicates that when voice currents come from transmitter 55 they will operate the switching point 53 thereby cutting off the telegraph transmission and connecting instead the convoy current and the voice currents. Due to syllabic variation the operation of the switching point 53 is variable in its timing, and after the switching point 53 has been operated the voice is delayed by the acoustic delay 8 so that the convoy current can get out ahead of the speech in order to cause switching operations at the receiving end prior to the arrival of speech.

The channel from the transmitting antenna 13 to the receiving antenna 14 comprises a mutable link. The convoy current arriving at the antenna 14 passes through the band-pass filter 29 and operates a switching point designated 57 in Fig. 7. As shown in Fig. 1 this switching point consists of the control exercised over the line between the band-pass filter 31 and the telegrad 32 and operation of the receiving singing suppressor by the relays of the receiving switching circuit and the control exercised over the receiving singing suppressor 19 by the relays of the receiving switching circuit. The voice currents and telegraph signals, which fall within the voice current range, go over the lower branch to the switching point 57. With no convoy current present the circuit is closed through the band-pass filter 31 to the telegraph receiver here designated 58. When the convoy current is flowing then the switching point 57 is operated to its alternate contact and closes a path to the telephone receiving apparatus 59.

With the aid of this fundamental circuit diagram it is believed that the further explanation will be somewhat easier to follow.

Fig. 2 shows a fundamental circuit diagram illustrating the arrangement found, for instance, in the Cole-Melhose patent.

In this case speech passes from the transmitting point 55 to the receiving point 59 through two units of delay, one designated 60 in the transmitting end of the circuit and the other designated 61 in the receiving end of the circuit. Prior art teachings have been to the effect that in order to prevent clipping a sufficient amount of delay must be placed in the speech path so that the control tone will always be able to close the speech path before the speech arrives at the point controlled by such control tone. Heretofore, it was believed and found practical to have this delay at any point in the circuit, either all at one end or the other or divided, part at the transmitting end and part at the receiving end. In the Cole-Melhose patent the delay is shown part at the transmitting terminal and part at the receiving terminal. Experience has shown, however, that as the mutable link introduces greater variations, such an arrangement is not wholly satisfactory. Experience shows that as a system of this nature is extended, the action of the mutable link becomes a greater factor than might have been otherwise expected.

Since the various currents at the same time flow in different circuits they encounter different delay factors. Speech, for instance, starting with a syllable containing a great amount of energy will cause faster operation of the TVHO than will speech starting with a syllable having a small amount of energy. This phenomenon is well known and need not further be described. Speech in the present circuit, therefore, is subject to delay but by its own character introduces a delay known as syllabic variation into the operation of both the telegraph and convoy current circuits. At the distant end the band-pass filter through which the convoy current and through which the telegraph currents must flow causes delay under the influence of the mutable link. Due to these various delays, then, the system of Fig. 3 has been devised. In this case, two units of delay 60 and 61 are placed at the transmitting end with the result that speech between

transmitter 55 and receiver 59 is delayed by the same amount as in the system of Fig. 2 but the delay being all at the transmitting end, avoids the phenomenon known as peeping. It is necessary to have the two units of delay to prevent clipping but these two units must be at the transmitting end to also prevent peeping.

Fig. 4 is a nest of graphs showing the envelope of keyed signals, that is, a weak, a medium and a strong signal as plotted between amplitude and time at the point of transmission. In Fig. 5, these same signals, that is, the weak, the medium and the strong are shown at the output of the band-pass filter. This change in form is characteristic and well known. The effect of these is shown in the graphs in Fig. 6 where two curves are shown plotted between time which it takes to operate a relay, such as the relay RSS against the energy reaching that relay over the mutable link. Given a strong signal, one which might come over the mutable link with very little attenuation, the operate time between the lower curve and the upper curve shows little difference, but, where the signal is weakened by attenuation, the difference of time that it takes the receiving singing suppressor to respond becomes very marked. Thus, with the mutable link introducing variations in the strength of signals arriving at the receiving end and operating the receiving singing suppressor relay, the response in this relay will be variable and in accordance with the action of the mutable link.

With this short explanation then the timing scheme of Fig. 1, Fig. 7 and fundamentally of Fig. 3 may be explained by the aid of Fig. 8. This figure consists of a number of horizontal lines each representing the duration in time of a certain factor. Lines A to I, inclusive, represent factors at the transmitting end and lines J to S, inclusive, represent factors at the receiving end. Starting from a given point represented by the vertical line T as the beginning, this timing operation line A represents an interval of speech transmission. This may be a syllable or a number of syllables put together to form a sentence. Lines B and C represent the action of the voice operated switching circuit and particularly the action of a relay therein, known as the transmitting voice hang-over relay TVHO. The amount of time by which these lines extend beyond the limit of the speech transmission A is known as the transmitting hang-over and is determined by the condenser 48. Line B represents the most favorable action of this relay, that is, when speech starts with a syllable having a high energy level. It will be seen that even under the most favorable condition this TVHO relay is delayed very slightly in operating after the speech A has started. The line C represents the most unfavorable action of this relay, that is, when speech starts with a syllable having a low energy level. The difference between the action of this relay under these two conditions is known as syllabic variation.

Lines D and E represent the telegraph signals as they are stopped by the action of the transmitting voice hang-over relay. The line D corresponds to the line B and the line E corresponds to the line C, therefore the difference between lines D and E is also known as syllabic variation. Lines F and G represent the transmission of convoy current through the action of transmitting voice hang-over relay. Lines F and G correspond to lines B and C, respectively, and again we have an example of syllabic variation. It should be noted that the telegraph signal is cut off at the instant that the convoy current starts.

Lines H and I represent the speech transmission as it appears at the radio transmitter. Under condition H the speech has been delayed one unit of time at the transmitting end as represented by the fundamental circuit, Fig. 2. Under condition I the speech has been delayed two units of time at the transmitting end as represented by the fundamental circuit, Fig. 3.

The four lines J, K, L and M represent the action of the receiving switching relays at the distant end of the channel and particularly the action of the receiving singing suppressor relay RSS. Lines J and K show the extreme operating conditions of the receiving singing suppressor relay under conditions explained in Fig. 6 and these lines correspond to line F showing the most favorable transmission of convoy current under syllabic variation. Lines L and M show extreme operating conditions of the receiving singing suppressor relay corresponding to line G the most unfavorable transmission of convoy current under syllabic variation.

The amount of time by which these lines extend beyond the lines F and G is known as the receiving hang-over and is controlled by delay circuit comprising the resistances 49 and 50 and the condenser 51.

Lines N and O represent the speech as delivered to the final receiving circuit. Lines N and O correspond to H and I, respectively, and in this connection it will be noted that they both occupy the same final position in time. However, lines H and I represent the position in time of the voice under these different conditions as they are transmitted over the mutable link and as they appear in the first hybrid coil at the receiving end.

Lines P, Q, R and S represent the ending of telegraph signal tone at the receiving end, P and Q in the case where there is no delay at the receiving end, as in the fundamental circuit, Fig. 3; and R and S in the case where there is delay in that point as in fundamental circuit, Fig. 2. Lines P and R correspond to line D at the transmitting end and lines Q and S correspond to line E. The reason for the extension of lines R and S well within the time of line A is the fact that the telegraph tone is within the voice range and hence it is delayed in reaching the receiving singing suppressor in the same manner as the voice is delayed.

Now by the amount that line R overlaps line J and line L or the amount that line S overlaps line K or line M the telegraph tone will be heard by the subscriber beyond the receiving singing suppressor because this apparatus is enabled by that much time before the telegraph signal tone has been cut off. This relation is shown graphically by a regrouping of the pertinent time indications with areas shaded by vertical lines. Such shaded areas represent "peeps."

By the present invention this annoying phenomenon is avoided as shown graphically in the regrouping of lines P and Q and lines J, K, L and M. Here there is no overlapping, in other words, the telegraph signal has always ended before the receiving singing suppressor has been enabled and hence there is no peeping.

Fig. 9 is in the nature of a résumé and is shown graphically by lines representing time indications in the same manner as in Fig. 8. In the first grouping marked normal it is noted that the convoy current starts or causes the operation of

relay RSS in between the ending of the telegraph signal and the starting of speech. This is the normal condition and the one to be desired. In the second case, marked "clipping," the convoy current or the operation of the relay RSS does not start until after speech has started. Since the listener cannot receive any speech until the RSS relay has operated then part of the speech has been clipped and this grouping of lines graphically illustrates the phenomenon of clipping. The third and last grouping of lines represents "peeping." Here with delay in that branch of the voice current circuit between antenna 14 and the switching point 57 (Fig. 7) the telegraph and speech have been delayed and hence the convoy current has operated the relay RSS before the ending of the telegraph, consequently the listener hears a very short interval of telegraph tone and this phenomenon is known as peeping.

What is claimed is:

1. In a communication system, a channel including a mutable link, means for transmitting voice currents over said channel, means for transmitting telegraph signals over said channel, means for switching said channel between voice terminal circuits and telegraph terminal circuits, voice operated means at the transmitting end of said channel for transmitting a convoy current over said channel for operating said switching means and delay circuits at said transmitting end for timing said convoy current to precede and trail said voice currents over said mutable link and the receiving end of said channel, the period of time by which said convoy current precedes and trails said voice currents being predetermined to overcome the maximum changed relationship between said convoy current and said voice currents created under extreme conditions in said mutable link whereby switching from telegraph terminal circuit conditions to voice terminal circuit conditions before telegraph transmission in the receiving end of said channel has ceased is prevented.

2. In a communication system, a channel including a mutable link, means for transmitting voice currents over said channel, means for transmitting telegraph signals over said channel, means for switching said channel between voice transmitting circuits and telegraph transmitting circuits, voice operated means at the transmitting end of said channel for transmitting a convoy current over said channel for operating said switching means, delay circuits for changing the relationship in time between said voice currents and said accompanying convoy current whereby said convoy current is made to overlap said voice currents upon transmission into said mutable link, means in the receiving end of said channel for separating said convoy current and said voice currents, means in that part of the receiving end of said channel into which said convoy current is diverted responsive to variations in said mutable link rendering the operation of said switching means at the receiving end of said channel variable in time, and means in said receiving circuit for maintaining the relation in time between said convoy current and said voice currents after they have been separated.

3. In a communication system, a channel including a mutable link, transmitting apparatus at one end of said channel and receiving apparatus at the other end of said channel, said transmitting apparatus comprising means for transmitting over said mutable link voice frequency alternating current telegraph signals, voice current responsive means for disabling said telegraph means, and for transmitting over said mutable link a convoy current, said receiving apparatus comprising means responsive to voice frequency alternating current telegraph signals, means for diverting voice currents and said convoy current into different paths, means responsive to said convoy current for switching said receiving apparatus from said telegraph means to voice current circuits, and means comprising voice current delay means at the transmitting end only for adjusting the time relation between the operation of said switching means and the arrival of telegraph signals and voice currents at the switching point in said receiving apparatus whereby overlapping in time of the operation of said switching means and the presence of either telegraph signals or voice currents is prevented.

4. In a communication system, a channel including a mutable link, voice frequency alternating current telegraph signal and telephone transmitting circuits at one end of said channel, telegraph and telephone receiving circuits at the other end of said channel, switching means responsive to voice current control at the transmitting end for switching the transmitting end of said channel from a normal condition in which said telegraph circuits are effective to a condition in which said telephone circuits are effective, means responsive to said switching means for transmitting a convoy current to the receiving end of said channel and means thereat responsive to said convoy current for switching the receiving end of said channel from a normal condition in which said telegraph circuits are effective to a condition in which said telephone circuits are effective, and means including acoustic delay circuits at the transmitting end only of said channel for insuring the operation of said switching means at the transmitting end of said channel after the arrival of voice frequency alternating current telegraph signals at the said receiving end switching point has ceased and before the arrival of voice currents at said point has begun.

5. In a communication system, a channel, means at the transmitting end of said channel (1) for transmitting voice frequency alternating current telegraph signals over said channel, (2) for transmitting voice currents over said channel, (3) responsive to voice currents for rendering said telegraph means ineffective and said telephone means effective, (4) for delaying said voice currents so that there will be a predetermined time interval between the ending of telegraph transmission and the start of telephone transmission, (5) responsive to voice currents for transmitting a convoy current over said channel starting at the ending of telegraph transmission and ending a predetermined time after the ending of telephone transmission, and means at the receiving end of said channel (1) responsive to said telegraph transmission, (2) responsive to said telephone transmission, (3) responsive to said convoy current for switching said channel from said first to said second means, (4) for separating said convoy current from said voice currents, and (5) a voice current path from said point of separation free of voice current delaying means.

6. In a communication system, a channel including a mutable link, means at the transmitting end of said channel (1) for transmitting voice frequency alternating current telegraph signals (2) for transmitting voice currents,

(3) responsive to voice currents for transmitting a convoy current with said voice currents (4) for switching from transmission of telegraph signals to transmission of convoy current and voice currents (5) for delaying voice currents (6) responsive to syllabic variation for delaying the operation of said switching means, and means at the receiving end of said channel (1) responsive to said telegraph signals (2) responsive to voice currents (3) responsive to said convoy current for switching from said telegraph receiving means to said telephone receiving means (4) comprising band-pass filters in the path of said convoy current for variably delaying the action of said third means under the influence of said mutable link (5) comprising band-pass filters in the path of said telegraph signals beyond said switching point, and (6) comprising a path for voice currents and for telegraph signal currents free of delay up to said switching point.

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