

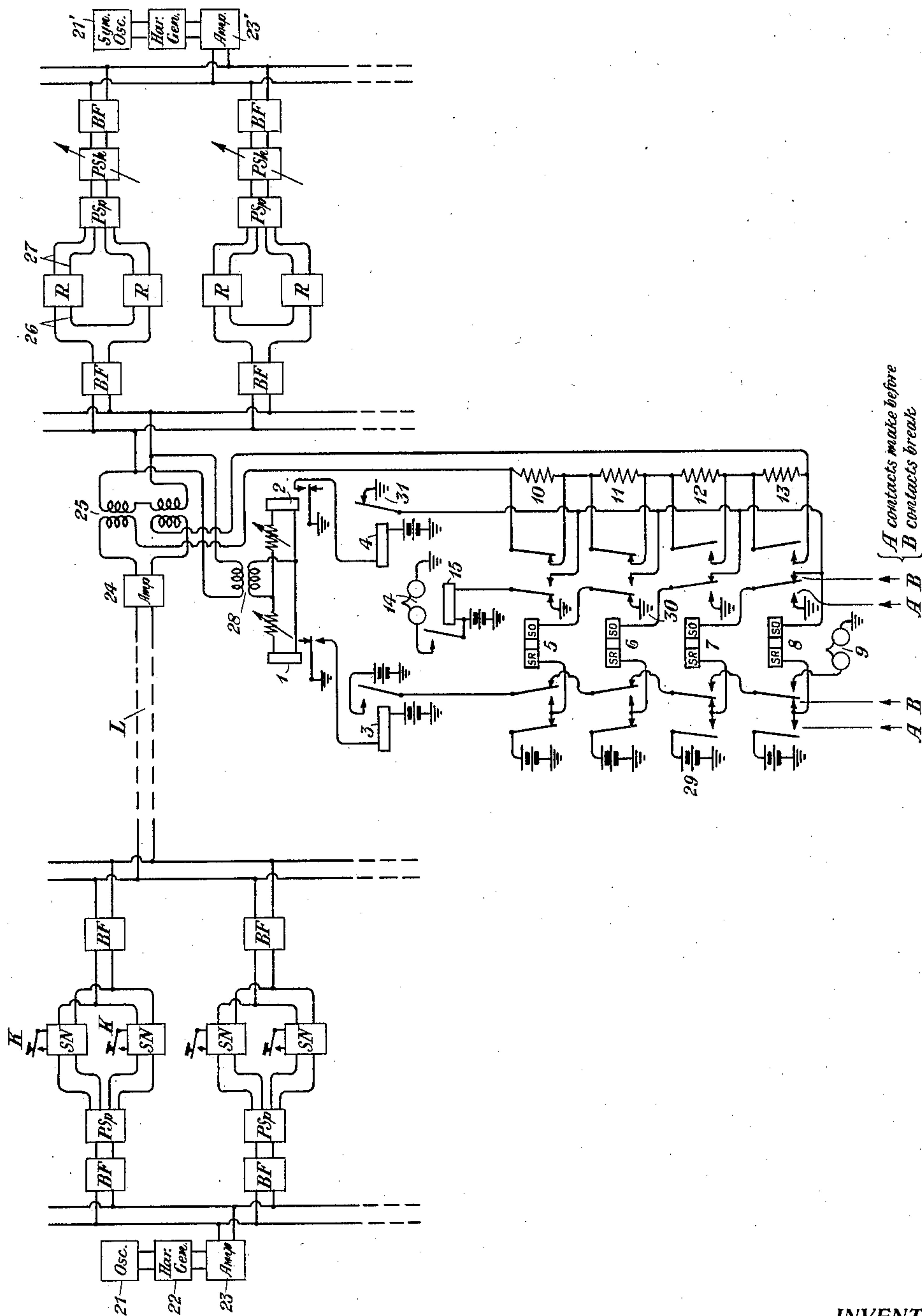
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L. C. ROBERTS

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ATTENUATION COMPENSATOR

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BY

INVENTOR
L. C. Roberts
gertor
ATTORNEY

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LELAND C. ROBERTS, OF WEST ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

ATTENUATION COMPENSATOR.

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It is an object of my invention to provide a method and corresponding apparatus for regulation of the transmission level in a signaling system. Another object of my invention is to provide for automatic adjustment to compensate changes of transmission in a multiplex phase discrimination telegraph system operating in the voice frequency range. Another object of my invention is to provide suitable average compensation for energy level changes in all the channels of a multiplex signaling system. These objects and various other objects of my invention will become apparent on consideration of a specific example of practice in accordance with the invention which I have chosen for disclosure in the following specification. It will be understood that the following description relates more particularly to this example of my invention and that the invention will be defined in the appended claims.

The drawing is a diagram showing a multiplex phase discrimination telegraph system with apparatus for automatically compensating changes in the energy level.

Alternating current of a certain fundamental frequency is generated by the oscillator 21 at the sending station at the left. The output from this oscillator goes to a harmonic generator 22 which delivers to the amplifier 23 a composite current comprising the said fundamental and its odd harmonics. The output from the amplifier 23 consists of these harmonics, which are separated by respective band filters BF, so that current of a single harmonic frequency will be found in the output of each such filter. Such a simple current from any one of these band filters goes to a corresponding phase splitter PS_p. This decomposes the current into two components 90° apart in phase which are sent respectively to the sending networks SN, each controlled by a key K. The effect of closure of the key K is to reverse the phase of the corresponding output current from the associated sending network SN; that is, the signal changes from spacing to marking or from marking to spacing are effected by phase reversal of the corresponding output currents from the sending networks SN. These output currents are superposed for the two phases of the same frequency and put through a corresponding band filter BF and with the similar currents of other frequencies put on the line L.

This line may be of any convenient kind, or it may be exemplified in a span of radio transmission. For a specific example, it may be a loaded line forming one circuit or conductor pair in a cable.

At the receiving station the composite received current goes through an amplifier 24 and a repeating coil 25 to the band filters BF which separate the components of various frequencies corresponding to the components considered at the sending end. The output from each band filter goes by conductors such as 26 to both of two receiving networks R.

The oscillator 21' at the receiving end is operated in exact synchronism with the oscillator 21 at the sending end. Means for insuring such synchronism are not shown, but how to provide them is well known in the art. The fundamental output current from the oscillator 21' goes to a harmonic generator which delivers a composite current through the amplifier 23' to the inputs of a set of band filters BF in multiple. Each one of these band filters passes a harmonic frequency corresponding to the frequency passed by the corresponding band filter BF for the current received from the line.

The output from each band filter for the locally generated current component goes through an adjustable phase shifter PS_h and thence to a phase splitter PS_p from which the two component currents 90° apart in phase are conducted respectively to the two receiving networks R, previously mentioned.

The current from the line to the receiving network R via the conductors 26 will be either in phase or in phase opposition with the current to the same receiving network via the conductors 27. The receiving network R indicates a "mark" when these two currents are in phase and a "space" when they are in phase opposition.

It will be seen that the total volume of current on the line is not affected by the signaling changes in this system. Any signaling change, effected by the operation of a key K at the sending end, will merely reverse the phase of some current component on the line without changing the magnitude of that current. Accordingly, it becomes practicable in this system to regulate the transmission level by the integral current on the line, and it is not necessary to transmit a current over a special "channel" unaffected by sig-

naling changes for the regulation of the transmission level. Moreover, even if regulation were made by means of the current on a special channel, this regulation might be somewhat imperfect for other channels corresponding to widely different frequencies. In the system here disclosed all the channels contribute to determine the regulation of the transmission level, as will now be shown; this gives an average regulation over the whole transmitting range.

It will be noticed that the output circuit from the amplifier 24 comprises the primary winding of the repeating coil 25 and in series therewith an adjustable impedance device with steps 10, 11, 12 and 13, each adapted to be included or shunted by the corresponding opening or closing of relay contacts, as shown.

Bridged across the secondary circuit of the repeating coil 25 is the primary of another repeating coil 28 whose secondary leads to two alternating current relays in multiple 1 and 2, each with an adjustable resistance in series therewith. These relays constitute a voltmeter relay.

These resistances are adjusted so that the armature of relay 1 will be operated, but the armature of relay 2 will be non-operated when the current is of suitable desired intensity. If the intensity of the current decreases a little, the armature of relay 1 will drop back, but if the current intensity increases a little, the armature of relay 2 will pick up. These armatures control the relays shown in the lower part of the drawing, which control the shunts around the potentiometer steps 10, 11, 12 and 13. Certain of the relays are slow-operating, as indicated by the symbol SO, and certain of the relays are slow-releasing, as indicated by the symbol SR. The contacts in the columns marked "A" make before the contacts in the columns marked "B" release. With the foregoing explanation and with the drawing, I may proceed at once to describe the operation of the system, as shown.

By previous operation of the relays, the impedance device is assumed to have been adjusted, so that steps 10 and 11 are cut out but 12 and 13 are cut in. Suppose, now, that the intensity on the line falls off slightly. The armature of relay 1 will release and close the circuit of relay 3, which, in turn, will close a circuit that may readily be traced through relay 7 to ground 31. Relay 7 will accordingly attract its armatures and close a locking circuit from battery 29 and open its initial circuit as energized from the armature of relay 3. Relay 7 will also prepare a new circuit from the armature of relay 3 through relay 8, and it will also shunt the step 12 of the potentiometer.

Cutting out step 12 will increase the current intensity in the relays 1 and 2, and relay 1 will pick up its armature which it dropped

shortly before. This will ordinarily happen promptly, so that relay 3 will release before relay 8 becomes energized over its newly established circuit.

If there should be further decrease of intensity on the line, relay 8 would be operated in the same way as described for relay 7 and, after that, if the intensity should fall enough so as again to cause the relay 1 to drop its armature, the effect would be to close at relay 3 a circuit through the alarm bell 9, thus calling the attention of an attendant to this extreme condition of affairs.

Supposing that with the apparatus in the condition shown in the drawing, the intensity should increase on the line, then the relay 2 would pick up its armature and energize the relay 4, which would open the holding or locking circuit shown in the drawing in effect for the relay 6. The deenergization of the relay 6 would open the shunt around step 11, thus cutting down the current to the relay 2 which would then drop its armature. Also the deenergization of relay 6 would change the circuits so as to put relay 6 in the same relation to relays 1 and 3 as the drawing shows for the relay 7. Another effect of the deenergization of relay 6 would be to change the connection for the holding circuit for relay 5 from the ground at 30 to the ground at 31. Similarly to the deenergization of relay 6, another increase of current on the line may cause the deenergization of relay 5, and still another such increase of current will open the circuit for the relay 15 and cause the ringing of the bell 14.

The regulator shown in the drawing may be introduced at any point on the line L where it may be desirable to adjust for changes of energy level. It may be conveniently placed at any repeater station on the output side of an amplifier element thereof.

I claim:

1. In combination, a signal transmitting line, means at the sending end to apply thereto an alternating current, means at the sending end to signal by phase reversal of said current, whereby the intensity of the current will be substantially unchanged by the character of the signals, an impedance adjusting device associated with the line at the receiving end, and means at the receiving end responsive to departure of the received current from normal intensity to operate said impedance adjusting device.

2. In combination, a signal transmitting line, means at the sending end to apply thereto a plurality of alternating currents of different frequencies, means at the sending end to signal on each such current by phase reversal of the current at the respective frequency, whereby the intensity of the current will be substantially unaffected by the signaling, means at the receiving end to separate the

currents of the respective frequencies and detect the signals thereon, an adjustable gain or loss device at the receiving end, and means responsive to departure of the received current from normal intensity to operate said gain or loss device, said gain or loss device being associated with said line to affect the currents therein before the said separation into separate channels.

3. In combination, a signal transmitting line, means at the sending end to apply thereto an alternating current, means at the sending end to signal thereon by phase reversal, whereby the current intensity is substantially unaffected by the signaling, a repeating coil interposed in said line at the receiving end, relays across said line on the output side of said coil, and an adjustable resistance system in series in said line on the input side of said coil, said relays being connected to control

said system, and means to receive the signals on said current at the receiving end.

4. The method of multiplex signaling over a transmission line, which consists in superposing alternating currents of various frequencies on the line and reversing their phase to produce signals, respectively, whereby the volume of current on the line is not affected by the signals, and, at the receiving end, testing the composite signaling current for its intensity, introducing a loss or gain accordingly to counteract the departure of intensity from a proper normal value, separating the currents of different frequencies into respective channels at the receiving end, and detecting the signals in the respective channels.

In testimony whereof, I have signed my name to this specification this 22nd day of March, 1926.

LELAND C. ROBERTS.