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LEVEL COMPENSATOR FOR TELEGRAPH SYSTEMS

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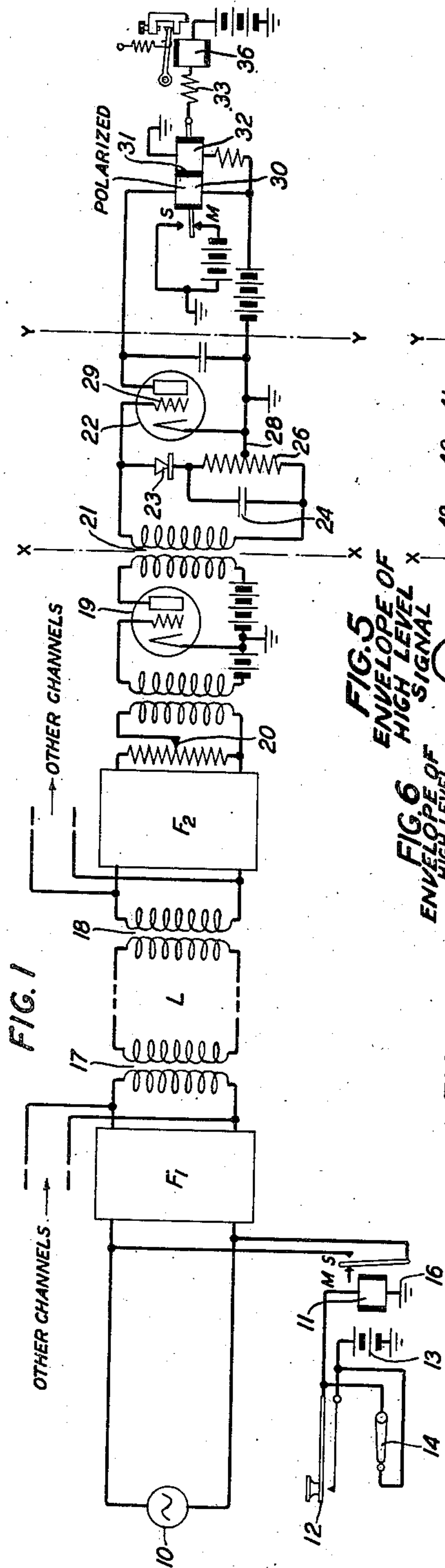


FIG. 2

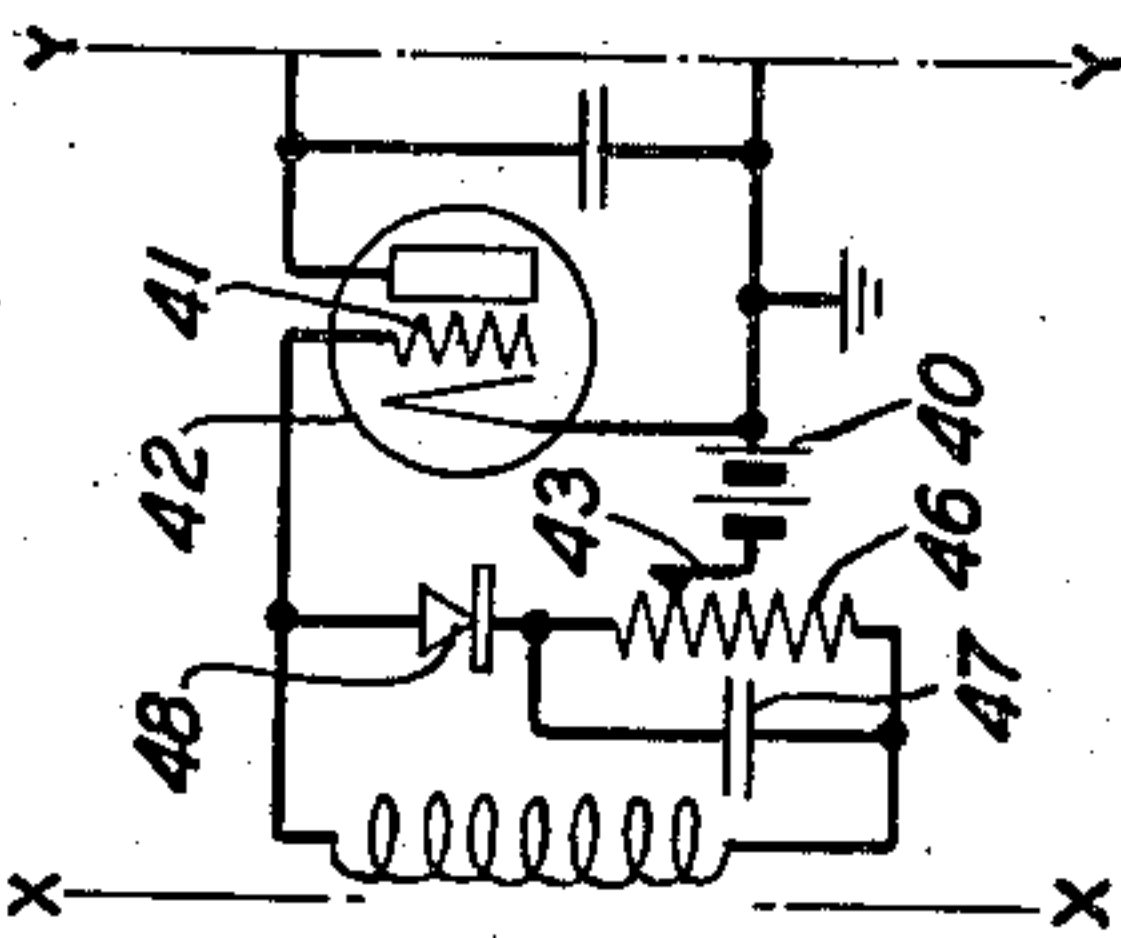


FIG. 5
ENVELOPE OF
HIGH LEVEL
SIGNAL

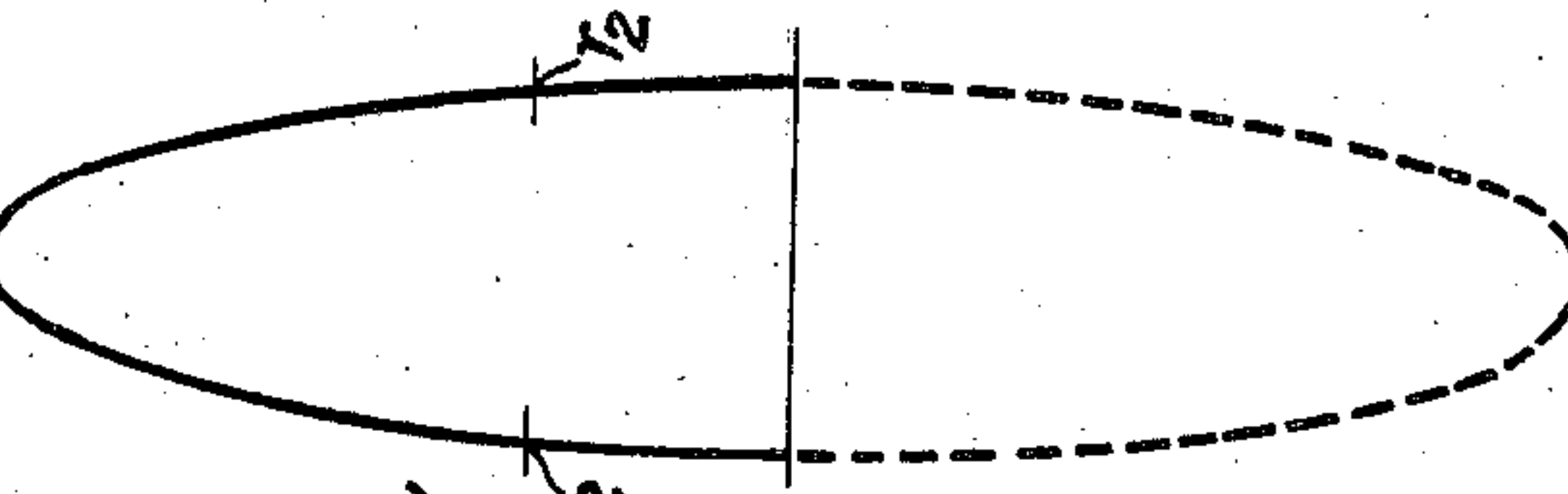


FIG. 6
ENVELOPE OF
HIGH LEVEL
SIGNAL

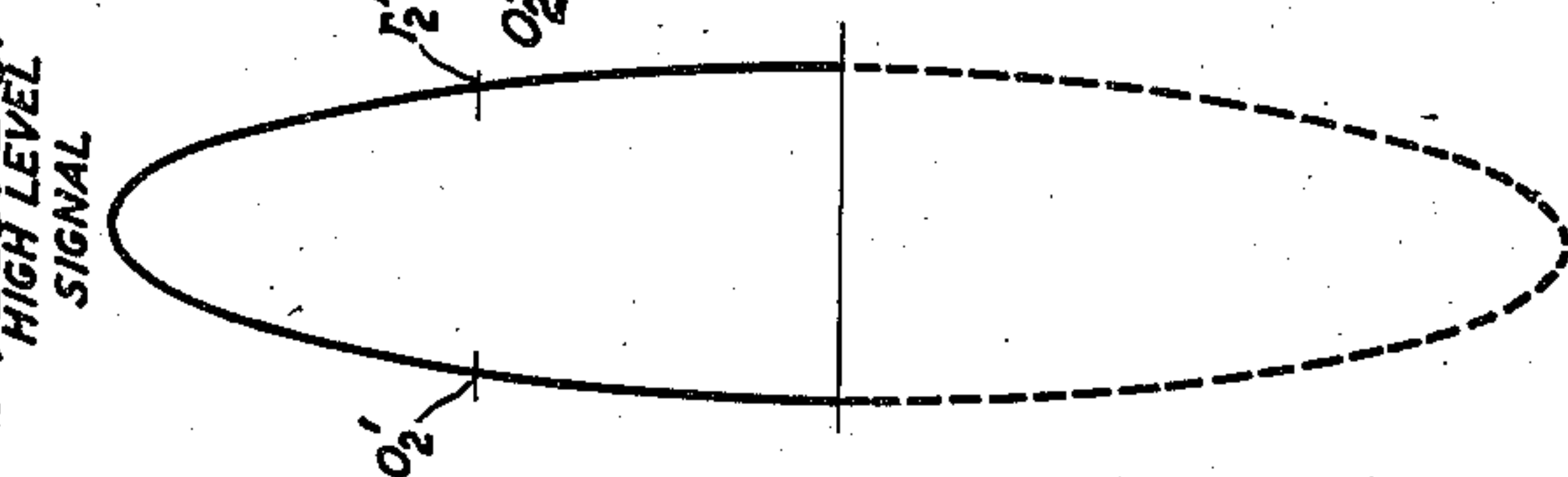
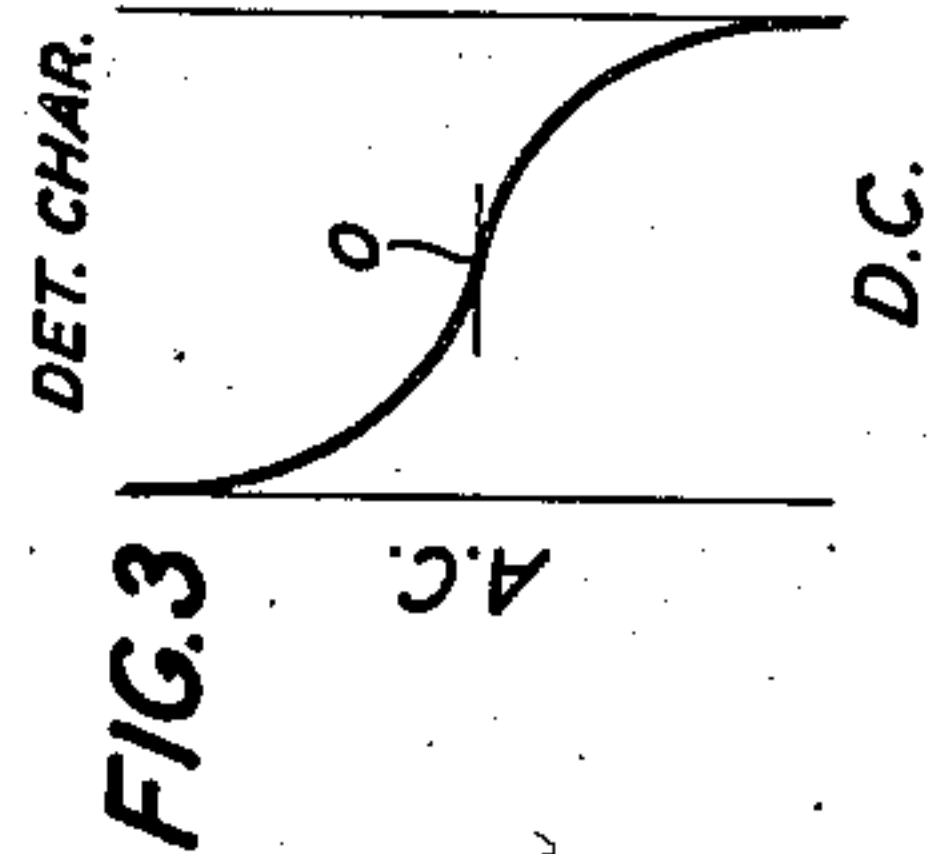
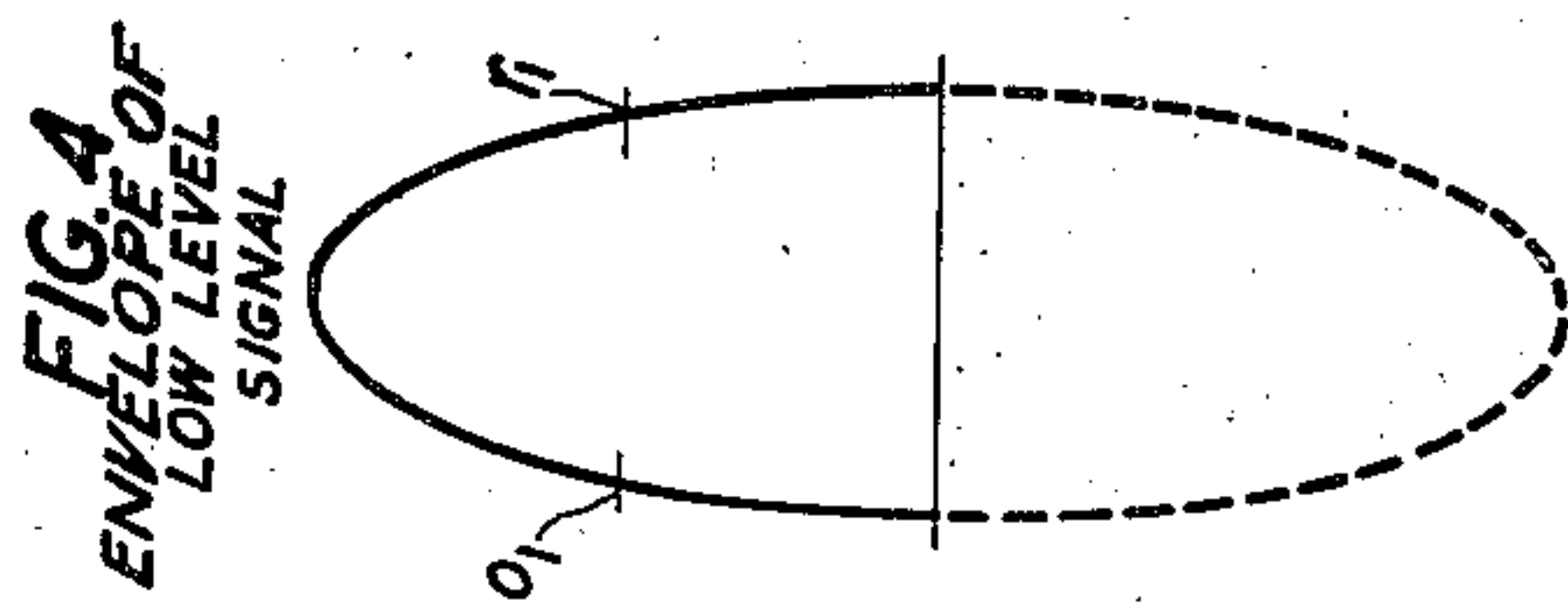


FIG. 4
ENVELOPE OF
LOW LEVEL
SIGNAL



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LEVEL COMPENSATOR FOR TELEGRAPH SYSTEMS

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4 Claims. (Cl. 178—88)

This invention relates to a telegraph system and particularly to a level compensator for use with a telegraph system.

An object of the invention is the improvement of telegraph signal transmission.

A more specific object of the invention is the prevention of the type of distortion commonly known as "telegraph bias," particularly when due to line attenuation changes.

It has previously been recognized in connection with the operation of telegraph systems, particularly telegraph systems utilizing vacuum tube detectors, that, even though marking (current) and spacing (no current) signals of equal duration be impressed on the line at the sending end, these marking and spacing signals at the receiving end will be found to be of unequal duration and will change from time to time. This form of distortion is commonly known as "telegraph bias" and results primarily from variations in the level of the received signals due to line attenuation changes.

In accordance with a feature of the present invention, the grid bias applied to the vacuum tube detector is varied in accordance with the level of the received signals in such a manner that "telegraph bias" is substantially eliminated.

In accordance with a specific embodiment of the invention, a network comprising a condenser and a resistance in parallel is connected across the input circuit of the detector, a rectifier being connected in series with the network. The received signals are rectified and the condenser is charged until the potential across it is equal to, or substantially equal to, the alternating-current peak voltage of the signal. As a cathode lead is connected to the mid-point of the resistance, one-half of the charge is effective to bias the grid of the detector.

In accordance with a further embodiment of the invention, a battery is included in the circuit and is effective to supply a constant biasing voltage to the detector supplementing the variable bias supplied by the condenser. In this instance, the cathode connection to the resistance is adjustable.

A full understanding of the operation of the arrangement contemplated by the invention and appreciation of the various advantageous features thereof will be gained from consideration of the following description in connection with the drawing in which:

Figure 1 shows a carrier frequency telegraph system including one embodiment of the invention;

Fig. 2 shows a modification of the detector tube circuit shown in Fig. 1;

Fig. 3 is a characteristic curve of the detector;

Fig. 4 is a curve representing the envelope of a low level signal;

Fig. 5 is a curve representing the envelope of a high level signal as received by systems not embodying the arrangement of the present invention; and

Fig. 6 is a curve representing the envelope of a high level signal as received by a system embodying the arrangement of the present invention.

Referring now to Fig. 1, a carrier frequency telegraph system is shown in a partially schematic manner. Oscillator 10 is shown connected across one channel at the sending station and supplies oscillations of a predetermined frequency thereto. Other channels may be provided as shown. In order periodically to interrupt and reestablish the train of oscillations over the channel, i. e., to produce the mark (current) and space (no current) signals, means for shorting the output of the oscillator is provided at the subscriber's station. This short-circuiting path is controlled through the contacts of relay 11, the operating circuit for which is controlled by key 12. When key 12 is closed to transmit a mark signal, a circuit is completed from battery 13, contacts of key 12, winding of relay 11, to ground 16, relay 11 operates and the short-circuiting path is open at contact M. However, when key 12 is opened to transmit a space signal, the armature of relay 11 drops back and a path is completed at contact S which shorts the output of oscillator 10 and a "no current" interval results. Switch 14 is provided at the substation and may be used for closing the line when the key is not being used.

Each channel is preferably provided with suitable filters, such as F_1 , and F_2 , which are effective to maintain proper separation between the various channels. As shown, the channels may be associated with line L through transformer 17 at the sending end and through transformer 18 at the receiving end. In the instance of the channel illustrated, the received signals passed by filter F_2 are impressed on the input circuit of amplifier 19, their intensity first being regulated as desired by potentiometer 20. The amplified signals then are transmitted through transformer 21 and impressed on the input circuit of detector tube 22. As shown, the input circuit includes a rectifier 23 in series with condenser 24 which is in parallel with resistance 26.

Due to the action of rectifier 23, the received

signals are rectified and when a signal is being received, a direct-current charge is transferred to condenser 24 such that the resulting potential across the condenser, and the drop across resistance 26 due to the charge leaking off through the resistance, are equal to, or substantially equal to, the alternating-current peak voltage of the signal. The charge on condenser 24 and the drop across resistance 26 varies, therefore, in accordance with the level of the received signals. Now as cathode lead 28 is connected to the mid-point of resistance 26, one-half of this varying potential will be impressed on grid 29 of the detector.

The output of detector 22 is connected in accordance with conventional telegraph practice to operating winding 30 of polarized relay 31, the relay being provided also with biasing winding 32.

Relay 31 operates in the usual manner to transmit impulses into the subscriber's loop, represented by resistance 33, which impulses are effective to operate sounder 36 in the usual manner.

Referring now for a moment to Fig. 3, the detector characteristic curve shown has been arrived at by plotting alternating-current input against direct-current output of detector 22. By proper adjustment of biasing winding 32, relay 31 is adjusted to operate at point O of the curve, i. e., the mid-point of the curve. That is, when the alternating-current input to the detector has a value corresponding to point O, the direct-current output is just sufficient to operate the relay. Now, obviously, if this operate point corresponds to substantially the same fraction of the total height of the envelope of the received signals for waves of different amplitudes, the bias of the telegraph signals delivered by relay 31 will be the same for waves of any amplitude.

By reference now to Figs. 4, 5 and 6, it will be clear that the particular method of varying the detector grid bias invented by applicant and described above does, as a matter of fact, assure the above relationship of the relay operate point to the envelopes of waves of different amplitudes.

Referring first to Fig. 4, the envelope of a typical low level dot signal is represented, the operate and release values of relay 31 being at points O_1 and r_1 , respectively. As transmitted a carrier telegraph dot signal consists of a number of oscillations of equal amplitude. The envelope of the signal as transmitted is, therefore, substantially rectangular in shape. Due to the characteristics of the line and associated apparatus, including the filters and vacuum tubes, the oscillations of the same signal, as received, do not start and stop abruptly but build up and die down rather slowly. The amplitudes of all the oscillations are not the same therefore and the envelope of the received dot signal does not have the straight sides of the sent-signal envelope but is curved as illustrated by Fig. 4. The vertical scale of Fig. 4 is the same as that of Fig. 3 so it is evident that when the received oscillations build up to the amplitude o_1 the telegraph relay will operate and will remain operated until the oscillations of the received signal die down to amplitude r_1 . The operate time of the relay, therefore, for the received dot signal is represented by the horizontal distance between points o_1 and r_1 of the signal envelope.

If conditions change so that the level of the received signal is increased materially, the envelope of the higher level signal may be as illustrated by Figs. 5 and 6. Without the arrange-

ment of the present invention the position of the high level signal with regard to the curve of Fig. 3 would be as shown by Fig. 5, the operate and release points of the relay being indicated respectively by o_2 and r_2 . (The vertical scale of Fig. 5 is the same as that of Figs. 3 and 4.) Since the operate and release points, o_2 and r_2 are relatively nearer the base of the curve than are corresponding points o_1 and r_1 of Fig. 4, the horizontal distance between points o_2 and r_2 is, of course, greater than the horizontal distance between points o_1 and r_1 . From this it follows that, without the arrangement of the present invention, the operate time of the relay on the high level signal would be longer than that of the low level signal; this is of course highly undesirable as it is necessary if distortion is to be avoided that the operate periods of the telegraph relay be of equal duration regardless of signal level.

With the level compensating arrangement of the present invention operative, however, the signal is superposed on the detector characteristic in different relationship, the relationship of the signal envelope to the detector characteristic under these conditions being as illustrated by Fig. 6. (The vertical scale of Fig. 6 is the same as that of Figs. 3, 4 and 5.) As described above, the increased signal amplitude results in a proportionate increase in the direct-current potential across condenser 24, one-half of this increased potential being added to the biasing potential of grid 29. This means, of course, that the received alternating-current signal is superposed on a larger negative direct-current potential so that the base of the signal envelope curve is lowered the same amount that the tip of the envelope is raised. The operate and release points, o_2' and r_2' now fall at the same relative points on the signal envelope as in the instance of Fig. 4; the horizontal distance between points o_2' and r_2' is the same as the horizontal distance between points o_1 and r_1 from which it follows that, with the arrangement of the present invention, the operate time of the telegraph relay is the same for the high level signal as for the low level signal. The signal is unaltered in length, therefore, despite the change in level, and distortion is avoided.

Referring now to Fig. 2, a modification of a part of the detector tube circuit is shown. In this instance a battery 40 has been added to the circuit which supplies a constant bias to grid 41 of detector 42 which supplements the varying bias supplied through the variable connection of cathode lead 43 to resistance 46. A condenser 47 and rectifier 48 are provided as heretofore, the arrangement functioning the same generally as the corresponding part of the system illustrated in Fig. 1. The potential of battery 40 preferably is of such a value as will permit, in the absence of any signal, a flow of space current through winding 30 of relay 31 (Fig. 1) that is not quite sufficient to operate the relay. The use of this arrangement results in a more accurate compensation by the self-adjusting bias for the changing level of received signals so that the arrangement functions effectively over a wider range of variations. It has been found desirable in the use of this arrangement to provide an adjustable connection of cathode lead 43 to resistance 46 in order that slight adjustments may be made if necessary to remove the small amount of negative bias which may be present in the received signals.

In order that the arrangement described above may operate with greatest efficiency there are

certain relationships between the various elements included between the input transformer and the detector associated therewith which it is desirable to maintain. For example, the impedance of the network bridged across the input of the detector consisting (in the instance of the circuit illustrated in Fig. 1) of rectifier 23, resistance 26 and condenser 24, preferably should be materially lower during the conducting cycle of the rectifier than the input impedance of the detector at any time. This relationship is desirable in order to prevent grid rectification from materially affecting the grid bias. On the other hand, the impedance of the bridged network should be materially higher than the impedance which is seen through transformer 21 in order to prevent any objectionable distortion of the voltage wave applied to the detector grid. Further, it is desirable that the time constant of resistance 26 and condenser 24 be greater than the duration of the longer spacing signals of the telegraph message in order that the automatic bias adjustment will follow only the changes in the general level of the received signals and will not follow the individual telegraph signals.

While certain specific embodiments of the invention have been selected for detailed description the invention is not, of course, limited in its application to the embodiments described. The embodiments which have been described should be taken as illustrative of the invention rather than restrictive thereof.

What is claimed is:

1. In a carrier telegraph receiving circuit including a grid-controlled vacuum tube detector normally with a fixed negative bias on the grid for detecting the telegraph signals and a telegraph relay controlled by the detected waves, means for reducing distortion including telegraph bias in said circuit with changes in the level of the received signals, said means being effective to superpose a variable bias on said fixed bias and comprising a condenser for storing a voltage charge substantially equal to the instantaneous peak value of the received signals, and means for applying a predetermined portion less than the whole of the stored voltage charge to the grid of said detector in such a direction that said applied portion supplements the normal negative bias of the grid.

2. In a carrier telegraph receiving circuit including a grid-controlled vacuum tube detector, normally with a fixed negative bias on the grid for detecting the telegraph signals and a tele-

graph relay controlled by the detected waves, means for reducing distortion including telegraph bias in said circuit with changes in the level of the received signals, said means being effective to superpose a variable bias on said fixed bias and comprising a condenser for storing a voltage charge substantially equal to the instantaneous peak value of the received signals, a resistance in parallel with said condenser and a connection between a predetermined point intermediate the extremities of said resistance and the cathode of said detector whereby a portion, less than the whole, of the stored voltage charge is applied to the grid of said detector, the polarity of the charge on said condenser being such that the grid is biased negatively thereby.

3. In a carrier telegraph receiving circuit including a grid-controlled vacuum tube detector normally with a fixed negative bias on the grid for detecting the telegraph signals and a telegraph relay controlled by the detected waves, means for reducing distortion including telegraph bias in said circuit with changes in the level of the received signals, said means being effective to increase the normal fixed negative bias of the grid upon an increase in the level of the received signals by a variable amount which is a predetermined fraction of the total increase of signal level over normal signal level and comprising a network, consisting of a resistance and a condenser in parallel, a rectifier in series with said network and a connection between the cathode of said detector and a predetermined point on said resistance intermediate the extremities thereof.

4. In a carrier telegraph receiving circuit including a grid-controlled vacuum tube detector for detecting the telegraph signals and a telegraph relay controlled by the detected waves, means for reducing distortion including telegraph bias in said circuit with changes in the level of the received signals, said means being effective to apply a negative bias to said grid which varies in accordance with changes in signal level and comprising a condenser for storing a voltage charge substantially equal to the instantaneous peak value of the received signals, a resistance in parallel with said condenser and a connection between a predetermined point substantially midway between the extremities of said resistance and the cathode of said detector whereby substantially half of the stored voltage change is effective to bias the grid of said detector.

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