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SIGNAL REPEATER

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FIG. 1

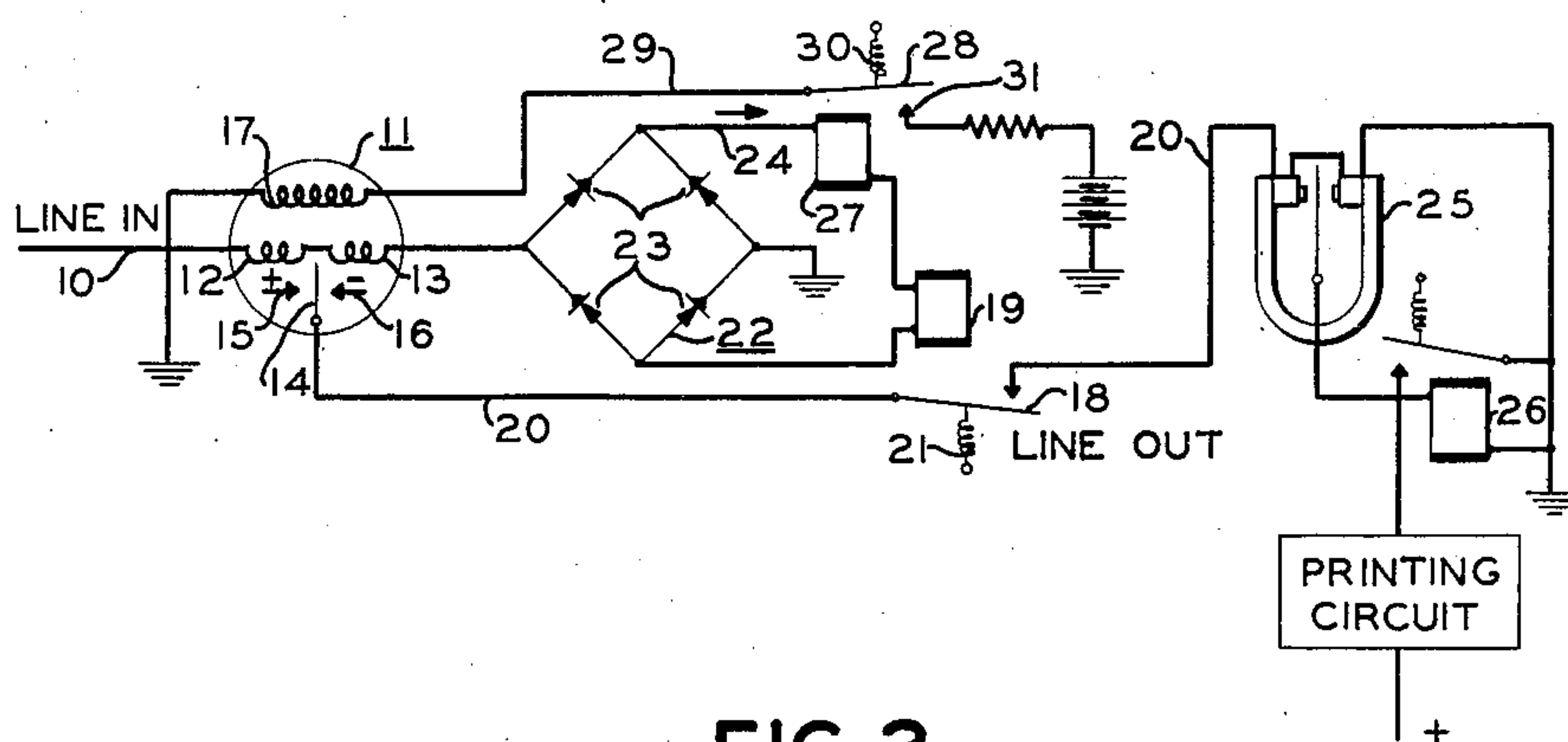


FIG. 2

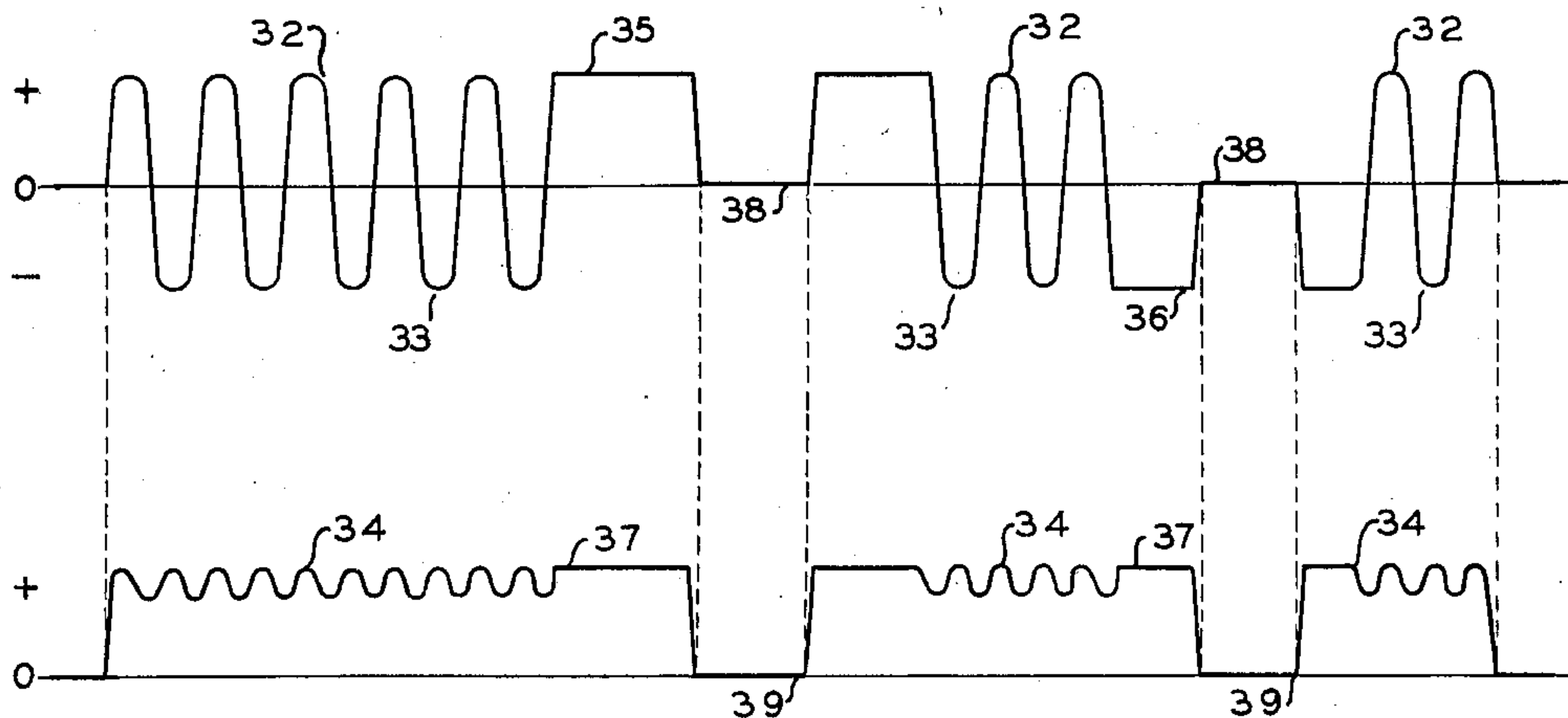
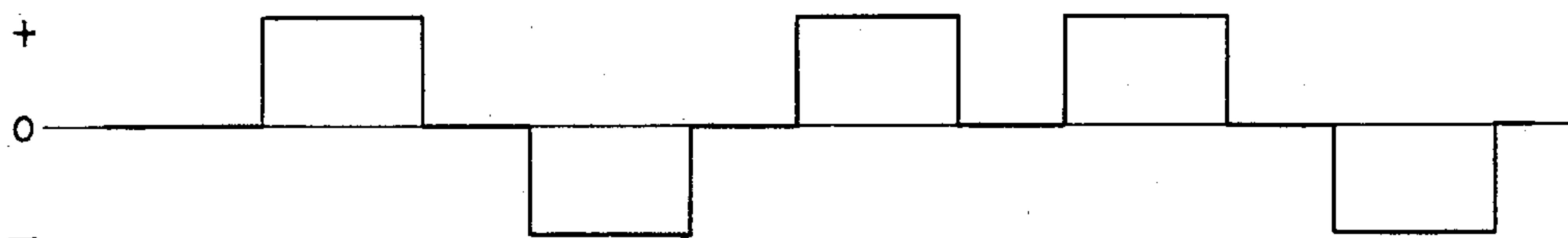


FIG. 3



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SIGNAL REPEATER

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7 Claims. (Cl. 178—70)

This invention relates to signal repeaters, more particularly to a repeater arrangement for repeating so-called "three current" signals or signals embodying positive, negative and zero values.

The primary object of this invention is to provide an arrangement whereby a high speed relay may be employed in the signal repeater for signals of so-called "three current" value to open the outgoing line for repeating zero current signals.

Another object of this invention is to provide apparatus for repeating signals of zero value having substantially the same time lag characteristics as the apparatus employed for repeating the positive and negative signals.

Still another object of this invention is to provide power circuit control for distant apparatus, such as printers or the like in subscribers' offices, which may be actuated at the sending end of the line so that the apparatus may be supplied with power at the proper time without the attention of the subscriber.

When the signals are repeated through electro-magnetic relays the time response characteristic is very important. If the arrangement is such that one part of a signal is repeated through one relay and another part through another relay, the response of the relays must be substantially the same if the signal is to be repeated without distortion. If a longer time is required by one of the relays to reproduce the signal than is required by the other, the various elements of the reproduced signal will not be properly related. From this it will be seen that the relay employed for the reproduction of the no current signal in the type of signals referred to above, must have the same time response characteristic as the relay for the positive and negative signal.

Heretofore, the no current portion of the signal was repeated by means of a relay combination employing a slow acting relay which would not respond to the current variations as the signal passed through zero in swinging from one value to another. When the zero portion of the signal was repeated through the old type arrangement, the extra lag of the slow acting relay displaced the zero portion of the signal by an amount substantially equivalent to the difference in time response between the relay repeating the different parts of the signal, causing the zero current to occur in a displaced or retarded position in the reproduced signals. With this arrangement it was impractical to operate repeat-

ers in a series in a signal circuit. The result would be that the zero portion of the signal would drop back the same relative amount as the signal passed through each repeater until finally the zero signal would become intermingled with the positive and negative portions of the signal and disappear altogether.

According to this invention, the positive and negative portions of the signal are repeated through a polarized relay. Rectifying means is placed in the line so as to rectify the positive and negative portions of the incoming signal and impress them upon a relay having substantially the same time response characteristic as the polarized relay. The high speed relay is biased to open position and acts to hold the line closed while the polar relay repeats the positive and negative incoming signals and to repeat the zero signal by opening the outgoing line when the incoming signal current is zero. The rectifier employed has substantially no inductance, and, therefore, is practically instantaneous in its response to the signals. It is then a simple matter to select a zero current repeating relay which has substantially the same inductance as the polarized relay.

When a rectifier arrangement is employed, according to this invention, the current output of the same is further utilized to operate a power control relay for connecting and disconnecting current to the local apparatus, such as printers, into which the signal is repeated, eliminating the necessity of attention from a subscriber to insure that the power is connected and disconnected to the printer at the beginning and ending of its service.

For a further description of this invention reference may be had to the accompanying drawing, together with the following description and claims, in which:

Fig. 1 is a diagrammatic illustration of the repeater circuit and control apparatus;

Fig. 2 is an illustration of the action of the repeater arrangement showing the position of the repeated no current signal; and

Fig. 3 represents a different type of signal which may be reproduced by the repeater arrangement illustrated in Fig. 1.

Referring particularly to Fig. 1, the signal repeater is diagrammatically illustrated. The incoming line 10 impresses the signals upon a polarized relay 11, which responds to repeat the positive and negative signal values. This relay comprises a pair of actuating coils 12 and 13 and a vibrating armature 14, which is al-

ternately energized by positive and negative currents impressed thereon as it engages the contacts 15 and 16 respectively. If polarizing flux is to be supplied to the relay electromagnetically, coil 17 may be employed and energized from the local power circuit, as will presently be described. The armature 14 of the polar relay is connected through the armature 18 of a neutral or direct current relay 19 to the outgoing line 20. The relay 19 is chosen to have substantially the same time response characteristic as the polar relay 11. The neutral relay is arranged to open and close the outgoing line 20 in accordance with whether the signal current is traversing the incoming line. The armature of the relay is biased toward open position by any suitable means, such as spring 21. The relay 19 is energized by pulsating direct current, resulting from a rectification of the signal current on the incoming line through rectifier 22 provided with units 23, connected in the line in the well known bridge circuit relation. The rectifier output current circulates through the circuit 24 in only one direction as indicated by the arrow.

This invention is particularly applicable to repeaters employed in connection with the operation of telegraph printers, such as the Burry type page printer, ordinarily employing signals of "three current" value. Since this type of printer is well known in the art, it is considered unnecessary to describe it in full. Therefore, only the stepping magnet of the printer, illustrated as magnet 25 in Fig. 1, and the circuit preparing magnet 26 are illustrated. The stepping magnet 25 responds to the signals to step the type wheel to the desired position, while the relay 26, in conjunction with relays, not illustrated, associated with a separate circuit known as the press circuit, not illustrated, to print from the type wheel, operate carriage return and line spacing mechanism at the end of each line.

Characters or numerals hereinafter designating portions of the signal current or rectifier current refer to Fig. 2.

When it is desired to operate a printer or printers a series of signal pulses embodying stepping pulses 32 and 33, holding pulses 35 and 36, and zero pulses 38 are transmitted over line 10, and repeated, as will be more fully described, into line 20. The latter line may extend directly to a printer located at the repeater station or to other repeaters and printers located at distant stations. As soon as the first current pulse is received at the repeater the relays 19 and 27 are energized by the pulsating direct current resulting from the signal current rectification in the rectifier 22. As the respective contacts are closed the relay 27 closes the power circuit to energize the coil 17 and any other apparatus desired at that station. Simultaneously, the relay 19 closes the outgoing line to permit signals to be repeated through the line to the stepping relay 25 of the printer or printers connected in the line. The stepping signal pulses cause the tongue 14 of the polar relay to vibrate in accordance therewith, engaging the contacts 15 and 16 alternately, sending reproduced signal pulses into the outgoing line and through the stepping relay 25 and circuit of relay 26 of the printer. At the end of this series of stepping pulses the signal current is prolonged for a period of time as a positive pulse 35 or a negative pulse 36, according to whether the last actuating pulse transmitted to the type wheel stepping magnet, was positive or negative. This

prolonged pulse holds the type wheel of the printer in the position to which it has been rotated by the stepping pulses. During the time of the prolonged signals for holding the type wheel, a steady current 37 is passed by the rectifier through the auxiliary circuit 24 causing the relays 19 and 27 to remain energized. When it is desired to print the next character the stepping and holding signal pulses are repeated and the apparatus goes through another cycle of operation in substantially the same manner. When the type wheel has reached the end of a printed line it must be returned to the left margin of the page for printing a new line. This return of the type wheel carriage is accomplished by sending a zero or no current signal pulse illustrated as 38 in Fig. 2 and repeated as 39 in the auxiliary circuit 24. This no current pulse is sent over the incoming line and must be repeated into the printer to accomplish the printing operation. The no current pulse when repeated through the relay 26 acts in combination with the press circuit, not illustrated, in a well known manner to accomplish the carriage return operation. The zero current pulse, when employed in connection with a repeater utilizing a polar relay, can be repeated only by opening the outgoing line circuit 20 at a point beyond the polar relay. This is necessary because of the fact that the tongue 14 of the polar relay 11 always remains upon the contact to which it last moved, thereby applying either plus or minus battery to the outgoing line not only during periods of positive or negative incoming signals but during periods of zero incoming signals as well.

Heretofore the no current signal pulse was repeated in the outgoing line by providing a high speed neutral relay in the incoming line. The armature of the relay was biased to a closed position and arranged to close a circuit to a slow acting relay during times of no current signal over the line circuit. During the reception of alternating or stepping current pulses, the armature of this relay vibrated on its contact opening and closing the line to the slow acting relay sending direct current pulses thereto in accordance with the alternating pulses. The slow acting relay was chosen so that it would not respond to attract its armature during such periods. When prolonged pulses were sent over the line circuit to hold the type wheel during the printing operation the high speed relay served to maintain the circuit to the slow acting relay open. On the other hand, when the no current pulses were upon the line circuit, the circuit to the slow acting relay would close and through its armature the relay would open the outgoing line. From this arrangement it will be seen that the time response characteristic of the no current signal repeating portion of the device was considerably slower than the response characteristic of the polar relay which repeated the positive and negative portions of the signal. The result was that the no current portion of the signal was displaced or retarded in its position in the repeated signal. When it was attempted to repeat the current through a series of several repeaters the no current signal would be proportionately displaced by each of the repeaters until it would finally fall upon the positive or negative portion of the repeated signal and disappear altogether.

On the other hand, when signals are repeated through the arrangement provided according to

this invention, the rectifier has practically no impedance to the incoming signal and the zero current signals appear at the output of the rectifier in their true position as illustrated by the relative zero currents, 38 and 39, of the upper and lower graphs of Fig. 2, respectively. As already stated the alternating current signals are rectified and appear as pulsating direct current 34. On the other hand, the prolonged signals, whether positive or negative, are repeated by the rectifier 22 as positive current pulses 37 of the lower graph. However, immediately upon the arrival of zero incoming signal current 38, the rectifier output and the current through the auxiliary circuit 24 will become zero deenergizing the relay 19 whereupon the biasing spring 21 will immediately retract the armature 18 opening the line 20. The opening of the line 20 establishes the condition of zero current thereon and the distant repeaters or printer relays connected in the line. In this arrangement, when the time operating characteristic of the relay 19 is designed to be equal to that of relay 11, the zero signal is repeated through the repeated combination in same relation to the positive and negative portions of the signal as it is received.

Since the relay 27 controlling the power circuit is operated from the output of the rectifier 22 this means that the power circuit will be opened by the biasing spring 30 during periods of zero signal. However, the power circuit remains open only for the length of period during which the zero current signals prevail. This arrangement has no ill effects because, as is well known, the carrier return of the Burry type printers is accomplished by energy stored in a spring during the movement of the type wheel across the page as the letter spacing occurs and no current is necessary for the operation of returning the type wheel to the left margin of the page and spacing the print. At the instant either positive or negative signal pulse is again impressed upon the line circuit, power will be restored to the various apparatus permitting the same to function in normal manner. It will be seen that the foregoing arrangement provides for the power to be cut off from the printers in a subscriber's office during periods when the service is not required by simply opening the line circuit or imposing a continuing zero current on the line at the sending end. Conversely, the subscriber's printers are connected to the power circuit merely by closing the line circuit or impressing a signal current thereon. This provision eliminates the necessity of subscriber turning the power on and off the printer at the proper time to make sure that the printer is in readiness for receiving signals and also at the end of the day to prevent a waste of power. In other words, the entire control of the operation of distant units including application of power thereto may be exercised at the main office or point of transmission of the signals.

Referring to Fig. 3 another form of signal is diagrammatically illustrated which may be repeated by apparatus arranged similar to that illustrated in Fig. 1. The graph of Fig. 3 is intended to represent three current signals of the type similar to those produced in cable service. A repeater arrangement comprising relays 11 and 19 may be employed to repeat such signals in substantially their true form giving not only the value of the positive and negative, but the zero signal as well with a minimum

amount of distortion. It is to be understood that this arrangement may be employed to repeat any other type of signal in which current of zero value is employed as a signal unit.

From the foregoing description it will be observed that a repeater arrangement has been provided which will repeat telegraphic signals embodying currents of positive, negative and zero value without distortion. The necessity of employing a slow acting relay to avoid response to high speed alternating current signals has been eliminated. When a rectifier of the copper-oxide or similar type is employed its response is substantially instantaneous and hence of itself does not introduce a time delay of any consequence in the apparatus. When a rectifier is employed it is seen that the time response characteristic of the zero current relay may be readily designed to be substantially the same as the relay for repeating the other part of the signal. The result is a repeated signal in which the various components occur in substantially their same relation as in the original signal.

It should be particularly pointed out that a repeater arrangement according to the invention enables signals to be re-repeated, or, in other words, transmitted through a series of repeaters located at separate points along a signal line. This is to be contrasted with the practice required when using the old arrangement embodying the slow acting relay for repeating zero signals. In this system repeaters could not be operated satisfactorily in series and it was necessary to decode the signals at the relay stations and retransmit them to the printers of the various subscribers. With the present apparatus the incoming signal is merely impressed upon a repeater located at a central office and circuits from this repeater may be extended to the various locations of subscribers printers. One or more of said circuits may be extended to a supplementary repeating center which in turn repeats to local subscribers printers at that point. The series may be extended through a considerable number of repeaters without the fear of the signals becoming appreciably distorted.

It is also to be observed that power circuit control provided according to this invention for any number of repeaters and subscribers printers connected in a signal system may be controlled at the point of origination of the signal.

It will be evident to those skilled in the art that the type of relay to be employed in a particular circuit arrangement may be readily ascertained from the conditions under which it is to be operated. It will further be apparent that this invention may be employed in connection with the operation of several types of telegraph apparatus and that its operation is not limited to Burry printers in connection with which it has been described.

While this invention has been illustrated in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible to various changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereon as are imposed by the prior art or as specifically set forth in the appended claims.

What I claim is:

1. In a system for repeating three current signals comprising zero, positive, and negative signal pulses, the combination of an incoming and outgoing line, a repeating polar relay coupling

said lines, a direct current relay biased to an open position and arranged to close and open the outgoing line, a full wave rectifier having its output coupled in the actuating circuit of
 5 said direct current relay, and means for impressing the incoming signals upon said rectifier so that either positive or negative current pulses through said rectifier produce uni-directional pulses through said relay operating the
 10 same to hold said outgoing line closed during the reception of both positive and negative pulses but to open the line during periods of zero pulses.

2. In a system for repeating three current signals comprising positive, negative, and zero current values, the combination of a first line over which signals arrive, a second line over which said signals are to be repeated, a high speed relay biased to an open position and arranged
 20 to close and open said second line, rectifier means in said first line, and circuit connections for energizing said relay from the output of the rectifier, said rectifier operating to produce uni-directional current from both positive and negative
 25 signals, whereby said relay is energized causing the same to hold said second line closed while signals of either positive or negative value are being received, but to open said line while signals of zero value are being received.

3. In a system for repeating three current signals including signals of positive, negative, and zero values, a combination of a first line over which the signals arrive, a second line over which signals are to be repeated, a direct current relay having an armature biased to an open
 35 position, said relay being arranged to close and open said second line, and a full wave rectifier arranged to produce a uni-directional current when the signals traversing said first line are impressed thereupon, said direct current relay
 40 being coupled to the output of said rectifier, whereby said second line is held closed only while signals of positive and negative value are being received and opened while signals of zero value are being received.

4. In a telegraph system employing three current signals embodying positive, negative, and zero pulses, a line circuit, a repeater in the line circuit, said repeater embodying a polarized relay for repeating the positive and negative
 50 pulses, a rectifier having substantially no impedance to the signals coupled in said line circuit, a direct current relay in the output circuit of said rectifier and cooperating therewith to repeat the zero signal pulse, the time operating
 55 characteristic of both relays being substantially the same whereby the respective current pulses are reproduced substantially in their original relation to each other.

60 5. In a telegraph repeater for three current

signals embodying positive, negative, and zero pulses, an incoming and an outgoing line for said repeater, a polar relay and a direct current relay having their armatures connected in series
 80 in the outgoing line, said relays having substantially the same time operating characteristic, said polar relay being coupled in the incoming line and having means responsive to the signals traversing said line and arranged to differentiate
 85 only between positive and negative signals for reproducing the same in the outgoing line, and means having substantially no impedance to the signals for coupling the direct current relay to said incoming line and arranged to differentiate
 90 only between zero and positive or negative signals for reproducing the zero signal in the outgoing line.

6. In a telegraph repeater for signals embodying elements of current values including positive and negative and elements of no current value, an incoming and an outgoing line coupled to
 95 said repeater, the combination of a polar relay and a direct current relay having their armatures connected in series in the outgoing line, said polar relay being coupled in the incoming
 100 line and having means responsive to the signals traversing said line and arranged to differentiate only between the positive and negative elements for reproducing the same in the outgoing line, a rectifier coupled in the incoming line and having
 105 its output coupled to said direct current relay, said rectifier and direct current relay cooperating to differentiate between the current and no current elements for reproducing the same in the outgoing line.

7. In a telegraph repeater for signals embodying elements of current values including positive and negative and elements of no current value, an incoming and an outgoing line coupled
 115 to said repeater, a polar relay and a direct current relay having their armatures connected in series in the outgoing line, said relays having substantially the same time operating characteristic, a rectifier in the incoming line having its
 120 output coupled to said direct current relay, said rectifier and direct current relay cooperating to respond differentially to the current and no current elements of the signal and arranged to maintain said outgoing line closed while current
 125 elements of a signal are being repeated and to open said line while no current elements on the signal are being repeated, said polar relay being coupled in the incoming line and having means responsive differentially between the positive
 130 and negative current elements and arranged to repeat said elements in said outgoing line while the same is maintained closed by said direct current relay.

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