Sept. 19, 1950 A. KAHN 2,522,874

CIRCUIT FAILURE INDICATOR FOR RECEIVING TELEGRAPHS

Filed Jan. 4, 1946

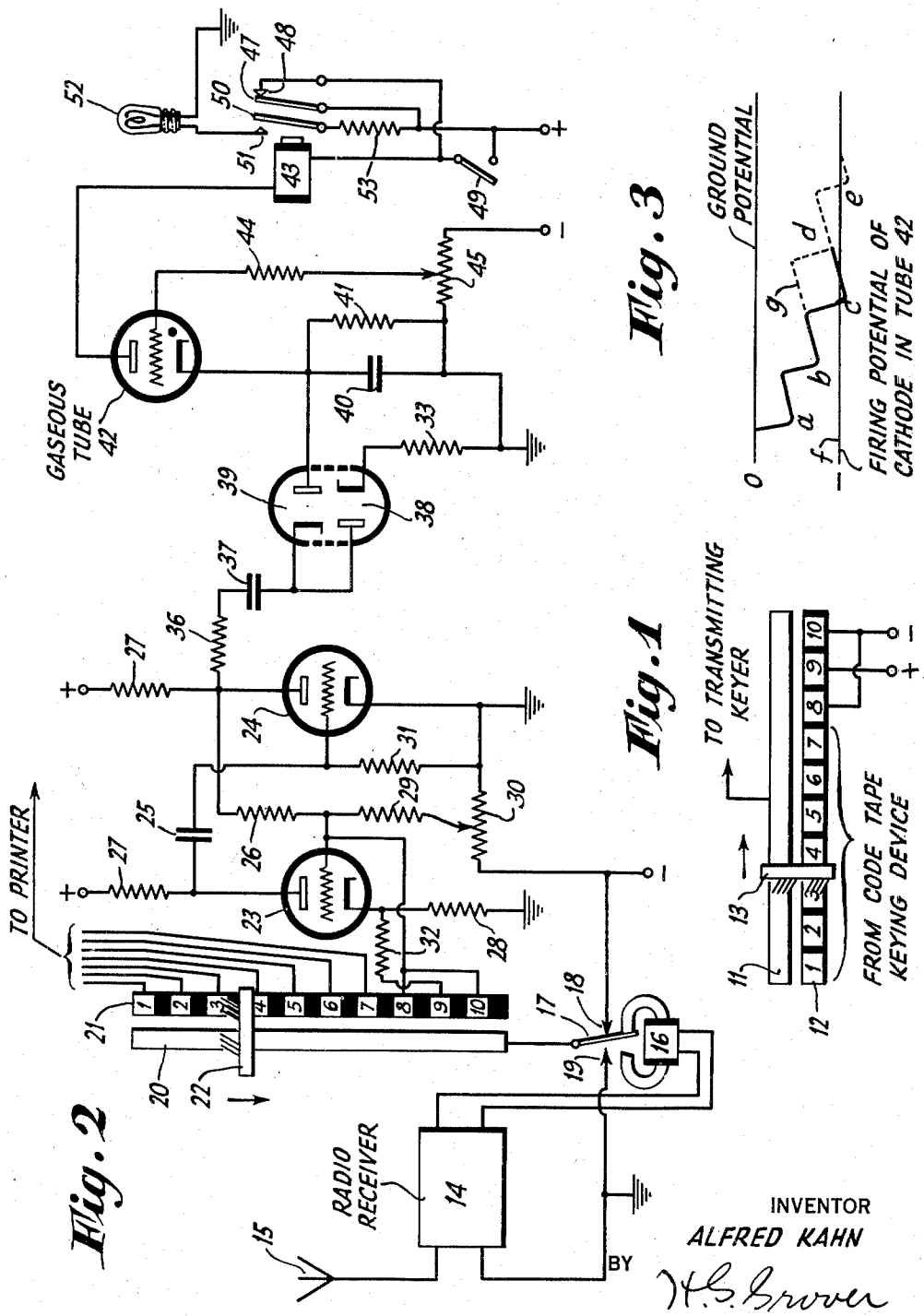


Fig. 2

Fig. 3

Fig. 1

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Patented Sept. 19, 1950

2,522,874

UNITED STATES PATENT OFFICE

2,522,874

CIRCUIT FAILURE INDICATOR FOR RECEIVING TELEGRAPHS

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Application January 4, 1946, Serial No. 639,088

11 Claims. (Cl. 178—69)

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This invention relates to an error indicator for a receiving telegraph. The principal purpose of the invention is to indicate conditions of signal reception, particularly when the communications channel fails to bring in the signal.

Various types of error indicating devices have been used in the past, such as those which develop an error indication whenever the code signal itself becomes mutilated. For example, in U. S. Patent Re. 22,394, which was a reissue on November 23, 1943, of an original Patent 2,183,147, dated December 12, 1939, and granted to John B. Moore et al., the apparatus used was adapted to respond normally to code signals all of which were composed of a uniform number of marking elements and a uniform number of spacing elements. Whenever the number of marking elements as received for any individual code signal became abnormal an error indication was produced. Such a system is more efficiently employed when the signals are multiplexed.

In multiplex printing telegraphy the code signals for a plurality of messages are continuously received and applied cyclically to the respective printers, each printer having a code translating device which operates to select a character to be printed. The printing function must follow the receipt of the last code element in a character signal. Hence the time intervals allowed to different printers for performing their printing functions are staggered so that the code selecting mechanism of each printer may be prepared to translate the signals assigned to it without any spacing between the signals for different printers.

With simplex operation, however, time must be allowed between successive character code combinations for the printer to operate, or else some sort of storage means must be provided which will permit of continuous reception of the code combinations and intermittent set-up of the character selections preceding the times required for mechanical functioning of the printer.

In my invention as herein disclosed I have provided a rotary distributor which comprises not only a sufficient number of segments for code signal translation, but also an additional number of segments which may be used for circuit condition indication. Such a distributor preferably has at least eight segments in the distributor ring, five of which are used for the conventional five-unit code and three of which are used for circuit condition indication. If the now well known seven-unit code is to be used, then seven segments will, of course, be required for character selection plus three additional segments for

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circuit condition indication, a total of ten segments, as in the embodiment herein disclosed.

It is an object of my invention to provide auxiliary error detecting equipment which may be advantageously used for producing a warning signal whenever receiving conditions over a radio or other communications channel become inoperative.

It is another object of my invention to provide an indicator to be used at a telegraph receiving station for calling attention to a communications channel failure.

Other objects and advantages of my invention will be made apparent in the detailed description to follow. This description is accompanied by a drawing in which

Fig. 1 shows a preferred arrangement of a rotary distributor to be used at a transmitting station for composing the character signals and for transmitting other pre-arranged signals to be used as in idle-time keying, as well as for producing the necessary controls at a receiving station which would permit of indicating an operational failure in the communications channel;

Fig. 2 shows a preferred circuit arrangement to be used for error indication at a receiving station, and

Fig. 3 shows a plot of cathode voltages in a gaseous tube corresponding to successive charges to be impressed upon a certain condenser in a portion of the circuit shown in Fig. 2.

It should be stated in the outset that my invention finds its greatest utility in detecting operational failures rather than in detecting occasional mutilations of the traffic signals. It is common practice when no traffic is being handled to continuously transmit an idle-time signal in order to maintain contact and synchronism between a transmitting and a receiving station, particularly in single channel operation. The idle-time signal has the same characteristics as other character signals. That is, it is composed of three marking elements and four spacing elements, provided the seven-unit code is used. It having the same characteristics of all other character combinations, failure to receive it during periods of traffic inactivity will produce an error indication on the printer.

But such an idle-time signal in my case is not necessarily applied to the distributor segments which are reserved for character code signals. The reason for this is that I preferably employ a distributor having supplemental segments to be used primarily for indicating circuit failure and for idle-time signals. By removing the idle-time

signal from the portion of the distributor which is used to selectively operate a printer a considerable saving is made in wear and tear on the code translating mechanism of the printer. The advantage of this arrangement is, therefore, apparent, particularly on circuits where the ratio of inactive to active periods is high, but where contact must be maintained between transmitting and receiving stations throughout a large part of the business day.

Another consideration which is apparent in the use of my invention is that no relay storage or other storage means are required for simplex operation of a printer. The distributor brush while passing over the supplemental segments allows time for mechanical functioning of the printer between code selecting operations.

Referring first to Figure 1, I show therein the arrangement of the distributor ring required at a transmitting station whereby the present invention may be practiced. At the transmitter I employ a solid distributor ring 11 and a segmented ring 12 comprising ten active segments numbered 1 to 10 inclusive. These rings are shown in developed form. Intervening between the segments are insulation segments which are of sufficient width to avoid short-circuiting between active segments when the brush passes over them. The rotor of the distributor has mounted thereon two interconnected brushes 13. Of the ten active segments, the first seven, that is, segments 1 to 7 inclusive, are connected to individual contacts of a keying device, preferably one conventionally controlled by a perforated tape. These segments may be normally active only during times when messages are transmitted, being ineffective at other times. The remaining segments 8, 9 and 10 are utilized primarily for idle time signals and for circuit failure indication functions. In order to generate signals for such purposes segments 8 and 10 are connected permanently to the negative terminal of a direct current source while segment 9 is connected to the positive terminal of said source. A neutral center-tap on the same source will be understood to be grounded.

The solid ring 11 collects the signals as composed by the tape keying device and applies them conventionally for keying the carrier wave of a radio transmitter.

Referring now to Fig. 2, I show a radio receiving unit 14 having on its input side an antenna circuit including an antenna 15 and a ground connection. On the output side of the unit 14 I show preferably a polar relay 16, the tongue 17 of which is arranged to swing between two contacts 18 and 19 having different potentials applied thereto. As shown in the drawing contact 18 is negative with respect to ground while contact 19 is grounded. The source usually employed is one in which an intermediate point thereof is grounded.

The relay tongue 17 is connected to the solid ring 20 in a receiving distributor. Associated with this ring is a segmented ring 21 having segments 1 to 10 inclusive corresponding to those of the transmitter distributor. In other words, segments 1 to 7 inclusive are those required for character code signal reception and translation in order to control a receiving printer. These segments are connected respectively to different selecting units in the printer. Segments 8, 9 and 10 are those which correspond with the pre-arranged idle-time and circuit condition indicating portion of the signals as will be described below.

Under normal operation of the receiving relay 16, and during the reception of traffic signals, either minus or ground potential will be applied to the respective segments 1 to 7 inclusive in accordance with the composition of each code signal. Translation of the code signals is accomplished conventionally and need not be described herein. The operation of relay 16 while the brush 22 traverses segments 8, 9 and 10 will be such that normally segments 8 and 10 receive negative pulses while segment 9 receives a relatively positive pulse, say, of ground potential.

The circuit arrangement of Fig. 2 includes two discharge tubes 23 and 24 which are connected as in a conventional trigger circuit arrangement. That is to say, the anode in tube 23 is coupled across a capacitor 25 to the grid in tube 24. The anode in tube 24 is coupled through a resistor 26 to the grid in tube 23. The anodes in the two tubes are connected to a positive terminal of a suitable direct current supply source through resistors 27. The cathode in tube 23 is connected to ground through a resistor 28. The grid in tube 23 is connected through a resistor 29 to a tap on a potentiometer 30, this potentiometer being connected between ground and a direct current source terminal more negative than ground, here indicated by a minus sign (—). The cathode in tube 24 is directly grounded and the grid in this tube is connected to ground through a resistor 31.

The grid in tube 23 is normally held sufficiently negative by adjustment of the tap on potentiometer 30 so that a positive pulse above the threshold bias must be applied to this grid in order to drive the tube conductive. Otherwise, for conductivity, the cathode in this tube must be driven more negative by a negative pulse from segment 9 in the distributor ring, such a pulse being impressed across a resistor 32. Since normally the pulses applied to segments 8 and 10 are negative and the pulses applied to segment 9 are at ground potential tube 23 remains non-conductive until a false signal is received over these segments. In such cases tube 23 will become conductive and this condition will result in the blocking of tube 24 due to the toggle action in this pair of tubes. Such toggle action may be reversed after a predetermined time interval which results from the time constant characteristics of the circuit, particularly as determined by the chosen values of the capacitor 25 in relation to resistors 26, 27 and 31.

The trigger circuit, comprising tubes 23 and 24 and associated circuit components, is utilized to operate a conventional pulse counting circuit arrangement which includes diode rectifier units 38 and 39 and time constant circuit consisting of a resistor 36 in series with a capacitor 37, these two elements being connected between the anode in tube 24 and the junction between the anode of the diode 38 and the cathode of diode 39. The cathode of diode 38 is connected to ground through a resistor 33. The anode in diode 39 is connected to ground through a resistor 41, this resistor being shunted by a capacitor 40.

In order to detect not less than a predetermined number of circuit failures in a given time interval and to provide non-detection of isolated cases of erroneous signal reception the counting circuit is arranged to ignite a gas filled tube 42. This tube has its cathode connected to the junction between the anode of the diode 39 and one electrode of capacitor 40. The anode in tube 42 is connected through the winding of a relay 43 and through normally closed contacts 47 and 48

of this relay to a positive potential source indicated by the plus sign (+). In shunt with the contacts 47 and 48 is a manually operable switch 49. The grid in the gas filled tube 42 is connected through a resistor 44 to a tap on a potentiometer 45, this potentiometer being connected between ground and the negative terminal of a source whose positive terminal is grounded.

Relay 43 is also provided with contacts 50 and 51 which are arranged to close before contacts 47 and 48 open. Contacts 50 and 51 when closed complete a circuit from the positive source terminal through a resistor 53 and through these contacts to an indicator lamp 52 one terminal of which is grounded.

Circuit operation

Under normal conditions tube 23 will be cut off and tube 24 will be conductive. This state will exist so long as segments 8 and 10 continue to apply negative potential to the grid of tube 23 and so long as segment 9 continues to impress ground potential on the cathode of tube 23.

If, however, the received error indicating pulses vary from their correct arrangement such as by the polarity of any one or more of the applied voltages being reversed, then the trigger circuit will be actuated in such manner that tube 23 becomes conductive and tube 24 is cut off. If this condition continues for a period of time determined by the tube electrode potentials and the time constant of the trigger circuit components, principally condenser 25 and resistor 31, then a voltage will be developed across the resistor 36 and condenser 37 such as to place a substantial charge on condenser 40, thus producing a voltage drop in resistor 41 and driving the cathode in the gas filled tube 42 more negative. The time constant of the trigger circuit including components 25 and 27 is so chosen that this circuit is not restored to its normal condition of stability in a time shorter than that required to send the three error indicating pulses, nor longer than that required to send the next group of signaling elements. Thus one and only one operation of the trigger circuit is possible during one revolution of the face-plate brushes 22.

At the moment when tube 24 is made non-conductive a positive pulse is coupled through condenser 37 to the interconnected anode and cathode elements of the diode tubes 38 and 39. The positive pulse is shorted to ground by diode 38 whose cathode is connected to ground through a resistor 33. The negative pulse produced by the return of the trigger circuit to normal will pass through the diode 39 and cause an increment of charge to appear across the terminals of condenser 40. Resistor 41 will discharge the condenser at a fixed rate. If the charge increment is repetitive for each distributor cycle, then after a fixed number of error cycles comes in, say, three, the net charge on condenser 40 will be such as to effectively drive the cathode in tube 42 negative with respect to the potential of its grid, so as to ignite this gaseous tube. By adjusting the grid bias as by means of the adjustable tap on the potentiometer 45 the magnitude of the charge increment on condenser 40 and on the cathode of tube 42 may be made operative after any reasonable required number of signals has been received in error. If the device has been set to operate on three errors and two are received in succession but not the third, then condenser 40 will discharge so that if another error is received on the next distributor cycle then tube 42 will not fire. However, should another error occur immediately then tube 42 will fire.

Fig. 3 explains the possible sequence of operations due to successive applications of charge potentials to the condenser 40. The firing voltage applied negatively to the cathode in tube 42 with respect to the voltage in its grid is represented by the line *f*. The charging potentials which drive the cathode more and more negative are represented by steep front slopes in the saw-tooth wave. Negative peaks of this wave are shown at points *a*, *b*, *c*, *d* and *e*. The longer slopes interconnecting the wave fronts represent discharges of the condenser 40 through resistor 41. If circuit failures occur during two successive cycles of the distributor but not a third then the condenser will discharge as along the dotted line *g* in the graph of Fig. 3. After that it would require two successive cyclic periods of circuit failure to bring the charging voltage on the condenser 40 to the point where the gas filled tube 42 would be ignited. This is shown at point *e* of the saw-tooth wave.

When tube 42 becomes conductive relay 43 operates and closes its contacts 50 and 51 for lighting the indicator lamp 52. Preferably relay 43 is of the quick-acting, slow-release type so that the lamp 52 will remain lit for an appreciable time to give the necessary error indication. If the switch 49 is left open then relay 43 will operate to open the anode circuit of tube 42 by breaking the contacts 47 and 48. This permits the counter circuit to again become effective upon repetition of the error signals. If, however, it is desired that the lamp 52 shall remain lit indefinitely to effect detection of only the first cyclic period of circuit failure, then switch 49 will be closed manually and tube 42 will remain conductive until the attendant opens the switch 49.

Tube 42 when it conducts, rapidly discharges condenser 40 so that the entire circuit is quickly conditioned to detect and indicate succeeding errors.

It will, of course, be understood that in carrying out my invention the number of segments to be included in the distributor rings 12 and 21 may be varied according to circumstances and according to the particular requirements of any printing telegraph system in which this device is to be employed.

It will also be understood by those skilled in the art that when my invention is applied to a synchronous simplex telegraph system synchronizing means of any well known type may be adopted for holding the receiving distributor in correct phase relation to the transmitting distributor. I have not shown any synchronizing means as an essential part of my invention, but call attention to the fact that where the 8th, 9th and 10th segments of my distributor are used for idle-time signals, these same signals must be relied upon for controlling the operation of the phase corrector during times when no message traffic is being transmitted. Only in the case of complete failure to receive any signals would phase correction fail of accomplishment.

Various modifications will, of course, suggest themselves to those skilled in the art. Such modifications may be employed without departing from the spirit and scope of the invention.

I claim:

1. A system for indicating circuit failures in a telegraph channel comprising a receiving distributor having segments for the translation of message code signals and other segments for the

translation of idle-time signals, electronic means coupled to said other segments and arranged to be activated by said idle-time signals when incorrectly received and unaffected by said idle-time signals when correctly received, and indicating means subject to control by said electronic means to provide an indication upon repetition of failure to receive said idle-time signals or upon reception thereof in mutilated form during a predetermined time interval.

2. A system for indicating circuit failures in a telegraph channel comprising a receiving distributor having segments for the translation of message code signals and other segments for the translation of idle-time signals, an electronic trigger circuit normally biased to maintain a first condition of stability and means coupled to said other segments for producing a second condition of stability of said trigger circuit during a predetermined time interval in response to failure to receive said idle-time signals or from reception thereof in mutilated form, and means subject to control by said trigger circuit for making an indication of circuit failure whenever said second condition of stability is repeatedly produced during said pre-determined time interval.

3. A system for indicating circuit failures in a telegraph channel comprising a receiving distributor having segments for the translation of message code signals and other segments for the translation of idle-time signals, and electronic trigger circuit normally biased to maintain a first condition of stability and means coupled to said other segments for producing a second condition of stability of said trigger circuit during a predetermined time interval, said means operating upon failure to receive said idle-time signals or from reception thereof in mutilated form, and means for making an indication of circuit failure whenever said second condition of stability is repeatedly produced during a time interval commensurate with a predetermined number of cycles of said distributor.

4. Monitoring apparatus for use in code signal reception comprising distributor means for allocating message code signals to a translator therefor and for differently allocating idle-time signals, electronic means having two conditions of stability, means for maintaining the first of said conditions so long as the idle-time signals are correctly received, and means responsive to failure to correctly receive an idle-time signal during any single cycle of said distributor means for inducing the second of said conditions, a gaseous tube having its discharge path connected in circuit with a device for storing energy pulses which arise during transitions from the second to the first of said conditions of stability in said electronic means, said tube having a control electrode connected in an input circuit by which it is triggered into conductivity in response to the upbuilding of said energy pulses to a critical value, a relay in circuit with the discharge path of said gaseous tube and indicator means operable by said relay during the conductive state of said gaseous tube.

5. Apparatus according to claim 4 and including a rectifier stage interposed between said electronic means and said device for storing energy pulses.

6. Apparatus according to claim 4 and including means for draining the pulse energy out of said storing device at a rate such that said critical triggering value is reached only after the persistence of idle-time signal failures for a predetermined number of cycles of said distributor means.

7. Monitoring apparatus for use with telegraph circuits comprising a receiving distributor having segments reserved for message signals and further segments reserved for pre-arranged signals, an electronic trigger circuit normally biased to maintain a first condition of equilibrium, means to couple said trigger circuit to said further segments to shift said trigger circuit to a second condition of equilibrium upon failure to receive said prearranged signals, means responsive to said shift of equilibrium to store an increment of electric energy for a pre-determined time interval, and means responsive to said stored electric energy to indicate a repeated failure to receive said pre-arranged signals during said time interval.

8. Monitoring apparatus for use with telegraph circuits comprising a receiving distributor having segments reserved for message signals and further segments reserved for pre-arranged signals, an electronic trigger circuit normally biased to maintain a first condition of equilibrium, means to couple said trigger circuit to said further segments to shift said trigger circuit to a second condition of equilibrium upon failure to receive said pre-arranged signals, the time constants of said trigger circuit having values at which the time at which the trigger circuit is restored to said first condition of equilibrium lies between the time required for transmission of said pre-arranged signals and said message signals, means responsive to said shift of equilibrium to store an increment of electric energy for a pre-determined time interval, and means responsive to said stored electric energy to indicate a repeated failure to receive said pre-arranged signals during said time interval.

9. Monitoring apparatus for use with telegraph circuits comprising a receiving distributor having segments reserved for message signals and further segments reserved for pre-arranged signals, an electronic trigger circuit normally biased to maintain a first state of equilibrium, means to couple said trigger circuit to said further segments to shift said trigger circuit to a second state of equilibrium upon failure to receive said pre-arranged signals, a capacitor coupled to said trigger circuit to store an increment of electric energy therein responsive to said shift of equilibrium, a resistor shunting said capacitor to discharge the same after a pre-determined time interval, and electron discharge means coupled to said capacitor to initiate an electron discharge in response to said stored energy to indicate a repeated failure to receive said pre-arranged signals during said time interval.

10. Monitoring apparatus for use with telegraph circuits comprising a receiving distributor having segments reserved for message signals and further segments reserved for pre-arranged signals, an electronic trigger circuit normally biased to maintain a stable state of equilibrium, means to couple said trigger circuit to said further segments to shift said trigger circuit to an unstable state of equilibrium upon failure to receive said pre-arranged signals, the time constants of said trigger circuit having values at which said trigger circuit is returned to said stable state of equilibrium before the next succeeding reception of said pre-arranged signals, a capacitor, a pair of rectifier devices coupling said capacitor to said trigger circuit, said devices being poled to discharge positive pulses and translate negative

pulses to charge said capacitor with an incremental charge in response to said return of equilibrium and means responsive to the charge on said capacitor to indicate a repeated failure to receive said pre-arranged signals.

11. Monitoring apparatus for use with telegraph circuits comprising a receiving distributor having segments reserved for message signals and further segments reserved for pre-arranged signals, an electronic trigger circuit normally biased to maintain a first condition of equilibrium, means to couple said trigger circuit to said further segments to shift said trigger circuit to a second condition of equilibrium upon failure to receive said pre-arranged signals, said trigger circuit having time constant of values at which the trigger circuit is returned to said first condition of equilibrium to be in readiness for the succeeding transmission, a capacitor, rectifier elements coupling said capacitor to said trigger circuit to place an incremental charge on said capacitor upon each return to said first condition of equilibrium in response to each failure to receive said pre-arranged signals, a resistor coupled to said capacitor to discharge the same at a predetermined rate, a circuit including a grid controlled gaseous discharge tube coupled to said capacitor, and adapted to be triggered into conductivity at a predetermined charge on said capacitor, a utilization device in circuit with the discharge path of said discharge tube whereby said utilization device is actuated upon triggering into conductivity of said discharge tube in response to the upbuilding of the charge on said capacitor, and means to vary the potential at which said discharge tube is triggered to vary the circuit failure repetition rate at which said utilization device is actuated.

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