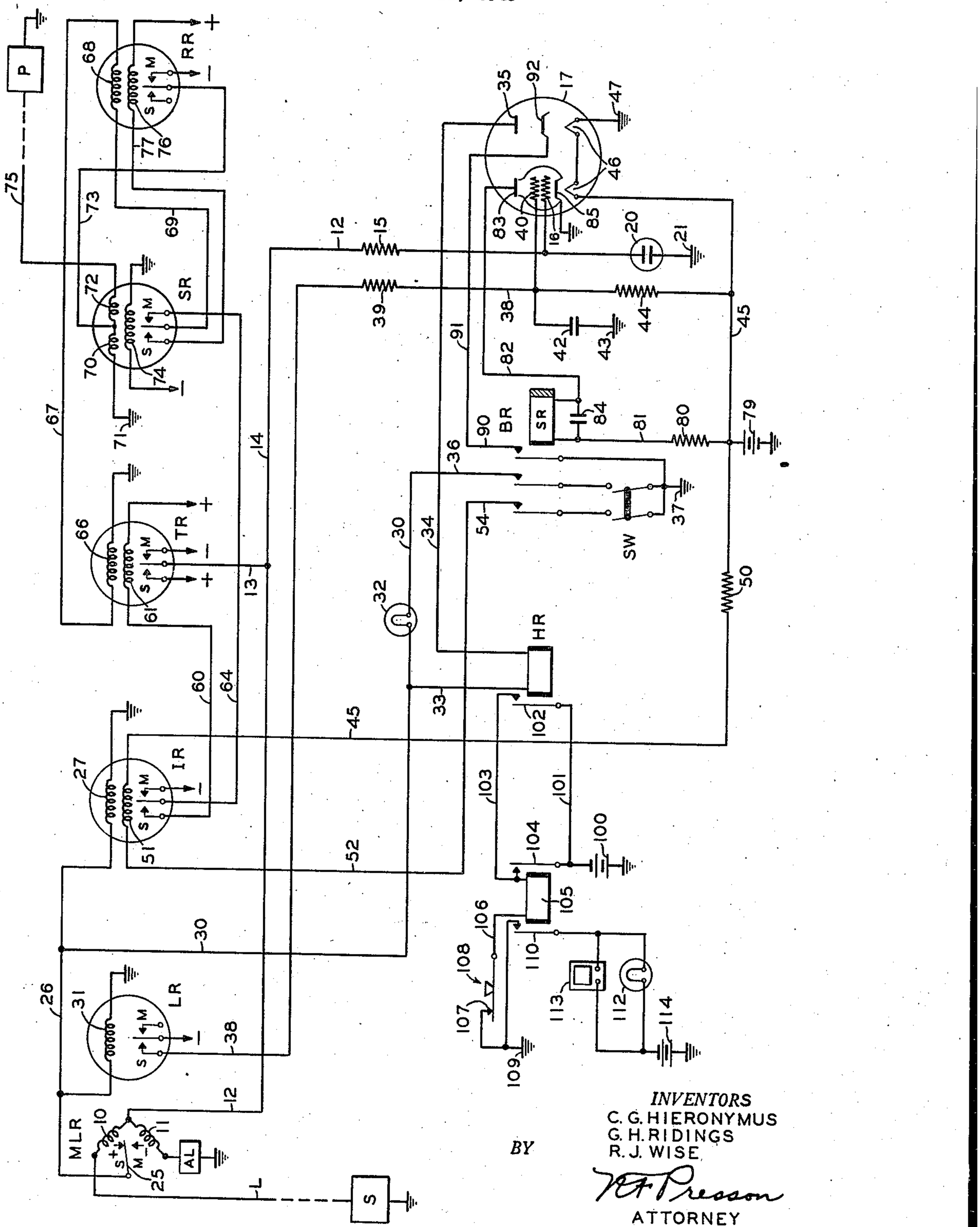
Nov. 5, 1946. C. G. HIERONYMUS ET AL 2,410,442

AUTOMATIC BLIND AND HIT DETECTOR

Filed Dec. 11, 1943



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Patented Nov. 5, 1946

2,410,442

UNITED STATES PATENT OFFICE

2,410,442

AUTOMATIC BLIND AND HIT DETECTOR

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Application December 11, 1943, Serial No. 513,918

8 Claims. (Cl. 178—58)

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This invention relates generally to an automatic blind and hit detector device, and more particularly to such a device for use with terminal repeater equipment employed in half-duplex telegraph printer circuits.

The present requirement of high transmission speed of telegraph messages makes necessary the rapid detection of any interruption in the transmission of the signals, since an interruption of only a very small part of a second in transmission may cause the garbling of an important word when recorded on a telegraph printer, reperforator, or similar recording device. For this reason it is highly important that a hit or break against the transmission be prevented from passing through the telegraph repeaters and that means be provided which will cause a prompt indication or alarm to be given at the repeater stations to notify an attendant of trouble on the circuit.

Teleprinter circuits are usually operated on half-duplex circuits in which transmission may proceed in either direction over the line, although when a station which is receiving wishes to send means must be provided to transmit a long "break" or a series of "blank" characters to render the sending station inoperative and also notify the sending station that the station which is receiving wishes to send. A short interruption due to a hit on the line, however, generally does not affect the station which is transmitting, and thus the station may be unaware of its occurrence, although as above stated it is apt to cause an error in the recorded message at the station which is receiving.

In telegraph parlance, to "blind" a repeater is to so arrange the repeater that line signals received by it from one direction, for example, from the east, will be passed on in another direction, for example, to the west, but signals received from the west will not be passed on to the east. The principal advantage of a "blinding" arrangement in connection with the present invention is that when a hit on the line occurs at a point separated by one or more repeaters from the station then transmitting, the hit will not appear in the intermediate sections between the transmitting station and the section in which the hit occurred, and this prevents the transmitted characters from being distorted or garbled in the intermediate repeater sections or in the transmitting station or in receiving stations connected to the intermediate repeater stations.

One of the objects of the invention is an automatic blind and break detector in which the

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receiving side of a repeater associated therewith is automatically blinded while the transmitting side is transmitting, and in which a hit or break against the transmission is prevented from passing through the repeater.

A further object is improved indicating means for producing a signal upon the occurrence of a hit on the line and for distinguishing between a hit and an intentional break against transmission.

Another object is a device of the character described, in which a relatively long "break" on the line or a continuous sequence of "blank" characters will cause the repeater to become unblinded and the break signal caused to pass through the repeater and break the transmission on the rest of the network.

Still another object is an automatic blind and break detector in which means are provided for readily eliminating the automatic blinding feature when desired without impairing the efficiency of the apparatus to function as a break detector.

An additional object is an automatic blind and break detector which may readily be connected to a telegraph repeater of conventional design such that the detector may be connected or disconnected at any time without interfering with the operation of the repeater.

The foregoing and other objects and advantages will be apparent from the following description, taken in connection with the accompanying drawing which illustrates one embodiment of the invention as applied to a half-duplex telegraph repeater.

Referring to the drawing, various of the relays illustrated are designated by reference letters generally suggestive of their functions, viz., main line relay MLR, leak relay LR, intermediate relay IR, transmitting relay TR, sending relay SR, receiving relay RR, "blind" relay BR and "hit" relay HR. The equipment shown may be located between a line section L and a line section or subscriber's drop 75, and preferably comprises terminal equipment at a sending and receiving station such as a stop-start teleprinter station S or P. The relays MLR, LR, IR, TR, SR and RR are polar relays, with marking and spacing contacts *m* and *s*. In the circuit illustrated, the operating windings of these relays are wound in such direction that, as they are viewed in the figure, current flowing from right to left through their windings normally causes the armatures or tongues of the relays to be actuated to the marking position *m*, and current flowing in the oppo-

site direction, i. e., from left to right, through the windings causes the relay armatures to be actuated to the spacing position *s*. For simplicity, plus and minus symbols are employed in most instances to designate positive and negative grounded battery, respectively.

As seen in the drawing, the telegraph line L is connected to one of the operating windings 10 of the main line relay MLR, the other winding 11 of the relay being connected through an artificial line network AL to ground. The apex of the windings 10 and 11 is connected by conductors 12 and 13 to the armature or tongue of the transmitting relay TR. The armature of the latter relay is connected by conductors 13 and 14 through a high resistance 15 to the control grid 16 of the amplifier section of an electron tube 17 which preferably, although not necessarily, is of the type known as No. 117L7GT. The value of the resistance 15 in the embodiment illustrated is of the order of one megohm, and the potential on the grid 16 of tube 17 is maintained negative until transmission starts, by reason of the negative battery supplied by the marking contact *m* and armature of the relay TR. Conductor 12 also extends to a gaseous discharge tube 20, for example, a neon tube, which is connected to ground at 21.

The armature or tongue 25 of relay MLR is connected by conductor 26 to the grounded winding 27 of intermediate relay IR and also to the grounded winding 31 of leak relay LR. Connected to the conductor 26 is a conductor 30 which includes a "blind" indicator device, such as a lamp 32, the circuit also extending to a conductor 33, winding of "hit" relay HR and conductor 34 to the anode or plate 35 of the rectifier section of tube 17. Conductor 30 also extends to the middle make contact 36 and armature of the "blind" relay BR, and from its armature extends through the right hand blade of the automatic blinding switch SW, when closed, to ground at 37.

The spacing contact *s* of relay LR is connected by conductor 38, which includes resistance 39, to the screen grid 40 of the amplifier section of tube 17. The screen grid circuit is connected to a condenser 42 which is connected to ground at 43. The circuit also extends through a resistance 44 and conductor 45 to positive grounded battery 79. The battery 79 is also connected to the heater elements or filaments 46 of tube 17 and thence to ground 47. The left hand portion of conductor 45 extends through a resistance 50, winding 51 of relay IR, conductor 52, outer make contact 54 and armature of the relay BR, and through the left hand blade of switch SW, when closed, to ground at 37.

The spacing contact *s* of relay IR is connected by conductor 60 to the winding 61 of relay TR, and thence to positive grounded battery. Armature of relay IR is connected by a conductor 64 to the marking contact *m* of relay SR. The grounded winding 66 of relay TR is connected, through conductor 67, winding 68 of relay RR, and conductor 69, to the armature of relay SR. The left hand winding 70 of relay SR is connected to ground at 71, and the right hand winding 72 is connected to the line or subscriber's drop 75. The two windings 70 and 72 are in opposition to each other, and the mid-point of these windings is connected by conductor 73 to the armature of relay RR. Winding 74 of relay SR is connected at one end to negative grounded battery and at its other end to ground, and operates as a biasing winding for the relay. The winding 76 of relay RR is connected at one end to positive grounded battery, and at its other end by a conductor 77 to the spacing contact of relay SR.

The operating winding of "blinding" relay BR, which is a slug relay of the slow-release type, is connected in a circuit comprising positive battery 79, resistance 80, conductor 81, winding of the relay, and conductor 82 to the plate or anode 83 of the amplifying section of tube 17. A condenser 84 is bridged across the winding of the relay to increase its slow-release characteristic. The inner make contact 90 and armature of the relay BR is connected in a circuit which includes ground at 37, conductor 91 and the cathode 92 of the rectifier section of tube 17.

Operation of the circuit

When transmission is not taking place in either direction, a steady marking condition is maintained on the line L, and the armatures or tongues of the polar relays remain at their marking positions *m*, since the armature 25 of the main line relay MLR is held against its marking contact *m* at this time. Assume, however, that station S starts transmission, in which case a spacing signal is received over the line L. This causes the armature 25 of relay MLR to move to its spacing contact *s*, thereby applying positive grounded battery to the operating windings 31 and 27 of relays LR and IR, causing their armatures to be actuated to their spacing contact *s*. The movement of the tongue of intermediate relay IR to its spacing contact applies positive grounded battery to winding 68 of receiving relay RR, through a circuit comprising the winding 61 of relay TR, conductor 60, spacing contact and tongue of relay IR, conductor 64, marking contact *m* and tongue of sending relay SR, conductor 69, winding 68 of relay RR, conductor 67 and winding 66 of relay TR to ground. This causes the armature or tongue of relay RR to move to its spacing contact *s*, thereby sending a spacing or no-current signal to the subscriber's start-stop printer P on line 75. The current for operating the relay RR flows from positive battery through the windings of relay TR in such a direction as to hold the tongue of TR against its marking contact. Since the tongue of relay TR remains against its marking contact during the reception of signals from line S, negative potential is maintained on grid 16 of tube 17 thereby preventing the tube from becoming conducting and inadvertently operating the break relay BR. This insures that false operation of the hit relay HR will not occur during normal transmission from station S, notwithstanding that the tongue 25 of relay MLR intermittently engages its spacing contact during such period of transmission. A biasing winding 74 of relay SR holds the tongue of SR against its marking contact when the spacing signal is sent to the subscriber's line, which removes battery from the other windings 70 and 72 of relay SR.

A following marking signal received from the line L causes the tongue of the main line relay MLR to return to its marking contact. This operates relays LR and IR so that their tongues move to their marking contacts. The negative battery now supplied through the tongue of relay IR operates relay RR, through its winding 68, causing the tongue of relay RR to move to its marking contact, thereby applying negative grounded battery to the junction of the opposed windings 70 and 72 of relay SR, and through the winding 72 of relay SR to the subscriber's drop 75. The current from the tongue of relay RR

also flows through the winding 70 of relay SR to ground at 71, the direction of the current flow in windiings 70 and 72 of relay SR being such as to neutralize their magnetic effect.

When the operator or subscriber at station P is transmitting to station S, through the repeater circuit shown, the first signal received from station P will necessarily be a spacing signal which is transmitted momentarily by opening the line 75. This line being opened, current ceases to flow in winding 72 of relay SR. Winding 70 of relay SR continues to carry current, however, from the tongue and marking contact of relay RR, and this current is of sufficient strength to overcome the effect of the biasing winding 74 of relay SR, and cause the tongue of relay SR to move to its spacing contact. This closes a circuit through grounded winding 66 of relay TR, conductor 67, winding 68 of relay RR, conductor 69, the tongue and spacing contact of relay SR, conductor 77, and winding 76 of relay RR, to positive grounded battery, thereby operating relay TR. Relay RR does not operate, however, because the currents flowing in windings 68 and 76 are in opposition to each other. Relay TR operates to move its tongue to its spacing contact, and the spacing signal from line 75 is through the winding 10 of the main line relay MLR to the line L. The next signal from station P that is marking in character causes negative current to flow in winding 72 of relay SR through the line 75 to ground at station P. By reason of the flow of current through winding 72, the effect of the biasing winding 74 is such as to move the tongue of relay SR from its spacing contact to its marking contact. The RR relay does not follow signals transmitted by station P, and therefore the tongue of the relay will remain on its marking contact. The circuit thus established by relay SR causes marking battery to flow through winding 68 of relay RR and winding 66 of relay TR to ground, thus operating relay TR to its marking position, and transmitting a marking signal through the winding 10 of relay MLR to the line L.

The only transmission which operates relay TR is that from the subscriber's line 75. The grid 16 of the tube 17 is connected through a one megohm resistor 15 to the tongue of the transmitting relay TR, and the potential on the grid is negative until transmission starts. As the TR relay operates, the positive potential on its spacing contact is applied to the grid of the tube, causing plate current to flow and operating the relay BR in the detector through a circuit which comprises positive battery 79, resistance 80, conductor 81, winding of relay BR, conductor 82, anode 83 of tube 17, and cathode 85 to ground. The relay BR is a slow-release relay to prevent it from following the transmitted signals, and does not release on continuous "letters" characters during transmission from line 75. The slow-release characteristics are obtained by a suitable slug over the core of relay BR and, as heretofore stated, this characteristic is further enhanced by the condenser 84 bridged across the operating winding of the relay.

Assuming the blinding switch SW to be closed, the outer make contact 54 and armature of operated relay BR closes a circuit from ground at 37, left hand blade of switch SW, armature and contact 54, conductor 52, winding 51 of relay IR, conductor 45 and resistance 50, to the grounded battery 79, causing current to flow through the winding 51 of relay IR in a direction to lock its armature against the marking contact and prevent it

from following any breaks on the circuit that operates main line relay MLR. The inner make contact 36 and armature of relay BR complete a circuit, when the relay is operated, from ground at 37, right hand blade of switch SW, armature and contact 36 of the relay, and conductor 30 through a "blind" indicator lamp 32, the circuit continuing through conductors 30 and 26 to the armature 25 and marking contact of MLR to negative grounded battery. The lamp 32, which may be of distinctive color, for example, red, remains lighted so long as the automatic blinding switch SW is closed and the station P on line 75 is transmitting through the regenerative repeater to the line L, thereby giving a visual signal to this effect. Should transmission from station P cease, the tongue of transmitting relay TR will move to its marking contact, and hence the potential on the grid 16 of tube 17 will again become negative, thereby causing the deenergization of relay BR and extinguishing the lamp 32. The neon tube 20 serves as a protective device to limit the potential applied to the control grid 16 and to protect it from any surges which may occur in the circuit.

It is necessary for the screen grid 40 of tube 17 to have a positive potential applied to it to allow plate current to flow through the BR relay circuit when the transmitting relay moves to its spacing contact. This required positive screen potential is applied by the condenser 42 which is held charged through a high resistance 44 from battery 79. A connection is also made from the screen grid 40 through conductor 38 and resistance 39 to the spacing contact of the leak relay LR. Since the tongue of this relay is connected to negative battery, the operation of this relay following signals received on the MLR relay will apply an opposing negative voltage to the screen grid and thus prevent operation of the BR relay while the main line relay is operated. This arrangement prevents signal lights from appearing on two repeaters (one on which the break occurs and the other on the one receiving) even if the blinding switch SW of the detector circuit is thrown to its off position.

The relay BR controls a circuit extending from the tongue 25 of relay MLR, conductors 26, 30 and 33, through the winding of the hit relay HR, conductor 34, anode 35 and cathode 92 of the rectifier section of tube 17, and thence through conductor 91 and the inner make contact 90 and armature of relay BR, when operated, to ground at 37. Due to the action of the rectifier, so long as the tongue of relay MLR is on its marking contact, the negative current will not flow through the coil of relay HR. A break or hit on the line L, however, causes the tongue of relay MLR to move to its spacing contact, and positive battery is applied to this circuit and causes relay HR to operate. The operation of relay HR closes an alarm circuit comprising grounded battery 100, conductor 101, operated armature and contact 102 of HR, conductor 103, winding of a signal relay 105, conductor 106, through the normally closed contacts 107 of a push button 108, and thence to ground at 109. Relay 105 operates and locks up through a circuit from the battery 100, armature 104 and make contact of the relay, winding of the relay and through the push button contacts 107 to ground 109, so that the relay 105 remains locked up until the push button 108 is opened by an attendant. A grounded armature 110 and make contact of the relay 105 controls alarm devices which in the present embodiment

comprise a lamp 112 and a bell or buzzer 113; so long as relay 105 is locked up these alarm devices continue to give both visual and audible alarm signals indicating a hit, until the relay 105 is de-energized by the depression of push button 108.

Any hits occurring on the line L during the transmission of signals from station S to station P are detected by a similar regenerative repeater and automatic blind and hit detector at station S, it being understood that station S includes the circuit and apparatus illustrated in connection with station P, including a sending and receiving printer.

A further function of the circuit associated with the screen grid 40 of tube 17 is to permit a break by the operator at station P when transmission is being effected from station S to station P. When station P transmits a long "open" or a continuous sequence of "blank" characters, the transmission of these over line L will cause the leak relay LR in a similar automatic blind and break detector at station S, which is sending, to apply sufficient negative potential to the screen grid 40 to cause the BR relay there to be released and thus pass the break through the repeater at the sending station. If the operator at station P is transmitting to line L and the other station S wishes to break the transmission, the operator at the latter station sends a long "open" or succession of "blank" characters. These characters when received by the main line relay MLR cause the tongue 25 of the relay to be actuated and remain against the spacing contact, causing relay LR to be operated to its spacing contact, and thus applying negative battery to the screen grid 40 so that relay BR is released and the break is received at station P. Since the printer at station P is of the sending and receiving type, the operator at station P will note from his printed copy or from the lapse of printing operations at his printer that the station S wishes to break. The automatic blinding feature is optional; if not desired it may be cut out by throwing the switch SW to its off position, and the circuit will still function as a hit or break detector.

Assuming a hit or break to occur in line L while station P is transmitting, the tongue of relay MLR will move to its spacing contact as a result of the hit or open on L. Negative battery will then be applied to the tongue of MLR and through conductors 26, 30 and 33, the winding of HR, conductor 34, the anode 35 and cathode 92 of rectifier section of tube 17, and thence to ground through conductor 91, the make contact 90 and armature of relay BR to ground, causing relay HR to be operated and actuate alarm relay 105. Relay IR will not be operated and will not repeat the hit or open from line L to station P because the tongue of relay IR is held against its marking contact by positive grounded battery 79 which flows through resistance 30, conductor 45, winding 51 of IR, conductor 52, outer make contact 54 and armature of relay BR through switch SW to ground 37.

Hits on line L which occur during transmission from station P through the repeater to the line L will not cause errors to be recorded at station P in regard to the sending subscriber's own transmission. This is of importance where another repeater is connected at the same station with the one shown in the drawing, and those which at station P may be transmitting simultaneously to another line or lines. In such case, hits on line L would not cause errors in signals sent from P over these other repeaters.

Various modifications of the circuit arrangement shown, and various equivalents or substitutes for the devices illustrated, will readily occur to those versed in the art, without departing from the spirit and scope of the present invention. For example, separate tubes may be employed instead of the composite tube 17, and other known types of amplifier, relay and rectifier devices suitable for the purpose may be employed instead of those shown. The disclosure, therefore, is for the purpose of illustrating the principles of the invention which is not to be regarded as limited except as indicated by the scope of the appended claims.

What is claimed is:

1. In a half-duplex system, a telegraph line and a two-way repeater connected thereto for repeating permutation code impulses received from and transmitted to the line, said repeater comprising a line relay having an armature operable between marking and spacing contacts for producing negative and positive current pulses respectively in accordance with marking and spacing impulses received from said line, means including a relay in said repeater for transmitting permutation code impulses to said line, means operable when transmission of code impulses is proceeding to said line for detecting a hit on the line, said means including a hit detecting relay controlled by the armature of said line relay and operable when the armature of the line relay is actuated to its spacing contact by a hit occurring on the line for giving an indication of such condition, and relay means automatically operative to prevent false operation of the hit relay when the armature of the line relay engages its spacing contact during the normal reception of code impulses received from said line.

2. In a half-duplex system, a telegraph line and a two-way regenerative repeater connected thereto for repeating start-stop code impulses received from and transmitted to the line, said repeater comprising a line relay having an armature operable between marking and spacing contacts for producing negative and positive pulses respectively in accordance with marking and spacing impulses received from said line, means including a relay in said repeater for transmitting start-stop code impulses to said line, means operable when transmission of code impulses is proceeding to said line for detecting a hit on the line, said means including a hit detecting relay controlled by the armature of said line relay and operable when the armature of the line relay is actuated to its spacing contact by a hit occurring on the line for giving an indication of such condition, means for preventing operating current from passing through the hit relay when the armature of said line relay is against its marking contact, and relay means automatically operative to prevent false operation of the hit relay when the armature of the line relay engages its spacing contact during the normal reception of code impulses received from said line.

3. In a half-duplex system, a telegraph line and a two-way regenerative repeater connected thereto for repeating start-stop code impulses received from and transmitted to the line, said repeater comprising a line relay having an armature operable between marking and spacing contacts for producing negative and positive pulses respectively in accordance with marking and spacing impulses received from said line, means including a relay in said repeater for transmit-

ting start-stop code impulses to said line, means operable when transmission of code impulses is proceeding to said line for detecting a hit on the line, said means including a hit detecting relay controlled by the armature of said line relay and operable when the armature of the line relay is actuated to its spacing contact by a hit occurring on the line for giving an indication of such condition, means including a rectifier for preventing operating current from passing through the hit relay when the armature of said line relay is against its marking contact, and relay means automatically operative to prevent false operation of the hit relay when the armature of the line relay engages its spacing contact during the normal reception of code impulses received from said line.

4. In a half-duplex system, a telegraph line and a two-way regenerative repeater connected thereto for repeating start-stop code impulses received from and transmitted to the line, said repeater comprising a line relay having an armature operable between marking and spacing for producing negative and positive pulses respectively in accordance with marking and spacing impulses received from said line, means including a relay in said repeater for transmitting start-stop code impulses to said line, means operable when transmission of code impulses is proceeding to said line for detecting a hit on the line, said means including a hit detecting relay in circuit with the armature of said line relay and operable when the armature of the line relay is actuated to its spacing contact by a hit occurring on the line for giving an indication of such condition, means including a rectifier connected in series with the operating winding of said hit relay for preventing operating current from passing through the hit relay when the armature of said line relay is against its marking contact, and relay means automatically operative to prevent false operation of the hit relay when the armature of the line relay engages its spacing contact during the normal reception of code impulses received from said line.

5. In a half-duplex system, a telegraph line and a two-way regenerative repeater connected thereto for repeating start-stop code impulses received from and transmitted to the line, said repeater comprising a line relay having an armature operable between marking and spacing contacts for producing current pulses respectively in accordance with marking and spacing impulses received from said line, means including a relay in said repeater for transmitting start-stop code impulses to said line, means operable when transmission of code impulses is proceeding from the transmitting side of the repeater to said line for detecting a hit on the line, said means including a hit detecting relay controlled by the armature of said line relay and operable when the armature of the line relay is actuated to its spacing contact by a hit occurring on the line for giving an indication of such condition, and circuit connections including a space discharge tube and a relay controlled thereby for automatically blinding the receiving side of the repeater while the transmitting side thereof is transmitting to the line thereby to prevent hits on the line from passing through the repeater.

6. In a half-duplex system, a telegraph line and a two-way regenerative repeater connected thereto for repeating start-stop code impulses received from and transmitted to the line, said repeater comprising a line relay having an armature operable between marking and spacing contacts for producing current pulses respectively in accordance with marking and spacing impulses received from said line, means including a relay in said repeater having an armature and marking and spacing contacts for transmitting start-stop code impulses to said line, means operable when transmission of code impulses is proceeding from the transmitting side of the repeater to said line for detecting a hit on the line, said means including a hit detecting relay controlled by the armature of said line relay and operable when the armature of the line relay is actuated to its spacing contact by a hit occurring on the line for giving an indication of such condition, circuit means including a space discharge tube having a control grid and a relay controlled by the tube for automatically blinding the receiving side of the repeater while the transmitting side thereof is transmitting to the line thereby to prevent hits on the line from passing through the repeater, and circuit connections for controlling the potential applied to the control grid of said tube in accordance with the position of the armature of the said transmitting relay.

7. In a half-duplex system, a telegraph line and a two-way regenerative repeater connected thereto for repeating start-stop code impulses received from and transmitted to the line, said repeater comprising a line relay having an armature operable between marking and spacing contacts for producing current pulses respectively in accordance with marking and spacing impulses received from said line, means including a relay in said repeater having an armature and marking and spacing contacts for transmitting start-stop code impulses to said line, means operable when transmission of code impulses is proceeding from the transmitting side of the repeater to said line for detecting a hit on the line, said means including a hit detecting relay controlled by the armature of said line relay and operable when the armature of the line relay is actuated to its spacing contact by a hit occurring on the line for giving an indication of such condition, circuit means including a space discharge tube having a control grid and a slow-release relay controlled by the tube for automatically blinding the receiving side of the repeater while the transmitting side thereof is transmitting to the line thereby to prevent hits on the line from passing through the repeater, and circuit connections for controlling the potential applied to the control grid of said tube to make the tube conducting or non-conducting in accordance with the position of the armature of said transmitting relay with respect to its marking and spacing contacts.

8. In a half-duplex system, a telegraph line and a two-way regenerative repeater connected thereto for repeating start-stop code impulses received from and transmitted to the line, said repeater comprising a line relay having an armature operable between marking and spacing contacts for producing negative and positive pulses respectively in accordance with marking and spacing impulses received from said line, means including a relay in said repeater for transmitting start-stop code impulses to said line, means operable when transmission of code impulses is proceeding from the transmitting side of the repeater to said line for detecting a hit on the line, said means including a hit detecting relay controlled by the armature of said line relay and operable when the armature of the line relay is actuated to its spacing contact by a hit occur-

ring on the line for giving an indication of such condition, circuit means including a space discharge tube having a control grid and a screen grid and a blinding relay controlled by said tube for automatically blinding the receiving side of the repeater while the transmitting side thereof is transmitting to the line thereby to prevent hits on the line from passing through the repeater,

and means including a relay controlled by said line relay for applying negative potential to said screen grid to prevent operation of the blinding relay when said line relay is operating.

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