Jan. 5, 1937. W. W. CRAMER 2,066,520

TELEGRAPH REPEATER

Filed Aug. 17, 1935 3 Sheets-Sheet 1

FIG. 1

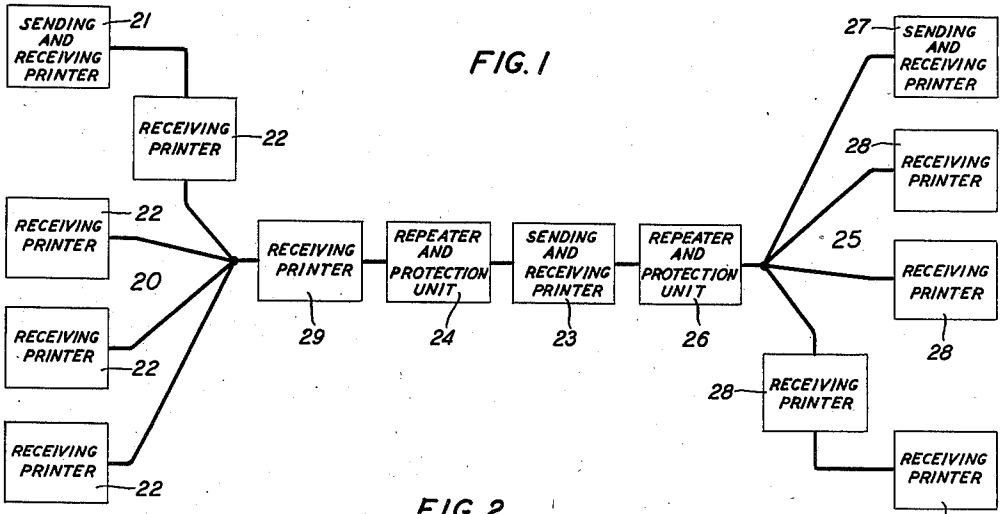
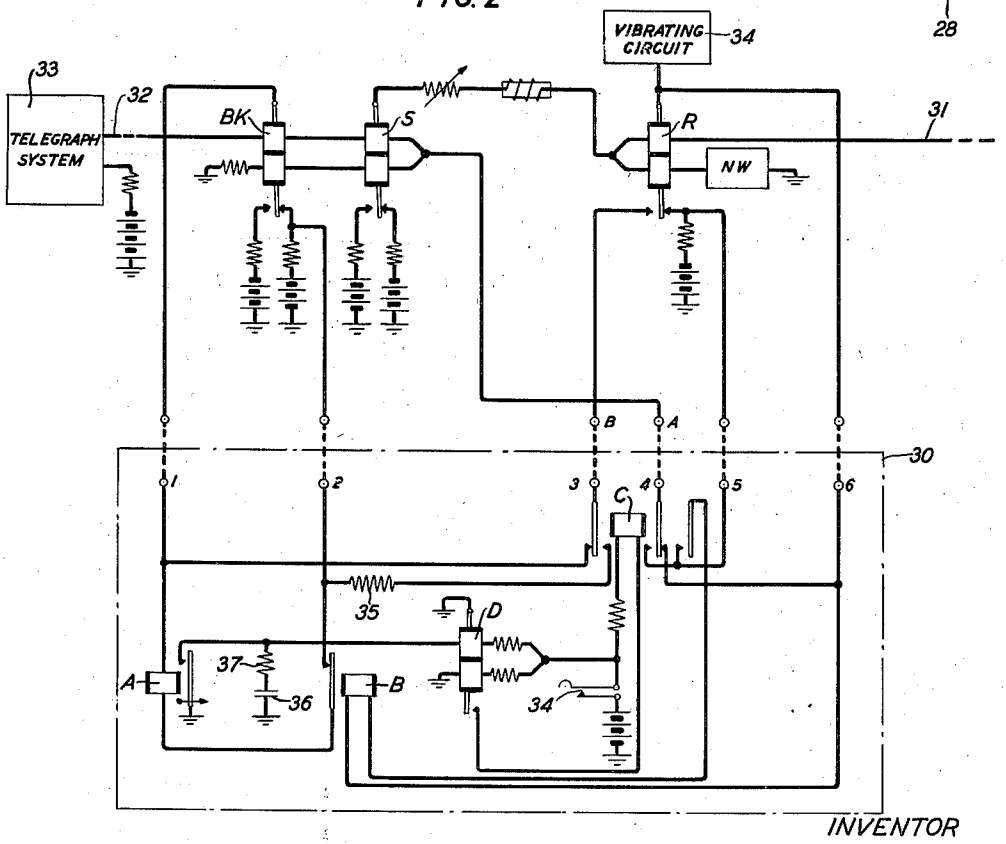


FIG. 2



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TELEGRAPH REPEATER

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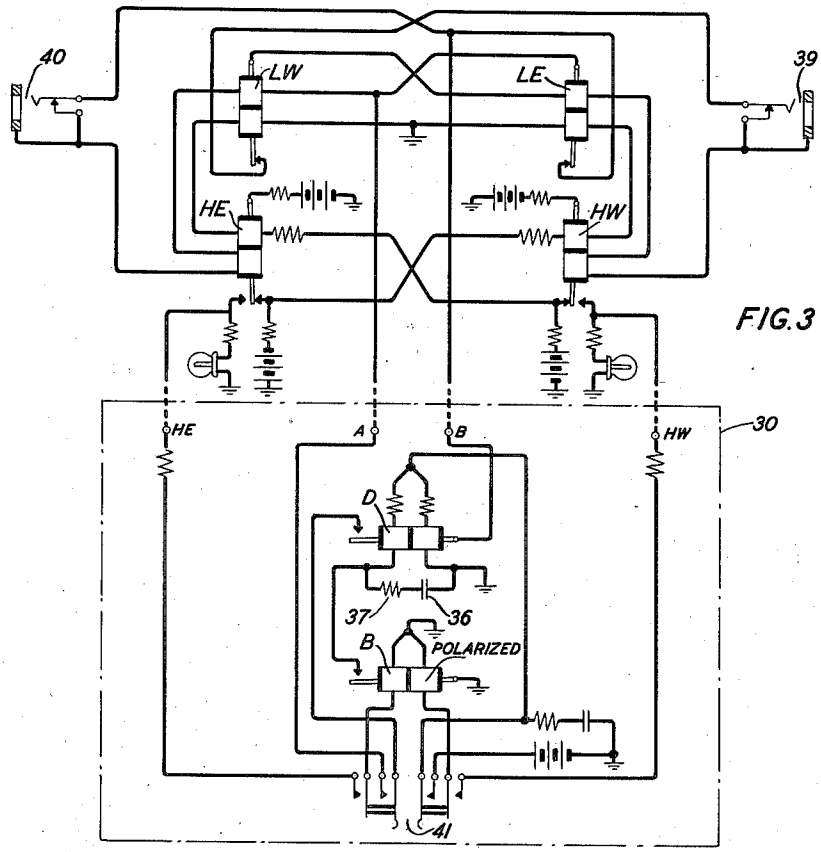

FIG. 3

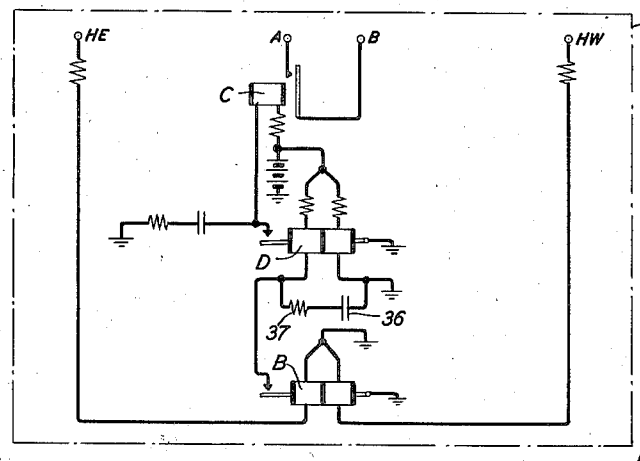

FIG. 3A

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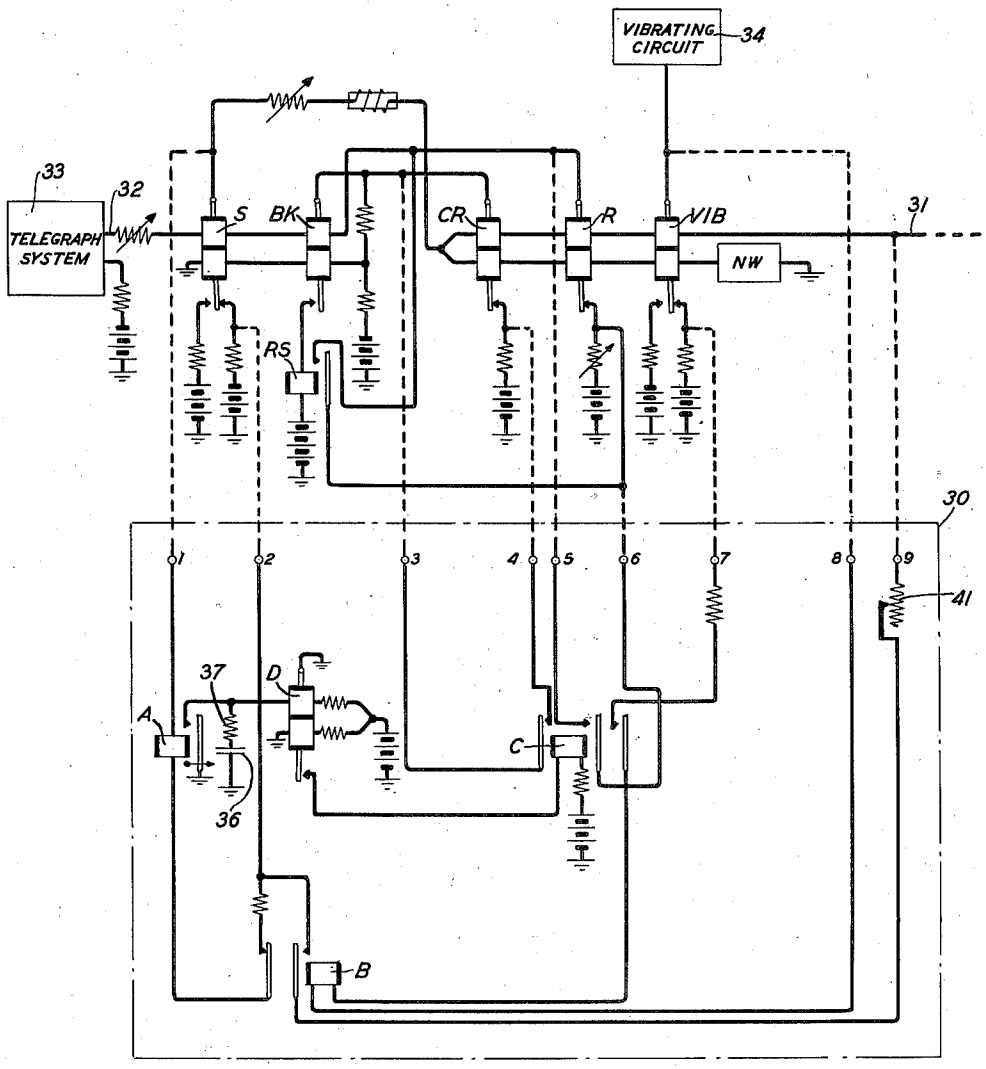
FIG. 4



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2,066,520

TELEGRAPH REPEATER

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Application August 17, 1935, Serial No. 36,614

7 Claims. (Cl. 178—69)

This invention relates to repeating systems and more particularly to impulse repeaters for use in telegraph systems.

In large extended telegraph systems having a large number of connected line stations, disturbances arising in any of these lines are transmitted to all the line stations, and interfere with the transmission of signal impulses over the system. The lines connected to these systems change from time to time, many of the changes being of a temporary nature so that it is impracticable to provide elaborate or special repeaters or other equipment for these lines. Other lines employ open wires and are therefore more subject to disturbances and momentary interruptions. However, these lines must not interfere with the transmission of signal impulses over the entire system.

The object of this invention is to provide a protection unit which may be readily attached to an impulse repeater which will prevent disturbances arising in one portion of a telegraph system from being repeated by the repeater and thus affecting the transmission of impulses over the entire telegraph system.

A feature of the invention relates to an accurately timed relay which will protect the system against momentary disturbances but will not interfere with long break signal impulses.

In brief this invention provides a unit which may be readily attached to telegraph impulse repeaters which comprises a slow release relay, the release time of which is accurately controlled, for short-circuiting the contacts of certain relays of the telegraph repeater during the operation of other relays in said telegraph repeater. Control relays are also provided for controlling this retarded relay in accordance with the operation of certain of the relays of the telegraph impulse repeater.

These and other objects and features of the invention may be more fully understood from the following description of several specific embodiments of the invention when read with reference to the attached drawings in which:

Fig. 1 shows a telegraph system employing several protection units in accordance with this invention;

Fig. 2 shows the terminal repeater to which a protection unit is applied;

Figs. 3 and 3A show a single line repeater to which protection units are connected; and

Fig. 4 a slightly different form of terminal repeater to which a protection unit is connected.

Referring now to Fig. 1, **20** represents the group of telegraph stations some of which, such as **21**, are provided with sending and receiving mechanisms, while others, such as **22**, are provided with receiving printers only. **25** represents another group of telegraph stations some of which, such as station **27**, are provided with sending and receiving printing apparatus while other stations, such as **28**, are provided with only receiving equipment. These two groups of stations are connected together by transmission lines which may include repeaters, such as **24** and **26**, as well as receiving printers, such as **29**, and send and receive the printer stations, such as **23**. Repeater **24** is equipped with the protection unit in accordance with this invention so that disturbances arising over the transmission line connecting the groups of stations **20** and **25** together will not interfere with the transmission of signals from any of the transmitting stations, such as **21**, to the other stations of group **20**. Thus signals originating in the group of stations **20** while being transmitted to all the other groups of the system are not disturbed or mutilated by any disturbances arising in any other part of the system shown in Fig. 1.

In a similar manner repeater **26** is provided with a protection unit which similarly protects the group of telegraph stations **25** from disturbances arising in other parts of the telegraph system during transmission of signals from any of the transmitting stations, such as station **27** of group **25**.

In order to simplify the description of this invention only three representative repeaters equipped with protection units will be described. These three repeaters, it will be understood, represent different classes of repeaters but do not include each and every specific type of repeater to which the unit in accordance with this invention can be applied.

Referring now to Fig. 2, the BK, S, and R relays represent the break, send, and receive relays of a terminal telegraph repeater employing a receiving relay and a balanced loop arrangement. Line **31** is connected to a long cable or open wire line which is subject to interfering currents which are sometimes called "hits". Line **32** represents the balanced loop which is connected to a telegraph system **33** which is not subject to many interfering currents or potentials. Connected to the repeater is a protection unit **30** which comprises relays A, B, C, and D which are connected to the repeater by means of terminals and lines **1**, **2**, **3**, **4**, **5**, and **6**. Assuming all the relays of both the repeater and

the protection unit to be in the position shown in Fig. 2 with the R, S, and BK relays to the right and switch contacts **34** closed, it will be observed that the circuits of all the relays of the protection unit **30** are in the released position. Under this condition if signals originate at the end of the open-wire line or cable **31** they will be immediately repeated through the repeater to the loop circuit **32** and teletypewriter exchange system **33**. Relay R will repeat the signals received from line **31** to loop **32**. It is noted that relay R is provided with a vibrating circuit **34** which is indicated in diagrammatic form to simplify the drawing circuit. It is to be understood, however, that this circuit includes other windings on the R relay as well as other apparatus usually employed in vibrating circuits and well known in the telegraph art. If signals originate from the opposite line, that is, from the telegraph system **33** and are transmitted over loop **32**, these signals will be immediately transmitted to line **31** by the send relay S which follows these signals and repeats them to line **31**. The moment the signals are received from telegraph system **33** over the line **32**, the armature of the BK relay which also follows the signals received from loop **32**, will move to its left-hand contact, thus energizing relay A of the protection unit **30**. The operation of relay A operates relay D on a circuit from ground on the armature of the A relay, contact of the A relay, the upper winding of the D relay through key **34** to battery. Relay D in operating completes an obvious circuit for the operation of relay C. Relay C in operating disconnects the common point of the two windings of the S relay from the armature of the R relay and connects it to the marking battery connected to the marking contact of the R relay. Relay C also connects the winding of relay B between the marking contact and the armature of the R relay. In addition relay C connects spacing battery through resistance **35** to the spacing contacts of the R relay. If any stray impulses are received over line **31** during the time signals are being transmitted from the telegraph system **33**, they will not be transmitted through the repeater since the transmission path from the armature of the R relay is now interrupted by the C relay. However, when the operator at the end of line **31** desires to transmit a break or open signal to the transmitting station in a telegraph system **33**, the operator will transmit a break or spacing signal which will cause the R relay to move to its left-hand or spacing contact, thereby operating the B relay which in turn opens the operating circuit for the A relay permitting the A relay to release. The release of the A relay, however, does not immediately release the D relay because the charging current of the condenser **36** in series with resistance **37** through the upper winding of relay D is sufficient to hold the D relay operated for an appreciable period of time. In the preferred embodiment of this invention the constants of condenser **36** and resistance **37** as well as of relay D are so chosen as to provide a delay of from 1 to 2 seconds from the release of the A relay until the D relay releases. When the D relay releases it releases the C relay which in turn completes the transmission path from the common point of the windings of the S relay to the contacts of the R relay which then transmits the open or break signal to the transmitting station of telegraph system **33**.

Thus during the transmission of signals from a telegraph station of telegraph system **33** momentary stray currents or circuit interruptions arising in line **33** if they are shorter than the delay time of relay D will not be transmitted back to telegraph system **33** and therefore will not interfere with the transmission of the signals over this telegraph. However, in case it is desired to send a break signal which must be longer than the release time of relay D, the break signal will then be transmitted over telegraph system **33** to all the stations in this system including the station transmitting signals. If it is desired, unit **30** may be temporarily disconnected by restoring the battery supply key **34** so that the battery is disconnected from the circuit. In this case the circuit operates as a normal repeater repeating all impulses in both directions at all times.

Fig. 3 shows a through or single line repeater equipped with a protection unit **30**. In this figure it is assumed that jack **39** is connected to a telegraph circuit which normally has current flowing in it and which is more or less subject to interfering or stray potentials and momentary circuit interruptions. Jack **40** is arranged to be connected to a telegraph circuit which normally has current flowing through it. The telegraph system and line connected to jack **40** is assumed to be substantially free from stray impulses and momentary circuit interruptions. The relays of this repeater represent the usual relays found in a single line repeater. Relays LE and HW follow signals received from the line connected to jack **39** while the LW and HE follow the signals received from line **40**. The LW relay repeats the signals received through jack **40** to the line connected to jack **39** while the HE relay reverses the biasing current through the biasing windings of the LE and HW relays during the time the LW relay has the line circuit windings of these relays open. The LE and HW relays operate in a similar manner and perform a similar function when signals are received from the line connection to jack **39**. The lines connected to jack **39** and **40** have not been shown since it is desired to simplify the drawing as much as possible. However, it is to be understood that any suitable telegraph line circuit which normally has current flowing therein which is interrupted to produce telegraph signal impulses may be connected to these jacks.

In case it is desired to protect the telegraph stations of the system and line connected to jack **40** during the time they are transmitting telegraph signals from disturbing currents and momentary circuit interruptions occurring in the line connected to jack **39**, key **41** of the protection unit **30** is operated. This connects one winding of the B relay over the HE lead to the spacing contact of the HE relay and the other winding of the B relay over the HW lead to the spacing contacts of the HW relay. This polarized B relay which has two windings is shown connected to serve as both the A and the B relay of the "hit" protection unit **30** of Fig. 2.

In case signals are transmitted from the line connected to jack **40**, the HE relay will follow these signals and in closing its spacing contact will operate the B relay over a circuit from battery on the armature of the HE relay to ground through the left hand winding of the B relay. The B relay on operating operates the D relay which in turn short-circuits the contact of the LE relay so that if due to some stray currents or circuit interruptions the LE relay should momentarily release, the D relay will maintain the cir-

cuit connected to jack 40 and thus prevent these stray currents or circuit interruptions from being repeated into line 40 and disturbing the transmission of the signals in the telegraph system connected to this line. However, in case it is desired to send a break signal from the line connected to jack 39 through to the transmitting station connected to the line connected to jack 40 it is necessary to send a long break signal through the circuit of jack 39. This causes relay LE and HW to release. As pointed out above, the relay LE is unable to transmit this break signal to the circuit of jack 40 at this time because its contacts are short-circuited by the contacts of relay D of the protection unit 30. The HW relay, however, also operates at this time and in operating completes a circuit through the right-hand winding of the polarized B relay. Current flowing in this circuit produces a greater magnetic effect which opposes the magnetic effect of the current flowing in the left-hand winding. This causes the armature of the B relay to open its contacts. If the circuit of the right-hand winding of the B relay is completed for a sufficiently long time, the D relay will release as in Fig. 2 when condenser 36 becomes charged thus removing the short circuit from around the contacts of the LE relay at which time the open or break signal is repeated to the circuit of jack 40. Thus the telegraph system connected to jack 40 is protected from momentary stray impulses received in line 39 during the time signal impulses are being transmitted from the telegraph system connected to jack 40. In case, however, it is desired to send a break signal to the telegraph system during this time, it is necessary to send a longer break signal which is eventually transmitted to the transmitting station connected to jack 40.

It thus appears that the timing of the release of the D relay of these protection units is a matter of rather great importance in this circuit. If the release time of this relay is too short the line or telegraph system connected to jack 40 will not be sufficiently well protected from momentary stray impulses or circuit interruptions arising in the line or system connected to jack 39. On the other hand if the release time of this relay is too long, it is necessary to send an exceedingly long break signal from the circuit of jack 39 in order that any break signal at all may be received in the circuit connected to jack 40. For these reasons it is very desirable that the release time of the D relay should not vary greatly but should be rather accurately controlled. In order to accomplish this it is necessary to provide a polarized D relay which is held non-operated by means of a biasing winding, this biasing winding is shown as the right-hand winding of the D relay in the drawings.

In certain cases it is desirable to isolate this polarized relay from the telegraph system for various reasons. In the first place, under certain conditions the contact pressure may not be sufficient as to reliably short-circuit the contact of the LE relay in which case it may be desirable to provide an additional C relay operated from the contact of the D relay which in turn short-circuits the contact of the LE relay. This is shown in Fig. 3A. In addition by employing the additional relay C the polarized D relay may be completely isolated from the telegraph circuit thus preventing any potential arising in the telegraph circuit from reaching the D relay. This is very desirable when, as is usually the case, the armature of the polarized relay is connected to the base and cover of the relay, because it tends to prevent shocks from the telegraph battery due to touching the frame or cover of the relay and also because it tends to prevent interference in the telegraph system dut to accidental grounds or other stray potentials or wires touching the relay frame or cover.

Fig. 4 shows a different type of terminal repeater to which protection unit 30 may be connected. This repeater employs in addition to the repeaters shown in Fig. 2 a CR relay and a VIB relay, as well as the R relay and balancing network NW. As RS relay is also provided. These relays func tion to transmit signals from the open wire line or cable 31 which is subject to an appreciable amount of interfering impulses or momentary circuit interruptions. The operation of this circuit is quite similar to that shown in Fig. 2. However, more contacts on the C relay of the protection unit 30 are required to short-circuit the contacts of various of the relays associated with line 31. The left-hand contact of the repeater relay short-circuits the contact of the CR relay during the time signal impulses are being transmitted from the telegraph system 33 over line 32 to line 31. The inner right-hand contact similarly short-circuits the contacts of the re-receiving relay R, while the outer right-hand contacts connect the B relay in circuit with the contacts of the VIB relay. Thus during the time signals are transmitted from a transmitting station of telegraph system 33, any momentary stray impulses which operate the VIB, CR and R relays from their marking contacts are not repeated to the telegraph line 32 and thus do not interfere with the operation of the telegraph system 33. However, in case a long spacing or break impulse is received from line 31 which is more than sufficiently long to operate the B relay, to release the A relay, to release the D relay after an interval of time, and to release the C relay, all in sequence, the remaining portion of said long impulse is then repeated or transmitted over line 32 to the transmitting stations as well as all of the other stations of the telegraph system 33. Under certain conditions it is necessary to provide a locking circuit for the VIB relay during the long interval of time that is necessary for line 31 to be open. This locking circuit is provided by lead 9. The resistance 41 of the protection unit 30 is provided to adjust this locking current, so that under normal conditions it does not interfere in any way with the normal transmission of signals through the repeater but does provide a locking circuit for the VIB relay during the time the break signal is being transmitted over line 31 when signals are also being transmitted from a transmitting station of the telegraph system 33.

Relay A of the protection unit may be somewhat slow in releasing to hold over signal impulses and thus materially reduce the wear of its contacts.

Having thus described the several specific embodiments of this invention, its novel features will now be particularly pointed out and set forth in the following claims.

What is claimed is:

1. In combination, a protection unit comprising retarding relay means and an impulse repeater comprising a first group of repeating relays for repeating impulses, a second group of repeating relays for repeating impulses, and an operative connection between said repeater and said unit whereby said retarding relay means disables said second group of repeating relays during the

operation of said first group of repeating relays.

2. A protection unit for an impulse repeater which transmits impulses from a first circuit to a second circuit, said protection unit comprising retarded relay means operative by said repeater during and for a predetermined time after the transmission of impulses from said first circuit to said second circuit and switching means controlled by said retarded relay means for maintaining said first circuit closed through the repeater.

3. A telegraph system comprising a plurality of stations, a plurality of lines connecting said stations together, a plurality of repeating devices normally operative to transmit the signal impulses between said lines, a plurality of protection units, an operative connection between said repeaters and said units, said units comprising relay means for short-circuiting a portion of said repeater transmitting means.

4. In combination an electrical impulse repeater comprising a first circuit, a second circuit, relay means connected to said circuits for repeating electrically impulses from either of said circuits to the other of said circuits and a protection unit comprising additional relay means for maintaining one of said circuits during and a short interval of time after the transmission of impulses from that circuit to the other circuit.

5. In combination an electrical impulse repeater comprising a first circuit, a second circuit, relays controlled by said first circuit for repeating impulses to said second circuit, other relays controlled by said second circuit for repeating impulses to said first circuit, and a protection unit comprising an accurately timed relay for momentarily disabling said other relays during the operation of said relays controlled by said first circuit.

6. In combination, an electrical impulse repeater for repeating impulses between two circuits and a protection unit comprising accurately timed relay means controlled by said repeater for preventing the transmission of short momentary impulses from one of said circuits to the other of said circuits during the transmission of signal impulses from said other circuit to said first circuit, but permitting the transmission of long signal impulses between said circuits at all times.

7. In combination, an electrical impulse repeater for repeating impulses between two circuits and a protection unit comprising a polarized relay, a condenser circuit therefor for accurately timing the release of said polarized relay, switch relays for controlling said polarized relay and an operative connection between said repeater and said protection unit whereby said protection unit prevents the transmission of momentary impulses from one of said circuits to the other of said circuits during the transmission of signal impulses from said other circuit to said first circuit, but permits the transmission of long break signals between said circuits at all times.

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