

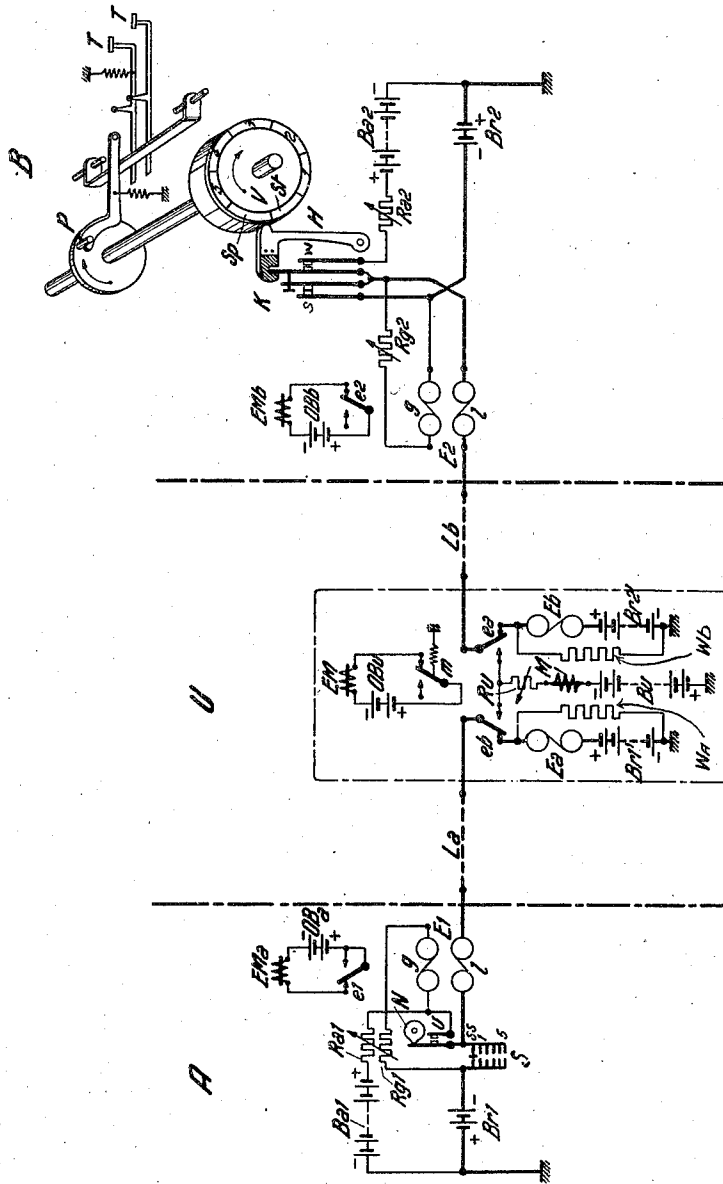
July 7, 1936.

M. AMANN ET AL

2,047,091

DOUBLE CURRENT TELEGRAPH INSTALLATION

Filed May 17, 1935



Inventors.

MAX AMANN and
SIEGFRIED CAHN

By

Dawell & Dawell

Attorneys.

UNITED STATES PATENT OFFICE

2,047,091

DOUBLE CURRENT TELEGRAPH
INSTALLATIONMax Amann and Siegfried Cahn, Frankfort-
on-the-Main, GermanyApplication May 17, 1935, Serial No. 22,160
In Germany May 19, 1934

9 Claims. (Cl. 178-2)

This invention relates to double current telegraph installations in which a battery for supplying what is called a "marking" current to the line is connected to the line at each end through a polarized receiving relay. In such telegraph installations, during the sending of the current signals effected by the transmitting contact, a "spacing" battery is connected to the line at the transmitting station which acts in opposition to the "marking" battery at the other end of the line and transmits a "spacing" current through the line in a direction opposite to that of the "marking" current. The voltage of this "spacing" battery is considerably greater than that of the "marking" battery at the same station so that in the receiving relay of the station at the other end of the line, the "marking" current and the "spacing" current are approximately equal. These "spacing" and "marking" currents which can be made to flow in either direction also flow through the receiving relay of the transmitting station but the "spacing" current at this end of the line, in consequence of the leakage losses along the line and the larger voltage of the "spacing" battery, is substantially greater than the "marking" current. The sensitive receiving relay of the transmitting station cannot, therefore, operate correctly during the signal transmission so as to transmit the signal combination. The transmitted text cannot, therefore, be recorded.

In order that the relay at the sending station may operate correctly, according to the invention, the relay is provided with a second winding which is switched in when the "spacing" battery is switched in. This second winding can be so designed that the resulting magnetic flux produced by it and by the winding connected to the line is of the same size as and acts in the opposite direction to the magnetic flux which is produced by the line winding of the relay when it is energized merely by the "marking" current.

An example of a telegraph installation in accordance with the invention is illustrated in the accompanying drawing. A telegraph installation is shown having two stations A and B which are connected together by a line L. Both stations are fitted out so that they can be used at any time for the transmission through the line of signals composed of five current signals. The drawing only illustrates those parts of the system at the two stations which are essential for the invention. The type of mechanical control used for the transmitting contact has been indicated only in the station B.

The line L is subdivided into two sections L_a

and L_b which are coupled together through a repeater U.

The telegraph apparatus of the station A is provided with a set of transmitting contacts S, comprising a contact ss, which is normally closed, for transmitting the start and stop signals and, parallel to this contact, five selectable contacts 1-5 which can be closed in sequence for transmitting the five current impulses. Such sets of transmitting contacts are known in telegraph apparatus of the Morkrum type. The contacts of the set S are in series with an earthed "marking" current battery Br₁ in the station A and the line winding l of the polarized receiving relay E₁. The "marking" current circuit runs through the section L_a of the line, the contact eb, the relay E_a of the repeater U and the steady current battery Br₁' provided therein. The batteries Br₁ and Br₁' are connected in series and are of the same size so that they allow a steady "marking" current to flow over the line and the receiving relays at each station.

In the station A, an earthed "spacing" battery BA₁ is also provided which is of at least double the voltage of the battery Br₁ or Br₁'; having regard to the loss of current through leakage along the line, the "spacing" battery frequently has to have a considerably higher voltage. The "spacing" battery BA₁ can be connected in opposition to the "marking" batteries Br₁ and Br₁'. In the normal condition, the battery BA₁ is disconnected at the contact u in order to save current. The contact u is controlled by a cam disc N which can be fixed to the (unillustrated) shaft of the transmitting distributor. As this transmitting distributor shaft makes a single revolution every time a signal is transmitted, the contact u will also be closed once every time a signal is transmitted. A protective resistance Ra₁ prevents the occurrence of high short circuit currents when the contacts of the set S and the contact u are simultaneously closed.

The line relay E₁ has, in addition to the line winding l, a counter winding g which can be short circuited by the contact ss and by the contacts S 1-5, after the contact u has been closed at the beginning of the revolution of the transmitting distributor shaft. This counter winding g is connected in series with the regulating resistance Ra₁ and is so designed that when short circuited, there is practically no appreciable delay in the operation of the relay E₁ due to the signal received through the winding l. If the short circuiting of the winding g is removed by opening the contact ss (for example, during the start

section at the beginning of each transmitted signal, at which instant the contact *u* is closed), a current will flow through it and the winding *l* from the "spacing" battery *Ba1*. The number of
 5 ampere turns of the counter winding *g* is made such that the resulting magnetic flux which is produced by the simultaneous energization of the two windings by the battery *Ba1* is of the same magnitude as the magnetic flux which normally
 10 is produced solely by the energization of the winding *l*. It flows, however, in the opposite direction to the latter flux.

The relay *E1* is constructed as a polarized relay. By means of its contact *e1*, it controls local
 15 circuits and in particular, the circuit which includes the receiving magnet *EMa* of the telegraph apparatus of the station A.

The telegraph apparatus of the station B includes a set of contacts *K* comprising a transmitting contact *s* which is normally closed and a further contact *w*. The set of contacts *K* is controlled through a control lever *H* by the cams
 20 *St*, *l* to *5* and *Sp* of a rotary cam switch *V*. The cams *St* and *Sp* come into use for the start and stop current signals while the cams *l* to *5* are differently set according to the operation of the keys *T* of a key board and thus determine the five current impulses. The cam switch *V* is released by means of a start stop coupling *P* at
 25 each signal transmission for one complete revolution. The construction of such a cam switch is described in detail in Patent No. 1,983,960. The transmission contact *s* is in the steady "marking" circuit which includes the earthed "marking"
 30 current battery *Br2*, the winding *l* of the receiving relay *E2*, the line section *Lb*, the contact *ea*, the relay *Eb* of the repeater *U* and the "marking" battery *Br2'*. The two batteries are connected in series and are of equal size. The earthed "spacing" battery *Ba2* of the station B has a considerably higher voltage than the "marking" battery
 40 *Br2*. The protective resistance *Ra2* allows the flow of current from the "spacing" battery to be regulated in accordance with the leakage occurring in the line section *Lb*. The "spacing" battery *Ba2* is connected by means of the contact *w* every time the set of contacts *K* is reversed. The set of contacts *K* is constructed as a make-before-break contact so that the contact *w* is closed at least for the duration of the opening of the
 50 contact *s*.

The relay *E2* has a counter winding *g* which works similarly to the counter winding of the relay *E1*.

55 The repeater *U* has, in addition to the polarized relays *Ea*, *Eb* connected in series through the earthed "marking" batteries *Br1'*, *Br2'*, a "spacing" battery *Bu* which, similarly to the "spacing" batteries *Ba1* and *Ba2* has a considerably higher voltage (at least twice as high) as the "marking" batteries *Br1'* and *Br2'*. This "spacing" battery
 60 *Bu* is earthed with opposite potential. In the "spacing" current circuit there are a neutral relay *M* and a resistance *RU*. The relay *M* through its contact *m* controls a local circuit in which, for example, the receiving magnet *EM* of a recording device or a switching device lies. The relays *Ea* and *Eb* are electrically polarized by a constant flow current through the resistances *Wa*
 70 and *Wb*.

The manner of operation of the arrangement is as follows:—

Let it be assumed that signals are to be transmitted from the station A to the station B and that the apparatus of both stations is ready for

operation. At the beginning of the transmission, the state of affairs is as illustrated; the relays *E1* and *Ea*, as well as the relays *Eb* and *E2* are energized and maintain their armatures in the illustrated normal position. A steady "marking" current flows in a particular direction through the line sections *La* and *Lb*.

During the start section of the transmitted signal, the steady "marking" current flowing through the section *La* is interrupted by means of the contact *ss* in favour of a "spacing" current from the battery *Ba1* flowing in the opposite direction which, in the meantime, has been connected by means of the contact *u*. The "spacing" battery *Ba1*, owing to its higher voltage, is able to overcome the counter voltage of the "marking" battery *Br1'* of the repeater *U*. The "spacing" current supplied from the battery *Ba1* reverses the polarity of the repeater relay *Ea* so that the latter throws its contact *ea*. The relay *Eb* remains under the influence of the current flowing through the resistance *Wb* in spite of being switched from the line section *Lb* into the illustrated position.

The contact *ea* opens the steady "marking" circuit through the line section *Lb* and connects the counter voltage of the "spacing" battery *Bu* to the line. The voltage of the battery *Bu* overcomes the voltage of the "marking" battery *Br2*. The "spacing" current from the battery *Bu* now flowing in the opposite direction to the "marking" current energizes the winding *l* of the relay *E2* so that the latter reverses its armature and interrupts the circuit for the receiving magnet *EMb*.

During the section following the start section of the signal, the contact *l* of the set of transmitting contacts *S* of the station is opened or closed according to the signal to be sent. If it is opened, then the state of affairs described above is maintained through the opening of the contact *ss*. If, however, it is closed, then the "marking" battery *Br1* is again connected directly to the winding *l* of the relay *E1* and the line section *La*. Although the "spacing" battery *Ba1* is connected in parallel with the battery *Br1* through the contact *u*, no "spacing" current can flow through the line because the "spacing" battery lies in series with the resistance *Ra1*. All the relays have their polarities reversed again by the "marking" current so that their contacts are returned into the illustrated position.

In this way, at each sequence of openings and closings of the transmitting contact, the magnet *EMb* is correspondingly influenced which causes the signal sent from the station A to be printed in known manner in the station B.

In order that the relay *E1*, the winding *l* of which is traversed, when the transmitting contact at the station A is opened, by a current from the "spacing" current battery *Ba1* which is considerably larger than the "marking" current, may follow the double current impulse free from distortion, the transmitting contact each time it is opened will also switch in the counter winding *g*. The magnetic flux produced by the two windings together is on their energization by the "spacing" current approximately equal to the magnetic flux which is produced, when the transmitting contact is closed, simply by the "marking" current flowing through the winding *l*. The same force is always exerted on the armature *e1* of the relay *E1*. The receiving magnet *EMa* controlled by the contact *e1* records the impression of the signal transmitted through the line *L*. The strength of the "spacing" current flowing

through the counter winding can be adjusted by means of the adjustable resistance $Rg1$.

In the repeater U, the relay M is intermittently energized during the signal transmission and controls the magnet EM through its contact m .

During the stop section at the end of each transmitted signal, the apparatus is again brought into the illustrated normal position.

The system operates in a like manner for the transmission of signals from the station B to the station A. In the station B, however, without in this way introducing any difference as regards the flow of current to the line, the "spacing" battery $Ba2$ is now always switched in for one signal section by means of the set of make-before-break contacts K and thus is only short circuited for a short time for the duration of the simultaneous closing of the contacts s and w . In contrast to the system at the station A in which the "spacing" battery $Ba1$ is also short circuited for the feed current signal elements through the resistance $Ra1$, a saving in current is thus produced.

The resistance $Ra1$ and $Ra2$ are adjustable and the voltages of the "spacing" batteries $Ba1$ and $Ba2$ are adapted to the leakage conditions in the line sections. The resistances $Rg1$ and $Rg2$ are also adjustable. They determine the size of the current flowing through the counter winding of the receiving relays. The resistances $Ra1$ and $Rg1$ can also be made adjustable in common as is shown in the case of the station A. Thus the adjustment of the voltage of the "spacing" current and of the current flowing through the counter winding of the relay at the transmitting station, according to the leakage of the line at each moment, is very much simplified.

As the "spacing" battery, the voltage of the battery Bu of the repeater U must be adapted to the leakage conditions in the line sections La and Lb . This is effected by means of the adjustable resistance RU. The adjustment of the resistance can be undertaken by hand by a supervisor according to the needs of the transmitting station A or B which are recorded at the repeater receiving apparatus. They can be adjusted by remote control by means of the magnet EM. In most cases it is sufficient to provide a single resistance RU; a suitable separate resistance could also, however, be provided for two line sections.

We claim:—

1. A double current telegraph installation comprising two stations, a line between said stations, a polarized receiving relay at each station connected to said line, a marking battery at each station connected through said receiving relay to said line and the marking batteries of the two stations being connected in series allowing a steady marking current to flow over the line and said receiving relays at each station, a spacing battery at one of said stations of higher voltage than the marking battery, a transmitting contact at said last mentioned station adapted to make said spacing battery effective for sending a spacing current in a direction opposite to the direction of the marking current, said polarized receiving relay being provided with a plurality of windings, one of which windings is connected to said line and to said transmitting contact and another being connected to said spacing battery.

2. A telegraph installation according to claim 1, in which the second winding of said receiving relay is designed so that the magnetic flux produced by it and by the line winding due to their energization by the spacing current is equal to

and acts in opposition to the magnetic flux which is produced by the line winding of the relay due to its energization only by the marking current.

3. A double current telegraph installation, comprising two stations, a line between said stations, a polarized receiving relay at each station, a marking battery at one of said stations, a spacing battery at one of said stations having a higher voltage than said marking battery, a transmitting contact at said last mentioned station adapted to make said spacing battery effective, said polarized receiving relay being provided with a plurality of windings, one of which windings is connected to said line and to said transmitting contact and another being connected to said spacing battery and being so designed that when short circuited, the operation of said relay is not delayed, said transmitting contact being adapted normally to short circuit that winding of said relay which is connected to said spacing battery.

4. A double current telegraph installation, comprising two stations, a line between said stations, a polarized receiving relay at each station, a marking battery at each station connected through said receiving relay to said line and the marking batteries at the two stations being connected in series allowing a steady marking current to flow over the line and said receiving relays at each station, a spacing battery at one of said stations, a transmitting contact at the last mentioned station adapted to make said spacing battery effective, an adjustable resistance included in the circuit of said spacing battery, said spacing battery having a higher voltage than the marking battery, said polarized receiving relay being provided with a plurality of windings, one of which windings is connected to the line and to the transmitting contact and another to said spacing battery.

5. A double current telegraph installation, comprising two stations, a line between said stations, a polarized receiving relay at each station, a marking battery at each station connected through said receiving relay to said line and the marking batteries at the two stations being connected in series allowing a steady marking current to flow over the line and said receiving relays at each station, a spacing battery at one of said stations having a larger voltage than the marking battery, a transmitting contact at said last mentioned station adapted to make said spacing battery effective, said polarized receiving relay being provided with a plurality of windings, one of said windings being connected to the line and to the transmitting contact and another being connected to said spacing battery, and an adjustable resistance in the circuit of the winding connected to said spacing battery.

6. A double current telegraph installation comprising two stations, a line between said stations, a polarized receiving relay at each station, a marking battery at each station connected to the said line, a spacing battery at one of said stations having a larger voltage than the marking battery at either station, a transmitting contact at the last mentioned station adapted to make said spacing battery effective, and an adjustable resistance in the circuit of said spacing battery, said polarized receiving relay being provided with a plurality of windings, one of said windings being connected to said line and to said transmitting contact and another being connected to said spacing battery and an adjustable resistance in the circuit of the winding connected to said spacing battery, the 75

two named adjustable resistances being constructed so as to be controlled in common.

7. A double current telegraph installation comprising two stations, a line between said stations, said line being subdivided into two sections, a repeater connected between said sections, said repeater comprising two relays, two marking batteries, each of said marking batteries being connected through one of said relays to one section of the line, a spacing battery, and contacts controlled by each of said relays, the contacts controlled by the relay connected to the first section of the line being adapted to connect said spacing battery to the second section of the line and vice versa.

8. A double current telegraph installation, comprising two stations, a line between said stations, said line being subdivided into two sections, a repeater connected between said sections, said repeater comprising two relays, two marking batteries, each of said marking batteries being connected through one of said relays to one section of the line, a spacing battery, a relay connected

in series with said spacing battery and contacts controlled by each of said relays connected to the marking batteries, the contacts controlled by the relay connected to the first section of the line being adapted to connect said spacing battery with the second section of the line and vice versa.

9. A double current telegraph installation, comprising two stations, a line between said stations, said line being subdivided into two sections, a repeater connected between said sections, said repeater comprising two relays, two marking batteries, each of said marking batteries being connected through one of said relays to one section of the line, a spacing battery, a relay connected in series with said spacing battery, an adjustable resistance connected in series with said spacing battery, and contacts controlled by each of said relays connected to the marking batteries and adapted to connect said spacing battery to said sections of the line.

MAX AMANN.
SIEGFRIED CAHN.