

April 14, 1942.

E. J. AGNEW

2,280,018

SIGNALING APPARATUS

Filed May 18, 1939

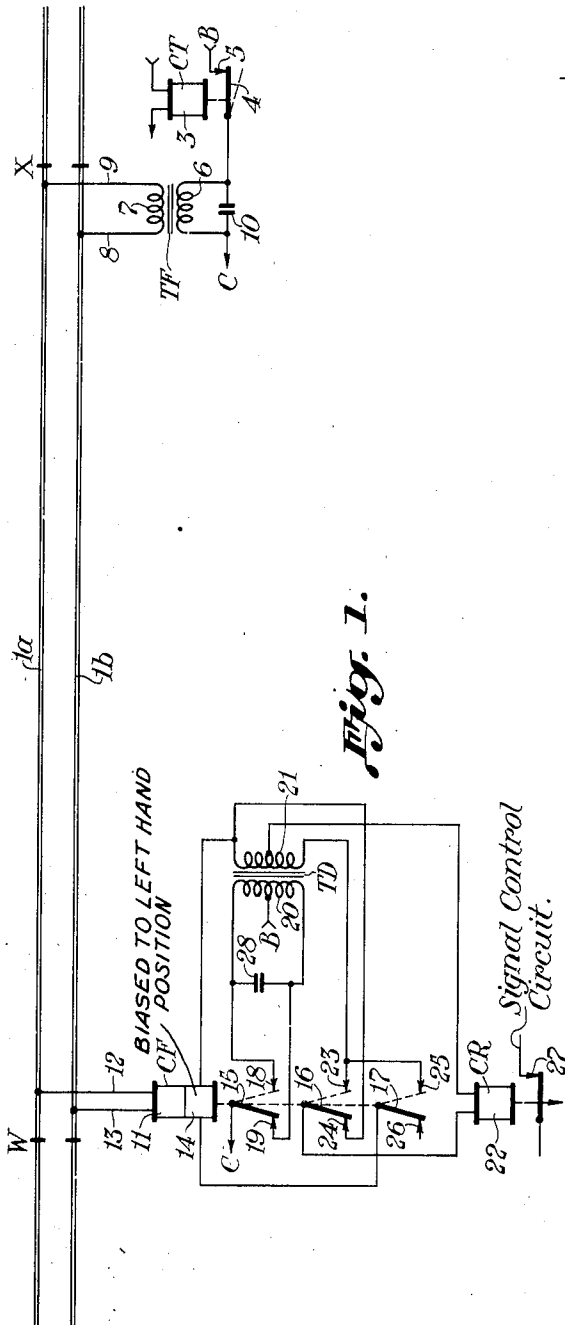


Fig. 1.

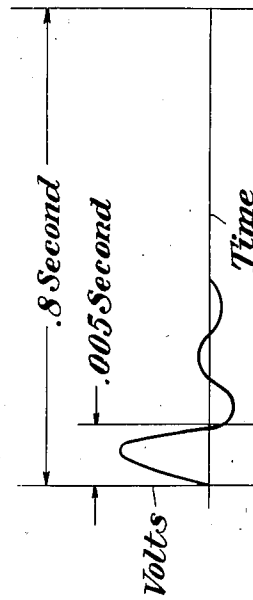


Fig. 2.

INVENTOR
Edward J. Agnew.
BY *Robert*
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,280,018

SIGNALING APPARATUS

Edward J. Agnew, Swissvale, Pa., assignor to The
Union Switch & Signal Company, Swissvale,
Pa., a corporation of Pennsylvania

Application May 18, 1939, Serial No. 274,414

6 Claims. (Cl. 178—67)

My invention relates to signaling apparatus, and more particularly to railway signaling apparatus.

An object of my invention is the provision of novel and improved means for operating a code following relay with substantially equal "on" and "off" periods in response to coded or time spaced impulses of signaling current when the duration of each such current impulse is relatively short as compared with the duration between successive impulses of such current. Other objects and advantages of my invention will appear as the specification progresses.

I shall describe one form of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawing, Fig. 1 is a diagrammatic view of one form of apparatus embodying my invention when used with a railway track circuit. Fig. 2 is a diagram illustrating characteristics of time spaced current impulses that may be used with the apparatus of Fig. 1. It will be understood, of course, that I do not wish to limit my invention to track circuits for railways but that this one use will serve to illustrate the many places where apparatus embodying my invention is useful. Apparatus for railway track circuits using time spaced impulses of current of the type here contemplated is covered by the Letters Patent of the United States No. 2,178,806, granted November 7, 1939 to W. P. Place and A. J. Sorensen for Railway signaling apparatus, and by the Letters Patent of the United States No. 2,197,417, granted April 16, 1940, to W. P. Place for Signal systems, and reference is made to these patents for a full understanding of the operation and utility of such apparatus, the present application being an improvement on such apparatus. Furthermore, code responsive apparatus shown in this application is an improvement on the apparatus shown and claimed in an application for Letters Patent, Serial No. 210,744, filed May 28, 1938, by F. H. Nicholson and L. R. Allison for Railway traffic controlling apparatus.

Referring to Fig. 1, the reference characters 1a and 1b designate the track rails of a stretch of railway which is formed with an insulated track section W—X by the usual insulated rail joints, and which section may be one of a series of consecutive sections of a railway signal system. The section W—X is provided with a track circuit including a source of coded current connected across the rails at one end of the section

and a code following track relay connected across the rails at the other end of the section.

The source of coded current includes a current source such as, for example, a track battery whose terminals are indicated at B and C, a code transmitter CT and a track transformer TF. The structure of the code transmitter is immaterial, several forms being well known to the art and as here shown the code transmitter CT is of the relay type whose operating winding 3 is permanently connected with a current source so that a contact member 4 is operated to periodically engage a stationary contact 5 at a predetermined rate, such as, for example, 75 times per minute. That is to say, the code transmitter CT divides time into successive operation cycles of a selected interval each, the contact member 4 being operated to break engagement with the stationary contact 5 once each operation cycle.

When contact 4—5 of code transmitter CT is closed a simple circuit is completed by which current is supplied from the track battery to the primary winding 6 of the track transformer TF. The secondary winding 7 of transformer TF is connected across the rails at one end of section W—X over wires 8 and 9, and a condenser 10 is connected across the primary winding 6.

When contact 4—5 is closed energy is stored in the magnetic circuit of transformer TF and condenser 10 is charged. The parts are preferably so designed with respect to the time constant of the circuit that energy in the magnetic circuit of transformer TF builds up rather slowly and no energy is inductively transferred to the track rails or at least the magnitude of the energy transferred to the rails at this time is so small that it can be neglected. Each time contact member 4 breaks engagement with contact 5, the energy stored in transformer TF and condenser 10 causes an electromotive force to be induced in the secondary winding 7 and which electromotive force in turn causes a current impulse to flow in the track circuit of section W—X, the current impulse having a damped wave form. The parts are so proportioned that the first half cycle of each such current impulse is of relatively high peak voltage and since the track circuit is non-tuned the ballast resistance and impedance of the track rails cause the current impulse to be highly damped with the result the first half cycle is materially larger than any of the following half cycles of the wave form so that each current impulse is in effect a single half cycle current impulse of a predetermined polarity. The parts are further so proportioned that the dura-

tion of the first half cycle of each current impulse is only a small portion of the operation cycle of the code transmitter. That is, the effective current impulse flowing in the track circuit is only one-half cycle in duration and its duration is small as compared with the cycle interval of the code transmitter. As illustrated in Fig. 2, the duration of the first half cycle of the current impulse may be of the order of .005 second whereas the duration of one cycle interval is .8 second when code transmitter CT is operated at the code rate of 75 cycles per minute or one cycle each .8 second. Also as illustrated in Fig. 2, the first half cycle of the current impulse is materially larger than any of the following half cycles due to the nature of the track circuit and the impulse is in effect a single half cycle of a given polarity. Hence, the duration of each effective current impulse is small as compared with the interval between successive impulses. It follows that as long as winding 3 of code transmitter CT is energized, time spaced or coded current impulses are supplied to the track circuit of section W—X, the duration of each current impulse being short and only a small portion of the cycle interval.

The high peak voltage of the current impulses is an aid in effecting a low train shunt resistance by breaking down the rail film resistance at the wheel-rail contacts, and the short duration of the current impulses requires but low energy output of the current source and it is possible to use the usual track battery as the current source.

A code following track relay CF has a first or operating winding 11 connected across the rails at the other end of section W—X over wires 12 and 13. The relay CF is provided with a second or holding winding 14 to be referred to more fully hereinafter.

In the instant case, the code following relay CF is of the polar quick acting type having polar contact members 15, 16 and 17 which are biased to seek the normal or left-hand position as viewed in the drawing when the relay is deenergized as well as being held in this normal position when the relay is energized by current of normal polarity. When relay CF is energized by current of reverse polarity the contact members 15, 16 and 17 are operated to the reverse or right-hand position. That is to say, code following relay CF has a first position to which its contact members are biased to engage respective first position contacts when the relay is deenergized and has a second position to which its contact members are operated to engage respective second position contacts when the relay is effectively energized. In this case relay CF is effectively energized when it is energized by current of reverse polarity. The connection of the operating winding 11 with the track rails is such that relay CF is effectively energized, that is, energized at reverse polarity, and its contact members operated to their respective reverse positions in response to the current flowing in the operating winding 11 due to each current impulse supplied to the track circuit of section W—X through the medium of transformer TF and its associated apparatus. During the period between successive current impulses of the track circuit the contact members of relay CF are operated by the biasing means of the relay to engage their respective normal contacts. It is clear, therefore, that code following relay CF is operated at a rate corresponding to the rate of occurrence of the track circuit current impulses. However, as

far as the energization of the operating winding 11 of relay CF by the track circuit current impulses is concerned, the contact members 15, 16 and 17 of relay CF are made to engage the respective second position or reverse contacts only for a brief interval each cycle interval due to the short duration of each current impulse of the track circuit. Consequently, as far as the energizing of the operating winding 11 by the track circuit current impulses is concerned, the "on" period of the relay CF during which its contact members 15, 16 and 17 engage reverse contacts 18, 23 and 25, respectively, is short as compared with the "off" period of relay CF during which the contact members 15, 16 and 17 engage normal contacts 19, 24 and 26, respectively.

With track relay CF operated and contact member 15 made to alternately engage reverse contact 18 and normal contact 19, direct current is alternately supplied to two portions of the primary winding 20 of a decoding transformer TD as will be readily understood by an inspection of the drawing. To be explicit, when normal contact 15—19 of relay CF is closed, direct current flows from terminal B to terminal C of the current source through the lower portion of primary winding 20, and when reverse contact 15—18 is closed current flows from the current source through the top portion of primary winding 20 of transformer TD. A condenser 28 may be connected across the primary winding 20 to reduce sparking at the contacts of relay CF. With direct current alternately supplied to the two portions of primary winding 20 of transformer TD an alternating electromotive force is induced in the secondary winding 21 of that transformer. With relay CF operated so that its contact member 16 is made to alternately engage reverse contact 23 and normal contact 24, the two portions of the secondary winding 21 of transformer TD are alternately connected with the operating winding 22 of a control relay CR and in the manner fully explained in the aforementioned application Ser. No. 210,744, the alternating electromotive force induced in the secondary winding 21 is rectified and current flows in the winding 22 of relay CR always in the same direction to effectively energize that relay.

The control relay CR is used to control a signal control circuit as desired, and as here shown the signal control circuit includes a front contact 27 of relay CR. Relay CR may be made slightly slow releasing so that its release at the intervals when the rectified current supplied thereto approaches the zero value is avoided.

To equalize the "on" and "off" periods of relay CF, the full secondary winding 21 of transformer TD is connected with the holding winding 14 of relay CF, the contact member 17 and reverse contact 25 of relay CF being preferably interposed in the connection. Each time operating winding 11 of relay CF is energized by a current impulse from the track circuit and the contact members 15, 16 and 17 are operated to engage the respective reverse contacts an electromotive force of a predetermined polarity is induced in the secondary winding 21 of transformer TD due to the building up of current in the top portion of primary winding 20 when contact 15—18 of relay CF is closed. This induced electromotive force in turn causes a corresponding impulse of unidirectional current to flow in the holding winding 14 of relay CF due to the closing of the contact 17—25 of relay CF. The connection of winding 14 is made such that the current thus flowing

therein energizes relay CF at reverse polarity and aids the energization effected by the current impulse flowing in the operating winding 11 with the result that the contact members 15, 16 and 17 are held in engagement with the respective reverse contacts for a period after the track circuit current impulse ceases to flow in the operating winding 11. After a brief period this electromotive force induced in the secondary winding 21 falls away to zero and the current ceases to flow in holding winding 14 so that relay CF is deenergized and its contact members 15, 16 and 17 are operated by the biasing element of the relay back to engage the respective normal contacts. The parts are so proportioned that the code following relay CF is held at its operated or reverse position by the current flowing in the holding winding 14 after the current impulse ceases to flow in the operating winding 11 for a period sufficient to cause relay CF to be operated at substantially equal "on" and "off" periods, and a more satisfactory condition of operation of the decoding transformer TD and control relay CR is accomplished than would be the case if the code following relay CF is operated by the current impulses supplied to the operating winding 11 alone.

It is to be observed that the electromotive force induced in secondary winding 21 due to relay CF being operated back to its normal position is not applied to the holding winding 14 since the connection is open at contact 17—25 of relay CF. However, contact 17—25 interposed in the connection to the holding winding 14 may not be needed because the electromotive force induced in secondary winding 21 in response to operation of relay CF back to its normal position and current dies down in the top portion of primary winding 20 of transformer TD and builds up in the lower portion of primary winding 20 is opposite in polarity to that induced in secondary winding 21 when relay CF is operated to its reverse position and current dies down in the lower portion of primary winding 20 and builds up in the top portion of the winding so that the current that would flow in holding winding 14 when relay CF is operated to its normal position would energize relay CF at normal polarity and such energization would tend to aid the biasing element of relay CF. Also, the energization of holding winding 14 in this latter case would fall to substantially zero before the next track circuit current impulse is applied to the operating winding 11 and hence such normal energization of the holding winding 14 when the relay CF is operated back to its normal position would not be harmful to the operation of relay CF.

I have found that a track circuit when provided with apparatus embodying my invention operates a code following relay with substantially equal "on" and "off" periods for all ordinary values of track ballast resistance and operation of the decoding transformer and associated control relay remains practically constant regardless of the variations of ballast conditions as effected by changes in weather conditions.

Although I have herein shown and described only one form of signaling apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In signaling apparatus wherewith a circuit is supplied with a signaling current consisting of time spaced current impulses with each such current impulse of short duration as compared with the duration between successive impulses, the combination comprising, a code following relay biased to a first position when deenergized and operable to a second position when effectively energized for closing first position contacts and second position contacts respectively, said relay provided with an operating winding and a holding winding with the operating winding connected with said circuit for effectively energizing said relay and operating it to its second position in response to each of said current impulses, said holding winding deenergized at said first position, a transformer, means including a first position contact and a second position contact of said relay to alternately supply direct current to two portions of the primary winding of said transformer to induce an electromotive force in the secondary winding of said transformer in response to operation of said relay, a first circuit means to connect the secondary winding of said transformer with the holding winding of said relay in such manner that the electromotive force induced in the secondary winding when the relay is operated to said second position causes current to flow in the holding winding which effectively energizes said relay and retains the relay at its second position for an interval after each said current impulse ceases to flow in the operating winding, and a second circuit means connected with said secondary winding and governed by contacts of said relay for controlling a signaling device by the electromotive force induced in said secondary winding.

2. In signaling apparatus wherewith a circuit is supplied with a signaling current consisting of time spaced current impulses with each such current impulse of short duration as compared with the duration between successive impulses, the combination comprising, a code following relay biased to a first position when deenergized and operable to a second position when effectively energized for closing first position contacts and second position contacts respectively, said relay provided with an operating winding and a holding winding with the operating winding connected with said circuit for effectively energizing said relay and operating it to its second position in response to each of said current impulses, said holding winding deenergized at said first position, a transformer, means including a first position contact and a second position contact of said relay to alternately supply direct current to two portions of the primary winding of said transformer to induce an electromotive force in the secondary winding of said transformer in response to operation of said relay, said secondary winding connected with the holding winding of said relay in such manner that the electromotive force induced in the secondary winding when the relay is operated to said second position energizes said relay so as to retain the relay at its second position for an interval after each of said current impulses ceases to flow in the operating winding whereby said relay is operated with substantially equal on and off periods in response to said time spaced current impulses, and a signal control circuit including a second position contact of said relay and said secondary winding of said transformer.

3. In signaling apparatus wherewith a circuit

is supplied with a signaling current consisting of time spaced current impulses with each such current impulse of short duration as compared with the duration between successive impulses, the combination comprising, a code following relay biased to a first position when deenergized and operable to a second position when effectively energized for closing first position contacts and second position contacts respectively, said relay provided with an operating winding and a holding winding with said operating winding connected with said circuit for effectively energizing said relay and operating it to its second position in response to each of said current impulses, said holding winding deenergized at said first position, a transformer having separate primary and secondary windings, means including a first position contact and a second position contact of said relay to alternately supply direct current to two portions of the primary winding of said transformer to induce an alternating current in the secondary winding of said transformer in response to operation of said code following relay, circuit means including a second position contact of said code following relay to connect said holding winding with said secondary winding to retain the code following relay effectively energized for an interval by the half cycle of alternating current induced in the secondary winding when the relay is operated to its second position to hold the relay at said second position after each of said current impulses ceases to flow in the operating winding, and signaling means alternately connected to two portions of said secondary winding over a first position contact and a second position contact of said relay.

4. In signaling apparatus wherewith a circuit is supplied with a signaling current consisting of time spaced current impulses with each such current impulse of short duration as compared with the duration between successive impulses, the combination comprising, a code following relay biased to a first position when deenergized and operable to a second position when effectively energized for closing first position contacts and second position contacts respectively, said relay provided with an operating winding and a holding winding with said operating winding connected with said circuit for effectively energizing said relay by each of said current impulses, a transformer having separate primary and secondary windings, means including a second position contact of said relay to supply direct current to a portion of the primary winding of said transformer to induce in its secondary winding an electromotive force of a predetermined polarity each time said relay is operated to its second position, means including a second position contact of said relay to connect the secondary winding of said transformer with the holding winding of said relay for effectively energizing said relay by said electromotive force to retain the relay at its second position for a period subsequent to each current impulse flowing in the operating winding to provide said relay with substantially equal on and off periods of operation, and signaling means controlled by said relay when operated.

5. In signaling apparatus wherewith a signaling circuit has means connected therewith for supplying coded current each current impulse of

which is of short duration as compared with the duration between successive impulses, the combination comprising, a code following relay biased to a first position when deenergized and operable to a second position when effectively energized for closing first position contacts and second position contacts respectively, said relay provided with an operating winding and a holding winding with said operating winding connected with the signaling circuit for effectively energizing said relay by each impulse of said coded current, a decoding transformer having separate primary and secondary windings, means including a first position contact and a second position contact of said relay to alternately supply direct current to two portions of the primary winding of said transformer to induce an alternating electromotive force in the secondary winding of said transformer, a control relay, means including a first position contact and a second position contact of the code following relay to alternately connect two portions of said secondary winding with said control relay to energize that relay by rectified current in response to the alternating electromotive force induced in said secondary winding, and other means including a second position contact of the code following relay to connect said secondary winding with the holding winding of said code following relay to so energize said code following relay by the half cycle of said alternating electromotive force created when the code following relay is operated to said second position as to provide substantially equal on and off operating periods of said code following relay.

6. In signaling apparatus wherewith a signaling circuit has means connected therewith for supplying coded direct current of a given polarity and each current impulse of which is of short duration as compared with the duration between successive impulses, the combination comprising, a polar code following relay having contact members biased to a normal position and operated to a reverse position when the relay is energized at reverse polarity, said relay provided with a first and a second winding with said first winding connected with said signaling circuit to energize said relay at reverse polarity in response to each impulse of said coded current, a decoding transformer having separate primary and secondary windings, means including a normal contact and a reverse contact of said relay to alternately supply direct current to two portions of the primary winding of said transformer to induce an alternating electromotive force in the secondary winding of said transformer when the relay is operated, means including a second position contact of the code following relay to connect said secondary winding with said second winding of said relay in such manner that said relay is energized at reverse polarity when the relay is operated to its reverse position to cause substantially equal on and off operation periods for that relay, a control relay, and means including a reverse contact and a normal contact of said polar relay to alternately connect two portions of the secondary winding of the transformer to said control relay to energize said control relay with unidirectional current when said polar relay is operated.

EDWARD J. AGNEW.