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TELEGRAPH RECEIVING SYSTEM

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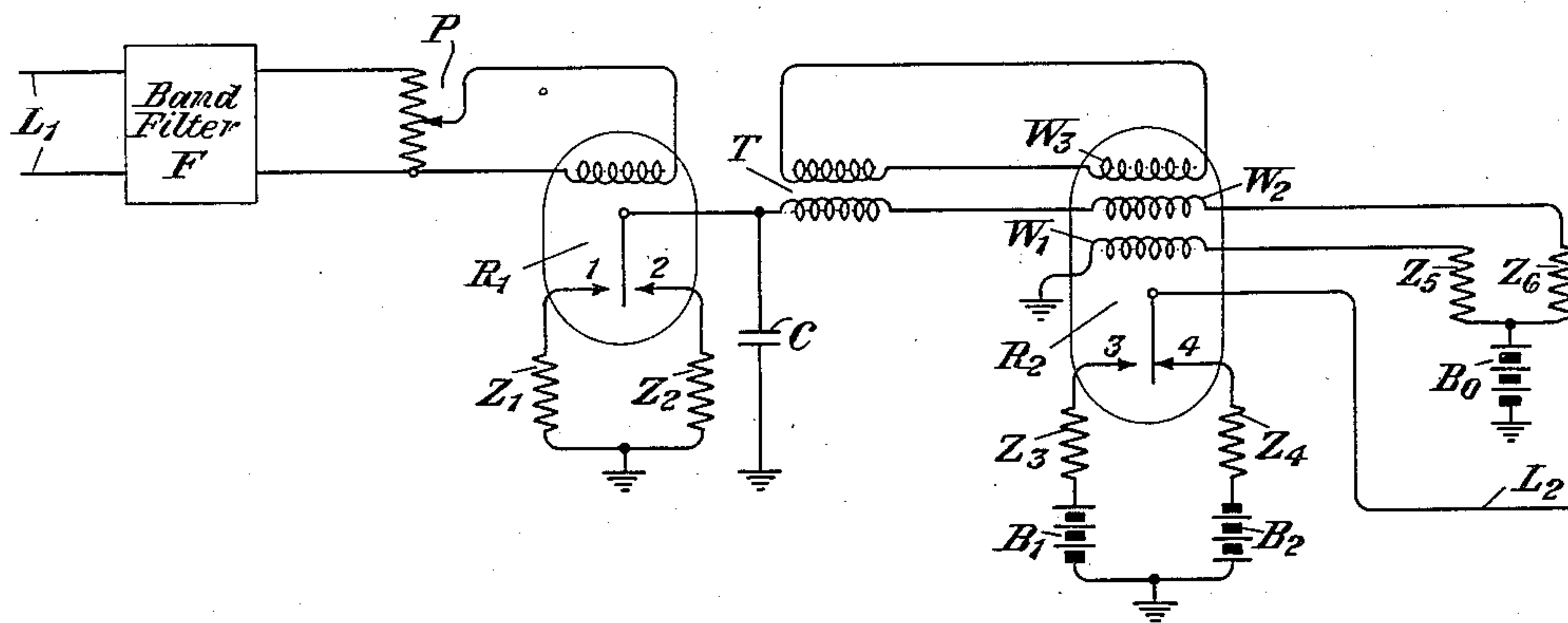


Fig. 1

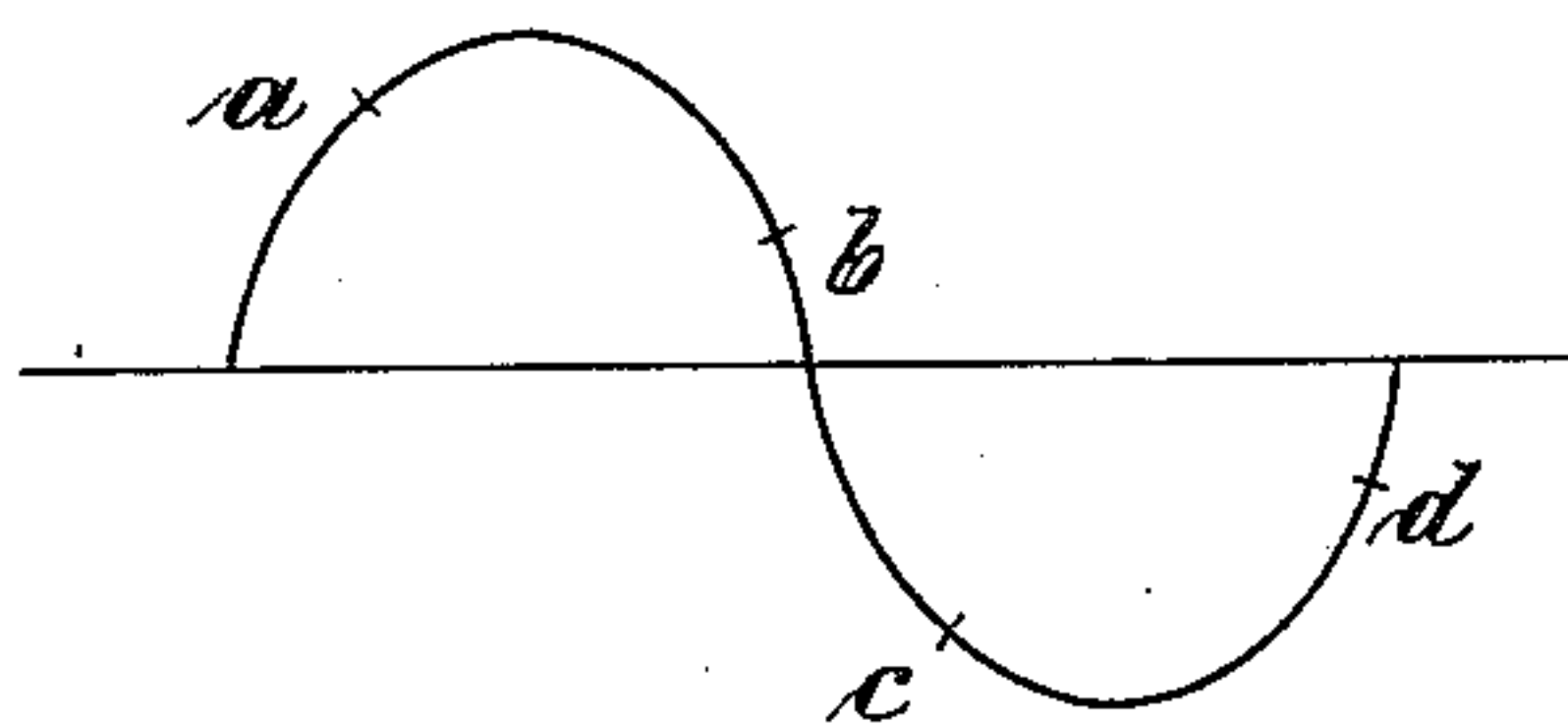


Fig. 2

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TELEGRAPH RECEIVING SYSTEM

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This invention relates to electromagnetic relays which may be employed in signaling systems, and particularly to arrangements for operating a direct current relay from the contacts of an alternating current relay.

The relay arrangement to be described hereinafter may be employed for receiving alternating current pulses such as are characteristic of carrier telegraphy. This relay arrangement is particularly adaptable for receiving alternating currents of especially low frequency. Pulses of alternating current are converted into pulses of direct current, each pulse of direct current corresponding to each received pulse of alternating current.

One of the objects of this invention is to provide an improved arrangement for receiving signals such as are characteristic of carrier telegraphy.

Another of the objects of this invention is to provide an arrangement for receiving alternating current pulses and to convert these pulses into corresponding direct current pulses with small or negligible distortion, in which the lengths of the direct current pulses correspond very closely to the lengths of the direct current pulses at the sending end.

Another of the objects of this invention is to provide an arrangement for interconnecting an alternating current relay, or any relay the armature of which may vibrate at a frequency between the limits of a predetermined band, or at a multiple of that frequency, and a direct current relay, so that the direct current relay may be continuously operated throughout the period during which suitable alternating current of the proper frequency is applied to the winding of the alternating current relay.

While this invention will be pointed out with particularity in the appended claims, the invention itself both as to its further objects and features will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing, in which Figure 1 represents an embodiment of the invention, and Fig. 2 represents both halves of an alter-

nating current cycle disclosing the points at which the apparatus of Fig. 1 is particularly responsive.

Referring to Fig. 1 of the drawing, a line L_1 is shown over which pulses of alternating or carrier current are transmitted in accordance with marking and spacing signals. The current transmitted over line L_1 may have a definite frequency or it may be composed of a plurality of frequencies constituting a band on either side of some definite carrier. A band filter F receives this current, freely transmitting such component frequencies as lie between its predetermined limits and substantially suppressing all other frequencies. While this band filter may be of any well known type, it is preferably of the type disclosed in the patent to G. A. Campbell, No. 1,227,113, dated May 22, 1917.

The output of the filter is impressed upon the winding of a broadly tuned alternating current relay through a potentiometer P , the potentiometer being employed for controlling the magnitude of the voltage of the impressed current. This alternating current relay is designated by the reference character R_1 , and it includes a rather stiff armature which may vibrate between contacts 1 and 2 on either side thereof. When no current is impressed upon the winding of relay R_1 , the armature is in its mid-position and does not close either of the specified contacts. These contacts are connected to resistances Z_1 and Z_2 , and the point common to these resistances is grounded.

It will be apparent that when alternating current of the proper frequency is impressed upon relay R_1 , current will be transmitted by the band filter F and will energize the winding of relay R_1 , causing its armature to vibrate between contacts 1 and 2 approximately at the frequency of the impressed carrier current. It will also be apparent that the band filter F does not form an indispensable element in the circuit arrangement shown, and that it may be omitted especially if the relay R_1 is one selectively responsive to currents of the proper frequencies, the armature of this relay closing both of the

associated contacts only when such currents are impressed.

A direct current relay having three windings is designated by the reference character R_2 . The armature of this relay may vibrate between contacts 3 and 4 on either side thereof, contact 3 being closed in accordance with a marking signal and contact 4 in accordance with a spacing signal. In order to render the following description readily understandable, the three windings of this relay will be designated W_1 , W_2 and W_3 , respectively.

A line which is suitable for transmitting direct current pulses characteristic of telegraphy is designated L_2 . This line is directly connected to the axis of rotation of the armature of relay R_2 . The contacts 3 and 4 between which the armature of relay R_2 may vibrate are serially connected with resistances Z_3 and Z_4 and batteries B_1 and B_2 , respectively, the point common to these batteries being grounded. When the armature of relay R_2 closes contact 3, current derived from battery B_1 flows over line L_2 through resistance Z_3 , yet when this armature closes contact 4, current of battery B_2 flows over line L_2 through resistance Z_4 .

A battery B_0 supplies the current necessary to energize the windings W_1 and W_2 of relay R_2 . The first of these windings W_1 is always connected in a local circuit with battery B_0 through a resistance Z_5 , the resistance controlling the magnitude of the continuous current. The second winding of relay R_2 designated W_2 is connected to battery B_0 through a resistance Z_6 , and current flows from battery B_0 through winding W_2 whenever the armature of relay R_1 closes either of the contacts 1 or 2.

A so-called "kick" transformer designated T is placed between the alternating current relay R_1 and the direct current relay R_2 . The primary winding of this transformer is connected between the axis of rotation of the armature of relay R_1 and winding W_2 of relay R_2 . The secondary winding of this transformer is connected in a local circuit in series with winding W_3 of relay R_2 . A condenser C is connected between the conductor attached to the axis of armature R_1 and ground, and this condenser is preferably one having a sufficiently large capacity so as to require a period of time equal to a few cycles of the alternating current impressed on relay R_1 to become charged completely to the voltage of battery B_0 .

When no alternating current flows over line L_1 , the winding of relay R_1 will not be energized and its armature will remain in the center or mid-position. Current will continuously flow from battery B_0 through the winding W_1 of relay R_2 , causing the armature of this relay to be biased against contact 4. Current will flow through winding

W_2 of relay R_2 of an amount sufficient only to cause condenser C to remain charged to the voltage of battery B_0 , but this current through winding W_2 will be insufficient to overcome the biasing effect of winding W_1 on the armature of the direct current relay.

When a pulse of alternating current of proper frequency is received, the armature of relay R_1 will vibrate between contacts 1 and 2 at the frequency of the impressed current and certain changes will be brought about in the condition of the circuit, particularly so far as it relates to the charge of condenser C and to the flow of current through winding W_2 to cause a corresponding movement of the armature of the direct current relay. The positive and negative halves of a complete alternating current cycle are shown in Fig. 2, and the effects upon the apparatus shown in Fig. 1 in response to received current will now be considered in more detail in connection with Fig. 2.

With the impression of current of the proper frequency upon line L_1 , and therefore upon the winding of relay R_1 , the armature of relay R_1 may close contact 1 at some such point in the positive half of the cycle as is designated a . Accordingly, there will be a substantial flow of current through the winding W_2 of relay R_2 , the circuit which is closed and effecting the flow of current including battery B_0 , resistance Z_6 , winding W_2 , the primary winding of transformer T , the armature of relay R_1 , contact 1, resistance Z_1 and ground. The resistance interposed in the circuit just traced may be such as to cause a flow of current through winding W_2 which is considerably greater than the flow of current continuously established through winding W_1 . In fact, the current flowing through winding W_2 may be practically twice as great as that flowing through winding W_1 . Since winding W_2 is wound in a direction opposite to that in which winding W_1 is wound, the electromagnetic effect of winding W_2 will be greater than that produced by winding W_1 and, accordingly, the armature of relay R_2 will leave contact 4 and soon close contact 3. During the closure of contact 1 by the armature of relay R_1 , condenser C discharges somewhat to a lower voltage.

As a point such as b is reached in the alternating current cycle pictured in Fig. 2, contact 1 is opened and the armature of relay R_1 moves toward contact 2. A current will continue to flow through the winding W_2 from battery B_0 to further charge condenser C , and the voltage impressed upon condenser C will tend to reach the voltage of battery B_0 . Due to the flow of current into the condenser C , the electromagnetic effect produced by winding W_1 will continue to be less than that produced by winding W_2 throughout the entire length of time required for the armature of relay R_1 to travel from con-

tact 1 to contact 2, and therefore, the armature of relay R_2 will remain closed against contact 3.

The armature of relay R_1 will close contact 2 when a point such as c is reached in the negative half of the alternating current cycle. A current will then flow through winding W_2 from battery B_0 , the circuit traced including resistance Z_0 , the primary winding of transformer T , the armature of relay R_1 and contact 2, resistance Z_2 and ground. The electromagnetic effect of winding W_2 will be considerably greater than that of winding W_1 , and therefore, the armature of relay R_2 will remain closed against contact 3. As in the case when the armature of relay R_1 was on contact 1, during the closure of contact 2 condenser C will again become partly discharged.

Further on in the alternating current cycle and at a point close to that designated d , the armature of relay R_1 will open contact 2 and begin traveling toward contact 1. While the armature is in motion a current will continue to flow from battery B_0 through winding W_2 and will tend to more fully charge condenser C . During the entire interval of time required by the armature of relay R_1 to travel from contact 2 to contact 1, the net electromagnetic effect of winding W_2 will be greater than that of winding W_1 , and therefore the armature of relay R_2 will remain closed against contact 3 throughout this entire interval.

From the consideration of the complete cycle shown in Fig. 2, it will be apparent that a current of more than an infinitesimal amplitude will be required to cause the armature of relay R_1 to close contact 1. This is due primarily to the relative stiffness of the armature, a substantial magnetic effect being required to swing it entirely to contact 1. It will be apparent that as the relative stiffness of this armature is increased, the greater will be the amplitude of the current required to cause the closure of contact 1, and vice versa. It will also be apparent that the armature begins to leave contact 1 somewhat before the current amplitude reaches the zero value. This is also due to the relative stiffness of the armature.

The condenser C is a necessary element in the arrangement disclosed. Were it not present, a pulse of alternating current, though causing the same motion of the armature of relay R_1 as already described hereinabove, would cause a pulsating current having large changes in amplitude to flow through winding W_2 , the current through winding W_2 first being at a zero value, rising to a maximum and then descending to the zero value, etc. This might cause the armature of relay R_2 to vibrate somewhat in synchronism with the armature of relay R_1 . Thus, the presence of condenser C smooths

out the current flow through winding W_2 . When the armature of relay R_1 vibrates in response to a pulse of alternating current of the proper frequency, the condenser C will prevent the current flowing through winding W_2 from ever reaching a zero value. In fact, condenser C is preferably one having a sufficiently large capacity, thereby permitting a substantial current to flow through winding W_2 when the armature of relay R_1 is in motion, so that the current through winding W_2 may produce a magnetic effect greater than that of winding W_1 . The value of the capacity of condenser C , however, must not be too large, for it may then prevent the armature of relay R_2 from leaving contact 3 for a longer period than is desirable after the alternating current has ceased to flow through the windings of relay R_1 at the end of the signal pulse.

The winding W_1 of relay R_2 is one employed to bias the armature against contact 4 when the armature of relay R_1 does not vibrate between contacts 1 and 2. It will be understood that to produce a similar biasing effect, this winding may be replaced by a spring (not shown), or by positioning the armature nearer one pole of the relay than the other (not shown), or by any other means.

It is to be noted that the transformer T has a primary winding interposed serially between the axis of rotation of the armature of relay R_1 and winding W_2 of relay R_2 . Since the secondary winding of transformer T is serially connected to winding W_3 of relay R_2 , this transformer tends to further couple windings W_2 and W_3 of relay R_2 . When a small increasing current flows through winding W_2 , the transformer will act to build up a substantial magnetic effect about winding W_3 , and therefore the relay R_2 will act more promptly and more positively. On the other hand, when the armature of relay R_1 ceases to vibrate between contacts 1 and 2, transformer T will tend to set up a current in its secondary which will cause winding W_3 to assist winding W_1 in retracting the armature. In effect, then, the transformer tends to cause the direct current relay to become accurately responsive to the envelope of the signals transmitted in the form of alternating current pulses.

While this invention has been described in a certain particular arrangement merely for the sake of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The combination of an alternating current relay tuned so that its armature may vibrate to close its associated contacts when the frequency of the impressed current varies

- between predetermined limits, a direct current relay having a pair of windings, a source of direct current potential, one of the windings of said direct current relay being connected to said source of potential so as to bias the armature of the direct current relay in one direction, and a condenser of large capacity, the other winding of said direct current relay being connected to said source of potential through the armature of the alternating current relay when it closes either of its contacts and accordingly biases the armature of the direct current relay in the opposite direction, the condenser being connected across the armature of the alternating current relay and its contacts and maintaining the flow of current through the latter winding of the direct current relay practically constant.
2. The combination of an alternating current relay the armature of which moves between two contacts which are connected in a local circuit, a direct current relay, a source of direct current potential, a condenser of large capacity connected between the armature of the alternating current relay and the local circuit connecting its contacts; said condenser, the winding of the direct current relay, and the source of direct current potential being connected in a series circuit.
3. The combination of an alternating current relay having two contacts between which its armature may vibrate, two resistances connected serially with said contacts, a source of potential, a direct current relay, and a condenser of large capacity, said condenser being connected between the armature of the alternating current relay and a point common to said resistances, the condenser being connected in series with said source of direct current potential through the winding of the direct current relay.
4. The combination of an electromagnetic relay operatively responsive only to alternating currents within a narrow band of frequencies on each side of some predetermined frequency, a direct current relay having a pair of windings, a source of direct current, means whereby one of the windings of the direct current relay may be energized with current from said source when the electromagnetic relay responsive to alternating currents is energized, and means to continuously energize the other of the windings of the direct current relay even during intervals when the electromagnetic relay responsive to alternating currents is not energized.
5. The combination of a band filter freely transmitting currents of a narrow band of frequencies on each side of a definite frequency, an alternating current relay of the electromagnetic type of operatively responsive only to the currents transmitted by said band filter, a direct current relay having two windings, a source of direct current potential, one of the windings of the direct current relay being continuously energized by the flow of current from said source of direct current potential, and means to energize the other of the windings of said direct current relay to operate said direct current relay continuously throughout the interval of time during which said alternating current relay is operated in response to current transmitted by the band filter.
6. The combination of an alternating current relay having an armature free to move between two contacts, a direct current relay, a battery, the winding of the direct current relay, the armature of the alternating current relay and the battery being connected in a series circuit, and a condenser shunting that part of the series circuit including the winding of the direct current relay and the battery, said condenser becoming charged to the voltage of the battery when the armature of the alternating current relay does not close either of its associated contacts and becoming discharged to a certain degree when the armature of the alternating current relay does close either of its associated contacts.
7. The combination of a band filter freely transmitting currents of frequencies between a pair of definite limits, an alternating current relay responsive to the currents transmitted by said band filter, two resistances connected in series between the contacts between which the armature of the alternating current relay may vibrate, a direct current relay having two windings, a source of direct current potential, and a condenser, one winding of the direct current relay and the source of direct current potential being connected in a series circuit, the other winding of the direct current relay, the source of direct current potential, the armature of the alternating current relay, and the resistances connected to the contacts between which said armature vibrates being also connected in a series circuit, said condenser shunting the circuit including the armature of the alternating current relay and the resistances connected to its contacts.
8. The combination of a direct current relay, an alternating current relay of the electromagnetic type, a condenser, a circuit including said condenser coupling said alternating current relay to the direct current relay to continuously operate the latter relay when alternating current is impressed upon the winding of the former relay, and means coupled to said circuit to accelerate the responsive action of the direct current relay when alternating current is intermittently impressed upon the winding of said alternating current relay.
9. In a system for receiving pulses of alternating current representing marking and spacing signals characteristic of telegraphy, the combination of an alternating current

5 relay of electromagnetic structure, a direct
current relay, a condenser, a circuit arrange-
ment including said condenser coupling said
relays and transmitting a substantial current
10 through the winding of the direct current
relay when current is applied to the winding
of the alternating current relay, and means
for coupling said circuit arrangement with
said direct current relay to accelerate the
15 responsive action of the direct current relay
as current is intermittently applied to the
alternating current relay in accordance with
marking and spacing signals.

10. In a telegraph receiving system, the
15 combination of an alternating current relay
of electromagnetic structure, a direct current
relay having three coupled windings, a source
of direct current potential, the first of the
direct current relay windings being continu-
20 ously energized with current from said source,
means whereby the second of said windings
may be energized with current from said
source during intervals when said alternating
current relay is responsive to a received pulse,
25 and a transformer for coupling the second
and third windings of said direct current
relay to accelerate the action of the armature
of the latter relay when pulses of current are
intermittently applied to said alternating
30 current relay in accordance with marking and
spacing signals.

In testimony whereof, I have signed my
name to this specification this 18th day of
March, 1929.

35 FRED J. SINGER.

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