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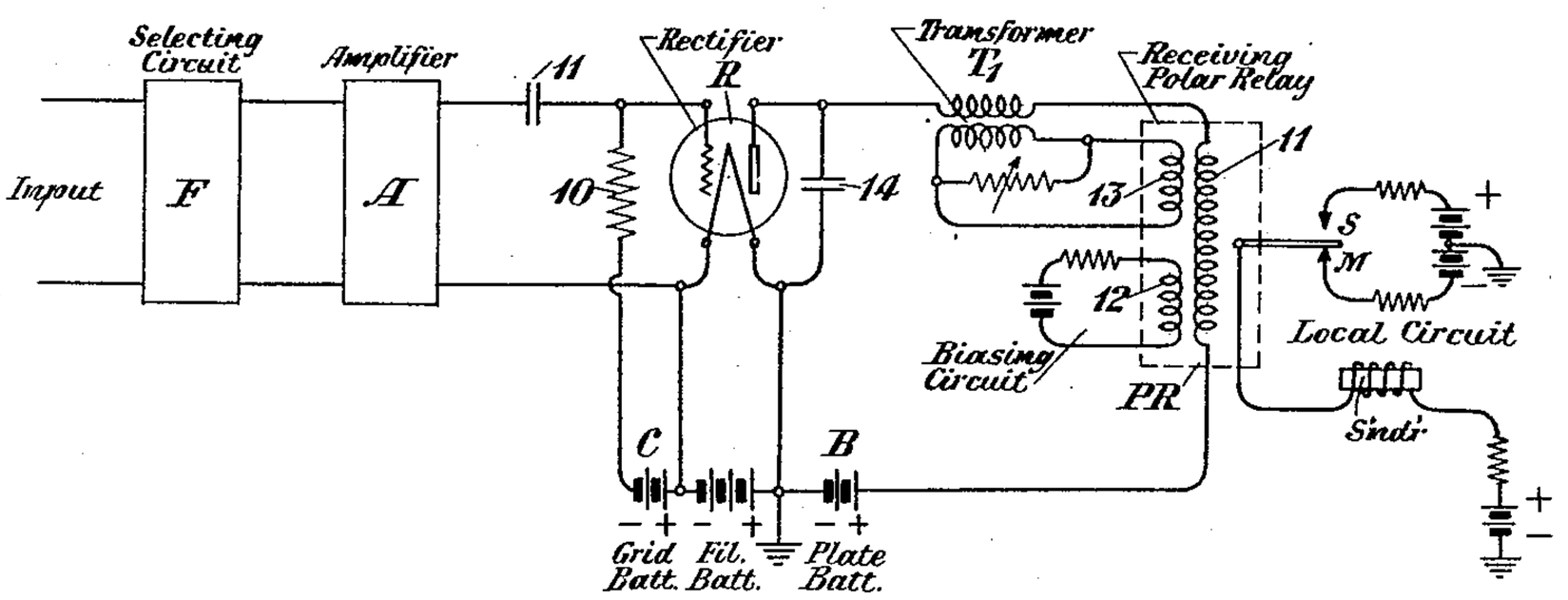

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CARRIER TELEGRAPH RECEIVER.

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This invention relates to a receiving circuit arrangement for carrier telegraph systems, and more particularly to arrangements to reduce the effect of static interference upon the received signal.

The effect of lightning and of other disturbances of the character usually referred to as static interference upon a carrier telegraph receiving circuit has been found to produce either of two effects, depending upon the condition of the circuit at the time the disturbance arises. When carrier current is being received from the distant end, and after being amplified is rectified to operate the sensitive polar relay, thereby closing the local loop, the effect of an interfering static impulse is to cause the polar relay to kick open. This is usually a short but violent kick. When no carrier current is being received and the relay armature is on its back contact, an incoming static disturbance causes the relay to kick its armature to its closed position. This is also a sharp, quick kick. In accordance with the present invention, it is proposed to slow up the action of the receiving circuit so that it will not respond to an impulse of short duration such as is produced by static interference. This may be accomplished by reversing the polarity of the kick winding of the polar receiving relay.

The invention may now be more fully understood from the following description when read in connection with the accompanying drawing, the figure of which shows a circuit diagram embodying a preferred form of the invention.

Referring to the drawing, the receiving circuit of a carrier telegraph system is shown comprising the usual selecting circuit F connected on the input side of an amplifier A, which may be of any well-known type, such, for example, as a vacuum tube. A rectifier tube R is provided, having the usual filament, grid and plate. The "C" battery is connected to the grid through a resistance 10, and a condenser 11 is provided to prevent the potential of the "C" battery from affecting the amplifier A. The potential applied to the grid through the resistance 10 is of such value that under normal conditions no space current can flow between the filament and plate due to the "B" battery. A polar receiving relay PR having a main winding 11, a biasing winding 12 and kick winding 13 is provided. The main winding 11 is connected in circuit with the plate of the rectifier tube and the "B" battery. The biasing winding is connected in circuit with a battery, and serves to bias the armature of the relay against its spacing contact S. The pull exerted by the biasing winding to hold the armature against the spacing contact S is in practice about one-half the pull exerted by the main winding 11 when carrier current is received to shift the armature to its marking contact.

The kick winding 13 is connected to the plate circuit through a transformer comprising a primary winding 1 and a secondary winding 2. The secondary winding 2 may be shunted by a variable resistance r for the purpose of reducing the kick in the winding 13 to a desired value. A condenser 14 is bridged between the plate and the filament to by-pass the high frequency component.

The arrangement above described is the same as the ordinary carrier telegraph receiving circuit as now employed in commercial practice, with the exception that the connections of the secondary winding of the transformer T_1 are reversed with respect to the kick winding 13 of the receiving relay, and the resistance r is added. In the usual form of circuit, the winding 2 is so connected as to aid in the movement of the armature under the influence of the operating current. It serves to quicken the action of the relay armature when moving from one contact to the other. In accordance with the present invention, a retarding action will be produced upon the relay armature when an incoming signal is applied to the detector circuit. The relay will not operate until the detector current has reached approximately its maximum or steady state value. The same condition will exist when a telegraph signal is received. That is, when the current starts to die down, an impulse will be produced in the secondary of the kick transformer and applied to the kick winding 13 in such a direction that it will tend to hold the relay on its contact until the operating current has approximately reached the zero value.

It has been found that the time lag thus

introduced into the operation of the relay eliminates the effect of disturbances due to lightning and the like, which are generally strong but quick impulses of short duration. While the reason for this is not entirely clear, owing to incomplete knowledge of the character of lightning disturbances, the following tentative theory is advanced for what it is worth, without vouching for its accuracy.

The effect of a lightning disturbance is to produce upon the transmission circuit a wave having a very high potential and a sharp front. If this wave consists of more than one oscillation, it is so rapidly damped that only the first pulse of the wave is of material consequence. This first pulse may be either positive or negative; and its effect upon the receiving circuit will depend upon the condition of the circuit at the time. As has already been explained, normally the grid of the rectifier tube is biased sufficiently negative so that no current flows in the space circuit in the absence of the received carrier current. The effect of the received carrier current is to render the grid less negative than normally during each positive half of the received oscillations so that rectified pulses are produced in the output circuit. A direct current component corresponding to the rectified pulses thus flows through the operating winding 11 to shift and hold the armature against its marking contact in opposition to the pull of the biasing winding. If at the moment a train of carrier waves is being received, a lightning disturbance should produce a sudden sharp wave, and this wave, if transmitted to the grid of the rectifier tube, should be of such polarity as to make the grid more negative, it is apparent that the interfering potential when added to the potential due to the "C" battery will cause the tube to operate so far down along the horizontal part of its characteristic that the positive peaks of the carrier waves will not produce any rectified impulses in the output circuit. The result will be as though the train of carrier waves had been momentarily interrupted during the sudden static disturbance, so that if the action of the relay is very quick, (as is the case when the normal connection of the secondary winding 2 is employed), the armature of the relay will be shifted from its marking contact to its spacing contact during the static impulse. Where, however, the connections of the secondary 2 are reversed, as in the present invention, the effect of the static impulse to interrupt the rectified current and thereby cause the armature to be shifted is neutralized by the kick impulse which momentarily tends to hold the armature in its assumed position. Consequently, the static disturbance can not cause a shifting of the armature unless it is of long duration.

If the static impulse is of such a character that it arrives upon the grid of the rectifier tube with a positive potential at the time carrier currents are being received, the only effect of the static impulse is to increase the operating current flowing through the winding 11. Therefore the armature which has already been shifted to its marking contact will merely be held against the marking contact by the effect of the static impulse, and no mutilation of the signal will occur in the local loop. If, however, no current is being received at the time such a positive impulse was impressed upon the grid, a rectified impulse of current would flow in the output circuit. Consequently, if the relay were quick in its action, as is the case with the usual circuit arrangement, the armature which would be resting upon its spacing contact would be suddenly shifted to the marking contact, thus mutilating the signal. If the connections of the secondary 2 are reversed, however, the sharp, sudden impulse of rectified current in the winding 11 will be opposed by the induced impulse in the winding 13 until the induced impulse dies down. Consequently, the armature will not be shifted unless the disturbing impulse is of long duration.

If the disturbing impulse arrives at the grid of the rectifier tube with a negative potential at a time when no carrier current is received, its only effect is to make the grid more negative, and no current being at this time flowing in the winding 11, the increased negative potential of the grid merely tends to further prevent such flow of current. No disturbing effect arises in this case. It will be observed, then, that while either a positive or negative disturbance may mutilate the signal, the positive disturbance will only mutilate the signal if no carrier current is being received; and the negative impulse will only mutilate the signal when carrier current is being received. The effect of the reverse of the connections of the winding 2 being to oppose the shifting of the armature for a brief interval after a change in current occurs, neither of these disturbing effects will have mutilated the signal unless the disturbance is unduly prolonged.

It has been found in practice that the arrangement herein described will operate quite satisfactorily during periods when lightning disturbances and other atmospheric discharges are quite prevalent. The circuit is, of course, slowed down to some extent by the use of this connection so that signaling must take place at a slightly slower rate. It is consequently desirable only to use a reverse connection of the winding 2 during periods when the disturbing influences prevail. During good weather conditions, the winding 2 should be so connected as to produce a kick impulse in the winding 13 which

tends to assist in shifting the armature 11, thereby increasing the speed of operation of the relay.

It will be obvious that the general principles herein discussed may be embodied in many other organizations widely different from those illustrated, without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. A receiving circuit for a telegraph system comprising an operating circuit, a relay having an armature, means to normally bias said armature against a normal contact, an operating winding in said operating circuit for shifting said armature from its normal contact, and an auxiliary winding upon the same core as said operating winding and inductively associated with said operating circuit so as to receive a kick impulse therefrom, said auxiliary winding being so poled that the kick impulse momentarily opposes the force tending to shift said armature.

2. A receiving circuit for a telegraph system comprising an operating circuit, a relay having an armature, a winding connecting in circuit with a local source to bias said armature against one contact, an operating winding in said operating circuit to shift said armature against the bias of said biasing winding, and an auxiliary winding upon the same core as said operating winding and inductively related to said operating circuit so as to receive a kick impulse therefrom, said auxiliary winding being so poled that the kick impulse momentarily opposes the force tending to shift the armature in either direction.

3. A receiving circuit for a telegraph system comprising an operating circuit, a relay having an armature, said armature being normally biased against one contact, an operating winding in said operating circuit to shift said armature to its alternate contact, and an auxiliary winding upon the same core as said operating winding and connected through a transformer to said operating circuit so as to receive a kick impulse therefrom, said auxiliary winding and transformer being so poled with respect to each other that the building up of a current or the cessation of the flow of current in said operating circuit will produce a momentary force in said auxiliary winding tending to oppose the shifting of said armature.

4. A receiving circuit for a telegraph system comprising an operating circuit, a receiving relay having an armature, a biasing winding in circuit with a local source for normally holding said armature against one of its contacts, an operating winding in said operating circuit for shifting said armature to its alternate contact, an auxiliary winding upon the same core as said operating winding and a transformer for associating said auxiliary winding with said operating circuit so as to receive a kick impulse therefrom, said auxiliary winding and transformer being so poled with respect to each other as to produce a force momentarily tending to prevent the shifting of said armature.

5. In a carrier telegraph receiving circuit, a detector having an output circuit, a receiving relay having an armature, means normally biasing said armature against one of its contacts, an operating winding in said output circuit and an auxiliary winding upon the same core as said operating winding and inductively related to said output circuit so as to receive a kick impulse therefrom, said auxiliary winding being so poled as to momentarily tend to oppose the shifting of said armature in response to the building up or cessation of current in said operating winding.

6. In a carrier telegraph receiving circuit, a detector, an output circuit for said detector, a receiving relay having an armature, a biasing winding connected in circuit with a local source to bias said armature against one of its contacts, an operating winding connecting said output circuit and responding to detected current therein to shift said armature to its alternate contact, and an auxiliary winding upon the same core as said operating winding and inductively related to said contact so as to receive a kick impulse therefrom, said auxiliary winding being so poled as to momentarily tend to oppose the shifting of said armature in response to the building up or cessation of current in said operating winding.

7. In a carrier telegraph receiving circuit, a detector, an output circuit therefor, a receiving relay having an armature, means to bias said armature against one of its contacts, an operating winding in said output circuit operating in response to detected current to shift said armature to its alternate contact, an auxiliary winding upon the same core as said operating winding and a transformer for connecting said auxiliary winding to said output circuit so as to receive a kick impulse therefrom, said auxiliary winding and transformer being so poled with respect to each other as to produce a momentary force in said auxiliary winding, which tends to momentarily oppose the shifting of said armature in response to the building up or cessation of current in said operating winding.

8. A carrier telegraph receiving circuit comprising a detector, an output circuit therefor, a receiving relay having an armature, a biasing winding in circuit with a local source to produce a force tending to bias said armature against one of its contacts, an operating winding in said output circuit tending to shift said armature to its

alternate contact in response to detected current, an auxiliary winding upon the same core as said operating winding and a transformer for associating said auxiliary winding with said output circuit so as to receive a kick impulse therefrom, said transformer and said auxiliary winding being so poled as to produce a force momentarily tending to oppose the shifting of said armature in response to the building up or cessation of current in said operating winding.

In testimony whereof, I have signed my name to this specification this 7th day of October, 1925.

VAUGHN P. THORP.