(No Model.)

P. B. DELANY.

TELEGRAPHY.

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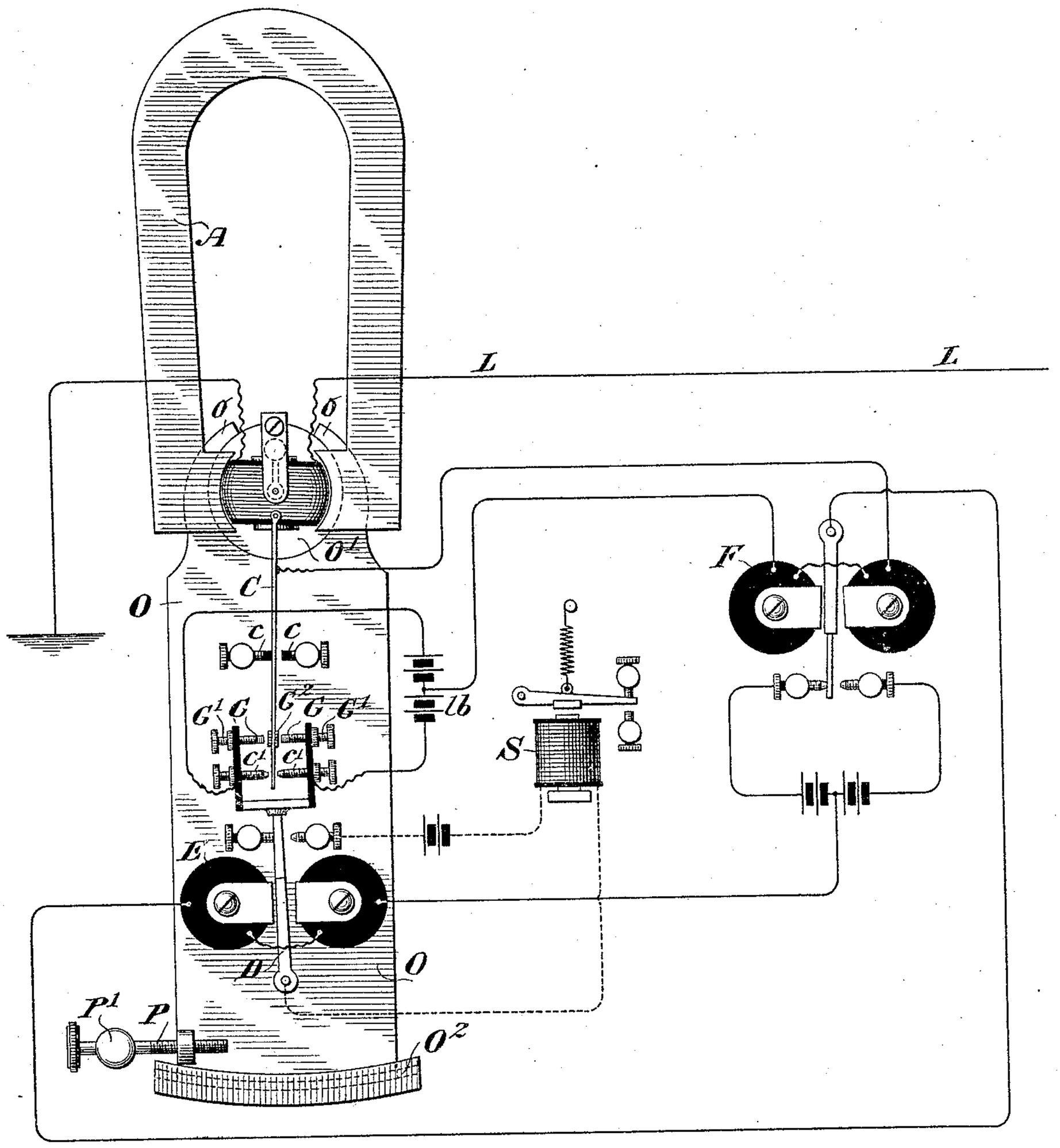

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TELEGRAPHY.

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To all whom it may concern:

Be it known that I, PATRICK B. DELANEY, a citizen of the United States, residing at South Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Telegraphy, of which the following is a specification.

My invention relates to a system of telegraphy adapted for use upon long or difficult circuits, such for instance, as ocean cables and very long underground lines.

The invention consists of an improved organization of receiving apparatus and a new method of operation, all as hereinafter set forth.

In carrying out my invention I construct the receiver in such manner that it will respond to or be influenced by impulses of alternating polarity or direction to effect the reception of the transmitted signal, either by sound, a permanent record or both. The apparatus I employ where the cable is very long or difficult resembles in some respects the well known Thomson cable recorder; that is to say I employ a permanent magnet in the field of which is located a delicately pivoted or suspended coil included in the main line. This coil is entirely unbiased, and tends to remain at rest in any position which it may be caused to assume. In this respect it is unlike the ordinary cable recorder. The coil carries or actuates a light contact arm that may be made of aluminium or other suitable material. When an impulse of current of one polarity passes in the coil it swings in one direction, and the passage of a current of opposite polarity or direction causes it to swing in the other direction. Its movement in either direction is limited by stops, preferably non-metallic. The end of the contact arm extending beyond these stops plays between two contacts carried by the rocking armature lever of a polarized relay or electro-magnet. The relation of the two pairs of stops to the contact arm is such that when moving in either direction the outer end of the arm first strikes the electrical contact or stop, whereupon a local circuit is completed. The completion of this local circuit effects the movement of the armature lever of the polarized electro magnet in the same direction as that in which the contact arm carried by the unbiased swinging coil is moving. The contact arm and rocking armature lever move together until the contact arm comes against its limiting stop. Then the continued movement of the armature lever carries the contact stop thereon away from the contact arm and the local circuit is broken. On the completion of the movement of the armature lever of the polarized magnet in one direction the local circuit of a sounder, recorder or register is closed, thus rendering manifest the signal represented by the received impulse that has caused the movement of the swinging coil. The contact arm of the coil now bears against its limiting stop preferably made of insulating material and is separated from the electrical stop carried by the armature lever, so that any trembling, chattering or vibration of the arm from any cause whatever does not affect the sounder or other receiving apparatus. In other words, the first movement of the contact arm results in the production of the intended signal in a complete and perfect manner, and any subsequent vibration or chattering of the arm against its limiting stop cannot mutilate the signal. The magnet included in the local circuit closed by the contact arm is preferably wound with a relatively high resistance, so that it will readily respond to the delicate contacts completed by the slight pressure of the arm upon its contacts. I also provide on the rocking armature lever two relatively minute pieces of iron, arranged one on each side of the contact arm and preferably mounted on the ends of non-magnetic adjusting screws carried by the rocking armature lever of the polarized magnet before mentioned, but they may be otherwise arranged. These pieces of iron become polarized from the magnetic field of the magnet of the receiving coil, and act upon a small armature mounted upon the swinging contact arm. They are so adjusted that when the contact arm has been moved against one of the contact stops on the rocking armature lever of the polarized magnet to complete the local circuit before described, the small armature on the contact arm comes into the field of the small piece of polarized iron located on the same side of the arm as said contact

stop, and is attracted. The contact between the arm and its contact stop is thus reinforced, and, as the rocking armature now moves with the arm the magnetic attraction assists the movement of the arm. When the contact arm is arrested by its non-metallic stop, both the contact stop and polarized piece of iron are by the further movement of the armature lever carried away from the contact arm, which then lies against its non-metallic limiting stop and out of contact with said contact stop, so that any trembling or chattering of the arm will not mutilate the signal. The forcible separation of the arm and the contact overcomes any welding or sticking of the contacts, which would otherwise have to be overcome by the next movement of the arm under the influence of a reverse current in the main line coil. This is an important feature in apparatus of this class and is believed to be novel. The limiting stops are made of non-metallic material to avoid any tendency to sticking, either from magnetic or current effects therein. When the contact arm has been arrested and the rocking armature lever continues its flight as just described, the contact stop and polarized iron piece on the opposite side of the contact arm are carried toward the arm and into proper position to effect a repetition of the operation just described when the contact arm moves in the opposite direction.

A description of my improved method of operation will be deferred until after the apparatus is described in detail with reference to the accompanying drawing, which is a diagram illustrating the invention.

A is a permanent magnet, between the poles of which is located the unbiased swinging coil (shown pivoted) through which the main line L is connected. The coil carries a contact arm C that plays between two limiting stops *c*, *c*, preferably of insulating material. The end of the arm extending beyond these stops plays between two insulated metallic stops *c' c'*, carried by the armature lever D of a polarized magnet E.

F is a polarized relay, one terminal of the coils of which is connected with the arm C. The other terminal is connected with the middle of a split battery *l b* whose poles are respectively connected with the stop *c' c'*. The armature lever of the relay F controls the local circuit of the polarized magnet E, and the armature lever D of this latter magnet controls the local circuit of an ordinary sounder, register or recorder S. If it is desired that the message shall be received by sound and also be recorded, S may be a combined recorder and sounder, as is well understood.

G, G, are the two small pieces of iron carried by non-magnetic adjustable screws G', G' mounted on the armature lever D, and G^2 is their small armature carried by the contact arm.

In cable telegraphy an electrical condition of the cable sometimes exists that tends to maintain the receiving coil in a displaced or biased position to one side of the theoretical central position. Such influences are generally ascribed to "earth currents" and may be prolonged for several minutes at a time—or longer. The effect of such currents is to give the coil of the receiver a tendency to remain in one position more than another. Should this condition of affairs arise in my system it would be desirable to accommodate the apparatus to the varying conditions and this may be accomplished in the following manner: The polarized magnet E, its armature lever and the non-magnetic limiting stops of the contact arm are all carried by a frame or bed-piece O that may be adjusted in an arc of which the axis of the main line receiving coil is the center. For instance the frame O may have curved arms *o* that embrace and turn upon a hub O' arranged on the base of the instrument concentric with the axis upon which the receiving coil turns. The opposite end of the frame may have a dovetail lug on its under face that travels in a curved way or track O^2, and the frame may be adjusted by a screw P mounted in a post P' and engaging a lug on the frame. The proper parallelism of the parts in radial lines of which the axis of the coil is the center may be maintained. As the operator notices any disturbances of the character stated he may suitably adjust the parts without interrupting the operation of the instrument by manipulation of the adjusting screw P. The small pieces of iron, being inductively polarized by the field of the receiver magnet, act attractively upon the minute armature carried by the contact arm, and they may be so adjusted with reference to this armature that when the contact arm is moved in one direction, thus closing the local circuit, and effecting the rocking of the armature lever in the same direction, the small magnetic piece that is thereby caused to approach the contact arm may be brought, when the rocking lever has reached the limit of its movement, in such proximity to the armature on the contact arm that it will exert attractive force upon the armature just sufficient to draw the contact arm toward it and closing the local circuit on its other contact, thus effecting a movement of the rocking armature lever in the reverse direction and effecting a repetition of the operation just described. With no current passing in the main line these parts of the receiver may therefore be so adjusted as to just maintain a regular automatic oscillation of the contact arm and of the coil which carries or actuates it. When this condition of equilibrium is established the passage of a very light current in the main receiver coil will hold the contact arm in one position or the other, according to the polarity or direction of said current, and effect the manifestation of the desired signal in the manner already described. For instance if a positive current is passing in the coil, the coil will be maintained in one position, say with the contact arm to the right;

when a negative current or one of opposite direction to the first mentioned current passes, the coil will be moved to the left and so maintained as long as the current is sufficiently effective in the coil. If therefore, this condition of equilibrium has been established and received currents alternating in polarity or direction pass in the main line coil the desired signal will be produced upon the receiver by the arresting effect of the main line current. When working with this adjustment of the instruments the parts could be so related that the attractive force of the small pieces of iron upon their armature would become effective to move the contact arm at the expiration of a period sufficient to produce the longest signal or dash, that is to say the attractive force of the polarized iron pieces will move the contact arm and terminate the signal at a time when the tailing current in the coil has become sufficiently weak or depleted. I prefer, however, to adjust the apparatus otherwise, *i.*, *e.*, so that the attractive effect of the small pieces of iron upon their armatures on the contact arm would be almost, but not quite sufficient to cause the oscillation of the arm in the manner above described. In that event, the received impulses passing in the main line coil would have but a minimum of work to perform and the coil would respond to the lightest current.

The mode of operation first described contemplates that the local devices shall exert an effect upon the contact arm just sufficient to regularly move it, and the received main line signal currents have merely to restrain or overcome this tendency to continued oscillation, and the adjustment may be such that extremely attenuated main line currents will effectively render themselves manifest upon the receiving devices. In the mode of operation last described the local devices exert an effect upon the contact arm not quite sufficient to move it and the received main line currents have only to supply the relatively small additional amount of energy to effect the proper movement of the arm. Both modes of operation are included, therefore, in one novel method which consists in locally influencing the movable part of the receiver to reduce, preferably to a minimum, the amount of energy required to control it to effect the production of the desired signals, and then supplying the energy required to exert such control from signal currents received over the main line. It will be seen, therefore, that these devices effect a reduction of the influence that has moved or tended to move the contact arm in the direction in which it has last moved, because the attractive piece acting thereon is moved away from the arm, while the influence that will move or tend to move the arm in the opposite direction is increased because the other attractive piece is moved toward the other side of the arm.

The rocking-arm of the local polarized instrument carrying the local contacts affords in effect a movable zero for the contact arm of the main receiving coil, for when the rocking arm reaches its limit after moving in the same direction as the contact arm of the main coil, the contact point on the opposite side has been carried along at the same time and left close to the contact arm, so that the slightest movement in the return direction under the influence of the main current brings it into contact with the other local contact post which results in a return or reverse movement of the rocking-lever.

It will be seen that while the movement of the main coil arm may be very slight, the movement of the rocking-arm and the contacts and attracting pieces carried thereby may be comparatively great, so as to insure a clear break between the contact arm of the main coil and the local contact points of the polarized relay and also to increase the discrepancy by reason of distance, between the attracting power of one attracting point over the other, always leaving the one on the side to which the main arm is to next move, closer to the small piece of iron or armature on the arm than the one which has last assisted in moving the contact arm.

So far as I am aware all other receivers for circuits or cables for which this receiver is specially designed have relied upon the weak and depleted currents arriving to actuate the movable part of the receiver and the rate at which this movable part may be actuated depends upon their delicacy of adjustment. Assuming that the movable part of my receiver may be as sensitively adjusted as the instrument now in use my system possesses the great advantages of overcoming by purely local means practically all the inertia of the movable part of the receiver, and effects of the tailing of the main line current so that the power of the feeble current coming over the cable instead of being expanded in overcoming this inertia, and current tailings is simply added to local power which may have already overcome ninety-nine per cent. thereof, and emphasizes or reinforces the movement of the movable part of the receiver converting an exceedingly feeble and uncertain movement into a positive and quick movement, thereby not only rendering signals certain and definite, but by reason of this increased power and quickness of movement greatly increasing the speed at which cables may be operated.

The receiving instrument at one point may be made the transmitter for another circuit making it possible to operate any distance desired, or to join up long or short cables into a practically continuous circuit. At present the transfer of messages from one long cable to another or to a short cable must necessarily be effected by manual retransmission which causes delay and errors.

I claim as my invention—

1. The combination of a receiver having a

movable part adapted to be moved in opposite directions by received currents of unlike polarity or direction, local devices magnetically influencing said part and tending to move it in opposite directions, and means controlled by the receiver for reducing the influence tending to move the movable part in the direction in which it has last moved and increasing the influence tending to move it in the opposite or return direction, whereby greater sensitiveness of the main receiver is obtained, substantially as set forth.

2. The combination of the movable part of a receiver, local devices magnetically influencing said part and tending to move it in opposite directions, and means controlled by the receiver for reducing the influence tending to move said part in the direction in which it has last moved and increasing the influence tending to move it in the opposite or return direction, substantially as set forth.

3. The combination of a receiver, having a movable part adapted to be moved in opposite directions by received currents of unlike polarity or direction, local devices influencing said part and tending to move it in opposite directions, and means controlled by the receiver for reducing the influence tending to move the movable part in the direction in which it has last moved and increasing the influence tending to move it in the opposite or return direction, whereby greater sensitiveness of the receiver is obtained, substantially as set forth.

4. The combination of the movable part of a receiver, local devices influencing said part and tending to move it in opposite directions, and local means controlled by the movable part of the receiver for reducing the influence tending to move said part in the direction in which it has last moved and increasing the influence tending to move it in the opposite or return direction, substantially as set forth.

5. In a telegraphic receiver the combination of a movable contact maker, two stops on each side thereof, one a movable contact stop, and the other a fixed limiting stop two pieces of polarized iron mounted one on each side of the contact maker and moving with the movable contact stops and an armature carried by the contact maker, substantially as set forth.

6. In a telegraphic receiver the combination of a magnet, the swinging main-line coil located in the field thereof, a contact maker carried or moved by said coil, a movable contact stop and a movable piece of soft iron mounted on each side of the contact maker and an armature, the movable pieces of iron being magnetized by the receiver magnet, substantially as set forth.

7. In a telegraphic receiver, the combination of the main receiver magnet, an unbiased movable main line coil located in the field thereof, the contact maker carried or actuated thereby, a polarized magnet, its rocking armature lever, a contact stop and an iron piece arranged on each side of the contact maker and carried by the rocking armature lever, an armature for said iron pieces carried by the contact maker, the limiting stops of the contact maker and a local circuit controlled at the contact stops that effects the movement of the armature lever, the combination being and operating substantially as set forth.

8. In a telegraphic receiver, the combination of the movable part of the receiver actuated by the main line currents, two attractive devices one on each side thereof and acting thereupon to tend to cause its movement in opposite directions, and means controlled by the movable part of the receiver for effecting the joint movement of said attractive devices, whereby when one of them is moved away from one side of the said movable part of the receiver the other one is moved into proximity to the other side thereof, substantially as set forth.

9. In a telegraphic receiver the combination of two magnetic devices creating two magnetic fields, the movable part of a receiver located in and attractively acted upon by both fields and devices controlled by the movable part of the receiver for causing the approach of one field toward the movable part as the other is moved away from it.

10. The combination of a device creating a permanent stationary magnetic field, the movable part of a receiver located in said field, two magnetic pieces located in said field and arranged to attract the movable part in opposite directions, and devices controlled by the movable part of the receiver for effecting the movement of said pieces and causing one of them to approach the movable part of the receiver as the other recedes from it.

11. The combination of the movable part of a receiver of electrical impulses, a local magnetic device acting thereupon and tending to cause its movement, means whereby the received main line current is caused to supplement the action of said local device and effect the movement of said part of the receiver in the direction in which it tends to move, and means controlled by said movable part for moving the magnetic device away from said part of the receiver.

12. In a telegraphic receiver the combination of a movable contact maker, two stops on each side thereof, one a movable contact stop, and the other a fixed limiting stop, two pieces of polarized iron mounted one on each side of the contact maker and moving with the movable contact stops, an armature carried by the contact maker, and means for bodily adjusting the iron pieces and movable stops in an arc of which the center of motion of the movable part of the receiver is the center, substantially as set forth.

13. In a telegraphic receiver, the combination of a magnet, the swinging main-line coil located in the field thereof, a contact maker carried or moved by said coil, a movable con-

tact stop and a movable piece of soft iron mounted on each side of the contact maker, an armature, the movable pieces of iron being inductively polarized from the receiver magnet, and means for bodily adjusting the iron pieces and movable stops to maintain their parallelism with the contact maker in radial lines of which the axis of the coil is the center, substantially as set forth.

14. In a telegraphic receiver, the combination with the swinging coil actuated by received impulses of current, and the contact arm carried or actuated thereby, of the limiting stops or contacts between which said arm works, the normally stationary support on which they are mounted, and means for gradually adjusting such support in an arc whose center of motion is the center of motion of the coil to change at will the position of said stops or contacts to adapt them to the biased position of the contact arm due to earth currents or other extraneous causes.

15. In a telegraphic receiver, the combination of the movable part thereof, local means influencing said part and acting oppositely thereupon to alternately move it in opposite directions and local means controlled by the movable part of the receiver to successively decrease the influence acting to move said part in the direction in which it has last moved and simultaneously increasing the influence acting to move it in the opposite or return direction.

In testimony whereof I have hereunto subscribed my name.

PATRICK B. DELANY.

Witnesses:
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