

Oct. 2, 1945.

L. A. MEACHAM

2,386,133

CALL TRANSMITTER

Filed Dec. 9, 1943

FIG. 1

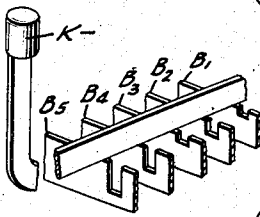
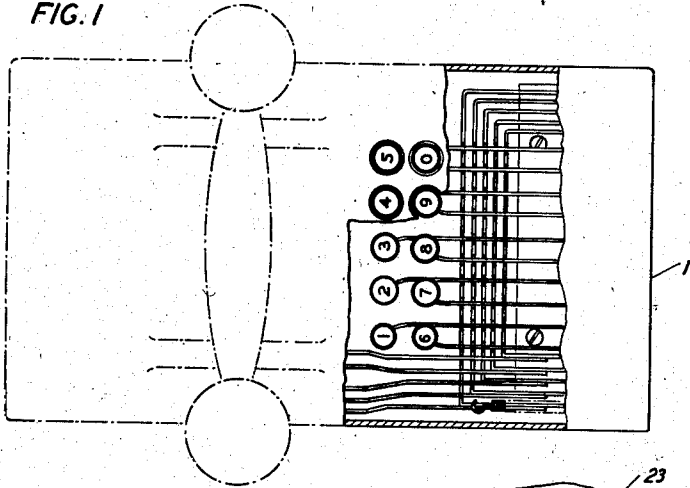


FIG. 5.

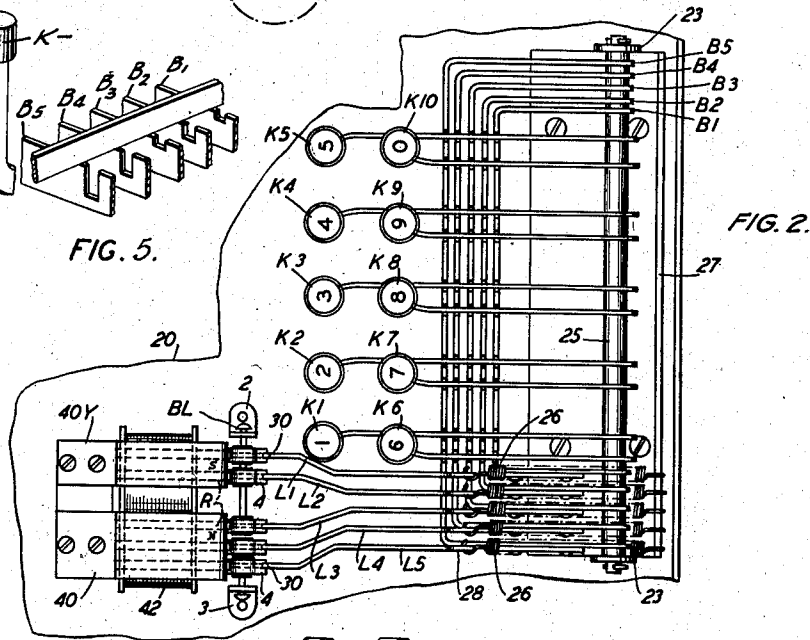


FIG. 2.

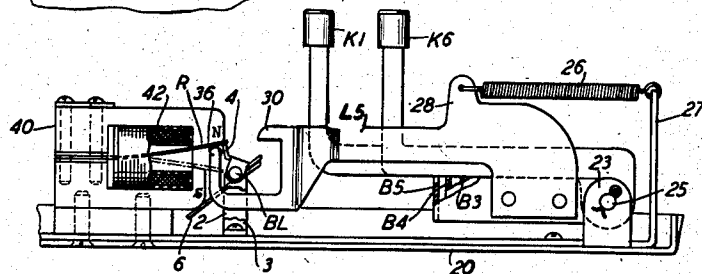


FIG. 3

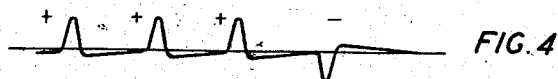


FIG. 4

INVENTOR
L. A. MEACHAM
BY *Marino*
ATTORNEY

UNITED STATES PATENT OFFICE

2,386,133

CALL TRANSMITTER

Larned A. Meacham, Summit, N. J., assignor to
Bell Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

Application December 9, 1943, Serial No. 513,559

6 Claims. (Cl. 179-90)

This invention relates to call transmitters and, more particularly, to key-control transmitters which are adapted to generate alternating current key signaling impulses that may be utilized, in one specific use, to indicate telephone station designations.

At the present time, telephone systems which operate on the basis of keyed alternating current signals are systems in which the signals themselves, when indicating a wanted telephone number, are impulses comprising coded combinations of frequencies, preferably within the voice frequency range, and these impulses are produced either by an alternating current generator having a number of reeds which can be simultaneously plucked in the required combination by a digit-designating key to induce the wanted frequencies in a pick-up coil interlinked with a magnetic field, or by the permutative application to the line of the required number of generators each individual to one of the frequencies. At the remote end of the line these frequencies are received by suitable frequency-responding apparatus which, in the most general case, comprises a channel for each frequency that includes a filter network tuned to the frequency to be passed, an amplifier, a rectifier for changing the amplified frequency into a direct current, and a sensitive relay to operate in response to that current, the momentary operation of the latter usually being registered in a suitable storage device of a switching control mechanism called the "sender" which, in response to the registration, controls the selective positioning of the switches that are to connect with the wanted line.

Telephone systems operating on alternating current impulses have a number of advantages over those which operate on direct current impulses. For example, they permit a longer "dialing" range and are faster than the dial operated system because the closure period of the required number of keys, each practically of equal duration, is less, on the average, than the corresponding operating period of the dial for producing the equivalent trains of pulses for indicating the same designation. These advantages make for the more rapid establishment of telephone connections with consequent benefits to the public which receives more rapid service and to the operating company which can render the service with less apparatus.

Key pulsing (as alternating current pulsing is usually termed) would be productive of even a greater saving if it were possible to simplify and reduce the quantity of central office apparatus

ordinarily necessary for response to the incoming signal frequencies, for instance, if economies could be effected in the channels which respond to the individual frequencies. As already intimated, these channels are fairly expensive due to the necessity of providing for each channel a complex filter network, an amplifier, a rectifier and a sensitive relay, and, further, additional equipment to protect the channels against false response to noise induced currents.

To the end of simplifying the quantity of central office equipment necessary for key pulsing and thus provide more efficient telephone service I have devised a telephone system covered by my copending application, Serial No. 514,482, filed Nov. 16, 1943, which operates on "polarized" signals; that is, a telephone system in which the designation of the wanted line consists entirely of a coded succession of spaced positive and negative wave-fronts. In other words, the impulses that comprise the wanted designation do not consist of a train of alternations of mixed or single frequencies persisting on the line for a given period, but only of a number of single half cycles permutatively spaced along the wave train to denote the coded indication of a digit or character.

The present invention has to do with a call transmitter intended for use with the invention covered by the above-mentioned copending application or, for that matter, with any other invention or device in which polarized impulses are utilized, and the object of the present invention is a call transmitter capable of generating polarized impulses of the type described which is simple and reliable to operate, compact in structure and economical to produce.

More specifically, the invention, in one embodiment described herein by way of illustration, comprises an electromechanical device provided with a number of numerical keys the depression of any one of which causes a number of pretensioned magnetic reeds housed within a coil each to traverse an appropriately poled magnetic field in a sequence which is determined by a permutation code. As a reed moves across a field, it effects a momentary change in the lines of force that traverse the coil and thereby causes a pulse to be induced in the coil the polarity of which is determined by the direction of the magnetic field in which the reed has moved. On the release of the key, the reeds are slowly restored to their pretensioned position so as to avoid any rapid change of flux through the coil and there-

fore avoid the production of any detectable pulses on the return of the key.

Other features and advantages of the invention will appear from the following description and the claims appended thereto, reference being had to the accompanying drawing in which:

Fig. 1 shows a plan view of the keys and bars of the device of my invention as incorporated in a typical telephone subscriber's set;

Fig. 2 is a plan view of the device itself;

Fig. 3 is a front view of said device; while

Fig. 4 is a typical wave which may be produced by the device.

Fig. 5 is a partial isometric showing of the relationship between one set of code bar notches and one of the keys used in operating the bars.

Referring now to the figures of the drawing in which identical designations in the different figures refer to identical parts, 1 is the body of a subscriber's telephone set in the interior of which the pulse generating mechanism of the present invention may be housed. A set of numbered key members K1, K2, K3, K4, K5, K6, K7, K8, K9 and K10 are pivotally supported on a shaft 25 which is rotatively mounted at both ends in the upright supports 23 secured to the base 20, which also secures the L-shaped plate 27. A plurality of U-shaped bars B1, B2, B3, B4 and B5 are freely supported on shaft 25 and are disposed for sequential operation by the downward movement of any one of the keys K1—K5 in combinations of four in accordance with a number code. To secure the sequential operations of the different bars B1—B5 as shown more particularly in Fig. 5, said bars are individually notched to different depths directly underneath the shank of the different key members in accordance with the sequence in which they are to be operated, the bar to be operated first in a sequence, for example, having a notch of minimum depth to insure first engagement by the shank of the key, the bar to be operated fourth in said sequence having a proportionally deeper notch, while the bar which is not to be engaged has a notch of a depth to insure that when the key is fully depressed, its shank will fully penetrate the notch without moving the bar.

To the adjacently disposed pivoted arms of the bars B1—B5 are secured the lever members L1, L2, L3, L4 and L5, respectively, each lever member being provided with an inner finger 30 and an outer finger 36, as shown in Fig. 3. Each lever member is also provided with an apertured lug 28 to which is attached one end of an individual spring 26, the other end of said spring being made secure in a hole in the upright plate 27, identical springs being provided for each lever member as shown. The spring 26 pulls on the lug 28, and since a bar B—secured to a lever L—is pivoted on the shaft 25, the spring tends to move both the bar and the connected lever in a clockwise direction and cause the finger 36 of the lever normally to push upwardly against an associated flexible magnetic reed R as more particularly described hereinafter. However, upon the depression of a key member K—, the engagement of any bar B— by the shank of said key member will cause the bar to rotate counter-clockwise against the force of the spring 26, said bar being carried with the key member to the full length of the latter's stroke. When pressure is removed from the key member, the tension stored in spring 26 hooked to the lever of said bar will cause the lever and the bar to be rotated clockwise, the cross-member of the bar lifting the key K— back

to its normal position by the time the lug 36 has pushed the reed R back to its own normal position as explained hereinafter.

On the base 20 is mounted an alternating current generator comprising two permanent horseshoe type magnets 40 and 40Y within which is secured the common coil 42. Each of the two magnets is made of two parts, one slightly longer than the other, and both magnets are mounted in opposite senses upon the base 20, that is, magnet 40, the forward magnet, is mounted so that its north pole N is on top while magnet 40Y is so mounted that its south pole S is on top. As shown in Fig. 3, the north pole N of the forward magnet 40 is longer than and overhangs the south pole S, while the south pole S of the rear magnet 40Y is longer than and overhangs its associated north pole N. Clamped between the poles of each magnet 40 and 40Y are a number of reeds R of magnetic material, magnets 40 and 40Y being sufficiently wide, in the present embodiment of the invention, to accommodate three and two reeds, respectively. The reeds are so designed that, preferably, they will be saturated by the lines of force emanating from whichever pole the reeds are resting against. The reeds are all formed with an initial curvature and so disposed within the magnets that, unrestrained, their curvature will cause them to assume a downward position with their respective forward ends resting upon the lower pole of the magnet. Now the magnets 40 and 40Y are so mounted upon the base 20 in relation to the lever members L1—L5 that when said lever members are in the normal position, their respective fingers 36 will push the reeds R up against the upper poles of the magnets, thereby placing said reeds under tension, the length of the reeds being such that the outer ends thereof protrude slightly beyond the edge of the upper pole.

A tripping device supported on a shaft BL secured between the clips 2 and 3 is located between the inner and outer fingers 30 and 36 of the levers L1—L5. This device consists of five Y-shaped tripping members 4 pivotally supported on the shaft BL and are so spaced upon said shaft that each is in aligned relation with a reed R and the finger 36 of an associated lever member L—. A spring 6, individual to each tripping member 4, is coiled around the shaft BL with one end resting on the curved underside of the lower pole of the magnet and the other end against the right under surface of the associated tripping member 4, the coiling of the spring around the shaft BL being such as to impart counter-clockwise rotation to its associated tripping member. Thus if any force is applied to the right end of a tripping member 4 to turn the latter clockwise, tension is stored in the spring which later will be utilized to turn the tripper 4 back to its original position. Again, if any key member K— is depressed and the shank thereof engages a bar B— to cause the attached lever member L— to be pushed downward, the finger 36 of the lever member is drawn away from the reed R, leaving the latter to be supported against the upper pole of the magnet solely by the left end of the associated tripper 4. As the lever L— continues its downward motion, the inner finger 30 engages the right end of the tripper and the force applied to the tripper by the lever member causes the left end of the tripper to slip out from under the reed R which, being now freed from all restraints, rapidly moves across the gap between the two poles of the magnet to come to

rest upon the face of the lower pole. When the reed strikes the face of the lower pole, it will, of course vibrate slightly, but with proper design of the reed this vibration will be of short duration and of insufficient amplitude to affect the state of magnetic saturation of the reed.

Having described the different mechanical elements of the device together with their arrangement and interrelation, I will now describe the manner in which the device operates.

With all the reeds positioned against the upper pole of their respective magnets, the lines of force of the magnet will have a path of lowest reluctance through the reeds, the direction of these lines being determined, of course, by the pole against which the reeds are held by the fingers 36. Thus, if we consider the three reeds clamped between the poles of the forward magnet 40, the lines will flow into the reeds at the forward ends and back into the upper part of the magnet at the rear end since the magnet 40 is formed with its north pole N on top and the south pole S below. On the other hand, for the two reeds clamped between the poles of the rear magnet 40Y, the lines of force will be oppositely directed, entering the reeds from the upper element of the magnet at the rear end thereof and leaving the reeds at the forward end thereof to flow back into said upper element of the magnet. Since the coil 42 is enclosed within both magnets, the fields of the two magnets interlink the coil.

Now when a key K— is depressed, four of the five bars B1—B5 are sequentially engaged by the shank of the key in accordance with the depth of their respective notchings. As each bar is engaged, it is forced down against the tension of its restoring spring 26 until the key comes to the end of its stroke. As the bar moves down, however, the outer finger 36 of the lever member L— connected to the engaged bar B— is withdrawn from the bottom of a reed R, and when the lever member has moved to a depth at which its inner finger 30 engages the right end of the tripper 4, the reed R is released and, due to its downward curvature, snaps from engagement with the upper pole of the magnet into engagement with the lower pole without appreciable vibration.

Considering more particularly the front reed clamped within the magnet 40, as the forward end of the reed leaves the north pole N and an air gap is introduced between the pole and the reed, the reluctance of the magnetic circuit increases and the resulting flux decreases, said flux continuing to decrease at approximately the same rate until the reed is midway between the two poles at which time its value will pass through zero and reverse in direction. Since the flux interlinks the coil 42, an electric potential will be induced therein whose direction and intensity are respectively determined by the direction and magnitude of the time rate at which the flux changes. As the forward end of the reed approaches the south pole of the lower magnet and the gap between this pole and the reed is reduced, the reluctance between the reed and the lower magnet is progressively decreased, the flux due to this magnet rapidly increases in the reed, reaching saturation when the reed comes to rest upon the surface of the pole. Since the flux due to the lower magnet is opposite in direction to that due to the upper pole, and since this flux likewise interlinks the coil 42, the increase of this flux induces an electric potential in the coil which is in the same direction as that produced by the decrease of the flux of the upper magnet and is

equally proportional to the time rate at which the flux is caused to be increased. Thus, depending upon whether the reed is located between the two poles of magnet 40 or the two oppositely disposed poles of magnet 40Y, a continuous pulse is produced in the coil which, starting from zero value, reaches a maximum amplitude in the direction determined by the flux of the upper pole and then declines again to zero as the reed, approaching the surface of the lower pole, becomes saturated. If the reed should vibrate slightly, on striking the lower pole, the generation thereby of unwanted electrical transients is precluded by the saturation of the reed. Each of the reeds, released at spaced intervals by the notchings on the bars engaged sequentially by the operated key member K—, produces a similar pulse the polarity of which is determined by whether the reed which is released is clamped within magnet 40 or within magnet 40Y. A series of four such pulses produced by the depression of a key K— is indicated in Fig. 4.

When the key K— is released, the tension stored in the springs 26 of the four operated bars B— will urge said bars to rotate in a clockwise direction about the shaft 25 back to their normal position. In doing so, they lift the key K— with them. Since the weight of the bars and that of the key are relatively heavy and the springs 26 have just sufficient restoring force, the levers L— attached to the bars B— are restored slowly, each of them, by means of its outward finger 36 pushing its aligned reed R against the upper pole of the magnet. Because of this slow restoration of the reed back to its original position, no detectable pulse will be generated on the return of the key. The inner finger 30 does not disengage the tripper 4 until the finger 36 has come to rest against the reed when the latter abuts the underside of the upper pole. Since the spring 6 was placed under tension by the downward stroke of the lever, the disengagement of the lever from the tripper 4 will cause the spring to turn counter-clockwise until the left end of the tripper is lodged underneath the restored reed. The same restoring action, of course, takes place with each reed released for operation.

While I have described my invention in connection with a specific embodiment thereof, it is to be understood that various other embodiments thereof may be made by those skilled in the art without departing from the spirit of the invention as defined within the scope of the appended claims.

What is claimed is:

1. A telephone call transmitter comprising a plurality of reed elements, a plurality of means holding said elements in pretensioned positions, and a set of key members each corresponding to a digit to be transmitted for actuating said means permutatively in a sequential order for releasing said elements from their pretensioned positions in the same order.

2. A telephone call transmitter comprising a plurality of magnetic reeds, a set of key members each corresponding to a digit or character, a plurality of bars disposed underneath said key members and notched at varying depths for actuation by each of said key members permutatively in a sequential order, lever members carried by the bars having means for holding the reeds normally in a pretensioned position, and a plurality of means for holding said reeds in said pretensioned positions following a partial operation of the bars by a key member and for disengaging said

means from the reeds upon the full operation of said key member.

3. A mechanism for the production of a series of single cycle pulses comprising a plurality of oppositely disposed magnets, a coil interlinked with the flux of said magnets, a plurality of magnetic reeds formed with an initial curvature and clamped within said magnets, means for normally and severally holding said reeds in a pretensioned condition against opposite poles of said magnets, and means for releasing said reeds in a permutative sequential order whereby their respective movements across the pole gap each induces an impulse of potential in said coil.

4. A mechanism for the production of a series of single cycle pulses comprising a plurality of oppositely disposed magnets, a coil interlinked with the magnetic field of said magnets, a plurality of magnetic reeds clamped between the poles of said magnets, each of said reeds having a curvature such that, in its clamped position, one end thereof will rest against a pole of a magnet, an actuating member for each of said reeds, means for causing each of said actuating members normally to pretension its associated reed against the opposite pole of the magnet, and a set of manually operable keys for engaging said actuating members in a permutative sequential order for releasing the associated reeds in the same order, whereby each of the released reeds moves across the pole gap and induces an impulse of potential in said coil.

5. A call transmitter comprising two magnets disposed in opposite polar relation, a coil interlinking the magnetic field of both of said magnets, a plurality of reeds clamped between the poles of said magnets, a set of manually operable key members, a plurality of means operated by each of said key members in a predetermined sequen-

tial order individual to each one of said key members, said means normally engaging said reeds for severally moving them to a pretensioned position against opposite poles of said magnets, a tripping member for each for holding the reed in said pretensioned position and operated by one of said means to release the reed from its pretensioned position following the operation of one of said keys, whereby the movement of the reed across the pole gap following its release will induce an impulse of potential in said coil.

6. A device for generating a train of single cycle pulses, the polarity of any pulse in the train bearing either the same or the opposite relation to the polarity of any other pulse, comprising a plurality of oppositely disposed magnets, a coil mounted within said magnets to interlink the magnetic fields thereof, curved magnetic springs clamped between said magnets and surrounded by said coil, a device for each spring normally holding said spring pretensioned against that pole of a magnet which is remote from the curved end of the spring, whereby a portion of the magnetic flux emanating from the pole in contact with the spring traverses and saturates the spring, and keying means for operating said devices in a predetermined sequence whereby the springs are released sequentially from their pretensioned positions to assume their respective normally curved positions, and whereby during the movement of each of the springs through the pole gap the magnetic flux through the spring is changed from a maximum in one direction to a maximum in the opposite direction to induce a single cycle pulse in said coil, the polarity of said induced pulse being determined by the disposition of the two poles of the magnet within which the spring is clamped.

LARNED A. MEACHAM.