

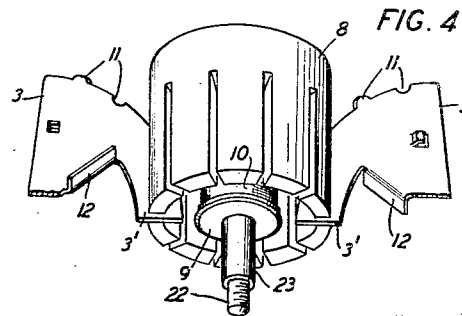
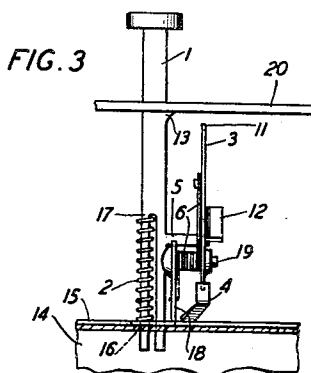
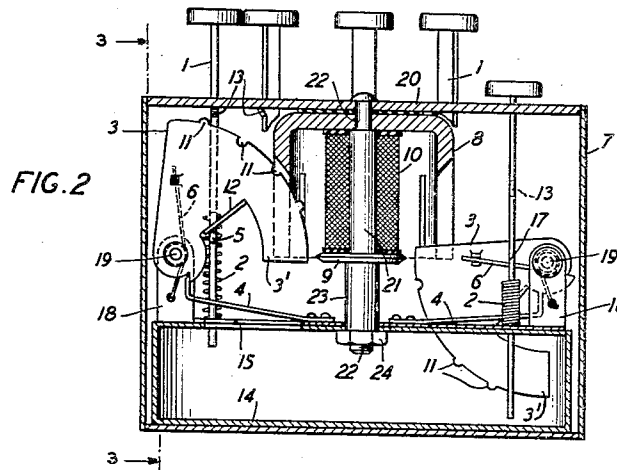
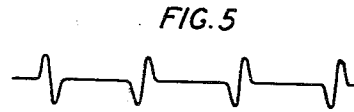
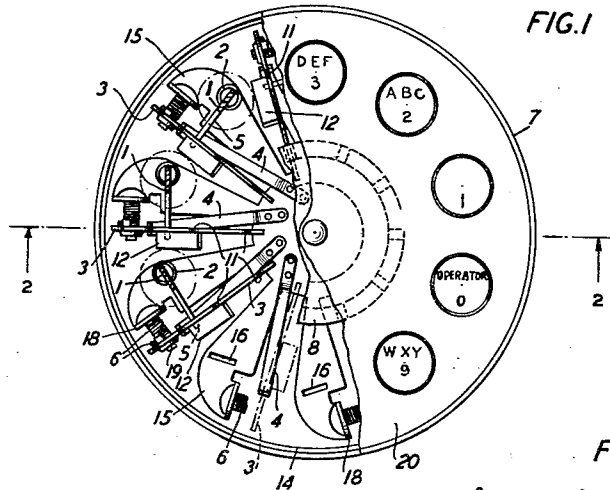
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CALL TRANSMITTER

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CALL TRANSMITTER

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6 Claims. (Cl. 179—90)

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This invention relates to call transmitters and more particularly to key-controlled transmitters which are adapted to generate alternating current key signal 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 the storage devices of a switching control mechanism called the "sender" which, in response to the registration, subsequently controls the selective positioning of the switches 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 of practically equal duration, is less, on the average, than the corresponding operating period of the dial for producing the equivalent trains of pulses that indicate 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 most usually termed) would be productive of even greater saving if it were possible to simplify and reduce the quantity of central office appara-

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tus 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, a sensitive relay and, further, additional equipment to protect the channels against false response to noise induced currents.

To the end of simplifying and reducing 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. 510,482, filed November 16, 1943, now Patent No. 2,396,111, granted March 5, 1946, 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 lobes of an alternative current. 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 alternations or single full cycles, the first half of each cycle denoting the coded indication of the pulse.

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 herein described by way of illustration, comprises an electro-mechanical device in which the depression of a numerical key causes a cam of high permeability to move rapidly through a magnetic field. The edge of each cam is so shaped as to vary the reluctance of the field and thus generate the desired series of single cycle pulses in a suitable coil interlinked with the magnetic field. On release of the key, the cam is restored more slowly to its normal position so that, as the cam returns, substantial change of magnetic reluctance is avoided and the production of any detectable pulses is precluded.

Other features and advantages of the invention will appear from the following description

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and the claims appended thereto, reference being had to the accompanying drawing in which:

Fig. 1 shows a plan view of the device with the key plate partly removed to show the interior arrangement of parts;

Fig. 2 shows a side elevation of the device along the section line 2—2 of Fig. 1;

Fig. 3 shows the key detail viewed from the left of Fig. 2, with the key in the normal position;

Fig. 4 is an isometric view of the magnet and pick-up coil assembly with two of the ten movable cams shown in a normal position by way of illustration, the other cams having been omitted to show more clearly the construction of the magnet;

Fig. 5 shows a curve of the wave form which may be produced by the device.

Referring to the various figures of the drawing in which identical designations in the different figures refer to identical parts, 7 is the receptacle or container which, preferably, may be round and dimensioned to fit the space in the telephone instrument which is provided for the conventional impulse dial. The top or key plate 20 is provided with ten equispaced holes radially disposed around the plate, and in each hole is inserted a key 1 whose shank 17, the lower portion of which is bifurcated, slidably passes therethrough. Each key is surmounted with a designating button containing the letters and the numeral usually found in the corresponding finger holes of the ordinary telephone dial, and each key can be moved up and down in the receptacle 7 by pressing upon the button thereof. At the bottom of the receptacle is placed a box-like structure 14 the top plate of which, among other things, is provided with holes which are aligned with and equal in dimension to corresponding holes in the key plate 20. The shank of each key is long enough to pass through the aligned hole in the box 14 with a portion of the shank normally protruding below the top plate thereof, thus providing the key with aligned vertical supports at two points to insure its unswerving vertical movement on depression and release. The depth of the box 14 is such, of course, as to provide, on the full depression of the key, full clearance between the end of the shank and the bottom of the box. The upward movement of the key is limited by the stop 13 which, as the key moves upwards in the manner shortly to be described, catches the under surface of the plate 20 and brings the key to rest.

Fitted into the receptacle 7 is the electromagnetic structure of the device. This structure comprises a hollow, inverted, cup-shaped permanent magnet 8 within which is fitted the hollow iron core 21 having the coil 10 mounted thereon and the whole assembly secured to the bottom of the plate 20 by means of the magnetic bolt 22 which passes through aligned holes in the center of the plate 20, the center of the magnet 8 and the center of the box 14, said bolt being force fitted through the core. To the lower end of the coil spoolhead is secured the magnetic collector ring 9 which is held tightly against the spoolhead by the nut 24 threaded upon the lower end of the bolt 22 and screwed tightly against the non-magnetic sleeve 23 which is mounted upon that portion of the bolt 22 that extends below the collector ring 9. The central hole in the box 14 is made wide enough permit the passage of the sleeve 23 therethrough

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and the latter extends clear through the hole to the under surface of the box, the nut 24 being threaded upon the bolt to engage the sleeve, which is thereby tightened against the collector ring 9 by an appropriate number of turns of the nut 24.

The magnet 8 is, as said before, a cup-shaped structure invertedly secured underneath the plate 20. This magnet is formed with ten equispaced narrow vertical slots through each of which an arcuately shaped cam 3 of high permeability is adapted freely to pass and move therewithin in a vertical plane, and each of the cams is so mounted upon the top plate of the box 14 as hereinafter set forth that, in its normal position, its edge is substantially in alignment with the rim of the collector ring 9. Each cam has an upturned vane 12 and the periphery of the cam is formed with four equally spaced indentations and projections 11, which are permutatively disposed thereon according to a code of four single alternating current cycles, each combination of which indicates one of the ten digits.

To the upper surface of the box 14 there is secured or otherwise provided in any suitable manner ten radially disposed ears 18 upon each of which is mounted one of the cams 3, the latter being freely supported upon the ear by means of a pin 19. Each ear is so located around the upper surface of the top plate of the box that, with the cam 3 located on the outer extremity of the pin 19 (see Fig. 3), the cam is positioned directly opposite a slot in the magnet 8. A coiled spring 6 is wound around the shank of the pin and anchored, on the one end, to a hole in the ear and, on the other end, to the cam near the left edge thereof. The spring is coiled so as to provide tension normally to urge the cam to rotate within the slot, but the cam is maintained against the spring tension and in its normal position with its lower edge in alignment with the rim of the collector ring 9 by the ratchet spring 4 latched in the escapement detent formed at the bottom of the cam. The spring 4, of which one is provided for each cam, is secured to the top of the box 14, each spring being positioned with respect to its cam normally to engage the escapement detent thereof. Opposite the end of each cam on the top plate of box 14 is a slot (not shown) which is wide enough to allow the free passage therethrough of the cam when the latter is rotated in the manner shortly to be described. Thus when a cam is rotated so that that portion of its periphery which lies outside of the magnet 8 is brought within the magnet so that its opposite extremity is practically in line with the rim of the collector ring 9 (as shown, for example, by the right cam in Fig. 2) a portion of the cam passes through the slot provided therefor in the top plate of box 14 into the well below the plate.

Each cam 3 is actuated by one of the keys 1. As previously stated, the lower portion of the shank 17 of each key is bifurcated, the left fork having a weak spring 2 coiled therearound with its upper end abutting against the juncture of the two forks and the lower end resting upon the upper plate of the box 14. The right fork has a horizontal projection 5 which normally rests underneath the vane 12 of the cam.

It will be observed that, with the cams 3 in their normal position, as indicated, for example, by the left cam in Fig. 2, there is a small air-gap

between the edge of the collector ring 9 and the bottom end of the cam. Now when the cam is rotated so as to fully enter the magnet slot as more particularly described hereinafter, this air-gap is increased when an indentation on the periphery of the cam passes the edge of the ring and is decreased when a projection passes the edge of the ring. The reluctance of the magnetic circuit formed by the magnet 3 and the core 21 through the intermediary of the rotating cam 3 thus increases in the case of an indentation and decreases in the case of a projection, thereby causing a decrease in the strength of the magnetic field in the former case and an increase in the latter case. For the brief interval during which an indentation 11 rapidly passes the edge of the ring 9, the magnetic field is varied from its normal strength at the time that the unindented surface of the cam is opposite the edge of the ring to a minimum strength when the greatest depth of the indentation is opposite the edge of the ring and back again to normal strength when the unindented edge of the cam is again opposite the edge of the ring. This will have the effect of inducing in the coil 10 (which may be assumed to be part of a closed electric circuit) a single cycle of alternating potential the first lobe of which is negative and the second lobe is positive. On the other hand, for the brief interval during which a projection rapidly passes past the edge of the ring, the reluctance of the magnetic circuit is decreased and the magnetic field there-through will vary from normal to a maximum when the highest point of the projection is nearest the edge of the ring and back to normal when the projection is well past the edge of the ring, thus giving rise in the coil 10 to a single cycle of alternating potential which is of opposite polarity to that produced by the indentation. A curve illustrative of the type of potential alternation that will be produced by the rotation of a cam is indicated in Fig. 5, which shows three positively polarized pulses followed by a negatively polarized pulse produced by a cam (not shown) having three projections followed by an indentation.

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

When a key 1 is depressed against the pressure of its spring 2, the associated magnet cam 3 does not move immediately, for the latter is held in place by the ratchet spring 4. However, as the key 1 approaches the bottom of its stroke, the projection 5 of the key strikes against the ratchet spring 4 and disengages the latter from the detent on the cam, allowing the cam to be rotated rapidly by virtue of the tension in spring 6 to the position illustrated by the cam 3 at the right in Fig. 2. As the cam rotates and its projections and indentations 11 pass rapidly by the edge of the collector ring 9, single cycles of alternating voltages of the type indicated in Fig. 5 are induced in the coil 10. The motion of cam 3 is stopped when its vane 12 strikes the top of the projection 5.

When the pressure is removed from the depressed key 1, the tension stored in spring 2 causes the key to be restored. In its upward movement, the projection 5 of the key engages the vane 12 of the cam and while the key is raised the cam is turned counter-clockwise about the pin 19, reaching its normal position by the time the dog 13 engages the under surface of the plate 20 and thus brings the key to rest. Since

spring 2 is weak and the mass of the key great relative to that of the cam, the key and the cam will restore very slowly as compared with the rapid movement of the cam on operation. Since the production of the alternating potential is a function of the time rate of change in the reluctance of the magnetic circuit, the slow rate at which the cam returns to normal will produce unappreciable changes in the reluctance of the circuit as the projections and indentations on the periphery of the cam 3 pass by the rim of the collector ring 9. No pulses identifiable as such will thus be produced on the return of the cam.

It is desirable that the angular velocity of the cam 3 be approximately constant while pulses are being generated so that they may be uniform in amplitude and spacing. The cams should, therefore, be arranged to be accelerated to their maximum velocity in the interval before the first pulse is produced. The "maximum velocity" may be maintained by the limiting action of the vane 12 projecting from the cam which provides suitable wind resistance.

While I have described my invention in connection with one specific embodiment thereof, it is to be understood that various other applications and 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 device for generating a polarized pulse comprising a magnetic circuit, a coil magnetically coupled to the lines of force of said circuit, and a controllable magnetic member for momentarily varying the reluctance of said circuit whereby said variation induces in said coil a single full-wave alternating potential.

2. A generator for the production of predetermined polarized electric impulses comprising a magnet, a pick-up coil mounted upon said magnet, a plurality of keys and means operated by each of said keys for varying the field of said magnet in accordance with the polarity of the impulses to be produced, whereby an increase in the intensity of said field caused by said means induces an electromotive force in one direction in said coil and a decrease of said field caused by said means induces an electromotive force in the opposite direction in said coil.

3. A generator for the production of predetermined polarized electric impulses comprising a magnet, a pick-up coil mounted upon said magnet, a plurality of keys, and a plurality of means each respectively operated by one of said keys for momentarily varying the field of said magnet as many times as there are impulses to be produced, whereby an increase in the intensity of said field caused by one of said key-operated means induces an electromotive force in one direction in said coil and a decrease in the intensity of said field caused by one of said key-operated means induces an electromotive force in the opposite direction in said coil.

4. A generator for the production of predetermined polarized electric impulses comprising a magnetic circuit including a stationary magnet and a plurality of magnetic elements disposed in proximity of said magnet to provide a normal reluctance for said magnetic circuit, means for moving any one of said elements in relation to said magnet for momentarily increasing or decreasing said reluctance permutatively a predetermined number of times equal to the number of impulses to be produced, and a pick-up coil in-

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terlinked with said magnetic circuit whereby the increase in the reluctance of said circuit caused by the movement of any one of said magnetic elements induces an electro-motive force in one direction in said coil and the decrease induces an electromotive force in the other direction in said coil.

5 5. A generator for the production of predetermined polarized electric impulses comprising a magnetic circuit including an inverted cup-shaped magnet having vertical slots radially and equally spaced thereon, a core interiorly affixed to the center of said magnet, and a plurality of arcuate magnetic cams each having on its periphery projections and indentations permutatively arranged thereon according to a predetermined code, the total of such projections and indentations being the same for each cam, each of said cams being positioned for rotatable movement within a slot in said magnet at a distance from the core to provide a normal air-gap between the core and the periphery of the cam which shall be increased by an indentation and decreased by a projection to thereby momentarily increase and decrease, respectively, the reluctance of said magnet circuit, and a pick-up coil mounted upon said core to interlink said magnetic circuit whereby the increase in the reluctance of said circuit induces an electromotive force in one direction in said coil and the decrease induces an electromotive force in the other direction.

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6. A generator for the production of equally spaced polarized electric impulses comprising a magnetic circuit including an inverted cup-shaped magnet having vertical slots radially and equally spaced thereon, a core interiorly affixed to the center of said magnet, said core having a collector ring at the base thereof, and a plurality of arcuate magnetic cams each having on its periphery equally spaced projections and indentations permutatively arranged thereon according to a predetermined code, the total of such projections and indentations being the same for each cam, each of said cams being positioned for rotatable uniform movement within a slot in said magnet at a distance from the collector ring to provide an air-gap between said collector ring and the periphery of the cam which upon the rotation of the cam shall be increased by an indentation and decreased by a projection to thereby momentarily increase and decrease, respectively, the reluctance of said magnetic circuit, and a pick-up coil mounted upon said core to interlink said magnetic circuit whereby the increase in the reluctance of said circuit induces an electromotive force in one direction in said coil and the decrease induces an electromotive force in the other direction in said coil.

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