Nov. 6, 1945. F. A. HUBBARD 2,388,358

IMPULSE TRANSMITTER

Filed July 24, 1943 2 Sheets-Sheet 1

FIG. 1

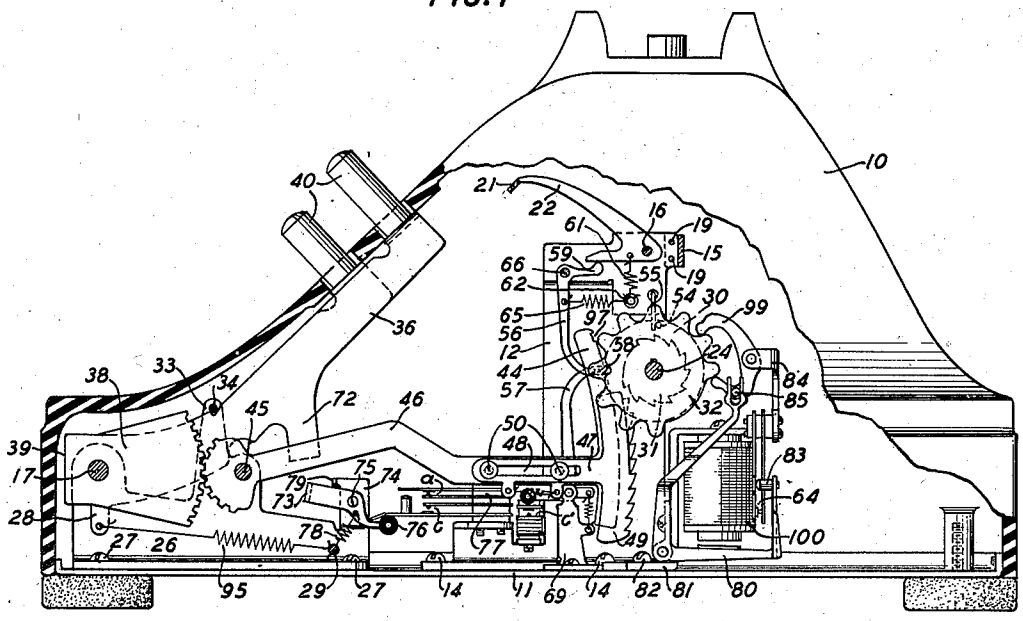

FIG. 2

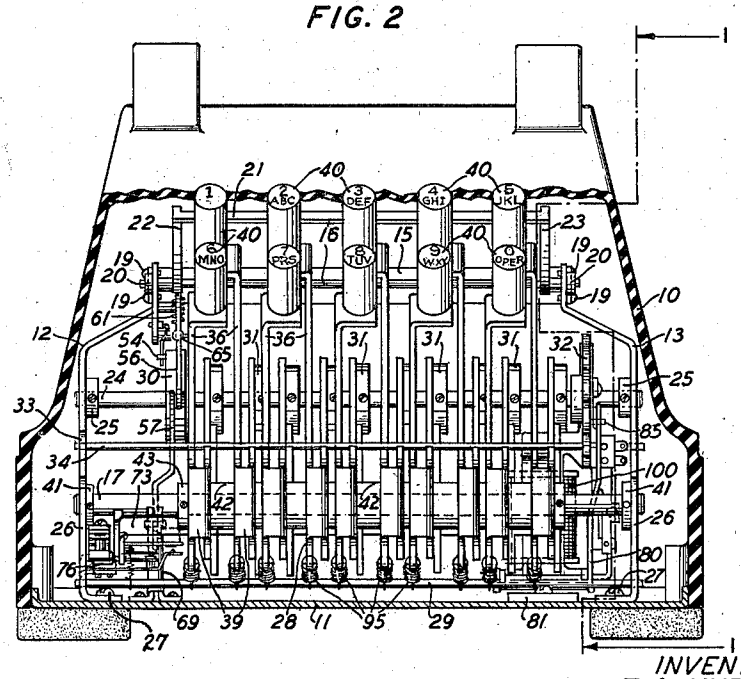

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FIG. 3

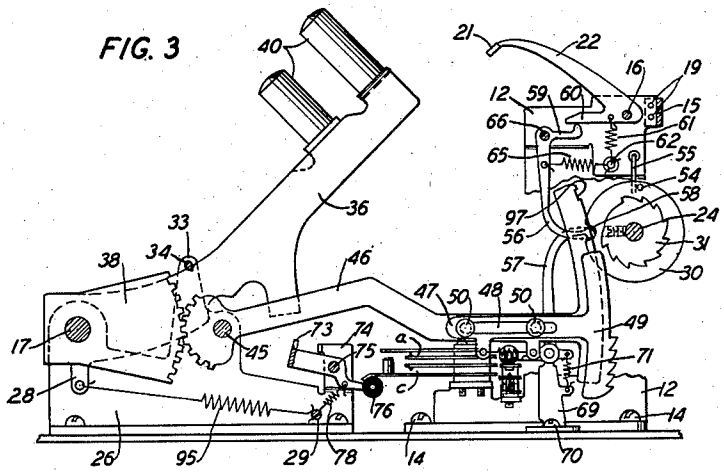


FIG. 4

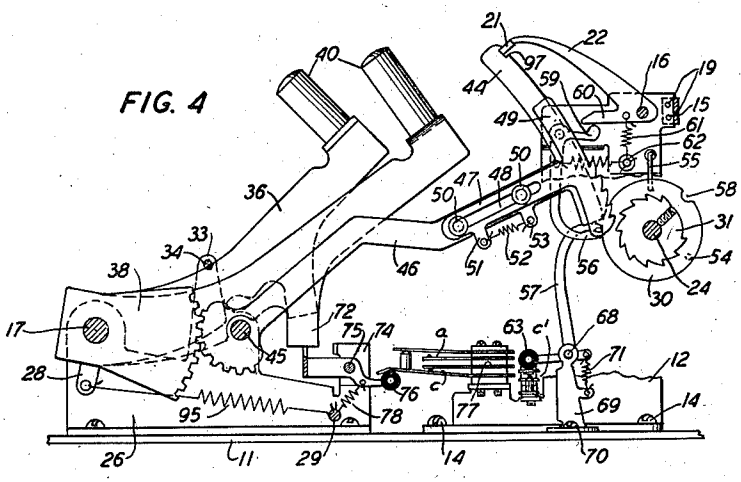
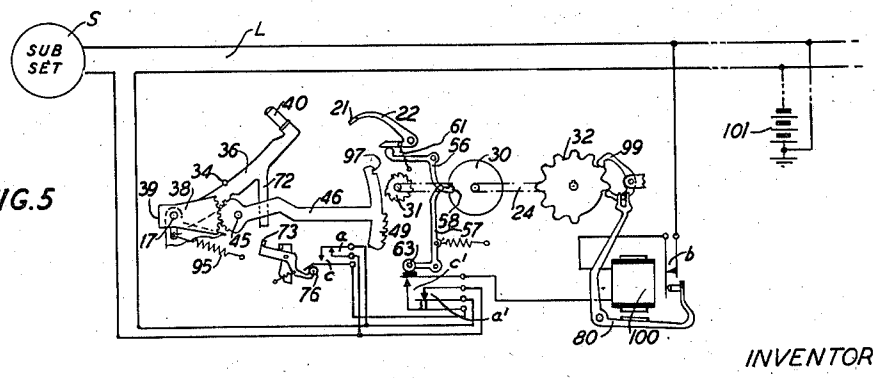


FIG. 5



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Patented Nov. 6, 1945 2,388,358

UNITED STATES PATENT OFFICE

2,388,358

IMPULSE TRANSMITTER

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Application July 24, 1943, Serial No. 495,983

12 Claims. (Cl. 177—380)

This invention relates to impulse transmitting devices and particularly to telephone call transmitters of the key operated type.

Impulse transmitters of the type employed at telephone subscribers' stations for the purpose of controlling the operation of automatic switches in the extension of telephone connections must, of necessity, produce pulses that are correctly timed, are clean and free of chatter. Besides these essential performance requirements, such transmitters should also embody characteristics that render them attractive from the subscriber's viewpoint.

It is the object of this invention to provide an impulse transmitter of the key operated type which functions to transmit impulses that are correctly timed and which, for its operation, imposes a minimum of requirements on the subscriber.

This object is attained in accordance with a feature of the invention by combining in a unitary structure an impulse counter which is variably set by the subscriber, by means of manually operable keys, to predetermine the number of impulses to be transmitted, and means which functions to restore the counter step-by-step at the speed or frequency at which it is desired to transmit the impulses and to simultaneously operate impulse controlling contact springs. More particularly, the transmitter of this invention contemplates the use of an escapement wheel which is rotatable in one direction under the control of manually operable keys, through arcs whose lengths determine the number of impulses to be transmitted, and of an electromagnetically controlled vibratable member, tuned to vibrate at the frequency at which the impulses are to be transmitted, which functions to count off the number of pulses predetermined by the setting of the escapement wheel and to simultaneously operate impulse controlling springs.

Another feature of the invention provides for the inclusion of the operating winding and contacts of a controlling electromagnet in the pulsing circuit, whereby the electromagnet functions as an interrupter to drive the pulse counting escapement wheel on electrical energy derived from the central office, or exchange battery, and the interrupter itself functions to repeatedly interrupt the pulsing circuit to produce pulses.

A further feature of the invention renders the actual transmission of pulses wholly independent of any control by an actuated key. More particularly, latching means is provided which serves to hold an actuated key in its operated position until the pulse counting escapement wheel has been returned to normal and a complete series of impulses transmitted.

Another feature contemplates the use of means which functions whenever any of the manually operable keys is fully depressed to effectively include the electromagnetic interrupter in the pulsing circuit. An ancillary feature provides an auxiliary set of contact springs which controls the inclusion of the electromagnetic interrupter in the pulsing circuit. These springs are automatically operated to disconnect the interrupter from the pulsing circuit when the escapement wheel has returned to normal thereby rendering the holding of a key operated for an abnormal period of time ineffective to cause the transmission of false pulses.

Still another feature is embodied in the structural design of the transmitter which permits of a uniform length of stroke for all keys and the application of substantially the same force to each key for its operation.

Other features are structural compactness which permits a key arrangement as compact as is consistent with adequate clearance to allow for large fingers and a certain amount of carelessness in keying; neatness in appearance; full visibility of the designation characters which identify the keys; and other characteristics which permit of a minimum of effort by, and inconvenience to the subscriber in the operation of the transmitter.

These and other features of the invention will be readily understood from the following detailed description when read in connection with the accompanying drawings, in which:

Fig. 1 is a side elevation of a telephone set (handset omitted) equipped with a call transmitter of the present invention. This view is taken along the line 1—1 of Fig. 2, looking in the direction of the arrows;

Fig. 2 is a front view of the set shown in Fig. 1. In this view a portion of the forward casing wall is broken away to expose the transmitter mechanism housed in the casing;

Figs. 3 and 4 are side views of details of the transmitter operating mechanism; Fig. 3 shows the mechanism in its normal unoperated condition and Fig. 4 shows the same mechanism in its fully operated position; and

Fig. 5 is a combined structural and circuit schematic which illustrates the various circuit controlling springs embodied in the transmitter structure and their circuit relations relative to

one another and to the elements controlled thereby.

Before entering into a detailed description of the structural design of the call transmitter shown in Figs. 1, 2, 3 and 4, the following description, made with reference to the schematic showing in Fig. 5 is offered with a view towards rendering the later comprehensive description of the structural details and their cooperation more clear.

The telephone substation set S is normally connected to the line L by way of the normally closed parallel associated contacts *a* and *a'*. The electromagnetic interrupter **100** whose interrupter contacts *b* are serially included with its operating winding in the pulsing circuit is normally open circuited at contacts *c'* and *c* which are serially related. The contacts *a* and *c* are of the make-before-break type and are controlled by an operating lever **73** through an insulating stud **76** carried on an integral extension thereof. The contacts *a'* and *c'* are also of the make-before-break variety and are controlled by cam lever **57** through the stud **63**.

The transmitter includes ten individually manually operable key levers **36** and when any such lever is actuated incident to the depression of a key **40**, a toothed segment **38** formed integrally with the lever **36** causes lever **46** to rotate counterclockwise on shaft **45**. The rotation of lever **46** is due to the meshing of the teeth of segment **38** with teeth on one end of the lever **46**. The lever **46** carries at its outer end a toothed rack **49** which is equipped with one or more teeth, the maximum number being ten. As the lever **46** rotates, the teeth on ratchet **31** are engaged by the teeth of the rack **49** and the ratchet is rotated through an arc commensurate with the number of teeth on the rack. The ratchet **31** is fixed to shaft **24** which also has fixed thereto a camming disc **30** and an escapement wheel **32**. The disc **30** and wheel **32** accordingly are rotated simultaneously with ratchet **31**.

The camming disc **30** is provided with a notch **58** which, when the disc is in its normal position, accommodates one end of each of the levers **56** and **57**. As the cam **30** moves off normal, the ends of levers **56** and **57** are forced out of the notch **58** and ride on the cam periphery. The lever **56** functions to prepare the latch **21—22** for engagement by the notch **97** in the rack **49** and the lever **57** functions to operate spring contacts *a'* and *c'*. Since the cam **30** moves off normal substantially as soon as the key lever **36** starts its downward movement, the contacts *a'* and *c'* are actuated during the depression of a key and before the key reaches its fully depressed position. Contacts *c'* connect the winding of electromagnet **100** to contacts *c* while contacts *a'* open one of the parallel connections of the subset S to the line L. The subset S however is still connected to the line by contacts *a*.

Subsequent to the operation of the contacts *a'* and *c'* and particularly, when the key lever **36** is fully depressed, the integral extension **72** of lever **36** engages the lever **73** causing it to function and operate contacts *a* and *c*. Thus when the key is fully depressed the subset S is disconnected from the line L and the winding of magnet **100** is substituted therefor.

The escapement wheel **32**, as indicated above, is fixed to shaft **24** and rotates through an arc similar to that through which the ratchet **31** is rotated. The wheel **32** is provided with ten teeth so that for each length of arc through which it is rotated, the wheel is advanced a corresponding number of teeth and this position of the escapement wheel is attained when the key lever **36** reaches the bottom of its stroke, which as described above, also determines the effective connection of the magnet **100** to the line L.

As the rack **49** reaches the upper limit of its travel the notch **97** is engaged by the latch bar **21** causing the key lever **36** and the lever **46** to be locked in their operated positions.

The electromagnet **100** now functions as an interrupter and through its armature **80** and escapement pawl **99** causes the escapement wheel **32** to be driven back to normal position step-by-step. Thus for each energization of magnet **100** the wheel **32** is rotated in a counterclockwise direction one tooth, and the pulsing contacts *b* are operated once. When the wheel **32** is returned to normal, the springs *b* will have been operated a number of times corresponding to the number of teeth through which the wheel **32** was advanced incident to the depression of a key.

When the cam **30** restores to normal coincidently with the return to normal of wheel **32** the ends of levers **56** and **57** resume their normal positions in the notch **58**, lever **56** operating latch **21—22** to cause the release of the operated key lever, and lever **57** restoring contacts *a'* and *c'* to normal. Contacts *c'* open the circuit to interrupter **100** and contacts *a'* reconnect the subset S to the line L. The latter operation is completed before the circuit to magnet **100** is opened. Thus the magnet resumes its normal condition and pulsing ceases. The armature **80** of magnet **100** is mechanically tuned to vibrate at the frequency or speed at which it is desired to transmit pulses so that the pulsing contacts *b* are operated a number of times corresponding to the setting of escapement wheel **32** and at a speed determined by the tuning of armature **80**. The energy for operating the magnet **100** is derived from battery **101** located at the central office.

Should the subscriber hold the actuated key depressed for an abnormal period of time the transmission of the series of impulses is not interfered with since the pulsing of the magnet **100** automatically ceases when the desired number of pulses has been transmitted and when the cam **30** restores to normal position. Contacts *c'* serve to insure the opening of the magnet circuit at the proper time while contacts *c* preclude the inclusion of the magnet winding in the pulsing circuit until the actuated key is fully depressed. Contacts *a* and *a'* perform obvious functions, the latter serving to reconnect the subset S to the line immediately upon cessation of the pulses.

Referring now particularly to Figs. 1, 2, 3 and 4 of the drawings, the call transmitter of this invention is housed within the telephone set casing **10** and is carried on the base **11** thereof by means of a number of brackets and mounting frames. One of the mounting frames is made up of two irregularly formed brackets **12** and **13** which are secured to the base **11** by means of screws **14**. These brackets extend vertically from the base **11** and at their upper ends are joined by a cross bar **15** which is secured to the ends of the vertical brackets **12** and **13** by means of screws or rivets **19**. The cross bar **15** serves to lend rigidity to the vertically extending brackets **12** and **13**.

Immediately in front of the cross bar **15** is located a rod or shaft **16**. The ends of shaft **16** pass through apertures in the upper ends of brackets **12** and **13** and are held against longitudinal displacement by the collars **20**. This shaft

serves to support a latching mechanism consisting of two slightly arcuate arms 22 and 23 integrally joined by a cross-piece 21. This latch is free to rotate about the shaft 16 and serves to lock the operating arm 46 and its corresponding key lever 36 in an operated position as hereinbefore described.

A shaft 24 is also supported between the brackets 12 and 13 and is adapted for rotation in suitably located apertures in the brackets. This shaft is located below the shaft 16 and in substantial alignment therewith. It serves to support a cam 30, ten ratchet wheels 31 and an escapement wheel 32. The cam, ratchet wheels and escapement wheel are all fixed to the shaft 24 and are rotatable therewith. The collars 25 serve to prevent longitudinal displacement of the shaft 24.

A pair of spider-like brackets 26 are secured to the base 11 by screws 27 and are located on either side of the base near its forward end. These brackets serve to support a shaft 17 which, in turn, supports ten key levers 36. Each key lever consists of two integrally formed portions, the lever portion per se, and a gear segment 38. The integral union of the two elements is indicated by the number 39 in Fig. 2. The ten levers and their associated gear segments are freely rotatable on the shaft 17. Each key lever is provided with a depending lug 28 to which one end of a spring 95 is fixed, the other ends of all such springs being fixed to a common shaft 29 which is supported in apertures located at the lower rear of the brackets 26.

Each of the brackets 26 is provided with a substantially centrally disposed vertical projection 33 which serves to support a stop rod 34. The stop rod 34 determines the normal positions of the ten key levers 36 and each key lever is normally held against the stop rod by its individual spring 95.

As more clearly shown in Fig. 2, the upper end of each of the key levers 36 is bent at right angles to provide a seat for a button or key 40 which is fixed to its respective seat in any suitable manner. In order to lend compactness to the structure and to provide for a compact and orderly arrangement of the buttons 40, the upper ends of five of the key levers 36 are bent to the left, viewing Fig. 2, and the upper ends of the remaining five key levers are bent to the right. By this construction the ten keys or buttons 40 may be arranged in two horizontal rows of five buttons each with the buttons of the upper row in alignment with those of the lower row. The shaft 17 is prevented from moving longitudinally by collars 41 fixed thereto in positions such as to abut the inner face of the brackets 26. The key levers 36 are held in spaced relation by means of collars 42, one of which is interposed between each pair of adjacent levers. The collars 43, fixed to the shaft 17, serve to hold the assembly of key levers 36 and interposed collars 42 in position on the shaft 17.

The spider-like brackets 26 also serve to mount the shaft 45, which is indicated in Figs. 1, 3, 4 and 5 but which does not appear in Fig. 2 because of its location in back of shaft 17. This shaft serves to mount ten operating levers 46 for rotation thereon. Each operating lever 46, as clearly illustrated in Figs. 1, 3 and 4, is an irregularly formed elongated member terminating at its outer end in an arcuate arm 44 and at its inner end in a toothed segment. The toothed end of each operating lever 46 is in permanent mesh with a corresponding key lever gear segment 38. Each operating lever 46 at its outer end carries a toothed rack 49 in such a manner that the latter is capable of slight movement longitudinally relative to its associated lever 46. This movement is made possible by providing the tooth rack 49 with an inwardly projecting arm 47 having a longitudinal slot 48 through which protrude the pins 50 which are fixed to the lever 46. The arm 47 is provided with a depending lug 51 to which one end of coil spring 52 is secured, the other end of spring 52 being secured to a similar depending lug 53 formed on the lever 46. The purpose of providing a construction whereby the toothed sector 49 may move relative to its supporting lever 46 will be pointed out hereinafter.

The cam 30 is provided with a pin 54 which normally abuts a stop 55 fixed to the bracket 12. The stop 55 determines the normal position of the cam 30. On its periphery the cam 30 is provided with a notch 58 which, when the cam is in its normal position accommodates the free ends of two cam levers 56 and 57. The lever 56 is a tripping lever and is provided with a backwardly projecting arm 59 which, when the cam 30 is in its normal position illustrated in Figs. 1 and 3, is in engagement with the projecting lug 60 on the latch arm 22. The arm 59 thus serves as a stop for the latching mechanism and determines its normal position. The lug 60 of the latching mechanism is held in engagement with the arm 59 of lever 56 by the spring 61, one end of which is secured to the latch and the other end of which is attached to a pin 62 fixed to the bracket 12. The cam end of lever 56 is held in constant engagement with the periphery of cam 30 by means of spring 65, one end of which is secured to the pin 62 and the other end of which is attached to the lever 56. From the interaction of the cam 30, lever 56 and the latching mechanism it is apparent that when the cam 30 moves off normal, that is, when it starts rotating in a clockwise direction, the cam end of the lever is forced out of the notch 58 and rides on the periphery of the cam. The lever thus pivots about its support 66 allowing the spring 61 to pull the latch downward. The latch thus assumes a position in which it is engageable by the notch 97 in the arcuate portion 44 of the operating arm 46 when the latter is actuated as will appear more fully from a later description.

The cam lever 57 also has its free end normally engaged in the notch 58 of cam 30 so that when the cam 30 moves off normal, the lever 57 rotates about its pivot 68 in such a manner that the insulating roller or stud 63 carried on a lower extension of the lever 57 functions to operate the spring contacts c' and a'. A bracket 69 secured to the base 11 by the screws 70 serves to pivotally support the lever 57 and also to mount the coil spring 71, the latter performing an obvious function.

Each of the ten ratchet wheels 31 is individual to a particular one of the ten toothed racks 49 and each is provided with a plurality of teeth. The ratchet wheels 31 are so positioned relative to their respective toothed racks 49 that when any of the latter is moved upwardly its teeth engage the teeth of the ratchet wheel and rotate the ratchet wheel in a clockwise direction through an arc commensurate with the number of teeth in the toothed rack employed to actuate it.

The shaft 24 which carries cam 30, the ratchet wheels 31 and the escapement wheel 32 is rotated incident to the operation of any of the key levers 36 in the following manner. When a key lever 36 is depressed by the application of a force

to the button 40 associated therewith, the corresponding operating lever 46 is caused to pivot on shaft 45 by virtue of the meshing of the teeth of the lever 46 with those of key lever segment 38. As the operating lever 46 moves upwardly, the toothed rack 49 carried thereby experiences a similar movement and the teeth of the latter engage the teeth of a ratchet wheel 31 causing the shaft 24 to rotate in a clockwise direction. The escapement wheel 32 which is secured to the shaft 24 rotates in the same direction. There are ten teeth on the periphery of the escapement wheel 32 and as the shaft 24 is rotated the escapement wheel is advanced from its normal position shown in Fig. 1; a number of teeth corresponding to the arc through which the shaft 24 is rotated.

Each key lever 36 is provided with a depending lug or projection 72 which, when a key lever is depressed engages a common bar 73 which is pivotally supported by two vertical projections 74 of the brackets 26. The bar 73 is provided at its left end, viewing Fig. 1, with a lug projecting inwardly from the pivot support 75 which carries an insulating roller or stud 76. When a key lever is fully depressed its associated lug 72 engages the bar 73 causing the insulating roller 76 to operate the spring pile-up 77 which includes the spring contacts *a* and *c*. These spring contacts are of the make-before-break type so that the contact *c* closes before the contact *a* opens as indicated in the description of Fig. 5 hereinbefore made. The contact operating bar is held in its normal unoperated position against the back stop 79 by means of spring 78.

At the rear of the operating mechanism thus far described is located an electromagnetic interrupter 100 whose armature 80 is mechanically tuned to vibrate at the frequency or speed at which it is desired to transmit pulses. The interrupter 100 is mounted on a bracket 81 secured to the base 11 by means of screws 82 and is provided with a set of contact springs whose contacts *b* are normally closed and are adapted to be actuated by the armature end carrying the stud 83. Included in the spring pile-up assembly is a bracket 84 which pivotally mounts the escapement pawl 99. The irregularly shaped armature 80 of interrupter 100 has its uppermost end slotted for the purpose of receiving the pin 85 secured to one arm of the pawl 99. The pawl 99 and the teeth of the escapement wheel 32 are so designed that when the shaft 24 is rotated in a clockwise direction the escapement wheel will experience a similar rotational movement and the pawl 99 will be actuated though performing no useful function at this time. However, when a key lever 36 has been depressed and the shaft 24 rotated in a clockwise direction, and when the key lever reaches the bottom of its stroke and causes the operation of contacts *a* and *c* of the spring pile-up 77, the winding of the interrupter 100 is effectively included in the pulsing circuit and is energized from the source 101. The interrupter thereupon causes the armature 80 to vibrate at the frequency or speed at which the pulses are to be transmitted and by virtue of its coupling with the pawl 99 operates the latter causing the escapement wheel 32 to be returned to normal position, step by step, at a speed or frequency determined by the mechanical tuning of the armature. The contacts *b* are serially included in the pulsing circuit and each time the winding of interrupter 100 is energized, the armature 80 acts upon the contacts *b* causing them to open the interrupter circuit and therefore, the pulsing circuit. Thus the pulsing circuit is interrupted a number of times corresponding to the number of teeth the escapement wheel 32 was advanced incident to the depression of a key lever.

The teeth on the ten toothed racks 49 vary in number from one to ten and the teeth appearances start at the lower end of the sector. In this manner the length of the operating stroke for each key is made the same and the operating mechanism required to be moved by the keys is displaced the same distance for each key operated, thereby requiring the application of substantially the same force to all keys.

A complete cycle of operations of the call transmitter resulting from the actuation of any key will now be described and for this purpose particular reference is made to Figs. 1, 3 and 4. Assuming the key or button 40 bearing the designation 5JKL is actuated, the corresponding key lever 36 and its integrally associated gear segment 38 are rotated on the shaft 17 in a clockwise direction. By virtue of the meshing of the teeth of gear segment 38 with the teeth on the end of a corresponding operating lever 46, the lever 46 and its associated toothed rack 49 swing upwardly. In the case described, the toothed rack 49 has five teeth so that the rack will pass the corresponding ratchet wheel 31 for a slight interval before the first tooth of the rack engages the first tooth of the ratchet wheel. The ratchet wheel will then begin its clockwise rotation and will advance through an arc corresponding to the five teeth on the toothed rack 49. As the ratchet wheel begins its movement, the shaft 24 starts to rotate causing the cam 30 to rotate also. As the cam 30 moves off normal the cam levers 56 and 57 are actuated, the former permitting the latch bar 21 to be moved under the action of spring 61 to a position in which it will be engaged by the notch 97 in the arcuate end piece 44 of the operating lever 46, and the latter causing the operation of spring contacts *c'* and *a'*. The closure of the spring contacts *c'* partially completes the operating circuit for the interrupter 100 and the opening of contacts *a'* opens one of the parallel connections of the subset to the line L.

The rotating shaft 24 carries with it the escapement wheel 32 so that the latter is advanced five teeth corresponding to the five teeth in the toothed rack 49. When the key lever 36 is fully depressed the arm 44 of the operating lever 46 reaches the upper limit of its travel and the notch 97 thereof is engaged by the latch bar 21 so that the operated key lever 36 and its corresponding operating lever 46 are held locked in their operated positions. Simultaneous with the latching of the operated levers, the contact springs of spring pile-up 77 are actuated by the engagement of the key lever projection 72 with the operating bar 73. Thus the subset S is disconnected from the line by the opening of contacts *a* and the operating circuit for interrupter 100 is completed by the closure of contacts *c*. The interrupter immediately starts functioning and through its armature 80 and the pawl 99, the escapement wheel is driven back to normal, step by step, at a speed determined by the mechanical tuning of the armature 80. Each time the escapement wheel is returned one tooth in a counter-clockwise direction by the action of pawl 99, the interrupter contacts *b* and therefore, the pulsing circuit is interrupted once. In the case at hand, the interrupter would function five times to cause the transmission of five correctly timed pulses.

The shaft **24** and its cam **30** also restore to normal with the escapement wheel **32** and when the pin **54** of the cam **30** engages the stop **55** the movement of the shaft, cam, ratchet wheel and escapement wheel is arrested and the cam levers **56** and **57** resume their normal positions. That is, their free ends move into the notch **58** in the cam periphery under the action of their respective springs **65** and **71**. The cam lever **56** trips the latch bar **21** causing the disengagement of the bar from the notch **97** in the arm **44** of the operating lever **46**. The operating lever **46** and its corresponding key lever **36** thereupon return to normal, the action of coil spring **95** serving to insure the restoration of these elements to normal.

In order to insure the passage of the teeth of rack **49** by the teeth of the ratchet wheel **31** as the operating lever returns to normal position, the rack **49** is permitted a slight longitudinal displacement along the axis of the supporting portion of the operating lever **46**. This movement is made possible by the slot **48** and pins **50**. As the teeth of the rack **49** pass over the teeth of the ratchet wheel **31**, the rack **49** is forced inwardly and away from the ratchet wheel thereby insuring the relatively free passage of the rack by the ratchet wheel and precluding the possibility of jamming.

When the cam lever **57** resumes its normal position the contacts *c'* are opened and the interrupter **100** is effectively disconnected from the line to preclude the possibility of any further pulsing action thereby.

It will be observed that should the subscriber hold the operated key lever down for an interval of time which extends beyond the pulsing period no harmful results ensue, since the interrupter **100** is automatically disconnected from the pulsing circuit by the opening of contacts *c'* which occurs when the correct number of impulses has been transmitted and the escapement wheel **32** has returned to normal. The spring pile-up which includes contacts *c'* also includes the contacts *a'* which are connected in parallel with contacts *a* of spring pile-up **77**. The contacts *a'* insure against a lost connection should the subscriber hold the key operated until after the train of pulses has been transmitted and thereby maintain the contacts *a* open and the subset S disconnected from the line L. The closure of contacts *a'* insures the reconnection of the subset to the line even though an actuated key is held operated. Contacts *a'* are intended to close before contacts *c'* open.

What is claimed is:

1. The combination in an impulse transmitter of an impulse counter, means for variably presetting said counter to predetermine the number of impulses to be transmitted by said transmitter, means for operating said counter to count off the predetermined number of impulses, a plurality of manually depressible keys, means controlled by said keys during the depression thereof for actuating said presetting means, means controlled by said keys when fully depressed for causing the actuation of said counter operating means, and pulsing contacts actuated by said counter operating means.

2. The combination in an impulse transmitter of an impulse counter comprising an escapement wheel, means for variably presetting said escapement wheel to predetermine the number of impulses to be transmitted by said transmitter, means for operating said escapement wheel to cause it to count off the predetermined number of impulses comprising an escapement pawl cooperatively associated with said escapement wheel and a member supporting said pawl and vibratable at a predetermined frequency of vibration, a plurality of manually depressible keys, means controlled by said keys during the depression thereof for actuating said presetting means, means controlled by said keys when fully depressed for causing said member to vibrate at its predetermined frequency of vibration whereby said escapement wheel operates through said escapement pawl to count off the predetermined number of impulses, and pulsing contacts controlled by said vibratable member.

3. A device for transmitting a predetermined number of impulses at a predetermined frequency comprising in combination, pulsing contacts, means for operating said pulsing contacts at the said predetermined frequency, and means for predetermining the number of operations of said contact operating means comprising an impulse counter rotatable in either direction, a plurality of manually operable keys, means controlled by any of said keys during the depression thereof for rotating said counter in one direction through an arc whose length determines the number of operations of said contact operating means, and means responsive to the full depression of any of said keys for rendering said contact operating means effective to rotate said counter in the reverse direction and to simultaneously operate said pulsing contacts a number of times corresponding to the arc length through which said counter was rotated in the said one direction.

4. A telephone transmitter comprising an electromagnetic pulsing device, rotatable means for predetermining the number of operations of said electromagnetic pulsing device, a plurality of manually depressible keys, means controlled by said keys during the depression thereof for variably setting said predetermining means, means responsive to the full depression of any of said keys for energizing said electromagnetic pulsing device, and means controlled by said electromagnetic pulsing device when energized for restoring said predetermining means.

5. A device for transmitting a predetermined number of impulses at a predetermined frequency comprising in combination, pulsing contacts, an armature mechanically tuned to vibrate at the said predetermined frequency for operating said pulsing contacts, an electromagnet for operating said armature, and means for limiting the number of operations of said armature comprising an impulse counter rotatable in either direction, manually operable means for rotating said counter in one direction from normal through an arc whose length determines the number of operations of said armature, means coupling said contact operating means and said counter, and means controlled by said manually operable means for rendering said electromagnet effective to operate said armature, whereby said armature vibrates at the said predetermined frequency and functions through said coupling means to drive said counter in a reverse direction to normal, step by step, and to simultaneously operate said pulsing contacts.

6. A device for transmitting a predetermined number of impulses at a predetermined frequency comprising in combination, pulsing contacts, an armature mechanically tuned to vibrate at the said predetermined frequency for operating said pulsing contacts, an electromagnet for operating

said armature, and means for limiting the number of operations of said armature comprising an escapement wheel rotatable in either direction, manually depressible keys, means controlled during the depression of any of said keys for rotating said escapement wheel in one direction from normal through a predetermined arc whose length determines the number of operations of said armature, an escapement pawl coupling said armature and said escapement wheel, and means controlled by any of said keys when fully depressed for rendering said electromagnet effective to operate said armature, whereby said armature vibrates at the said predetermined frequency and functions through said escapement pawl to rotate said escapement wheel in the reverse direction to normal, and to simultaneously operate said pulsing contacts.

7. A device for transmitting a predetermined number of impulses at a predetermined frequency comprising in combination, pulsing contacts, an armature mechanically tuned to vibrate at the said predetermined frequency for operating said pulsing contacts, an electromagnet for operating said armature, and means for limiting the number of operations of said armature comprising an escapement wheel rotatable in either direction, manually depressible keys, means controlled during the depression of any of said keys for rotating said escapement wheel in one direction from normal through an arc whose length determines the number of operations of said armature, means controlled by any of said keys during the depression thereof for preparing an operating circuit for said electromagnet, an escapement pawl coupling said armature and said escapement wheel and adapted to drive said escapement wheel to normal when the operating circuit for said electromagnet is completed, means controlled by any of said keys when fully depressed for completing the operating circuit for said electromagnet whereby said armature vibrates at the said predetermined frequency and functions through said escapement pawl to drive said escapement wheel back to normal and to simultaneously operate said pulsing contacts, and means effective when said escapement wheel restores to normal for opening the operating circuit for said electromagnet.

8. A telephone transmitter comprising pulsing contacts, a vibratable member for operating said contacts and mechanically tuned to vibrate at a predetermined frequency, an electromagnet for operating said vibratable member, means for predetermining the number of vibrations of said vibratable member, a plurality of manually depressible keys, means controlled by said keys during the depression thereof for variably setting said predetermining means, means responsive to the full depression only of any of said keys for energizing said electromagnet whereupon said vibratable member is vibrated at the said predetermined frequency to operate said pulsing contacts a number of times corresponding to the setting of said predetermining means, and means operating automatically when said contacts are operated a number of times corresponding to the setting of said predetermining means for deenergizing said electromagnet.

9. In combination, a pulsing circuit, an electromagnetic interrupter effective to interrupt said pulsing circuit when included therein, a reciprocably rotatable impulse counter, a plurality of manually depressible keys, means controlled by said keys during the depression of any thereof for rotating said counter in one direction from its normal position through an arc of predetermined length, means controlled by said keys when fully depressed for including said interrupter in said pulsing circuit, means controlled by said interrupter when included in said pulsing circuit for driving said counter in the reverse direction to its normal position, whereby said interrupter functions during the reverse rotation of said counter to interrupt said pulsing circuit a number of times commensurate with the length of arc through which said counter was rotated during the depression of any of said keys, and means responsive to the return of said counter to its normal position for automatically excluding said interrupter from said pulsing circuit.

10. In combination, a station, a pulsing circuit, and an impulse transmitter at said station comprising an electromagnet normally excluded from said pulsing circuit and operable to interrupt said pulsing circuit when included therein, manually depressible keys, an impulse counter adapted to be set in a plurality of positions each of which determines the number times said electromagnet operates to interrupt said pulsing circuit, means controlled by any of said keys for setting said counter in one of said positions, means responsive to an off-normal movement of said counter incident to the depression of said any key for initiating the inclusion of said electromagnet in said pulsing circuit, and means controlled by said any key when fully depressed for completing the inclusion of said electromagnet in said pulsing circuit, whereupon said electromagnet functions to interrupt said pulsing circuit a number of times corresponding to the setting of said counter.

11. An impulse transmitter comprising in combination, pulsing contacts, an electromagnetic interrupter having an armature for controlling the operation of said pulsing contacts, a plurality of manually depressible keys, an impulse counter comprising an escapement wheel, an escapement pawl carried by said armature and adapted to drive said escapement wheel in one direction when said armature is vibrated, means controlled by any of said keys during the depression thereof for driving said escapement wheel in the other direction through an arc of predetermined length, means responsive to the full depression of any of said keys for energizing said interrupter whereupon said armature is vibrated and said escapement wheel is driven through said escapement pawl in said one direction through an arc of said predetermined length and said pulsing contacts are operated, means effective when any of said keys is fully depressed for locking the key in its depressed position, means effective when said escapement wheel is driven through an arc of the said predetermined length in the said one direction for releasing said key, and other means simultaneously effective for deenergizing said interrupter.

12. An impulse transmitter as described in the preceding claim wherein said other means functions to deenergize said interrupter irrespective of the depressed condition of said key following the operation of said key releasing means.

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