May 21, 1929. F. L. FISHER ET AL 1,714,302

IMPULSE SENDING MACHINE

Filed June 9, 1919 3 Sheets-Sheet 1

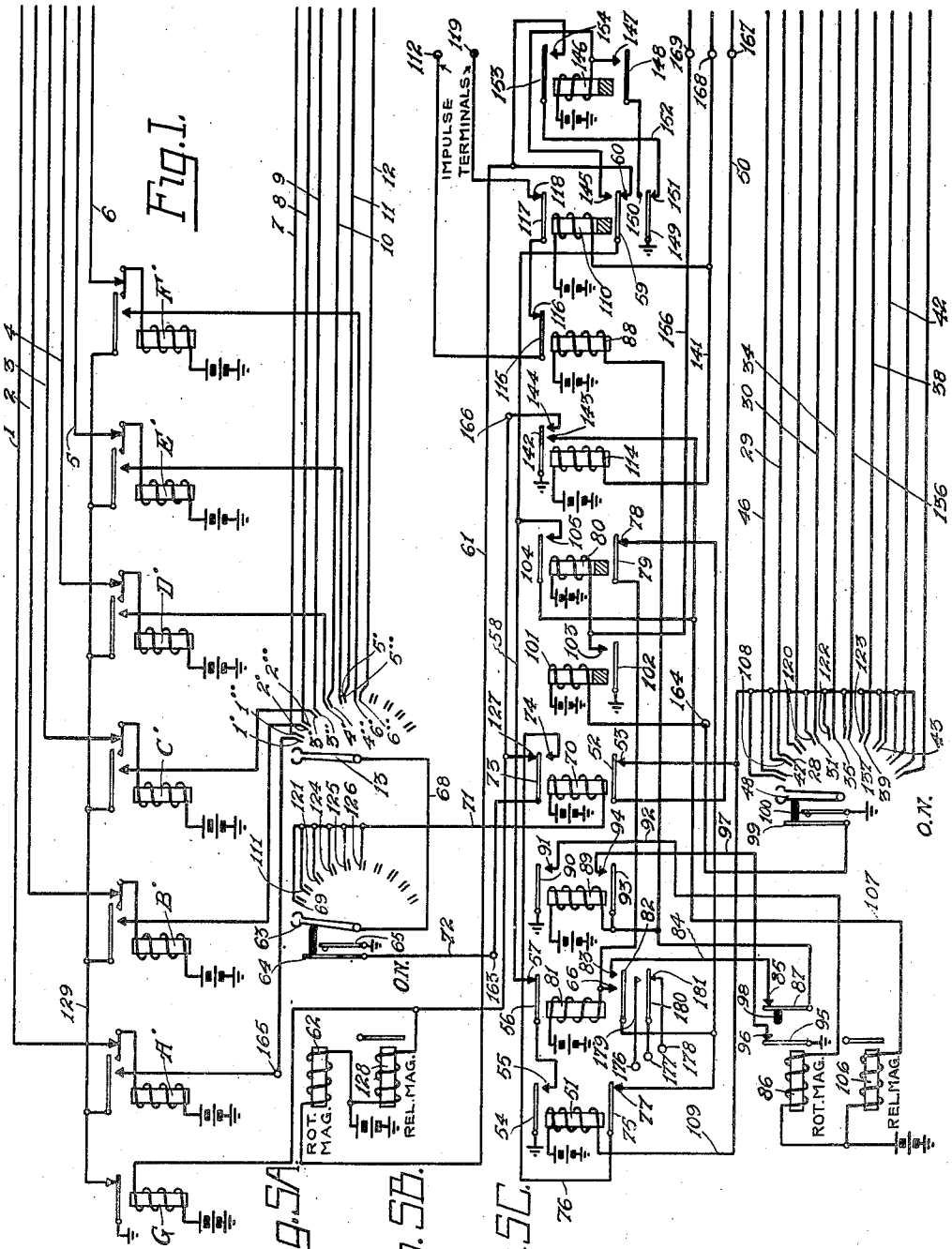

Fig. I.

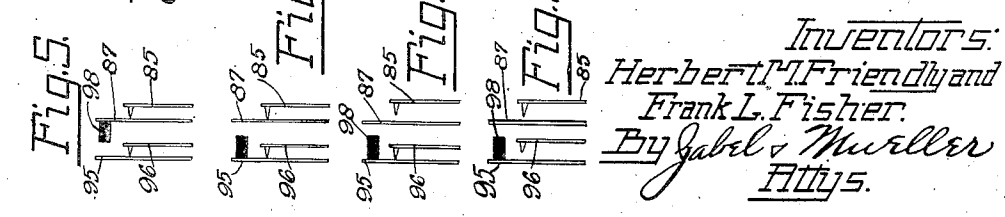

Fig. 5. Fig. 5A. Fig. 5B. Fig. 5C.

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Filed June 9, 1919 3 Sheets-Sheet 2

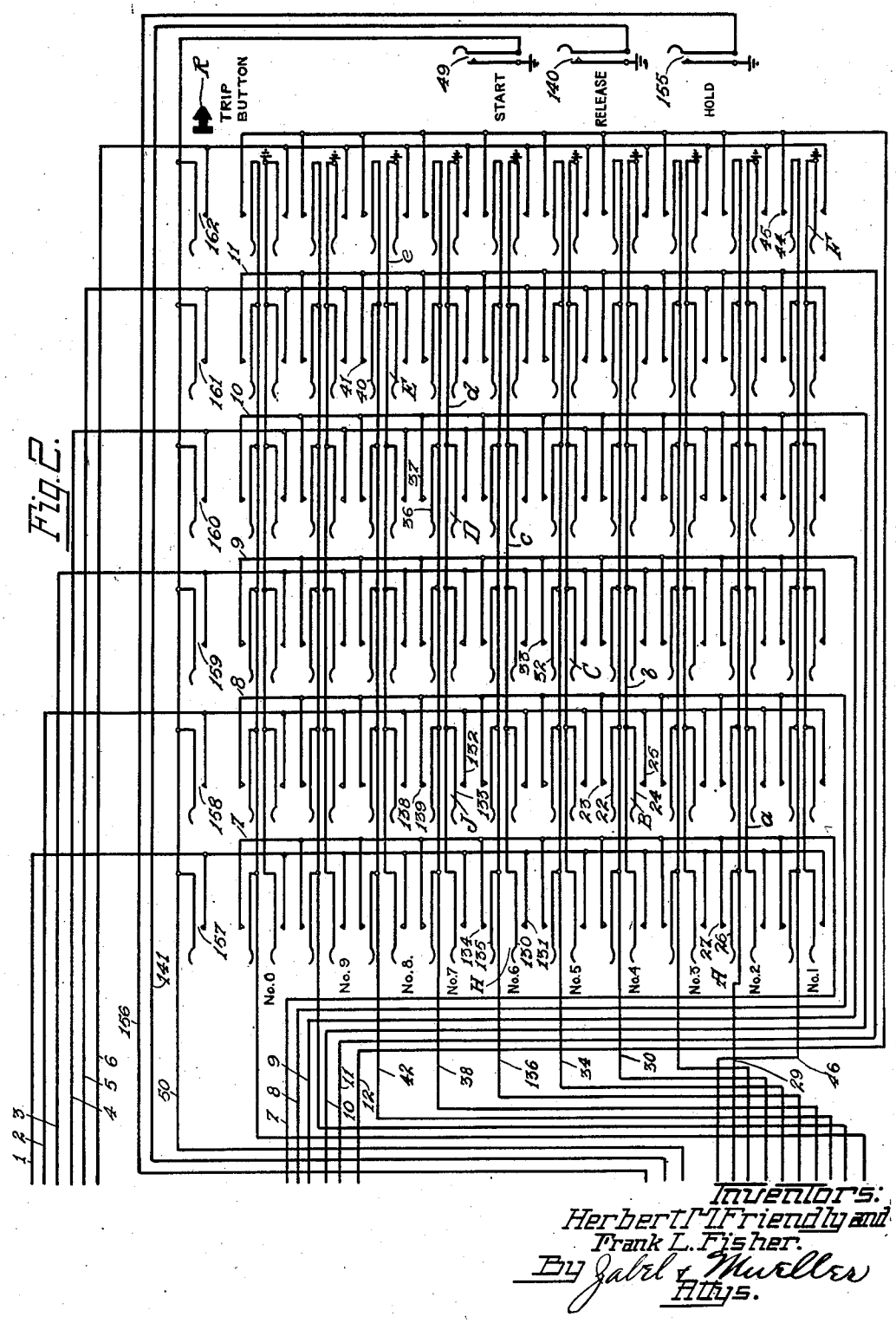

Fig. 2.

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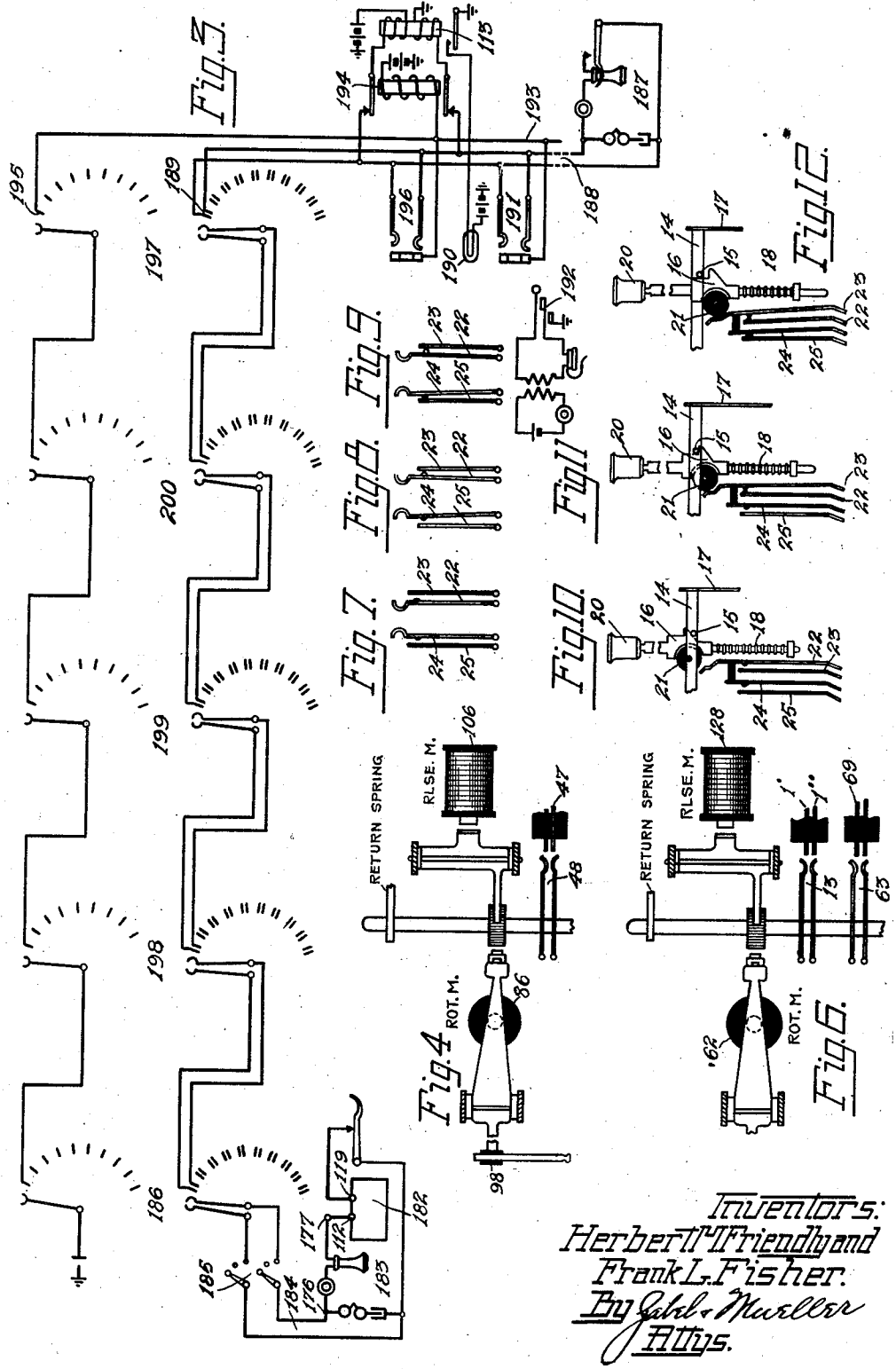
Filed June 9, 1919 3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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IMPULSE SENDING MACHINE.

Application filed June 9, 1919. Serial No. 302,807.

Our invention relates to the arts of machine, semi-mechanical, automatic and semi-automatic telephone systems, and also to message telegraph and fire alarm telegraph and signal systems, as well as to other arts.

An object of the present invention is to enable a pre-setting to be made through the agency of the designated pre-setting keys; this setting is to control a companion operative device interlinked with same, the office of which is to effectuate circuit openings and closings, or other circuit changes, in a manner consistent with the said key settings.

To illustrate the application of the invention, and the invention itself, its special application to a so-called automatic telephone system of the well known two-wire type will be described, the device contemplated under the present invention being employed as a calling device in lieu of the so-called dial calling device of well known form of the general type as shown in British patent to Dicker, No. 29,654 of 1910.

Calling devices of the latter type restrict the pre-setting to single digit series. That is to say, a setting for a successive digit of a telephone number cannot be made until the preceding digit series has been transmitted and the device has become normal.

The prime object of the presnt invention as applied to automatic telephone systems is to provide a means for enabling the calling party to partly or to completely pre-set the impulse transmitting device contemplated herein by depressing set-keys, whereupon the operative element will automatically transmit the train of series of impulses constituting the one or more digits of the called number pre-set.

It is clear that the present invention is also adaptable to switchboard use, where operators are called upon to transmit a comparatively large number of calls in rapid succession. As thus applied the operator may transmit calls with a relatively small expenditure of physical effort and mental exertion, for a pre-setting may be quickly accomplished and thereafter the device will self-function, its starting being automatically initiated, or initiated at will.

A means is also provided whereby the device, after being pre-set may be restored to normal, at will, without functioning as an impulse transmitter; also that it may be thus restored to normal while functioning.

A means is also provided precluding the functioning of the operative elements of the device for a predetermined period after a directed restoration to normal has been made. This is to obviate the possibility of otherwise starting a new series or a new train of impulses before the slow-releasing mechanism in the telephone switching system has had time to restore, in case a pre-setting is made and the functioning of the operative element initiated immediately after a directed release.

A means is also provided for permitting the calling party to arrest the transmission of the impulses, effective at the end of any single digit series of a number train being sent, when the means for arresting is brought into requisition, and is further adapted to cause the transmission of impulses to proceed, at will, to normally complete the unsent pre-set digit series of the number train.

The present invention also contemplates an auxiliary control facility incidental to the facility for effectuating the primary control. The auxiliary control means is to be applied to associated circuits, as by grounding or opening conductors at pre-determined junctures before a train of impulses is started; at the time a train of impulses is started; at the time a train of impulses cease, etc.

These, and other objects of the present invention will be understood by reference to the accompanying schematic circuit drawings and semi-schematic detail drawings, together with the descriptions thereof, in which:—

Fig. 1 is the operative transmitting element;

Fig. 2, which attaches to the right of Fig. 1 so the lines running to the margins register, shows the setting keys for pre-setting the operative or transmitting element of the device, and also the auxiliary keys thereof for adapting the control of the device to the will of the operator or calling party;

Fig. 3 represents diagrammatically a calling telephone or sub-station set, including a sending device as shown in Figs. 1 and 2, together with a preselector, four selectors, a connector and a called line and telephone;

Fig. 4 shows the lower rotary element and first bank contact set of Fig. 1;

Fig. 5 shows a detail of the interrupter contact device on left of Fig. 4;

Figs. 5ª, 5ᵇ and 5ᶜ show successive operative positions of the device shown in Fig. 5;

Fig. 6 shows the upper rotary element and first bank contact set of Fig. 1;

Fig. 7 shows the normal relation of the key springs of the individual set-keys shown in Fig. 2;

Fig. 8 shows the locked or intermediate position of the key springs shown in Fig. 7;

Fig. 9 shows the extreme down position of key springs shown in Fig. 7; and

Figs. 10, 11 and 12 represent the key positions shown in Figs. 7, 8 and 9 respectively.

The set-keys in Fig. 2 are in strips of ten, mechanically interlinked, so that depressing any key releases to normal any key in the strip which may have been in a depressed state. In setting a key it is depressed to an extreme down position and when the depressing pressure is removed it will return to an intermediate position as shown in Figs. 8 and 11, and be retained thus mechanically locked until any other key in the same strip is depressed, whereupon it will become unlocked and restore to normal. Strips of keys with this general characteristic of locking and unlocking are not new and are used for other purposes.

The rotary elements of Fig. 1 each have a rotary magnet, release magnet and bank contacts adapted to be engaged by a wiper set in each said rotary element. These wipers rotate from a normal position engaging the sets of bank contacts successively by steps responsive to the functioning of the respective rotary magnets. The wipers are adapted to be restored to normal responsive to the actuation of the respective release magnet. The said rotary elements have no vertical movement.

In order to obviate prolixity of description, circuits traced from ground to the winding of a designated relay or magnet, one winding terminal of which is shown as applied to permanent grounded battery, will be assumed as constituting an energizing circuit in which the designated relay or magnet actuates and incidentally functions normally. In the same manner relay armatures and contact springs shown applied to permanent ground will be assumed as themselves constituting ground.

Referring to Fig. 2, there are six strips of ten companion set-keys, each set-key being as shown in Figs. 10, 11 and 12. The lower key of each said strip corresponds to digit "1"; the second key from the lower end corresponds to digit "2"; the successive keys vertically, representing digits in numerical order, the top-most key representing "0." Each strip corresponds to a digit of the called number. Thus, the first strip on the left is the sixth or hundred-thousands digit strip. The second strip from the left is the fifth or tens-thousand digit, and the last strip on the right is the first or units digit. This is assuming the pre-set number is to have six digits. If, however, there are only three set-keys depressed to the extreme down position, starting with the left-hand strip and set consecutively, the third strip from the left will then represent the first or units digit and the first strip on the left will represent the third or hundredth digit and the intermediate strip will represent the second or tens digit. Thus, for example, if telephone number "245781" were to be set, keys A, B, C, D, E, and F would be depressed. But if telephone number "245" were to be pre-set, keys A, B, and C only would be depressed.

Assume the device is set to transmit a train of digit impulse series constituting the telephone number "245781" exampled above. At the time key A was depressed to its extreme down position conductor 1 was grounded to permanently grounded common conductor *a* through lower contact-set of key A, and this ground was removed upon the depressing pressure being removed by reason of said lower contacts disengaging incident to the key A assuming its intermediate position as shown in Figs. 8 and 11. Incident to conductor 1 becoming thus momentarily grounded, relay A′, which is specific to the first key strip, will energize through its normally made contact and actuate and lock, its armature engaging its companion make before break contacts, incidentally applying the locking ground from armature of normal relay G to bank contact 1, and to disassociate conductor 1 after relay A′ locks as described. Relay A′ will remain locked through its armature to ground received from the armature of relay G as long as said G remains normal.

In the same manner as described in relation to key A and relay A′, depressing key B will cause relay B′ to actuate over conductor 2 from permanently grounded common conductor *b* and lock to ground received from armature of relay G and apply this ground to bank contact 2′. It follows that when keys A, B, C, D, E, and F are depressed in making the said pre-setting, relays A′, B′, C′, D′, E′, and F′ which keys and relays are similarly related over conductors 1, 2, 3, 4, 5 and 6 respectively, became locked to ground on armature of relay G, and this ground was applied to bank contacts 1′, 2′, 3′, 4′, 5′, and 6′, the conductors 1, 2, 3, 4, 5 and 6 becoming freed from the windings of relays A′, B′, C′, D′, E′, and F′ respectively incidental to their actuation.

It will be noted that had any key in the first strip, other than key A, been depressed, the same functioning of relay A′ and the grounding of bank contact 1′ would have taken place. Likewise, depressing any key in the strips in which keys B, C, D, E, and F are, would have caused the described func-

tioning of relays B', C', D', E', and F' and the grounding of bank contacts 2', 3', 4', 5', and 6', respectively.

It will be further noted that all set-keys of the six digits shown have their contact springs corresponding to 24 of set-key B permanently grounded; said contact springs of like digit set-keys in the six strips being shown connected to a common conductor as *b*, for example, which is grounded. Obviously each said spring corresponding to said 24 may be independently grounded or all set-keys shown may have their said corresponding contact springs tied to a common and this common applied to ground.

It is clear from the foregoing that the relays A', B', C', D', E', and F' are not specific to individual set-keys of a strip, but on the contrary are common to all keys of the corresponding strip, each said relay being a relay common to all the numbers of the digit, rather than an individual digit-relay, as it would be, if specific to a single key of a key strip. It follows, that only such common relays will be caused to actuate whose digit strips have had set-keys depressed to the extreme down position therein, so if the telephone number being called consists of the first three digits, "245", only relays A', B', and C' will be caused to actuate; this is irrespective of the fact that other keys in successive digit strips, as for example, D, E and F are in their respective intermediate positions as shown in Figs. 8 and 9, due to having been so set incident to a previous number setting, and the operative element in Fig. 1 having subsequently been caused to be returned to normal automatically, or directively, as will hereinafter be further referred to. In fact, the office of relays A', B', C', D', E', and F', which have a primary relation to conductors 1, 2, 3, 4, 5 and 6, causing bank contacts 1', 2', 3', 4', 5', and 6' respectively to become grounded in a secondary manner, is to insure that only for each new setting in a key-strip, can a corresponding said bank contact become grounded through the agency of the relay specific to the specific key-strip in which the depression of a key occurs. That is to say, bank contacts 1', 2', 3', 4', 5', and 6' are specific to key-strips in which keys A, B, C, D, E, and F are, and further, that they can only become grounded respectively, after a normal condition in Fig. 1 has ensued, by a new setting function transpiring in a related key-strip.

Conductors 7, 8, 9, 10, 11, and 12 (Fig. 2) lead from the first, second, third, fourth, fifth and sixth strips respectively; each said conductor leading as a common from corresponding normally disengaged contact springs (as 23 of B) of each key of its strip, to bank contacts 1'', 2'', 3'', 4'', 5'' and 6'', the said companion bank contacts being adapted to be engaged by the electrically joined blades of the wiper 13. Thus, when wiper 13 engages a companion pair of bank contacts it will cause them to become electrically connected, and if one contact of the pair is grounded as before described, this ground will be communicated to its companion bank contact and leading-in conductor. As for example, if bank contact 1' is grounded to armature of relay G due to relay A' being in the actuated position, this ground will be communicated to conductor 7, if wiper 13 is caused to engage the first pair of bank contacts 1'—1''. In the same manner, wiper 13 will cause ground found on 2', 3', 4', 5', and 6' to be communicated to bank contacts 2'', 3'', 4'', 5'', and 6'' and the conductors 8, 9, 10, 11 and 12 respectively, if caused to successively step by rotation into the said bank contact positions.

Figs. 7, 8, 9, 10, 11 and 12 may be assumed to represent key B, for example, it being borne in mind that all individual set-keys are similar. The locking bar 14, shown in part only, carries a pin 15 corresponding to each set-key of a strip, which pins are designed to engage the offset in the key member 16 due to tension of spring 17 causing the bar to move into retaining engagement when the key-member 16 is depressed. The lower side of member 16 is angular and designed to push the bar 14 against the tension of the spring 17 responsive to depressing the key.

It will be noted that incident to plunger 16 being depressed the locking bar 14 will cause any key of the strip which may be in the locked position as shown in Fig. 11 to be disengaged so the said latter key may restore to normal position as shown in Fig. 10, under the tension of the contact-springs, and also from the resilience of the compression spiral spring 18 on the stem 19. Thus, under normal operation, but one set-key in a strip can be in an off-normal position, and depressing any set-key will automatically restore a previously depressed and locked set-key in the same strip to normal.

The insulated member 21 causes the normally disengaged contact-springs to engage progressively when the button is depressed, as for example, contact-spring 22 will engage contact-spring 23 when the insulated member 21 is in the locked or retained position, and contact-spring 24 will engage contact-spring 25 in addition when the insulated member 21 is in the extreme down position, and only while held so under depressing pressure on button 20; it returning to the former position, wherein contact-springs 24 and 25 are disengaged and contact-springs 22 and 23 are engaged, when the depressing pressure is removed.

By reference to Figs. 7, 8, 9, 10, 11 and 12 it will be noted that the contact-springs of each key-strip to which conductor 7 is common is only engaged by its companion key-spring

when the key is in an off-normal position; that is, in its extreme depressed position, or in its intermediate or locking position and that when it is in a normal position the said contacts are free. It thus follows that if set-key A is in its extreme depressed position, or in its locked position, contact-spring 26 will engage contact-spring 27 and that a condition of circuit continuity will exist between bank contact 1'' and bank contact 28 of the lower rotary element of Fig. 1. It then follows that if wiper 13 engages companion contacts 1'—1'', assuming bank contact 1' is grounded by reason of a key setting as set forth, the ground on 1' described as received from armature of relay G will be communicated to bank contact 1'', conductor 7, key contact-springs 26 and 27 in engagement and conductor 29 to said bank contact 28.

It likewise follows that when set-key B is in its locked or set position and its contact springs 22 and 23 are therefore in engagement, a condition of circuit continuity exists from bank contact 2'' by way of conductor 8 and said engaged contacts of key B, and over conductor 30 to bank contact 31. Also, that when set-key C is in its locked or set position and its contact-springs 32 and 33 are therefore in engagement, a condition of circuit continuity exists from bank contact 3'' by way of conductor 9 and said engaged contacts of key C, and over conductor 34 to bank contact 35. Also, that when set-key D is in its locked or set position and its contact springs 36 and 37 are therefore in engagement a condition of circuit continuity exists from bank contact 4'' by way of conductor 10 and said engaged contacts on key D, and over conductor 38 to bank contact 39. Also, that when set-key E is in its locked or set position and its contact-springs 40 and 41 are therefore in engagement, a condition of circuit continuity exists from bank contact 5'' by way of conductor 11 and said engaged contacts of key E and over conductor 42 to bank contact 43. Also, that when set-key F is in its locked or set position and its contact-springs 44 and 45 are therefore in engagement a condition of circuit continuity exists from bank contact 6'' by way of conductor 12 and said engaged contacts of key F and over conductor 46 to bank contact 47.

It will be noted that a numerical relation exists between the lower set of bank contacts in Fig. 1 adapted to be engaged by the right hand blade of wiper 48 and the six strips of set-keys in Fig. 2. That is, the ten said bank contacts, counting from the uppermost set down, corresponds to all set-key strips, counting from the lowermost set-key up. Thus, bank contact 47 corresponds to set-keys in all digit strips representing digit "1"; bank contact 28 corresponds to set-keys in all digit strips representing digit "2"; bank contact 31 corresponds to set-keys in all digit strips representing digit "4"; bank contact 35 corresponds to set-keys in all digit strips representing digit "5"; etc.

Recapitulating, we observe that the bank contacts adapted to be engaged by right hand blade of wiper 13, counting from the uppermost set down, correspond to all keys of each digit strip respectively, the said counting beginning with the left-hand strip, and that the bank contacts adapted to be engaged by right-hand blade of wiper 48, counting from the uppermost set down, corresponds to a numerically similarly related key in each digit strip, counting beginning with the lowermost set-key. Thus, the former rotating element (having wiper 13) may be termed the digit distributor, while the latter rotating element (having wiper 48) may be termed the digit finder.

Before discussing the effective functions in the telephone switching system in making the stated call, telephone number 245681, the operative functions of the impulse transmitting device proper will be discussed.

Assume the stated key-setting has been made and that relays A', B', C', D', E', and F' are locked actuated, and that therefore bank contacts 1', 2', 3', 4', 5', and 6' are grounded by way of armature of relay G and the locked armatures of the said relays respectively. Next, assume that start-key 49 is thereafter depressed, causing its contact-springs to engage and thus apply the ground during the period of depression to conductor 50 and to the winding of relay 51 by way of armature 52 and its normal contact 53, causing said relay 51 to actuate, applying ground on its armature 54 to its contact 55, thence through armature 56, contact 57, conductor 58, armature 59, contact 60, conductor 61 to winding of rotary magnet 62, causing it to actuate and drive wipers 13 and 63 into their first (off-normal) rotary position respectively, incidentally causing off-normal spring contacts 64—65 to engage, after wiper 13 has engaged bank contact 1'.

As has been described, when wiper 13 moves into its first rotary position, the ground on bank contact 1' will be communicated over conductor 7, key contacts 27—26, conductor 29 to bank contact 28.

Wiper 13 being now grounded, due to its engagement with bank contact 1', this ground is communicated to wiper 63 over conductor 68 and to engaged bank contact 69, conductor 71, and relay 70, causing said relay 70 to actuate and interrupt contacts 52—53; thus opening the continuity of conductor 50, also, closing conductor 72, (which receives off-normal ground through contacts 65—64,) through armature 73 of relay 70 to its alternate contact 74 and over conductor 76 to armature 75 of deactuated relay 51.

Incidental to contacts 52—53 opening grounded conductor 50 (or if this ground is removed by permitting start-key 49 to return

to normal) relay 51 will deactuate, removing the ground from the winding of the rotary magnet 62 and causing it to deactuate, and also close a circuit path from ground on off-normal spring 65, spring 64, conductor 72, armature 73, alternate contact 74, armature 75, normal contact 77, contact 78 and armature 79 of slow-releasing relay 80 to winding of relay 81, causing said 81 to actuate and lock through contact 66, armature 82 to ground on spring 65 over the described circuit path, and incidentally apply this ground to contact 83, conductor 84, contact 85 of the interrupter device on rotary magnet of lower element of Fig. 1, spring 87 to windings of relays 88 and 89 in multiple, causing both said 88 and 89 to actuate. Incidental to the actuation of relay 89 ground on its armature 90 will be applied to its make contact 91 and over conductor 92 to the winding of the rotary magnet 86, causing said 86 to actuate. Also, responsive to the actuation of relay 89 its armature 93 engages its make contact 94, communicating ground on spring 95 of rotary magnet 86 to its normal contact 96 over conductor 97 to the winding of relay 89, thus supplementing the ground described as applied to the winding of relay 89 from off-normal spring 65.

Responsive to the actuation of rotary magnet 86, insulated member 98, which is mechanically linked with the armature of said 86, will attract into engagement with spring 95. However, the mechanical relationship and adjustments between the springs 85—87, 96—95 and member 98 (also shown in Figs. 5, 5^A, 5^B, and 5^C) is such that when member 98 is attracted, spring 85 flexes so that it remains in electrical engagement with spring 87 until member 98 engages spring 95 and has flexed it appreciably and before disengaging it from spring 96 as shown in Fig. 5^A, but still not disengaging springs 85—87 until a further flexing of spring 95 as shown in Fig. 5^B; this disengaging of springs 85—87 being followed by the disengaging of springs 96—95 as shown in Fig. 5^C. Relay 89 was described as being held actuated by a ground path from its winding through armature 93, contact 94, conductor 97, contact 96 to grounded spring 95. Also relay 89 is held actuated by a ground path from its winding to the contact springs points of 87—85, conductor 84, contact 83, armature 82, contacts 77—75, conductor 76, contacts 74—73, conductor 72 off-normal spring 64 to grounded spring 65. Thus the relay 89 and its multipled relay 88 will remain actuated until both said paths become opened. One path becomes opened when spring 87 flexes out of engagement with spring 85; the other path becomes opened when spring 95 flexes out of engagement with spring 96. It will be noted that as long as relay 89 remains actuated its armature 90 retains ground on the winding of the rotary magnet 86, causing it to maintain a tractive force on its pawl-carrying armature, of which member 98 is a fixed part. It will be clear that by adjusting the tension and arc of engagement of the said sets of springs flexed by member 98 respectively, the throw or angle of gyration of the pawl-carrying armature comprising member 98 as an element, will be correspondingly varied, as well as the characteristic period of vibration. Thus, the novel arrangement, whereby relays 89 and 88 are controlled by a combined functioning of two independently adjustable sets of contacts acting jointly as an interrupter has a greater range of adjustment and a more positive, uniform and fixed period than can be attained by a single-set interrupter device. In fact, this novel interrupter of the present invention may be termed a composite interrupter as distinct from simplex interrupters formerly known; it has wide adaptations in this and other arts. Also, regardless of the angular movement of the armature of rotary magnet 86 the relays 89 and 88 may be governed by the said contacts controlled by member 98, so the period of actuation of the said latter relays may be readily modified and varied, and therefore the characteristic of the call selection impulses controlled by relay 88 as shall be adverted to presently, may be also modified.

Relay 81 remains actuated over the described path until relay 51 actuates by reason of wiper 48 finding ground on bank contact 28, applied over the described path to bank contact 1″, wiper 13, bank contact 1′ and grounded armature of relay G.

Responsive to the described actuation of the rotary magnet 86 wiper 48 is driven into the first rotary position, its electrically joined blades linking the first pair of bank contacts, and off-normal spring 99 will engage grounded spring 100, causing slow-releasing relay 101 to actuate and apply ground on its armature 102 to contact 103 and to the winding of slow-releasing relay 80, causing it to actuate and open contacts 78—79 and close armature 104 upon contact 105 leading to conductor 58. Armature 104 leads to winding of release magnet 106 over the conductor 107. However, at this juncture no actuating ground will be applied to said 106 since the circuit continuity of conductor 58 is broken by reason of contact 55 being disengaged from armature 54.

At the instant contacts 95—96 and 85—87 are caused to open as described, relays 89 and 88 become deenergized and deactuated. Armature 90 will, in turn, remove the ground from the winding of the rotary magnet 86 and it will deactuate, causing contacts 95—96 to close; followed by the closure of contacts 85—87. At the time contacts 85—87 close, ground will be reapplied to windings of relays 89 and 88, causing said relays to reactu-

ate to cause the rotary magnet 86 to reactuate over the circuit path previously described, driving wiper 48 a second rotary step; its blades engaging the second set of bank contacts 28—108.

With the stated set-key setting, conductor 29 leading from bank contact 28 is in circuit continuity through set-key contacts 26—27 and conductor 7 to bank contact 1″ of the upper element and with the blades of wiper 13 electrically joining bank contacts 1″ and 1′, and bank contact 1′ grounded through armature of relay G as described. This ground received from bank contact 1″ on said 28 will be applied from the right hand blade of wiper 48 to the lefthand blade thereof, and to bank contact 108 and to conductor 109, which is common to all bank contacts, of which 108 is one, adapted to be engaged by the left hand blade of said 48. Conductor 109 leads to winding of relay 51, and it is therefore actuated from the said ground application. Relay 89 deactuated as before at the instant both contact-sets 85—87 and 95—96 became open coincidently opening contacts 90—91 and causing the rotary magnet 86 to thereupon again deactuate. Armature 75 will attract from normal contact 77 before contacts 85—87 reestablish, and thus remove the locking ground from the winding of relay 81, as well as the initial actuating ground from the winding of relay 81. The latter relay will deactuate. Relay 89 which opened as before described incidental to the actuation of the rotary magnet 86 will not reactuate at this juncture; that of the rotary magnet 86 returning to normal, because conductor 84 is now free of ground due to contact 77 being free from armature 75. Then, the ground on armature 54 will be applied to make contact 55, armature 56, normal contact 57, conductor 58, make contact 105, armature 104, conductor 107 to winding of release magnet 106, causing it to actuate and restore wiper 48 to normal and open off-normal contacts 99—100, causing relay 101 to deactuate its period thereafter; this followed by the deactuation of relay 80 its period after said 101.

The said ground on armature 54 communicated to conductor 58 also leads through armature 59 and normal contact 60 of slow releasing relay 110 and over conductor 61 to the winding of the rotary magnet 62 of the upper element, causing it to actuate and drive wipers 63 and 13 to the second rotary position; the former wiper engaging bank contact 111 and the latter wiper electrically joining bank contacts 2′ and 2″. Bearing in mind that the linked blades of wipers 63 and 13 respectively are joined by conductor 68 and that the left hand blade of wiper 63 is so designed that it engages adjacent bank contacts as it passes successively from one rotary position to the next, as for example, it engages bank contact 111 before it leaves bank contact 69. Also, that left-hand blade of wiper 13 is so designed that it engages adjacent bank contacts, as for example, it engages bank contact 2′ before it leaves bank contact 1′. And also keeping in mind that bank contact 1′, 2′, 3′, 4′, 5′, and 6′ are grounded and relays A′, B′, C′, D′, E′ and F′ are actuated by virtue of the initial setting described, it will be clear that relay 70 remains actuated and ground from off-normal spring 65 will thus exist on armature 75 of relay 51.

In the foregoing functioning of relay 88, wherein it actuated two times effective from the prime actuation of relays 81 and 89 and the rotary magnet 86, the circuit path between impulse terminal 112, contacts 115, 116, contact 117, 118 to terminal 119 was interrupted two times at contacts 115–116 of relay 88. As will be seen presently the described opening of the said circuit between the terminals 112–119 constitute a means of effectuating control of automatic switches in an exchange and therefore constitute a call selection control, in this instance representing digit "2", simulating the functioning of the impulse contacts of a so-called dial calling device referred to at the outset wherein "2" is pulled.

At this juncture relays A′, B′, C′, D′, E′ and F′ are still actuated and locked as ensued at the initial setting described, and off-normal springs 64–65 are in engagement, and so remain until wipers 63 and 13 return to normal, as will appear later. Wipers 63 and 13 are in their second rotary position, respectively, being rigidly connected to the driving shaft which cooperates with and is drawn by the pawl-carrying armature of rotary magnet 62. In the lower element, relay 51 is restored to normal coincident with wiper 48 and contact-springs 99—100 restoring to normal, followed by the deactuation of relays 101 and 80 in sequence consistent with their release characteristics. Relay 70 is held actuated until wipers 63 and 13 move from the sixth rotary position after having successively progressed by step movement to the said sixth position, which position is the last one having a grounded bank contact engageable by the left-hand blade of wiper 13. Thus, with the exception of said 70 all relays in the lower element are normal. However, incident to relay 80 deactuating, the described circuit path from ground off-normal spring 65 to winding of relay 81 is again established, and the said 81 actuates resultant thereto, locking and incidentally grounding winding of relays 89 and 88 as before described. The functioning of the rotary magnet 86 will be as before described upon said 89 actuating and its cycles of actuation and deactuation will continue as before until wiper 48 encounters ground on bank contact 31, reached on the fourth ro-

tary step, relays 89 and 88 deactuating and reactuating four times, or in other words, completing four operative cycles in the manner as before described in which it completed two such cycles only, constituting the second digit "4".

Relays 101 and 80 actuated in sequence upon wiper 48 moving off-normal into its first rotary position as before. It is thus clear that after right-hand blade of wiper 48 engages a grounded contact causing the release magnet 106 to actuate and restore said 48 to normal and also cause rotary magnet 62 to actuate and drive wipers 63 and 13 a step in advance as described, a period of incapacitation ensues, dependent upon the accrued release characteristics of relays 101 and 80, which were described as deactuating in sequence. This function is what introduces a delay of determined duration, set by the adjustment of said 101 and 80, between the successive digit series of the number train being sent, to allow for automatic functioning of selector switches as in trunk group selection, for example.

It has been described how, with the stated key setting, bank contacts 1″, 2″, 3″, 4″, 5″, and 6″ are electrically linked to bank contacts 47, 28, 31, 35, 39 and 43, and that counts 1′, 2′, 3′, 4′, 5′, and 6′ are grounded. This will continue, as will be apparent presently, until relay G is caused to actuate incidental to wiper 13 moving forward from its sixth rotary position. Therefore, as wiper 13 advances in steps it will successively ground the bank contacts 28, 31, 35, 39, 43 and 47; one said latter bank contact only being grounded for each rotary position of wiper 13.

At the instant wiper 48 attains the fourth rotary position, its right hand blade finding ground thereon on bank contact 31; said ground being received from bank contact 2″, by way of companion blades of wiper 13 as described, this ground is conducted through left-hand blade of wiper 48 to bank contact 120 and to conductor 109 which condition causes the same functioning as before described incident to said 109 becoming grounded. However, in this instance wipers 13 and 63 are caused to move into the third rotary position responsive to the actuation of rotary magnet 62. Wiper 63 will maintain ground on conductor 71 by way of bank contact 121 received from bank contact 3″ over conductor 68; the said ground being also communicated to bank contact 3′ and thence to bank contact 35 of the lower element over path described.

As before, upon the deactuation of relay 80, relay 81 will actuate, followed by relay 89 and the before described functioning of the rotary magnet 86 will ensue, though in this instance its cycles of operation, together with those of the described coacting relays, will continue until the right-hand blade of wiper 48 encounters grounded bank contact 35 occupying the fifth rotary position. As before, the rotary position attained by wiper 48 will index the cycles of operation of the rotary magnet 86 and its coacting relays. Thus, relay 88 will complete five operative cycles, constituting the third digit "5" in the manner first described in which it completed two such cycles only.

Upon the right-hand blade of wiper 48 encountering bank contact 35 the ground described as being thereon is communicated to the left-hand blade of said wiper and to bank contact 122 leading to conductor 109, and the latter leading to the winding of relay 51, causes it to actuate and unlock relay 81 and also causes rotary magnet 62 to drive wipers 63 and 13 one step into the fourth rotary position and further causes release magnet 106 to actuate and in turn cause wiper 48 to restore to normal, opening ground from conductor 109 and allows relay 51 to restore to normal. Off-normal contacts 99—100 will open causing relays 101 and 80 to return to normal in consistent sequence, initiating a reactuation of relays 81 and 89 and the attendant functioning as before described.

In the manner before described and over the circuit path stated, wiper 13 will apply ground on bank contact 4′ to bank contact 4″ and to bank contact 39 of lower element. In the manner now clear from the previous descriptions wiper 48 will rotate by steps until its right-hand blade encounters bank contact 39 occupying the seventh rotary position and its left-hand blade encounters bank contact 123 leading to conductor 109 and to the winding of relay 51 as stated previously, said 51 actuating. In the manner as before set forth the said rotary position attained by wiper 48 indexes the cycles of operation of the rotary magnet and its coacting relays. Thus, relay 88 will complete seven operative cycles of the character hereinbefore set forth, constituting the fourth digit "7". Resultant to the actuation of relay 51 rotary magnet 62 will drive wipers 63 and 13 one rotary step into the fifth rotary position and cause release magnet 106 to actuate and in turn cause wiper 48 to restore to normal, followed by the deactuation of relays 101 and 80 in consistent sequence.

Left-hand blade of wiper 13 now encounters ground on bank contact 5′ and conducts said ground to the right-hand blade thereof and to bank contact 5″ leading to bank contact 43 of the lower element.

As before, upon the deactuation of relay 80, relay 81 will actuate, followed by relay 89, and the before described functioning of the rotary magnet 86 will ensue, though in this instance its cycles of operation, together with those of the described co-acting relays, will continue until the right-hand blade of wiper

48 encounters grounded bank contact 43 occupying the eighth rotary position. As before, the rotary position attained by wiper 48 will index the cycles of operation of the rotary magnet 86 and its coacting relays. Thus, relay 88 will complete eight operative cycles constituting the fifth digit "8" in the manner first described in which it completed two such cycles only.

The functioning of relay 51 incident to the right-hand blade of wiper 48 encountering a grounded bank contact has been fully described, together with the resultant deactuations of relays 81 and 89 and the actuation of rotary magnet 62, which in this instance causes wipers 63 and 13 to move into the sixth rotary position and also the actuation of release magnet 106 which causes wiper 48 to restore to normal, followed by the returning to normal of relays 101 and 80 in consequent sequence.

Left-hand blade of wiper 13 now encounters grounded bank contact 6′ and conducts said ground to the right-hand blade thereof to bank contact 6″ and to bank contact 47 of the lower element.

As before, upon the deactuation of relay 80, relay 81 will actuate, followed by relay 89 and the before described functioning of the rotary magnet 86 will ensue, though in this instance its cycles of operation, together with those of the described coacting relays, will continue until the right-hand blade of wiper 48 encounters said grounded bank contact 47 occupying the first off-normal rotary position. As before, the rotary position attained by wiper 48 will index the cycles of operation of the rotary magnet 86 and the coacting relays. Thus, relay 88 will complete one only operative cycle, constituting the sixth digit "1" in the manner first described in which it completed two such cycles.

The functioning of relay 51 incident to the right-hand blade of wiper 48 encountering a grounded bank contact has been fully described, together with the resultant deactuation of relays 81 and 89 and the actuation of rotary magnet 62, which in this instance causes wipers 63 and 13 to move into the seventh rotary position and also the actuation of the release magnet 106 which causes wiper 48 to restore to normal; followed by returning to normal of relays 101 and 80 in consistent sequence.

It was described how, as left-hand blade of wiper 63 rotated from bank contact 69 to bank contact 111 and thence to bank contact 121 electrical continuity with conductor 71 was uninterruptedly maintained, and also, that ground was uninterruptedly maintained on the blades of wiper 13 while passing from contact 1′ to contact 6′. Bank contacts 124, 125 and 126 consecutively following bank contact 121 serve to maintain the said electrical continuity between the left-hand blade of wiper 63 and conductor 71 until said 126 is disengaged incident to the onward movement of the said wiper.

It has also been described how relay 70 was held actuated from the ground received from the armature of relay G, and conductor 68 joining wipers 63 and 13. Thus, when wiper 13 moves beyond the sixth bank position; in this instance being the last bank position having a grounded bank contact engageable by wiper 13 the ground is removed from conductor 71 and relay 70 will deactuate, armature 73 retracting into engagement with its normal contact 127. A circuit now exists from the grounded spring 65, spring 64, conductor 72, armature 73, normal contact 127 to winding of release magnet 128, causing it to actuate and restore wipers 63 and 13 to normal and open off-normal springs 64—65 to deenergize release magnet 128. Relays 101 and 80 may or may not have returned to normal due to their slow release characteristic; in fact it is only necessary that relay 70 shall deactuate before relay 80 closes its normal contacts 78—79 to insure that relays 81 and 89 shall not reactuate and cause the rotary magnet 86 to actuate and introduce an actuation of relay 88, which latter function might cause a false impulse to be introduced into susceptible equipments in the automatic exchange. It will be noted that the winding of relay G is in multiple relation with release magnet 128, and therefore actuates coincident therewith. The actuation of relay G disconnects ground from common conductor 129, which constitutes the locking ground of relays A′, B′, C′, D′, E′, and F′ and also is the secondary source of ground for bank contacts 1′, 2′, 3′, 4′, 5′ and 6′. The six latter relays will return to normal and ground will also be removed from the six latter bank contacts.

The operative element Fig. 1 of the impulse sending device is now normal. However, bank contacts 1′, 2′, 3′, 4′, 5′, and 6′ are still linked through the set key contacts to bank contacts 28, 31, 35, 39, 43 and 47 over the previously described path through the stated contacts of set-keys A, B, C, D, E and F; the said latter keys remaining as set until a subsequent setting in respective digit strips changes any or all of them, it being borne in mind that only a new setting of set-keys, wherein they are caused to be depressed to their extreme down positions respectively, can introduce a factor of control of the operative element after relay G has actuated. That is to say, regardless of the fact the digit strips have depressed set-keys, such depressed set-keys are not a factor of control, nor do they constitute an effective setting unless they have been individually depressed to their extreme down position respectively, and further, that such set-keys

so depressed to their extreme down positions are in digit strips in successive numerical relation, counting from the extreme left-hand strip. A correction of a set digit may be made by depressing a new key to its second position only.

Illustrative of the latter statement it may be assumed that in a setting of telephone number 245681 set-key B was, through inadvertence, only depressed to the intermediate position, and, therefore, due to the stated adjustments of the lower set of contact springs 24—25 of said B, said latter springs will remain disassociated. Then, since conductor 2 will not have had ground applied thereto, relay B′ will have remained normal and no ground will have been applied to bank contact 2′. Thus when wipers 63 and 13 move into the second rotary position, wiper 13 will fail to find ground, and, therefore, from the descriptions, it will be clear relay 70 will deactuate, and as before set forth, the deactuation of relay 70 will cause release magnet 128 and relay G to actuate; the said actuation of relay G unlocking the relays A′, C′, D′, E′ and F′ as before set forth, the operative element shown in Fig. 1 thus restoring to normal without susceptibility to keys A, C, D, E and F or the set condition of their dependent relays A′, C′, D′, E′ and F′. In this instance, the operative element Fig. 1 functioned as if digit "2" in the first series only were set.

If keys A, B, and C (representing telephone number 245) only are depressed to their respective down positions (causing relays A′, B′ and C′ to actuate and lock) and keys D, E and F left as previously set, the operative element Fig. 1, including relay 88, will function as first described after depressing start-key 49 as before, wiper 48 rotating successively to bank contacts 28, 31 and 35 and releasing upon attaining the said bank contacts respectively. Wipers 63 and 13 will rotate as before by steps to the third position and thence to the fourth position, and failing to find ground on bank contact 4′, because relay D′ has remained normal since relay G last actuated, the relay 70 will be caused to be deactuated in the manner before described because of wiper 63 becoming ungrounded and release magnet 128 will actuate and restore wipers 63, and 13 to normal and cause relay G to actuate and unlock A′, B′, and C′, together with relays 101 and 80 in the manner before set forth, resulting in the operative element Fig. 1 restoring to normal.

Assuming set-key H representing digit "6" in the first or left-hand numerical order key strip, and set-key J, representing digit "7" in the second numerical order key strip are next depressed to their respective extreme down positions in a new setting, this being designed to cause relay 88 to effectuate circuit openings to constitute telephone number "67", relays A′, and B′ will be caused to actuate. Relay A′ will receive ground and function as first described, over conductor 1 by way of key springs 130—131 of set-key H and to grounded common *c*. Relay B′ will receive ground and function as first described over conductor 2 by way of key springs 132—133 of set-key J and grounded common *d*. Incidental to the keys A and B being thus depressed from a previous setting, set-keys A and B situated in the same strips respectively as set-keys H and J, will restore to normal due to the described locking bar action. Upon depressing pressure being removed the said springs of keys H and J will disengage in the manner described in relation to set-key B. Springs 134—135 of key H will also close incident to the depression and remain closed until released to normal and complete an electrical path from bank contact 1″ over conductor 7 and conductor 136 to bank contact 137 of lower element. Springs 138—139 of set-key J will also close incident to the depression and remain closed until released to normal and complete an electrical path from bank contact 2″ over conductor 8 and conductor 38 to bank contact 39 of lower element.

It will be noted here that since contact-springs 36—37 of key D are closed due to a previous setting and that no key has been newly set and the numerical order strip containing key D the said contacts will remain closed during the functioning of the operative element Fig. 1 resultant to the setting of keys H and J following the depressing of start-key 49. Therefore, the described circuit path from bank contact 4″ over conductor 10 through said contacts 36—37 to conductor 38 and bank contact 39 will still exist. This condition of bank contact 39 having electrical continuity with bank contacts 2″ and 4″ will cause no operative confusion since when wiper 13 functioning in the manner described rotates from engagement with bank contact 2′ ground will be removed from wiper 63 and the described restoration to normal of the operative element Fig. 1 will reensue. If, now, it is assumed a setting of said H and J were remade and also the keys C and D are depressed to the extreme down positions respectively, relays A′, B′ and C′ and D′ will actuate as before described responsive thereto, and in this case bank contacts 2″ and 4″ are linked from conductors 8 and 10 through key-springs 138—139 and 36—37 respectively to conductor 38 and to bank contact 39 of the lower element of Fig. 1. From the foregoing it is clear that when wiper 13 engages bank contacts 2′ and 2″ (assuming that start-key was depressed to initiate the functioning of the operative element Fig. 1) not only is bank contact 39 of the lower element grounded, but also bank contact 4″ of the upper element. However, since only one contact 39 is

grounded in the lower element, its (39) rotary position will definitely index the cycles of actuation of relay 88, being seven. Then, when wiper 13 has progressed by successive steps to bank contact 4'' in the manner described and it engages bank contacts 4' and 4'', bank contact 2'' will become grounded as well as said bank contact 39. As before, the rotary position of 39 will index the cycles of actuation of relay 88, so seven cycles of actuation of said relay will again transpire; the telephone number thus constituted being "6757". Upon wiper 13 stepping into the fifth rotary position and finding no ground on bank contact 5' due to relay E', being normal; set-key E not having been depressed since relay G actuated and removed ground which in a previous setting locked it, the relay 70 will deactuate in the manner before set forth and the operative element Fig. 1 will return to normal consequent thereto, as in the instance described.

Assume that when the operative element Fig. 1 is functioning as described consequent to the setting of keys A, B, C, D, E and F and the depressing of start-key 49, it is desired to erase or negate the setting and also release to normal any automatic switches operated, responsive to the actuation of relay 88. Further, assume this erasure is to take place while impulses constituting the third digit "5" is transpiring. That is to say, while wipers 63 and 13 are in their respective third rotary positions and wiper 48 is moving from normal towards, but not yet reaching, the bank contacts 35 and 122 attained upon the fifth rotary step. Release key 140 is depressed, applying ground to conductor 141 leading to the windings of relays 110 and 114 in multiple, causing them to actuate. Armature 142 of relay 114 will apply its ground to its two make contacts 143 and 144. Contact 143 leads over conductor 107 to winding of release magnet 106 and to armature 104 of relay 80. Contact 144 leads to winding of release magnet 128 and winding of relay G in multiple. Both said release magnets 106 and 128 and relay G will actuate consequent to said ground application from armature 142 and release the wipers 48, 63 and 13 to normal. Relay G, due to its removing the locking ground from conductors 129, will cause relays A', B', C', D', E' and F' to deactuate and negate the setting of the keys A, B, C, D, E and F.

Assume that while the device is not effectuating impulsing, but that the functioning has started; that is, at the period of prolonged closure between two digit series; the release key 140 is depressed. The relays 110 and 114 will function and cause the release magnets 106 and 128 and relay G to actuate and restore the wipers of Fig. 1 and disconnect the locking ground from conductor 129, causing the decade relays A', B', C', D', E' and F' to deactuate, and as before, when the depressive pressure is removed from key 140, the device is receptive to a new setting, it being borne in mind that the operative element is incapacitated against rotary movement of its wipers until relay 110 has restored its period after key 140 is released.

Assume, now, that after the described setting of keys A, B, C, D, E and F it is desired to erase or negate the said setting before start-key 49 is depressed. Release key 140 is depressed, causing relays 110 and 114 to actuate as before described. Armature 142 will apply ground to contact 143 and 144 as before and cause release magnet 106 and 128 and relay G to actuate. The wipers in Fig. 1 being normal, only relay G will have an effective function; that of removing locking ground from conductor 129, causing relays A', B', C', D', E' and F' to restore to normal, so when the depressing pressure is removed from key 140, the device is receptive to a new setting and may be caused to start operative function when relay 110 restores.

From previous descriptions it was observed that during the period of rotation of the wiper 48 relay 80 is held actuated, and also for a period after the release to normal of said wiper, consistent with the release characteristics of relays 101 and 80. Thus, relay 80 is actuated at the time the release key 140 was depressed. Therefore, ground applied to armature 104 is applied also to make contact 105 and armature 59 of actuated relay 110, make contact 145 to winding of slow-releasing relay 146 and its contact 147, causing said 146 to actuate and lock its winding through said 147 to armature 148, which latter armature receives ground from attracted armature 149 and its make contact 150 of actuated relay 110. Relays 110 and 114 will remain actuated as long as release key 140 is held depressed, and relay 110 for a period thereafter consistent with its release characteristic, it being borne in mind contacts 117—118 included in the path described as normally closed between impulse terminals 112 and 119 open the impulse conductors which in the example lead to automatic telephone switches of the two-wire type, and that the said switches will be caused to release if the impulse circuit controlling them remains open a longer period than the period of release of the said switches. This is characteristic of automatic switches of the two-wire type. In other words, the impulse circuit included into the circuit leading to the automatic switches is opened a period of such duration, that it is in effect a release, such as is occasioned by replacing the receiver on the hook of a calling telephone of the two-wire automatic type.

If, now, it is assumed that a directed release is initiated during the functioning of the device Fig. 1 by depressing key 140 and this release function of the operator is forthwith

followed by a new key setting and the depression and subsequent release of the start-key 49 before relay 110 has returned to normal, conductor 61 is prevented from receiving ground from armature 54 due to contacts 59—60 being open. It was described how rotary magnet 62 must receive ground from conductor 61 to initiate the functioning of Fig. 1 from the setting of keys in Fig. 2. This latter condition being borne in mind, it is clear that an automatic start means must function under the condition or a redepressing of start-key 49 must be resorted to after relay 110 has restored to normal. This would lead to confusion and indefiniteness.

The function of relay 146 is, therefore, to automatically impart a starting ground to conductor 61 after a directed release, simulating the condition which would ensue upon depressing start key 49 and it accomplishes this as follows: Relay 146 being dependent upon relay 110 by reason of its winding receiving locking ground through contacts 149—150 will deactuate its period after the deactuation of relay 110. Then, after relay 110 deactuates and before relay 146 deactuates, ground on armature 149 to normal contact 151, conductor 152, armature 153 and make contact 154 is applied to conductor 61 and to the winding of rotary magnet 62, causing it to function and incidentally close off-normal contacts 64—65, and due to relay 70 being caused to actuate from ground on wiper 63 as before set forth, the relays 81 and 89 will be caused to actuate also and initiate the rotation of wiper 48; all as before set forth descriptive of a setting up and directed starting ground being applied thereafter over conductor 50. The relay 146 deactuates its period after applying a ground thus to rotary magnet 62 of sufficient duration.

It will be noted that relays 110 and 146 only actuate responsive to a directed release, and therefore not incident to a normal release, wherein conductor 141 is not caused to become grounded.

Assume that the operator desired to arrest the progress of a train of digit series, for example; this on account of wishing to verify a number before permitting the final or at least a next succeeding digit series of the number train to be sent. Depressing holding button 155 will cause a ground to be applied to conductor 156 and to the winding of relay 80. The key 155 will be held depressed only as long as it is desired to arrest the functioning of Fig. 1, but, as will appear, the functioning will not be arrested during the progress of a digit series. To so arrest the progress during the period of a digit series would vitiate the call, though the depressing pressure were released and the device allowed to complete its functioning in accordance with the key-setting.

It is clear that if calling the telephone number 245781 exampled, the holding button 155 were depressed after the impulses constituting the digit "7" were started, and if the complete digit series of seven interruptions were not to be normally effectuated, a digit of smaller numerical value would result, so that when the device was allowed to continue functioning upon releasing pressure on key 155, a new digit made of the fragment of the "7" not sent would be introduced. Thus, two errors; one of a smaller digit series substituted for the "7", and the other of an additional digit, would result before the final two digits would be sent, would ensue. However, due to relay 101 remaining locked its period after wiper 48 restores and that this latter can only take place upon said 48 finding ground on contact 39, the full seven impulses will transpire. It was described how the deactuation of relay 80, closing its contacts 78—79 served to start a new digit series by causing relay 81 to reactuate. In the present state, that of conductor 156 being grounded through contacts of key 155, relay 80 will not deenergize and thereafter relay 81 cannot reactuate and initiate the next digit series. When the ground is removed from the said 156 by removing the depressing pressure from key 155, relay 80 will return to normal after its period expires and normal functioning will ensue.

It is thus clear that a release to normal can be realized at any instant, and that an arresting of the progress of a number train can only be realized effective at the end of a digit series.

Should the holding key 155 be depressed after a digit series has been completed, but before relay 80 restored to normal consistent with its period, the result would, in effect, prolong the releasing of said 80 for the duration of the depressing pressure on said 155.

It has been described how, after making a key-setting in the digit strips, the start-key 49 was directly depressed to initiate the operative functioning of Fig. 1. It will now be explained how, through supplemental means, the said initiation of the functioning can be made automatic, effective coincident with the normal depressing of a set-key in any digit; the digit being changeable at will.

Automatic start-keys 157, 158, 159, 160, 161 and 162 correspond to digit strips one to six, counting from the left, and they are preferably mounted above the digit strips and the respective keys are mounted numerically relevant to the said strips respectively. These automatic start-keys are preferably of the same general mechanical type as the digit keys; that is, depressing any key will automatically release to restoration any other key in the strip.

A button R is related to the start keys locking bar, so depressing it will shift the bar and restore any key set therein. Key R would be depressed if it were decided to change the

control from automatic start to normal starting through the agency of key 49. Buttons or equivalent means for releasing keys held by a locking bar are not new as generally applied in other applications.

Assume that it is desired to have the operative element of Fig. 1 start functioning incident to any set-key in the second digit strip from the left being depressed; key B for example. Button of key 158 will be depressed, and it being of the general locking type as used for the digit key strips, will remain so depressed with its contacts engaged. It is obvious that any key of well known form, not mechanically interlinked with other similar keys may be substituted for key 158, only, it will be apparent keys which are mechanically automatically released by the shift-plate action upon changing a starting setting are desirable as by this device only one setting can ensue regardless of frequent changes made to suit the whims of or the capabilities of the operator. It is to be borne in mind that as the operative element begins functioning upon the set-key B in the designated digit being depressed to the extreme down position the functioning will progress normally coincident with set-keys in succeeding digits being set and their cooperating common digit relays functioning. For example, if the operative element begins functioning upon said depressing of set-key B, relays C', D', E', and F' will be then normal. However, they will be caused to actuate normally upon keys C, D, E and F respectively being depressed as described; this regardless of the order of the setting-up. It will be recognized that should the operator not have operatively depressed the succeeding set-key in each digit respectively before wipers 63 and 13 move into a rotary position corresponding to a succeeding digit key-strip, left-hand blade of wiper 13 will fail to find a ground on its cooperating bank contact, and therefore, the restoration to normal of the operative element Fig. 1 will forthwith ensue in the manner described. Subsequent key-settings in digits beyond the set starting digit then having no operative control because common digit relays which were set consecutively before the restoration to normal have, by their deactuation, ungrounded corresponding bank contacts engageable by wiper 13 and therefore, even if start key 49 were depressed, no operative functioning could ensue. Normally, the start-key 49 would not be depressed where the device is pre-set to automatically start functioning incident to setting in a predetermined digit key-strip.

Assuming the condition set forth, that of key 158 being set depressed. Then, when set-key B is depressed (or any other set-key in its digit strip) and conductor 2 is caused to become grounded as described, incident to energizing relay B', closed contacts in key 158 will communicate this ground to conductor 50 and to winding of relay 51 as before set forth in starting, through the depressing of start-key 49. However, in the instance of key 158 being set, no special physical operation is required and time is therefore gained by allowing the transmission of the impulses to proceed ahead of the complete setting of all the keys.

Terminal 163 of upper off-normal will become grounded incident to the first operative functioning of the element of Fig. 1, and remain so grounded until its restoration to normal. Terminal 164 of lower off-normal springs will become grounded incident to wiper 48 moving "off-normal" and so remain until it has returned to normal. Thus, terminal 164 is grounded only while impulses constituting a digit series of a number train ensues. Terminal 165 becomes grounded incident to the first digit set-key setting being made, and so remains until element Fig. 1 restores to normal, or in other words from the instant of first converting the device shown in Figs. 1 and 2, to the instant it is restored to normal or is released from conversion assuming the extreme left-hand digit strip is set before others. Terminal 166 becomes grounded at the instant the element Fig. 1 is caused to restore to normal, and so remains until the restoration to normal of wiper 63 is completely accomplished, it being borne in mind that if a directed release occurs from depressing release-key 140, 163 will remain so grounded until conductor 141 leading from said 140 becomes ungrounded. Terminal 167 becomes grounded incident to the initiation of the starting of the functioning of the operative element Fig. 1. It remains grounded until the pressure upon the prime starting-key is removed. Terminal 168 becomes grounded incident to a directed release, and remains so grounded until depressing pressure is removed from release key 139. Terminal 169 becomes grounded incident to depressing the hold key 155 and so remains grounded until said 155 is released. Terminals 176, 177 and 178 lead to relay springs 179, 180 and 181 respectively. Contact springs 180 and 181 are normally closed, so a closed path normally exists between terminals 177 and 178. Contact springs 179 and 180 close incident to the actuation of relay 81, so a closed path exists between terminal 176 and 177 when relay 81 is actuated, and it follows that an open circuit condition exists betwen terminals 177 and 178 when relay 81 is actuated.

It will be noted that the functioning of off-normal contact springs 99 and 100 will not be coincident with the functioning of relay springs 180 and 179. It is clear that the device as contemplated in the present invention shows schematically in Figs. 1 and 2 and diagrammatically in Fig. 3 comprehends more than simply an impulse device. It also con-

templates a control device incident thereto. An example of the latter is wherein while relay 81 is actuated, and therefore impulsing is transpiring, contact springs 179 and 180, through terminals 176 and 177 short-circuit the telephone set 183 in Fig. 3.

The condition recited in relation to Fig. 3 is approximately simulated in dial calling devices referred to wherein contained contact springs short-circuit the interlinked telephone set at off normal positions of the dial calling device; that is, when the calling plate is off-normal. The latter circuit condition is set up to prevent disturbance in the telephone circuit while impulsing, and for other reasons.

Fig. 3 is a diagrammatic representation of a calling telephone 183 of the automatic type including an impulse sending device 182 as shown in Figs. 1 and 2. A line 184 leads to a pre-selector 185; the latter having access to a first selector 186. The said first selector and other selectors are of any of the well-known two-wire type.

Telephone 187 connected to line 188 may be assumed to be the called telephone, number 245781 leading from connector bank set 189. It is assumed that telephone 187 is enabled to gain attention of the central operator by removing the receiver from the hook switch and thus close its internal circuit, causing relay 113 to actuate and attract its armature, and cause calling lamp 190 contiguous to spring jack 191 to glow. The operator can gain access to said telephone by inserting switching plug 192 into spring jack 191. This will cause ground on sleeve conductor of plug 192 to be applied over conductor 193 to winding of relay 194, causing it to actuate and disassociate relay 113 and extinguish lamp 191. It also applies a busy ground to bank contact 195 and sleeve of spring jack 196 and so maintains it until ground is removed from said 193 incident to withdrawing plug 192. While ground is thus on 193 a "busy" will be found on the sleeve of 196 and also on private bank contact 195. That is, said 188 will not be seizable thru a connector, as 197. However, the said functioning of telephone 187 is secondary to the present invention since its salient objects are directed to effectuating call selection.

The telephone 187 is shown as of the manual type for simplicity. It is obvious a telephone of the automatic type may be substituted, using well known central office incoming calling pre-selectors in access to selectors and connectors, in lieu of the manual equipment shown.

Assume that after receiver on telephone set 183 is removed from its hook-switch and access is had to selector 186 the said keys A, B, C, D, E and F are depressed to their respective down positions and start-key 49 is depressed. The shaft of selector 186 (which may be termed the first digit selector) will be caused to raise two steps responsive to two open impulses from contacts 115—116, registering with the second level and there rotate into the first disengaged trunk bank contact set leading to second selector 197 (which may be termed the second digit selector). Upon four open impulses occurring at contacts 115—116 the wipers of 198 will raise four steps and register with the fourth bank level, and there rotate into the first disengaged contact, leading to third selector 199 (which may be termed the third digit selector). Upon seven open impulses occurring at contacts 115—116, the wipers of 200 will raise seven steps and register with the seventh bank level and there rotate into the first disengaged bank contact set leading to connector 197. Upon eight open impulses occurring at contacts 115 and 116 the wipers of 197 will rotate in one step or position and seize the first bank contact set which leads to telephone 187 and numbered 245781, incidentally grounding conductor 193 and causing relay 194 to actuate and disassociate bridged relay 113; also placing a "busy" ground on sleeves of spring jacks 191 and 196.

Substituting a dial calling device of well known type as before referred to, for the device represented by 182 and operating it to call the stated telephone number as normally done, will cause the same functioning of selectors 186, 198, 199, 200 and connector 197, the dial calling device in this instance being an alternative means of effectuating call selection. A prolonged opening of contacts 115—116 will cause a release and restoration of switches interlinked with line 184 as if the hook-switch on telephone set 183 were depressed to open the telephone circuit to normal condition. This function is well known, as applied to systems of the stated type, when employing a dial calling device in the telephone set in lieu of the device indicated by 182.

It is obvious the present invention is susceptible to wide adaptations and detailed modifications in design, such as effectuating closed circuit impulses in lieu of open circuit impulses; ground impulses to a single conductor or alternate conductors, etc.

Having thus described one adaptation illustrative of our invention, what we claim is:—

1. An impulse sending machine comprising sets of set-keys, means for sending series of impulses in definite numerical order responsive to said keys, and automatic means for interchangeably starting said impulse means responsive to operating the key of a random pre-determined series regardless of the order of setting.

2. A reciprocating impulse sending machine comprising an impulse sender control device, sets of set-keys for different digits of a number, positions on said control device com-

monly related to the numerically corresponding keys of the respective said sets of set-keys, a digit distributor having distributing positions corresponding to the number of sets of keys, a common connection from each said position to said keys of the corresponding set and a common connection from the corresponding digit key of each set to a corresponding position on the impulse sender control device, means including said reciprocating device, whereby as the digit distributor reaches each position the operated key in the corresponding set will determine the number of impulses to be transmitted, and automatically applied means for making equal pauses between the last impulse of each digit series and the first impulse of the next following digit series regardless of the number of impulses in the respective digit series of the number.

3. A sending machine comprising sets of set-keys, the set-keys corresponding to the different digits of a number, automatically applied, means for successively sending a plurality of like or unlike series of impulses responsive to said keys including a reciprocating wiper having a plurality of impulse positions successively associated with the keys for the successive series of impulses, and means for advancing and releasing said wiper for each series of impulses.

4. An impulse sending machine comprising sets of set-keys, means for sending series of impulses responsive to said keys, there being a specific set of set-keys for each series, means for disabling the sending of impulses, means including a manual key for rendering the last said means effective, and automatic means for preventing the said last means from becoming effective during the sending of an impulse series.

5. In an impulse sending machine comprising groups of numerical order set-keys, each said group of keys belonging to a different numerical order, there being a set-key specific for each digit of each numerical order, means for sending series of impulses responsive to setting one or more said set-keys of different numerical orders respectively, means for directively causing the negation of the condition set-up by the setting of the respective set-keys and the restoration of the sending machine during the process of said sending without restoring the set-keys, and automatically controlled means for again initiating the operation of the first said means consequent upon the expiration of a predetermined period after the said restoration, provided a new setting of the set-keys has been effected before the restoration has become complete.

6. In an impulse sending machine comprising groups of numerical order set-keys, each said group of keys belonging to a different numerical order, there being a set-key specific for each digit of each numerical order, means for sending series of impulses responsive to setting one or more said set-keys of different numerical orders respectively, and means for directively causing the negation of the condition set-up by the setting of the respective set-keys and the restoration of the sending machine during the process of said sending without restoring the set-keys.

7. In an impulse sending machine comprising groups of numerical order set-keys, each said group of keys belonging to a different numerical order, there being a set-key specific for each digit of each numerical order, means for sending series of impulses responsive to setting one or more said set-keys of different numerical orders respectively, means for directively causing the negation of the condition set-up by the setting of the respective set-keys and the restoration of the sending machine during the process of said sending without restoring the set-keys, and automatically controlled means for preventing the initiation of the operation of the first said means until a predetermined period has elapsed after the restoration of the sending machine.

8. In an impulse sending machine comprising groups of numerical order set-keys, each said group of keys belonging to a different numerical order, there being a set-key specific for each digit of each numerical order, means for sending series of impulses responsive to setting one or more said set-keys of different numerical orders respectively, means whereby the time required to complete the sending is determined by the number of impulses in each series sent, and means for retaining an indication of the last setting until a new setting is thereafter made.

9. In an impulse sending machine comprising groups of numerical order set-keys, each said group of keys belonging to a different numerical order, there being a set-key specific for each digit of each numerical order, means for sending series of impulses responsive to setting one or more said set-keys of different numerical orders respectively, means whereby the number of series sent will correspond to the number of set-keys operated and the time the machine is occupied in each series is determined by the number of impulses constituting the respective series sent, and means for retaining an indication of the last setting until a new setting is thereafter made.

10. In an impulse sending machine comprising sets of set-keys, means for sending series of impulses responsive to the setting-up of a condition of the said keys while maintaining the condition set-up by all the set-keys set until all the series have been sent, and means for thereafter effacing the condition set-up by the set-keys while maintaining the operated state of the keys set.

11. A sending machine comprising set-keys the set-keys corresponding to the different

digits of a number, automatically applied means for successively sending a plurality of like or unlike series of impulses responsive to said keys including a reciprocating wiper having a plurality of impulse positions successively associated with the keys for the successive series of impulses, and means for advancing and releasing said wiper for each series of impulses.

12. A sending machine comprising set-keys for sending digit series of impulses, a reciprocating wiper and cooperating fixed contacts, means including the set-keys for grounding the fixed contacts one at a time in numerical correspondence with the value of the respective digits of the series and the numerical order of the digit series, and means including the reciprocating wiper cooperative with the fixed contacts for determining the number of impulses in each digit series.

13. A sending machine comprising set-keys for sending digit series of impulses, a reciprocating wiper and cooperating fixed contacts, means including the set-keys for grounding the fixed contacts one at a time in numerical correspondence with the value of the respective digits of the series and the numerical order of the digit series, and means including the reciprocating wiper cooperative with the fixed contacts for determining the number of impulses in each digit series and the number of digit series.

14. A sending machine comprising set-keys for sending digit series of impulses, a reciprocating wiper and cooperating fixed contacts, means including the set-keys for grounding the fixed contacts one at a time in numerical correspondence with the value of the respective digits of the series and the numerical order of the digit series, means for causing the reciprocating wiper to successively advance sweep the fixed contacts until a grounded contact is encountered and thereupon retract over the fixed contacts preparatory to again advance sweeping the fixed contacts until a grounded contact is again encountered, means whereby each contact advance sweeped over determines an impulse of a digit series corresponding to the respective advance sweep movement, means whereby the retracting movement of the wiper is not effective to determine a said impulse, and means whereby the advance sweep movements of the wiper will determine the number of series and the value of the respective digit series sent by the sending machine.

15. An impulse sending machine comprising numerical order set-keys, a start mechanism for said sending machine, means for setting the sending machine by operating one or more of the set-keys in correspondence with any digit train to be sent by the sending machine, and means for at will interchanging the start mechanism so the sending machine will start sending consequent upon setting the machine to send a digit of a predetermined random numerical order of the digit train to be sent.

16. An impulse sending machine comprising sets of set-keys, means for sending series of impulses corresponding in numerical value to the actuated keys, there being a specific set of set-keys for each series and means including a key for temporarily arresting the sending effective at the end of the series being sent when said key is depressed.

17. An impulse sending machine comprising numerical set-keys, means for sending series of impulses responsive to said keys, and means for automatically starting the said impulse sending means responsive to operating any set-key, said means including a pre-set starting-key for each numerical order.

18. In an impulse transmitting device, a plurality of impulse control keys, an impulse sender responsive to said keys for variably placing the sender in condition to operate depending upon the keys operated, means for effacing the condition set up by any of the keys which have not yet been responded to by the sender and for restoring the sender, and means for preventing the sender from initiating a reoperation until a predetermined time after it has become restored.

19. In an impulse transmitting device, a plurality of impulse control keys, an impulse sender responsive to said keys for variably placing the sender in condition to operate depending upon the keys operated, means for effacing the condition set up by any of the keys which have not yet been responded to by the sender and for restoring the sender, and means for preventing the sender from initiating a reoperation until a predetermined time after it has become restored regardless of when a new setting of the keys is made.

20. In an impulse sending machine comprising an impulse sender control device, sets of set-keys for different digits of a number, a digit distributer having distributing positions corresponding to the number of sets of keys, means controlled by the digit distributer in combination with the set-key set of the respective sets for determining the number of impulses to be sent by the control device for each position of the digit distributer, and means interchangeably responsive to the setting of a key of any set of the set-keys to initiate the functioning of the said device.

21. An impulse sending machine comprising an impulse sender control device, sets of set-keys for different digits of a number, a digit distributer having distributing positions corresponding to the number of sets of keys, connections extending from the digit distributer through the keys to the impulse control device for determining the number of impulses to be sent for each position of the digit

distributer, and means interchangeably responsive to any set of the set-keys to initiate the functioning of the said device.

22. In an impulse sending machine comprising an impulse device normally in a state of rest, sets of set-keys for different numerical orders respectively, a numerical order distributer having distributing positions corresponding to the number of sets of set-keys, means for operating the said distributer from a successive numerical order set of set-keys upon the completion of a series of impulses by the impulse device corresponding to a digit of a numerical order, and automatically applied means for initiating the functioning of the impulse control device incident to making a setting in a predetermined one of the numerical order sets of set-keys.

23. In an impulse sending machine comprising sets of numerical order set-keys, there being one specific set of set-keys for each numerical order, a plurality of start keys, means for sending series of impulses responsive to the setting of said set-keys, automatically applied means for starting said impulse sending means consequent upon operating a set-key for a predetermined numerical order series, and means including one of said start keys for changing the said predetermined series.

24. In an impulse transmitting device, a plurality of impulse control keys, a normally closed impulse circuit, an impulse sender responsive to said keys for variably placing the sender in condition to open and then close said impulse circuit for a short duration a plurality of times depending upon the control keys operated, means for effacing said condition of the sender responsive to a directed manual operation, and means for opening the impulse circuit for a predetermined prolonged duration responsive to said manual operation.

25. In an impulse transmitting device, a plurality of impulse control keys, an impulse circuit, an impulse sender responsive to said keys for variably placing the sender in condition to apply impulses over the impulse circuit depending upon the keys operated, means for effacing said condition of the sender responsive to a directed manual operation, and means for disabling the impulse circuit for a predetermined duration responsive to said manual operation.

26. An impulse sending apparatus comprising sets of set-keys, means for sending a train of impulse series wherein each series is comprised of a random plurality of impulses responsive to first setting a plurality of said keys corresponding in number to the number of series to be sent including a reciprocating wiper having a plurality of impulse positions, means for advancing and restoring said wiper over a corresponding number of the impulse positions for each series of impulses, and automatically applied means whereby the train of series of impulses will be sent consecutively irrespective of the number of impulses in the respective series of the train.

27. An impulse sending apparatus comprising sets of set-keys, means for sending a train of impulse series wherein each series is comprised of one or more impulses responsive to first setting a plurality of said keys corresponding in number and numerical order to the number of series to be thereafter sent and the number of impulses in the respective series, a reciprocating wiper having a plurality of impulse positions, means for advancing and restoring said wiper over a corresponding number of the impulse positions for each series of impulses, and automatically applied means whereby the train of series of impulses will be sent consecutively in numerical order irrespective of the number of impulses in the respective series of the train.

28. An impulse sending apparatus comprising sets of set-keys, means for sending a train of impulse series wherein each series is comprised of a random plurality of impulses responsive to first setting a plurality of said keys corresponding in number and numerical order to the number of series to be thereafter sent including a movable circuit link having a plurality of impulse positions, means for advancing said link for each series of impulses sent, means including said link for determining the number of impulses in each series, and automatically applied means whereby the train of series of impulses will be sent consecutively in numerical order irrespective of the number of impulses in the respective series of the train.

29. In an impulse sending mechanism comprising a plurality of set-keys, the keys belonging to successive numerical orders, means for sending a train of series of impulses in definite numerical order responsive to setting the set-keys in corresponding numerical order, and automatically applied means for starting said impulse means consequent upon operating a predetermined said set-key after the set-key having the highest numerical order has been operated.

30. In an impulse sending mechanism comprising a plurality of set-keys, the keys belonging to successive numerical orders, means for sending a train of series of impulses in definite order responsive to setting the set-keys in corresponding order, and automatically applied means for starting said impulse means consequent upon operating a predetermined said set-key after the set-key having the highest order has been operated.

31. A sending mechanism comprising set-keys for sending digit series of impulses, a counting wiper and cooperating fixed contacts, a numerical order wiper and cooperating contacts, means including the numerical order wiper and set-keys for grounding the

fixed contacts one at a time in numerical correspondence with the value of the respective digits of the series and the numerical order of the digit series, means including the numerical order wiper and the counting wiper cooperative with the fixed contacts for determining the number of impulses in each digit series and the number of digit series, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

32. A sending mechanism comprising set-keys for sending digit series of impulses, a counting wiper and cooperating fixed contacts, a numerical order wiper and cooperating contacts, means including the numerical order wiper and set-keys for applying potential to the fixed contacts one at a time in numerical correspondence with the value of the respective digits of the series and the numerical order of the digit series, means including the numerical order wiper and the counting wiper cooperative with the fixed contacts for determining the number of impulses in each digit series, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

33. A sending mechanism comprising set-keys for sending digit series of impulses, a counting wiper and cooperating fixed contacts, a numerical order wiper and cooperating contacts, means including the numerical order wiper and set-keys for applying a potential to the fixed contacts one at a time in numerical correspondence with the value of the respective digits of the series and the numerical order of the digit series, means including the numerical order wiper and the counting wiper cooperative with the fixed contacts for determining the number of impulses in each digit series and the number of digit series, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

34. An impulse sending apparatus comprising impulse series determining contacts for controlling the sending of a train of impulse series in accordance with the pre-setting of a plurality of said determining contacts, a counting wiper and cooperating fixed contacts, means for rendering said determining contacts in a set condition at will, a numerical order wiper and cooperating contacts, means including the numerical order wiper and the set determining contacts for applying a potential to the fixed contacts one at a time in numerical correspondence with the value of the respective impulse series of the train to be sent and the numerical order of the impulse series constituting the train to be sent responsive to the set said determining contacts, means including the numerical order wiper and the counting wiper successively cooperative with each of the various fixed contacts having said potential applied thereto for determining the number of impulses in each series of the train, the numerical order of sending the various series of the train and the number of impulse series in the train, means for causing a delay in sending to form a space between immediately succesive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

35. An impulse sending apparatus comprising impulse series determining contacts for controlling the sending of a train of impulse series in accordance with the pre-setting of a plurality of said determining contacts, a counting wiper and cooperating fixed contacts, means for rendering said determining contacts in a set condition at will, means for effacing said set condition at will, a numerical order wiper and coperating contacts, means including the numerical order wiper and the set said determining contacts for applying a potential to the fixed contacts one at a time in numerical corresepondence with the value of the respective impulse series of the train to be sent and the numerical order of the impulse series constituting the train to be sent responsive to the set determining contacts, and means including the numerical order wiper and the counting wiper successively cooperative with each of the various fixed contacts having said potential applied thereto for determining the number of impulses in each series of the train, the numerical order of sending the various series of the train and the number of impulse series in the train.

36. In an impulse sending apparatus comprising impulse series determining contacts for controlling the sending of a train of like or unlike impulse series in accordance with the co-existing setting of said determining contacts, a counting wiper and cooperating fixed

contacts, a numerical order wiper and cooperating contacts, means including the numerical order wiper and its cooperating fixed contacts and the determining contacts for applying a potential to the fixed contacts one at a time in numerical correspondence with the value of the respective impulse series of the train to be sent and the numerical order of the impulse series constituting the train to be sent responsive to the set said determining contacts, means including the counting wiper successively cooperative with each of the various fixed contacts having said potential applied thereto by the numerical order wiper for determining the number of impulses in each series of the train, the numerical order of sending the various series of the train and the number of impulse series in the train, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

37. An impulse sending apparatus comprising impulse series determining contacts for controlling the sending of a train of like or unlike impulse series in accordance with the co-existing setting of said determining contacts, a counting wiper and cooperating fixed contacts, a numerical order wiper and cooperating contacts, means including the numerical order wiper and its cooperating fixed contacts and the set said determining contacts for applying a potential to the fixed contacts one at a time in numerical correspondence with the value of the respective impulse series of the train to be sent and the numerical order of the impulse series constituting the train to be sent responsive to the set determining contacts, means including the counting wiper successively operating from normal cooperative with each of the various fixed contacts having said potential applied thereto by the numerical order wiper for determining the number of impulses in each series of the train, the numerical order of sending the various series of the train and the number of impulse series in the train, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

38. An impulse sending apparatus comprising impulse series determining contacts for controllng the sending of a train of random impulse series in accordance with pre-setting a plurality of said determining contacts, each said contact set belonging to a specific numerical order unlike any other said contact which has been set, means whereby each said contact which has been set determines an impulse series of specific value at random, a counting wiper and cooperating fixed contacts, means for rendering said determining contacts in a set condition at will, a numerical order wiper and cooperating contacts, means including the numerical order wiper and its cooperating fixed contacts and the determining contacts for applying said potential to the fixed contacts one at a time in numerical correspondence with the value and numerical order of the respective said contacts set, means including the counting wiper successively cooperative with each of the various fixed contacts having said potential applied thereto by the numerical order wiper for determining the number of impulses in each series of the train, the numerical order of sending the various series of the train irrespective of the number of impulses in each said series and the number of impulse series in the train, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

39. In an impulse sending apparatus comprising sets of set-keys, means for sending series of impulses corresponding in numerical value and order to the actuated set-keys, there being a specific set of set-keys for each series, means including an auxiliary key for temporarily arresting the sending effective only at the end of the series being sent when the said auxiliary key is operated, and means for restoring the sending at will without operating a said set-key.

40. In an impulse effecting apparatus comprising groups of impulse series determining contacts, each group belonging to a different numerical order, means for setting a plurality of said determining contacts wherein no two said contacts set belong to the same numerical order, each said determining contact tied to an auxiliary fixed impulse series determining contact, said fixed contacts positioned in the progressive order of their numeral value, a hunting wiper for successively sweeping from normal position one or more said fixed contacts in progressive order with respect to their numeral value, means for disabling said wiper from hunting responsive to encountering a predetermined potential on a said fixed contact, means for restoring the hunting wiper to normal position consequent upon its hunting operation becoming

disabled, a numerical order distributing wiper and cooperating numerical order distributing contacts, an impulse contact set, a source of said predetermined potential, means for applying said potential through the distributing wiper and through said cooperating distributing contacts thereof one at a time in progressive numerical order, means for applying the potential from the respective last said contacts to the corresponding set first determining contacts one at a time in progressive numerical order and with correspondence to said application of potential through the respective said distributing contacts, means whereby the said potential from last said contacts is applied to said fixed contacts one at a time in progressive numerical order and numeral value in correspondence with the respective corresponding set first said determining contacts, and automatically applied means including the hunting wiper and said disabling means and said restoring means for causing said impulse contact set to effect a train of impulse series in correspondence with the progressive numerical order and numeral value of first said determining contacts set.

41. In an impulse effecting apparatus comprising groups of impulse series determining contacts, each group belonging to a different numerical order, means for setting a plurality of said determining contacts wherein no two said contacts set belong to the same numerical order, each said determining contact tied to an auxiliary fixed impulse series determining contact, said fixed contacts positioned in the progressive order of their numeral value, a hunting wiper for successively sweeping from normal position one or more said fixed contacts in progressive order with respect to their numeral value, means for disabling said wiper from hunting responsive to encountering a predetermined potential on a said fixed contact, means for restoring the hunting wiper to normal position consequent upon its hunting operation becoming disabled, a numerical order distributing wiper and cooperating numerical order distributing contacts the distributing wiper and its cooperative said contacts for successively applying said potential through said determining contacts to numerically corresponding said impulse series determining contacts, an impulse contact set, a source of said predetermined potential, and automatically applied means including the distributing wiper and said hunting wiper and said disabling means and said restoring means for causing said impulse contact set to effect a train of impulse series in correspondence with the progressive numerical order and numeral value of first said determining contacts set.

42. An impulse sending apparatus comprising impulse series determining contacts for controlling the sending of a train of impulse series in accordance with the co-existing setting of said determining contacts, a movable circuit link and cooperating fixed terminals, means including the set said determining contacts for applying a potential to the fixed terminal one at a time in numerical correspondence with the value of the respective impulse series of the train to be sent and the numerical order of the impulse series constituting the train to be sent responsive to the set determining contacts, means including the movable circuit link successively operating from normal cooperative with each of the various fixed terminals having said potential applied thereto for determining the number of impulses in each series of the train and the numerical order of sending the various series of the train, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

43. In an impulse effecting apparatus comprising groups of impulse series determining contacts, each group belonging to a different numerical order, means for setting a plurality of said determined contacts wherein no two said contacts set belong to the same numerical order, each said determining contact tied to an auxiliary fixed impulse series determining contact, said fixed contacts positioned in the progressive order of their numeral value, a hunting wiper for successively sweeping from normal position one or more said fixed contacts in progressive order with respect to their numeral value, means for disabling said wiper from hunting responsive to encountering a predetermined potential on a said fixed contact, means for restoring the hunting wiper to normal position incidental to its hunting operation being disabled, an impulse contact set, a source of said predetermined potential, and automatically applied means including the hunting wiper and said disabling means and said restoring means for causing said impulse contact set to effect a train of impulse series in correspondence with the progressive numerical order and numeral value of first said determining contacts set.

44. In an impulse effecting apparatus comprising groups of impulse series determining contacts, each group belonging to a different numerical order, means for setting a plurality of said determining contacts wherein no two said contacts set belong to the same numerical order, each said determining contact tied to an auxiliary fixed impulse series determining contact, said fixed contacts positioned in the progressive order of their numeral value, a hunting wiper for successively

sweeping from normal position one or more said fixed contacts in progressive order with respect to their numeral value, means for disabling said wiper from hunting responsive to encountering a predetermined potential on a said fixed contact, means for restoring the hunting wiper to normal position incidental to its hunting operation being disabled, an impulse contact set, a source of said predetermined potential, means for causing said impulse contact set to effect an impulse incidental to said wiper advancing to a said fixed contact in its hunting operation, and automatically applied means including the hunting wiper and said disabling means and said restoring means for causing said impulse contact set to effect a train of impulse series in correspondence with the progressive numerical order and numeral value of first said determining contacts set.

45. In a call director, a plurality of register switches for registering the digits in called numbers, a sending switch including means for retransmitting registered digits, a sequence switch for placing said sending switch under control of said register switches in succession, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

46. In a call director, a plurality of register switches for registering the digits in called numbers, a sending switch controlled by said register switches independently and successively, a sequence switch controlled by said sending switch to shift the control thereof from said register switch to the next register switch, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

47. In a call director, a plurality of register switches for registering the digits in called numbers, a sending switch, multiple connections between the banks of said register switches and between the multiply connected banks of said register switches and the bank of said sending switch, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

48. In a call director, a plurality of register switches for registering the digits in called numbers, a sending switch including means for transmitting series of impulses in accordance with registered digits, multiple connections between the banks of said register switches and the bank of said sending switch to enable the sending switch to be controlled through the medium of said register switches, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

49. A sending machine comprising set-keys, and means for sending a plurality of like or unlike series of impulses responsive to and after the operation of a plurality of said keys including a reciprocating wiper having a plurality of impulse positions with means for advancing and releasing said wiper for each series of impulses.

50. In an impulse sending apparatus comprising sets of set-keys, means including a reciprocating wiper having a plurality of impulse positions for sending a plurality of impulse series wherein each series is comprised of a plurality of impulses responsive to setting a plurality of said keys corresponding in number to the number of series to be sent prior to the transmission of any complete series, means for advancing and restoring said wiper over a corresponding number of the impulse positions for each series of impulses, and means whereby the series of impulses will be sent consecutively in the order in which the keys are operated irrespective of the number of impulses in the respective series.

51. An impulse sending apparatus comprising sets of set-keys, means including a reciprocating wiper having a plurality of impulse positions for sending a plurality of impulse series wherein each series is comprised of one or more impulses responsive to first setting a plurality of said keys corresponding in number to the number of series to be sent prior to the transmission of any complete series and the number of impulses in the respective series, means for advancing and restoring said wiper over a corresponding number of the impulse positions for each series of impulses, and means whereby the series of impulses will be sent consecutively in the order in which the keys have been operated irrespective of the number of impulses in the respective series.

52. An impulse sending apparatus comprising sets of set-keys, means including a

counting wiper having a plurality of impulse positions for sending a plurality of impulse series wherein each series is comprised of a plurality of impulses responsive to first setting a plurality of said keys corresponding in number to the number of series to be sent prior to the transmission of any complete series, means for advancing said wiper for each series of impulses, means including the wiper for determining the number of impulses in each series, means whereby the series of impulses will be sent consecutively in the order in which the keys are operated irrespective of the number of impulses in the respective series, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

53. In a telephone system, a control circuit for setting a train of automatic switches to connect a calling and a called line, a transmitting device for transmitting a plurality of series of impulses to operate said switches, one series for each digit in the number of the called line, a sending switch controlled by said transmitting device during the transmission of impulses, said switch operating to count the impulses in each series and including means for terminating each series when the required number of impulses has been transmitted, means for automatically moving said switch to normal position after each series of impulses is finished to prepare for the transmission of the next series, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

54. In an automatic impulse sender, a sending relay for generating groups of impulses, a stop relay for determining the number of impulses in each group, a progressively movable switch and means for operating it during the generation of each group of impulses, a wiper on said switch for controlling said stop relay, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

55. In an automatic impulse sender, an interrupter for generating groups of impulses, a counting device comprising a switch, means for advancing said switch a definite distance per impulse during the generation of each group of impulses, means being provided for restoring said switch to normal after each group of impulses is generated, means responsive each time to a predetermined movement of said switch for terminating the group of impulses which is being generated, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

56. In an automatic impulse sender, an impulse generating device, a counting device, means for operating said devices synchronously to transmit predetermined series of impulses, means for restoring the counting device after each series is finished, and a slow-acting device for introducing a time interval between the successive series.

57. In an automatic impulse sender, a switch control conductor, a contact device for producing series of impulses in said conductor, a counting device individual to said contact device for determining the number of impulses in each of said series, a plurality of storage devices, means for placing said counting device under the control of said storage devices successively, means for causing a delay in sending to form a space between immediately successive said series longer than the space between impulses of a series, and means whereby a longer delay is avoided following a said series of impulses having a random number of impulses than occurs following a said series having a relatively larger number of impulses than said random number.

58. The combination, with an automatic switch for connecting a calling and a called line, of a sending switch and control circuit connecting said switches, a stepping magnet for said sending switch, a relay in said sending switch for simultaneously transmitting impulses to said stepping magnet and over said control circuit to the said first switch said impulses being transmitted in groups in accordance with the digits in the number of the called line, and means for releasing said sending switch after each group of impulses transmitted.

59. The combination, with an automatic switch for connecting a calling and a called line, of a sending switch and a control circuit connecting said switches, a stepping magnet for said sending switch, a relay in said sending switch, contacts on said relay for alternately opening and closing said control cir-

cuit, and other contacts on said relay for operating said stepping magnet at the same time.

60. In a telephone system, an automatic switch for connecting a calling and a called line, a sending switch having a stepping magnet, a control circuit for said first switch, a separate control circuit for said magnet, and relay mechanism in said sending switch for simultaneously transmitting impulses over said circuits.

61. In a telephone system, an automatic switch for connecting a calling and a called line, a sending switch having a stepping magnet, a control circuit for said first switch, a control circuit for said magnet, a relay mechanism in said sending switch for simultaneously transmitting impulses over said circuits, a test wiper for said sending switch, a series of fixed test contacts successively engaged by said test wiper, and means in said sending switch controlled over said test wiper and a predetermined one of said contacts for stopping the transmission of impulses.

62. In a telephone system, an automatic switch for connecting a calling and a called line, a sending switch having a stepping magnet, a control circuit for said first switch, a control circuit for said magnet, relay mechanism in said sending switch for simultaneously transmitting impulses over said circuits, a test wiper for said sending switch, test contacts, means for placing a potential on any test contact to the exclusion of the rest of said contacts, and means in said switch for stopping the transmission of impulses when said test wiper engages a test contact on which a potential has been placed.

63. In a telephone system, an automatic switch for connecting a calling and a called line, a sending switch having a stepping magnet, a control circuit for said first switch, a control circuit for said magnet, a vibrating relay in said sending switch for simultaneously transmitting impulses over said circuits, and an interrupter machine associated with said sending switch for controlling said relay.

64. In a telephone system, a control circuit for setting a train of automatic switches to connect a calling and a called line, a sending switch having a stepping magnet, relay mechanism in said sending switch, an interrupter for operating said relay mechanism a plurality of times in accordance with a plurality of digits, contacts on said relay mechanism and transmitting a series of impulses to said stepping magnet each time said mechanism is operated, and other contacts on said relay mechanism for producing a series of interruptions in said control circuit each time said mechanism is operated.

65. In an automatic impulse sender, an interrupter for generating groups of impulses, a counting device comprising a switch, means for advancing said switch a definite distance per impulse during the generation of each group of impulses, means being provided for restoring said switch to normal after each group of impulses is generated, means responsive each time to a predetermined movement of said switch for terminating the group of impulses which is being generated, said group terminating means comprising a relay, and circuit arrangements controlled by the switch for energizing the relay at predetermined points in the movement of the switch and for deenergizing the relay whenever the switch reaches normal position.

66. The combination, with an automatic switch for connecting a calling and called line, a sending switch and a control circuit connecting said switches, a stepping magnet for said sending switch, a relay in said sending switch for simultaneously transmitting impulses to said stepping magnet and over said control circuit to the said first switch, means for causing said impulses to be transmitted in groups in accordance with the digits in the number of the called line, and means comprising a slow relay for introducing a definite delay between groups.

67. In an automatic impulse sender, a plurality of storage devices, means including a counting device for generating series of impulses in accordance with the setting of said storage devices, means for restoring the counting device after each series has been transmitted, and a slow acting relay effective until after the counting device has restored for introducing a time lapse between the successive series.

68. In an automatic impulse sender, a plurality of storage devices, means including a counting device for generating series of impulses in accordance with the setting of said storage devices, means for restoring the counting device after each series has been transmitted, a control terminal adapted for connection to an electrical device for operating same in accordance with the electrical condition of said terminal, and means for applying a specific operating potential to said terminal responsive to the starting of each said series.

69. In an automatic impulse sender, a plurality of storage devices, means including a counting device for generating series of impulses in accordance with the setting of said storage devices, means for restoring the counting device after each series has been transmitted, a control terminal adapted for connection to an electrical device for operating same in accordance with the electrical condition of said terminal, and means for applying a specific operating potential to said terminal responsive to the completion of the final one of said series.

70. In an automatic impulse sender, a plurality of storage devices, means including a

counting device for generating series of impulses in accordance with the setting of said storage devices, means for restoring the counting device after each series has been transmitted, a control terminal adapted for connection to an electrical device for operating same in accordance with the electrical condition of said terminal, and means for applying a specific operating potential to said terminal only during the duration of each said series.

71. In an automatic impulse sender, an impulse generating device, a counting device, manually operated directive means for setting up a condition for predetermining a train of impulses constituted of a plurality of series of random number of impulses in each said series and in predetermined succession of said series irrespective of the number of impulses in the respective series, a magnet for causing the movement of said counting device, means for operating said generating device and said counting device synchronously to transmit said train of series, means for restoring the counting device after each said series is finished, and means exclusive of said magnet effective for introducing a time interval between the immediately successive series of the train of series transmitted.

In witness whereof, I hereunto subscribe my name this 5th day of June, A. D. 1919.

FRANK L. FISHER.

In witness whereof I hereunto subscribe my name this second day of June, A. D. 1919.

HERBERT M. FRIENDLY.