July 8, 1941. M. L. HASELTON 2,248,819

SIGNAL TRANSMITTING MEANS

Original Filed Jan. 20, 1928 7 Sheets-Sheet 1

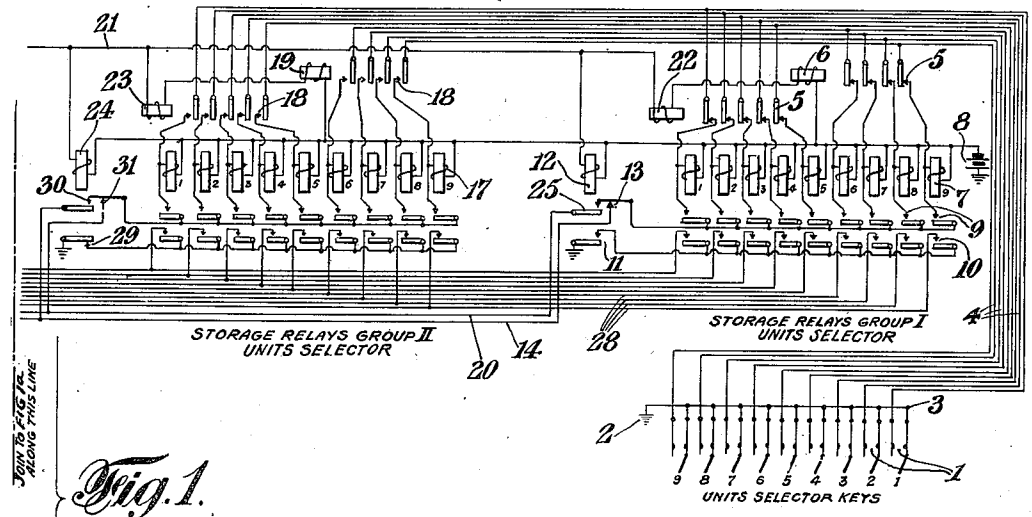
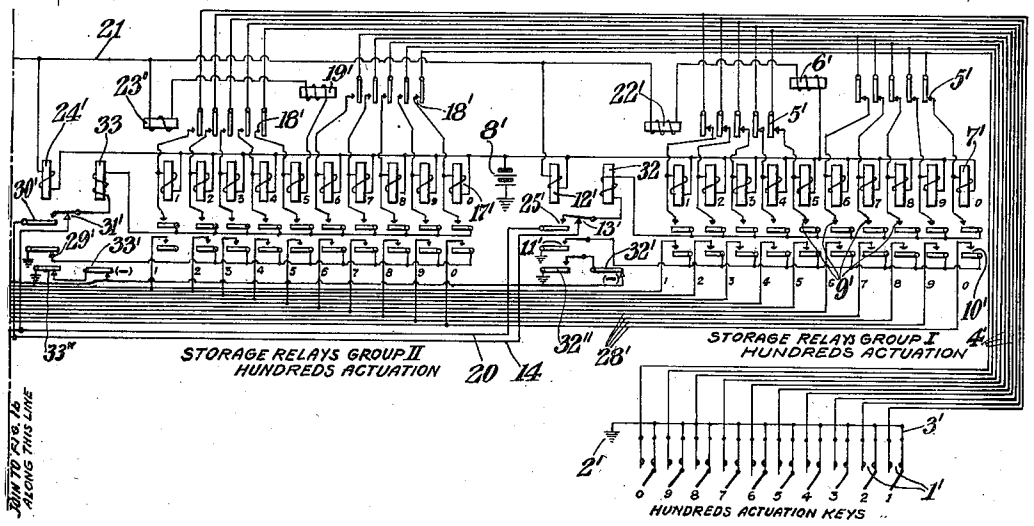


Fig. 1.



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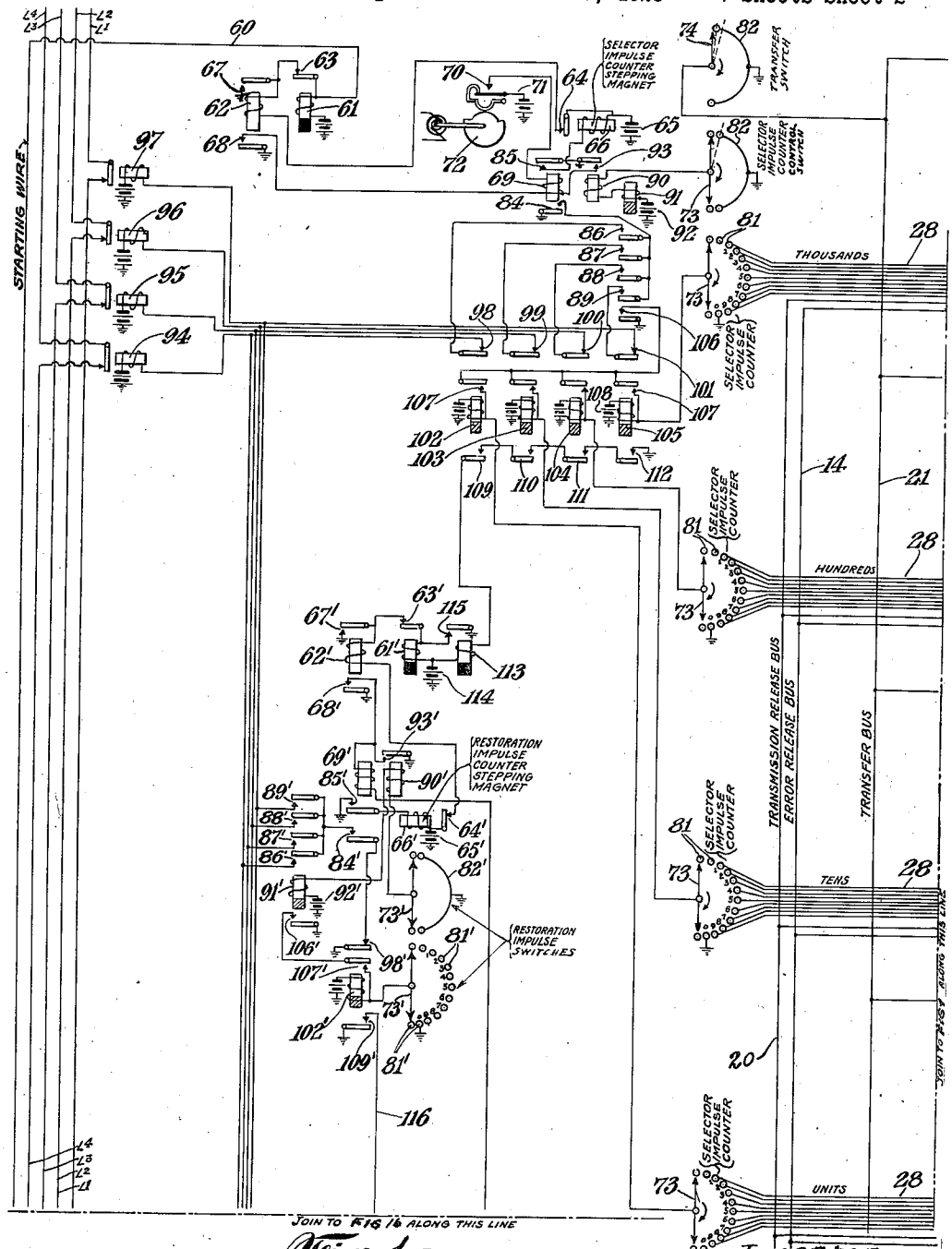

Fig. 1a.

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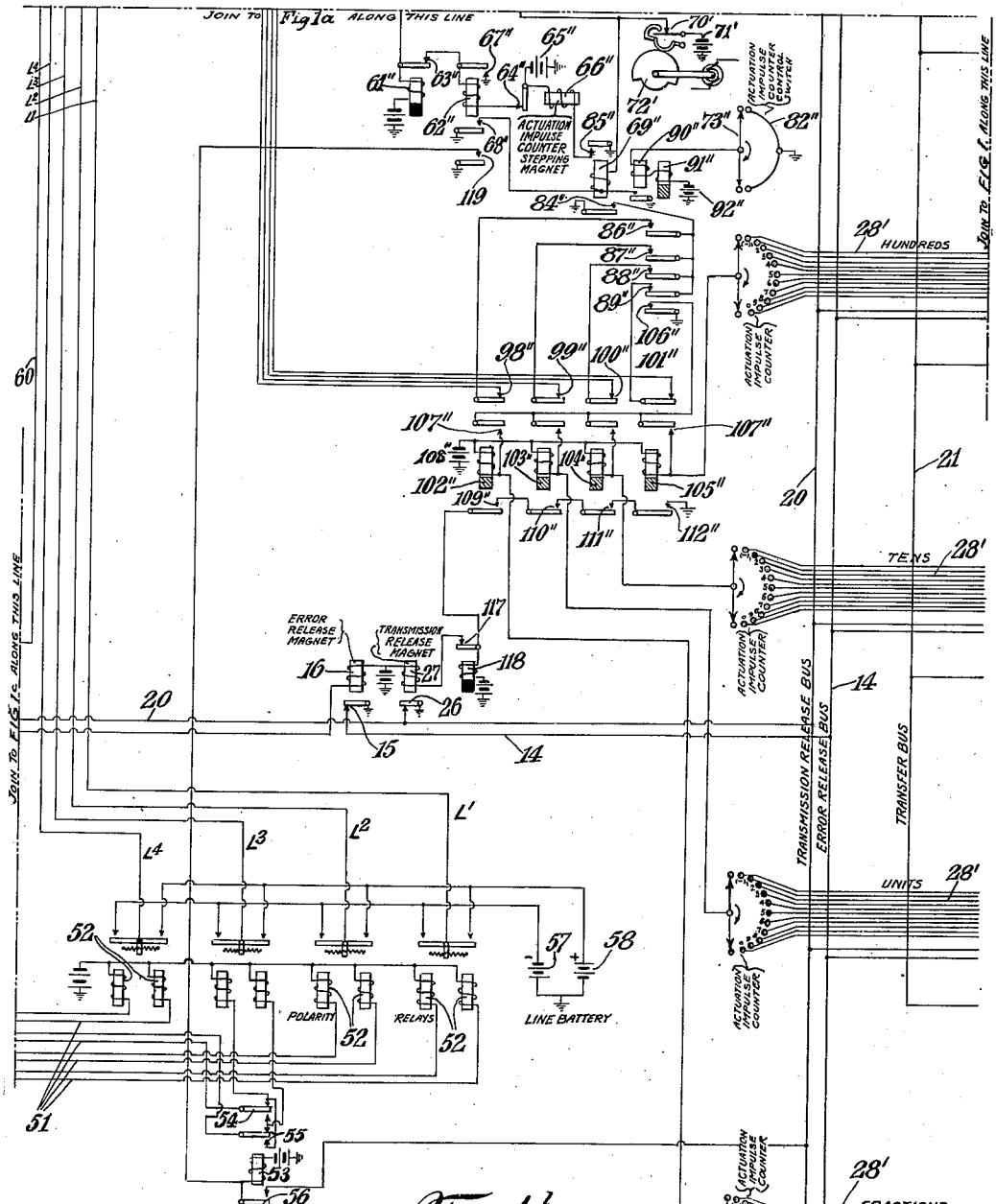

Fig. 1b.

LINE POLARITY L1	L2	L3	L4	INDICATOR UNITS CHOSEN	
+	−	+	−	ACTUATION	LAST
+	−	−	−	RESTORATION	
+	−	+	+	ACTUATION	LOW
+	−	−	+	RESTORATION	
−	+	−	−	ACTUATION	LOW AND LAST
−	+	+	−	RESTORATION	
+	+	−	−	ACTUATION	HIGH
+	+	+	−	RESTORATION	
−	−	+	+	ACTUATION	HIGH AND LAST
−	−	−	+	RESTORATION	
+	+	−	+	ACTUATION	OPEN
+	+	+	+	RESTORATION	

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Fig. 6.

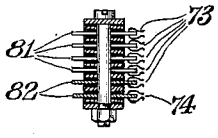
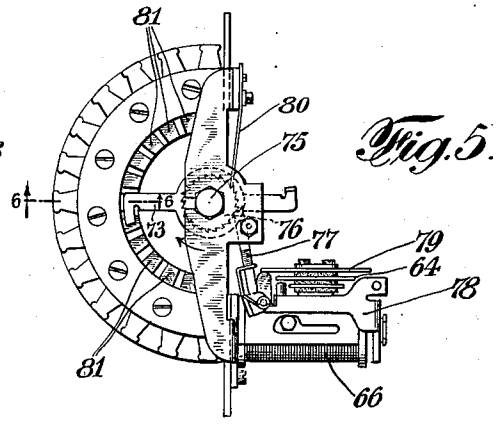


Fig. 5.



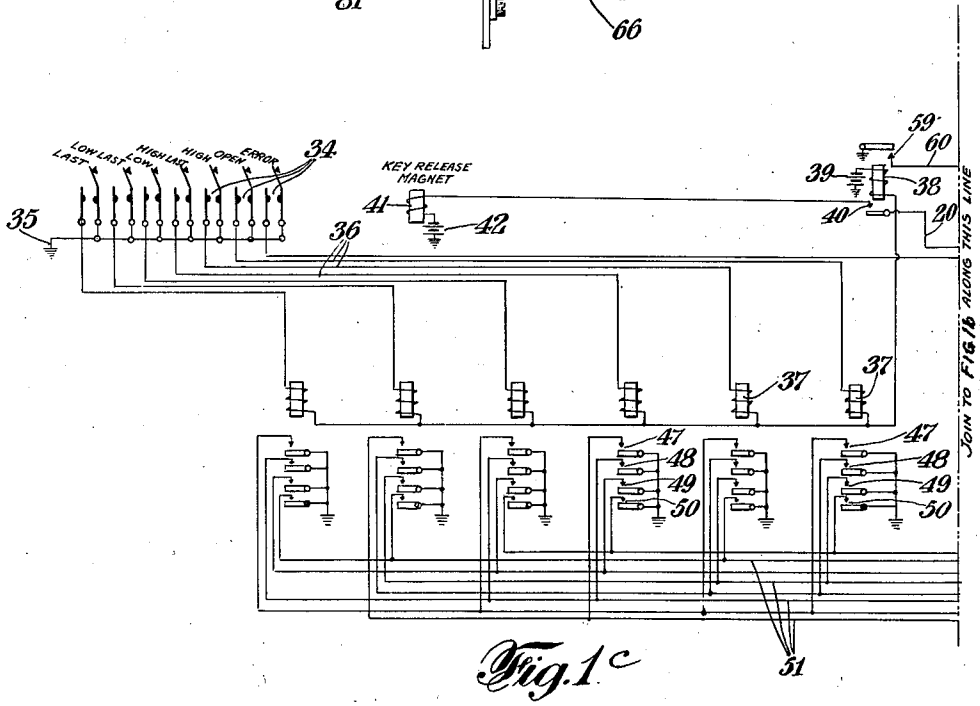


Fig. 1c

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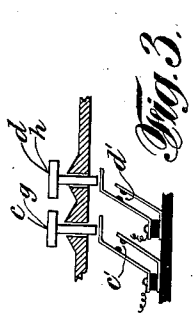

Fig. 3.

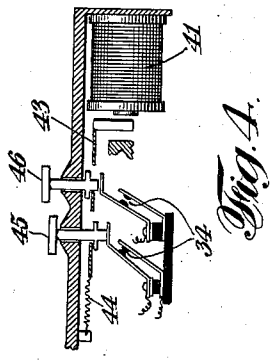

Fig. 4.

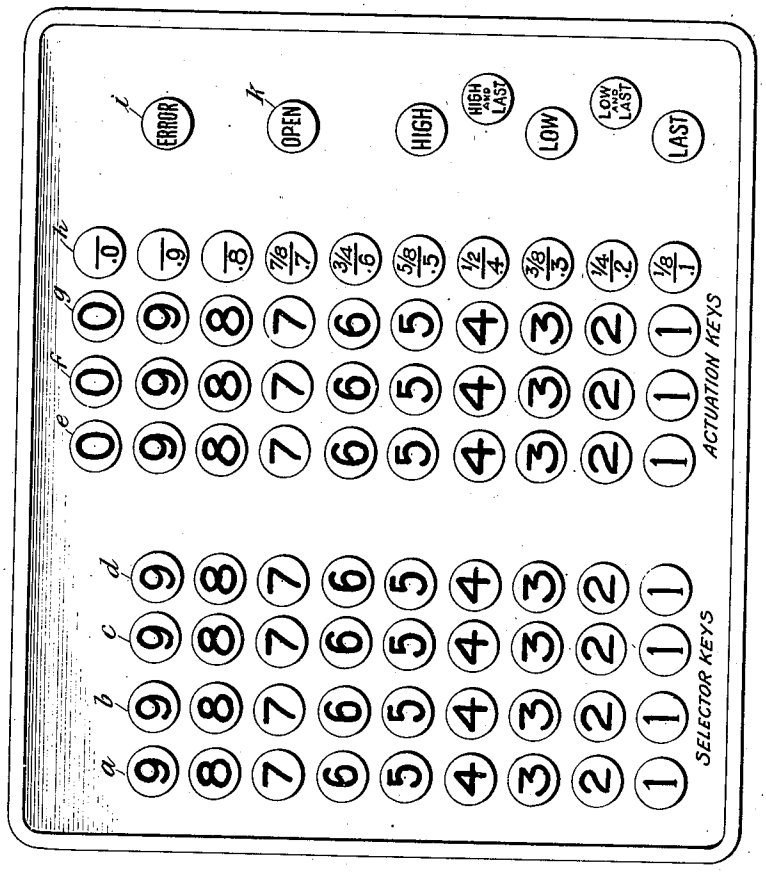

Fig. 2.

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Fig. 7

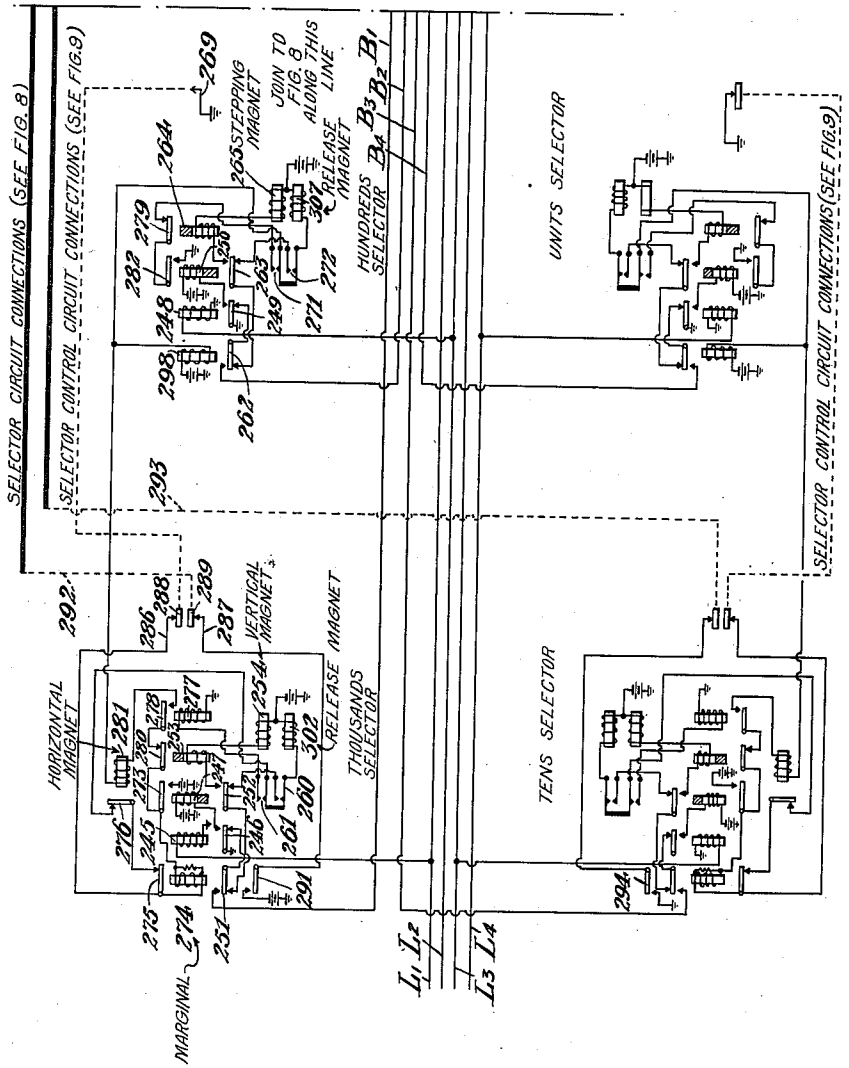
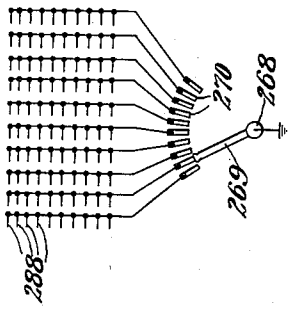


Fig. 9



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SIGNAL TRANSMITTING MEANS

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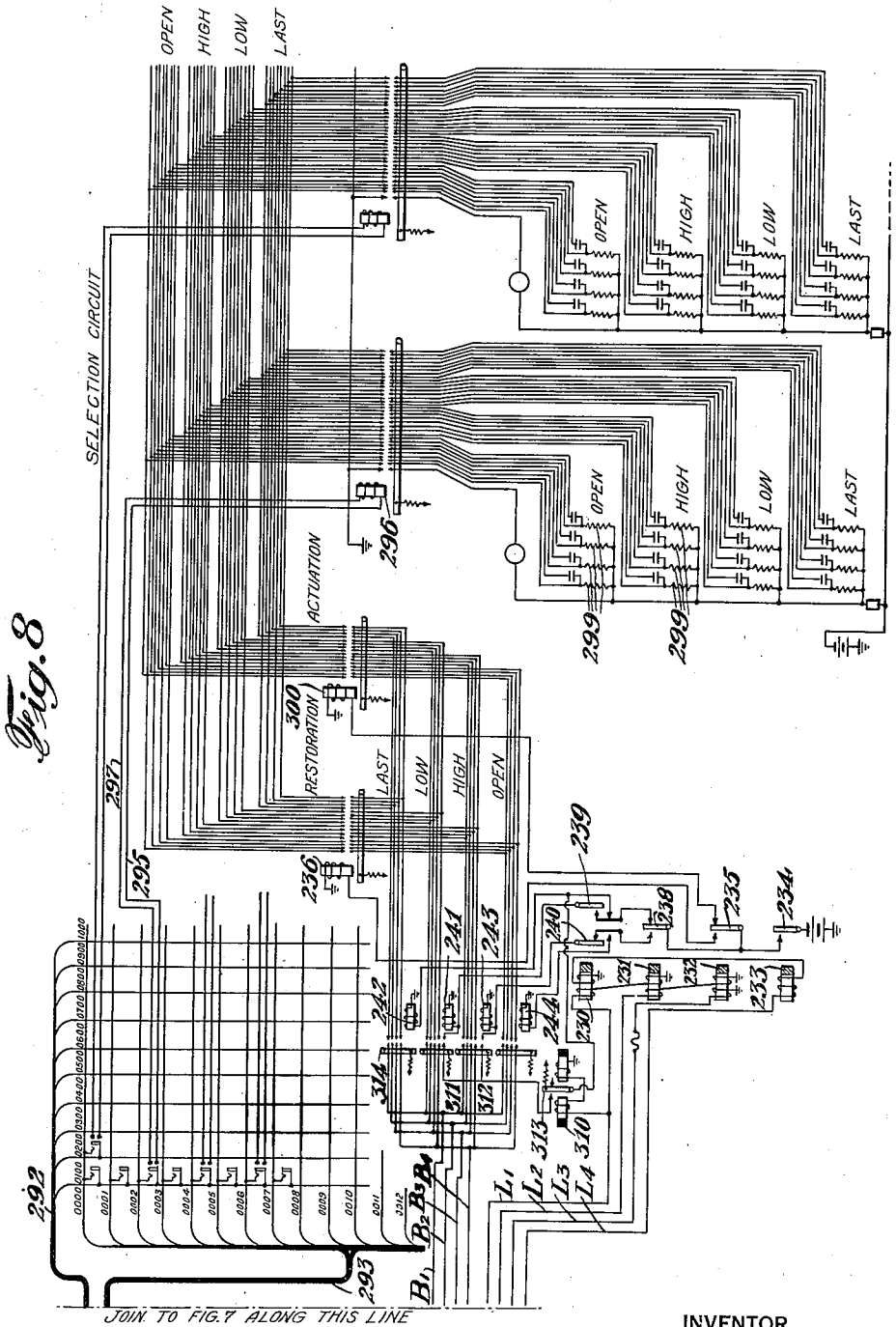

Fig. 8

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Patented July 8, 1941

2,248,819

UNITED STATES PATENT OFFICE

2,248,819

SIGNAL TRANSMITTING MEANS

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Application January 20, 1928, Serial No. 248,069
Renewed October 10, 1939

29 Claims. (Cl. 177—353)

This invention relates to electrical signaling and more particularly to signaling apparatus and methods whereby distinctive current variations representative of certain information may be transmitted from a central point or points to one or more receiving stations at which the information is to be displayed or posted or otherwise made available for use.

The invention according to one of its phases, although not restricted thereto, is particularly adaptable to the transmission of varying stock or commodity price quotations from a central point, such as a stock exchange, to numerous brokers' offices at each of which the quotations may be automatically posted on bulletin boards or otherwise. This application relates primarily to improved transmitting methods and means such as may be utilized for example, with receiving means as disclosed in my copending application Ser. No. 244,873, filed January 6, 1928, entitled "Electrical signaling", now U. S. Patents Nos. 1,890,876, 1,890,877 and 1,946,531. However, it will be understood that the invention of this application, according to many of its phases, is applicable to other forms of receiving apparatus.

The objects of my invention include the provision of apparatus of the above indicated class which will be adaptable with a wide degree of flexibility to various operating conditions and which will be accurate, rapid and dependable in operation.

Further and more specific objects, features and advantages will clearly appear from the following description taken in connection with the accompanying drawings and claims which form a part of this specification.

The invention comprises the novel signaling methods, features, circuit arrangements, and combinations of circuits and parts as hereinafter described, but by way of example only, as illustrative of certain preferred embodiments of the invention.

In the drawings, Figs. 1, 1*a*, 1*b* and 1*c* comprise a schematic diagram of the circuit arrangements of one embodiment of the invention;

Fig. 2 illustrates an operating keyboard for use in conjunction with the circuits of Figs. 1, 1*a*, 1*b* and 1*c*.

Fig. 3 is a sectional view illustrating typical selector or actuation keys of the keyboard of Fig. 2;

Fig. 4 is a sectional view showing the construction of typical "starting keys" such as the "open," "high," "low" or "last" keys, etc., of the keyboard of Fig. 2;

Fig. 5 shows one form of impulse counting device, such as may be used in connection with the circuits of Figs. 1, 1*a*, 1*b* and 1*c*; and

Fig. 6 is a sectional view taken substantially along the line 6—6 of Fig. 5.

Keyboard arrangement

In order to exhibit at brokers' offices the varying quotations of stocks, commodities or other items in the customary manner, means should be provided for posting, say, four digits of each quotation, that is, the hundreds, tens, units and fraction value. The brokers' customers are also generally desirous of knowing the "open," "high," "low" and "last" quotations for each stock or item and accordingly provision should be made for giving these four quotations for each stock. Furthermore, in order to provide for the transmission of quotations for all or substantially all of the large numbers of stocks and other items, such as listed on various exchanges of the country, means should be available for transmitting a corresponding large number of distinctive and different current variations. In my patents, above referred to, I have disclosed various means whereby such multitude of distinctive current variations may all be transmitted over a relatively small number of line wires used in common for the current variations representing quotations of the numerous items, selecting means being provided at each receiving station for identifying the current variations according to the respective stocks or items represented thereby and for applying or causing to be applied, similar identified variations to corresponding indicating units for posting a plurality of digits for showing either the "open," "high," "low" or "last" quotation of any desired stock or item. Of course, at times quotations for either the "high and last" or the "low and last" will be alike and for such instances I have provided means for simultaneously actuating the indicators for either the "high and last" or the "low and last."

The transmitting arrangement hereinafter described first performs the function of transmitting a group of distinctive current variations which operate to control the identifying or selector means at the receiving stations. The transmitter then functions to transmit a group of current variations for actuating the particular indicators chosen by the selector means. Also the transmitter of my invention provides means for rendering such actuating current variations effective to operate either the "open,"

"high," "low" or "last" quotation indicators, or if desired either the "high and last" or the "low and last" together.

In order to provide a rapid and accurate method of performing the selecting steps with the apparatus, each stock or other item, for which quotations are to be transmitted, is preferably arbitrarily designated by a distinctive group of numerals or other characters. For example, a certain stock might be identified as No. 1212. It is convenient to use as many as four digits for identifying the various items inasmuch as with such a system, as many as 9999 separate items may be thus identified and also, if but a relatively smaller number of items are to be frequently quoted, such frequently quoted items, such as "active" stocks, may be designated by numbers composed of small digits such as 2—1—2—1, for which only corresponding small numbers of current variations need be transmitted. Furthermore, with the particular system here disclosed, it is of further convenience to provide designating numbers having four digits in that the current variations which perform the selecting steps corresponding to each of such four digits may be simultaneously transmitted over an equal number of line wires, namely four, the same four line wires being subsequently used for simultaneously and independently transmitting the current variations for actuating the four selected indicator units for one quotation.

Referring to Fig. 2, a plurality of tiers of selector switch keys are indicated at *a*, *b*, *c* and *d*, one such tier being provided for each of the four digits of a stock designating number. It will be noted that nine switch keys are provided in each tier, the same respectively bearing identifying numerals from 1–9. Referring to Fig. 3, it will be noted that each of the switch keys when pressed serves to close switches as at *c'* and *d'*, thus closing a circuit through such switches so long as the operator holds the corresponding switch keys in depressed position. The switches as at *c'* and *d'* have spring contacts as shown, whereby the switches are normally open when pressure is not applied to the switch key buttons. As hereinafter explained, four line wires may be provided respectively corresponding to each of the four tiers of keys *a*, *b*, *c* and *d*, and the switches operated by such keys function through apparatus suitable to transmit over said line wires respectively a number of current variations corresponding to the numeral on the particular key which is pressed.

As shown in Fig. 2, another and similar group of keys designated as actuating keys, may be provided and likewise arranged in four tiers, *e*, *f*, *g* and *h*, corresponding respectively to the four digits of each quotation and also corresponding respectively to the same four line wires above referred to. It will be noted that in each of these tiers ten keys are provided and numbered respectively from 1–9 and the 10th key bearing the indicia zero. These keys provide respectively for sending over the several line wires groups of actuating impulses varying in number from 1–10 depending upon which of the keys has been pressed.

It will be noted that although zero keys are provided in the actuation key group, none are provided in the selector key group. This is for the reason that apparatus hereinafter explained may be provided whereby if no selector key in any or all of the selector tiers is pressed, then on the line wires corresponding to such tiers, ten selector impulses will be transmitted, thus preventing the selectors from remaining inactive or disconnected at the receiving stations. That is, if no selector keys were pressed in tiers *a*, *b* and *c* and the key 1 were pressed in tier *d*, then the quotation indicators for stock number 0001 would be selected at the receiving stations. Again, if the operator pressed key number 9 in tier *a*, but pressed no other selector keys, the indicators for item number 9000 would be chosen at the receiving stations. It is apparent therefore that "zero" keys are not necessary in the selector key group. On the other hand in the actuation key group it is desirable to provide for the setting of the quotation indicators either at "blank" or at "zero." With the keys arranged as shown in Fig. 2, the pressing of the zero actuation keys functions to transmit groups of ten current variations for setting the corresponding chosen quotation digit indicators at zero, whereas if keys are not pressed in the actuation key groups, the digit indicators will remain at positions exhibiting blanks, the indicators after being selected having been automatically restored to blank positions by means hereinafter described.

It will be observed that actuation key tiers *e*, *f* and *g*, bear indicia which may be used respectively to correspond to the hundreds, tens and units of the quotation transmitted, while the tier *h* bears indicia corresponding to various fraction values, either decimal or common, depending upon which characters are used on the corresponding quotation digit indicators which are selected at the receiving stations. For example, the ten keys of this tier may be labeled with the characters .1 to .9 and 0 and keys from .1 to .7 may be also labeled with common fraction characters from ⅛ to ⅞ respectively.

On the keyboard as shown in Fig. 2 an additional key *i*, similar in construction to the keys above described, but bearing the indicia "error" may be used to operate circuit arrangements for releasing the connections established by reason of the previous pressing of any of the selector or actuation keys. Another group of similar keys may also be provided as indicated at *k*, which are utilized to determine whether the actuation impulses shall function to operate the "open," "high," "low," "last," "high and last" or "low and last" quotation indicators.

The keyboard may be operated as follows: For example, if the operator wishes to transmit for item No. 1212 a quotation comprising 106¾, he may press selector keys 1—2—1—2 respectively of the four selector tiers, and also press actuation keys 1—0—6—¾ respectively of the four actuation tiers. That is, these eight keys may be pressed either in succession in any convenient order, or simultaneously as the operator may desire. After all of these keys have been pressed, if it should be discovered that one or more of the keys have been pressed by mistake, the operator would press the error key *i*, whereupon circuit connections set up by reason of the previous pressing of the eight keys, selector and actuation, would all be restored to normal. That is, circuit connections which have not as yet actively operated to transmit signals will be restored, but circuit connections which may have been established before a previous pressing of one of the keys *k* will continue to be engaged in transmission of signals and will be unaffected by the "error" key. The operator will next press the desired eight keys or a lesser number. Then if none of the keys *k* are in depressed condition, one of the

same may be now pressed by the operator, which will start the sending of distinctive groups of impulses over the line wires corresponding to the particular eight selector and actuation keys which have been pressed. Immediately upon pressing one of the keys of the group *k*, such key as pressed will be locked down and the other keys of this group will be locked up, such locking continuing until the transmission of the distinctive groups of current variations is automatically completed.

Meanwhile, however, during the automatic transmission of these groups of impulses, the operator may reset the selector and actuation keys to correspond to any desired new quotation which is to be next transmitted. Then as soon as the locking of the keys of the group *k* is released, another key of such group may be pressed for starting the transmission of the second quotation. It is therefore unnecessary for the operator to await the actual transmission of a quotation over the line wires before setting the selecting and actuating keys for the next quotation, and accordingly substantially the maximum possible speed of operation of the keyboard is obtainable. That is, the speed of operation of the keyboard may be limited only by human skill in operating the same. Yet the locking of the keys of the group *k* automatically prevents confusion of the digits of one quotation with those of the succeeding, and since the selector and actuation keys may be pressed in any desired sequence or concurrently at the operator's convenience, in any event there is no possibility of confusion of the selector impulses with the actuation impulses by reason of false settings.

Inasmuch as provision is made to actuate the keyboard for selecting and sending a new quotation before the previous quotation is completely transmitted, it is apparent that storage means is necessary for storing the information of each setting, at least for a limited time. In my aforesaid patents provision for such storage is made in the form of a perforated tape, the perforations being made prior to actual use of the tape and being distinctively arranged to indicate the quotations of desired stocks. Another manner in which such storage could be accomplished would be by the use of two or more keyboards, but according to the particular embodiment of my invention here disclosed, I have obviated the necessity for a plurality of keyboards, and instead have provided two sets of relays operated upon alternately by a single keyboard. Typical groups of relays for this purpose are designated on Fig. 1, as Groups I and II, the operation of which will be hereinafter described in detail.

In the system described in my aforesaid patents, the choice as between "open," "high," "low" and "last," "high and last" or "low and last" is accomplished by establishing various combinations of polarities on the four line wires. That is, when the transmission of signals is initiated, a sustained potential on each line wire of a predetermined polarity is set up, then the subsequent selecting and actuating current variations take the form of potential interruptions or drops on the line wires. With the keyboard and circuit arrangements of this invention, such sustained potentials are established by the pressing of the keys *k*, which at the same time initiate the transmission of current variations and shift the selector and actuation keys from cooperation with the storage relays of one group to those of the other group. Since the chosen one of keys *k* remains depressed until the sending of one quotation is completed, it is apparent that the predetermined line potentials established by pressing one of such keys may also be maintained, subject to the current variations, throughout the sending of one quotation, and therefore all selecting and actuating impulses of a given group will be directed either to the "open," "high," "low" or "last" indicators, depending upon which key *k* is pressed.

Storage relay circuits

The circuits of the digit storing relays are largely indicated on Fig. 1. At the top of Fig. 1 the two alternately used groups of the relays for the "units" selector keys are shown. It will be understood that similar groups will be provided respectively for the tens, hundreds and thousands digits of the stock or item designating numbers. These additional relay groups are attached respectively to the wires bearing the indicia tens, hundreds and thousands on Fig. 1*a*. For simplicity such additional groups of relays are not shown as they are constructed and arranged in the same manner as those shown at the top of Fig. 1.

Likewise, at the lower part of Fig. 1, the two alternately used groups of storage relays for the hundreds actuation keys are illustrated, additional groups (not shown) being provided and connected to operate over the wires designated as tens, units and fractions on Fig. 1*b*.

The miniature numbers used designating the keys, relays and impulse counter contacts are considerably smaller than the numerals used in designating other parts of the apparatus and should not be confused therewith.

Referring to Fig. 1, we will first assume that all relays are de-energized and that the operator presses the units selector key #9. This closes the corresponding switch contacts 1 and establishes a circuit from ground 2, through ground wire 3, the switch 1 and the corresponding relay bus 4, a normal contact 5 of a transfer relay 6, the coil of a digit storing relay 7 (relay for digit #9) to battery and ground at 8. Digit storing relay 7 therefore operates and closes contacts at 9 and 10. Contact 10 prepares a circuit to the transmitter but this circuit is however open at a contact 11 of a transfer relay 12. Contact 9 in closing establishes a holding circuit for relay 7 which is as follows: battery and ground at 8, coil of relay 7, contact 9, a normal contact 13 of the transfer relay 12, an error release bus 14, thence to a normal contact 15 of an error release magnet 16. (See Fig. 1*b*.) This circuit holds digit storing relay 7 operated but conditions its circuit so that it may be released whenever error release magnet 16 is energized.

In a similar manner any digit storing relay may be "locked up" over the error release bus 14 by pressing the keys. It may be noted that digit storing relays in Group II as at 17 are disconnected at normal contacts 18 of transfer relays 19 and 23. Therefore pressing of the keys has no effect at this time on any of the relays in Group II. The error release bus 14 as well as a transmission release bus 20 and a transfer bus 21 are common to all digit storing relays, both for selection and actuation.

If, now, the transfer bus 21 is grounded, all the transfer relays such as 6, 12, 19, 22, 23 and 24 are energized, since all have one terminal connected to the battery and ground 8 and their other terminal connected to the bus 21. This ground may be placed in the transfer bus at the

proper time by the transmitter per se, as explained hereinafter. The transfer relays therefore open all normal contacts as at 5 of relays 6 and 22 of Groups Nos. I, and close make contacts as at 18 of relays 19 and 23 of Group No. II. Also the contact 9 of relay 7 which is closed, is transferred from the ground on error bus 14 to another ground on the transmission release bus 20, by the closing of a contact 25 and subsequent opening of the contact 13 of relay 12. The holding circuit of relay 7 is now completed over the transmission release bus 20, (see Fig. 1b), and a contact 26 of a transmission release relay 27 to ground. This relay is energized by the transmitter when all impulses for one quotation have been transmitted, as explained hereinafter. The relay 12 in closing also closes the contact 11, thereby placing a ground on the 9th contact of a units selector impulse counter, through the contact 10 of the relay 7, and through a sender bus as at 28 to the 9th contact of the units selector impulse counter as shown on Fig. 1a.

The reverse of the above described circuit changes occurs by the operation of transfer relays 19, 23 and 24. That is, the ground at contact 29 of relay 24 is removed from sender busses 28 by the opening of the contact 29; also the holding circuit of all of the Group II relays is transferred from the transmission release bus to the error release bus by operation of the contacts 30 and 31 of the relay 24. This places the Group II digit storing relays in condition to record such digits as are next chosen on the keyboard.

The operation of the digit storage relays of the actuation groups may be the same as of those above described. However, as above explained, it is desirable to provide ten actuation keys in each group and accordingly ten storage relays are provided in each actuation group, and furthermore, as shown in the lower portion of Fig. 1, relays 32 and 33 have been added which are in series with the holding circuits of the groups of digit storing relays. The relays 32 and 33 correspond to the blank spaces on the indicator units selected at the receiving stations.

Parts of the actuation storage relay circuits which are similar to corresponding parts of the selector storage relay circuits are identified on the drawings by the same numerals accompanied by prime marks.

If no keys are pressed, relays 32 and 33 do not operate and the "blank" wire of the actuation bus group 28' remains grounded through one or the other of contacts 32' and 33'. Assuming however that a contact of Group I has been pressed, then the circuit of relay 32 will be closed either by way of error release bus 14' or transmission release bus 20', through either contact 13' or 25', thence through the coil of relay 32 to one of the contacts as at 9' of the particular storage relay which has been actuated, thence through such relay to battery and ground at 8'. Therefore, when certain of the actuating keys of Groups Nos. I are pressed, the relays such as at 32 (of the "hundreds," "tens," units" and "fractions" groups) cause the ground connections to be removed from the "blank" actuation busses, but when no actuation keys are pressed, the relays 32 being inactive permit the contacts 32' to remain closed. The contacts 32' complete their circuits through other contacts as at 32'' which are under the control of transfer relays 12'. When the actuation keys of Groups Nos. I are being set, the transfer relays 12' are inactive and hence contacts 32'' remain open until a transfer to Groups Nos. II is made, whereupon energization of relays 12' closes contacts 32'' for effecting completion of the grounding circuits through contacts 32' whenever no keys have been pressed in the corresponding groups. Then, as will be hereinafter explained, the corresponding contact marked (—) on the actuation impulse counters being grounded, will cause the impulse counter to send no impulses, thus leaving the corresponding selected indicators at the receiving stations in positions to indicate blanks. Actuation storage relay Groups Nos. II are arranged in a similar manner, that is, when transfer is made from Group I to Group II, relay 24' will be energized, thus opening a ground circuit through a contact 33''. Then if keys are not pressed in Groups Nos. II, the relays 33 will remain idle permitting the ground circuit to be conditioned through closed contacts 33'. Thereafter upon transfer back to Group I, relay 24' will be de-energized, thus closing the ground circuit through the contact 33'', contact 33', "blank" actuation bus, to the (—) contact on the corresponding actuation impulse counter, such ground being maintained during the existing actuation cycle and until the next transfer, but not interfering with the resetting of Groups Nos. I.

As to constructional features and details of the digit storing relay groups which are not herein described at length, reference may be had to various prior art patents and publications, which describe somewhat similar arrangements, but modified and adapted to a distinctly different purpose, namely automatic telephone switching, as explained for example by H. H. Harrison in his book on "Automatic Telephony," Longmans Green & Co., London, 1924, pages 130–134.

It will now be apparent that by the use of the storage relays above described, the actual transmission of current variations may be provided for to take place simultaneously with the resetting of the keys for a subsequent quotation. The function of the storage relays it will be observed is to apply a ground connection to proper contacts on the selector and actuation impulse counters. That is, referring to Figs. 1a and 1b, it will be noted that an actuation impulse counter is provided respectively for each of the groups of transmitter busses 28 and 28', such impulse counters having arcuately arranged groups of contacts corresponding respectively to the units, tens, hundreds and thousands selector digits and the fractions, units, tens and hundreds of the actuation digits. Such impulse counters will be hereinafter described in detail.

Assuming now that the operator has pressed the desired selector and actuation keys, he is now ready to start the actual transmission of the current variations which will correspond in number to the designating numbers of the storage relays of the various Groups Nos. I which have been energized by the pressing of the corresponding keys.

"Starting keys" and choice of "open," "high," "low" and "last" indicators

Referring now to Fig. 1c, the next operation is the depression of any desired one of the six keys 34 (which have been designated as group *k* in Fig. 2 in order to distinguish from the numbered digit keys). For example, if the "open" key is pressed, this completes a circuit from a ground at 35 through contacts of a switch 34 through a corresponding one of the connection wires 36 to one of the corresponding potential selector relays as

at 37, the winding of a starting relay 38 to battery and ground 39. The relay 38 thereupon operates and completes through a contact 40, a circuit from the transmission release bus 20, through a key release magnet 41 to battery and ground at 42. The holding magnet 41 (see Fig. 4) operates to displace a template as at 43 against the tension of a spring 44. The template 43 is shaped so as to engage with the various keys of group *k* as follows: When for example a key as at 45 is depressed and the magnet 41 is thereupon energized as above explained, the template will engage the stem of such key in a manner apparent from the drawings and prevent the same from being raised until the magnet is deenergized. At the same time keys which are in raised position, as for example key 46, will also have their stems engaged by the template 43 in the manner shown, whereby such keys are held against being depressed until the magnet 41 is de-energized.

Referring now again to Fig. 1*c*, concurrently with the actuation of the relay 38, the particular relay 37 which has been energized will cause a group of four contacts as at 47, 48, 49 and 50 to be closed. The relays 37 are each arranged with these groups of four contacts so as to apply a ground connection to one or the other of the two wires of each of four pairs of connection wires 51. These pairs of wires are in turn connected respectively to pairs of line polarity relays as at 52 (see Fig. 1*b*), so that when certain of the groups of contacts 47, 48, 49 and 50 are closed, the corresponding relays 52 operate to connect the four main line wires, L1, L2, L3, L4, each to either a source of negative potential 57 or a source of positive potential 58. This operation it will be understood serves to apply the sustained potentials to the lines, of such polarities as to determine whether "open," "high," "low" or "last" indicators will be operated by subsequent current variations, and also with certain combinations of potentials to permit the operation of "high" or "low" indicators with the "last" indicators at the receiving stations. On Fig. 1*b*, a tabulation is given of suitable line potentials which may be applied to permit the desired control of the receiving indicators arranged as described in my aforesaid patents. For example, if the "last" key is pressed, potentials will be normally applied to the line wires L1, L2, L3 and L4, respectively, as follows: plus, minus, plus, minus. With these potentials, any actuation impulses transmitted over the lines will serve to operate the "last" receiving station indicators.

Now, if it is desired to operate the transmitter of this invention in conjunction with receiving circuits such, for example as shown in Fig. 12 of my Patent 1,890,876, the line polarities may be first established for "restoration" purposes as indicated in the tabulation of Fig. 1 of this application. After the necessary number of "restoration" impulses are transmitted in a manner hereinafter explained, the polarity of line L3 may be quickly reversed, whereupon the line potentials will be such as to permit "actuation" of the chosen indicators at the receiving stations. This shifting of the polarity of line L3 is accomplished by the operation of a relay 53 acting in conjunction with relay switch members 54, 55 and 56, the operation of which will be hereinafter explained in detail. The association of the line wires with the line polarity changing switches and the sources of potential 57 and 58 is fully explained in connection with Fig. 6 of my Patent No. 1,890,876.

Selector impulse transmitting circuits

At the same time that the line potentials are being established as above explained, the starting relay 38 (see Fig. 1*c*) also closes a contact 59 which, it will be observed, connects a ground with a "starting wire" 60, (see Figs. 1*b* and 1*a*) which, when energized, initiates the transmitting action through the medium of relays 61 and 62. The relay 61 may be of a slow acting type with a copper slug on its armature end causing the relay to be slow to operate. The relay 62 may be of the ordinary quick acting type. Upon energization of the "starting wire" 60, the relay 61 operates after a short delay, but only after the quick acting relay 62 has operated through a normally closed contact 63, such circuit running from ground through contact 59, starting wire 60, contact 63, coil of relay 62, a contact 64, to battery and ground at 65, the contact 64 being under the control of a selector impulse counter stepping magnet 66. The relay 62 then is provided with a holding circuit by reason of the closing of a contact 67 which connects the relay 62 directly to ground in lieu of having its circuit run through contact 63 and the starting wire to ground. Upon the actuation of relay 61 the starting wire circuit is broken at the contact 63. This may occur at approximately 0.1 second after relay 62 has operated and causes the circuit of the starting wire to remain open at this point until the transmission of current variations for one quotation is completed; thereafter the same circuit is opened at contact 59 until the starting key is pressed for the following quotation. Thereby, repetition of the actuation of the selector circuits is prevented until a starting key is again pressed. Before proceeding further with the transmitting circuits, the impulse counter construction will be described.

Impulse counter construction. — The impulse counters or switches may take the general form of the well known rotary line switches as used in automatic telephony switching, one example of such a switch being shown in the above cited work by Harrison on page 41. Inasmuch as the details of construction of such switches are well known, only the features particularly adapting such switches to this invention will be here described.

As shown in Fig. 5, this switch may be of the rotary step-by-step type having five double rotary wiper arms as at 73 and one single rotary wiper arm as at 74. (See Fig. 1*a* for schematic illustration.) These wipers may all be mounted in alignment on, but insulated from, a single shaft as at 75 (see Fig. 5), cooperating with a ratchet 76 and pawl 77 so as to be rotated step-by-step always in the same direction. The pawl in turn may be driven by an armature as at 78 of the stepping magnet 66. The pawl as advanced by the armature engages one of the teeth of the ratchet 76 and as the magnet 66 is de-energized, the ratchet together with the wiper arms are rotated one step in the direction of the arrow by the force of a spring 79 acting against the pawl member. Reverse movement of the ratchet and wipers may be prevented as by a spring dog 80.

The outer ends of four of the wipers 73 respectively are arranged to come into contact successively with thirteen contact points as at 81, arranged as shown in arcuate groups. Two of the wipers, namely one of the double wipers 73, and

the single wiper 74 come into contact with continuous arcuate segments 82 and are used for the control of the transmitters and the transfer bus as hereinafter explained. The manner in which the switch 64 above mentioned is associated with the stepping magnet 66 is indicated in Fig. 5, the switch 64 being arranged to open its circuit whenever the magnet 66 is energized.

The operation of the selector impulse counter or switch will now be explained in connection with the diagram on Fig. 1*a*.

It will be observed that for clearness on Fig. 1*a* the step-by-step switch of Fig. 5 has been shown schematically as divided into six groups or parts, one bank of contacts or else a segment being included in each part. The manner in which segments 82 cooperate with wipers 73 and 74 is shown. That is, wiper 74 is normally out of contact with its segment 82, but when the wiper 74 is advanced in the direction of the arrow through, say, approximately one-half step, then contact will be made with its corresponding segment 82 (which is grounded), and such contact will be maintained throughout the succeeding one-half revolution of the wiper, whereupon such contact will be broken during the next one-half revolution. The wiper 73 (having double arms) above referred to, which cooperates with another of the segments 82, it will be observed, normally has both its arms out of contact with the segment 82. However, upon rotation of such double wiper through an angle equivalent to substantially one full step, contact will be made with the segment 82 (which is also grounded) and such ground connection will be maintained until the wiper rotates through one-half revolution to another normal position. Upon rotation of the wipers through the succeeding one-half revolution, the above action will be repeated. The manner in which the other wipers 73 cooperate with the various contacts 81 is apparent from the above description taken in connection with the drawings.

Reverting again to the operation of the selector transmitting circuits: relay 62 in operating also closes a contact at 63, which conditions an impulsing circuit from ground to the make contact 68, through the winding of an impulsing relay 69, to a make contact 70 of a motor driven interrupter 72 and thence to battery and ground at 71. The interrupter 72 may comprise a motor operated cam as shown for closing the switch 70 during intervals of time substantially equal in length to the desired length of the current variations or impulses which are transmitted. After the preparation of the circuit through impulsing relay 69 by the closing of contact 68, subsequent operations of the interrupter 72 cause groups of impulses to be generated in the circuit.

When the first impulse from the interrupter 72 causes energization of magnet 69, this magnet closes contacts as at 84 and 85. Contact 84 merely grounds a circuit without immediate effect, since it will be noted that its circuit remains open at contacts 86, 87, 88 and 89. Accordingly, if the first impulse generated by the interrupter 72 should happen to be of abnormally short duration, such "clipped" impulse cannot be made effective to cause false operation of the transmitter. Meanwhile contact 85 closes the circuit through the stepping magnet 66, such circuit comprising battery and ground at 65, magnet 66, contact 85 to ground. This energizes the magnet 66 and causes the wipers 73 and 74 to be advanced the initial step. Concurrently contact 64 is opened by the energization of magnet 66 and consequently, relay 62 is "dropped out," releasing its holding circuit at the contact 67 and also releasing its contact 63. The releasing of contact 63 in turn removes the ground return of the circuit of impulse relay 69. However, another ground return is applied to the winding of impulse magnet 69, placing the same now under control of the impulse counter, by the action of a relay 90 connected in circuit with a relay 91 and battery and ground at 92, and operating to close a contact 93, which in turn connects the coil of relay 69 to ground. Contact 68 is then ineffective until the next quotation is to be transmitted. The circuit of the coil of relay 90, it will be observed, has just been completed through that one of the wipers 73 which has advanced one step into contact with its grounded segment 82. Meanwhile also the single wiper 74, as soon as it has advanced as much as one-half step, causes the transfer bus 21 to be grounded through its grounded segment 82, thereby causing the transfer bus to be energized to effect a transfer of one group of storage relays from the operating key control to the transmitting apparatus, while transferring the other group of storage relays from the transmitter to the keyboard control in a manner as above explained. It will be observed that inasmuch as the wiper 74 continues in contact with its segment 82 only during one-half revolution of the impulse counter, the transferring action will be reversed during the succeeding one-half revolution. That is, one complete cycle of operation of the impulse transmitting switches is completed upon movement of the same through 180°, but the wipers 73 having double arms, upon completion of one cycle are again ready to operate through another cycle utilizing the wiper arm which was inactive during the previous cycle.

Relay 91 upon being energized through its circuit above traced, closes the contacts 86, 87, 88 and 89, which serve to complete impulse circuits to line impulse relays 94, 95, 96 and 97, respectively, which circuits are each completed through contacts 98, 99, 100 and 101, respectively, the latter contacts in turn being respectively under the control of "digit cut-off" relays 102, 103, 104 and 105. At the same time relay 91 also prepares a holding circuit for the digit cut-off relays by closing a contact 106. The circuits through the line relays run from ground through contact 84, respectively through the contacts 86, 87, 88 and 89, thence respectively through contacts 98, 99, 100 and 101 to the line relays, thence to battery and ground in each case as shown. The holding circuit for the digit cut-off relays runs from ground through contact 106, thence through contacts as at 107, one of the latter being provided as shown for each of the digit cut-off relays, and thence through the respective digit cut-off relays to battery and ground.

These circuit changes are made successively upon the occurrence of each succeeding impulse as generated at the interrupter 72, and the wipers 73 and 74 continue to advance step-by-step. When one of the wipers 73 reaches a contact 81 which has been grounded by the operation of the keyboard as above explained, then the corresponding digit cut-off relay is actuated and its corresponding holding circuit is established, thus preventing the sending of further impulses over the corresponding line wire by reason of the opening of contacts 98, 99, 100 and 101.

For example, supposing contact #9 of the

thousands bank has been grounded. Then immediately upon the arrival of the brush 73 upon contact #9, relay 105 operates, opening the contact 101 which prevents further impulses from going to the line relay 97. Also relay 105 at the same time closes its contact 107, which establishes its holding circuit from ground through contacts 106 and 107, relay 105, to battery and ground 108.

Each of the relays 102, 103 and 104 operate in a similar manner when the other wipers 73 arrive at grounded contacts of the hundreds, tens and units impulse counter groups. In each case the particular contacts 91 which represent zeros, it will be noted, are permanently grounded as above stated in connection with the description of the keyboard, so that a total of ten impulses will be transmitted whenever no other contacts of the corresponding groups have been grounded.

The relays 91, 102, 103, 104 and 105 are of a slow acting type with copper slugs on the heel ends of the cores, whereby these relays are made slow to release. The relay 91 may be delayed in opening for 0.1 second and the relays 102, 103, 104 and 105 are preferably delayed somewhat longer. These delays permit other circuits hereinafter described to be established for transmitting indicator restoration and actuation impulses. As each of the digit cut-out relays 102, 103, 104 and 105 operates, it closes a corresponding one of the series contacts 109, 110, 111 and 112. When all of these series contacts are closed, then the transmission of selector current variations over the four line wires is completed. Accordingly at that time the circuits are ready for the transmission of impulses for restoring the selected indicators to zero prior to reactuation. Thus when all of these four series switches are closed, a ground connection is made for the circuit of a relay 113, which circuit is continued to ground through a battery 114. The relay 113 is of the type which is slow to operate as symbolically indicated and serves to interpose a delay between the transmission of selector impulses and the succeeding transmission of restoration impulses, such delay being desirable by reason of the selector circuit arrangements at the receiving stations as described in my aforesaid patents.

Transmission of indicator restoring impulses

The relay 113 after the short delay, closes contact 115, which establishes a circuit through relay 61′ as follows: ground, contact 115, coil of relay 61′ to battery and ground 114. The relay 61′ corresponds in function to the relay 61 above described in connection with the selector transmission circuits. From this point the circuits for the transmission of indicator restoration impulses are analogous to the circuits above described for transmission of the selecting impulses and the relays, contacts and parts which perform similar functions are therefore indicated on Fig. 1*a* with the same reference numerals, such reference numerals being accompanied by prime marks in the case of the restoration impulse transmitting circuits. With receiving arrangements as described in my aforesaid Patent No. 1,890,876, provision is made for restoring the indicators to zero by applying to such indicators as have been selected a sufficient number of impulses, namely ten, to advance the indicators to either a blank or zero setting regardless of what their previous setting may be. Therefore, it is not necessary in the restoration impulse transmitting circuits to "cut off" the number of impulses except after ten have been transmitted. Furthermore, the ten restoration impulses may be transmitted simultaneously over the four line wires so that but a single restoration impulse counter is required, common to all four lines, having ten steps or contact positions as indicated at 81′. The construction of such impulse counter may be the same as that shown in Fig. 5, except that only one bank of contact points 81′ need be provided to operate in conjunction with a double wiper 73′. Furthermore, the transfer bus controlling wiper 74 of course need not be here provided, although for control purposes a wiper 73′ is used in conjunction with an arcuate segment 82′.

Since the ten restoration impulses are transmitted simultaneously over all four line wires, the four separate relays 102, 103, 104 and 105 may be replaced by a single relay 102′, having a single set of contacts 98′, 107′ and 109′, the functions of which are obvious from reference to the description of contacts 98, 107 and 109. The contacts 86′, 87′, 88′ and 89′ operating in conjunction with the relay 91′ serve to bring the impulses from contact 84′ directly to the connections for the four line relays 94, 95, 96 and 97 respectively.

It will be observed that an interrupter 72′ (see Fig. 1*b*) independent of the interrupter 72 may be provided so that if desired the duration and spacing of the restoration interruptions may be made different from that of the selector interruptions. This is desirable for the reason that in some instances it may be found advisable to operate the receiving station selecting devices at a step-by-step rate different from that of the indicating devices. However, inasmuch as the restoration and actuation impulses both act upon the receiving station indicators, the same interrupter 72′ may be conveniently used for the transmission of restoration impulses, as well as the transmission of actuation impulses in a manner hereinafter described.

The function of the contact 109′ is to cause a connection wire 116 to be grounded upon completion of the transmission of restoration impulses. At this time the circuits are ready for the transmission of the actuation impulses for moving the receiving station indicators to the desired new positions to exhibit a new quotation. The wire 116 has the same function in respect to the actuation impulse transmission as the starting wire 60 has in connection with the selector impulse transmission. When the wire 116 is grounded at contact 109′ the relays and contacts of the restoration impulse transmitting circuits are brought to normal positions in readiness for the succeeding quotation transmission.

Transmission of indicator actuation impulses

In a manner similar to the operation of the selector and restoration impulse transmitting circuits, the indicator actuating impulse transmitting circuits shown on Fig. 1*b* are placed in operation by the energization of a relay 61″. From this point on the actuation impulse transmitting circuits continue through a cycle of operations in the same manner as the above described operation of the selector impulse transmitting circuits, and on Fig. 1*b* the actuation impulse transmitting relays and contacts bear reference numerals with double prime marks, the same numerals being used as on corresponding parts of the selector transmitter.

An actuation impulse counter is provided similar in practically all its details to the selector im-

pulse counter except that of course the transfer bus control wiper 74 and its segment 82 are omitted. Also the zero contacts here are not permanently grounded since zero actuation keys are provided instead. After the last actuation impulse has been transmitted, the series contacts 109'', 110'', 111'' and 112'' are all closed whereby a circuit is completed through a contact 117 to the transmission release magnet 27 above referred to. This causes relay 27 to operate for a short time, thus opening the ground connection at 26 to the transmission release bus 20. After a short delay, a relay 118 opens the contact 117, whereby relay 27 is again de-energized. Referring to Fig. 1, it will be noted that the momentary removal of the ground at contact 26 from the transmission release bus 20 will cause the storage relays, then associated therewith, to be released in preparation for a new setting.

On the other hand, if the operator had made a mistake in pressing certain of the keys prior to the transfer action, then pressing of the error key would have actuated error release magnet 16, which would have momentarily removed the ground at contact 15, of error release bus 14. This would have released the storage relays associated therewith prior to transmission of impulses corresponding thereto.

The momentary removal of the ground at contact 26 from the transmission release bus 20, it will be noted, also causes de-energization of the key release magnet 41, which in turn permits the key 34 which had been pressed, to rise back to normal position with a consequent deenergization of the starting relay 38, which in turn opens contact 40, causing the key release magnet circuit to remain open until another quotation is to be transmitted.

Referring again to Fig. 1*b*, it will be observed that at the relay 62'' I have provided an additional make contact 119, which becomes closed upon actuation of relay 62''. That is, upon initiation of the transmission of actuation impulses, a circuit is then established from ground, through contact 119, through the coil of polarity reversing relay 53, to battery and ground. Thereupon the relay 53 operates and actuates its contacts 54 and 55, and also upon its contact 56. It will be observed that contacts 54 and 55 comprise in effect a double pole, double throw switch which is associated with two of the polarity connections 51 in a manner whereby the polarity applied to line L3 is reversed upon actuation of relay 53. Therefore, when the circuits above described are prepared for the initial transmission of actuation impulses after the completion of the transmission of restoration impulses, the polarity of line L3 is reversed so as to shift the receiving station apparatus from restoration conditions to actuation conditions. Inasmuch as relay 62'' remains energized only for a short period, the contact 56 on relay 53 is provided for establishing a holding circuit for relay 53 by way of the transmission release bus 20, the latter being grounded at contact 26. Relay 53 therefore remains actuated throughout the period of transmission of actuation impulses, but upon removal of the ground from the transmission release bus, relay 53 drops to normal thus preparing the circuits to apply the proper line potentials for the next selecting step.

Receiver

As hereinbefore stated, the transmitter may be employed with any suitable type of receiver, for example, as disclosed in my aforesaid application Ser. No. 244,873, on which, among others, U. S. Patents Nos. 1,890,876 and 1,890,877 have issued, and to which reference may be had for a more detailed disclosure of such a receiver. Figs. 7 to 9 diagrammatically illustrate the receiver.

The various potentials imposed on lines L_1, L_2, L_3, L_4 by the transmitter energize selecting magnets 230, 231, 232 and 233 (Fig. 8). Line L_1 is extended through the coils of magnets 230 and 231 and line L_2 is extended through the coils of magnets 231 and 232. The operation of these two magnets is to effect selection of indicators within a group of indicators by connecting the various bus lines "last," "low," "high" and "open," with main actuating lines B_1, B_2, B_3, B_4. Line L_3 is extended through the coil of magnet 232 which controls the selection of restoration and actuation busses for the indicators. Line L_4 is extended through the coil of the magnet 233 and the coil of the magnet 230. The magnet 233 connects the various selecting switches and magnets to the grounded battery.

If, for example, the transmitter causes positive potentials to be set up in lines L_1 and L_4 and negative potentials in L_2 and L_3, line L_4 energizes the magnet 233 which through its switch 234 connects the switch system to the battery. The potentials on lines L2 and L3 being of like sign, the magnet 232 will be energized and its switch member 235 will be drawn into position to complete a circuit from the battery through the restoration magnet 236 connecting all the restoration bus lines to the main bus lines for the "last," "low," "high" and "open" indicators. The positive potential on line L1 and the negative potential on line L2 will have no effect on the magnet 231 and, accordingly, its spring switch 238 will remain in the position shown. The positive potential on line L1 and the positive potential on line L4 will cause energization of the magnet 230 and closing of the open switch 239 and opening of the closed switch 240. This completes the circuit from the battery through switches 234, 238, 239 to "low" magnet 241, which connects the main "low" bus wires to the main actuating wires B1, B2, B3 and B4. The potentials imposed on these lines have therefore connected the restoration bus lines for the "low" indicators to the main actuating lines B1, B2, B3, B4. The "last", "high" and "open" magnets 242, 243 and 245 are controlled respectively by potentials as shown in Fig. 1*b*.

Selection of groups of indicators

Referring to Fig. 7, the potential on line L1 will have energized magnet 245 which attracts its spring switch 246 to complete a circuit from a battery through the coil of a slow-to-release magnet 247, and the spring switch 246 to ground. The polarity imposed on line L2 will have energized magnet 248 in the hundreds selector which completes through its spring switch 249 a circuit from a battery through the coil of a slow-to-release magnet 250 to ground. Similar magnets in the tens selector and units selector will have been energized, but the description of the selecting mechanism will be limited to the cooperating thousands and hundreds selectors, which are the same respectively as the tens and units selectors.

When the selection impulse counters of Fig. 1*a* operate, the potentials over lines L1, L2, L3, L4 are interrupted by the relays 94, 95, 96 and 97. Considering, first, the interruptions of potential in line L1, the effect of an interruption is to de-energize the magnet 245 of Fig. 7 so as to com-

plete a circuit from ground through spring switch 246, spring switch 251, spring switch 252 of magnet 247, through the coil of the slow-to-release magnet 253, and the coil of the vertical stepping magnet 254, to a battery and ground. As set forth in detail in my aforesaid patents, selector switches of the well known "Strowger" type are employed, in which a selector shaft in the thousands selector is raised one step for each energization of a vertical magnet, such as the magnet 254. As the shaft is raised, it permits the switches 260 and 261 to close and remain closed as long as the shaft is in elevated position.

An interruption of the potential on line L2 deenergizes the magnet 248 in the hundreds selector and establishes a circuit from ground through spring switch 249, spring switch 262, spring switch 263 of slow-to-release magnet 250, coil of the slow-to-release magnet 264 and coil of the stepping magnet 265 to the battery and ground. The energization of the stepping magnet 265 operates a hundreds selector shaft 268, Fig. 9. This shaft carries a grounded switch arm 269 which is moved over a series of contacts 270 as the shaft is rotated. The shaft also carries off neutral switches 271 and 272 (Fig. 7) which are constructed to close and remain closed as long as the shaft 268 is out of home position. After the interruptions over lines L1 and L2 have ceased, that is, when the vertical adjustment of the selector shaft of the thousands selector and the angular adjustment of shaft 268 of the hundreds selector have been completed, the cessation of interruptions of potentials on line L1 will cause the magnet 245 to remain energized, which will maintain the magnet 247 energized and prevent further energization of magnets 253 and 254 and cause the slow-to-release magnet 253 to deenergize. Energization of the magnet 247 has drawn its switch member 273 to complete the circuit from the grounded battery, switch member 273, coil and shunt of magnet 274, switch member 275, switch member 276, switch 261 through the coil of a magnet 277 to ground, thus preparing a circuit through the switch member 278 of the magnet 277.

The cessation of impulses on line L2 maintains the magnet 248 energized, which maintains the circuit over the magnet 250 and breaks the circuit through the magnet 264, which closes a circuit at the point 279. As the magnet 253 in the thousands selector deenergizes, it closes a circuit from the battery over the switch 273, switch 280, switch 278, through the coil of the horizontal stepping magnet 281, through the switch 271 in the hundreds selector, switch 279, and switch 282 of magnet 250 to the ground. This energizes the horizontal magnet 281 which rotates the thousands selector shaft one step, and opens the switch 276 which breaks the circuit through the magnet 277 thus breaking the circuit through the magnet 281. When the circuit through the magnet 281 is broken the switch 276 again completes the circuit through the magnet 277 which in turn completes the circuit through magnet 281.

When the selector shaft of the thousands selector is elevated by interruptions over line L1 as previously described, the contacts 286 and 287 are raised into alinement with a horizontal row of contacts 288 and 289. As the magnet 281 is energized and deenergized to rotate the shaft these contacts are moved along the selected row of contacts 288 and 289 and the energization and deenergization of the magnet 281 is continued until the contact 286 finds a live contact 288 which is grounded through one of the contacts 270 (Fig. 9) and the arm 269. When this occurs the circuit over the magnet 277 will be shunted and the magnet 274 will be energized to attract its switch 275 and prevent further energization of the magnet 277. This in turn prevents completion of the circuit through the magnet 281 over the switch member 278. Energization of the magnet 274 also moves the switch member 251 to connect the line B1 through switch members 251 and 246 to ground. Energization of magnet 274 also attracts its switch member 291 which extends a circuit from battery over switch member 291, contacts 287 and 289, selector line 292 to a panel board (Fig. 8).

One of the tens selector lines 293 has been connected by mechanism similar to that in the thousands selector through a switch 294 to ground. The selector line 292 at the point of intersection with the line 293, is connected by one side of a double plug to a line 295 extending through the coil of a group selector magnet 296 and then over line 297 to the other side of the plug to the line 293 and to ground. This energizes the magnet 296 and selects a group of indicators corresponding to the adjustment of the selectors in Fig. 7 under the control of the selection impulses received from the transmitter. Each of the indicator elements of the indicator units of the groups of indicators is diagrammatically indicated at 299.

When the circuit was made at 279 in the hundreds selector, the magnet 298 in the selector was energized by a circuit from ground, battery, coil of the magnet 298 over switch 271, switch 279, switch 282 to ground. Energization of the magnet 298 attracts the switch member 262 and connects line B2 through the switch member 262 and switch member 249 to the ground, upon deenergization of magnet 248 by interruptions on line L2. In the same manner lines L3 and L4 are connected respectively to lines B3 and B4 in the tens and units selectors.

By means of the mechanism so far described the impulses sent over the lines L1, L2, L3, L4 have caused the selection of a group of indicators, of certain indicators within the group, and have connected these lines with restoration busses for these indicators, and the restoration impulses sent over the lines L1, L2, L3, L4 will cause corresponding impulses over the lines B1, B2, B3, B4, and over the restoration bus lines to the selected indicators to restore the indicator elements of the selected indicators to zero or blank, depending upon the particular type of indicators employed. By means of a known construction, as stated in the aforesaid patents, and a structure similar to that shown in the patent to Frischknecht et al., 1,852,994, dated April 5, 1932, the circuits leading to these indicators will be opened at the time the indicators reach their zero or blank positions. After the selected indicators have thus been restored, positive polarity is quickly applied to the line L3. This will cause deenergization of the magnet 232 in Fig. 8 which will release its switch member 235 and connect the battery to the actuation magnet 300, which will connect the main bus lines to the forward actuation bus lines. The actuation impulses are then sent over lines L1, L2, L3, L4 and the resulting impulses over lines B1, B2, B3, B4 will pass through the indicator actuating bus lines to the selected group of indicators and the selected indicator in the group. This will actuate the in-

dicators forwardly an amount determined by the actuation impulses received.

The restoration and actuation of the selected indicator is now complete and the positive and negative sources of polarity 57 and 58 (Fig. 1b) will be disconnected from the lines L1, L2, L3, L4. This will cause the magnet 245 in the thousands selector (Fig. 7) to be deenergized, which causes the deenergization of magnet 247, which in turn causes deenergization of magnet 274, and all the parts will be restored to the position in which they are shown in the drawings. The same thing will occur in the hundreds, tens and units selectors. After the magnets 245 and 247 have been deenergized a circuit will be completed from the battery through the release magnet 302, switch 260, switch 252, switch 251, and switch 246 to ground. Energization of the magnet 302 permits the selector shaft to be rotated to home position and to drop under the influence of gravity to vertical home position, and as it drops into its home position, it opens the switch connections 260 and 261. All the elements of the thousands selector are now in home position. In the hundreds selector deenergization of the magnets 248, 250 and 298 completes a circuit from the battery through the release magnet 307, through contacts 272, switch 263, switch 262, and switch 249 to ground. This energizes magnet 307 which causes the shaft 268 (Fig. 9) to return to its home position. The same thing occurs in the tens and units selectors.

Combination selection of indicators

It may at times be desirable to simultaneously restore and actuate a plurality of indicators in a group, such as the "low" and "last", and the "high" and "last," indicators of the selected group. For this purpose the line L1 is branched over the coil of the polarized magnet 310, Fig. 8, which is responsive to negative impulses from line L1. When the magnet 310 is energized it prepares a circuit from the "low" and "high" magnets 241 and 243 over the switch members 311 and 312 and over its own switch 313 to the circuit which controls energization of the "last" magnet 242 of the "last" switch member 314. When the polarity on line L1 is negative and either the "low" or the "high" bus line is selected, the "last" bus line will be selected simultaneously.

While the invention has been described in detail with respect to a particular preferred example thereof which gives satisfactory results, it will be understood by those skilled in the art after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention and it is intended therefore in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. The combination of two sets of groups of storage relays, a bank of keys for energizing each group of relays, holding circuits for said relays, a common error release bus for said holding circuits, a key for opening said bus to release the connected set of relays, means for connecting the sets of relays alternately to said keys, a transmission release bus for releasing a set of relays after transmission under their control has been effected, means for initiating control of transmission under one set and transferring the connection from the holding circuits to the transmission release bus and for disconnecting this set from the keys and connecting the other set to the keys.

2. The combination of two sets of storage relays, a set of keys, means normally connecting one set of relays to said keys, an error release bus, a transmission release bus, holding circuits for said relays comprising alternately the error release bus and the transmission release bus, said holding circuits for the connected set comprising the error release bus and said holding circuits for the disconnected set comprising the transmission release bus, and means for disconnecting said one set from the keys and connecting the other set to the keys and simultaneously substituting the transmission release bus for the error release bus in the holding circuits of the set being disconnected and for substituting the error release bus for the transmission release bus in the holding circuits of the other set.

3. In an apparatus of the character described, the combination of a plurality of transmission lines, sources of positive and negative potentials, means for connecting each of said lines with either source of potentials, keys for controlling said connecting means for selectively applying different characters of potentials to said lines, locking means for said keys operated under control of said keys as said keys control the connecting means, means for transmitting impulses over said lines by interrupting said potentials, keys for controlling the number of impulses transmitted, and a transmission release magnet automatically operable after the completion of transmission of impulses to release said locking means for said first mentioned keys.

4. In an apparatus of the character described, the combination of impulse transmission mechanism, a plurality of transmission lines over which impulses are transmitted by said transmission mechanism, a plurality of keys, means controlled by the keys for selectively imposing and maintaining different characters of potentials on said lines, and means also controlled by said keys for initiating transmitting action by said transmission mechanism.

5. In an apparatus of the character described, the combination of impulse transmission mechanism, a plurality of transmission lines over which impulses are transmitted by said transmission mechanism, a plurality of keys, means controlled by the keys for selectively imposing and maintaining different characters of potentials on said lines, means also controlled by said keys for initiating transmitting action by said transmission mechanism, and means for preventing initiation by said keys of transmission of impulses prior to the completion of the transmission previously initiated.

6. In an apparatus of the character described, the combination of two sets of a plurality of denominational series of digit relays, a corresponding plurality of series of digit contacts adapted to be grounded by energization of its associated digit relay, a switch mechanism comprising a switch member for connecting said sets of relays alternately to said contacts, switch members traveling over said contacts, an impulse control switch, an impulse stepping magnet for operating all of said switches, a series of denominational transmission control impulse lines, means controlled by said impulse control switch for electrically responsively connecting said lines to said impulse stepping magnet, and means for opening said lines as their respective switches engage grounded contacts.

7. In an apparatus of the character described, the combination of impulse transmission mechanism for automatically successively transmitting

two sets of variable numbers of impulses, a plurality of transmission starting keys, a plurality of transmission channels over which said impulses are transmitted, means controlled by said keys for imposing different combinations of positive and negative potentials on said channels, and means for preventing a second operation of said keys prior to completion of transmission of both sets of impulses.

8. In an apparatus of the character described, the combination of means for simultaneously transmitting a plurality of series of a variable number of impulses over a plurality of line channels, means for controlling the number of impulses transmitted over each line channel by cutting off the line channel from the impulse transmitting means, means for transmitting a series of a fixed number of impulses over said line channels, and means actuated as the last line channel is cut off for setting the second mentioned transmitting mechanism in operation.

9. In an apparatus of the character described, the combination of means for simultaneously transmitting a plurality of series of a variable number of impulses over a plurality of line channels, means for disconnecting each line channel as the series of impulses transmitted thereover has been completed and for closing one of a plurality of contacts in series, said series of contacts when closed establishing a circuit, and a transmitting mechanism for sending a fixed number of impulses, set in operation under control of said circuit.

10. In an apparatus of the character described, the combination of means for simultaneously transmitting a plurality of series of a variable number of impulses over a plurality of line channels, means for disconnecting each line channel as the series of impulses transmitted thereover has been completed and for closing one of a plurality of contacts in series, said series of contacts when closed establishing a circuit, a slow acting magnet in said circuit, and a transmitting mechanism for sending a fixed number of impulses, set in operation by said magnet.

11. In an apparatus of the character described, the combination of means for simultaneously transmitting a plurality of series of variable numbers of impulses over a plurality of line channels, means for disconnecting each line channel as the series of impulses transmitted thereover has been completed and for closing one of a plurality of contacts in series, said series of contacts when closed establishing a circuit, a slow acting magnet in said circuit, a transmitting mechanism for sending a fixed number of impulses, set in operation by said magnet and comprising a single impulse counter switch, and means to connect said switch to said plurality of line channels to transmit impulses over said channels simultaneously.

12. In an apparatus of the character described, the combination of a plurality of transmission channels, means for sending a variable number of impulses over said channels, means for sending a fixed number of impulses over said channels, means for sending a second variable number of impulses over said channels, means actuated as an incident to the transmission of the last impulse of the first variable number of impulses to connect the fixed impulse transmitting means to said channels and to set it in operation, and means actuated as an incident to the transmission of the last impulse of the fixed number of impulses to connect said second variable impulse sending means to said channels and to set it in operation.

13. In an apparatus of the character described, the combination of a plurality of transmission channels, means for sending a variable number of impulses over said channels, means for sending a fixed number of impulses over said channels, means for sending a second variable number of impulses over said channels, means for connecting said first sending means to said channels and for setting it in operation, means actuated automatically concurrently with the transmission of the last of said first variable number of impulses on each line channel to disconnect this channel from the sending means and to prepare a circuit completed concurrently with the last of said impulses on the channel disconnected last, to connect the fixed number sending means to said channels and set it in operation, and means actuated automatically concurrently with the transmission of the last of the fixed number of impulses to disconnect the fixed number sending means from said channels and to connect the second variable number sending means to said channels and to set it in operation.

14. In an apparatus of the character described, a transmission mechanism, the combination of a plurality of transmission channels, means for imposing different combinations of positive and negative potentials on said channels, a transmission mechanism for automatically successively transmitting by interruption of said potentials a variable number of impulses, a fixed number of impulses and a second variable number of impulses over said channels, means operated as an incident to the operation of said first mentioned means for setting said transmission mechanism in operation, and means automatically operated at the termination of the transmission of the fixed number of impulses to modify the combination of potentials on said channels.

15. In an apparatus of the character described, transmission channels, means for imposing combinations of positive and negative potentials on said channels, means for sending a fixed number of impulses over said channels by interrupting said potentials, means for sending a variable number of impulses over said channels by interrupting potentials, and means set in operation after termination of transmission of said fixed number of impulses to change the combination of potentials and to set said variable number sending means in operation.

16. In an apparatus of the class described, the combination of means for transmitting a variable number of impulses, keys for controlling said transmitting means, means for setting said transmitting means in operation, means for transmitting a fixed number of impulses, means for automatically setting said second mentioned transmitting means in operation at the conclusion of the operation of said first mentioned transmitting means, and a third transmitting means for transmitting a variable number of impulses, means for controlling said last mentioned transmitting means, and means automatically setting said last mentioned transmitting means in operation at the conclusion of the operation of said second mentioned means.

17. In a sending mechanism, the combination of means for transmitting two sets of variable electrical signals in succession, means for controlling the variations in said sets of signals, and automatic means providing for a time lapse

between the transmission of said sets of signals equal to the maximum time allowed for the transmission of the second set of variable signals.

18. The combination of two sets of electrically controlled storage devices, means for alternately controlling said storage devices, means for alternately sending signals under control of said sets of storage devices, means for initiating the transmission of signals under control of one set and for conditioning the other set to be controlled, means controlling said sending means to transmit spaced signals under control of the controlling set of storage devices, and means for controlling the automatic transmission of a constant signal during the time space interval between said spaced signals.

19. The combination of two groups of storage relays, means for operating said groups of storage relays for effecting a subsequent control, means for transmitting impulses under control of one of said groups of storage relays, means responsive to circuits made over the contacts of said group of storage relays during the operation of said transmitting means for terminating the transmission of impulses under control of said group of storage relays, means automatically set in operation by the operation of said responsive means for transmitting a constant signal, means for transmitting impulses under control of the other of said groups of storage relays, means automatically set in operation at the termination of the transmission of said constant signal for setting said last mentioned transmitting means in operation, and means controlled by circuits made over the contacts of operated relays of said second group of storage relays for terminating the transmission impulses under the control of said second group of storage relays.

20. In a system for disseminating information in regard to stocks or other items, the combination of two sets of storage devices each set comprising storage devices for storing information as to the item designation and storage devices for storing information as to the price or value, a transmitting mechanism common to said two sets of storage devices for transmitting signals under control of said sets of storage devices, range registering means, means under control of said range registering means for setting said transmitting mechanism in operation to transmit signals under control of an operated set of storage devices, means for locking said range registering means in operated condition, means for automatically conditioning the other set of storage devices to receive registrations whereby the storage devices of said other set may be operated as transmission is being made under control of said first set of storage devices, means automatically operable at the conclusion of transmission of signals under control of the first set of storage devices for releasing said storage devices and said range registering means whereby said range registering means may again be operated to immediately effect transmission of signals under control of the second set of storage devices.

21. In a system for disseminating information in regard to stocks or other items, the combination of storage means for storing information as to the item designation and as to the price or value, a transmitting mechanism for transmitting signals under control of said storage means, range registering means, means under control of said range registering means for setting said transmitting mechanism in operation, means for locking said range registering means, means for setting up item designation and price or value in said storage means during operation of the transmitter while transmitting information under control of said storage means, and means for releasing said range registering means automatically at the conclusion of the operation of said transmitter whereby said range registering means may again be operated to immediately effect transmission of signals under control of the second set of storage devices.

22. In a transmitter for transmitting messages each composed of a plurality of groups of code impulses, a keyset having a plurality of keys including a group of initiating keys; a common group of contacts adapted to be closed in varying combinations by depression of said keys; means for storing the code signals resulting from closing of said contacts, each message being completed by depression of one of said initiating keys; and means for locking all of said initiating keys while the preceding message is stored in said means for storing the signals.

23. In a system for disseminating information in regard to stocks or other items, the combination of an assembly of indicators, groups of price or value digit storage relays, a counting mechanism, impulsing means for actuating said indicators, circuits including digit lines adapted to be prepared by said groups of storage relays and adapted to be completed by said counting mechanism during actuating of said indicators under the control of said price or value digit groups, and switching relays in said circuits adapted to disconnect the indicators from the impulsing means as the circuits are completed across the price or value digit groups of relays.

24. In a system for disseminating information in regard to stocks or other items, a plurality of groups of indicators, impulse leads, means for associating the indicators of any group with said leads, impulsing means for sending actuation impulses over said leads to set the indicators in any group associated therewith, stop relays for opening said leads, price or value registers, counting mechanism, circuits for said stop relays controlled during impulsing by said counting mechanism cooperating with said price or value registers, other circuits for certain of said stop relays which are independent of control by said counting mechanism, and means for closing a variable number of said other circuits before starting to send said actuation impulses.

25. In a telegraph system, a channel of communication, means to transmit groups of signals over said channel representative of quotations of stocks or other items, and means to transmit concurrently with the transmission of each of said groups of signals an additional signal for indicating the range of a quotation represented by the particular group.

26. In a system for transmitting quotations in regard to stocks or other items, a transmission circuit, means for transmitting groups of signals over said circuit representative of quotations of stocks or other items, said groups each including item selection and item price or value signals, and means for transmitting concurrently with the transmission of each of said groups of signals an additional signal for indicating the range of the quotation represented by the particular group.

27. In a quotation transmitting system for stocks or other items, a plurality of price or value digit storage devices, each comprising a plurality of relays, means for setting the relays

of said storage devices to store quotations, a plurality of impulsing circuits, means for intermittently closing said circuits, means operated in timed relation with said closing means for causing the relay contacts of said storage devices successively to control said impulsing circuits, an outgoing transmission circuit, and relays included in said impulsing circuits for repeating impulses over said transmission circuit.

28. In a quotation transmission system, a transmission circuit having alternative tributary branches, transmitting apparatus associated with each of said branches for transmitting quotations and including a set of levers and means for generating groups of electrical impulses representative of quotations in accordance with the variable actuation of said levers, a storage device in each of said branches for momentarily storing the quotations set up, and means for operatively connecting each of said branches in which a quotation is stored successively to said transmission circuit and for preventing such connection when no quotation is stored.

29. In a transmitter for transmitting groups of code impulses representative of quotations, a key set having a plurality of keys for initiating and controlling the transmission of the item selection, range and actuation signals which comprise the quotations, a group of contacts adapted to be closed in varying combinations by depression of said keys, means for storing the key signals resulting from said contacts, each quotation being completed by depression of one of a plurality of said initiating keys, means controlled by the depression of one of said initiating keys for initiating transmission of a quotation, and means for rendering ineffective all of said initiating keys while the preceding quotation is stored in said means for storing the signals.

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