

June 1, 1948.

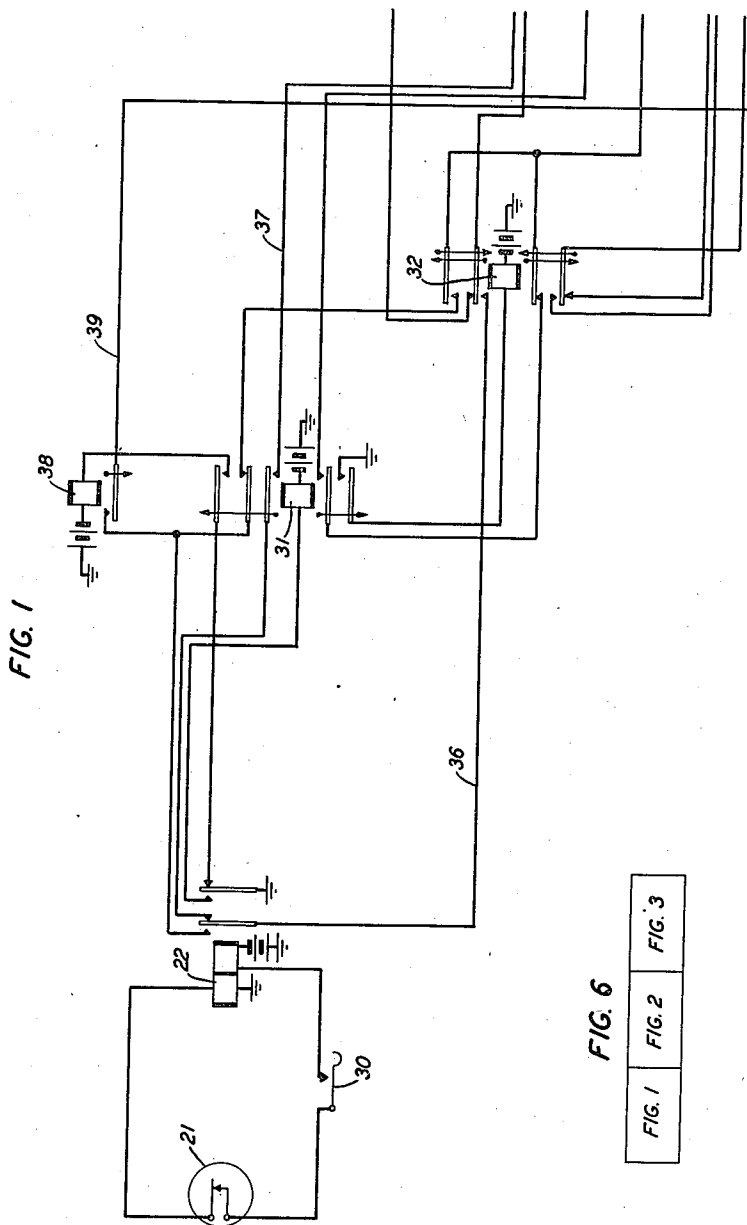
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2,442,702

SELECTIVE SIGNALING SYSTEM

Filed Sept. 20, 1945

4 Sheets-Sheet 1



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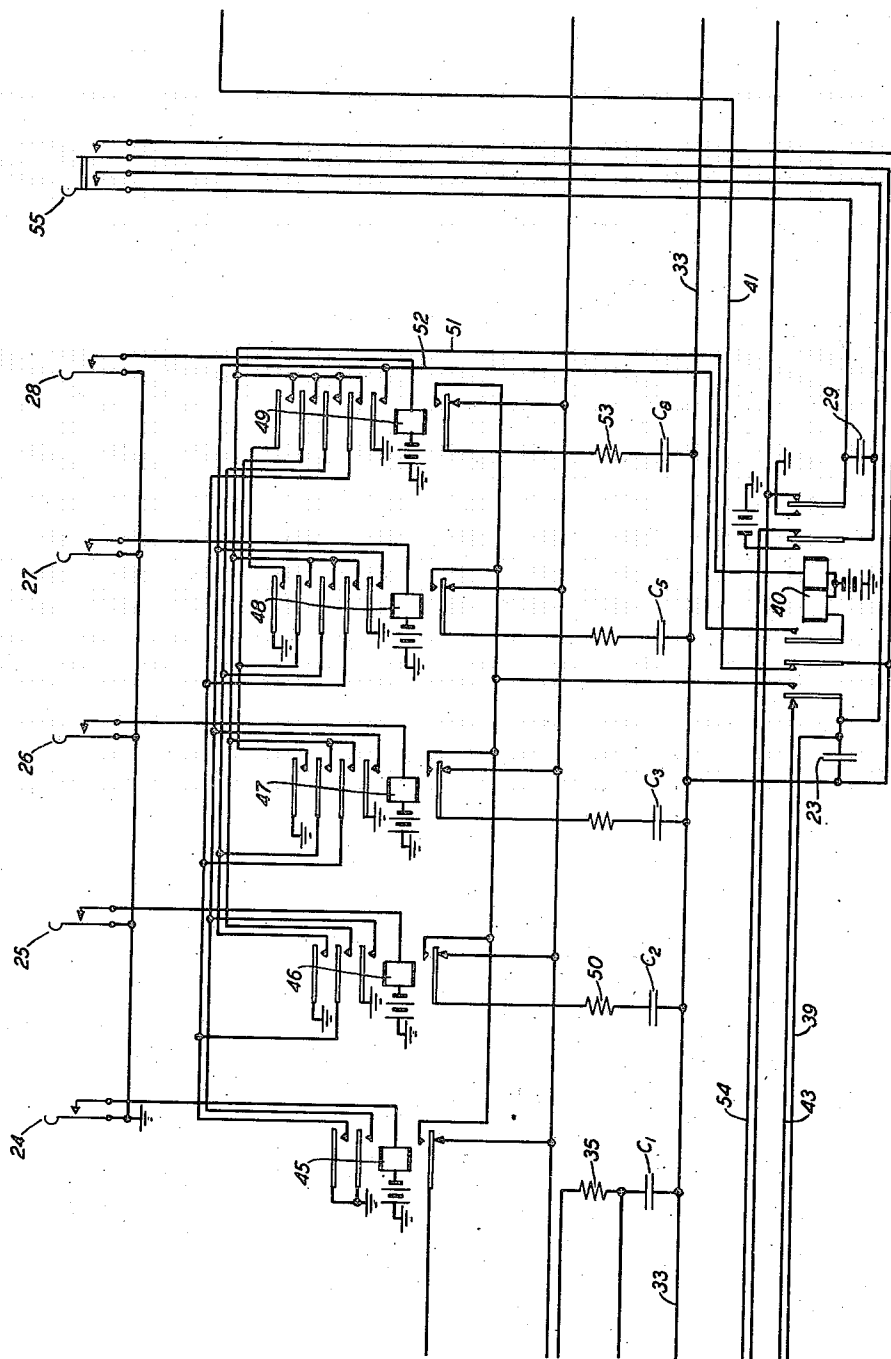
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FIG. 2



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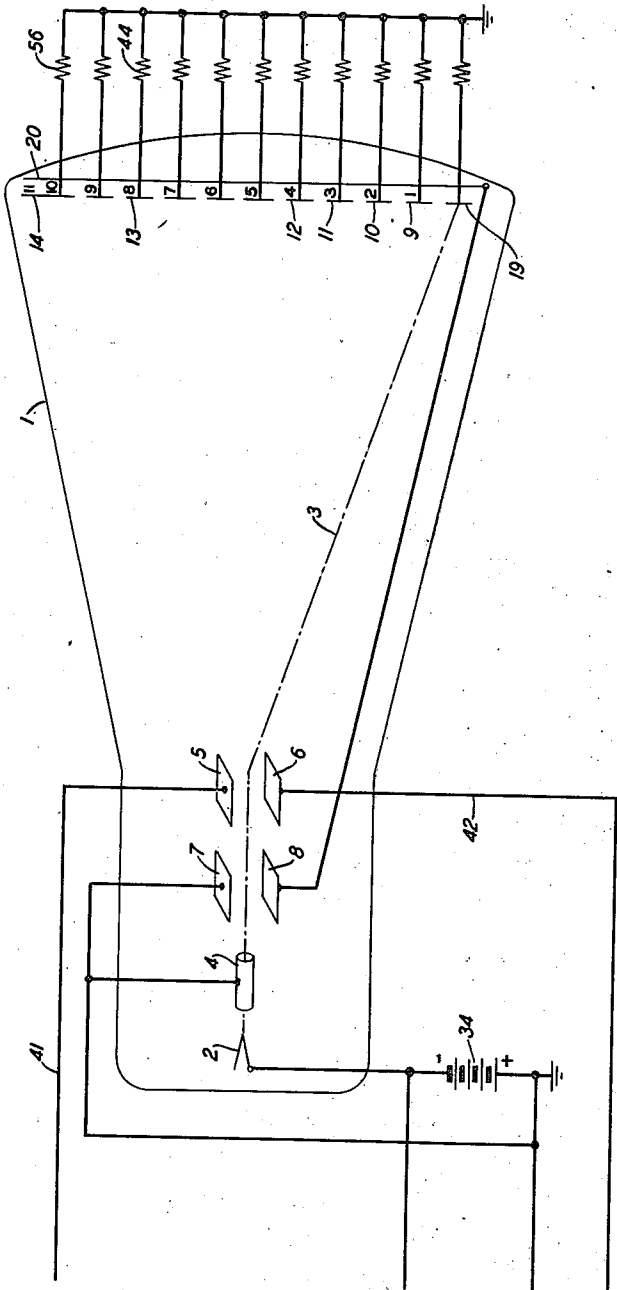
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FIG. 3



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FIG. 4

CONDENSERS	C ₁	C ₂	C ₃	C ₅	C ₈	
CHARGE VALUES	1	2	3	5	8	SUM OF CHARGES
CODES	●	●	○	○	○	3
	●	○	●	○	○	4
	●	○	○	●	○	6
	●	○	○	○	●	9
	○	●	●	○	○	5
	○	●	○	●	○	7
	○	●	○	○	●	10
	○	○	●	●	○	8
	○	○	●	○	●	11
	○	○	○	●	●	13

FIG. 5

CONDENSERS	C ₁	C ₂	C ₃	C ₅	C ₈		
CHARGE VALUES	1	2	3	5	8	SUM OF CHARGES	(SUM OF CHARGES-2)
CODES	●	●	○	○	○	3	1
	●	○	●	○	○	4	2
	○	●	●	○	○	5	3
	●	○	○	●	○	6	4
	○	●	○	●	○	7	5
	○	○	●	●	○	8	6
	●	○	○	○	●	9	7
	○	●	○	○	●	10	8
	○	○	●	○	●	11	9
	○	○	○	●	●	13	11

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SELECTIVE SIGNALING SYSTEM

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4 Claims. (Cl. 177-353)

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This invention relates to electric signaling and translating systems and particularly to those capable of using different methods for the expression of numbers.

An object of the invention is to translate into a common system of notation numbers or other characters of like nature when expressed in different systems of notation.

Other objects are to realize greater flexibility in the use of numbering systems and to simplify and otherwise improve the means required for translating the electric signals representing one system of notation into those of another system.

Another object of the invention is an improved means for expressing numbers in code and for translating them into the decimal system of notation.

According to the present invention applicant has devised a signal translating system that is capable of receiving series of incoming electrical impulses representing numbers in the decimal system or incoming electrical impulses of a different character representing said numbers in a code system of notation and in either case storing, repeating, or otherwise translating the incoming signals in accordance with the decimal system of notation. More specifically applicant's translating device may consist of an electron beam tube having means for driving a cathode beam over a series of say, ten anodes corresponding to the ten values of a digital place in a number in the decimal system. The potential for driving the electron beam is accumulated on a condenser connected in the external control circuits. When the incoming signal impulses are transmitted on the decimal basis, each impulse of a digital series causes a corresponding unit charge to be impressed upon the condenser. At the end of the series the total charge on the condenser is sufficient to move the electron beam to the corresponding anode where it is held as a registration of the digital value. When the code system of notation is used, a plurality of code condensers are employed, one for each element of the code, and the charges impressed upon these code condensers are subsequently transferred to the beam controlling condenser. If, for example, the code is one having five possible elements, some pair of elements of the five serving to express each of the numbers, the pair of code condensers receiving charges for each number transfer their charges to the beam controlling condenser where they are added to give a total charge which is capable of deflecting the electron beam to the particular anode represent-

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ing the value of the corresponding number in the decimal system. A keyboard of five keys or any other suitable means may be used for setting up the coded numbers.

A feature of the invention is a translating system in which the code condensers have different capacity values and in which the addition of the charges on any two of those condensers representing a coded number gives a total charge bearing a definite relation to the number in terms of the electron beam deflection.

Another and related feature of the invention is a translating system of the character described in which an auxiliary condenser is provided for subtracting a fixed amount of charge from the summation of the charges transferred from the code condensers to the beam controlling condenser. By subtracting a fixed amount from the sum of the charges a resulting charge is obtained which corresponds exactly to the decimal value of the number.

The foregoing and other features of the invention will be discussed more fully in the following detailed specification.

In the drawings accompanying the specification:

Figs. 1, 2 and 3, when taken in the order illustrated in Fig. 6, disclose a signaling and translating system incorporating the features of the present invention. Fig. 1 shows an impulse transmitter and associated circuits for sending impulses in accordance with the decimal system. Fig. 2 illustrates a keyboard and associated circuits for setting up numbers in accordance with a code system of notation; and Fig. 3 illustrates a beam tube for receiving the numbers or characters represented in either system of notation.

Figs. 4 and 5 are tables of codes for the expression of number or other characters.

The electron beam tube 1, which serves as a translating device, is provided with a cathode 2 for producing a beam 3 of electrons, an accelerating anode 4, and two sets of deflector plates 5-6 and 7-8. The tube is also provided with a series of ten objective anodes 9, 10, 11, 12, etc., one for each of the numerals of the decimal system, and a normal position anode 19 on which the beam 3 normally rests. The forward end of the tube 1 is additionally equipped with a common electrode 20 which may take the form of a plate or other suitable shape. The electrode 20 lies behind the series of objective anodes and is so positioned that it intercepts the electron beam when the latter is not in full engagement with one of the objective anodes.

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Numbers in accordance with the decimal system of notation are transmitted to the tube 1 for registration by means of a dial 21 and an impulse relay 22. Each impulse produced by the relay 22 causes a unit charge to be impressed upon the condenser C1, which is transferred to the storage condenser 23 prior to the receipt of the succeeding impulse. The accumulated charges on the condenser 23, representing the value of the number to be transmitted, cause the beam 3 of the tube 1 to move to an anode corresponding to said number.

Numbers represented by any suitable code may also be registered by the beam tube 1. To this end a keyboard consisting of five keys 24 to 28, inclusive, is provided for establishing charges on corresponding condensers C1, C2, C3, C5 and C8. While any desired code system of notation may be used, the one here illustrated comprises five units, each number being represented by a combination of two of these units. The first code unit, corresponding to the depression of key 24, is expressed by the charge on condenser C1. The second code unit, corresponding to the depression of key 25, is expressed by the charge on condenser C2, the value of which is twice that of condenser C1. Similarly, the third code unit is expressed by the charge on condenser C3, which is three times the value of the charge on condenser C1; and in like manner the last two units are expressed by the charges on condensers C5 and C8, which are respectively five and eight times the value of the charge on condenser C1. To express any desired number from 1 to 10, inclusive, two of the keys are depressed, and the charges on the two corresponding condensers are transferred to and added on the storage condenser 23, which in turn serves to impress the accumulated voltage on the control plates 5 and 6 of the tube 1. Condenser 23 has a capacity many times greater than condensers C1 to C8.

The code system of notation employed herein may be better understood from an examination of the tables in Figs. 4 and 5. From these tables it will be noted that the capacities of the condensers are such that the sum of the charges on any two consecutive condensers is equal to the capacity of the succeeding condenser. With this relationship of charges, if ten combinations of two each are chosen for the ten numerals, starting with condenser C1 and proceeding accordingly, the sums of these combinations of charges occur in the order illustrated in the last column of Fig. 4. That is to say, the sum of the first combination of two charges (C1+C2) is three, the sum of the succeeding combination (C1+C3) is four, etc., to the sum of the last combination (C5+C8) which is thirteen. It will be seen, of course, that the numbers in the last column of Fig. 4 do not correspond to the ten cardinal numbers of the decimal system. However, if the number 2 is subtracted from each one of these sums and the results rearranged as illustrated in Fig. 5, the ten cardinal numbers 1 to 10 are obtained, with the one exception that the number 11 appears instead of number 10, a variation which is taken care of in a manner to be explained hereinafter. The subtraction of a constant number, number 2, from each of the combination sums is effected by means of a small condenser 29 which is arranged to be connected in opposition to the storage condenser 23 on which the combination sum is accumulated.

A description of the operation of the system will now be given, and for this purpose assume

first that a number in the decimal system is to be transmitted to and registered by the beam tube 1. More specifically, assume that the transmitting dial 21 is manipulated to send a series of eight impulses. Before operating the dial 21 a key 30 is closed to complete the operating circuit of relay 22. Relay 22 closes an obvious circuit for slow release relay 31, which in turn closes an operating circuit for slow relay 32. While relay 31 is operated and before relay 32 has attracted its armatures a circuit is closed for discharging condenser C1. This circuit may be traced from the upper terminal of the condenser through the front contacts of relay 31, normal contacts of relay 32, conductor 33 to the lower terminal of the condenser. After a brief interval relay 32 operates and opens the discharge circuit of the condenser.

On the opening of the circuit for the first impulse relay 22 releases, but relay 31, being slow, maintains its armatures attracted. The slow release relay 38 is now operated in a circuit from battery through its winding, front contact of relay 31, back contact of relay 22 to ground. Relay 38, being slow to release, remains operated during subsequent operations of the impulse relay 22. The release of relay 22 also closes a charging circuit for condenser C1, which may be traced from the positive pole of battery 34 over conductor 33, condenser C1, resistor 35, front contacts of relay 32, conductor 36, back contacts of relay 22, front contacts of relay 31, conductor 37 to the negative pole of battery 34. A definite predetermined charge is accumulated on condenser C1 during the open period of the impulse. This charge accumulated by condenser C1, which, as will be seen, is sufficient to advance the electron beam 3 from one anode to the next, may be regarded as a charge of unit value. At the end of this first open period the contacts of dial 21 close, and relay 22 reoperates. The charged condenser C1 is now connected to the larger storage condenser 23 for the purpose of transferring its accumulated charge thereto. The circuit for this transfer may be traced from the upper terminal of condenser C1, resistor 35, front contacts of relay 32, conductor 36, front contacts of relay 22, front contacts of relay 38, conductor 39, condenser 23, conductor 33 to the lower terminal of condenser C1. Upon the next opening of the dial contacts, relay 22 releases and condenser C1 is recharged for the second impulse. When the dial contacts close at the end of the second impulse, relay 22 operates, and the charge on condenser C1 is transferred to condenser 23 where it is added to the charge representing the previous impulse. In like manner each of the succeeding impulses results in the addition of an incremental charge to the condenser 23.

It will be noted that the condenser 23 is connected across the control plates 5 and 6 of the tube 1 over a circuit traceable from the left terminal of condenser 23, back contacts of relay 40, conductor 41, plates 5 and 6, conductor 42, front contacts of relay 32, conductor 43, back contacts of relay 40 to the right terminal of condenser 23. As each charge increment is added to condenser 23, the corresponding voltage applied to the plates 5 and 6 causes the beam 3 to step from one anode to the next until at the end of the series of eight impulses the beam 3 is brought to rest on the No. 8 anode 13.

When the last impulse of the series has been transmitted, relay 22 holds its armatures attracted, and relay 38 releases after a brief interval.

Relay 38 on releasing opens the transfer circuit over which the charges were transferred from condenser C1 to condenser 23, thus isolating condenser 23.

Should the operating voltage applied to plates 5 and 6 diminish somewhat by leakage or otherwise during the time the beam is engaging a selected anode, the beam tends to restore toward its original position on the normal position anode 19. This deviation of the beam causes it to impinge partially on the back electrode plate 20. The impingement of the beam on electrode 20 causes the establishment of a circuit which may be traced from the positive pole of battery 34, correcting plates 7 and 8, electrode 20, beam 3, cathode 2 to the negative pole of battery 34. The voltage applied to plates 7 and 8 due to partial impingement of the beam on back plate 20 is of such polarity that it prevents further drift of the beam towards its normal position but retains the beam on the selected anode. This feature is disclosed more fully in applicant's copending application Serial No. 617,631, filed September 20, 1945.

With the beam 3 established and maintained in engagement with the selected anode 13 a voltage is set up across the resistor 44 in the work circuit which may be used for any desired purpose. When the registration of the digit by the tube 1 is no longer required, the beam 3 may be restored to its normal position in any convenient manner. In the circuits illustrated this is accomplished by opening the key 30 to release the impulse relay 22. The release of relay 22 results in the reoperation of relay 38 in the circuit previously traced. After an interval relays 32 and 38 release. However, while relays 32 and 38 are maintaining their armatures operated following the release of relay 31 a circuit is closed for discharging the condenser 23. This circuit may be traced from the right terminal of said condenser, conductor 39, front contacts of relay 38, back contacts of relay 31, front contacts of relay 32, conductor 33 to the opposite terminal of condenser 23. Condenser 23 is discharged in this circuit and is ready for the next use. The discharge of the condenser removes the voltage from plates 5 and 6 permitting the beam 3 to restore to its normal position anode 19.

Assume next that it is desired to register the decimal digit 8 on the beam tube 1 by means of the code keys shown in Fig. 2. Reference to Fig. 5 will show that the digit 8 is represented by the sum of the charges on condensers C2 and C8 when corrected by subtracting a fixed charge of two units. This subtraction, it will be remembered, is performed by the small condenser 29 as will presently be explained in greater detail. Inasmuch as the keys 24 to 28, inclusive, correspond respectively to condensers C1, C2, C3, C5 and C8, the operator depresses keys 25 and 28 simultaneously for the purpose of setting up the digit 8. Key 25 operates the associated relay 46, and key 28 operates the associated relay 49. Relays 45 to 49, inclusive, serve to maintain the condensers C1, C2, C3, C5 and C8 in a charged condition and, on operating, to transfer the charges on the condensers to the storage condenser 23. The charging circuit for condenser C1, for example, may be traced from the positive pole of battery 34, conductor 33, condenser C1, resistor 35, normal contacts of relay 32, normal contacts of relay 45 to the negative pole of battery 34. Similar charg-

ing circuits may be traced for the other condensers.

When any pair of the key-operated relays are energized the charges on their associated condensers are transferred cumulatively to the condenser 23. Preparatory to the transfer of the charges, relay 40 is operated over a circuit which depends upon the energization of a pair of the relays 45 to 49, inclusive. In the present instance, the operating circuit for relay 40 may be traced from battery through the right winding of said relay, conductor 51, closed contacts of relays 49 and 46 to ground. Relay 40 locks in a circuit from battery through its left winding, conductor 52 and thence to ground in a circuit extending in multiple to the front contacts of operated relays 49 and 46. Thus the control relay 40 will not operate until at least two of the keys have been depressed, and will remain operated until the last key has been released. While relay 40 is operated, it charges the small correcting condenser 29 over an obvious circuit. Also at the time relay 40 operates the charges on condensers C2 and C8 are transferred cumulatively to condenser 23. The transfer circuit for condenser C2 may be traced from the upper terminal of said condenser, resistor 50, front contact of relay 46, front contact of relay 40, condenser 23, conductor 33 to the opposite terminal of condenser C2. Similarly, the charge on condenser C8 is transferred over a circuit including resistor 53 and the front contacts of relays 49 and 40.

It should be noted at this point that the keyboard for charging the code condensers C1, C2, C3, C5 and C8 may take other suitable forms. For instance, it may comprise ten keys, one for each of the cardinal numbers 1 to 0. In this case the contacts of each key would be wired in an obvious manner to operate the pair of relays 45 to 49 representing the desired code.

Following the transfer of the charges to the condenser 23, the depressed keys are released to release the associated relays 46 and 49. Thereupon relay 40 releases, the charges on condensers 23 and 29 are added algebraically, and the resultant voltage is applied to the plates 5 and 6 of tube 1. The circuit for this purpose may be traced from the right terminal of condenser 23, back contacts of relay 40, conductor 43, back contacts of relay 32, conductor 54, back contacts of relay 40, condenser 29, back contacts of relay 40, conductor 42, plates 6 and 5, conductor 41, back contacts of relay 40 to the left terminal of condenser 23. It will be recalled that the sum of the charges on condenser 23 has a value of 10 (Fig. 5) and that the charge on condenser 29 has a value of 2. Since these condensers are connected in opposition in the circuit traced, the resultant charge has a value of 8, representing the desired digit, and the voltage applied to the plates 5 and 6, therefore, causes the beam 3 to move to the No. 8 anode 13.

When the registration is no longer required the reset key 55 is operated, and obvious circuits are closed for discharging condensers 23 and 29. The discharge of the condensers permits the beam 3 to restore to its normal position.

In order that the digit 10 may be registered in the tube by the code keys in accordance with the code table of Fig. 5, the last anode 14 of the series is made extra long. The sum of the two charges used for deriving the digit 10 is equal to 13, and the subtraction of the constant charge 2 from this value leaves a charge of 11 units rather than one of 10 units. Thus the beam 3

7 is deflected to a position on the anode 14 corresponding to the number 11. However, the work resistor 56 connected to the anode 14 represents the digit 10.

It will be understood that many changes and variations will occur to those skilled in the art both for the controlling circuits and for the structural arrangements of the beam tube. Other codes may be devised and other means for impressing numbers and characters in accordance with these codes upon the tube for registration or other forms of translation. All of these, however, are believed to come within the scope of applicant's invention as defined in the appended claims.

Where in the claims a decimal system of notation is referred to, this is not to be construed as limiting the claims to a scale-of-ten system of notation since the invention is equally applicable to other than scale-of-ten number systems, the term decimal being used for brevity of expression.

What is claimed is:

1. The combination in a translating system of means for producing an electron beam, means for charging a plurality of condensers, each of which is a different multiple of a unit of capacity, means for selecting said charged condensers in a plurality of different combinations to represent numbers in code, deflecting electrodes adjacent to the path of said beam, a beam controlling condenser connected to said electrodes, means for combining the component charges on said selected condensers representing any desired number in said beam controlling condenser, to electrostatically deflect said electron beam to a position indicative of said number.

2. A signaling system comprising a plurality of condensers, each of a different multiple of a unit of capacity; means for normally charging said condensers to their respective capacities; means for selecting different combinations of said condensers, each such combination totaling to a different number of units of capacity and being respective to a different digit in a code system of notation; a common storage condenser; means for transferring to said storage condenser the combined charge on a selected combination of said first-mentioned condensers; and means

responsive to the charge accumulated on said storage condenser for translating such charge into an effect respective to the digit corresponding to the selected combination of condensers.

3. The combination in a translating system of means for producing series of electric signals respective to different digits in the decimal system, said means comprising an impulsing device, a transfer condenser, and means for discharging and charging said condenser under control of said impulsing device; means for producing electric signals respective to said different digits but in a code system of notation, said latter means comprising a plurality of condensers including said transfer condenser, each of a different multiple of a unit of capacity, means for normally charging said condensers to their respective capacities, and means for selecting said charged condensers in a plurality of different combinations respective to said different digits; a storage capacitance common to each of said signal producing means for accumulating charges from said transfer condenser or said selected combination of condensers upon operation of either of said signal producing means; and means responsive to the charge accumulated on said common capacitance for translating the charge thereon into an indication of the digit respective to the produced signals.

4. The combination of the preceding claim in which of the plurality of condensers comprised in said second-mentioned signal producing means, the condenser of smallest capacity is the transfer condenser of said first-mentioned signal producing means.

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