

Feb. 9, 1954

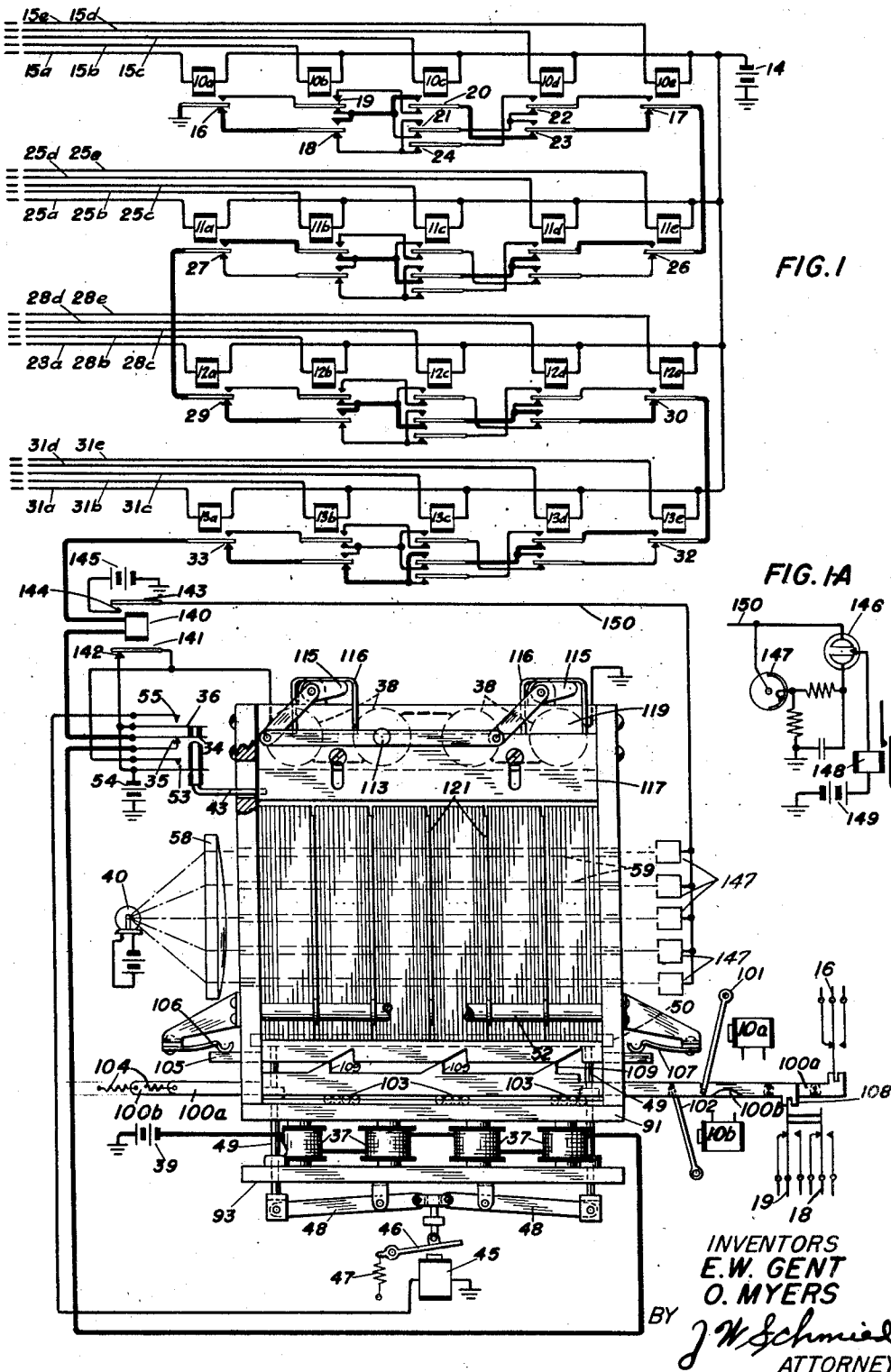
E. W. GENT ET AL

2,668,877

ELECTROMECHANICAL TRANSLATOR

Filed Nov. 4, 1947

4 Sheets-Sheet 1



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ELECTROMECHANICAL TRANSLATOR

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FIG. 2

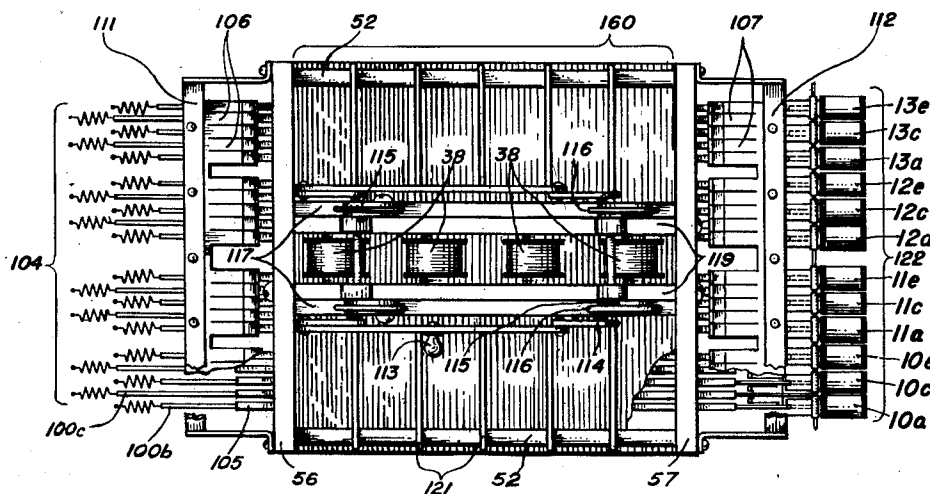
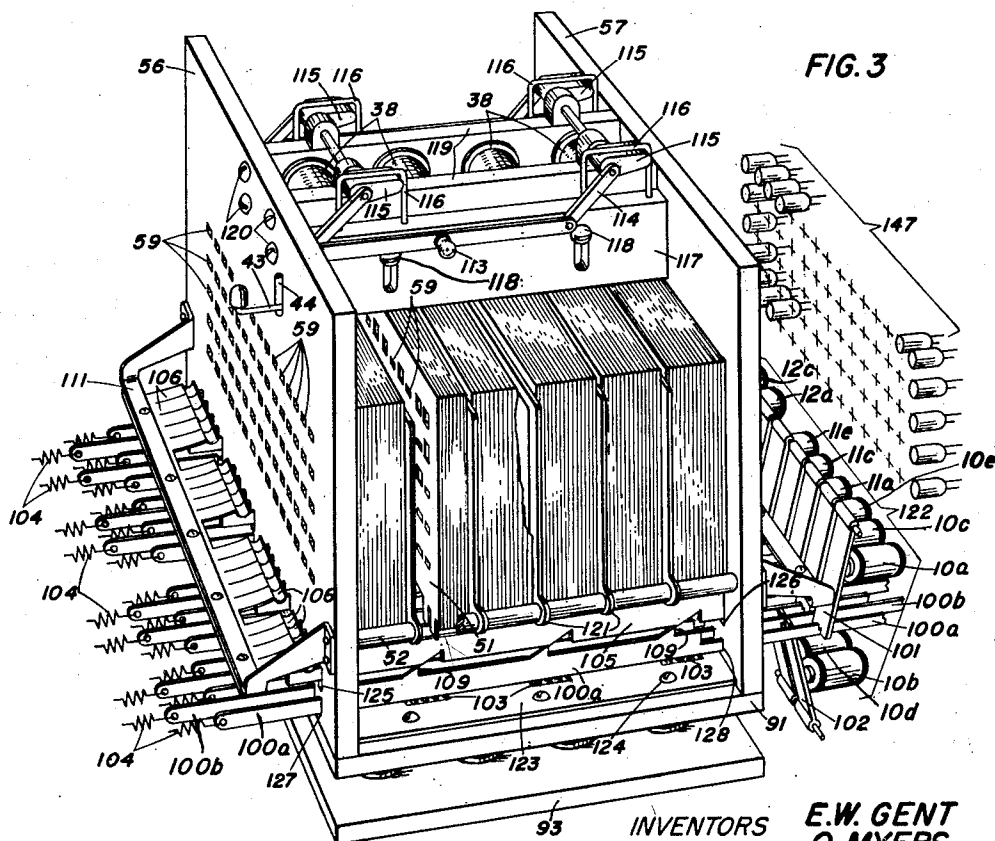


FIG. 3



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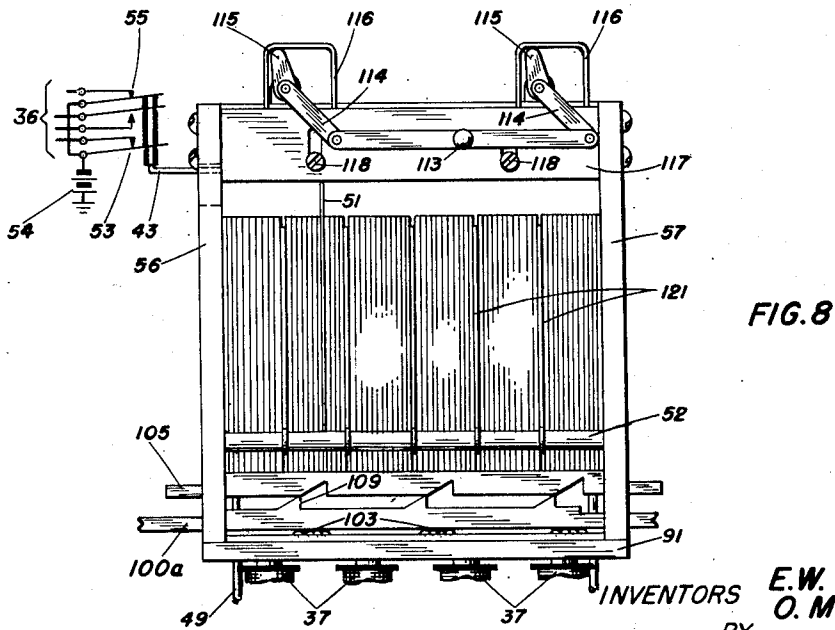
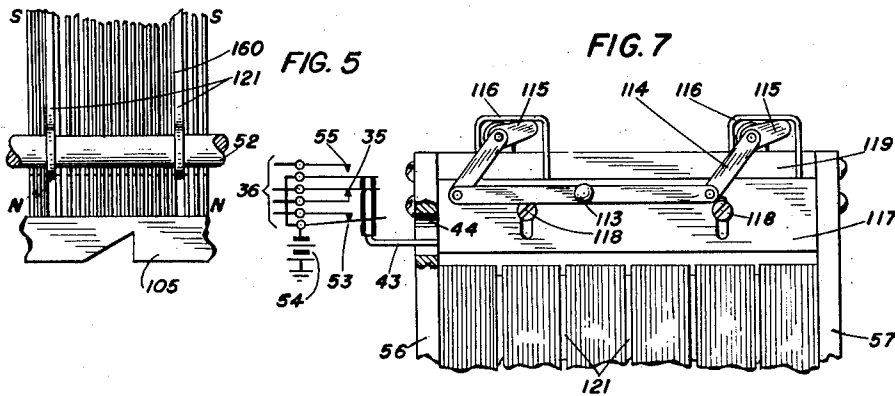
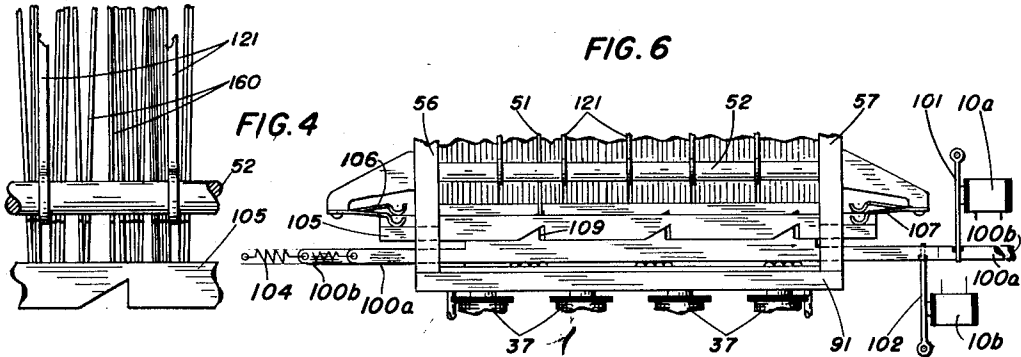
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4 Sheets-Sheet 3



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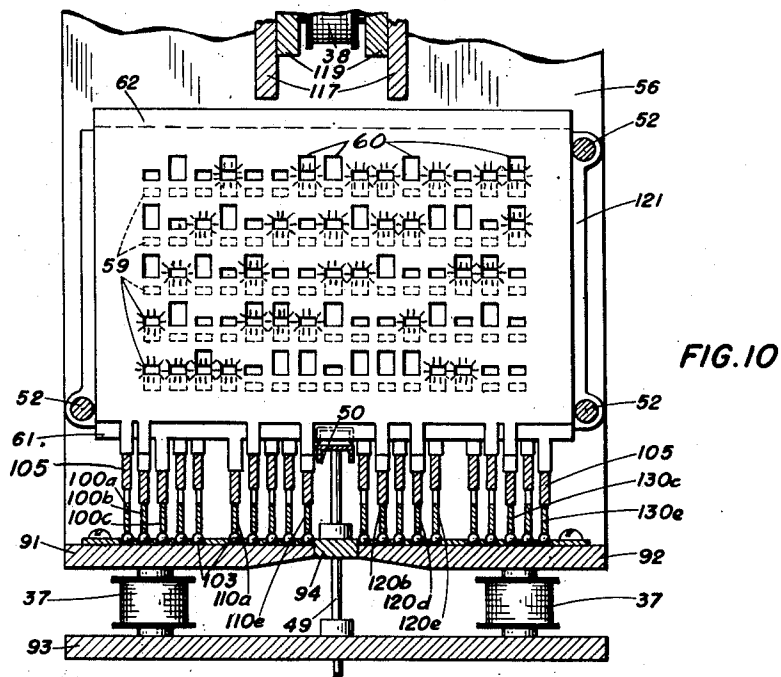
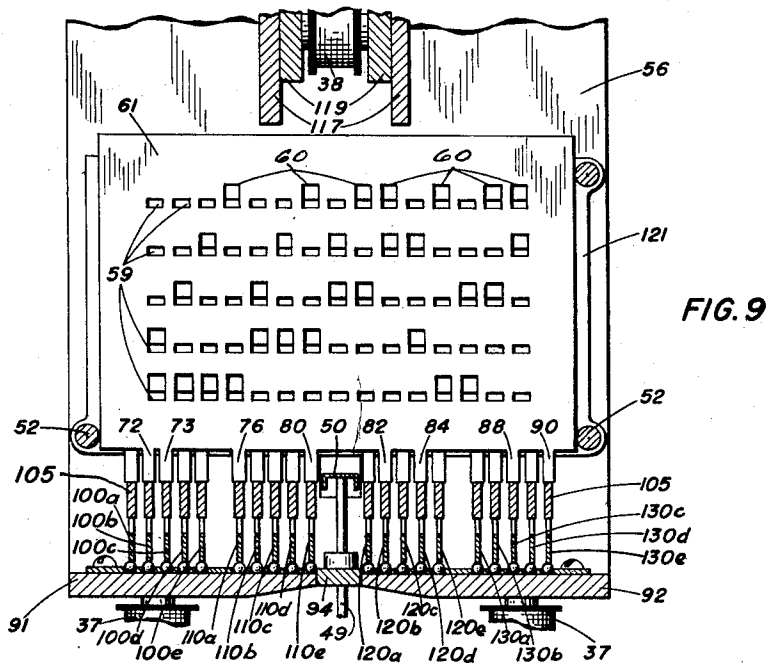
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UNITED STATES PATENT OFFICE

2,668,877

ELECTROMECHANICAL TRANSLATOR

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Application November 4, 1947, Serial No. 784,024

28 Claims. (Cl. 179—18)

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This invention relates to improvements in electromechanical translators of the type disclosed in copending application of Oscar Myers, Serial No. 707,020, filed October 31, 1946, now Patent 2,558,577, granted June 26, 1951.

More particularly the invention relates to card translators employing perforated cards of magnetic material through which controlled radiant energy is directed to operate an output register.

An object of this invention is to provide a translator which is compact in form, relatively simple in construction and inexpensive of manufacture as compared with existing translators.

Another object of the invention is to provide a translator capable of rapidly providing a large number of selections for translating input signals received in one code to output signals in a different code, such as may be employed in telephone central office switching and similar applications.

A further object of this invention is to provide an electromechanical card translator in which any selected card may be quickly and easily removed for replacement by another card bearing a different set of coded designations.

Translators may be employed in telephone practice to effect interconnection between different automatic telephone systems, or between two automatic telephone exchanges employing different combinations of code groups or for many other operations in automatic telephone offices. As more automatic telephone dial exchanges are interconnected in an expanding network, the necessity for rapid and reliable translation of one signaling code to another becomes increasingly important. At present such translation is accomplished by large and complex rack and panel installations containing large numbers of relays and other intricate switching apparatus. In such an arrangement, changing from one system to another involves the interchanging of thousands of soldered cross-connections, a tedious and costly procedure. The use of electromechanical card translators of the type herein disclosed offers a practical solution to this problem in that such changes may be accomplished merely by removing one card from the translator and replacing it with another card having differently coded perforations. As will become apparent from the detailed description which follows, our invention provides a translator which affords a rapid, reliable, and relatively inexpensive means for accomplishing a multitude of translation operations in telephone systems.

Among the functions which may be automati-

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cally performed by this translator are the following: determination of the number of digits in a code, determination of kind of marker to be used, operation of various traffic registers, selection of alternate routes to a distant exchange, location of called trunk group and determination of which digits to send out and which digits to suppress.

In the preferred arrangement of the invention disclosed by the appended drawings, it will be observed that twenty input circuits are illustrated, connected with means for translating to 75 output circuits. This arrangement is merely illustrative of one embodiment of our invention which, it is to be understood, is not limited to the particular combination disclosed in the drawings.

In the description of operation which follows, it is contemplated that the input register may be operated by two out of a group of five input circuits, although, of course, the invention may be adapted to any type of input code such as two out of six or three out of five, or any other combination desired.

The number of output circuits which may be controlled is not limited to 75 as illustrated in the drawings, or to any other fixed number, but is limited only by the number of perforations which may be included in cards of the translator and the number of photosensitive cells grouped in the output register. Likewise the number of input circuits is not limited to twenty as illustrated but may be any number depending upon the requirements of the system to which the translator is adapted. Thus, a translator of the type herein disclosed if provided with forty input circuits divided into eight groups of five each and operated on the same code, i. e., two out of five, could operate upon one thousand cards to provide combinations of one hundred million selections. If operated on a different code, such as three out of six, an even greater number of selections may be obtained.

Regardless of the size of the translator, and the number of input and output circuits which it may be designed to control, the method of operation which is the subject of this invention remains the same. This method comprises: first, reducing input circuit information to a single element, i. e., an individual card; second, operating upon the selected individual card to move it in translation; and third, projecting from the translated card output circuit information. In our invention the first two steps are accomplished simultaneously by means of se-

lecting bars on which the coded card rests. Operation of the input register by a distinctive input code energizes a combination of electromagnets which lower a certain combination of selecting bars thereby allowing a particular card to move in translation. Thus the act of selection and translation is accomplished simultaneously in one operation.

Reference is now made to the appended drawings in which:

Fig. 1 illustrates the input register, shown in schematic circuit diagram, connected with the operating elements of our mechanical card translator, here shown in a side view elevation.

Fig. 1A discloses one form of output circuit which may be employed in conjunction with each photosensitive cell of the translator output register.

Fig. 2 is a top view of the card translator of Fig. 1.

Fig. 3 is a perspective drawing representing a three-dimensional view of the complete card translator of Figs. 1 and 2 with the radiant energy source and collecting lens removed.

Fig. 4 is a partial end view showing the random arrangement and haphazard separation of the magnetic cards in an idle translator.

Fig. 5 is a partial end view of the same group of magnetic cards shown in Fig. 4, here illustrating the orderly and uniform separation of these cards when operated upon by a strong magnetic field from the lower translator magnets as will subsequently be described in greater detail.

Fig. 6 is a partial side view detail showing two selecting bars in operated position.

Fig. 7 is a side view detail showing the lifting magnet pole-piece 117 associated with control switch 36 at the start of their upward traverse prior to removing a selected card from the stack.

Fig. 8 is a side view of the translator showing the lifting magnet pole-piece 117 in its extreme elevated position, with associated control switch 36 completely operated, and a selected magnetic card 51 raised above the remaining stack and in contact with the upper magnet pole-piece, ready for removal from the stack.

Fig. 9 is a front or face view of the end card 61 in the translator stack as viewed from the end nearest the photoelectric cells of the translator output, showing the translator in idle condition with none of the selecting bars operated, and with the lifting magnet pole-pieces 117 in their normally lowered position. This view also illustrates the manner of recording output information on the cards by means of a distinctive pattern of elongated perforations 50 superimposed on certain of the standard perforations 59 in such manner that the elongated perforations are continuations of or extensions of the standard perforations which are the same in each card.

Fig. 10 is the same face view of Fig. 9 showing the card 61 of Fig. 9 in translated position, but partially concealed behind another card 62 which has been interposed between the translated card and the plane of the observer of Fig. 10. Here radiant energy, represented as light rays, may be seen to penetrate those perforations of card 62 which are aligned with elongated perforations of card 61, while penetration of the remaining perforations in card 62 is prevented by opaque portions of translated card 61.

Referring first in greater detail to Figs. 2 and 3 we see a top view and perspective projection, respectively, of a preferred embodiment of the translator device which is the heart of our in-

vention. It will be observed that the translator comprises a plurality of perforated cards 160 of magnetic material maintained in stacked relationship by guide bars 52 and space plates 121 between non-magnetic end plates 56 and 57. The magnetic cards 160 are supported in their stacked relationship by projections extending from their lower edges as may be seen by the individual card 51 partially disclosed behind cut-away portion of guide bar 52 in Fig. 3 and by individual card 61 shown in Fig. 9 which has projections 72, 73, 76, 86, 82, 84, 88 and 98. These projections rest upon magnetic code bars as shown at 105 in Figs. 3 and 9, which extend through vertical slots 125 and 126 in end plates 56 and 57, respectively, and in turn are supported by magnetic selecting bars, such as 100a, which extend through slots 127 and 128 in end plates 56 and 57, respectively, and rest upon steel ball bearings 103, shown in Fig. 3. The ball bearings 103 are held in their proper position within slots appropriately spaced in supporting plate 123 which is in turn secured by screws 124 to magnetic pole-piece 31, as seen in Fig. 3. The spacer-guide bars 52 are supported by end plates 56 and 57. In the end plate 56 will be seen a plurality of regularly spaced perforations 59 which correspond in size and positioning to similar perforations through all of the magnetic cards 160. Corresponding perforations, hidden from view in these drawings, extend through rear end plate 57 in alignment with a plurality of photosensitive cells 147, in such a manner that light or other radiant energy which may be projected in parallel paths through aperture 59 of end plate 56 will, when all the cards 160 are in normal stacked relationship as here shown, pass through the corresponding apertures 59 in said plurality of cards, and thence through the apertures 59 of end plate 57 to fall upon the photosensitive cells 147.

As shown by 105 in Fig. 3 the lower edges of the code bars 105 are all provided with a plurality of saw-toothed notches 109 into which may be fitted a corresponding plurality of saw-toothed projections on the upper edges of corresponding selecting bars as illustrated by 100a in Fig. 3. The projections on the upper edges of the selecting bars function as cams by means of which the code bars are supported. The code bars are held down against the cam projections of their corresponding selecting bars by a plurality of pretensioned springs 106 and 107 which are secured to brackets 111 and 112 mounted on end plates 56 and 57 respectively. At the left end of all the selecting bars are tensioned coil springs 104 which normally hold the idle selecting bars in the extreme position to the left as viewed in Fig. 3. At the opposite ends of the selecting bars, as seen to the right in Figs. 2 and 3, are a plurality of electromagnets 122, each of which cooperates with one of the selecting bars through a magnetic armature by means of which the selecting bar may be moved to the right against the tension of spring 104 whenever the corresponding electromagnet is energized. Details of this arrangement are illustrated in the lower right-hand portion of Fig. 3 where it may be seen that electromagnet 10a (which is one of the plurality of electromagnets 122) when energized will attract magnetic armature 101 which is engaged with selecting bar 100a, thereby causing selecting bar 100a to move to the right, thus allowing code bar 105 to slide downward through slots 125 and 126 to a lower position, under the pressure of springs 106 and 107. In like manner when elec-

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tromagnet 10b (which is also one of the plurality of electromagnets 122) is energized, armature 102 which engages selecting bar 100b will be moved to the right and its corresponding code bar will be lowered. When all of the code bars which support a particular card are thus lowered, the card itself will be correspondingly lowered into translated position. In the preferred arrangement illustrated herein, operation of any eight selecting bars on the basis of two out of each group of five will lower the corresponding eight code bars to allow one card to be lowered into translated position. All the remaining cards are retained in normal stacked position because they are supported by one or more code bars which have not been displaced.

At the top of the translator structure, as clearly shown by Fig. 3, are electromagnets 33 situated between fixed magnetic pole-pieces 119 which in turn are secured to non-magnetic end plates 56 and 57 by means of screws 120. Adjacent to pole-pieces 119 and in magnetic contact therewith are movable pole-pieces 117 held in intimate contact with pole-pieces 119 by means of screws 118 extending through slots which enable the pole-pieces 117 to slide vertically along the outer faces of the pole-pieces 119. Mechanical means are provided for raising or lowering the pole-pieces 117 under the control of an operator. Thus, when the operator moves hand lever 113 to the right, motion is transmitted to crank 114 which rotates cams 115 in a counter-clockwise direction to exert a lifting force on brackets 116 whereby pole-pieces 117 are elevated. Fig. 7 shows the operation of cams 115 upon brackets 116 to raise pole-pieces 117 when lever 113 has been moved a short distance to the right. Fig. 8 shows the position of cams 115 in brackets 116 when pole-pieces 117 have been raised to their extreme elevated position, as a result of lever 113 being moved to its extreme right-hand position. Movement of the lever 113 to the left will return pole-pieces 117 to their normal lowered positions as illustrated by Fig. 3.

Fastened to the left end of lower pole-piece 117 as seen in Fig. 3 is insulated switch arm 43 which extends through vertical slot 44 in the end plate 56. Arm 43 operates spring switch 36 (shown in Fig. 1) as will be described in detail in reference to other figures.

Referring now to Fig. 1 in greater detail it will be seen that the input register, which is diagrammed schematically, comprises the electromagnets 10a through 10e, 11a through 11e, 12a through 12e, and 13a through 13e, inclusive. It will be observed that one terminal of each of the electromagnets 10a through 13e is connected to one side of the battery 14, the other side of battery 14 being grounded. The other terminals of the electromagnets connect to the leads 15a through 15e, 25a through 25e, 28a through 28e, and 31a through 31e, inclusive, these leads in turn connecting to the sender which receives the dialed information and sends it to the card translator for decoding action by the translator. The sender is not shown in Fig. 1 as it is not the subject of this invention, but may be of a well-known type common to telephone practice.

In the two-out-of-five system of registration illustrated by Fig. 1, when the first digit of a code number is received from the sender two out of the first five electromagnets in Fig. 1 become energized, with the particular two magnets which are actuated being determined by the number which has been dialed. Thus, for example, if

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the number 2 is dialed, electromagnets 10a and 10c may be energized, while electromagnets 10b and 10e may be energized if the digit 9 is dialed. Associated with the magnets 10a and 10e are the two dual contact switches 16 and 17 respectively. When the electromagnets are not energized the armatures of these switches are positioned so as to make electrical connection with the lower contacts. When the respective electromagnets are energized, however, the armatures are moved so as to establish a continuous circuit at the upper contacts. The electromagnets 10b, 10c and 10d each operate two sets of switch contacts similar to the switches 16 and 17, and, in addition, the magnet 10c operates a third armature 24 which is of the one contact variety. The lower contact of switch 16 is connected to the armature of switch 18 and the upper contact of switch 16 is connected to the armature of switch 19, both of the armatures 18 and 19 being responsive to the electromagnet 10b. In addition, the upper contact of armature 18 is connected to the lower contact of armature 19. In like manner, the upper contact of armature 19 is connected to the lower contact of armature 20 and the lower contact of armature 19 is connected to the upper contact of armature 20 as well as the lower contact of armature 21, while the upper contact of armature 21 and the only contact of 24 are connected to the lower contacts of the armature 18. Armature 20 is connected to the lower contact of armature 23, armature 21 is connected to the upper contact of 23 and the lower contact of 22, and armature 24 is connected to the upper contact of 22. Finally, armatures 22 and 23 are connected to the upper and lower contacts respectively of armature 17. In turn armature 17 is connected with armature 26 which is responsive to electromagnet 11e in the second bank of electromagnets illustrated by Fig. 1.

It will be readily seen that two of the five electromagnets 10a through 10e must be operated in order to establish a continuous circuit from armature 17 to ground, and that operation of any two magnets in this bank will accomplish this purpose, and further, that operation of more than two magnets out of the five in this bank will impose a discontinuity in the circuit.

Now let us assume, for the purpose of illustration, that the sender has grounded leads 15b and 15c, thus operating electromagnets 10b and 10c in Fig. 1. Armatures 18 and 19 will now be attracted by electromagnet 10b and, in like manner, armatures 20, 21 and 24 will be attracted by electromagnet 10c. In this condition a continuous circuit will be established from ground through armature 16 to armature 18, thence through the upper contacts at 18 to the upper contacts at 20, thence through armature 20 to the lower contacts at 23, thence through armature 23 to armature 17, as shown by the heavy line. In like manner, the sender operates to simultaneously ground two out of the five input register leads in each of the remaining banks 25a through 25c, 28a through 28c, and 31a through 31c. Thus if leads 25a and 25e are grounded in the second bank, electromagnets 11a and 11e will be operated to complete a circuit from armature 26 through armature 27 as shown by the heavy line, and in like manner, if leads 28b and 28d are grounded by the sender, electromagnets 12b and 12d will be operated to complete a continuous circuit from armature 29 to armature 30, and in the last bank if leads 31c and 31e are grounded by the sender magnets 13c

and 13e will be operated to complete a circuit from armature 32 to armature 33 as shown by the heavy line. Thus it will be seen that when the sender operates two out of five electromagnets in each bank of the input register, continuity of circuit is established from ground through relay coil 140, thence through spring 34 and contact 35 of switch 36, thence through the lower electromagnets 37 and battery 39. In this manner the electromagnets 37 and relay 140 are energized by the potential from battery 39. Operation of relay 140 deenergizes upper magnets 38 and applies anode potential to all the photo-electric cells 147, as shown by the detail schematic of one element in Fig. 1A, simultaneously with the energization of lower magnets 37.

The 20 electromagnets 10a through 10e, 11a through 11e, 12a through 12e, and 13a through 13e, diagrammed schematically in Fig. 1 are physically located at the right of the translator as shown in Figs. 2 and 3 and are each associated with a corresponding selecting bar. For example, armature 101 of electromagnet 10a is connected to selecting bar 100a and armature 102 of electromagnet 10b is connected to selecting bar 100b as shown in Fig. 3. It will be observed in Figs. 2 and 3 that the 20 electromagnets are arranged in groups of five each, electromagnets 10a, 10c and 10e being mounted above electromagnets 10b and 10d as seen in Fig. 3. Similarly, electromagnets 11a, 11c and 11e are mounted adjacent to electromagnets 10a, 10c and 10e and above electromagnets 11b and 11d. This is also true for electromagnets 12a through 12e and 13a through 13e. As shown in Fig. 2 electromagnets 12a, 12c and 12e are mounted above 12b and 12d (not visible) and electromagnets 13a, 13c and 13e are mounted above 13b and 13d (also not visible).

At the same time that eight of the electromagnets 10a through 13e are operating to complete a circuit to ground as described above, each of these same eight magnets operates on its associated selecting bar of the translator, thereby enabling a selected card to move in translation as hereinbefore described.

In the lower right-hand corner of Fig. 1 magnets 10a and 10b are shown in their true physical relationship to their respective magnetic armatures 101 and 102, engaged with selecting bars 100a and 100b, respectively, in such manner that when the magnets are energized the armatures will be attracted and the selecting bars will be moved through the translator in the direction from left to right in the drawing of Fig. 1. Thus, the selecting bar 100a which is seen clearly in front of selecting bar 100b in Fig. 1 will be moved over ball-bearings 103, against the tension of spring 104, when armature 101 is attracted by electromagnet 10a. At the right-hand extremity of this selecting bar will be seen a mechanical coupling 108 which operates the dual contact switch 16 when the selecting bar is moved by magnet 10a. This contact switch 16 is the same contact switch which is identically numbered in the top left portion of the schematic diagram of Fig. 1. In like manner, the electromagnet 10b, when energized, operates upon its magnetic armature 102 to pull its associated selecting bar 100b in a direction moving from left to right through the translator of Fig. 1, and at the same time operating switch armature springs 18 and 19 which, as we have previously seen, are identically numbered in the schematic diagram of the input register circuit shown in the upper portion

of Fig. 1. With the electromagnets 10a and 10b unenergized, which is in the condition shown by the drawing of Fig. 1, selecting bars 100a and 100b are maintained in their extreme positions to the left, in the view of Fig. 1, by the tension of springs 104.

In Fig. 1 it will be observed that the selecting bar 100a is provided with a plurality of saw-tooth projections 109 along the upper edge and these projections serve as cams by means of which the code bar 105 is supported. When the selecting bar 100a is moved to the right, the point of support of cams 109 is shifted thereby allowing code bar 105 to be lowered under the pressure exerted by springs 106 and 107. All the other selecting bars have similar saw-tooth cams which cooperate in the same manner with recesses in corresponding code bars, as may be more clearly seen in reference to Figs. 2, 3 and 6. With two electromagnets in each bank or group of the input register operated, a total of eight selecting bars will be pulled to their extreme right-hand positions, and the corresponding eight code bars will be lowered. As will be described in greater detail in reference to Figs. 9 and 10, the lowering of eight code bars operates to select one card from the translator stack and allows the selected card to be moved in translation to a position out of alignment with the remaining cards of the stack.

The electromagnets 37 situated beneath the selecting bars and their associated code bars, create a strong magnetic field which assists the downward movement of the selected card in translation. The function of these magnets is two-fold in that first they exert a downward pull on all of the magnetic cards, thereby adding to the force of gravity to assist in the downward movement of the selected card to its translated position, and secondly they create a magnetic field which passes through all of the cards in such a manner that corresponding edges of adjacent cards are similarly magnetized. This induction of like magnetic poles in corresponding edges of all of the magnetic cards creates a tendency for adjacent cards to repel each other, thus assuring a slight but uniform separation between cards. This magnetic separation of cards reduces interleaf friction between adjacent cards, thereby reducing wear on the cards and further facilitating the movement of a selected card into its translated position. As we have seen above, the lower electromagnets 37 are operated when a circuit is completed through the input register by operation of two out of five magnets in each of the four groups.

Fig. 5 illustrates the manner in which operating clearance is provided between adjacent cards of the stack when like magnetic poles are induced in corresponding edges of the cards. This may be contrasted with the haphazard and random separation between cards illustrated by Fig. 4 which discloses a condition that may prevail when electromagnets 37 are not energized.

At the top of the translator illustrated in Fig. 1 may be seen "lifting magnets" 38, here shown in dotted lines as they are hidden from view behind lifting pole-piece 117. These upper magnets provide means for removing a selected card from the stack whenever this may be desired, and also, in the normal cycle, they exert a lifting force to speed the restoration of a selected card to the stack upon completion of each translation. The arrangements of these magnets and their associated pole-pieces may be better ascertained from an examination of Figs. 2 and 3

which illustrate the translator as seen from the top, and in isometric projection, respectively. Referring again to Fig. 1, it will be seen that when the sender releases the input register, current flow through relay 140 is interrupted and armature 141 falls off to close with contact 142, thereby completing a circuit from battery 54 through the coils of lifting magnets 38. At the same time, armature 143 is released from contact 144, thereby removing potential from line 150 connected with the anodes of the photosensitive output circuits as shown by Fig. 1A. Simultaneously with the energization of upper magnets 38 by the release of relay 140, lower magnets 37 are deenergized as are all of the electromagnets of the input register, so that any selected card which had been previously lowered in translation is now rapidly restored to its normal position within the stack as will be described hereinafter.

When the input register is again operated, current flows through relay 140, armature 141 comes up to deenergize upper magnets 38, armature 143 comes down to close with contact 144 and apply potential from battery 145 to the anodes of all tubes in the output circuits, as illustrated by gas tube 146 and photoelectric cell 147 in Fig. 1A, and simultaneously magnets 37 are energized to pull down a selected card in translation. Radiant energy from source 40 passes through collecting lens 58, following channels 59 through the stacked cards, penetrating the stack only through those apertures which have not been blocked by opaque portions of the translated card, and finally falls on the photosensitive output cells 147 in an illuminated pattern corresponding to the pattern of the coded perforations in the translated card. Since potential has been applied from battery 145 to the anode of all output tubes 147, through operation of relay 140, those photoelectric tubes on which radiant energy impinges, one of which is represented schematically by Fig. 1A, will trigger their associated gas discharge tubes, as represented by 148 in Fig. 1A, to operate output relays as 149, by means of current which flows from battery 149 through the now ionized gas discharge tube 148.

It is to be understood that each photosensitive cell has associated with it a gas discharge tube for controlling an output relay, and the plurality of relays thus controlled comprise an output register. Any suitable light sensitive circuit may be employed to control these output registers, the arrangement shown in Fig. 1A being merely one form of operable circuit. Another form might embody high current light sensitive cells which operate output relays directly without the aid of intervening gas tubes, or still another form may eliminate the electromagnetic output relays and employ trigger tubes as the output register. The details of the light sensitive control circuit disclosed in Fig. 1A are per se claimed to be novel.

When it is desired to remove a particular card from the stack, the selected card to be removed is first lowered in the normal manner by sending the code for the desired card into the translator. This may be accomplished by means of the usual sender, as described above, or by means of an auxiliary keyset circuit which grounds two out of five leads in each bank of the input register. With the selected card lowered into translated position the operator then moves hand lever 113 to the right, rotating cams 115 in a counter-clockwise direction and thereby exerting an upward force on brackets 116 to lift the sliding

pole-pieces 117 as seen in Figs. 7 and 8. Protruding from the left-hand extremity of lower pole-piece 117 as seen in Fig. 3 is insulated switch arm 43, shown clearly in Fig. 3, which moves upward through slot 44 to operate switch 36 as the associated pole-piece 117 is raised. This switch provides means for deenergizing lower magnets 37 and energizing ejecting magnet 45 shown at the very bottom of the translator in Fig. 1, beneath the magnets 37. Ejecting magnet 45 cooperates with the upper magnets 38 to assist in removing a selected card from the stack. This cooperation is rendered in the following manner: As seen in Fig. 1, when the electromagnet 45 is energized, armature 46 is pulled down against restraining force of spring 47, the movement of armature 46 being transmitted through linkages 48 and connecting rods 49 to an ejecting bar 50 which extends horizontally beneath the center of all the cards in the translator stack. An end view of bar 50 and its connection with one of the rods 49 may be clearly seen in the drawings of Figs. 9 and 10. Upward movement of the bar 50 when magnet 45 is energized lifts a selected card from its lowered code bars and rapidly returns the selected card from its translated position to a position within the stack. The inertia of this rapidly moving card raises the selected card above the remaining cards in the stack to a position where the selected card comes under the control of the field of upper magnet pole-pieces 117. As the upper magnets 38 are now energized and the lower magnets 37 are deenergized by operation of switch 36, the selected card immediately upon rising into the field of magnets 38 adheres to lifting pole-pieces 117 as illustrated by card 51 in the drawing of Fig. 8. As the lever 113 is moved to its extreme right-hand position, cams 115 are rotated counter-clockwise to a position illustrated by the drawing of Fig. 8 where they have operated upon brackets 116 to raise the lifting magnet pole-pieces 117 to their uppermost position. The selected card 51, which is adhering to magnetic pole-pieces 117, has now been elevated a sufficient distance above the stack so that the coded projections along its lower edge are above the space guide bar 52, and the selected card may now be removed from the translator by withdrawing it sidewise from the stack.

The sequence of operations controlled by switch 36 when the operator moves lever 113 to the right to raise pole-pieces 117 is as follows: First, insulated switch arm 43 comes up to close contacts 53 on switch 36 thereby closing a circuit to energize magnets 38 from battery 54 as seen in Fig. 1. This condition is illustrated in the drawing of Fig. 7. Second, contact 35 on switch 36 is opened, thereby deenergizing the lower magnets 37 as seen in Fig. 1. Third, contact 55 on switch 36 is closed to complete a circuit from battery 54 through electromagnet 45 as seen in Fig. 1. Electromagnet 45 in operating operates the ejecting bar 50. This last condition is illustrated by the drawing of Fig. 8.

The manner in which a distinctive pattern may be impressed upon the output bank of photosensitive cells by transmission of radiant energy through a selected card which has been lowered in translation will be better understood from an examination of Figs. 9 and 10 which show face views of the stacked cards as seen in a cross-section of the translator taken through the plane of the selected card, and viewed from the end of the stack nearest the output register

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147. Fig. 9 illustrates the idle condition of the translator with all of the cards aligned in their normal stacked relationship, their coded projections such as 72, 73, 76, 80, etc. shown in Fig. 9 resting normally on idle code bars 105, none of the selecting magnets and associated selecting bars having been operated, and with the radiant energy source unenergized. In this condition all of the standard holes in the cards are aligned as at 59. This view illustrates clearly how coded output information is recorded on the translator cards by means of elongated perforations 60 which are superimposed in a distinctive pattern on certain of the regular perforations 59, as illustrated in the top horizontal row by the elongations of the fourth, seventh, ninth, tenth, twelfth, fourteenth and fifteenth holes as counted from left to right. Similarly, it will be noted that in the second horizontal row, counting down from the top, elongations have been provided at the third, sixth, eighth, tenth, eleventh and fifteenth holes as counted from left to right. In like manner elongations are provided in the third row for the second, fifth, eighth, ninth, thirteenth and fourteenth columns, and in the fourth row for the first, fifth, sixth, seventh and eleventh columns, and in the bottom row for the first, second, third, fourth, twelfth and thirteenth columns as counted from left to right. Careful examination of the bottom edge of card 61 as illustrated in Fig. 9 will disclose that coded projections 72, 73, 76, 80, 82, 84, 88 and 90 rest upon two code bars 105 out of each of the four groups of five code bars illustrated. Thus it will be seen that if the corresponding two code bars in each group are lowered, the card 61 will be correspondingly lowered into translated position. However, if any one or more of these code bars are not lowered the card 61 will be prevented from dropping into translation. Now if the input register is operated by energization of magnets 10b and 10c, as illustrated in the first bank of Fig. 1, 11a and 11e, as illustrated in the second bank, 12b and 12d, as illustrated in the third bank, and 13c and 13e, as illustrated in the fourth bank of Fig. 1, selecting bars 100b, 100c, 110d, 110e, 120b, 120d, 130c and 130e, illustrated in cross-section in Fig. 9, will all be operated to lower the code bars on which the projections of card 61 rest, whereby the card 61 will be lowered into its translated position. This translated condition is illustrated by the drawing of Fig. 10 wherein the card 61 is partially concealed from view by another card 62 which is shown in normal stacked relationship interposed between the viewpoint of the observer and the plane of the card 61.

When the proper selecting bars are operated and their associated code bars are lowered, translation of the selected card is accelerated by the downward attraction of the strong magnetic field created by magnets 37 through their associated pole-pieces 91 and 92. These pole-pieces 91 and 92 are separated by a block of non-magnetic material 94 through which ejecting rod 49 passes to operate ejecting bar 50 as previously described. A plurality of magnetic paths will be seen to extend between pole-pieces 91 and 92 through the steel ball bearings 103 which are in intimate contact with pole-piece 91, thence through the magnetic selecting bars which rest upon these ball bearings, thence through the code bars which rest on these selecting bars, thence through the coded projections on one side of the magnetic cards which rest upon these code bars, thence through the magnetic cards themselves to the

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coded projections on the other side of the cards and from here through the associated code bars, selecting bars and steel ball bearings which are in intimate magnetic contact with pole piece 92. The magnetic circuit between electromagnets 37 is completed through the magnetic base plate 93. The magnetism which is thus induced in the magnetic translator cards, as was explained previously, in addition to accelerating the movement of the cards in translation also provides operating clearance between adjacent magnetized cards as illustrated by Fig. 5.

When the information recorded by elongated holes on the selected card has been registered upon the photosensitive cells of the output register 147, magnets 10b, 10c, 11a, 11e, 12b, 12d, 13c and 13e which were operated to select card 61 may now be deenergized by release of the input register, whereupon springs 104 as shown in Figs. 1, 2, 3 and 6 will operate to restore all the selecting bars to normal. Card 61 will now be returned to its normal position of alignment with the remaining cards in the translator stack and the translator will be conditioned to operate upon another card. As explained above, restoration of selected cards to their normal position is accelerated by means of lifting magnets 38 under the control of relay 149 which is inserted in the circuit of lower magnets 37 in such manner that when magnets 37 are deenergized, upper lifting magnets 38 are simultaneously energized. Thus interruption of the input circuit through the input register and magnets 37, following completion of each translation, deenergizes relay 149 allowing armature 141 to fall against contact 142 and thereby closing a circuit from battery 54 through magnets 38. In this manner, energization of upper magnets 38 during the restoral phase of each translating cycle lifts all of the magnetic cards from the code bars, thereby reducing the load to be lifted by restoring springs 104, and thus facilitating complete restoration of all code bars to their normal uppermost positions.

The photosensitive elements of the output register may each be adapted to operate a relay or a vacuum tube circuit as shown in Fig. 1A, whereby a number of useful functions may be performed. For example, our translator may be employed to replace route relays and route relay cross-connections in markers, or to provide information associated with a particular subscriber at a telephone office arranged for automatic message accounting. Many other uses may be found in communication and related arts for a versatile translator of the type herein disclosed.

While we have described one specific embodiment of our invention, and suggested other useful variations thereof, it is understood that various other embodiments may be made by those skilled in the art without departing from the spirit of our invention as defined within the scope of this specification and the appended claims.

What is claimed is:

1. A translating device comprising a plurality of perforated record cards, means for holding said cards in horizontal stacked relationship, each of said cards having a plurality of extensions along the bottom edge thereof, said extensions being grouped in a distinctive arrangement for each card, a plurality of supporting bars extending beneath said stacked cards providing means of support on which extensions of said cards rest, supporting means for said supporting bars which permit said bars to be individually

lowered when operated upon, restraining means which normally hold said supporting bars in their uppermost positions, an input register comprising a plurality of electromagnets adapted to lower individual supporting bars when said electromagnets are energized, whereby upon energization of a distinctive group of said electromagnets in accordance with an input code selected cards may be lowered in translation from said stack, a source of energy directed against said cards and transmissible through perforations of said selected cards in translation, and an output register comprising a plurality of elements responsive to said energy to effect an output registration corresponding to the perforations of said selected cards.

2. A translating arrangement comprising a plurality of input registers, a plurality of output registers, a plurality of stackable magnetic plates each having a distinctive pattern of serrated edges and a plurality of distinctive perforations, means for maintaining said magnetic plates in stacked relationship, means for selectively displacing individual plates singly from said stack by operation upon said distinctively serrated edges in response to coded designations impressed upon said input registers, and means controlled by the distinctive perforations of a selected plate for operating said output registers.

3. A translating arrangement comprising a plurality of input registers, a plurality of output registers and a device comprising a plurality of magnetic plates in horizontal stacked relationship, each of said plates having a plurality of teeth arranged in a distinctive pattern along one edge thereof, said teeth resting upon a plurality of magnetic selecting bars whereby the stacked plates are supported, said input registers operating on said selecting bars in response to coded input signals so as to cause one of said stacked magnetic plates to drop below its normal position, a plurality of perforations in all of said plates arranged in alignment when said plates are in stacked relation, auxiliary perforations on said plates arranged in a distinctive pattern for each plate, and means controlled by the auxiliary perforations of said displaced plate and the aligned perforations of said stacked plates for operating said output registers.

4. A translating device comprising a plurality of input registers, a plurality of stackable magnetic plates, means for maintaining said plates in horizontal stacked relation, a plurality of teeth extending from a corresponding edge of each plate in said stack, said teeth arranged in a distinctive pattern for each plate, a plurality of magnetic code bars in intimate contact with said magnetic teeth thereby supporting said magnetic plates, means for displacing certain of said code bars in response to a coded designation impressed upon said input registers whereby a particular plate supported solely by said displaced bars will be selected from said stack and moved into a lower position out of alignment with the remaining stacked plates, a plurality of main apertures corresponding in all of said plates, said apertures arranged in alignment when said plates are in normal stacked position, auxiliary apertures in all of said plates, said auxiliary apertures arranged in a distinctive pattern for each plate, and means for transmitting directed energy through the auxiliary apertures of said displaced plate to effect a distinctive output registration corresponding to the coded arrangement of auxiliary apertures in said selected plate.

5. A translating device comprising a plurality of perforated plates of magnetic material, means for holding said plates in horizontal stacked relationship, each of said plates having a plurality of protrusions extending from one edge thereof, said protrusions being grouped in a distinctive arrangement for each plate, a first group of parallel bars of magnetic material extending horizontally beneath said stacked plates and providing means of support on which protrusions of said plates rest, the underside of each of said parallel bars being formed as one surface of a cam mechanism, a second group of parallel bars of magnetic material extending horizontally beneath said first group of bars, the upper surfaces of the bars in said second group being formed as cams corresponding to and cooperating with the cam surfaces of bars in said first group and providing means of support on which said first bars rest, restraining means limiting said first bars to vertical movement when operated upon by the cams of said second bars, additional restraining means limiting said second bars to horizontal movement, a plurality of electromagnets each adapted to move one of said second bars longitudinally when energized, connecting means for energizing distinctive groups of said electromagnets whereby upon energization of each group of electromagnets corresponding groups of said parallel bars are operated to lower to a translating position an individual selected magnetic plate from said stack in accordance with an input code, restoring means whereby upon de-energization of said electromagnets after a translation said bars operate to restore said selected plate to said stack, and a plurality of photosensitive output elements operable by radiant energy transmitted through distinctive perforations in a selected plate when lowered in translation.

6. A plurality of stacked magnetic metal plates having perforated apertures, certain of said apertures common to all of said plates in their normal aligned condition, other perforated apertures individual to each plate, means for maintaining said plates in alignment, directed energy producing means common to all of said apertures, a plurality of separate energy responsive means aligned with said producing means and said common apertures, a plurality of teeth extending from a corresponding edge of each plate in a distinctive pattern for each plate, means for displacing a selected plate by operating upon the distinctive pattern of teeth in said plate so as to withdraw said selected plate from the aligned stack sufficiently to cause the distinctive apertures individual to the selected plate to be aligned with certain apertures common to all of said plates and to cause all other common apertures to be blocked by opaque portions of the partially withdrawn plate, so that only the receiving means which are aligned with said distinctive apertures will be energized.

7. A plurality of stacked plates of magnetic material having a plurality of transparent apertures common to all plates, additional transparent apertures in each plate aligned adjacent to certain of said common apertures whereby a distinctive pattern of said additional apertures is provided for each plate, radiant energy producing means directed through common apertures of said stacked plates, a plurality of radiant energy detecting means responsive to said producing means, said detecting means aligned with said producing means and said common transparent apertures, a plurality of magnetic protrusions

extending from a corresponding edge of each magnetic plate in a different pattern for each plate, means for displacing a selected plate by magnetic operation upon the distinctive pattern of protrusions in said plate so as to realign said selected plate with respect to the remaining stack in such manner that said radiant energy detecting means receive only energy transmitted through the particular transparent apertures which are peculiar to the individual plate selected.

8. In a translator employing a plurality of movable magnetic translating plates in a stack, magnetic selecting bars, means for inducing additional magnetic field in said plates to assist said selecting bars in displacing selected magnetic plates, additional magnetic means arranged adjacent opposite edges of said magnetic plates from said selecting bars and said first magnetic means, and control means for energizing said additional magnetic means simultaneously with release of said selecting bars and said first magnetic means, whereby a selected magnetic plate may be withdrawn from the stack.

9. A translating device comprising a plurality of perforated record cards, means for holding said cards in horizontal stacked relationship, each of said cards having a plurality of extensions along the bottom edge thereof, said extensions being grouped in a distinctive arrangement for each card, a plurality of supporting bars extending beneath said stacked cards providing means of support on which extensions of said cards rest, supporting means for said supporting bars which permit said bars to be individually lowered when operated upon, restraining means which normally hold said supporting bars in their uppermost position, an input register comprising a plurality of electromagnets adapted to lower individual supporting bars when said electromagnets are energized, whereby upon energization of a distinctive group of said electromagnets in accordance with an input code selected cards may be lowered in translation from said stack, a source of radiant energy directed against said cards and transmissible through perforations of said selected cards in translation, and an output register comprising a plurality of photosensitive elements responsive to said radiant energy to effect an output registration corresponding to the perforations of said selected cards.

10. A translating device comprising a plurality of perforated record cards, means for holding said cards in horizontal stacked relationship, each of said cards having a plurality of extensions of magnetic material along the bottom edge thereof, said extensions being grouped in a distinctive arrangement for each card, a plurality of magnetic code bars extending beneath said stacked cards providing means of support on which said magnetic extensions of said cards rest, magnetic supporting means for said code bars which permit said bars to be individually lowered when operated upon, means for producing a magnetic field through said supporting means, said code bars and said magnetic extensions whereby said extensions tend to adhere to said code bars, restraining means which normally hold said code bars in their uppermost positions, an input register comprising a plurality of electromagnets adapted to lower individual code bars when said electromagnets are energized, whereby upon energization of a distinctive group of said electromagnets in accordance with an input code any of said cards may be lowered in translation from said stack, a source of radiant energy directed

against said cards and transmissible through perforations of said selected cards in translation, and an output register comprising a plurality of photosensitive elements responsive to said radiant energy to produce an output registration corresponding to the perforations of said selected cards.

11. A translating device comprising a plurality of perforated record cards of magnetic material, means for holding said cards in horizontal stacked relationship, each of said cards having a plurality of extensions along the bottom edge thereof, said extensions being grouped in a distinctive arrangement for each card, a plurality of supporting bars of magnetic material extending beneath said stacked magnetic cards and providing means of support on which extensions of said cards rest, magnetic supporting means for said supporting bars which permit said bars to be individually lowered when operated upon, means for creating a magnetic field through said supporting means, said supporting bars, and said magnetic cards whereby said cards tend to adhere to said selecting bars, restraining means which normally hold said supporting bars in their uppermost positions, an input register comprising a plurality of electromagnets adapted to lower individual supporting bars when said electromagnets are energized, whereby upon energization of a distinctive group of said electromagnets in accordance with an input code selected cards may be lowered in translation from said stack, a source of radiant energy directed against said cards and transmissible through perforations of said selected cards in translation, and an output register comprising a plurality of sensitive elements responsive to said radiant energy to effect an output registration corresponding to the perforations of said selected card.

12. A translating device comprising a plurality of perforated magnetic record cards, means for holding said cards in horizontal stacked relationship, each of said cards having a plurality of extensions along the bottom edge thereof, said extensions being grouped in a distinctive arrangement for each card, a plurality of supporting bars of magnetic material extending beneath said stacked cards providing means of support on which extensions of said cards rest and to which said extensions tend to adhere through attraction, supporting means for said supporting bars which permit said bars to be individually lowered when operated upon, restraining means which normally hold said supporting bars in their uppermost positions, magnetic means adapted to induce magnetism of like polarity in corresponding edges of adjacent magnetic record cards such that said cards tend to repel each other so as to provide operating clearance between magnetic cards in said stack, an input register comprising a plurality of electromagnets adapted to lower individual supporting bars when said electromagnets are energized, whereby upon energization of a distinctive group of said electromagnets in accordance with an input code a selected card may be lowered in translation from said stack, a source of radiant energy directed against said cards and transmissible through perforations of said selected card in translation, and an output register comprising a plurality of elements responsive to said radiant energy to effect an output registration corresponding to the perforations of said selected card.

13. A translating device comprising a plurality

of perforated record cards of magnetic material, means for holding said cards in horizontal stacked relationship, each of said cards having a plurality of extensions along the bottom edge thereof, said extensions being grouped in a distinctive arrangement for each card, a plurality of code bars of magnetic material extending beneath said stacked cards and providing means of support on which extensions of said cards rest, magnetic supporting bars for said code bars which permit said code bars to be individually lowered when operated upon, means for inducing a magnetic field through said supporting bars, said code bars and said magnetic cards, said means adapted to induce magnetism of like polarity in corresponding edges of adjacent magnetic record cards such that said cards tend to repel each other so as to provide operating clearance between cards in said stack, additional magnetic means adjacent opposite edges of said stacked magnetic cards from said code bars and said first magnetic means, whereby upon operation of said second magnetic means with release of said first magnetic means and said code bars a selected card may be withdrawn from said stack, a source of radiant energy directed against said cards and transmissible through perforations of said selected card in translation, and an output register comprising a plurality of elements responsive to said radiant energy to effect an output registration corresponding to the perforations of said selected card.

14. A translating device comprising a plurality of perforated record cards of magnetic material, means for holding said cards in horizontal stacked relationship, each of said cards having a plurality of extensions along the bottom edge thereof, said extensions being grouped in a distinctive arrangement for each card, a plurality of supporting bars of magnetic material extending beneath said stacked cards and providing means of support on which extensions of said cards rest, magnetic supporting means for said supporting bars which permit said bars to be individually lowered when operated upon, a first magnetic means adapted to induce magnetism of like polarity in corresponding edges of adjacent record cards through said supporting means said supporting bars and said extensions, said magnetism creating a tendency for said extensions to adhere to said supporting bars and for said cards to repel each other within said stack, a second magnetic means adjacent opposite edges of said stacked magnetic cards from said supporting bars, additional mechanical means extending beneath said horizontally stacked cards and adapted to cooperate with said second magnetic means when operated concurrently therewith so that a selected card may be ejected from said stack, restraining means which normally hold said supporting bars in their uppermost positions, an input register comprising a plurality of electromagnets adapted to lower individual supporting bars when said electromagnets are energized, whereby upon energization of a distinctive group of said electromagnets in accordance with an input code a selected card may be lowered in translation from said stack, a source of radiant energy directed against said cards and transmissible through perforations of said selected card in translation, and an output register comprising a plurality of elements responsive to said radiant energy to effect an output registration corresponding to the perforations of said selected card.

15. The method of translating a first plural digit number into a second plural digit number by means including one selectable element for each number to be translated comprising the steps of registering said first number, displacing the selectable element corresponding to said first number simultaneously with said registration, and incident to said displacement registering said second number through the medium of said displaced element.

16. A translating device comprising a plurality of perforated plates of magnetic material, means for holding said plates in horizontal stacked relationship, each of said plates having a plurality of protrusions extending from one edge thereof, said protrusions being grouped in a distinctive arrangement for each plate, a first group of parallel bars of magnetic material extending horizontally beneath said stacked plates and providing means of support on which protrusions of said plates rest, the under side of each of said parallel bars being formed as one surface of a cam mechanism, a second group of parallel bars of magnetic material extending horizontally beneath said first group of bars, the upper surfaces of the bars in said second group being formed as cams corresponding to and cooperating with the cam surfaces of bars in said first group and providing means of support on which said first bars rest, restraining means limiting said first bars to vertical movement when operated upon by the cams of said second bars, additional restraining means limiting said second bars to longitudinal movement, a plurality of electromagnets each adapted to move one of said second bars longitudinally when energized, connecting means for energizing distinctive groups of said electromagnets whereby upon energization of each group of electromagnets corresponding groups of said parallel bars are operated to lower to a translating position an individual selected magnetic plate from said stack in accordance with an input code, restoring means operative upon said lower horizontal bars and a magnetic restoring means situated above said horizontally stacked magnetic plates operative thereon and cooperating with said first named restoring means whereby upon the deenergization of said electromagnets and energization of said magnetic restoring means after a translation said bars operate to restore said selected plate to said stack, and a plurality of photosensitive output elements operable by radiant energy transmitted through distinctive perforations in a selected plate when lowered in translation.

17. A translating device comprising a plurality of perforated plates of magnetic material, means for holding said plates in horizontal stacked relationship, each of said plates having a plurality of protrusions extending from one edge thereof, said protrusions being grouped in a distinctive arrangement for each plate, a first group of parallel bars of magnetic material extending horizontally beneath said stacked plates and providing means of support on which protrusions of said plates rest, the under side of each of said parallel bars being formed as one surface of a cam mechanism, a second group of parallel bars of magnetic material extending horizontally beneath said first group of bars, the upper surfaces of the bars in said second group being formed as cams corresponding to and cooperating with the cam surfaces of bars in said first group, and providing means of support on which said first bars rest, restraining means limiting

said first bars to vertical movement when operated upon by the cams of said second bars, additional restraining means limiting said second bars to horizontal movement, a plurality of electromagnets each adapted to move one of said second bars horizontally when energized, connecting means for energizing distinctive groups of said electromagnets whereby upon energization of each group of electromagnets corresponding groups of said parallel bars are operated to lower to a translating position an individual selected magnetic plate from said stack in accordance with an input code, restoring means operative upon said lower horizontal bars and a magnetic restoring means situated above said horizontally stacked magnetic plates operative thereon and cooperating with said first named restoring means whereby upon deenergization of said electromagnets and the energization of said magnetic restoring means after a translation said bars operate to restore said selected plate to said stack, additional magnetic control means situated above said horizontally stacked magnetic plates whereby upon release of said electromagnets, the operation of said lower horizontal bars and the operation of said magnetic control, a selected magnetic plate may be drawn from a position of translation to a position above the remaining stack to facilitate the removal of said selected plate from said stack, and a plurality of photosensitive output elements operable by radiant energy transmitted through distinctive perforations in a selected plate when lowered in translation.

18. A translating device comprising a plurality of perforated plates of magnetic material, means for holding said plates in horizontal stacked relationship, each of said plates having a plurality of protrusions extending from one edge thereof, said protrusions being grouped in a distinctive arrangement for each plate, a first group of parallel bars of magnetic material extending horizontally beneath said stacked plates and providing means of support on which protrusions of said plates rest, the under side of each of said parallel bars being formed as one surface of a cam mechanism, a second group of parallel bars of magnetic material extending horizontally beneath said first group of bars, the upper surfaces of the bars in said second group being formed as cams corresponding to and cooperating with the cam surfaces of bars in said first group and providing means of support on which said first bars rest, restraining means limiting said first bars to vertical movement when operated upon by the cams of said second bars, additional restraining means limiting said second bars to horizontal movement, a plurality of electromagnets each adapted to move one of said second bars longitudinally when energized, connecting means for energizing distinctive groups of said electromagnets whereby upon energization of each group of electromagnets corresponding groups of said parallel bars are operated to lower to a translating position an individual selected magnetic plate from said stack in accordance with an input code, additional magnetic means situated below said horizontally stacked magnetic plates and said parallel bars to facilitate downward movement in translation of said selected magnetic plate, restoring means whereby upon deenergization of said electromagnets and said additional magnetic means after a translation, said bars operate to restore said selected plate to said stack, and a plurality of

photosensitive output elements operable by radiant energy transmitted through distinctive perforations in a selected plate when lowered in translation.

19. A translating device comprising a plurality of perforated plates of magnetic material, means for holding said plates in horizontal stacked relationship, each of said plates having a plurality of protrusions extending from one edge thereof, said protrusions being grouped in a distinctive arrangement for each plate, a first group of parallel bars of magnetic material extending horizontally beneath said stacked plates and providing means of support on which protrusions of said plates rest, the under side of each of said parallel bars being formed as one surface of a cam mechanism, a second group of parallel bars of magnetic material extending horizontally beneath said first group of bars, the upper surfaces of the bars in said second group being formed as cams corresponding to and cooperating with the cam surfaces of bars in said first group and providing means of support on which said first bars rest, restraining means limiting said first bars to vertical movement when operated upon by the cams of said second bars, additional restraining means limiting said second bars to horizontal movement, a plurality of electromagnets each adapted to move one of said second bars horizontally when energized, connecting means for energizing distinctive groups of said electromagnets whereby upon energization of each group of electromagnets corresponding groups of said parallel bars are operated to lower to a translating position an individual selected magnetic plate from said stack in accordance with an input code, additional magnetic means situated below said horizontally stacked magnetic plates and said parallel bars to facilitate downward movement in translation of said selected magnetic plate, restoring means whereby upon deenergization of said electromagnets and said additional magnetic means after a translation, said bars operate to restore said selected plates to said stack, further magnetic means situated above said horizontally stacked magnetic plates and operative thereon and being adapted to cooperate with said restoring means to facilitate restoration of said selected plate to normal stacked relation with said horizontally stacked plates upon energization of said further magnetic means and deenergization of said electromagnets and said additional magnetic means after a translation, and a plurality of photosensitive output elements operable by radiant energy transmitted through distinctive perforations in a selected plate when lowered in translation.

20. A translating device comprising a plurality of perforated plates of magnetic material, means for holding said plates in horizontal stacked relationship, each of said plates having a plurality of protrusions extending from one edge thereof, said protrusions being grouped in a distinctive arrangement for each plate, a first group of parallel bars of magnetic material extending horizontally beneath said stacked plates and providing means of support on which protrusions of said plates rest, the under side of each of said parallel bars being formed as one surface of a cam mechanism, a second group of parallel bars of magnetic material extending horizontally beneath said first group of bars, the upper surfaces of the bars in said second group being formed as cams corresponding to and cooperating with the cam sur-

faces of bars in said first group and providing means of support on which said first bars rest, restraining means limiting said first bars to vertical movement when operated upon by the cams of said second bars, additional restraining means limiting said second bars to horizontal movement, a plurality of electromagnets each adapted to move one of said second bars horizontally when energized, connecting means for energizing distinctive groups of said electromagnets whereby upon energization of each group of electromagnets corresponding groups of parallel bars are operated to lower to a translating position an individual selected magnetic plate from said stack in accordance with an input code, a second electromagnetic means situated below said horizontally stacked magnetic plates and said parallel bars to facilitate downward movement in translation of a selected magnetic plate, restoring means operative upon said lower horizontal bars whereby upon deenergization of said electromagnets and said second electromagnetic means after a translation, said bars operate to restore said selected plate to said stack, a third electromagnetic means situated above said horizontally stacked magnetic plates and operative thereon and being adapted to cooperate with said restoring means to facilitate the restoration of said selected plate to normal stacked relation with said horizontally stacked plates upon energization of said third electromagnetic means and deenergization of said electromagnets and said second electromagnetic means after a translation, additional means for elevating said third electromagnetic means above the top of said horizontally stacked magnetic plates whereby upon energization of said third electromagnetic means with concurrent deenergization of said electromagnets and said second electromagnetic means and the operation of said lower horizontal bars, a selected magnetic plate may be drawn from a position of translation to a position above the remaining stack to facilitate the removal of said selected plate from said stack, and a plurality of photosensitive output elements operable by radiant energy transmitted through distinctive perforations in a selected plate when lowered in translation.

21. In a switching system for interconnecting a plurality of instrumentalities in predetermined circuit combinations, a light source, a photoelectric sensing means upon which the light from said source impinges, a selector mechanism disposed between said light source and said sensing means for modifying the light impinging on the latter means, said selector mechanism including a plurality of stacked control elements each having an operative position to which it is moved and each further having vari-sized apertures therein completely identifying one of said circuit combinations, cam members coupled to said control elements for adjusting the same to operative position, means to operate said cam members to move one of said control elements to operative position to the exclusion of the others to thereby modify the transmission of light through said selector mechanism and its impingement upon said sensing means to activate the latter in accordance with the circuit combination identified solely by the operated control element, and means responsive to the activation of said sensing means for establishing the identified circuit combination.

22. In a switching system, the combination of selector means for initiating the interconnection of instrumentalities in one of a plurality of pre-

determined circuit combinations, a selector mechanism responsive to said means, a light source, and a light responsive electronic element operatively associated with said source; said selector mechanism including a series of motor-driven cams controlled by said selector means and further including a plurality of independently operable and controlled elements coacting with said cams for movement to operative position thereby and each having means formed thereon for identifying any one of the various combinations of interconnections between said instrumentalities by modifying the light from said source passing through an operative controlled element and impinging upon said electronic element, means associated with said electronic element to enable the same to distinguish the light as modified, and means coacting with said electronic element to effect the interconnection between the instrumentalities identified by said operated controlled element.

23. A device including a stack of essentially plane cards which are at least partially magnetic, said cards being modified by scannable indicia, a supporting and mounting frame within which said cards are mounted in a normally stacked position, each of said cards having freedom of movement in one direction in the plane of the card into a selected position under control of codewise operable selecting means cooperating with codewise edge modifications of said cards, means operable to propel a selected card exclusively of other cards in a direction reversely of its selecting direction of movement, magnet means made effective incident to the operation of said propelling means to apply force tending to hold said selected card in a thusly propelled position beyond its normally stacked position whereby it may be more readily removed from said stack.

24. In a device according to claim 23, magnetic means energizable to tend to move a selected card to a selected position, and means operable incident to the energization of said magnet means to insure temporary deenergization of said magnetic means.

25. In a device according to claim 23, retaining guides cooperating with each card to restrict lateral movement of any said card in other than the directions toward its selecting or removing positions while it is in its normal or selected position.

26. In a card device including a stack of cards which are magnetic at least along an edge thereof, means for facilitating card withdrawal consisting of selecting means to select a card for withdrawal, force applying projecting means to project a card whereby it is carried to a freely withdrawable position, and magnetic means in addition to said force applying projecting means for retaining it in said freely withdrawable position.

27. A card scanning device including a stack of cards having openings therethrough, a source of radiant energy located to project such energy through aligned openings in said cards, output means including radiant energy responsive means on the far side of said stack from said source, said cards having individual normal positions and individual selected positions, means operable at times for selecting and displacing at least one card from its normal position to its selected positions, said openings being of such dimensions and arranged with respect to one another so that such selecting and displacing changes the number of such aligned openings, and

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means operable concurrently with any such displacing to condition said output means from a condition inhibiting response to a condition permitting response to the energy traversing such changed number of aligned openings.

28. A device in accordance with claim 27 wherein the responsive means includes elements, means whereby the condition inhibiting response is established by a non-responding electrical condition of said elements, and means whereby the condition permitting response is established by changing said non-responding electrical condition

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to a responding condition by application of electrical voltage to said elements.

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