

July 11, 1961

W. WHITNEY

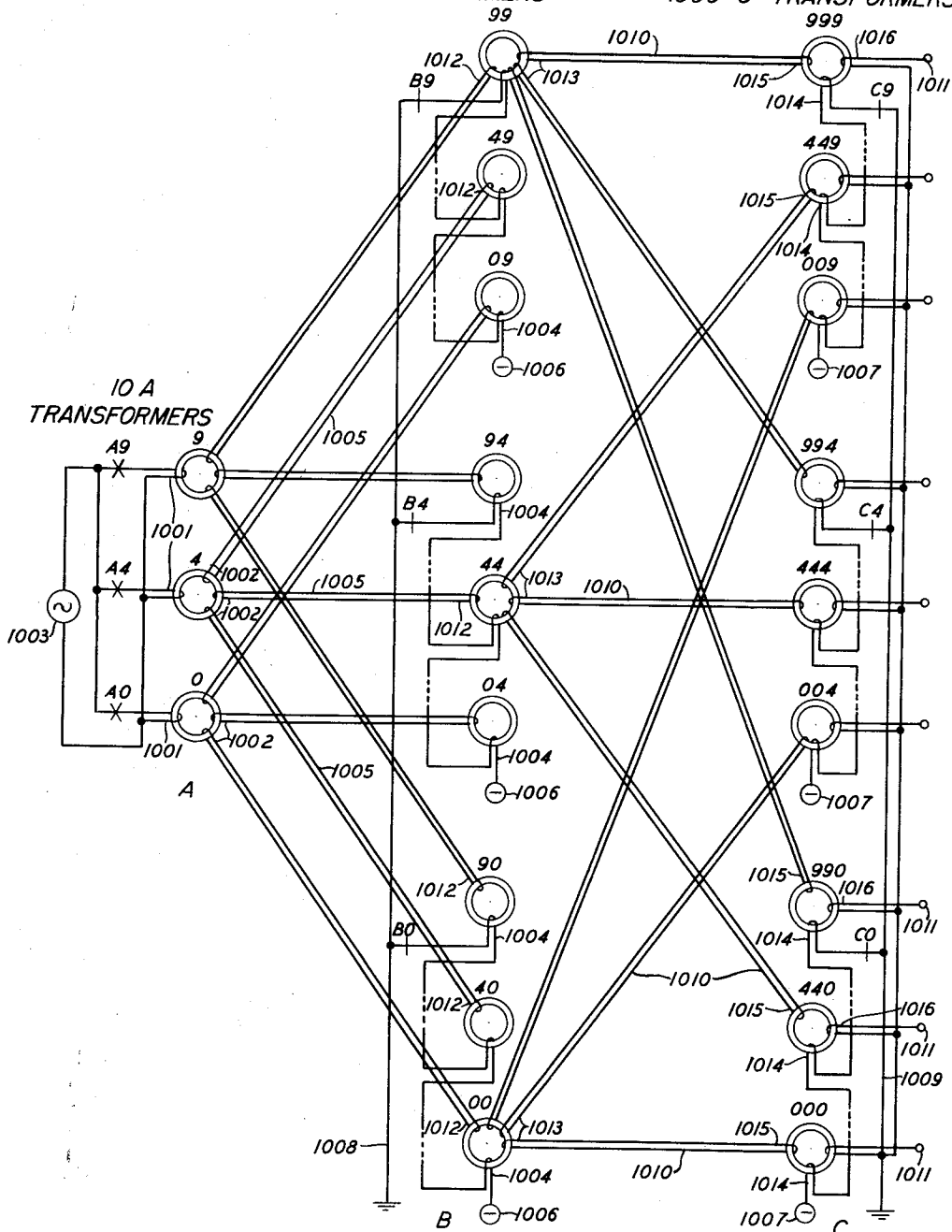
2,992,421

INDUCTION TYPE TRANSLATOR

Filed March 29, 1956

100 B TRANSFORMERS

1000 C TRANSFORMERS



INVENTOR
W. WHITNEY
BY *[Signature]*
ATTORNEY

1

2,992,421

INDUCTION TYPE TRANSLATOR

Wiley Whitney, Madison, N.J., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

Filed Mar. 29, 1956, Ser. No. 574,832

9 Claims. (Cl. 340-347)

This invention relates to code translators and more particularly to such translators in which multiwinding saturable-core transformers comprise the active translating elements.

In the past, a variety of translators have been proposed, illustrative of which is that described in patent No. 2,369,474 granted to H. P. Luhn on February 13, 1945. Relays, diodes, gas tubes and other devices have been utilized in different circuits designed to fulfill special translating requirements met in telephone switching apparatus, computers and other devices. Rapidity of operation, low cost, small size, and low power consumption have been characteristics sought and obtained with varying degrees of success. The apparatus contemplated by this invention is believed to be especially advantageous in these respects, the primary object of the invention being to combine all these characteristics in one device.

In accordance with one feature of this invention, two stages of saturable-core transformers are tandemly connected to one stage of conventional transformers to provide one thousand paths leading from a source of alternating current connected to the first stage to one thousand output terminals, each path being specifically referable to a different combination of three-out-of-thirty control leads, of which ten are appropriately connected to each of the aforementioned stages.

In accordance with another feature of this invention, the saturating windings on the various transformers are interconnected in such manner that deactivating two of twenty control leads, i.e., one out of each group of ten connected to the two saturable stages, will effectively unblock only one of the one thousand aforementioned paths and leave the remaining nine hundred ninety-nine paths effectively blocked.

In accordance with yet another feature of this invention, the transformers are arranged in three groups corresponding to units, tens and hundreds, respectively.

In accordance with still another feature of this invention, connections are made from secondary windings on each of the first and second stage transformers to appropriately selected primary windings of saturable transformers in the next succeeding stages, thereby providing the thousand individual paths mentioned above.

Referring now to the drawing, the single figure shown thereon is a schematic diagram of translating apparatus constructed in accordance with the principles underlying the invention.

The translator is divided into three sections, namely, the first, second and third stages which are identified A, B and C, respectively. Stage A is comprised of ten transformers numbered "0" through "9" and ten associated A digit relays "A0" through "A9." The operating coils of these relays are not shown; however, a pair of normally open contacts of each is appropriately interposed in a different one of the paths leading from the source of alternating current 1003 to the nine first array transformers, of which only those numbered 0, 4 and 9 are shown.

Each A stage transformer is provided with one primary and ten secondary windings, only three of the secondary windings being shown on the representative transformers 0, 4 and 9 in order to facilitate clarity in the figure.

2

Stage B is comprised of one hundred transformers numbered "00" through "99" and ten associated B digit relays "B0" through "B9." Again, the operating coils are not shown; however, a pair of normally closed contacts of each B relay is appropriately interposed in paths leading from ground to the transformer saturating windings 1004, the saturating windings being connected in groups to source 1006 and to ground through these contacts for reasons hereinafter explained.

Each B stage transformer has one primary winding 1012, one saturating winding 1004 and ten secondary windings 1013, only three of the secondary windings being shown on three representative transformers 00, 44 and 99 in order to avoid congestion in the figure. The one hundred primary windings are appropriately connected to the 100 A stage transformer secondary windings over loops 1005, and the 1000 B stage secondary windings are appropriately connected to the 1000 C stage transformer primary windings 1015 over connecting loops 1010.

Stage C comprises 1000 transformers numbered "000" through "999" and ten associated C digit relays "C0" through "C9." As with the aforementioned A and B stage relays, the C stage relay operating coils are not shown; however, a pair of normally closed contacts of each C relay is appropriately interposed in paths leading from ground to the transformer saturating windings 1014, the saturating windings being connected in groups to source 1007 and to ground through these contacts for reasons hereinafter explained.

Each of the one thousand C stage transformers has one primary winding 1015, one saturating winding 1014 and one secondary winding 1016. One lead from each secondary winding is separately connected to an output terminal 1011, while the remaining lead may be similarly separately connected or (as shown) commoned with the others and grounded.

Although the ten A digit, ten B digit and ten C digit relay operating coils are not shown, it will be obvious to one skilled in the art that they may be connected to any one of a well-known variety of devices that transmit decimal information in the form of an energized A conductor, an energized B conductor and an energized C conductor. If, for example, the number 942 were desired to be transmitted and translated, such devices would energize the three leads respectively connected to the operating coils of the A9 relay, the B4 relay and the C2 relay, closing the indicated contacts of relay A9, and opening the indicated contacts of relays B4 and C2.

The one hundred aforementioned secondary windings 1002 of the ten A stage transformers are selectively connected to the one hundred primary windings 1012 of the B stage transformers according to a predetermined numerical relationship whereby the ten secondaries 1002 of transformer A0 are connected to the primaries 1012 of B stage transformers 00, 01, 02, 03 . . . 09, the ten secondaries of transformer A1 are connected to the primaries of B stage transformers 10, 11, 12, 13 . . . 19, . . . and the ten secondaries of transformer A9 are connected to the primaries of B stage transformers 90, 91, 92, 93 . . . 99. Thus each A stage transformer is connected to the ten B stage transformers that are identified by a two-digit number of which the first digit is the A stage transformer number.

Each of the B stage transformers is similar to its A stage counterpart except for the saturating windings 1004. The ten secondary windings 1013 of each B stage transformer are appropriately connected to ten primary windings 1015 on the numerically associated C stage transformers. For example, the ten secondary windings of B stage transformer 99 are connected to the ten primary windings on C stage transformers 990, 991, 992 . . .

999. Thus each B stage transformer is connected to the ten C stage transformers that are identified by a three-digit number of which the first two digits are the B stage transformer number.

The C stage comprises 1000 transformers identified 000 through 999 and are similar to those of the B stage except that each C stage transformer is equipped with only one secondary winding. As hereinbefore mentioned, each of these secondary windings may be connected to ground and to an output terminal which, in turn, may be connected to any of a variety of signal responsive devices such as, for example, gas tubes, transistors and relays.

In operation, decimal three-digit information is presented to the translator in the form of an operated condition of one of the ten A digit relays, one of the ten B digit relays and one of the ten C digit relays. As set forth above, these operated relays represent, in permutation, a number between 000 and 999. If, for example, the number selected is 449, the A4, B4 and C9 relays will be operated and an alternating-current path will be extended from the source 1003 to output terminal 449. This is accomplished in the manner now to be described.

Operation of a selected one of the ten A digit relays will result in closure of its associated contacts which will extend a path from the source of alternating current 1003 to the selected transformer. If, for example, the selected A digit is 4, relay A4 will be operated by the aforementioned associated apparatus (not shown), and the path will be extended from source 1003 to the primary winding 1001 of transformer A4, thereby exciting it. A voltage corresponding to the primary voltage will then be induced in each of the ten secondary windings 1002 of transformer A4 (only three are shown). These induced voltages are conducted over the interconnecting loops 1005 to the ten primary windings 1012 of the B stage transformers 40, 41, 42 . . . 49. If any one of these ten B stage transformers is not magnetically saturated, a flux will be induced therein and a resulting voltage will correspondingly appear in the ten secondary windings wound thereon. All of the B stage transformers, however, are normally saturated by the direct current that flows from ground over conductor 1008, through the normally closed contacts B0—B9, through the saturating windings of the one hundred B stage transformers, and thence to negative battery 1006. Accordingly, the alternating-current voltage is not passed through B stage unless and until one of the B relays is operated.

In response to the operation of one of the B stage relays, for example relay B4, the direct-current saturating path is interrupted at normally closed contacts B4 and the ten transformers numbered 04, 14, 24, 34, 44 . . . 94 become unsaturated and act as normal transformers. The only one of these ten, however, to which energizing alternating-current potential is conducted, is the core numbered 44, the number 44 corresponding to the permutation of the selected A digit 4 and the selected B digit 4.

Continuing the explanation of operation by way of example, a C digit is selected and the corresponding relay is operated. If, for example, the digit 9 is selected, the C9 relay is operated, thereby removing saturating current from each of the one hundred C stage transformers identified with numbers the last digit of which is 9. These are 009, 019, 029, 039 . . . 109 . . . 199 . . . 209 . . . 299 . . . 999. Only one of these one hundred C stage transformers, however, is activated by an alternating-current potential conducted thereto from B stage because the ten secondary windings of the selected B stage transformer 44 are connected to the ten C stage transformers numbered 440, 441, 442 . . . 449. Transformer 449 is, therefore, the only C stage transformer both unsaturated and energized by the aforementioned alternating-current potential. Accordingly, an alternating-current potential is induced in its output winding and conducted to its associated output terminal over the obvious path. No potential will be induced in any of

the remaining C stage transformers since the remaining nine cores 440—448 are all saturated by the direct-current flowing from ground over conductor 1009, through the normally closed contacts of relays C0—C8 and thence through the saturating windings to battery.

One lead of each of the C stage output windings is commoned to ground. However, this connection is immaterial to the invention since both leads of each output winding may be brought out separately to terminals.

Although the foregoing description is specifically related to the exemplary number 449, it is obvious that any other number from 000 to 999 will be translated in response to the appropriate numerical selection and operation of one of the ten A relays, one of the ten B relays and one of the ten C relays.

While I have illustrated my invention by a particular embodiment thereof, said invention is not limited in its application to the specific apparatus and particular arrangement therein disclosed. Various applications, modifications and arrangements of the invention will readily occur to those skilled in the art.

The terms and expressions which I have employed in reference to the invention are used as terms of description and not of limitation, and I have no intention in the use of such terms and expressions of excluding equivalents of the features shown and described or parts thereof, but on the contrary, intend to include therein any and all equivalents, modifications and adaptations which may be employed without departing from the spirit of the invention.

What is claimed is:

1. A code translator comprising in combination a source of alternating current and a source of direct current, a first plurality of transformers individually connectable through selectively operable connecting means to said source of alternating current, a second plurality of transformers, a plurality of output terminals severally representative of said second plurality of transformers, means for selectively connecting said output terminals each to the one of said second plurality of transformers which it represents, means for connecting two or more of said second plurality of transformers to each of said first plurality of transformers, means for selectively connecting groups of said second plurality of transformers to said source of direct current thereby to saturate the transformers in said groups, and means for selectively disconnecting said groups from said direct-current source, whereby in response to the presentation of information expressed by the operation of one of said connecting means and the disconnection of one of said groups of transformers, said information is translated to an activated condition of the representative one of said second plurality of transformers, thereby activating the corresponding one of said plurality of output terminals.

2. A code translator comprising in combination a source of alternating current and a source of direct current, a first, a second and a third plurality of selectively operable connecting means, each of said pluralities of connecting means being representative of a digit in a three-digit number, a first array of transformers each selectively connected through a different one of said first plurality of connecting means when operated to said source of alternating current, a second array of transformers electrically disposed in groups each connected to a different one of said first array of transformers, said transformers of said second array being electrically disposed in different groups, each selectively connected through a different one of said second plurality of connecting means when unoperated to said source of direct current thereby to be magnetically saturated by said direct current, a third array of transformers electrically disposed in groups each connected to a different one of said second array transformers, said transformers of said third array being further electrically disposed in different groups each selectively connected through a different

5

one of said third plurality of connecting means when unoperated to said source of direct current thereby to be magnetically saturated by said direct current, and a plurality of output terminals each representative of a different three-digit number and each connected to a different one of said third array transformers, whereby in response to the operation of one of the connecting means in each of said three pluralities of connecting means, a signal is conducted from said alternating-current source only to the one output terminal representative of the number presented by the permutation of the three operated connecting means.

3. A code translator comprising a first plurality of transformers arranged in a first array, a second plurality of transformers arranged in a second array, and a third plurality of transformers arranged in a third array, each of the transformers in said first and second arrays having a primary winding and a plurality of secondary windings, the transformers in said third array each having a primary winding and a secondary winding, the secondary windings of the transformers in said first and second arrays being selectively connected respectively to the primary windings of the transformers in said second and third arrays, an output terminal connected to each of said third array transformer secondary windings, an alternating-current source, means for selectively connecting said alternating-current source to the primary winding of any one of the transformers in said first array thereby to excite the selected one of said transformers and induce corresponding alternating voltages in the secondary windings thereof, means including the secondary windings of the selected transformer for applying said corresponding alternating voltages to the primary windings of certain of the transformers in said second array thereby to excite said certain of the transformers in said second array and induce other corresponding alternating voltages in the secondary windings thereof, means including the secondary windings of said certain of the transformers in said second array for applying said other corresponding alternating voltages to the primary windings of certain of the transformers in said third array thereby to excite said certain of the transformers in said third array and induce yet other corresponding alternating voltages in the secondary windings thereof, and means for selectively saturating all except certain predetermined ones of the transformers in said second and third arrays thereby to permit alternating current from said source to appear at only the output terminal connected to one preselected transformer in said third array.

4. A translator according to claim 3 in which said means for selectively connecting said alternating-current source to the primary winding of any one of the transformers in said first array comprises a plurality of selectively operable path-extending devices which, when operated, severally represent items of information to be translated and are effective to selectively extend paths from said source of alternating current to said transformers in said first array.

6

5. A translator according to claim 3 in which said means for selectively saturating all except certain predetermined ones of the transformers in said second and third arrays comprises a source of direct-current voltage and a path extending device connected to said source operable to extend a path from said source to said all except certain predetermined ones of the transformers in said second and third arrays thereby saturating said all except certain predetermined ones of the transformers in said second and third arrays with direct current.

6. A translator according to claim 5 in which said means for selectively connecting said alternating-current source to the primary winding of any one of the transformers in said first array comprises a plurality of selectively operable path extending devices which, when operated, severally represent items of information to be translated.

7. A translator according to claim 6 in which one of said three arrays contains a fewer number of transformers than each of the remainder of said arrays.

8. A translator according to claim 6 in which said first array consists of ten transformers, said second array consists of one hundred transformers, and said third array consists of one thousand transformers.

9. A code translator comprising a plurality of transformers each having a primary winding and disposed in at least two arrays, the transformers of each array but the last having a plurality of secondary windings and the transformers of said last array each having a single secondary winding, an output terminal connected to each of said last array transformer secondary windings, an alternating-current source, means for applying an alternating-current signal from said source to the primary winding of a selected one of the transformers in the first of said arrays thereby to induce corresponding signals in the secondary windings thereof, means including said secondary windings of said selected transformer for applying corresponding signals to the primary windings of pluralities of transformers in the remaining said arrays, and means for selectively saturating all but one of said plurality of transformers in each said remaining array to permit said signals to appear at only one output terminal in accordance with the selected one of said first array transformers and the selective saturation of the transformers in each said remaining array.

References Cited in the file of this patent

UNITED STATES PATENTS

50	2,369,474	Luhn	Feb. 13, 1945
	2,620,974	Valvat	Dec. 9, 1952
	2,686,838	Dehn	Aug. 17, 1954
	2,751,546	Dimmer	June 19, 1956
	2,782,399	Rajchman	Feb. 19, 1957
55	2,810,785	Lee	Oct. 22, 1957
	2,812,450	Barney	Nov. 5, 1957
	2,813,260	Kaplan	Nov. 12, 1957
	2,822,532	Thompson	Feb. 4, 1958