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Ramsey

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[54] **TREE COUNTER CODE SIMULATOR**

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[52] **U.S. Cl.**..... **178/26 R;** 178/17.5; 178/82 A

[51] **Int. Cl.**..... **H03r 13/00;** H04l 3/00

[58] **Field of Search**.... 178/26 R, 26 A, 82 R, 82 A, 178/115; 340/347 DD, 324 R, 365 R; 35/5, 6

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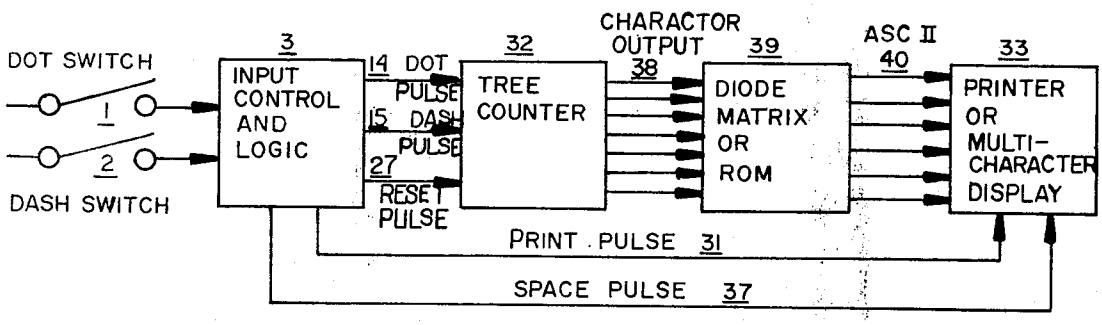
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[57] **ABSTRACT**

Use of a tree counter for translating, storing and displaying Morse or similar code signals.

19 Claims, 6 Drawing Figures



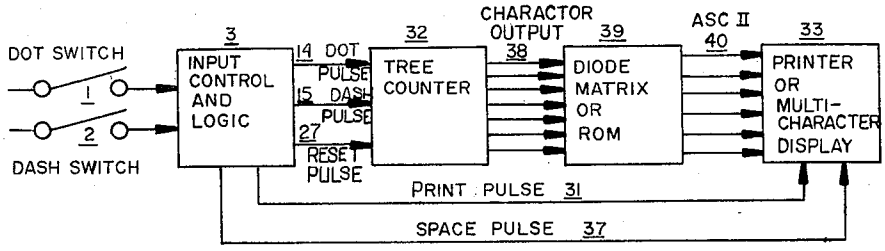

DOT SWITCH
1
2
DASH SWITCH
3
INPUT CONTROL AND LOGIC
14 DOT PULSE
15 DASH PULSE
27 RESET PULSE
32
TREE COUNTER
CHARACTOR OUTPUT
38
39
DIODE MATRIX OR ROM
ASC II
40
33
PRINTER OR MULTI-CHARACTER DISPLAY
PRINT PULSE 31
SPACE PULSE 37

Fig 1

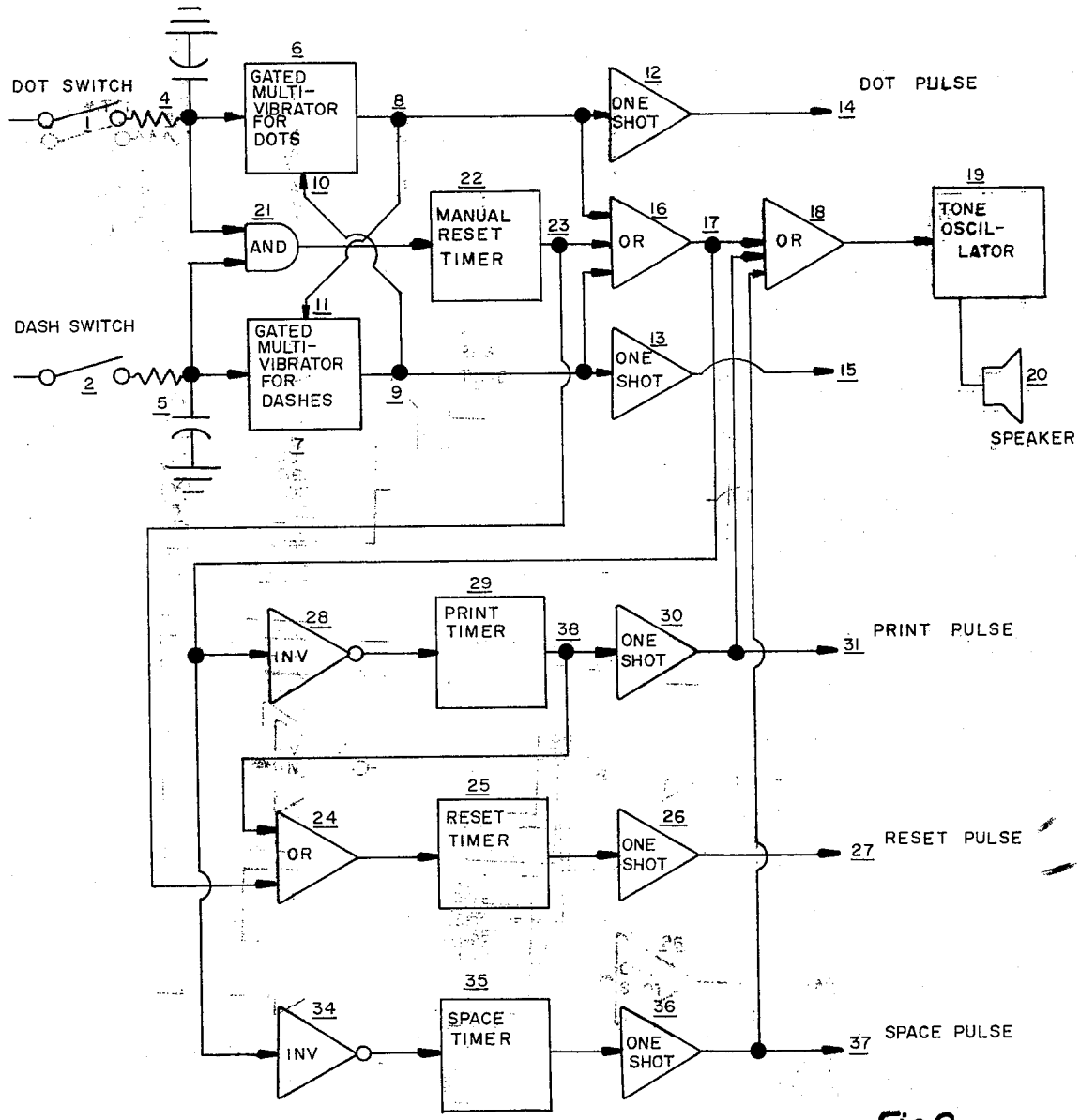

DOT SWITCH
1
4
6
GATED MULTI-VIBRATOR FOR DOTS
8
10
12
ONE SHOT
14
DOT PULSE
21
AND
22
MANUAL RESET TIMER
23
16
OR
17
18
OR
19
TONE OSCIL-LATOR
20
SPEAKER
DASH SWITCH
2
5
11
GATED MULTI-VIBRATOR FOR DASHES
9
7
13
ONE SHOT
15
29
PRINT TIMER
28
INV
38
30
ONE SHOT
31
PRINT PULSE
25
RESET TIMER
24
OR
26
ONE SHOT
27
RESET PULSE
35
SPACE TIMER
34
INV
36
ONE SHOT
37
SPACE PULSE

Fig 2

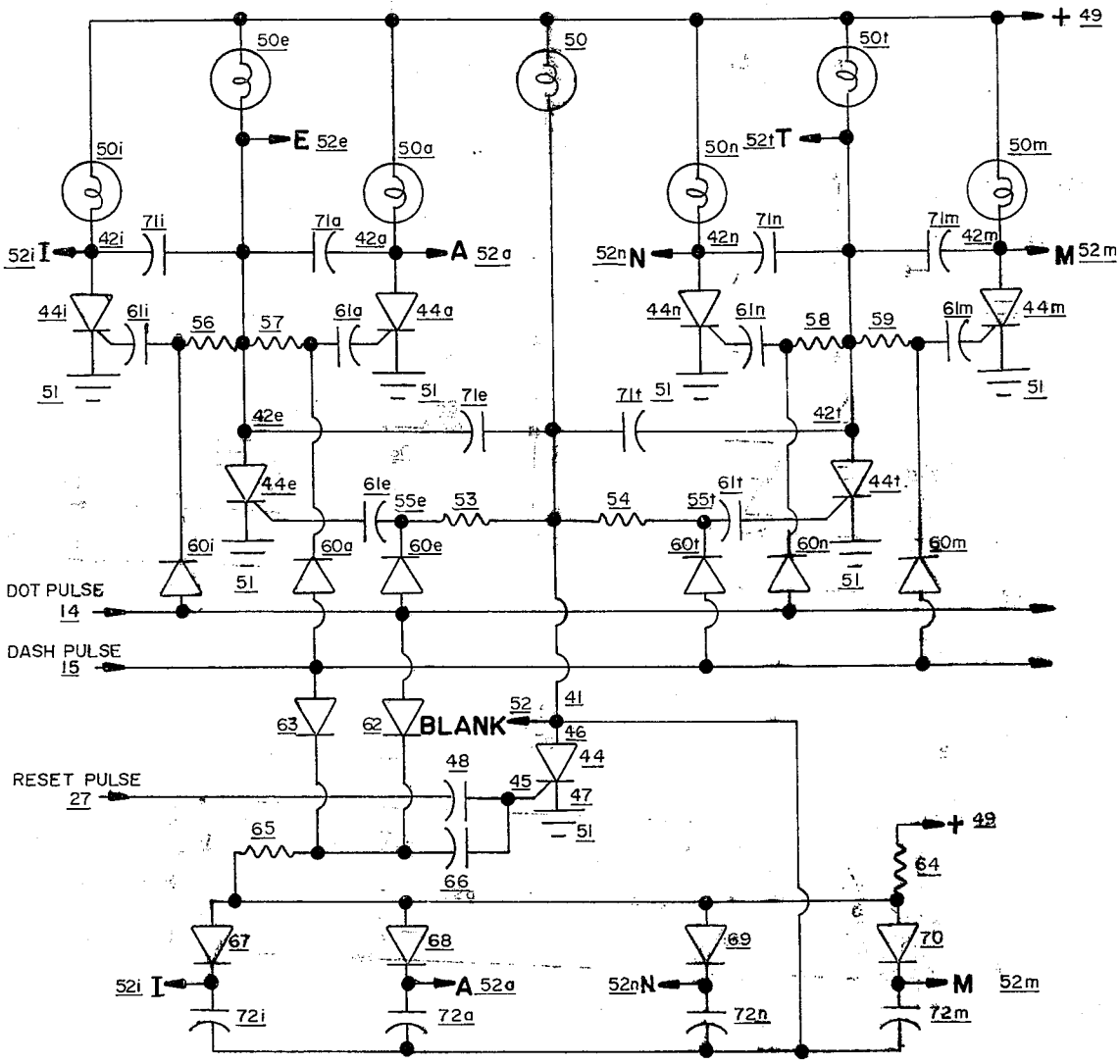

+ 49
50e
50
50t
E 52e
50i
50a
50n
52t T
50m
52i I
42i
71i
71a
42a
A 52a
52n N
42n
71n
71m
42m
M 52m
44i
61i
56
57
61a
44a
44n
61n
58
59
61m
44m
51
71e
71t
42e
42t
44e
61e
55e
53
54
55t
61t
44t
60i
60a
60e
60t
60n
60m
DOT PULSE
14
DASH PULSE
15
63
62
BLANK
52
41
46
44
48
45
47
RESET PULSE
27
65
66
64
67
68
69
70
72i
72a
72n
72m

Fig 3

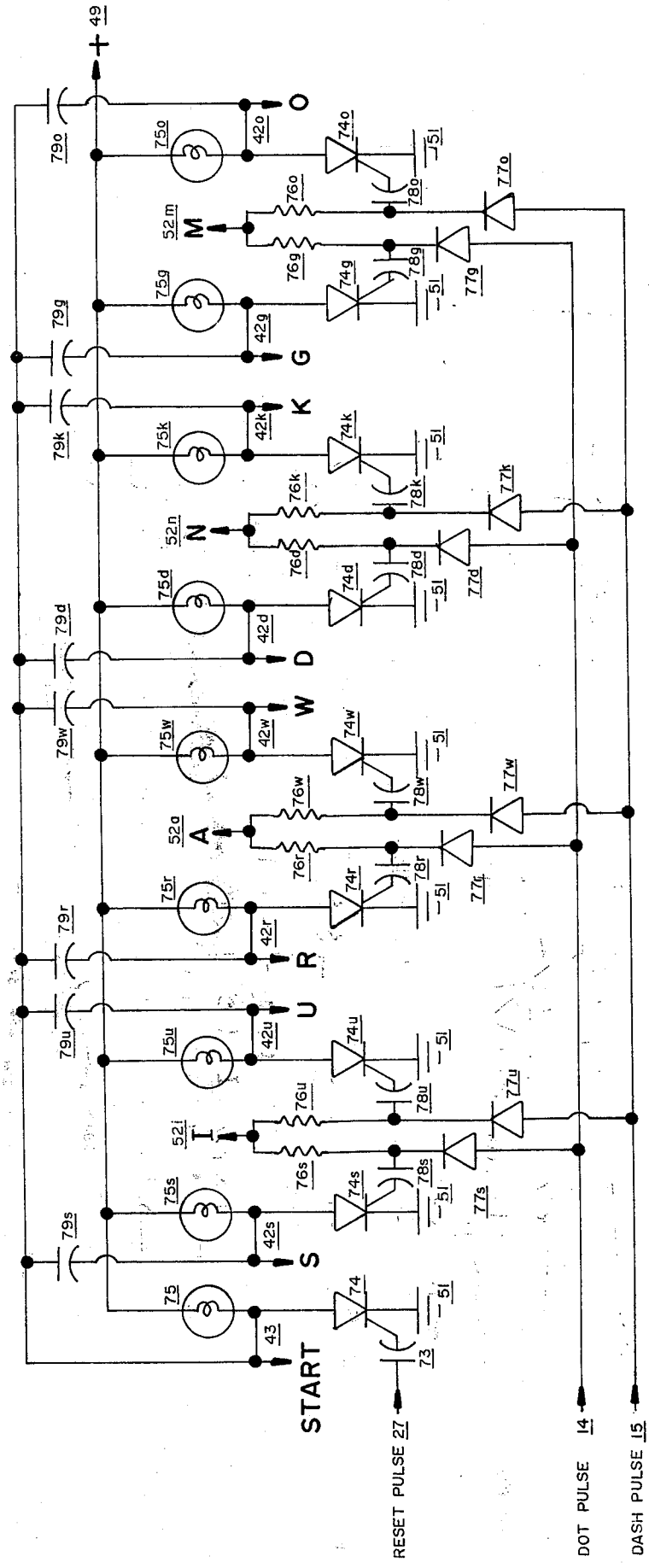

+ 49
START
S
U
R
A
W
D
N
K
G
M
O
I
RESET PULSE 27
DOT PULSE 14
DASH PULSE 15

Fig 4

6-BIT BINARY OUTPUT
BIT-32
BIT-16
BIT-8
BIT-4
BIT-2
BIT-1
+49
BLANK
START

Fig 5

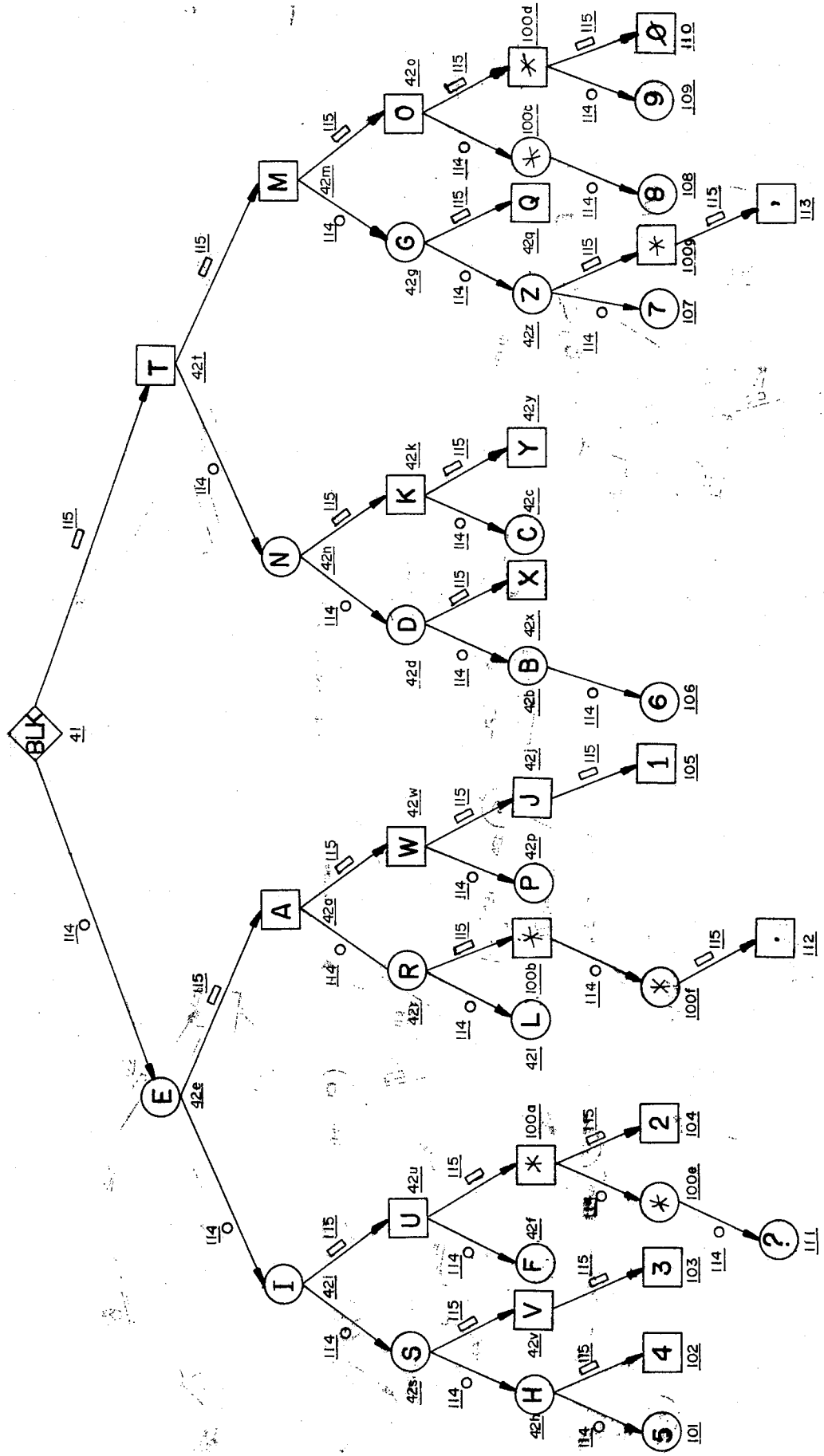

BLK
41
E
42e
T
42t
A
42a
I
42i
M
42m
N
42n
R
42r
S
42s
U
42u
W
42w
V
42v
G
42g
D
42d
Z
42z
O
42o
K
42k
H
42h
L
42l
P
42p
F
42f
Q
42q
J
42j
B
42b
C
42c
X
42x
Y
42y
100a
100b
100c
100d
100e
100f
100g
1
105
2
104
3
103
4
102
5
101
6
106
7
107
8
108
9
109
Ø
110
?
111
.
112
,
113
115
114

Fig 6

TREE COUNTER CODE SIMULATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a communications device suitable for use by handicapped persons. More particularly, it relates to a system for sending, controlling and converting telegraphic codes for visual character display.

2. Description of the Prior Art

Conventional printing or display systems using binary type codes such as ASCII (American Standard Code for Information Interchange) or a synchronous code, for example, a system such as depicted in U.S. Pat. No. 2,840,637, require six bits or six operations for each character for a repertoire of 64 characters, or a 64 character key board. Learning six elements for each character is difficult. Furthermore, systems such as found in U.S. Pat. Nos. 2,894,067; 2,996,577; 3,196,210, and 3,505,667 assume and require a degree of skill that is certainly greater than a novice or handicapped operator can readily obtain. In addition, such systems would require extensive and expensive alteration to be converted to a single-character readout. Also, the dot-dash detectors of prior art systems increase complexity and require low timing tolerances.

SUMMARY OF THE INVENTION

After extended investigation, I have found a system which has solved these problems. In its broadest aspect, my invention involves use of a modified ring counter circuit for converting Morse or similar code signals to characters and storing them so that they can be read on a scan panel or like board or display unit as desired. The system which I employ uses two switches or inputs, thereby eliminating the need for dot-dash detection. A further advantage of my system is that a handicapped operator can tap out by foot, or otherwise signal the Morse or other code so that the desired message is quickly lit up or displayed. In fact, an operator can soon learn which buttons, for example, to signal, for instance, by pressing a pedal, to cause the desired characters or letters to light up or otherwise appear on the readout panel without even having to know the Morse code. In other words, the operator himself or herself may actually originate the signals. Furthermore, any handicapped person having a yes or no output can operate the machine of the invention, which has the further advantage of being electrically operable.

A still further advantage of my tree counter is that it offers storage of a serial code with fewer, more economical components. My counter offers direct conversion to binary letter codes and is stored in individual characters for direct usage if desired. Timing and control circuitry are greatly simplified over prior art systems. Word and character timing is universal and adjustable to a user's needs.

More specifically, my invention may employ a simple three-position switch, viz, left-center-right, left for dot and right for dash. Individual character indicator lamps are arranged in what may be described as an inverted tree configuration, such as depicted in FIG. 6 of the drawing, to be described hereinafter, on a front panel which permits them to be readily observed by the user. Left and right locations are maintained such that an E may be readily observed as a dot, or one operation of the left switch. Likewise, A may be readily observed upon operating one left switch and then one right switch. With this physical configuration by means of character indicator lamps, for example, an operator does not have to have a rote memorization of the Morse code to operate the communicator. This feature may be further reinforced by using squares around the character lamps to indicate dashes and circles to indicate dots. Colors on the switches and lamps may also be used to greatly reduce learning time.

My invention constitutes an improvement on prior art decoding-storage-readout or like communication, translation or reader systems in that my tree-counter configuration provides a direct, economical light output which advises an operator of the real time status. It also offers storage of a serial code with fewer, more economical components. Conversion with the tree counter offers direct conversion to binary letter codes and is already in individual characters for direct usage, if desired. Timing and control circuitry are highly simplified. The word and character timing is completely universal and adjustable to a user's needs. As already suggested, my device is capable of using a three-position switch, that is, a left-center-right, the left for dot and the right for dash, thus making it ideal for learning and for the handicapped. Dot and dash detectors are eliminated, thereby reducing cost. Multivibrators may be used to send multiple dots and dashes, thereby aiding an operator further. The tree-counter configuration, a read-only memory (ROM), or a diode matrix provides improved means to convert a serial asynchronous telegraphic-type code to a serial synchronous and parallel code for communication functions, enabling use of conventional multicharacter printers or displays.

The control and logic configuration or circuitry provides easy access by an operator to the tree counter for easier learning, storage, display, and communication, for example, when using the Morse code.

According to the invention, gated multivibrators (dot and dash) provide automatic, precisely timed and spaced long or short tones for the aid of the operator. These signals may be adjusted in terms of speed to suit the needs of the operator's physical ability and learning level. The system may be adjusted to whatever timing the operator's ability or the speed of the incoming signals permits. Also, with my system, two switch inputs may be adjusted to almost any person who can communicate yes and no if the letter and word space is provided by appropriate adjustable elapsed timing. The control timing and logic circuit employs conventional solid-state logic building blocks.

Dots and dashes may be sent both automatically, for example, upon sending a dot tone, or manually, by the operator pushing the switch by hand or foot, according to the invention. For example, the dot switch, which may be operated automatically, sends one dot and a space. Keeping the dot switch closed sends a series of dots with the required spaces. A change to the dash switch after any number of dots sends a trailing dash, or series, again with the required spaces. The spaces provided by timing in multivibrators are element spaces. That is, they are equal to the space times for the dot and dash elements of a character. At the same time a dot or dash tone is output to the user, a short pulse is sent to a tree-counter circuit such as described hereinafter. These short pulses may be dot, dash, or reset start in any desired combination.

Further, according to the invention, a manual reset may be provided to correct an error by the user before multicharacter display or printing. This is activated by closing both dot and dash switches simultaneously, thereby causing a tone longer than a dash and advising the user that both switches have been closed, also providing a reset pulse to start over in the tree-count storage. This mode can also be used to send a space (blank) to the printer or multicharacter display.

An elapse timer may be used for the printing functions by accumulating time after the last dot, dash, or reset. This elapse time may be equivalent to the character space of the Morse code and also made adjustable for the user's needs. The print signal may be fed to the multicharacter display or printer at the end of the elapse time. Accordingly, the tree counter system of the invention, for example, for the character A, which is dot-dash in Morse code, can be implemented by sending a dot which activates the character E, followed by a dash, which moves the tree counter to character A. For A to be printed, the dash must be sent before the character elapse time is completed. Thus, as already suggested, the timing can be adjusted to a length commensurate with the ability of the operator and does not require a high degree of precision.

At the end of the elapse character time, a tone "tic" (shorter than a dot) may be sent to advise the operator that a pring has occurred. This permits maximum learning in terms of user proficiency and speed and use by a blind or other seriously handicapped person.

After a pring signal, a reset pulse is automatically sent. This restores the tree counter to a blank/start mode.

Among other features of the invention is the advantage that a second elapse time greater than the character elapse time may be included to provide an automatic space for words if a dot or dash is not sent in the adjustable time. This affords flexible usage. For example, by waiting out the second elapse time, the space or blank is sent followed by a tone tic. If a new character is started before the second elapse time is complete, the space is not sent.

The basic storage or latching circuits of the tree counter system of the invention provide for storage by locking on to the character required and turning on a series circuit indicator light in an individual anode circuit. The on condition of the storage-latching device allows an individual character to be output in electronic terms since the anode pulls to a low voltage through its load, the indicator light or resistor. Other circuits, for example, silicon controlled rectifier (SCR) forming unused characters in this mode, are off, the indicator lamps are off (current low), and the anode voltages are "high" for the "output." High or low anode voltages may also be used according to the invention to form the unique parallel binary code output and output individual character information.

Gate controlled, storage-latching and turn-off circuitry has a further advantage in that it economically handles the high power required for indicator lamps and storages without complicating interfacing circuitry and logic.

The preceding and other features and advantages of the invention will become more apparent from the following brief description of the drawing and of certain preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing,

FIG. **1** is the block diagram of a system according to the invention.

FIG. **2** is a schematic depiction of one form of input control and logic according to the invention.

FIG. **3** is a schematic depiction of the circuitry of a representative tree system of the invention.

FIG. **4** depicts diagrammatically a storage circuit simplification of a tree counter such as that shown in FIG. **3.**

FIG. **5** is a schematic diagram of a diode matrix and logic for a sixbit binary output circuit useful according to the invention.

FIG. **6** is a block diagram showing a tree count sequence according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the exemplary embodiment of the invention disclosed in FIG. **1** and FIG. **2,** dot switch **1** and dash switch **2,** as operated, provide full control and operation of the communication system of the invention using telegraphic-type code. Switches **1** and **2** act on control input and logic circuits **3** to perform the necessary operations of the system. More specifically, these switches each act on resistor-capacitor networks **4** and **5** whereby noises such as contact bounces and erratic operations are filtered out by the electrical time constant of the network. Dot imputs on switch **1** causes a gated dot-multivibrator **6** to oscillate, sending a signal to its output **8,** a preset, precisely timed dot-mark and space which is adjustable internally in the electronic circuit. If dot switch **1** is opened before the first mark-space cycle has ended, only one dot is sent. If dot switch **1** is still closed by the operator at the end of a first dot mark-space cycle, a second dot mark-space is sent and so on. Gated dash-multivibrator **7** and output **9** operate in a like manner. The dot mark and dash mark are adjusted internally in the electronics of the multivibrators to provide a dash mark longer than a dot mark so that they may be distinguished by the user. The spaces can also be adjusted to suit the user.

Output **8** of dot-multivibrator **6** is also connected to inhibit **11** of the dash-multivibrator. Output **9** of dash-multivibrator **7** is also connected to inhibit **10** of the dot-multivibrator. Inhibits **10** and **11** prevent a dash mark from beginning before the last dot mark-space cycle has ended and prevent a dot mark from beginning before the last dash-mark space cycle has ended. Dot and dash outputs **8** and **9** from the multivibrators are also connected to a dot one-shot **12** and a dash one-shot **13.** One-shots **12** and **13** form a dot pulse on dot-pulse line **14** and a dash pulse on dash-pulse line **15.** Dot and dash mark-space signals **8** and **9** are also connected to an OR-gate **16** (positive logic) which is output at **17** to a second OR-gate **18,** which connects to a tone oscillator **19** feeding a speaker **20.** Tone oscillator **19** and speaker **20** function to provide an audible tone with any one or all of the following signals: dot-mark, dash-mark, long tone reset mark, and tic mark for print signal and space signal to aid the operator.

A long-tone mark is included to further aid the operator, although not necessary for full automatic operation. However, it is ueful in sending an extra space or correcting an error in the operator's telegraphic code

before a printout occurs. For example, AND-gate **21** connected to both dot and dash inputs, after noise filtering, acts on a timer manual reset **22**, which provides a long tone (by adjustment, longer than a dash) to advise the operator that this function has occurred, this long tone to be provided through OR-gates **16** and **18** to tone oscillator **19** and speaker **20**.

A manual reset timer **22** also outputs a signal at **23** through OR-gate **24**, to a reset timer **25** and one-shot **26**, a reset pulse at reset line **27** to reset TREE-counter **32** to the starting condition, thus allowing error correction in the telegraphic code by and for the operator. Output **17** of OR-gate **16** feed a signal to an inverter **28**, which sends spaces, in positive logic, to a print-timer **29**. This is the elapse time accumulation from the last dot mark, dash mark or long reset mark through OR-gate **16**. When adjustable print-timer **29** times out, a signal is sent to one-shot **30**, causing a print signal on print line **31** and to a multicharacter printer or display **33**. This functions to print an extra space, or, if a dot/-dash input is provided before the print-timer **29** elapses, a new character is printed or displayed.

Output **17** of OR-gate **16** also feeds a signal to inverter **34** which provides an elapse time through space-timer **35** to one-shot **36** to result in a space signal on space line **37**, and to a multicharacterr printer and display **33**. This time is adjusted longer than the print-elapse time and may be used to automatically send one space used for a word space.

Print line **31** and space line **37** are also connected to OR-gate **18** and produce the tic, a very short tone, through oscillator **19** and speaker **20** to advise the operator that a print and then a space have occurred.

A connection **38** is provided from print timer **29** to the OR-gate **24** to reset timer **25**, one-shot **26** and reset line **27** to TREE-counter **32**. This automatically resets the tree counter at the end of the print cycle on a character.

The complete asynchronous operation of the input control and logic is such that all useful communication described above can be performed by an operator using dot switch **1** and dash switch **2**, suitable waiting time or elapse time, and necessary adjustments.

At this point in the configuration, the function flow is asynchronous data. Thus, storage of the asynchronous serial code which includes the aforementioned dot pulse **14**, dash pulse **15**, and reset pulse **27** is required. TREE-counter **32** of FIG. **1** is also asynchronous in function and performs the data storage or memory. The data from the TREE-counter **32** are output as characters on lines **38** to diode matrix or so-called read-only memory (ROM) **39**. The characters are converted to binary code appearing on lines **40** and input to a printer or display **33**.

Referring next to FIG. **3**, the tree-counter configuration disclosed and illustrated features seven similar circuits. These circuits "tree-count" one at a time in a definite sequence as controlled by dot-pulse line **14**, dash-pulse line **15** and reset pulse line **27**, This is what I prefer to call a tree-count sequence. As each circuit turns on, the last circuit turns off, each circuit turning on latches in its proper sequence and remains on until forced off by the turn-on action of the next count.

While the illustration of circuits in FIG. **3** employs seven circuits, three or more circuits are useful in tree counting according to the invention. In FIG. **3**, seven circuits **42***i*, 42*e*, 42*a*, 41, 42*n*, 42*t*, and **42***m* are shown and may be used with nine storage circuits **43**, **42***s*, **42***u*, 42*r*, 42*w*, 42*d*, 42*k*, 42*g*, and **42***o* of FIG. **4**. See also Tables I and II which follow. These may be employed so as to form 63 characters on a binary output, using a simple logic circuit and diode matrices such as illustrated in FIG. **5**.

In using a tree counter according to the invention, one may employ the seven circuits of FIG. **3**, sequencing or counting through each circuit one at a time, starting at the outset at circuit blank **41**. Each count turns on the next circuit and turns off the last circuit. The next circuit to be turned on is selected by a logic function inherent in the on circuit and the dot or dash pulse lines **14** or **15**. A reset pulse on line **27** will return the on to the blank circuit **41** from any other circuit.

Each circuit is interconnected to perform the tree counting or sequences upon command of pulse lines **14**, **15**, and **27**. With respect to blank circuit **41**, the circuit contains a gated controlled latching device **44**, with a gate or input **45**, and anode **46**, and a cathode **47**. The anode to cathode is the major electric path of gated controlled latching device **44**. Device **44** is off at the outset and turns on by action of an input pulse at gate **45**. This also latches electric-currentwise, thus holding until forced to release by reducing the major current to zero. Capacitor **48** passes a reset pulse on line **27** to gate **45** at the outset, turning on blank **41**, latching the major current path, plus potential **49**, through indicator lamp **50**, anode **46** to cathode **47** of the device **44** to ground **51** zero potential. Character indicator lamp **50** and device **44** form a major power path, thus providing the useful functions of direct character indication of blank, without interfacing, performing the storage of this character by a latching action (each circuit does the same). Also blank is output at terminal **52** for other uses. This output is low because voltage or potential drop through indicator lamp **50** acts as a load resistor caused by the on current. Before blank is on, the lamp, acting as a pull-up resistor, causes the voltage at terminal **52** to be high because the current is zero in the off case.

The other circuits of FIG. **3** contain gated-controlled latching devices **44***i*, 44*e*, 44*a*, 44*n*, 44*t*, and **44***m* for like purposes. They also contain indicator lamps **50***i*, 50*e*, 50*a*, 50*n*, 50*t*, and **50***m* for idividual character indication. Each circuit also contains output terminals **52***i*, 52*e*, 52*a*, **52***n*, 52*t* and **52***m*.

The tree counter of the invention has the inherent ability in terms of power and configuration to directly indicate the character stored and to output this information or data for further use. Each circuit has its own power drive capability and an indication of character status to aid the operator.

Anode **46**, being at a low voltage in the on state, performs the selection of the next character or circuits that can be turned on. This is performed by resistors **53** and **54**, which cause the voltage at junctions **55***e* and **55***t* to be low, the same as blank anode **46**, which would be low in this case because blank is on. Accordingly, E **42***e* and T **42***t* circuits are readied for a following count. I **42***i*, A **42***a*, N **42***n* and M **42***m* circuits are not readied because resistors **56**, **57**, **58** and **59** are high due to anodes of circuits E **42***e* and T **42***t* being high. Therefore, with blank **41** on, a dot pulse on line **14** will pass through diode **60***e* and capacitor **61***e*, turning on an E **42***e* circuit or character. A dot pulse does not pass through diodes **60***i*, 60*n*, or **62** as they are reverse-

biased in terms of the high level of voltage carried by resistors **56, 58, 64,** and **65.**

In like manner, when the blank is on at the outset, selector resistors **57, 59, 64,** and **65** allow only the T **42***t* circuit to be turned on with a dash pulse on line **15,** the diodes **60***a*, 60*m* and **63** not passing the pulse. Only diode **60***t* and capacitor **61***t* pass the pulse. In like manner, the selection with E **42***e* on becomes **42***i* with the next dot, or A **42***a* with the next dash. With T **42***t* on the next selection becomes N **42***n*, with the next dot, or M **42***m* with the next dash. Diodes **60***i*, 60*a*, 60*n*, and **60***m* and capacitors **61***i*, 61*a*, 61*n*, and **61***m* are used in these counts in the manner already described.

Reset pulse line **27** is not prevented from turning on blank **41** circuit at any stage of the count, thereby resetting the count from any character. The count may be stopped at any character to allow the elapse timer to perform a print of the desired character followed by the reset.

The tree-counter of FIG. **3** ends at the I **42***i*, A **42***a*, N **42***n*, or M **42***m* (second count level) and may recycle by a third count level back to blank **41.** After the third count level, the seven circuits of FIG. **3** will sequence as before. This is performed by resistor **65** blocking dot and dash pulses through diodes **62** and **63** and capacitor **66** by resistor **64** also being high when E **42***e* or T **42***t* are on. When the count reaches I, A, N or M, diode **67, 68, 69,** or **70** pull resistor **64** low and thus allow diode **62** or **63** to pass a dot or dash, thereby turning on blank **41** through capacitor **66.** The count then can recycle as before.

This recount feature is intended to implement the 63-character repertoire of Tables I and II, which follow, and is used in conjunction with a nine-character storage such as that of FIG. **4** to perform this. This feature is useful in a data management scheme according to the invention.

TABLE I

81	I	E	A	BLANK	N	T	M	80
START	I	E	A	(BLANK)	N	T	M	
S	5	H	4	S	*	V	3	
U	*	F	*	U	?	*	2	
R	*	L	*	R	.	*	*	
W	*	P	*	W	*	J	1	
D	6	B	*	D	*	X	*	
K	*	C	*	K	*	Y	*	
G	7	Z	,	G	*	Q	*	
O	8	*	*	O	9	*	∅	

TABLE II

81	I	E	A	BLANK	N	T	M	80
START	1	2	3	4	5	6	7	
S	8	16	24	32	40	48	56	
U	9	10	11	12	13	14	15	
R	17	18	19	20	21	22	23	
W	25	26	27	28	29	30	31	
D	33	34	35	36	37	38	39	
K	41	42	43	44	45	46	47	
G	49	50	51	52	53	54	55	
O	57	58	59	60	61	62	63	

The configuration of FIG. **3** has also a turn-off function of the last character or circuit. Every circuit has a capacitor connection (anode-to-anode) which performs the turn-off function. With blank **41** on, the anode-to-anode capacitor **71***e* is charged such that if E **42***e* turns on, the voltage at anode **46** is forced low, thereby turning off blank **41.** All of these circuits function in a like manner, using turn-off capacitors **71***e*, 71*t*, 71*i*, 71*a*, 71*n* or **71***m* during counting and turn off capacitor **72***i*, 72*a*, 72*n* or **72***m* during reset. Accordingly, only one circuit in FIG. **3** is on at a time.

The nine storage circuits of FIG. **4** are illustrative of an implementation of the data management scheme of aforementioned Tables I and II. These circuits are like those of FIG. **3** except for the interconnection configuration, the nine circuits being start **43,** S **42***s*, U **42***u*, R **42***r*, W **42***w*, D **42***d*, K **42***k*, G **42***g*, and O **42***o*. Each circuit contains gate-controlled latching devices **74,** 74*s*, 74*u*, 74*r*, 74*w*, 74*d*, 74*k*, 74*g*, and **74***o* which are respectively used on FIG. **3.** Indicator lamps for nine circuits Start **75,** S 75*s*, U 75*u*, R 75*r*, W 75*w*, D 75*d*, K 75*k*, G 75*g*, and o 75*o* are also used.

Referring again to FIG. **4,** at the outset, a reset pulse on line **27** causes start **43** to turn on through capacitor **73** (at the same time Blank **41** of FIG. **3** turns on). The selector resistors **76***s*, 76*u*, 76*r*, 76*w*, 76*d*, 76*k*, 76*g*, and **76***o* of the storage circuits are connected to anode output terminals I **52***i*, A **52***a*, N **52***n*, and M **52***m* of FIG. **3,** so that the storage circuits of FIG. **4** count only at a third level of dot-and-dash pulses on lines **14** and **15** respectively. The dot-pulse line **14,** dash-pulse line **15,** and reset-pulse line **27** of FIGS. **3** and **4** are common. Therefore S **42***s* will turn on if I **42***i* is on, the selector resistor **76***s* being low, and a dot-pulse is sent on line **14.** S **42***s* remains on until reset by start **43** circuit.

If I **42***i* is on after the second level count, only selector resistors **76***s* and **76***u* of FIG. **4** are low. Therefore, a dot on line **14** at the third level count will turn on only S **42***s* of FIG. **4** through diode **77***s* and capacitor **78***s*. Likewise, a dash on line **15** at the third level count will turn on only U **42***u* of FIG. **4,** through diode **77***u* and capacitor **78***u*. The circuit S **42***s* or U **42***u*, once turned on, will remain on until reset.

If A **42***a* is on after the second level count, only selector resistors **76***r* and **76***w* of FIG. **4** are low. Therefore a dot on line **14** at the third level count will turn on only R **42***r* of FIG. **4** through diode **77***r* and capacitor **78***r*. Likewise a dash on line **15** at the third level count will turn on only W **42***w* of FIG. **4** through diode **77***w* and capacitor **78***w*. The circuit R **42***r* or W **42***w* once turned on, will remain on until reset.

If N **42***n* is on after the second level count, only selector resistors **76***d* and **76***k*, of FIG. **4** are low. Therefore, a dash on line **15** at the third level count will turn on only K **42***k* of FIG. **4** through diode **77***k* and capacitor **78***k*. The circuit D **42***d* or K **42***k* once turned on will remain on until reset.

If M **42***m* is on after the second level count, only selector resistors **76***g* and **76***o*, of FIG. **4,** are low. Therefore, a dot on line **14** at the third level count will turn on only G **42***g* of FIG. **4** through diode **77***g* and capacitor **78***g*. Likewise, a dash on line **15** at the third level count will turn on only O **42***o*, of FIG. **4** through diode **77***o* and capacitor **78***o*. The circuit G **42***g* or O **42***o* once turned on will remain on until reset.

Also as S **42***s*, U **42***u*, R **42***r*, W **42***w*, D **42***d*, K **42***k*, G **42***g* or O **42***o* turns on, Start **43** is turned off by capacitor **79***s*, 79*u*, 79*r*, 79*w*, 79*d*, **79***k*, 79*g*, or **79***o*. These capacitors also turn off S, U, R, W, D, K, G, or O on reset when start **43** turns on.

At the third level count, the tree counter of the configuration of FIG. **3** returns to blank **44** as previously explained, and will tree count again through E, I, A, T,

N, and M. Thus, counting through Levels **1** to **5**, two circuits are always on, one in FIG. **3** and one in FIG. **4**, describing the 63 character repertoire of Tables I and II aforementioned.

The intersection of the two character circuits that are on describes the desired character of the 63-character repertoire. For example, if character I is desired, two dots are input by the operator, and at the end of the count, I **42***i* and start **75** are on. As is confirmed by Table I aforementioned, row **80** is start and column **81** is I. Therefore, the character assignment in this particular instance would be I at this intersection. This combination forms a binary output of 1 according to Table II wherein is shown a representative binary output code for a tree counter according to the invention, and by the configuration of FIG. **5**.

As a further example, if H is desired, four dots are input by the operator, thereby counting to circuits S **42***s* and E **42***e* which are on. The row **80** and column **81** intersection become character H of Table I, wherein is given a typical character assignment for a tree counter according to the invention. The binary output shown in Table II is **16** for the H assignment. It should be noted a count level of 0, 1, 2, 3, 4, or 5 will define all 63 character assignments of Table I and all binary outputs of Table II.

A stop count circuit (not shown) may be included to limit the tree count at Level **5** using the output of Start **43**, I **42***i*, A **42***a*, N **42***n* and M **42***m* of FIG. **3** and FIG. **4** in conjunction with a logic gate configuration to further input inhibits on lines **10** and **11** of FIG. **2**.

The **16** indicator lamps of the circuits in FIG. **3** and FIG. **4** display to the operator the status of the characters stored. Changes or corrections may be made before the character is printed or displayed on a multi-character system.

Further, the panel board may be arranged in a manner which greatly simplifies the learning of a code such as Morse, and the need for rote memorization of a code by the user is eliminated, as will be seen more clearly from a study of FIG. **6** and Table III, which follows and which shows one tree counting sequence for a full or general tree counter according to the invention.

TABLE III

TREE COUNTING SEQUENCE FOR FULL TREE COUNTER

CHARACTER	MORSE-CODE	COUNT LEVEL (NO. OF DOTS OR DASHES IN CHARACTER) START	1st	2nd	3rd	4th	5th	6th	OUTPUT ASCII CODE
A	.-	(BLK),	. →E,	- →A.					1
B	-...	(BLK),	- →T,	. →N,	. →D,	. →B.			2
C	-.-.	(BLK),	- →T,	. →N,	- →K,	. →C.			3
D	-..	(BLK),	- →T,	. →N,	. →D.				4
E	.	(BLK),	. →E.						5
F	..-.	(BLK)	. →E,	. →I,	- →U,	. →F.			6
G	--.	(BLK),	- →T,	- →M,	. →G.				7
H	....	(BLK),	. →E,	. →I,	. →S,	. →H.			8
I	..	(BLK),	. →E,	. →I.					9
J	.---	(BLK),	. →E,	- →A,	- →W,	- →J.			10
K	-.-	(BLK),	- →T,	. →N,	- →K.				11
L	.-..	(BLK),	. →E,	- →A,	. →R,	. →L.			12
M	--	(BLK),	- →T,	- →M.					13
N	-.	(BLK),	- →T,	. →N.					14
O	---	(BLK),	- →T,	- →M,	- →O.				15
P	.--.	(BLK),	. →E,	- →A,	- →W,	. →P.			16
Q	--.-	(BLK),	- →T,	- →M,	. →G,	- →Q.			17
R	.-.	(BLK),	. →E,	- →A,	. →R.				18
S	...	(BLK),	. →E,	. →I,	. →S.				19
T	-	(BLK),	- →T.						20
U	..-	(BLK),	. →E,	. →I,	- →U.				21
V	...-	(BLK),	. →E,	. →I,	. →S,	- →V.			22
W	.--	(BLK),	. →E,	- →A,	- →W.				23
X	-..-	(BLK),	- →T,	. →N,	- →D,	- →X.			24
Y	-.--	(BLK),	- →T,	. →N,	- →K,	- →Y.			25
Z	--..	(BLK),	- →T,	- →M,	. →G,	. →Z.			26
1	.----	(BLK),	. →E,	- →A,	- →W,	- →J,	- →1.		49
2	..---	(BLK),	. →E,	. →I,	- →U,	- →*,	- →2.		50
3	...--	(BLK),	. →E,	. →I,	. →S,	- →V,	- →3.		51
4	....-	(BLK),	. →E,	. →I,	. →S,	. →H,	- →4.		52
5	.....	(BLK),	. →E,	. →I,	. →S,	. →H,	. →5.		53
6	-....	(BLK),	- →T,	. →N,	. →D,	. →B,	. →6.		54
7	--...	(BLK),	- →T,	- →M,	. →G,	. →*,	. →7.		55
8	---..	(BLK),	- →T,	- →M,	- →O,	. →*,	. →8.		56
9	----.	(BLK),	- →T,	- →M,	- →O,	- →*,	. →9.		57
∅	-----	(BLK),	- →T,	- →M,	- →O,	- →*,	- →∅.		48
(.)	.-.-.-	(BLK),	. →E,	- →A	. →R,	- →*,	. →*	- →(.).	46
(,)	--.--	(BLK),	- →T,	- →M,	. →G,	. →Z,	- →*,	- →(,).	44
(?)	..--..	(BLK),	. →E,	. →I,	- →U,	- →*,	. →*,	. →(?).	63
(*)	Other special characters can use the remaining combinations.								XX
(BLK)	None	(BLK).							32

A two-character indication of FIG. **3** and FIG. **4** is direct for blank, E, T, I, A, N, M, S, U, R, W, D, K, G, and O, often used letters. Other letters become obvious when using a simple memory aid. For example, H, being dot-dot-dot-dot in Morse code is formed by SE, the S being dot-dot-dot and the E being dot. It would only be necessary to remember that H was S followed

by an E. It is convenient to note the E must follow the S before the elapse timer times out to print or display the H. In some applications, it is desirable to have a full three counter, for example such as shown in FIG. 6. However, one can operate according to the invention by using only the first or top three levels of the tree counter depicted in FIG. 6, and nine storage circuits of FIG. 4, if desired.

Further, it should be noted that all printer and multicharacter displays 33 have special functions such as bells, line space, erase, back space, etc. These can be implemented by using outputs of special character assignment such as those shown in Tables I, II, and III as (*) hereinabove.

From the preceding description it can be readily seen that combining FIGS. 2, 3, and 4 forms a 63-character system of unique economy whereby two circuits may always be on so as to define a character in the manner indicated in the pattern of Tables I and II. Of course, the circuitry may be extended or reduced to any desired count level or character repertoire.

Referring again to FIG. 5, and additionally to FIG. 3 and FIG. 4, using diode matrix 82 and 92 connected to the anodes of an individual character output of FIG. 3 and FIG. 4 results in direct and economical conversion to parallel binary data such as those shown in Table II, with a unique representation for each character to be used for data transfer according to the invention.

With respect to the aforementioned converting tree counter output to binary code, FIG. 5 shows a major current path for circuits I 42*i*, E 42*e*, A 42*a*, Blank 41, N 42*n*, T 42*t* and M 42*m* of FIG. 3 output to a diode matrix 82. This diode matrix is further output on 3-bit binary lines 83, 84 and 85. These binary lines are connected to three "NOR" gates 86 and through three inverters 87 to lines 88, 89, and 90. These lines are one-half the representative special binary code, namely line 88 bit 1, line 89 bit 2, and line 90 bit 4. The other inputs of "NOR" gates 86 are connected through diode 91 to start circuit 43, via line 80. If start circuit 43 is on, gate controlled latching device 74 conducting, then diode 91 allows "NOR" gates 86 to control lines 88, 89 and 90 via diode matrix 82. Diode matrix 92 is not in use when circuit start 43 or S 42*s* is on. When start 43 is off, gates 86 and diode matrices 82 no longer control binary lines 88, 89, and 90, bit 1, bit 2, and bit 4 as line 80 is high. With start 43 off, inverter 93 and line 81 allows the three "NOR" gates 94 to control binary lines 96, 97 and 98, bit 8, bit 16, and bit 32 by diode matrix 82 through the three inverters 95. The diode matrix 92 can control binary lines 88, 89, and 90 at any time through drivers 99. The configuration of FIG. 5, the stored output of the 16 latching circuits, diode matrices 82 and 92, "NOR" gates 86 and 94, diode 91, inverter 93, drivers 99, and inverters 95, and 87 provide a binary output such as represented on Table II herein above. The data remain present until the circuits are reset. Then the binary data reverts back to a blank binary code. This special binary code may be converted to standard binary data such as ASCII with a read-only memory.

The 6-bit binary data may be converted by a read-only memory 39 to standard binary data required on lines 40 of FIG. 1 of the particular print or multicharacter display 33 used.

Referring now more specifically to the full tree counter of FIG. 6, the count starts at Blank (BLK) 41 and progresses through the sequence per Table III herein above to the desired character. As one circuit turns off, a new one turns on. The count or sequence is the same as for the tree counter shown in FIG. 3 for circuits Blank (BLK) 41, E 42*e*, T 42*t*, I 42*i*, A 42*a*, N 42*n*, and M 42*m*.

TABLE IV

I 42*i*	S 42*s* or U 42*u*
A 42*a*	R 42*r* or W 42*w*
N 42*n*	D 42*d* or K 42*k*
M 42*m*	G 42*g* or O 42*o*
S 42*s*	H 42*h* or V 42*v*
U 42*u*	F 42*f* or (*) 100*a*
R 42*r*	L 421 or (*) 100*b*
W 42*w*	P 42*p* or J 42*j*
D 42*d*	B 42*b* or X 42*x*
K 42*k*	C 42*c* or Y 42*y*
G 42*g*	Z 42*z* or Q 42*q*
O 42*o*	(*) 100*c* or (*) 100*d*
H 42*h*	(5) 101 or (4) 102
V 42*v*	(3) 103
(*) 100*a*	(*) 100*e* or (2) 104
(*) 100*b*	(*) 100*f*
J 42*j*	(1) 105
B 42*b*	(6) 106
Z 42*z*	(7) 107 or (*) 100*g*
(*) 100*c*	(8) 108
(8) 100*d*	(9) 109 or (ϕ) 110
(*) 100*e*	(?) 111
(*) 100*f*	(.) 112
(*) 100*g*	(.) 113

In Table IV herein above, each circuit indicated in the left column permits selection of the corresponding circuit on the next right column, per the dot or dash signal input on the next count.

Each of the circuits may be the same as the basic circuits of FIG. 3. Alternatively, other storage devices such as flip-flops with a simple logic turn-off may be used according to the invention. Indicator lamps of the tree counter of FIG. 6 may be arranged on the panel board so as to aid learning, for example, the dots being a left operation and dashes a right operation as shown by arrows 114 and 115, respectively.

The output terminal of the tree counter of FIG. 6 may be connected to a diode matrix of any specific binary code desired, for example, the ASCII already mentioned.

In the representative tree counter system which I have found particularly useful according to the invention of FIG. 6, the tree-counting sequence is as follows:

1. A reset pulse (automatic from the control or at user choice) sets the start/blank storage/latching device and lamp "on" and the data output lines are in the electronic configuration of the blank code for the multicharacter printer and display device used.

2. The next input (dot or dash) pulse feeds all (½-dot and ½-dash) gate controlled circuits, but only one acts on the circuit readied (programmed) by the logic resistor. In this particular example, only the E and T circuits are readied. Thus, if a dot is pulse, the E turns on, and, if a dash is sent, a T turns on. When the E or T turns on, the circuit action also turns off the start/blank circuit. Thus, either E or T is stored, and, if the print time elapses either E or T is printed. This result is followed by an automatic reset to start/blank position caused by the control timer.

3. The second dot or dash selects either I or A if the first element pulse was a dot, or either N or M if the first element pulse was a dash. This turning "off" the E or T insures that only the desired letter is on and only the desired individual letter is output to the printer or multicharacter display.

4. The third, fourth, and fifth dot or dash selects a

character based on previous dot and dash combinations in like manner. Simple calculation shows five count levels of dots and dashes in a 63-character repertoire which is adequate for most applications. However, the circuitry may be extended or reduced to any desired count level or character repertoire.

A 63-character tree counter such as explained herein above may be simplified by using the seven characters of dot-dash count levels twice and adding eight or nine storage circuits at a third-count level. This involves simply splitting the "start" and "blank" indicator and circuits and means that size, cost and circuitry can thus be reduced. Such a simplified version requires only 15 or 16 circuits.

In such a simplified tree counter (special tree-counter) there are two characters or indications at all times. Thus characters are formed by two lights. A is formed by start and A being on. B (which is dash-dot-dot-dot) is formed by D, and E being on, whereas D is dash-dot-dot followed by E, which is dot. Thus B is formed by a simple memory aid.

Seven tree counting circuits according to the system of the invention, assuming Morse code, include blank (0 count level); E and T (1st count level); and I, A, N and M (2nd count level). Nine storage circuits may be represented by start, S, U, R, W, D, K, G, and O. Except for the "start" circuit which is used at the outset of the counting cycle, nine storage SCR circuits are used only after the third count level of dots and dashes.

The individual character outputs may be interfaced directly to some available printers or multicharacter displays, or a read-only memory (ROM), may be used to convert to the code required such as ASCII shown in Tables I and II, herein above.

Tables I and II show the assignment for 63 characters in terms of 16 storage latching device circuits. The circuits of the tree counter (I, E, A, Blank N, T, and M) and the other circuits (Start, S, U, R, W, D, K, G, and O) provide 63 characters. The letters, numbers and punctuation of the standard Morse code are shown at the proper combinations of the two circuits that are "on." For example, start/blank is "on" after a reset or at the outset. This yields blank from Table I and outputs a 6-bit binary 4 similar to that depicted on Table II. Other characters are formed by other combinations. An asterisk or star hereinafter referred to as a miscellaneous character, indicates that other symbols may be assigned to correspond to the type printer or multicharacter display used. Table I below shows these unique 6-bit data in negative logic after the 16-line output of the tree count-storage circuits passes through two 3-bit diode matrices and a simple logic circuit. The first 3-bit matrix outputs **1, 2, 3, 4, 5, 6,** and **7** in binary code for the I, E, A, blank, N, T, and M circuits respectively. The "S" circuit switches the logic to outputs **8, 16, 24,** 32, 40, 48, and **56** on the I, E, A, blank, N, T, and M respectively, as shown in the drawing to be described hereinafter. U, R, W, D, K, G, O, add to the above first 3-bit by 8, 16, 24, 32, 40, 48 and 56 respectively in the second 3-bits. This 6-bit output may be converted directly to the 6-bit code standard used in the printer with a ROM.

While the invention has been described in terms of preferred embodiments, the claims appended hereto are intended to encompass all embodiments which fall within the spirit of the invention.

Having thus described my invention and certain preferred embodiments thereof, I claim:

1. A system for converting no more than three different signals into a stored representation of at least seven characters comprising sensing means responsive to said signals for discriminating between said signals and storing characters indicated by said discriminating between said signals, storing means responsive to said sensing means for holding a character represented by one of said signals if the same signal or a second different signal is not sensed within a predetermined time following said sensing of said one signal, further storing means responsive to said sensing means for holding a character represented by a second of said signals or a character represented by sensing said one and then said second signal following said sensing of said one if another signal is not sensed within the same or a different predetermined time, a plurality of additional storing means responsive to said sensing means for holding additional characters represented by one or more of said signals in any particular order of said one or more of said signals after said predetermined time has elapsed, correction means associated with said plurality of sensing and storing means for erasing the holding of one or more or all of said characters and additional correction means associated with said plurality of sensing and storing means for resetting to blank by erasing all characters held prior to said erasing, said system permitting storage of at least 7 characters by said sensing and discriminating between said no more than three different signals.

2. The system of claim **1** additionally having means for indicating said stored characters upon a display panel at the time of storage or subsequent to said storage.

3. The system of claim **1** wherein said stored characters are output via electrical lines to a diode matrix where they are converted to a binary code and input to a printer or display.

4. The system of claim **1** wherein the at least two different signals comprise a dot and a dash.

5. The system of claim **4** wherein said means for storing characters indicated by said dot comprise a gated dot multivibrator having a preset, timed dot-mark and space-mark output, said means for storing characters indicated by said dash comprise a gated dash multivibrator having its own preset, timed dot-mark and space-mark output, said output of said dot multivibrator being connected to an inhibit of said dash multivibrator and said output of said dash multivibrator being connected to an inhibit of said dot multivibrator, said outputs of said dot multivibrator and said dash multivibrator being connected to respective dot and dash one-shots, respective pulse lines for pulsing dots and dashes from said one-shots thereon, said dot and dash outputs being connected electrically to means for producing sensible signals for dots, dashes, erasure and resetting to a blank and a spacing tic.

6. The system of claim **5** wherein said sensible signals are audible.

7. The system of claim **5** wherein said sensible signals are visible.

8. The system of claim **5** wherein said sensible signals are both audible and visible.

9. The system of claim **5** wherein said dot and dash outputs are connected to said means for producing sen-

sible signals by an OR-gate arrangement connected to a tone oscillator which feeds a speaker.

10. The system of claim **5** wherein said dot and dash outputs are connected to said means for producing sensible signals by an OR-gate arrangement connected to lights on a display panel for flashing characters representing one or more of said dots and dashes according to a particular order of one or more dots or dashes or of one or more dots or dashes followed by one or more additional dots or dashes.

11. The system of claim **10** wherein said signals are Morse code signals.

12. The system of claim **10** wherein said characters comprise letters of the Arabic alphabet and a blank.

13. The system of claim **10** wherein said characters comprise letters of the Arabic alphabet, a blank, a miscellaneous character and numbers 1 through 9.

14. The system of claim **10** wherein the characters comprise letters of the Arabic alphabet, a blank, miscellaneous character, numbers 1 through 9, a period, a comma and a question mark.

15. The system of claim **10** wherein said characters comprise 15.

16. The system of claim **10** wherein said characters comprise 63.

17. A process for reception, storage and display of Morse or other code which comprises transmitting code signals via respective gated multivibrators, thereby causing them to oscillate in the order of reception of signals indicating transmission of dots and dashes, thereupon sending signals to their respective outputs for dots and dashes, by means of timed inhibits preventing a dash from being stored before a predetermined dot space cycle has ended and preventing a dot from being stored before a predetermined dash space cycle has ended, and storing said dots and dashes as specific characters according to the order received by a known code.

18. The process of claim **17** wherein the code is the Morse code.

19. The process of claim **17** wherein said stored characters are visibly displayed by passing them via electrical lines through a tree-counter to a diode matrix where they are converted to a binary code which is input to a printer or display.

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