June 24, 1958 J. T. McNANEY ET AL 2,840,637

SYSTEM FOR CONVERTING TELEGRAPHIC CODE INTO CHARACTERS

Filed Feb. 28, 1955 3 Sheets-Sheet 1

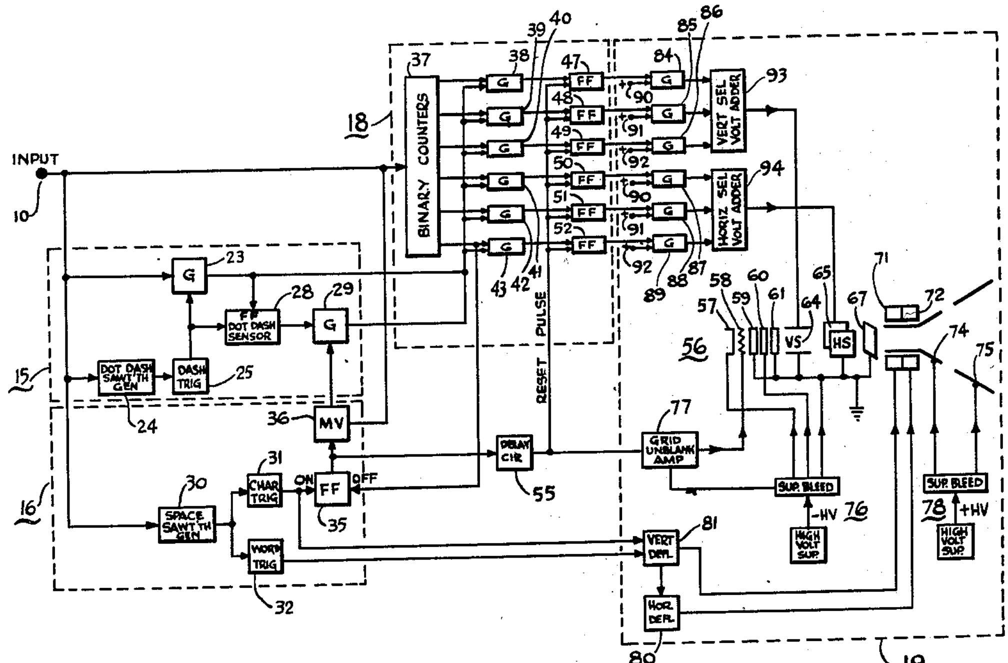

FIG_1

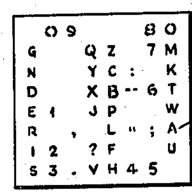

FIG_4

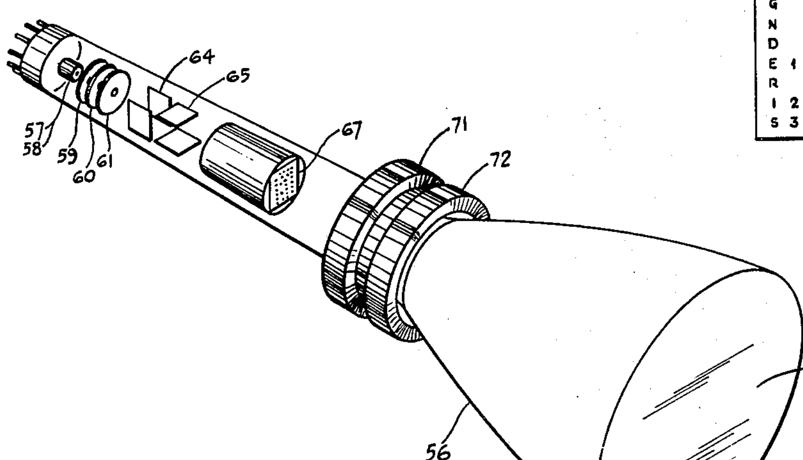

FIG_3

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SYSTEM FOR CONVERTING TELEGRAPHIC CODE INTO CHARACTERS

Filed Feb. 28, 1955 3 Sheets-Sheet 2

MORSE TO BINARY CODE CHART

11 17 14 12 13

A	.—	101111	W	.——	100111
B	—...	011100	X	—..—	011011
C	—.—.	010100	Y	—.——	010011
D	—..	011000	Z	——..	001100
E	.	100000	1	.————	100001
F	..—.	110100	2	..———	110001
G	——.	001000	3	...——	111001
H	....	111100	4	....—	111101
I	..	110000	5	.....	111110
J	.———	100011	6	—....	011110
K	—.—	010111	7	——...	001110
L	.—..	101100	8	———..	000110
M	——	001111	9	————.	000010
N	—.	010000	0	—————	000001
O	———	000111	,	.—.—.—	101010
P	.——.	100100	"	.—..—.	101101
Q	——.—	001011	?	..——..	110011
R	.—.	101000	—	—....—.	011101
S	...	111000	:	—.—.—.	010101
T	—	011111	;	.—..—	101110
U	..—	110111	.	...—.—	111010
V	...—	111011			

FIG_2

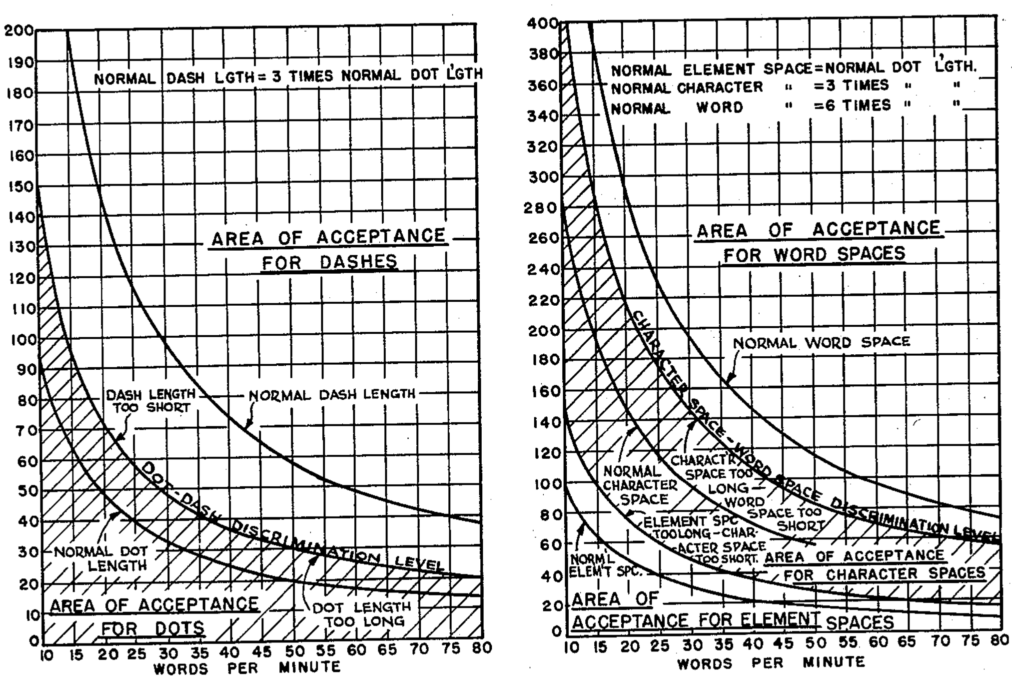

FIG_5

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June 24, 1958 J. T. McNANEY ET AL 2,840,637

SYSTEM FOR CONVERTING TELEGRAPHIC CODE INTO CHARACTERS

Filed Feb. 28, 1955 3 Sheets-Sheet 3

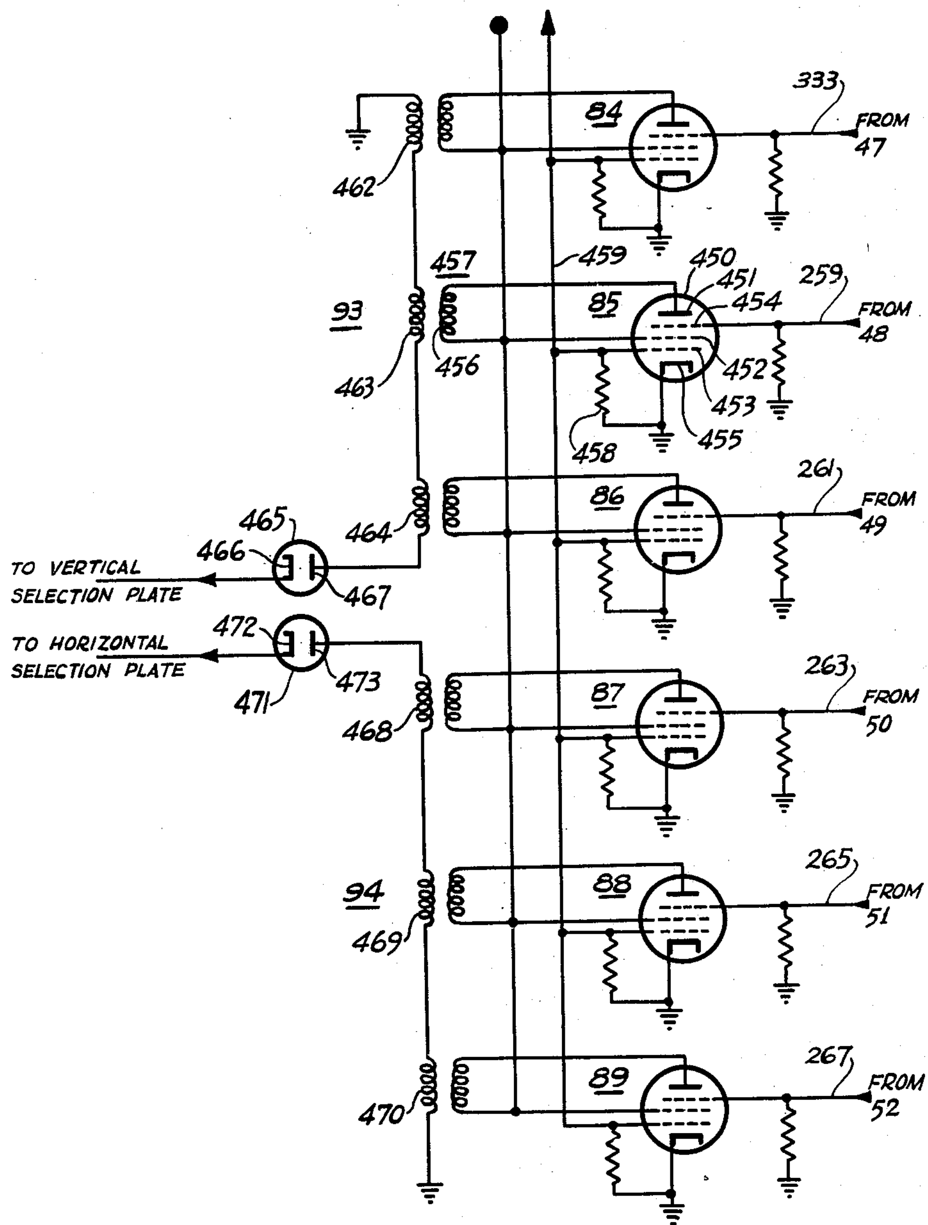

Fig-6

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SYSTEM FOR CONVERTING TELEGRAPHIC CODE INTO CHARACTERS

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Application February 28, 1955, Serial No. 491,116

5 Claims. (Cl. 178—15)

This invention relates generally to a system for converting telegraphic code into characters and more particularly to such a system for substantially instantaneous visual display of characters corresponding to code signals.

Cathode ray tube display tubes in which an electron beam is shaped into desired character type information for direct reading visual presentation upon a screen of the display tube are known to the prior art. These tubes employ a matrix which is a stencil like presentation of desired character-shaped openings. The electron beam emitted by a cathode of the cathode ray tube is intercepted, after emission and prior to impingement upon the cathode ray tube screen, by the matrix. The beam illuminates the opening of the desired character thereby shaping the beam into a cross-section shaped in accordance with the character opening shape. The shaped beam then impinges upon the cathode ray tube screen presenting a character thereon simulating the character shape. By applying proper selection and deflection voltages to the cathode ray tube characters are selected from the matrix and deflected on the screen to permit formation of words and sentences.

These display tubes then become important in permitting quick resolution of code into characters. Such codes form the bases for radio and landline communications, namely, Morse, Continental and like codes which are utilized in world-wide communications. In these codes the dot-dash signal system is used to interrupt, generally a continuous wave radio or landline transmission, commonly referred to as C. W. code. This code is changed into binary coding for presentation to proper circuitry which responds to apply the necessary display tube voltages to produce the desired character display.

Messages may be received over a wide range of speeds which are comparable to that of hand-worked signals to the high speed transmission rates of modern telegraph systems. These operational rates, of present equipment, may vary from 10 to 80 words per minute. The display tube and associated circuits are capable of speeds of several thousand words per minute.

The basic time measurement of such a system is the dot signal. The dash is generally three times the length of the dot. All information sent by C. W. code is coded into the dot-dash code. The individual letters, numerals, punctuation marks and the like, which are coded, must be spaced properly to permit intelligent resolution upon reception. Further, grouping of characters or words is desired and therefor spacing is necessary intermediate such groups to aid in resolution upon reception. With the dot as the basis of time measurement, the spaces separating successive impulses of a particular coded character are of one dot length. The spaces between characters or impulse groups are equal to three dots and the spaces between groups of characters or words are equivalent to six dots. The particular parameters involved in converting code information for visual character presentation upon the display tube screen, are a minimum of a single dot length impulse and a maximum of six dot length impulses for information, character spacing or word spacing denotation.

The present invention utilizes the coded information received by an ordinary communications receiver or from a landline and presents this information to circuitry necessary to convert the dot-dash information into proper selection and deflection voltages for properly operating the cathode ray display tube and presenting a visual character display upon the screen of the display tube.

Morse, Continental and like codes, as previously explained, are sent in dot and dash pulses. Therefore, it is necessary to differentiate a dot from a dash. In addition, an element space (the spacing between consecutive dots or dashes), a character space (the spacing between groups of dots or dashes), and a word space (the spacing between groups of characters or words) must be sensed as such.

A dot-dash discriminator is provided for sensing the dot or dash and spacing. The discriminator circuit develops triggering pulses to a code converter. The code converter transforms the discriminator pulses into "yes-no" information which is supplied to the display tube control circuit. The "yes-no" information received by the tube control circuit is converted to proper horizontal and vertical selection voltages to select the proper character from the display tube matrix for presentation upon the display tube screen. Additional circuitry is supplied to position the characters in proper sequence upon the screen.

As this system lacks mechanical inertia, very high speeds of code reception and resolution are possible.

It is an object of this invention to provide a system which converts telegraphic code into characters.

It is another object of this invention to provide a system capable of resolving code into characters with minimal inertia.

It is another object of this invention to provide a system for resolution of code into characters which system permits reasonable variations in speeds of the transmitting operators.

It is another object of this invention to provide a system for resolution of code into characters which is capable of adjusting itself to varying dot and dash lengths within reasonable limits.

It is another object of this invention to provide a system capable of resolving equally well varying quality code transmissions into a visual character presentation.

Other objects and advantages will hereinafter appear. For the purpose of illustrating our invention, an embodiment thereof is shown in the accompanying drawings, wherein:

Figure 1 is a block diagram of a system embodying the invention;

Figure 2 shows an illustrative Morse to binary code conversion chart;

Figure 3 is a perspective view partially in section of a cathode ray display tube diagrammatically shown in Figure 1;

Figure 4 is an enlarged view of a portion of the matrix of the cathode ray display tube of Figure 3;

Figure 5 shows curves illustrating discrimination and tolerance limits of the embodiment of Figure 1;

Figure 6 is a schematic circuit diagram of the gates and adder portions of the system.

Referring more particularly to the drawings, Figure 1 is illustrative of an embodiment of the invention for converting telegraphic code into characters. Figure 1 is shown in block diagram form and includes an input **10**. Various codes such as Morse, Continental or the like, generally designated as telegraphic code may be presented to input **10**. Telegraphic code **11** is shown in Figure 2 and is generally composed of dot signals **12** and dash signals **13** for characters **14**. The dot and dash signals **12, 13**, whether received from a radio communications receiver or a landline are generally sent by continuous radio wave or continuous wave landline transmission. Therefore, formation of the dot and dash signals **12, 13** actually becomes an aggregate of forming differing length square waves. These square waves, representing dot and dash signals **12, 13**, have a leading edge which generally indicates an abrupt rise in voltage and a trailing edge which generally indicates an abrupt drop in voltage. The portion intermediate the leading edge and the trailing edge is varied in length to thereby indicate either the dot signal **12** or the dash signal **13**. It should be appreciated, accordingly, that the invention utilizes as its basic constituents devices which measure time and devices which respond substantially instantaneously to predetermined time measurement.

The dot signal **12** is utilized as the basic measure of time. As is shown in Figure 5, which figure will be examined in greater detail further on, the normal dash signal lenth is three times the length of the dot signal. The normal element space, that is, the space between dot or dash signals, is equivalent to a normal dot signal length; that of a normal character space, that is, the space intermediate a group of dot and dash signals signifying a character, is equivalent to three times a normal dot signal length; and that of a normal word space, that is, groups of characters, is equivalent to six times the length of a normal dot signal length.

When the dot or dash signal **12, 13** is impressed upon input **10**, a first means **15**, is needed, which is responsive to the code **11** or dot and dash signals **12, 13** for sensing and discriminating between the dot and dash signals. A second means **16** which is also responsive to the code **11** impressed upon input **10**, is provided for sensing spacing of the dot and dash signals **12, 13** and of the character and word spacings or of the groups of signals **12, 13**. The dot and dash signals having been identified and proper spacing being supplied, it is now necessary to convert this information into a binary code **17**, illustrated in Figure 2. The numeral "1" shown in binary code **17** represents "yes" information, and the numeral "0" shown in binary code **17** represents "no" information. The binary code **17**, therefore, is merely a "yes" and "no" information which results as output from a third means **18**.

Third means **18** is responsive to the code **11** impressed upon input **10**, to first means **15** and to second means **16** for selectively converting output of the first means **15** and the second means **16** into "yes" and "no" information. A fourth means **19** is responsive to second means **16** and utilizes the "yes" and "no" information of third means **18** for presenting the code **11** as characters **14**. In addition, a coincidence means **29**, which may be grouped with first means **15**, is shown as an And gate, as is well known in the prior art as shown in Figure 10.16, page 379 of "Waveforms," edited by Chance et al., published by McGraw-Hill Book Company, Inc., New York, 1949, and is responsive to the remainder of the first means **15** for selective operation of the second means **16** through coincidence means **29** to cause responses in the third means **18**.

The broad overall aspect of the present invention having been described, a more detailed description to further the understanding of the instant embodiment follows. The embodiment as shown in block diagram in Figure 1, utilizes a new and novel combination of known elements, namely; And gates, designated as "G" in the drawing and which may be constructed pursuant to the teachings of Chance et al. in the book entitled "Waveforms," published by McGraw-Hill Book Company, Inc., New York, 1949, page 379, Figure 10.16, shown in the drawings as various gates, namely, gates **23, 29, 38** through **43** and **84** through **89**, which gates respond to a pulse of energy to open the gate and to pass a second information pulse through the gate, each gate having two inputs and a single information pulse output; sawtooth generators constructed in accordance with the teachings of Samuel Seely in his book entitled "Electron-Tube Circuits," published by McGraw-Hill Book Company, Inc., New York, 1950, page 449, utilize either the circuits of Figures 20–17 or 20–18, or, the preferred circuit as shown in the figure of problem 20–7 on page 458, in the sawtooth generators **24** and **30**, for time measurement of signals **12, 13** and space lengths, in which the amplitude of the sawtooth function is substantially directly proportional to the length of the input function utilized. For example, as the dash signal **13** is three times the length of the dot signal **12**, the sawtooth amplitude for dash signal **13** will be three times that for dot signal **12**. The sawtooth generators are followed by amplitude-sensing trigger circuits, such as an Evans trigger circuit as illustrated by O. S. Puckle on page 80 of his book "Time Bases," published by John Wiley & Sons, Inc., New York, 1951, and used in the circuits **25, 31** and **32**. These trigger circuits will trigger only when the sawtooth amplitude reaches a predetermined amplitude. The general curves of response for these trigger circuits are shown in Figure 5 as for example for the areas of acceptance for dashes and word spaces. In addition, flip-flop circuits, of well known circuitry as is shown by Seely in his book entitled "Electron-Tube Circuits," McGraw-Hill Book Company, Inc., New York, 1950, pages 419 through 422, preferably utilizing the Eccles-Jordan circuit shown in Figures 19–14, and designated as "F.F." in the drawing and numbered as **28, 35, 37, 47** through **52**, are employed as "yes" and "no" or "on" and "off" switches. These flip-flop circuits merely act as switches, one pulse turning the switch "on" and thereby passing "yes" information, and another pulse turning the switch "off" with resulting "no" information being permitted to pass. Third means **18** and fourth means **19** may utilize the construction shown in Serial Nos. 340,245, filed March 4, 1953, and 340,596, filed March 5, 1953, both assigned to the common assignee hereof. The aforestated circuits are used with well known binary counter circuits, constructed in accordance with the teachings of Warren H. Bliss in his article "Electronic Digital Counters," published in the April 1949 issue of "Electrical Engineering," page 309, vol. 68, No. 4, to convert telegraphic code **11** into binary code **17** which is converted into characters **14**.

First means **15** is adapted to receive either dot signal **12** or dash signal **13** and includes a dot gate **23** and a dot-dash sawtooth generator **24**. Dot gate **23** passes the leading edge of code pulses, whether dot or dash. This leading edge pulse passes on to means **18**, energizing one of the gates **38** through **43**. Dot gate **23** also initiates a pulse in response to the trailing edge of the received code pulse. This initiated pulse also passes to means **18**, through the energized gate of gates **38** through **43** to a corresponding one of flip-flop switches **38** through **52**. Should gate **23** be turned off middle way through a dash pulse, the trailing edge of the dash pulse will not pass through gate **23** and no produced pulse will pass from dot gate **23** to gates **38** through **43** and in turn, to the flip-flop switches. The leading edge of either signal **12** or **13** starts the dot-dash sawtooth generator operating to build up a sawtooth amplitude. A dash trigger **25** responds to a predetermined sawtooth amplitude equivalent to the dash signal length and triggers when that amplitude is reached, thereby furnishing an output which closes the dot gate **23** and at the same time turns on a dot-dash flip-flop sensor **28**. Since dot gate **23** is capable of passing the trailing edge of either a dot or dash pulse in its open position, should gate **23** not pass the trailing edge of a pulse, the signal must be a dash signal 13 and is sensed as such, and passed through dot-dash sensor 28 to open a coincidence means or gate 29. Coincidence gate 29 remains in an open condition until dot-dash sensor 28 is turned off by a subsequent dot pulse.

When dot signal 12 is received by first means 15, the leading edge thereof is passed through dot gate 23 and at the same time starts the dot-dash sawtooth generator 24. The length of dot signal 12 does not permit sufficient sawtooth amplitude to permit dash trigger 25 to operate, therefore dot gate 23 remains in an open position and turns off the dot-dash sensor 28, if it was in the on position also closes coincidence gate 29.

The second means 16 furnishes the spacing function. An element space causes no action by second means 16, however, character and word spaces cause second means 16 to generate an output. Included in second means 16 is a space sawtooth generator 30 which begins its sawtooth amplitude generation upon receipt of the trailing edge of dot or dash signal 12 or 13. Connected in parallel, and to the output of space generator 30, are a character space trigger 31 and a word space trigger 32. The output of character trigger 31 is connected to a space flip-flop switch 35 which is turned on in response to trigger 31. A multivibrator 36, constructed in accordance with Figure 18–2, page 396, of Seely, "Electronic-Tube Circuits," McGraw-Hill Book Company, Inc., New York, 1950, is responsive to the character and word triggers 31, 32 through the on position of space switch 35. Multivibrator 36 furnishes pulses to the third means 18 and to the coincidence gate 29, which gate 29 being in an open position following dash signal 13, will pass pulse therethrough from multivibrator 36 to the third means 18.

Third means 18 includes a plurality of binary counters 37, each of which may be constructed as shown in Figure 19–15, page 420, of Seely "Electronic-Tube Circuits," published by McGraw-Hill Book Company, Inc., New York, 1950, or may be constructed as desired in accordance with the aforementioned Eccles-Jordan circuit, which furnish six outputs for six converter gates 38 through 43, which in turn furnish six outputs for six converter flip-flop switches 47 through 52 whose output in turn is utilized by the fourth means 19. Assuming the first code 11 received at input 10 is dot signal 12, the leading edge of dot signal 12 is also conducted directly to binary counters 37, which are thereby advanced one count. The binary counter 37 therefore opens converter gate 38 which gate 38 is now ready to receive and pass therethrough a second or information pulse. The information pulse is the trailing edge of dot signal 12 which has passed through dot gate 23 and is presented to all of the converter gates 38 to 43. As converter gate 38 is the only open gate, the trailing edge of dot signal 12 passes therethrough and turns converter switch 47 to an on or "yes" position. Should the second signal be dash signal 13, which together with dot signal 12 is code 11 for the character "A," then as previously explained, dash trigger 25 responds to dot-dash sawtooth generator 24 to close dot gate 23 and at the same time turn on dot-dash sensor 28 which in turn opens coincidence gate 29. The leading edge of dash signal 13 has advanced binary counters 37 one additional count and has opened converter gate 39. However, as the dot gate 23 is closed, the trailing edge of dash signal 13 cannot pass to converter gate 39, converter gate 39 passes no information to converter switch 48 leaving it in a "no" information position. This cycle can be repeated for a maximum total of six dot and dash signals.

When the final signal 12 or 13 has been received, assuming it to be dash signal 13 as illustrated above and completing the character "A," the space generator 30 begins generation at the receipt of trailing edge of signal 13 and generates a sawtooth of sufficient amplitude to cause character trigger 31 to operate. Trigger 31 turns space switch 35 on, which in turn permits multivibrator 36 to generate pulses. Pulses from multivibrator 36 function to complete the binary count in binary counter 37, thereby assuring that all of gates 38 through 43 are serially energized. Also, in certain instances energy pulses from multivibrator 36 function to set up "yes" information in those converter switches 47 through 52 not acted upon by the incoming code. In either of its functions, multivibrator 36 serves to fill out a complete 6-unit binary code for each character. Coincidence gate 29 has remained in an open position following dash signal 13. Binary counters 37 are now advanced in response to multivibrator 36 which sends its pulses through coincidence gate 29 to converter gates 40, 41, 42 and 43 which are opened and presented with multivibrator output thereby turning converter switches 49, 50, 51 and 52 on or in a "yes" information position. When converter gate 43 has been opened, the binary counter 37 output is fed back to space switch 35 turning it off and stopping multivibrator 36. Should the last code information of a character have resulted in dot signal 12, coincidence gate 29 will remain closed and no output would reach the remaining converter gates and the converter switches remaining would indicate "no" information. Thus, whether the remaining converter switches will indicate "yes" or "no" information depends upon whether the last element of code information for a respective character was a dash or a dot. Upon completion of character 14, a delay circuit 55, of any well known type such as is shown in Figure 19–8, page 418, of Seely "Electronic Tube Circuits," published by McGraw-Hill Book Company, Inc., New York, 1950, which receives its responses from space switch 35, initiates at a predetermined delay time a reset pulse to reset converter switches 47 to 52 to their normal off or "no" information position in readiness for the next code 11 to be presented to input 10.

The "yes" and "no" information, contained by converter switches 47 to 52 at the end of a character, is utilized by fourth means 19. Fourth means 19 utilizes as the heart thereof a cathode ray display tube 56, diagrammatically shown in Figure 1 and structurally shown in Figure 3. The display tube 56, which is known in the art, employs a cathode 57 which emits a stream of electrons. A grid 58, along with anodes 59, 60 and 61 control the emitted electrons and shape them into an electron beam positioned along the axis of display tube 56. Vertical selection plates 64 and horizontal selection plates 65 are positioned about the tube axis for electrostatically deflecting the beam in response to a predetermined voltage pattern to illuminate a particular matrix character 66 in matrix 67. Matrix 67, shown in detail in Figure 4, is preferably made of a metallic medium into which character-shaped openings are made. These character-shaped openings or matrix characters 66 cause the electron beam to be shaped in accordance with the character selected by the selection plates 64, 65.

The character-shaped beam then is deflected to a predetermined position upon display tube screen 70 by vertical and horizontal deflection coils 71, 72. Additional anodes 74, 75 may be provided to accelerate the beam toward screen 70. Proper predetermined voltages are supplied from power supply 76 to cathode 57 and anode 60. Grid 58 receives its control voltage from grid unblanking amplifier 77, of known construction. Amplifier 77 also receives its voltages from supply 76 and is triggered in response to delay circuit 55 thereby providing display tube 56 unblanking. Anodes 74, 75 receive their power from power supply 78. Vertical and horizontal deflection circuits 80, 81 are of well known construction and are responsive to output of character and word triggers 31, 32 to present proper voltages to coils

71, 72 to effect screen position advance, either character or word space advance, as indicated.

The operation of display tube 56, as described, utilizes predetermined voltages applied to the selection plate 64, 65 in response to the "yes" and "no" information of converter switches 47 to 52 from third means 18.

Fourth means 19 includes three vertical selection gates 84, 85 and 86 which are controlled by converter switches 47, 48 and 49, respectively for utilizing third means 18 output. Three horizontal selection gates 87, 88 and 89 are controlled by converter switches 50, 51 and 52, respectively. The information signals or voltages to be passed by the selection gates when in an open position are first, second and third predetermined fixed voltages 90, 91 and 92, respectively. These three voltages are the fixed input for gates 84, 85 and 86, in that order, and likewise, for gates 87, 88 and 89, in that order.

The output of gates 84, 85 and 86 is received by a vertical selection voltage adder 93, of any well known construction, and likewise, the output of gates 87, 88 and 89 is received by a horizontal selection voltage adder 94. The output of vertical selection voltage adder 93 being applied to vertical selection plates 64, and the ouput of horizontal selection voltage adder 94 being applied to horizontal selection plates 65, thereby positioning the beam to illuminate a character corresponding to the code 11 received at input 10.

Assuming the conditions of converter switches 47 through 52 to be in the yes, no, yes, yes, yes, yes condition, respectively, in response to the character 14 "A," converter switch 47 will open vertical selection gate 84 and first voltage 90 will be presented to adder 93; switch 48 being "no," gate 85 will remain closed; switch 49 being "yes," gate 86 will be opened and third voltage 92 will be added to first voltage 90 in vertical selection voltage adder 93 to determine the vertical selection plates 64 voltage. Converter switch 50 will be in a "yes" position and therefore open horizontal selection gate 87 and first voltage 90 will pass to the horizontal selection voltage adder 94; switch 51 is "yes," so gate 88 is open to pass second voltage 91 to adder 94 to be added to first voltage 90; switch 52 is "yes," so gate 89 is open to pass third voltage to adder 94 to be added to first and second voltages 90, 91 resulting in the voltage to be applied to the horizontal selection plates 65. Plates 64, 65, having these voltages impressed upon them will set up the electrostatic field to position the electron beam to illuminate the matrix character "A," which character is subsequently presented in visual display on the screen 70 by impingement of the electron beam thereupon.

Illustrated in Figure 6 is a circuit embodiment of the vertical and horizontal selection gates 84 through 89, vertical selection voltage adder 93 and horizontal selection voltage adder 94, all of which comprise the pertinent part of Figure 5 in application Serial No. 340,245, filed March 4, 1953, and assigned to the common assignee hereof. Inclined herein is explanatory matter material to Figure 6, taken from pages 49 through 54 of the aforesaid application, Serial No. 340,245. The adder unit serves to transform a parallel representation of the code group, as developed by the six converter flip-flop switches 47 through 52 into two uni-directional potentials. Each of the gating circuits 84 through 89, is functionally and physically similar and includes an electron tube 450, which has an anode 451, a screen grid 452, second control grid 454, first control grid 453 and a cathode 455. Corresponding components of each circuit are assigned the same reference numerals. Anode potential is afforded tube 450 by a potential source (not shown), which is connected to the anode 451 through primary winding 456 of a transformer 457. The primary winding employed in each of the gating circuits are functionally similar and preferably have an equal number of turns. The control grid 453 of each circuit is both returned to ground through a grid return resistor 458 and connected by lead 459 to an oscillator (not shown), which may be of a conventional design and well known to those skilled in the art. The second control grid 454 of each of gating circuits 84 through 89 is inter-connected with the memory flip-flop switches 47 through 52, shown in Figure 1, by coupling said control grids 454 to the leads 333, 259, 261, 263, 265 and 267, respectively, which carry high or low voltages appearing in the output of the flip-flop switches. The leads 333, 259, 261, 263, 265 and 267 are at low potential conditions in the "no" condition and at a high potential when a "yes" code element appears in the associated channel.

The sinusoidal output generated by the oscillator is continuously applied in parallel over the lead 459 to the first control grids 453 of the six gating tubes. The uni-directional potentials which appear at the output of the flip-flop switches in Figure 1 in the presence of a "no" condition of the particular code element, and which are impressed upon the second control grids 454 of the associated gating tubes, are insufficient to allow conduction of the tube 450 even though sinusoidal oscillator voltage is applied to the first control grid 453. A "yes" condition of the particular code element will cause a high potential positive pulse at the output of the associated flip-flop switch and upon its being transferred to the second control grid by one of the leads 333, 259, 261, 263, 265 or 267, will cause the second control grid 454 to be driven positively. This allows tube 450 to become conductive and an alternating voltage, as the result of the oscillator voltage being applied to the first control grid 453, appears across the primary winding 456 of the transformer 457. These alternating currents, which flow through the primary windings 456, induce voltages in either of the two accumulator networks 93 or 94. Accumulator network 93 comprises secondary windings 462, 463, 464 and a rectifying element 465, which includes a cathode 466 and an anode 467. Network 94 comprises secondary windings 468, 469 and 470 and a rectifying element 471 which also includes a cathode 472 and an anode 473. A step-up factor of the windings 464, 463 and 462 and windings 468, 469, and 470 are in the relationship of 4, 2 and 1, respectively, thus, establishing predetermined voltages in the relationship of 4, 2 and 1 in the presence of "yes" conditions for the respective code elements. The windings 462, 463 and 464 are serially connected in a manner to be series aiding such that the individual voltages which appear across each winding are additive. Windings 468, 469 and 470 of the accumulator network 94 are similarly interconnected to be series aiding and also providing additive potentials. Thus, the individual voltages which appear across each winding of the two networks are additive. The winding 464 and windings 468 are separately connected to anodes 467 and 473 of the rectifiers 465 and 471, respectively. The cathodes 466 and 472 are connected in any suitable manner to the vertical and horizontal deflection plates 64 and 65, respectively.

In operation, when the six converter flip-flop switches have been cleared by the reset pulse, all of the switches are in the "no" condition and the low potentials appearing at leads 333, 259, 261, 263, 265 and 267 are of insufficient magnitude to allow conduction of the gating tubes. Hence, the voltages induced to the adder networks 93 and 94 are zero and no deflection voltage is supplied to the display tube. Upon one of the switches 47 through 52 being placed in the "yes" condition, an output voltage is impressed on one of the gating tube's grids 454 of sufficient potential magnitude to effectuate triggering of the respective gating tube and with the oscillator voltage applied in parallel to the first control grid 453, an alternating voltage appears across one of the associated primary windings 456. Considering initially the selection of the correct row of openings within the matrix 67 wherein code elements afford the required information, the additive voltages induced in accumulator networks 93 and 94 have, as a result of the individual step-up factors, a voltage potential output which, when applied to the vertical and horizontal selection plates establishes the required electrostatic field for positioning the electron beam upon the correct character of matrix 67.

Figure 5 shows one set of curves illustrating the areas of acceptance for dots and dashes and another set of curves illustrating the areas of acceptance for word spaces, character spaces and element spaces. The discriminating ability of the system disclosed, herein, regarding the length of dots, dashes and spaces is shown to be more than adequate over the range shown from 10 to 80 words per minute by these performance curves. For example, at 60 W. P. M. the time of a dot signal may vary between 3 and 23 milliseconds; a dash signal between 24 milliseconds and infinity; an element space, between 2 and 23 milliseconds; a character space, between 24 and 73 milliseconds; and a word space between 74 and infinity.

Although the indicated speeds are based on normal time lengths of elements and spaces, the system is capable of adjusting itself to substantially instantaneous changes in speed. For example, if at a 60 W. P. M. rate the time of a dash is increased from 47 to 57 milliseconds, the average rate becomes less than 60 W. P. M. and the system adjusts itself substantially instantaneously to the new speed, while retaining at the same time its discriminating between different length code elements and different length spaces of code 11. The wide limits between the curves being the acceptable limits which may not be exceeded.

The particular embodiment of the invention illustrated and described herein is illustrative only and the invention includes such other modifications and equivalents as may readily appear to those skilled in the art, within the scope of the appended claims.

We claim:

1. A system for converting telegraphic code into a visual presentation of characters including said code having selectively presented dot and dash signals and a cathode ray display tube having a matrix therein, comprising, first means responsive to said code for sensing and discriminating between said dot and dash signals, second means responsive to said code for sensing and effecting spacing of said signals and groups of said signals, coincidence means responsive to said first means for selective operation of said second means therethrough, third means responsive to said code, said first means and said coincidence means for selectively converting output of said first means and said second means into "yes" and "no" information, said second means having means supplying energy pulses to said third means for completing the output of said first means in said third means to the same number of elements of said "yes" and "no" information regardless of the number of dots or dashes in the code character received, fourth means responsive to said second means and said third means for presenting predetermined selection and deflection voltages to said display tube whereby a selected character of said matrix is positioned at a predetermined display position on said display tube, and means responsive to said second means for restoring said third means and said fourth means to their respective predetermined original conditions.

2. A system for converting telegraphic code into a visual presentation of characters including a source of code, said code comprising selectively presented dot signal and dash signal, each signal having a leading edge and a trailing edge, and a cathode ray display tube having a matrix therewithin, said tube being capable of selectively displaying said characters, said system comprising an input for receiving said leading edge and said trailing edge, a plurality of binary counters and a dot-dash sawtooth generator, both being responsive to said leading edge, a space sawtooth generator responsive to said trailing edge, a dash trigger selectively responsive to said dot-dash sawtooth generator, a dot gate selectively responsive to said dash trigger, said dot gate being adapted to pass said trailing edge of said dot signal, said dot gate closing in response to said dash trigger, a dot-dash sensor responsive to said dot gate output and said dash trigger for off and on position, respectively, a coincidence gate responsive to said dot-dash sensor, a character trigger and a word trigger each being selectively responsive to said space sawtooth generator, a space flip-flop switch selectively responsive to said character trigger, a multivibrator responsive to said character trigger through said space switch, said binary counters being responsive to said multivibrator, a plurality of converter gates, said converter gates being selectively responsive to said multivibrator through said coincidence gate, said space switch being responsive to the last of said converter gates, a plurality of converter flip-flop switches matching and being responsive to one only of each of said converter gates, said converter flip-flop switches selectively producing "yes" and "no" information, fourth means for presenting said code as characters upon said display tube, said fourth means being responsive to said "yes" and "no" information of said converter flip-flop switches, said fourth means being further selectively responsive to said character trigger and said word trigger.

3. A system for converting telegraphic code into a visual presentation of characters including a source of code, said code comprising selectively presented dot signal and dash signal, each signal having a leading edge and a trailing edge, and a cathode ray display tube having a matrix therewithin, said tube being capable of selectively displaying said characters, said system comprising an input for receiving said leading edge and said trailing edge, a plurality of binary counters and a dot-dash sawtooth generator, both being responsive to said leading edge, a space sawtooth generator responsive to said trailing edge, a dash trigger selectively responsive to said dot-dash sawtooth generator, a dot gate selectively responsive to said dash trigger, said dot gate being adapted to pass said trailing edge of said dot signal, said dot gate closing in response to said dash trigger, a dot-dash sensor responsive to said dot gate output and said dash trigger for off and on position, respectively, a coincidence gate responsive to said dot-dash sensor, a character trigger and a word trigger each being selectively responsive to said space sawtooth generator, a space flip-flop switch selectively responsive to said character trigger, a multivibrator responsive to said character trigger through said space switch, said binary counters being responsive to said multivibrator, a plurality of converter gates, said converter gates being selectively responsive to said multivibrator through said coincidence gate, said space switch being responsive to the last of said converter gates, a plurality of converter flip-flop switches matching and being responsive to one only of each of said converter gates, said converter flip-flop switches selectively producing "yes" and "no" information, fourth means for presenting said code as characters upon said display tube, said fourth means being responsive to said "yes" and "no" information of said converter flip-flop switches, said fourth means being further selectively responsive to said character trigger and said word trigger, and means selectively responsive to said character trigger through said space switch for restoring at a predetermined time said converter flip-flop switches and said fourth means to their respective predetermined conditions.

4. A system for converting telegraphic code into a visual presentation of characters including a source of code, said code comprising selectively presented dot signal and dash signal, each signal having a leading edge and a trailing edge, and a cathode ray display tube having a matrix therewithin, said tube being capable of selectively displaying said characters, said system com-

prising an input for receiving said leading edge and said trailing edge, a plurality of binary counters and a dot-dash sawtooth generator, both being responsive to said leading edge, a space sawtooth generator responsive to said trailing edge, a dash trigger selectively responsive to said dot-dash sawtooth generator, a dot gate selectively responsive to said dash trigger, said dot gate being adapted to pass said trailing edge of said dot signal, said dot gate closing in response to said dash trigger, a dot-dash sensor responsive to said dot gate output and said dash trigger for off and on position, respectively, a coincidence gate responsive to said dot-dash sensor, a character trigger and a word trigger each being selectively responsive to said space sawtooth generator, a space flip-flop switch selectively responsive to said character trigger, a multivibrator responsive to said character trigger through said space switch, said binary counters being responsive to said multivibrator, a plurality of converter gates, said converter gates being selectively responsive to said multivibrator through said coincidence gate, said space switch being responsive to the last of said converter gates, a plurality of converter flip-flop switches matching and being responsive to one only of each of said converter gates, said converter flip-flop switches selectively producing "yes" and "no" information, fourth means for presenting said code as characters upon said display tube, said fourth means including selection means and deflection means for presenting predetermined selection and deflection voltages to said display tube, said selection means being responsive to said "yes" and "no" information of said converter flip-flop switches, and said deflection means being selectively responsive to said character trigger and said word trigger, and means selectively responsive to said character trigger through said space switch for restoring at a predetermined time said converter flip-flop switches and said fourth means to their respective predetermined conditions.

5. A system for converting telegraphic code into a visual presentation of characters including a source of code, said code comprising selectively presented dot signal and dash signal, each signal having a leading edge and a trailing edge, and a cathode ray display tube having a matrix therewithin, said tube being capable of selectively displaying said characters, said system comprising an input for receiving said leading edge and said trailing edge, a plurality of binary counters and a dot-dash sawtooth generator, both being responsive to said leading edge, a space sawtooth generator responsive to said trailing edge, a dash trigger selectively responsive to said dot-dash sawtooth generator, a dot gate selectively responsive to said dash trigger, said dot gate being adapted to pass said trailing edge of said dot signal, said dot gate closing in response to said dash trigger, a dot-dash sensor responsive to said dot gate output and said dash trigger for off and on position, respectively, a coincidence gate responsive to said dot-dash sensor, a character trigger and a word trigger each being selectively responsive to said space sawtooth generator, a space flip-flop switch selectively responsive to said character trigger, a multivibrator responsive to said character trigger through said space switch, said binary counters being responsive to said multivibrator, a plurality of converter gates, said converter gates being selectively responsive to said multivibrator through said coincidence gate, said space switch being responsive to the last of said converter gates, a plurality of converter flip-flop switches matching and being responsive to one only of each of said converter gates, said converter flip-flop switches selectively producing "yes" and "no" information, fourth means for presenting said code as characters upon said display tube, said fourth means including three horizontal selection gates and three vertical selection gates, a plurality of predetermined voltage sources one of said voltage sources being associated with each of said gates, a vertical selection voltage adder and a horizontal voltage adder both being responsive to their respective sets of selection gates, horizontal and vertical selection plates presented by said display tube, said vertical selection plates being responsive to said vertical selection voltages adder and said horizontal selection plates being responsive to said horizontal selection voltage adder, said vertical selection gates and said horizontal selection gates being responsive to said "yes" and "no" information of said converter flip-flop switches whereby said characters are selected from said matrix for display upon said display tube in response to said code impressed upon said input, said fourth means being further selectively responsive to said character trigger and said word trigger, and means selectively responsive to said character trigger through said space switch for restoring at a predetermined time said converter flip-flop switches and said fourth means to their respective predetermined conditions.

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