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Atkin

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[54] **ELECTRONIC CHARACTER GENERATING SYSTEMS**

[75] Inventor: **Laurence Walter Atkin,** Richmond, England

[73] Assignee: **Aston Electronic Developments Limited,** Deepcut, Camberley Surrey, England

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May 5, 1972 Great Britain 20983/72

[52] **U.S. Cl.** .... **340/324 AD,** 178/7.5 D, 340/324 A

[51] **Int. Cl.** **G06f 3/14**

[58] **Field of Search** ..... 340/324 AD, 324 A; 178/7.5 D

[56] **References Cited**

UNITED STATES PATENTS

3,335,416	8/1967	Hughes	340/324 A
3,440,639	4/1969	Sander et al.	340/324 A
3,594,756	7/1971	Granberg et al.	340/324 A
3,631,456	12/1971	Yokoyama	340/324 A
3,668,687	6/1972	Hale	340/324 AD
3,696,387	10/1972	Nussbaum	340/324 AD
3,696,388	10/1972	Eichelberger	340/324 A
3,711,849	1/1973	Hasenbalg	340/324 A

Primary Examiner—David L. Trafton

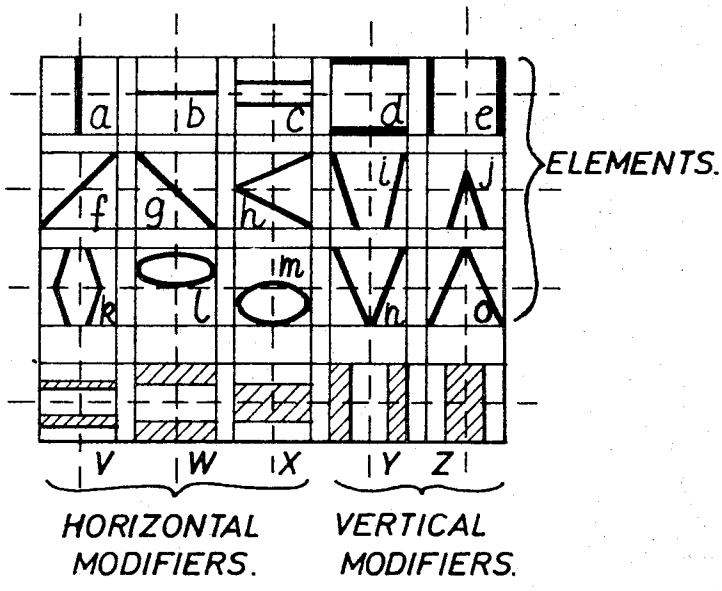
Attorney, Agent, or Firm—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

An electronic system for generating characters for television display by employing selected combinations of analogue waveforms. Ramp waveforms, usually of sawtooth form, are generated at line and field periods and are used to generate in turn triangular and parabolic waveforms.

A memory contains data representing the shape of individual elements of characters for each quadrant of a display area and is actuated by a digital store. The memory serves to gate selected combinations of all the waveforms, together with blanking waveforms derived from the triangular waveforms, to synthesize a video character waveform. Means is provided for producing from the video character waveform a further video waveform, defining an area to outline the characters, which acts on a conventional video signal to hold the latter at the black level so that the video character waveform can be inserted thereon.

22 Claims, 13 Drawing Figures



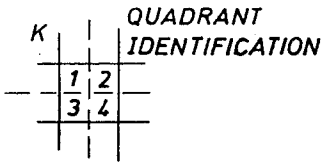


Fig.1.

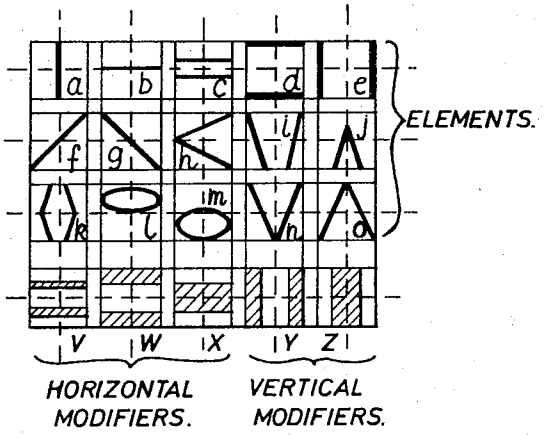
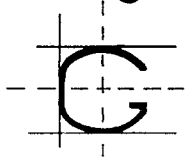


Fig.2.

Fig.3.



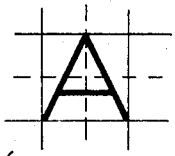
QUAD 1 { ELEMENT (MODIFIER X
ELEMENT e MODIFIER W

QUAD 2 { ELEMENT (MODIFIER X

QUAD 3 { ELEMENT m MODIFIER X
ELEMENT e MODIFIER W

QUAD 4 { ELEMENT m MODIFIER X
ELEMENT C MODIFIER Z

Fig.4.



QUAD 1 { ELEMENT O NO MODIFIER

QUAD 2 { ELEMENT O NO MODIFIER

QUAD 3 { ELEMENT O NO MODIFIER
ELEMENT C MODIFIER Y

QUAD 4 { ELEMENT O NO MODIFIER
ELEMENT C MODIFIER Y

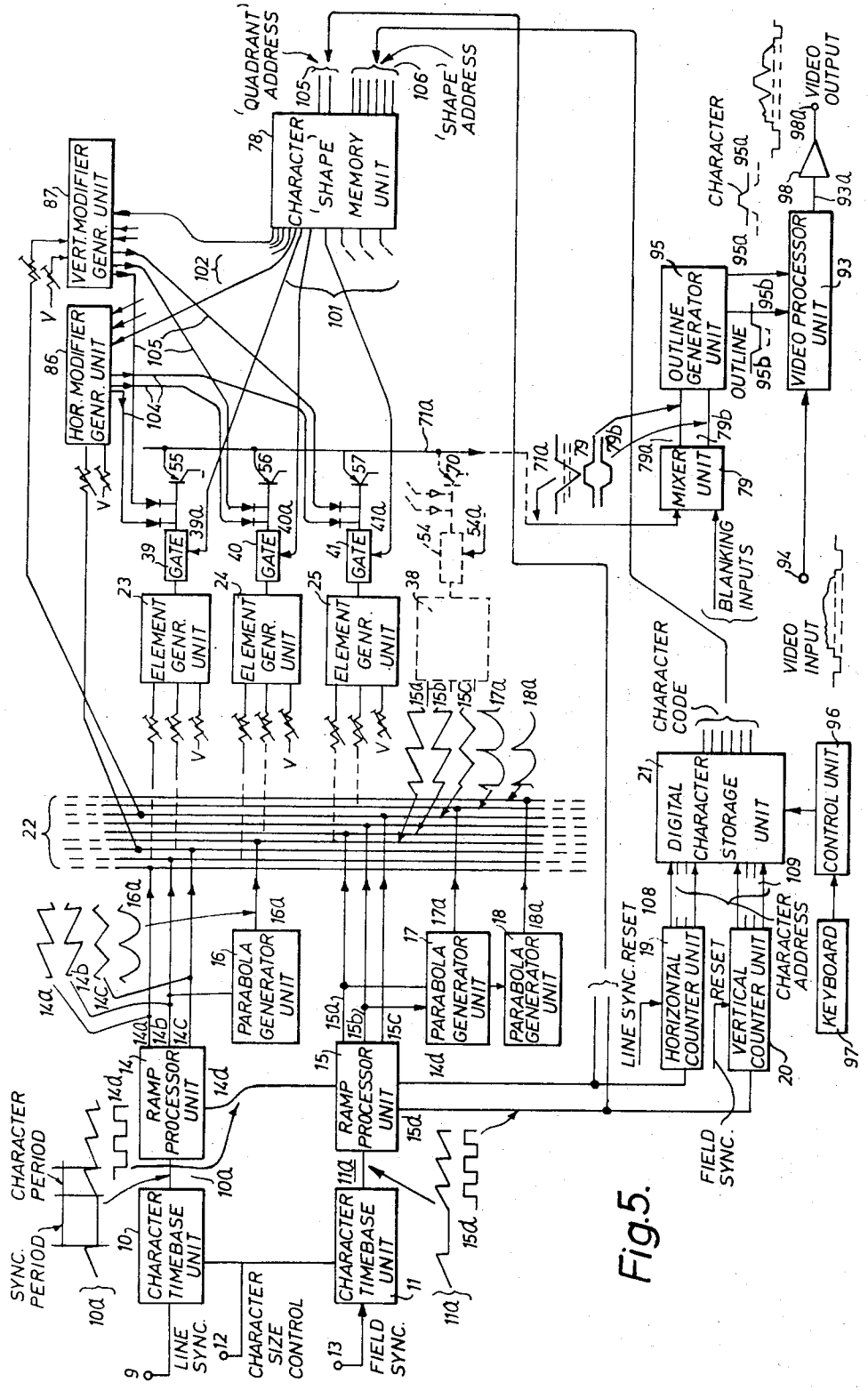

SYNC. PERIOD
CHARACTER PERIOD
CHARACTER TIMEBASE UNIT
LINE SYNC.
CHARACTER SIZE CONTROL
FIELD SYNC.
RAMP PROCESSOR UNIT
PARABOLA GENERATOR UNIT
ELEMENT GENR. UNIT
GATE
HOR. MODIFIER GENR. UNIT
VERT. MODIFIER GENR. UNIT
CHARACTER 'SHAPE' MEMORY UNIT
'QUADRANT' ADDRESS
'SHAPE' ADDRESS
LINE SYNC. RESET
HORIZONTAL COUNTER UNIT
VERTICAL COUNTER UNIT
RESET
CHARACTER ADDRESS
DIGITAL CHARACTER STORAGE UNIT
CHARACTER CODE
KEYBOARD
CONTROL UNIT
OUTLINE GENERATOR UNIT
OUTLINE
MIXER UNIT
BLANKING INPUTS
VIDEO PROCESSOR UNIT
VIDEO OUTPUT
VIDEO INPUT
CHARACTER

Fig.5.

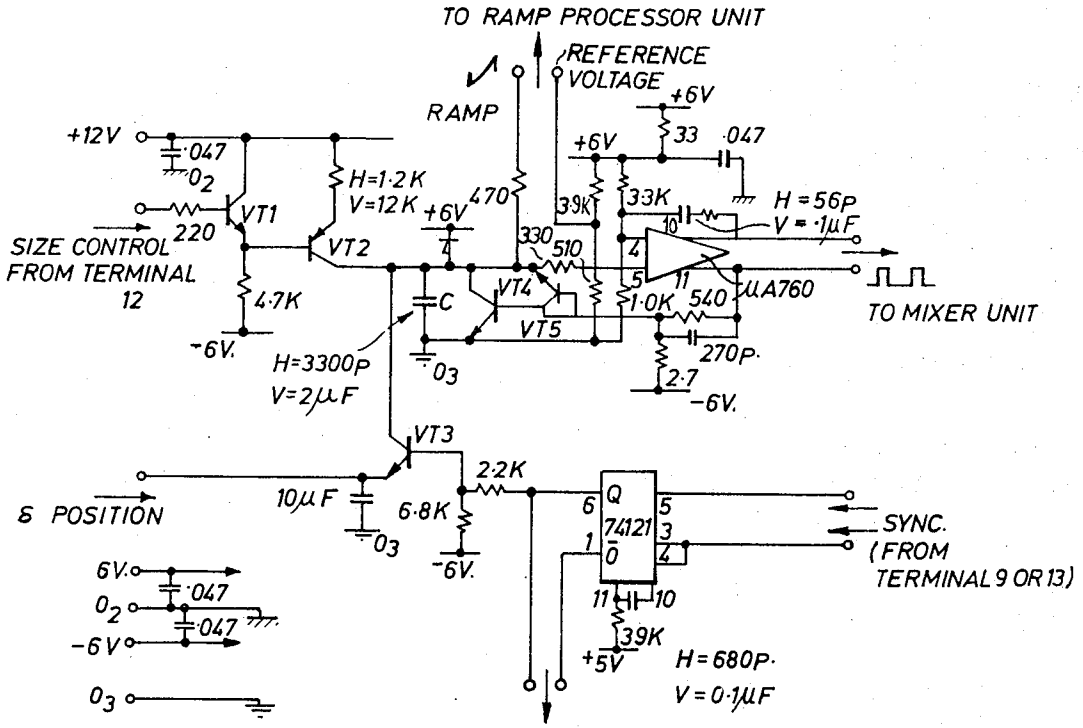


Fig.6. CHARACTER TIMEBASE UNIT.

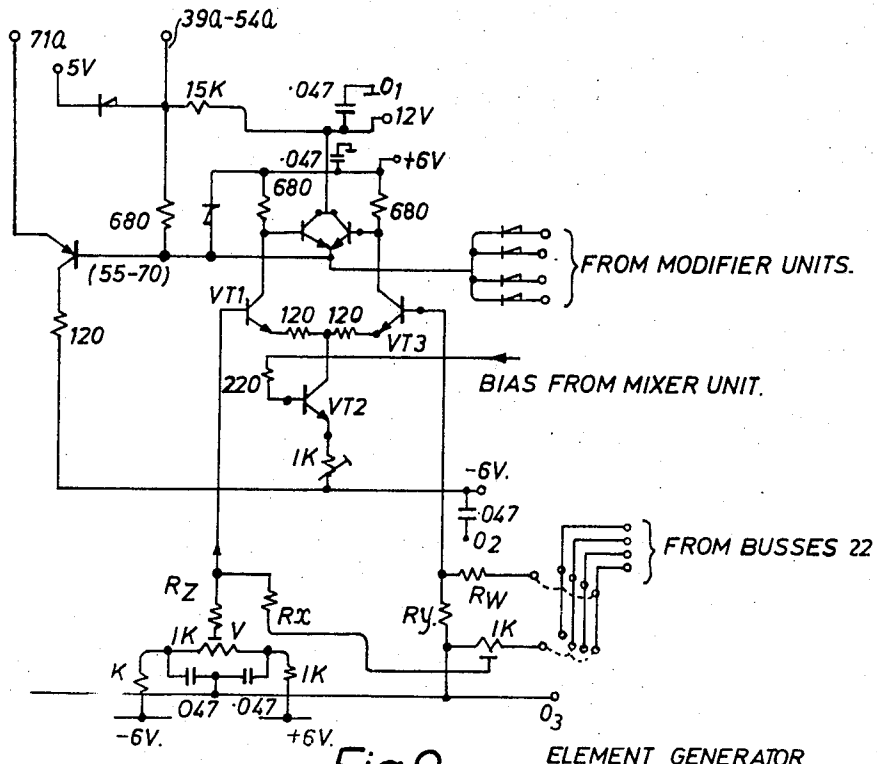


Fig.9. ELEMENT GENERATOR UNIT.

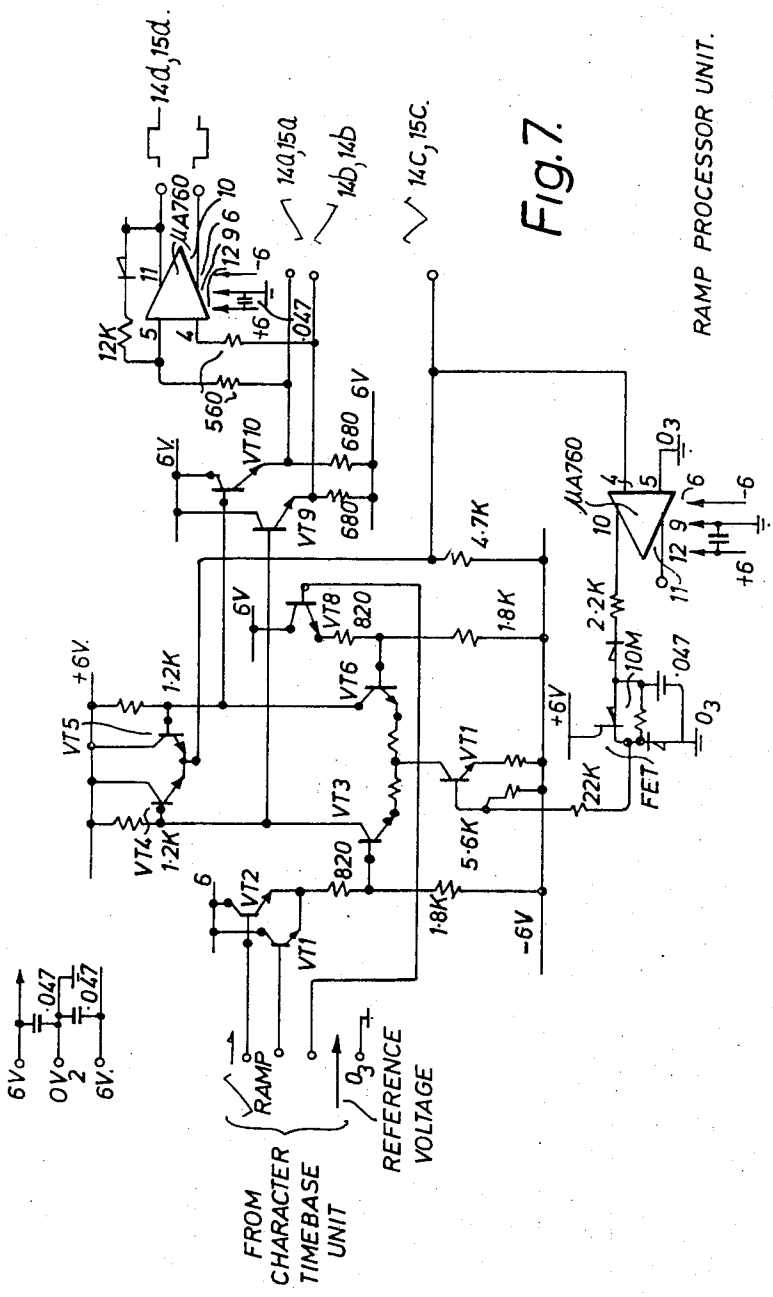

RAMP PROCESSOR UNIT.
14d, 15d.
14a, 15a
14b, 14b
14c, 15c.
μA760
12K
560
680
4.7K
1.8K
2.2K
10M
22K
5.6K
1.2K
820
FET
VT1
VT2
VT3
VT4
VT5
VT6
VT8
VT9
VT10
6V
-6V
+6V
-6
+6
·047
RAMP
REFERENCE VOLTAGE
FROM CHARACTER TIMEBASE UNIT

Fig. 7.

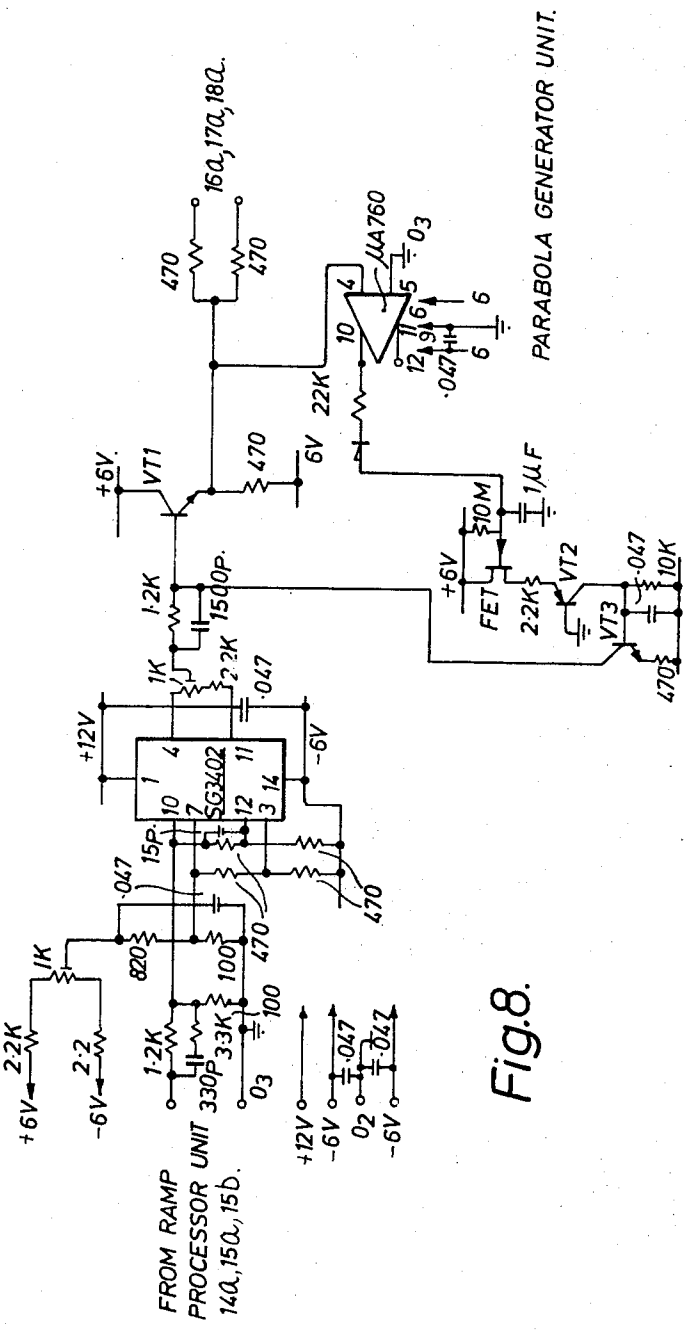

PARABOLA GENERATOR UNIT.
FROM RAMP PROCESSOR UNIT 14a, 15a, 15b.
160, 170, 180.
μA760
SG3402
FET
VT1
VT2
VT3
+6V
-6V
+12V
6V
470
22K
1·2K
1K
2·2K
10M
1μF
·047
10K
1500P.
15P.
330P
33K
100
820
2·2
O_3
O_2

Fig.8.

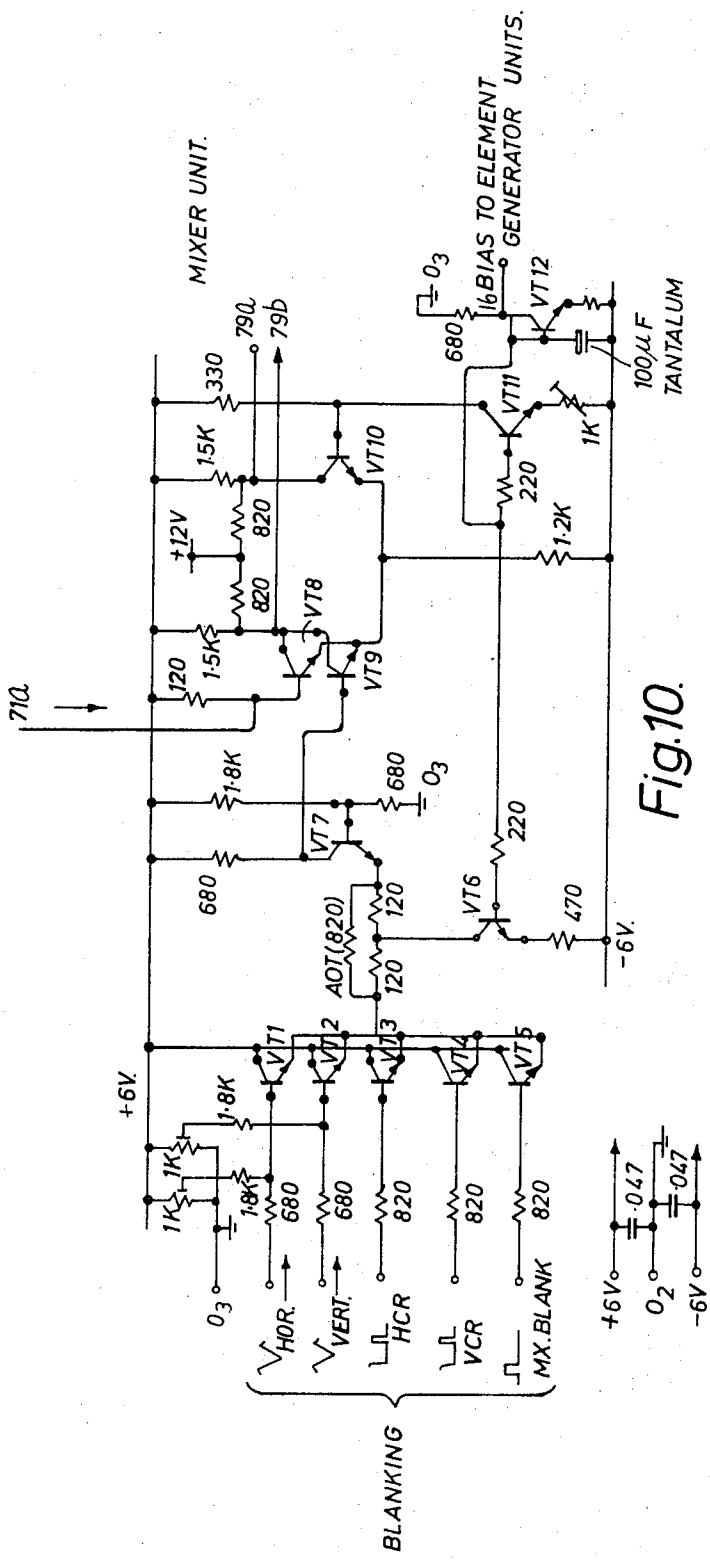

MIXER UNIT.
79a
79b
BIAS TO ELEMENT GENERATOR UNITS.
16
100μF TANTALUM
+12V
+6V.
-6V.
71a
AOT(820)
VT1
VT2
VT3
VT4
VT5
VT6
VT7
VT8
VT9
VT10
VT11
VT12
330
1.5K
820
120
1.8K
680
220
1.2K
470
1K
O_3
HOR.
VERT.
HCR
VCR
MX.BLANK
BLANKING
+6V
O_2
-6V
.047

Fig.10.

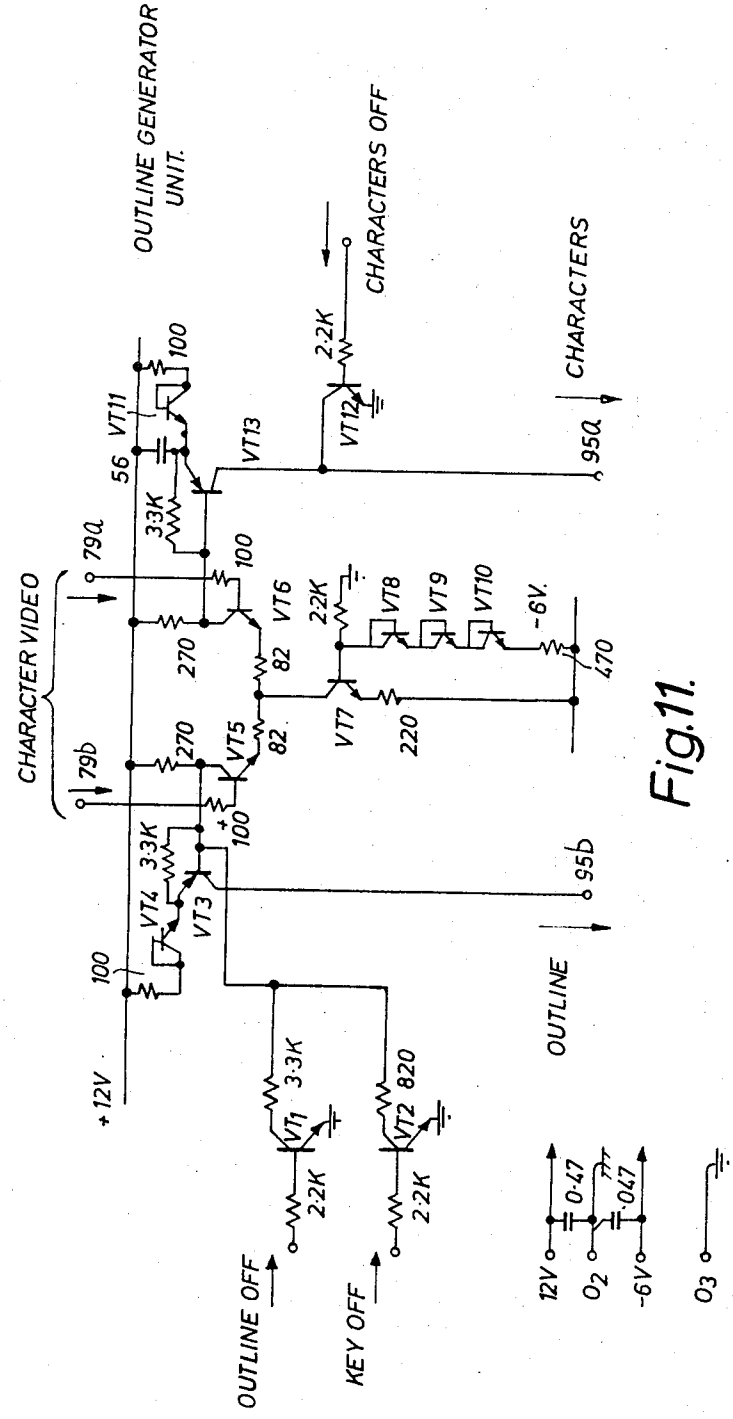

OUTLINE GENERATOR UNIT.
CHARACTERS OFF
CHARACTERS
CHARACTER VIDEO
79a
79b
56
VT11
100
3·3K
VT13
2·2K
VT12
95a
VT6
270
82
VT5
VT8
VT9
VT10
-6V.
470
VT7
220
VT4
VT3
95b
OUTLINE
+12V
VT1
3·3K
2·2K
VT2
820
OUTLINE OFF
KEY OFF
12V
O2
-6V
O3
0·47
·047

Fig.11.

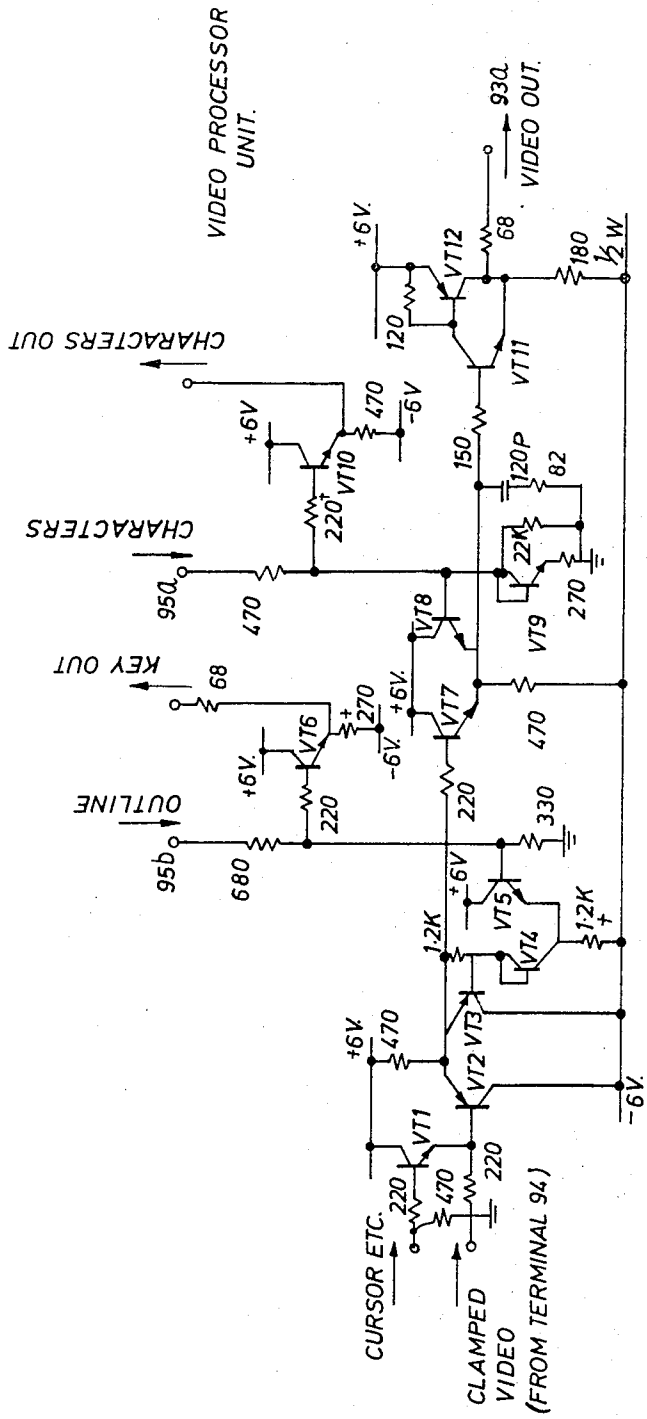

VIDEO PROCESSOR UNIT.
VIDEO OUT.
93a
+6V.
VT12
68
180 ½ W
120
VT11
CHARACTERS OUT
+6V
470
-6V
VT10
150
120P
82
220
CHARACTERS
95a
22K
270
VT8
VT9
470
KEY OUT
68
VT7
+6V.
270
-6V.
VT6
+6V.
220
470
OUTLINE
95b
680
220
330
+6V
VT5
1·2K
1·2K
VT4
VT3
+6V
470
VT2
-6V.
VT1
220
470
220
CURSOR ETC.
CLAMPED VIDEO (FROM TERMINAL 94)
+6V.
·047
O2
·047
-6V.
O3

Fig.12.

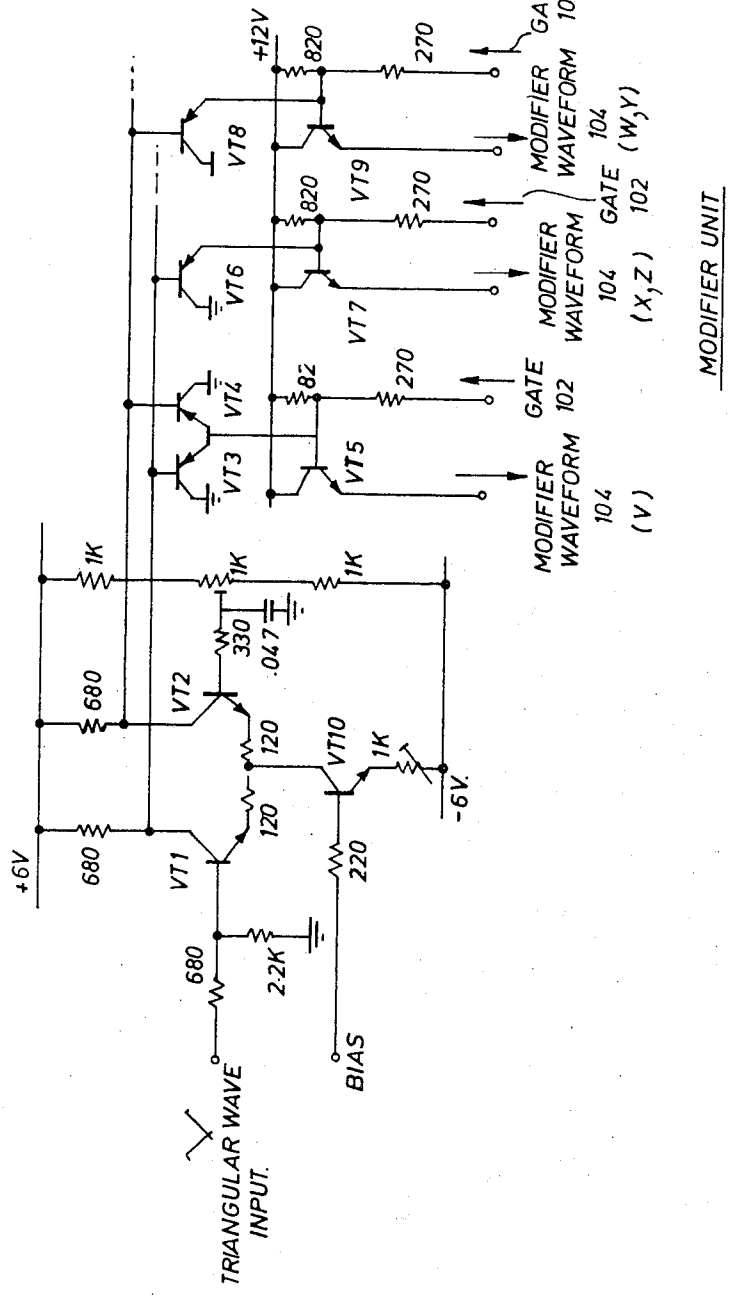

+12V
820
270
GATE 102
MODIFIER WAVEFORM 104 (W,Y)
VT8
VT9
820
270
MODIFIER WAVEFORM 104 (X,Z)
GATE 102
VT6
VT7
VT4
VT3
82
270
GATE 102
MODIFIER WAVEFORM 104 (V)
VT5
1K
1K
1K
330
.047
680
VT2
120
VT10
1K
-6V.
+6V
680
VT1
120
220
680
2.2K
TRIANGULAR WAVE INPUT.
BIAS
MODIFIER UNIT

Fig.13.

ELECTRONIC CHARACTER GENERATING SYSTEMS

BACKGROUND TO THE INVENTION

The present invention relates to an electronic system for generating video signals representing characters for television display.

It is known to superimpose characters such as captions etc. on a television picture display by directly placing caption cards or the like in front of a television camera. It is however, for many purposes more convenient to automate this process so that the characters are generated electronically. Electronically generated characters for displays of this type may be built up from a matrix of dots; however, such characters tend to show stepped edges to curved and sloping strokes. Where smooth, well formed outlines are desired it is generally necessary to use analogue waveform generation techniques and this invention relates especially to the latter aspect.

Hitherto analogue character-generating systems have had a number of disadvantages. The characters are generally restricted to a fixed size, since for instance the parabolic waveforms used to form circular or eliptical character-strokes are produced by frequency-sensitive circuits. Further, while it is often considered desirable for maximum clarity when white characters, for instance, are displayed against light-toned backgrounds, that they should have thin black outlines, the apparatus generally required to provide such outlines is relatively complex and costly.

It is a general object of the invention to provide an improved electronic system of the above-mentioned kind.

SUMMARY OF THE INVENTION

According to the invention there is provided an electronic system for generating video signals representing characters for television display; said system comprising means for producing ramp waveforms conforming with vertical and horizontal character rates, respectively, means for producing from each of said ramp waveforms further waveforms including at least substantially parabolic waveforms, means for producing directly from selected combinations of all the waveforms outputs representing character elements, and means for producing said video signal from said character element-representing outputs.

The ramp waveform producing means would usually have separate inputs connectible to line and field sync pulse sources and preferably also a common input for receiving a character size control signal.

The further waveform producing means preferably provide, for vertical and horizontal senses, as well as parabolic waveforms, additional ramp waveforms such that there are provided in total waveforms both of sawtooth and of triangular form, (the latter being substantially isosceles) and a substantially square waveform one edge of which corresponds to the vertex of the isosceles-triangular waveform. The vertices of the triangular waveforms in their preferred form define the vertical and horizontal character centre-lines respectively, and the character elements are thereby generated symmetrically about the centre-lines in each case.

It will be appreciated that, at least over the range of frequencies corresponding to the range of character sizes desired, all the further waveform producing means, with special reference to the parabolic waveform producing means, should function substantially independently of waveform frequency. Thus, as all waveforms substantially retain their shape and amplitude as the ramp waveform frequency is adjusted the size of the displayed characters may be altered without substantially changing their form. It is a novel and preferred feature of the invention that parabola generating means are employed require (except as may be required for the compensation of high-frequency response) no reactive components, and which are thus frequency independent, enabling the size of circular or eliptical character elements to be changed in a straightforward and convenient manner.

In order that the characters may be positioned as required on a television display, a digital store may be provided, controlled by a keyboard or other means, and addressed or interrogated by means of the outputs of horizontal and vertical counter units each receiving for instance appropriate square waveforms from the further waveform producing means. The coded information output from the digital store (which may be in the form of some standard character code, e.g., ASCII Code) at any instant, must be translated into information specifying the nature, i.e., the shape, of the corresponding character elements, and this may be achieved by a fixed memory means performing the function of a 'look-up table'. The character elements are conveniently and preferably specified within the character shape memory, for each quadrant of the character display area.

The character element producing means may comprise a number of element generator units, and typically fifteen may be required to generate an adequate repertoir of character elements for the synthesis of a full alpha-numeric character font together with a useful range of punctuation signs and symbols.

Each element generator unit receives a selected combination of waveforms from the waveform producing means, and preferably has characteristics such that the rate of transition of its output waveform is substantially dependent upon and is controlled by the rate of change of that selected combination. Thus the 'profile' of the eventual video character waveform has a rate of rise and fall, in directions both parallel to and perpendicular to the scanning lines, which is also controlled thereby and substantially dependent thereon.

The outputs of the element generator units may be gated to a common output, as demanded by the character shape memory unit, in order to synthesise the required sequence of characters. Further gating or blanking signals may also be applied at the outputs of the element generator units in order that partial or shortened elements may be generated where necessary; a means for generating vertical and horizontal modifiers to drive this further gating may be provided and its function will be clarified in the following description.

Preferably there is provided a means for producing a definitive outline to the characters, and the invention provides a novel method of generating a waveform defining an area outlining the characters by operating upon the character waveform. Since this waveform in its preferred form consists of signal excursions, representative of the profile of the characters, having distinct and controlled rise and fall periods, new video waveforms may be derived therefrom, the first of which

is defined by the narrow peaks thereof to delineate the area of the displayed characters and the second of which is defined by the broader troughs thereof to delineate an area outlining the displayed characters.

The invention may be understood more readily and various other features of the invention may become more apparent from consideration of the following description.

BRIEF DESCRIPTION OF DRAWINGS

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

FIG. 1 depicts the quadrant identification used in connection with the generation of characters;

FIG. 2 identifies and depicts the elements and blanking modifiers used in the generation of characters;

FIGS. 3 and 4 depict typical characters together with the elements and modifiers applicable thereto;

FIG. 5 is a block schematic diagram of a character-generating system made in accordance with the invention;

FIG. 6 is a circuit diagram of one of the character timebase units used in the system shown in FIG. 5;

FIG. 7 is a circuit diagram of one of the ramp processor units used in the system shown in FIG. 5;

FIG. 8 is a circuit diagram of one of the parabola generator units used in the system shown in FIG. 5;

FIG. 9 is a circuit diagram of one of the element generator units used in the system shown in FIG. 5;

FIG. 10 is a circuit diagram of the mixer unit used in the system shown in FIG. 5;

FIG. 11 is a circuit diagram of the outline generator unit used in the system shown in FIG. 5;

FIG. 12 is a circuit diagram of the video processor unit used in the system shown in FIG. 5; and

FIG. 13 is a circuit diagram of the modifier unit used in the system shown in FIG. 5.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring initially to FIG. 1, the square area K on which a character is to be displayed, usually on a cathode ray tube, is notionally divided into quadrants denoted 1–4. FIG. 2 depicts graphically the various rectilinear and curvilinear elements of equal thickness and denoted $a - o$ which are used in the production of characters superimposed on the area K. FIG. 2 also depicts graphically the various horizontal and vertical blanking modifiers denoted $v - z$ which are again used in the production of the characters. These modifiers $v - z$ serve, when coincidently generated with the elements $a - o$ to blank or mask out the portions of the elements $a - o$ which fall in the shaded areas.

As described hereinafter, the system employs circuits for generating waveforms representing the elements $a - o$ and modifiers $v - z$ and all alphanumeric characters can be produced by an appropriate combination of these waveforms. Thus, for example, FIGS. 3 and 4 show the letters G and A together with the elements and modifiers applicable to each quadrant 1–4 of the area K.

FIG. 5 depicts a character-generation system and as shown the system has a horizontal character timebase unit **10** and a vertical character timebase unit **11.** The units **10, 11** have common inputs connected to a terminal **12** which receives a signal which controls the size of the characters. The size of the characters may be selected from one of a number of pre-set sizes or may be varied continuously by means of a variable voltage. The unit **10** has an input which is connected to a terminal **9** which receives line sync pulses from an associated T.V. system. Similarly the unit **11** has an input connected to a terminal **13** which receives frame or field sync pulses from the associated T.V. system. In certain applications these sync pulses may be generated within the system itself. The units **10, 11** produce outputs **10***a*, **11***a* respectively which are in the form of ramp waveforms, more particularly sawtooth waveforms as depicted, representing the horizontal and vertical character rates. The units **10, 11** each employ a capacitor charged from a current source controlled by the input **12** to the units **10, 11.** These capacitors are each repeatedly charged and discharged between upper and lower voltage levels. The values of the capacitors and the charge currents are selected to provide the appropriate vertical and horizontal character rates. The current sources in the units **10, 11** may be adjustable together so as to vary the frequency of the sawtooth waveforms without altering the ratio of the frequencies of the waveforms.

The output **10***a* from the unit **10** is fed to the input of a ramp processor unit **14** and similarly the output **11***a* from the unit **11** is fed to the input of a ramp processor unit **15.** The unit **14** provides four outputs designated **14***a* to **14***d* which have waveforms as illustrated i.e. the output **14***a* is the same shape as the input **10***a*, the output **15***b* is the inverse of the input **14***a*, the output **14***c* is a triangular wave derived from the input **10***a* and the output **14***d* is a square wave also derived from the input **10***a*. The unit **15** also provides four outputs designated **15***a*–**15***d* which correspond to the outputs **14***a*–**14***d* respectively. The output **14***d* from the unit **14** is connected to the input of a horizontal counter unit **19** which also receives the line sync pulses which provide a reset facility. Similarly, the output **15***d* from the unit **15** is connected to the input of a vertical counter unit **20** receiving the field sync pulses again providing a reset facility. The output **14***b* from the unit **14** is connected to the input of a parabolic generator unit **16** which provides an output **16***a* having a waveshape as illustrated. The outputs **15***a*, **15***b* from the unit **15** are connected to the inputs of parabola generator units **17, 18** respectively. The units **17, 18** have outputs **17***a*, **18***a* with a waveshape as illustrated. The shape and amplitude of the outputs **16***a*, **17***a*, **18***a* are substantially independent of the frequency of the basic sawtooth waveforms. The outputs **14***a*–**14***c*, **15***a*–**15***c*, **16***a*, **17***a*, **18***a* are used to produce the waveforms corresponding to the elements $a - o$ depicted in FIG. 2 by appropriate combination of parts of the sawtooth, triangular and parabolic waveforms and are connected to busses generally designated **22.** Fifteen element generator units **23–38** which produce these element-waveforms each has three inputs two of which may be connected to selected ones of the busses **22,** i.e. to selected ones of the outputs **14***a*–**14***c*, **15***a*–**15***c*, **16***a*, **17***a* and **18***a*, via potentiometers represented in FIG. 5 as variable resistors. The third input to each unit **23–38** receives a bias voltage v via a potentiometer also represented as a variable resistor. As described, each element generator unit **23–38** may be in the form of a differential amplifier constituting a level detector. The position and angle (and size in the case of the curved elements) of the display elements represented by the resultant waveform

from each of the units **23–38** is dependent on the bias level and on the shape and amplitude of the inputs thereto. The output from each of the units **23–38** is connected to a gate **39–54** which is triggered via an enable input **39***a*–**54***a* provided by an output collectively designated **101,** of a character shape memory unit **78.** The output from each gate **39–54** is connected to the base of a P-N-P transistor **55–70.** The emitters of these transistors **55–70** are connected together via a common output **71***a* so as to synthesize by combination the particular character to be displayed at any instant. The output **71***a* is connected in turn to an input of a mixer unit **79.** A horizontal modifier generator unit **86** and a vertical modifier generator unit **87** have inputs connected to the outputs **14***c* **15***c* of units **14, 15,** respectively via the busses **22** and via potentiometers represented as variable resistors in FIG. **5.** The units **86–87** also receive bias voltages v via potentiometers also represented as variable resistors. The units **86,87 86, 87** have a plurality of outputs, denoted **104, 105** respectively. These units **86, 87** serve to provide the modifiers *v–x* and *y–z* respectively shown in FIG. **2.** The outputs from the units **86, 87** are selectively connected to the bases of the transistors **55–70** via diodes so that, when required, the transistors **55–70** may provide outputs with waveforms dependent on both the element and the modifier waveforms applied thereto.

The units **86, 87** are also controlled by outputs, collectively designated **102,** from the memory unit **78.** This unit **78** has two sets of inputs, namely a quadrant address **103** and a shape address **106,** which specify digitally the appropriate selection of the units **23–38** and the outputs from the units **86–87.** The inputs **105** to the unit **78** are taken from the outputs **14***d*, **15***d* of the units **14, 15** and the inputs **106** are taken from the output of a digital character storage unit **21** which provides encoded information defining a sequence of character. The unit **78** then converts this encoded information into a corresponding sequence of gating signals. The unit **21** has two sets of inputs **108, 109** which collectively represent the character address. The inputs **108** are taken from the outputs of the horizontal counter unit **19** and the inputs **109** are taken from the outputs of the vertical counter unit **20.** The unit **21** is controlled by a control unit **96** which has provision to enable a desired sequence of characters to be stored and edited. Unit **96** may be actuated by a manual keyboard as indicated in FIG. **5** or alternatively, for instance, connected to an external computer or other data source. The mixer unit **79** has blanking inputs as well as the main input **71***a* and provides two outputs **79***a* and **79***b*, one the inverse of the other, which represent the video character waveform. The blanking inputs serve inter alia to inhibit the character signals during the inter-character periods both vertically and horizontally. A typical input waveform **71***a* and typical outputs **79***a*, **79***b* are illustrated in FIG. **5.** The outputs **79***a*, **79***b* are connected to an outline generator unit **95** which produces an output **95***a* representing the character for display and a complementary output **95***b* used to provide a definitive outline for the character. As described hereinafter the outline generator unit **95** has two limiting amplifiers. The first amplifier is arranged to transmit only the narrower peaks of the video character waveform, so as to produce an output forming the waveform defining the displayed character area. The second amplifier transmits only the broader troughs of the video character waveform, so as to produce an output forming a "keying" signal by means of which the output of the first limiting amplifier may be inlaid into the television display. The outputs **95***a*, **95***b* which may have typical waveforms as illustrated are connected to a video processor unit **93** which has an input connected to a terminal **94** which usually receives a clamped video signal from the associated T.V. system. In certain applications such as, for example, where an alphanumeric display only is required the video input would not be used. The output from the unit **93** is taken through an amplifier **98** which delivers a system output **98***a*, having a typical waveform as shown, corresponding to the incoming video signal at terminal **94** with the selected character inset therein.

FIG. **6** depicts the basic circuit employed for the character timebase units **10, 11.** In FIG. **6,** the variation in components for the horizontal and vertical timebase units is designated by the letters W and V and similar designations are used in the case of the other circuits. As shown in FIG. **6,** the circuit employs a capacitor C which is charged by a current source VT_2. The output sawtooth waveform developed across the capacitor is applied to a terminal **5** of an integrated circuit **μA760** acting as a comparator to compare the rising voltage of the ramp of the sawtooth with a fixed reference voltage applied to a terminal **4.** The output from the integrated circuit **μA760,** which changes state whenever the rising voltage of the sawtooth exceeds the reference voltage, is taken to the mixer unit **79** as one of the blanking inputs and is fed back to the switch on the transistor VT_4 to thereby discharge the capacitor C. In this way the basic sawtooth is generated. The size control signal serves to vary the bias on the base of the transistor VT_2. The sync pulses are applied to an integrated circuit **74121,** acting as a one-shot multivibrator, which serves to discharge the capacitor and to inhibit charging thereof during the sync period (see **10***a* FIG. **5**). The circuit has a further control signal (not shown in FIG. **5**) which is denoted "δ position". This signal serves to shift the resultant character in the display by increments by taking the initial discharge voltage (sync period, **10***a* FIG. **5**) on the capacitor C below zero. As shown, this control signal is applied to the emitter of the transistor VT_3. In this circuit the NPN transistor may be of type BC109 and the PNP transistors may be of type BC179. The diodes may be of type IN4148.

FIG. **7** depicts the basic circuit employed for the ramp processor units **14, 15.** The circuit employs a differential amplifier VT_3, VT_5 which receives the input waveform from the associated unit **10, 11** and a fixed voltage developed across the emitter load of transistor VT_8. The amplifier VT_3, VT_6 produces the sawtooth voltages across its collector loads and these voltages are fed via emitter followers VT_9, VT_{10} to form the outputs **14***a*, **15***a*, **14***b*, **15***b*. Transistors VT_4, VT_5 have their bases driven by the amplifier VT_3, VT_6 and have a common emitter load which produces the triangular output **14***c*, **15***c* by following the most positive voltage at the collectors of the transistors VT_3, VT_6. The triangular waveform developed across the emitter load of the transistors VT_4, VT_5 is also applied to an input of an integrated circuit **μA760** acting as a comparator. The output pulses from the comparator **μA760,** integrated and stored on capacitor **C1,** drive a field-effect transistor FET. This circuit acts as a peak detector and con-

trols a transistor VT_7. This transistor VT_7 defines the current in the differential amplifier VT_4, VT_5 and serves to precisely clamp the negative-going peaks of the triangular waveforms to zero, at the same time precisely defining the d.c. level of the sawtooth waveforms. The sawtooth waveform developed across the collector load of the transistor VT_6 is also applied to an integrated circuit μA760 acting as a switch to produce the square wave outputs **14***d*, **15***d* and the inverse thereof. In this circuit the transistors $VT_1 - VT_{10}$ may in fact be combined in integrated circuits of the type SG3821 thus ensuring that the relationship between the triangular and sawtooth waveform is closely maintained despite temperature and other changes. The diodes may be of the type IN4148.

FIG. **8** depicts the basic form of the parabola generator units. The circuit employs an integrated circuit **SG3402** acting as a double-balanced modulator or multiplier to generate the parabolic waveforms **16***a*, **17***a*, **18***a*. The circuit **SG3402** is adapted to multiply together voltages supplied to terminals **10** and **12,** and since in this case these voltages are substantially the same linear waveform the square function thereof, i.e. parabolic waveform, is produced at terminal **4** and its inverse at terminal **11.** The potentiometer shown between these terminals acts as an amplitude control. The potentiometer feeding terminals **7** and **3** of the circuit **SG3402** serves to set the required d.c. bias conditions.

In a similar manner to the circuit shown in FIG. **7,** the parabolic waveform produced by the integrated circuit **SG3402** has its negative peaks precisely clamped to zero by a feedback network composed of a comparator μA760, a storage capacitor **C1** and a field effect transistor F.E.T. forming a peak detector and controlling current source VT_2, VT_3. The NPN transistors may be of type **BC109** and the PNP transistor may be of type BC179. The diodes may again be of type IN4148. It will be appreciated that the double-balanced modular **SG3402** carries out the squaring function on the sawtooth or triangular waves in a manner effectively independent of waveform frequency; other circuit techniques having similar properties could equally employed.

FIG. **9** depicts one of the element generator units **23–38** which also incorporates the transistor **55–70** (FIG. **5**) with its associated gate and diodes. In this preferred form, in contradistinction to the diagrammatic representation of FIG. **5,** the transistor **55–70** and its associated gate **39–54** are not separate entities but the transistor **55–70** itself serves also as the gate **39–54.** As shown in FIG. **9,** the circuit employs links whereby the appropriate selection of the busses **22** can be made. The inputs from the busses **22** are connected to the bases of transistors VT_2, VT_3 forming a differential amplifier. The resistors R*w*, R*x*, R*y*, Rz are selected according to the identity of the element to be generated. The bias voltage *v*, shown separately in FIG. **5,** is in fact produced by a network within the circuit as shown. The differential amplifier VT_1, VT_3 drives the bases of transistors VT_4, VT_5 the emitters of which are coupled together and drive the base of the output transistor **55–70.** The current in the differential amplifier VT_1, VT_3 is controlled by a transistor VT_2 which receives its bias voltage from the mixer unit **79.** This transistor VT_2 has a variable resistor as its emitter load which serves to set the d.c. level of the output waveform. The gate input **39***a*–**54***a* and the inputs from the modifying units **86–87** are applied to the base of the transistor **55–70,** and serve to turn off the transistor **55–70** when present.

The PNP transistors may be of type BC179 and the diodes may again be of type IN4148. The NPN transistor may be combined as an integrated circuit of type SG3821, again with the benefit of relative immunity from thermal drifts.

The function of the element generator unit, FIG. **9,** will now be described, taking the simple case of Element *a* shown in FIG. **2.** Since Element *a* lies parallel to one of the scanning axes, only one sawtooth waveform, in this case the horizontal sawtooth **14***a* for example, is required for its generation. The sawtooth **14***a* is linked from the appropriate bus **22** onto resistor R*w*, the ratio between resistors R*w* and R*y* being chosen to give the required waveform amplitude at the base of the transistor VT_3. Rx is omitted in this case, while Rz has a nominal value to feed bias voltage v to the base of the transistor VT_1. Consider now the situation where the sawtooth **14***a* begins its sweep. The transistor VT_3 will be cut off and the transistor VT_1 fully conducting. As sawtooth **14***a* rises in voltage the transistor VR_3 commences to conduct, its collector voltage falls and the output voltage from the unit **71***a*, i.e. on output also falls. (This assumes, of course, that the element is gated ON by the gate input (**39***a*–**54***a*) being low and the modifier input diodes being non-conducting). However, once the voltage at the collector of the transistor VT_1 exceeds that of the transistor VT_3, the transistor VT_4 will conduct, the transistor VT_5 will turn off, and the output voltage on **71***a* will again rise. The input sawtooth **14***a* has thus been converted into an output triangular wave similar to waveform **71***a* shown in FIG. **5.** The negative peak of this waveform corresponds to the centre of the element *a* shown in FIG. **2,** and this centre may be moved to right or left by adjustment of bias voltage *v*. The width of element *a* is defined by the width of the output waveform **71***a* at a critical voltage (set in the Mixer Unit **79**) and may be adjusted by means of the variable resistor in the emitter of the transistor VT_2. It will be appreciated that if the bias voltage is now 'modulated' by adding to it a suitable amplitude of vertical sawtooth waveform via the resistor R*x*, the position of the peak of the output triangular waveform **71***a* will be similarly modulated to produce diagonal elements such as *f* and *g* in FIG. **2.** If either of the input waveforms is a triangular rather than a sawtooth then the output triangular waveform **71***a* will have two negative peaks (corresponding to the rising and falling slopes of the input) resulting in the 'double' elements, such as *c*, *d*, *e* in the case of a single input waveforms to the Element Generator, and such as *h*, *i* etc. in the case of two (vertical and horizontal) input waveforms. The elliptical elements *l* and *m* are of course the result of the combination of the horizontal parabola **16***a* with the appropriate one of vertical parabolas **17***a*, **18***a* in one of the element generators.

FIG. **10** depicts the circuit used for the mixer unit. The circuit employs a limiting differential amplifier VT_8, VT_9, VT_{10}. The transistor VT_8 receives the common output **71***a* from the element generator units **23–38,** and the transistor VT_9 receives an additive blanking signal developed across the collector load of an amplifier VT_7 fed from an array of transistors VT_1–VT_5 receiving the individual blanking inputs. The

transistors VT_1–VT_{12} may be combined in integrated circuits of type SG3821.

FIG. **11** depicts the circuit for the outline generator unit. As shown the circuit has additional control inputs denoted "character off", "key off" and "outline off".

The circuit employs a differential amplifier VT_5, VT_6 whose anti-phase outputs are further amplified and inverted by transistors VT_3 and VT_{13} respectively. However, the amplitude of the voltage swings at the collectors of the transistors VT_5 and VT_6 is set (as defined by the biasing network of transistor VT_7), in relation to the base-emitter junction voltages of transistors VT_3, VT_4 and VT_{11}, VT_{13}, such that the transistor VT_{13} turns on only after the transistor VT_3 is fully turned off and vice versa. The resulting clipping action, illustrated by waveforms **95***a* and **95***b* in FIG. **5**, ensures that the final character waveform lies entirely within its corresponding outline or 'key' waveform.

The NPN transistors may be of type BC109 and the PNP transistors may be of type BC179.

FIG. **12** depicts the circuit of the video processor unit.

A video signal into which the character waveforms are to be inserted is applied to the base of an emitter-follower VT_2, the video waveform being charged or DC restored such that it's black-level is at zero volts. Transistor VT_3 is normally non-conducting; however, when a character is to be inserted the negative-going outline waveform **95***b*, developed across resistor **R1**, and applied to the base of the transistor VT_3 via transistors VT_5 and VT_4, inhibits any positive-going excursion of the emitter of the transistor VT_2, holding the video signal at its black level and thus reserving a 'hole' into which the character waveform may be inserted. The video waveform is now fed to a second emitter-follower VT_7. Transistor VT_8 is normally non-conducting except when the positive-going character waveform **95***a*, developed across resistor **R2** in series with the base-emitter junction of VT_9, drives the base of the transistor VT_8 positive, causing the video waveform to rise to it's white level. The final waveform is buffered by an amplifier VT_{11}, VT_{12}. A subsidiary video input, marked 'Cursor' in FIG. **12**, is provided for use where composing aids, such as a cursor, are required to be added to the video signal. Subsidiary outputs, marked Key Out and Characters Out, are also provided for use where it is more convenient for the insertion of the characters into a video signal to be accomplished in equipment located remotely from the character generator.

The PNP transistors may be of type BC179 and the NPN transistors of type BC109.

FIG. **13** depicts the circuit of the modifier units **86, 87** for clarity showing only typical output switches. The appropriate triangular waveform **14***c*, **15***c* is applied to one input of a differential amplifier VT_1, VT_2. The balance of the amplifier may be set by adjusting the voltage level at the second input. Transistors VT_8, VT_9 for instance, comprise a gate such that, when the gate input **102** is high one output of the differential amplifier is available at the emitter of the transistor VT_9, and this output **104** may be connected to one or more selected modifier inputs of the element generator units **23–38**, to inhibit the corresponding element waveform in the manner of modifiers W or Y in FIG. **2**. Similarly the modifier waveform **104** available typically at the emitter of the transistor VT_7 may be connected to inhibit element waveforms in the manner of modifiers X or Z in FIG. **2**, and the modifier waveform **104** available at the emitter of the transistor VT_5 may be connected to inhibit in the manner of modifier V in FIG. **2**.

I claim:

1. An electronic system for generating video signals representing characters for television display; said system comprising:

a. means for producing ramp waveforms conforming with vertical and horizontal character rates, respectively;

b. means for producing from each of said ramp waveforms further waveforms including at least parabolic waveforms;

c. means for directly producing from selected combinations of said waveforms outputs representing character elements; and

d. means for producing said video signals from said character element representing outputs.

2. A system according to claim **1**, wherein said ramp waveform producing means has separate inputs connectible to line and field sync pulse sources.

3. A system according to claim **1**, wherein the ramp waveform producing means has means for controlling the frequency of the ramp waveforms to thereby control the size of the characters.

4. A system according to claim **1**, wherein said waveforms include triangular waveforms.

5. A system according to claim **1**, wherein said waveforms include sawtooth waveforms.

6. A system according to claim **1**, wherein said further waveform producing means also produces square waveforms having transistions substantially corresponding to the horizontal and vertical character centre-lines respectively.

7. A system according to claim **1**, wherein said further waveform producing means comprises parabola generator means each receiving a ramp waveform and producing a parabolic waveform therefrom, the parabolic waveform generating means operating substantially independently of the ramp waveform frequency.

8. A system according to claim **1**, wherein the character element producing means essentially processes the selected combinations of waveforms in a linear manner.

9. A system according to claim **1**, wherein the rate of transition of the outputs of the character element producing means is substantially dependent upon and controlled by the rate of change of the selected combination of input waveforms.

10. A system according to claim **1**, wherein there is further provided a memory unit serving to selectively actuate the character element producing means according to the character to be synthesised, the memory unit serving to actuate said character-element producing means to separately specify the shape of the characters in quadrants of a display area.

11. A system according to claim **10**, wherein there is further provided a digital storage unit adapted to provide to the said memory unit a sequence of character codes specifying a sequence of characters to be displayed.

12. A system according to claim **11**, wherein means are provided to enable the recording, editing and ac-

cessing of data in the said digital storage unit, representative of a sequence of characters to be displayed.

13. A system according to claim **11,** wherein there are further provided horizontal and vertical counter units effectively clocked from the horizontal and vertical ramp waveforms respectively, the counter units having reset inputs respectively connectible to line and field synchronising pulse sources and outputs collectively specifying a character address and feeding said storage unit.

14. A system according to claim **1,** wherein the character-element producing means comprises a plurality of substantially identical element generator units having inputs connected to a selected combination of the waveforms.

15. A system according to claim **10,** wherein the character-element producing means comprises a plurality of substantially identical element generator units having inputs connected to a selected combination of the waveforms, the output from each element generator unit being gated by signals from said memory unit.

16. A system according to claim **1,** further comprising means for selectively modifying the outputs from the said character-element producing means, said modifying means serving to generate waveforms which blank out selected parts of the outputs from the said character element producing means in relation to the quadrants of the character display areas.

17. A system according to claim **16,** wherein the output from each element generator unit is gated by signals from the modifying means.

18. A system according to claim **16,** wherein said modifying means comprises a horizontal modifier generator unit and a vertical modifier generator unit which generate signals which blank out selected horizontal and vertical parts of the character display.

19. A system according to claim **10,** wherein there is further provided means for selectively modifying the outputs from the said character-element producing means, said modifying means being controlled by signals from the memory unit to generate waveforms which blank out selected parts of the outputs from the said character element producing means in relation to the quadrants of the character display areas.

20. A system according to claim **1,** wherein a video processing means is provided having a first input for receiving a background video signal, a second input for receiving a video signal derived from said outputs of the element producing means representing the synthesised characters and an output reproducing the background video signal having superimposed thereon a character representing component.

21. A system according to claim **1,** wherein means are provided to derive from said outputs from the element producing means or from the said video signal representing the synthesised characters, a further video signal representing a definitive outline for the synthesised characters.

22. A system according to claim **20,** wherein means is provided for producing a further video signal representing a definitive outline for the synthesised characters and acting as a key whereby the said video signal representing the synthesised characters may be inlaid into the said background video signal.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,810,166 Dated May 4, 1973

Inventor(s) Laurence Walter ATKIN

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

IN THE SPECIFICATION:

Col. 5 lines 37 and 38, change "character" to --characters--.

Column 5, line 68, delete "only the broader troughs of".

Column 6, line 4, after "display." insert --If the second amplifier is allowed to transmit only the broader troughs of the video character waveform then this keying signal forms an outline completely surrounding the character.--.

Column 6, line 19, change "W" to --H--.

Column 8, line 26, delete "71a" after "unit" and insert --71a-- after "output".

Column 9, line 26, change "charged" to --clamped--.

Signed and Sealed this

fifth Day of *August 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks