Oct. 27, 1959 YOSHIHARU MITA 2,910,681

APPARATUS FOR PRODUCING AUDIO-VISUAL DYNAMIC DESIGNS

Filed May 17, 1955 3 Sheets-Sheet 1

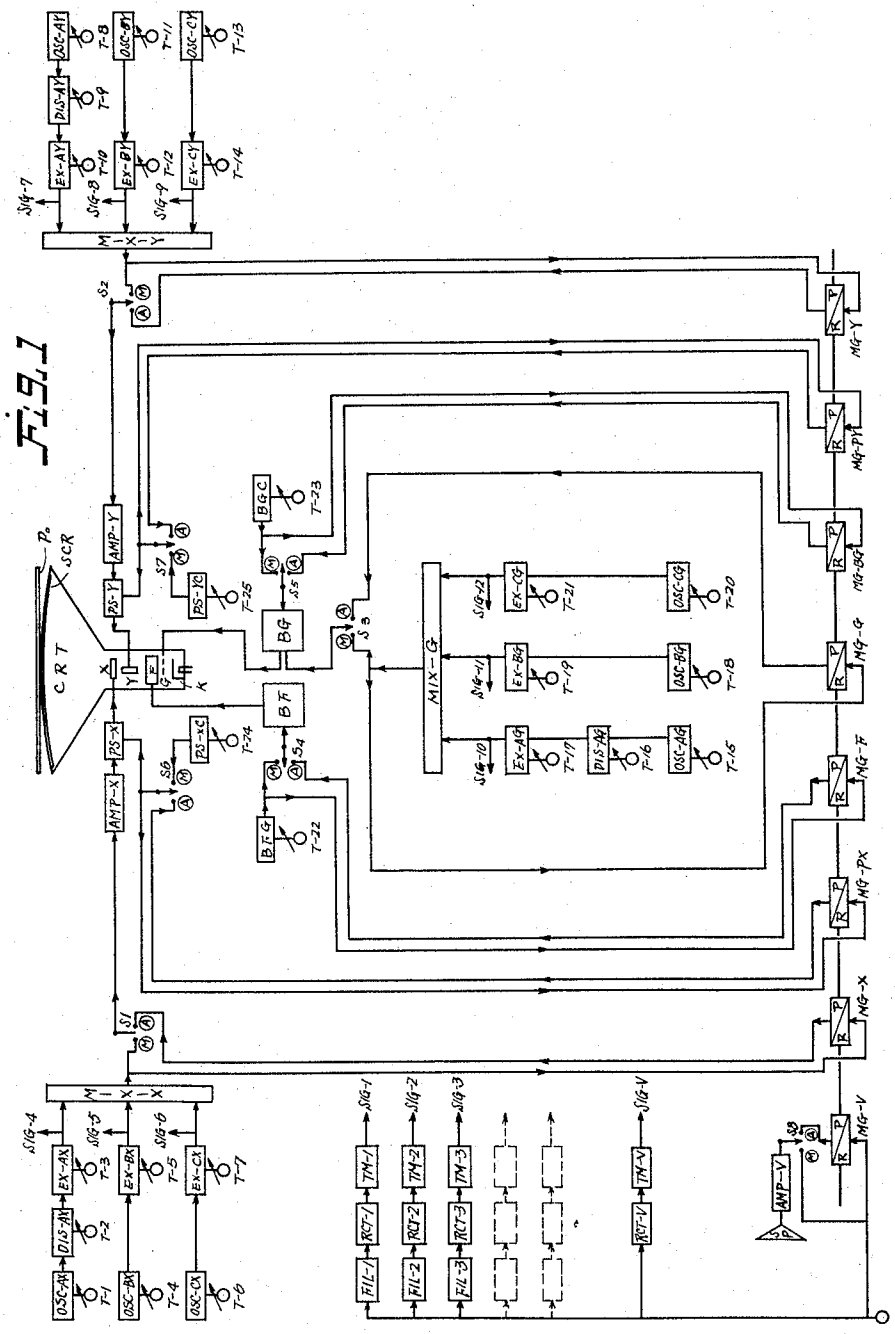

Fig. 1

INVENTOR.
YOSHIHARU MITA

BY

ATTORNEYS

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Fig. 2

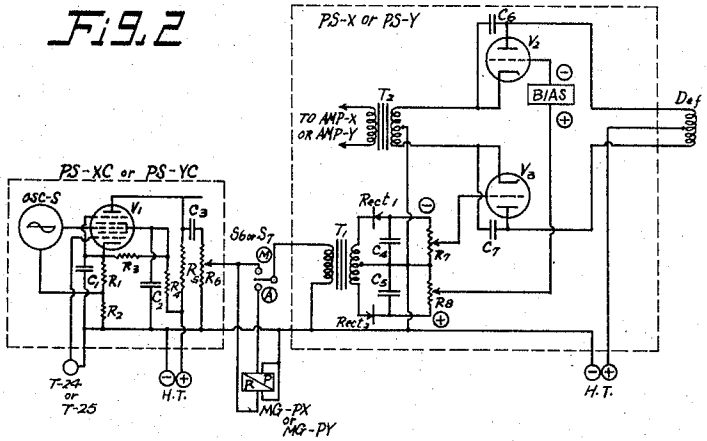


Fig. 3

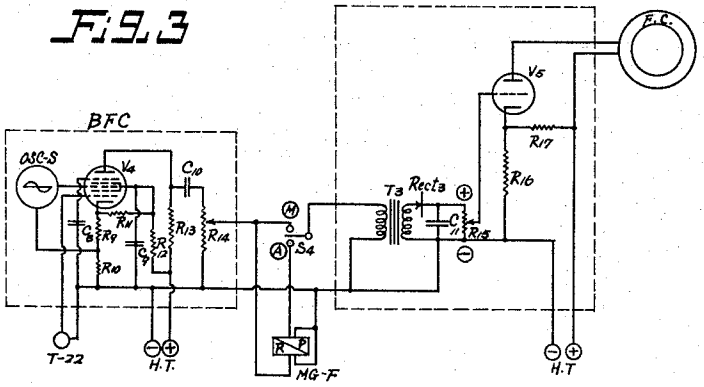
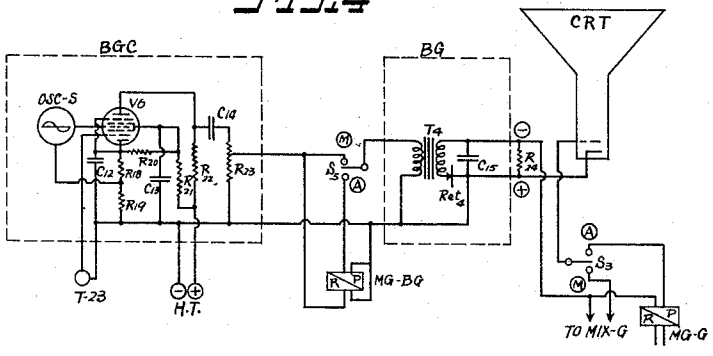


Fig. 4



INVENTOR.
YOSHIHARU MITA

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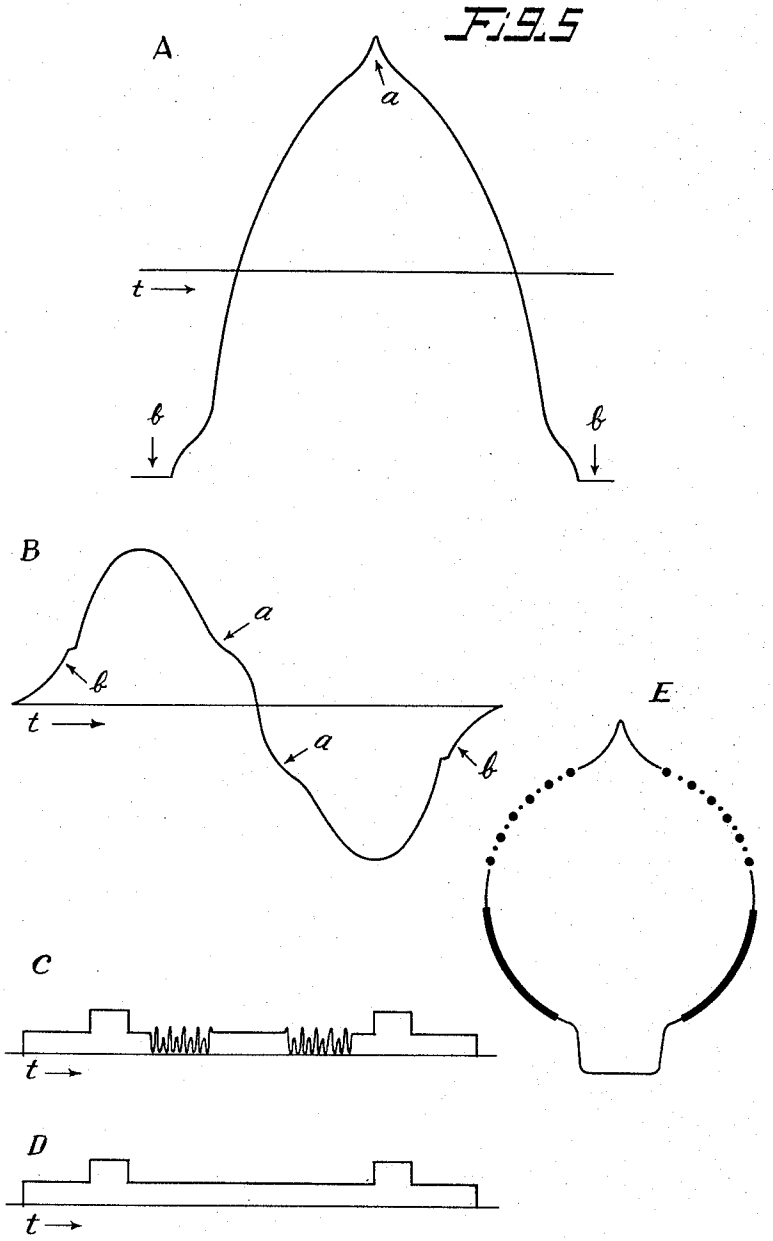
FIG. 5



INVENTOR.
YOSHIHARU MITA

BY

Kiel, Ackerman, Morris, Head & Simpson
ATTORNEYS

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2,910,681

APPARATUS FOR PRODUCING AUDIO-VISUAL DYNAMIC DESIGNS

Yoshiharu Mita, Meguro-ku, Tokyo, Japan

Application May 17, 1955, Serial No. 509,069

Claims priority, application Japan November 8, 1954

3 Claims. (Cl. 340—324)

This invention relates principally to a method and device for producing designs and patterns in motion on a fluorescent screen of a cathode-ray tube by means of an electro-analog method.

It is an object of this invention to provide a method of and a device for producing artistic designs and patterns in motion on a fluorescent screen of a cathode-ray tube by means of an electro-analog method established in analogue with such a principle as standing in the designs by artists and also

It is another object of this invention to provide a method of and a device to obtain a dynamic audio-visual performance for artistic appreciation.

Further object of this invention is to provide a method of and a device for recording and reproducing such audio-visual performances electrically.

I name such a device as "Figurescope."

The basic figures of designs and patterns are the circle, triangle and square, and designs and patterns are featured by arranging combinations of such three basic components under certain rhythms and processing them with deformations, line-cuttings, variations in sharpness and gradation, etc. in accordance with certain tones; so any complicated designs and patterns can be analyzed into such three basic components. Therefore, should we turn attention to such a possibility that an electrical operation which is analogous with that in the production of designs and patterns by artists is obtainable by employing certain types of alternating currents, it is obvious that we can have such a device which is capable of producing designs and patterns electrically so many in variety and so quickly in speed that a hand-drawing can never attain.

It is well known that the designs and patterns involve their proper meanings and feelings as in music, and should we turn attention to such a possibility that dynamic variations of such designs and patterns are available by processing them manually and/or automatically with music or other sounds which involve same meanings and feelings as in the designs and patterns by means of certain electrical processes, it is obvious that we can have such an electrical device which presents us a dynamic audio-visual performance for artistic appreciation, in which the designs and patterns stand up with music or other sounds from time to time in multifarious ways.

It is preferable that such an audio-visual performance is processed by an artist who is capable of understanding the meanings and feelings of music as well as designs and patterns at performance and through his skillfulness, and it is preferable furthermore that such a performance can be recorded and reproduced. Should we turn attention to such a possibility that the recording thereof can be made by recording the designs and patterns as well as music in the form of electrical signals, it is obvious that we can have the recording and reproduce the dynamic audio-visual performance at any time.

For a better understanding of this invention, references are taken to the accompanying drawings, wherein Fig. 1

is a schematic diagram illustrating an example of a figurescope according to this invention; Fig. 2 is a connection diagram illustrating examples of an axis positioning device and a control signal device therefor which are included in a figurescope shown in Fig. 1; Fig. 3 is a connection diagram illustrating examples of a focusing control device and a control signal device therefor which are included in a figurescope shown in Fig. 1; Fig. 4 is a connection diagram illustrating examples of a cathode-ray tube control grid bias control device and a control signal device therefor which are included in a figurescope shown in Fig. 1; and Fig. 5 is a sample of figure obtainable by an operation of a figurescope, A being a voltage wave form to be applied to the vertical axis of a cathode-ray tube, B a voltage wave form to be applied to the horizontal axis, C a voltage wave form to the control grid, D a voltage wave form to the focusing device and E a resultant figure obtained on a fluorescent screen.

As shown in Fig. 1, an example of a figurescope according to this invention is referable as consisting of the following parts:—

CRT: a cathode-ray tube.
X: a horizontal deflection device, by way of example of a cathode-ray control device.
Y: a vertical deflection device, by way of example of a cathode-ray control device.
F: a focusing device, by way of example of a cathode-ray control device.
G: a cathode-ray tube control grid, by way of a cathode-ray control device.
K: a cathode-ray tube cathode including electron emission parts.
SCR: a fluorescent screen.
P_0: a transparent dielectric material.
PS–X: a horizontal axis positioning device.
PS–XC: a horizontal axis positioning signal device.
MG–PX: a recording and reproducing device for horizontal axis positioning signal.
S_6: a switch for selecting direct or reproducing performance of horizontal axis positioning.
AMP–X: a horizontal axis input amplifier.
OSC–AX: a frequency or phase controllable sine-wave oscillator for horizontal axis.
OCS–BX: a frequency or phase controllable triangle-wave oscillator for horizontal axis.
OSC–CX: a frequency or phase controllable square-wave oscillator for horizontal axis.
DIS–AX: a distortion control amplifier for sine-wave for horizontal axis.
EX–AX: an expanding or compressing amplifier for sine-wave for horizontal axis.
EX–BX: an expanding or compressing amplifier for triangle-wave for horizontal axis.
EX–CX: an expanding or compressing amplifier for square-wave for horizontal axis.
MIX–X: a mixer for horizontal axis input.
MG–X: a recording and reproducing device for horizontal axis input.
S_1: a switch for selecting direct or reproducing input to horizontal axis.
PS–Y: a vertical axis positioning device.
PS–YC: a vertical axis positioning signal device.
MG–PY: a recording and reproducing device for vertical axis positioning signal.
S_7: a switch for selecting direct or reproducing performance of vertical axis positioning.
AMP–Y: a vertical axis input amplifier.
OSC–AY: a frequency or phase controllable sine-wave oscillator for vertical axis.
OSC–BY: a frequency or phase controllable triangle-wave oscillator for vertical axis.

OSC–CY: a frequency or phase controllable square-wave oscillator for vertical axis.
DIS–AY: a distortion control amplifier for sine-wave for vertical axis.
EX–AY: an expanding or compressing ampilfier for sine-wave for vertical axis.
EX–BY: an expanding or compressing amplifier for triangle-wave for vertical axis.
EX–CY: an expanding or compressing amplifier for square-wave for vertical axis.
MIX–Y: a mixer for vertical axis input.
MG–Y: a recording and reproducing device for vertical axis input.
S_2: a switch for selecting direct or reproducing input to vertical axis.
BG: a cathode-ray tube control grid bias control device.
BGC: a cathode-ray tube control grid bias control signal device.
S_5: a switch for selecting direct or reproducing performance of cathode-ray tube control grid bias control.
MG–BG: a recording and reproducing device for cathode-ray tube control grid bias control signal.
OSC–AG: a frequency or phase controllable sine-wave oscillator for cathode-ray tube control grid.
OSC–BG: a frequency or phase controllable triangle-wave oscillator for cathode-ray tube control grid.
OSC–CG: a frequency or phase controllable square-wave oscillator for cathode-ray tube control grid.
DIS–AG: a distortion control amplifier for sine-wave for cathode-ray tube control grid.
EX–AG: an expanding or compressing amplifier for sine-wave for cathode-ray tube control grid.
EX–BG: an expanding or compressing amplifier for triangle-wave for cathode-ray tube control grid.
EX–CG: an expanding or compressing amplifier for square-wave for cathode-ray tube control grid.
MIX–G: a mixer for input to cathode-ray tube control grid.
MG–G: a recording and reproducing device for input to cathode-ray tube control grid.
S_3: a switch for selecting direct or reproducing input for cathode-ray tube control grid.
BF: a cathode-ray tube focusing control device.
BFC: a cathode-ray tube focusing control signal device.
MG–F: a recording and reproducing device for cathode-ray tube focusing control signal.
S_4: a switch for selecting direct or reproducing performance of cathode-ray tube focusing control.
AMP–V: an audio amplifier.
SP: a loud speaker.
MG–V: a recording and reproducing device for audio program.
S_8: a switch for selecting direct or reproducing audio program.
FIL–1: a low frequency band pass filter.
FIL–2: a medium frequency band pass filter.
FIL–3: a high frequency band pass filter.
RCT–1: a rectifier.
RCT–2: a rectifier.
RCT–3: a rectifier.
RCT–V: a rectifier.
TM–1: a time-constant circuit.
TM–2: a time-constant circuit.
TM–3: a time-constant circuit.
TM–V: a time-constant circuit.
T–1: an input terminal for frequency or phase control voltage for sine-wave oscillator for horizontal axis.
T–2: an input terminal for distortion control voltage for sine-wave distortion control amplifier for horizontal axis.
T–3: an input terminal for amplitude control voltage for expanding or compressing amplifier for sine-wave for horizontal axis.
T–4: an input terminal for frequency or phase control voltage for triangle-wave oscillator for horizontal axis.

T–5: an input terminal for amplitude control voltage for expanding or compressing amplifier for triangle-wave for horizontal axis.
T–6: an input terminal for frequency or phase control voltage for square-wave oscillator for horizontal axis.
T–7: an input terminal for amplitude control voltage for expanding or compressing amplifier for square-wave for horizontal axis.
T–8: an input terminal for frequency or phase control voltage for sine-wave oscillator for vertical axis.
T–9: an input terminal for distortion control voltage for sine-wave distortion control amplifier for vertical axis.
T–10: an input terminal for amplitude control voltage for expanding or compressing amplifier for sine-wave for vertical axis.
T–11: an input terminal for frequency or phase control voltage for triangle-wave oscillator for vertical axis.
T–12: an input terminal for amplitude control voltage for expanding or compressing amplifier for triangle-wave for vertical axis.
T–13: an input terminal for frequency or phase control voltage for square-wave oscillator for vertical axis.
T–14: an input terminal for amplitude control voltage for expanding or compressing amplifier for square-wave for vertical axis.
T–15: an input terminal for frequency or phase control voltage for sine-wave oscillator for cathode-ray tube control grid.
T–16: an input terminal for distortion control voltage for sine-wave distortion control amplifier for cathode-ray tube control grid.
T–17: an input terminal for amplitude control voltage for expanding or compressing amplifier for sine-wave for cathode-ray tube control grid.
T–18: an input terminal for frequency or phase control voltage for triangle-wave oscillator for cathode-ray tube control grid.
T–19: an input terminal for amplitude control voltage for expanding or compressing amplifier for triangle-wave for cathode-ray tube control grid.
T–20: an input terminal for frequency or phase control voltage for square-wave oscillator for cathode-ray tube control grid.
T–21: an input terminal for amplitude control voltage for expanding or compressing amplifier for square-wave for cathode-ray tube control grid.
T–22: an input terminal for cathode-ray tube focusing control signal modulation voltage.
T–23: an input terminal for cathode-ray tube control grid bias control signal modulation voltage.
T–24: an input terminal for horizontal axis positioning control signal modulation voltage.
T–25: an input terminal for vertical axis positioning control signal modualtion voltage.
T–V: an audio input terminal.
SIG–1: an output terminal for control voltage corresponding to low frequency audio level.
SIG–2: an output terminal for control voltage corresponding to medium frequency audio level.
SIG–3: an output terminal for control voltage corresponding to high frequency audio level.
SIG–4: an output terminal for control voltage corresponding to amplitude of sine-wave for horizontal axis.
SIG–5: an output terminal for control voltage corresponding to amplitude for triangle-wave for horizontal axis.
SIG–6: an output terminal for control voltage corresponding to amplitude of square-wave for horizontal axis.
SIG–7: an output terminal for control voltage corresponding to amplitude of sine-wave for vertical axis.
SIG–8: an output terminal for control voltage corresponding to amplitude of triangle-wave for vertical axis.
SIG–9: an output terminal for control voltage corresponding to amplitude of square-wave for vertical axis.

SIG–10: an output terminal for control voltage corresponding to amplitude of sine-wave for cathode-ray tube control grid.

SIG–11: an output terminal for control voltage corresponding to amplitude of triangle-wave for cathode-ray tube control grid.

SIG–12: an output terminal for control voltage corresponding to amplitude of square-wave for cathode-ray tube control grid.

SIG–V: an output terminal for control voltage corresponding to audio level.

and these parts are arranged and connected so that an independent input voltage which is appropriately mixed with sine-wave, triangle-wave and square-wave voltages is applied to each of the horizontal axis, vertical axis and control grid of the cathode-ray tube, where amplitude, frequency and phase of the sine-wave, triangle-wave and square-wave and distortion of the sine-wave in each input to the horizontal axis, vertical axis and control grid of the cathode-ray tube are adjustable manually and/or automatically, and cathode-ray tube control grid bias control, focusing control and positionings of either horizontal and vertical axis are also adjustable manually and/or automatically, and such functions stand for those in the basic composition of designs and patterns by artists as follows:

(1) The sine-wave component applied to the horizontal and vertical axes stands for the circular component in designs and patterns.

(2) The triangle-wave component applied to the horizontal and vertical axes stands for the triangular component in designs and patterns.

(3) The square-wave component applied to the horizontal and vertical axes stands for the square component in designs and patterns.

(4) The sine-wave component applied to the cathode-ray tube control grid stands for the smooth nodular and clear/obscure components in designs and patterns.

(5) The triangle-wave component applied to the cathode-ray tube control grid stands for the sharp nodular and clear/obscure components in designs and patterns.

(6) The square-wave component applied to the cathode-ray tube control grid stands for the unique nodular and clear/obscure components in designs and patterns.

(7) Bias for the cathode-ray tube control grid determines the brightness of designs and patterns.

(8) Focusing control determines the thickness and sharpness of lines in designs and patterns.

(9) Frequencies of input currents or voltages to the horizontal axis, vertical axis, cathode-ray tube control grid and focusing control determine the rhythm and tone of designs and patterns.

Therefore, by setting appropriately frequencies, phases and amplitudes of the voltages or currents which are supplied from the sine-wave oscillators OSC-AX and OSC–AY, triangle-wave oscillators OSC–BX and OSC–BY and square-wave oscillators OSC–CX and OSC–CY which are provided in the horizontal axis and vertical axis circuits, and by applying the voltages or currents to the horizontal axis and vertical axis respectively after mixing each of them by the mixers MIX–X and MIX–Y, it is possible to obtain a Lissajous figure as of an artistic design on the fluorescent screen of the cathode-ray tube, wherein an appropriate control on the distortion control amplifiers DIS–AX and DIS–AY brings a deformation on the figure; thickness and sharpness of lines of the figure can be adjusted optionally by controlling the focusing; and brightness of the figure can be controlled optionally by controlling bias for the cathode-ray tube control grid. Furthermore, optional line-cuttings on the figure can be performed by applying to the cathode-ray tube control grid such voltages obtained by mixing voltages, which are supplied from the sine-wave oscillator OSC–AG, triangle-wave oscillator OSC–BG and square-wave oscillator OSC–CG of which frequencies, phases

and amplitudes are appropriately adjusted, through the mixer MIX–G and by being superimposed on an appropriate bias voltage, and certain types of deformations on such line-cuttings can be made by controlling the sine-wave distortion control amplifier DIS–AG which is provided in the cathode-ray tube control grid circuit. Further modifications of the figure can be made by appropriate applications of control voltages from the terminals SIG–4 to SIG–12 to the terminals T–1 to T–25 in any combinations.

In case where a figure produced on a comparatively narrow area of the fluorescent screen with a high brightness, by putting the transparent dielectric material P_0 on the outside part of the fluorescent screen, several luminant radial bands can be drawn towards corner of the fluorescent screen, because of discharges of static charge on the inside of the fluorescent screen, the discharge taking place through the shortest paths towards the positive inside wall of the cathode-ray tube.

The processing of such designs and patterns with music or other sounds can be made by either such operations as varying compositions of the figures, which are obtained by the process as explained in the foregoing paragraphs, in harmony with music or other sounds by manual controls, or such automatic operations as performable by applying control voltages, which are obtainable from the terminals SIG–1 to SIG–3 and SIG–V while music or other sounds are heard at the speaker SP through the audio amplifier AMP–V and audio input terminal T–V, to the terminals T–1 to T–25 appropriately, and furthermore, by the manual/automatic parallel operations.

For example, in order to process such designs and patterns with variations in the general level of the musical sounds, the control voltage, which is available from the terminal SIG–V through the rectifier RCT–V and time-constant circuit TM–V, is applied to the expanding or compressing amplifier EX–AX as an amplitude control voltage through the terminal T–3, whereby the amplitude of sine-wave component to the horizontal axis is varied in accordance with the variations in the general level of the musical sounds, and appropriate applications thereof to the expanding or compressing amplifiers EX–BX, EX–CX, EX–AY, EX–BY and EX–CY through the terminals T–5, T–7, T–12 and T–14 bring about the subsequent variations in amplitudes of triangle-wave and square-wave components to the horizontal and vertical axes in accordance with those in the general level of the sounds.

Furthermore, appropriate applications of such a control voltage to the expanding or compressing amplifiers EX–AG, EX–BG, EX–CG through the terminals T–17, T–19 and T–21 bring about the subsequent variations in amplitudes of sine-wave, triangle-wave and square-wave components to the cathode-ray tube control grid for line-cuttings of the figure in accordance with those in the general level of the sounds; appropriate applications of such a control voltage to the terminals T–1, T–4, T–6, T–8, T–11, T–13, T–15, T–18 and T–20 bring about the subsequent variations in frequency or phase of sine-wave, triangle-wave and square-wave components to the horizontal axis, vertical axis and cathode-ray tube control grid and thus vary the Lissajous figure compositions and spacings of line-cutting in accordance with the variations in the general level of the musical sounds; appropriate applications of such a control voltage to the terminals T2, T–9 and T–16 bring about the subsequent variations in distortions of sine-wave components to the horizontal axis, vertical axis and cathode-ray control grid and thus vary the deformations of the figure and line cuttings thereof in accordance with the variations in the general level of the musical sounds; appropriate applications of such a control voltage to the terminals T–22, T–23, T–24 and T–25 bring about the subsequent variations in thickness and brightness of line, horizontal axis position and

vertical axis position in accordance with variations in the general level of the musical sounds.

In order to process such designs and patterns with the variations in the level of low-note involved in the musical sounds, a control voltage, which is available at the terminal SIG–1 through the low-pass filter FIL–1, rectifier RCT–1 and time-constant circuit TM–1, is applied to the terminals T–1 to T–25 appropriately in the same manner as in the above; in order to process such designs and patterns with the variations in the level of medium-note involved in the musical sounds, a control voltage, which is available at the terminal SIG–2 through the medium frequency pass filter FIL–2, rectifier RCT–2 and time-constant circuit TM–2, is applied to the terminals T–1 to T–25 appropriately in the same manner as in the above, and in order to process such designs and patterns with the variations in the level of high-note involved in the musical sounds, a control voltage, which is in accordance with the level variations of the high-note and available at the terminal SIG–3 through the high-pass filter FIL–3, rectifier RCT–3 and time-constant circuit TM–3, is applied to the terminals T–1 to T–25 appropriately in the same manner as in the above. Such operations of processing designs and patterns with music or other sounds are automatic, but such a processing can be performed either manually or automatically, or by an automatic/manual parallel operation. For example, in such a design as illustrated in Fig. 5E, an appropriate application of controls on frequencies of the oscillators OSC–AG, OSC–BG and OSC–CG will bring about a rotation of the spot parts in clockwise or anti-clockwise direction; an appropriate application of controls on the expanders or compressors EX–AG, EX–BG and EX–CG will bring about a variation in types of the spottings; an appropriate application of controls on frequencies of the oscillators OSC–AX, OSC–BX and OSC–CX or OSC–AY, OSC–BY and OSC–CY will bring about a rotation of the main figure as well as changes in its design in an amusant way; an appropriate application of controls on the expanders or compressors EX–AX, EX–BX and EX–CX and/or EX–AY EX–BY and EX–CY will bring about an expansion or compression of the whole figure; and such controls can be made either manually or automatically by applying the control voltages available from the terminals SIG–V, SIG–1; SIG–2, etc. to the control terminals T–15, T–18, T–20, T–17, T–19, T–21, T–1, T–4, T–6, T–8, T–11, T–13, T–3, T–5, T–7, T–10, T–12, T–14, etc., wherein the figure will stand up with variations in a general level of applying sound or music for the processing in case where the control voltage from the terminal SIG–V is used for such processings; by use of the terminal SIG–1, the processing will be made with variations in low note components thereof; and by use of the terminal SIG–2, with those in high note components thereof.

Recording and reproduction of such designs and patterns in motion can be made electrically by the recording and reproducing devices MG–V, MG–X, MG–PX, MG–F, MG–G, MG–BG, MG–PY and MG–Y (such as a multi-channel magnetic recording and reproducing device), wherein the recording and reproducing device MG–V is for recording and reproducing music or other sounds with which designs and patterns are to be processed, the recording and reproducing device MG–X is for current or voltage for the horizontal axis, the recording and reproducing device MG–PX is for control signal for horizontal axis positioning, the recording and reproducing device MG–F is for control signal for focusing, the recording and reproducing device MG–G is for voltage to be applied to the cathode-ray tube control grid, the recording and reproducing device MG–BG is for bias voltage to be applied to the cathode-ray tube control grid, the recording and reproducing device MG–PY is for control signal for vertical axis positioning, the recording and reproducing device MG–Y is for current or voltage for the vertical axis, and R denotes a recording device and P a reproducing device. Recordings of such designs and patterns as well as music or other sounds for such a processing can be made automatically when the switches S_1 to S_7 are on the position M and the reproductions on the position A.

In such ways, according to this invention, a figurescope presents us either still designs and patterns and those in motion in which they stand up with music or other sounds, and such a figurescope can be used for various purposes such as artistic appreciation, production of designs and patterns, production of dynamic audio-visual title-backs and intermezzo programs for television, talkie-pictures, etc. in either direct or reproduction performances.

The horizontal axis positioning device PS–X and vertical positioning device PS–Y employed in a figurescope are of a same design, and the horizontal axis positioning control signal device PS–XC and vertical axis positioning control signal device PS–YC are of a same design also.

As shown in Fig. 2 an example of these devices is referable as consisting of the following parts:

OSC–S: an alternating current oscillator.
V_1: a vacuum tube having two control grids.
V_2, V_3: a power amplifier type vacuum tube.
C_1, C_2, C_6, C_7: a by-pass condenser.
C_3: a coupling condenser.
C_4, C_5: a smoothing condenser.
R_1, R_2, R_3: a grid-bias resistor for vacuum tube V_1.
R_5: an anode resistor for vacuum tube V_1.
R_6: a variable resistor for controlling output of vacuum tube V_1.
R_4: a screen-grid resistor for vacuum tube V_1.
T–24/T–25: an input terminal for horizontal or vertical axis positioning control signal voltage.
H.T.: an anode power input terminal.
S_6/S_7: a switch for selecting direct or reproducing performance of vertical or horizontal axis positioning control signal.
MG–PX/MG–PY: a recording and reproducing device for horizontal or vertical axis positioning signal.
T_1: a transformer.
$Rect_1$, $Rect_2$: a rectifier.
R_7, R_8: a variable resistor for setting center of horizontal or vertical axis.
T_2: an input transformer for horizontal or vertical axis.
Def: a deflection coil for horizontal or vertical axis.
BIAS: a grid-bias supply source for vacuum tube V_2.

and these parts are arranged and connected as shown in Fig. 2, wherein each anode current to the vacuum tubes V_2 and V_3 flows through the deflection coil Def in opposite direction each other; each anode current is controlled by respective grid voltages to the vacuum tubes V_2 and V_3; two D.C. voltages, which are developed at the resistors R_7 and R_8 due to a flow of current obtained by rectifying with the rectifiers $Rect_1$ and $Rect_2$ an alternating current being supplied through the transformer T_1, are supplied to the grids of the vacuum tubes V_2 and V_3 respectively in such a way that an increase in the said alternating current brings a negative increase in the grid voltage to the vacuum tube V_3 and a positive increase in the grid voltage to the vacuum tube V_2 on the other hand and vice versa; therefore, positioning of axis can be made by controlling amplitude of the alternating current; the said alternating current is supplied from an oscillator OSC–S to the transformer T_1 through the vacuum tube V_1 and amplitude of the alternating current is controlled by applying a control voltage to a control-grid of the vacuum tube V_1 through the terminal T–24/T–25 so that the axis positioning can be made by the control voltage; when the switch S_6/S_7 is on the position M, the alternating current of which amplitude varies in accordance with the control voltage is recorded on the recorder MG–PX or MG–PY as an axis positioning sig-

nal; the reproduction of such an axis positioning performance can be made by setting the switch S_6/S_7 on the position A as the recorded signal is reproduced and delivered to the transformer T_1; and input for drawing designs and patterns is supplied to the deflection coil Def through the transformer T_2 and the condensers C_6 and C_7 at the same time.

As shown in Fig. 3, an example of the focusing control device BF and the focusing control signal device BFC employed in the figurescope is referable as consisting of the following parts:

OSC–S: an alternating current oscillator.
V_4: a vacuum tube having two control grids.
V_5: a power amplifier type vacuum tube.
C_8, C_9: a by-pass condenser.
C_{10}: a coupling condenser.
C_{11}: a smoothing condenser.
R_9, R_{10}, R_{11}: a grid-bias resistor for vacuum tube V_4.
R_{12}: a screen-grid resistor for vacuum tube V_4.
R_{13}: an anode resistor for vacuum tube V_4.
R_{14}: a variable resistor for controlling output from vacuum tube V_4.
R_{15}: a variable resistor for controlling focusing origin.
R_{16}, R_{17}: a grid-bias resistor for vacuum tube V_5.
S_4: a switch for selecting direct or reproducing performance of focusing.
MG–F: a recording and reproducing device for focusing control signal.
T–22: an input terminal for focusing control signal modulation voltage.
T_3: a transformer.
$Rect_3$: a rectifier.
F.C.: a focusing coil.
H.T.: an anode power input terminal.

and these parts are arranged and connected as shown in Fig. 3, wherein anode current to the vacuum tube V_5 flows through the focusing coil F.C.; the anode current is controlled by grid voltage to the vacuum tube V_5; a D.C. voltage, which is developed at the resistor R_{15} due to a flow of a direct current obtained by rectifying with the rectifier $Rect_3$ an alternating current being supplied through the transformer T_3, is applied to the grid of the vacuum tube V_5; therefore, the focusing can be controlled by controlling amplitude of the alternating current; the said alternating current is supplied from an oscillator OSC–S to the transformer T_3 through the vacuum tube V_4 and amplitude of the alternating current is controlled by applying a control voltage to a control-grid of the vacuum tube V_4 through the terminal T–22 so that the focusing control can be made by the control voltage; when the switch S_4 is on the position M, the alternating current of which amplitude varies in accordance with the control voltage is recorded on the recorder MG–F as a focusing control signal; the reproduction of such a focusing control performance can be made by setting the switch S_4 on the position A as the recorded signal is reproduced and delivered to the transformer T_3 thereby; and the variable resistor R_{15} is to be used for setting the focusing origin.

As shown in Fig. 4 an example of the cathode-ray tube control-grid bias control device BG and cathode-ray tube control-grid bias control signal device BGC employed in the figurescope is referable as consisting of the following parts:

OSC–S: an alternating current oscillator.
V_6: a vacuum tube having two control grids.
C_{12}, C_{13}: a by-pass condenser.
C_{14}: a coupling condenser.
R_{18}, R_{19}, R_{20}: a grid bias resistor for vacuum tube V_6.
R_{21}: a screen-grid resistor for vacuum tube V_6.
R_{22}: an anode resistor for vacuum tube V_6.
R_{23}: a variable resistor for controlling output from vacuum tube V_6.
R_{24}: a resistor.
S_5: a switch for selecting direct or reproducing performance of cathode-ray tube control grid bias control.
MG–BG: a recording and reproducing device for cathode-ray tube control grid bias control signal.
T_4: a transformer.
S_3: a switch for selecting direct or reproducing input to cathode-ray tube control grid.
MG–G: a recording and reproducing device for cathode-ray tube control grid input.
T–23: an input terminal for cathode-ray tube control grid bias control signal modulation.
H.T.: an anode power input terminal.
CRT: a cathode-ray tube.

and these parts are arranged and connected as shown in Fig. 4, wherein a D.C. voltage, which is developed at the resistor R_{24} due to a flow of a D.C. current obtained by rectifying with the rectifier $Rect_4$ an alternating current being supplied through the transformer T_4, is applied to the control grid of the cathode-ray tube as a bias; therefore, the bias voltage can be controlled by controlling amplitude of the alternating current; the alternating current is supplied to the transformer T_4 from the oscillator OSC–S through the vacuum tube V_6 and amplitude of the alternating current can be controlled by applying a control voltage to a control grid of the vacuum tube V_6 through the terminal T–23 so that the grid bias to the cathode-ray tube control grid is controlled by the control voltage; when the switch S_5 is on the position M, the alternating current of which amplitude varies in accordance with the control voltage is recorded on the recorder MG–BG, the reproduction of such a bias control performance can be made by setting the switch S_5 on the position A as the recorded signal is reproduced and delivered to the transformer T_4 thereby; and the output from the mixer MIX–G or reproducer MG–G is applied to the control grid of the cathode-ray tube through the switch S_3 being superimposed on the said grid bias.

Fig. 5 shows an example of figure produced by such a figurescope and its electrical components. The figure as shown in Fig. 5–E is obtainable by applying a current having such a wave-form, frequency and amplitude as shown in Fig. 5–A to the vertical axis, a current having such a wave-form, frequency and amplitude as shown in Fig. 5–B to the horizontal axis, a voltage having such a wave-form as shown in Fig. 5–C and a current as shown in Fig. 5–D to the focusing device. Such a current as shown in Fig. 5–A is obtainable by adding a triangular component *a* and a square component *b* to a sine-wave which is the main component of the current, and such a composition is made by adjusting each frequency, phase and amplitude of the output current from the sine-wave oscillator OSC–AY, triangle-wave oscillator OSC–BY and square-wave oscillator OSC–CY in the vertical axis circuit appropriately and by mixing such output currents by the mixer MIX–Y in the vertical circuit; such a current as shown in Fig. 5–B is obtained by adjusting each frequency, phase and amplitude of output currents from the sine-wave oscillator OSC–AX, triangle-wave oscillator OSC–BX and square-wave oscillator OSC–CX in the horizontal axis circuit appropriately and so as to have 90° phase difference with the current as in Fig. 5–A; such a current as shown in Fig. 5–C is obtained by adjusting each frequency, phase and amplitude of output voltage from the sine-wave oscillator OSC–AG and square-wave oscillator OSC–CG and distortion control of the distortion control amplifier DIS–AG appropriately and by mixing such output voltages appropriately by the mixer MIX–G in the cathode-ray tube control grid circuit, and by superimposing the mixed voltages on a bias voltage; and such a current as shown in Fig. 5–D is obtained by applying the control voltage from the terminal SIG–12 to the terminal T–22 as the control signal to the focusing control device BF from the focusing con-

trol signal device BFC is modulated with a square-wave as in Fig. 5–D thereby.

An example of processing such a figure as in Fig. 5–E with dynamic variations is referred to in the following. When the frequency or phase relation between the sine-wave components to the horizontal axis and vertical axis is varied by adjusting the control voltages being applied to the sine-wave oscillator OSC–AY and/or OSC–AX, the circle in Fig. 5–E will be transformed into a complicated figure and it can be twisted and rotated in either horizontal or vertical-wise; when a distortion is given in the sine-wave components by adjusting the control voltages being applied to the distortion control amplifiers DIS–AY and/or DIS–AX, a deformation will be given to the circular component of the figure; when the expanding or compressing amplifiers EX–AY, EX–BY, EX–CY, EX–AX, EX–BX and EX–CX are controlled by a control voltage such as available from the terminal SIG–V, the volume of the figure will vary according to the variation in general level of music or other sounds which are being heard at the speaker SP; when only the expanding or compressing amplifiers EX–AY and/or EX–AX are controlled by a control voltage such as available from the terminal SIG–V, the volume of only the circular component in the figure will vary in accordance with the variation in general level of music or other sounds at performance; when only the expanding or compressing amplifiers EX–BY and/or EX–BX are controlled, the volume of only the triangular component will vary; when only the expanding or compressing amplifiers EX–CY and/or EX–CX are controlled, the volume of only the square component will be effected; when the frequency or phase of sine-wave component being applied to the cathode-ray tube control grid is varied by adjusting control voltage for the sine-wave oscillator OSC–AG, a rotation in clock-wise or anti-clock-wise direction will take place in the spotting parts in the figure; when the control voltage to the bias control signal device BGC is varied, brightness of the figure will change; and when the control voltage to the focusing control signal device BFC is varied, thickness of lines of the figure will change. By performing such operations automatically and/or manually in harmony with music or other sounds at performance, an artistic dynamic audio-visual performance, in which the figure stands up with the music or other sounds, can be obtained. Furthermore, by adding other controls such as on the axis positioning signal device PS–YC and/or PS–XC, more complicated dynamic variations can be processed on the figure. Recording of such figures in motion as well as such sounds can be made automatically during the operation by the recorders MG–Y, MG–PY, MG–BG, MG–G, MG–F, MG–PX, MG–X and MG–V, and the reproduction can be made by playing back such a record.

What is claimed is:

1. In apparatus for producing dynamic visual designs from a musical audio signal, cathode ray means including a screen, means for producing a spot of light on said screen, first control means for controlling the intensity of said spot, second control means for deflecting said spot in one direction, and third control means for deflecting said spot in a transverse direction, signal means for applying alternating current signals derived from a musical audio program to said control means, a multi-track recording-reproducing device, means for applying said alternating current signals to said device to be recorded, means for simultaneously applying said musical audio program to said device to be recorded synchronously with said alternating current signals, and means for subsequently connecting said device to said control means to reproduce the recorded signals and apply the same to said control means to produce on said cathode ray means said dynamic visual designs derived from said musical audio program while simultaneously reproducing said musical program recorded on said multi-track recording-reproducing device.

2. In apparatus for producing visual designs, a cathode ray tube having a screen including fluorescent material, means for impinging a cathode ray beam on said screen including a high potential electrode adjacent the periphery of said screen, first control means for controlling the intensity of said beam, and second control means for controlling deflection of said beam, means for applying alternating current signals to said control means to produce a figure on said screen, and a member of optically transparent dielectric material in contact with a central portion of said screen and having a portion adjacent said high potential electrode for effecting dissipation of the static charge produced by impingement of said beam on said screen and for thus effecting movement of light patterns outwardly from said central portion.

3. Apparatus for producing a reproducible record of dynamic aesthetic visual designs synchronized with a musical program from which said designs are derived comprising, a source of electrical audio signals, multi-track recording means, a cathode ray tube, means to record said audio signals on a first track of said recording means, means to derive control signals from said audio signals, means to apply said control signals to said cathode ray tube to produce dynamic visual designs having geometrical characteristics determined by the musical characteristics of said audio signals, and means to record said control signals on a second track of said recording means synchronously with the recording of said audio signals to produce a record of an audio-visual dynamic design.

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