APPARATUS FOR GENERATING A REPRESENTATION OF THE JUNCTION BETWEEN TWO SOLIDS IN A CATHODE RAY TUBE DISPLAY

L. HARRISON III

Filed Jan. 15, 1968

Aug. 4, 1970

3,523,289

2 Sheets-Sheet 2

INVENTOR

LEE HARRISON, III
MEANS AND METHOD FOR GENERATING SHADOWS ON CONTINUOUS SURFACES IN AN IMAGE PRODUCED BY AN ELECTRONIC IMAGE GENERATOR

Filed Jan. 15, 1968

INVENTOR:

LEE HARRISON III

BY UNGELAND, RYAN, GILL, EISEN, ROBERTS

ATTORNEYS
SYSTEM FOR RECORDING THE SURFACE CHARACTERISTICS OF AN OBJECT

Filed Oct. 21, 1963

Inventor:

Lee Harrison,

By Kingsland, Rogers, Jeffs & Robbins

Attorneys
Bone Man

With scanner and getting off back of figure

Creating pulse at edges (sin θ = 0) and a pulse by threshold off film (interwaklins)

With video and multiplier network (using a gated D-C video)

With plugboard, counter, and programmed blanking
REQUIREMENTS:

A. PLACEMENT
B. SIZE
C. MOTION

A. PLACEMENT

When film is in place, area of scan-distortion must be placed to correspond with position of eye or mouth or eyebrow.

1. Vertical & horizontal placement

B. SIZE

The size of area of scan-distortion must be varied in width (horiz.) and height (vary no. of scan lines involved in distortion)

C. MOTION

Motion is accomplished by varying amount of distortion from

1) No distortion (straight scan) to 2) Full parabolic distortion

by varying envelope.

(Above) Remain constant for ea. figure.

Envelope waveforms necessary

Mouth & eyebrows

Eye

Eye

Eye

Eyes are superimposed on skin film using celluloid & moved accordingly.
SYSTEM TECHNICAL DESCRIPTION

THE SYSTEM III/IV OVERALL BLOCK DIAGRAM IS SHOWN IN FIG. 4.
STORE 3 KEY FRAMES, INITIAL (I), FINAL (F), AND SPARE

\( K = \text{no. of frames between key frames} \)

\( P_i = \text{parameter} \quad i = 1, 2, 3 \quad S_i = \text{segment} \quad i = 1, 2, \ldots, 10 \)

Note: 

\[ A \]
Monitor Power Supply
CIRCLE BONE

(GATED ± SINE, ± COSINE GENERATOR)

* ≈ .15 A²

(PARALLEL FUSIE POLYSTYRENE)
CIRCLE BONE BLANKER
SCANIMATE POWER SUPPLIES (+5V ±15VDC)
Diode D1 - D4 on heatside with output Resistors

VIEW IS OF METAL SIDE DOWN
Block Diagram

Vidicon Shading Compensation
Notes: All Res. \( \frac{1}{2} \text{W} 5\% \).

All Diodes IN3064.

SINE SHAPING NETWORK

CAMERA SHADING COMP.
VOLTAGE REGULATOR FOR SINE SHAPING NETWORK

-15V

12k

1mA

2.9V

2.4k

500

2N3569

-3.5V

-0.6V

7.5k

500

2N4354

-15V

15mA

3.3k

1N3060

-2.9V

820

-15V

5mA

0.1mA

16V

-2.3V @ 6.25mA TO SINE SHAPER
\[ R_2 = \frac{4V}{1\times10^{-3}} = 4k \]
\[ R_2 = \frac{4V}{1\times10^{-3}} \approx 3.9k \]
\[ J_B = \frac{1V}{5\times10^{-2}} = 2\times10^{-5} \]
\[ J_B = \frac{1.4V}{5\times10^{-2}} = 2\times10^{-4} \]
\[ R_1 = \frac{-10.4V}{8\times10^{-3}} = 1.3\times10^5 \]
\[ R_1 = \frac{-10.4V}{8\times10^{-3}} = 130k \]
\[ R_2 = \frac{4.6V}{6\times10^{-5}} = 766\times10^5 \]
\[ R_2 = \frac{4.6V}{6\times10^{-5}} = 76k \]

\[ Z_{IN} = \frac{130k}{75k} = \frac{9.75\times10^7}{2.65\times10^8} = 4.76\times10^4 \]
\[ 47k/19.5k = \frac{9.16\times10^3}{6.65\times10^4} = 1.378\times10^4 \]

\[ Z_{IN} = 13k \]

Phase Splitter
Basic process

Vary length

1) control flip-flops

II) control direction

III) control volume

Vary length

1) Control flip-flops (one for every bone) (30 in system)
INPUT #1 FROM PRECEDING MSMV

MONOSTABLE (ONESHOT) MULTIPIRATOR

THIS DEVICE MAKES THE PULSE THAT OPENS THE GATE. IT IS TRIGGERED BY THE ADJOINING MSMV. THE LENGTH OF ITS OUTPUT PULSE DETERMINED BY THE BONE-LENGTH POT.

TO NEXT MSMV

GATE OpENER

θ GATE #1
CONTROLS ANGLE IN X-Y PLANE

ALL θ GATE OUTPUTS ARE ADDED TOGETHER

ϕ GATE #2
CONTROLS ANGLE IN Z-Y PLANE

ALL ϕ GATE OUTPUTS ADDED TOGETHER

SKIN GATE #3
P (radians) DETERMINED AT WHICH SIDE OF SKIN YOU'RE LOOKING AT

OUTPUT TO SCANNER

NOTES

1. THE 1ST MSMV OF THE CHAIN IS FIRED BY THE COUNTER (LOW COUNTER)
2. THE LAST MSMV SENDS PULSE TO SWITCH ACROSS INTEGRATING CAPACITOR WHICH SHORTS OUT CAPACITOR
NOTES

1. A COUNTER IS USED TO SYNCHRONIZE THE HIGH \& LOW (24 CPS) FREQUENCIES.
   (A HIGH FREQ. IS FED INTO THE MONOSTABLE MULTI-VIBRATORS WHICH OPERATE
   THE GATES, THE LENGTH OF TIME THAT A GATE IS HELD OPEN (BECAUSE OF THE MSMV
   IS A DISCRETE LENGTH BECAUSE THE HIGH FREQ. PULSES CAUSE A CAPACITOR IN THE
   MSMV TO BUILD UP LIKE A STEP , AND THERE WILL BE A PARTICULAR
   LEVEL AT WHICH THE MSMV WILL CLOSE A GATE, EVEN THOUGH THE BONE-LENGTH
   POT IS A CONTINUOUS (LINEAR) RESISTANCE POT) IN ORDER THAT THE CHAIN OF MSMV'S
   IS FIRED OFF AT A TIME EXACTLY CORRESPONDING TO ONE OF THE DISCRETE STEPS,
   WE COUNT DOWN IN A VERY EXACT \& STABLE MANNER BY USING THE COUNTER.
   WE CHOOSE A LOW FREQ. OF 24 CPS BECAUSE THIS IS THE FRAME RATE OF
   STANDARD MOTION PICTURE PROJECTION, THUS AN OPERATOR OF THE DEVICE IS
   WORKING IN "REAL TIME" WHEN HE IS ANIMATING, AND OUR FRAMES RECORDED ON
   TAPE CORRESPOND TO FILM FRAMES.

SINE-COSINE GENERATOR - THE COUNTER
THE SINE-COSINE GEN (3A) DIVIDES BONE LENGTHS INTO DISCRETE STEPS OR INCREMENTS,
THE EXACT CUT-OFF OR START TIME OF EACH BONE CORRESPONDS TO A HIGH FREQUENCY BEAT.
THUS THE LOW FREQ. SYNCHRONIZED WITH THIS SAME BEAT ELIMINATES BONE JITTER BY ELIMINATING-
MINUTE LENGTH CHANGES WHICH OCCUR THROUGHOUT SYNC.
\( a \) A SINE, COSINE FUNCTION GENERATOR AND \\
\( b \) AN INTEGRATOR

\[ \text{SINE-WAVE INPUT (HF)} \]
\[ \text{FROM CLOCK} \]

\[ \Theta_1 \Theta_2 \]

\[ \text{DIFFERENT D.C. LEVELS, FROM GATE} \]
\[ \text{DETERMINED BY D.C LEVEL OUT OF GATE \text{- EX.} \Theta_1} \]

\[ \text{HIGH FREQUENCY} \]
\[ \text{X, Y, Z, W} \]

\[ \text{RELATIONSHIP OF PULSE} \]
\[ \text{TO G INTEGRATOR} \]

\[ \text{HOLDING CAPACITOR} \]
36b) BONE GENERATOR

1. The output of the integrators represent the x and y components of the bone vectors, which, when combined on a scope, give the desired bone.

2. Bones are connected because of the continuous integration and the "memory" of capacitors.

3. Parts of the skin network are an integral part of the integrators of the bone gen. Those parts are not shown here. See the 'skin network' where the analytic geometrical formulas are followed to produce the end product.
TIMING CONTROL (for 24 cps frame rate)

D.C. CONTROLLED OSCILLATOR

12,298 cps

COUNTER 512:1 REDUCTION

24 cps

Synchronized with line frequency

51 COUNTER

12 cps

60 cycle line input

PHASE COMPARATOR (D.C. OUTPUT)

12 cps
CAMERA AMP LC NETWORK

This network allows for the rotation of the axis of projection, and has the effect of changing the observers viewing angle.

\[ X = k_t \sin \theta \cos \phi + A \cos \phi \cos k_t \theta + A \cos \theta \sin k_t \theta \]

\[ Y = k_t \cos \theta \cos \phi + A \cos \theta \sin k_t \phi \]

\[ Z = k_t \sin \phi + A \cos \phi \cos k_t \phi \]

To X deflection on scope display.

To Y deflection.
$$x = k_t \sin \theta \cos \phi + A \sin \phi \cos k_1 t + A \cos \phi \sin k_1 t$$

$$y = k_t \cos \theta \cos \phi + A \cos \phi \sin k_1 t - A \sin \phi \cos k_1 t$$

$$z = k_t \sin \theta + A \cos \phi \cos k_1 t$$
generates 3-dimensional effect of bones in space

put amplifiers on input & output of all multipliers

Electronics be stick M N.