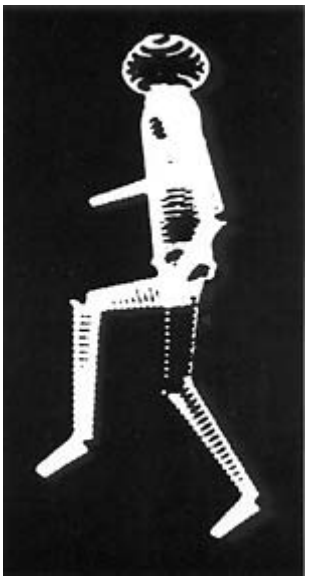
NOTES FOR AN EARLY ANIMATION DEVICE
Lee Harrison

The following paper is reprinted in facsimile form as the most primary and authentic source of Lee Harrison's original concept for electronic animation. These notes eventually materialized as the ANIMAC animation system.
D.D.



[illegible]

[illegible] Today [illegible] Dec. 29, 1961
[illegible], 44

Witnessed by [illegible]
LG 12/29/61

THE CLOCK OR MASTER OSCILLATOR, IS A ~~[illegible]~~ STABLE, VARIABLE-FREQUENCY WAVEFORM GENERATOR.

~~THE OUTPUT OF THE CLOCK.~~

THERE ARE TWO ~~[illegible]~~ SIGNAL OUTPUTS OF THE CLOCK OR MASTER OSCILLATOR. ONE IS A SQUARE WAVE, THE OTHER, A SINE WAVE. THE OUTPUTS ARE AT THE SAME FREQUENCY. ~~[illegible]~~

THE FUNCTION OF THE CLOCK IS TO FURNISH THE "DRIVING-SIGNALS" TO THE DEVICE. IT IS ALSO A MEANS BY WHICH THE INNER WORKINGS OF THE DEVICE ARE "TIME-SYNCHRONIZED."

WE REFER TO THE OUTPUT OF THE CLOCK AS "HIGH FREQUENCY," ~~[illegible]~~ BECAUSE WE COUNT DOWN (BY MEANS OF A COUNTER TO BE DESCRIBED LATER) TO THE "FRAME FREQUENCY", ~~[illegible]~~ THUS ESTABLISHING A FRAME RATE. FRAME RATE IS THE RATE AT WHICH WE DRAW ONE COMPLETE FIGURE OR PICTURE ON THE DISPLAY SCOPE.

BECAUSE THE COUNTER PERFORMS A FIXED-RATIO-COUNTDOWN, THE LOW FREQUENCY IS ALWAYS A LOWER MULTIPLE OF THE HIGH FREQUENCY. THUS, BY VARYING THE HIGH FREQUENCY, WE AUTOMATICALLY VARY THE LOW FREQUENCY OR FRAME RATE.

DURING THIS DEVELOPEMENTAL PERIOD, WE ARE OPERATING AT FRAME RATES BETWEEN 24 AND 30 CYCLES PER SECOND (CPS). 30 cps IS DESIRABLE AT THIS TIME BECAUSE

a.) THE LIGHTING IN OUR WORKSHOP IS SUCH THAT AT A LOWER FRAME RATE, WE SEE A BOTHERSOME FLICKER, and

b). IT IS VERY EASY TO SYNCHRONIZE THE FREQUENCIES TO 60-CYCLE LINE FREQUENCIES (JUST TWICE THE FRAME RATE) WITH A HAND ADJUSTMENT AND THEREBY ELIMINATE WHAT IS KNOWN AS "HUM" OR LINE NOISE, WHICH IF NOT SYNCHRONIZED CAUSES A SLOW WOBBLE OF THE PICTURE.

IN THE FUTURE, WE WILL INSTALL A FEEDBACK TIMING CONTROL IN THE COUNTER CIRCUIT WHICH WILL AUTOMATICALLY SYNCHRONIZE ALL FREQUENCIES TO THE LINE (60CPS) AND

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Page 2

THUS ELIMINATE THE NECESSITY OF HAND[...] AND ALSO ASSURE AN EXACT 24 CP[...]

THE SQUARE WAVE OUTPUT IS FED INTO AND IS FED DIRE[...] THE COUNTER. IT IS ALSO THE DRIVING [...] FOR THE HORIZONTAL DEFLECTION GENERATO[...] SKIN SCANNER (TO BE DECRIBED LATER[...]

THE SINE WAVE OUTPUT IS FED INTO T[...] SAMPLERS (SAMPLER GATES) TO BE DESCRIB[...], ALS[...] 90 DEGREE PHASE SHIFTER WHOSE OU[...] BECOMES A COSINE WAVE (IN RELA[...] ORIGINAL SINE WAVE) WHIC[...] FED INTO THE OTHER SET OF SAMPL[...] BOTH SINE AND COSINE WAVES ARE F[...] MODULATORS (TO BE DECRIBED LATER)[...]

THE FUNCTION OF THE CLOCK MAY BE [...] BY THE TAPE RECORDER, WHERE TH[...] ARE RECORDED ON ONE OF THE CH[...] USED AS DRIVING SIGNALS OF THE [...] SYNCHRONIZING ALL RECORDED SI[...] AS THE "TAPE CLOCK".

COUNTER & TIMING CONTROL

THE COUNTER IS A CHAIN OF BISTABLE MULTIVIBRATORS. THE INPUT TO THE FIRST BSMV IN THE CHAIN IS THE HIGH FREQUENCY SQUARE WAVE FROM THE CLOCK. THE OUTPUT OF THE FIRST BSMV IS A SQUARE WAVE WHICH IS EXACTLY ½ THE FREQUENCY OF THE INPUT. THUS EACH BSMV IN THE CHAIN HALVES ITS INPUT FREQUENCY.

AT THE PRESENT TIME WE HAVE 9 BSMV'S IN THE COUNTER CHAIN. THIS GIVES A COUNTDOWN RATIO OF 512:1. THUS FOR A FRAME RATE OF 24 FRAMES/SEC, THE HIGH FREQUENCY MUST BE 12,288 CPS

THERE IS NOTHING MAGIC ABOUT THIS SELECTED RATIO OF 512 TO 1. THE CHOISE OF IT AT THIS TIME WAS GOVERNED BY THE EASE WITH WHICH WE ARE ABLE TO USE THE HIGH FREQUENCY IN THE FUNCTION (SINE-COSINE) GENERATOR NETWORK. IF THE FREQUENCIES USED IN THAT NETWORK GET TOO HIGH, THE GENERATOR DOES NOT PERFORM AS WELL AS WE'D LIKE IT TO. WE HAVE NOT HAD TIME TO REDESIGN THE NETWORK. HOWEVER IT WORKS WELL UP TO 16 OR 17 KC. EASILY ALLOWING FOR 30 CPS FRAME RATE.

OF COURSE, THE HIGHER FREQUENCY WE USE, THE GREATER "BONE & SKIN" RESOLUTION WE MAY HAVE (THIS WILL BE EXPLAINED LATER.)

THE OUTPUT OF THE FIRST BSMV, BESIDES BEING FED INTO THE 2ND BSMV, IS ALSO FED INTO THE DELAY MULTIVIBRATORS IN THE AFORE-MENTION SINE-COSINE FUNTION GENERATOR NETWORK, AND ACTS AS A DRIVING SIGNALS FOR THOSE DELAY MV'S. IN OTHERWORDS, IT CAUSES THE DELAY MV'S TO ACCURATELY A SAMPLING OF THE SINE-AND COSINE WAVES IN THE SAMPLERS AT ½ THE FREQUENCY OF THE SINE-& COSINE WAVES IN THE SAMPLERS, OF THEM ARE 2 CYCLES TO SAMPLE FROM.

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Page 4

THE SIGNIFICANCE OF THIS IS THAT WE CAN
THAN A 360° ROTATION, A BONE. (
MORE FULLY)

THE TIMING CONTROL IS A FEEDBACK
WHICH SYNCHRONIZES THE FREQUE
& LOW) TO THE 60 CPS LINE-FREQUENCY
ASSURING AN EXACT 24 CPS FRAM

HUM: THE ELECTRONIC EQUIPMENT OPE
RECIEVED FROM A 60-CYCLE SUPPLY LINE.
60 CPS IS PRESENT IN WIRES AND CABLES
EQUIPMENT, AND HAS A TENDENCY TO RADI
AMOUNT OF THIS POWER TO ADJACENT PA
IS THAT THERE IS ALWAYS PRESENT A SLIGHT
ON THE LINES, IN THE AMPLIFIERS, AND
REGULATED-VOLTAGE SUPPLIES. THIS MAY
BY SHIELDING AND
SUPPLIES, OR IT MAY BE COMPENSATED F
ALL OF THE FREQUENCIES TO THIS HUM.
SUPPOSE WE ARE OPERATING AT 23.999 FRA
AND THE LINE RIPPLE IS AT 60 CPS. THE
TO SLOWLY UNDULATE BECAUSE OF A BE
THE TWO, NON-MULTIPLE FREQUENCIES
BY MAKING THE FRAME RATE EXACTLY
DRAW A COMPLETE FRAMES FOR EVERY

THERE ARE 2 INPUTS TO THE TIMING CONTR
THE 24 CPS FROM THE COUNTER, THE OTHER
THE LINE. THE 24 CPS FRAME RATE IS FED
WHOSE OUTPUT IS THEREFORE 12 CPS. THE
(60 CPS) IS FED INTO A 5:1 COUNTER (BU
AND ITS OUTPUT IS 12 CPS. THESE 2 FREQU
FED INTO A PHASE-COMPARITOR. THE OUTPU
COMPARITOR (A D.C. VOLTAGE) IS FED INTO
OSCILLATOR WHOSE MEAN OUTPUT FREQUENC
HIGH FREQUENCY WHICH WHEN FED INTO THE

(COUNTER, WILL PRODUCE 24 CPS (ACCURATELY AS THE LINE FREQUENCY IS 60 CPS) AT THE OUTPUT OF THE COUNTER. FOR USE WITH A TRIAC ARRANGED THE OSCILLATOR CIRCUIT IS ARRANGED BY A NOTCH TUNED TO 60 CPS, WHICH SHOULD ACCOMPANY A CHANGE IN THE LINE FREQUENCY, AND THUS THE FREQUENCIES COMMING OUT OF THE

ELECTRONIC GATE-COMMUTATOR OR MONOSTABLE MULTIVIBRATOR CHAIN

THE CHAIN OF MONOSTABLE MULTIVIBRATORS (MSMV) IS AN ELECTRONIC COMMUTATOR WHICH OPENS AND CLOSES A SERIES OF "BONE" GATES IN A SEQUENTIAL MANNER. IN OTHER WORDS, THE MSMV'S FURNISH THE DRIVING (OPENING & CLOSING) SIGNALS TO THE GATES.

THE INPUT TO THE FIRST MSMV IN THE CHAIN IS A SQUARE-WAVE PULSE (SAY 24 CPS) WHICH COMES FROM THE COUNTER. WHEN THE PULSE ARRIVES, IT CAUSES THE MSMV TO FLIP INTO ITS OTHER (UNSTABLE) STATE, FOR A LENGTH OF TIME AS DETERMINED BY ITS INTEGRAL R.C NETWORK. BY VARYING R, THE LENGTH OF TIME DURING WHICH THE MSMV IS IN ITS UNSTABLE STATE MAY BE VARIED. ~~ONCE THIS TIME HAS LAPSED, THE~~ DURING THIS "OPEN" TIME, A CHANGE IN VOLTAGE OCCURS ON ONE OF ITS OUTPUTS. THIS VOLTAGE IS USED TO OPEN A NUMBER OF GATES CONNECTED TO IT. WHEN THE "OPEN" TIME HAS LAPSED, THE MSMV AUTOMATICALLY FLIPS BACK INTO ITS ORIGINAL STATE (STABLE) AND CHANGES BACK THE OUTPUT VOLTAGE DRIVING THE GATES, THUS CLOSING THEM. DURING THE FLIP-BACK, A PULSE SIMILAR TO THE ONE THAT CAUSED THE ORIGINAL FLIP IS GENERATED AT ANOTHER OUTPUT POINT, AND THENCE IS SENT TO THE NEXT MSMV IN THE CHAIN WHERE A SIMILAR OPERATION OCCURS, THUS OPENING THE NEXT GROUP OF ASSOCIATED GATES FOR A TIME DESCRIBED BY THE R ASSOCIATED WITH THAT 2ND MSMV. THIS COMMUTATING ACTION CONTINUES UNTIL ALL THE MSMV'S IN THE CHAIN HAVE GONE THRU THEIR INDIVIDUAL CYCLES.

THE "DRIVING OUTPUT" OF THE MSMV'S (SHOWN IN FIG 1.) IS USE TO PERFORM A NUMBER OF TASKS. FOR EXAMPLE, THIS OUTPUT MAY BE USED TO CLOSE THE ELECTRONIC SWITCHES ACROSS THE

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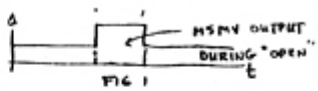

FIG 1

INTEGRATING CAPACITORS, THUS CAUSING THE
TO "FLY BACK" TO ITS STARTING POINT.
THESE SIGNALS ARE USED THEREFORE AS
THE FLYBACK CIRCUIT, TO BE DESCRIBED LA
ANOTHER USE OF THE MSMV OUTPUT IS T
THE DISPLAY BEAM. BY APPLYING THE MSM
THE GRID OF THE DISPLAY CRT, THE
-OFF" DURING THE "OPEN" TIME OF THE
IN THIS MANNER, FLYBACK RETRACES, AND
BONE-PLACING RETRACES - (AS IN THE AR
BEAM MUST MOVE FROM THE STARTING PO
SHOULDER AND THENCE PROCEDE TO DRA
DURING THAT "PLACEMENT" BONE DRAWING
IS BLANKED OUT) MAY BE BLANKED O

AS MENTIONED BEFORE, THE LENGTH
THAT A MSMV REMAINS IN ITS OPEN POSITION
BY R OF THE INTEGRAL RC. NETWORK.
VARYING EACH OF THE RESISTANCES ASSOC
EACH MSMV-RC-NETWORK, AN OPERATOR
"SET-UP" A FIGURE OR CHARACTER TO H
"BONE" LENGTHS, AND OVERALL STRUC
IN THIS SETUP PROCEDURE, DETERMINES
IN WHICH THE PARTICULAR BONES WILL BE
DETERMINES THIS SEQUENCE HE MAKES
CONNECTIONS BETWEEN THE MSMV'S AND
IN ADDITION TO DETERMINING AND SETTING
BONE LENGTHS.

THE MSMV CHAIN IS A SWITCHING
NETWORK WHICH REGULATES THE OPENING
THE BONE GATES, THE VARIOUS TASKS
COULD BE DONE IN OTHER WAYS, SUCH AS
SYSTEM; (b.) BINARY COUNTER SYSTEMS WIT
NETWORKS c.) OTHER ELECTRONIC ARRAN
MECHANICAL SYSTEMS.

BONE GATES.

ASSOCIATED WITH EACH BONE, AND BEING DRIVEN BY A MSMV OF THE MSMV CHAIN, ARE A NUMBER OF ELECTRONIC GATES. THE GATES ARE NORMALLY CLOSED, BUT ARE OPENED BY THE RECTANGULAR WAVE FORM RECEIVED FROM THEIR DRIVING MULTIVIBRATOR. THERE IS AN OUTPUT FROM THE GATE ONLY DURING THE "OPEN" PERIOD, AND THE NATURE OR CHARACTER OF THIS OUTPUT IS ~~A FAITHFUL REPRODUCTION OF THE~~ GOVERNED BY THE INPUT SIGNAL. IF THE INPUT IS A D.C. SIGNAL, THEN THE OUTPUT WILL BE A CORRESPONDING D.C SIGNAL, (SIMILARLY IF THE INPUT IS A SINE WAVE OR OTHER SHAPED SIGNAL, THE OUTPUT WILL LOOK LIKE THE INPUT.) IN OTHER WORDS, THE GATE PASSES OR ALLOWS TO PASS THRU IT ANY SIGNAL THAT IS PRESENT AT ITS INPUT DURING THE "OPEN-PERIOD" OF THE GATE.

THE GATES FOR EACH BONE ARE IN PARALLEL, AND OPERATE SIMULTANEOUSLY, AND SEND SIGNALS TO DIFFERENT PARTS OF THE DEVICE IN ORDER TO "MAKE" BONES AND CONTROL THEIR VECTORIAL POSITIONS IN SPACE. A GATED D.C WAVEFORM (AS WILL BE SHOWN LATER) MAKES A STRAIGHT BONE. A GATED "SHAPED" WAVEFORM WILL MAKE A BONE WHOSE AXIS IS NOT STRAIGHT, BUT HAS THE INTEGRATED, VECTORIAL DIRECTION (OR SHAPE) PRESCRIBED BY THE SHAPED INPUT.

BY VARYING THE D.C. VOLTAGE APPLIED TO THE FIRST GATE, THE ANGLE (θ) THAT THE BONE MAKES WITH THE X-AXIS OF THE DISPLAY IS VARIED. A VARIABLE POTENTIOMETER MAY BE USED TO VARY THE INPUT VOLTAGE, OR OTHER MEANS MAY BE USED, OF COURSE). THE SECOND GATE IS USED TO CONTROL THE ANGLE THAT THE BONE MAKES WITH THE X-Y PLANE IN SIMILAR FASHION

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BY VARYING THAT D.C. INPUT, THE TH
USED TO CONTROL THE ANGULAR POSI
CALLED "ROTATIONAL POSITION") OF TH
BONE.

ADDITIONAL GATES MAY BE USED
FASHION TO CONTROL OTHER PARA
BONE — SUCH AS INTENSITY, etc, Text

THE FIRST TWO GATES CALLED "Θ"
THEIR OUTPUT SIGNALS TO SIMILAR, AN
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TO CORRESPONDING CHANNELS OF TH
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THE OUTPUTS OF CONSECUTIVE Θ
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[redacted] - COSINE FUNCTION GENERATOR

THERE ARE 2 SINE-COSINE FUNCTION GENERATORS. ONE RECEIVES ITS INPUT FROM THE ⊙-GATES, THE OTHER FROM THE ϕ GATES.
EACH GENERATOR HAS 2 OUTPUTS FOR EACH INPUT. THE RANGE OF VOLTAGES AT THE INPUT REPRESENT ANY DESIRED ANGLE [illegible] OF THE BONE, AND THE TWO VOLTAGE OUTPUTS HAVE THE RELATION OF THE SINE AND COSINE RESPECTIVELY [illegible] (SEE GENERAL THEORY)
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A SINE-COSINE FUNCTION GENERATOR HAS IN ITS NETWORK A DELAY MULTIVIBRATOR, A NARROW-OUTPUT MONOSTABLE MULTIVIBRATOR, [illegible], 2 WAVE-SAMPLING GATES AND A HOLDING CAPACITOR ON THE OUTPUT OF EACH SAMPLING GATE.
THE DELAY MULTIVIBRATOR HAS TWO INPUTS. ONE INPUT COMES FROM THE 2nd STAGE OF THE COUNTER, AT ½ THE HIGH FREQUENCY AND IS OF THE SQUARE WAVE TYPE. THIS INPUT CAUSES THE DELAY M.V. TO CHANGE STATES. IT WILL REMAIN IN THIS STATE UNTIL IT FLIPS BACK AUTOMATICALLY INTO ITS ORIGINAL STATE. THE LENGTH OF TIME THAT IT REMAINS IN THE UNSTABLE STATE IS DETERMINED BY THE 2ND INPUT. THIS 2ND INPUT (WHICH COMES FROM THE GATES) IS A D.C. VOLTAGE WHOSE VALUE DETERMINES THE LENGTH OF TIME THE DELAY M.V. WILL DELAY. [illegible]

[illegible] DRIVING INPUT [illegible] COUNTER, AS [illegible] ABOVE IS AT [illegible] HIGH FREQUENCY. THIS MEANS THAT THE DELAY M.V. PERFORMS ITS FUNCTION ONCE FOR [illegible] CYCLES OF THE HIGH FREQUENCY. THIS ALLOWS A SAMPLING OF [illegible] COSINE WAVES TO BE TAKEN ONCE 2 CYCLES OF THE WAVES, WHICH ALLOWS FOR A ONE-DEGREE CHANGE OF MORE THAN 360 DEGREES.

SINE-COSINE FUNCTION GENERATOR

L. Hammond

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THE DELAYED INPUT TRIGGERS THE NARROW-OUTPUT MONOSTABLE MULTIVIBRATOR WHICH IS AT THIS HIGH FREQUENCY. THIS MEANS THAT THE DELAY M.V. PERFORMS ITS FUNCTION ONCE FOR EVERY 2½ CYCLES OF THE HIGH FREQUENCY. THIS ALLOWS A SAMPLING OF INTO BOTH COSINE WAVES TO BE TAKEN ONCE 2½ CYCLES OF THE WAVES, WHICH ALLOWS FOR A HALF-ANGLE ERROR OF NOT MORE THAN 2½° BETWEEN SAMPLINGS.

page 10

THE OUTPUT OF THE DELAY M.V. IS D... AND CLIPPED, SO THAT ONLY A PULSE... THE TRAILING EDGE OF THE CHANGE-OF-S... SENT ON TO THE NARROW-PULSE MSMV.

THE INPUT TO THE NARROW PULSE MS... NARROW TRIGGER PULSE COMING FR... DELAY MV. THE OUTPUT OF THE MSMV... NARROW, STRAIGHT SIDED PULSE WHICH... DRIVE (OR OPEN) 2 SAMPLING GATES... ARE VERY FAST ACTING. A... TO THE GATES IS A SINE WAVE (T... A COSINE WAVE (TO THE OTHER) COM... THE SINE WAVE GENERATOR (CLOCK) AN... PHASE-SHIFTER RESPECTIVELY, THUS... OF THE GATES IS A VERY NARROW PULSE... (OR VALUE OF VOLTAGE) IS DETERMINED BY... AT WHICH THE SINE AND COSINE WAV... SAMPLED, WHICH TIME WAS DETERM... THE TRAIL EDGE OF THE DELAY M.V... WAS DETERMINED BY THE D.C. VOLT... UPON IT, THIS VOLTAGE HAVING... BY THE OUTPUT OF THE BONE GATES... OF SUCH PULSES FOR ANY GIVEN D... IMPRESSED UPON THE DELAY M.V. IS... BY THE LENGTH OF ANY GIVEN BONE...

BECAUSE OF THE HOLDING CAPA... WITH THE OUTPUT OF EACH SAMPLI... THERE APPEARS ACROSS EACH CAPACI... D.C. VOLTAGE REPRESENTIN... VALUE OF SINE OR COSINE, FOR A NO... THIS ANALOG CAPACITIVE PAIR BECOME IS OR SO ALTERNATE PULS... THE BONE IS BEING SAMPLED.

THERE ARE OTHER WAYS OF GENERAT... COSINE FUNCTION, ONE SIMPLE WAY WO... LET THE OUTPUT OF THE BONE GATES SUPPLY VOL... SINE-COSINE POTENTIOMETERS BUT THESE POTS A...

DEC 2 9 1954

* I WOULD BE REQUIRED THAT THERE BE ONE ONE EIGHTH GATE, AND CONTROLLING IMPULSE FOUND AMONG EQUALLY SPACED INTERVALS.

INTEGRATORS

THE INTEGRATOR IS A HIGH GAIN AMPLIFIER WHICH HAS A FEEDBACK CAPACITOR TO ITS INPUT. ITS FUNCTION IS TO PERFORM CONTINUOUS INTEGRATION OF THE SIGNALS PRESENTED TO ITS INPUT. THERE ARE THREE INTEGRATORS IN THE BONE GENERATOR, ONE FOR EACH COORDINATE (ie X, Y, Z) OF THE FIGURE.

IF THE INPUT TO AN INTEGRATOR IS A D.C. VOLTAGE, THE OUTPUT IS A RAMP FUNCTION. THE INITIAL CONDITIONS (STARTING VOLTAGES ON THE OUTPUT WHICH DETERMINE THE STARTING POINT OF EACH BONE ON THE DISPLAY) ARE DETERMINED BY THE VOLTAGE ACROSS THE FEEDBACK CAPACITOR. IF THERE IS NO DISCHARGE OF THAT CAPACITOR, THEN THE OUTPUT OF THE INTEGRATOR WILL BE A SEQUENCE OF D.C. VOLTAGES WILL BE JOINED TOGETHER". WHENEVER THE CAPACITOR IS DISCHARGED OR "SHORTED OUT", THE INITIAL CONDITION VOLTAGES ARE RESTORED, AND THE DISPLAY BEAM RETURNS TO A "ZERO" OR "STARTING" POSITION. (THE FLYBACK CIRCUIT TO BE DESCRIBED PERFORMS THE FUNCTION OF SHORTING OUT & DISCHARGING THE CAPACITOR AS DESIRED OR REQUIRED TO DRAW A FIGURE OR IMAGE.)

THE RATE OF VOLTAGE PRESENTED TO THE INPUT DETERMINES THE SLOPE (RATE OF CHANGE) OF THE OUTPUT. THE COMBINATION OF ANY TWO OF THE INTEGRATORS WHEN PRESENTED TO EACH OF THE X & Y DEFLECTION CIRCUITS OF THE DISPLAY, WILL GIVE THE PROJECTION OF THE FIGURE (OR IMAGE BEING DRAWN) ON THE PLANE DETERMINED BY THE COMBINATION. FOR EXAMPLE, IF THE X AND Y INTEGRATORS OUTPUTS ARE USED, THEN THE DISPLAY WILL BE A VIEW WHICH IS THE PROJECTION OF THE FIGURE ON THE X, Y PLANE. SIMILARLY, IF THE Y AND Z OUTPUTS ARE USE, THE VIEW WILL BE A PROJECTION OF THE FIGURE ON THE Y, Z PLANE.

INTERMEDIATE VIEWS MAY BE OBTAINED BY COMBINING ALL THREE INTEGRATOR OUTPUTS IN PROPER AMOUNTS; THUS AN OPERATOR OF THE DEVICE TO VIEW OBJECT OR FIGURE FROM ANY POSITION FUNCTION OF COMBINING THESE INTEGRATORS IN A PROPER FASHION IS CARRIED OUT BY "CAMERA ANGLE NETWORK" TO BE DESCRIBED

THE VALUE OF VOLTAGE PRESENTED TO THE AN INTEGRATOR DETERMINES THE RATE OF VOLTAGE AT THE OUTPUT, (SLOPE). IF THE INPUT D.C. VOLTAGES TO THE X AND Y INTEGRATORS ARE THE COS Θ AND SIN Θ RESPECTIVELY THE OUTPUT OF THE INTEGRATORS WHEN APPLIED INTO THE HORIZONTAL AND VERTICAL AMPLIFIERS OF A DISPLAY SCOPE WILL CAUSE THE BEAM TO DRAW A LINE ON THE SCOPE WHOSE ANGLE WITH THE HORIZONTAL IS Θ.

BACK NETWORK.

THE FUNCTION OF THE FLYBACK NETWORK IS TO SHORT OUT OR DISCHARGE THE CAPACITORS (C) ASSOCIATED WITH THE INTEGRATORS AT DESIRED TIMES DURING THE SEQUENCE OF BONES AND AT THE END OF A CYCLE OF BONE GENERATION. DISCHARGING OF THE CAPACITORS CAUSES THE BEAM OF THE DISPLAY CRT TO FLY BACK TO THE STARTING POSITION.

AN ELECTRONIC SWITCH DISCHARGES THE CAPACITOR. PULSES WHICH CLOSE THE SWITCH COME FROM AN AMPLIFIER WHICH IS IN TURN FED BY PULSES (WHICH ARE SELECTED AS DERIRED) COMING FROM SELECTED MULTIVIBRATORS OF THE MSMV CHAIN. ALSO, A PULSE WHOSE DURATION IS DETERMINED BY THE TIME OF THE LAST MSMV TO THE BEGINNING OF A NEW CYCLE OF THE FIRST MSMV IS GENERATED BY A BISTABLE MULTIVIBRATOR. THIS FLYBACK BI-STABLE MV RECEIVES A PULSE FROM THE LAST MSMV AS IT CLOSES. THIS PULSE FLIPS THE BSMV AND ITS OUTPUT CAUSES THE SWITCHES TO CLOSE. THIS BSMV STAYS IN THE "CLOSED" STATE UNTIL IT RECEIVES ANOTHER INPUT PULSE WHICH THIS TIME COMES FROM THE [redacted] COUNTER, THE SAME PULSE WHICH STARTS THE CHAIN OF MSMV'S.

DIODES CONNECT ALL OF THE PULSE INPUTS TO THE AMPLIFIER WHICH ACTIVATES THE SWITCHES SO AS TO PREVENT PULSES FROM FEEDING BACK INTO THE GATES AND THUS CAUSING IT TO OPERATE OUT OF SEQUENCE.

THE ELECTRONIC SWITCHES REMAIN CLOSED DURING THE DURATION OF A PULSE, BE IT LONG OR SHORT.

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page 14

SKIN NETWORK.

THE FUNCTION OF THE SKIN NETWORK IS
COMBINE THE VARIOUS VOLTAGE REPRESEN
$\sin\theta$, $\cos\theta$, $\sin\phi$, $\cos\phi$, $K_1 t_x$, K_1
$\cos K_2 t$ AND THE VIDEO signal A_z
PROPER FORMULAMATIC REPRESENTATION
GEOMETRIC PROJECTIONS OF THE FIG
BEING GENERATED. FOR QUICK REFER
EXPLANATION
TABULAR REPRESENTATION OF THESE
IS GIVEN BELOW.

Kt_x

$\sin\theta$: } D.C. VALUES OF VOLTAGE WH
$\cos\theta$: } IS AS THE SINE AND COSINE OF

DEC 2 1958 IX

$\sin\phi$: } DC. VALUES OF VOLTAGE WHOS
$\cos\phi$: } IS AS THE SINE AND COSINE

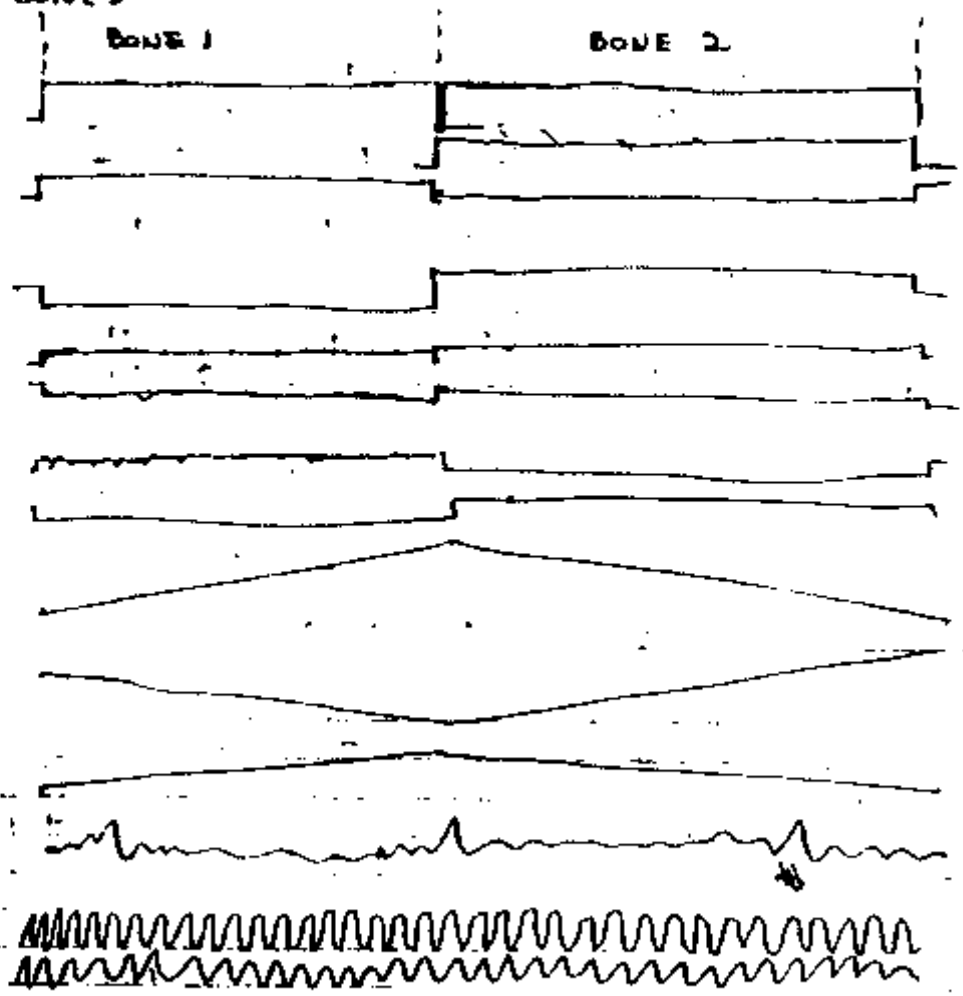
$K_1 t_x$ }
$K_1 t_y$ } RAMP FUNCTIONS OF VOLTAGE
$K_1 t_z$ } OF INTEGRATORS X, Y AND Z
WHERE THE CONSTANT K_1 IS
FACTOR, WHICH IS A DEVICE F

GAINS OF DISPLAY AMPLIFIERS OF THE GAINS OF THE
AMPLIFIERS AND ALSO A FUNCTION OF THE AMPLI
INPUT SINE AND COSINE WAVES TO THE INTEGRA
SIMPLICITY THESE EFFECTS ARE ACCOUNTED FO
OF THIS "LUMPED CONSTANT" K_1.

$\sin K_2 t$: } SINE AND COSINE WAVE
$\cos K_2 t$: } WHOSE FREQUENCY (TH
IS DETERMINED BY K_2, AN
AMPLITUDE IS CONSIDERED T
TO 1 (ONE UNIT). (FOR A M
REPRESENTATION WE'D HAVE TO USE
DENOTE THIS WAVE, BUT WE SIMPLIF
BY LETTING $a = 1$ unit, which m

CAPITAL A IS USED TO DENOTE THE VIDEO SIGNAL WHICH COMES FROM THE SKIN SCANNER. THIS IS A WIDE BAND SIGNAL WHOSE UPPER FREQUENCIES ARE VERY HIGH.

TO SHOW THE INTER-RELATIONSHIP OF THE VARIOUS SIGNALS, A PICTOGRAPH IS GIVEN BELOW FOR 2 BONES



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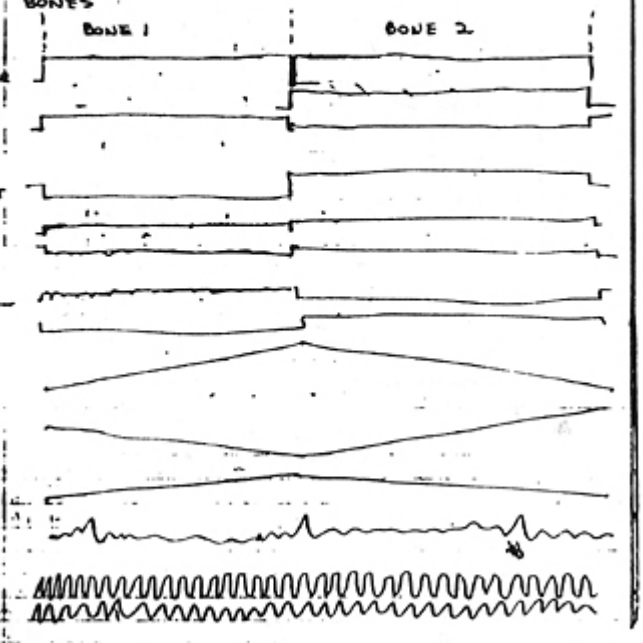

page 16

TWO ALGEBRAIC FUNCTIONS ARE PERFORMED IN THE PORTION OF THE DEVICE WHICH WE CALL THE NETWORK, NAMELY MULTIPLICATION AND

ASSOCIATED WITH EACH MULTIPLIER ARE AND OUTPUT AMPLIFIERS, WHICH ARE NECESSARY TO ALLOW AN ANOLOGUE TO PERFORM THE TASK OF MULTIPLICATION. THE MULTIPLIERS REQUIRE A "CENTER TAP" THE THREE INPUTS TO THE MULTIPLIERS. THE IMPORTANT THING HERE IS NOT HOW THE PARTICULAR TASK, BUT THAT WE DO

DEC 2 9 1961

ADDERS ARE MERELY RESISTOR NETWORKS ADD THE VARIOUS SIGNALS PRESENTED

ALGEBRAICALLY SPEAKING, THE SKIN NETWORK THE PREVIOUSLY MENTIONED SIGNALS THEM SO THAT

$$x = k_1 t_x \cos\theta \cos\phi + A \cos\theta \sin\phi$$

$$y = k_1 t_y \sin\theta \cos\phi + A \sin\theta \sin\phi \cos$$

$$z = k_1 t_z \sin\phi + A \cos\phi \cos k_2 t$$

HERE, x, y AND z REPRESENT THE VECTORIAL COMPONENTS OF THE FIGURE AND 2 OF THESE SIGNALS TO THE OF A DISPLAY CRT, THE RESULTING A PROJECTION OF THE 3 DIMENSIONAL THE PLANE DETERMINED BY THE COMPONE

BY THE GEOMETRIC SELECTION AND ALL THREE OF THESE COMPONENTS, AND PROJECTION OF THE 3 DIMENSIONAL FIG

CAMERA-ANGLE NETWORK

THE FUNCTION OF THE CAMERA ANGLE NETWORK IS TO ALGEBRAICALLY (AND THUS GEOMETRICALLY) COMBINE THE X, Y, AND Z COMPONENTS OF THE THREE DIMENSIONAL FIGURE IN SUCH A MANNER AS TO ALLOW FOR THE PRESENTATION OF ANY PROJECTION OR VIEW OF THE FIGURE WHEN THE OUTPUTS OF THIS NETWORK ARE PRESENTED TO THE X AND Y CHANNELS OF A DISPLAY CRT.

2 ALGEBRAIC FUNCTIONS ARE PERFORMED: THE FIRST IS MULTIPLICATION BY A CONSTANT, THE SECOND IS ADDITION.

THE "MULTIPLICATION BY A CONSTANT" IS IN EFFECT THE TAKING OF THE SINE AND COSINE OF THE VECTOR AND IS ACCOMPLISHED BY A NETWORK OF VARIABLE "SINE-COSINE" POTENTIOMETERS. ADDITION IS PERFORMED USING A FIXED RESISTANCE NETWORK.

ANGLES Θ' (THETA PRIME) AND Φ' (PHI PRIME) REPRESENT THE ROTATION OF THE XY PLANE ABOUT THE X AXIS AND THE XZ PLANE ABOUT THE Z AXIS.

2 SIN-COSINE POTS GANGED TOGETHER (WITH WIPERS ON A COMMON SHAFT) IS THE MECHANISM FOR PERFORMING THE PROPERLY-RELATED MULTIPLICATION BY CONSTANTS, IE TAKING THE SINES & COSINES IN THE PROPER RELATIONSHIP.

THERE ARE TWO SUCH MECHANISMS. ROTATION OF THE SHAFT OF ONE, CONTROLS THE VIEWING ANGLE Θ'. THE OTHER CONTROLS Φ'. AMPLIFIERS ASSOCIATED WITH THE NETWORK OF SINE-COSINE POTS ARE AN ELECTRONIC NECESSITY. THE TWO OUTPUTS OF THIS NETWORK ARE FED INTO THE X AND Y CHANNELS OF THE DISPLAY CRT, AND REPRESENT THE BEAM-POSITIONAL INFORMATION NECESSARY TO DRAW THE FIGURE

page 17

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page 18

EVENTUALLY, WE'LL USE CONTROLLING SI
POSITION THE SHAFTS $\Theta' + \phi'$, SO THAT
ANGLES MAY BE RECORDED ON THE
RECORDER ALONG WITH OTHER CONTR
IN OTHER WORDS, WE'LL RECORD SIGNALS F
SERVOS WILL REACT, THUS RECORDIN
ANGLES.

page 17

SKIN GENERATOR.

THE FUNCTION OF THE SKIN GENERATOR IS TO GENERATE A VIDEO SIGNAL, THE MAGNITUDE OF WHICH REPRESENTS THE DISTANCE [redacted] (OR THICKNESS) BETWEEN THE BONE (VECTOR) AND THE SURFACE (OR SKIN) OF THE OBJECT OR FIGURE BEING DRAWN.

THE SKIN GENERATOR IS A FLYING SPOT SCANNER WHICH SCANS A SPECIALLY PREPARED PHOTOGRAPH THE DENSITY OF WHICH CONTAINS THE DESIRED "THICKNESS" INFORMATION.

GENERAL

THE SKIN GENERATOR IS A HIGH SPEED COMMUTATOR WHICH CONVEYS IN PROPER SEQUENCE AND SYNCHRONIZATION THE THICKNESS INFORMATION [redacted] WHICH IS RETAINED IN CONSISTENT [redacted] FORM OF [redacted] INFORMATION STORAGE DEVICE OR MEDIUM.

THE FLYING SPOT SCANNER IS A [redacted] A SPECIAL (SHORT PERSISTANCE) CATHODE RAY TUBE IN WHICH THE BEAM SWEEPS OUT A PRESCRIBED RASTER (PATERN OF LINES). THE BEAM PRODUCES A SHORT PERSISTANCE SPOT OF LIGHT ON THE FACE OF THE TUBE. THIS SPOT OF LIGHT IS OPTICALLY CONDUCTED AND FOCUSED ON THE PHOTOGRAPHIC TRANSPARENCY WHICH TRANSMITTS VARYING AMOUNTS OF LIGHT ACCORDING TO THE FILM DENSITY, THUS THE PHOTOGRAPHIC TRANSPARENCY MODULATES THE INTENSITY OF THE LIGHT, AS THE SPOT SWEEPS OR SCANS ACROSS IT. THIS MODULATED LIGHT IS COLLECTED BY A CONDENSING LENS AND PRIMARILY FOCUSSED ON A PHOTO-MULTIPLIER TUBE WHICH CONVERTS THE MODULATED LIGHT INTO A VOLTAGE SIGNAL (VIDEO). (IN GENERAL THIS SYSTEM ACTS AS A HIGH SPEED COMMUTATOR, COMMUTATING MANY PIECES OF INFORMATION IN THE DESIRED STREAM

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page 20

OR SEQUENCE.)
THE VIDEO SIGNAL IS THEN ADDED
SPEAKING) TO THE BONE SIGNAL
THE POSITIONAL INFORMATION TO THE DI
WHICH REPRESENTS THE THICKNESS OF
OR FIGURE BEING DRAWN.

THE MOVEMENT OF THE FLYING SPOT
BY DEFLECTION AMPLIFIERS IN "SCANN
CONTROLLING DEFLECTION WAVE FORMS" AR
IN THE DEFLECTION GENERATORS
, WHICH ARE
AND DRIVEN BY AN INPUT FROM T

THE RASTER (PATTERN OF MOVEMENT OF THE
THE SCANNER IS BASICALLY RAS
WITH SOME LOCALIZED MODIFICATION
PATTERN FOR SPECIAL, SKIN DISTORTIO
AS IN LIP, EYE & OTHER FACIAL
PLASTIC TYPE MOVEMENTS. (SUCH
EFFECTS WHICH WOULD BE
DEVELOPED AS A FUNCTION OF

DEC 2 9 1961 THE SKIN GENERATOR MAY ALSO BE U
DEVELOPE OTHER SKIN INFORMATION
COLOR, TEXTURE, SHADING, (THI
DISCUSSED LATER.)

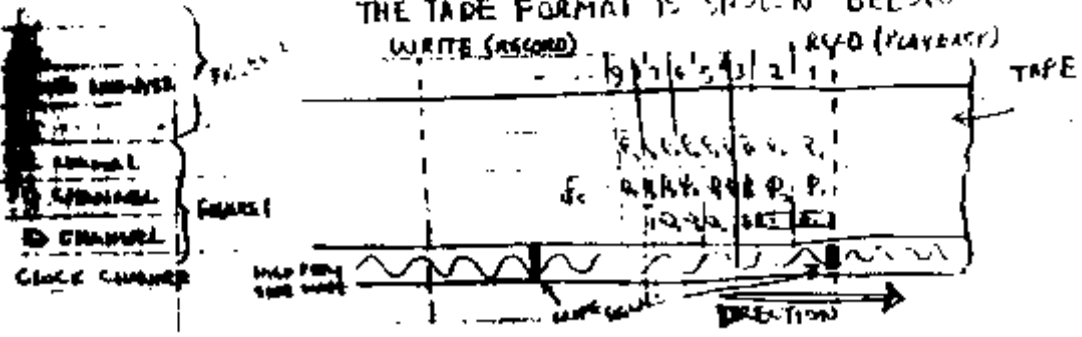
Recording Network: (Tape Recorder)

The Function of the RECORDING NETWORK IS TO RECORD THE joined-together OUTPUT SIGNALS (MULTIPLEXED SINGLE-SIGNAL) AND ALLOW FOR THE PLAY-BACK OF THESE SIGNALS. THE RECORDER IS A MULTI-CHANNELED RECORDER. ON ONE CHANNEL IS RECORDED THE CLOCK FRAME-SIGNALS FOR SYNCHRONIZATION. Sound is recorded on another

SELECTIVE RECORDING OF INDIVIDUAL GATE-OUTPUTS OR GROUPS OF GATE-OUTPUTS IS ACCOMPLISHED WITH RECORDING GATES WHICH ARE ACTIVATED BY THE MULTIVIBRATORS ASSOCIATED WITH THE BONE GATES DESIRED TO BE RECORDED. A SWITCH MAY BE EMPLOYED TO HOLD THESE RECORDING GATES OPENED. IF IT IS DESIRED TO RECORD ALL OF THE BONES. (AS AN OPERATOR MAY DO AT THE BEGINNING OF AN ACT)

~~THE TAPE MOVES ACROSS~~ THE WRITE HEADS ARE ~~OF THE TAPE RECORDER FIRST, THEN ON TO~~ SITUATED "UPSTREAM" FROM THE "READ" HEADS AS FAR AS TAPE MOTION IS CONCERNED, THE SIGNALS WHICH ARE PASSED BY THE RECORDING GATES ARE THENCE RECORDED ON THE TAPE BY THE WRITE HEADS. THE SIGNALS THUS RECORDED ARE ALMOST IMMEDIATELY READ BY THE "READ" HEADS ~~FROM~~ WHICH THE SIGNALS ARE AMPLIFIED AND SENT INTO THE BONE GENERATION NETWORK.

THE TAPE FORMAT IS SHOWN BELOW



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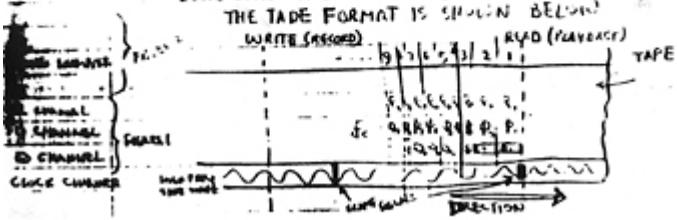

THE CLOCK CHANNEL HAS RECORDED ON IT THE SINE WAVE PLUS THE INTERMITTANT FRAME [illegible] THESE SIGNALS ARE SEPERATED [illegible] AND THE SINE WAVES ARE SENT TO [illegible] GENERATOR & THE FRAME PULSES ARE [illegible] THE COUNTER CHAIN.

AFTER THE θ AND φ TAPE CHANNELS ARE [illegible] RECORDED SIGNALS, SELECTIVE RE-RECORDING IS ACCOMPLISHED BY MAKING CONNECTIONS [illegible] SELECTED MSMV's & THE RECORDING GATES SO THAT THE GATES ARE OPENED AT THE TIMES OF OCCURRENCE OF THE [illegible] THE [illegible] θ & φ GATES ASSOCIATED WITH THE SELECTED MSMV's, (THE INITIAL RECORDING [illegible]

FOR EXAMPLE, SUPPOSE AN OPERATOR WISHED TO RE-RECORD THE ANGULAR ACTIONS OF THE 5th BONE. HE'D CONNECT THE PULSED OUTPUTS OF MSMV's # 4 & 5 TO THE [illegible] ACTUATING INPUT TERMINAL OF THE RECORDING GATES. THUS THE ONLY TIME RECORDING WOULD OCCUR WOULD BE AT THE START SPOTS ON THE TAPE THAT CORRESPONDED TO THE PREVIOUSLY RECORDED ACTIONS OF BONES 4 & 5. THE WRITE HEADS WOULD BE ACTIVATED AT THOSE TIMES WOULD OBLITERATE THE PREVIOUSLY RECORDED SIGNALS AND LEAVE THE NEWLY DESIRED SIGNALS ON THE TAPE. AT THE END OF THE TIME, THE RECORDING GATES ARE CLOSED & THE READ HEADS PICK UP THE OLD SIGNALS, THE NEW SIGNALS, AND TRANSMIT THEM TO THE DEVICE TO STIMULATE THE DESIRED MOTION ON THE DISPLAY.

OTHER TAPE CHANNELS ARE USED IN SIMILAR MANNER TO RECORD AND CONTROL OTHER PARAMETERS OF THE BONE. FOR EXAMPLE, THE ρ (RHO) CHANNEL IS USED TO CONTROL THE ROTATIONAL POSITION

CONTROL OF MOTION & OTHER PARAMETERS

BY CONTROLING THE VOLTAGE INPUTS TO THE BONE GATES, THE POSITIONS, ATTITUDES, PLASTIC AND OTHER SPACIAL PARAMETERS ARE CONTROLED. THE FUNCTION OF THE CONTROLS IS TO GENERATED THE DESIRED SIGNALS FOR THE VARIOUS MOTIONS. IN GENERAL, THE CONTROLLING SIGNALS ARE VERY LOW FREQUENCY - IN SOME CASES PRACTICALLY D.C. (THE SAMPLING RATE FOR EACH BONE SIGNAL TO BE MULTIPLEXED IS 24 TIMES PER SECOND. IN ONE SECOND, UNLESS THE ACTION OF A BONE IS VERY SWIFT, THE VOLTAGE VARIATION FROM THE BEGINING TO THE END OF ONE DRAWING CYCLE ($\frac{1}{24}$ sec) OF ONE BONE ($\approx \frac{1}{5}$ (1/24) ET = $\frac{1}{120}$ sec) IS VERY SLIGHT. THAT IS TO SAY, SUPPOSE THE VOLTAGE VARIES 5 VOLTS IN ONE SECOND DUE TO THE TURNING OF A POTENTIOMETER, THEN THE VARIATION FROM THE BEGINNING TO THE END OF A BONE IS $\frac{1}{120}$ VOLTS WHICH IS SUCH A SMALL CHANGE THAT THE BONE APPEARS STRAIGHT.)

NETWORKS OF VARIABLE RESISTORS AND VERY LOW-FREQUENCY GENERATORS MAY BE USED TO GENERATE INTERRELATED BONE-GROUP ACTIONS OR MOTIONS. AS THE MANIPULATION OF THE POTENTIOMETER INPUTS IS SIMPLIFIED, IT MAY BE CONSIDERED THAT THE 'CONTROLS' MAY BECOME MORE AND MORE COMPUTER-LIKE, WHERE MANY BONE MOTION FUNCTIONS ARE GENERATED AUTOMATICALLY.

HIGHER FREQUENCIES AND THE USE OF SAW-TOOTH SHAPED WAVEFORMS IN PLACE OF D.C. INPUTS WILL GIVE BONES OTHER THAN STRAIGHT. FOR EXAMPLE A SAWTOOTH CONTROL INPUT WILL GIVE A WIGGLY

page 23

CONTROL OF MOTION & OTHER PARAMETERS

BY CONTROLING THE VOLTAGE INPUTS TO THE BONE GATES, THE POSITIONS, ATTITUDES, AND OTHER SPACIAL PARAMETERS ARE CONTROLLED. THE FUNCTION OF THE CONTROLS IS TO GENERATED THE DESIRED SIGNALS FOR THE VARIOUS MOTIONS. IN GENERAL, THE CONTROLLING SIGNALS ARE VERY LOW FREQUENCY - IN SOME CASES PRACTICALLY D.C. (THE SAMPLING RATE FOR EACH BONE SIGNAL TO BE MULTIPLEXED IS 24 TIMES PER SECOND. IN ONE SECOND, UNLESS THE ACTION OF A BONE IS VERY SWIFT, THE VOLTAGE VARIATION FROM THE BEGINNING TO THE END OF ONE DRAWING CYCLE ($\frac{1}{24}$ sec) OF ONE BONE ($\approx \frac{1}{5}(\frac{1}{24})$ of a bone) IS VERY SLIGHT. THAT IS TO SAY, SUPPOSE THE VOLTAGE VARIES 5 VOLTS IN ONE SECOND DUE TO THE TURNING OF A POTENTIOMETER, THEN THE VARIATION FROM THE BEGINNING TO THE END OF A BONE IS $\frac{1}{24}$ VOLTS WHICH IS SUCH A SMALL CHANGE THAT THE BONE APPEARS STRAIGHT.)

NETWORKS OF VARIABLE RESISTORS AND VERY LOW-FREQUENCY GENERATORS MAY BE USED TO GENERATE INTERRELATED BONE-GROUP ACTIONS OR MOTIONS. AS THE MANIPULATION OF THE POTENTIOMETER INPUTS IS SIMPLIFIED, IT MAY BE CONSIDERED THAT THE CONTROLS MAY BECOME MORE AND MORE COMPUTER-LIKE, WHERE MANY MOTION FUNCTIONS ARE GENERATED AUTOMATICALLY.

CURVED BONES MAY BE PRODUCED BY APPLYING VARIABLE FREQUENCIES TO THE BONE GATES. SHAPED WAVEFORMS IN PLACE OF D.C. INPUTS WILL GIVE BONES OTHER THAN STRAIGHT. FOR EXAMPLE, A SAWTOOTH CONTROL INPUT WILL GIVE A WIGGLY

page 24

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BONE; A SINUSOIDAL INPUT (
PROPER PHASE & FREQUENCY) WILL
CIRCULAR BONE; A SQUARE
INPUT WILL MAKE A ZIG ZAG
TYPE BONE; A RAMP INPUT TO TH
WILL MAKE A CURVED OR ARCHED
SPECIAL WAVEFORMS MAY ALS
either BEFORE OR AFTER THE INTEG
PASSING THROUGH THE SAMPLING MOD
TO PRODUCE DESIRED MUTATIONS O
(TECHNIQUES SUCH AS THESE MADE BY
ON MANY OCCASIONS AND WILL BE
WHEN TIME ALLOWS)

JOY-STICKS & FINGER CON
DEEN DESIGNED FOR EASY, MECH
MANIPULATION OF THE CONTROLS &
THE SUBJECTS OF LATER PATENTS
INPUTS FOR FACIAL EXPRESSIONS
THESE TECHNIQUES INCLUDE
TRANDUCED FROM ACTUAL FACIAL
USING A NETWORK OF STRAIN GAGE

SHADING (AND COLOR) NETWORK

4/29/61

THE ELECTRONIC SIGNALS COMING OUT OF THE CAMERA ANGLE NETWORK ARE BEAM-POSITIONING SIGNALS; (Just as FINGERS CONTROL THE POSITION OF A PENCIL ON PAPER). THE FUNCTION OF THE SHADING (AND COLOR) NETWORK IS TO GOVERN THE BEAM INTENSITY AS IT DRAWS THE FIGURE OR OBJECT, IN ~~PLACE OF CONSTANT~~ (HIGH FREQUENCY) VARIATIONS IN INTENSITY ASSOCIATED WITH SKIN SHADES & SHADOWS, TEXTURES etc, which arise from the surface VARIATIONS IN THE SKIN. (COLOR VARIATIONS IN THIS SENSE ARE THOUGHT OF IN TERMS OF A THREE-COLOR (MULTI-COLOR) PROCESS WHERE FOR EXAMPLE THE ~~WORK~~ OF THREE DISPLAY SCOPES, ALL OPTICALLY SUPERIMPOSED, AND EACH SCOPE HAS A COLOR FILTER ON ITS FACE. BY VARYING THE INTENSITIES OF THE 3 BEAMS, THE OPTICAL IMAGE HAS FULL SPECTRUM COLOR CAPABILITY. THUS THIS TOPIC IS CALLED SHADING (AND) COLOR NETWORK.)

THE 'SKIN' VIDEO SIGNAL CONTAINS THE INFORMATION ABOUT THE ORTHOGONAL DISTANCE BETWEEN BONE AND SKIN. IN THE FULL BASIC FORMAT, THE RATE OF CHANGE OF THE VIDEO SIGNAL IS USED TO CONTROL (THE SLIGHTNESS (SHADING)) OF HIGH FREQUENCY SKIN VARIATIONS TO ACCENTUATE SKIN FEATURES WHICH OCCUR BETWEEN THE EDGES OF THE OBJECT BEING DRAWN IN THIS FORMAT. BY DIFFERENTIATING THE SKIN VIDEO A RATE-OF-CHANGE SIGNAL IS OBTAINED. A THRESHOLD NETWORK DETECTS ALL RATES (STATES) ABOVE A PRESCRIBED ABSOLUTE VALUE. THE CLIPPED OUTPUT OF THE THRESHOLD NETWORK IS AMPLIFIED AND SCALED, HENCE USED TO MODULATE POINT INTENSITY FOR SHADING, EDGE EFFECTS (EDGE SHADOWS etc)

SHADING (AND COLOR) NETWORK

14/29/61

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SHADING, EDGE EFFECTS (EDGE SHADOWS etc)

page 26

ARE PRODUCED IN ACCORDANCE WITH SKIN VECTOR POSITION WHICH IS A FUNCTION OF THE PHASE OF THE FREQUENCY SINE WAVE FROM

IN ADDITION, A HIGH FREQUENCY OR A FOCUS FLARE MAY BE EMPLOYED HEAVY-UP OR THICKEN THE LINE ACTION ALSO BEING MODULATED WITH PHASE OF

DO NOT VARY WITH FLAT COLOR EFFECTS, OR GRAYS OF BONE POSITION, MAY BE PRODUCED BY GATING IN THESE MODULATING SIGNALS BEING BONE GATES DESIGNED FOR THAT PURPOSE. INPUT TO THE GATES A HIGH FREQUENCY A CERTAIN PATTERN, WHICH WHEN APPLIED TO MODULATE DURING THE DRAWING OF A PARTICULAR BONE A TEXTURED PATTERN. MORE SPECIFICALLY SIGNALS CONTAINING DESIGNS OF PRE-DESIGNS MAY BE APPLIED IN THIS MANNER THE DESIRED EXTERIOR APPEARANCE OF AN ARTICLE AS A SOAP BOX OR OTHER PRODUCT, OR A SHIRT PATTERN OR A FUR PATTERN ON AN ANIMAL OR (TO GENERATE THIS INTENSITY VIDEO A SCANNER WOULD BE REQUIRED, OR A SCANNING TECHNIQUE WHERE OPTICAL MASKS USED TO HAVE THE SKIN-SCANNING BEAM FLYING SPOT FOCUSED ON TWO (OR FILMS - WHERE ONE FILM CONTAINS INFORMATION AND ANOTHER CONTAINS COLOR, PATTERN OR TEXTURE INFORMATION

OVERLAP PREVENTION AND SCAN CONVERSION

BECAUSE THE DISPLAY BEAM IS DRAWING A 2-DIMENSIONAL PROJECTION OF A 3-DIMENSIONAL IMAGE IN A CONTINUOUS MANNER IT IS NECESSARY TO PROVIDE A MEANS OF PREVENTING THE BEAM FROM DRAWING OVER A PORTION OF THE IMAGE WHICH HAS ALREADY BEEN DRAWN. THUS A SPECIAL DEVICE FOR "OVERLAP PREVENTION" HAS THE FUNCTION OF DOING AWAY WITH "GHOST" IMAGE OR OVERLAP.

OVERLAP MAY BE CLASSIFIED INTO TWO TYPES, ONE TYPE OCCURS WHEN THE "BACK PART" OR PART OF THE IMAGE ON THE SIDE AWAY FROM THE VIEWER IS DRAWN. THIS OVERLAP IS PREVENTED BY TURNING OFF THE INTENSITY OF THE BEAM ACCORDING TO THE VECTORIAL POSITION OF THE SKIN VECTOR WHICH IS A FUNCTION OF 1) PHASE OF THE HIGH FREQUENCY, AND 2) THE CAMBRA ANGLE (WHICH GOVERNS THE POSITION OF "PLANE OF PROJECTION").

THE 2ND TYPE OF OVERLAP OCCURS WHEN ONE PART OF AN OBJECT OR FIGURE OVERLAPS ANOTHER PART, OR WHERE ONE FIGURE IS IN FRONT OF ANOTHER. BY USING A SPECIAL DISPLAY TUBE WHICH HAS IN IT, TWO OR MORE ELECTRON GUNS, ONE OF WHICH IS A "WRITE" GUN, ANOTHER OF WHICH IS AN "ERASE" GUN (HAVING SELECTIVE ERASURE CAPABILITY). AND HAVING THE ERASE GUN PRECEDE THE WRITE GUN BY EMPLOYING A SLIGHT DELAY IN THE "WRITE" SIGNALS (BOTH GUNS GETTING THE SAME DISPLAY SIGNALS HOWEVER) OVERLAP MAY BE PREVENTED, AS LONG AS THE OBJECT OR PART OF THE OBJECT WHICH IS TO BE DISPLAYED IS DRAWN IN THE SEQUENCE COMPATIBLE WITH THIS METHOD (NAMELY, LAST

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WITH LOW, REPRODUCTION + SCANN
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MAY BE ATTAINED.