

PATENT SPECIFICATION

(11) 1319410

DRAWINGS ATTACHED

1319410

- (21) Application No. 6324/73 (22) Filed 22 May 1970
 (62) Divided out of No. 1318051
 (31) Convention Application No. 828154 (32) Filed 27 May 1969 in
 (33) United States of America (US)
 (44) Complete Specification published 6 June 1973
 (51) International Classification G06K 15/20//A63F 9/00
 (52) Index at acceptance

H4T 1 4A2 4B1 4B2



(54) APPARATUS AND METHOD FOR USE IN PLAYING GAMES ON A CATHODE RAY TUBE

(71) We, SANDERS ASSOCIATES, INC., a corporation organised and existing under the laws of the State of Delaware, United States of America, of Daniel Webster Highway, South Nashua, New Hampshire, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is performed to be particularly described in and by the following statement:—

This invention relates to an apparatus and method by means of which cathode ray tubes, including those of standard television receivers can be utilized as active rather than passive instruments, for example by using them to play a game. This is accomplished in certain embodiments by having participants in a game manipulate controls of a control unit connected to a television receiver to cause a symbol, such as a rectangle, circle, ring, star, cross, spot or a plurality of spots, to be displayed upon the television screen by means of which the participants can play a variety of games. However, the invention is not limited to such use. Those operating the controls can for example participate in simulated training programs, as well as carry out other activities. By way of example, modified versions of the well-known game of ping-pong may be played by two participants by physically or electronically placing an appropriate mask representing the net upon the screen of the television receiver. Three display spots represent two bats or paddles and a ball wherein the ball is moved in a particular direction when "hit" by a bat or paddle.

Heretofore, color and monochrome television receivers have been used generally by the home and other viewers as passive devices; i.e., the television receiver is used only as a display means for programming originating at a studio. The viewer is limited to selecting the presentations available for viewing and is not a participant to the extent that he can control or influence the nature of, or add to

the presentation displayed on the receiver screen.

A standard receiver employed with auxiliary equipment to provide an active form of home entertainment is described in our British patent specification No. 1,268,821. Since most homes are equipped with television receivers, the only expense required to provide added family enjoyment is the expense of a control unit of one type or another.

According to the present invention there is provided for use in combination with a cathode ray tube, apparatus for generating a symbol for display on the screen of the cathode ray tube wherein the position of the symbol can be influenced as a result of a manual operation by a participant in a game, including means for generating electrical signals defining a hit symbol (as herein defined), either means for generating electrical signals defining a hitting symbol (as herein defined) whose position on the screen can be controlled by the said manual operation, or detector means, whose position in relation to the screen can be controlled by the said manual operation, directed towards the hit symbol to determine the presence thereof, means for ascertaining coincidence (as herein defined) on the screen between said hitting symbol and said hit symbol, said hit symbol and the edge of the screen or said hit symbol and the line of direction of the detector means towards the screen and means to impart a distinct motion to the hit symbol upon the occurrence of the said coincidence.

In one use of the present invention it is possible for one or more participants in a game to actively use a standard television set while receiving background and other pertinent pictorial information from a cooperative commercial TV, closed-circuit TV, or CATV (Community Antenna T.V.) station, thus combining or alternating studio and home-generated information on the TV screen.

In one particular application of the present invention it is possible to use a standard TV

[Price 25p]

Price 33p

5 set for playing a game or for other activities without the need for any kind of internal electrical connection to the TV set for the introduction of video and/or chroma signals, the only connections required being to the externally-accessible antenna terminals.

10 In accordance with one embodiment of the present invention, a television apparatus for use in playing a game is provided for generating video signals in accordance with the standardized television format, which signals may be controlled by an individual operator by means of a joystick or other manually operative means. The television apparatus 15 for playing a game comprises control apparatus having included therein the necessary electronic circuits to produce signals which are compatible with standard television receivers.

20 The control apparatus has video signal control means mounted thereon for each outlet to a television receiver and connecting means are provided for coupling the video signals generated within the control box to the television receiver.

25 By way of illustration, the television gaming apparatus can be used for playing a game of ping-pong by providing on a TV screen two spots which represents bats or paddles. Means are provided for enabling the players 30 to control the vertical movement of the spots. Means are also provided for generating on the screen of the television receiver a third spot which represents the ping-pong ball, which spot automatically moves from an off-screen left position to an off-screen right position and vice versa unless "hit" by a bat or paddle spot whereupon the ball spot will 40 change direction. The players have further controls for changing the vertical position of the ball spot.

45 Suitable overlays or presentations from a cooperative TV station may be used in conjunction with said games to enhance the aesthetic appeal thereof.

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:

50 FIG. 1 is a pictorial view illustrating the principle components of an embodiment of the invention;

FIG. 1A is a pictorial view illustrating an alternate embodiment for the control unit of FIG. 1;

55 FIG. 2 is a sketch illustrating a typical TV screen and overlay mask as employed in an embodiment of this invention;

FIG. 3 is a sketch illustrating the manner in which spots are formed on a TV screen;

60 FIG. 4 is a block diagram illustrating the spot generation;

FIG. 5 is a block diagram of the preferred mode of generating spots on a TV screen;

65 FIG. 6 is a plurality of sketches illustrating shapes of representative spots;

FIG. 7 is a schematic of a sync/sawtooth generator employed in the embodiment of FIG. 5;

FIG. 8 is a schematic showing of circuits employed in the embodiment of FIG. 5;

FIG. 9A is a schematic of potentiometer controls used to generate slicer control voltages;

FIG. 9B is a schematic of joystick controlled potentiometers used to generate slicer control voltages;

FIG. 9C is a schematic of joystick controlled potentiometer-integrator control used to generate slicer control voltages;

FIG. 10A is a schematic of a position flip-flop used to control spots in certain applications of this invention;

FIG. 10B shows representative waveforms of the circuit of FIG. 10A;

FIG. 11A is a block diagram of apparatus for controlling a "hit" spot;

FIG. 11B is a sketch illustrating the manner in which the apparatus of FIG. 11A controls a "hit" spot;

FIG. 11C is a schematic of the horizontal gated differentiator of FIG. 11A;

FIG. 11D is a schematic of the bilateral switch, integrator and wall bounce control of FIG. 11A;

FIG. 12A is a diagram of apparatus for a simulated ping-pong game;

FIG. 12B is a sketch of a TV screen illustrating the manner of play of a ping-pong game of FIG. 12A;

FIG. 12C is a sketch of a TV screen illustrating the manner of play of a simulated hockey game using the apparatus of FIG. 12A;

FIG. 12D is a sketch of a TV screen illustrating the manner of play of a simulated baseball game;

FIG. 13 is a sketch illustrating a class of games ("chase" games) which can be played using the apparatus of this invention;

FIG. 14 is a diagram of apparatus for a simulated hockey game;

FIG. 15A is a diagram of apparatus for simulated handball game;

FIG. 15B is a sketch of a TV screen illustrating the manner of play of a simulated handball game using the apparatus of FIG. 15A;

FIG. 16A is a diagram of apparatus for playing a simulated pintable or pinball game;

FIG. 16B is a sketch of a TV screen illustrating the manner of play of a pintable or pinball game using the apparatus of FIG. 16A;

FIG. 17A is a diagram of apparatus for a simulated bowling game;

FIG. 17B is a sketch of a TV screen illustrating the manner of play of a bowling game using the apparatus of FIG. 17A;

FIGS. 18A—18C are block diagrams of "built-in" embodiment of the invention;

FIG. 19 is a simplified block diagram of another embodiment of TV gaming apparatus; and

FIG. 20 is an alternate embodiment of circuits employed in the embodiment of FIG. 5.

The principal components of one embodiment of a television gaming system configured according to the invention are illustrated in FIG. 1 which is a pictorial view showing a television receiver 10, a control unit 14 and means 12 for connecting control unit 14 to receiver 10. The television receiver 10 employed can be any of the standard commercially available models that are generally used for home entertainment. Either a monochrome or colour television set may be used with the present invention since the basic principles of the invention apply to both types. The connection means 12 is in this embodiment a shielded cable, for example, shielded twin lead, and is attached to the antenna terminals of receiver 10 in conventional fashion.

Control unit 14 generates video signals shown as spots 20₁, 20₂ and 21. The spots 20₁ and 20₂ are positioned on the receiver screen 18 by knobs 16₁, 17₁, and 16₂, 17₂, respectively. For clarity, the spot 21 is illustrated as a circle and the spots 20 are illustrated as diamonds, however, many shapes can be generated. In the devices to be described hereinafter, circles are generally employed.

Knob 16₁ controls the vertical position of spot 20₁ while knob 17₁ controls the horizontal position thereof. Thus, it can be seen that the spot 20₁ may be positioned at any point on the screen by the proper manipulation of knobs 16₁ and 17₁. Spot 20₂ is positioned in like manner by knob 16₂, 17₂. In this embodiment spot 21 is automatically positioned on a screen 18 without manual control. This will be described more fully hereinafter. A reset switch 26 is shown on the control unit 14 and is used to reset the picture on the television screen. For example, a game may be played in which one spot is to be positioned over the other and when this is accomplished one spot will disappear and the background will change color. When games of this nature are played, a reset means is required before play can be resumed. Reset switch 26 performs this function.

A knob 15 controls background color for color TV receiver applications wherein a chroma generator is employed in the manner set forth in said British Patent Specification No. 1,268,821. Alternatively, control unit 14 may be broken up into a master control unit containing the electronic circuits and individual control units containing control knobs 16₁, 17₁, and 16₂, 17₂, whereby each participant may operate from a position away from

the other and so not to interfere with other players. This is illustrated in FIG. 1A wherein control unit 14 is broken up into a master control unit 27 and individual control units 22 and 23. The master control unit 27 contains the electronic circuitry found in control unit 14 and controls 26 and 15. Knobs 16₁, 17₁ and 16₂, 17₂ which position the spots 20₁ and 20₂ are situated on individual control units 22 and 23 respectively.

Each pair of knobs 16₁, 17₁ and 16₂, 17₂ may be combined into a single joystick permitting control of the horizontal and vertical spot positioning by a single control means.

Other spot position control means (not shown) can be incorporated into the control unit(s) and these will be described hereinafter.

Rather than provide a separate control unit, the electronic circuitry of the control unit could be built into the television receiver as a constituent part thereof and the receiver sold as both an active and passive home entertainment system. Control units containing the actual manipulating controls can be provided as above.

A typical sequence of steps to play a game using the present invention would be as follows: 1. Attach connection means 12 to TV set 10 at the antenna terminals thereof, if not already attached; 2. turn the TV set on; 3. select the proper channel on the set for the control unit being used; 4. apply power to the control unit; 5. attach a mask on the face of the TV screen; if required for the game to be played; 6. begin the game.

Referring now to FIG. 2, a television screen 18 is illustrated having three spots 24₁, 24₂, and 25 displayed thereon. Spots 24 are "hitting" spots and spot 25 is a "hit" spot. Spots 24₁ and 24₂ represent, for example, hockey players while spot 25 represents a hockey puck. An overlay mask 30 of some type of transparent material such as plastics or the like, having some type of pattern, picture or other illustration pertaining to the particular game to be played is shown in a lifted position. Prior to engaging in a game, the overlay mask 30 is temporarily attached to television screen 18 and in such close proximity to it as not to create any distortion when viewed with reference to spots 24 and 25. One type of overlay mask represents a hockey field to be used for playing a modified game of hockey. Still another pattern could represent a ping-pong table, baseball diamond, etc. These are but a few of the many type games that can be adapted for use with the present invention.

Alternatively, rather than employ overlay mask 30, the pattern to be provided could be displayed directly on the screen 18. The pattern could be broadcast by TV stations or alternatively could be sent to a non-used

channel over closed-circuit or CATV (Community Antenna T.V.) lines. It could also be generated electronically in the video control system.

5 The basic theory of TV gaming devices as described herein is now set forth.

Referring to FIG. 3, at time zero the TV electron beam is at the upper left of screen 18. It starts moving quickly to the right and slowly downwards. Sixty-three and one-half (63.5) microseconds later a 5 microsecond horizontal sync pulse is fed into the TV set, causing the beam to fly back rapidly to the left of the screen. The beam then moves to the right for 63.5 microseconds until the next horizontal sync pulse causes the next flyback to the left. After about 250 such horizontal scans (lines) the beam has progressed to the bottom of the screen. A vertical sync pulse fed into the TV set causes rapid (1 millisecond) vertical flyback to the top of the screen and another cycle begins.

Now, still referring to FIG. 3, assume that the major portion of the screen is dark (beam blanked) except for the areas shown as SPOT 1 and SPOT 2 beginning at the co-ordinate points T_{H1} , T_{V1} and T_{H2} , T_{V2} respectively. The spots are made by passing a (positive) unblanking video signal to the TV set when, and only when, the "beam" is passing over the areas of the spots. (Quotes are used around beam because although there is no real beam when blanking is in effect, the scanning signals occur and can be thought of as moving the "non-existent beam" in the scanning pattern).

The video (unblanking) signals required for spot generation are described with the aid of FIG. 3. To derive SPOT 1, assume that a pulse of width W_H is generated to T_{H1} microseconds after the occurrence of each horizontal sync pulse. Define these new pulses as P_{H1} —horizontal video pulse for SPOT 1. If these P_{H1} pulses were used as unblanking (video) in the TV set, the beam would brighten whenever it had moved a distance equivalent to T_{H1} from the left side of the screen. It would stay bright for a length equivalent to W_H and then darken. This would happen all during the vertical scan and 250 bright little line segments of width W_H would appear to the eye as a vertical column (shown shaded in FIG. 3).

Now, SPOT 1 vertical video pulses P_{V1} are made to be of width W_V and to occur T_{V1} milliseconds after the start of the vertical sweep. W_V is on the order of 63.5 microseconds, permitting some ten horizontal scans to take place while P_{V1} is on. If P_{V1} were used alone as the unblanking (video) signal to the TV set, ten lines, the width of the set would be brightened while P_{V1} was on and a bright horizontal bar of width W_V (shown shaded in FIG. 3) would be viewed.

65 As the last step in spot generation, SPOT

1 horizontal video pulses (P_{H1}) and vertical video pulses (P_{V1}) are passed through a coincidence gate. The gate has an output only when both P_{H1} and P_{V1} are on. The gate output becomes SPOT 1 video (unblank) signal. From FIG. 3 it is obvious that the beam is now unblanked only where the P_{H1} vertical shaded column and P_{V1} horizontal shaded bar overlap. Thus, a bright spot SPOT 1, comprised of about ten small line segments, each W_H wide, is developed. SPOT 2 is developed in the like manner.

FIGS. 4 and 5 are block diagrams illustrating the manner in which the signals discussed with respect to FIG. 3 are generated.

Referring to both Figs. 4 and 5, the timing for the system of playing games by TV is established by a horizontal sync-sawtooth generator 31 and a vertical sync/sawtooth generator 32. The horizontal sync-sawtooth generator 31 generates a series of negative horizontal sync pulses 33 having a repetition rate equivalent to the standard horizontal scanning frequency used in United States commercial television receivers and the vertical sync/sawtooth generator 32 generates a series of negative vertical sync pulses 34.

The horizontal sync-sawtooth generator 31 also generates a 15.75 KHz sawtooth wave 35 (as shown in FIG. 5). Sawtooth wave 35 has amplitude limits of +E and 0. It is directly coupled to a SPOT 1 horizontal slicer 36. A "slice" of the sawtooth ramp of length W_H is passed through the slicer. By varying voltage e_{H1} , delay T_{H1} can be varied for spot positioning from left to right of the TV screen.

A 60Hz sawtooth 37 is generated by vertical sync-sawtooth generator 32 and is similarly sliced in a SPOT 1 vertical slicer 29, to give ramp width W_V and a voltage controlled delay T_{V1} determined by the value of the voltage e_{V1} . The two sliced waves are differentiated by capacitors 38 and 39 which connect to the low input impedance of a SPOT 1 coincidence gate 40. Since the current through a capacitor is

$$C \frac{de}{dt}, \quad 115$$

current pulses appear only during the ramp portions of the sliced waveform. Although the slope of the vertical ramp is only about 1/260 times that of the horizontal ramp

$$\left(\frac{60H_z}{15750H_z} \right), \quad 120$$

by making capacitor 39 approximately 260 times the value of capacitor 38, current

pulses i_{H1} and i_{V1} are made equal in magnitude. Both i_{H1} and i_{V1} must be present to exceed in magnitude the (negative) threshold of the gate thus producing the SPOT 1 video signal.

If the invention is to be employed in conjunction with TV systems having operating frequencies (number of horizontal lines and vertical flyback) different from those described then the vertical and horizontal sync/sawtooth generators would be constructed to operate at other required frequencies. This would be particularly applicable in conjunction with foreign (other than U.S.) TV systems.

Other spots are generated in similar fashion. For example, SPOT 2 horizontal slicer 41 is also coupled to the horizontal sync/sawtooth generator 31, and SPOT 2 vertical slicer 42 is also coupled to vertical sync/sawtooth generator 32. The horizontal and vertical slicers 41 and 42 are coupled to a SPOT 2 coincidence gate 43 by capacitors 44 and 45, respectively. All video spot signals are fed to an OR gate and pulse shaper 46. The OR gate prevents excessive brightening when spots are positioned on top of one another. The pulse shaper is required because in the present embodiment 6 volt sawtooth waveforms are used. With such low voltage the slicing action is soft (rounding at beginning and end of ramp slice). Consequently, the current pulses produced by differentiation of the ramp slicers are rounded pulses. Without shaping they produce a spot without sharply defined edges . . . the edges just "fade out" gradually in the dark background. The summer modulator and RF oscillator 28 are set forth in our British Patent Specification No. 1,268,821. The RF signals presented to the antenna terminals is detected and processed by the TV receiver in the standard manner and displayed on the screen thereof. The output from OR gate and pulse shaper 46 is applied to a summer which sums all the signals presented thereto (including sync pulses from the horizontal and vertical sync/sawtooth generators, outputs from chroma generator, if used etc.). This forms the composite video signal. This signal is applied to a modulator and RF oscillator for modulating the video information with the RF oscillator carrier to generate the requisite modulated RF signal which is coupled to the TV antenna terminals.

One of the objects of the present invention is a system to produce a round spot which in some instances is more pleasant and interesting than a square or rectangular spot, (especially for "ball" games like ping-pong, baseballs, etc.). This is achieved (even with the pulse shaper which just gives the round spot sharply defined edges) by the "rounded edges" of the current pulses going into the coincidence gate. For example, the leading and

trailing edges of current pulses i_{V1} are rounded. Thus any i_{H1} pulses which are added to i_{V1} at this time will have thinner portions protruding below the gate threshold level than those appearing during the full amplitude middle of i_{V1} . Subsequent pulse shaping of the pulses which "get past" the gate threshold steepens their sides (for sharp spot edges) but doesn't change their width. Thus the spot is narrower at top and bottom than it is in the middle.

Some of the various spot shapes which can be generated are shown in FIG. 6. Spots a, b and c are generated simply by varying the threshold 53, shown in Fig. 8, of coincidence gate 40 for an individual spot. Or, alternatively all the spots can be made to change shape together by changing the amplitude and slope of the common sawtooth generators.

Spots d and e are made either by changing sawtooth slope (thus changing W_H and W_V), or by changing the slice amplitude (again changing W_H and W_V).

Various other shapes (four pointed star, cross, etc.) can be generated by simple adjustments of various component values or voltages and by switching. All spots can be made hollow as described hereinafter.

Referring now to FIG. 7, there is illustrated thereby schematically one embodiment of the sync/sawtooth generators. A generator of this type is described in detail in our U.S. Patent Specification No. 3,497,829.

The SPOT 1 slicers 36, 29, the SPOT 1 coincidence gate 40 and the OR gate and pulse shaper 46 are illustrated schematically in FIG. 8. The horizontal 15.75 Hz sawtooth waveform 35 and the vertical 60 Hz sawtooth wave 37 waveform are sliced in the slicers 36 and 29, respectively. The slicers comprise means for generating a predetermined slice of the sawtooth waveforms and in the present embodiment include back-to-back diodes 47, 48, and 49, 50, respectively. The input sawtooth waveforms are applied to one side of the diode pair, with the other side being capacitively coupled via capacitors 51, 52, respectively to ground and being supplied voltages e_{H1} and e_{V1} , respectively. Diodes 47—50 are preferably germanium diodes because their low conduction voltage drops permit the achievement of reasonably small spot size (determined by sliced ramp duration) with a 6 volt sawtooth. The capacitors 51, 52 serve to make delay control voltages e_{H1} and e_{V1} appear as true voltage sources in cases where they come from the sliders of relatively high impedance potentiometers. The differentiating capacitors 38, 39 producing i_{H1} and i_{V1} are followed by the coincidence gate 40. Variable threshold level is provided by a potentiometer 53 to produce desired spot size and shape as mentioned hereinbefore.

Spot video signals are passed through a

diode "OR" gate 54 of the OR gate and pulse shaper 46. The "multi spot" OR video signal then passes through a pulse shaper 55 which steepens the sides and squares off the tops of the pulses, giving sharply defined spot edges and uniform brightness over the area of the spot.

The pulse shaped video signal is then fed, along with the negative horizontal and vertical sync signals (and chroma generator output, if applicable) to the summer modulator and RF oscillator 28 as indicated in FIG. 4.

If desirable, the 60 Hz sync can be extracted from a photosensor directed toward the front of the TV screen and horizontal sync can be obtained from a pickup coil as described in said British Patent Specification No. 1,268,821. Spots can be generated by using the video signal described above to short circuit or "crowbar" the antenna terminals; the RF oscillator not being used. These features are compatible with a cooperating TV or CATV station as described in said British Patent Specification No. 1,268,821.

Referring now to FIG. 20, there is illustrated thereby another embodiment of spot generation for TV gaming. This embodiment is very much like the embodiment of FIG. 8, however, changes have been made thereto for providing improved temperature and voltage stability such that the spots generated will maintain their size to a greater degree over wider temperature and voltage excursions.

The timing for the system is established by a horizontal sync/sawtooth generator 210 and a vertical sync/sawtooth generator 211. These generators are like the generators 31, 32 illustrated in FIG. 7, however they use a V_{cc} voltage, in the instant example, 9 volts which is higher than the positive voltage of FIG. 7.

The sawtooth outputs of the generators 210, 211 are applied to a horizontal slicer 212 and vertical slicer 213, respectively. The slicers 212, 213 are like the slicers 36, 29 of FIG. 8 with the exception that silicon diodes are used in place of germanium diodes for temperature stability. However, silicon diodes have a much greater voltage drop and, therefore, the 0 volt sawtooth is used in order to get a steeper sawtooth and thereby not increase spot size which would occur if the 6 volt sawtooth of FIG. 8 was used.

The two sliced waves are differentiated, as before, by capacitors 214 and 215 and applied to a spot coincidence gate 216. The DC voltage for the spot coincidence gate 216 is stabilized by a zener diode 217. A diode 218 is also used for temperature compensation. The principal change in spot coincidence gate 216 is contrasted to spot coincidence gate 40 of FIG. 8 is the addition of a peak detector 219 which detects the peak of the

horizontal spot pulses which ride on the vertical spot pulses and feeds this signal back to appropriately bias the coincidence gate to maintain spot size.

The OR gate 220, pulse shaper 221, summer 222 and RF oscillator and modulator 223 serve the same functions as described with respect to FIG. 8.

Prior to describing various games that can be played using the present invention, several of the electronic functions which the system is capable of providing are described herein. Many of these depend strongly upon the voltage control positioning features of the system.

The voltages e_{H1} , e_{V1} indicated with reference to FIGS. 5 and 8 control a spot's horizontal and vertical position. Changing e_{H1} from zero volts to, for example, +6 volts moves a spot across the screen from off-screen right to off-screen left. A similar change in e_{V1} moves a spot from off-screen bottom to off-screen top.

In one embodiment, the e_H and e_V voltages are derived from the slides of the potentiometer 56 and 57 which are connected between ground and, for example, +6 volts (see FIGS. 9A). Knobs 16₁, 17₁ and 16₂, 17₂ of FIGS. 1 and 1A are attached to the potentiometers controlling the positions of SPOT 1 and SPOT 2. If more than two positioned spots are required, additional potentiometers and knobs 16_n, 17_n would be required in addition to spot horizontal and vertical slicers and spot coincidence gates. Alternatively, two potentiometers (one vertical, one horizontal) may be connected to a single joystick 58 in order to provide the user single handed control of position (see FIG. 9B).

If the control potentiometers 56, 57 (Fig. 9A) for the e_H and e_V voltages are followed by integrators 59, 60, respectively, (see FIG. 9C) with e_{Hn} and e_{Vn} obtained from the outputs of the integrators, a different type of spot positioning is obtained. For example, with the two potentiometers mechanically connected to a single joystick 58 (Fig. 9B), the spot will move as long as joystick 58 is away from its center position. The speed of spot movement is proportional to the distance the joystick is offset from its center position and the direction of spot motion is determined by the angular position of the joystick.

Whereas the simple H and V joystick of FIG. 9B gives direct control in which the spot returns to center screen when the joystick is returned to center, this "integrator joystick" of FIG. 9C merely stops the spot wherever it happens to be when the joystick is returned to center position.

The resulting "spongier" positioning action is much more interesting for certain types of games such as chase, hockey ("spongy" motion simulates gliding skaters very well) soccer, car racing, etc.

Referring now to FIG. 10A there is illustrated thereby yet another arrangement for providing spot positioning voltages e_{Hn} and e_{Vn} .

When the flip-flop 61 is set so that output 62 is high and output 63 is low, the voltage at point 64 can be varied from approximately zero to $+V$ volts (for example, 6 volts) by adjusting potentiometer 65 (Potentiometer 66 has no effect since it is disconnected from the circuit by a pair of back biased diodes 67, 68). With flip-flop 61 in its other stable state, potentiometer 66 controls the voltage at point 64 and potentiometer 65 is disconnected by a pair of diodes 69, 70.

If the delay control voltage lead for a spot (the e_{Vn} or e_{Hn} input) is connected to point 64 the spot can be made to move (rapidly) between two stable positions. The stable positions being controlled by potentiometers 65 and 66.

For certain applications, rapid motion is not desirable. In these cases an RC time constant provided by a resistor 71 and a capacitor 72 is added. The spot still moves between two stable positions but gives the effect of moving fast when "kicked" or "hit" and then gradually slowing down and finally stopping.

If the RC time constant is replaced by an integrator the spot will move at constant velocity. Naturally, if two flip-flops are used (one for horizontal and one for vertical) a spot can be made to move to any one of four pot-controllable stable positions.

Typical waveforms taken at points 62, 63, and 64 are illustrated in FIG. 10B. The trigger to flip-flop 61 can be the output from a coincidence circuit or a "serve" flip-flop as will be described hereinafter.

By changing the triggering sequence of two flip-flops different paths are obtained. A slow free-running flip-flop is useful to "serve" a ball which has gone off-screen when used in a ping pong game, etc. This is described in greater detail hereinafter.

For playing games, two functionally different types of spots are often generated, a "hit" spot and a "hitting" spot. The "hit" spot stimulates a ball, a hockey puck, etc. A "hitting" spot simulates bat or paddle, a hockey stick, a golf club, a hand, etc. The uses for "hit" and "hitting" spots will become readily apparent when various games are described hereinafter.

When used in this specification and claims in relation to a symbol or spot which appears on the face of a cathode ray tube and which is used in playing a game, the term "hit" refers to a symbol or spot whose position on the screen is not directly controlled by a player in the game. The "hit" spot is a target symbol which can apparently be hit either by a further symbol or by the "line of fire" of an aimed detector device, both being under

the direct control of a player, and be given a distinct motion thereby.

The term "hitting" when used in this specification and claims in relation to a symbol or spot on the face of a cathode ray tube, refers to a symbol or spot whose position, when used in playing a game, is directly controlled by a player in the game. The "hitting" spot can be caused to move over, or the aimed detector device can be aimed at various points on, the face of the cathode ray tube under the direct control of a player and apparently be caused to hit a "hit" spot.

The term "coincidence", when used in this specification and claims in relation for example to two spots or to a spot and an aimed detector device includes the case when either two spots appear to contact one another or a spot and the line of fire of the aimed device strikes a spot and is not limited to the case in which the spots overlap one another or the line of fire is centered on the spot.

Referring now to FIGS. 11A—11D, there is illustrated yet another electronic function which is included in the present invention.

This electrical function provides the e_H and e_V spot positioning voltages to a "hit" spot such as spot 73 in FIG. 11B. These voltages, the outputs of the circuit of FIG. 11A, are applied to the horizontal and vertical slicers of the "hit" spot generator. The inputs to the circuit of FIG. 11A are the control voltages of a "hitting" spot, for example, spot 74 or spot 77 of FIG. 11B. The embodiment shown is for applications having two hitting spots which could represent, for example, two ping-pong bats or paddles in a simulated ping-pong game.

The "hitting" spots' horizontal control voltages are applied to a horizontal gated differentiator 85 and the "hitting" spots' vertical control voltages are applied to a vertical gated differentiator 86. Each of the gated differentiators has as further inputs thereto outputs from a pair of one shot multivibrators 81, 82. The multivibrators 81, 82 are triggered by outputs from a pair of coincidence detectors 83, 84, respectively. Coincidence detector 83 signifies coincidence between a first "hitting" spot, for example, spot 74, and the "hit" spot, for example, spot 73. Coincidence detector 84 signifies coincidence between a second "hitting" spot, for example, spot 77, and the "hit" spot. One embodiment of the coincidence detectors is illustrated in said British Patent Specification No. 1,268,821.

The gated differentiators 85, 86 provide pulses whose amplitudes are proportional to the horizontal and vertical components of the velocity of the "hitting" spot at the instant of contact between the "hitting" and "hit" spots. The pulse width is that of the pulses from the one shot multivibrators 81, 82, and

track
to
motor
ed
can
ral
em
in.
lt-
ys-
80
er-
ri-
e_{Hn}
lts
off-
ilar
een
ges
tio-
een
see
of
en-
DT
aed
ters
in
cers
two
tal)
in
on-
Fig.
ved
IG.
out-
of
ple,
on-
the
way
spot
nce
ion
ned
of
the
oy-
tor
spot
tick
125
ion
of
ton
car
130

the pulses from the differentiators 85, 86 cause the "hit" spot to travel in the direction in which it was hit and at a speed proportional to how "hard" it was hit.

5 A preferred embodiment of horizontal gated differentiator 85 is shown in FIG. 11C. Vertical gated differentiator 86 is constructed in like fashion. The differentiator is comprised of capacitors 190 and 191 and feedback amplifier 78. The input signals H_1 and H_2 are coupled to the differentiator. A pair of switches, 75 and 76, follow the differentiating capacitors, 190 and 191. The switches 75, 76 are normally closed. One or the other is opened by a signal from either multivibrator 81 or 82 allowing the differentiator to differentiate the H_1 or H_2 input signal according to which spot makes coincidence with the hit spot. The resistors 87, 88 prevent shorting to ground of the desired signal when the other signal switch 76 or 75 is closed. Resistor 89 is the differentiating feedback resistor. The output pulse of this circuit can be positive or negative depending upon the direction of the "hitting" spot when it coincides with the "hit" spot. Using the preferred gated differentiator of FIG. 11C, undesirable overshoots and preshoots are avoided since the switching is accomplished following the differentiating capacitors rather than before them.

Referring again to FIG. 11A, to provide the control voltages for the "hit" spot, the signal

$$35 \quad \frac{dH_n}{dt}$$

must be integrated for a period of time. If the signal is integrated for a period of time equivalent to the relatively short pulse width of the one shot multivibrators, the "hit" spot would move only during this time and this is too fast a spot movement. Accordingly, it is desirable to "stretch" the time of spot movement, by for example, providing an RC delay to the

$$45 \quad \frac{dH_n}{dt}$$

signal. This would be a simple matter if

$$\frac{dH_n}{dt} \text{ and } \frac{dV_n}{dt}$$

were always one polarity. However, since

$$\frac{dH_n}{dt} \text{ and } \frac{dV_n}{dt}$$

50 can be either polarity a more complex arrangement is necessary.

When either "hitting" spot makes coincidence or contact with the "hit" spot a coincidence pulse from multivibrators 81 or 82 allows the bilateral gates 92 and 93 to pass positive or negative

$$\frac{dH_n}{dt} \text{ and } \frac{dV_n}{dt}$$

pulses to stretching capacitors 94 and 95, respectively. After the coincidence pulse ends, the bilateral gates return to their open or high impedance state and the voltages on capacitors 94 and 95 decay at a rate determined by the capacitors and resistors 106 and 107.

The stretched pulses at capacitors 94 and 95 are coupled to integrators 90 and 91. The outputs of the integrators are voltages e_H and e_V . These voltages become the control voltages for the "hit" spot.

The resultant effect is that the "hit" spot moves in the same direction in which the "hitting" spot is moving when coincidence is made. If hit "hard", the "hit" spot moves rapidly and far. If the "hitting" spot is moving slowly at coincidence, the "hit" spot is merely "nudged" a short distance and moves slowly.

In the embodiment illustrated, a wall-bounce feature is included. When the "hit" spot is to travel, for example, along the line 102 (see FIG. 11B), switch 104 (FIG. 11A) is open and switch 105 is closed and the signal bypasses an inverter 108. When the "hit" spot reaches the edge of the TV screen, it is desired that it "bounce" back as shown by line 103 of FIG. 11B, simulating, for example, a puck bouncing off the wall of a rink in a simulated hockey game or a billiard ball bouncing from a cushion. The "hit" spot bounces from the sides of the screen with a reflection angle equal to the incidence angle. When the spot reaches the edges of the screen, switch 104 closes and 105 opens. The signal from the bilateral gate is thus now applied to the integrator via inverter 108. A horizontal or vertical wall sensor 109, 110, as the case may be, provides the requisite signal to cause the switching of switches 104, 105 and 198, 193.

Note, in the event the wall bounce feature is not required, the horizontal system of FIG. 11A may be modified by deleting switches 104, 105, inverter 108 and the horizontal wall hit sensor 109, like components also being deleted from the vertical system.

The bilateral gate 92, integrator 90 and horizontal wall bounce circuitry is shown in greater detail in FIG. 11D. Like circuitry is also provided for the vertical portion of the system.

The differentiated signal pulse

dHn

dt

is applied to bilateral gate 92 which is comprised of a pair of transistors 180, 181. Signals indicative of coincidence between a "hitting" and "hit" spot are obtained from the two sides of the coincidence multivibrators and are applied to the bases of the transistors as shown, negative pulses turning 181 on and positive pulses turning 180 on. The switches 104, 105 of FIG. 11A are comprised of transistors 182, 183, respectively. The output "hitting" spot control signal e_H is obtained at the output of integrator 90.

The output from integrator 90 is also applied to horizontal wall hit sensor 109 which comprises a pair of zener diodes 182a, 183a which cause the switching of a flip-flop 184 when voltage is reached equivalent to off-screen voltage (for example, 0 volts or +6 volts). Initially, flip-flop 184 is set to a given state upon coincidence between either "hitting" spot and the "hit" spot by an output from transistor 185 to insure correct direction of the "hit" spot. If the flip-flop were in the wrong state, the "hit" spot would move 180° from the desired direction.

The circuits 186 and 187 are provided to prevent oscillation of the flip-flop 184 and failure to flip correctly which can occur if the "hit" spot approaches an off-screen position very slowly such that only a poor rise time signal is available to trigger the flip-flop.

With voltage control of a spots' horizontal and vertical position it is obvious that it's motion is similar to that of a spot on an oscilloscope. Thus, the TV spot can be made to follow any path that can be made on an oscilloscope.

One example of this is Lissajous patterns. Phase displaced sinusoids used for horizontal and vertical positioning (applied as the e_H and e_V inputs to the spot slicers) result in spot paths of circles, ellipses, "figure eights", etc.

As previously mentioned, spot size and configuration may be altered. For example, the shape of a spot can be changed to simulate 3D effects (e.g., a bowling ball which gets smaller as it rolls down the alley). This is accomplished by varying the threshold potentiometer 53 of the coincidence gate of FIG. 8. This can be readily accomplished electronically by a varying voltage input.

In certain embodiments a hollow spot or ring may be desired and this can be readily achieved by inverting the "non-square" pulses at the base of shaper 55 of FIG. 8 and subtracting from the original pulses to "hollow" them out.

Other electronic functions which may for example be generated are negative video, stroboscopic and kaleidoscope effects, even-

odd spot displacements and slave spots. These will now each be described in detail.

In certain gaming applications such as simulated hockey it is desirable to use a black spot (e.g. for a hockey puck). This is accomplished by inverting the video signal.

Colored spots can be generated by applying the video signal to the phase shifter portion of the chroma generator via, for example, a variable resistor.

If a pulse generator running at an integral multiple of 15.75 kc is synchronized with the horizontal sync signals and the pulses fed to the video summation stage, a background of black and white vertical columns is obtained. If the horizontal video signal from a "spot" is used to synchronize the pulse generator, the columns can be moved from side to side. Horizontal bars can be similarly obtained with a 60 cps pulse generator.

Coincidence gating the vertical columns with the horizontal bars so that the screen is brightened only where they cross one another yields a "checkerboard" pattern of bright squares or rectangles on a dark background; inversion of the signal of course give black squares on a white background.

When the horizontal and vertical positioning voltage of a spot are obtained from nominal quadrature sinusoids, various different patterns are obtained as the sinusoid frequency and phase shift are changed. Some patterns are stationary; others have motion; some are a combination. The effect is somewhat similar to that of a stroboscope or kaleidoscope.

If the output is a photosensor directed towards a bright spot on a TV set is fed to a flip-flop even-odd "spot discernment" can be obtained. This flip-flop is reset each time so that a first side A of the flip-flop is high. When the spot comes on, the flip-flop flips at the 60 cps vertical scan rate. If the spot remains on for an even number of scans, side A of the flip-flop is high when the spot is removed. If the spot is on for an odd number of scans, side A stays low when the spot is removed. Thus, a coded spot, visually identical to other, can be discerned electronically. The flip-flop can, of course, ring a bell, light a light, etc.

Normally, the vertical and horizontal current pulses of a spot are coincidence gated as shown in FIGS. 5 and 8 in the coincidence gates 40 and 43.

If the vertical pulse of one spot is coincidence gated with its own horizontal pulse and with the horizontal pulse of a second spot, then a third spot appears. It is called a "slave" spot because its horizontal position is controlled by one of the "real" spots and its vertical position by the other. Obviously, with two "real" spots two slave spots are easily generated.

The material which follows contains a description of typical games which can be played using the electronic functions set forth above. These games are only exemplary of the many games which can be played and are set forth to merely illustrate some of the ways in which the various electronic functions are combined.

The way in which a simulated ping-pong game is played will now be described with reference to FIGS 12A and 12B.

A simulated ping-pong ball 113 is generated by spot 3 generator 114 which has inputs thereto from vertical sync/sawtooth generator 115 and horizontal sync/sawtooth generator 116 (of the type set forth in FIG. 7). The spot generators are similar to those set forth in FIG. 8. The control voltages for the horizontal slicers of spot 3 generator 114 are derived from a flip-flop positioner 117 of the type described in FIG. 10A. Flip-flop positioner 117 provides control voltage at outputs 118, 119 which move the ball between off-screen positions H_L , V_L and H_R , V_R . Flip-flop positioner 117 is controlled by a slow free-running or "serve" flip-flop 120 and by the output from a coincidence detector 121. In one state flip-flop 122 will serve the ball from off-screen left to off-screen right and in the other state from off-screen right to off-screen left. The output from coincidence detector 121 is used to switch flip-flop states when the ball is hit by one of the two simulated paddles. The "serve" flip-flop 120 is coupled to both sides of flip-flop 122. With this arrangement, if a paddle hits the ball first, the "serve" flip-flop cannot retrigger flip-flop 122 until the ball goes off screen on the other side of the screen.

The inputs to coincidence detector 121 are the spot 1 (paddle 123) video pulse, the spot 2 (paddle 124) video pulse and the spot 3 (ball 113) video pulse which are derived from the respective spot generators 125, 126 and 114. The video pulses are obtained from the outputs of the coincidence gates of the spot generators, for example, the output of coincidence gate 40 of the spot generator shown in FIG. 8.

The V_R and V_L off-screen positions of ball 113 are controlled by players A and B, respectively, by adjustments of potentiometers 125, and 126 via knobs 127 and 128, respectively.

The vertical positions of paddles A and B are determined by the setting of potentiometers 129 and 130 which provide the vertical control voltages to the vertical slicers of the spot 1 and spot 2 generators 125a, 126a, respectively. Knobs 131 and 132 control the potentiometers 129, 130.

This simulated ping-pong game is played as follows:

The deflection circuits for the ball 113 are connected, via RC time constant circuits

133, 134a to the flip-flop 122 which moves the ball between off-screen positions H_L , V_L and H_R , V_R . The RC time constant prevents instantaneous spot motion. Additionally, since the resulting velocity is exponential in nature the spot starts fast and slows down; by moving the potentiometers 134, 135 which control the H_R and H_L positions, in one direction the RC time constants can be modified so that the ball's motion is fairly slow. Moving the potentiometers 134, 135 in the other directions gives a faster game.

Assume the ball is at H_L , V_L , it is "served" automatically when the free-running flip-flop 120 flips. The ball proceeds towards H_R , V_R . Player B moves the bat or paddle B vertically (by turning knob 132 connected to potentiometer 130) to try to hit the ball. If he misses it he loses a point as it goes off-screen right (where it will be "served" automatically again by the free-running flip-flop).

However, if he hits the ball it bounces off his paddle and starts left toward H_L , V_L . Now he has control of its flight, and by adjusting V_L with his other hand (by turning knob 128 connected to potentiometer 126) he can send the ball up or down and even try to "wiggle" it around player A's paddle.

Player A controls the vertical motion of paddle A (by turning knob 131 connected to potentiometer 129) and, if he hits the ball, gains control of its path by adjusting V_R (by turning knob 127 connected to potentiometer 125).

Play can be made fast or slow by setting H_L and H_R (potentiometer 135, 134) or by setting the paddles in different horizontal positions (by adjusting potentiometers within the generators 125a, 126a).

When color is used, the ball and paddles are white, the "table" green. Overlays or TV or CATV backgrounds showing a lined table and net enhance the effect. The game can be played by two man teams. One man controls the paddle, the other man the path of the ball.

By modification of the embodiment of FIG. 12, a game of gun ping-pong can be played. In this embodiment the players use light sensor guns instead of paddle spots to hit the ball back and forth. An output from the light sensor is used to trigger flip-flop 122 instead of coincidence detector 121. The control knobs 131 and 132 are not required. Whereas, it is difficult for one man to aim a gun and control a potentiometer, the game is best with two man teams. One man shoots; his partner controls the ball's path. Or, if a pistol is used a player can shoot with one hand and use a potentiometer with the other. Or, a ramdown or pseudo-random electronic change of V_R and V_L can be used.

Illustrative electronics for performing this "gun" function is illustrated in our British Patent Specification No. 1,268,821. A light

sensitive cell is contained, for example, within the barrel of a gun and used for trigger an SCR. A switch is provided for resetting same.

A simple ice hockey game can be played which uses the same mechanics (FIG. 12A) as the above ping-pong games including the "automatic serve" flip-flop (see FIG. 12C). The paddles (now "goalies") are moved closer in toward the center where the puck is moving faster.

If player B (with spot 138) hits the puck 137 it moves to the left and he controls its path by moving V_L . He tries to "wiggle" the puck around goalie A (spot 139) and into the goal.

Player A controls V_R after he hits the puck.

In color TV application, it is preferred to use white goalies, a black puck (using negative video) and blue ice.

Again, this game is adaptable to two man teams, and even more if more spots are used.

Another game which can be played using most of the system shown in FIG. 12A is a simulated baseball game. This is illustrated in FIG. 12D.

The pitcher controls the path of a ball 140 by adjusting knobs 127 and 128 connected to potentiometers 125 and 126 which, therefore, controls V_L and V_R . The ball, therefore, goes from position H_L , V_L to H_R , V_R .

Another knob (not shown) is connected to potentiometer 134 and thereby permits speed control by the pitcher.

The batter tries to hit ball 140 by moving bat 141 (spot 2) vertically by turning knob 132. Spot 1 is not required for this game. If the batter connects, the ball will be "hit" left, back to position H_L , V_L . If the batter misses, the ball will be automatically returned as in the above games.

In an alternate embodiment, the free-running "serve" flip-flop 120 can be eliminated and a push button set and reset of flip-flop 122 can be used for manual "pitch" and reset.

One class of games makes use of the electronic function illustrated in FIG. 9C and is shown in FIG. 13. This class of games requires one or more joystick controls 142 coupled to integrators 143. The outputs from the integrators are applied to the horizontal and vertical slicers of their respective spot generators. With this set-up race games, etc., may be played. The somewhat sluggish "spongy" effect of the integrator and the non-return to center requires more skill of the players than a "straight control" joystick.

Of course, appropriate backgrounds or overlays can be employed. A third (or more) "obstacle" spot can be used. If a player hits it, the coincidence pulse can be used to

make all spots disappear or to change screen color, etc., as described in said British Patent Specification No. 1,268,821. For chase games, coincidence of the pursuer and pursued can do the same thing.

A more sophisticated ice hockey game than that described with respect to FIG. 12C may be played employing the circuits previously set forth. This game is set forth in FIG. 14. The vertical and horizontal sync-sawtooth generators, the spot generators, the OR gate and pulse shaper and the summer and RF oscillators serve the same function as previously described. The control voltages to the horizontal and vertical slicers of the spot 1 generator are obtained from the outputs of a joystick integrator 144 of the type illustrated in FIG. 9C and the control voltages for the slicers of the spot 2 generator are obtained from the outputs of a second joystick integrator 145.

The control signals for the horizontal and vertical slicers of the spot 3 generator are obtained at the outputs 147, 148 of "hit" spot and wall bounce system 146. "Hit" spot and wall bounce system is shown in detail in FIG. 11. The inputs to the system 146 are the respective outputs of the joystick integrators 144 and 145.

With two players on joystick integrators 144, 145 and a puck which moves "in direction hit", a realistic ice hockey game results. The semi-sluggish response of the integrators gives an effect similar to real hockey players gliding on ice. They can't stop or reverse direction instantaneously. The puck can be nudged along if hit easily or set fast if hit rapidly. It may be noted here that the "ball moves in direction hit" function derives the hitting potential from differentiation of the hitting spot's positioning voltages. Since the defending spot must be in motion to be effective, it comes as a surprise to a player "standing still guarding his goal" when the puck glides right through his stationary defending spot.

If the puck is hit very hard, it may bounce off several sides of the screen before stopping. With the sluggish joystick integrator spots and the bounce from screen sides, a player must anticipate the "bounce". He cannot usually go right after the puck, but must move to a spot which he anticipates the puck will pass after bouncing. This game may be simplified somewhat by deleting the wall bounce feature in the manner hereinbefore described.

A simulated handball game is achieved when the player's spots are on straight control joysticks without integrators (as shown in FIG. 9B). The hit spot with wall bounce system of FIG. 11 is employed to supply the "hit" spot or ball generator's slicer control voltage with one minor variation. One of the comparator reference voltages is deleted so

that the "hit" spot or ball will not "bounce" off the bottom of the screen.

Wall bounce is used on screen top, right and left. Player A hits ball. It must hit front (top) wall sometimes during its flight. Player B tries to hit ball. If he misses the ball, it disappears off-screen bottom, he loses a point and the ball is then automatically served from off-screen after a certain length of time by using a flip-flop arrangement like that shown in FIG. 10 in conjunction with a slow free-running flip-flop for automatically triggering same or a push button trigger for manual reset.

This handball game is illustrated in FIGS. 15A and 15B. The general system electronics 149 is the same as shown in FIG. 12A. The control voltages for the slicers of spot 1 generator are obtained from a single control joystick as in FIG. 9B. Spot 1 generator generates the spot 151 representing Player A. A second single control joystick provides control voltages for the spot 153 associated with Player B. The ball or "hit" spot 154 is generated by spot generator 3 and receives its slicer control voltages from a "hit" spot and wall bounce system 155, which is similar to that of FIG. 11A; however, the sensor corresponding to the bottom wall does not have a 0 reference level so that the ball will "bounce" off all the walls but the bottom one. A position flip-flop 156 similar to that of FIG. 10A is used to return the ball to the "playing area" but being triggered from a switch 157. Alternatively, a slow free-running or "serve" flip-flop could be employed as described hereinbefore.

FIGS. 16A and 16B illustrate a simulated pinball game. The spot 3 or ball generator receives its vertical and horizontal slicer control voltages from a pair of integrators 158 and 159. Note in this application the spot 1 and 2 generator of general system 149 are not required. The player operates a joystick 160 to cause a ball 161 to move. The ball keeps moving as long as the joystick is off the center position. The ball will "bounce" off the walls or edges of the screen since a pair of comparators 162 and 163 will cause a pair of flip-flops 164 and 165 to change the direction of the ball by reversing the polarity of the signals applied to integrators 158, 159 in the manner previously described when discussing the circuit of FIG. 11.

Various "scoring" spots are placed on the screen by overlays, electronically, etc., as is a game end zone 167. Play is commenced by a player "throwing" joystick 160 in some off center position and removing his hand. Ball 161 then keeps moving. When it hits a side wall it bounces, when it hits "scoring" spots points are scored. Play continues until the ball happens to go into "game end" zone 167.

The score is observed visually. However, the scoring spots can be generated electronic-

ally by additional spot generators and score made on occurrence of coincidence using a coincidence detector of the type described hereinbefore.

A simulated bowling game illustrated in FIGS. 17A and 17B is played by providing an "alley" 168 overlay or TV-CATV background. It should go from one corner bottom screen to opposite corner top screen, narrowing to give a 3D effect. One or more spots simulating bowling pins are at upper end of alley. One spot 169 is illustrated. Player "bowls" a ball 170 by "throwing" a joystick 171. If pin (pins) are hit, they disappear. If missed, ball just keeps going past them off the screen. Ball can be returned to start point either with joystick or an instantaneous push-button reset (not shown).

The joystick 171 is connected to potentiometers 172, 173 whose outputs are connected via integrators 174, 175 to the control voltage outputs to the horizontal and vertical slicers of the spot 3 generator of the generator system 149. If the ball 170 hits pin 169, a coincidence detector and crow-bar circuit 176 causes the pin to disappear. One embodiment of said coincidence detector and crow-bar circuit is disclosed in said British Patent No. 1,268,821. The ball would be made smaller as it approaches the pins by using a varying voltage as the voltage applied to the threshold set resistor. In this game the vertical control voltage would be used.

The various games illustrated above are only a few of the multitude of games which can be played using the concepts taught by this invention. The electrical functions to generate various configurations can be combined in any number of possible ways. For example, a golf putting game can be played over a green background using a black negative video hole. A small white spot can be used as the golf ball and a larger white spot used as the putter. The putter spot can be controlled by a straight joystick of the type illustrated in FIG. 9B. The ball can be controlled from circuitry like that shown in FIG. 11A, preferably without the wall bounce feature. The game can be further enhanced, if desired, by coincidence pulse timing such that if ball is moving very slowly when it hits the hole it will disappear. If the ball is moving very fast, it will go right across the hole.

A simpler version would not require coincidence circuitry. If the ball comes to rest over the hole, the hole's negative video signal overrides the ball's video and blanks out the ball.

In another example, cushion billiards can be played. The player's balls are on straight control joysticks (see Fig. 9B). Third ball is hit using control of FIG. 11A. Wall bounce is used on all four sides. Player hits a third ball. The latter must hit at least one cushion

12
score
ng a
ribed
d in
iding
rack-
ttom
row-
spots
d of
layer
stick
r. If
i off
point
ush-
ntio-
cted
ltage
icers
sys-
coin-
176
nent
-bar
tent
ade
ng a
the
ver-
are
high
t by
to
om-
For
ayed
ega-
t be
spot
i be
type
con-
IG.
nce
ced,
such
hits
ving
e.
oin-
rest
gnal
the
can
ight
l is
nce
bird
ion

first and then hit opponent's ball to score a point.

For skilled players, the third ball must hit two cushions first; and the game can be elaborated to three cushion billiards.

Maze games can also be played using the various features. TV screens are not large enough to permit a normal "line type" maze. The "correct" path through the maze is too obvious. Therefore, a "number maze" was devised. An overlay or background divided into rectangles is used. A number is in each rectangle.

One of two players is designated as EVEN, the other as ODD. EVEN moves his spot (or ring) so that the sum of his and opponent's numbers is even. ODD moves so as to make the sum odd.

The resulting pattern of moves enables the maze designer to keep the two players on separate paths or on shared paths. The maze paths are drawn first and the numbers are then inserted. Mazes can be simple or complex, containing many false paths and dead ends. Normally, moves are one space at a time horizontally or vertically.

As a variation, if one player can land on the same number his opponent occupies elsewhere, he takes an extra move. (ODD is permitted to do this also even though in so doing he makes a temporarily even sum).

Unless a large number of rectangles are used, the maze designer is limited when trying to keep players on separate isolated paths.

Considerably more pattern flexibility results if one path can jump across another. This is accomplished by jumps between identical numbers with one space in between them. For example, if a player is on a 2 and needs to move to an odd number such as 7, after he moves to the 7 he can jump a space in horizontal or vertical directions to another 7. Multiple jumps are permitted and can be incorporated in the maze.

More intricate and interesting patterns can be laid out if a 3 term sum is used, i.e., players make the sum of the two number they occupy and the one they intend to move to be even or odd accordingly.

An easier version of this is done with colors. The "code" available to the designer is the same. If red and white rectangles are used for example, the "rule" for both players is simply "move to red, unless both on red".

A simple game can be played wherein a lettered background or overlay is used. Players move spots to jointly spell a word. The player ending a word loses a point.

A spelling game can be played by putting letters in columns. Players advance a column if they can add a letter to a jointly spelled word. They drop back one or more columns if they can find a nappropriate letter only there.

As mentioned before, the control units or

any parts thereof can be built into a television receiver as a constituent part thereof rather than be a separate unit and coupled to antenna terminals as described above. In other embodiments some of the elements contained in the gaming apparatus can be eliminated and replaced by some of the functions which are already provided in conventional television receivers.

FIGS. 18A through 18C are examples of television gaming apparatus which can be built into a conventional television receiver.

Referring now to FIG. 18A, there is illustrated one embodiment of a built-in television apparatus. The entire apparatus of FIG. 18A or any parts thereof can be built into a television receiver 190. In the manner described hereinbefore, the spots are provided by spot generators 191 to 192. The spot generators receive inputs from the vertical sync-sawtooth generator 115 and the horizontal sync/sawtooth generator 116 synchronised with the TV set generator. The voltage control inputs to the spot generators can be derived from respective potentiometers or respective potentiometer outputs in connection with respective integrator outputs or other spot generators etc. In other words, the voltage control inputs can be any and all voltage control inputs described hereinbefore.

The outputs from the spot generators are applied via an OR gate and pulse shaper 193 to a summer 194. Summer 194 also receives the sync outputs from the vertical sync/sawtooth generator 115 and the horizontal sync/sawtooth generator 116. Summer 194 is different from the summers previously described in that no RF oscillator or separate modulator is required since the output therefrom is coupled internally directly to the video circuitry of the TV receiver 190.

The output from summer 194 is connected to, for example, a contact 203 of a switch 200. The center arm 201 of switch 200 is coupled to the video amplifier 196 of the conventional TV receiver 190. Another contact 202 of switch 200 is coupled to the video detector of the conventional TV receiver 190. In this manner receiver 190 can be switched from the video detector or passive viewing mode of operation (to receive broadcast programs) to the summer or active mode operation.

In certain embodiments, it is necessary to connect both contacts 202 and 203 to the video amplifier, where, for example, the active mode TV receiver will be used in conjunction with broadcast programs which broadcast background or other information. Broadcast is used herein in the broadest sense to include programs generated by a CATV station, programs generated by a closed-circuit TV arrangement, information generated by a video tape recorder or by a slide projector. Many of the symbol generations herein described can

70

75

80

85

90

95

100

105

110

115

120

125

130

be superimposed upon backgrounds generated by a broadcast station and games played in conjunction therewith.

Of course, the other systems previously described can also be built into the TV receivers with the outputs therefrom applied to the antenna input of the TV receiver.

Referring now to FIG. 18B, there is illustrated another built-in TV gaming apparatus. In this embodiment the vertical sync/sawtooth generator 115 and the horizontal sync/sawtooth generator 116 are replaced by vertical sawtooth generator 197 and horizontal sawtooth generator 198 which generate merely sawtooth waves rather than sync pulses and sawtooth waves. The sawtooth generators 197 and 198 are synchronized to the sync of the conventional receiver 190 by a pair of outputs from a sync separator 199. In this embodiment a separate summer 194 is not required since the sync pulses are derived from the conventional receiver as broadcast by a broadcasting station and thereby external sync pulses are not required. Therefore, the input of contact 203 in this embodiment is merely the output from pulse shaper 193.

In another embodiment of a built-in TV gaming apparatus (see FIG. 18C) the sawtooths required for spot generation are derived from the vertical and horizontal yoke deflection circuits 304, 205 within the conventional TV receiver 190. Buffer circuits 206 and 207 change the current sawtooth of the deflection circuitry to voltage waveforms and provide the proper polarity and amplitude correction. Since the vertical and horizontal yoke deflection circuitry are already synchronized, no external sync is required nor is any additional internal connection required. Additionally, any waveform generated within the conventional television receiver can be utilized, where appropriate, for TV gaming symbol generation.

The apparatus of the invention can be used with a unit which is designed solely for playing games and which does not have the capability to receive broadcast programs. Such an arrangement is illustrated in the simplified block diagram of FIG. 19.

The spots are provided, in the same manner as hereinbefore described, by spot generators 191, 192 which receive sawtooth inputs from the sync/sawtooth generators 115, 116 and also receive voltage control inputs e_v and e_H . The outputs from the spot generators 191, 192 are coupled to OR gate and pulse shaper 193.

The output from OR gate and pulse shaper 193 is applied to the intensity input of a cathode ray tube 209 via a video amplifier 208. By appropriately selecting the parameters of the spot generators, appropriate video pulse size can be developed, and, therefore, the video amplifiers eliminated.

The vertical sync pulses from vertical sync/sawtooth generator 115 are applied to the vertical yoke of CRT 209 via a vertical deflection oscillator 224 and vertical amplifiers 225 in known fashion.

The horizontal sync pulses from horizontal sync/sawtooth generator 116 are applied to the horizontal yoke of CRT via horizontal oscillator 226 and horizontal amplifiers 227 in known fashion. The horizontal amplifier also supplies the high voltage to CRT 209 via a high voltage rectifier 228.

Thus, it is to be understood that the embodiments shown are illustrative only, and that many variations and modifications may be made without departing from the principles of the invention herein disclosed and defined by the appended claims.

Having regard to the provisions of Section 9 of the Patents Act, attention is directed to the claims of our co-pending Patent Application No. 25007/70 (Serial No. 1318051).

WHAT WE CLAIM IS:—

1. For use in combination with a cathode ray tube, apparatus for generating a symbol for display on the screen of the cathode ray tube wherein the position of the symbol can be influenced as a result of a manual operation by a participant in a game, including means for generating electrical signals defining hit symbol (as herein defined), either means for generating electrical signals defining a hitting symbol (as herein defined) whose position on the screen can be controlled by the said manual operation, or detector means, whose position in relation to the screen can be controlled by the said manual operation, directed towards the hit symbol to determine the presence thereof, means for ascertaining coincidence (as herein defined) on the screen between said hitting symbol and said hit symbol, said hit symbol and the edge of the screen or said hit symbol and the line of direction of the detector means towards the screen and means to impart a distinct motion to the hit symbol upon the occurrence of the said coincidence.

2. Apparatus as claimed in claim 1 wherein said means for generating a hitting symbol includes means for providing horizontal and vertical control signals for varying the horizontal and vertical positions of said hitting symbol.

3. Apparatus as claimed in claim 2 wherein said means for providing horizontal control signals includes a voltage source, a potentiometer coupled across said voltage source and an integrator coupled to the arm of said integrator, said control being derived at the output of said integrator.

4. Apparatus as claimed in claim 1 wherein said means for generating a hit symbol includes means for providing a horizontal and vertical control signal for varying the

be superimposed upon backgrounds generated by a broadcast station and games played in conjunction therewith.

Of course, the other systems previously described can also be built into the TV receivers with the outputs therefrom applied to the antenna input of the TV receiver.

Referring now to FIG. 18B, there is illustrated another built-in TV gaming apparatus. In this embodiment the vertical sync/sawtooth generator 115 and the horizontal sync/sawtooth generator 116 are replaced by vertical sawtooth generator 197 and horizontal sawtooth generator 198 which generate merely sawtooth waves rather than sync pulses and sawtooth waves. The sawtooth generators 197 and 198 are synchronized to the sync of the conventional receiver 190 by a pair of outputs from a sync separator 199. In this embodiment a separate summer 194 is not required since the sync pulses are derived from the conventional receiver as broadcast by a broadcasting station and thereby external sync pulses are not required. Therefore, the input of contact 203 in this embodiment is merely the output from pulse shaper 193.

In another embodiment of a built-in TV gaming apparatus (see FIG. 18C) the sawtooths required for spot generation are derived from the vertical and horizontal yoke deflection circuits 304, 205 within the conventional TV receiver 190. Buffer circuits 206 and 207 change the current sawtooth of the deflection circuitry to voltage waveforms and provide the proper polarity and amplitude correction. Since the vertical and horizontal yoke deflection circuitry are already synchronized, no external sync is required nor is any additional internal connection required. Additionally, any waveform generated within the conventional television receiver can be utilized, where appropriate, for TV gaming symbol generation.

The apparatus of the invention can be used with a unit which is designed solely for playing games and which does not have the capability to receive broadcast programs. Such an arrangement is illustrated in the simplified block diagram of FIG. 19.

The spots are provided, in the same manner as hereinbefore described, by spot generators 191, 192 which receive sawtooth inputs from the sync/sawtooth generators 115, 116 and also receive voltage control inputs e_v and e_h . The outputs from the spot generators 191, 192 are coupled to OR gate and pulse shaper 193.

The output from OR gate and pulse shaper 193 is applied to the intensity input of a cathode ray tube 209 via a video amplifier 208. By appropriately selecting the parameters of the spot generators, appropriate video pulse size can be developed, and, therefore, the video amplifiers eliminated.

The vertical sync pulses from vertical sync/sawtooth generator 115 are applied to the vertical yoke of CRT 209 via a vertical deflection oscillator 224 and vertical amplifiers 225 in known fashion.

The horizontal sync pulses from horizontal sync/sawtooth generator 116 are applied to the horizontal yoke of CRT via horizontal oscillator 226 and horizontal amplifiers 227 in known fashion. The horizontal amplifier also supplies the high voltage to CRT 209 via a high voltage rectifier 228.

Thus, it is to be understood that the embodiments shown are illustrative only, and that many variations and modifications may be made without departing from the principles of the invention herein disclosed and defined by the appended claims.

Having regard to the provisions of Section 9 of the Patents Act, attention is directed to the claims of our co-pending Patent Application No. 25007/70 (Serial No. 1318051).

WHAT WE CLAIM IS:—

1. For use in combination with a cathode ray tube, apparatus for generating a symbol for display on the screen of the cathode ray tube wherein the position of the symbol can be influenced as a result of a manual operation by a participant in a game, including means for generating electrical signals defining hit symbol (as herein defined), either means for generating electrical signals defining a hitting symbol (as herein defined) whose position on the screen can be controlled by the said manual operation, or detector means, whose position in relation to the screen can be controlled by the said manual operation, directed towards the hit symbol to determine the presence thereof, means for ascertaining coincidence (as herein defined) on the screen between said hitting symbol and said hit symbol, said hit symbol and the edge of the screen or said hit symbol and the line of direction of the detector means towards the screen and means to impart a distinct motion to the hit symbol upon the occurrence of the said coincidence.

2. Apparatus as claimed in claim 1 wherein said means for generating a hitting symbol includes means for providing horizontal and vertical control signals for varying the horizontal and vertical positions of said hitting symbol.

3. Apparatus as claimed in claim 2 wherein said means for providing horizontal control signals includes a voltage source, a potentiometer coupled across said voltage source and an integrator coupled to the arm of said integrator, said control being derived at the output of said integrator.

4. Apparatus as claimed in claim 1 wherein said means for generating a hit symbol includes means for providing a horizontal and vertical control signal for varying the





tical
1 to
tical
impli- 70
ntal
1 to
ntal
227
lifier 75
209
the
and
may
iples
ined 80
Sec-
ected 85
pli-
i).
ode
nbol 90
ray
can
era-
cing
sin- 95
ker
fin-
hose
by
ans, 100
can
ion,
nine
ning
reen 105
hit
the
of
the
tion 110
of
rein
bol 115
and
ori-
ting
rein
trol 120
tio-
and
aid
the
rein
bol
ital
the 125

horizontal and vertical positions of said hit symbol.

5. Apparatus as claimed in claim 4 wherein said means for providing horizontal control signals for said hit symbol includes means for causing said hit symbol to move back and forth across the screen.

6. Apparatus as claimed in claim 5 wherein said means for causing said hit symbol to move back and forth across the screen includes a slow free-running multivibrator.

7. Apparatus as claimed in claim 5 further including means for detecting coincidence between a hit symbol and a hitting symbol and means for causing said hit symbol to change direction upon coincidence.

8. Apparatus as claimed in any one of the preceding claims wherein the means for imparting a distinct motion to the hit symbol upon coincidence with the edge of the screen includes means for causing the hit symbol to move away from the coincidence position with a reflection angle equal to the incident angle at which the hit symbol approached the coincidence position.

9. Apparatus for generating signals representing a "hitting" symbol and a "hit" symbol as herein defined to be displayed on the screen of a television receiver, comprising means for synchronizing a television raster scan, means for generating electrical signals representing a hitting symbol, means coupled to said means for generating signals representing a hitting symbol for generating first and second control signals to vary the horizontal and vertical positions of said hitting symbol, means for ascertaining coincidence (as herein defined) between a hitting symbol and a hit symbol, first means for differentiating a portion of the signal output of said first control signal generating means upon coincidence between said hitting symbol and said hit symbol, second means for differentiating a portion of the signal output of said second control signal generating means upon coincidence between said hitting symbol and said hit symbol, first means for integrating said first differentiated signal for providing a first hit symbol control voltage, second means for integrating said second differentiated signal and for providing a second hit symbol control voltage, and a hit symbol generator having as control inputs thereto said first and second hit symbol control voltages whereby a distinct motion is imparted to the hit symbol which moves with a velocity proportional to the velocity of a hitting when coincident therewith.

10. Apparatus as claimed in claim 9 further including first and second RC delay circuits coupled to said first and second differentiating means, respectively.

11. Apparatus as claimed in claim 10, further including means for reversing the polarity of said first and second hit symbol

control voltages when the outputs of said first and second integrators reach at least a first predetermined voltage level.

12. Apparatus as claimed in claim 11, wherein said polarity reversing means, includes a first and second comparators coupled to the outputs of said first and second integrators, respectively, means for applying reference signals to said first and second comparators, and means for reversing the polarity of the outputs of said differentiators responsive to outputs of said comparators.

13. Apparatus as claimed in claim 12, further including first and second bistable multivibrators coupled to said first and second comparators, respectively, the outputs of said bistable multivibrators signifying the desired relative polarity of said integrator outputs.

14. Apparatus for generating signals representing a first and second hitting symbol and a hit symbol to be displayed on the screen of a television receiver, comprising means for generating sync signals, means for generating a first sawtooth wave, means for generating a second sawtooth wave, a first hitting symbol generator, a second hitting symbol generator, a hit symbol generator, means for applying said first and second sawtooth waves to said symbol generators, means for generating first and second control signals for said first hitting symbol generator, means for coupling said first and second control signals to said first hitting symbol generator, means for generating third and fourth control signals for said second hitting symbol generator, means for coupling said third and fourth control signals to said second hitting symbol generator, means for generating fifth and sixth control signals for said hit symbol generator, means for coupling said first and sixth control signals to said hit symbol generator, means for coupling said first, second, third and fourth control signals to said means for generating fifth and sixth control signals and means for coupling the outputs of said symbol generators and said sync signals to the television receiver, wherein said means for generating fifth and sixth control signals includes first means for detecting coincidence between said first hit symbol and said hitting symbol, second means for detecting coincidence between said second hit symbol and said hitting symbol, a first monostable multivibrator coupled to said first coincidence means, a second monostable multivibrator coupled to said second coincidence means, first, second, third, and fourth gates having as inputs thereto said first, third, second and fourth control signals, respectively, means for coupling the output of said first monostable multivibrator to said first and third gates, means for coupling the output of said second multivibrator to said second and fourth gates, a first differentiator coupled to said first and

second gates, a second differentiator coupled to said third and fourth gates, first sampling means coupled to said first differentiator, second sampling means coupled to said second differentiator, first and second OR gates, the outputs thereof being coupled to said first and second sampling means, respectively, the inputs thereof being coupled to both said monostable multivibrators, first and second peak detectors coupled to said first and second sampling means, respectively, and first and second integrators coupled to said first and second peak detectors, respectively, said fifth and sixth control signals being derived at the outputs of said first and second integrators, respectively.

15. Apparatus as claimed in claim 14, further including third and fourth OR gates, each coupled to both said monostable multivibrators, a first and second bistable multivibrator, each having first and second inputs, said first inputs taken at the outputs of said third and fourth OR gates, respectively, a first and second comparator, the outputs thereof being coupled to second inputs of said first and second bistable multivibrators, respectively, said first and second comparators being coupled to said first and second integrators, respectively, means for generating reference voltages, means for applying said reference voltages to said comparators, and first and second means for reversing the polarity of the outputs of said peak detectors, said polarity reversing means coupled to the outputs of said first and second bistable multivibrators, respectively.

16. Apparatus as claimed in claim 1 including means for causing the hit symbol to move from a position off-screen on one side of the screen to a position off-screen on the other side of the screen and wherein the vertical position of the hitting symbol can be changed in accordance with the manual operation of the control element by the participant in a game.

17. Apparatus as claimed in any one of the preceding claims including means for causing a hit symbol to return to the screen subsequent to it having moved off the screen when it is not coincident with a hitting symbol or with the line of direction of the detector means.

18. Apparatus as claimed in claim 1 including means for causing a hit symbol to return to the screen subsequent to it having moved off the screen, and wherein the detector means controlled by the participant is a light sensitive gun.

19. Apparatus as claimed in claim 1 wherein the vertical position of the hitting symbol can be varied as a result of a manual operation by one participant in a game, the vertical positions between which the hit symbol moves can be varied as a result of a manual operation by a second participant in a game and the hit symbol reverses direction upon the occurrence of coincidence with the hitting symbol.

20. Apparatus as claimed in claim 1 including means for generating a second hitting symbol whose position on the screen can be controlled by the manual operation of a second participant in the game, and means to impart a distinct motion to the hit symbol upon the occurrence of coincidence between the hit symbol and the second hitting symbol.

21. Apparatus as claimed in claim 20 including means for causing the hit symbol to change direction upon coincidence between either of said hitting symbols, means for causing said hit symbol to bounce off three of the four sides of the cathode ray tube upon coincidence therewith and to be off-screen when coincident with the fourth side of the cathode ray tube upon coincidence therewith and to be off-screen when coincident with the fourth side of the cathode ray tubes and means for returning the hit symbol after it has gone off-screen at the fourth side of the cathode ray tube.

22. Apparatus as claimed in any one of the preceding claims, including modulator means for coupling the electrical signals generated therein to the video amplifier of a television.

23. Apparatus as claimed in claim 1 substantially as described herein with reference to the accompanying drawings.

BARON & WARREN,
16, Kensington Square,
London, W.8,
Chartered Patent Agents.

