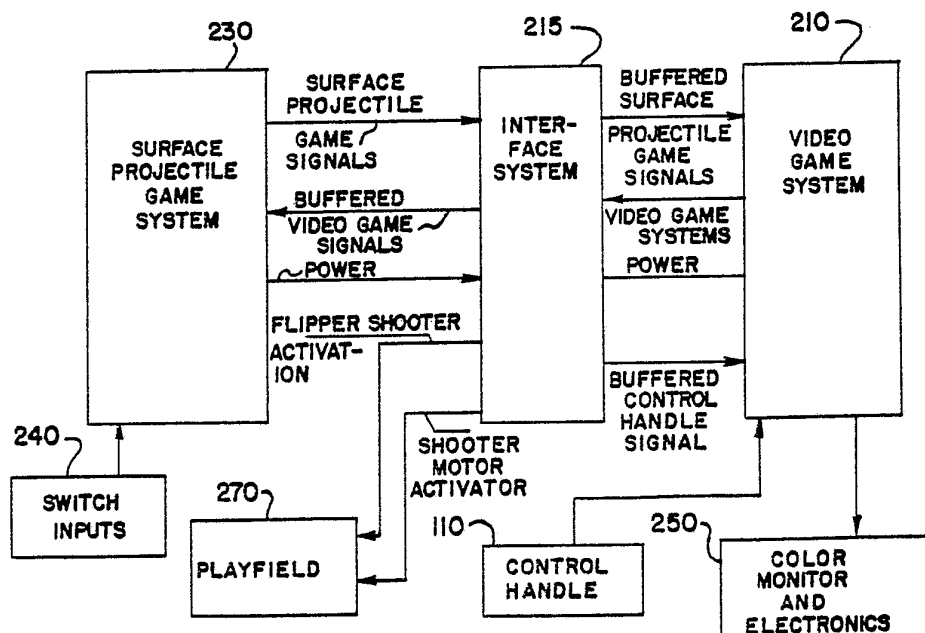




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(54) Title: COMBINATION INTERACTIVE VIDEO-SURFACE PROJECTILE GAME



(57) Abstract

A combination interactive video and surface projectile game having novel transitional play features for transferring game play and earned bonuses between the video (140) and surface projectile (120) phases of the combination game. In one embodiment, game play during the surface projectile game (120) phase affects the display presentation and play options during the video game phase. Alternation between the surface projectile game (120) and video game (140) phases of the combination game, in turn, can affect the future game play, including the retention or loss of bonus options and player benefit characters.

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COMBINATION INTERACTIVE
VIDEO-SURFACE PROJECTILE GAME

A microfiche appendix as provided herewith having 6 microfiche sheets and a total of 327 frames provides software program listings for use with the systems modules in FIGS. 6-9 to create one embodiment of an interactive combination video and surface projectile game system having the features as disclosed herein.

This invention relates to amusement games and more particularly to video and surface projectile games.

Amusement games have been limited to either a video display or a physical playfield. The conceptual and physical embodiments of games have kept the surface projectile game and video game two separate entities, each requiring its own play and display areas.

A combined and interactive surface projectile and video game housed in a single cabinet is taught in copending application U.S. Serial No. 395,860 entitled Combination Video-Surface Projectile Game, assigned to the assignee of the present application. In that copending application, a combination video-surface projectile game system is provided wherein game play is switched between a video game and a surface-projectile game under control of the game system. In one embodiment, as single user control provides a set of inputs used by the system in both the video game and surface projectile game modes. In another embodiment, a partially reflective-partially transmissive cover lies spaced above the playfield, and a video display lies spaced above and partially facing the cover. The system selectively activates the video display in the video game mode so as to block out the playfield visuals. The system selectively deactivates the video display in the surface-projectile game mode such that the playfield is visible through the cover. In another embodiment, the playfield and video display are visible simultaneously.



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In accordance with one aspect of the present invention, there is provided a combination interactive video and surface projectile game having novel transitional play features for transferring game play and earned bonuses between the video and surface projectile phases of the combination game. In one embodiment, game play during the surface projectile game phase affects the display presentation and play options during the video game phase. Various means are disclosed for alternating between the surface projectile game and video game phases of the combination game, which in turn can affect the future game play, including the retention or loss of bonus options and player benefit characters.

A better understanding of these and other features of the present invention may be had from a consideration of the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1A is a perspective view of a first combination game embodiment illustrative of the present invention,

FIG. 1B is a top view of another compatible playfield layout with that of FIG. 1A;

FIG. 2 is a side view of the game of FIG. 1A;

FIG. 3 is a game system block diagram in accordance with one embodiment of the present invention illustrating the interconnection of separate video game and surface projectile game computers;

FIG. 4 is an electrical block component diagram;

FIG. 5 is a functional electrical block diagram including interconnect structure;

FIG. 6A is a block diagram and FIG. 6B is a detailed electrical schematic, each of a combined video

game and interface system module;

FIG. 7A is a block diagram and FIG. 7B is a



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detailed electrical schematic of a lamp/solenoid driver game system module;

FIG. 8A is a block diagram and FIG. 8B is a detailed electrical schematic, each of a surface
5 projectile game and interface system module; and

FIG. 9 is a detailed electrical schematic of the combined game power supply module.

Referring to FIG. 1, a combination game illustrative of one embodiment of the present invention
10 is shown. The game is comprised of a cabinet 100 housing appropriate electromechanical, and electronic components for performing all necessary game and control functions. Spaced beneath the top surface of the cabinet 100 is a downwardly sloping playfield 120
15 upon which a surface projectile 124 caroms. In the illustrated embodiment, the playfield has targets 125, trip switches 126, lights 127, flippers 128, and pockets 129 mounted upon the surface thereof. A cover 130 is mounted atop the cabinet spaced above the playfield. A
20 selectively illuminatable video display 140, such as a color cathode ray tube, is shown housed in a back panel 145 mounted to the cabinet 100. The relative positioning of the video display in the illustrated embodiment of the game can be more clearly seen by
25 reference to FIG. 2, showing the playfield 120 being viewable at a downward angle by the user, from the front of game at the user control (110, 112, 113, 114), and the video display being viewable at a straight ahead or slightly upward angle by the user.

30 Referring again to FIG. 1, graphical illustrations and or lights and speakers can be mounted within and upon the cabinet 100, the playfield 120, and/or the back panel 145. A user control on the exterior of the cabinet 100 provides user control
35 signals responsive to user activation of the user control. In the illustrated embodiment, the user



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control is shown as comprising a video control comprising a joy stick 110 and surface projectile game control comprising push-button switches 112 and 113 for flipper control and 114 for number of players selection. However, other types of user controls can be utilized in accordance with the teachings of the present invention, including a single combined game control. One or both of the push buttons 112 or 113 can provide means for shooting the surface projectile onto the playfield, such as by activating a solenoid within one of the pockets 129 for ejecting the surface projectile therefrom. Other configurations of push-buttons, joy sticks, and switches can be mounted to the exterior of the cabinet 100, to provide user control functions responsive to user activation, such as for controlling aspects of video game action, shooting the initial ball, choosing the number of players, special function buttons, etc. The electronics housed within the cabinet 100 includes first means for selectively operating the system as a surface projectile game responsive to a first set of operational conditions, and second means for operating the system as a video game responsive to a second set of operational conditions. The sets of operational conditions are determined responsive to the overall video and surface projectile game play (such as score, sequence and number of targets hit, etc.) and the user control. In one embodiment, the pockets 129 are selectively enabled to capture the surface projectile upon user placement of the surface projectile in one of the pockets 129, responsive to a third set of operational conditions, whereafter the operation of the system is switched from the surface projectile game to the video game. In a preferred aspect of this embodiment, lamps 132, adjacent the pockets 129, are illuminated to indicate to the players that the third set of operational conditions has occurred, and that



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placement of the surface projectile 124 in one of the pockets 129 having an illuminated lamp will transfer game play to the video game. Upon return from the video game to the surface projectile game, the captured
5 surface projectile 124 is propelled out of the pocket, such as by a solenoid, and the player resumes play of the surface projectile game.

The electronics housed within the cabinet 100 includes means for communication between the first means
10 (i.e. surface projectile game) and the second means (i.e. video game) so as to provide an interactive combination game.

FIG. 1B is a top view of a playfield layout compatible with the description and drawing of FIG. 1A.

15 Referring to FIG. 2, there is shown a side view of the combination video and surface projectile game system of FIG. 1. The video display 140 is mounted in the back panel 145 for direct viewing by the user who is positioned at the user control. The video display and
20 playfield are separately viewable. The video display 140 can alternatively be mounted within a recess in the playfield 120 in the cabinet 100. No back panel for housing the video display is then necessary.

Referring to FIG. 3, a block diagram of the
25 combination interactive video game and surface projectile game system is shown illustrating the interconnection of the various elements of the combination game. For purposes of illustration, and not by way of limitation, the functional aspects of the interactive
30 video game system is shown, divided into logical functional blocks. As was discussed above with reference to FIG. 1, a downwardly sloping playfield 270 having targets thereon and pockets therein provides the surface upon which the surface projectile game is
35 played. Additionally, a surface projectile 124 caroms about the playfield. The playfield can also have trip



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switches 126, lights 127, and flippers 128. A video display monitor 250 provides means for presenting the video game. The user input means 209 provides a user signal responsive to the players actions. As described
5 above with reference to FIG. 1, the user input means 209 can be comprised of pushbutton switches for flipper control (such as 112 and 113), pushbutton switches for selecting the number of players to play the game (e.g. 114) and a joystick for interacting with the video game
10 (e.g. 110). A logic means, such as the switch matrix 240, provides surface game signals responsive to activation of the targets and the pockets by the surface projectile on the playfield 270. Logging means provide history signals indicative of the video and surface
15 projectile game history for each of the players of the game. The logging means can be a separate function, or can be integrated as part of the surface projectile game processing module 230, or alternatively can be a part of both the surface projectile game processing module 230
20 and the video game processing module 210. The surface projectile game processing module 230 provides means for providing a surface projectile game including movement of said surface projectile about the playfield 270. The video game system 210 provides a sequence means for
25 selecting one of a plurality of predefined still video presentations responsive to the input means and the logging means, and provides means for providing an animated video game presentation, from a sequence of selected ones of a plurality of predefined still video
30 presentations on the video display 250, responsive to the sequence means, including in the display presentation a player representative character which is responsive to the input means. Thus for example, in the illustrated game of Baby Pac-Man, the PAC-MAN character
35 is the player representative character. Alternatively, in a space epic game, the player's space ship or missile



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represents the player representative character. First control means provide for selectively alternating game play between the video game and the surface projectile game responsive to the logging means. The first control means can form a part of the surface projectile game processing module 230, or a part of the video game processing module 210, or can form a separate controller module. Various means can be provided for alternating between the video and surface projectile game and vice versa.

In one embodiment, the video game processing module 210 provides means for alternating from the video to the surface projectile game responsive to the player representative character being positioned in a predefined location 291 within the video presentation 290 as shown in FIG. 4. In another embodiment, means are provided for alternating from the surface projectile game to the video game responsive to activation of a predefined combination of targets and the subsequent placement of the surface projectile in a predefined one of the pockets 129. The means for alternating from the surface projectile game into the video game can be embodied in the surface projectile game processing module 230, in the video game processing module 210, or in a separate controller module. In a preferred embodiment, a light (132 of FIG. 1A-B) indicates which of the pockets is the predefined pocket.

In one embodiment, the system alternates from the video to the surface projectile game responsive to the eradication of the player representative character during the video game, responsive to an indication by the video processing module 210. For example, in the Baby Pac-Man game, the PAC-MAN player representative character being caught and eaten by a ghost results in the eradication of the player. Alternatively, in a space epic game, the destruction of a players base or



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space ship is the eradication of that players representative character.

In an alternate embodiment, the surface game processing module 230 and the video game processing module 210 provide means for providing a player benefit character for utilization in the video game presentation responsive to the logic means and logging means, such that the player can advantageously combine the player benefit character and the player representative character in playing the video game. For example, in the Baby Pac-Man game, the player can earn a power capsule by repeatedly hitting selected targets 125 so as to cause the word PAC-MAN to be spelled out on the playfield, as can be seen with reference to FIGS. 1A-B.

Then, upon alternation of the video game to the surface projectile game, the power capsules are available to the player representative character for use in playing the video game. Alternatively, or additionally the player can earn bonus fruit to score bonus points during the video game, and/or can earn extra tunnel openings 292 (exits and entrances) on the video play screen, and/or can increase the speed with which the player representative character can move through the tunnel, off the screen in a wrap around function, all by activation of predefined combination of targets during the play of the surface projectile game for that players turn. Upon earning player benefit characters, and entering the video game portion of a players turn, different means of alternating from the video to the surface projectile game can be provided. In one embodiment, means are provided for alternating from the video to the surface projectile game responsive to the player representative character being positioned in a predefined location within the video presentation, and any and all of the player benefit characters of the video presentation existing prior to alternating to the



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surface projectile game are made part of that players video presentation upon the next alternation to the video game for that players turn. In a different embodiment, means are provided for alternating from the video to the surface projectile game responsive to the eradication of the player representative character during the play of the video game, in which case various options can be provided for continuing that players turns. As a first alternative, any player benefit character of the video presentation existing prior to eradication of that players representative character is cancelled from being part of the video display for that player upon the next alternation to the video game. An alternate embodiment, the player retains his player benefit characters of the video presentation which existed prior to eradication of this player's representative character, but is otherwise penalized in terms of length of turn or difficulty of game play. In the preferred embodiment, each players turn is comprised of both a video and a surface projectile game. The system can have a plurality of players, each player completing a turn in sequence prior to the next player commencing a turn. Each player can receive a plurality of turns in one complete combination game for that player, such as two, three, four, etc. turns. Additionally, means can be provided for alternating from the surface projectile game to the video game responsive to the surface projectile rolling to an out of play region, such as the pocket behind the flippers. In this case, the players turn can be deemed to end, and/or player benefit characters can be lost, and/or play can be returned to the video game with the limitation that the player has no predefined position through which the player representative character can be placed to return to the surface projectile game for that turn. In the latter case, the player must either complete the board,



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such as eating all the dots to clear the screen (or destroying all enemy ships in an alternate game), prior to reviving the means for returning to the playfield without loss of the players representative character.

- 5 Alternatively, or additionally, tunnel exits and entrances can be closed to further complicate the game.

As described above, and as shown with reference to FIG. 4, the video game system includes a display presentation 290 having a player representative character 293 which is responsive to the input means, and in one embodiment the display presentation can further include at least two openings 292 between which the player representative character 293 can exit and enter the video display presentation so as to wrap around the video display. In other words, the player representative character by passing through one of the openings, leaves the video presentation display, but is logically coupled around the video presentation display to the other extremity side, and reenters the video presentation through the complimentary opening. Responsive to activation of predefined combinations of targets and switches upon the playfield, and the surface game signals generated therefrom, the time period occurring between the exit and entrance from the video presentation between the tunnel openings can be varied, thus adding another player benefit character feature which can be earned. Also shown in FIG. 4 are other examples of player benefit characters, including bonus fruit 295 and power capsules 294, which can be earned during the play of the surface projectile game.

Referring again to FIG. 3 the combination video and surface projectile game system is further comprised of solenoid/lamp driver system 220 for providing electrical drive for the solenoids and lamp drivers utilized in conjunction with the surface projectile game. Thus, responsive to the surface projectile game



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processing module 230, the solenoid/lamp driver system 220 selectively activates lamps forming part of the playfield display, such as lights 127 and 132, and activates solenoids such as on the kickers for

5 rebounding the surface projectile, the flippers for responding to the user input means pushbuttons, and the surface projectile propellant means within the pockets 129. Additionally, a power module 260 provides regulated power supplies for driving the remainder of

10 the systems modules of the combination video and surface projectile game systems of FIG. 3.

Referring to FIG. 5, a block diagram of combination game system illustrating one aspect of the present invention is shown. The block diagram of FIG. 5

15 illustrates the interconnection of the separate video game system 210 to the surface projectile game system 230 via an interface system 215. The control handle 110, is coupled to the interface system 215. The push button switch inputs 240 are coupled to the surface game

20 system 230. The interface system 215 provides buffered control handle signals to the video game systems 210, and the surface game system 230 provides flipper shooter activation and shooter motor activation signals to the playfield 270, responsive to user activation of the

25 switch inputs 240. Bidirectional data communication is provided between the game system 230 and 210 via the interface system 215, as designated in FIG. 5 by the surface projectile game signals (buffered and non-buffered) and the video game signals (buffered and

30 non-buffered). In the block diagram of FIG. 5, each of the systems 230 and 210 includes necessary game electronics, and can have separate or common power supplies, sound systems, audio amplifiers, and speakers. The electronic system design illustrated in

35 FIG. 5 allows the two parts of the game, video and surface projectile, to be developed independently, yet



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in an integrated system manner.

The system level description of the interface for the illustrated embodiment of FIG. 5 will now be discussed. The logical interconnection of the two systems 230 and 210 is via messages as illustrated in FIG. 5. Messages can be transmitted bidirectionally between the surface projectile system 230 and the video game system 210. Although the reaction to the messages need not be specified until the game design is complete, the physical message channel and signaling conventions can be specified in advance. Various other communications protocols and interface systems can be utilized consistent with the teachings of the present invention.

In one embodiment of the system of FIG. 5, each of the systems 230 and 210 contain respective processor based systems. Alternatively, a single microprocessor based system can be utilized to implement both the video and surface projectile game functions. Alternatively, in place of a microprocessor based system, means can be provided for sequencing through predefined logical sequences responsive to control inputs received from the control handle 110 and switch inputs 240.

Referring now to FIG. 6A and 6B, the video game and interface system module for a Baby Pac-Man game embodiment of the present invention is illustrated. FIG. 6A is a functional grouping block diagram of the elements in the detailed electrical schematic of FIG. 6B. The individual electronic components of FIG. 6B are enclosed in various dashed boxes and numbered to correspond to the functional block numbering of FIG. 6A. In this way the description of the detailed electrical schematic is made more easily understandable.

Interactive communication between the surface projectile game and video game processing systems is accomplished via interface buffer circuitry 315,



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latching means 311 and 312, and programmable peripheral interface adapter 330 responsive to the video processor 340 and associated circuitry 320, 350, and 370, and responsive to various inputs to the interface buffer

5 315. Data from the surface projectile game system is conveyed to the video game system as video input data, coupling via the interface buffer 315 to the latch 312 and latched responsive to a latch input signal from the surface projectile game system. The video input data

10 stored in the latch 312 is selectively output as data to the video processor 340, responsive to the video processor 340, via gating means 320 which provides an output enable signal "OE" to the latch means 312 to enable the data to be output therefrom. Additionally,

15 information on the surface projectile game play is provided to the video game system via switch return inputs coupled via the buffers 315 and input therefrom to the programmable interface means 330 which selectively outputs switch return data to the video

20 processor means 340. Switch strobe outputs are provided from the video processing means 340, via the programmable interface means 330 which outputs the switch strobes via buffering means 315 for coupling to the switches. Additionally, status data is provided to

25 the surface projectile game from the video processor 340 via the programmable interface means 330 through the interface buffers 315. An enable status signal is provided from the surface projectile game system to the buffers associated with the status data output to

30 provide active data signals output from the buffers associated with the status data. Alternatively, when the enable status signal is inactive, the outputs from the status data buffers is at a floating or high impedance signal level. Communications of information

35 from the video game system to the surface projectile game system is accomplished by the video processor 340



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communicating video output data to the latch 311 for output via the buffers 315 to the surface projectile game system as video output data. The video output data from the video processor 340 is clocked into the latch 5 311 responsive to the video processor 340 via the gating means 320. The surface projectile game system provides an enable output signal via the buffer means 315 for coupling to an output enable, "OE", input of the latch means 311 for selectively enabling active signal outputs 10 from the latch means 311 to the surface projectile game system via the interface buffer means 315.

Alternatively, when the enable output signal is at an inactive level, the output of the latch means 311 is at a high impedance floating voltage level, providing no 15 useful data of its own. Outputs Q0 to Q7 of FIG. 6B represent the video output data to the surface projectile game system as coupled to connector J1.

Inputs D0 to D7 represent the video input data from the surface projectile game system, as coupled to connector 20 J1. The latch input data signal as coupled to pin 6 of connector J1 connects to the latch means 312 and additionally is coupled to the programmable interface means 330. Additionally, the enable output data and enable status data signals, and the status data signals 25 themselves are also shown as coupled to connector J1 of FIG. 6B. The switch strobe signals and switch return signals are shown as coupled to connector J2 to and from the surface projectile game system elements,

respectively. Unregulated and regulated power from the 30 system power supply module are coupled via connector J3 to the video game system module, and more specifically to the voltage regulator and reset circuitry module 390 for the video game system module. Regulated voltage and reset signals for use in the remainder of the circuitry 35 of the video and interface system module is provided from the voltage regulator and reset circuitry module



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390. Additionally, self test means 380 are provided, coupled to the programmable interface means 330, and responsive to the video processing means 340, to allow self test of the video and interface system module.

5 The video game logic and video display processing and sequencing are provided by the video processor 340 in conjunction with the program read write memory 350 and program read only memory 360, along with associated address decode circuitry 370. The actual
10 video display sequencing signal generation is provided by the video display processor 460, in conjunction with the display read write memory 470, with the outputs of the video display processor 460 being amplified by video amplifier and level shifting circuitry 480 for coupling
15 to connector 490 for coupling to and driving a color display monitor. Data is communicated from the video processor 340 to the video display processor 460 for generating and determining the video display presentation to be provided on the monitor.

20 Sound generation for the video game, and partial sound generation for the surface projectile game, are provided by the sound processor 400, in conjunction with address interface means 405, read only memory 410, digital to analog converter means 420,
25 filtering means 430, power amplifier means 440, and a speaker coupled to connector 450 for generating the sound. Communication to the video processor 340 and surface projectile game system is accomplished via the programmable interface means 330 which couples to the
30 sound processor 400. Sound is digitally synthesized responsive to data coupled to the sound processor 400 from the programmable interface means 330 and responsive to stored sound patterns as contained in the read only memory 410. Additionally, read only memory 410 provides
35 for the logical sequencing of the sound microprocessor 400 for controlling the interface to the programmable



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interface means 330 as well as generation of digital sound pattern outputs. The digital sound pattern outputs of the processor 400 are coupled to digital to analog converting means 420 for conversion to analog 5 signal outputs. The digital to analog converter 420 outputs are coupled to filtering means 430 to shape the analog signals to provide the desired sound. The output from the filter 430 is coupled to a power amplifier means 440 for amplifying the filtered sound signals and 10 for providing an output to connector 450 for coupling to one or more speakers.

Referring now specifically to the detailed elements of FIG. 6B, and relating these elements to the description above for FIGS. 6A and 6B in a functional 15 block sense, specific component values for the illustrated embodiment will be described. The interface buffer 315 is comprised of series resistor-parallel capacitor to ground configurations on each of the video input and video output data lines, enable output data 20 and enable status data lines, latch input data and status data lines and switch strobe and switch return lines. Additionally, isolation amplifiers U3 and U4 are provided, after the resistor-capacitor stage, to isolate and buffer the signals from the surface projectile game 25 system prior to coupling to the latches 311 and 312 and peripheral interface means 330. Additionally, inverting isolation buffers U6 are provided between the peripheral interface means 330 output and the capacitor-resistor stages for the status data outputs to the surface 30 projectile game system. The latches 311 and 312 are conventional bipolar TTL devices, and as illustrated are 74LS374 devices, available from a number of vendors including Texas Instruments Incorporated. The video processing means 340 is illustrated as a Motorola 35 Semiconductor Company MC6809, 8 bit microprocessor. The most significant address outputs of the video processor



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340 are input to address decode circuitry 370, including address decoder circuit 74LS155, a TTL circuit decoder-multiplexer, providing two line to four line decode-multiplexing, which in conjunction with NAND-gates U35 and NOR-gates U5 of the address decode means 370, and NAND-gates U35 of the gating means 320, provide address select signals for utilization with the memory chips and peripheral interface means 330 and clock and output enable signals for utilization with the latches 311 and 312, respectively. The video program read write memory is comprised of 4Kb (four kilobit) static RAMs, illustrated as Motorola MCM 2114, 1KX4 static read-write memories for a total of 1KX8 of read-write program memory 350. The program read only memory is comprised of read only memories, each comprising 2KX8, for a total of 4KX8 of read only memory. The video display processor 460 is comprised of a Texas Instruments TMS9928 video display processor, utilized in conjunction with eight each of 16KX 1 bit dynamic RAMs, illustrated as MCM 4517-15 by Motorola, comprising a total of 16KX8 bits of the video RAM 470. The video amplifier and dematrix section 480 is comprised of operational amplifiers LM359 (available from National Semiconductor, Inc. and other manufacturers) and supporting resistive and capacitive circuitry. The peripheral interface means 330 is comprised of a Motorola MC6821 peripheral interface adaptor unit. The sound processor 400 is comprised of a Motorola MC6803 microprocessor with supporting clock and reset circuitry. The sound read only memory 410 is comprised of two 2KX8 read only memories, providing a total of 4KX8 bits of sound read only memory. The interface 405 for the sound processor is comprised of transparent latch 74LS373, such as by Texas Instruments, and supporting NAND-gate circuitry to provide address decode for utilization in conjunction with the sound ROM 410. The digital to analog converter



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420 is illustrated as comprising a ZN429E-8, 8 bit digital to analog converter manufactured by Zentex, plus supporting resistors, capacitor and transistor, Alternatively any equivalent 8 bit digital to analog converter could be utilized. The low pass filter circuitry as illustrated is comprised of LM3900 Norton amplifiers, as manufactured by National Semiconductor Corporation (among others), plus supporting resistors and capacitors, forming in composite the low pass filter

430. An integrated power amplifier, such as a TDA2002, and supporting capacitors and resistors form the power amplifier 440 for amplifying the sound output for coupling to the connector 450, J5, for connection to speaker output. The voltage regulator portion of the voltage regulator and reset circuitry 390 is comprised of a capacitor-inductor filter, rectifying diodes, zener diodes, and monolithic voltage regulators such as the illustrated LM7805 and LM323 regulators, both available from National Semiconductor Corporation (as well as from numerous other sources). The output of the voltage regulator section provides a regulated plus 8.2 volts, plus 5 volts, and ground reference. The reset circuit portion of the voltage regulator and reset circuitry 390 taps the rectified voltage after the rectifying diodes, and before the voltage regulators, and is comprised of a 7.5 volt zener diode in conjunction with resistors, transistors, capacitors, and diodes, to form a power up reset circuit to provide a pulse for resetting the microprocessors 340, 460, 400, and programmable interface means 330, upon initial power up, or upon a power drop or surge.

Referring to FIGS 7A-B, the block diagram and detailed schematic for the lamp/solenoid driver combination system module is shown. The detailed electrical components of FIG. 7B are grouped by dashed boxes to functionally correspond to the functional



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blocks having the same numbers in FIG. 7A. Referring now to FIGS. 7A-B together will allow for more easily understanding the functioning of the detailed electrical schematic of FIG. 7B. Address, lamp inhibit, and strobe 5 signals are provided from the surface projectile game system module for coupling to connector 501 and therefrom to respective one of sixteen decoders 505 and 506, which each respectively provide one of sixteen outputs as active responsive to the address signals and 10 strobe signal inputs. The outputs from the one of sixteen decoders 505 and 506 are coupled to buffer driver circuitry 510 for selectively gating on various lamps on the playfield as coupled via connector 515. Referring specifically to FIG. 7B, the inhibit signals 15 PD0 and PD1, and the strobe signal, as coupled to connector 501, are coupled via series damping resistors 502 and shunted by pull-up resistors 503 to the inputs of the respective one of sixteen decoders 505 and 506, comprising, as illustrated in FIG. 7B, Texas Instruments 20 74514 integrated circuits. The outputs of the one of sixteen decoders 505 and 506 are coupled to the buffer driver interface means 510. More specifically, each output from the one of sixteen decoders 505 and 506 are coupled via respective series current limiting resistors 25 to the gates of respective SCRs for selectively activating/deactivating the SCRs to a conductive state. The lamp sources on the playfield coupled to the connectors 515 are coupled to the anode of corresponding SCRs, with the cathode of all the SCRs coupled in common 30 to an SCR ground return, as shown coupled to connector 511. Thus, when one of the SCRs is activated by a respective output from the one of sixteen decoders 505 or 506, that corresponding SCR is turned on to a conductive state, thereby coupling the lamp source 35 connected to the respective point of connector 515 to ground so as to complete the lamp circuit for that lamp,



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causing the lamp to illuminate. As illustrated, the SCRs are 2N6050 devices, commercially available from numerous sources.

Referring again to both of FIGS. 7A-B, the solenoid driver portion of the module will now be described. Inputs from the surface projectile game are coupled to the connector 521. These inputs include inputs from the momentary solenoids (PB0-PB2), a solenoid bank select input CB2, and continuous solenoid data inputs PB4-PB6. The momentary solenoid data from the surface projectile game system, inputs PB0-PB2, are coupled to a one of eight decoder device which selectively provides an active one of eight outputs responsive to the momentary solenoid data inputs and to the solenoid bank select signal, CB2. The outputs from the one of eight decoder 525 are coupled via buffers/drivers 535 to connector 540 for coupling to the solenoids, so as to provide for surface projectile game system control of kickers, drop targets, drop target resets, and saucer movements. As shown in more detail in FIG. 7B, the momentary solenoid data inputs PB0-PB2 are shunted by pull-up resistors 532 and are coupled to the address inputs of the one of eight decoder 525, comprising a 74LS138 integrated circuit, from Texas Instruments, Inc. (as well as numerous other sources). The buffers/drivers 535 are each comprised of multi-stage transistor buffer driver amplifiers including supporting resistors, capacitors, and diodes. Alternatively, an integrated circuit version of solenoid drivers having sufficient voltage and current capability can be utilized.

The continuous solenoid data inputs from the surface projectile game system, inputs PB4-PB6, are directly coupled to buffer/driver means 531 which provides outputs for driving the right and left maze saucers as coupled to connector 540, and for driving the



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flipper enable relay 552 and the left and right flipper coils 550 via relay contacts 553. Power for the flipper enable relay is provided via connector 557 and is coupled thereto from the system power module. Referring now to FIG. 7B for more detail, the buffer/driver means 531 is illustrated as comprising a separate two-stage transistor amplifier buffer for each of the continuous solenoid data inputs PB4-PB6. Each two-stage transistor amplifier/buffer is illustrated as comprising a common emitter configuration with supporting resistors, blocking diode, and capacitor to provide necessary voltage and current drive capacity for energizing the flipper enable relay and maze saucers. Alternatively, integrated circuit amplifier/buffer means can be provided for the buffer/driver means 531. The continuous solenoid data input PB6, is amplified by the buffer/driver means 531, and selectively activates the flipper enable relay 552, which when energized causes contacts 553 to close thereby coupling the left and right flipper buttons, as coupled to connector 558, to the respective left and right flipper coils as coupled to connector 550. Thus, the surface projectile game energizes the flipper enable relay 552, which thereby closes contacts 553 coupling the flipper buttons to the flipper coils allowing user control of the flippers.

The lamp/solenoid driver combination systems module as illustrated in FIGS. 7A-B further includes a voltage regulator 545 for providing regulated +5 volt power to the other circuitry on the lamp/solenoid driver combination systems module. The unregulated power input is coupled from the system power module to connector 541, and therefrom to the voltage regulator means 545. As illustrated in FIG. 7B, the unregulated voltage input is 13 to 16 volts DC, and the voltage regulator circuitry is comprised of a monolithic voltage regulator, such as a National Semiconductor LM323K, a



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Fairchild Semiconductor Corporation 78H05KC, or a Lamda Semiconductor Corporation LAS1405. In addition to the monolithic regulator, the voltage regulator means 545 further comprises input filter capacitors, voltage
5 reference and level setting resistors, and output filter capacitors. An additional function provided at connector 541 is providing a solenoid ground return for solenoid return signals coupled to connector 541. Additionally, regulated +5 volts outputs can be provided
10 from connector 541.

Referring now to FIGS. 8A-B, a functional block diagram and corresponding detailed electrical schematic diagram for the surface projectile game system module are illustrated. The detailed electrical and electronic
15 components of FIG. 8B are functionally blocked by dashed lines and numbered to correspond to the functional blocks of FIG. 8A, so as to aid in understanding the operation of the surface projectile game system module. Regulated and unregulated power is coupled to connector
20 601. The regulated power is filtered and thereafter coupled to provide power to the remaining electronic components of the surface projectile game system module of FIGS. 8A-B. The unregulated power source input is filtered and fed to the valid power detector circuitry
25 610 which rectifies and level shifts the unregulated power source to provide a reset signal output, RST, and a rechargeable battery back-up power source VAUX for coupling to the read-write memory 650 to protect against data loss during power drops or power down. The reset
30 signal, RST, is provided responsive to detection of an initial power up, or upon the recovery from a power drop, and provides a high level signal for coupling to the reset/ signal inputs of the surface projectile game system processor 625 and programmable interface adapters
35 630 and 632. The RST signal reinitializes the system processor 625 and peripheral interface adapters 630 and



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632 to resynchronize and provide for proper system operation. Additionally, an unregulated power source input coupled to connector 601 is rectified and coupled to the zero crossing detector circuitry 605 which provides a signal output once for each zero crossing of the unregulated power source. The output from the zero crossing detector 605 is coupled to the programmable interface adapter 630. Referring to FIG. 8B for greater detail, the regulated power source coupled to connector 601 is a +5 volt DC source, plus a ground reference source, with the +5 volt DC source coupled via series inductor and bypassed by various capacitor values to provide regulated +5 volt power to the remaining electronic circuitry of FIG. 8B. The unregulated power source coupled to connector 601 is coupled via a rectifying diode, such as the illustrated 1N4148, and bypassed by a capacitor, for coupling to the zero crossing detector 605. The zero crossing detector 605 is comprised of a three-stage inverter amplifier, having resistive input which is diode shunted to +5 volts, and having positive resistive feedback from the output of the second stage back to the input of the first stage, and providing an inverted output from the third inverter stage for coupling to the input CB1 of the programmable interface adapter 630, a Motorola 6820 or 6821 peripheral interface device, as illustrated. Additionally, an 11.9 volt unregulated power source is coupled via a series inductor, and bypassed by a filter capacitor, for coupling to the VAUX circuit and the RST circuitry. The filtered 11.9 volt unregulated signal is coupled via series resistor and rectified by diode CR5, as illustrated a 1N40148, for providing a signal for coupling to the reset circuitry and for providing power for charging the 3.6 volt DC battery cells via the resistor R12, which provide an output point at the junction of the diode CR5 and resistor R12 for coupling



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to filter capacitor C13 thereby providing a VAUX output to the read-write memory 650. As illustrated in FIG. 8B, the read-write memory 650 is comprised of two read-write memory devices, U7 and U8. The VAUX signal is coupled to read-write memory device U8 to provide for non-volatile read-write storage, which as illustrated is a 5101L-3 low power CMOS read-write memory, commercially available from a number of sources. The U7 read-write memory as illustrated, is a Motorola 6810 read-write memory device, also available from a number of commercial sources. The diode CR5 provides for reverse polarity blocking to allow the 3.6 volt DC battery to provide the power via the VAUX signal to the read-write memory U8 of read-write memory 650, when the main power source feeding the 5 volt regulating source drops below the 3.6 volt DC level. The filtered 11.9 volt unregulated signal is also coupled via a 8.2 volt zener diode to a level detect and level shift two transistor multi-resistor stage circuit, the first stage being configured as an NPN common emitter, the second stage being configured as a PNP common emitter, for providing a reset signal (RST) for output to the surface projectile game system processor 625, illustrated as a Motorola 6800, and the programmable interface adapters 630 and 632, illustrated as Motorola 6820 or 6821 integrated circuit devices. Additionally, the RST signal is fed back via resistor R2 to the input of the first stage the two-stage transistor circuit to provide feedback.

Referring again to FIGS. 8A-B together, a description of the logical sequencing circuitry can be provided. A clock generator circuit 615 generates the necessary clock signals for operating the system processor 625 and peripheral interface adapters 630 and 632. The output of the clock circuit is amplified by the clock buffers 620 for driving the clock inputs of



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the system processor 625 and for driving clock decode circuitry 628 for providing timing signals for controlling the read only memory 640, read-write memory 650, and peripheral interface adapters 630 and 632 in a compatible manner as required by the system processor 625. Numerous signals to and from the surface projectile game playfield are coupled via connector 660 to the surface projectile game system control module as illustrated in FIG. 8B. The microprocessor 625 generates playfield switch strobes, cabinet switch strobes, and lamp strobes for interface to the surface projectile game playfield apparatus and cabinet. Additionally, a latch strobe is provided as an output from the surface projectile game system from the processor 625 via the peripheral interface adapter 630. Display data signals, such as the display digit enable signals, display blanking signal, display latch strobes, and display segment data, are output via connector 660 responsive to the processor 625 and peripheral interface adapters 630 and 632. Data is provided from the surface projectile game system playfield switches and cabinet switches by the playfield switch return signals, and cabinet switch return signals, via connector 660 and therefrom to programmable interface adapter 630 which couples the received data signals to the system processor 625. Additionally, the system processor 625 provides momentary solenoid data and sound data outputs, continuous solenoid data outputs, and solenoid bank and sound select outputs via the programmable interface adapter 632 which couples to connector 660. As described above with reference to FIGS. 7A-B, the momentary solenoid data and continuous solenoid data signals are coupled to the lamp/solenoid driver combination module at connector 521. A display interrupt generator circuit 636 provides periodically repeating interrupt signals which are coupled to



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programmable interface adapter 632 for periodically interrupting operation of the system processor 625.

The operation of the surface projectile game system module selectively enables and controls the

5 logical sequencing and responsive play characteristics of the surface projectile game, including sampling and responding to playfield switches, and selectively causing activation and deactivation of playfield solenoids and flippers, responsive to surface projectile

10 game inputs, inputs from the video game system module, and the logical sequencing program as contained in read only memory 640. The read-write memory 650 provides for scratch pad data storage for the processor 625, and additionally provides non-volatile storage of game

15 operational parameters, such as high score, number of plays per token, game difficulty, etc., in non-volatile backed-up memory U8. The display interrupt generator 636 allows the surface projectile game system processor 625 to periodically sample the coin shute switches, and

20 perform any other necessary general housekeeping even during a video game presentation when the surface projectile game system module would otherwise be inactive, so as to not lose any input data. However, this is done in such a manner as to not cause a

25 noticable interrupt to the player in the video game presentation and responsiveness.

Referring specifically to FIG. 8B, the clock 615 is illustrated as comprising two monolithic integrated circuit pulse generators configured with

30 feedback to a multi-vibrator oscillator providing a two-phase clock compatible with the Motorola 6800 operating characteristics. The two-phase outputs, $\phi 1$ and $\phi 2$, are coupled to the clock buffers 620. The clock buffers, as illustrated, are comprised of integrated

35 circuit inverting amplifiers, with the outputs pulled-up to +5 volts via 1K resistors, and the output further



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passed through series damping resistors, 20 ohms in the illustrated embodiment, prior to coupling to the Ø1 and Ø2 inputs of the 6800 system processor 625. As shown in FIGS. 8A and B, the microprocessor 625 provides control 5 signal outputs, data outputs, and address outputs, for coupling to the programmable interface adapters 630 and 632, the read only memory 640, and read-write memory 650. Control signal outputs from the processor 625 and outputs from the clock generator circuitry 615 are 10 coupled to memory and peripheral interface timing generator circuitry 628 which via a combination of NAND gates and inverters provide necessary timing signals to synchronize data transfer to and from the memories 640 and 650 and peripheral interface adapters 630 and 632, 15 to and from the processor 625. The output from peripheral interface adapter 630 is coupled to output buffers 658 which couple therefrom to the connector 660. The output buffers 658 are comprised of series diodes with paralleled shunted resistors and capacitors 20 feeding to a series output resistor, for each of the peripheral interface adapter 630 ports PA0-PA7, corresponding to the playfield switch return signals and playfield switch strobe signals. The buffer 658 additionally is comprised of shunt capacitors to ground 25 coupling therefrom via series resistors to the connector 660 for coupling signals between the ports of the programmable interface adapters 630 and 632 and the connector 660 signals for cabinet switch strobes, cabinet switch returns, lamp address, lamp data, lamp 30 strobes, display segment data, display latch strobe, display blanking, display digit enable signals, momentary solenoid/sound data, continuous solenoid data, and solenoid bank/sound select data signals. Additionally, gating logic 634 is interposed between the 35 connector 660 and the peripheral interface adapter 632 ports PA0-PA3 for providing the display latch strobe



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signals, the gating means 634 being disabled responsive to the CA2 port output of peripheral interface adapter 630, which provides the display blanking signal via buffer means 658 to connector 660.

5 Referring to FIG. 9, a detailed electrical schematic for the combination game system power supply module is illustrated. AC power, for example 115-120 volts AC, is coupled via connector 700 via interlocks, switches, and fuses, to connector 711, which couples the
10 AC power source, via an additional fuse F1, to the primary side of transformer 720. As illustrated, the primary side of transformer 720 can be wire strapped to select different input operating voltage sources such that the system's power supply module illustrated in
15 FIG. 9 is compatible with external voltage sources of 115 VAC, 120 VAC, 220 VAC, 240 VAC (and could additionally be made to provide for compatibility with other voltage and frequency sources if needed). Additionally, as illustrated in FIG. 9, the transformer
20 720 has two independent primary coil windings, and five independent secondary coil windings. As illustrated, the secondary coil voltage outputs are 6.5 volts AC, 49 volts AC, 14.2 VAC, a switch illumination voltage designated SW.ILL., and 120 volts AC isolated to the
25 system monitor (video display). Each of the secondary outputs at 6.5 volts, 49 volts and 14.2 volts AC, are coupled via fuses and/or rectifier bridges to the connector 740 for coupling regulated and unregulated power sources, and ground returns, to the surface
30 projectile game system module, the video game system module, and the solenoid/lamp driver interface system module. As illustrated, 6.5 volts AC, 43 volts DC, 11.9 volts DC, and ground are coupled to the connector 740. Additionally, the SW.ILL. AC signals are coupled to the
35 playfield, and the 120 volt AC power source is coupled to the video monitor.



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In addition to the above described embodiments, various other means of embodying a combination video and surface projectile game can be utilized consistent with the teachings of the present invention. Additionally, 5 other interface system structures and protocols can be utilized consistent with the teachings of the present invention.

While there have been described above various embodiments of systems and methods for creating a 10 combination video game and surface projectile game system having unique play features therefor, for the purpose of illustrating the manner in which the invention may be used to advantage, it will be appreciated that the invention is not limited thereto. 15 Accordingly, any modification, variation, or equivalent arrangement within the scope of the accompanying claims should be considered to be within the scope of the invention.



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WHAT IS CLAIMED IS:

1. A combination interactive video and surface projectile game, for use by a player, comprising:
 - a) a video display
 - b) input means for providing a user signal
5 responsive to the player,
 - c) a downwardly sloping playfield having targets thereon and pockets therein,
 - d) a surface projectile movable about the playfield,
 - 10 e) logic means for providing surface game signals responsive to activation of said targets and said pockets by said surface projectile,
 - f) logging means for providing history signals indicative of the video and projectile game history of
15 the current player,
 - g) sequence means for selecting one of a plurality of predefined still video presentations responsive to said input means and said logging means;
 - h) first means for providing an animated video
20 game presentation, from a sequence of selected ones of a plurality of predefined still video presentations on said video display, responsive to said sequence means, including in said display presentation a player representative character which is responsive to said
25 input means,
 - i) second means for providing a surface projectile game including enabling movement of said surface projectile about said playfield;
 - k) first control means for selectively
30 alternating game play between said video game and said surface projectile game, responsive to said logging means, and
 - l) means for alternating from said video to said surface projectile game responsive to said player
35 representative character being positioned in a



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predefined location within said video presentation.

2. The system as in Claim 1 wherein said first controller means is further comprised of:

means for alternating from said surface
5 projectile game to said video game responsive to
activation of a predefined combination of targets and
subsequent placement of of said surface projectile in a
predefined one of said pockets.

3. The system as in Claim 1 further
10 characterized in that said first control means
alternates from said video to said surface projectile
game responsive to the eradication of said player
representative character during said video game.

4. The system as in Claim 1 further comprising:
15 means for providing a player benefit character
for utilization in said video game presentation
responsive to said logic means and logging means,
wherein the player can advantageously combine
said player benefit character and said player
20 representative character in playing said video game.

5. The system as in Claim 4 wherein said first control means is further comprised of:

means for alternating from said video to said
surface projectile game responsive to said player
25 representative character being positioned in a
predefined location within said video presentation,
said system further characterized in that any
said player benefit character of the video presentation
existing prior to alternating to said surface projectile
30 game is made part of the video presentation upon the
next alternation to the video game.

6. The system as in Claim 4 further
characterized in that said first controller alternates
from said video to said surface projectile game
35 responsive to the eradication of said player
representative character during said video game,



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said system further characterized in that any said player benefit character of the video presentation existing prior to alternating to said surface projectile game is cancelled from being part of the video display
5 upon the next alternation to the video game.

7. The system as in Claim 1 further characterized in that each player's turn is comprised of both a video and a surface projectile game.

8. The system as in Claim 7 further
10 characterized in that said system can have a plurality of players, each player completing a turn in sequence prior to the next player commencing a turn.

9. The system as in Claim 7 further characterized in that each player receives a plurality
15 of turns in one complete combination game.

10. A combination interactive video and surface projectile game, for use by a player, comprising:

- a) a video display
- b) input means for providing a user signal
20 responsive to the player,
- c) a downwardly sloping playfield having targets thereon and pockets therein,
- d) a surface projectile movable about the playfield,
- 25 e) logic means for providing surface game signals responsive to activation of said targets and said pockets by said surface projectile,
- f) logging means for providing history signals indicative of the video and projectile game history of
30 the current player,
- g) sequence means for selecting one of a plurality of predefined still video presentations responsive to said input means and said logging means;
- h) first means for providing an animated video
35 game presentation, from a sequence of selected ones of a plurality of predefined still video presentations, on



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said video display, responsive to said sequence means, including in said display presentation a player representative character which is responsive to said input means,

5 i) second means for providing a surface projectile game including enabling movement of said surface projectile about said playfield;

k) first control means for selectively alternating game play between said video game and said
10 surface projectile game, responsive to said logging means; and

means for alternating from said surface projectile game to said video game responsive to activation of a predefined combination of targets and
15 subsequent placement of said surface projectile in a predefined one of said pockets.

11. The system as in Claim 10 wherein said first control means is further comprised of:

means for alternating from said video to said
20 surface projectile game responsive to said player representative character being positioned in a predefined location within said video presentation.

12. The system as in Claim 10 further characterized in that said first control means
25 alternates from said video to said surface projectile game responsive to the eradication of said player representative character during said video game.

13. The system as in Claim 10 further comprising:

30 means for providing a player benefit character for utilization in said video game presentation responsive to said logic means and logging means,

wherein the player can advantageously combine said player benefit character and said player
35 representative character in playing said video game.

14. The system as in Claim 13 wherein said



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first control means is further comprised of:

means for alternating from said video to said surface projectile game responsive to said player representative character being positioned in a
5 predefined location within said video presentation,
said system further characterized in that any said player benefit character of the video presentation existing prior to alternating to said surface projectile game is made part of the video presentation upon the
10 next alternation to the video game.

15. The system as in Claim 13 further characterized in that said first controller alternates from said video to said surface projectile game responsive to the eradication of said player
15 representative character during said video game,
said system further characterized in that any said player benefit character of the video presentation existing prior to alternating to said surface projectile game is cancelled from being part of the video display
20 upon the next alternation to the video game.

16. The system as in Claim 10 further characterized in that each player's turn is comprised of both a video and a surface projectile game.

17. The system as in Claim 16 further
25 characterized in that said system can have a plurality of players, each player completing a turn in sequence prior to the next player commencing a turn.

18. The system as in Claim 16 further characterized in that each player receives a plurality
30 of turns in one complete combination game.

19. A combination interactive video and surface projectile game, for use by a player, comprising:
a) a video display,
b) input means for providing user signal
35 responsive to the player,
c) a downwardly sloping playfield having



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targets thereon and pockets therein,

d) a surface projectile movable about the playfield,

e) logic means for providing surface game
5 signals responsive to activation of said targets and said pockets by said surface projectile;

f) logging means for providing history signals indicative of the video and projectile game history of the current player,

10 g) sequence means for selecting one of a plurality of predefined still video presentations responsive to said input means and said logging means;

h) first means for providing an animated video game display presentation, from a sequence of selected
15 ones of a plurality of predefined still video presentations, on said video display, responsive to said sequence means, including in said display presentation a player representative character which is responsive to said input means, and further including at least two
20 openings between which said player representative character can exit and enter the video display presentation so as to wrap around the video display;

i) means responsive to said surface game signals for varying the time period occurring between
25 said exit and entrance between said tunnel openings;

j) second means for providing a surface projectile game including enabling movement of said surface projectile about said playfield; and,

k) first control means for selectively
30 alternating game play between said video game and said surface projectile game, responsive to said logging means.

20. The system as in Claim 19 wherein said first control means is further comprised of:

35 means for alternating from said video to said surface projectile game responsive to said player



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representative character being positioned in a predefined location within said video presentation.

21. The system as in Claim 19 wherein said first controller means is further comprised of:

5 means for alternating from said surface projectile game to said video game responsive to activation of a predefined combination of targets and subsequent placement of said surface projectile in a predefined one of said pockets.

10 22. The system as in Claim 19 further characterized in that said first control means alternates from said video to said surface projectile game responsive to the eradication of said player representative character during said video game.

15 23. The system as in Claim 19 further comprising:

means for providing a player benefit character for utilization in said video game presentation responsive to said logic means and logging means,

20 wherein the player can advantageously combine said player benefit and said player representative character in playing said video game.

24. The system as in Claim 23 wherein said first control means is further comprised of:

25 means for alternating from said video to said surface projectile game responsive to said player representative character being positioned in a predefined location within said video presentation,

said system further characterized in that any
30 said player benefit character of the video presentation existing prior to alternating to said surface projectile game is made part of the video presentation upon the next alternation to the video game.

25. The system as in Claim 23 further
35 characterized in that said first controller alternates from said video to said surface projectile game



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responsive to the eradication of said player
representative character during said video game,

said system further characterized in that any
said player benefit character of the video presentation
5 existing prior to alternating to said surface projectile
game is cancelled from being part of the video display
upon the next alternation to the video game.

26. The system as in Claim 23 further
characterized in that said player benefit character is
10 provided in an alternating available/non-available timed
manner for utilization in said video game presentation.

27. The system as in Claim 19 further
characterized in that each player's turn is comprised of
both a video and a surface projectile game.

15 28. The system as in Claim 27 further
characterized in that said system can have a plurality
of players, each player completing a turn in sequence
prior to the next player commencing a turn.

29. The system as in Claim 27 further
20 characterized in that each player receives a plurality
of turns in one complete combination game.



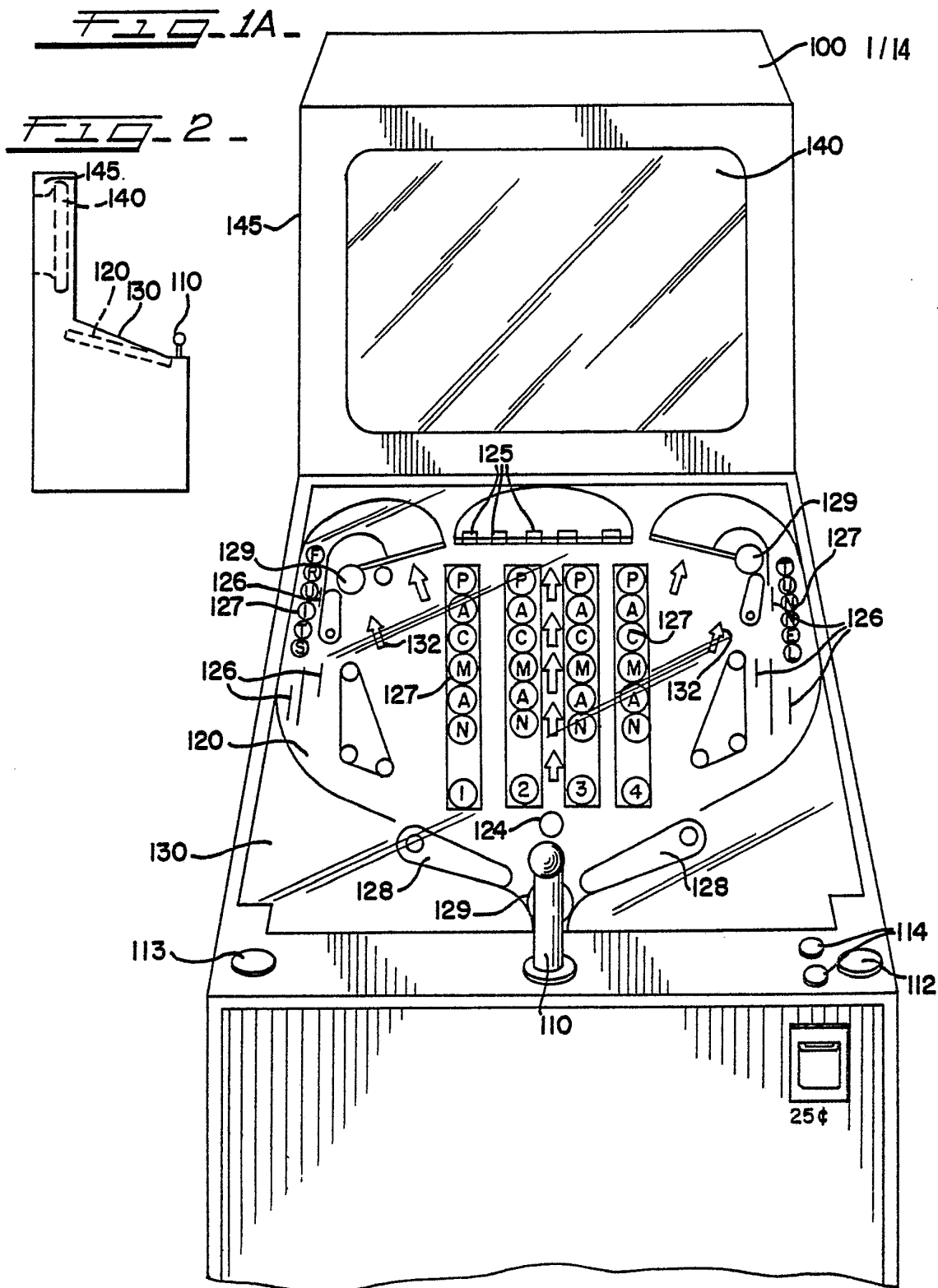
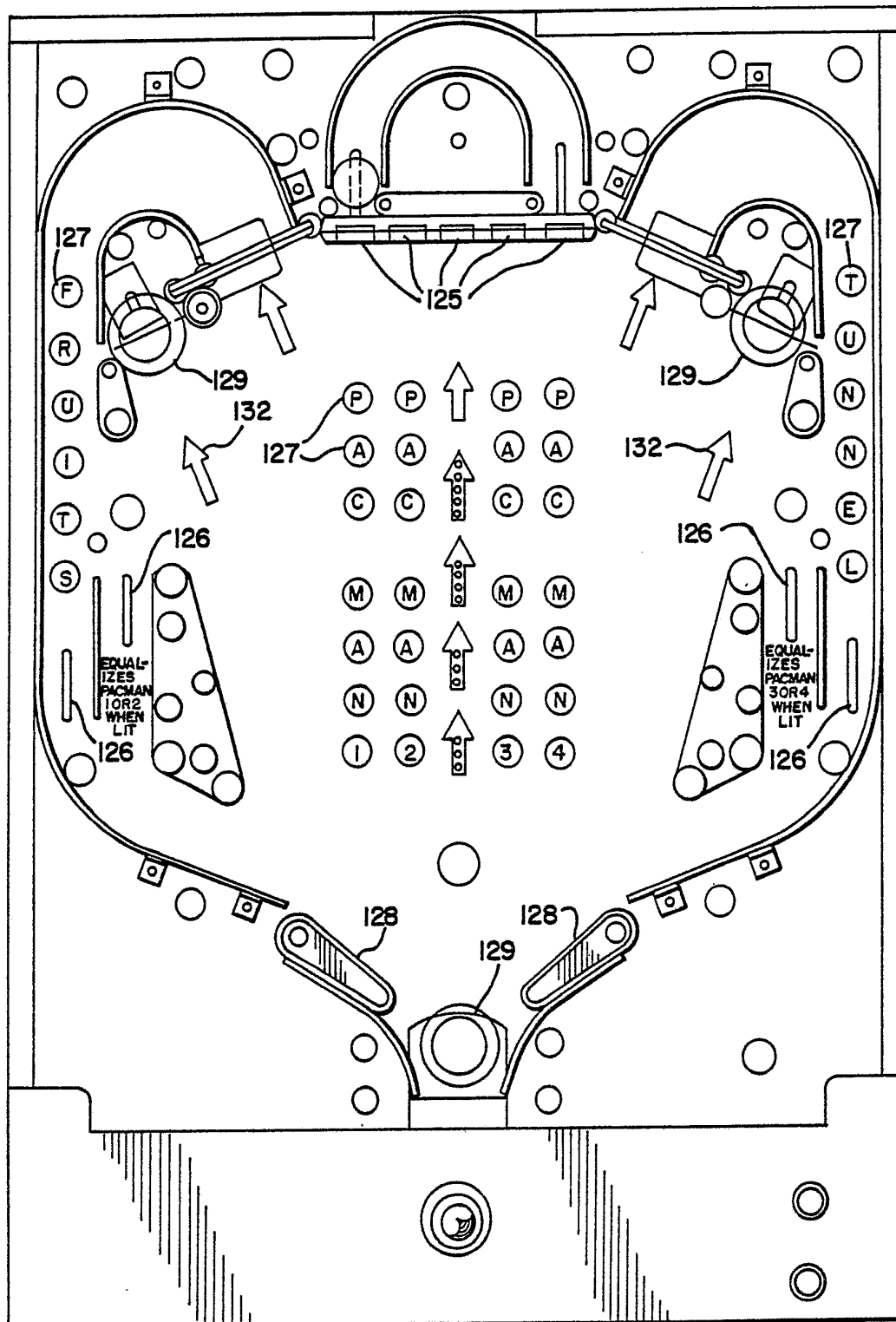
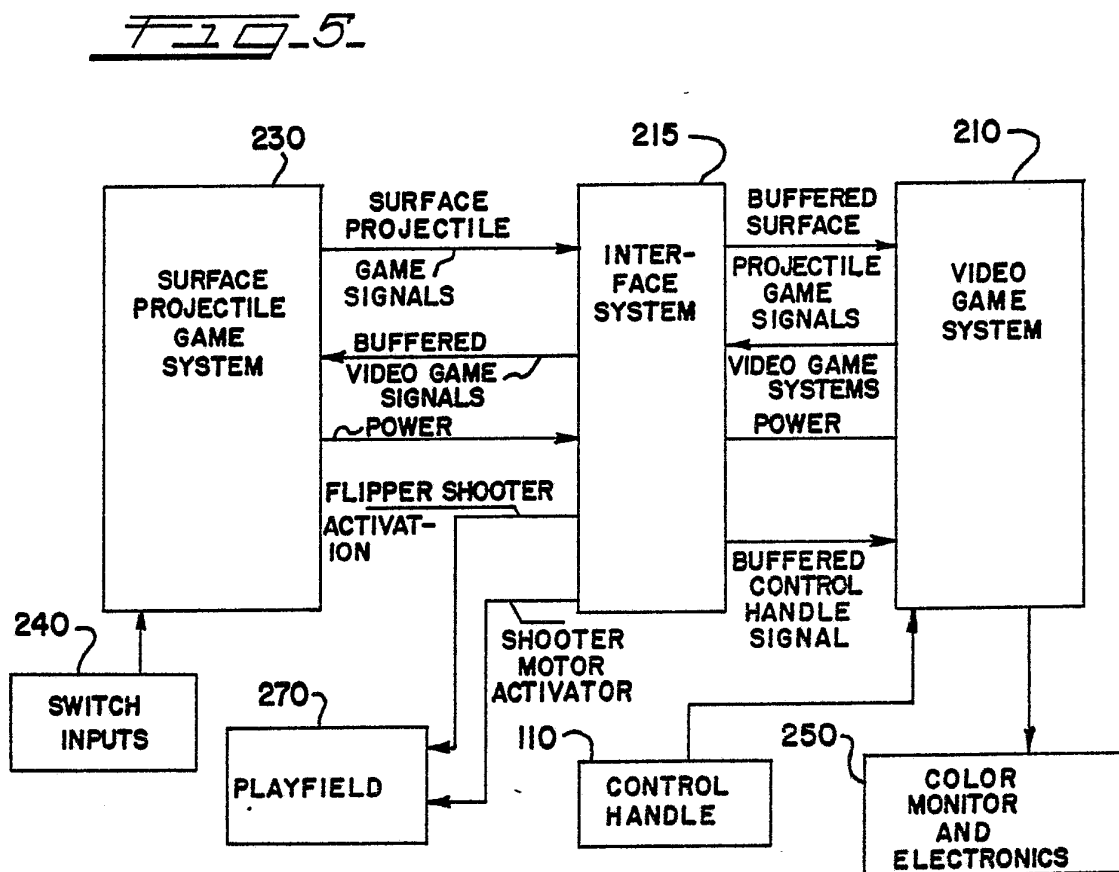
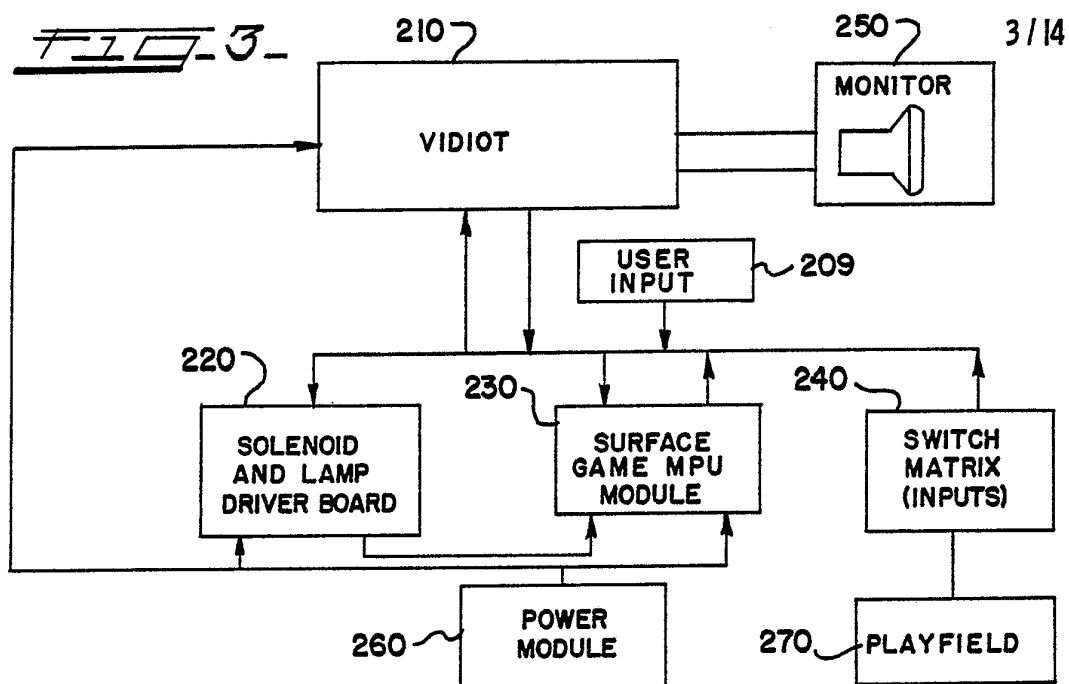
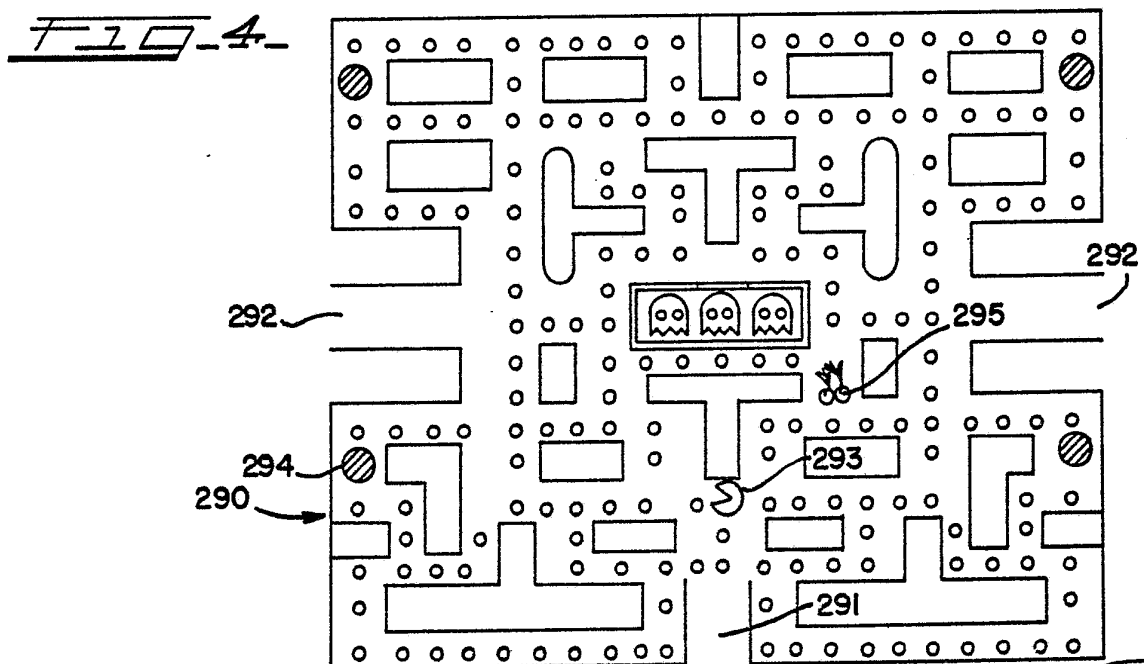
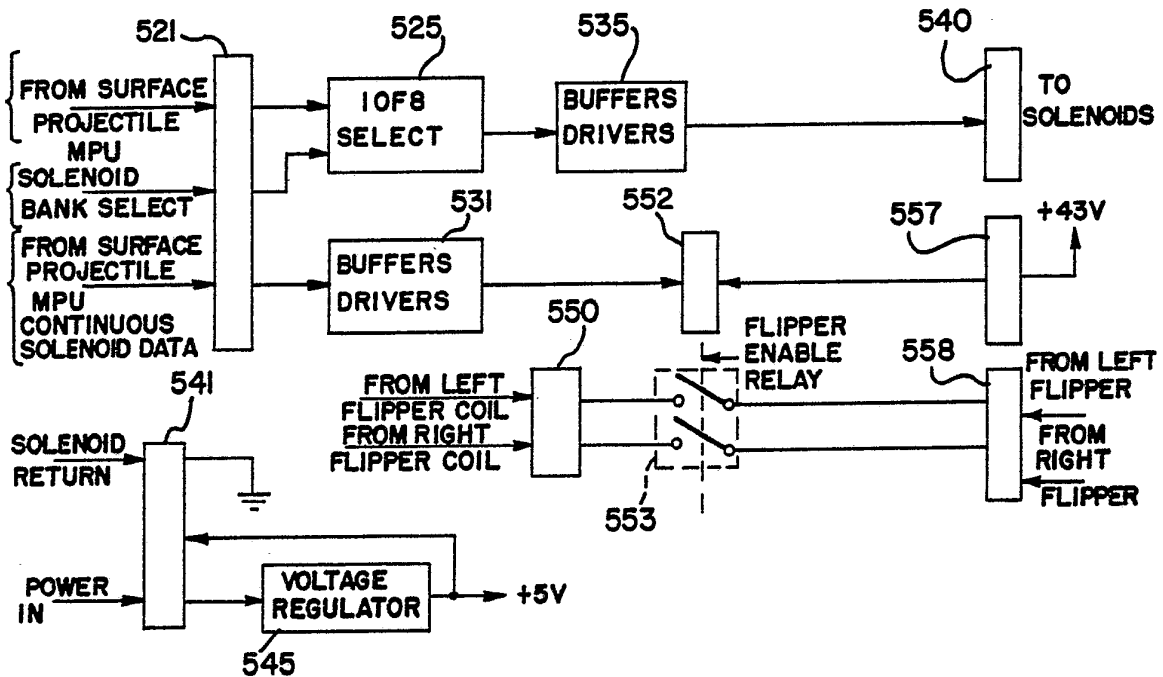
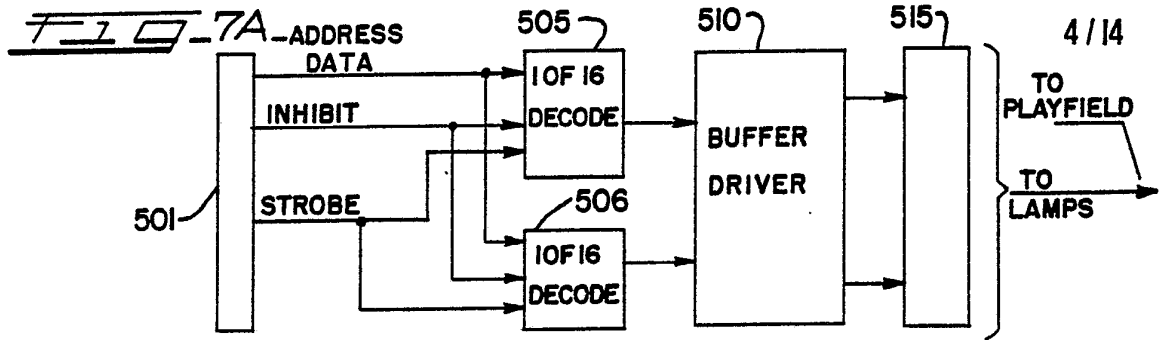


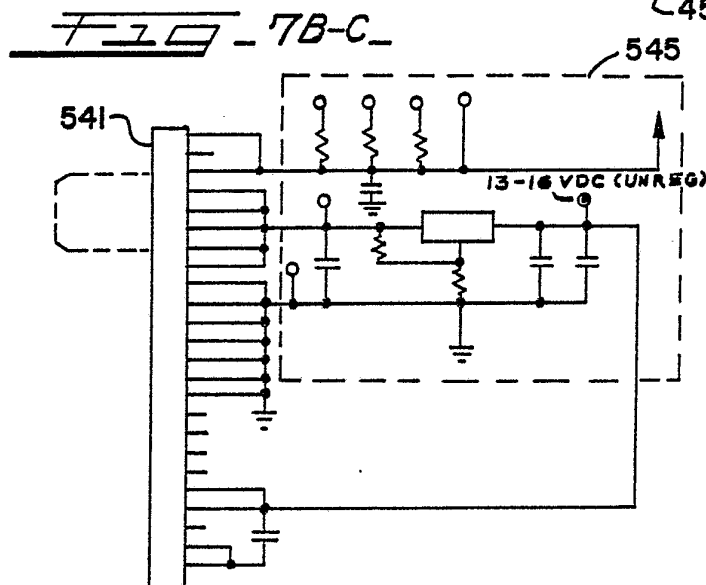
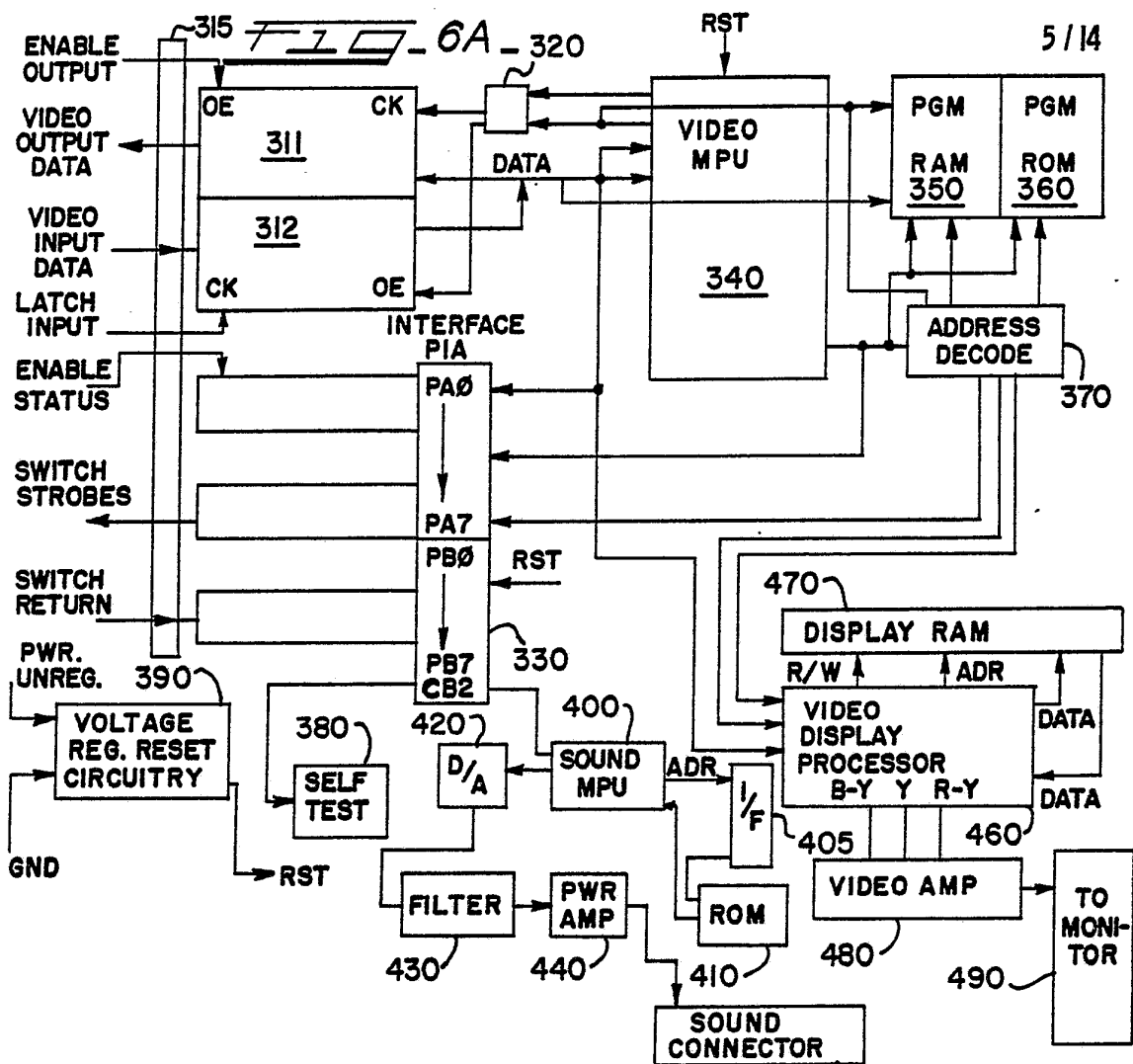
FIG. 1B

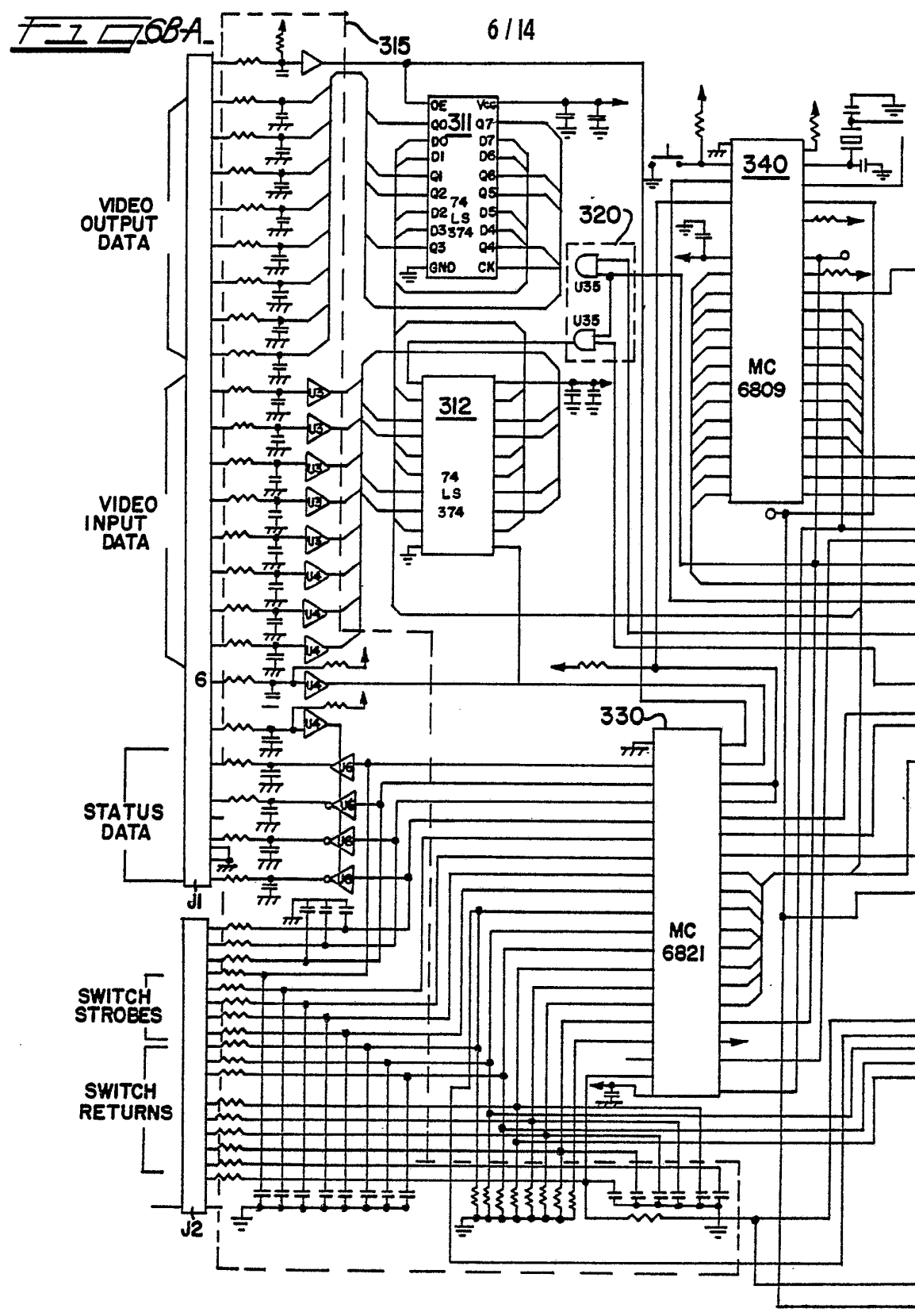
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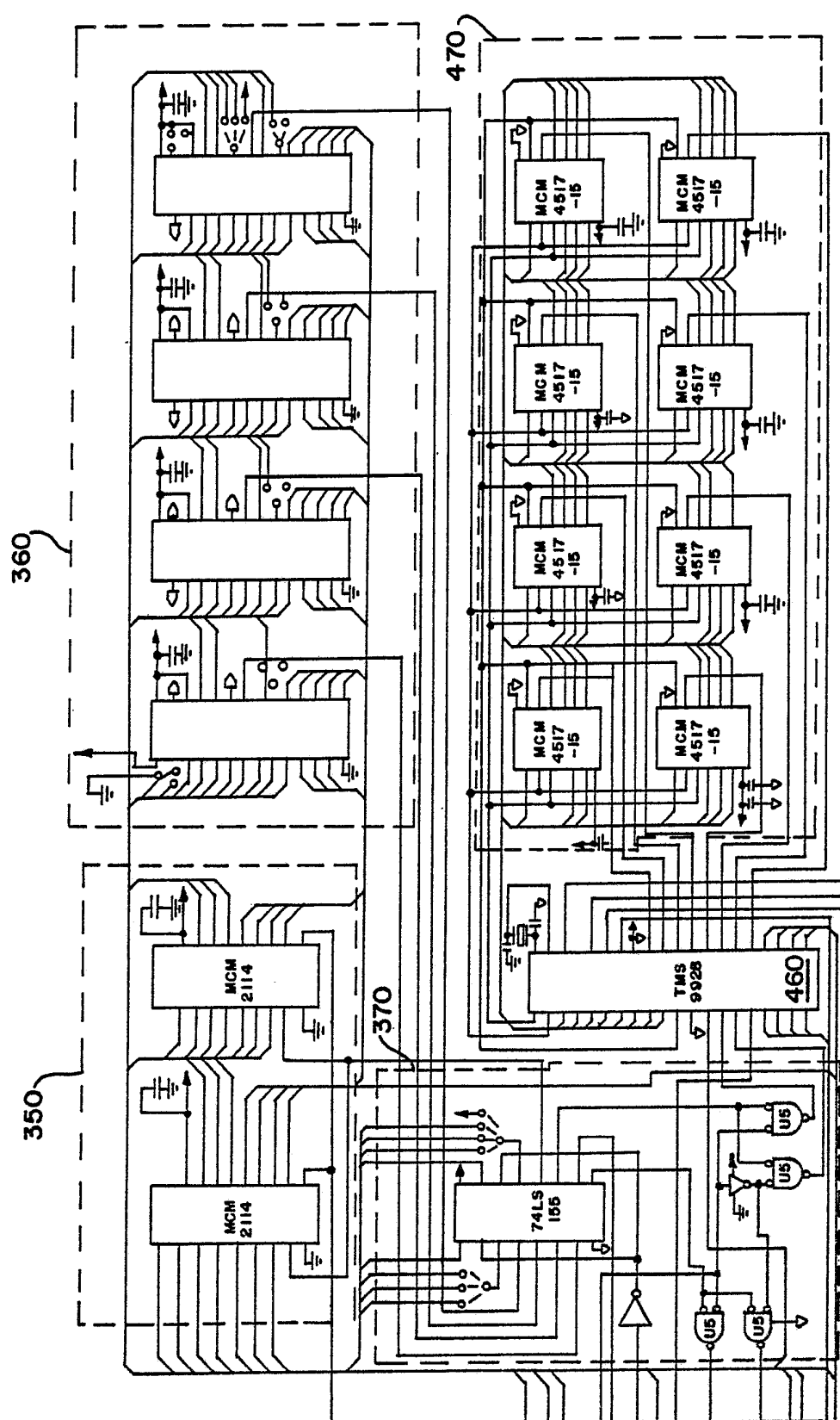




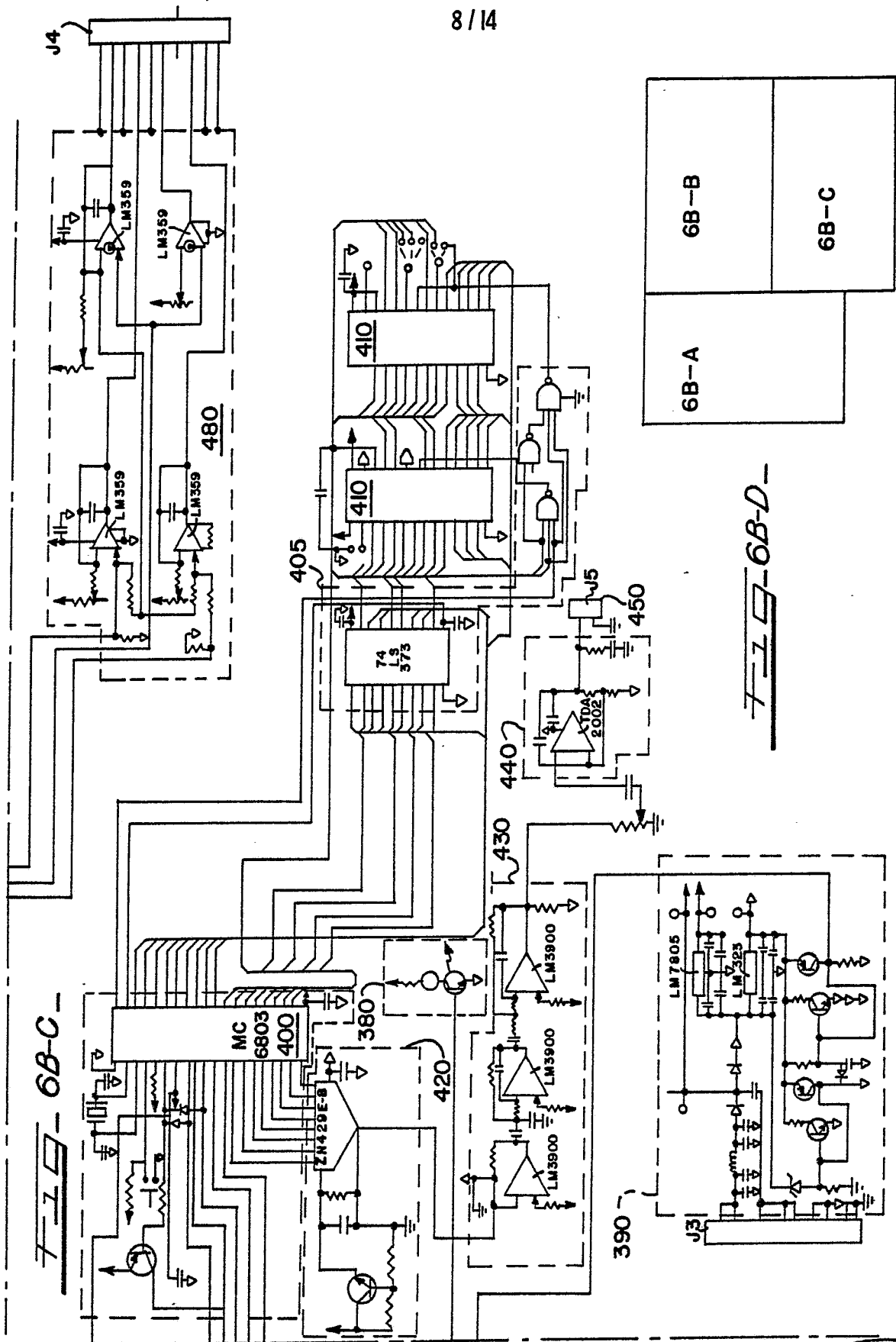


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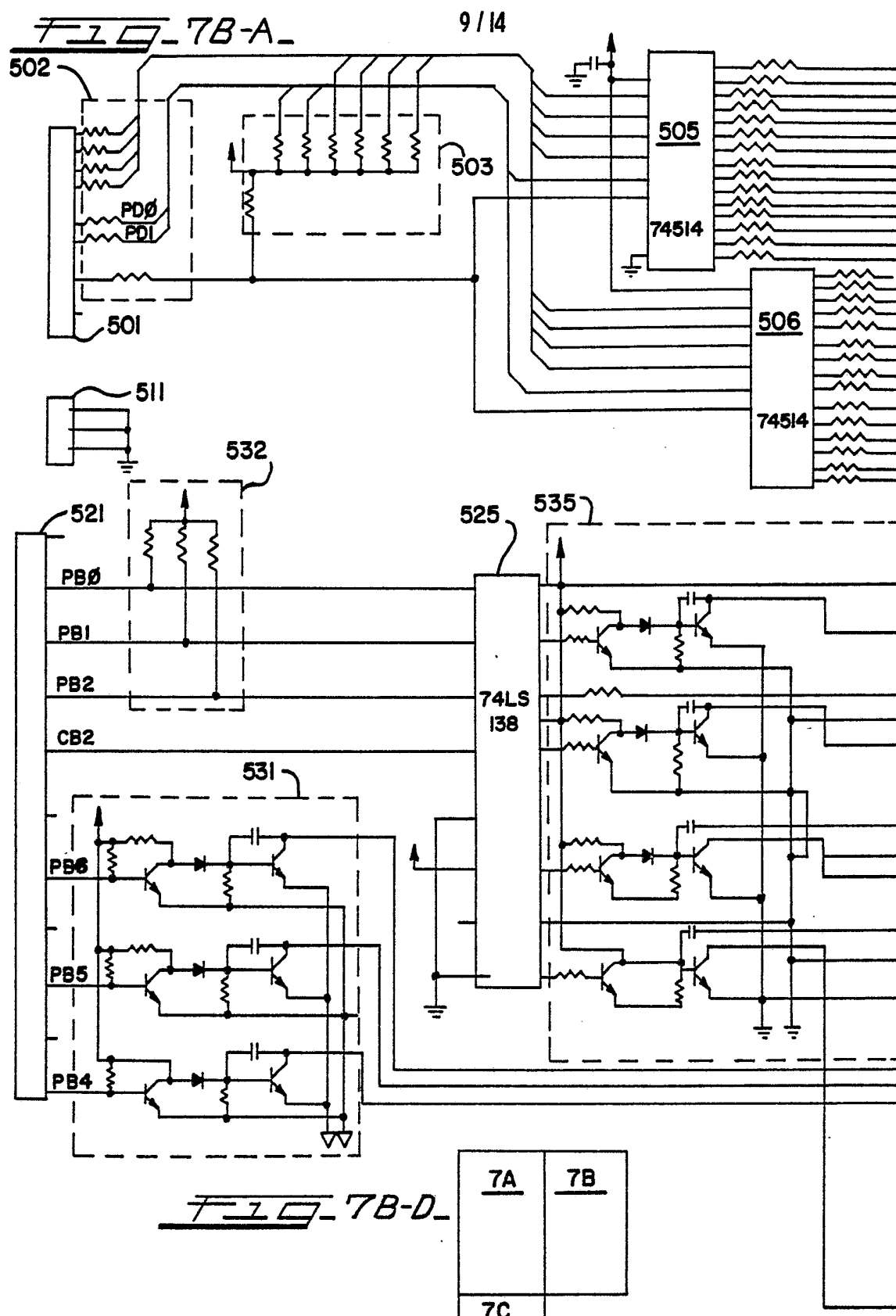
FIG. 6B-B

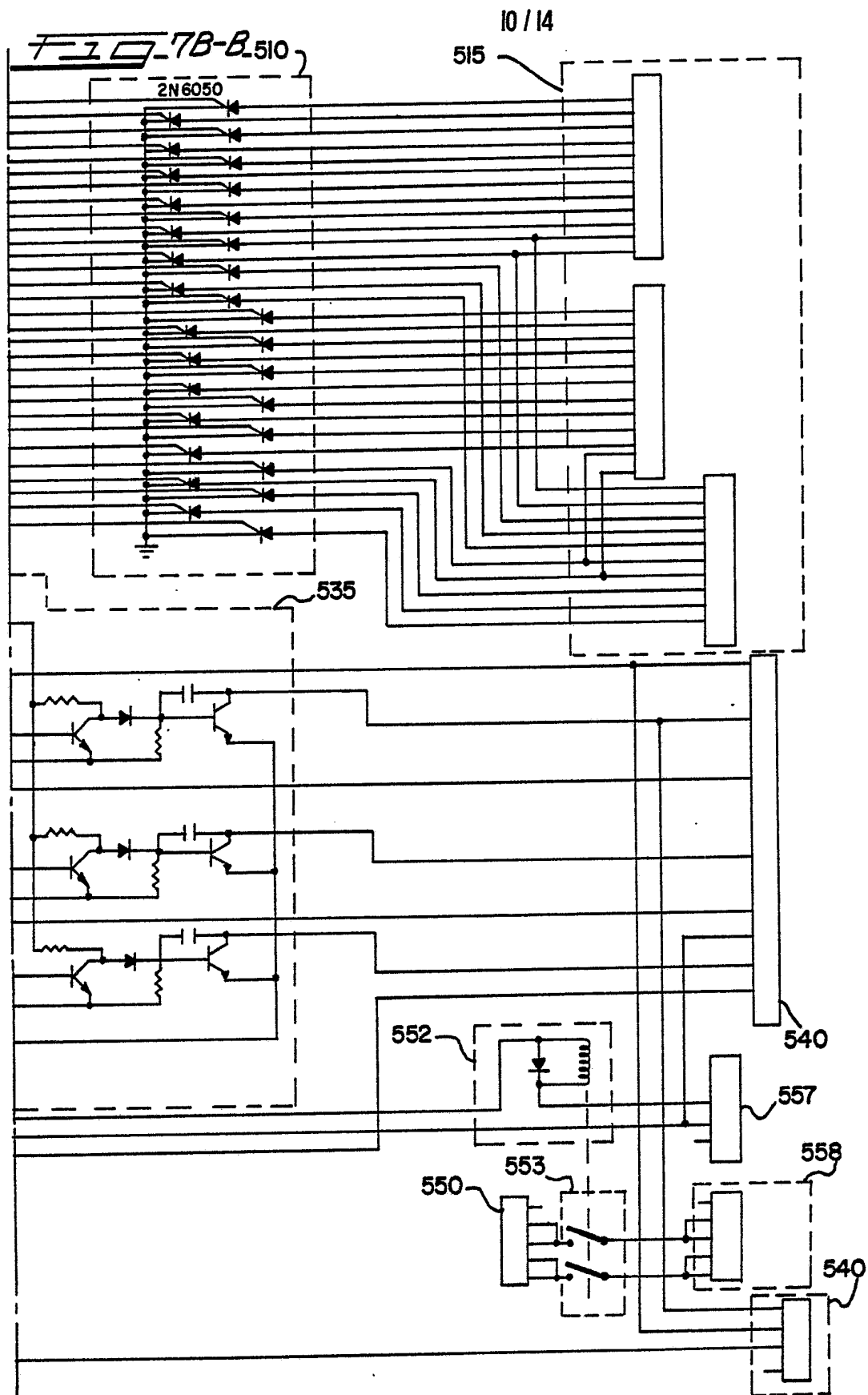


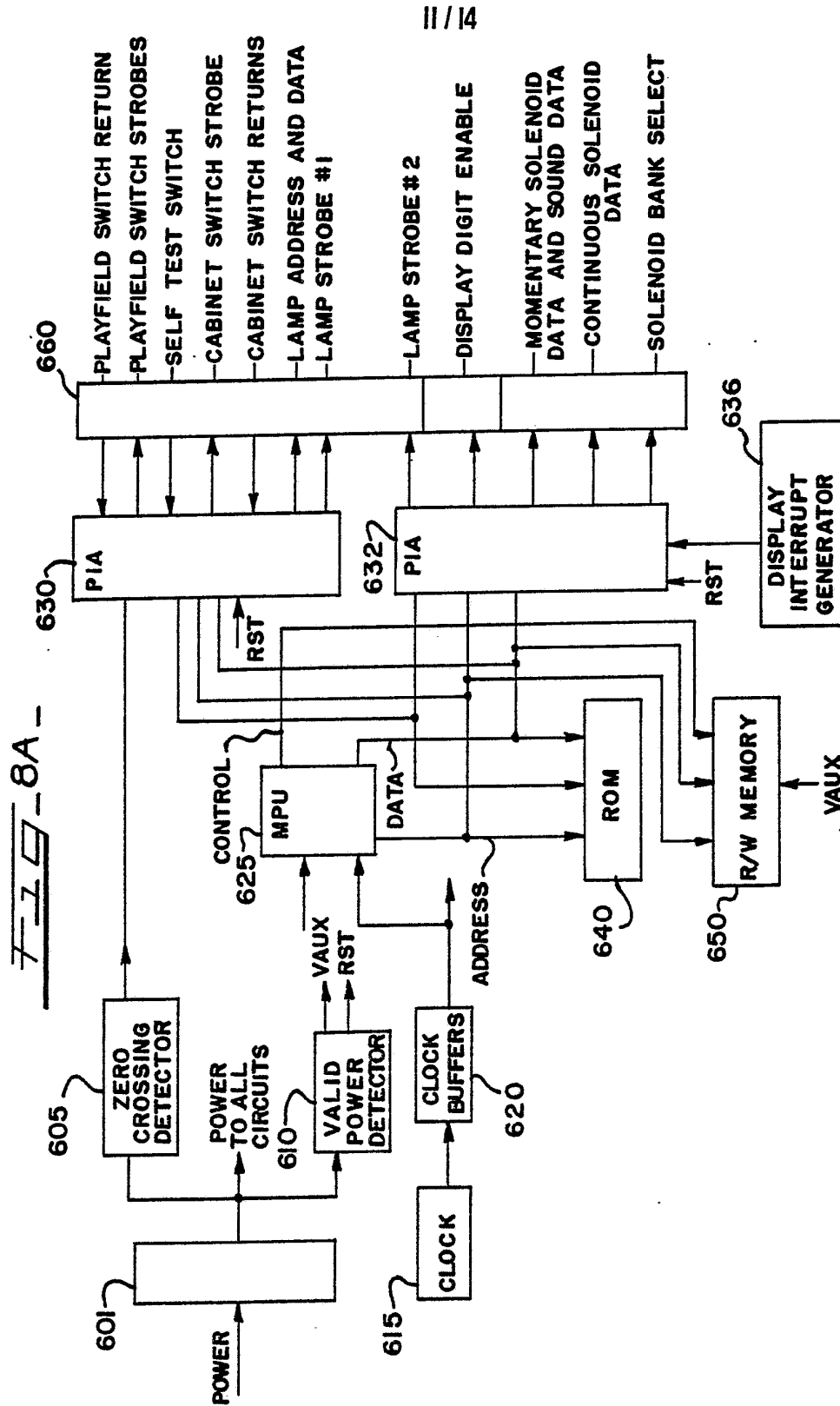
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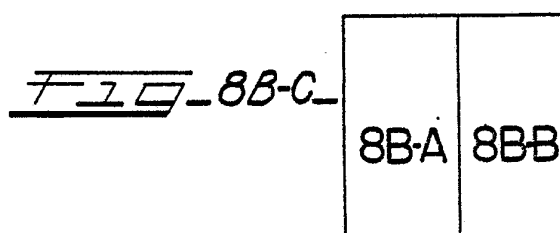
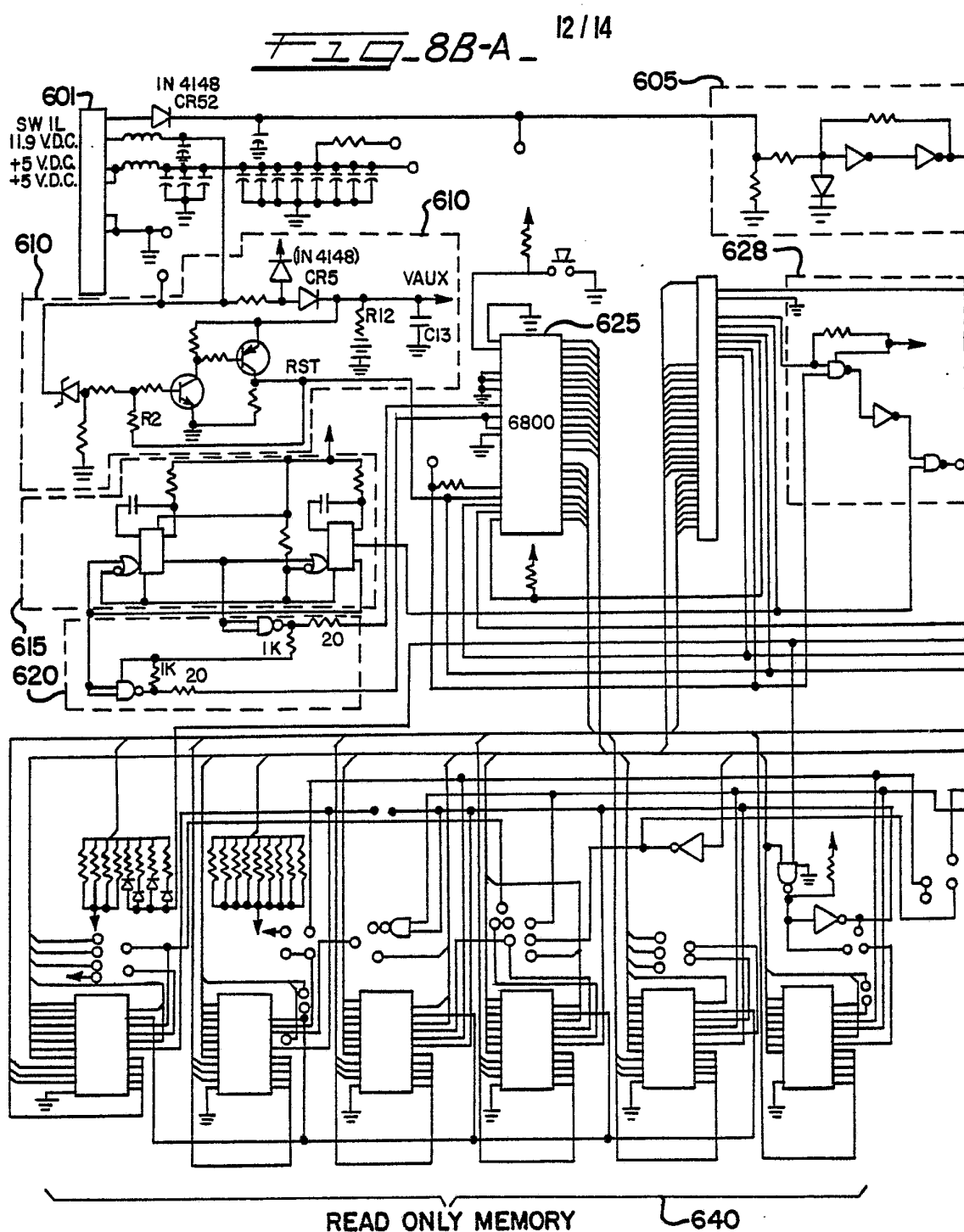


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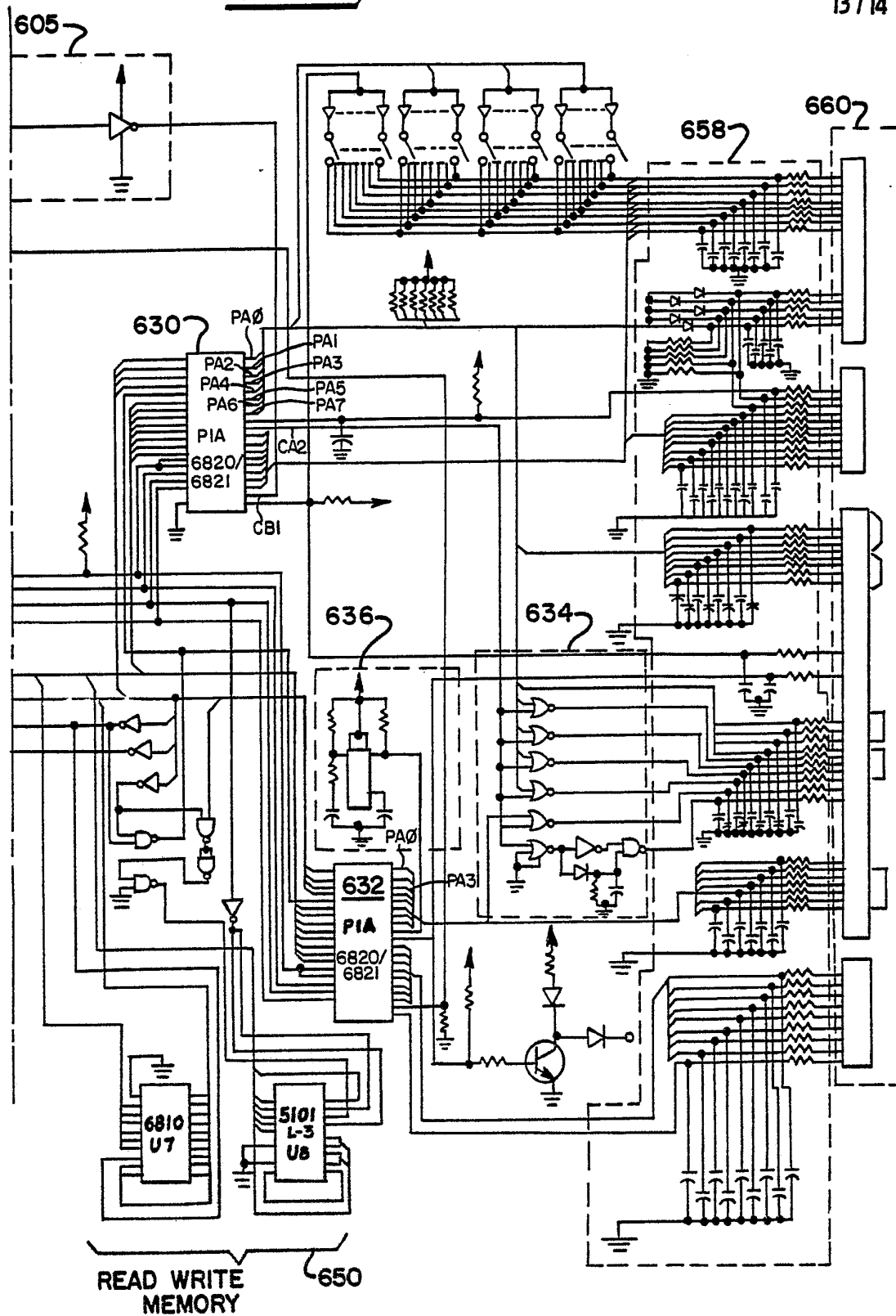




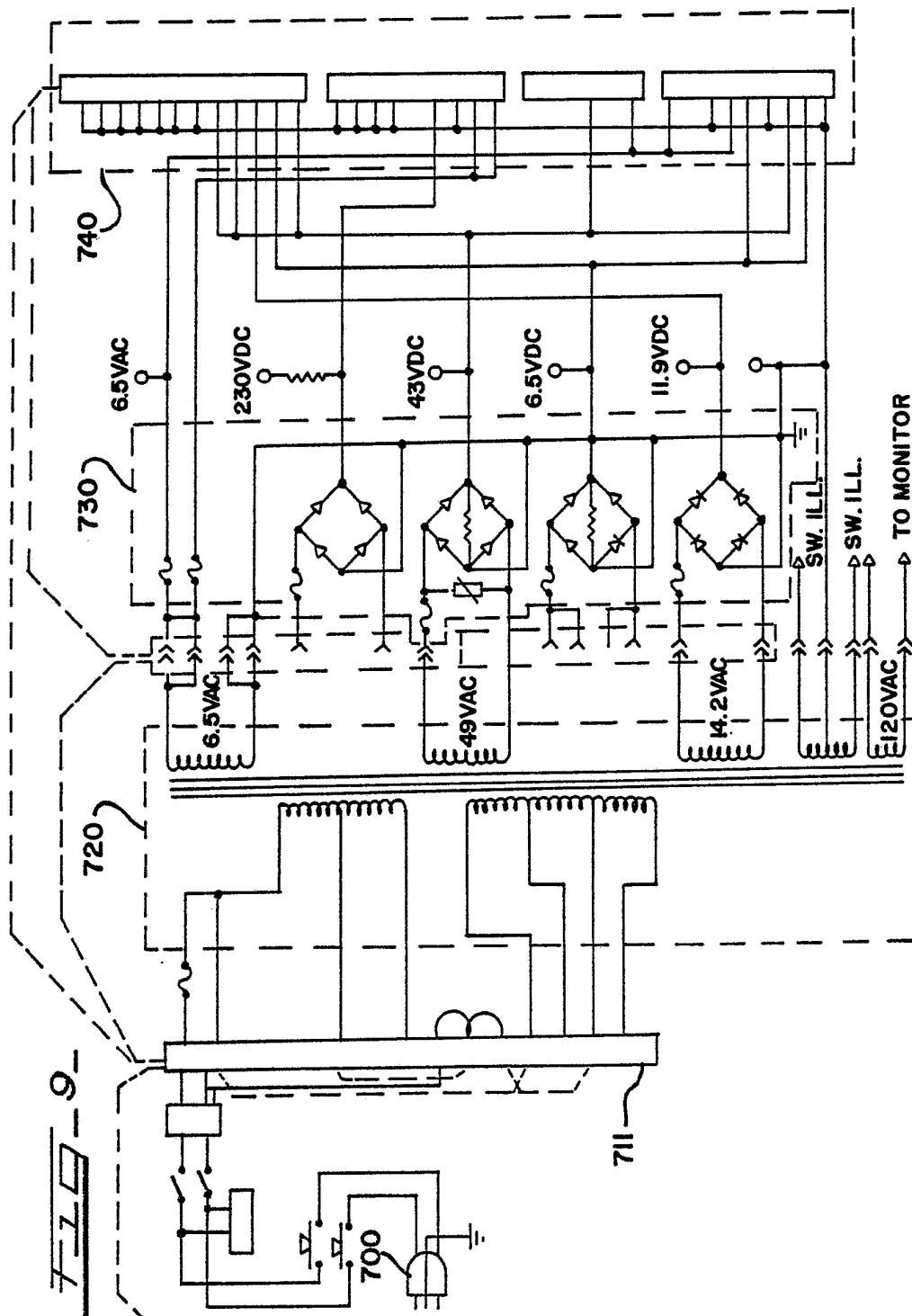


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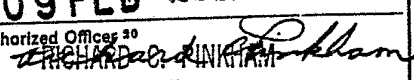


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INTERNATIONAL SEARCH REPORT

International Application No PCT/US83/01771

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³			
According to International Patent Classification (IPC) or to both National Classification and IPC ³			
A63F 7/02, A63F 9/22			
II. FIELDS SEARCHED			
Minimum Documentation Searched ⁴			
Classification System	Classification Symbols		
US	273/1E, 85G, 118A, 118D, 118R, 121A, DIG. 28; 272/10, 13, 18		
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵			
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴			
Category ⁶	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷		Relevant to Claim No. ¹⁸
X/Y,P	US, A, 4,375,286	30 July 1983 SEITZ	1, 3, 7-9/2, 4-6, 10-29
Y,P	US, A, 4,363,485	14 December 1982 EDWALL	2, 4-6, 10-18, 21
Y	US, A, 4,129,883	12 December 1978 STUBBEN	4-6, 19-29
¹⁵ * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family			
IV. CERTIFICATION			
Date of the Actual Completion of the International Search ¹		Date of Mailing of this International Search Report ²	
13 January 1984		09 FEB 1984	
International Searching Authority ¹		Signature of Authorized Officer ²⁰	
ISA/US		 S.P.E.	