United States Patent

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[73] Assignee **The United States of America as represented by the Secretary of the Navy**

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[54] **LARGE-AREA DISPLAY SYSTEM**
7 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **178/6.8,** 178/DIG. 6, 178/DIG. 35
[51] **Int. Cl.** **H04n 7/18**
[50] **Field of Search** ..... 178/6.8, 7.88, DIG. 35, DIG. 6, DIG. 20

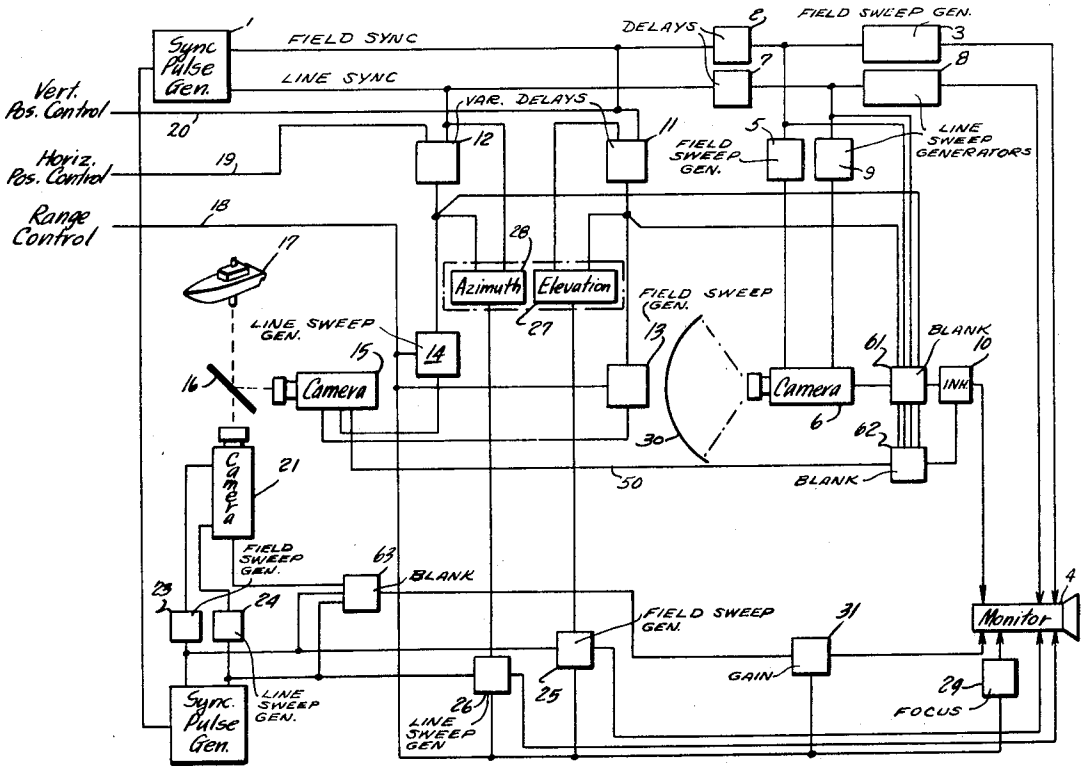
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ABSTRACT: A television system presenting a picture of a large area with relatively coarse resolution in which a small area for the display of a high-resolution picture is blanked out and a high-resolution picture inserted in the blanked out area.



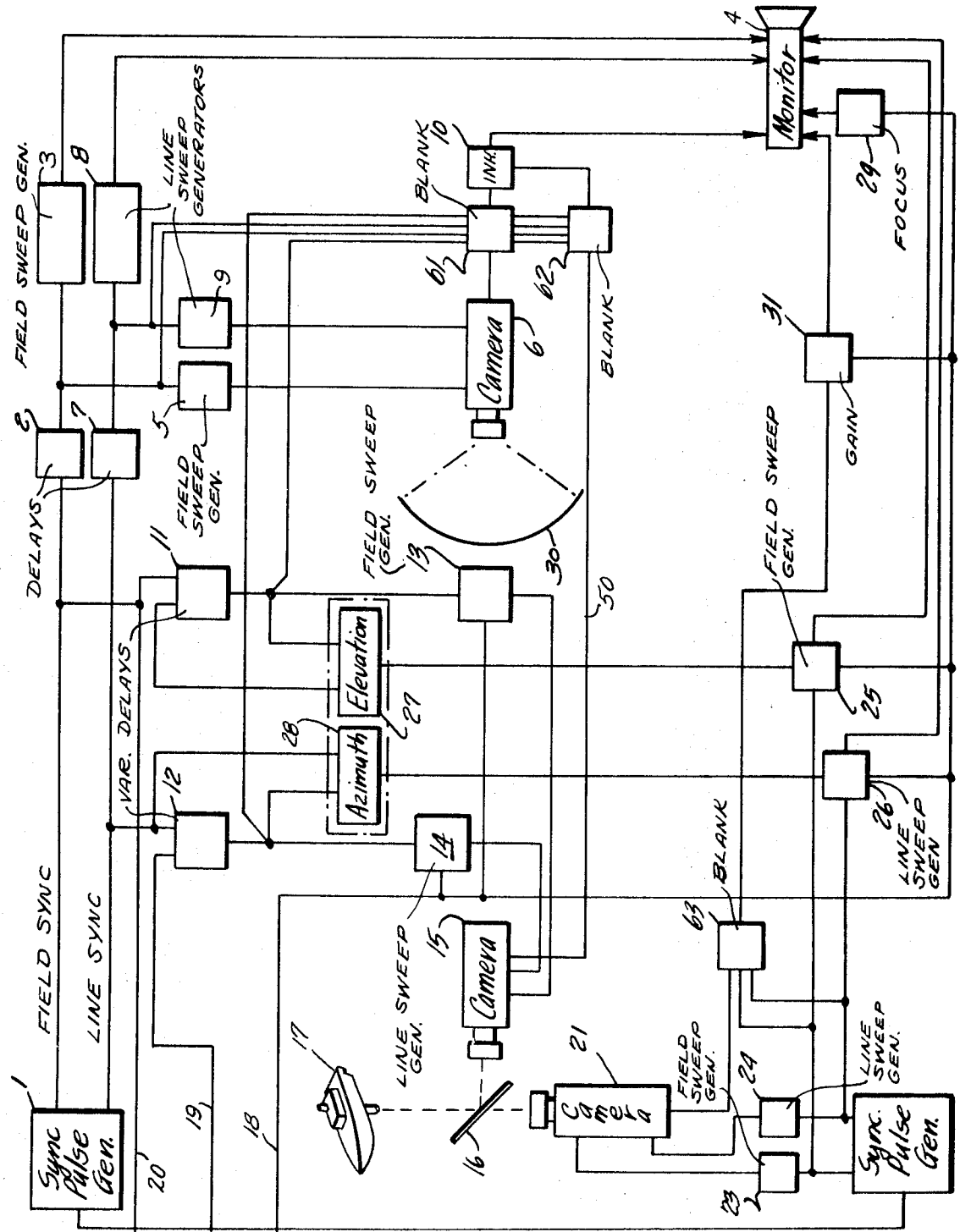


Fig. 1

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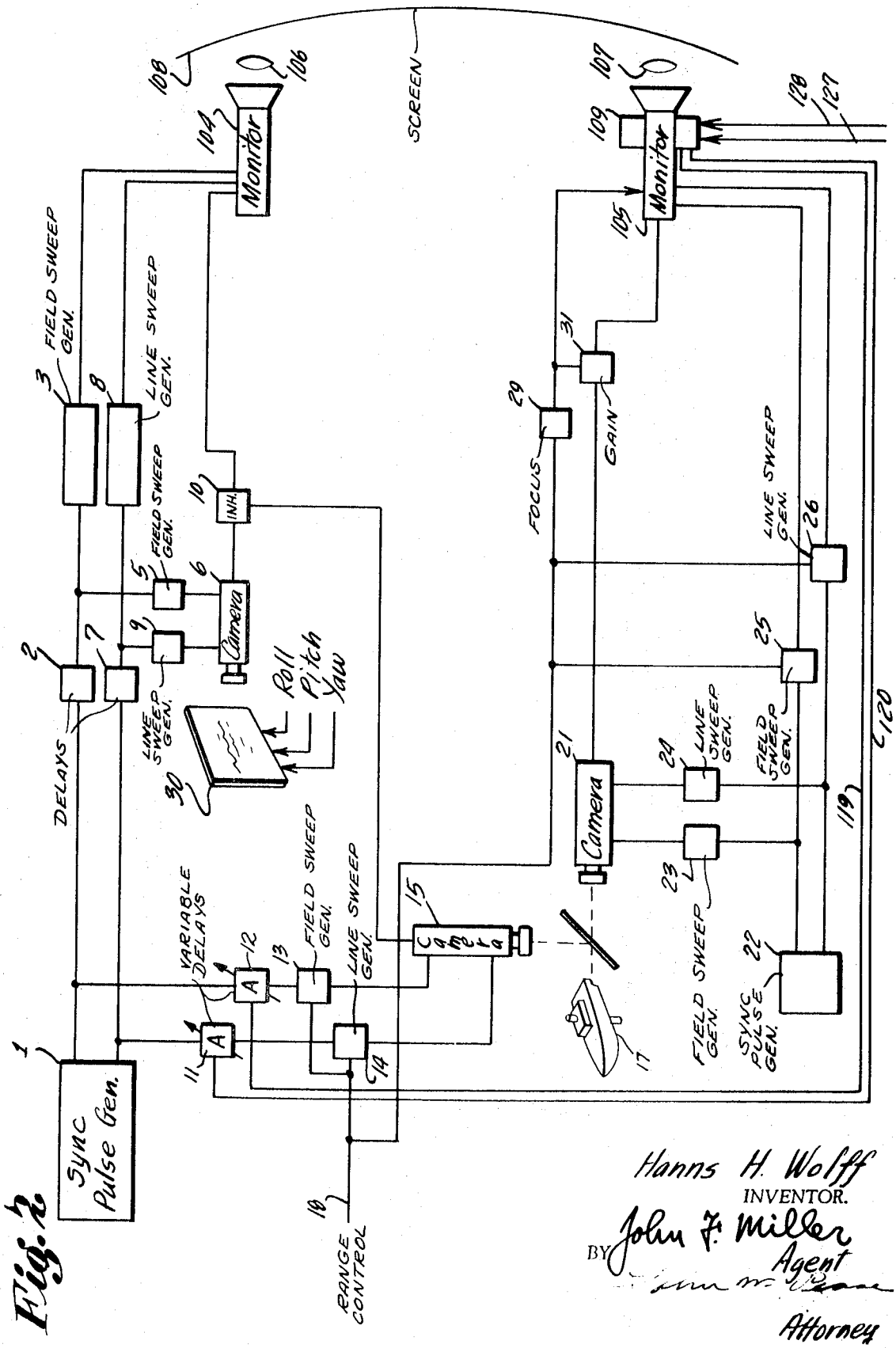


Fig. 2

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Fig. 4

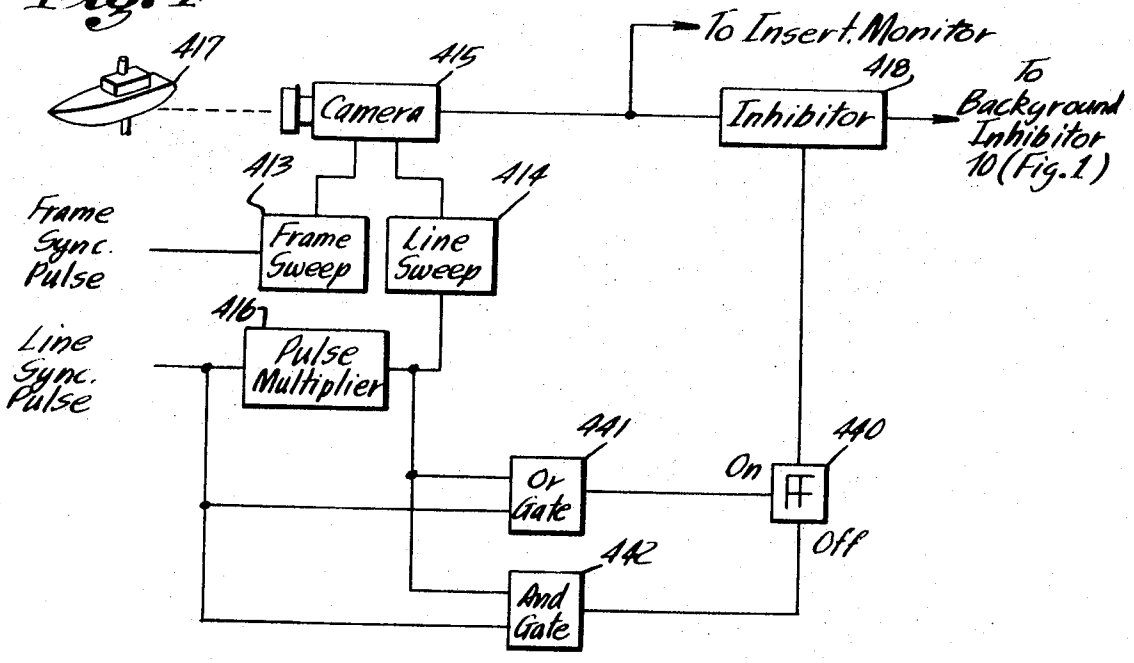
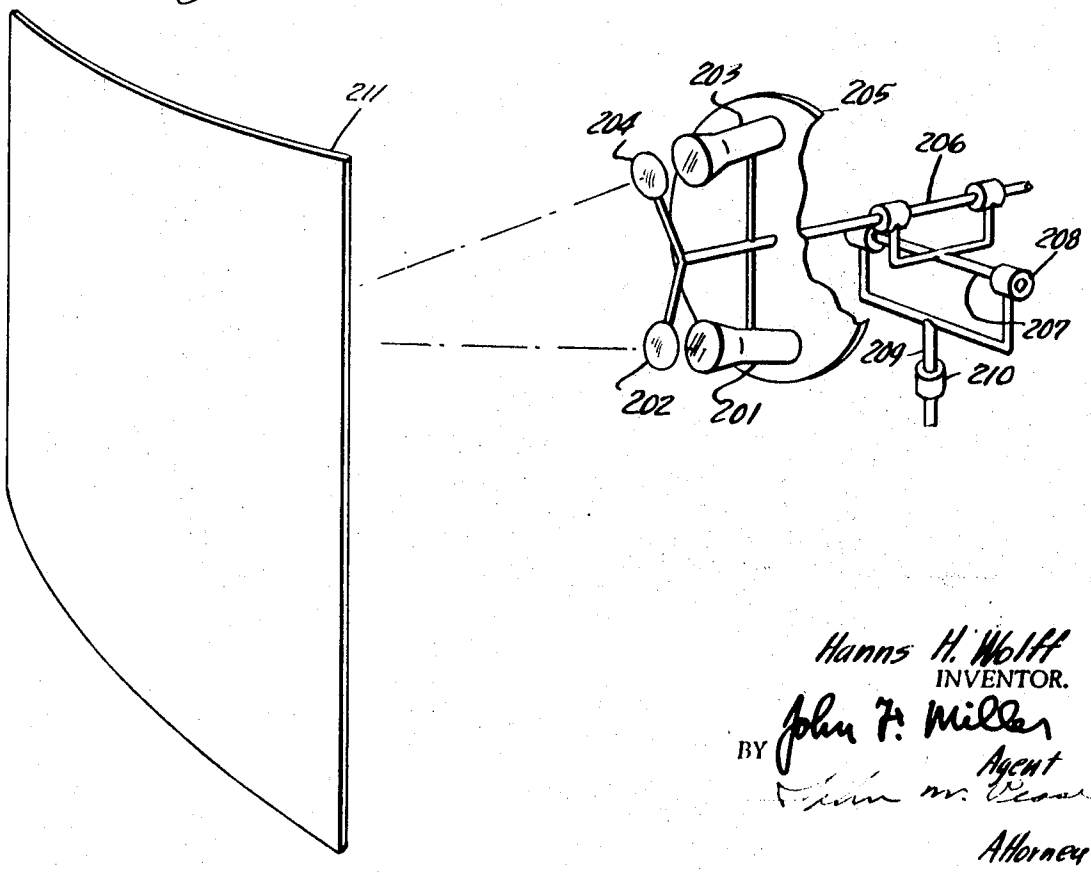


Fig. 3



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LARGE-AREA DISPLAY SYSTEM

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

CROSS-REFERENCE TO RELATED APPLICATIONS

This application embodies apparatus described in detail in applicant's copending U.S. Pat. application Ser. No. 535,659 filed Mar. 14, 1966, now U.S. Pat. No. 3,479,454, and U.S. Pat. No. 3,420,953.

BACKGROUND OF THE INVENTION

The present invention is in the field of television and is concerned with a large-area display in which a specific small area is displayed with very high resolution.

Visual display systems of the nonprogrammed type often used in training devices often require a synthesis of separately generated pictures.

To display a small picture with high resolution in a large area display, a system known as the "shrunken raster" system has been developed in which one field of a large-area presentation is displayed followed by a field of a small-area high-resolution picture which is followed by the interlacing field of the high-resolution small-area display. THis complete cycle is continuously repeated.

This prior art system allows the use of small area displays of high brightness only, since due to the integration of the large- and small-area displays both displays are visible at the integrated area unless the small-area display overrides the large-area display in intensity and thereby avoids a disturbing "-bleed-thru" of the large-area display.

SUMMARY OF THE INVENTION

In accordance with the invention a television system, more particularly a closed circuit television system, displays a large area. Means are provided to blank out a specific small area which may be of any shape or form, into which a small high-resolution picture is inserted.

Means may be provided to change the scale of the small picture to be displayed.

Furthermore, means may be provided to vary the location of the small-picture display within the large-area display.

A small-area model, picture or transparency to be displayed may be projected onto two television cameras; for example, by means of a beam splitter. One of these cameras is scanned with the raster of the large-area display and forms the means to blank out the small area from the large-area display, while the other camera is scanned by a relatively high-resolution raster. Means are provided to locate the high-resolution display into the blanked out area of the large-area display.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings show two examples of circuitry in accordance with the present invention in block diagram form.

FIG. 1 shows a system which uses a multigun cathode-ray tube.

FIG. 2 shows a system which uses two cathode-ray tubes; one for the large-area display and one for the high-resolution insert.

FIG. 3 shows an embodiment suitable for use in an aircraft carrier landing trainer.

FIG. 4 shows an embodiment employing a single model camera.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, a sync pulse generator system 1 generates field and line sync pulses for a television raster. The field sync pulses are passed through a pulse delayer 2 and control a field sweep generator 3 for the field deflection system of

gun 01 of a two-gun cathode-ray tube monitor 4. The field sync pulses from sync pulse generator system 1 also control a field sweep generator 5 which controls the field deflection system of a main camera 6. The line sync pulses from generator 1 are delayed similarly by a line sync pulse delay network 7 and the delayed pulses control a line sweep generator 8 for the control of the line deflection means of gun 01 of monitor 4, as well as a line sweep generator 9 for the control of the line deflection means of main camera 6. The two-gun systems of monitor 4 are designed and arranged so that the deflection means and intensity control means of the two guns are independent from each other.

THe video output of camera 6 feeds the control grid of gun 01 of monitor 4 over an inhibitor circuit 10 (the function of which will be explained later).

Background camera 6 is directed towards a large-area background 30 (model, picture or transparency) to be displayed by monitor 4. The field and line sync pulses of sync pulse generator 1 are also fed to two variable pulse delay systems 11 and 12, which control two field and line sweep generators 13 and 14 which in turn control the deflection systems of a model camera 15. Camera 15 receives, e.g., via a beam splitter 16, the model of a "target" 17 to be inserted into the large-area display on monitor 4. A target range signal, generated by, for example, a program control computer or by manual control, is provided via line 18 to the field and line sweep generators 13 and 14. The range signal controls the slope of the field and line sweeps and thereby controls the apparent size of the model target with respect to the large area display in the manner taught in applicant's U.S. Pat. No. 3,420,953. The video output of camera 15 is connected over a line 50 to control inhibitor circuit 10. When a target signal from the target 17 is picked up by the camera 15, the video signal from camera 15 causes inhibitor circuit 10 to prevent background video signal from camera 6 from passing to the intensity control of gun 01 of monitor 4. Target 17 is arranged (for example, set against a black background) so that it alone is picked up by camera 15. This results in a "cutout" or blank space in the background picture displayed on monitor 4 which has the shape of target 17.

The cut out of target 17 in the large area background 30 may be positioned anywhere within the large area or may be moved completely off the large-area background 30 in the manner taught in applicant's U.S. Pat. No. 3,420,953. This is accomplished for example, by inserting fixed delays 2 and 7 in the lines connecting sync pulse generator 1 to monitor line and field sweep generators 3 and 8 and inserting variable delay circuits 11 and 12 between 1 and sweep generators 13 and 14 for camera 15.

The delay of field pulse delayer 2 is preferably equal to at least the duration of one field. The line pulse delayer 7 delays the line sync pulse by at least one line period. The variable field sync pulse delayer 11 permits a delay over a range of at least two field periods, for example, between zero and two field periods, while line sync pulse delayer 12 permits a delay over a range of at least two line periods, for Example, between zero and two line periods. Variable sync pulse delayers 11 and 12 therefore make it possible to place the cutout of target 17 anywhere within the large area 30 displayed on the monitor 4 by varying the timing of the camera sweeps with respect to the monitor sweeps in connection with appropriate blanking circuits 61, 62, and 63 for inhibiting the parts of the video signals not to be displayed, if desired. In this case, of course, sync generator systems 1 and 22 (mentioned below) will have to be synchronized as indicated by the connecting line between them. 61, 62, and 63, shown in the video output lines of cameras 6, 15, and 21, respectively, are used partially or totally. Such blanking circuits are shown and described in applicant's U.S. Pat. No. 3,420,953. Their effect is to prevent a portion of a target which is offscreen on, say, the right-hand side of the monitor, from reappearing on the left-hand side, and vice versa. The same is the case for targets leaving the display upwards or downwards. These blanking circuits are not

required in the present invention if there is no requirement for a target to move offscreen. Delayers 11 and 12 receive control signals which are either manually generated or preferably, program control computer generated, via lines 19 and 20.

The signals for lines 18, 19, and 20 may be provided by a computer that determines the range and location of target 17 within or, if blanking circuits 61, 62, and 63 are used partially or totally, outside the total background display as a function of nonprogrammed actions, for example, the actions of a trainee in a flight trainer.

The high-resolution target picture to be displayed in the large area display is provided by a camera 21 which also scans target 17 via the beam splitter 16. This camera is controlled by a sync pulse generator 22 which provides field and line sync pulses to field and line sweep generators 23 and 24 which in turn control the deflection systems of camera 21. The field and line sync pulses from sync pulse generator 22 are also fed to field and line sweep generators 25 and 26 which control the deflection circuits of gun system 02 of the monitor 4. The video output of camera 21 controls the control grid of gun system 02 of monitor 4. The range signal provided by line 18 also controls the slope of the sweep voltages generated by the field and line sweep generators 25 and 26 to assure that the high-resolution picture insert provided by gun 02 of monitor 4 has the same size as the blanked out area of gun system 01 of monitor 4. The larger the slope of deflection generators 13 and 14 is, the smaller must be the slope of deflection generators 25 and 26.

Since the delay provided by field sync delayer 11 and line sync pulse delayer 12 controls the position of the blanked-out area of the large-area display the undelayed (or the delayer 2 and 7 delayed pulses) and the pulses delayed by delayers 11 and 12 are also fed into position control converters 27 and 28 which in turn control a bias voltage to the field and line sweep generators 25 and 26 and thereby position the insert image appropriately into the blanked-out area in the manner taught in applicant's U.S. Pat. application Ser. No. 535,659.

The position control converters 27 and 28 are shown as a functional element only to explain the systems interactions. Converters 27 and 28 develop an analog output proportional to the delay of a delayed pulse from 11 or 12 with respect to a sync pulse. Since lines 19 and 20 usually provide an analog signal representing the position of the target within the background, these signals may be used to control the bias to the field and line sweeps of sweep generators 25 and 26 directly.

The range signal from line 18 is also fed to focus control network 29 which controls the focus of gun 02 of monitor 4 as a function of the size of the insert raster and to a video gain control system 31 for an adjustment of the video gain as a function of the apparent range.

Instead of using a separate sync pulse generator 22 the sync pulse generator 1 could supply the sync pulses for the field and line sweep generators 23 and 24, as well as the field and line sweep generators 25 and 26, if the same field and line frequencies can be used both for the relatively coarse large-area background display system and the high-resolution, small-area target display system.

The system described can be used for the visual simulation of an aircraft carrier landing trainer. The background could consist, for example, of a transparency carrying a picture of the ocean surface, as well as the horizon line and a skyscape.

The transparency is mounted in a two-directional displacement system for X AND Y motion and is rotatable either within the system or by rotating the entire displacement system. Three servosystems control this mounted mechanism in such manner that the picture received by the background camera corresponds to the roll, pitch, and yaw orientation of the aircraft. Other mechanical arrangements can be made; for example, the background transparency may be movable in X and Y direction only, while the rotation of the background display is achieved by rotating the camera.

A model of the target 17, for example, an aircraft carrier, is mounted on a plate. The plate is gimballed and the gimballed system is rotatable. The proper orientation with respect to the aircraft orientation is also achieved by three servosystems.

Instead of using a transparency which represents a still picture, a film may be used which is slowly moved parallel to the horizon and thereby simulates motion of the clouds and of the water. This system is also driven by three servosystems to present the proper orientation of the insert with respect to cameras 15 and 21.

The surface of the mounting plate of the insert facing the camera system is neither reflecting nor radiating so that only the target model generates video signals in the cameras 15 and 21 and only the target proper is blanked out from the background and inserted into the background.

To provide a display for the observer that corresponds to the aircraft orientation, the six servosystems for the orientation of the background and the insert are preferably controlled by the program control computer.

FIG. 2 shows a system in which two monitors, cathode-ray tubes 104 and 105, are used and in which the pictures which are generated by these two monitors are projected over two optical systems 106 and 107 onto a preferably spherical screen 108.

A monitor 104 provides the picture of the background while a monitor 105 provides the high-resolution insert. The circuitry controlling the monitor 104 is essentially the same as the one used for controlling gun 01 of monitor 4 shown in FIG. 1; that is, sync pulse generator system 1 via pulse delayers 2 and 7 controls field sweep generator 3 and line sweep generator 8 which in turn control the deflection means of monitor 104. Field sweep generator 5 and line sweep generator 9 control the deflection system of main camera 6 which is looking at the background 30. The orientation of background 30 with respect to the camera 15 is controlled in pitch, roll and yaw as described before. The video output of main camera 6 is fed through an inhibitor circuit 10 to the video control system of monitor 104.

Variable pulse delayers 11 and 12 control the field and line sweep generators 13 and 14 which in turn control the deflection systems of the blanking signal camera 15, the video output of which provides the inhibiting, blanking signals to the inhibitor circuit 10. Camera 15 is directed via a beam splitter 16 to the insert scene 17, the position of which in respect to cameras 15 and 21 is controlled as described previously. The range control signal provided via line 18 controls the slope of field and line sweep generators 13 and 14 and thereby controls the apparent size of the insert scene with respect to the background scene.

However, the apparatus of FIG. 2 differs from the system described and shown in FIG. 1 in that the position of the insert with respect to the background, that is , the amount of pulse delay in pulse delayers 11 and 12, is not controlled directly by the program control computer but by signals via lines 119 and 120 derived from sensor means which are associated with position control means 109 of monitor 105, the function of which will be explained later.

Insert camera 21 provides the insert video signal to monitor 105. A field and line sync pulse generator 22 controls the field and line sweep generators 23 and 24 which control the deflection means of camera 21. Field and line sweep generators 25 and 26 which are also synchronized by the sync signal from sync signal generator 22 provide the deflection signal to the deflection means of monitor 105. Both field and line sweep generators 25 and 26 receive a range control signal via line 18, which controls the amplitude and thereby the slope of these deflection generators and thereby controls the size of the presentation of monitor 105. The range control signal from line 18 is also fed to a focus control system 29 which adjusts the focus and if desired also the gain of the video signal of the insert video by means of a video gain control 31.

While background monitor 104 may be mounted in fixed position to projection screen 108 the monitor 105 is mounted

in a structure **109** which makes it possible to change the orientation of the insert projection system consisting of monitor **105** and optical system **107** in azimuth and elevation. The azimuth and elevation control signals are derived from the program control computer and are fed over lines **127** and **128** to the position control system **109**. Misalignment of the blanked-out area in the background and the projected insert caused by slack in the motion of the projection system **105/107** is avoided since the pulse delays of pulse delayers **11** and **12** are controlled by the sensor means associated with position control means **109** via lines **119** and **120**.

The above-described embodiments of the invention are given as examples only. Other arrangements can be made within the scope of this invention. For example, in a system for an aircraft carrier landing trainer in which not only the aircraft carrier but also landing lights have to be appropriately displayed to the observer the background model may be arranged as described hereinbefore whereby the transparency or film is movable in a single plane only and the apparent rotation of the background is provided by a rotation of the background camera. The system uses a background display monitor system as described in connection with FIG. **2** while the insert display system consists of two mechanically linked monitors; one for the carrier and one for the landing lights. This monitor system is rotatable about its center axis so that the rotation of the target insert monitor coincides essentially with the rotation of the landing light monitor. The system is also rotatable in azimuth and elevation. The proper position and size of the landing lights as a function of the carrier position heading and range and the cockpit orientation in pitch, roll and yaw is processed by the program control computer. The monitor generating the colored landing lights may be a conventional color television tube.

This monitor system is shown in FIG. **3** in schematic form. A target monitor **201** with the attached lens system **202**, as well as a landing light monitor **203** with the attached lens system **204** is mounted on a plate **205**. The plate **205** is rotatable by a servo driven shaft **206** and the bearings of shaft **206** are mounted on a shaft **207** which is also servo driven and held by the bearings system **208**. This whole system is rotatable via shaft **209** which is also servo driven and mounted in the fixed bearing system **210**. Both monitors **201** and **203** are thereby solidly linked together and focused to the same area of the display screen **211**.

Instead of using two cameras for the target generator, one to provide the inhibiting cutout signal to the main background video signals and another one to provide the video signals for the insert monitor, a single camera can be used to perform both functions.

FIG. **4** shows that part of an embodiment of such a system which would replace corresponding components of the system shown in FIGS. **1** and **2**.

A target camera **415** looking at a target **417** is controlled by a frame sweep signal generator **413** which receives the frame sync pulses of the main system delayed to place the target appropriately into the background.

A line sweep signal generator **414** of a single target camera **415** receives the appropriately delayed line sync pulses provided by the sync pulse generator **1** of the main system and additional sync pulses from the line sync pulse multiplier **416** which is activated by a line sync pulse from generator **1**. This makes the camera **415** scan several lines during the interval between successive line scans of the background camera **6** of the system of FIG. **1**. The line sync pulse multiplier may, for example, increase the line pulse repetition rate **5** fold. Multiplier **416** activates sweep generator **414** when a line sync pulse is received from generator **1**, then furnishes several successive additional pulses to activate **416** before the next line sync pulse is received from generator **1**. The camera **415** is connected to monitor **4** of FIG. **1** to provide a high-resolution video signal to the insert gun of the monitor while the other gun is displaying the surrounding background area. Similar connections would be made to monitors **104** and **105** if a single target camera is used with the apparatus of FIG. **2**. Target camera **415** is also connected through an inhibitor **418** to inhibit circuit **10** of FIG. **1** which passes or inhibits the background video, depending on the state of gate **418** and the video output signal from target camera **415**.

To assure that the video signal of the camera **415** is inhibiting the background camera video only, while the line sync pulse initiated sweep of camera **415** provides video signals, inhibitor **418** releases inhibiting signals to the background camera inhibitor **10** only during line scans which are directly initiated by the line sync pulses from generator **1** but not during line sweeps that are initiated by the line sync pulses derived from the line sync pulse multiplier **416** during the interval between successive line pulses from generator **1**.

To achieve this, a flip-flop **440** is provided which furnishes and inhibition signal to inhibitor **418** during the interval between successive line sync pulses from generator **1** if one of the sync pulses from multiplier **416** is present (but not during the sync pulse from generator **1**). An OR gate **441** turns the inhibiting signal to inhibitor **418** on, if only a sync pulse from sync pulse multiplier **416** is present but no initiating line sync pulse is present, and an AND gate **442** turns the inhibitor **418** on when a sync pulse from **1** and one of the sync pulses from **416** coincide.

What is claimed is:

1. In a simulator-type training device having display means for projecting a background image and one or more movable foreground images, the improvement comprising:

means for blanking an area in a background image proportional to a foreground object, means for inserting a foreground image in the blanked area, and electronic means for electronically varying the size, position, and aspect of said blanked area and said inserted image simultaneously,

said display means include a multigun cathode-ray display tube system and a plurality of television cameras, connecting means connecting said cameras to said cathode-ray tube system for transmitting video information from said cameras to said cathode-ray tube system to produce said background image by one cathode-ray gun display and said foreground image by another cathode-ray gun display, said connecting means including means to operate said cameras at different scanning rates.

2. THe apparatus of claim **1**, wherein said plurality of television cameras include a background camera positioned to scan a background scene and one or more model cameras positioned to scan one or more models to derive video information to produce said background image and at least one foreground image.

3. The apparatus of claim **2**, said cathode-ray tube system including at least two electron guns, said background camera being connected to furnish video signals to control a first of said electron guns, an inhibiting circuit connected between said background camera and said first electron gun to inhibit the video signal to said first electron gun when a signal is present on a control input of said inhibit circuit, and a model camera having a video output connected to said control input of said inhibit circuit.

4. THe apparatus of claim **3**, wherein said means for inserting said foreground image comprises a second model camera connected to furnish video signals to a second electron gun of said cathode-ray tube system.

5. The apparatus of claim **4**, including a single model, a beam splitter arranged to produce two optical images of said model, said first model camera being positioned to scan a first of said images, said second model camera being positioned to scan a second of said images.

6. The apparatus of claim **3**, the video output of said model camera being connected to furnish video signals to a second electron gun of said cathode-ray tube system to thereby inset an image of said foreground object.

7. The apparatus of claim **6**, and including synchronizing means for providing a plurality of synchronizing frequencies,

means connecting said synchronizing means to said background camera, said monitor, and to said target camera, said target camera having a scanning rate higher than the scanning rate of said background camera in order to provide a higher resolution insert image.