

A MULTI-DISPLAY ILLUMINATED SYSTEM

FIELD OF THE INVENTION

The present invention relates generally to an illuminated multi-display apparatus. The invention further relates to a method of composing a multi-image from a plurality of source images.

BACKGROUND TO THE INVENTION

10 The specification of International patent application No. PCT/GB98/00800 describes a poster display system where a masking grid is moved back and forth across an image grid to create the visual effect of different and separate images gradually fading or merging one into the other.

15 The image grid is formed with a multiplicity of image strips with adjacent strips defining portions of different images. The masking grid has alternate opaque and transparent strips which are configured and overlayed on the image grid to reveal selected ones only of the

20 multiplicity of image strips. The specification of PCT/GB98/00800 focuses on specific constructional details of the poster display system and in particular "compression means" which promote intimate contact between the image and masking grids. Back and forth movement of

25 the masking grid is effected by rotation of a cam in one direction which has a peripheral surface shaped so that it engages a roller which is mounted to a front plate. The front plate is coupled to the masking grid whereby rotation of the cam via a motor provides the required

30 movement of the masking grid.

The specification of International patent application No. PCT/IB98/02137 describes an illuminated display device

which functions in a similar fashion to the poster display system of PCT/GB98/00800. The display device of PCT/IB98/02137 includes a relatively complicated mechanical drive arrangement for sliding the masking grid
5 back and forth across the image grid. The mechanical drive arrangement includes a pair of opposing rollers to which opposing edges of the masking grid are fixed. One of the drive rollers is rotationally oscillated via a lever which is moved up and down by a cam which engages
10 and drives a fulcrum to which the lever is connected. The cam is fixed to a motor which when rotated in one direction effects the rotational oscillation of the drive roller via the lever, fulcrum and cam arrangement.

15 SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided an illuminated multi-display apparatus comprising:

20 a display frame being adapted to mount a multi-image film and a shutter film which are configured to overlay one another, the multi-image film including a series of adjacent strips of different images and the shutter film having a series of opaque and transparent strips of predetermined widths;

25 a linear actuator mounted to the display frame and operatively coupled to the shutter film or the multi-image film; and

digital control means electronically coupled to the linear actuator to effect a reciprocating sliding movement
30 of the shutter film whilst the multi-image film is fixed stationary to the display frame, or vice versa, said films being aligned wherein the transparent strips of the shutter film reveal strips of one of the images of the

multi-image film whilst the other image strips are obscured by the opaque strips of the shutter film and thereafter movement of the multi-image or the shutter film gradually reveals another of the images of the multi-image
5 film.

Typically the shutter film and the multi-image film are shaped orthogonal.

10 Preferably the linear actuator is one of a pair of linear actuators both being operatively coupled to an edge of the shutter film or the multi-image film. More preferably an opposing edge of the shutter or the multi-image film is coupled to the display frame via biasing means wherein
15 said film is suspended across the display frame. Generally the biasing means is in the form of one or more tension springs connected at opposing ends to the display frame and the shutter or the multi-image film, respectively.

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Typically the digital control means comprises a processor circuit and a user interface electronically coupled to one another, the processor circuit being configured to provide a digital signal to the linear actuator so as to control
25 the reciprocating sliding movement of the shutter or the multi-image film. More typically the user interface is in the form of a control panel.

Preferably the processor circuit includes at least one
30 processor integrated circuit, a storage integrated circuit and a linear actuator control circuit, said processor integrated circuit being configured to provide a digital drive signal to the actuator control circuit for effective

reciprocating movement of the shutter or the multi-image film via the linear actuator. More preferably the storage integrated circuit is in the form of an E²PROM being designed to store data such as shutter film alignment data. Generally the linear actuator circuit is one of a pair of said circuits each being configured to provide the digital signal to the respective linear actuator.

Preferably the digital control means includes a position sensor which provides positioning reference to the processor circuit. More preferably the position sensor is one of a pair of sensors being incorporated in the linear actuator.

Typically the processor circuit includes an auxiliary input and output interface for implementing additional/optional functions such as synchronisation, controlling external device and/or receiving control signal from external device.

Preferably the linear actuator includes a stepper motor having an output shaft being designed to engage a slide member which is guided by a sleeve or track, the stepper motor being electronically coupled to the digital control means so as to rotate the output shaft in opposing rotational directions and effect reciprocating movement of the slide member which is operatively coupled to the shutter or the multi-image film. More preferably the slide member is coupled to the shutter or the multi-image film via a coupling element which is configured to detachably engage the slide member and the shutter or the multi-image film for its reciprocating movement.

Preferably the apparatus also comprises a housing in which the display frame is mounted. More preferably the housing includes a front and a rear panel hinged to one another, the front panel having a transparent viewing window and
5 the rear panel being adapted for mounting of the apparatus. Generally the display frame is hinged to the rear panel to provide access to both the front and rear of the display frame.

10 Generally the multi-image is composed from two (2) to four (4) source images or files.

According to another aspect of the present invention there is a method of composing a multi-image from a plurality of
15 source images, said method comprising the steps of:

opening each of a plurality of source files containing source image data corresponding to the respective plurality of source images;

selecting predetermined strips of said source image
20 data from each of the plurality of source files; and

storing said strips of source image data in a target file having image data corresponding to the multi-image, said strips being stored at assigned addresses in the target file.

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Preferably the step of selecting predetermined strips of image data involves calculating and initialising read addresses for each of the source files. More preferably said step also involves reading said strips of image data
30 from assigned of the read addresses for each of the source files.

Preferably the step of storing said strips of image data in a target file involves calculating and initialising write addresses for the target file. More preferably said step also involves writing said strips of image data from
5 each of the source files to assigned of the write addresses of the target file.

Typically the method involves a preliminary step of analysing each of the source files to ensure they are
10 compatible with subsequent steps. More typically said preliminary step includes but is not limited to a check of each of the source files in relation to:

- i) the tagged image format (TIF) version;
- ii) the colour mode;
- 15 iii) the compression settings; and/or
- iv) the photometric interpretation settings.

Generally the multi-image is composed from two (2) to four
20 (4) source images or files.

Alternatively or additionally the method involves creation of a shutter image including a series of adjacent transparent and opaque strips, the shutter image being configured to overlay or underlay the multi-image wherein
25 the transparent strips are substantially aligned with and thus reveal one of the predetermined strips on the multi-image which are from one of the source images.

Typically the method further comprises the step of writing
30 registration marks image data to a predetermined address of the target file, said registration data providing registration marks on the multi-image which assist in alignment of the multi-image with a shutter image.

Additionally or alternatively the method involves writing of the following data to predetermined addresses of the target file:

- 5 i) colour reference bar; and
- ii) other assistant marks.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to achieve a better understanding of the nature
10 of the present invention a preferred embodiment of an illuminated multi-display apparatus and a method of composing a multi-image from a plurality of source images will now be described, by way of example only, with reference to the accompanying drawings in which:

15 Figure 1 is a perspective view of an illuminated multi-display apparatus partly opened;

Figure 2 is a front elevational view of a display frame of the multi-display apparatus of Figure 1;

Figure 3 is a side elevational and enlarged sectional
20 view of the display frame of Figure 2;

Figure 4 is perspective and elevational views of a linear actuator taken from the multi-display apparatus of Figure 1;

Figure 5 is a logic flow sheet of digital control
25 means of the multi-display apparatus of Figure 1;

Figure 6 is a schematic illustration of a user interface;

Figure 7 is a block diagram of the overall structure of a method of composing a multi-image from a plurality of
30 source images according to one embodiment of the invention;

Figure 8 shows two sample screens of a user interface of the method of Figure 7;

Figure 9 is a flow chart showing various steps involved in analysing data of source files of each of the source images; and

Figure 10 is a flow chart of the various steps involved in composing a multi-image from the source files.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figure 1 there is one embodiment of an illuminated multi-display apparatus 10 comprising a display frame 12 mounted between a front and a rear panel 14 and 16 which are hinged to one another. The multi-display apparatus 10 is designed to function in a similar manner to the poster display systems of the admitted prior art where a shutter film is moved back and forth across a multi-image film.

The display frame 12 is hingedly connected to the rear panel 16. The front and rear panels 14 and 16 together form a housing. Generally, the multi-display apparatus 10 is mounted to a wall or other support structure by one or more brackets (not shown) fixed to the rear panel 16. The front and rear panels 14 and 16 include perimeter frames 18 and 20, respectively, fabricated in this example from spray painted or powder coated steel. The front panel 14 includes a transparent plastic, toughened glass or polycarbonate window 22 mounted across its frame 18. The front panel 14 also includes locking means (not shown) designed to releasably engage the rear panel 16 so as to inhibit tampering.

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As shown in Figures 2 and 3 the display frame 12 is shaped generally orthogonal with a pair of opposing longitudinal elements 24A and 24B interconnected at adjacent ends by

transverse elements 26A and 26B. A transparent plastic sheet 28 is in profile shaped similar to the display frame 12. The plastic sheet 28 is fixed to the opposing transverse frame elements 26A and 26B so that it bows slightly outwards. A multi-image film 30 is fixed stationary to the display frame 12. A shutter film 32 intimately overlays the shutter film 30. Both the multi-image and shutter films 30 and 32 are in profile shaped orthogonal and are of similar dimensions to the display frame 12. Opposing transverse edges of the shutter film 32 are coupled to the respective upper and lower transverse frame elements 26A and 26B via biasing means which is in the form of a series of tension springs such as 34.

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Importantly, the multi-display apparatus of this example includes a pair of linear actuators such as 36 mounted to the display frame 12 and operatively coupled to the shutter film 32. The linear actuators 36 are designed to effect a reciprocating sliding movement of the shutter film 32 across the multi-image film 30 which is fixed stationary to the display frame 12. Thus, in operation transparent strips of the shutter film 32 reveal strips of one of the images of the multi-image film 30 whilst the other image strips are obscured by opaque strips of the shutter film 32. Thereafter, movement of the shutter film 32 gradually reveals another of the images of the multi-image film 30.

30 As best shown in Figure 4 each of the linear actuators 36 of this embodiment include a stepper motor 38 having an output shaft 40 which is designed to engage a slide member 42 whereby rotation of the shaft 40 in opposing rotational

directions effects reciprocating movement of the slide member 42. The output shaft 40 includes a helical groove or "thread" which engages a corresponding shaped groove (not shown) in the slide member 42. The slide member 42
5 is guided by a sleeve such as 44 with which it slidably engages. In this particular construction of the multi-display apparatus 10 the linear actuator 36 is mounted to the upper transverse frame element 26A.

10 As shown in Figures 4 and 5 a position sensor 48 is incorporated in each of the linear actuators of this embodiment. The sensor 48 is electronically connected to the controller PCB 52 to provide positioning reference. In this embodiment, the sensor 48 is triggered when the
15 slide member 42 reaches its highest "home" position.

As shown in Figure 3 each of the linear actuators such as 36 are coupled to the shutter film 32 via a coupling element 46. The coupling element 46 is in this example in
20 the form of an elongate hook member which at one end is coupled with the slide member 42 and at an opposite hooked end releasably engages an opening (not designated) in a corner portion of the shutter film 32. Reciprocating movement of the slide member 42 as effected by the stepper
25 motor 38 thus translates reciprocating movement to the shutter film 32 via the coupling element 46.

The multi-display apparatus also comprises digital control means electronically coupled to each of the linear
30 actuators 36 so as to control the reciprocating sliding movement of the shutter film 32 across the multi-image film 30. Figure 5 is a logic flow diagram depicting one form of the digital control means shown generally as 50.

The digital control means comprises a processor circuit 52 and a user interface which is in the form of a control panel 54. The processor circuit 52 is configured to provide a digital signal to each of the linear actuators
5 such as 36 so as to control the reciprocating sliding movement of the shutter film 32. The processor circuit 52 includes a processor integrated circuit 56, a storage integrated circuit 58, and a linear actuator control circuit 60. The processor integrated circuit 56 is
10 configured to provide a digital drive signal to the actuator control circuit 60 for effective reciprocating movement of the shutter 32 via the linear actuator such as 36. The storage integrated circuit 58 in this embodiment is in the form of an E²PROM being designed to store data
15 such as shutter film alignment and timing setting data. The linear actuator circuit 60 is one of a pair of circuits each being configured to provide a respective digital signal to each of the linear actuators such as 36. Additionally, the processor circuit 52 also includes an
20 auxiliary input/output interface 68 which is configured to transmit and/or receive digital signals such as synchronisation trigger signal.

Figure 6 schematically illustrates one form of a user
25 interface or control panel 54 of the illuminated multi-display apparatus 10. This control panel includes a three-digit display unit 62, three control buttons marked "-", "F" for function, and "+", together with a reset button marked "R". The control panel is connected to the
30 processor circuit via a detachable cable 66. The control panel 54 allows a user to configure the way in which the multiple images are displayed and also allows a user to perform shutter film alignment when necessary. In normal

operation the linear actuators such as 36 which are controlled by the processor unit 52, synchronously drive the shutter film 32 in a reciprocating sliding motion across the multi-image film 30 so as to effect multi-image display. In a service mode, a user can instruct either of the linear actuators such as 36 to move separately to perform shutter film 32 alignment via the control panel 54. This alignment position for each of the linear actuators such as 36 can then be stored in the integrated circuit of the E²PROM. The user can also program the way in which the multiple images are displayed. Typical programmable options are display time for each image and transforming time between two images.

Figure 7 is a block diagram of the general structure of a method of composing a multi-image from a plurality of source images. In this embodiment the multi-image is produced on a translucent image film made of Duratrans. The multi-image is the result of a laser photographic output from a target multi-image file. The essence of the invention resides in composition of the multi-image file from a plurality, usually two to four, of source files each containing source image data corresponding to the respective source images. The resultant multi-image of the target file includes adjacent strips defining portions of the different source images. This multi-image is then used in conjunction with a shutter film or masking grid on a poster display system.

The method of this embodiment of the invention allows a user to combine two or more image files to compose a multi-image file so as to accurately produce a multi-image. Similarly, the method has the capability of

producing a shutter image which is configured to be used in conjunction with the multi-image to produce the fading or merging effect of multiple images as described in the prior art.

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Figure 8 shows two sample screens produced by the methodology or software of this embodiment of the invention wherein:

- (i) the user is able to specify the parameters, or in
10 this example the size, of the multi-image target file;
- (ii) details pertaining to the various source files including their location format and properties can individually be specified.

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Figure 9 is a detailed flowchart representing the various preliminary steps involved in analysing and formatting the source image files from which the multi-image is to be composed. These steps are designed primarily to ensure
20 that the source files are compatible with subsequent steps involved in reading data and then writing it to the target file. Otherwise, the specific steps of Figure 9 are self-explanatory and, it should be appreciated, merely exemplary of this embodiment of the invention.

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Figure 10 illustrates another detailed flowchart outlining the various steps involved in composing a target file from the various source files of the source images. The general steps involved in composing the multi-image file
30 are as follows:

- (i) each of the source files is opened and the respective image data checked to ensure that it is of an appropriate and compatible format;

- (ii) a target file is created with a specified strip data size;
- (iii) image data is read from each of the source files at predetermined addresses;
- 5 (iv) the image data read from the source files is written to the target file at assigned addresses;
- (v) the multi-image data file can then be outputted directly from a computer to a laser photographic device to produce the multi-image itself.

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Otherwise, the specific steps in composing the multi-image target file are detailed in the flowchart of Figure 10. The software of this embodiment of the invention also has the capability of producing "registration marks" in the multi-image to assist in alignment of the image strips with that of a shutter image. Conveniently, the adjacent transparent and opaque strips of the shutter image may be produced from the software of this broad aspect of the invention and wherein the shutter is made of image setting film. The transparent strips of the shutter are composed in a similar manner to the image strips which are extracted from the source image. Therefore, the computerised and digital methods of composing the multi-image and shutter films achieve a relatively high accuracy and consistency with an excellent fade-in/fade-out or merging effect. Accurate alignment of the shutter and multi-image films are also achieved with the assistance of registration marks provided on both films.

30 Now that a preferred embodiment of the invention has been described in some detail it will be apparent to those skilled in the relevant art that at least an embodiment of the illuminated multi-display apparatus and the method of

composing a multi-image from a plurality of source images has at least the following advantages:

- (i) the illuminated multi-display apparatus permits accurate alignment of the shutter and multi-image films via the linear actuator and digital control means;
- (ii) by using the digital control means a user can program the display time and transforming speed so as to create different visual effects; and
- 10 (iii) the apparatus can be configured to operate synchronously and/or interactively with other devices;
- (iv) the multi-image apparatus is relatively simple in construction with reduced mechanical parts;
- 15 (v) the method allows for composition of multi-image film having image strips of relatively high accuracy and consistency; and
- (vi) the method provides multi-image film which in conjunction with shutter film provides an enhanced
20 "merging effect".

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described.

25 For example, the transparent window may be in the form of a lens which produces a 3-D image. The apparatus, and in particular the linear actuator, of the described embodiment may be actuated by a timer so that it operates during predetermined periods. The apparatus may also

30 include movement sensors which activate a sound system which is incorporated in the apparatus. It should also be appreciated that the multi-image film as opposed to the shutter film may be reciprocated via the linear actuator

to display the multi-images. The linear actuator need not
be limited to the stepper motor embodiment but rather may
extend to practically any device which provides linear
reciprocating movement which can be controlled via a
5 digital control. In relation to the method of composing a
multi-image, the image data contained in the source files
may be of practically any format or nature provided it can
be extracted and written to a target file. The images of
the source files may be quite similar where the image of
10 the target file then provides animation.

All such variations and modifications are to be considered
within the scope of the present invention the nature of
which is to be determined from the foregoing description.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An illuminated multi-display apparatus comprising:
a display frame being adapted to mount a multi-image
5 film and a shutter film which are configured to overlay
one another, the multi-image film including a series of
adjacent strips of different images and the shutter film
having a series of opaque and transparent strips of
predetermined widths;
10 a linear actuator mounted to the display frame and
operatively coupled to the shutter film or the multi-image
film; and
digital control means electronically coupled to the
linear actuator to effect a reciprocating sliding movement
15 of the shutter film whilst the multi-image film is fixed
stationary to the display frame, or vice versa, said films
being aligned wherein the transparent strips of the
shutter film reveal strips of one of the images of the
multi-image film whilst the other image strips are
20 obscured by the opaque strips of the shutter film and
thereafter movement of the multi-image or the shutter film
gradually reveals another of the images of the multi-image
film.
- 25 2. An illuminated multi-display apparatus as defined in
claim 1 wherein the linear actuator is one of a pair of
linear actuators both being operatively coupled to an edge
of the shutter film or the multi-image film.
- 30 3. An illuminated multi-display apparatus as defined in
claim 2 wherein an opposing edge of the shutter or the
multi-image film is coupled to the display frame via



biasing means wherein said film is suspended across the display frame.

4. An illuminated multi-display apparatus as defined in claim 3 wherein the biasing means is in the form of one or more tension springs connected at opposing ends to the display frame and the shutter or the multi-image film, respectively.

5. An illuminated multi-display apparatus as defined in any one of the preceding claims wherein the digital control means comprises a processor circuit and a user interface electronically coupled to one another, the processor circuit being configured to provide a digital signal to the linear actuator so as to control the reciprocating sliding movement of the shutter or the multi-image film.

6. An illuminated multi-display apparatus as defined in claim 5 wherein the user interface is in the form of a control panel.

7. An illuminated multi-display apparatus as defined in claim 5 or 6 wherein the processor circuit includes at least one processor integrated circuit, a storage integrated circuit and a linear actuator control circuit, said processor integrated circuit being configured to provide a digital drive signal to the actuator control circuit for effective reciprocating movement of the shutter or the multi-image film via the linear actuator.

8. An illuminated multi-display apparatus as defined in claim 7 wherein the storage integrated circuit is in the



form of an E²PROM being designed to store data such as shutter film alignment data and timing setting data.

9. An illuminated multi-display apparatus as defined in
5 any one of claims 5 to 9 wherein the linear actuator circuit is one of a pair of said circuits each being configured to provide the digital signal to the respective linear actuator.
- 10 10. An illuminated multi-display apparatus as defined in any one of the preceding claims wherein the processor circuit includes synchronization signal input and output being configured to effect synchronized display of images from other of the illuminated multi-display apparatus.
- 15 11. An illuminated multi-display apparatus as defined in any one of the preceding claims wherein the linear actuator includes a stepper motor having an output shaft being designed to engage a slide member which is guided by
20 a sleeve or track, the stepper motor being electronically coupled to the digital control means so as to rotate the output shaft in opposing rotational directions and effect reciprocating movement of the slide member which is operatively coupled to the shutter or the multi-image
25 film.
12. An illuminated multi-display apparatus as defined in claim 11 wherein the slide member is coupled to the shutter or the multi-image film via a coupling element
30 which is configured to detachably engage the slide member and the shutter or the multi-image film for its reciprocating movement.



13. An illuminated multi-display apparatus as defined in any one of the preceding claims 5 wherein the digital control means includes a position sensor which provides positioning reference to the processor circuit.

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14. An illuminated multi-display apparatus as defined in any one of the preceding claims also comprising a housing in which the display frame is mounted.

10 15. An illuminated multi-display apparatus as defined in claim 14 wherein the housing includes a front and a rear panel hinged to one another, the front panel having a transparent viewing window and the rear panel being adapted for mounting of the apparatus.

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16. An illuminated multi-display apparatus as defined in claim 15 wherein the display frame is hinged to the rear panel to provide access to both the front and rear of the display frame.

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17. An illuminated multi-display apparatus as defined in any one of the preceding claims wherein the multi-image is composed from two (2) to four (4) source images or files.

25 18. An illuminated multi-display apparatus substantially as herein described with reference to Figures 1 to 6.

19. A method of composing a multi-image from a plurality of source images, said method comprising the steps of:

30 opening each of a plurality of source files containing source image data corresponding to the respective plurality of source images;



selecting predetermined strips of said source image data from each of the plurality of source files; and

storing said strips of source image data in a target file having image data corresponding to the multi-image,
5 said strips being stored at assigned addresses in the target file.

20. A method of composing a multi-image as defined in claim 19 wherein the step of selecting predetermined
10 strips of image data involves calculating and initialising read addresses for each of the source files.

21. A method of composing a multi-image as defined in claim 20 wherein said step also involves reading said
15 strips of image data from assigned of the read addresses for each of the source files.

22. A method of composing a multi-image as defined in any one of claims 19 to 21 wherein the step of storing said
20 strips of image data in a target file involves calculating and initialising write addresses for the target file.

23. A method of composing a multi-image as defined in claim 22 wherein said step also involves writing said
25 strips of image data from each of the source files to assigned of the write addresses of the target file.

24. A method of composing a multi-image as defined in any one of claims 19 to 23 involving a preliminary step of
30 analysing each of the source files to ensure they are compatible with subsequent steps.



25. A method of composing a multi-image as defined in claim 24 wherein said preliminary step includes a check of each of the source files in relation to:

- i) the tagged image format (TIF) version;
- 5 ii) the colour mode;
- iii) the compression settings; and/or
- iv) the photometric interpretation settings.

26. A method of composing a multi-image as defined in any
10 one of claims 19 to 25 wherein the multi-image is composed from two (2) to four (4) source images or files.

27. A method of composing a multi-image as defined in any one of claims 19 to 26 alternatively or additionally
15 involving creation of a shutter image including a series of adjacent transparent and opaque strips, the shutter image being configured to overlay or underlay the multi-image wherein the transparent strips are substantially aligned with and thus reveal one of the predetermined
20 strips on the multi-image which are from one of the source images.

28. A method of composing a multi-image as defined in any one of claims 19 to 27 further comprising the step of
25 writing registration marks image data to a predetermined address of the target file, said registration data providing registration marks on the multi-image which assist in alignment of the multi-image with a shutter image.

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29. A method of composing a multi-image as defined in any one of claims 19 to 28 additionally or alternatively

involving writing of the following data to predetermined addresses of the target file:

- i) colour reference bar; and
- ii) other assistant marks.

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30. A method of composing a multi-image from a plurality of source images, said method being substantially as herein described with reference to Figures 7 to 10.

