

MICROFICHE RECORDING SYSTEM

The present invention relates to apparatus for automatic prevention of unintended double exposure in annotatable archival microfiche recording systems employing an intermediate film to carry a record image from an imaging station to a transfer station where the microfiche film card receives the record image. The invention also relates to use of said apparatus to warn of failure to transfer the image.

There has been developed by the applicant and co-workers an archival hard copy microfiche recording system which reflects light off of a document placed on a document-receiving platform and projects an image of it in greatly reduced form onto an initially transparent intermediate dry silver film strip carried by a film head unit. The film strip is dispensed from a cassette mounted on the film head, and is fed by film advancing means to an imaging region where a selected area of the film strip to be exposed can receive the projected light image. A pressure element presses the selected area of the film strip against a planar backing aperture defining a projection plane and an imaging area, and the film is then exposed to the light image. The film head is next

moved along guides from the imaging station to a developing station, where a hot shoe pressing against the exposed area of the film causes development of the image to form an opaque image in the exposed areas thereof. The film head is then moved to an image transfer station, where the image on the dry silver film is to be replicated on a positive initially opaque microfiche film card of the photo-developing type (See U.S. Patent 4,137,078 issued June 30, 1979, to Izu and Ovshinsky). The microfiche card is held indexed on a movable carriage so that a predesignated frame of the card receives the image on the intermediate film. A pressure element presses the film card and the intermediate film strip together between the output prism of a flash lamp housing and a backing plate. Image transfer is accomplished by energizing the flash lamp to direct light through the intermediate film, immediately rendering transparent the previously opaque areas struck by the high intensity flash lamp light on the selected frame of the microfiche film card. To replicate a new image the film head is returned to the imaging station, where the cycle is repeated.

(17)

The microfiche card may be examined via a "read" mode of the system. With the film head positioned away from the imaging lens, the microfiche film card carriage, which is accurately locatable in x and y directions by means of an indexing system, is moved on a track to a station under the lens. An illumination system is moved next to the microfiche film card carriage and then the chosen frame of the card is projected back to the document receiving area.

The system also possesses the capability of "annotating" or "updating" existing records stored on the microfiche film. This arises from the nature of the two film systems used. The intermediate film is of the reversal type; dark areas on the chosen hard copy replicate as transparent areas and light areas replicate as opaque upon development. Hard copy having black lettering on a white page will thus replicate on the intermediate film as an opaque rectangle with transparent letters. The microfiche film, however, is an initially opaque photodeveloping positive film which is rendered irreversibly transparent where struck by high intensity light during flash exposure. Thus, dark markings on the original docu-

ment replicate as irreversibly transparent images on an otherwise still opaque microfiche film frame. These remaining opaque regions on the microfiche film remain "annotatable," i.e., convertible in that they can be rendered transparent by a subsequent flash exposure. It is this aspect of the microfiche film that allows for updating of microfiche records. As used throughout this disclosure and in the appended claims the term "annotatable" will be understood to refer to a film that is capable of accepting a second image after exposure and development of a first image in the same general region.

Thus, if a copy of a document is imaged on a microfiche film card frame where the indicia on the document are dark lines on a light background, these dark lines are now stored as irreversible clear lines on the microfiche card. To update the microfiche film card with new entries in a specified still convertible area of a microfiche film card frame one prepares on intermediate film a fresh image consisting of the new entries only. This is accomplished by using as a source for the new image a dark-line record on a white background placed on the document receiving platform, e.g.,

typewritten black text on white paper. The new image, consisting after development solely of transparent new entries on an otherwise opaque imaging area, is then replicated at the transfer station onto the microfiche film card frame. These new entries are thus replicated as additional irreversible clear indicia on the selected frame. Proper registry of the new record is achieved by using the "read" mode of the system to assist in orienting the new entries on the document receiving platform before the intermediate film is exposed to receive the new image. Here an image of the chosen frame to be updated is projected back onto the document receiving platform, using the "read" mode previously described. A white sheet of paper bearing the new record indicia is then placed on the document receiving platform and moved around until the new indicia are properly positioned with respect to the projected image of the microfiche film card. The frame is now updated by carrying out a conventional "record" cycle, i.e., the microfiche film card is returned to the transfer station, the film head is moved to the imaging station, whereupon the image of the new record indicia is projected, exposed, devel-

oped, and replicated onto the microfiche film card frame at the transfer station.

Such annotatable systems are inherently vulnerable to record wipeout by an unintended second exposure; accidental selection by the operator of an exposed microfiche film card frame in the belief that it is a fresh one can result in the superposition of a new record image over an old one, with concomitant obliteration of the old record. In one aspect, this invention relates to providing a sensing means to distinguish between fresh frames and exposed ones, and to provide automatic prevention of accidental multiple exposure thereby.

It is equally basic to archival systems that a failure of the system to produce a record image on the microfiche film card be immediately communicated to the operator. In practice this is generally a result of failure of the flash lamp to fire. In another aspect, this invention relates to providing sensing means to detect automatically such a flash failure.

In accordance with one of the features of the invention there is provided in an annotatable microfiche film recording system like that pre-

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vously described means for sensing the reflectivity of a chosen sensing area on a selected microfiche frame, where the sensing area is disposed external to the image of the record copy.

5 Illumination means are provided to render the sensing area irreversibly transparent by photo-development during the process of replicating the intermediate film image of the record copy on the microfiche frame. Control means responsive to the
10 sensing means are provided to disable the source of illumination employed for the replication process when a clear non-reflecting sensing area is detected, for preventing accidental double exposure of the microfiche frame.

15 A specific feature of the invention comprises making the sensing means in the form of a light source and a photodetector to sense the reflectivity of the sensing area.

Another specific feature of the invention
20 comprises incorporating the light source and photodetector into the backing element used during the replication process.

In accordance with another feature of the invention, an operator controlled override of the
25 disabling of the source of illumination permits

the subsequent double exposure necessary for annotating or updating a frame.

A further feature of the invention comprises providing an alarm means responsive to the control means so as to warn the operator that the frame chosen has a prior image on it.

In accordance with another feature of the invention the sensing means includes a light sensing means disposed to detect the passage of the light from the source of illumination employed in the replication process through the sensing area. Failure to detect a light pulse, even during the initial exposure, indicates failure of the source of illumination. Control means responsive to failure to detect such a pulse are provided. An alarm means responsive to the control means are provided to warn the operator of illumination failure.

In accordance with another feature of the invention illumination failure during exposure of a previously unexposed frame is achieved by a second reflection sensing after exposure. Detection of a reflecting sensing area during this second sensing is indicative of illumination failure. Similar control and alarm means serve to warn the operator.

According to the invention there is provided a microfiche film recording system for forming and storing images of record copy including means for forming an image of the copy within a prescribed imaging area of an intermediate photographic film in which any portion of the imaging area can be imaged by radiant energy from the record copy to yield an image upon development in those regions of the imaging area illuminated by the radiant energy, means for replication of the image onto an annotatable microfiche photographic film by directing radiant energy from a frame illumination means through the imaging area of the intermediate film and onto the microfiche photographic film thereby forming an image on the microfiche photographic film being an annotatable permanent record formed by the absorption of the radiant energy as it strikes the microfiche photographic film and the microfiche film having designated frames for receiving the image at prescribed locations on the microfiche film, means for exposing a given sensing area on the microfiche photographic film during replication so that the status of the sensing area after replication constitutes a permanent indication that the selected frame has been exposed, each of the frames having a unique corresponding sensing area associated therewith and each corresponding sensing area being disposed so as not to substantially interfere with replication of the record copy, status sensing means for sensing the status of the corresponding sensing area for a chosen frame before replication, disabling control means responsive to the status sensing means for disabling the replication means when the status sensing means detects a status of the corresponding sensing area indicative of prior exposure of the chosen frame, means for adding an additional image to a previously exposed frame of the microfiche film utilizing the means for replication, and operator controlled means for overriding the disabling control means which is selectively operable to permit adding of an additional image.

The preferred embodiment of this invention will now be described by way of example, with reference to the drawings accompanying this specification in which:

5 Fig.1 is a block diagram of the control circuitry of the microfiche recording system and the optical sensing system of the invention;

10 Fig.2 is a perspective view of a travelling film head including an intermediate film dispensing cassette positioned at the imaging station with a film head cover in the open position to show details of the film dispensing system;

Fig.3 is a perspective view of the travelling film head and a carriage therefor movably mounted on guides;

15 Fig.4 is a perspective view of the lens shroud and backing pad in position at the imaging station for initial imaging of the intermediate film;

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Fig. 5 is a perspective view of the developed recorded image on the intermediate film after development by the hot shoe at the developing station;

5 Fig. 6 is a plan view of a portion of an initially opaque microfiche film card, showing pre-formed indexing markings;

 Figs. 7A-7C are elevational views of the imaging region between the payout and takeup lips
10 of the intermediate film head of Fig. 2 at the imaging, developing, and transfer stations;

 Figs. 8A-8C are plan views showing the effects of superposition of intermediate film image, microfiche indexing markings, and flash prism
15 boundaries in two embodiments of the invention;

 Fig. 9 is a side sectional view of the film advance sensor and encoder wheel assembly of the film head; and

 Figs. 10A and 10B are partially sectioned
20 side and front elevational views respectively of a portion of the film head in position for image transfer to the microfiche card, and show the sensing foot in place for image sensing and flash detection.

Fig. 1 includes a block diagram of the control system for sequencing the operation and movement of an intermediate film head 1 and a head carriage 2 between various stations of a microfiche recording system. Head carriage 2 is advanced to the various stations illustrated in Fig. 1 by tension in a belt 3 extending between an idler pulley 4 and a motor driven pulley 5. A pulley drive motor 6 is controllably driven in both directions by a system timing and control circuit 7 operating through a motor control circuit 8. The stations illustrated are an imaging station 10, where the exposed area of the initially transparent intermediate film strip on film head 1 is exposed to a light image, such as light reflected off of a hard copy, a heat-applying developing station 12 where the light-exposed areas of the intermediate film are rendered opaque, and an image transfer station 14. A microfiche film card carriage 16 at image transfer station 14 positions, under control of a fiche carriage position control means 18, a selected frame of a microfiche film card 20 for reception of an image last formed on the film strip carried by intermediate film head 1. Microfiche film card 20 is

preferably made from a photo-developing initially opaque archival film of the dispersion type disclosed in U.S. Patent No. 4,137,078 issued to Izu and Ovshinsky, wherein a transferred image is

5 formed automatically upon exposure to a high intensity flash of radiant energy, such film being completely insensitive to exposure to normal room ambient light or even direct sunlight. The film carried by the film head is preferably more light

10 sensitive and is latently imaged by the relatively less intense light reflected and imaged from hard copy. The intermediate film carried by the film head is preferably a dry-silver heat-developed film.

15 As used herein, the term film head refers to a frame removably attached to a carriage, and a film supply unit removably mountable on the frame. Film head 1 carries a film supply means E, a film takeup means F, and a film clamping or holding

20 means B. In various embodiments of the invention all three are sequentially controlled by system timing and control circuit 7. For example, supply means E may include a supply reel or cassette, and various guide rollers as well as film driving

25 means where the supply reel is to be driven. Film

takeup means F may include a takeup reel and guide roller means as well as film tensioning means and takeup reel drive means. In addition, intermediate film head 1 may include an end-of-film sensor D which may respond to a marking on the intermediate film. Intermediate film head 1 may also include a tension sensor G responsive to tension in the film. End-of-film sensor D and tension sensor G perform control functions which respond to end-of-film or film breakage and disable operation of the system under these circumstances. A film break warning means 25 and an end-of-film warning means 25' serve to warn the operator of such situations. Intermediate film head 1 may also include a film head interlock switch C which communicates the status of a light sealed film dispenser cover to system timing and control circuit 7, so that the system cannot be operated with the cover open and the intermediate film inside thus subject to light fogging.

Initially, intermediate film head 1 is moved to motor imaging station 10, where an imaging area of the film strip is placed under a projection lens 21 contained in a lens shroud 22 (see Fig. 7A). Film clamping means B is actuated to a film

release condition and an area of fresh intermediate film strip is advanced into the imaging area by driving the supply or takeup means E or F. Payout length is governed by the film movement sensing means A, which effects generation of electrical signals measuring the length of film payout to the system timing and control circuit 7, the number of which measures the payout length. After the requisite film advance, the system timing and control circuit 7 stops driving of the film supply or takeup means E or F and actuates the clamping or holding means B back to a film holding condition, whereupon a signal from the system timing and control circuit 7 raises a backing pad 26 up against a pad limit stop 23. A subsequent command from system timing and control circuit 7 actuates a lens shroud moving means 21' to lower lens shroud 22 to clamp the intermediate film between backing pad 26 and the base of lens shroud 22. A document receiving platform 28 is next illuminated by flash lamps 30 and 32 energized by an exposure pulser 34 on command from system timing and control circuit 7, the image of the platform and its contents being relayed to projection lens 21 by two mirrors 36 and 38. On command, a pad lifting solenoid 24

drops backing pad 26, and lens shroud moving means 21' lifts lens shroud 22, thereby releasing the film. Intermediate film head 1 is now moved to developing station 12, where a shoe lifting solenoid 40 controlled by system timing and control circuit 7 raises a hot shoe 42 (see Fig. 7B) against an imaging area 9 (see Fig. 2) of a film strip 71 for a predetermined length of time set by system timing and control circuit 7, whereupon shoe lifting solenoid 40 drops hot shoe 42. Intermediate film head 1 is then moved to a position which places imaging area 9 of film strip 71 over a flash prism 44 on a flash housing 46. A selected frame of microfiche film card 20 on microfiche film card carriage 16 is moved into appropriate position over flash housing 46 with system timing and control circuit 7 controlling fiche carriage position control means 18. The desired frame of microfiche film card 20 is selected by operation of keys of a keyboard 17 which cause control circuit 7 to operate fiche carriage position control means 18. On command of system timing and control circuit 7, a flash lifting solenoid 48 raises flash housing 46 against a limit stop 49. A backing element 50 is lowered by the backing element

moving means 51 so as to press the imaging area of the intermediate film strip into intimate contact with microfiche film card 20 and backing element 50 (see Fig. 7C). Image transfer is achieved by triggering the flash tube (not shown) in flash housing 46 by a command from system timing and control circuit 7 operating through a flash pulser circuit 52. Immediately after exposure, lifting solenoid 48 drops flash housing 46, and backing element moving means 51 raises backing element 50, thereby releasing the two films.

Pad lifting solenoid 24 and a projection light source 11 are mounted on an image station carriage 13. A station carriage position control means 15 is commanded by system timing and control circuit 7 to position either pad lifting solenoid 24 or projection light source 11 under lens 21. For reading or updating a microfiche, fiche card carriage 16 is moved by fiche carriage position control means 18 to a position under lens 21, and projection light source 11 is moved into position below it so as to project the image on the microfiche back onto document receiving platform 28 for inspection and, where an add-on of information is to be made on the frame of the microfiche card

involved, an overlay of the added information can be properly positioned over the projection image. The recording system carries out the desired "read," "record" and microfiche frame positioning operations as commanded by the operator by depressing the appropriate keys on keyboard 17 connected to system timing and control circuit 7. System timing and control circuit 7 is powered by a power supply 55 connected to the power line by a main power switch 53 and a system interlock switch 57 actuated to an open position by opening a system access door (not shown). In the exemplary form all sequencing and sensing operations are carried out by a program stored in a minicomputer memory, the minicomputer constituting a portion of system timing and control circuit 7. Computer control is not, however, essential to the claimed subject matter of this disclosure; manual switch sequencing of conventional circuitry could alternatively be employed.

Refer now to Figs 2 and 3 which show the details of an exemplary intermediate film head 1. Fig. 3 shows intermediate film head 1 removably mounted as by screws 63 on head carriage 2 guided for horizontal movement on guide rods 61. Fig. 2

shows intermediate film head 1 positioned at imaging station 10. Backing pad 26, hot shoe 42, flash prism 44, and projection light source 11 are also shown. Intermediate film head 1 is shown as including a film supply section 1A including a removable film dispensing cassette 62 mounted on a film head frame 64 and held in position by a cassette support ledge 66. Intermediate film strip 71 exits cassette 62 through a slot 74 in a top ledge 70, passing next around an idler roller 76 where it presses against a compliant friction pad 78 which places a drag force on film strip 71, and thence through an end-of-film sensor unit 80. Film strip 71 then passes around an encoder roller 82 and back over a film clamp lifter 84, then over a clamping block 86 where it then exits the film supply section between a payout lip pad 88' and a pad (not shown) mounted on a film head cover 89 and over a payout lip 88, where one frame width of the film strip is exposed for external processing at what may be called an imaging area of the film head.

In this embodiment the film holding or clamping function is achieved by a short clamp blade (not shown) mounted inside film head cover 89.

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When film head cover 89 is closed, the blade presses down on film strip 71 to pin it to clamping block 86. Film head cover 89 is tensioned down by a loading spring (not shown). Clamping release is achieved by a solenoid (not shown) drawing down the exterior end of a pivoted lift bar 114, thus raising the interior end of the lift bar carrying film clamp lifter 84 to force the lifter into contact with the interior face of film head cover 89 against the force of the loading spring. This raises film head cover 89 sufficiently to raise the clamp blade out of its film engaging position, thereby releasing film strip 71.

Film head frame 64 has a large open region 91 between film supply section 1A and a film takeup section 1B of intermediate film head 1. This open region receives backing pad 26, hot shoe 42 and flash housing 46 at imaging, developing and image transfer stations 10, 12 and 14. The film passes over a takeup lip 90 on the takeup side of the imaging area and then proceeds over a dancing roller 94 carried on an arm (not shown) tensioned by a spring (not shown) which forces the roller away from the takeup lip 90, and serves to keep the film under tension. The film then winds on a

motor driven takeup reel 98 driven by a takeup motor (not shown) mounted on film head frame 64. Takeup reel 98 is mounted on a drive shaft 98' which makes connection to the motor in any suitable way, such as by a pulley belt coupling so that the entire intermediate film head 1 can be removed from head carriage 2, as by removing screws 63-63 and raising intermediate film head 1 therefrom, where the film can be threaded through the film head conveniently away from head carriage 1.

Fig. 9 shows details of an intermediate film feed control means incorporated in the film head and shown in the drawings. This means responds to rotation of encoder roller 82, the rotation of which is detected by a light sensing unit 126 mounted on film head frame 64, and which monitors the passage of opaque interruptor lines 128 on a transparent encoder wheel 130 attached to the outboard end of an encoder roller shaft 132, wheel 130, shaft 132, and roller 82 being rigidly interconnected. The passage of one of lines 128 interrupts a light beam from a light source 127 to a photodetector 129. The series of light pulses detected by the light sensing unit is transmitted to system timing and control circuit 7 as the

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intermediate film pays out over encoder roller 82 during film advance. The pulses are counted by system timing and control circuit 7. When the count reaches a predetermined value, system timing and control circuit 7 terminates power to the film advance motor (not shown), which drives takeup reel 98. Film breakage during the film advance process causes loss of tension in intermediate film 71, resulting in loss of friction contact between the film and encoder roller 82. Encoder roller 82 ceases to turn, and the sensing pulses cease as a result. Cessation of such pulses during a film advance cycle causes system timing and control circuit 7 to abort the cycle and actuate film break warning device 25.

To accomplish double exposure prevention, backing element 50 (see Fig. 7C) employed at transfer station 14 preferably includes photosensing means, as shown in Figs. 1, 10A and 10B. When microfiche film card 20 and intermediate film strip 71 are pressed into contact for image transfer as shown in Figs. 10A and 10B, an exposure monitor circuit 316, a subunit of system timing and control circuit 7, proceeds to interrogate the chosen microfiche frame. A light source 282,

preferably a light emitting diode, in backing
 element 50 is energized via a power lead 320.
 Light from source 282 is conducted by a linear
 array of light pipes 286 to illuminate a reserved
 5 sensing area 296 (qrst in Fig. 8C) on microfiche
 film card 20. As will be shown subsequently, if
 the chosen frame on the microfiche card has under-
 gone a prior exposure, this sensing area qrst will
 be clear instead of opaque and reflecting. An
 10 unexposed frame will thus reflect light back from
 the sensing area into a parallel second linear
 array of light pipes 288 to a photodetector 290
 connected by a signal lead 318 to two exposure
 monitor circuit peripheral one-bit latches (pref-
 15 erably simple resettable flip-flop circuits) 306
 and 304. Immediately before the energization of
 light source 282, a double exposure warning circuit
 308 clears the latch 304 by pulsing a reset line
 312, resulting in a logical "0" (zero) as the
 20 state of a latch sensing line 314. Upon energiza-
 tion of light source 282, a reflection sensed by
 photodetector 290 will send a signal pulse via
 lead 318 which changes the state of latch 304 and
 puts latch sensing line 314 in a "1" state. A
 25 program-controlled branching stored in the memory

of the system timing and control circuit controls
program flow according to the state of latch sens-
ing line 314. Before the program will sequence to
allow a trigger pulse to be sent to the flash
5 pulser 52 a "1" must be sensed on the sensing
line, indicating a reflecting sensing area grst
and hence the presence of a previously unexposed
frame. If the frame has been previously exposed,
the sensing area will be clear and no light pulse
10 will be reflected to photodetector 290, in which
case latch sensing line 314 remains in a "0" state.
If a "0" is detected on the sensing line the pro-
gram branches to cause a double exposure circuit
310 to actuate a double exposure warning means 292
15 which alerts the operator and causes the program
to abort the remainder of the cycle. If the choice
of an exposed frame was erroneous, the operator
simply selects another frame by means of keyboard
control 17 and the interrogation process is re-
20 peated after microfiche film card 20 is reposi-
tioned. If multiple exposure of a chosen frame is
desired, as is always the case with annotating or
updating, the operator actuates a manual override
switch 294, which is sensed during program execu-
25 tion to cause the program to ignore pre-exposure
sensing during the replication cycle.

Alternatively, the initial prior exposure history sensing may be done by transmission sensing. With microfiche film card 20 and intermediate film strip 71 in contact for image transfer, a weak pulse from flash pulser circuit 52 causes a low intensity light flash to irradiate the two films. The flash pulser power is adjusted by means well known to the art to cause the output of the flash lamp (not shown) in flash housing 46 to be well below the threshold necessary to photo-develop microfiche film card 20. This light pulse will only be detected by photodetector 290 if reserved sensing area 296 (see Fig. 8C) is clear, indicating a prior exposure has occurred for that frame. Implementation of suitable control logic follows the outlines previously set forth herein. In this embodiment light source 282 is unnecessary.

Either embodiment will serve to warn of imminent double exposure. However, the transmission sensing method is vulnerable to failure if the flash lamp becomes erratic with age and fails to fire during the sensing operation.

The reflecting sensing area qrst (see Fig. 8C) is positioned so that upon first exposure of

any frame, the sensing area will be rendered irreversibly clear by and during the course of the exposure. Moreover, even on first exposure a trailing fraction of the light pulse from flash housing 46 will pass through the sensing area. This latter feature will be employed to accomplish the second object of the invention, and will be discussed subsequently in one embodiment of the invention.

10 The reflecting sensing area qrst (see Fig. 8C) is reserved by properly indexing imaging area 9 (see Fig. 2) on intermediate film 71 to framing bars and stripes on microfiche film card 20. Fig. 6 shows a portion of microfiche film card 20 with
15 clear transparent framing bars 276 and framing stripes 278 thereon, the remainder of the area of the card being opaque reflecting photodeveloping film. Such marks are placed on the microfiche film card during manufacture to identify a given
20 frame by assigned row and column indices. Referring to Fig. 4, an interior boundary 300 of the base of lens shroud 22 sets the perimeter of the light field passing therethrough, and establishes the boundaries of the record copy imaging area 9
25 on intermediate film 71. Regions external to

imaging area 9 on intermediate film strip 71 are thus protected from exposure and are clear after development. Fig. 5 shows a perspective partial view of intermediate film head 1 and imaging area 9 of intermediate film 71 after development by hot shoe 42. In this illustration the image of the record copy with transparent text indicia 302 is shown as filling the entire available area.

Figs. 8A, 8B, and 8C show the evolution of the preferred procedure for reserving a sensing area (qrst in Fig. 8C) on microfiche film card 20. Flash prism 44 is dimensioned such that when in contact for image transfer its outer boundaries, denoted by rectangle abcd of Fig. 8A, are located precisely within the microfiche frame markings consisting of four clear transparent framing bars 276 and two framing stripes 278. Only those regions within rectangle abcd are thus susceptible to exposure. If imaging area 9 on the intermediate film, denoted by the smaller rectangle efgh in Fig. 8A, is centered in the chosen frame, then flash illumination during image transfer will result in the intermediate areas between the margins of these rectangles being rendered clear, as shown in Fig. 8B. Any of these clear areas may be

used for exposure sensing. However, in the exemplary form of the invention an enlarged sensing area is achieved by offsetting imaging area 9 such that its lower boundary ef is placed to be substantially coterminous with the flash prism boundary ab, as indicated by the arrow in Fig. 8A. Subsequent exposure results in a larger sensing area 296 (denoted by rectangle qrst) as shown in Fig. 8C.

10 Alternative embodiments may be employed wherein the sensing areas corresponding to each of the frames lie wholly outside the frame region of microfiche film card 20, e.g. on the peripheral regions of the card. Here, however, auxiliary exposure means must be employed to expose the
15 sensing area corresponding to the chosen frame undergoing replication, and the reflection sensing means must be suitably positioned to interrogate this sensing area. By this means a larger image
20 is achieved in a given frame at the expense of added complexity.

 The second aspect of the invention, the ability to detect failure of the flash lamp to fire during replication, is achieved by either of two
25 embodiments. In the first embodiment flash lamp

failure is detected by sensing the passage of light from the flash lamp through reflecting sensing area qrst in Fig. 8C. This is achieved by a flash failure sensing circuit 322 (Fig. 1). Immediately prior to triggering the flash pulse circuit 52, light source 282 is deenergized by system timing and control circuit 7, and another one-bit latch 306 is set to a "0" on a sensing line 326 by a reset pulse sent out on a reset line 324. If a light pulse is detected by the photo-detector during the transfer operation, either by burnthrough on initial exposure or from a clear sensing area during an annotation, a pulse sent via signal lead 318 to latch 306 triggers it to output a "1" state on sensing line 326. Program branching occurs by the methods previously described; the presence of a "0" on sensing line 326 immediately after triggering flash pulse 52 indicates flash failure and causes actuation of a flash failure alarm means 328.



CLAIMS

1. A microfiche film recording system for forming and storing images of record copy including means for forming an image of said copy within a prescribed imaging area of an intermediate photographic film in which any portion of said imaging area can be imaged by radiant energy from said record copy to yield an image upon development in those regions of said imaging area illuminated by said radiant energy, means for replication of said image onto an annotatable microfiche photographic film by directing radiant energy from a frame illumination means through said imaging area of said intermediate film and onto said microfiche photographic film thereby forming an image on said microfiche photographic film being an annotatable permanent record formed by the absorption of said radiant energy as it strikes said microfiche photographic film and said microfiche film having designated frames for receiving said image at prescribed locations on said microfiche film, means for exposing a given sensing area on said microfiche photographic film during said replication so that the status of said sensing area after said replication constitutes a permanent indication that the selected frame has been exposed, each of said frames having a unique corresponding sensing area associated therewith and each said corresponding sensing area being disposed so as not to substantially interfere with replication of said record copy, status sensing means for sensing the status of the corresponding sensing area for a chosen frame before said replication, disabling control means responsive to said status sensing means for disabling said replication means when said status sensing means detects a status of said corresponding sensing area indicative of prior exposure of said chosen frame, means for adding an additional image to a previously exposed frame of said microfiche film utilizing said means for replication, and operator controlled means for overriding said disabling control

means which is selectively operable to permit adding of an additional image.

2. A microfiche film recording system according to claim 1 in which each said corresponding sensing area is contained within its associated frame and said means for exposing a given sensing area and said frame illumination means are the same.

3. A microfiche film recording system according to claim 1 or claim 2 in which said status indicative of prior exposure is a changed reflectivity and said status sensing means is a reflection sensing means.

4. A microfiche film recording system according to claim 3 in which said reflection sensing means comprises a reflection photodetecting means and a sensing illumination means, said sensing illumination means being disposed to illuminate said corresponding sensing area at a level below the exposure threshold of said microfiche film and said reflection photodetecting means being disposed to sense light from said sensing illumination means reflected off said corresponding area, and said disabling control means is responsive to the output of said reflection photodetecting means.

5. A microfiche film recording system according to claim 3 or claim 4 further comprising a backing element for said microfiche film during the exposure thereof by said frame illumination means, said backing element including said reflection sensing means and each said corresponding sensing area being contained within its associated frame.



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6. A microfiche film recording system according to any preceding claim further comprising alarm means responsive to disabling of said replication means by said disabling control means.

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7. A microfiche film recording system according to any preceding claim further including means for detecting failure of said frame illumination means to expose said microfiche film comprising means for exposing said corresponding sensing area by said frame illumination means during exposure, property sensing means for sensing during or after an attempted exposure by said frame illumination means a property of said corresponding sensing area indicative of exposure, failure alarm means for warning of said failure, and failure control means responsive to said property sensing means for activating said failure alarm means when the absence of said property is sensed during or after an attempted replication.

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8. A microfiche film recording system



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according to claim 7 in which said property is a
substantial loss of reflectivity resulting from exposure
and said property sensing means is reflection sensing
means, said failure control means responding to said
5 reflection sensing means to activate said failure alarm
means when a substantially high reflectivity indicative
of exposure failure is detected by said property sensing
means after an attempted replication.

10 9. A microfiche recording system according to claim 7
or claim 8 in which said status sensing means and said
property sensing means are a common sensing means, said
disabling control means being responsive to said
reflection photodetecting means before an attempted
exposure and said failure control means being responsive
15 to said reflection photodetecting means during or after
said attempted exposure.

20 10. A microfiche film recording system according to
claim 7 in which said property is decreased opacity
resulting from exposure and said property sensing means
is a transmission photodetecting means disposed to sense
light from said frame illumination means passing through
said corresponding sensing area during the exposure of
said associated frame, said failure control means
25 responding to failure of said transmission photodetecting
means to detect light from said frame illumination means
during an attempted exposure of said associated frame.

30 11. A microfiche film recording system according to
claim 10 further comprising a backing element for said
microfiche film during the exposure thereof by said frame
illumination means, said backing element including said
transmission photodetecting means and each said
corresponding sensing area being contained within its
associated frame.

35 12. A microfiche film recording system according to
claim 10 or claim 11 in which said status sensing means



and said transmission photodetecting means are a common photodetecting means.

13. A microfiche film recording system substantially as hereinbefore described with reference to and as
5 illustrated in the accompanying drawings.
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