# United States Patent [19]

**Murphy, Jr. et al.**

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[54] **PHOTOGRAPHIC DATA STORAGE METHOD SYSTEM AND MEDIUM**


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**Related U.S. Application Data**

[63] Continuation of Ser. No. 862,692, Oct. 1, 1969.

[52] **U.S. Cl.** ..... **354/77**, 354/105, 355/40

[51] **Int. Cl.** ..... **G03b 17/24**

[58] **Field of Search** ..... 95/1.1; 355/20, 40



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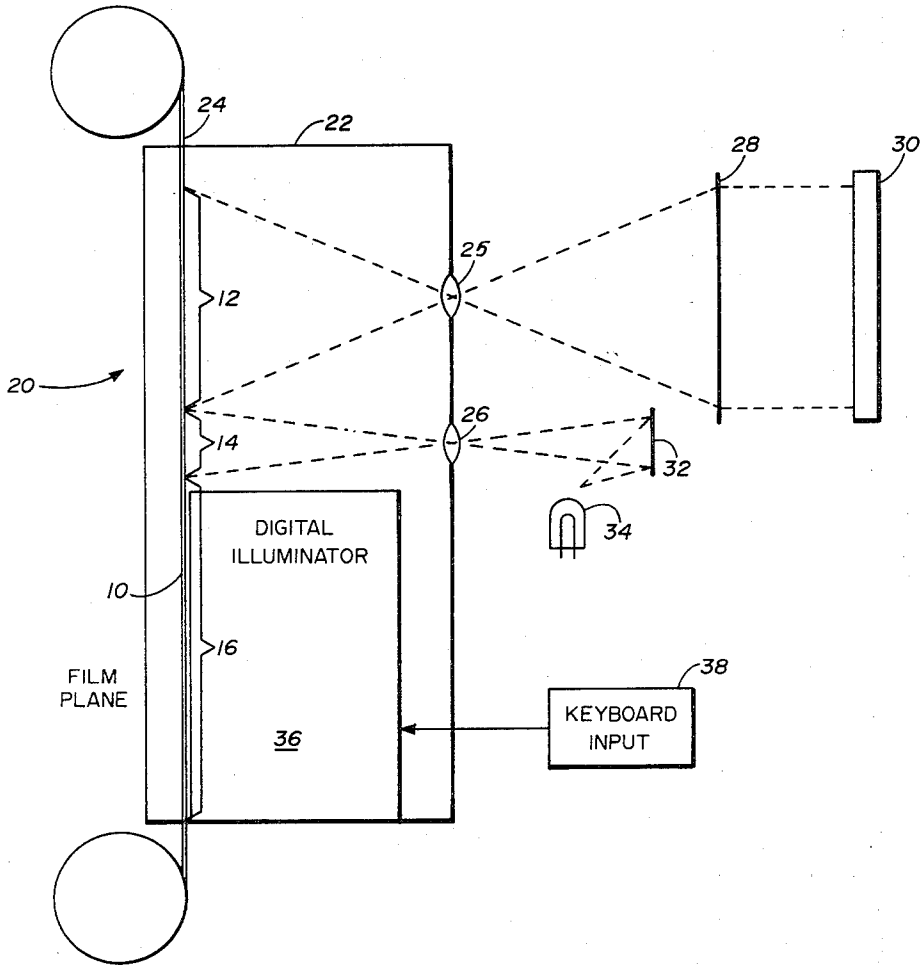
*Primary Examiner*—John M. Horan



[57] **ABSTRACT**

A method, system and storage medium for capturing, storing, and retrieving large inventories of photographic data with high resolution is disclosed. The image to be stored is projected onto a predetermined limited area of a photographic film. Machine readable data identifying the image is projected onto another portion of the photographic film. The film is then developed and cut to the dimensions required by conventional card reading and collating machines so that the photographic data can be mechanically retrieved from storage.


**9 Claims, 4 Drawing Figures**



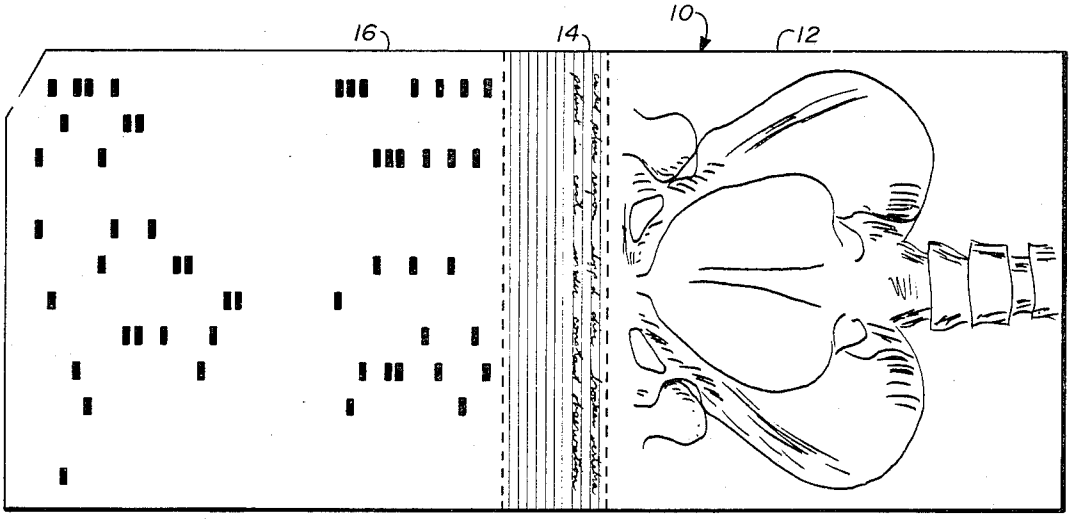



FIG. 1

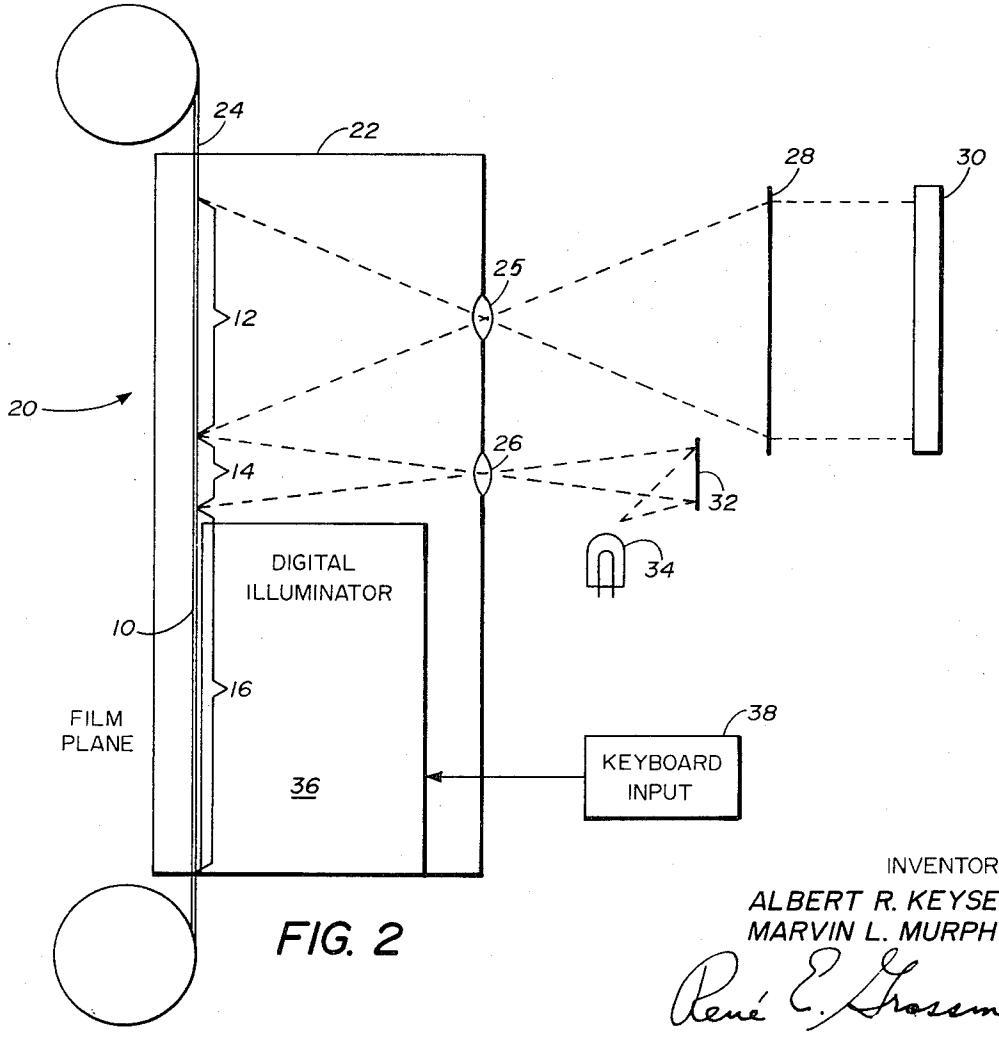



FIG. 2

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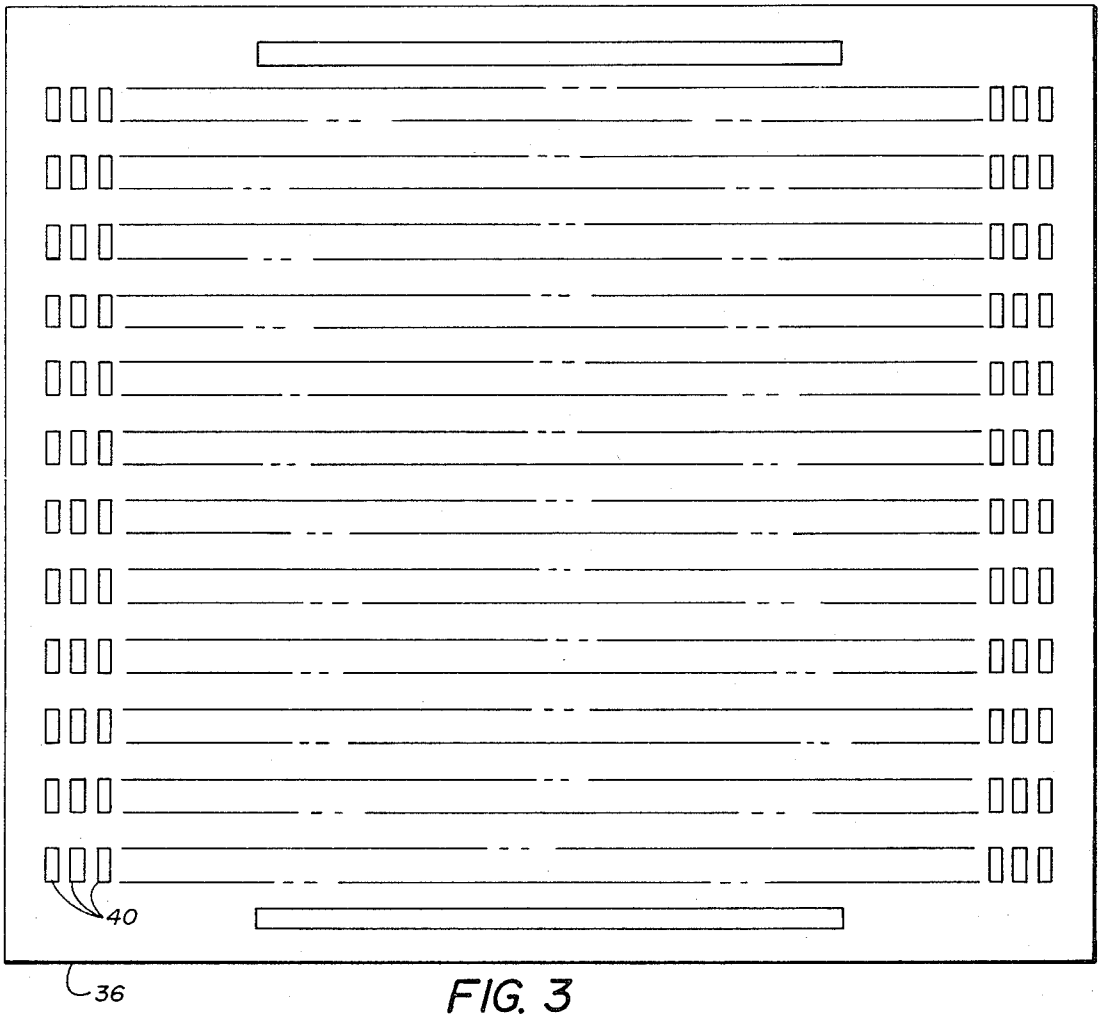



FIG. 3

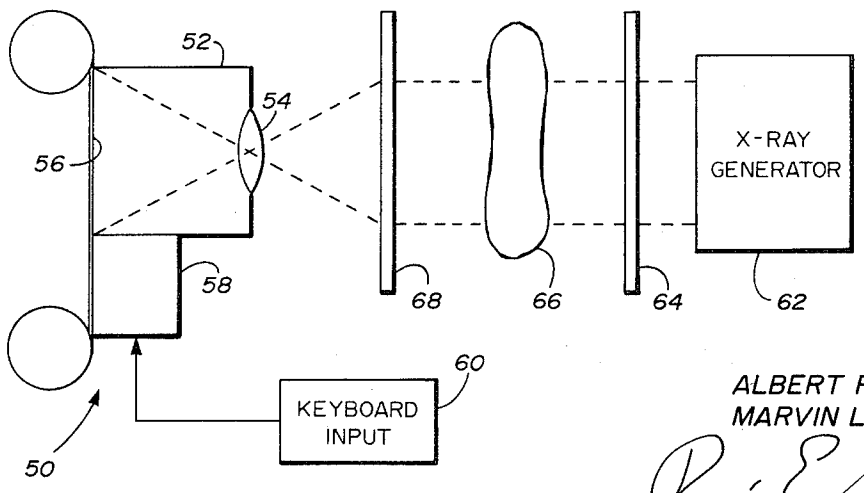



FIG. 4

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# PHOTOGRAPHIC DATA STORAGE METHOD SYSTEM AND MEDIUM

This is a continuation, of application Ser. No. 862,692, filed Oct. 1, 1969.

This invention relates generally to the storage and retrieval of data, and more particularly relates to the storage and retrieval of photographic data which requires high resolution such as x-rays, aerial photographs, seismic data, and the like.

It has been common practice for a number of years to read, sort, and collate punched cards upon which visual data such as typewritten information has been recorded. Photographic data such as microfilm has also been mechanically retrieved by glueing the microfilm in a hole cut from a standard IBM card which contains the identifying data in keypunch form. However, preparing the cards for this purpose is a multi-stage process carried out by hand which is not only expensive but is highly subject to human as well as mechanical errors. Further, 35 mm film is about the maximum which can be used in this process because of the nature of the card structure. With this limitation on the size of the film, it is not possible to record the various shades of gray necessary to reproduce many types of photographic data such as x-rays, aerial photographs, seismic data and the like with the required fidelity and range of gray tones.

This invention is concerned with an improved method, system and storage medium for acquiring, storing and retrieving photographic data. In accordance with the method of the invention, an image is photographically stored on one portion of a film while another portion of the film carries machine readable data identifying the image. The film is dimensioned such that the film may be read and collated by a standard card reader. In accordance with an important more specific aspect of the invention, the machine readable data is also photographically recorded. The photographic data may be acquired from a transparency, such as an x-ray or negative, or may be acquired directly, as from the image of an x-ray flouroscope.

The system, in accordance with the invention for carrying out the method, is comprised of a camera including means for simultaneously exposing the film with the photograph data and means for storing the machine readable data on the film. In one embodiment, the machine readable data is put on the film by selectively energizing the lights of a light matrix to expose the film. In accordance with other aspects of the invention, the image is derived by projecting light through a negative, or as an original acquisition directly from the object the image of which is to be stored and identified.

The storage medium comprises a base sheet, preferably transparent, having a developed photographic emulsion on one portion of the base sheet forming a visible image and machine readable data carried by another portion of the base sheet. In the preferred form, the machine readable data is a series of areas of exposed emulsion.

As a result of the invention, the larger area for photographic storage is provided for a given size which increases the size of the image that can be reproduced, while increasing the resolution and quality of the image. This provides a practical means for storing x-rays or other photographic data where high quality and resolution is essential. To this end, the emulsion on the



storage media can be optimized without affecting the digital portion of the storage medium. The method is more economical because all information can be recorded at one time by one process. This also significantly reduces the possibility of error in matching up photographic data with identifying data. The unique storage medium is immediately ready for use after development and is more permanent because of improved structural integrity.

The novel features believed characteristic of this invention are set forth in the appended claims. The invention itself, however, as well as other objects and advantages thereof, may best be understood by reference to the following detailed description of illustrative embodiments, when read in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates a data storage card in accordance with the present invention;

FIG. 2 is a schematic diagram of a data acquisition system in accordance with the present invention;

FIG. 3 is a schematic illustration of the digital illuminator of FIG. 2; and

FIG. 4 is a schematic diagram of another data acquisition system in accordance with the present invention.

Referring now to the drawings, and in particular to FIG. 1, a data storage card in accordance with the present invention is indicated generally by the reference numeral **10.** The card **10** is comprised of a transparent base material, such as Mylar, acetate or other polyester material which is coated, preferably in its entirety, with a photographic emulsion. Any standard emulsion may be used, and the emulsion may be optimized for the particular type of photographic data which is to be stored.

Photographic data, such as the x-ray illustrated in the drawings and alphanumeric data, such as a doctor's report, is stored as transparencies in areas **12** and **14,** respectively, of the card.

The card **10** has the dimensions of a standard IBM punch card. Machine readable data identifying the photographic data is stored in area **16** so that the card can be retrieved from a stack of like cards by a conventional IBM type card reading and collating machine.

In accordance with the broader aspects of the invention, the machine readable data in the area **16** may be encoded using conventional keypunch equipment after first exposing the entire area **16** to produce an opaque background area for the standard perforations. However, in the preferred form of the invention, the machine readable data is encoded by exposing the emulsion in the area **16** only in selected areas corresponding to the standard perforations, thus eliminating the separate keypunch step. In accordance with other aspects of the invention, the machine readable data in area **16** may be alphanumeric data recorded photographically or otherwise. In the latter case, the card may be sorted using alphanumeric character recognition equipment.

Referring now to FIG. 2, a system for producing the card **10** is shown. The system includes a camera **22** for which a continuous supply of film **24** is provided. The film **24** is preferably the same width as the card **10** so that the film need only be cut to the proper length after development. The camera **22** has a suitable lens system, represented by lenses **25** and **26,** for projecting the image from a transparency **28,** such as a full size x-ray,

onto the area 12 of the film portion 10. A light source 30 projects light through the x-ray 28. The photographic data may include alphanumeric data 32, such as a handwritten doctor's report, which is projected onto the area 14 of the film by means of the light source 34 and lens 26.

A digital illuminator 36 is operated by a conventional computer input-output keyboard 38 to expose the film in predetermined spots within the area 16. The face of the digital illuminator 36 is illustrated in FIG. 3, and is comprised of an array of individual lights 40 corresponding in number and orientation to the positions of the potential holes in a standard IBM punch card. The light sources 40 are individually controlled by the keyboard input 38 in substantially the same manner as the punch equipment for standard IBM cards, as will be readily evident to those of ordinary skill in the art. The sources 40 may be any suitable light which will expose the photographic emulsion. The input-output keyboard 38 preferably includes a suitable storage means for the data which is to be recorded on the card 10 so that the data can be typed for verification before energizing the light matrix to expose the film. After exposure, the film is opaque in the same areas where apertures would be in a conventional punched card. Such a card can nevertheless be read by conventional card reading equipment without modification of the equipment in most cases.

When using the system, the x-ray 28 and the alphanumeric data 32, such as the doctor's report describing the x-ray, are placed at the positions illustrated. The patient's name and other pertinent identifying data is typed in by the keyboard 38. Upon actuation of a print switch (not illustrated), lights 30 and 34 and the digital illuminator 36 are all energized for a period of time sufficient to expose the film portion 10. The film portion 10 then need only be developed and cut to the appropriate length to complete the data acquisition and storage. The particular photographic data together with the doctor's report can then be retrieved by standard card sorting and collating equipment.

Referring now to FIG. 4, another system in accordance with the present invention is indicated generally by the reference numeral 50. The system 50 includes a camera 52 having a lens 54 for projecting an image onto a continuous roll film 56 as heretofore described. The photographic data is produced by a conventional fluoroscope which includes generally an x-ray generator 62, a collimating lens 64, and a fluorescent screen 68. The x-ray energy passing through an object 66 causes a visible image to be produced on the screen 68 which is then recorded on the film 56. A digital illuminator 58, identical to the digital illuminator 36 shown in FIGS. 2 and 3, provides a means for photographically recording the data identifying the images in machine readable language.

Thus the system 50 provides a means for simultaneously encoding both digital or alphanumeric identification data at the time of the initial acquisition of the photographic data. This is achieved merely by inputting the identifying data from the keyboard input 60 while exposing the visible x-ray image from the fluorescent screen 68. The film may then be cut, stored and retrieved as previously described.

From the above description of preferred embodiments of the invention, it will be appreciated that a practical method for storing and retrieving large volumes of photographic data has been described. By using a piece of film having the dimensions of a standard data card, the photographic image can be significantly larger than in standard microfilm punch cards where the film is glued in a cutout in the card. The process of assembling the film and the machine readable data is greatly simplified by putting the machine readable identifying data directly on the film. The need for complex mechanical keypunch equipment is eliminated by photographically storing the machine readable data. The photographic data can be recorded in either positive or negative form from either a photographic negative or directly from the object the image of which is to be stored. Photographic data as used in the appended claim is intended to include any visual image, an image from which a visual image can be reproduced, including alphanumeric data. Machine readable data is intended to include both digitally coded data and alphanumeric machine data.

Although preferred embodiments of the invention have been described in detail, it is to be understood that various changes, substitutions and alterations can be made in these embodiments without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

**1.** A system for storing photographically processed seismic data for retrieval by a card reading and collating machine, the system comprising:

a. a camera means including a roll of film, a chamber with first and second lenses, shutters for the first and second lenses and means for feeding the roll of film through the camera chamber in the optical paths of the first and second lenses;

b. an information bearing transparency supported in the path of the first lens, and a first area of the portion of the roll of film within the camera chamber;

an information bearing opaque medium mounted in the path of the second lens and a second area of the portion of the roll of film within the camera chamber;

d. a light encoder means including a digital illuminator operatively responsive to indexing signals for forming light signals for a third area of the portion of the roll of film within the camera chamber;

e. an actuator operatively coupled to the shutters of the first and second lenses and digital illuminator to actuate the shutters and digital illuminator to expose the portion of the roll of film within the camera chamber to record the data and information of the transparency and opaque data bearing medium, and the indexing signals of the digital illuminator; and

f. means for developing and cutting the exposed film into transparency cards for a card reading and collating machine.

**2.** A system for storing photographically processed seismic data for retrieval by a card reading and collating machine, the system comprising:

a. a camera loaded with a roll of film, said camera having a film exposure chamber through which the roll of film is intermittently fed, first and second lens means forming optical paths to first and second areas of the portion of film within the camera chamber, and first and second shutters for the first and second lens means;

b. a processed seismic data bearing transparency;
c. a first support means operatively supporting the processed seismic data bearing transparency in the path of the first lens means and the first area of the portion of film in the exposure chamber of the camera;
d. a first light means for illuminating the processed seismic data bearing transparency;
e. an alpha-numeric data bearing medium;
f. a second support means operatively supporting the alpha-numercial data bearing medium in the path of the second lens means and the second area of the portion of film in the exposure chamber of the camera;
g. a second light means for illuminating the alpha-numeric data bearing medium;
h. a digital illuminator means having a plurality of light emitting elements operatively mounted within the camera to expose a third area of the portion of film in the exposure chamber of the camera;
i. a computer input-output keyboard coupled to the digital illuminator means for selectively operating the light emitting elements;
j. means operatively coupled to the first and second shutters and to the digital illuminator means for actuating same to expose the three areas of the portion of the roll of film in the exposure chamber of the camera;
k. means for rolling up the exposed portion of the roll of film while bringing in an unexposed portion of the film into the camera chamber; and
l. means for developing and cutting the exposed film into cards for a card reading and collating machine.

**3.** An apparatus for producing film type indexed processed seismic data storage cards comprising:
a. a camera including a reel for a roll of film, an exposure chamber, a film guide means for guiding film through the exposure chamber, and a take-up reel for collecting exposed film;
b. two image forming means including first and second shutters and a digital illuminator means operatively connected to the camera chamber to form optical paths to the film area of the film guide means;
c. support means for supporting a processed seismic data bearing transparency, and an opaque data bearing medium in areas in the respective paths of the two image forming means and the film area of the film guide means in the camera chamber;
d. means for illuminating the support areas for the processed seismic data baring transparency and alpha-numeric data bearing medium of the support means;
e. means for selecting elements of the digital illuminator means; and
f. actuator means operatively coupled to the first and second shutters of the two image forming means and the digital illuminator means for actuation whereby when the camera is loaded with film the portion of film within the exposure chamber is exposed.

**4.** An apparatus for producing film type indexed data storage cards comprising:
a camera including a chamber having a film guide, first and second lens means, shutters for the first and second lens means, and means for feeding a roll of film intermittently through the camera chamber;
b. a first support means including a light source and means for supporting a data bearing transparency in front of the light source and in the path of the first lens means and a first area between the film guide of the camera chamber through which the roll of film is fed;
c. a second support means including means for illuminating the data bearing surface of an opaque medium and a support means for supporting the opaque medium in the path of the second lens means and a second area between the film guide of the camera chamber through which the roll of film is fed;
d. a light encoder means including a digital illuminator operatively carried by the camera chamber in a path to a third area between the film guide of the camera chamber through which the roll of film is fed;
e. actuator means operatively coupled to the shutters of the first and second lens means and to the digital illuminator to actuate the shutters and digital illuminator whereby when the camera is loaded with a roll of film, the first and second support means loaded respectively with a data bearing film transparency and an information bearing opaque medium, the encoder set with an indexing code, and the actuator operated the areas of the portion of the roll of film within the camera chamber are exposed to record the data of the transparency and opaque medium and the indexing information; and
f. means for developing and cutting an exposed roll of film into cards for a card reading and collating machine.

**5.** A system for storing photographically processed seismic data for retrieval by a card reading and collating machine comprising:
a. a camera means including a reel for a roll of film, a chamber through which the roll of film is intermittently drawn for exposure, and a take-up reel for collecting the exposed film;
b. at least two separately illuminated data bearing objects;
c. at least two separate image forming means including at least two camera shutters supported by the camera chamber respectively in separate paths between the area of the camera chamber where the portion of the roll of film is held and the at least two separately illuminated data bearing objects;
d. a light encoder means including a digital illuminator operatively carried by the camera chamber in another path to the area of the camera chamber where the portion of the roll of film is held;
e. an actuator operatively coupled to the at least two camera shutters and digital illuminator for actuating the at least two shutters and digital illuminator whereby when the camera is loaded with a roll of film at least three separate areas of the portion of the roll of film within the camera chamber are exposed; and
f. means for developing and cutting the exposed film into cards for a card reading and collating machine.

6. A system according to claim 5, wherein the at least two camera shutters and the digital illuminator are actuated simultaneously by the actuating means.

7. A system according to claim 5, wherein said at least two separately illuminated data bearing objects include a processed seismic information bearing transparency.

8. A system according to claim 5, wherein said at least two separately illuminated data bearing objects include a flourosceope.

9. A system according to claim 5, wherein said at least two separately illuminated data bearing objects include an opaque alpha-numeric data bearing medium.

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