United States Patent [19]

Swank

[11] **3,807,846**

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[54] **GRID AND CO-ORDINATE LOCATION PROJECTION SYSTEM**

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[73] Assignee: **The National Cash Register Company,** Dayton, Ohio

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[52] **U.S. Cl.** **353/27,** 353/40
[51] **Int. Cl.** **G03b 23/08,** G03b 21/11
[58] **Field of Search** 353/25–27, 353/40

[56] **References Cited**

UNITED STATES PATENTS

3,319,518	5/1967	Carlson	353/27
3,410,640	11/1961	Rhodes	353/27
3,244,067	4/1966	Jonker	353/27

Primary Examiner—Louis R. Prince
Assistant Examiner—A. Jason Mirabito
Attorney, Agent, or Firm—George J. Muckenthaler; Wilbert Hauk, Jr.; J. T. Cavender

[57] **ABSTRACT**

In a microform reader, a grid is permanently inserted into the optical system near the projection lens, and a pair of crosshairs, remotely controlled, are located near the plane of the grid. The cross hairs provide a visual co-ordinate location within the grid pattern. A remotely controlled aperture stop is insertable into the optical path when it is desired to project a shadow image of the grid and the crosshairs onto the screen to aid in determining the location of information on the microform for rapid retrieval thereof.

15 Claims, 11 Drawing Figures

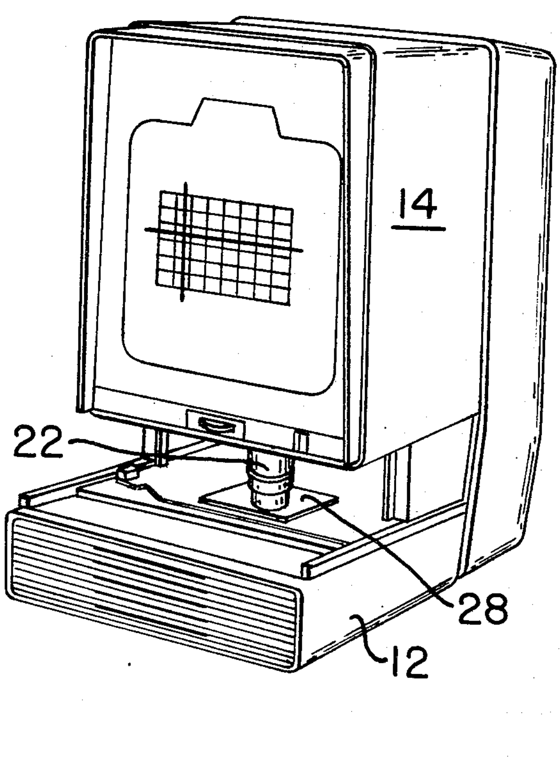


FIG. 1

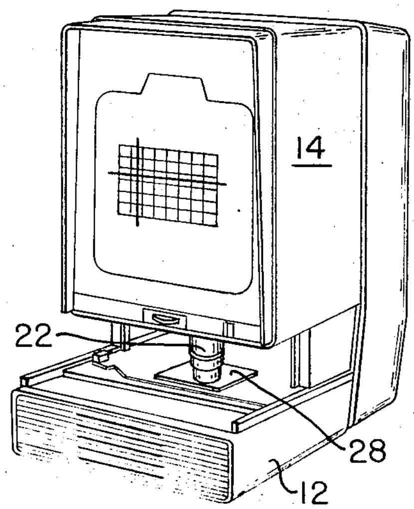


FIG. 2

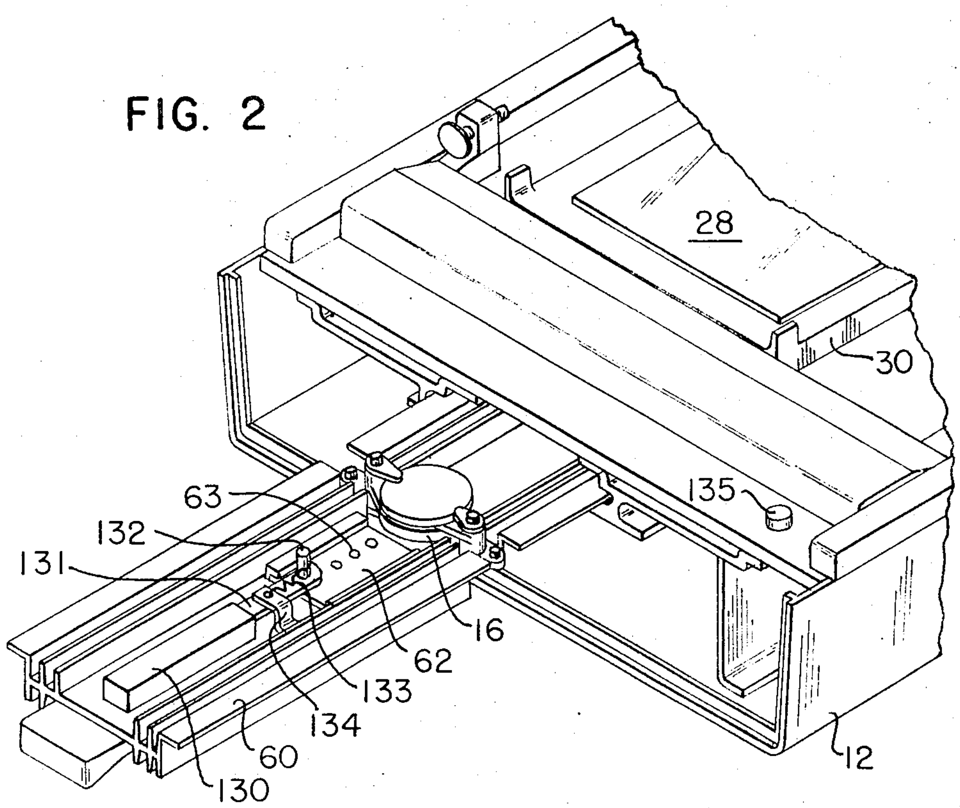


FIG. 3

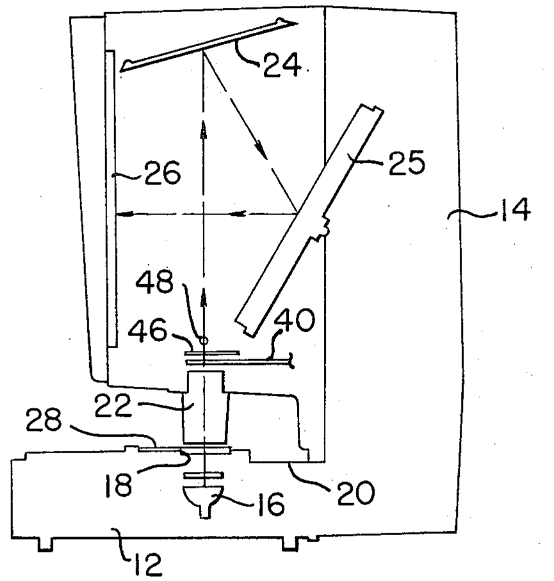


FIG. 4

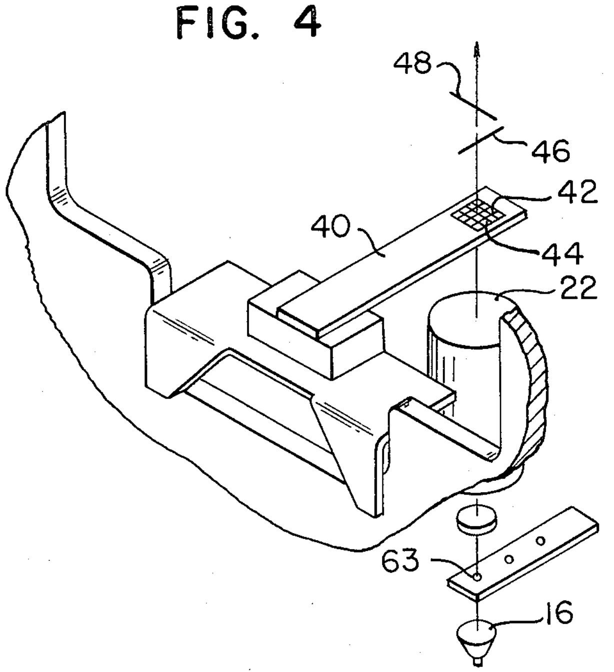


FIG. 6

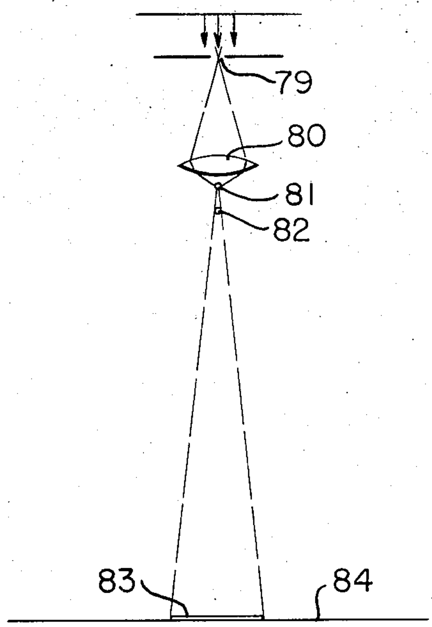


FIG. 5

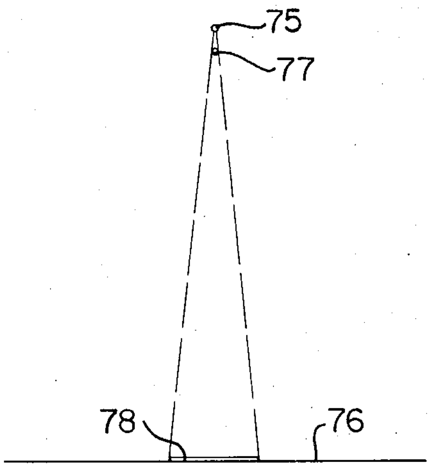


FIG. 7

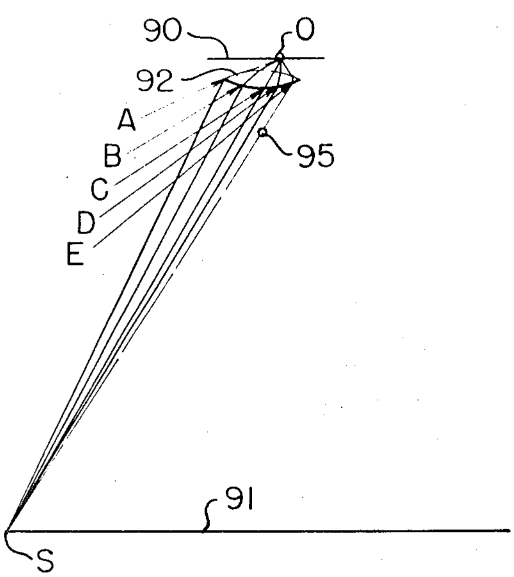


FIG. 8

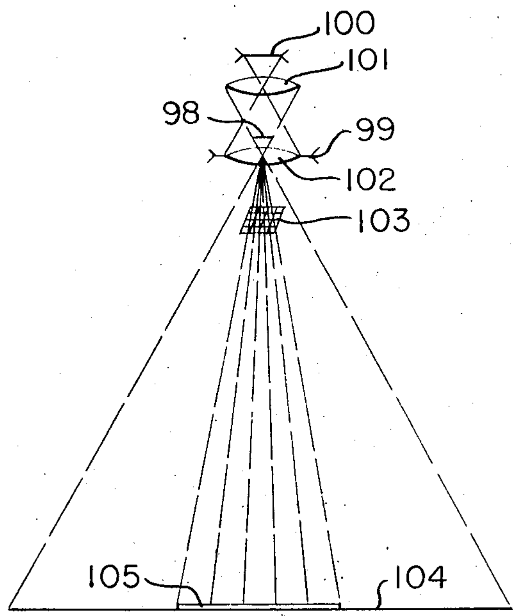


FIG. 9

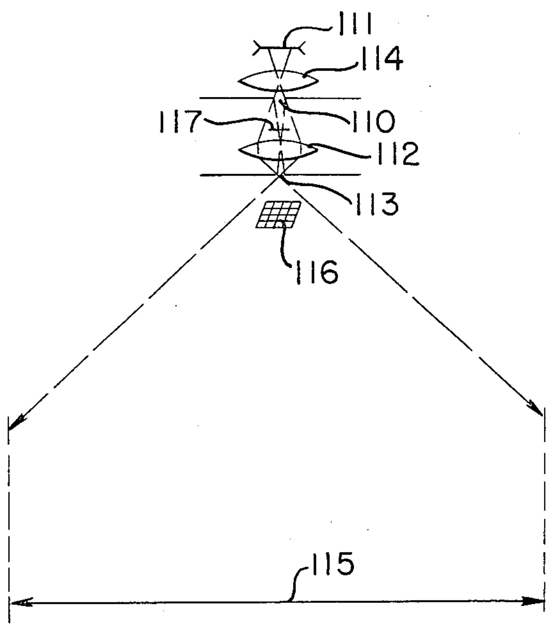


FIG. 10

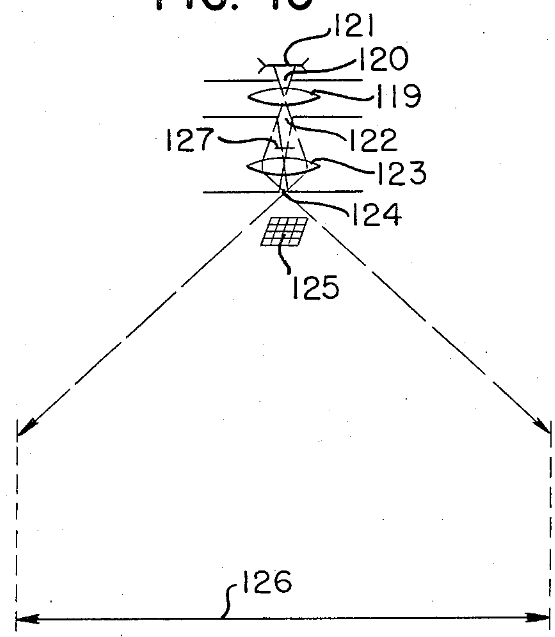
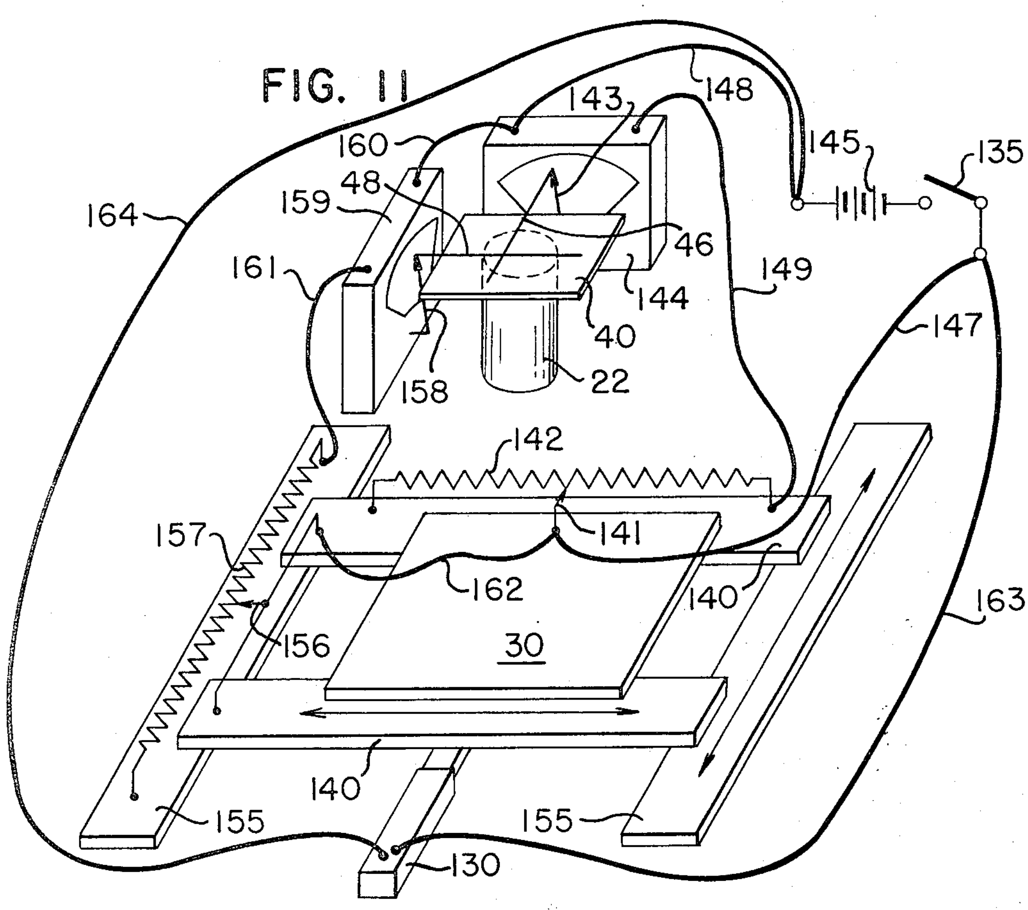


FIG. 11



GRID AND CO-ORDINATE LOCATION PROJECTION SYSTEM

BACKGROUND OF THE INVENTION

The use of the microform image as a means for storing and for retrieving information has greatly increased over the years by reason of the huge volume of such information being required in the business field. Because of the fact that many pages of information in human readable form can be condensed into microimage form for critical storage considerations, it becomes necessary to provide equipment to retrieve certain desired information in the shortest possible time. In the matter of a microform of the fiche type, wherein the fiche contains the microimages in row and column format, an operator wishes to have a quick indication of the location of certain information in regard to the position of the microfiche when it is inserted into a reader for viewing thereof.

One of the ways and means for such indication is to provide an index system on the reader wherein the rows and columns of images on the microfiche are readily available and are observed by the operator, which index system contains a schedule corresponding to that of the rows and columns of images. Another of the ways and means for such indication is to provide additional apparatus within the projection system of the reader whereby an array pattern is superimposed on the screen over the microfiche data to permit the operator to rapidly move the microfiche to the desired position.

Representative of the prior art relating to image projecting apparatus and to the retrieval of information in U.S. Pat. No. 2,471,800 issued to E. Von Mulinen and showing shadow image projection indicating apparatus for producing an enlarged shadow image of a part of a movable body exposed to a source of light. A plurality of light transmittive rod-like bodies are arranged adjacent each other to form one coherent body, the ends of the bodies being spaced from a screen to project an image onto a shadow surface plane, and to provide a high degree of sharpness of the image on the plane, an edge of the screen being used to separate an illuminated part from a shaded portion.

U.S. Pat. No. 3,319,518 issued to C. O. Carlson shows and describes a system for retrieving microimages formed on superpositioned microforms wherein alternate display of either form is provided by moving the position of the objective lens. Additionally, an indexing arrangement is placed adjacent the microform and simultaneous display of index data and one of the microforms is seen on the screen to locate a selected set of images on the form. A small amount of light is split from the beam to project the index data onto one screen while directing the beam to another screen to display the image.

Another example of optical multiplication of images is U.S. Pat. No. 3,320,852 issued to G. B. Parrent, Jr. and B. J. Thompson which shows and describes optical pattern repetition wherein a diffraction grating is placed between two lens systems in the optical path. The grating is a plate having apertures of differing sizes which provide for varying intensity in producing a plurality of images of a single object.

An information display system in U.S. Pat. No. 3,400,992 issued to J. T. McNaney, uses a coplanar

light beam deflection and selection apparatus wherein an opaque mask with an aperture therein is placed in the optical path to deflect the beams from their initial convergent paths about a point along the axis which is intersected by a common plane of the system.

Superimposition of light spots and a grid in U.S. Pat. No. 3,411,844 issued to F. Jonker, teaches the use of projection apparatus for superposing a readout grid on data film images wherein the rays of light from the light transmitting spots and from the grid share a common optical path onto a common viewing screen. The readout grid enables ready determination of the visible light spots.

And, U.S. Pat. No. 3,472,585 issued to R. A. Halberg and J. L. Sundquist shows and describes image locating means for a projection device wherein a template bearing format corresponding to that of a microfiche indicates to the operator the position of the images on the fiche.

SUMMARY OF THE INVENTION

The present invention relates to projection systems and more particularly to the use of a grid and coordinate pattern in the optical path to effect the location of desired information for rapid retrieval thereof. In information retrieval apparatus, such as is exemplified by microforms and readers therefor, the operator places the microform into the reader wherein the optical path of the projection system is available to project any of the microimages, by movement of the microform, onto a screen for viewing an enlarged image.

A transparent plate, or the like, is permanently inserted into the optical path between the projection lens and the screen, the plate having a grid pattern etched or scribed thereon, and a pair of crosshairs are supported in a position near the plane of the grid pattern. With these objects in the optical path and with a microform in position in the reader for viewing thereof, the image is observed in normal fashion on the screen, as the grid and crosshairs do not show as being projected onto the screen.

However, upon insertion of the microform of fiche into position in the reader to be observed, it is desirable to locate the particular microimage in the shortest possible time. To enable the operator to orient and to locate such particular microimage, a movable aperture stop is arranged to be inserted into and removed from the optical path. The aperture stop may be in the form of a plate having a plurality of apertures therein, a selected aperture being matched to a particular magnification ratio of a lens in the projection assembly. With the fiche image being projected onto the screen, the aperture stop is moved into the optical path and, by reason of the light being subjected to an aperture smaller than that of the regular projection system, a shadow of the grid and the crosshairs is superimposed over the original image being projected on the screen. The crosshairs can be attached to a deflection device such as a meter movement or other suitable means or they can be moved by means of a mechanical linkage connected to the microfiche holder and thereby move with the movement of the holder to aid in determining the particular location of an image on the fiche. In other words, the crosshairs show the location of the microfiche in relation to the projection lens and as the holder is moved, the crosshairs likewise move across the grid to give an indication to the operator. In effect, the grid and the co-ordinates appear as shadows superimposed over the microfiche information projected onto the screen, thereby providing a coarse and fine indication of the position of the fiche, the coarse indication being that displayed by the grid and co-ordinate, and the fine indication being the display of the row and column numbers in the portion of the fiche observed.

In accordance with the above discussion, the principal object of the present invention is to provide apparatus for rapid retrieval of information on a microform.

Another object of the present invention is to provide means for indicating the location of a microform in relation to the projection lens optical axis.

A further object of the present invention is to provide microform position indicating means observable on the reader screen to enable rapid retrieval of the microform information.

An additional object of the present invention is to provide a grid and co-ordinate location of microimages wherein the co-ordinates are movable into the light projection path and appear as shadows on the reader screen.

And a final object of the present invention is to provide for superimposition of a grid and co-ordinate shadow image over a microform image for locating a desired image.

Additional advantages and features of the present invention will become apparent and fully understood from a reading of the following description taken together with the annexed drawings, in which:

FIG. **1** is a front perspective view of a microform reader incorporating the structure of the present invention;

FIG. **2** is a perspective view showing parts of the optical system employed in the reader;

FIG. **3** is a diagrammatic view in side elevation of the transparency carrier, the projection lens assembly, and the mechanism associated with the transparency carrier for superimposing an image on the screen;

FIG. **4** is a perspective view of a plate containing the grid thereon;

FIGS. **5–10** are diagrammatic views showing certain theory used in the practice of the invention; and

FIG. **11** is a diagrammatic view showing a typical electromechanical system relating the movement of the microform holder to the co-ordinates associated with the grid.

Referring now to FIGS. **1–4**, a microform reader or viewer has a generally rectangular-shaped base portion **12** supporting an upper box-like enclosure **14**, the base portion containing a source of light **16** directed upwardly through an aperture **18** in a frame plate **20** and through a projection lens assembly **22.** The enclosure **14** contains an upwardly positioned mirror **24** (FIG. **3**) held at an angle to reflect an image onto a rearwardly positioned mirror **25** also held at an angle to carry the reflected image onto a screen **26,** in a vertical position at the front of the reader enclosure **14,** for viewing by the operator. The light from source **16,** as seen in diagrammatic form in FIG. **3,** shines in a path through the aperture **18,** through a microfilm or microform **28,** and through the projection lens assembly **22** to mirror **24,** then to mirror **25** which reflects the image onto the screen **26.** The microfilm or microform **28** is carried in a holder **30** (FIG. **2**) which holder is movable in the X and Y directions at the option of the operator for observing a desired microimage on the film and which microimage is magnified and projected onto the screen in enlarged image form.

As is well known, the images on the microfilm, of course, cannot be read by the human eye and therefore it is impossible to "read" the location or position of a particular microimage without the aid of magnifying means. Since it is desirable to locate such particular microimage as quickly as possible when using the reader, means should be provided within the reader for moving the holder **30** containing the microfilm **28** to a position generally corresponding to the area of a microimage which is within the knowledge of the operator. In other words, the operator may know generally the format of the columns and rows of microimages on a particular film and thereby enable moving of the film to such area for projection of certain images onto the screen. However, even when the general area of the desired microimages appears on the screen it is important to view the particular image as quickly as possible.

The present invention provides for "coarse tuning" followed by a "fine tuning" of the pattern of microimages for retrieval of the desired information.

Within the path of light from the source **16** and positioned between the projection lens assembly **22** and the mirror **24** is a transparent plate **40** rigidly held in place by suitable means, the plate having scribed or etched thereon a plurality of intersecting lines **42, 44** to form a grid-like pattern, as seen in FIG. **4.** The scribed or etched lines **42, 44** are viewable on the screen **26** under certain conditions and are used for indicating or locating the position of the image desired to be read. Adjacent the plate **40,** FIGS. **3** and **4** are a set of co-ordinates in the form of crosshairs **46, 48** which are supported and carried in a manner to permit movement of the crosshairs as a unit whenever the microform holder is moved about by the operator.

As was mentioned earlier, the lines **42, 44** of the grid are viewable on the screen **26** only under certain conditions. In normal operation of the reader, the grid and co-ordinates do not appear on the screen because of the positioning of the elements along the path of light at a certain distance from the projection lens. This distance is selected at a range of 2–3 inches from the projection lens to effect a proper image on the screen under these certain conditions, which will be described later.

Referring now to FIG. **2** which shows certain of the containments within the base portion **12,** the light source **16** and its associated parts are supported from a tray **60,** the tray being slidable out the front of the base portion for maintenance purposes. For reason of controlling the amount of light being admitted through the lens and onto the screen, a plate **62** is inserted over the source **16** when it is desired to superimpose the grid shadow over the particular microimages. The plate **62** may include a plurality of different sized apertures **63** therein aligned in a manner so that upon sliding of the plate across the source of light, a real image of the aperture is formed between the projection lens and the grid which, in turn, acts as a point source illuminating the grid and projecting the shadow of the grid onto the screen. The different sized apertures also permit the use of lenses of different magnification ratios in a typical reader.

In the teaching of the invention and for a better understanding thereof, FIGS. 5–10 have been included in the application, wherein FIG. 5 shows a point light source 75 which radiates light rays equally in all directions and producing illumination on the screen 76. When a small point 77 of finite size is located along the optical axis between the point light source 75 and the screen 76, a shadow 78 is projected onto the screen. FIG. 6 shows a system that produces essentially the same optical results as shown in FIG. 5, except that the small point light source is now produced by inserting an aperture stop 79 into a light beam which then passes through a condenser lens 80 and is reimaged at point 81 on the other side of the lens from the aperture stop 79. This virtual image 81 produced by aperture stop 79 then acts as a point light source for the finite size point 82 to cast a shadow 83 of point 81 onto the screen 84.

In FIG. 7 is shown a microform or microfiche 90 which is imaged onto the screen 91 by means of the projection lens 92. Each point 0 of the microfiche located at the film plane radiates light energy toward the projection lens thereby producing light rays OA, OB, OC, OD, and OE. These typical rays are then bent by the projection lens 92 and all will converge again at the screen plane 91 at the location indicated as S. If the point 95 is introduced into this system, all of the typical rays except E-S will converge at the screen plane. In other words, by introducing point 95 into the optical system, every point 0 on the film plane 90 is reimaged at the screen plane 91 by all those rays that are not stopped by the intersecting point 95. Since the point 0 chosen at the film plane 90 is any arbitrary point of the microfiche that is projected onto the screen, it can be seen that the total fiche image projected on the screen is impaired by the introduction of point 95 in that the brightness is slightly reduced since a few of the incoming image rays for any point on the screen are stopped. It will be noted, though, that the resolution will not be seriously impaired provided that the point 95 is small and reasonably close to the projection lens 92. As point 95 is moved closer to the condenser lens, the image of the point blurs and tends to fade out, and conversely, as point 95 is moved closer to the screen 91, the shadow of the point becomes sharper on the screen. The best range for point 95 has been found to be approximately 2–3 inches from the projection lens 92.

FIG. 8 shows a microfilm projection system consisting of a filament 100, a condenser lens 101 which lens reimages the filament into the plane 99 of a projection lens 102. The object film plane is located in a manner at 98 so that it is not at the image plane of the filament, but is imaged onto the screen by means of the projection lens 102. Also included in FIG. 8 is a grid screen 103 which is inserted and positioned near the projection lens 102, and which grid corresponds optically to point 95 in FIG. 7. In the FIG. 8 configuration, with the grid 103 close to the projection lens 102, the grid is projected onto the screen 104 in a manner that the image 105 of the grid 103 is badly blurred and cannot be observed by the operator. This concept is also similar to that in FIG. 6 to produce a net dimming of the screen 104, but with no loss of resolution assuming that the grid pattern 103 is comprised of fine lines and is relatively simple. In this way it can be seen that the introduction of the grid 103 has not affected the microfilm projection system in any way other than to produce a slight dimming of the screen brightness.

The same optical system of FIG. 8 is shown in FIG. 9 wherein an aperture stop 110 has been introduced and is inserted into the illumination path beyond a condenser lens 114, the aperture stop permitting only a small amount of the luminous flux from the filament 111 to pass therethrough and having an object film plane at 117. This flux is captured by the projection lens 112 and is reimaged at 113 to form the image of the aperture stop, and wherein this virtual aperture stop 113 is seen to appear as an apparent point source of light which, in turn, is projected onto the screen 115. Since the grid 116 lies between this point source of light and the screen 115, the image of the grid (shadow of the grid) is thus projected onto the screen.

FIG. 10 shows another way and means for accomplishing similar results as FIG. 9, namely the projection of the grid and crosshairs onto the screen. In FIG. 10 an aperture stop 120 is inserted into the optical path beyond the condenser lens 119 and near the filament 121, and is reimaged to form an image 122 of the stop, the object image plane being at 127, and which stop image, in turn, is reimaged on the other side of the projection lens 123 to produce an apparent point source of light 124. A grid 125 is positioned between the apparent point 124 and the screen 126 whereon a shadow of the grid appears when the aperture stop 120 is inserted into the optical path.

Referring back to FIG. 2 wherein the tray 60 holding the light source 16 has been pulled out to expose the source and the aperture stop plate 62, a solenoid 130 is positioned within the tray and includes a plunger 131 connected to the plate 62 by means of a pin 132. A spring 133 is connected to the pin 132 and a bracket 134 secured to the tray, whereby when it is desired to insert the aperture stop 62 into the optical path, a button or switch 135 is pushed to energize the solenoid 130 and to move the aperture plate forward or to the right in FIG. 2 where one of the apertures 63 will be positioned over the light source 16. The pin 132 can be made removable to provide for adjustment in the length of travel of the aperture plate 62 if a different aperture is desired. Other means for controlling the positioning of the aperture plate may be by manual mechanical operation or by pneumatic methods.

In FIG. 11 is shown a preferred method of controlling the position of the co-ordinates or crosshairs 46, 48 in relation to movement of the microfiche holder 30. As the holder 30 is moved to the right or left in the X direction along rails or frame members 140, a wiper 141 secured to the holder 30 slides on a resistor 142 supported from member 140. A change in resistance moves the pointer 143 of a meter 144 which is energized by means of a power supply 145 and controlled by the switch 135, through leads 147, 148, and 149, with leads 163 and 164 being connected to the solenoid 130. Likewise, as holder 30 is moved fore or aft in the Y direction along rails or frame members 155, a wiper 156 secured to the holder 30 slides on a resistor 157 supported from member 155. A change in resistance moves the pointer 158 of a meter 159 which is energized from an extension lead 160 of lead 148, and controlled by leads 161 and 162.

The meters 144 and 159 have pointer extensions which are the crosshairs 46, 48 to effect the co-ordinates as seen across the grid image on the screen. The pointer extensions are positioned over the projection lens and located as closely as possible to the grid without interference in operation. It may be convenient to place one crosshair above the grid and the other below. Any non-linearity introduced into the system by the positioning and characteristics of the meters and their movements can be nullified by the use of electrically non-linear resistors **142** and **157.**

A simple mechanical method of connecting the cross-hairs and causing movement thereof in relation to the microfiche holder may be accomplished by the use of cables and pulleys so positioned and located to maintain a taut control over the system.

It is thus seen that herein shown and described is a grid and co-ordinate projection system wherein a grid has been added to the illumination system and an aperture stop is insertable between the light source and the projection lens to effect a redistribution of the light by the aperture and to project a shadow of the grid on the screen. When the aperture stop is removed from the illumination system, the reader works normally, except that the screen brightness is reduced slightly by the presence of the grid. It must be noted, though, that the image of the grid is so greatly blurred that it cannot be discerned on the screen because the grid lines are finely constructed and the grid is located close to the projection lens.

When the grid is in place and the film is located at the film plane, the film will be projected onto the screen and can be easily read with no reduction in resolution. When the aperture stop is inserted into the optical path, the shadow of the grid is projected onto the screen and the image of the film at the film plane also is projected onto the screen. The grid lines appear boldly on the screen while the film image is dimmed slightly but can easily be read. When the switch **135** is activated and the aperture stop is moved into place, it may be desirable to increase the lamp voltage and bring the screen brightness up to a more suitable level. THe crosshairs are located in approximately the same plane as the grid and as the microform holder is moved, the crosshairs move across the grid to indicate to the operator the location of the microforms in relation to the projection lens. The apparatus enables the accomplishment of the objects and advantages mentioned above, and while only one embodiment of the invention has been disclosed herein, certain variations such as in the condenser optics may occur to those skilled in the art. It is contemplated that all such variations, not departing from the spirit and scope of the invention hereof, are to be construed in accordance with the following claims.

What is claimed is:

1. Projection apparatus for viewing microimages comprising a
- microimage holder, a
- light source, a
- projection lens assembly for focusing rays from the light source along a path to a viewing screen for display of an enlarged image thereon,
- grid means positioned in said path adjacent the projection lens assembly,
- co-ordinate means connected with the microimage holder and movable across the grid means,
- means defining an aperture positionable in said path for effecting display of an image of said grid means and said co-ordinate means on the screen, and
- means for controlling the position of the aperture means to observe said enlarged image when said aperture means is out of said path and to observe the grid and co-ordinate image along with said enlarged image upon said aperture means being in said path to determine the position of the microimage in relation to the projection lens assembly.

2. The apparatus of claim **1** wherein the grid means comprises a transparent plate with intersecting scribe lines thereon.

3. The apparatus of claim **1** wherein the co-ordinate means comprise crosshairs movable with the microimage holder.

4. The apparatus of claim **1** wherein the aperture means comprises a plate having a plurality of apertures therein and movable into and out of the optical path of the light source.

5. The apparatus of claim **1** wherein the means for controlling the position of the aperture means is a manually operated direct linkage.

6. The apparatus of claim **5** wherein the direct linkage is solenoid operated.

7. The apparatus of claim **5** wherein the direct linkage is pneumatically operated.

8. Means for indicating the position of microimages in relation to a projection lens assembly, said means comprising a
- microimage holder, said lens assembly projecting an enlargement of said microimages onto a viewing screen, a
- transparent plate positioned in the path of projection from the lens assembly to the viewing screen, said plate having a plurality of intersecting lines to define a grid thereon, a
- pair of co-ordinate members positioned adjacent the transparent plate and connected with the microimage holder for movement therewith, an
- aperture plate defining an aperture therein and positioned to be moved to place the aperture into and out of the path of projection of the lens assembly, and
- means for controlling movement of the aperture plate into the path of projection to observe both the enlargement of said microimages and an image of the grid and the co-ordinate members on the screen.

9. The subject matter of claim **8** wherein the co-ordinate members comprise crosshairs movable with the microimage holder.

10. The subject matter of claim **8** wherein the controlling means comprises a manually operated direct linkage.

11. The subject matter of claim **10** wherein the linkage is solenoid operated.

12. The subject matter of claim **10** wherein the linkage is pneumatically operated.

13. A method of indicating to the operator the location of microimages in relation to a projection lens assembly by use of a grid and movable co-ordinate members comprising the steps of
- placing the grid and co-ordinate members into the path of light rays projected onto a viewing screen, moving the microimages into said path for viewing thereof, such movement causing the co-ordinate

members to move across the grid in a manner corresponding to the position of the microimages, and

limiting the amount of light rays emitting from the projection lens assembly for simultaneously observing images of the grid, the co-ordinate members, and the microimages on the screen.

14. The method of claim **13** wherein the means for limiting the amount of light rays comprises an aperture stop.

15. The method of claim **13** wherein the means for limiting the amount of light rays comprises a plate having a plurality of apertures therein.

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