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(54) IMAGE PROJECTION APPARATUS

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to image projection apparatus for use with an image record medium of the kind having a plurality of images arranged in rows and columns, e.g. a microfiche. Such a record medium requires movement in X and Y directions relative to the optical axis of the projection system for selective projection of the images on the record medium.

The prior art discloses many projectors which have been designed for this purpose and the mechanisms by which the microfiche or other such medium is moved are basically slide devices having guides so arranged that the microfiche can be moved in either or both of the X—Y directions. In most instances, a carrier for the microfiche is moved to a fully extended position generally outside of the viewer casing or housing in which the mechanism is contained so that microfiche can be readily arranged and positioned on the carrier. Further, the microfiche is usually arranged and moved in a flat plane that is normal to the optical axis. Such a structure necessitates that means be provided for holding the microfiche flat in this plane. Usually, the selected image must be located by trial and error, unless means is provided for relating the respective image areas to visual scales. In this case, each scale must be referred to individually in order to obtain location of the proper image relative to the optical axis in both of the X—Y directions.

According to the present invention there is provided image projection apparatus for use with a record medium having a plurality of images arranged in rows and columns,

comprising an optical projection system, a shifting mechanism arranged to receive a record medium and move it through an image projection gate in X and Y directions relative to the optical axis of the projection system, first and second drive means arranged to control the shifting mechanism for movement of the record medium in said directions respectively; and image selection means arranged to control the first and second drive means for locating a selected image in the projection gate, the shifting mechanism comprising a carriage arranged for translational movement in one of said directions along an operational axis that is spaced from and normal to the optical axis, record medium guide means on the carriage and a record medium carrier movable with the carriage and mounted for pivotal movement about the operational axis relative to the carriage to co-operate with the guide means on the carriage for moving the record medium in the other of said directions.

The invention will now be described by way of example with reference to the accompanying drawings which illustrate features of a microfiche reader constructed in accordance with a preferred embodiment of the invention.

In the accompanying drawings:—

Fig. 1 is an elevational view of a microfiche format showing the arrangement of the images thereon;

Fig. 2 is a partial side elevation showing the relationship of a microfiche carriage relative to a fixed loading station in a casing or housing;

Fig. 3 is a partial plan view of a microfiche carrier showing means designed to cooperate with holes in the microfiche to retain the same for movement by the carrier;

Fig. 4 is a side elevation showing the relationship of an optical projection system to the microfiche carriage;

Fig. 5 is a plan view showing the manner in which respective stepping motors are

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coupled to the carriage and to the carrier;

Fig. 6 is a plan view similar to Fig. 5 showing various operating solenoids;

Fig. 7 is a rear elevational view showing the operating solenoids and, particularly, a shutter arrangement for blocking the projection system while changing a microfiche; and

Fig. 8 is a schematic wiring diagram showing the manner in which the operation of the device is controlled in conjunction with the operating solenoids and a programmer control.

With reference particularly to Fig. 1, a microfiche 10 comprises a sheet of film on which a plurality of images 11 are arranged in X-Y directions in rows and columns. Along one edge, which will be the leading edge on insertion into the microfiche carriage to be described, a pair of spaced holes 12 are provided for a purpose to be described hereinafter. Microfiche record mediums are well known in the art. However, in accordance with the system that is used, the record medium can be transparent in which case a transmission projection system is used, or it can be opaque, for example, photographic paper, in which case a reflection projection system is used.

As illustrated, a microfiche shifting mechanism generally designated by the numeral 15, is arranged within a casing or housing 16 only a small portion of which is shown in Fig. 2. The casing 16 is provided with a slit or throat 17 into which a microfiche can be inserted for receipt by the shifting mechanism 15. With reference to Fig. 4, an optical projection system 19 is arranged within the casing 16 relative to an optical axis 20 and comprises a reflector 21, a projection lamp 22, a condenser lens system 23, and a projection lens system 24 which directs a selected image onto a screen (not shown) that is mounted on the casing 16 in a position for viewing by an operator. The optical system 19 is mounted on the underside of a U-shaped mounting member 25. The throat 17, therefore, provides and serves as a fixed loading station through which the record medium 10 can be inserted into and withdrawn from the device by the operator.

The shifting mechanism 15 is mounted on a shaft 27 that is journaled in side plates 28 and 29 of the member 25, one end being directly coupled at 30 to a stepping motor 31, see Fig. 5 and 6. A stepping motor 32 is mounted adjacent to the other end of the shaft 27 and carries a pulley 33 which is engaged by a cable 34 which, in turn, encircles spaced pulleys 35 and 36 adjacent the stepping motor 31. One end of the cable 34 is connected to one side frame member 38 of a microfiche carriage 39 and the other end is connected by spring 40 to another

side frame member 41 of the carriage 39.

The carriage 39 comprises the side frame members 38 and 41 having bearing portions 42 and 43, respectively, and a tie bar 44 which joins the frame members at one end, see Fig. 2. At the opposite end, as viewed in Fig. 2, an opening 45 is formed by a plurality of shim plates 46, as also seen in Fig. 5. The inner surface of each of the frame members 38 and 41 is provided with a generally arcuate recess 47 for engaging and guiding the side edges 13 of the microfiche 10.

A carrier 50 for the microfiche 10 comprises a plate 51 that is mounted on the shaft 27 by a coupling designated by the numeral 52. Such a coupling is one in which a cage 53 is provided with a plurality of balls 54 in engagement with the shaft 27, the structure being such that it permits translational movement of the microfiche carriage 39 and the carrier 50 as a unit along the shaft 27 and pivotal movement of the carrier 50 on the shaft 27 relative to the carriage 39. The manner in which this is accomplished by stepping motors 31 and 32 is described more fully hereinafter.

The plate 51 carries an L-shaped member 57, the leg 58 of which is provided with a slot 59, which is aligned with the guide recesses 47 in the members 38 and 41, for receiving the leading end of the microfiche 10 that is inserted in the throat 17. A slide member 60 is mounted centrally relative to the member 57 and carries a pair of spaced pins 61 for engaging the correspondingly spaced apertures 12 in the microfiche 10. The slide member 60 is urged in a direction toward the microfiche 10 by a spring 62 so as normally to maintain the pins 61 in engagement with the microfiche 10, thereby retaining the record medium during movement within the casing 16 in the course of positioning the selected images in a projection gate on the optical axis 20 of the optical system 19.

With reference to Figs. 6 and 7, a number of solenoids are shown which are associated with the microfiche shifting mechanism and operate in sequence according to a predetermined cycle of operation. A rotary solenoid 65 is mounted on the side plate 29 and with rotary motion of its armature 66, a pin 67 engages the end of a lever 68 that is pivotally mounted at 69 intermediate its ends on an extension 70 of the plate 29. The end 71 of the lever 68 engages the slide member 60 to urge it in a direction toward the shaft 27 as seen in Fig. 2, in order to withdraw the pins 61 from the holes 12 in the microfiche 10. A rotary solenoid 75 is mounted on an intermediate section 76 between the plates 28 and 29 of the member 25 and the rotary motion of its armature 77 moves a pin 78 against a lever

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79 which is pivotally mounted on the under-
surface of the section 76 at 80, a free end 81
engaging an actuating member 82 that is
slideably mounted for movement toward
the plates 46 as will be described
hereinafter. A rotary solenoid 85 is also
mounted on the section 76 and, upon rota-
tion of its armature 86 in a
counterclockwise direction, as seen in Fig.
7, a rod 87 in engagement with a slot 88 in a
shutter member 89 that is pivotally mounted
on a bracket 90 at 91 causes the shutter
member to move relative to the projection
lens system 24 so as to block projection of
any image on the screen.

Means for selecting an image to be pro-
jected on the screen comprises a selector,
designated by the numeral 100, which is
provided with a plurality of keys or buttons
101 each of which corresponds to the loca-
tion by row and column of an image 11 on
the microfiche 10. The selector 100 is also
provided with an unload button 102 and a
start button 103. A programmer control 105
comprises circuitry for providing a com-
plete sequence of operation for the
microfiche shifting mechanism 15. For ex-
ample, the programmer control 105 will
remember the position by row and column
of the selected image that is currently in
the projection gate and its relationship to
the next selected image to be positioned in
the projection gate. In this way, proper in-
struction for the direction of rotation of the
stepping motors 31 and 32 is provided. As a
result, there is no need for the operator to
have access to the microfiche 10 at any
time except for insertion and withdrawal
thereof from the throat 17.

The manner in which a cycle of operation
is accomplished can be best described in
connection with the schematic wiring
diagram shown in Fig. 8 and the disclosure
in Fig. 2. Normally, the carriage 39 with the
carrier 50 will be pivoted so that the open-
ing 45 is aligned with the throat 17, the
carriage 39 being moved to this position by
the energization of the solenoid 75 and the
engagement of the member 82 with the
plates 46 forming the opening 45. When the
member 82 is moved to the left, as viewed in
Fig. 2, the carriage 39 pivots about the shaft
27 to align the opening 45 with the throat
17. When in this position, the plates 46 are
urged against a roller 95 that is carried on
the free end of a leaf spring 96 secured to
the underside of the section 76 by means of
screws 97. the spring 96 serves to maintain
the plates 46 against the rod 82 so as to en-
sure proper alignment of the opening 45
with the throat 17. Also, when the solenoid
75 is de-energized, the spring 76 urges the
carriage 39 into a normal operating position
in which it is held against a bearing or stop.

member 73 on the underside of the member
76.

It is assumed at this time that the
microfiche shifting mechanism is in an
operating condition and that a power supply
106 has been connected to the various ele-
ment as generally shown in Fig. 8. In this
connection, the programmer control 105
has energized suitable means in its circuitry
for maintaining a switch 110 in a closed
position to maintain the solenoid 75
energized. Also, when in this position, the
programmer control 105 maintains a switch
111 in a closed position so that the solenoid
65 is maintained in an energized condition.
Under this condition, the solenoid 65 main-
tains the end 71 of the lever 68 against the
slide member 60 so that the pins 61 are
withdrawn, thereby maintaining the slot 59
free to accept the leading end of a
microfiche. Also, the programmer control
105 maintains a switch 112 in a closed posi-
tion to maintain the solenoid 85 in an
energized condition thereby holding the
shutter member 89 in an obstructing posi-
tion relative to the system 24.

With the various parts in the positions
just described, a microfiche 10 can be in-
serted in the throat 17. The record medium
is urged downward and is edge-guided by
opening 45 into the guide recesses 47 in the
carriage 39 which, in turn, direct the
leading end of the microfiche into the slot
59 in the member 58 of the carrier 50. When
the microfiche has been positioned in this
way, a portion thereof may still be extend-
ing from the throat 17. At this point, the
operator actuates the start button 103 which
through the programmer control 105 first
cuts out the solenoid 65 so that the pins 61
can engage the soles 12 in the microfiche
10. Next, through the programmer control
105, the stepping motor 31 will first be
stepped by the sequencing of the switches
115 and 116, so that the shaft 27 is rotated in
a counterclockwise direction (Fig. 2) to
move the carrier 50 in the same direction,
thereby drawing the microfiche 10 into the
casing and along the recesses 47 in the side
plates 38 and 41. Since the motor 31 is a
stepping motor, the movement of the
carrier 50 is intermittent. When the carrier
50 has reached a position in which the
microfiche 10 has been completely drawn
through the opening 45 and is within the
casing 16, a switch 117 is closed, thereby
providing a signal to the programmer con-
trol 105 to open the switches 110 and 112
whereupon the carriage 39 will be returned
to its normal position by a spring 96 with de-
energization of the solenoid 75 and the
shutter member 89 will be withdrawn from
its obstructing position to a position as
shown in fig. 7. A switch 118 together with

the switch 117 respectively determine the extreme positions of the carriage 39 relative to one end of the shaft 27 and of the carrier 50 as described above and supply an initiating signal for the programmer control 105. With the microfiche 10 completely drawn into the casing 16 and the carriage 39 in the full line position as shown in Fig. 2, any movement of the carrier 50 in a clockwise direction (Fig. 2) will now move the microfiche in a plane to the right of throat 17, as seen in Fig. 2, which will be totally within the casing 16 so that the operator will have no access to the microfiche 10 during projection of any image. Since a button 101 has been actuated for a selected image, the motor 32 will be energized to move the carriage 39 in the X direction along the shaft 27 in increments until the column containing the selected image is positioned in the projection gate on the optical axis of the projection system. The direction of rotation of the motor 32 will be determined by the programmer control 105 with the closing of either switch 113 or switch 114. The movement of the motor 32 is imparted to the carriage 39 by means of the cable 34 and the drive system associated therewith as described above.

At the same time, the stepping motor 31 can be energized to rotate the shaft 27 so that the microfiche is moved in the Y direction by the carrier. The carrier 50 moves about the axis of the shaft 27 until the row containing the selected image is located in the projection gate on the optical axis of the projection system. Depending on which image has been selected, either one or both of motors 31 and 32 are energized. The energization of the motor or motors and the respective direction of rotation thereof is determined by the programmer control 105 via switches 113, 114, 115 or 116. As stated above, the programmer control 105 will remember the position of the image being projected and determine the relationship of the next selected image thereto. As a result, the required direction of rotation of each of the motors 31 and 32 is determined automatically.

When the operator desires to withdraw the microfiche 10 from the device, the unload button 102 is actuated which results in the following sequence of operation. Irrespective of the position of the microfiche carriage 39 and the carrier 50 relative to the shaft 27, the motors 31 and/or 32 are energized to move the carriage 39 and the carrier 50 into a predetermined position relative to the optical axis 19 of the projection system 20. Typically, the carrier 50 will be rotated to a maximum position in counterclockwise direction and the carrier 50 will be positioned along the shaft 27 such that a preselected column on the microfiche

10 is properly oriented with respect to the optical axis 19 and thus the microfiche 10 is positioned centrally relative to the throat 17.

The solenoid 85 is first energized to move the shutter 89 into its light-obstructing position and the solenoid 75 is energized at the same time to move the carriage 39 into alignment with the throat 17 so that with movement of carrier 50 the microfiche 10 is directed and moved into the throat 17. When the carrier 50 reaches the end of its travel, the solenoid 65 is energized so as to withdraw the pins 61 from the holes 12 in the leading end of the microfiche 10, thereby permitting the operator to withdraw the microfiche. With the various parts in the positions just described, another microfiche can be inserted in throat 17 and the cycle of operation just described may be repeated with respect to each selected image.

While the microfiche reader described hereinabove has been disclosed in connection with the image selector 100, the manner in which the image selection is made can vary without altering the cycle of operation. For example, image selection may be associated with a program of image projection in which the images in the rows and columns are arranged in a random sequence, so that some means or device for making the proper selection is necessary. Instead of a single button 101 as disclosed herein, a button corresponding to the X direction and another to the Y direction may be actuated to position selected images in the projection gate. Also inasmuch as the image size on the record medium can vary depending on the recording magnification, the increment of the movement of motors 31 and 32 will have to be related to the actual physical size of the image areas and the number of such images recorded on the record medium.

WHAT WE CLAIM IS:—

1. Image projection apparatus for use with a record medium having a plurality of images arranged in rows and columns, comprising an optical projection system, a shifting mechanism arranged to receive a record medium and move it through an image projection gate in X and Y directions relative to the optical axis of the projection system, first and second drive means arranged to control the shifting mechanism for movement of the record medium in said directions respectively, and image selection means arranged to control the first and second drive means for locating a selected image in the projection gate, the shifting mechanism comprising a carriage arranged for translational movement in one of said directions along an

the switch 117 respectively determine the extreme positions of the carriage 39 relative to one end of the shaft 27 and of the carrier 50 as described above and supply an initiating signal for the programmer control 105. With the microfiche 10 completely drawn into the casing 16 and the carriage 39 in the full line position as shown in Fig. 2, any movement of the carrier 50 in a clockwise direction (Fig. 2) will now move the microfiche in a plane to the right of throat 17, as seen in Fig. 2, which will be totally within the casing 16 so that the operator will have no access to the microfiche 10 during projection of any image. Since a button 101 has been actuated for a selected image, the motor 32 will be energized to move the carriage 39 in the X direction along the shaft 27 in increments until the column containing the selected image is positioned in the projection gate on the optical axis of the projection system. The direction of rotation of the motor 32 will be determined by the programmer control 105 with the closing of either switch 113 or switch 114. The movement of the motor 32 is imparted to the carriage 39 by means of the cable 34 and the drive system associated therewith as described above.

At the same time, the stepping motor 31 can be energized to rotate the shaft 27 so that the microfiche is moved in the Y direction by the carrier. The carrier 50 moves about the axis of the shaft 27 until the row containing the selected image is located in the projection gate on the optical axis of the projection system. Depending on which image has been selected, either one or both of motors 31 and 32 are energized. The energization of the motor or motors and the respective direction of rotation thereof is determined by the programmer control 105 via switches 113, 114, 115 or 116. As stated above, the programmer control 105 will remember the position of the image being projected and determine the relationship of the next selected image thereto. As a result, the required direction of rotation of each of the motors 31 and 32 is determined automatically.

When the operator desires to withdraw the microfiche 10 from the device, the unload button 102 is actuated which results in the following sequence of operation. Irrespective of the position of the microfiche carriage 39 and the carrier 50 relative to the shaft 27, the motors 31 and/or 32 are energized to move the carriage 39 and the carrier 50 into a predetermined position relative to the optical axis 19 of the projection system 20. Typically, the carrier 50 will be rotated to a maximum position in counterclockwise direction and the carrier 50 will be positioned along the shaft 27 such that a preselected column on the microfiche

10 is properly oriented with respect to the optical axis 19 and thus the microfiche 10 is positioned centrally relative to the throat 17.

The solenoid 85 is first energized to move the shutter 89 into its light-obstructing position and the solenoid 75 is energized at the same time to move the carriage 39 into alignment with the throat 17 so that with movement of carrier 50 the microfiche 10 is directed and moved into the throat 17. When the carrier 50 reaches the end of its travel, the solenoid 65 is energized so as to withdraw the pins 61 from the holes 12 in the leading end of the microfiche 10, thereby permitting the operator to withdraw the microfiche. With the various parts in the positions just described, another microfiche can be inserted in throat 17 and the cycle of operation just described may be repeated with respect to each selected image.

While the microfiche reader described hereinabove has been disclosed in connection with the image selector 100, the manner in which the image selection is made can vary without altering the cycle of operation. For example, image selection may be associated with a program of image projection in which the images in the rows and columns are arranged in a random sequence, so that some means or device for making the proper selection is necessary. Instead of a single button 101 as disclosed herein, a button corresponding to the X direction and another to the Y direction may be actuated to position selected images in the projection gate. Also inasmuch as the image size on the record medium can vary depending on the recording magnification, the increment of the movement of motors 31 and 32 will have to be related to the actual physical size of the image areas and the number of such images recorded on the record medium.

WHAT WE CLAIM IS:—

1. Image projection apparatus for use with a record medium having a plurality of images arranged in rows and columns, comprising an optical projection system, a shifting mechanism arranged to receive a record medium and move it through an image projection gate in X and Y directions relative to the optical axis of the projection system, first and second drive means arranged to control the shifting mechanism for movement of the record medium in said directions respectively, and image selection means arranged to control the first and second drive means for locating a selected image in the projection gate, the shifting mechanism comprising a carriage arranged for translational movement in one of said directions along an



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operational axis that is spaced from and normal to the optical axis, record medium guide means on the carriage and a record medium carrier movable with the carriage and mounted for pivotal movement about the operational axis relative to the carriage to co-operate with the guide means on the carriage for moving the record medium in the other of said directions.

2. Apparatus as claimed in Claim 1, wherein the carriage is mounted for pivotal movement about the operational axis between a first position in which an opening allowing insertion of the record medium into the guide means is aligned with a record medium loading station, and a second position in which the opening is out of alignment with the loading station, the carrier being movable between a first position adjacent to the loading station for receiving an end of the record medium and a second position in which the record medium is completely drawn through the opening thereby allowing movement of the carriage to its second position.

3. Apparatus as claimed in Claim 1 or 2, wherein the guide means on the carriage has an arcuate portion for engaging and guiding opposite edges of the record medium during movement of the carrier.

4. Apparatus as claimed in Claim 1, 2 or 3, wherein the record medium is retained for movement by the carrier by at least one releasable retaining pin arranged to engage a corresponding hole or holes in the record medium.

5. Apparatus as claimed in Claim 4 as appended to Claim 2, including means

operable when the carrier is in the first position for actuating and holding the retaining pin or pins in a released position during movement of the record medium into or out of the loading station.

6. Apparatus as claimed in Claim 2 or any Claim appended thereto, wherein means are provided for engaging and pivoting the carriage to position the opening at the loading station.

7. Apparatus as claimed in Claim 2 or any Claim appended thereto including shutter means normally displaced from the projection system and responsive to the carriage being in its first position for blocking the projection system.

8. Apparatus as claimed in any of the preceding Claims wherein the first drive means comprises a stepping motor and a cable drive connecting the motor to the carriage for moving it along the operational axis.

9. Apparatus as claimed in any of the preceding Claims wherein the second drive means comprises a stepping motor directly coupled to a shaft defining the operational axis, the carriage being slidably mounted on the shaft for translational movement therealong and the carrier being slidably coupled to the shaft for rotation therewith.

10. Image projection apparatus constructed substantially as described herein with reference to and as shown in the accompanying drawings.

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