United States Patent [19]

Yevick

[11] **3,865,485**

[45] **Feb. 11, 1975**

[54] **CYLINDRICAL LENS BONDED MICROFICHE**

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[73] Assignee: **Personal Communications Inc.,** Stamford, Conn.

[22] Filed: **July 10, 1973**

[21] Appl. No.: **377,929**

[52] **U.S. Cl.** **355/46,** 353/27, 354/110, 354/124, 355/54, 355/71

[51] **Int. Cl.** **G03b 27/62**

[58] **Field of Search** ..... 355/46, 34, 53, 54, 71; 352/58; 353/27, 25, 30; 95/18 P; 354/110, 124

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Primary Examiner—Richard A. Wintercorn

Attorney, Agent, or Firm—Cameron, Kerkam, Sutton, Stowell & Stowell

[57] **ABSTRACT**

A microfiche having integral lensettes below which are aligned micro images to assure optical registry of the stored intelligence and the lensettes. According to this invention, the microfiche is made in two laminar halves which may be bonded together or relatively movable during indexing of the fiche. The integral lensettes are replaced by rows of crossed strip lenses (bar lenses). The strips are longitudinally convex and may be separate or in the form of convex channels in the fiche.

13 Claims, 11 Drawing Figures

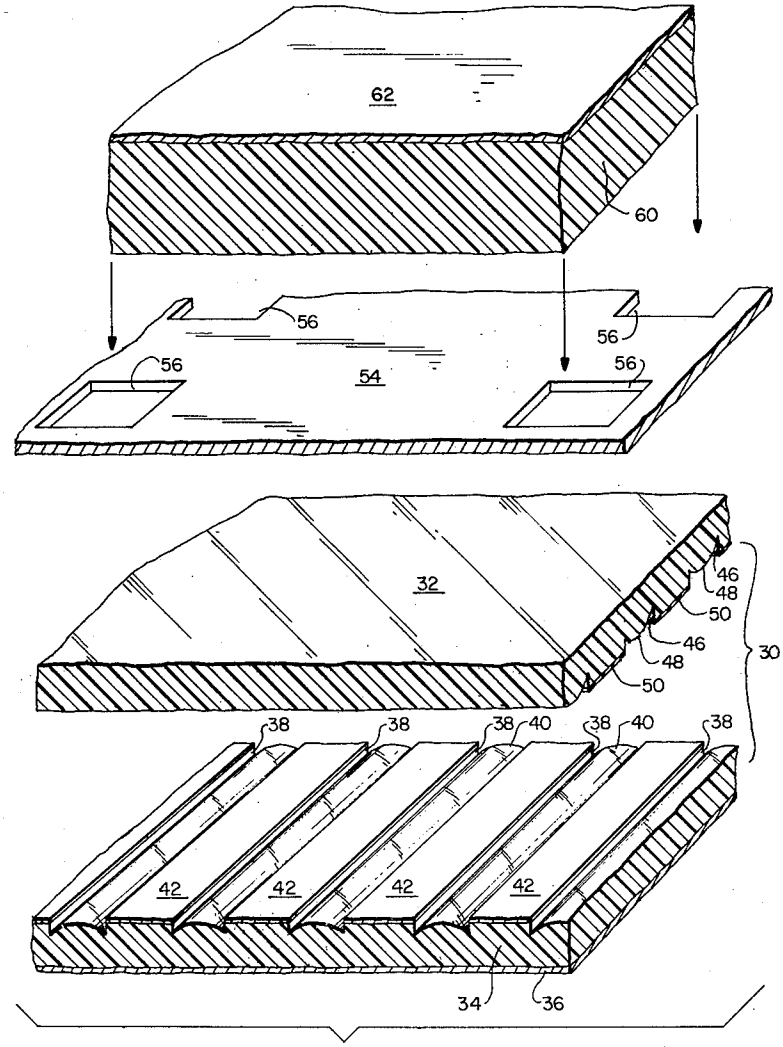
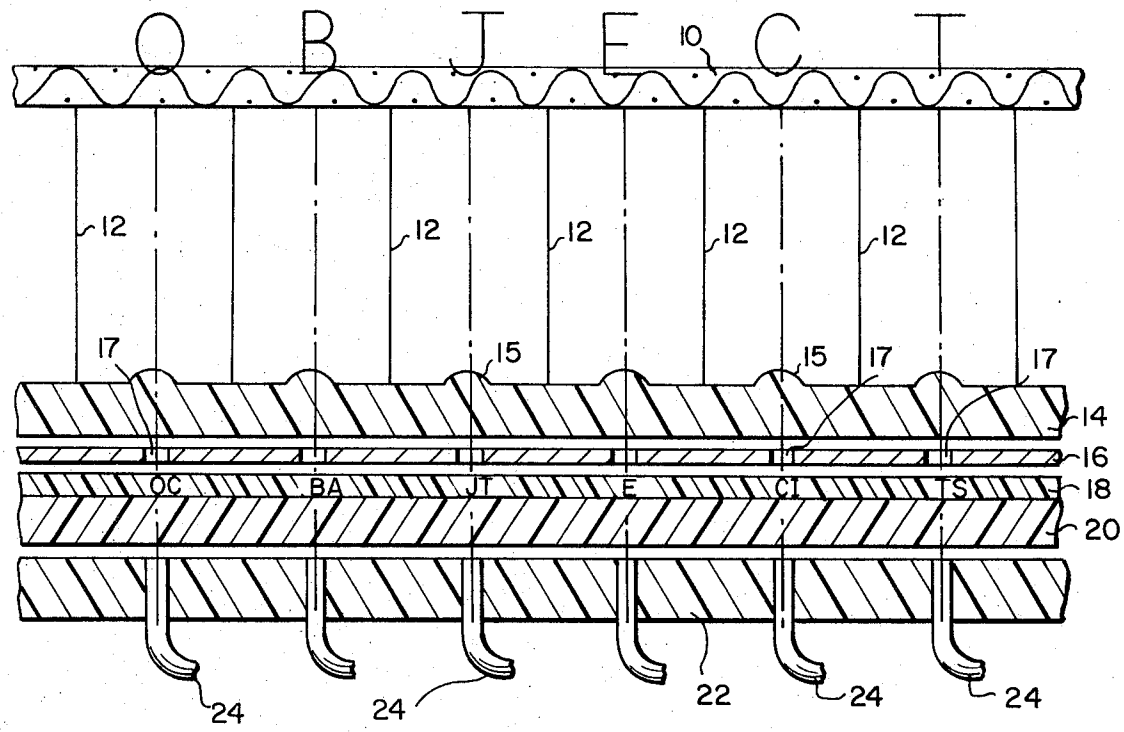


FIG. 1 (PRIOR ART) U.S. PATENT 3,704,068



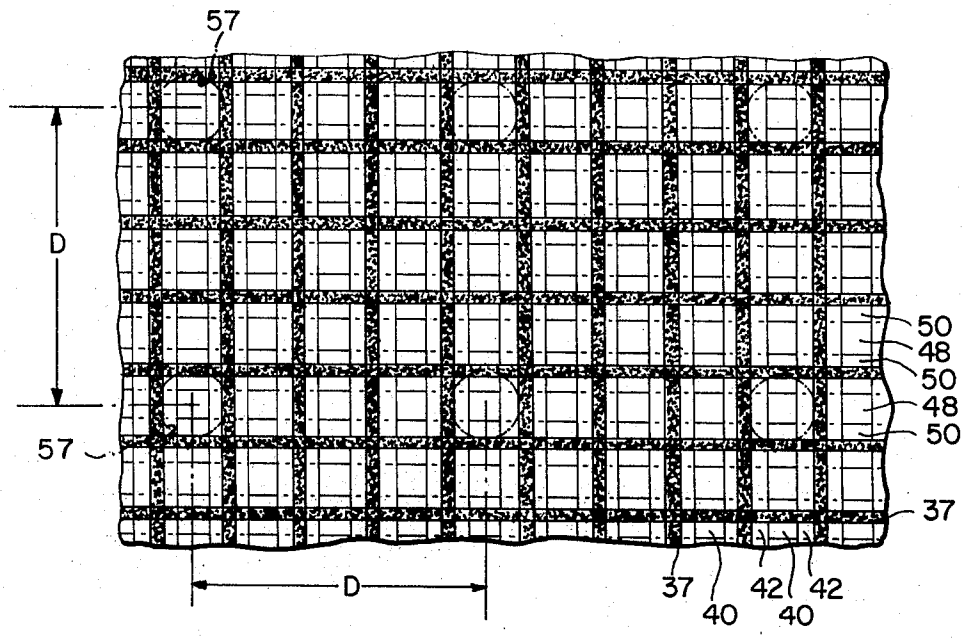


FIG. 8

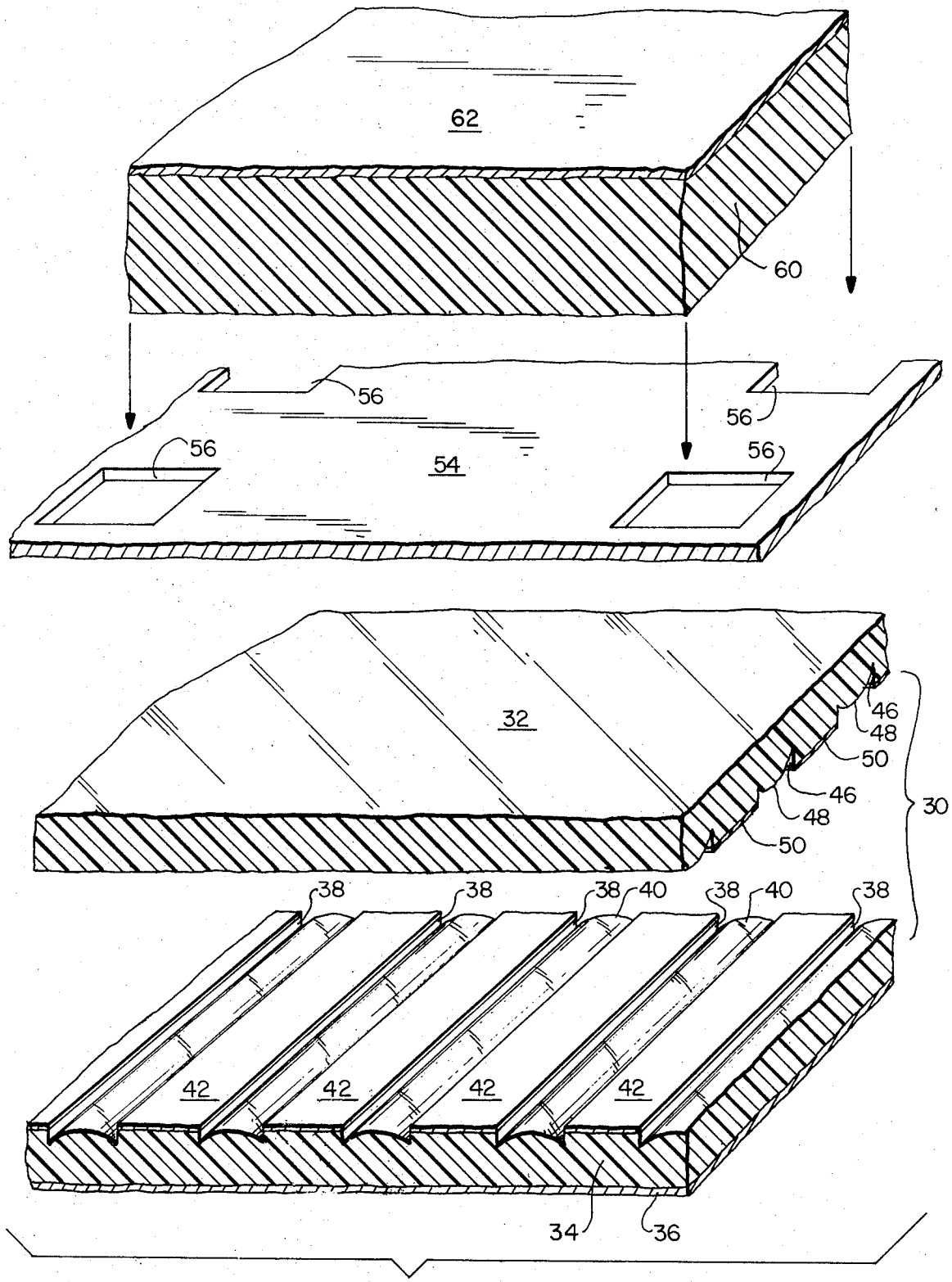

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FIG. 2

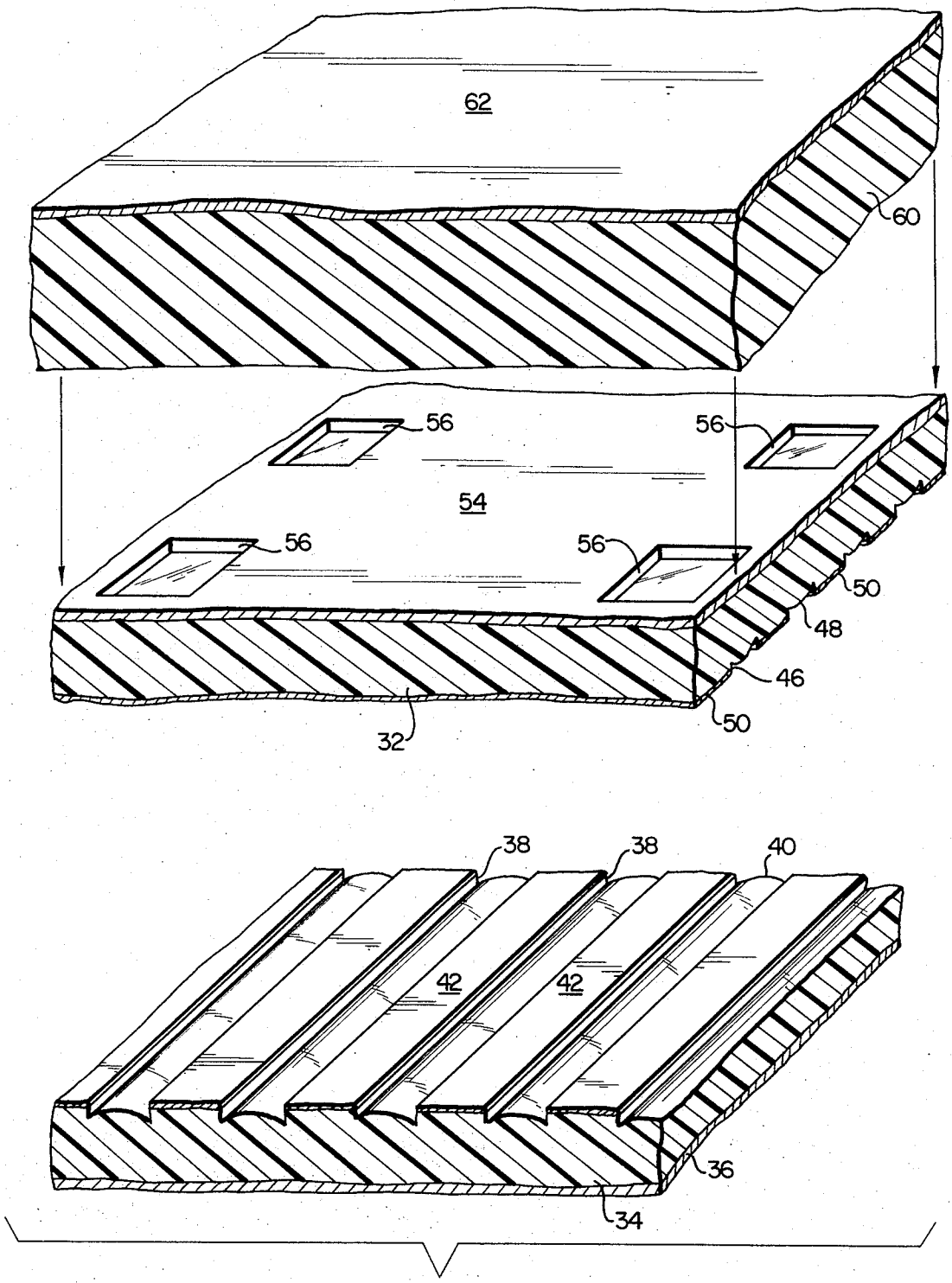

FIG. 3

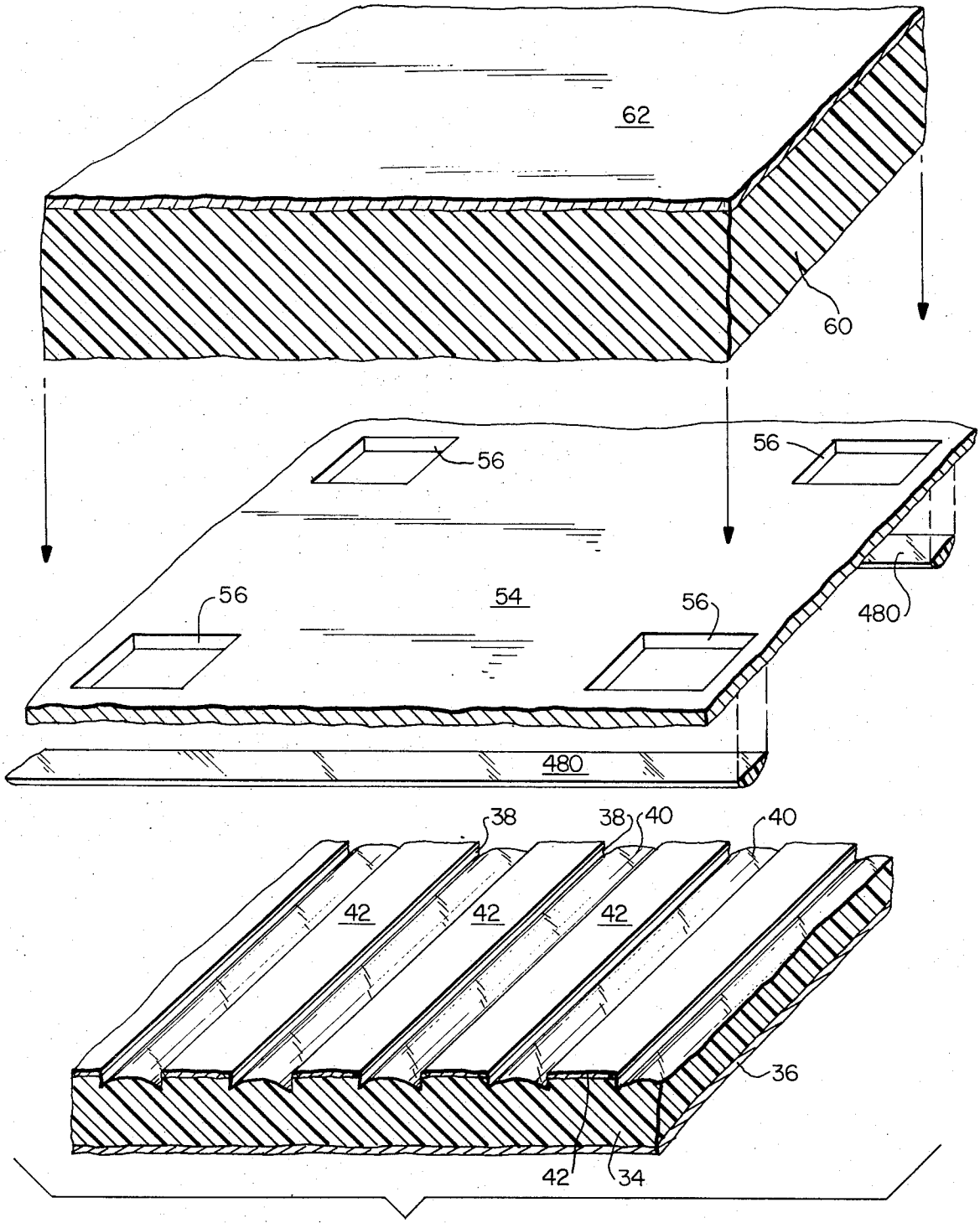

FIG. 4

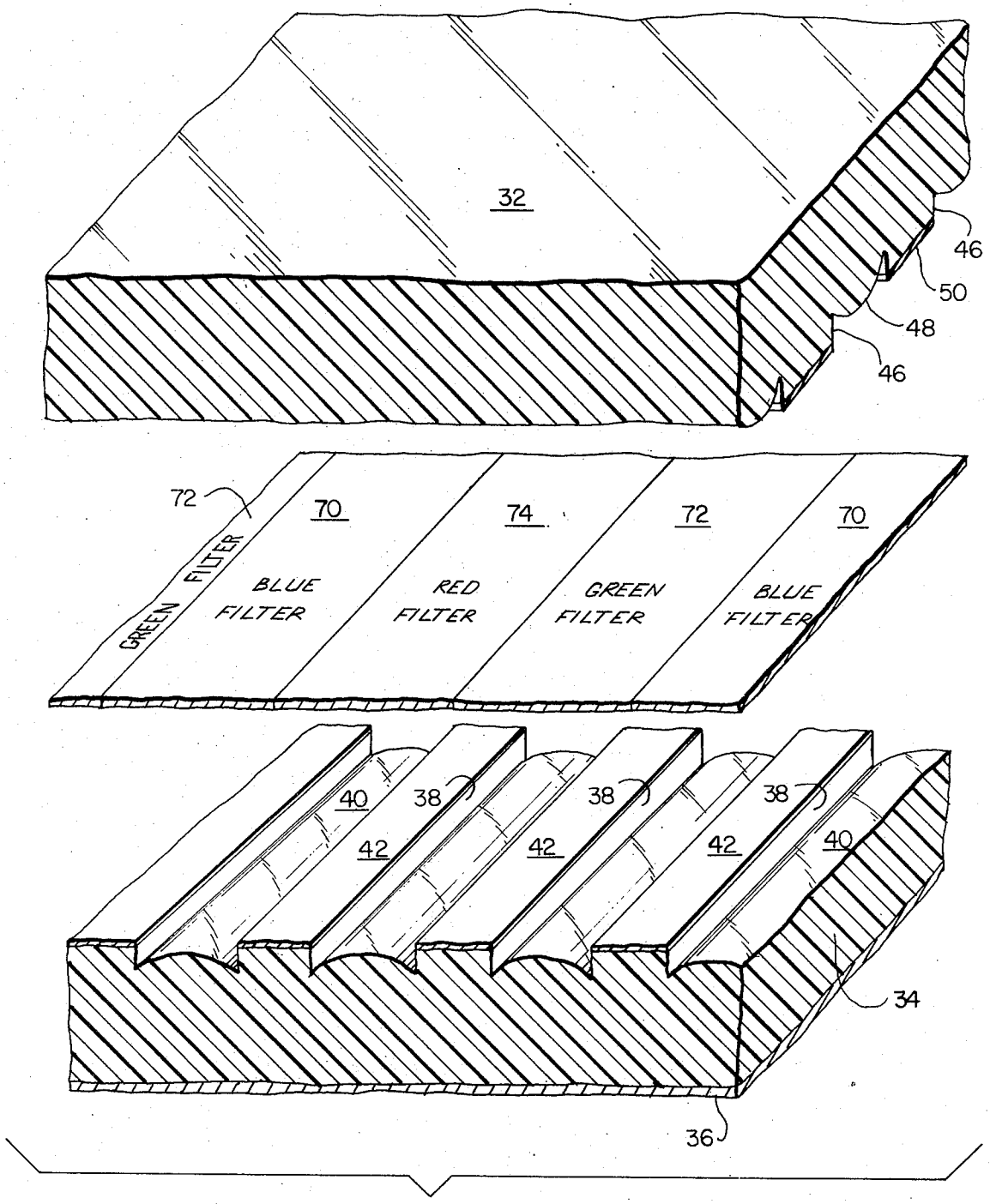
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FIG. 5

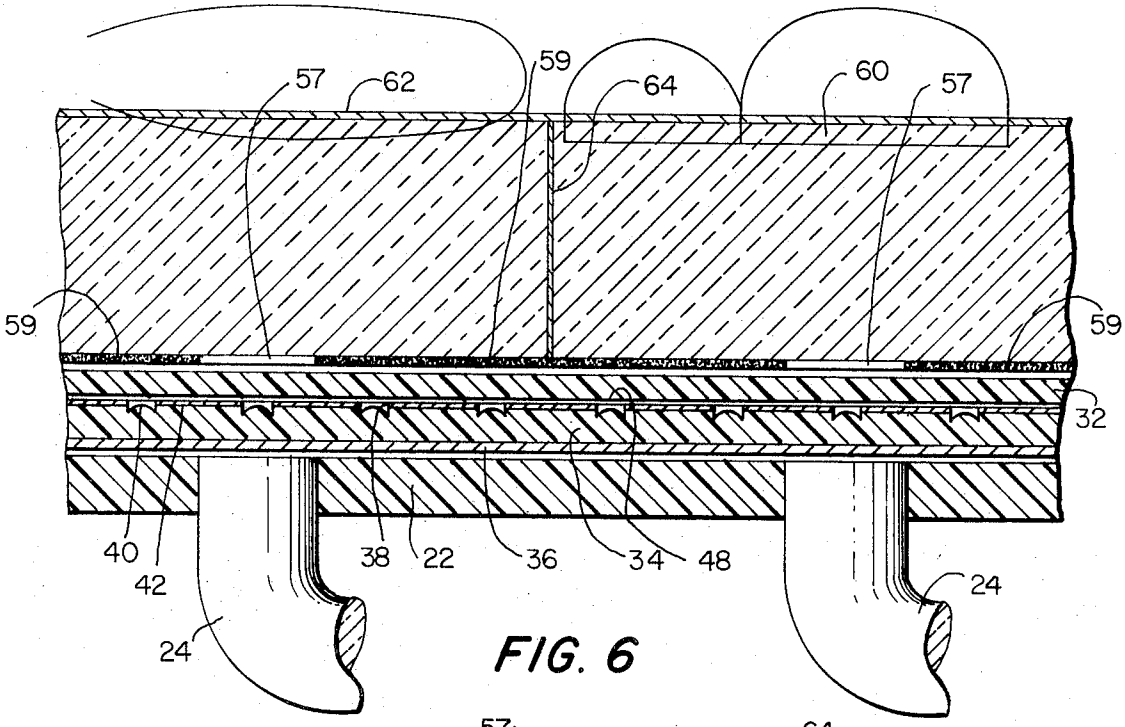
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FIG. 6

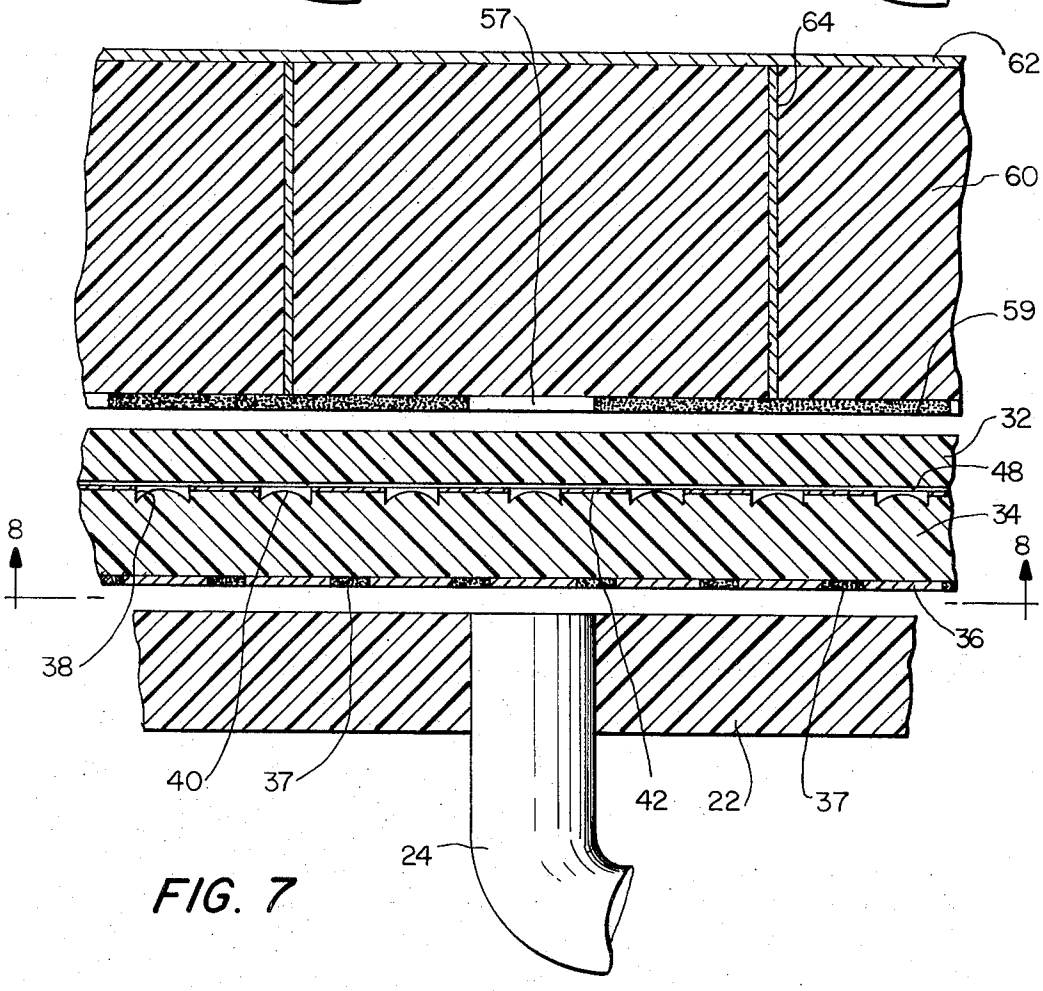
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FIG. 7

FIG. 11

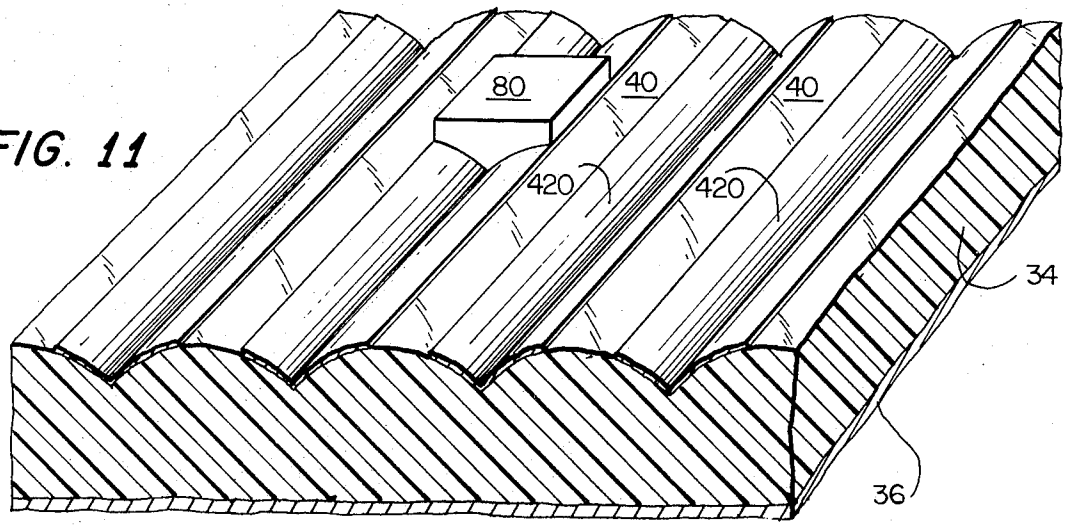


FIG. 9

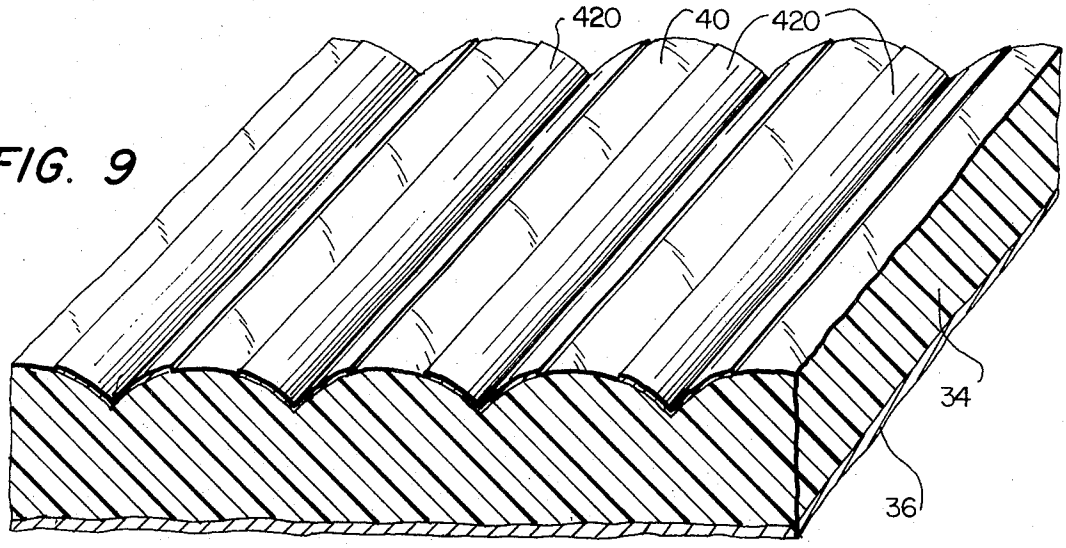
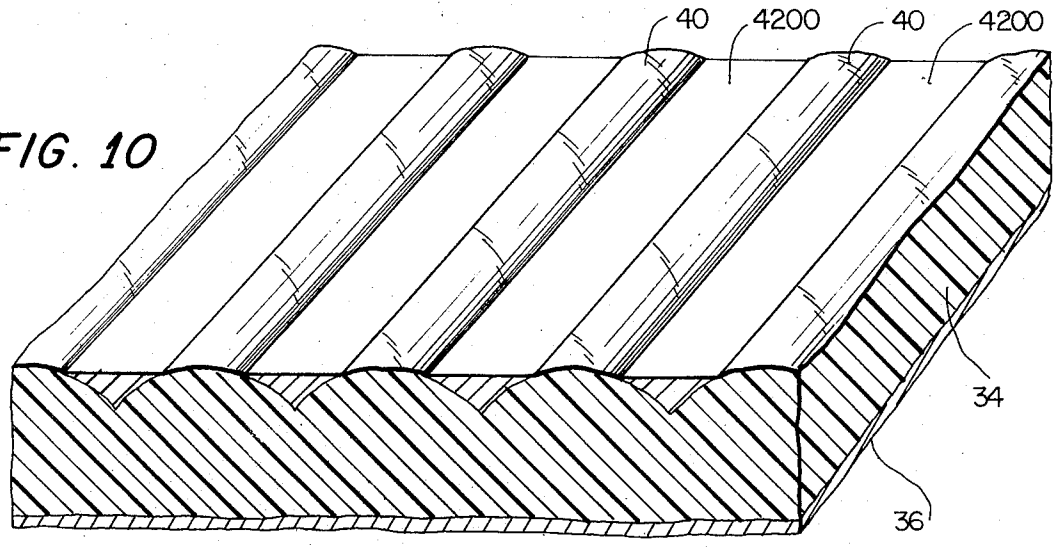


FIG. 10



CYLINDRICAL LENS BONDED MICROFICHE

This invention relates to the recording of information by means of optical storage devices and more particularly to that class of optical storage device known as a microfiche, sometimes termed simply a fiche. Typically a microfiche is formed of a relatively flat, thin plastic substrate, base or carrier which includes or carries an emulsion, the emulsion in turn carrying a large number of micro images. The micro images are generally arranged in a rectangular array on the fiche and the fiche is placed into a projection apparatus for projection and enlargement of each individual element of the array. Suitable indexing means are employed for scanning the entire microfiche, i.e., sequentially placing each micro image in registry with a projection lens and a source of projecting illumination.

While such devices have been known it is only recently that workers in this art have become aware that the use of a great number of relatively small lenses, sometimes termed lensettes because of their smallness, may be employed to realize relatively short throwing or projection distances. U.S. Pat. No. 3,704,068 issued Nov. 28, 1972 to Adnan Waly discloses such a device.

This invention also displays utility as a camera in the sense that a great number of scenes each comprising non-discrete information (a landscape or a portrait) as well as discrete information (such as the printed word) may be recorded.

According to the Waly patent, the microfiche is indexed relative to the lensettes through which the micro information (micro images) is projected and enlarged for viewing on a screen. In distinction to this arrangement, a microfiche may be formed wherein the lensettes are integral with the substrate which carries the emulsion and micro images. This latter construction insures that there is always optical registry between the micro images and the projection lensettes. In this latter construction, integral lensettes may be formed by embossing a plastic fiche such as of methyl methyacrylate by means of known embossing techniques employing, for example, a cylinder provided with the plurality of regularly arrayed and spaced depressions which are pressed upon the top surface of the plastic substrates to form the lensettes.

According to the present invention, a microfiche is formed wherein the lensettes are even more simply, speedily, and accurately formed. Instead of embossing to provide a plurality of lensettes, the microfiche is of a two-piece laminar or sandwich construction. The facing surfaces of the two layers are each provided with grooves. The grooves define channels whose surfaces are longitudinally convex. The two halves are then placed together such that the channels cross each other. The channels on each half being spaced from each other, and each of the two halves formed of a transparent substance, the net result is a microfiche having the equivalent of lenses arranged in a rectangular array and located intermediate the top and bottom surfaces of the fiche. The photographic emulsion carrying the micro images is positioned on the lower face of the lower laminar half.

IN THE DRAWINGS

FIG. 1 is a partially schematic view illustrating a prior art construction of a microfiche and reader.

FIG. 2 is an exploded view illustrating the construction of the microfiche according to this invention.

FIG. 3 is a view similar to FIG. 2 and illustrates an embodiment.

FIG. 4 is a view similar to FIG. 2, and illustrates still another embodiment.

FIG. 5 is a view similar to FIG. 2 and illustrates an embodiment for use with color viewing.

FIGS. 6 and 7 are views similar to FIG. 1, and illustrate microfiches according to this invention in combination with a reader.

FIG. 8 is a view along section 8—8 of FIG. 7.

FIGS. 9, 10, and 11 illustrate still further embodiments of a microfiche.

Referring now to the drawings, FIG. 1 is a view illustrating a prior art construction such as shown in U.S. Pat. No. 3,704,068 issued to Adnan Waly. There, a viewing screen 10 is formed adjacent a plurality of opaque walls 12, the walls functioning as septa and which extend upwardly from a plastic plate 14 formed of, for example, methyl methacrylate. A plurality of bosses 15 define integral lensettes on the top surface of plate 14. An opaque plate 16 is provided with a plurality of apertures 17, each aligned with a corresponding lensette 15. The numeral 18 denotes a photographic emulsion carrying a plurality of discrete micro images, here illustrated, for purposes of clarity, as characters of the alphabet. The numeral 20 denotes a transparent carrier, conveniently formed of a polyester, supported by a guide member 22 through which extends a plurality of light pipes 24. Light pipes 24 are of conventional construction and are of the type which are totally internally reflecting. In operation, light is passed through the light pipes 24, upwardly through the plate 20 and the micro information on photographic emulsion 18, thence through the apertures 17 and the lensettes 15 for projection and enlargement on viewing screen 10. Each lensette 15 being a simple lens, the projected image would be inverted and reversed but is shown in FIG. 1 as erect. Unless microfiche 20 (and associated photographic emulsion 18) is perfectly aligned with both the apertures 17 of mask 16 and lensettes 15 of plate 14, the projected micro information might become partially lost to the viewing screen. Similarly, in the event that the fiche 20 should undergo changes in dimension occasioned by changes in ambient temperature or humidity, optical registry between the light pipes 24, the apertures 17, and the lensettes 15 might not occur with respect to the micro information. Thus, when the microfiche 20 is indexed for the next image, such as the message CAT IS, a portion of this information might likewise be lost to the viewing screen.

To overcome this difficulty, the microfiche 20, photographic emulsion 18, and plate 14 with associated integral lensettes 15 may be all made integral, with the mask 16 then being placed, for example, above the thus composite microfiche. To form such a microfiche, lensettes such as 15 may be embossed over the other surface fiche 20, and the fiche inverted from that position shown. However, this may entail manufacturing difficulties, such as constancy of spacing, wear of the embossing wheel, expense of fabrication of the embossing wheel or cylinder, etc. The present invention is a solution of these problems and may be broadly defined as the concept of making the microfiche in two sheet-like or laminar halves. Each half is provided with spaced,

parallel channels which are lengthwise convex and which, when closely crossed, function as lensettes.

Referring now to FIG. 2 of the drawings, the numeral 30 denotes such a composite microfiche as defined by top half 32 and a bottom half 34, the latter carrying a photographic emulsion 36 on its lower surface. The photographic emulsion carries micro images of information adapted to be projected on a viewing screen. Alternatively the emulsion 36 may be unexposed when the invention is employed as a camera. The bottom plate 34 is provided with a plurality of spaced, parallel channels 38 which are longitudinally convex as indicated by the convex surface 40 of each channel. An opaque substance 42, such as an opaque plastic or coating, is placed on the transparent plastic between channels 38. The micro information recorded and stored in emulsion 36 is located beneath the channels 38, and extends beneath the opaque portions 42. In lieu of an emulsion, the micro images may obviously be printed on the plastic substrate 34.

The upper half 32 is, similarly, provided with identical channels 46 having convex surfaces 48. Again, the channels are spaced from each other and are parallel, with the inter-channel space being covered by an opaque coating 50 identical to opaque coating 42.

An opaque mask 54 having a rectangular array of openings 56 positioned between the top of the fiche and the lower surface of screen 60 having viewing surface 62. The screen 60 may be also of a transparent plastic such as methyl methyacrylate and its top surface 64 may be roughened, coated, or the like, for the purpose of defining a viewing surface or screen.

The reader will now be in a position to comprehend that the two halves 32 and 34 are joined to thereby define a two-part laminate, with the channels 38 of lower half 34 crossing at right angles to channels 46 of upper half 42. As will be recognized by workers in this art, the crossed, curved surfaces 40 and 48 function as a convex-convex lens, such lenses being located wherever the channels 40 intersect. As will be more fully described in detail below, in operation the composite microfiche 30 is indexed relative to the screen 60 and associated mask 54 for the purpose of displaying (or recording) optical information.

Referring now to FIG. 3 of the drawings, another embodiment is illustrated. Here, the upper half of the fiche is bonded to mask 54, and in turn bonded to the lower surface of block 60 having viewing screen 62. In this modification, the lower half 34 moves relative to the upper half 32 during readout and thus indexing takes place only with respect to the lower half. The upper half is thus stationary with respect to the viewing screen and the mask.

Referring now to FIG. 4 of the drawings, an embodiment similar to the embodiment of FIG. 3 is illustrated. As will be later more fully described, the indexing of the movable fiche or movable part of the fiche results in a projection of optical information only through apertures 56 in the screen 54. Thus, from a consideration of FIG. 3, it is seen that all of those channels 46 and associated convex, longitudinal lenses defined by surface 48 are not used. Accordingly, in lieu of a top half 32, such as shown at FIG. 3, the entire top half may be replaced by elongated lenses 480 which are positioned beneath the apertures 56. Each of the elements 480 may be regarded as an optical strip which, as in the previously-described embodiment, crosses at right angles with respect to the channels 38 in the lower half of the fiche. In practice, the optical strips 480 are fixed relative to the lower portion of mask 54, the cross mask is in turn positioned adjacent and fixed to the bottom surface of the methyl methyacrylate block 60 which carries the viewing surface 62. In operation, the lower half 34 of the fiche is indexed both transversely and parallel to the channel 38. As before, the longitudinal lenses or strips 480 act to effectively define, in cooperation with lower elements 40, convex-convex lenses for the projection and enlargement of micro-images carried by emulsion 36.

Referring now to FIG. 5 of the drawings, a modification is illustrated which exhibits utility in color microoptics. Here, a plastic sheet contains blue, green, and red filter sections 70, 72 and 74. These filters alternate and span the entire area of the composite microfiche. The filters are arranged in alternating strips, with the blue filter spanning one channel 38, the adjacent green filter spanning the adjacent channel 38, and the red filter 74 spanning the next adjacent channel 38. This completes the cycle with the fourth channel 38 now being spanned by a blue filter 70, and so on. For viewing, or recording, a mask such as mask 54 is used having apertures 56 which are of a size to span the channels 38, so that one channel projects blue images, the next green images, and the next red images, through the same mask opening 56.

Referring now to FIG. 6 of the drawings, a composite microfiche such as has been described is illustrated in combination with a projection or viewing apparatus. During this description, it will be apparent that the same apparatus is susceptible of use as a recording device, i.e., as a camera.

The lower laminar half portion 34 carrying emulsion 36 is supported on the top of panel 22 into which extends the terminii of light pipes 24. Each terminal is in alignment with micro images in emulsion 36 and with a channel 38. The (orthogonal) channels on the top laminar half 32 cross the channels 34, as previously described, and only one longitudinally convex lens portion 48 is thus illustrated. Screen 60 carries opaque septa 64 for precluding optical cross-talk. Openings 57 in opaque coating 59 function as a coarse mask and are in alignment with the termini of light pipes 24. In practice, the number of channels 38 between adjacent light pipes 24, depending upon the desired dimensions, may be in the order of 25, while only five are illustrated due to space limitations in the drawings. During operation of the device, the composite microfiche defined by the top and bottom halves is indexed, by suitable indexing mechanism, so that a particular set of crossed, longitudinal lenses 40 and 48 are positioned in alignment with the termini of light pipes 24 and openings 57. Light shines through the light pipes 24, through the micro images stored on emulsion 36, thence through the crossed longitudinal lenses where it is magnified and projected for viewing. In order to view the next screen, the composite microfiche is again indexed, bringing still another set of crossed, longitudinal lenses into optical registry with the termini of light pipes 24 and openings 57.

Referring now to FIG. 7 of the drawings, a similar arrangement is illustrated, the difference being that field stops 37 are incorporated into emulsion 36, each field stop 37 defined by an opaque strip. The strips thus cross each other, as illustrated at FIG. 8 of the draw-

ings. The mode of operation of FIG. 7 is the same as that described with respect to the arrangement shown at FIG. 6.

Referring again to FIG. 8 of the drawings, a view taken along line 8—8 of FIG. 7 is depicted, with the distance D representing the spacing between mask apertures 57. Again, for purposes of illustration, only a few crossed, lenses are shown between each opening 57 due to drawing space limitations. As shown at the lower right-hand portion of FIG. 8, the crossed field stops 37 appear towards the reader in full lines, while opaque portions 42 have between them the longitudinal, convex lenses 40 of the lower half 34 of the composite fiche. Going further away from the reader, into the paper, one sees the opaque portions 50 of the upper half 32 of the composite fiche, and the longitudinal, convex lenses 48 of that upper half. The crossing of opaque strips 42 and 50 forms five aperture stops bordering the crossed channel lenses 40 and 48.

Referring now to FIG. 9 of the drawings, another embodiment is illustrated of a composite microfiche, the bottom half only being illustrated. Here, the curved or convex and longitudinal lenses 40 are milled or molded or otherwise formed on the top surface of the bottom half 34. Opaque coatings 420 are placed as indicated in the troughs between the curved lenses 40. The same method or manufacture is employed with respect to the upper (not illustrated) half of the composite fiche.

Referring now to FIG. 10 of the drawings, another embodiment is illustrated differing from that in FIG. 9 only in the thickness of the opaque portions in the trough, the opaque portions here being denoted by the numeral 4200.

Referring now to FIG. 11 of the drawings, a mode of assembling halves of the fiche shown at FIG. 9 is illustrated, and employs bosses 80 of any suitable material such as methyl methyacrylate positioned in the troughs. The bosses are spaced in a periodic array and may be embossed into 34. Similar bosses 80 may be present in the upper (not illustrated) half of the composite fiche.

Typically, the overall microfiche may be of a thickness of 7 mils for any of the embodiments shown. The entire thickness of the reader (camera) of FIGS. 6 and 7 may be a half an inch or less. The magnification is typically 25, and the radius of curvature of the longitudinal lenses may be 1.28 mils. The distance from the lensettes to the viewing surface may be in the order of 100 mils and the width of the channels may be in the order of 1 mil. The spacing D (see FIG. 8) may be 100 mils.

As known in the plastic arts, either or both laminar halves may be uniaxially or biaxially stretched to increase their strength.

It will be apparent that the photographic emulsion 36 in any of the embodiments may be exposed or unexposed or replaced by a print of an exposed emulsion, depending on the intended use, i.e., a reader or a camera.

I claim:

1. A composite microfiche formed of two laminar halves, each half defined by a generally flat substrate having parallel, spaced channels on one face thereof, each channel having a curved surface throughout its length to define a channel lens, the inter-channel surface on said one face being opaque, the two said halves placed with their channeled faces facing each other and with the channel lenses of one half crossing the channel lenses of the other half to define a projection lens at each crossing, one of said laminar halves carrying a photographic emulsion over a surface thereof.

2. The microfiche of claim 1 wherein said two halves are bonded together.

3. The microfiche of claim 1 wherein said channel lenses are convex.

4. The microfiche of claim 1 wherein said two halves are contiguous yet relatively movable in parallel planes, whereby the two halves may slide relative to each other and remain the same laminar thickness.

5. The microfiche of claim 1 including color filters positioned between said crossed lenses, the number of colors being at least two in number, one color being aligned with each channel lens of one of said laminar halves.

6. A microfiche reader/camera apparatus including a viewing screen parallel and spaced from a microfiche defined by a transparent substrate carrying a photographic emulsion on one surface, the other surface having a plurality of parallel, spaced channels each being curved on its surface throughout its length, the intra-channel surface of said other surface being opaque, a plurality of parallel, longitudinal lenses in the form of strips fixedly mounted with respect to said viewing screen, said strip lenses being contiguous to and crossing the said channel lenses, a projection lens defined at each such crossing, said microfiche substrate being slidable with respect to said strip lenses yet maintaining the same composite thickness.

7. The microfiche apparatus of claim 6 including an apertured, opaque mask fixed relative to said viewing screen and to which said strip lenses are fixed, said strip lenses being aligned with and crossing said apertures.

8. The microfiche of claim 6 including color filters positioned between said crossed lenses, the number of colors being at least two in number, one color being aligned with each channel lens.

9. A laminar half for a composite microfiche, including, a transparent substrate having a plurality of parallel and convex, lens-forming corrugations on one surface thereof and carrying a photographic emulsion at the other surface thereof, the depressed areas of said corrugated surface between said lenses defining troughs and being opaque, said opaque areas extending laterally from the lowest parts of said troughs.

10. The laminar half of claim 9 including, a spacing boss positioned in a trough, whereby to abut a similar boss in a similar laminar half to thus space two such laminar halves.

11. The laminar half of claim 9 wherein said troughs are coated with an opaque film.

12. The laminar half of claim 9 wherein said troughs are filled with an opaque substance.

13. A microfiche having a photographic emulsion on one surface thereof, said emulsion carrying micro images, opaque bands carried by said emulsion and intersecting each other to function as optical stops, said bands intersecting each other thereby forming closed polygons, each of which encloses a distinct micro image.

* * * * *