

United States Patent

[11] 3,582,204

[72]	Inventor	Iben Browning
		745 Distel Drive, Los Altos, Calif. 94022
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2,371,172	3/1945	Hotchner	353/38
2,794,977	6/1957	Stoddart.....	340/378.2
2,807,663	9/1957	Young.....	178/15
2,981,140	4/1961	Ogle	353/38X
3,151,520	10/1964	Nadeau	353/38
3,399,475	9/1968	Rinder.....	340/378X

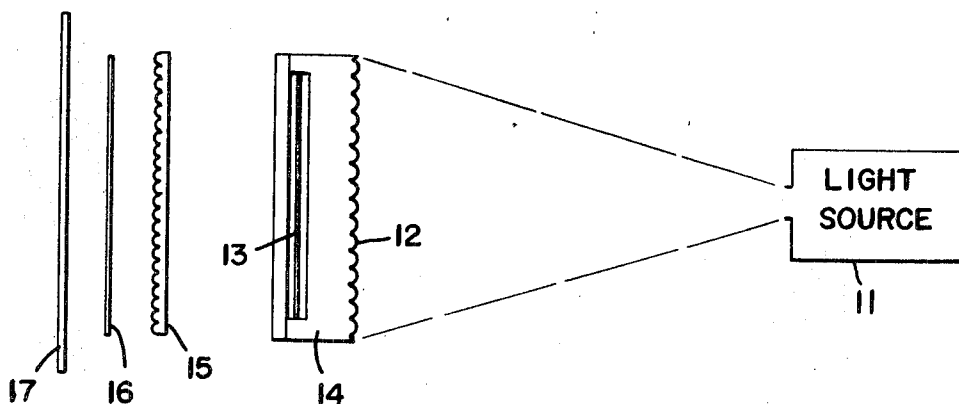
Primary Examiner—Harry N. Haroian
Attorney—Limbach & Limbach & Sutton

[54] REPRODUCTION SYSTEM USING PUNCHED TAPE
9 Claims, 11 Drawing Figs.

[52]	U.S. Cl.	353/38
[51]	Int. Cl.	G03b 21/14
[50]	Field of Search	353/36- —38, 25—27, 46—50; 340/378, 324.1; 178/15, 30, 90

[56] **References Cited**
UNITED STATES PATENTS
1,984,004 12/1934 Wildhaber..... 350/131

ABSTRACT: An optical display method and apparatus is disclosed wherein information is selectively reproduced either simultaneously or sequentially from simple characters which form letters, numerals or more complex signs in combination according to the coded sequence of punched holes in a punched paper tape.



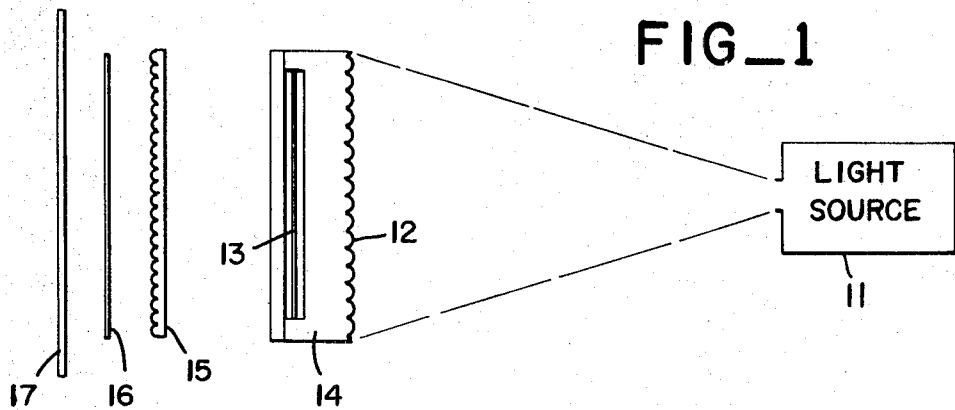


FIG_2

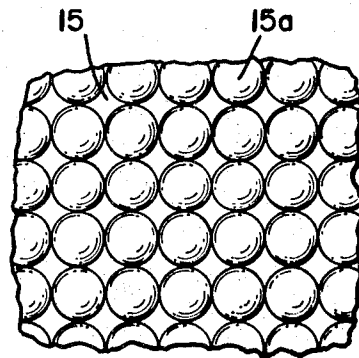


FIG_4A

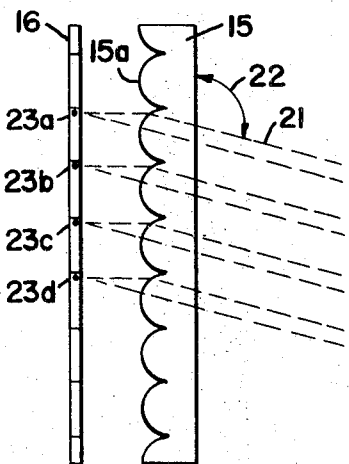


FIG_4B

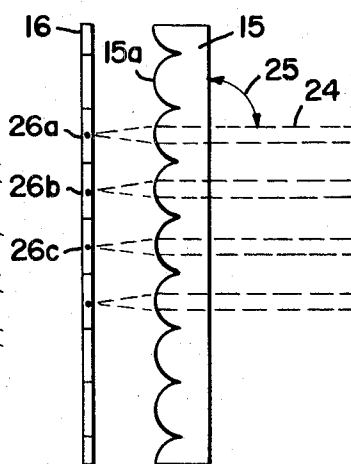
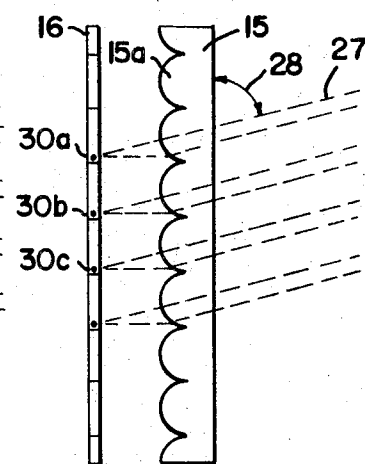
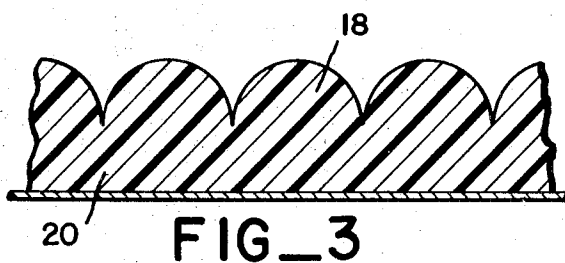


FIG_4C



INVENTOR
IBEN BROWNING

BY

Townsend and Townsend
ATTORNEYS

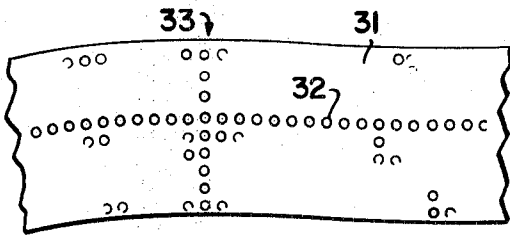


FIG_5

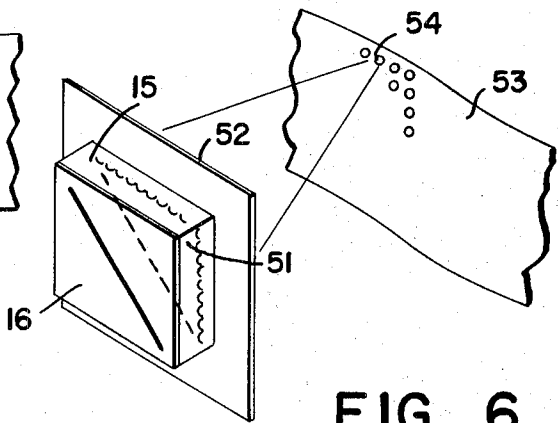
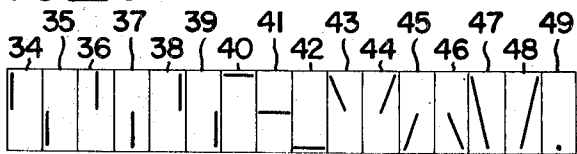


FIG_6

FIG_7



34, 35, 38, 39, 40, 41



34, 35, 38, 39, 40, 41, 42



34, 35, 40, 42



43, 44, 45, 46



47, 48

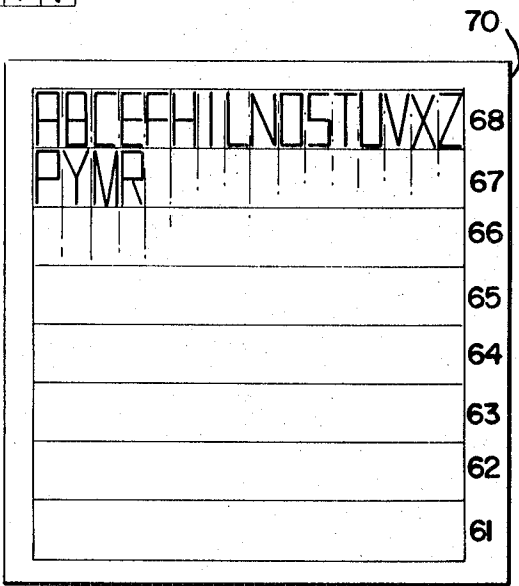


FIG_9

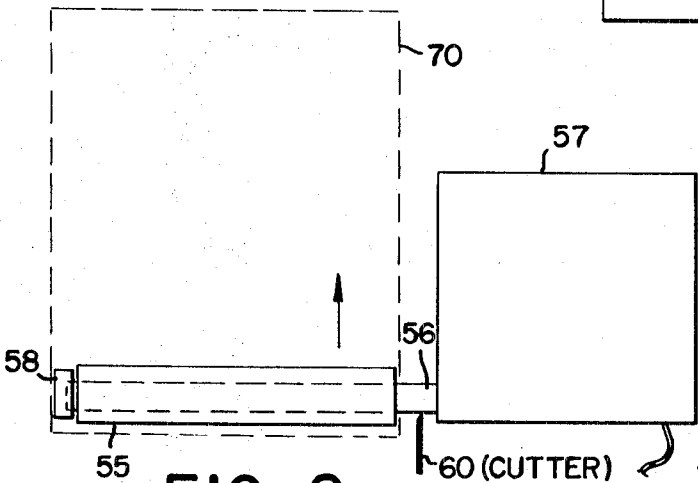


FIG_8

INVENTOR
IBEN BROWNING

BY

Townsend and Townsend
ATTORNEYS

REPRODUCTION SYSTEM USING PUNCHED TAPE

BACKGROUND OF THE INVENTION

This invention relates to a new and improved method and apparatus for selectively reproducing information and displaying information encoded in a punched tape or similar recording medium.

1. Description of the Prior Art

It is often necessary that information be timely reproduced and presented where it is accessible to large numbers of people. For instance, current airline and railroad schedules, running scores in athletic events, market information, and news are often displayed on large boards. It is also often desirable to provide means for graphical display of computer output information.

2. Summary of the Invention

It is an object of this invention to provide a method and apparatus for reproducing and displaying information which is inexpensive and simple, requiring no electronic memory devices, yet which is highly flexible in the display format. Another object of the invention is to provide a method and apparatus controlled by a punched paper tape for timely reproduction and display of computer output information and information transmitted over commercial communications media. In particular, the invention proposes a method of reproducing information encoded in the configuration of holes punched in a paper tape by selectively transmitting light through the holes to optically reproduce the information encoded in the configurations of holes for projection on a screen.

In order to accomplish these results, the present invention contemplates the formation of letters, numbers and more complex signs or symbols from simple lines, character, or units of information displayed in combination on a screen. Each of the simple characters or units of information combined to form the complex symbols is uniquely selected by the light from a light source behind a paper tape passing through a punched hole in a predetermined position on the punched tape and displayed on a screen. Each of the simple characters responds to the light from one and only one hole position in the punched tape so that complex signs or symbols may be formed by a combination of simple characters produced by the light passing through a coded combination of holes in the punched tape.

In order to provide unique 1 to 1 correspondence between the simple characters or information units and the light passing through the holes in the punched tape, the present invention further contemplates interposing a lens mosaic and a preexposed film light mask between the punched tape and screen. The film light mask is sequentially preexposed with the character information on each of a plurality of exposure sheets by light from a different one of a plurality of substantially point light sources corresponding to each of the possible punched hole positions on a punched tape projected through the exposure sheet and lens mosaic onto the film mask. The film mask is preexposed to light from a different point light source position for each different simple character so that each different character exposure is formed by light from only one particular light source or punched hole position relative to the lens mosaic and film mask. The film light mask is thus position-sensitive to the incident light, that is, selectively transparent only in one character to light from a given position.

Thus, the invention contemplates positioning the preexposed film mask at the focal plane of the lens mosaic formed by the focal points of the lenses comprising the lens mosaic between the lens mosaic and screen. Light from a point light source established by a hole in the punched tape is focused through the lens mosaic onto the film mask in a multitude of points of unique position corresponding to the position of the hole punched in the tape. The film light mask is selectively transparent to light at the angles of incidence produced by one of the punched hole positions in only one simple character

which thus appears on the screen. A combination of holes on the tape projects light of different point sources onto the film mask and therefore a combination of simple characters onto the screen corresponding to the various characters preexposed from those same point light sources to form letters, numbers, or more complex symbols.

While the whole screen can be illuminated by each point source typically each point illuminates only a particular portion of the screen, so that words or many symbols can be formed.

Other aspects of the invention will become apparent in the embodiments of the invention hereinafter described.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic side elevational view of one form of apparatus embodying the present invention;

FIG. 2 is a fragmentary front view of one lens mosaic utilized in the apparatus of FIG. 1;

FIG. 3 is a detailed cross-sectional view from the side of the lens mosaic illustrated in FIG. 2;

FIGS. 4a, 4b and 4c are fragmentary cross-sectional views from the side of the lens mosaic and film light mask illustrating the variation in the focal plane position of focused light incident on the lens mosaic from different point light sources;

FIG. 5 is a fragmentary perspective view of a punched tape;

FIG. 6 is a diagrammatic perspective view of an apparatus and method for forming the film mask;

FIG. 7 is a diagram of one possible format of simple characters for forming letters, numbers or more complex symbols;

FIG. 8 is a block diagram of one form of display mechanism for use in conjunction with the present invention; and

FIG. 9 is a diagram of the address positions for the mechanical holder of the display mechanism illustrated in FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the embodiment of the present invention schematically illustrated in FIG. 1 there is provided an optical train including a light source 11 and condenser lens mosaic 12 for focusing the light onto each of the possible punched hole positions on a paper tape 13 having punched therein a coded combination of holes to form a plurality of point light sources, a mechanical holder 14 for the punched tape and a lens mosaic 15 for focusing the light from each different punched hole in paper tape 13 through a different portion of a film light mask 16 to a screen 17 for display of information according to the coded combination of holes punched in paper tape 13.

In the operation of the invention light from source 11 passes through condenser lens 12 and is focused to a plurality of points at the possible punched hole positions on the punched tape 13. Light is transmitted only through a coded combination of holes punched in the tape and is focused by the lens mosaic 15 onto the film mask 16 which selectively transmits light depending upon the relative position of the point light sources in the punched tape 13 to produce letters, numerals, or more complex signs or symbols on screen 17 from combinations of simple characters or units of information preexposed on the film mask 16.

The simple characters or information units utilized in forming more complex symbols on screen 17 are uniquely associated with holes at different positions on the punched tape by means of the mosaic lens 15 and the film mask 16. As illustrated, in FIG. 2, the lens mosaic 15 is an array of a multitude of hemispherical microlenses of a transparent lens material, such as, for example, plastic. The hemispherical microlenses may be closely packed in a rectilinear array as illustrated in FIG. 2 or an array of staggered rows, a circular array, or other closely packed arrays. The opposite side of the lens mosaic is a substantially flat plane. A lens mosaic structure other than that schematically illustrated can be utilized so long as separate lens portions of the mosaic focus the light incident thereon. Formation of such lenses is disclosed and described in my U.S. Pat. No. 3,267,826 issued on Aug. 23, 1966.

Referring to FIG. 4a, rays of light 21 incident to the flat surface of the lens mosaic at some angle 22 will be focused at a plurality of small points 23a, 23b, 23c, etc. on film mask 16 by the microlenses 15a of the lens mosaic. Referring to FIG. 4b, light rays 24 incident to the flat surface of the lens mosaic at a right angle 25 will be focused at a different plurality of points 26a, 26b, etc. on film mask 16 by the microlenses 15a. Referring to FIG. 4c, light rays 27 incident to the lens mosaic at an angle 28 will be focused at yet another set of points 30a, 30b, etc. on film mask 16 by the microlenses 15a. In fact, for every different angle of incidence, the light will be focused at a different set of points on the film mask 16.

It is this result which is utilized in providing a unique 1 to 1 correspondence between the holes in the punched tape and the simple characters or information units utilized in combination to form letters, numerals and more complex characters. Thus, the film mask 16 is preexposed for selective transmission of light depending upon the angles of incidence across the lens mosaic of the incident light produced by the position of the hole in the punched tape through which the incident light must pass.

For forming the film light mask for such selective transmission, reference is made to FIGS. 5 and 7. FIG. 5 illustrates a punched tape 31 including a series of offcenter punched holes 32 constituting sprocket holes which permit the paper tape to be mechanically engaged by a sprocket wheel. These holes do not serve as the point light sources referred to. Eight holes providing point light sources can be punched in any vertical column 33 in the tape 31 as shown. The position of any hole determines the angles of incidence at the lens mosaic of light passing through. The light passing through a particular hole strikes the lens mosaic at varying angles of incidence unique for each of the microlenses comprising the lens mosaic.

In order to prepare a film mask 16, a display format is chosen comprising an alphabet of simple lines or characters to be used in combination to form numerals, letters and more complex symbols. The number of simple lines or characters in the alphabet is limited only by the number of available punched hole positions per operative unit length of the punched tape. One such format or alphabet of simple symbols or information units is illustrated in boxes 34 through 49 of FIG. 7. Such simple lines or characters may be combined to form more complex symbols as for example the letter A by combining the characters in boxes 34, 35, 38, 39, 40 and 41. Other examples of combinations are shown in FIG. 7. Each simple line or character is assigned to a different hole position in one of two vertical columns of the punched tape 31. In this embodiment the operative unit length of the punched tape is thus the length occupied by two vertical columns.

To prepare the film mask 16, the film mask in its unexposed form is positioned at the focal plane of the lens mosaic 15, i.e., the plane of focal points produced by the lenses comprising the lens mosaic as illustrated in FIG. 6. The unexposed film mask is then sequentially exposed to light passed through the lens mosaic in the configuration of each of the simple lines or characters from a different point light source in the punched tape for each character. The angles of incidence of the light passing through the different holes of the punched tape is thus unique for each character.

In order to accomplish this, a set of masks 52 is formed corresponding to the alphabet of simple lines or characters. Each mask is opaque except for a transparent line or character corresponding to one of the simple characters or information units in the display format or alphabet. For the alphabet set forth in FIG. 7, a set of 16 masks would be formed and sequentially placed adjacent the flat surface of lens mosaic 15 between the punched tape 53 and the lens mosaic 15. Condensed light from a source behind the tape would then be sequentially permitted to pass through one of each of the 16 different holes in two vertical columns of punched tape 53. Thus, when mask 52 corresponding to simple character 47 is positioned adjacent the flat surface of lens mosaic 15, condensed light from a source behind the punched tape might be

permitted to pass through hole 54 and no others to produce an image of symbol 47 on the film mask 16 as illustrated in FIG. 6. Light would be permitted to pass through a different hole for each different mask corresponding to each different simple line or character of the display alphabet. After each simple line or character is exposed on the film mask 16 through a different hole in punched tape 53 and therefore with light of different angles of incidence, the film is developed to form a selectively transparent light mask 16 and positioned in the apparatus as illustrated in FIG. 1.

Film light mask 16 is positioned at the focal plane of the lens mosaic 15. It is apparent that the film mask will selectively project an image of any particular simple character or information unit on screen 17 for a light of particular angles of incidence to lens mosaic 15 only, depending upon the position of the punched hole on punched tape 13 through which condensed light from the condenser lens 12 and light source 11 passes.

FIGS. 8 and 9 illustrate a display mechanism for use in conjunction with the apparatus illustrated in FIG. 1 and a commercial teletype machine. The display mechanism comprises a mechanical holder 55 for holding a punched tape 56 supplied by a teletype machine 57 which receives information transmitted over a commercial communication media and punches the paper tape encoding the information accordingly. The punched tape 56 issues through mechanical holder 55 until it contacts a photodevice 58. The photodevice detects the tape, actuates a cutter mechanism 60 to cut the tape as indicated in FIG. 8, and additionally detects an address contained in the end of the tape in the form of a coded combination of punch holes. As illustrated in FIG. 9, eight addresses or positions 61 through 68 may be provided for the mechanical holder and punched tape. Upon determination of the address 68, for example, photodevice 58 instructs a transport mechanism here not shown to remove the mechanical holder currently located at address 68 and transport mechanical holder 55 and put it in place at address 68.

In this arrangement the condenser lens 12 of FIG. 1 may form a part of the mechanical holder for the punched tape as also shown in FIG. 1. Once the mechanical holder is in position, light from the light source passes through the condenser lens, punched holes in the paper tape, lens mosaic, and film mask as heretofore described to project the information encoded in the configuration of punched holes on the screen 70 shown in outline in FIGS. 8 and 9. In the arrangement of FIGS. 8 and 9, light from each particular hole punched in the punched tape projects character information onto a designated area of the screen only. Furthermore, the holes in any chosen operative length of the tape, i.e., the width of two vertical columns, transmit light to project a combination of characters forming a more complex symbol, i.e. a letter, on a designated area of the screen only, so that words and sentences may be formed. Such words may be projected simultaneously as in the embodiment illustrated in FIGS. 8 and 9, or sequentially by passing the tape through the holder as light is projected on the screen. Thus, information received by the teletype machine over commercial communication lines may be currently displayed for public consumption.

The preexposed film mask may be preexposed with information units such as image fragments so that the more complex signs and symbols formed in combination comprise graphs or pictures. The invention is thus also particularly suitable for graphic display of computer output information encoded in a punched tape. Further, a moving image effect can be achieved by stepping the paper tape along in incremental movements, provided that the number of image fragments required for the desired variety of images be advanced per increment of motion. In this respect, the configuration of point light sources may be stationary, and the film mask and lens mosaic moved relative to the light sources. In the simplest case, where each light source produces a complete image from the film mask on the screen, i.e., the film mask is preexposed with complete images, the plurality of light sources may com-

prise a sequence of punched holes or small lamps in staggered positions. The film mask and lens mosaic would be moved along the linear sequence to a position before each punched hole or lamp sequentially, the position of any one lamp or punched hole in the linear sequence relative to the film mask and lens mosaic when positioned before it being different, to thereby produce in time a sequence of different images producing a motion effect if desired. When only one light source at a time is used to form a complete image, if each light source comprises a simple lamp, each successive lamp in the linear sequence may be shielded from any other by dividers defining the position of the film mask and lens mosaic relative to it.

Other light sources in addition to a punched paper tape or a sequence of lights may also be used. For instance, the information may be encoded in a diffraction grating producing a configuration of point light sources from light incident on the grating.

A plurality of point light sources can also be provided by selective shuttering of a stationary light source from different positions. Thus, a shutter array could be interposed between a light source and the lens mosaic and preexposed film. Light passed through different shutters of the array would project light of differing angles of incidence on the lens mosaic. Such a shutter array could be an array of conventional shutters or a ceramic lattice shutter array comprised of a plate of ferroelectric ceramic material, such as hot-pressed lead zirconate-lead titanate, having an anisotropic optical response to light when polarized and also comprised of a plurality of electrodes across the plate for selective polarization of localized regions of the plate. Each localized region comprises a shutter portion in the array substantially transparent to light when polarized in a direction normal to the major surface to which light is incident and substantially opaque to light when polarized parallel to the major surface.

The phrase "plurality of point light sources" as used herein and in the following claims is intended to mean a plurality substantially point light sources such as would be provided by the means described in the foregoing specifications.

While certain embodiments of this invention have been shown and described, it will be apparent that other adaptations and modifications can be made without departing from the true spirit and scope of the invention.

What I claim is:

1. A reproduction system comprising in combination: means for providing a plurality of point light sources at different positions on a plane; a lens mosaic spaced from the plane of point light sources and through which light of different angles of incidence from said point light sources depending upon the position of said point light sources is focused; a film mask positioned in the focal plane of the lens mosaic, said film mask being preexposed to form a plurality of transparent portions thereon comprising information units each forming a fraction of a more complex information sign, each of said transparent portions being positioned for selective transparency to light of approximately certain angles of incidence to the lens mosaic only; means for illuminating simultaneously a plurality of said point light sources, and a screen spaced from the film mask on which said information units are projected to form in combination more complex signs according to the configuration of point light sources.

2. A reproduction system as set forth in claim 1 wherein the means for providing a plurality of point light sources comprises in combination: a light source, a condenser lens mosaic spaced from the light source for focusing light incident thereon to a plurality of points, and a punched tape positioned adjacent the condenser lens mosaic having hole punch positions corresponding to the focused light points from the con-

denser lens mosaic and having punched therein a coded configuration of holes for selective transmission of light whereby said information units are projected on said screen by light from the coded configuration of holes in the punched tape to form in combination more complex signs according to said coded configuration of holes.

3. A reproduction system as set forth in claim 2 further provided that light from each particular hole punched in said punched tape projects an information unit onto a designated area of the screen only.

4. A reproduction system as set forth in claim 2 further provided that light from a coded configuration of holes punched in said punched tape projects a combination of information units forming a more complex sign on a designated area of the screen only.

5. A reproducing system comprising: a lens mosaic; means for positioning a film mask on one side of said lens mosaic at the focal plane of the lenses comprising said lens mosaic; means for establishing a plurality of point light sources at a position on the other side of said lens mosaic and spaced therefrom; and means positioned between said point light source means and said lens mosaic for passing light from a given plurality of point light sources of said point light source means to only certain of the lenses of said lens mosaic for producing a predetermined light pattern on said film mask adjacent said certain lenses.

6. A reproducing system as set forth in claim 5 wherein the point light source means comprises in combination: a light source, a condenser lens mosaic spaced from the light source for focusing light incident thereon to a plurality of points, and a punched tape positioned adjacent the condenser lens mosaic having hole punch positions corresponding to the focused light points from the condenser lens mosaic.

7. A reproducing system as set forth in claim 5 wherein the means for passing light from a given plurality of point sources of said point light source means to only certain of the lenses of said lens mosaic comprises a light mask having a transparent portion in the desired configuration.

8. A reproducing system comprising: a lens mosaic; a film mask preexposed to form a plurality of transparent portions thereon comprising information units each forming a fraction of a more complex information sign, means for positioning said film mask on one side of said lens mosaic at the focal plane of the lenses comprising said lens mosaic; means for establishing a plurality of point light sources at a position on the other side of said lens mosaic and spaced therefrom; and means positioned between said point light source means and said lens mosaic for passing light from selected point light sources of said point light source means to at least certain of the lenses of said lens mosaic for producing a predetermined light pattern on said film plane adjacent said certain lenses.

9. A reproduction system comprising in combination: means for providing a plurality of point light sources at different positions along only one line on a plane; a lens mosaic spaced from said point light sources; a film mask positioned adjacent the lens mosaic at the focal plane of the lenses comprising the lens mosaic, said lens mosaic constructed and positioned with each separate lens portion thereof receiving light from different point light sources at different angles of incidence and focusing such light at corresponding different positions of said film mask, said film mask being preexposed to form a plurality of transparent portions thereon, each of said transparent portions being positioned for selective transparency to light of approximately certain angles of incidence to the lens mosaic only; and a screen positioned adjacent the film mask on which certain of said transparent portions are projected according to the configuration of point light sources.