June 26, 1962 D. G. GUMPERTZ ET AL 3,041,600

CHARACTER PROJECTION APPARATUS

Filed Jan. 31, 1957

3 Sheets-Sheet 1

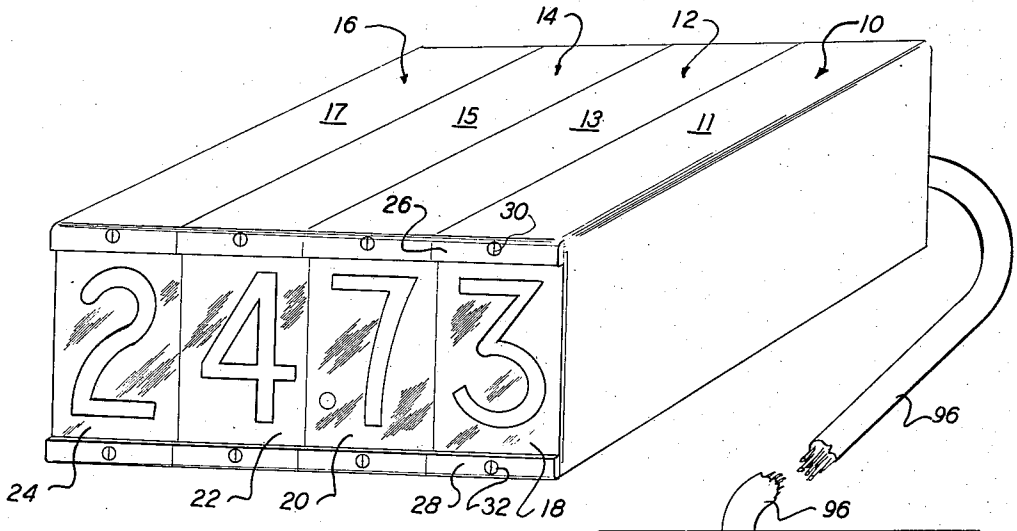


FIG. 1.

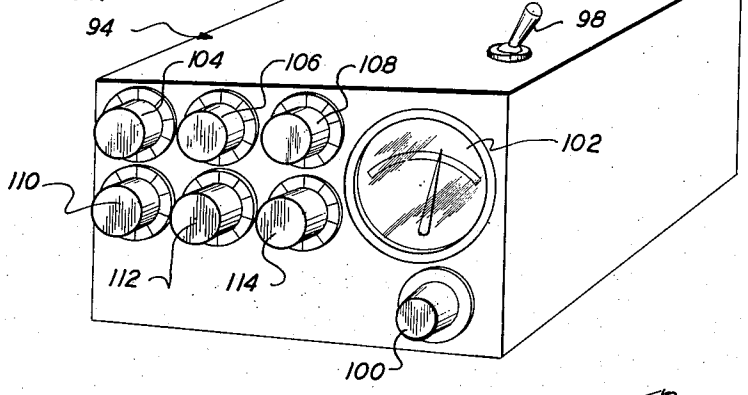
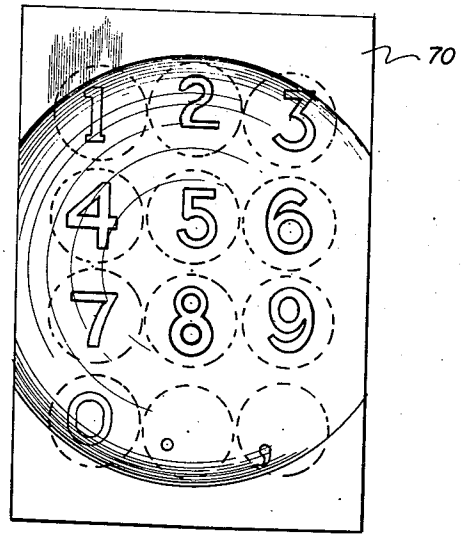


FIG. 4.



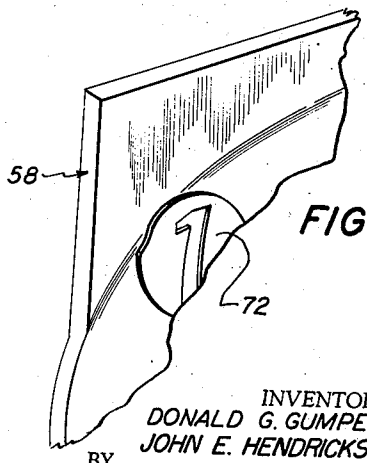


FIG. 5.

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CHARACTER PROJECTION APPARATUS

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3 Sheets-Sheet 2

FIG. 2.

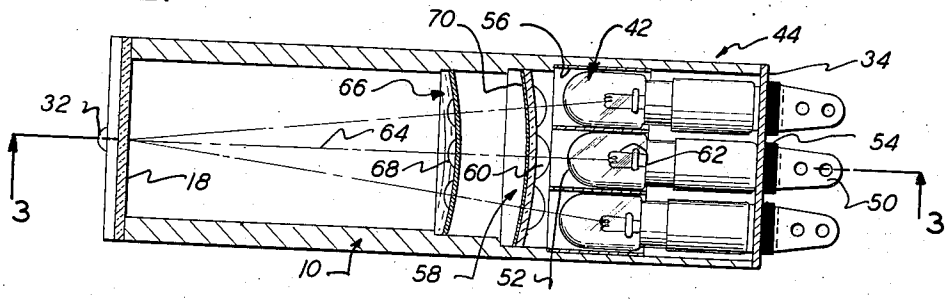
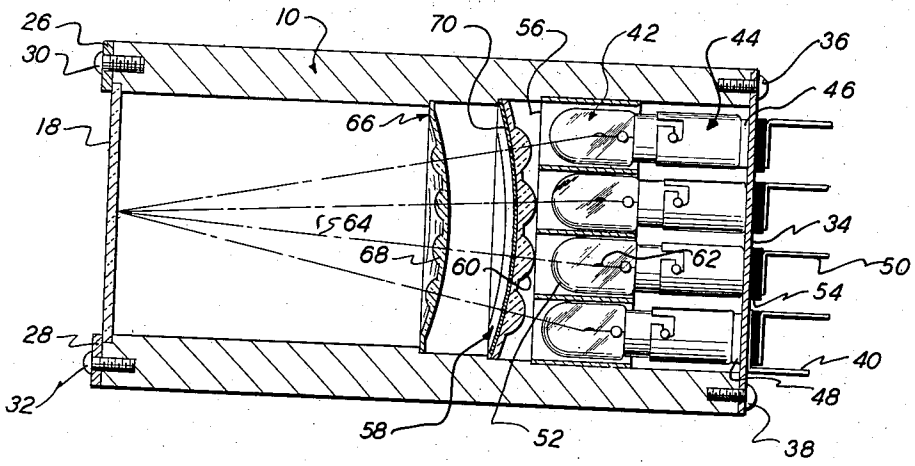


FIG. 3.



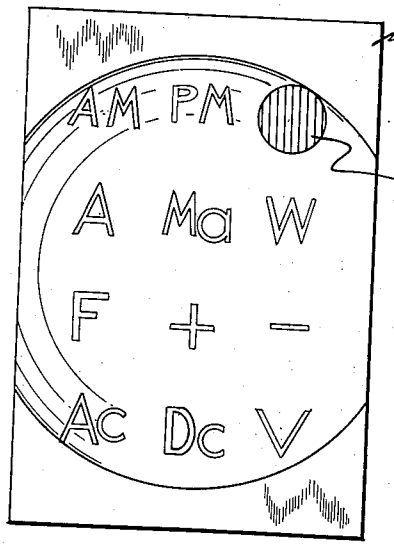


FIG. 6.

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CHARACTER PROJECTION APPARATUS

Filed Jan. 31, 1957 3 Sheets-Sheet 3

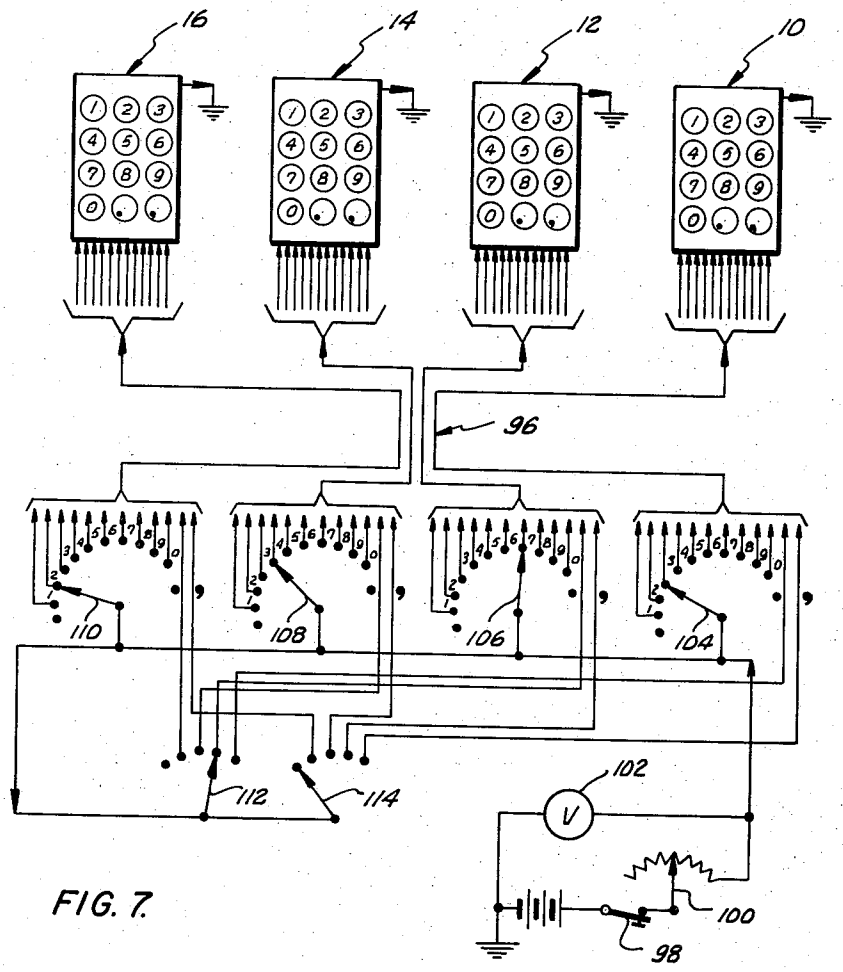


FIG. 7.

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CHARACTER PROJECTION APPARATUS

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12 Claims. (Cl. 340—378)

This invention relates to converging projection systems and has particular reference to an electrically operated character displaying unit which provides a selection of characters without relying upon moving parts.

The apparatus may be employed as a single unit, or may be assembled in groups of two, three, four, etc., as desired. It is referred to as a character displaying unit because it may be used to selectively display letters of the alphabet and other marks or symbols as well as numbers. For example, the display unit or units may be employed to provide numeric output indications from digital volt meters, computers, counters and the like. Also, for example, such units may be used in multiple to build up an electrically operated flight table for displaying names of particular airlines, flight numbers, times of departure and arrival, etc.

There are various types of conventional display units presently available; and a lot of effort has gone into making them very compact and small in size. Typical of conventional units are those which employ stacked Lucite plates, each engraved with a single number, with an arrangement of miniature "grain of wheat" lamps for illuminating any selected plate from its edge. Another type employs glow tubes having an arrangement of stacked wires which are formed into numbers.

Among the problems attendant conventional displaying units is the requirement for special forms of miniature lamps, which have a relatively short lifetime and which are relatively expensive in comparison with ordinary small light bulbs. Additionally, in the devices employing stacked numbers, the numbers tend to mask or clutter one another, even though only one of them is illuminated at a time. Also, because of this stacked characteristic, these devices must be viewed approximately from their direct front and cannot be adequately viewed from any appreciable angle. In some types of units, when one lamp burns out, the entire unit must be replaced.

The display unit of the present invention overcomes these difficulties, and offers several advantages from a cost, lifetime and viewability standpoint. Further, the display unit of the present invention is versatile, in that the sets of characters which are set up to be selectively displayed by the unit can be changed, and burned out lamps can be replaced.

The display unit of the present invention employs a translucent viewing screen which is viewed from the front. A plurality of lamps are arranged in a compact group behind the screen, and means defining a plurality of character forms is disposed between the lamps and the screen. Each character form is associated with a particular lamp, and aligned between that lamp and the screen. Optical means is disposed between the lamps and the screen; and the optical means concurrently focuses all characters approximately in the same area on the screen, so that when a lamp is turned on, an image of its associated character is projected on that area of the screen.

A preferred embodiment of the invention includes an opaque, rectangular housing, with the translucent viewing screen connected across the front end of the housing and extending for the entire width of the housing. A support plate is removably connected across the back end of the housing. A plurality of lamp sockets are arranged in a compact group and connected to the supporting plate. The sockets face toward the viewing screen, with

the sockets around the perimeter of the group being slightly advanced in location toward the screen. A plurality of lamps are releasably engaged in the sockets, and a plurality of partitions coupled together in the form of a grating are releasably engaged between the lamps of the group and with the housing. A first plate of transparent material is supported across the interior of the housing, this plate being curved approximately spherically upon a radius from the center of the screen, and disposed with its concave side facing toward the screen. The first plate has a plurality of condensing lens portions formed integrally therein, with each condensing lens portion being aligned with its axis falling approximately upon a straight path extending between the filament of a corresponding lamp of said plurality of lamps and the center of the screen, and being focused to appreciably transmit in the approximate direction of said path only such light as would emanate from the filament of its corresponding lamp, to the substantial exclusion of any light emanating from adjacent lamps. The characters are formed by means located adjacent to the concave side of the first plate, with each character being disposed in alignment with a corresponding one of the condensing lens portions of the plate. A second plate of transparent material is supported across the interior of the housing at a position between the first plate and the screen, the second plate being curved approximately spherically upon a radius from the center of the screen and disposed with its concave side facing toward the screen. The second plate has a plurality of projecting lens portions formed integrally therein, each projecting lens portion being aligned with its axis falling approximately upon the straight path extending from the filament of its corresponding lamp to the center of the screen. The projecting lens portions are focused on the corresponding character forms and on the screen, so as to project a magnified image of the character onto the screen when the corresponding lamp is turned on. Hence, a plurality of projection systems are disposed behind the screen, with their respective axes of projection converging at the center of the screen. The projection systems are formed by a plurality of projection lenses, objects, condensing lenses and light sources supported in concentric spherically curved arrays so that like elements are equidistant from the center of the screen, with each projection lens being aligned coaxially with a corresponding condensing lens, object and light source on a radius from the center of the screen so as to comprise one of said projection systems.

By projecting characters onto a screen, a one-plane presentation is afforded. There is no masking or cluttering, and the image on the screen can be viewed from most any angle.

The optical system employed permits the asemblage of a plurality of light bulbs into a very compact group without having them interfere with one another. For example, the standard T-3¼ miniature bayonet base lamp, G.E. No. 39, costing approximately 15¢, works satisfactorily. These lamps have a much longer lifetime and are much less expensive than the special lamps generally employed in conventional devices. Also, they are individually replaceable. The compact grouping of the lamps makes the entire unit small enough to be comparable in size to the conventional devices. For example, a display unit may be 5" x 2½" x 2½" and yet be capable of selectively providing a 2" display of any number between zero and nine.

Since the screen extends for the width of the housing, the units when assembled in a group afford a substantially continuous screen surface for faster, easier reading. Molding the condensing lenses integrally in one piece of transparent material, and molding the projecting lenses in the same fashion, cuts down on the price of the unit.

The display unit of the invention costs about one-half as much as many of the conventional units.

All the character forms may be defined in a single sheet of material, this sheet being shaped to fit against the concave side of the plate of condensing lenses, the sheet being removable so that it may be replaced with a similar sheet on which different characters are formed. Also, the characters may be formed by painting on the concave side of the condensing lens plate, by any suitable process. In the latter instance, the condensing lens plate is removable so that it may be replaced by a different but similar condensing lens plate having different characters applied thereto.

In one embodiment of the invention, a mere colored film is substituted for one character form, and another character form consists of a decimal point. The bulbs associated with this character form and the color may be turned on concurrently with another one of the bulbs of the same unit so as to display not only a number, for example, but also to add color or a decimal point at the same time. Color may be employed to indicate positive or negative quantity, a.m. or p.m. in the presentation of the time of day, and so forth.

The invention is explained in greater detail with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of four display units hooked up to a control box;

FIG. 2 is a sectional plan view of one of the display units of FIG. 1;

FIG. 3 is a sectional elevation taken along line 3—3 of FIG. 2;

FIG. 4 is an elevation of a single piece of film which defines a plurality of character forms;

FIG. 5 is a fragmentary perspective view of a condensing lens plate, with the character forms painted on one side of the plate;

FIG. 6 is an elevation of a single piece of film defining a variety of character forms as well as a color that may be employed in the display unit; and

FIG. 7 is a schematic diagram of the circuit of the apparatus of FIG. 1.

Referring to FIGS. 1 to 3, each display unit **10**, **12**, **14**, **16**, includes an elongated, rectangular housing **11**, **13**, **15**, **17** respectively, composed of electrical insulating material, with a translucent viewing screen **18**, **20**, **22**, **24**, supported across the front end of the housing for receiving a projection from the back and being viewed from the front. The viewing screen is preferably composed of transparent material such as Lucite, with the back surface of the viewing screen being frosted by any suitable process.

As in FIG. 1, the viewing screen **18** extends across the width of the housing **11** and is supported at its top and bottom by a pair of narrow plates **26**, **28** held by screws **30** and **32** respectively. The other display units of FIG. 1 are similarly constructed. Hence, when a plurality of display units are placed side by side, the viewing screen and supporting plates line up to afford an apparently continuous surface for faster, easier reading.

Each of the display units of FIG. 1 is constructed as shown with reference to the display unit **10** in FIGS. 2 and 3. A conductive supporting plate **34** is connected across the opposite end of the housing from the viewing screen by screws **36**, **38** and an electrical terminal **40** is coupled to the supporting plate and extends rearwardly therefrom for acting as a common electrical connection. A plurality of lamps **42** are releasably engaged in a corresponding plurality of sockets **44**, the sockets being structurally supported on the supporting plate **34**, and facing toward the viewing screen with the sockets around the perimeter of the group being slightly advanced in location toward the screen in order to give the front of the group of lamps somewhat of a spherical curvature as a group. This advancement in location is accomplished by spacers such as shown at **46**, **48**. Each lamp of the plurality of lamps **42** has associated therewith an individual terminal such as shown at **50** for a typical lamp **52**, the terminal being insulated from the base plate by an insulator as shown at **54**.

A plurality of partitions are coupled together in the form of a grating **56**, the grating being removably inserted between the lamps and in engagement with the housing so that it insures the lateral position and alignment of each lamp. The grating is composed of opaque material and shields each lamp from every other lamp so as to reduce the possibility of spurious reflections of light from interfering with the operation of the apparatus.

A first plate of transparent material **58** is releasably supported across the interior of the housing immediately in front of the lamps, the plate being curved approximately spherically upon a radius from the center of the screen and disposed with its concave side facing toward the screen. A plurality of condensing lenses such as the one shown at **60** are integrally formed in the plate **58**, each condensing lens being composed and oriented so that it is focused to receive light from the filament of its corresponding lamp, such as the filament **62** of the lamp **52**, and so that its axis falls approximately upon a straight path extending between the filament of its corresponding lamp and the center of the screen. A typical path is illustrated by the numeral **64**. Hence, each condensing lens will appreciably transmit in the approximate direction of said path only such light as would emanate from the filament of its corresponding lamp, to the substantial exclusion of any light as would emanate from adjacent lamps.

A second plate **66** of transparent material is releasably supported across the interior of the housing at a position between the first plate and the screen, the second plate being curved approximately spherically on a radius from the center of the screen and disposed with its concave side facing toward the screen. A plurality of projecting lenses, such as that shown at **68**, are formed integrally in the second plate, each projecting lens being aligned with its axis falling approximately on the straight path extending from the filament of its corresponding lamp to the center of the screen.

As can be seen, there are twelve condensing lenses, twelve associated projecting lenses and twelve associated lamps. Obviously, these lenses are individually positive or converging as opposed to the negative or diverging type. As is apparent, each lens is substantially in the form of a figure of revolution about its axis. Each condensing lens and associated projecting lens may be called an optical system. The spherical curvature of the physical arrangement allows for use of simple optical systems which optically converge toward the center of the screen.

As best illustrated in FIGS. 4 to 6, and particularly in FIG. 5, means defining a plurality of character forms is disposed adjacent to the concave side of the first plate. The means defining the character forms may be a single sheet of film **70** as illustrated in FIG. 4, which sheet is shaped to fit against the concave curvature of the condensing lens plate **58**. When composed in this way the film is removable and may be replaced by a similar film sheet having different characters formed in it. As illustrated by the dotted line circles, each character so formed is disposed in alignment with a corresponding one of the condensing lens portions of the first plate.

As illustrated in FIG. 5, the character forms may be defined by a film of opaque material **72** painted on the concave side of the first plate **58** at least in the immediate areas of the condensing lens portions. The object of the film sheet or paint film is to blacken out the area adjacent each condensing lens except that area forming the character.

Examples of various symbols, letters and numbers which may be employed are illustrated in the film sheet **74** of FIG. 6. Also in FIG. 6, a colored film portion is illustrated at **76**. One way of accomplishing the colored film portion is to paste a colored piece of film over a transparent portion of the film sheet.

The projecting lenses are focused on the character forms on the back of the associated condensing lenses and on the screen for projecting a magnified image of the character onto the screen when the associated lamp is turned on. The optical convergence of the lens systems causes all of the characters to be focused on top of each other on the same area of the screen, but no image appears on the screen until one of the lamps is turned on. Hence, there is no interference due to this convergence.

The condensing lens plate **58** and the projecting lens plate **66** are each formed in a single piece of material which reduces the cost of the unit and results in a more stable structure. Although inferior, it is possible to construct the lens plates **58**, **66** from opaque material and mount individual lenses therein.

To illustrate the operation of the invention, a control box **94** is shown connected by an electrical cable **96** to the four display units of FIG. 1. Power is turned on by a switch **98** and the applied voltage and hence the brilliance of the lamps is determined by the setting of a knob **100**, the voltage being indicated on a meter **102**. The knobs **104**, **106**, **108** and **110** are respectively associated with the display units **10**, **12**, **14** and **16**. Each knob is a rotary switch for selecting which, if any, of the lamps of the associated display unit is to be turned on, so that its associated character will be projected on the screen of the unit. The brilliance of the image formed on the screen is determined by the setting of the knob **100**, and a 6.3 volt operation gives adequate illumination for average conditions when using G.E. No. 39 lamps. Under these conditions a lamp has an estimated 10,000 hour life, which life may be ten times greater provided that the usage of the lamps is evenly distributed in the unit. Of course, at higher illuminations the lifetime of each lamp is shorter.

The character forms employed in the units of FIG. 1 are those illustrated by the film sheet **70** of FIG. 4. As can be seen, the decimal point and the comma are relatively small symbols, so that when one of the lamps is turned on to project a character onto the screen, the lamp associated with the decimal point or comma may be turned on at the same time to project the decimal point or comma onto the screen at an adjacent location.

A knob **112** is connected to turn on a particular lamp of any of the four display units, this being the lamp which projects the decimal point, concurrently with whatever other character appears on the display unit screen. Likewise, knob **114** is employed to turn on the particular lamp of each unit which projects a comma.

As illustrated in FIG. 1, the number being projected is 24.73 with the display unit **12** displaying both a seven and a decimal point. The setting of the knob **106** has turned on the lamp that projects the seven, and the lamp of the same unit which projects the decimal point is concurrently turned on by the setting of the knob **112**. Simple electrical connections are made by way of the cable **96** to the terminals at the rear of the display units.

Referring to FIG. 7, there is shown a schematic circuit diagram of the apparatus of FIG. 1, wherein the reference numerals applied in FIG. 1 are carried over and applied to the analogous circuit elements of FIG. 7. Thus, knobs **104**, **106**, **108**, **110**, **112**, **114** are shown as rotary switches for connecting power through a cable **96** to the individual lamps of the four display units **10**, **12**, **14**, **16**. The knob **100** for adjusting the brilliance of the lamps is shown as a rheostat connected in electrical series with a battery and with the on-off switch **98**. The voltmeter **102** measures the voltage applied to the lamps.

We claim:

1. Character displaying apparatus comprising a housing, a translucent viewing screen connected across the front end of the housing, a plurality of lamps arranged in a compact group and adapted to be selectively turned on and off, means releasably supporting the lamps at the back end of the housing with the lamps facing toward the viewing screen, a first plate of transparent material supported

across the interior of the housing, said first plate being curved approximately spherically upon a radius from the center of the screen and disposed with its concave side facing toward the screen, said first plate having a plurality of condensing lens portions formed integrally therein, each condensing lens portion being aligned with its axis falling approximately upon a straight path extending between the filament of a corresponding lamp of said plurality of lamps and the center of the screen and being focused to appreciably transmit in the approximate direction of said path only such light as would emanate from the filament of its corresponding lamp, to the substantial exclusion of any light as would emanate from adjacent lamps, means defining a plurality of transparent forms of characters located adjacent the concave side of said first plate, with each character so formed being disposed in alignment with a corresponding one of the condensing lens portions of the plate, and a second plate of transparent material supported across the interior of the housing at a position between the first plate and the screen, the second plate being curved approximately spherically upon a radius from the center of the screen and disposed with its concave side facing toward the screen, said second plate having a plurality of projecting lens portions formed integrally therein, each projecting lens portion being aligned with its axis falling approximately upon the straight path extending from its corresponding lamp filament to the center of the screen, the projecting lens portions being respectively focused on the character forms and on the screen so as to project a magnified image of a character onto the screen when the corresponding light is turned on.

2. Apparatus of claim 1, wherein the character forms are defined by opaque material painted on the concave side of the first plate at least in the immediate areas of the condensing lens portions.

3. Apparatus of claim 1 wherein the character forms are defined in a sheet of material shaped to fit against the concave side of the first plate, said sheet of material being removable so that it can be replaced by a similar sheet having different characters formed in it.

4. Character displaying apparatus comprising an approximately rectangular housing, a translucent viewing screen connected across the front end of the housing and extending for the entire width of the housing, a supporting plate removably connected across the back end of the housing, a plurality of lamp sockets arranged in a compact group inside the housing and facing toward the viewing screen, the lamp sockets being secured to the supporting plate with the sockets around the perimeter of the group being slightly advanced in location toward the screen, a plurality of lamps releasably engaged in the sockets, a plurality of partitions coupled together in the form of a grating and releasably engaged between the lamps of the group and with the housing, a first plate of transparent material supported across the interior of the housing, said first plate being curved approximately spherically upon a radius from the center of the screen and disposed with its concave side facing toward the screen, said first plate having a plurality of condensing lens portions formed integrally therein, each condensing lens portion being aligned with its axis falling approximately upon a straight path extending between the filament of a corresponding lamp of said plurality of lamps and the center of the screen and being focused to appreciably transmit in the approximate direction of said path only such light as would emanate from the filament of its corresponding lamp, to the substantial exclusion of any light as would emanate from adjacent lamps, means defining a plurality of transparent forms of characters located adjacent the concave side of said first plate, with each character so formed being disposed in alignment with a corresponding one of the condensing lens portions of the plate, and a second plate of transparent material supported across the interior of the housing at a position between the first plate and the screen, the second plate

being curved approximately spherically upon a radius from the center of the screen and disposed with its concave side facing toward the screen, said second plate having a plurality of projecting lens portions formed integrally therein, each projecting lens portion being aligned with its axis falling approximately upon the straight path extending from the filament of its corresponding lamp to the center of the screen, and the projecting lens portions being focused on the corresponding character forms and on the screen so as to project a magnified image of the character form onto the screen when the corresponding lamp is turned on.

5. In projection apparatus having translucent viewing screen which receives projections from the rear and which is viewed from the front, the combination which comprises a plurality of at least ten character projection systems disposed behind the screen with their axes of projection converging at the center of the screen, said projection systems comprising a plurality of elements including a plurality of projection lenses, a plurality of objects, a plurality of condensing lenses and a plurality of light sources located approximately in concentric spherically curved arrays so that within each plurality the elements thereof are equidistant from the center of the screen, with each projection lens being aligned coaxially with a corresponding condensing lens, object and light source on a radius from the center of the screen so as to comprise one of said projection systems.

6. In combination with character displaying apparatus having a translucent viewing screen which is viewed from the front, and having a plurality of at least ten convergent character projection systems disposed behind the screen for projecting characters upon the same area of the screen, the improvement which comprises an additional projection system located behind the screen adjacent to and convergent with the others and including means for projecting a color onto the same area of the screen for lending a colored background to said area of the screen.

7. In combination with character displaying apparatus having a translucent viewing screen which is viewed from the front, and having a plurality of at least ten convergent character projection systems disposed behind the screen for selectively projecting relatively large characters centrally onto the same area of the screen, the improvement which comprises an additional character projecting system located behind the screen adjacent to and convergent with the others and including means for projecting a relatively small symbolic mark onto the screen at an off-center location in said area.

8. In character displaying apparatus having a translucent viewing screen which is viewed from the front and a plurality of at least ten character projection systems disposed behind the screen for projecting characters onto the same area of the screen, the combination which comprises a plurality of at least ten lamps, each of the lamps having a filament and forming a part of one of the projection systems, a plurality of lamp sockets for mounting the lamps, the lamp sockets being clustered together in side by side locations and oriented approximately parallel to one another and perpendicular to the screen, and means supporting the lamp sockets at different distances from the screen so that the positions occupied by the filaments of the mounted lamps lie approximately upon a spherical surface.

9. In apparatus having a viewing screen and a plurality of converging projection systems for selectively projecting images of different objects onto the screen, the combination which comprises a plate of transparent material having an approximately spherical curvature, a plurality of substantially similar positive lenses formed integrally in the plate, and corresponding pluralities of objects and light sources, each lens and corresponding object and light source being disposed in optical alignment in a different one of said projection systems with the optical axis of the lens coinciding with the axis of projection.

10. In apparatus having a translucent viewing screen which receives projections from the rear and is viewed from the front and having a plurality of converging projecting systems disposed behind the screen for selectively projecting images of different objects onto the screen, the combination which comprises a plate of a transparent material which is curved approximately spherically upon a radius from the center of the screen and having a plurality of at least ten substantially similar positive lenses formed integrally therein at separate locations, and corresponding pluralities of objects and light sources, each lens and corresponding object and light source being disposed in optical alignment in a different one of said projection systems with the optical axis of the lens coinciding with the axis of projection.

11. Apparatus of claim 10 wherein one side of the second plate is a smooth approximately spherical surface, and wherein each object comprises a film of opaque material abutting said surface and defining a character form.

12. In apparatus having a translucent viewing screen which receives projections from the rear and is viewed from the front and having a plurality of converging projection systems disposed behind the screen for selectively projecting images of different objects onto the screen, the combination which comprises a plurality of projection lenses formed integrally in a first plate of transparent material having an approximately spherical curvature, a corresponding plurality of condensing lenses formed integrally in a second plate of transparent material having an approximately spherical curvature and disposed behind the first plate, a corresponding plurality of objects disposed adjacent the second plate, and a corresponding plurality of light sources disposed behind the second plate, each projection lens and corresponding condensing lens, object and light source being disposed in optical alignment in a different one of said projection systems with the optical axis of the projection lens and of the condensing lens coinciding with the axis of projection.

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