Jan. 3, 1967 J. HOURDIAUX 3,295,910

CURVED PROJECTION SCREENS

Filed April 3, 1964 4 Sheets-Sheet 1

Fig. 1.

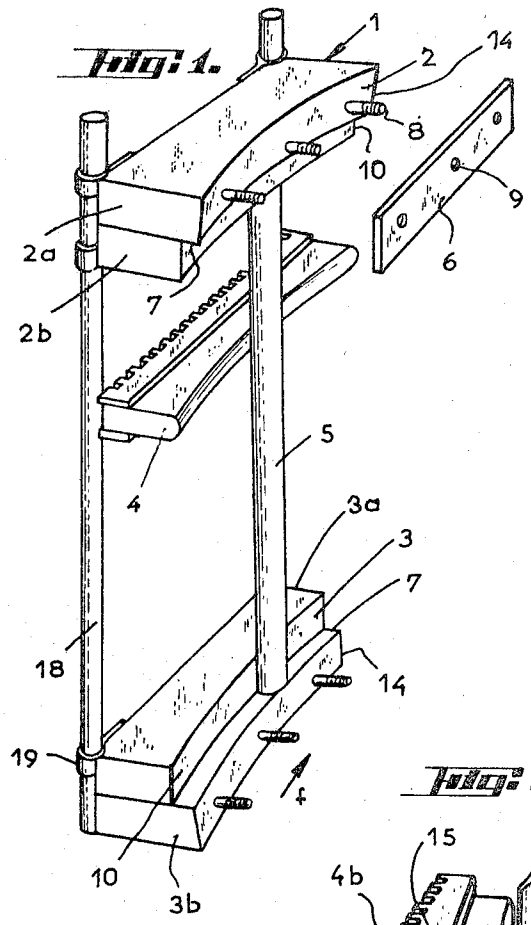


Fig. 2.

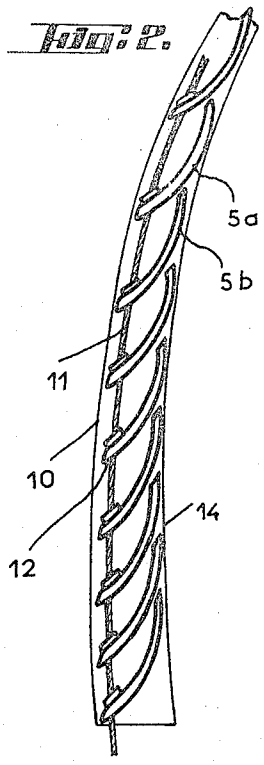
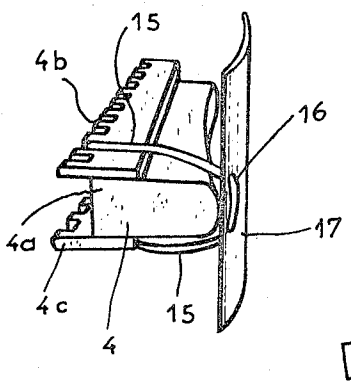


Fig. 3.



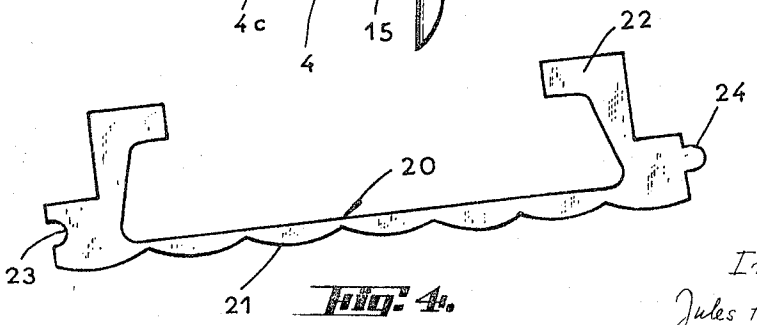


Fig. 4.

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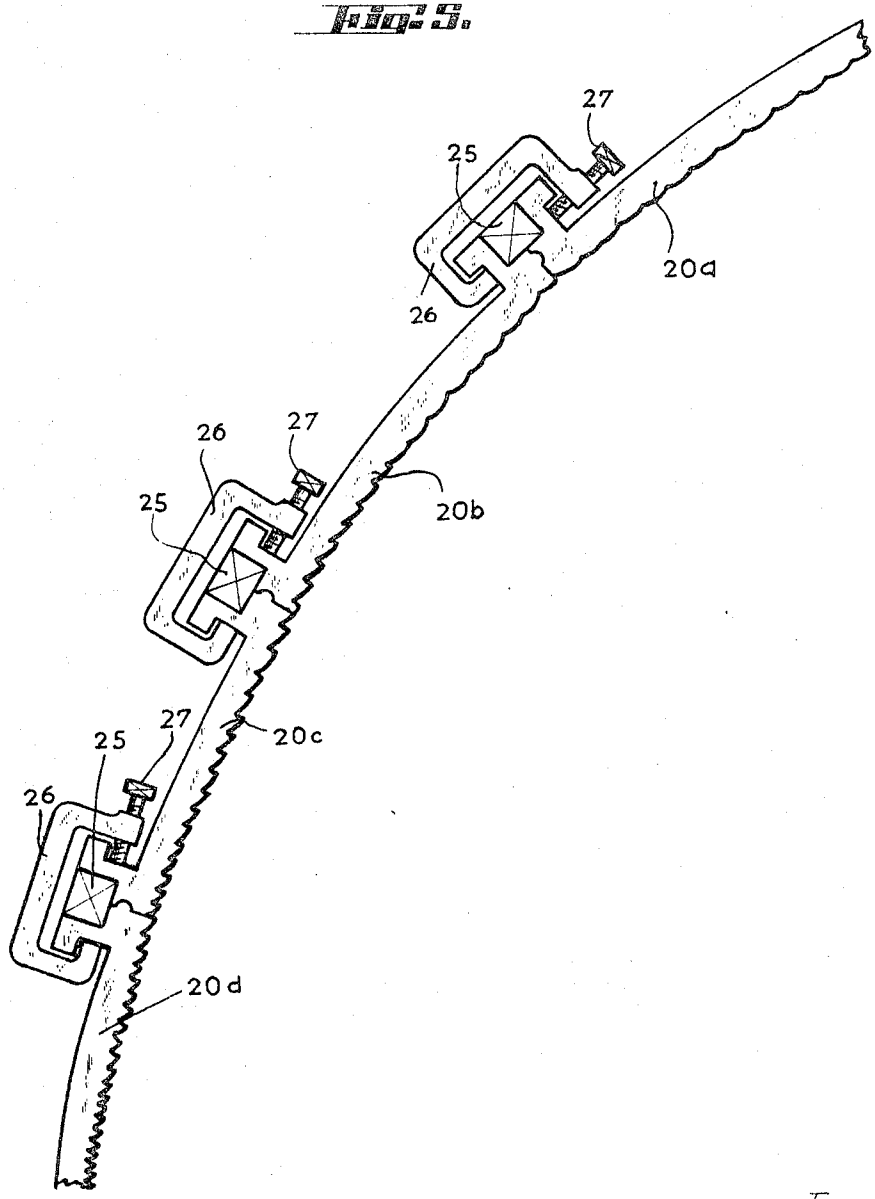
Jan. 3, 1967 J. HOURDIAUX 3,295,910

CURVED PROJECTION SCREENS

Filed April 3, 1964 4 Sheets-Sheet 2

Fig. 3.



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Jan. 3, 1967 J. HOURDIAUX 3,295,910

CURVED PROJECTION SCREENS

Filed April 3, 1964 4 Sheets-Sheet 3

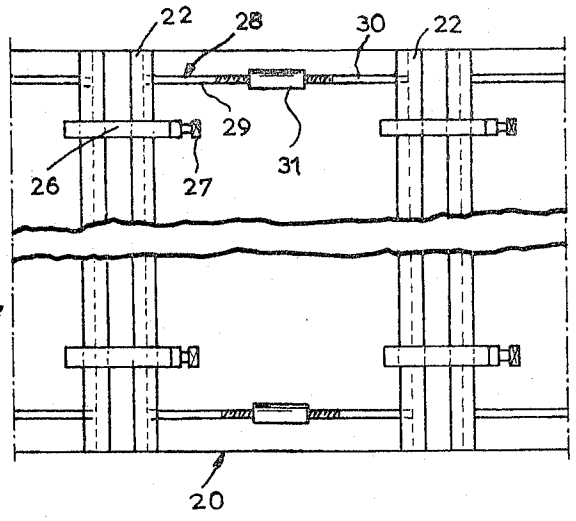


Fig. 6.

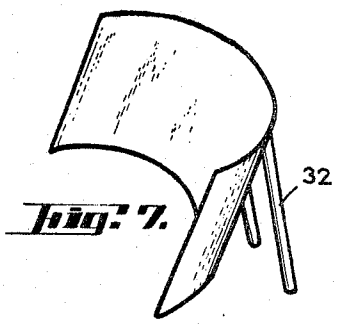


Fig. 7.

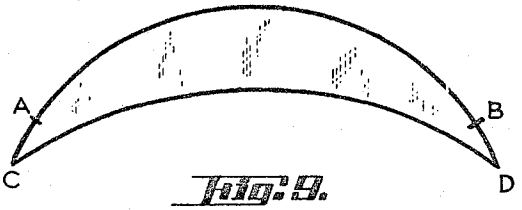
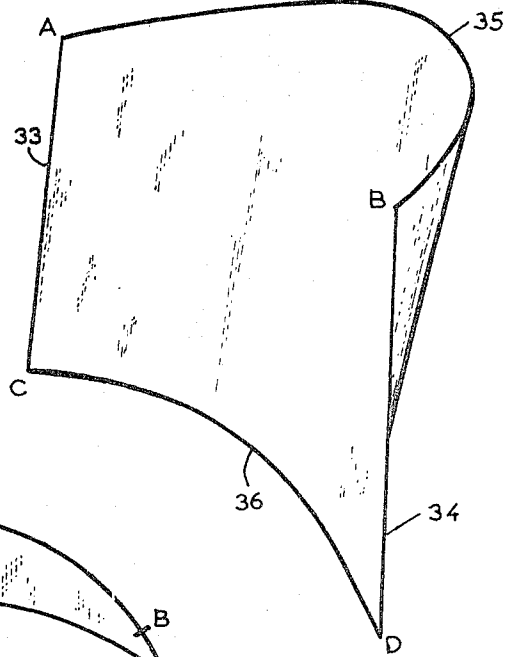


Fig. 9.

Fig. 8.



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CURVED PROJECTION SCREENS

Filed April 3, 1964 4 Sheets-Sheet 4

Fig. 10.

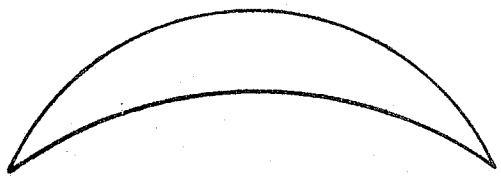

Fig. 11.

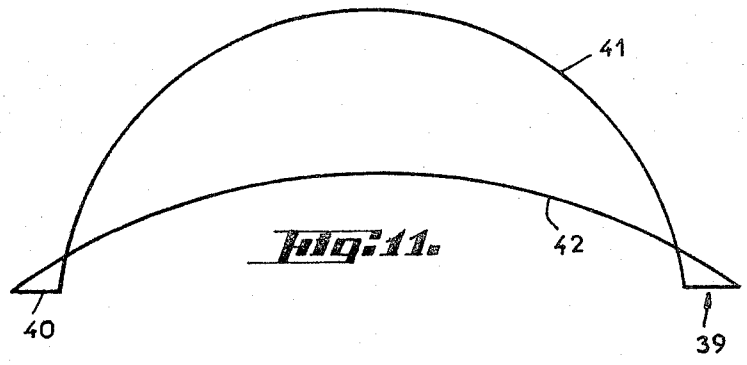

Fig. 12.

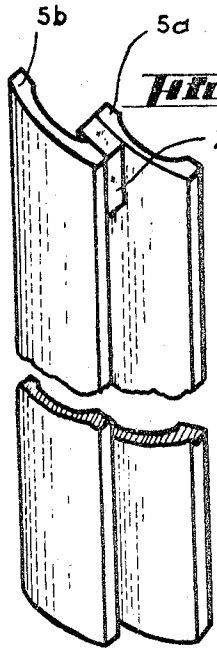

Fig. 13.

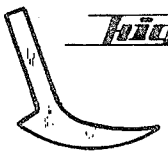

Fig. 14.

Fig. 15.

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United States Patent Office 3,295,910 Patented Jan. 3, 1967

3,295,910

CURVED PROJECTION SCREENS

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Filed Apr. 3, 1964, Ser. No. 360,163
Claims priority, application France, Apr. 6, 1963, 930,681
7 Claims. (Cl. 350—125)

This invention relates essentially to a curved screen for projecting motion picture films or the like.

It is known for projecting motion picture films to use curved screens of cylindrical or spherical configuration, the image-receiving face of the screen being convex or concave, and consisting as a rule of a plurality of juxtaposed elements or sections having a suitable angular setting and formed each with a mat light-diffusing surface constituting an elementary screen.

The manufacture of screens of the type broadly set forth hereinabove is attended by delicate constructional problems, due notably to the great quantity of strips, rods, bars or the like to be used and assembled simultaneously, the necessity of providing adequate means for securing the elements on a suitable frame structure or the like, and the difficulty of giving the proper angular setting to each light-diffusing element or section.

It is also known to use screens wherein the component elements are so directed that throughout the screen-surface their mat light-diffusing faces be substantially parallel to a same direction at right angles to the axis of the film projection beam.

This invention is concerned with a screen of the type broadly set forth in the preceding paragraph wherein the problems usually encountered in the manufacture of the component elements and the assembling of these elements for constructing the screen are solved in a simple and economical manner.

The method of making a curved screen according to this invention is remarkable notably in that it consists in preparing longitudinal panels having their two large sides substantially parallel to each other, in associating with each panel light-diffusing elements substantially parallel to said large sides, imparting to each element an angular setting differing from one panel to the other, and preferably on a same panel juxtaposing said panels along said large sides and securing said panels in the relative positions thus obtained, the angular setting thus given to the light-diffusing elements being subordinate to the position of the panel in the completed screen and such that the light-diffusing faces of said elements be substantially parallel to a same direction at right angles to the axis of the film projection beam.

Preferably, the light-diffusing elements are mounted on said panels before assembling these panels into the final structure.

According to an alternate form of embodiment of this invention the panels may be associated beforehand to constitute the screen frame structure and the light-diffusing elements are subsequently mounted on said frame structure, with a proper angular setting relative to said panels, and fastened in this angular setting or position through any known and adequate means.

The panels according to this invention are secured in the relative positions obtained after the juxtaposition step by utilising connecting means which may be carried by the panels themselves and/or common to only two adjacent panels; in this case a separate frame structure or the like may be dispensed with; alternatively, said connecting means may consist of a frame structure or the like, and in this case each panel is secured independently on said frame structure or the like; according to another variation the frame structure proper may consist

of elementary frames and in this case each panel is preferably secured on an elementary frame prior to the panel assembly step in order to constitute completely self-contained prefabricated elements; of course, the frame or frame structure may have any suitable configuration and may consist for example of any desired structural or constructional elements such as tubes and/or angle members or sections.

According to a specific form of embodiment the panel surface which is to face the projection apparatus is formed with ribs or the like of adequate contour, extending longitudinally and constituting a series of light-diffusing elements having each a well-defined angular setting; in this case, a screen ready for use may be obtained by simply assembling unitary panels with one another or if necessary on a frame structure.

The panels according to the present invention must be so constructed that the complete screen may have any desired and suitable configuration, notably cylindrical or spherical, concave or convex; since, as a rule, the projection apparatus is at a higher level than the horizontal center line of the screen when the latter is cylindrical with vertical generatrices, thus producing an objectionable asymmetry in the final projector and screen assembly, it is possible, according to a complementary feature of this invention, to provide panels and, if desired, the frame structure associated therewith, of such configuration that this asymmetry be reduced to a minimum; this result may be obtained for example by inclining backwards a concave cylindrical screen or by utilising a concave screen meeting the following requirements:

(a) Its surface configuration is derived from a cylindrical surface but differing therefrom in that the radii of curvature of the cross sections taken upon successive planes increase gradually.

(b) This surface is so directed with respect to the horizontal plane and so bound, that the final or complete screen comprises two substantially vertical lateral sides and two horizontal upper and lower sides, the aforesaid planes being horizontal and the radii of curvature increasing from the lower side to the upper side.

These screen shapes are advantageous notably in that they eliminate substantially for the audience distortions such as barrel distortion.

The light-diffusing elements are clamped on each panel by means inherent to said panel and/or common to a panel assembly, such as tight cables or the like; preferably, however, these means are inherent to each panel or even to each diffusing element.

It is another object of this invention to provide a curved screen for projecting motion picture films, which is arranged according to the method set forth hereinabove and remarkable notably in that it consists of longitudinal panels of which the two large sides are parallel to each other and constitute elementary screens juxtaposed along said large sides and secured to one another with or without a frame structure, each panel being provided with light-diffusing elements substantially parallel to said large sides, said panels carrying setting means adapted to maintain between each light-diffusing element and the adjacent corresponding region of the panel carrying this element an angle of a value consistent with the position of said panel on the screen and preferably with the position of the light-diffusing element carried by the panel.

According to a first form of embodiment the aforesaid panel consists of at least one upper shoe, a lower shoe, the light-diffusing elements being disposed between, and bearing with their ends on shoulder portions of said shoes.

The angular setting of the various light-diffusing elements of the screen is obtained in this case preferably as follows: The light-diffusing element is laid on said

shoulder, care being taken to bring one of its longitudinal edges in contact with the wall limiting this shoulder, and the other edge of this element is caused to engage the mat, light-diffusing face of the preceding element located nearer to the central region of the screen, this last-named element being directed in a similar fashion by bearing on the one hand against said wall and on the other hand against the preceding light-diffusing element; each light-diffusing element being so disposed as to overlap at least slightly the preceding element in the longitudinal direction, the degree of overlap, for identical light-diffusing elements throughout the screen, being variable and such that the greater the distance between the element considered and the central region of the screen, the greater the overlap between adjacent elements; the overlapping of any element by the next element and, therefore, the angular setting of this next element which results from the fact that it bears with one of its edges on said first element, is adjusted by bracing means consisting for example of a cable extending in succession through the rods and passing through holes formed in the overlapping portions of said rods, said cable or the like carrying adequate stop means or the like rigid therewith.

According to a first form of embodiment of this invention the panel broadly described in the preceding paragraph consists of a section member having one face formed with longitudinal ribs or the like extending substantially at right angles to the axis of the optical projection, each rib constituting a light-diffusing element.

The section member utilised in this case constitutes a unitary element acting at the same time as a panel, as light-diffusing elements, and as fastening and clamping means, whereas these components, although assembled to constitute a unitary structure, did not constitute a one-piece part in the first form of embodiment.

According to a third form of embodiment of this invention the elementary screen is made of corrugated sheet material of which each longitudinal rib constitutes a light-diffusing element of which the angular setting is a function of the sheet sectional contour as in the second form of embodiment contemplated hereinabove; however, since this sheet material has not a sufficient rigidity, even in its corrugated form, a support is used which may consist of the shoes described in conjunction with the first form of embodiment, the ends of these corrugated sheets fitting in a suitable channel or shoulder (for example the shoulders formed on said shoes) to constitute a panel in conjunction with said shoes; in this case the panels thus obtained are assembled in a manner corresponding to the procedure set forth in the description of the first form of embodiment.

Other features and advantages of this invention will appear as the following description proceeds with reference to the accompanying drawings showing various forms of embodiment of curved screens constructed according to this invention.

In the drawings:

FIGURE 1 is a perspective diagrammatic view showing a panel mounted on a frame structure, according to a typical form of embodiment of this invention;

FIGURES 2 and 3 illustrate in perspective details of the panel construction of FIGURE 1;

FIGURE 4 is a cross section showing a sectional member constituting a panel according to a modified form of embodiment of the invention;

FIGURE 5 is a plane view from above showing a typical method of assembling screen panels of the type illustrated in FIGURE 4, this construction permitting of dispensing with the provision of a frame structure;

FIGURE 6 is a rear view showing an assembly procedure somewhat similar to the preceding one in the case of panels of the type shown in FIGURE 4;

FIGURE 7 illustrates a screen arrangement according to this invention;

FIGURE 8 is a perspective view showing another screen arrangement according to this invention;

FIGURE 9 is a projection on a horizontal plane of the screen contour shown in FIGURE 8;

FIGURES 10 and 11 illustrate in projection on a horizontal plane the contours of two screens according to this invention;

FIGURE 12 shows the relative positions of two adjacent light-diffusing elements of the screen illustrated in FIGURES 8 and 9, as well as the means contemplated for maintaining these positions, and

FIGURES 13, 14 and 15 show the contour of three different types of independent light-diffusing elements.

Referring first to the form of embodiment illustrated in FIGURES 1 to 3 of the drawings, the panel **1** consists of an upper wooden shoe **2**, a lower wooden shoe **3**, an intermediate wooden support **4**, light-diffusing elements or strips **5** made of light alloy (of which only one is shown in FIGURE 1), and plates such as **6** for the upper shoe; if desired, the aforesaid shoes and support may be made of metal, plastic or any other suitable material. The upper shoe **2** consists of two parts **2***a*, **2***b* of different length providing a shoulder **7** in which the upper ends of the strips or rods **5** are caused to abut; similarly, the lower shoe **3** consists of two parts **3***a*, **3***b*; said parts **2***a*, **2***b* carry screw threaded stubs such as **8** in the case of the upper shoe; besides, the plates **6** are formed with holes **9** engageable by said screw-threaded studs so as to keep the upper and lower ends of strips **5** against the parts **2***a*, **2***b*, on the one hand, and **3***a*, **3***b* on the other hand, in the predetermined positions of these strips; parts **2***a*, **2***b*, **3***a* and **3***b* are assembled by any suitable means such as bolts or the like.

FIGURE 2 shows more particularly means for setting the strips **5** in different adjustment positions; the width of the shoulder ledge formed on the lower shoe decreases gradually in the direction of the arrow *f*; a strip such as **5***b* bears on the one hand against the rear wall **10**, also shown in FIGURE 1, of shoulder **7**; the different strips are thus caused to overlap one another on a predetermined width, this overlapping width increasing towards the outer edges of the screen; this feature is obtained by means of a cable **11** passing through holes **12** formed in the overlapping strip portions which are therefore concealed to the audience; this cable is provided with stop means **13** secured at fixed points along this cable, for example by welding.

When the strips have been positioned as shown diagrammatically in FIGURE 2, the plate **6** may be threaded on the studs **8**, its lower portion engaging the front wall **14** of shoulder **7** and its upper portion bearing against the front light-diffusing face of the strips **5**, whereby these strips may be kept in their desired initial positions; the plate **6** may be initially plane and as it is pressed against the wall **14** by tightening nuts carried by said studs **8**, this plate gradually assumes the curvature of this wall; on the other hand it may be noted that it is the contour of the front wall **14**, not that of the back wall **10** of shoe **3**, that determines the screen configuration; if this configuration is for instance cylindrical, the assembly of front walls **14** of lower shoes **3** of all the juxtaposed panels of the screen forms a circular arc and the contour of the assembly of back walls **10** may also be a circular arc but having a greater radius than the preceding one, with a different centre, whereby the centre angle of said second arc be greater than the centre angle of the first arc.

The intermediate support **4** (see more particularly FIGURE 3) consists of a body **4***a* and of a pair of comb-like toothed, notched or castellated portions **4***b*, **4***c* secured on the body **4***a* through any suitable means (not shown); the front wall of body **4***a* is coplanar with the rear wall **10** of the shoulder of shoe **3** and of the corresponding wall of the shoulder of shoe **2**, and has the same curvature as these walls; when a strip **5** tends to sag or bend at mid-height, it may be straightened out by clamping the strip

on the body 4*a* by means of a cable 15 of which one is anchored by welding or by means of a swell or a stop member of any suitable type solid with this cable, between the teeth of comb 4*b*, the other end being retained in a similar fashion between the teeth of comb 4*c*; this cable extends through a pair of holes 16, 17 formed through the strip 5 in the region thereof which is concealed by one of the adjacent strips.

The panel 1 is secured on a frame structure, of which only one portion is visible in FIGURE 1, by means of tubes 18 and clamping collars such as 19 formed with lug extensions permitting their fixation on the rear face of the shoes.

FIGURE 4 illustrates a sectional member 20 of the central portion of the screen; this sectional member has ribs 21 formed on its visible face to constitute the light-diffusing elements; it also carries side lugs 22 for clamping juxtaposed members 20 against each other, said lugs being formed on their lateral surface the one with a groove 23 and the other with a bead 24 adapted to engage the registering groove 23 of the adjacent sectional member.

FIGURE 5 illustrates an assembly comprising four sectional members of this type; longitudinal gaskets or like elements 25 are interposed between the outer faces of the coupled lugs of adjacent sectional members; these sectional members are kept assembled and clamped against each other by means of screw clamps 26 actuated by screws 27 in a well known manner; the means illustrated in FIGURE 6 permit of modifying at will the curvature of the sectional member by reducing or increasing same exactly to the desired value, irrespective of the position of the panel concerned in the complete screen, in case the desired and proper shape were not obtained directly during the shaping operation, for example with a view to simplify the manufacture by making only non-curved sectional members; this adjustment of the curvature of the sectional members is obtained by means of special extension devices 28 comprising two axially aligned screw-threaded rods 29, 30 adapted to be moved away from or towards each other by turning a nut or tapped sleeve 31, these rods bearing with their outer or opposite ends against the lugs 22 of the corresponding sectional member.

FIGURES 4 and 5 illustrate on the other hand the manner in which the angular setting or direction of the mat light-diffusing faces (constituting in this case light-diffusing elements incorporated in a unitary structure) carried by the sectional members is obtained; in the sectional member 20 of FIGURE 4 which corresponds to a panel located in the central portion of the screen all the ribs 21 have substantially the same inclination with the corresponding region of the section body, this angle being practically zero; on the other hand a sectional member such as 20*d* of FIGURE 5 is formed with ribs 21*d* of which the useful portions have an angular position which with respect to the corresponding region of the body of the sectional member, is practically the same for all the ribs, the angle formed between the useful portion of any one rib and said corresponding region being greater than in the case of sectional member 20; the corresponding angles of sectional members 20*c*, 20*b* and 20*a* have intermediate values; the angular setting of the useful portions of these ribs is governed by the fact that these portions must be substantially perpendicular to the axis of the film projection beam.

Of course, this perpendicularity may also be obtained in a still better way by gradually varying the preceding angle on a same panel, so that no discontinuity in the value of this angle occurs when passing from one sectional member to the next one, but it is obvious that this specific arrangement is likely to complicate more or less the panel design.

To facilitate the handling of the component elements, especially in the case of peripheral panels according to the first form of embodiment wherein the strips are arranged more closely to one another it will be advantageous to reduce the width of each panel to a greater extent than that illustrated in the case of the panels of FIGURE 5 concerning the second form of embodiment; thus, a 130-inch high screen covering a width of 30 feet may comprise about 1,600 strips and consist advantageously from this point of view of 26 panels, the peripheral panels being 8-inch wide and the central panel 24-inch wide, the other panels having intermediate widths; this panel width depends essentially on their weight and preferably the panels are so calculated that their weights be substantially equivalent, thus loading to narrower peripheral panels wherein the strips are closer to each other.

FIGURE 7 shows a cylindrical screen inclined obliquely to the horizontal and supported at the back by struts shown very diagrammatically at 32, the contour of this screen is formed by sides which are neither vertical nor horizontal; however, the cylindrical surface of this screen may be extended as far as to its intersections with horizontal and vertical planes, notably to its intersection with the lower horizontal plane in order to provide a screen configuration less confusing for the spectator.

The screen shown in FIGURES 8 and 9 of the drawings has two substantially vertical sides 33 (AC) and 34 (BD) and two sides 35 (AB) and 36 (CD) lying in horizontal planes, the upper side 35 having a smaller radius of curvature than the lower side 36; the increase in the radius of curvature in the direction of the lower portion of the screen is gradual, the thus illustrated surface being an adjusted surface.

This screen arrangement permits of having an upper edge AB of same length as the lower edge CD, whereby the overlapping of one strip by the next strip may be constant throughout the strip height.

The screen illustrated in FIGURE 10 has features similar to those of the screen shown in FIGURES 8 and 9, except that the right-hand and left-hand sides of the screen are vertical, the upper edge 37 of the screen being in this case longer than its lower edge 38.

FIGURE 11 shows in projection a screen of which the right-hand and left-hand side edges 40 are inclined forwards, the upper edge 41 of this screen having in this case a smaller radius of curvature than its lower edge 42 for the reasons set forth hereinafter.

The sections of the screen which are taken upon successive horizontal planes may consist, in the vicinity of the right-hand and left-hand edges of this screen, of straight segments.

The light-diffusing elements adapted, through the medium or not of panels of the aforesaid type, to accommodate the curvature of the screen shown in FIGURES 8 and 9, have a gradually decreasing inclination to the horizontal in directions away from the vertical medium plane of this screen; when these light-diffusing elements consist of identical separate strips, means are therefore provided, according to this invention, for creating an angle between any two adjacent strips, since these strips must overlap each other partially to a same extent throughout their length, that is, at the top as at the bottom of the screen, wedge means will advantageously be used with a view to create the aforesaid angle; this is shown in FIGURE 12 wherein the two adjacent strips 5*a*, 5*b* of the screen shown in FIGURES 8 and 9 are separated by a wedge 43. It will also be noted that as a consequence of the difference between the strip curvature at the top and bottom of the screen the strips are warped to a certain extent; this warping may be compensated by using the aforesaid wedges.

Of course, if a screen having the configuration shown in FIGURE 10 is contemplated wedge members such as 43 may be used but in this case the wedge members are so disposed that the strips overlap more at the bottom than at the top (fan-like strip arrangement).

FIGURE 13 shows a light-diffusing element of substantially L-shaped cross section, the light-diffusing element illustrated in FIGURE 14 being on the other hand crescent-shaped, with one end sharp and the other bevelled.

FIGURE 15 illustrates a cross-sectional contour of a light-diffusing element of trough-like configuration, with both ends bevelled; strips of this type are incorporated in the screen structures illustrated in FIGURES 1, 2 and 3.

Of course, this invention should not be construed as being limited by the specific forms of embodiment shown and described herein by way of example; thus, the panels, light-diffusing elements, frame structures, angular setting means, fastening and clamping devices, as well as the screen configurations and contours described and illustrated herein may be modified or replaced by any other suitable and equivalent arrangements and means; thus, it may be pointed out, inter alia, that the intermediate support **4** of FIGURES 1, 2 and 3 may be disposed backwards, that is, at the rear of shoes **2, 3**, liners or shims of different thicknesses being disposed between the front face of the shoes and the strips; in this case, by providing if necessary a plurality of intermediate supports and adjusting the thicknesses of the shims, linings or wedges from one strip to another and from one intermediate support to another, a screen curvature in the vertical direction of the screen may be obtained (to provide a part-spherical concave or convex surface of regular or irregular shape, this curvature being either fixed or varying gradually in a direction parallel to the upper edge of the screen from the right-hand edge to the left-hand edge thereof, and this last-named curvature may be concave or convex according to the desired optical result.

What I claim is:

1. A projection screen comprising a series of individual panels which are secured together in side-by-side relation, each panel comprising at least one upper and one lower shoe each provided with a curved shoulder, securing plates mounted on said shoes, a plurality of elongated juxtaposed screen elements comprising rigid members extending between said shoes, each rigid member having a slightly bulged portion provided with a light-diffusing front face, said front faces together constituting a single curved projection surface and being substantially parallel to a direction perpendicular to the projection axis throughout the screen surface, said rigid members being clamped between the shoulders of said shoes whereby they are maintained in proper spacial relationship and angular setting.

2. A projection screen as claimed in claim **1**, wherein said single projection surface is a substantially cylindrical surface its generatrices being parallel to a plane perpendicular to the vertical plane comprising the projection axis.

3. A projection screen as claimed in claim **1**, wherein said single projection surface is a surface generated by a straight line, the cross sections of said surface taken upon horizontal planes being circular arcs which on the one hand have radii of curvature increasing gradually from top to bottom and which, on the other hand, correspond to a center angle decreasing gradually from top to bottom, said circular arcs having their centers in a vertical plane comprising the projection axis.

4. A projection screen as claimed in claim **1**, further comprising at least one intermediate support disposed between said upper and lower shoes, said elongated rigid members bearing against said intermediate support and being secured thereon by means of clamping members.

5. A projection screen as claimed in claim **4** wherein each elongated rigid member is formed with holes provided in the portion thereof which is overlapped by the adjacent elongated member, and wherein said clamping members comprise cables passing through said holes and comb-shaped fastening members secured on said intermediate supports, said cables being retained between the teeth of said comb-shaped fastening members.

6. A projection screen as claimed in claim **5**, further comprising wedge members inserted between any two adjacent rigid members.

7. A projection screen as claimed in claim **1** wherein said single projection surface is a substantially cylindrical surface with vertical generatrices.

References Cited by the Examiner

UNITED STATES PATENTS

1,122,192	12/1914	Clark	88—28.9
1,279,262	9/1918	Clark	88—28.9
1,834,177	12/1931	Petrowsky	88—28.92
1,883,291	10/1932	Ives	88—28.9
2,476,521	7/1949	Waller	88—28.9
3,026,770	3/1962	Smith	88—28.9
3,037,424	6/1962	Capetta	88—28.92

FOREIGN PATENTS

182,311	7/1922	Great Britain.
894,186	3/1944	France.
531,527	9/1954	Belgium.
229,044	11/1958	Australia.
1,236,602	6/1960	France.

JULIA COINER, *Primary Examiner.*