

Description

This invention relates to projection screens and more particularly to projection screens for motion pictures, slide projectors, video projectors, light projectors or other types of projectors including electronic projections or combinations thereof.

In the prior art there exists various types of projection screens. One example of such projection screens is the type found in most motion picture theaters. This type of projection screen generally comprises a reflective layer provided on a flat support. While such projection screens have been utilized for many years in motion picture theaters and similar smaller versions have been used for other applications, such screens have certain disadvantages.

In particular, the distribution of reflected light across the projection screen is not even and "hot spots" exist on the projection screen. Furthermore, such screens are not high in light efficiency and therefore require a very bright light source be provided in the projector which in turn results in high energy costs and generally high operating costs for the projector. In addition such screens are heavy, generally erected for use in one location and are not portable.

Other screens have been developed which have attempted to overcome the disadvantages of above described prior art projection screens. Examples of such other prior art projection screens are contained in United States patents listed as follows:

2,753,818	3,720,455
4,022,522	4,323,301
4,339,175	

A further projection screen is known from US 3998522, which discloses a screen comprising a membrane stretched over a frame which has a curved rim. A plenum is arranged behind the membrane, from which gas is withdrawn, whereby the membrane adopts a concave, spherical form.

In view of prior art, it is a general object of the present invention to provide a projection screen which has even reflected light distribution, higher light efficiency, lower energy cost, higher resolution and contrast, and lower operating cost.

It is another object of the present invention to provide a projection screen which could be portable and is of a shape which can be set thereby matching the distribution of the audience and the size and shape of the theater.

According to the present invention there is provided a projection screen comprising:

- an elastic elongate film having a front surface, a back surface and a periphery;
- a means coupled to said periphery of said film for defining the shape of said periphery of said elongate film such that said shape include at least a portion which is curved, and which is located in a plane substantially normal to the general extent of said elongate film;
- a means for creating a pressure difference between the medium in front of and behind said film; characterised in that the screen further comprises:
- a means for sensing a position of at least a portion of said elongate film; and
- a means for controlling the means for creating said pressure difference in response to said means for sensing said position of said film such that said position of said film is maintained in a predetermined position whereby the shape of the elongated film is defined by the means for defining the shape of said periphery of said film and by said pressure difference.

The above mentioned features and objects of the present invention will become more apparent with reference to the following description taken in conjunction with the accompanying drawings wherein like reference numerals denote like elements and in which:

Figure 1 is a front view of a projection screen in accordance with the teachings of the present invention;
 Figure 2 is a cross-sectional view of the projection screen of Figure 1 along the line 2-2 in Figure 1 which also shows the additional elements of the present invention;
 Figure 3 is a cross-sectional view of the projection screen of Figure 1 along the line 3-3;
 Figure 4 is a block diagram of a control unit utilized in the present invention;
 Figure 5 illustrates an alternate shape for the projection screen of Applicant's invention; and
 Figure 6 is a perspective view of the projection screen of Figure 1.

Referring to Figures 1 through 3 and 6, shown therein is a projection screen in accordance with the teachings of the present invention. The projection screen includes a support chamber 2 over which a thin membrane

or film 4 is stretched and attached thereto at only its periphery. The film 4 is preferably a seamless elastic film, but for certain applications it need not be seamless. Also, the film 4 can be any elastic material such as a polymer fabric, metallic foil, composite or the like; but is preferably made from polyvinyl chloride acetate. The support chamber 2 includes vertical and horizontal side members 6 and 8, respectively, and as can be seen clearly in Figures 1, 2 and 6, the side member 6 in a plane normal to the periphery of the film 4 is curved and in a similar manner the side member 8 in a plane perpendicular to the periphery of the film 4 is also curved. The curve of the side members 6 and 8 can be a spherical shape, a compound curve, aspherical, a conical section, etc. In addition, the shapes of the curves of the side members 6 and 8, respectively, do not have to be the same and in most instances will not be the same. Furthermore, the shape of the curves of the side members 6 and 8 are predetermined and selected in accordance with the distribution of the audience and the size and shape of the viewing theater wherein the projection screen is to be placed.

Provided within the support chamber 2 is a sensor 10. This sensor 10 directly or indirectly senses the position of at least a portion of the film 4 and indirectly senses a pressure differential between the front surface and the back surface of the film 4 and outputs a signal indicative of the position of the film 4 which also indirectly indicates the pressure differential. The sensor 10 may be any type of sensor which can directly or indirectly sense the position or pressure differential. An example of a sensor which would directly sense the pressure differential would be a pressure sensor and an example of a sensor which would directly sense the position and indirectly sense the pressure differential would be a proximity sensor which senses the proximity of the film 4 to the sensor 10 as a result of the deformation of the film caused by the pressure difference. Such proximity sensors could include magnetic sensors, electro-magnetic sensors, electronic sensors, mechanical sensors, etc.

The output of the sensor 10 is provided to a control unit 12. The control unit 12 controls a solenoid operated butterfly valve 14 which is coupled to the chamber formed between the support chamber 2 and the film 4 by a hose 16. A continuously running blower 18 is also coupled to the hose 16 and provides a source of vacuum thereto. The valve 14 is controlled by the control unit 12 such that when the sensor 10 senses that the required predetermined position of the film 4 (in other words, some pressure differential) has been achieved, the valve 14 is turned OFF to close the hose 16 to maintain the pressure differential and the predetermined position. If the film 4 moves away from the predetermined position as a result of the pressure differential decreasing the control unit 12 in response to the signal from the sensor 10 will then turn the valve 14 back ON to open the hose 16 to increase the pressure differential until the predetermined position of the film 4 is achieved again. It should be apparent that by utilizing the above described structure, the pressure differential is regulated or modulated to maintain the position of the film 4 with a certain design range around the predetermined position.

It should be apparent from the above description that the pressure difference between the front and back surfaces of the film 4 will deform the film 4 until a desired position of the film 4 is achieved. As a result, the shape of the film 4 will not only be set by the curve of the side members 6 and 8, but also by the predetermined position resulting from the pressure differential. Therefore, the shape of the film 4, which in fact is the surface upon which the image is to be projected, can be varied by changing the pressure differential to set the position of the film 4.

Referring to Figure 4, shown therein is a control unit 12 in accordance with the teachings of the present invention. The control unit 12 includes a comparator 20 for receiving an output signal from the sensor 10 and comparing with a preset value from a reference setter 22. The predetermined value set in the reference setter 22 corresponds to the required preset position of the film 4 and this reference value is compared with the signal from the sensor 10 by the comparator 20. When the reference value is equal to the signal from the sensor 10, the comparator 20 will output a signal to an electronic switch 24. Power is applied to the electronic switch 24 for the valve 14 and the electronic switch 24 is provided between the power source and valve 14. Therefore, when the comparator 20 outputs a signal indicating that the output signal from the sensor 10 is at the same level as the reference value from the reference setter 22, the electronic switch 24 is turned off and power to the valve 14 is interrupted.

In addition to the above description, it should be apparent to those of ordinary skill in the art that when utilizing certain types of sensors utilized as the sensor 10, an element or member may be required to be placed in contact with the back surface of the film 4; however, the placing of such an element or member on the back surface of the film 4 may have a deleterious effect upon the shape of the film 4. Therefore, to overcome such a problem or disadvantage, a flexible member 30 in the form of web, as shown by a dotted line in Figure 2, may be provided within the support chamber 2 and the member 32 to be detected by the sensor 10 can be provided on the flexible member 30 which is hanging down inside of the support chamber 2. In addition, it should be apparent that this flexible member 30 must be provided so that the back surface of the film 4 contacts the flexible member 30 before the film 4 reaches the desired shape. Also, it should be apparent that while the above description has been described in terms of essentially evacuating the chamber formed between the support

chamber 2 and the film 4, it would also be possible to provide super atmospheric pressure to the front surface of the film 4. Furthermore, while the film 4 has previously been described as being imperforate, it could be provided with holes therethrough so that sound could more easily pass through the film 4. In addition, while a blower is described as being utilized as the means to create the pressure differential; other devices such as pumps, fans, valves or combinations of such devices could be utilized also. Still further, while the control of the pressure differential has been described in terms of ON/OFF control, it could also be accomplished by proportional control. Finally, while the support chamber 2 has been described and shown in the Figures as being rectangular, other shapes would be possible such as circular, triangular, hexagonal, etc. and an example of such a different shape is shown in Figure 5 wherein the support chamber 2' is a hexagonal shape and the film 4' is provided onto the hexagonal support chamber 2'.

It should be apparent to those skilled in the art that the above describe embodiments are merely illustrative of but a few of the many possible specific embodiments which represent the application of the principles of the present invention. Numerous and various other arrangements could be readily devised by those skilled in the art without departing from the scope of the present invention as defined in the claims.

Claims

1. A projection screen comprising:

- an elastic elongate film (4) having a front surface, a back surface and a periphery;
- a means (2,6,8) coupled to said periphery of said film (4) for defining the shape of said periphery of said elongate film (4) such that said shape includes at least a portion which is curved, and which is located in a plane substantially normal to the general extent of said elongate film (4);
- a means (18) for creating a pressure difference between the medium in front of and behind said film (4);
- characterised in that the screen further comprises:
 - a means (10) for sensing a position of at least a portion of said elongate film (4); and
 - a means (12) for controlling the means (14,18) for creating said pressure difference in response to said means (10) for sensing said position of said film (4) such that said position of said film (4) is maintained in a predetermined position whereby the shape of the elongated film (4) is defined by the means (2,6,8) for defining the shape of said periphery of said film (4) and by said pressure difference.

2. A projection screen according to Claim 1, wherein said means (10) for sensing said position of said film comprises a proximity sensor.

3. A projection screen according to Claim 1, wherein said means (10) for sensing said position of said film comprises a pressure sensor.

4. A projection screen according to any one of Claims 1 to 3, wherein said means (14,18) for creating a pressure difference comprises a blower (18) and a solenoid operated valve (14).

5. A projection screen according to any one of Claims 1 to 4, wherein said means (2,6,8) coupled to said periphery of said film (4) for defining said shape of said periphery of said elongate film is a frame.

6. A projection screen according to Claim 5, further comprising a vacuum chamber (2) coupled to said frame.

7. A projection screen according to any preceding claim, wherein said elongate film (4) is seamless.

8. A projection screen according to Claim 6, wherein said frame is rectangular in shape.

9. A projection screen according to Claim 6, wherein said frame is polygonal in shape.

10. A projection screen according to Claim 4, wherein said means (12) for controlling the means for creating said pressure difference comprises a reference setting means (22) for setting a reference signal and a comparator (20) for comparing an output of said means (10) for sensing said position with said reference signal.

11. A projection screen according to Claim 2, wherein said means coupled to said periphery of said film for defining said shape of said periphery of said elongate film is a frame, and further comprising a vacuum

chamber 2 and the film 4, it would also be possible to provide super atmospheric pressure to the front surface of the film 4. Furthermore, while the film 4 has previously been described as being imperforate, it could be provided with holes therethrough so that sound could more easily pass through the film 4. In addition, while a blower is described as being utilized as the means to create the pressure differential; other devices such as pumps, fans, valves or combinations of such devices could be utilized also. Still further, while the control of the pressure differential has been described in terms of ON/OFF control, it could also be accomplished by proportional control. Finally, while the support chamber 2 has been described and shown in the Figures as being rectangular, other shapes would be possible such as circular, triangular, hexagonal, etc. and an example of such a different shape is shown in Figure 5 wherein the support chamber 2' is a hexagonal shape and the film 4' is provided onto the hexagonal support chamber 2'.

It should be apparent to those skilled in the art that the above describe embodiments are merely illustrative of but a few of the many possible specific embodiments which represent the application of the principles of the present invention. Numerous and various other arrangements could be readily devised by those skilled in the art without departing from the scope of the present invention as defined in the claims.

Claims

1. A projection screen comprising:
 - an elastic elongate film (4) having a front surface, a back surface and a periphery;
 - a means (2,6,8) coupled to said periphery of said film (4) for defining the shape of said periphery of said elongate film (4) such that said shape includes at least a portion which is curved, and which is located in a plane substantially normal to the general extent of said elongate film (4);
 - a means (18) for creating a pressure difference between the medium in front of and behind said film (4);
 - characterised in that the screen further comprises:
 - a means (10) for sensing a position of at least a portion of said elongate film (4); and
 - a means (12) for controlling the means (14,18) for creating said pressure difference in response to said means (10) for sensing said position of said film (4) such that said position of said film (4) is maintained in a predetermined position whereby the shape of the elongated film (4) is defined by the means (2,6,8) for defining the shape of said periphery of said film (4) and by said pressure difference.
2. A projection screen according to Claim 1, wherein said means (10) for sensing said position of said film comprises a proximity sensor.
3. A projection screen according to Claim 1, wherein said means (10) for sensing said position of said film comprises a pressure sensor.
4. A projection screen according to any one of Claims 1 to 3, wherein said means (14,18) for creating a pressure difference comprises a blower (18) and a solenoid operated valve (14).
5. A projection screen according to any one of Claims 1 to 4, wherein said means (2,6,8) coupled to said periphery of said film (4) for defining said shape of said periphery of said elongate film is a frame.
6. A projection screen according to Claim 5, further comprising a vacuum chamber (2) coupled to said frame.
7. A projection screen according to any preceding claim, wherein said elongate film (4) is seamless.
8. A projection screen according to Claim 6, wherein said frame is rectangular in shape.
9. A projection screen according to Claim 6, wherein said frame is polygonal in shape.
10. A projection screen according to Claim 4, wherein said means (12) for controlling the means for creating said pressure difference comprises a reference setting means (22) for setting a reference signal and a comparator (20) for comparing an output of said means (10) for sensing said position with said reference signal.
11. A projection screen according to Claim 2, wherein said means coupled to said periphery of said film for defining said shape of said periphery of said elongate film is a frame, and further comprising a vacuum



chamber (2) coupled to said frame, and an elongate portion of material (30) coupled at one end to said chamber (2) and hanging downwardly between said proximity sensor and a rear surface of said elongate film.

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Patentansprüche

1. Eine Projektionswand mit:
 einer elastischen, ausgedehnten Folie (4) mit einer Vorderseite, einer Rückseite und einer Peripherie; einem Mittel (2, 6, 8), das mit der Peripherie der Folie (4) verbunden ist, um die Gestalt der Peripherie der ausgedehnten Folie (4) derart zu bestimmen, daß diese Gestalt wenigstens einen Teil umschließt, der gekrümmt ist und in einer Ebene im wesentlichen senkrecht zur allgemeinen Erstreckung der ausgedehnten Folie (4) liegt;
 einem Mittel (18) zur Erzeugung einer Druckdifferenz zwischen dem Medium vor und hinter der Folie (4);
 dadurch gekennzeichnet, daß die Wand weiterhin umfaßt:
 ein Mittel (10) zum Abfühlen einer Position wenigstens eines Teiles der ausgedehnten Folie (4); und
 ein Mittel (12) zur Steuerung der Mittel (14, 18) zur Erzeugung der Druckdifferenz in Abhängigkeit von dem Mittel (10) zum Abfühlen der Position der Folie (4) derart, daß die Position der Folie (4) in einer vorbestimmten Position gehalten ist, so daß die Gestalt der ausgedehnten Folie (4) durch das Mittel (2, 6, 8) zur Bestimmung der Gestalt der Peripherie der Folie (4) und durch besagte Druckdifferenz bestimmt ist.
2. Eine Projektionswand nach Anspruch 1, bei der das Mittel (10) zum Abfühlen der Position der Folie einen Annäherungssensor umfaßt.
3. Eine Projektionswand nach Anspruch 1, bei der das Mittel (10) zum Abfühlen der Position der Folie einen Drucksensor umfaßt.
4. Eine Projektionswand nach einem der Ansprüche 1 bis 3, bei der die Mittel (14, 18) zur Erzeugung eines Druckunterschiedes ein Gebläse (18) und ein magnetbetätigtes Ventil (14) umfassen.
5. Eine Projektionswand nach einem der Ansprüche 1 bis 4, bei der das Mittel (2, 6, 8), das mit der Peripherie der Folie (4) verbunden ist, um die Gestalt der Peripherie der ausgedehnten Folie zu bestimmen, ein Rahmen ist.
6. Eine Projektionswand nach Anspruch 5, die weiterhin eine mit dem Rahmen verbundene Vakuumkammer (2) umfaßt.
7. Eine Projektionswand nach einem der voranstehenden Ansprüche, bei der die ausgedehnte Folie (4) nahtlos ist.
8. Eine Projektionswand nach Anspruch 6, bei der der Rahmen von rechtwinkliger Gestalt ist.
9. Eine Projektionswand nach Anspruch 6, bei der der Rahmen von polygonaler Gestalt ist.
10. Eine Projektionswand nach Anspruch 4, bei der das Mittel (12) zur Steuerung der Mittel zur Erzeugung der Druckdifferenz ein Bezugs-Einstellmittel (22) zum Einstellen eines Bezugssignals und einen Komparator (20) zum Vergleichen eines Ausgangs des Mittels (10) zum Abfühlen besagter Position mit dem Bezugssignal umfaßt.
11. Eine Projektionswand nach Anspruch 2, bei der das Mittel, das mit der Peripherie der Folie zur Bestimmung der Gestalt der Peripherie der ausgedehnten Folie verbunden ist, ein Rahmen ist, und weiterhin eine Vakuumkammer (2) vorgesehen ist, die mit dem Rahmen verbunden ist, und ein länglicher Materialabschnitt (30), der mit dem einen Ende der Kammer (2) verbunden ist und zwischen dem Annäherungssensor und einer Rückseite der ausgedehnten Folie nach unten hängt.

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Revendications

1. Ecran de projection comprenant:



un film élastique allongé (4) ayant une surface avant, une surface arrière et une périphérie;
 un moyen (2, 6, 8) couplé à ladite périphérie dudit film (4) pour définir la forme de ladite périphérie dudit film allongé (4) de telle manière que ladite forme inclut au moins une partie qui est courbée et qui est située dans un plan sensiblement normal à l'étendue générale dudit film allongé (4);

un moyen (18) pour créer une différence de pression entre les milieux situés devant et derrière ledit film;

caractérisé en ce que l'écran comprend en outre:

un moyen (10) pour détecter une position d'au moins une partie dudit film allongé (4); et

un moyen (12) pour commander le moyen (14, 18) pour créer ladite différence de pression en réponse audit moyen (10) pour détecter la position dudit film (4) de telle manière que de ladite position dudit film (4) est maintenue dans une position prédéterminée, de sorte que la forme du film allongé (4) est définie par le moyen (2, 6, 8) pour définir la forme de ladite périphérie dudit film (4) et par ladite différence de pression.

2. Ecran de projection selon la revendication 1, dans lequel ledit moyen (10) pour détecter ladite position dudit film comprend un capteur de proximité.
3. Ecran de projection selon la revendication 1, dans lequel ledit moyen (10) pour détecter ladite position dudit film comprend un capteur de pression.
4. Ecran de projection selon l'une quelconque des revendications 1 à 3, dans lequel ledit moyen (14, 18) pour créer une différence de pression comprend un ventilateur (18) et un clapet commandé par un solénoïde (14).
5. Ecran de projection selon l'une quelconque des revendications 1 à 4, dans lequel ledit moyen (2, 6, 8) couplé à ladite périphérie dudit film (4) pour définir ladite forme de ladite périphérie dudit film allongé est un cadre.
6. Ecran de projection selon la revendication 5, comprenant en outre une chambre sous vide (2) couplée audit cadre.
7. Ecran de projection selon l'une quelconque des revendications précédentes, dans lequel ledit film allongé (4) est sans soudure.
8. Ecran de projection selon la revendication 6, dans lequel ledit cadre a une forme rectangulaire.
9. Ecran de projection selon la revendication 6, dans lequel ledit cadre a une forme polygonale.
10. Ecran de projection selon la revendication 4, dans lequel ledit moyen (12) pour commander le moyen pour créer ladite différence de pression comprend un moyen de fixation de référence (22) pour fixer un signal de référence et un comparateur (20) pour comparer une sortie dudit moyen (10) pour détecter ladite position audit signal de référence.
11. Ecran de projection selon la revendication 2, dans lequel ledit moyen couplé à ladite périphérie dudit film pour définir la forme de ladite périphérie dudit film allongé est un cadre, et comprenant en outre une chambre sous vide (2) couplée audit cadre et une partie allongée de matériau (30) couplée à une extrémité de ladite chambre (2) et suspendue vers le bas entre ledit capteur de proximité et une surface arrière dudit film allongé.

