

L. X. CHAMPEAU.
 ADJUSTABLE ILLUMINATION DEVICE FOR SKYLIGHTS.
 APPLICATION FILED SEPT. 16, 1920.

1,419,918.

Patented June 20, 1922.

2 SHEETS—SHEET 1.

FIG 1

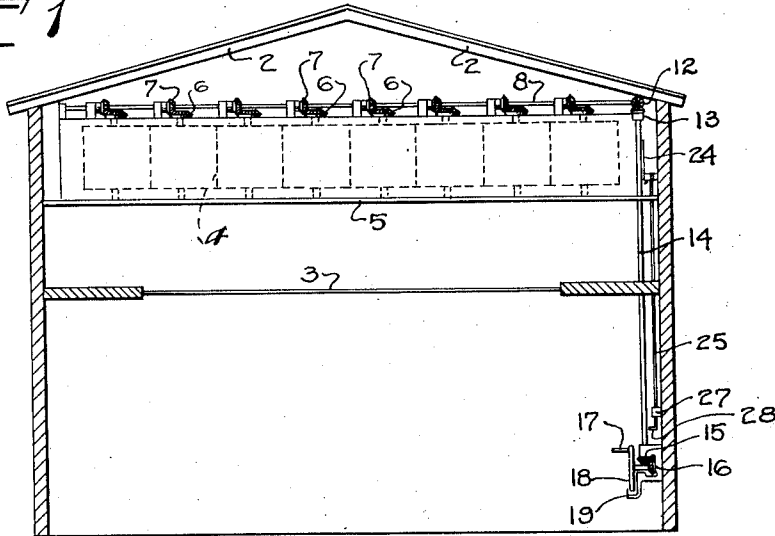


FIG 2

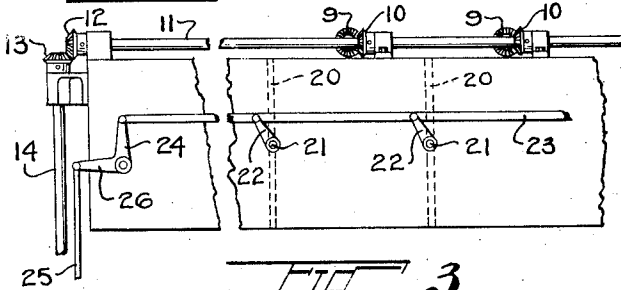


FIG 3

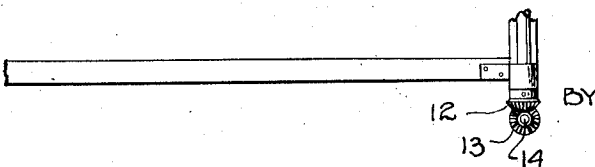
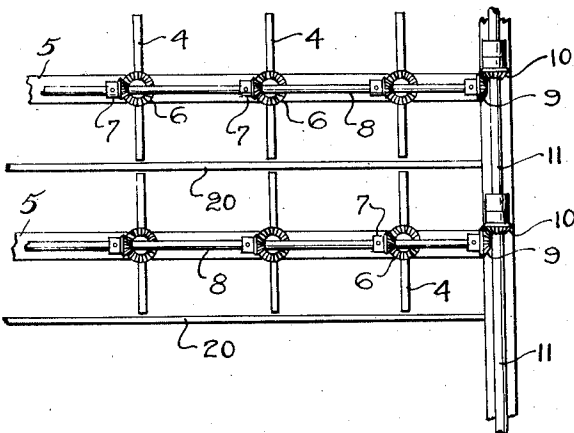


FIG 10

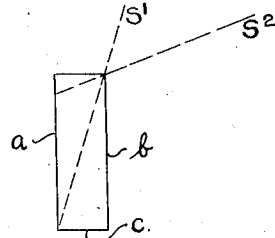
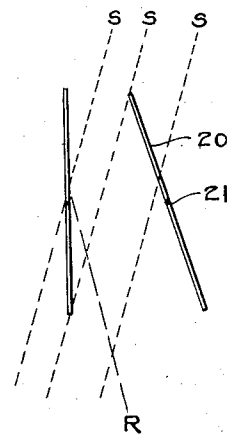


FIG 4



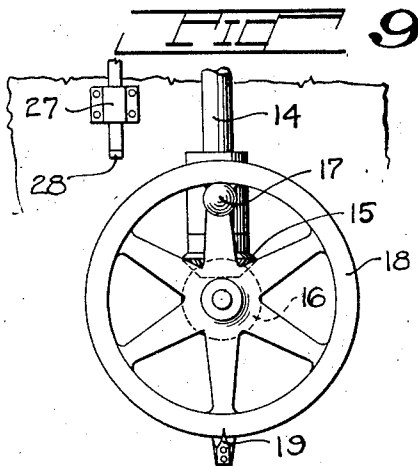
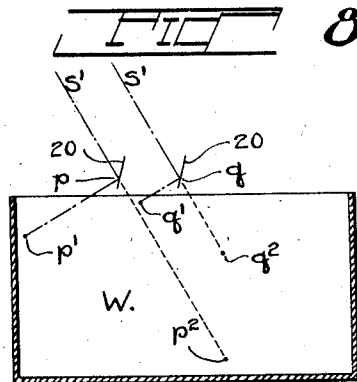
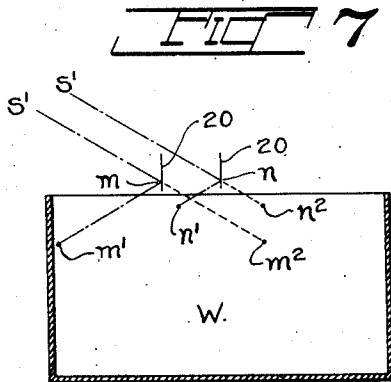
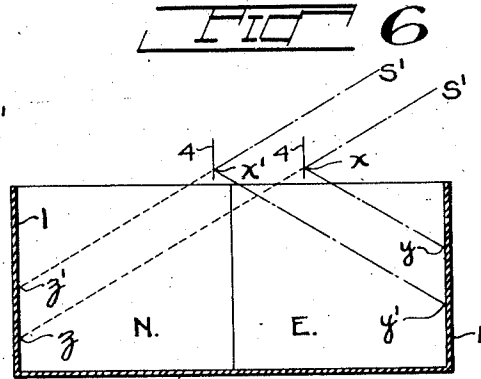
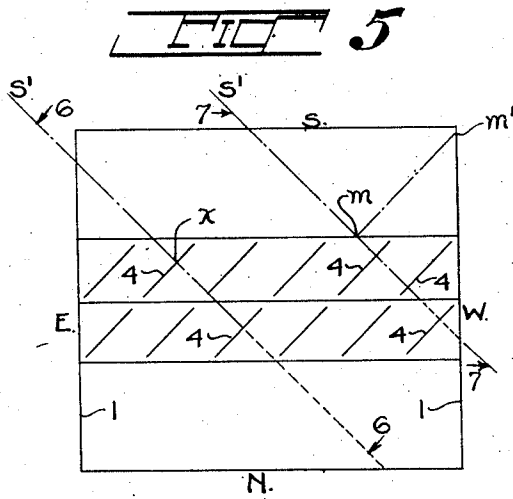
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 BY *Newell and Spencer*
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UNITED STATES PATENT OFFICE.

LAWRENCE X. CHAMPEAU, OF JERSEY CITY, NEW JERSEY.

ADJUSTABLE ILLUMINATION DEVICE FOR SKYLIGHTS.

1,419,918.

Specification of Letters Patent. Patented June 20, 1922.

Application filed September 16, 1920. Serial No. 410,793.

To all whom it may concern:

Be it known that I, LAWRENCE X. CHAMPEAU, a citizen of the United States, residing at Jersey City, New Jersey, have invented certain new and useful Improvements in Adjustable Illumination Devices for Skylights, of which the following is a clear, full, and exact description.

This invention relates to skylight illuminating devices for art galleries, exhibition halls, studios, museums, and the like, and has for its object such improvement in the construction and arrangement of such devices that daylight is utilized to better advantage.

As a result of my improved construction, light is more evenly distributed to the different parts of the interior to be illuminated, and more light is available throughout the day and at different seasons of the year. Furthermore, a larger amount of light is made available than has heretofore been possible.

Other features and advantages will become apparent from the detailed description and claims when taken in connection with the accompanying drawings, in which—

Fig. 1 is a transverse sectional view through a room showing my improved device in use;

Fig. 2 is a fragmentary side elevation looking from the right inside of the side wall of the room Fig. 1;

Fig. 3 is a top plan view with some of the parts broken away;

Figs. 4 to 8 and Fig. 10 are diagrams illustrating the action of my device in controlling the reflection and transmission of light; and

Fig. 9 is an enlarged detail of the means for controlling the movement of the light reflecting and transmitting surfaces.

In order that the objects displayed on the walls of art galleries or the like may be viewed to the best advantage, it is essential that they be well illuminated at all times, and it is desirable that the amount of illumination shall be uniform throughout the day and also during different seasons of the year. These conditions are, of course, impossible of even approximate attainment, where direct sunlight is permitted to shine upon the floor or walls of the interior, for this would result, in the northern hemisphere, in the north wall being much more intensely illuminated than the south wall; and the west wall

would be flooded with light in the morning, while the east wall would be under-lighted. In the afternoon these conditions would, of course, be reversed. Efforts have been made to prevent direct sunlight from entering the interior, and various forms of shutters have been used to cut off the excess light. Devices in the form of tubes or cells have also been proposed. With shutters, these have to be closed, or nearly closed, during the middle portion of the day, resulting in the cutting off of too much light.

In a cell structure, those walls of the cells running east and west must be close enough together in proportion to their depth, so that the sun at meridian altitude at the time of the summer solstice will not shine directly below the north wall of any two adjacent walls. In 40° north latitude, the sun at the summer solstice is only about 16½ degrees from the zenith. Therefore, the walls of a cell must be more than three times as deep as they are apart. At any other time of the day than noon, therefore, the amount of light available in the room below is less than it is possible to utilize and in fact much less than that which is available with my improved skylight construction. What has been said with respect to the failure of an ordinary cell structure to provide uniform and ample light under the various conditions of day and season will be made more apparent by the diagram shown in Fig. 10. Here *a* and *b* represent two adjacent cell walls running east and west, and *c* a cross cell wall. If *S'* indicates the position of the sun at noon at the summer solstice, then the distance apart of *a* and *b* must be less than one-third their depth in order to prevent the sun shining through at noon at this time.

At the time of the winter solstice, however, the sun at noon will be about in a position shown at *S*², and only a small portion of the surface of the walls *a* and *b* will be directly illuminated by it. It is, therefore, obvious that with the same depth of wall greater reflecting and transmitting surfaces will be available if these walls are farther apart in winter than in summer, and farther apart during the forenoon and afternoon of the same day than at noon. Of course, as the sun changes its altitude during the day it reaches a position in the east or west such that it will shine in between east and west walls *a* and *b*, but this is prevented in the usual cell construction by the cross walls *c*,

With my improved construction, I obtain the effect of walls variably spaced for different seasons of the year and also take care of the changing position of the sun during the day, and provide at all times a large surface for the reflection and transmission of light to the space below. With my construction, furthermore, the light is very evenly distributed over the walls of the room at all times of the day, and the maximum sunlight availed of.

While my invention may be practiced in a number of ways and by the use of members of different dimensions and arranged for a variety of movements, yet for the purpose of illustrating one practical embodiment of the invention, I have shown surfaces mounted for movement on vertical axes and other surfaces situated adjacent thereto and mounted for movement on horizontal axes, the surfaces mounted on vertical axes being adapted to be moved so as to present themselves at a right angle to a vertical plane passing through the sun as the sun changes its position during the day. By this construction, the distance between groups of surfaces may be greater in proportion to their depth than in constructions heretofore used. The horizontally mounted surfaces may be tilted more or less as needed to cut off excess sunlight during certain portions of the day, especially in summer.

Referring to the drawings, in which I have illustrated my invention in more or less diagrammatic form, 1 indicates the side walls of the gallery or other display room having a roof 2 made of material through which sunlight may readily enter and fall upon the light reflecting and transmitting surfaces of my improved sunlight illuminating device, which is situated under the roof and above a skylight 3 forming the ceiling of the room and which may be transparent, but preferably only semitransparent or may be composed of prisms in some cases.

My improved device includes a plurality of series of members 4 supported for vertical movement on cross-beams 5; these members being shown clearly in Fig. 3. These members 4 constitute independently movable frames, in which may be fastened material which will transmit and reflect light in substantially equal degree and for this purpose cheesecloth may be used, or what is known as opal or milky glass, or other suitable material. The members 4 may occupy a position shown in Fig. 3, in which they are shown as occupying a north and south direction, and this is the position they would occupy in the early morning and late afternoon when the sun occupies a position substantially due east or due west. As the sun changes its position, these members are designed to be rotated each on its own axis so as to present its surface substantially nor-

mal to a vertical plane passing through the sun, so that when the sun reaches the meridian the members 4 will be alined and form in effect a continuous surface extending in an east and west direction. There are a plurality of series of members 4 running across the top of the room to be illuminated, two series of these members being shown in Fig. 3, and in order to move all the members of all the series in unison they are connected together in any suitable manner. Preferably, I provide the upper end of each axis, on which the member 4 swings, with a beveled pinion 6 which engages with a beveled pinion 7 mounted on a shaft 8, there being a pinion 7 for each pinion 6, as clearly indicated in Figs. 1 and 3. Each shaft 8 has a beveled pinion 9 on one end, as indicated in Fig. 3, these pinions 9 engaging similar beveled pinions 10 mounted on a shaft 11 running at right angles to the shafts 8. It is, of course, obvious that the shaft 11 might be operated by a motor or any suitable power means or by hand, and for the purpose of illustrating my invention merely, I have shown a hand operated means for the shaft 11. For this purpose, one end of said shaft is provided with a beveled pinion 12 engaging a similar beveled pinion 13 mounted at the top of a vertical shaft 14, which at the bottom thereof carries a beveled pinion 15 engaging a similar beveled pinion 16 which is adapted to be rotated by a hand lever 17 connected to a dial 18. This dial may be suitably graduated, a pointer 19 being provided for convenience of setting the dial 18. The graduations may be varied to suit different conditions, and may read in hours or fractions thereof, or otherwise, as the particular case may require. In some cases it may be desirable to drive the shafts 8 by a motor mechanism, so that the members 4 are driven constantly in accordance with the movement of the sun. For many purposes, however, this extreme accuracy of movement is not essential, and an adjustment of the members 4 every little while—as, for instance, every quarter of an hour or half hour—is sufficient.

When the members 4 of any two groups or series of members are in alinement, the depth of the members 4, with respect to the distance between the groups is not greater than the ratio 5 to 4, and therefore, from what has already been said, it will be apparent that with this ratio of depth to distance apart, the sun towards midday at some times of the year would shine directly upon the skylight 3, and therefore directly into the room beneath if means were not provided to prevent this. At this point it may be well to refer to the diagram, Fig. 10, and to the fact that, in order to prevent the sun from shining through, when it reaches its greatest meridian altitude in summer, it is essential that

the distance between the two surfaces, with respect to their depth, be in the ratio of about 1 to 3. In order, however, to use shallow members, such as 4, and yet prevent the sun from shining through when it reaches a high altitude, and also to utilize the greatest amount of sunlight at all times of the year, I provide a series of surfaces mounted upon horizontal axes, and alternating with each series of members 4, these surfaces being shown in top plan view in Fig. 3, and one of them in end elevation in Fig. 4 and being indicated by the numeral 20. The distance apart of the surfaces 20, with respect to their depth, is also approximately in the ratio of 5 to 4. Under these circumstances, therefore, the conditions would be such that at noon, on the day of the summer solstice, it would be necessary to tilt the members 20—such tilting, for example, being indicated diagrammatically in Fig. 4. In this figure, the proportion of depth to distance apart between a series of members 4 and one of the surfaces 20 is such that when the surface 20 is tilted, as shown in said figure, the sun's rays—indicated by the lines S—S—S will not shine directly through to the room below, but will be diffused by transmission through and reflection from, the material composing the members 4 and the surfaces 20, a single reflected ray being indicated in Fig. 4 at R. At noon at other seasons of the year than the summer solstice, the surfaces 20 would be maintained in a more nearly vertical position. It is, of course, understood that the dimensions of the members and the distance apart are given for the purpose of illustrating the principle of operation of my improved device, and that these distances and dimensions will be varied to suit different requirements. It will also be understood that while the amount of tilting of the surface 20 is shown in Fig. 4 as just sufficient to prevent direct sunlight from reaching the room below, it may be desirable to cut off some of the sunlight falling upon the members 4 by tilting the surfaces 20 somewhat farther than is shown in said figure.

As already stated, the surfaces 20 are mounted on horizontal axes, these being indicated at 21, and for the purpose of moving all of these surfaces in unison, I secure to the end of each axis 21 an arm 22, to which arms are connected the rod 23, pivoted at each end upon a vertical arm of a bell-crank 24, one of said bell-cranks being shown in Fig. 2. It is obvious that power means of any suitable nature may be provided for moving the rod 23; but for the purpose of my present disclosure, I have illustrated manual means for moving this rod, and for convenience in operating the same from the floor of the room I connect a rod 25 to the arm 26 of the bell-crank, said arm 25 being suitably guided at 27, and at its lower end I provide a handle 28,

or other suitable means by which it may be manipulated, to tilt the surfaces 20 to any desired angle with the vertical, within their range of movement.

Not only do the surfaces 20 act to prevent direct sunlight coming through during the middle of the day at certain seasons of the year, and also to cut off a portion of the sun, if desired, at certain times, but they also act to better distribute the light reflected and transmitted to the walls of the room. The manner in which both the members 4 and the surfaces 20 function to distribute the light, will be best understood by reference to the diagrams shown in Figs. 5 to 8 inclusive.

In Fig. 5, the square shows diagrammatically the four walls of a room, at the top of which my improved device is situated. Two rays of light, S'—S', are indicated; and the members 4 are indicated as positioned so that they form a right angle with the vertical plane passing through the sun. Fig. 6 shows a view looking towards the north-east corner of the room in the direction of the arrows 6—6. Considering these two views together, a ray of light from S' striking a member 4 at x will be reflected in the same vertical plane to the point y on the east wall. Similarly, a ray of light striking a member 4 at x' would be reflected to the point y' on the east wall. Transmitted light from the points x and x' will pass to the north wall at the points z and z' respectively.

Considering now a ray of light coming from the sun and falling upon the surfaces 20, and referring to Figs. 5 and 7, Fig. 7 being a view looking in the direction of the arrows 7—7 of Fig. 5. A ray of light striking the surface 20 at the point m would be reflected to m' on the west wall and transmitted to the point m^2 also on the west wall. A ray of light striking the surface 20 at the point n will be reflected to the point n' on the west wall and be transmitted to the point n^2 also on the west wall. From a consideration of Fig. 5, it will be noted that a ray of light striking at m is reflected to m' which is on the west wall but almost at the juncture of the west and south walls. It will be evident, therefore, that rays of light striking the surface 20 to the left of the point m would be reflected to the south wall. It will thus be seen that all four walls of the room are properly illuminated and that the greatest illumination is between the floor and the ceiling, which is the location best adapted to the display of art works which are hung upon the walls of the room.

In Fig. 8 are illustrated the points to which the light would be reflected and transmitted from the surfaces 20 if said surfaces are slightly tilted, the light coming from a higher point in the sky than that shown in Fig. 5. From Fig. 8 it will be readily seen that, although the light comes from a high

altitude, nevertheless it may be thrown towards the proper height on the walls to be illuminated by properly tilting the members 20. In said Fig. 8 the light striking at p is reflected to p' and transmitted to p'' ; the light striking at q being reflected to q' and transmitted to q'' on the west wall.

In tracing the rays of light in these diagrams only a single reflected and transmitted ray has been considered for the sake of simplicity. Since, however, the material composing the members 4 and the surfaces 20 is such as to diffuse the light striking upon them, it is obvious that not only will the light follow lines indicated in the diagrams but in Fig. 6, for instance, the reflected light will not only reach the wall at the point y , but at points both above and below said point y . However, the most intense illumination would be at the point y . Similarly with the transmitted rays striking the member 4 at the point x and in the case of such rays likewise the point of greatest illumination would be at the point z and would diminish upon either side of said point.

While I have described and shown a practical embodiment of my invention, and indicated a number of ways in which it may be used, in view of the great adaptability to different conditions of day and season and to the wide variations of dimensions and structure which may be resorted to in carrying out the principle thereof, I do not in any manner restrict myself to the device shown. Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A skylight illuminating device including a support and having members mounted on vertical axes and movable on said support to present a surface to the sun at substantially a right angle to a vertical plane including the rays of the sun falling upon such surface as the sun changes its position during the day.

2. A skylight illuminating device having members mounted on vertical axes, said members aligning to form a substantially continuous surface running in an east and west direction when in one position, said members movable to present each a surface to the sun at substantially a right angle to a vertical plane including the rays of the sun falling upon such surface, as the sun changes its position during the day.

3. A skylight illuminating device including members mounted on vertical axes, said members aligning to form a substantially continuous surface running in an east and west direction when in one position, other members having surfaces extending in an east and west direction and mounted for movement on horizontal axes so as to be tilted toward and away from the first mentioned surfaces which are maintained vertical.

4. A skylight illuminating device having members mounted on vertical axes, said members aligning to form a substantially continuous surface running in an east and west direction when in one position, said members movable to present each a surface to the sun at substantially a right angle to a vertical plane including the rays of the sun falling upon such surface, as the sun changes its position during the day, other members having surfaces extending in an east and west direction and mounted for movement on horizontal axes so as to be tilted toward and away from the first mentioned surfaces which are maintained vertical.

5. A skylight illuminating device including members having surfaces mounted on vertical axes, said members aligning to form a substantially continuous surface running in an east and west direction when in one position, other members having surfaces extending in an east and west direction and mounted for movement on horizontal axes so as to be tilted towards and away from the first mentioned members, the latter members alternating with the former.

6. A skylight illuminating device having members mounted on vertical axes and movable to present a surface to the sun at substantially a right angle to a vertical plane including the rays of the sun falling upon such surface, as the sun changes its position during the day, and members mounted adjacent to said first mentioned members on horizontal axes which run in an east and west direction.

7. A skylight illuminating device having members mounted on vertical axes, said members aligning to form a substantially continuous surface running in an east and west direction when in one position, said members movable to present each a surface to the sun at substantially a right angle to a vertical plane including the rays of the sun falling upon such surface, as the sun changes its position during the day, and other members mounted adjacent said first mentioned members on horizontal axes which run in an east and west direction.

8. A skylight illuminating device having members mounted on vertical axes, said members aligning to form a substantially continuous surface running in an east and west direction when in one position, said members movable to present each a surface to the sun at substantially a right angle to a vertical plane including the rays of the sun falling upon such surface, as the sun changes its position during the day, and means for moving all of said members simultaneously.

9. A skylight illuminating device having members arranged in groups and mounted on vertical axes, said members aligning to

form a substantially continuous surface running in an east and west direction when in one position, said members movable to present each a surface to the sun at substantially a right angle to the vertical plane including the rays of the sun falling upon such surface, as the sun changes its position during the day, and other members alternating with said groups of members, said other members mounted on horizontal axes which run in an east and west direction.

10. A skylight illuminating device having groups of members mounted on vertical axes, said members aligning to form a substantially continuous surface running in an east and west direction when in one position, said members movable to present each a surface to the sun at substantially a right angle to a vertical plane including the rays of the sun falling upon such surface, as the sun changes its position during the day, the depth of said members in proportion to the distance apart of the groups of members when in alignment being not greater than the ratio 5 to 4, and other members of substantially the same depth situated between adjacent groups of said first mentioned

members, and mounted to swing on horizontal axes running in an east and west direction.

11. A skylight illuminating device having groups of members mounted on vertical axes, said members aligning to form a substantially continuous surface running in an east and west direction when in one position, said members movable to present each a surface to the sun at substantially a right angle to a vertical plane including the rays of the sun falling upon such surface, as the sun changes its position during the day, the depth of said members in proportion to the distance apart of the groups of members when in alignment being not greater than the ratio 5 to 4, and other members of substantially the same depth situated between adjacent groups of said first-mentioned members and mounted to swing on horizontal axes running in an east and west direction, and means for simultaneously moving all of said members and of each group.

Signed at New York, N. Y., this 9th day of September, 1920.

LAWRENCE X. CHAMPEAU.