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Nov. 14, 1933. E. WILDHABER 1,935,219

METHOD OF AND MEANS FOR PROJECTING PICTURES

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FIG. 1

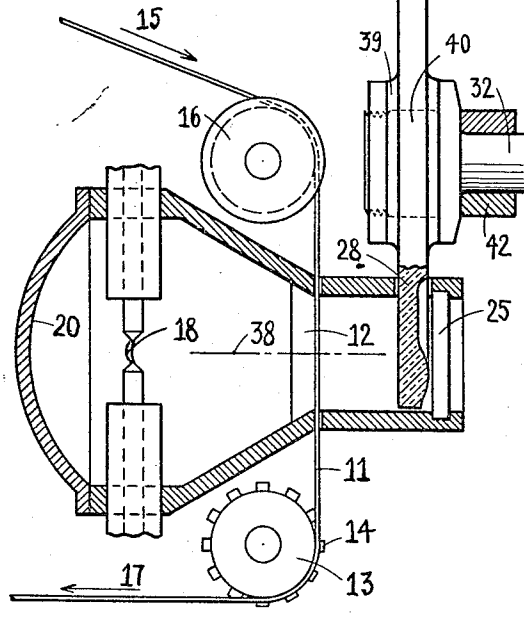


FIG. 2

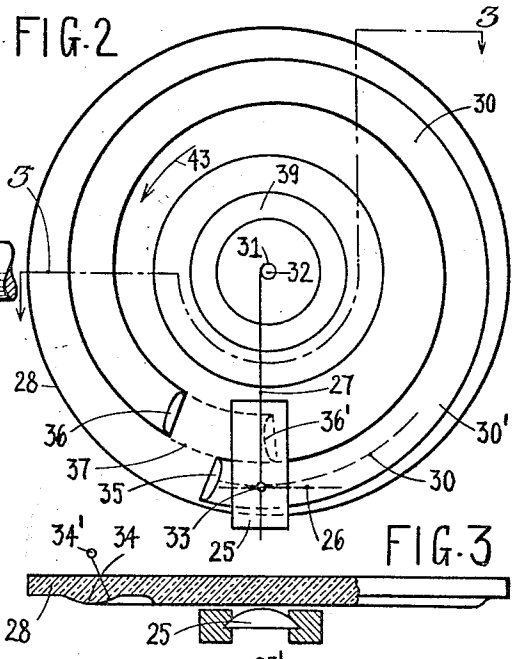


FIG. 3

FIG. 4

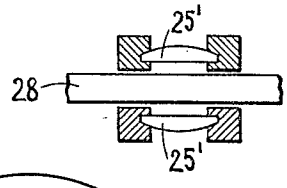
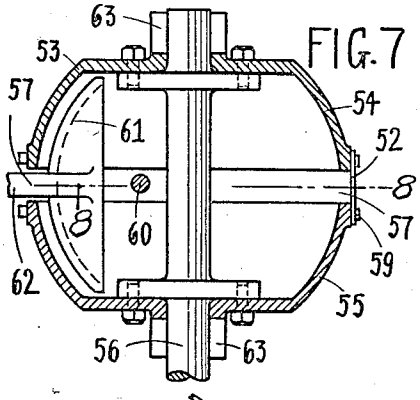


FIG. 7



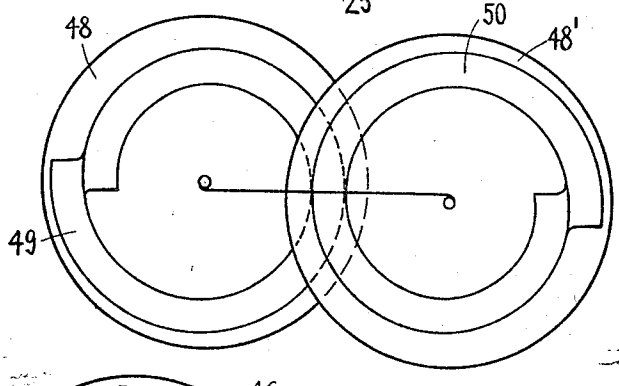
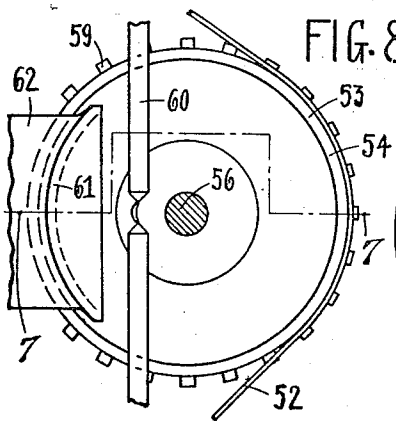


FIG. 6

FIG. 8



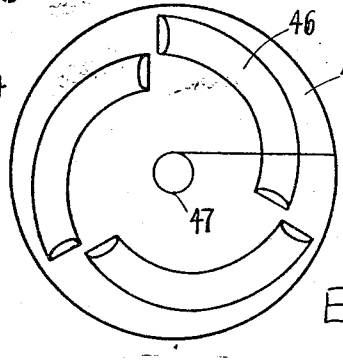


FIG. 5

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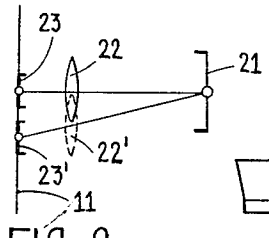


FIG. 9

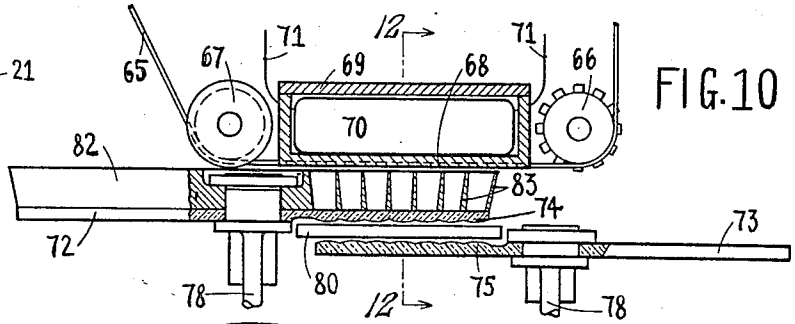


FIG. 10

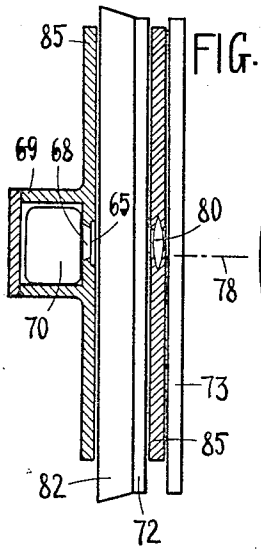


FIG. 12

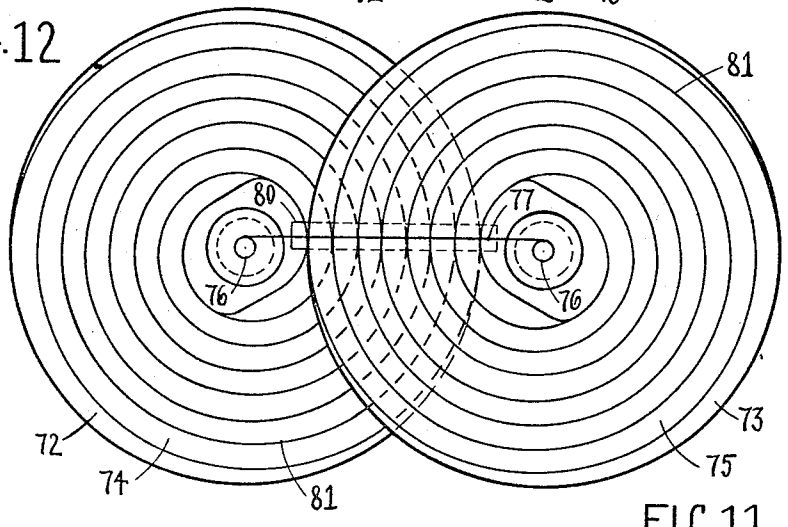


FIG. 11

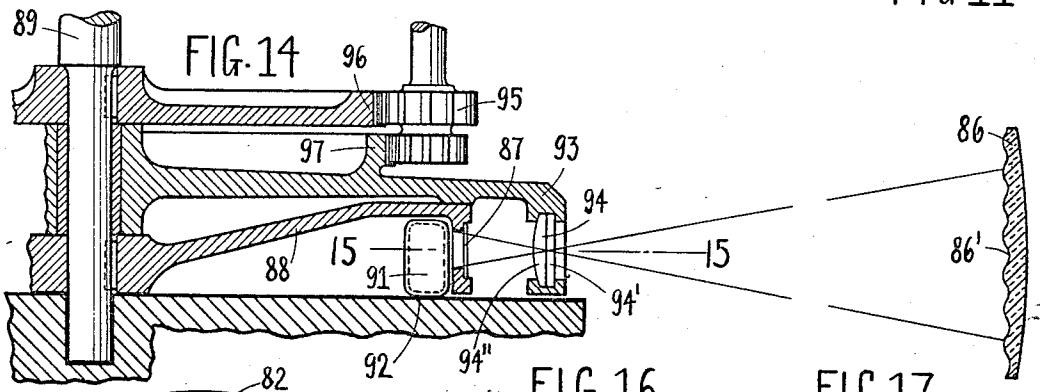


FIG. 14

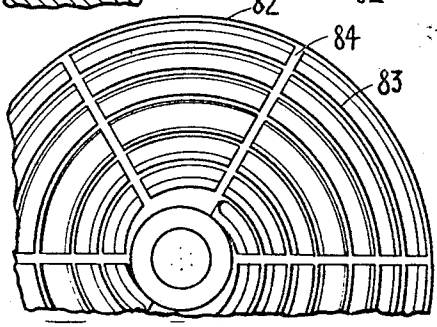


FIG. 13

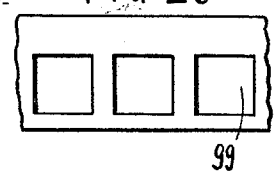


FIG. 16

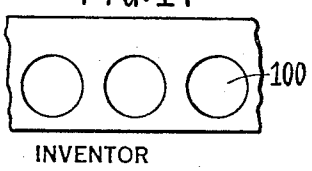


FIG. 17

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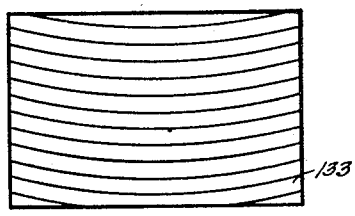


FIG. 21

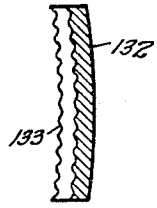


FIG. 22

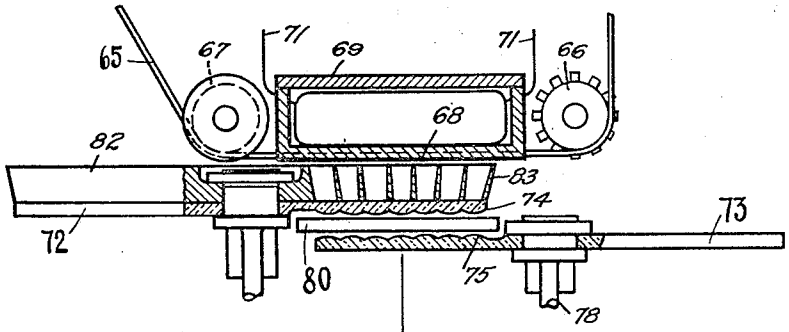
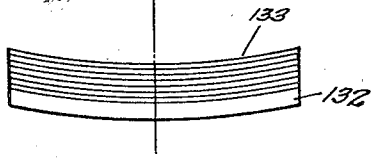


FIG. 10A



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FIG. 18

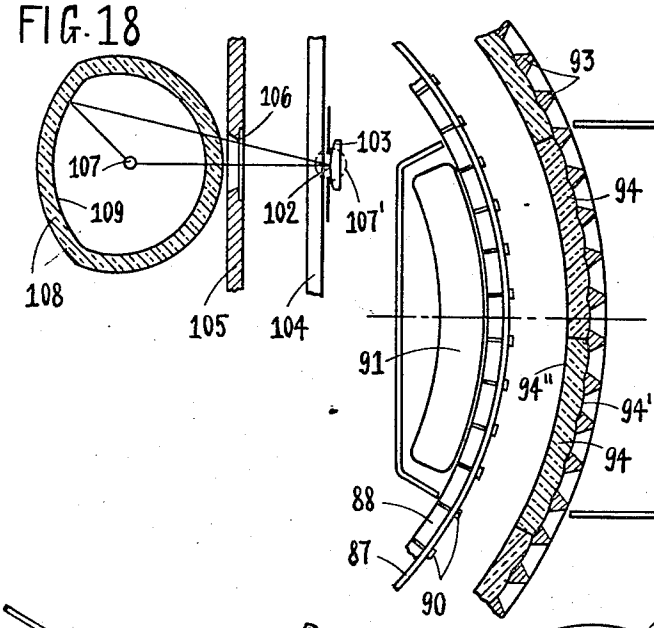
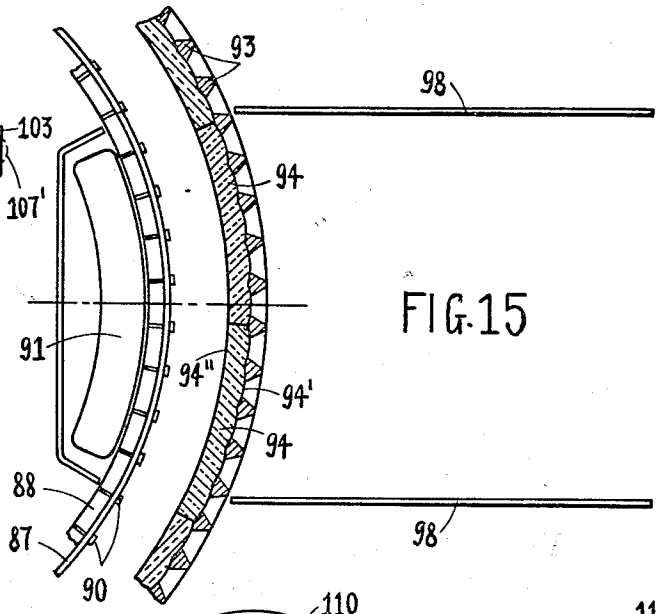


FIG. 15



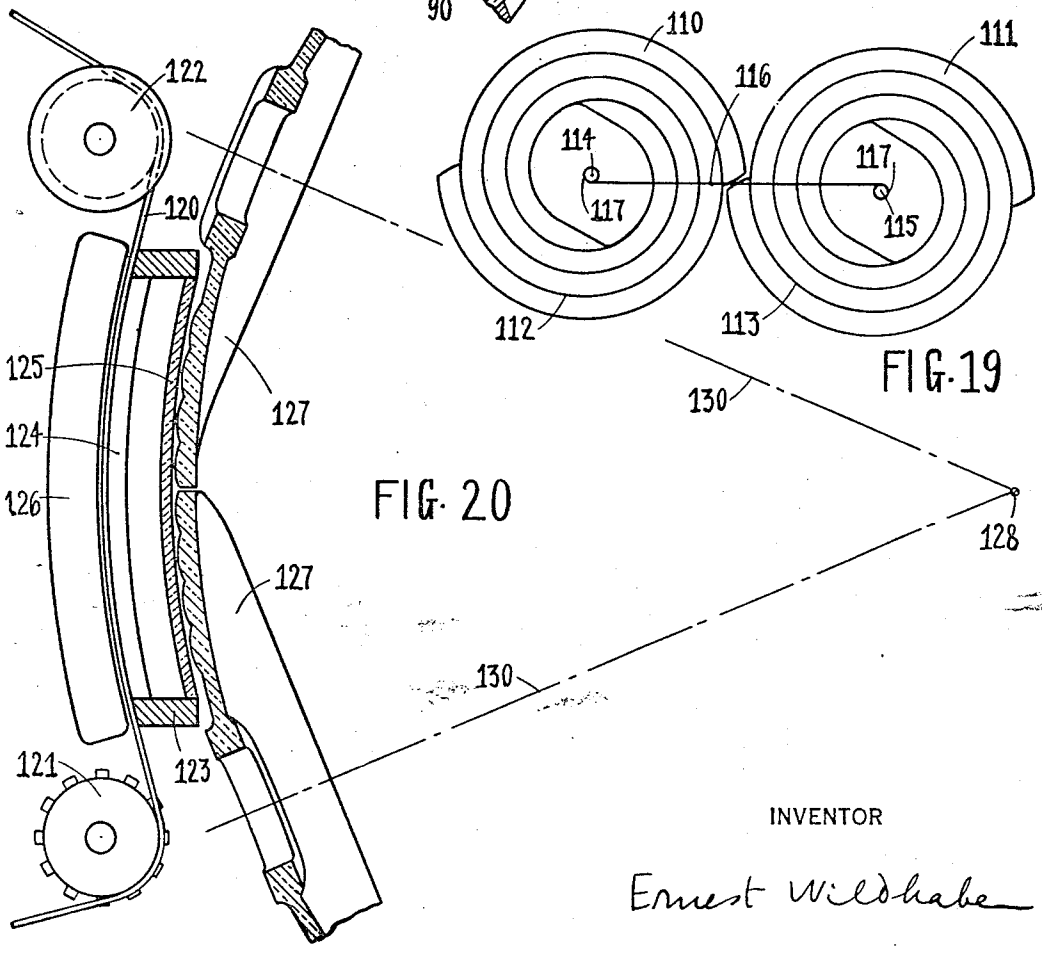


FIG. 20

FIG. 19

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Patented Nov. 14, 1933 1,935,219

UNITED STATES PATENT OFFICE

1,935,219

METHOD OF AND MEANS FOR PROJECTING PICTURES

Ernest Wildhaber, Brooklyn, N. Y.

Application July 5, 1928. Serial No. 290,625

17 Claims. (Cl. 88—16.8)

The present invention relates to methods of and means for projecting pictures, and particularly to methods and means for projecting pictures from a continuously moving strip or film.

One object of the present invention is to provide a novel method of forming stationary images of pictures disposed on a continuously moving strip or film, whereby a rotary member of novel and simple structure is used to compensate the motion of the picture strip. A further object is to provide a method of projecting stationary pictures from a strip disposed on a rotating drum.

A still other aim is to provide a rotary disk for accomplishing the aim specified, said disk containing refractory portions of constant and curved profile.

Another object is to provide an improved method of projecting pictures by forming direct or real images so as to prevent waste of light through the diffusing action of a conventional screen.

A further main object is to provide a novel and efficient method of projecting a plurality of pictures simultaneously, in such manner, that the different pictures simultaneously projected may be seen from different, nonoverlapping areas, and that each picture may be successively seen from a single area. Projection of this character makes it possible to effect vision in full relief, that is to say with full stereoscopic sensation, as will be further explained hereafter. In this connection the method according to the present invention can be considered as an improvement of my "Method of projecting pictures", filed June 23, 1927, Serial No. 200,894, by providing a continuous film motion in methods of the said character.

A still other important aim is to provide a method of simultaneously projecting a plurality of pictures adjacent an object suited to diffuse light substantially in one direction only, in such manner that said pictures may be seen from a series of different vertical zones, and that said zones are continuously moved in one direction, while the picture film also moves continuously.

Further objects will appear in the course of the specification and from recital of the appended claims.

Some embodiments of the present invention are illustrated in the accompanying drawings, in which

Fig. 1 is a sectional view of a device diagrammatically indicating an embodiment of the present invention which contains a single refractory disk of novel structure.

Fig. 2 is an end view of said disk and of a stationary cylindrical lens cooperating therewith.

Fig. 3 is a plan view, partly in section, of the rotary disk and stationary lens indicated in the Figures 1 and 2, the view being taken downwardly from the top of Fig. 2, see 3—3 of Fig. 2.

Fig. 4 is a partial plan view similar to Fig. 3, illustrative of a slight modification.

Fig. 5 is an end view of a refractory disk of modified structure, as compared with the disk shown in the Figures 1 to 3.

Fig. 6 is an end view of a pair of rotary disks constructed and used in accordance with the present invention. The said disks overlap each other and cooperate with each other.

Fig. 7 is a section along lines 7—7 of Fig. 8, illustrative of an embodiment of the present invention, in which a film is directly projected from a continuously rotating drum.

Fig. 8 is a view and a section corresponding to Fig. 7, the view being taken along central plane 8—8 of Fig. 7.

Fig. 9 is a diagram illustrating an operating principle in projecting pictures from a moving film.

Fig. 10 is a diagrammatic plan view, partly a section, illustrative of a device for simultaneously projecting a plurality of pictures in accordance with the present invention.

Fig. 11 is a front view of the rotary disks indicated in Fig. 10 and of a stationary lens, illustrative of the operation of the optical means provided.

Fig. 12 is a side view corresponding to Fig. 11 and Fig. 10, and partly a section along lines 12—12 of Fig. 10.

Fig. 13 is a partial end view of a member for preventing interference of adjacent pictures, as indicated at 82 in Fig. 10, the view being taken in the direction of the axis of rotation.

Fig. 14 is an axial section of a modified device for simultaneously projecting a plurality of pictures, in accordance with the present invention.

Fig. 15 is a section along lines 15—15 of Fig. 14.

Fig. 16 and Fig. 17 are partial front views corresponding to Fig. 14, illustrative of two slightly modified structures.

Fig. 18 is a diagram illustrative of a novel source of light and of adjacent parts, such as may be used in simultaneously projecting a plurality of pictures in accordance with the present invention.

Fig. 19 is an end view of a pair of cooperating refractory disks, as may be used in accordance

with the present invention for simultaneously projecting a plurality of pictures.

Fig. 20 is a plan view, partly a section, of a modified arrangement for simultaneously projecting a plurality of pictures.

Fig. 10A is an assembly view, indicating the device shown in Fig. 10 in cooperation with screen means of preferred character.

Fig. 21 and Fig. 22 are a front view and a side view of the screen means also shown in Fig. 10A, the screen means being shown partly in section in Fig. 22.

Referring particularly to Fig. 1, Fig. 2 and Fig. 3, the numeral 11 denotes a transparent film, or broadly a picture strip, which is continuously fed past a suitable aperture 12 by means of a toothed roll 13. The latter contains teeth 14 which engage with holes provided in the film. The film is introduced in direction 15, passes over guiding roll 16 and aforesaid roll 13, and leaves in direction 17. Aperture 12 contains a suitable recess for guiding the film.

A source of light 18 is provided back of and adjacent film 11, and is diagrammatically indicated as an arc light. A concave mirror 20 is disposed back of the lens, to throw the light forward and to concentrate it to aperture 12. It is of course understood that in place of mirror 20 or with it a conventional system of lenses may be provided.

A general principle for effecting a stationary image of a picture of a moving film or strip is already known and will now be briefly stated with reference to Fig. 9. The image 21 formed by a lens 22 of a picture 23 remains in its position (21) without change, when not alone film 11 moves in a manner to displace picture 23 to position 23', but also lens 22 moves to a position 22'. The path of the film and the path covered during the same time by lens 22 are proportional to the respective distances from image 21, as known.

According to the present invention a spherical lens is dissolved or decomposed into a cylindrical lens 25 (Fig. 1) extending in the direction of motion of the film, and into another cylindrical lens whose straight generatrices are disposed at right angles to lens 25 in direction of line 26, Fig. 2. The superposition of two cylindrical lenses of equal radii, extending in directions at right angles to each other, is known to be equivalent, or practically equivalent, to a spherical lens.

Motion of lens 22 of Fig. 9 can be represented or enacted by moving alone the latter cylindrical lens, while maintaining lens 25 stationary. Such motion could be effected by moving said lens along the central line 27 of lens 25 (see Fig. 2) while maintaining the direction of said moving lens continuously at right angles to line 27. This can be embodied in a simple mechanical manner as follows:

A lens equivalent to the moving cylindrical lens is wrapped along a spiral on the plane face of a refractory disk 28. Preferably the said spiral is made an involute 30, having a base circle 31 tangent to a central line 27. It is well known that an involute (30) has a constant pitch along any tangent (27) to its base circle, and that it intersects such tangents always at right angles. Line 26 is therefore a tangent to said involute. As disk 28 turns on its axis 32, central line 30 intersects central line 27 in a point 33, which moves along line 27 at a constant rate, while central line 30 remains continuously perpendicular to line 27. The rate of travel of said intersection point (33) per revolution of disk 28 equals the circumference of base circle 31, as well known. This amount should equal the rate of travel of spherical lens 22 of Fig. 9, that is to say it should be in such proportion to the corresponding displacement of the film, as the distances of the lens and of the film from the image produced are to each other. The profile of spiral lens 30', in a section tangent to base circle 31, is made equal to the profile of the equivalent cylindrical lens, namely a circular arc 34 having a center 34', see Fig. 3. In the instance illustrated the displacement of the film per revolution of disk 28 equals the distance or pitch of adjacent pictures, and base circle 31 is therefore so chosen that its circumference is slightly smaller than said pitch, in proportion to the above said distances.

The curvature of a cylindrical lens 25 and spiral lens 30' may be computed with the known means of the art, and is substantially equivalent to the curvature of a corresponding plane-spherical lens.

Although center line 30 of the spiral lens differs from tangent 26, the two lines deviate from each other in a direction contained in the tangential plane at point 33, and for this reason it is found that the said departure is practically meaningless. In other words within the area considered the spiral lens (30') is suited to fully replace the aforesaid cylindrical lens having a direction 26.

Preferably the spiral lens is not used on its entire width, but only on part of it, namely on parts adjacent center line 30. The remainder of the width is then made opaque, for instance by covering it with an adhesive and nontransparent color. The other parts of disk 28 are also made opaque.

Lens 25 may also be screened down, that is to say the active width of the lens may be reduced as described with reference to spiral lens 30'.

In the embodiment illustrated in Fig. 2, the involute does not cover a full revolution. In this instance picture reproduction ceases an instant between projection of adjacent pictures, as the spiral lens terminates at 35 and at 36. It is however also well possible and frequently preferable to provide an overlapping involute, for instance by letting it continue along dotted lines 37, to an end 36'. In such case two adjacent pictures will be simultaneously projected during a very short instant. The short duration of projection is not sufficient to create any blurs, and contains the advantage that light is continuously projected to the screen or to whatever object the pictures are projected to.

Disk 28 is provided with a hub 39, with which it may be rigidly secured to a cylindrical projection 40 of shaft 32. The latter is journalled in bearings 42 of which one only is shown.

Axis 32 (see Fig. 2) is offset from the elongated longitudinal center line of the projected pictures by an amount smaller than the width of said pictures. The center line of the pictures coincides with line 27, Fig. 2. Moreover axis 32 is offset from central plane 38, Fig. 1, which is perpendicular to the direction of motion of film 11.

Disk 28 is rotated in direction of arrow 43, while toothed wheel 13 is turned in timed relation to the rotation of said disk. Operative connections to turn two shafts in timed relation to each other are well known and are omitted in the drawings.

Cylindrical lens 25 could of course also be disposed on the inside of disk 28, if so desired, or cylindrical lenses 25' may be disposed on the outside and on the inside of disk 28. This is dia-

grammatically illustrated in Fig. 4, where a portion only of disk 28 is indicated.

Furthermore systems of other lenses may be provided in addition, if so desired. It is understood that explanation is here confined to the simplest embodiments of the present invention, where its novel nature is most evident and undiluted.

Fig. 5 illustrates a disk 45 containing multiple spirals 46, which are preferably made involutes. Again the profile of the glass portion, or broadly of the optical means, is constant along lines tangent to base circle 47, and is moreover a circular arc having its center also on an involute.

When multiple spirals 46 are provided, the speed of rotation of the disk may be reduced as many times as there are individual spirals. A reduction in speed is sometimes advantageous, especially when the disk provided has a large diameter, inasmuch as it reduces centrifugal stress.

Overlapping disks 48, 48', see Fig. 6, may in some cases be provided to counterbalance the curvature of the spirals. As the spirals 49 of disk 48 are curved oppositely as compared with the spirals 50 of disk 48', the combination of the two disks substitutes still more closely a cylindrical lens with straight central line, than a single disk can. Such refinement and complication may be considered in large embodiments of the invention.

Fig. 7 and Fig. 8 indicate an embodiment, in which a film 52 is directly projected from a cylindrical drum 53, which is then preferably made of larger diameter. If so desired, correction for the cylindrical curvature of the drum may be provided, and may be computed with the known methods of the art. Such correction is required especially when the diameter of drum 53 is small. When drum 53 is of large diameter, the same optical means may be used as indicated in the embodiment shown in the Figures 1 to 3. They are therefore omitted in Fig. 7 and Fig. 8.

Drum 53 consists of two cup portions 54, 55 rigidly secured to a shaft 56. On the outside the cup portions are separated by a slot 57 having a width equal to the active height of the pictures of film 52. The cup portions are further provided with teeth 59 which engage with customary holes contained on the sides of film 52.

A source of light 60, diagrammatically indicated as an arc light, throws much of its light to the spherical surface of a stationary mirror 61, which is held in place by means of a projection 62 which reaches through slot 57. Mirror 61 throws light to the portion of film 52 which is being projected, in a manner that light is emitted from the transparent portions of the pictures.

Shaft 56 is journalled in bearings 63 and is rotated in timed relation to the rotation of the optical means previously described and omitted in Fig. 7 and Fig. 8.

After having thus described some of the embodiments of the present invention operating along lines somewhat similar to known art, namely which substitute intermittent motion of the film by continuous motion and which provide rotary means for effecting the necessary adjustment, other important embodiments will now be described, in which further and radical departures from established practice are made.

One preferred application of the present invention is to simultaneous projection of a plurality of pictures.

Reference is made to Fig. 10, Fig. 11 and Fig. 12, in which the numeral 65 denotes a film or picture strip, which is fed at a constant rate by means of a toothed roll 66. The film passes first over guiding roll 67, and then past a long aperture 68 to roll 66. Film 65 contains pictures preferably disposed in such manner, that lines to be reproduced as vertical lines extend perpendicular to the lengthwise direction of the film. This differs from the arrangement of the pictures on a conventional film. On film 65 persons which stand upright are pictured in a direction perpendicular to the length of the film, whereas on conventional films upright persons are pictured in a direction lengthwise of the film.

Back of aperture 68 and enclosed in a casing 69 a source of light is disposed, which consists of a gas filled tube extending along the whole length of aperture 68 and reaching preferably over the length of said aperture. The gas contained in tube 70 may be of any character suited to emit uniform light when electric current is sent through it. Frequently the gas is maintained under less than atmospheric pressure, as well known. Two wires 71 serve to convey electric current to tube 70. As the construction of lights or tubes of this character is known, the electrodes and other details are omitted in the drawings.

When a plurality of pictures are simultaneously projected, in a manner that they may be seen from different areas, it is important to emit light in the same various directions from every point of a picture, and for this reason a source of uniform light as the one indicated is much more desirable, than when projecting pictures to a screen in conventional manner.

The optical means used in the illustrated embodiment for effecting stationary images of a plurality of pictures disposed on a moving strip follow the same general principle as those of the embodiment described with reference to Figures 1 to 3, with such changes and adaptations as will be presently explained.

Two rotary disks 72, 73 are disposed in front of film 65, overlapping each other. They consist of glass or of other suitable refractory material and contain what might be called spiral lenses 74, 75. In the embodiment shown the lenses 74, 75 are disposed along double spirals, and more specifically along double involutes, having base circles 76. The lenses 74, 75 are formed integral with the disks 72, 73 and contain a constant and circular profile in any plane tangent to a base circle 76. The center line constituted by the centers of the circular profiles of said various planes is also an involute, as is readily understood by those familiar with mathematics.

Joint tangent 77 to both base circles 76 is disposed on the level of the center line of the film. The two disks are rotated at equal angular speed and in the same direction of revolution, as if a band wrapped around one of the base circles or base cylinders 76 and extending along tangent 77 would have to be wrapped to the other base cylinder.

The action of either disk 72, 73 and also the combined action of both is to substitute a plurality of cylindrical lenses which extend parallel to the plane of film 65, and whose generatrices are perpendicular to tangent 77. The motion of said lenses along tangent 77 is represented or reproduced by rotating said disks 72, 73 on their axes 78.

A stationary cylindrical lens 80 is disposed intermediate the disks 72, 73 and extends in a

direction parallel to the portion of film 65 which is projected. Its center line is projected into line 77, Fig. 11. The said cylindrical lens 80, and the cylindrical lenses represented by the disks 72, 73, replace together a plurality of spherical lenses moving along line 77, that is to say in the direction of the film motion.

Proportions are so chosen, that the motion of said imaginary spherical lenses is slightly smaller than the corresponding motion of film 65, to effect stationary images, as explained with reference to the diagram Fig. 9. In other words the pitch of the involutes 81 is slightly smaller than the pitch of the pictures of film 65.

Disks 72, 73 are rotated on their axes 78 in timed relation to the rotation of roll 66.

Disks 72, 73 contain spirals or involutes 81 covering such an area as to simultaneously represent a plurality of cylindrical lenses, whereas in the previously described embodiments a single cylindrical lens was represented by the rotary disks. The individual involutes 81 are seen to continue through a plurality or revolutions.

Preferably the spiral lenses are made opaque on part of their width, as described also with respect to previous embodiments. Only the central part of the width of the individual arcs are then utilized. Likewise the transparent portion of stationary cylindrical lens 80 may be suitably reduced and confined to the central part of the arc profile. Such procedure permits to obtain accurate and clear images without the use of expensive lens systems, which would correct for increasing errors obtained from points increasingly distant from the central point of a composite lens. Such correction is however also possible in the present case and may be provided especially on large and expensive embodiments. It is governed by the same principles as the correction of spherical lens systems.

To avoid interference between adjacent pictures, a member 82 is rigidly connected with disk 72 and its shaft 78. Member 82 consists of metal or of a material which is either naturally opaque or made opaque through covering its surface. It contains projections or walls 83 following the spirals 81 of disk 72, in a manner to separate adjacent portions of the spiral lenses. A partial end view of member 82 is afforded by Fig. 13. It contains radial ribs 84, which reinforce the spiral projections 83 and maintain them in place. As member 82 and disk 72 rotate at a fast rate, the said ribs do not create a perceptible disturbance.

Member 82 prevents sidewise interference between the individual projected pictures. Stationary walls or opaque screens 85 are further provided, see Fig. 12, to prevent outside interference and diffusion. In Fig. 12 the rotary members are diagrammatically indicated in view, omitting their shafts.

A plurality of pictures are simultaneously projected in such manner as to form images on the same area or substantially the same area. This is obtained in the manner described, by continuing projection of each individual picture much longer than in the embodiment described with reference to Fig. 1, namely during a path which is a multiple of the pitch of the pictures on their film. The path of projection exceeds the said pitch as many times, as there are simultaneously projected pictures.

The images of the simultaneously projected pictures are not formed on a screen of conventional character, which would result in blurs and confusion, but on or adjacent means suited to make the different images visible from different nonoverlapping places or areas. Such means will now be briefly described. A detailed description of such means is given in my copending application entitled: "Method of and means for projecting pictures", filed on even date herewith, namely on July 5, 1928, Serial No. 290,626.

Let it be supposed that a picture is projected with a lens and through a certain small opening adapted to and adjacent said lens, so that an image is formed on a large other lens, for instance on a lens of the general form of lens 86, Fig. 14. Inasmuch as said image is formed on said large lens itself, it is practically not altered by said lens, but remains at the same place and size as if said large lens were not existing.

All the rays forming the image on said large lens pass through the aforesaid small opening, and these rays will be so modified or deflected through the large lens, that they again pass through a comparatively small area, namely through the area which constitutes the image of said opening as formed by the large lens. The complete image of the projected picture can be seen from every point of said area, and from points in front and from points back of said area, but from no place outside of it.

Inasmuch as pictures simultaneously projected to said large lens are projected through different openings, the said pictures are visible from different areas, which correspond to the images of said openings as formed by the large lens referred to.

Preferably the area of visibility is artificially enlarged in vertical direction, by providing a large lens (86) having a certain wavy surface 86′ on one side. The waves of said surface extend along parallel or substantially parallel horizontal lines and are suited to diffuse the light rays in one direction only, or substantially in one direction, so that the images of said apertures are vertically enlarged. This feature is pointed out with full detail in my companion application referred to. If so desired, slight diffusion may also be provided in horizontal direction, but preferably not so much that the areas of visibility overlap. In any case the surface of the large lens is so altered in its minute configuration, that diffusion takes place more in one direction than in another, while the general shape remains unchanged.

What has been said about lens 86 also holds true in principle for concave mirrors, whose surface may also be so altered that diffusion takes place in one direction, for increasing the height of the zones of visibility of the projected pictures.

In either case the zones of visibility may be made nonoverlapping vertical strips, which move from one side to the other in correspondence with the motion of the film.

This manner of projection not only operates with a minimum of loss of light, but also permits stereoscopic vision with full relief, namely if the film has been made for that purpose. This again is fully described in my companion application.

In the embodiment illustrated in Fig. 10A, pictures disposed on strip 65 are projected to a concave and reflective screen 132 by a projection device of the character described with reference to Fig. 10. Screen 132, which is separately shown in Fig. 21 and Fig. 22, contains minute surface waves (133) which extend in one general direction, and which like waves 86′ of lens 86, Fig. 14, provide diffusion only in one

direction. Waves 133 are optically smooth and fully reflective in their lengthwise direction and do not provide diffusion in that direction.

Fig. 14 and Fig. 15 illustrate another embodiment of the present invention. A film 87 is fed to a wheel 88 mounted on a vertical axis 89, and containing teeth 90, which engage holes of film 87. Wheel 88 contains suitable apertures through which light may be projected to film 87. Segmental tube 91 constitutes a source of light of the character described with reference to Fig. 10 and Fig. 12, and is disposed on a stationary base 92. It occupies the part of the circumference on which picture projection is effected. A further wheel 93 is loosely mounted on shaft 89 and contains lenses 94 for projecting pictures to a large lens 86, which has already been referred to. Lenses 94 consist of segments, which are best seen in Fig. 15. On the outside, said segments contain cylindrical portions 94' having a circular profile, and straight line elements extending parallel to axis 89. The inside is formed by a surface of revolution coaxial with axis 86 and having a circular profile 94'' in axial section which is substantially equal to the circular profile of portions 94'. The superposition of said outside and inside surfaces results in equivalents of individual spherical lenses, as is readily understood.

The lenses thus obtained are moved in timed relation to the motion of wheel 88 which contains the film, the relation between the motion of the film and of the lenses being the same as previously described. To effect such motion, the two wheels 88, 93 are rotated at slightly differing ratios by means of pinions 95 meshing with gears 96, 97 connected with the wheels 88, 93. A dark screen 98 (Fig. 15) prevents extreme diffusion. In the embodiment illustrated interference between adjacent pictures is not directly prevented: The various pictures are projected exactly to the same area, inside of which no interference takes place. Outside of said area dark surfaces may be provided for absorbing stray rays, that is to say interference rays.

In the Figures 16 and 17 two slightly modified forms of apertures are shown, which are disposed in front of the lenses 94, namely a rectangular form 99 and a circular form 100. In the embodiment referred to in the Figures 14 and 15, the latter form is slightly preferred.

Fig. 18 illustrates a modified source of uniform light, which permits to concentrate light to small apertures 102 provided adjacent the lenses 103 and 104, the latter being a rotary lens of the type described. A stationary member 105 contains a recess serving as a guidance for a film 106. The source of light consists of an incandescent tube 107 of small diameter, which is suited to emit light uniformly from its surface when electric current is made to pass through it. It is enclosed in a glass tube of cylindrical form and of changing curvature in the shown section perpendicular to tube 107. On portion 108 the inside surface 109 is covered with a layer of reflecting material, so as to constitute a cylindrical mirror. The radius of curvature of surface 109 and its distance from tube 107 is so assumed, that an image 107' of tube 107 is formed by surface 109 adjacent aperture 102. As a large portion of the light passes through said image 107', much of it also passes through aperture 102.

Fig. 19 illustrates two nonoverlapping disks 110, 111, which contain lenses extending along involutes 112, 113 and which are rotatable on parallel axes 114, 115. The said axes are disposed on either side of line 116, which is tangent to either base circle 117. The two disks are rotated in opposite directions of revolution at a ratio of one to one. The film is fed in the direction of tangent 116 in the manner already described. Cooperating, nonoverlapping disks 110, 111 may be provided especially on small embodiments of my invention, for simultaneously projecting a plurality of pictures.

The characteristics of the involute curve which are made use of in the present invention are not confined to the use of straight lines 116 and to a straight path of the film, but also exist when the path of the film is circular. An application of this character will now be briefly explained with reference to Fig. 20.

A film 120 is fed by toothed wheel 121 over guiding roll 122 and circular guidance 123, which contains an aperture 124. A substantially cylindrical lens 125 is disposed in front of aperture 124 and extends in the direction of the motion of film 120. Lens 125 has a constant cross section containing a circular arc profile. A source of light 126 is disposed back of the film.

Two rotary disks 127 are provided, which in general are analogous to the disks 110, 111 referred to in Fig. 19, and which contain lenses extending along involutes. The involutes are in this instance however spherical involutes, such as may be described by a point of a plane which is unwrapped from a base cone. The axis 130 of said base cone is made the axis of rotation of a disk 127, and intersects the center 128 of the circular path 123 of film 120. The axes 130 are inclined from opposite sides to the plane of the drawings, that is to say to the medium plane of circular guidance 123.

The qualities of spherical involutes are sufficiently known, and are known to be analogous to the qualities of the plane involutes, so that further explanation is unnecessary.

Numerous modilcations may be made in my invention without departing from its spirit, by simply applying the established and customary knowledge of the art. For definition of its scope it is relied on the appended claims.

What I claim is:

1. In a device for projecting pictures, a rotary disk having refractory portions extending along an involute and having a constant arcuate profile in planes at right angles to said involute.

2. The method of projecting pictures, which consists in simultaneously projecting a plurality of pictures from different points to the same area to form overlapping images, in rendering said images simultaneously visible from different zones respectively in a manner that each of said images is visible from only one of said zones at a time, and in continuously displacing said zones of visibility in one direction, so that a picture becomes successively visible from the whole range of said zones.

3. The method of projecting pictures, which consists in simultaneously projecting a plurality of pictures from different points to the same area to form overlapping images, in rendering said images simultaneously visible from different and nonoverlapping zones respectively in a manner that each of said images is visible from only one of said zones at a time, and in continuously displacing said zones of visibility in one direction, so that a picture becomes successively visible from the whole range of said zones.

4. The method of projecting pictures, which

consists in simultaneously forming overlapping images of a plurality of pictures, in rendering said pictures simultaneously visible from different vertical zones respectively in a manner that each of said images is visible from only one of said zones at a time, and in continuously displacing said zones of visibility so that a picture becomes successively visible from the whole range of said zones.

5. In a device for simultaneously projecting a plurality of pictures, a picture carrier, pictures provided on said carrier, a source of light, stationary optical means disposed in the path of light coming from said pictures, a pair of adjacent and nonoverlapping rotary disks mounted on different axes and containing spiral lenses, the spiral lenses of said two disks being disposed to cooperate with different portions of said stationary optical means, means for rotating said disks on their axes, and means for continuously feeding said picture carrier in timed relation with the rotation of said disks.

6. In a device for simultaneously projecting a plurality of pictures, a picture carrier, means for continuously moving said picture carrier, a source of light, means for simultaneously forming stationary overlapping images of a plurality of pictures of said moving picture carrier, and means for concentrating light while avoiding diffusion in at least one plane parallel to the direction of projection, said last named means being disposed adjacent said images, for rendering the simultaneously formed images visible from different zones respectively.

7. In a device for simultaneously projecting a plurality of pictures, a picture strip, means for continuously moving said strip in a substantially horizontal direction, means for simultaneously forming stationary overlapping images of a plurality of pictures of said moving strip, and means for concentrating light while avoiding diffusion in at least one plane parallel to the direction of projection, said last named means being disposed adjacent said images, for rendering the simultaneously formed images visible from different zones respectively.

8. In a device for simultaneously projecting a plurality of pictures to the same area, a picture strip, projection means, means for rendering each of the simultaneously projected pictures visible from a different and single zone, and means for continuously changing the relation between said picture strip and said projection means, for continuously displacing said zones of visibility.

9. In a device for projecting pictures from a continuously moving strip, means for moving a picture strip, a source of light, a stationary lens extending in the general direction of motion of said strip, said lens having a constant profile in planes perpendicular to the motion of said strip, rotary optical means disposed adjacent said lens, said rotary optical means and said stationary lens being suited to represent the equivalent of a plurality of lenses moving in the direction of said strip, and opaque separating walls rotatable in unison with said rotary optical means and extending in the direction of the path of light, for preventing interference between the images of adjacent pictures.

10. In a device for projecting pictures of a continuously moving strip, rotary optical means extending along a spiral and disposed in the path of light coming from said pictures for compensating for the continuous motion of said strip, the axis of said rotary means being offset from the longitudinal center line of said strip an amount smaller than the width of said strip and being so positioned that said spiral is substantially perpendicular to the direction of motion of said strip.

11. A rotary disk having refractive portions extending along a spiral, said spiral having a constant advance along a line offset from the center of rotation of said disk and being substantially perpendicular to said line, said portions having curved profiles in planes perpendicular to said spiral.

12. A rotary disk having refractive portions extending along a spiral, said spiral having a constant advance along a line offset from the center of rotation of said disk and being substantially perpendicular to said line, said portions having curved profiles of constant radius in planes perpendicular to said spiral.

13. A rotary disk having refractive portions extending along an involute of a circle, said portions having convex profiles of constant radius in planes perpendicular to said involute.

14. A rotary disk having a plane general surface and containing refractive portions extending along an involute of a circle, said involute having a plurality of complete turns, and said portions having curved profiles of constant radius in planes perpendicular to said involute.

15. A rotary disk having a spherical general surface and containing refractive portions extending along a spiral, said spiral having a constant advance along a circular arc offset from the center of rotation of said disk and being substantially perpendicular to said circular arc, said portions having curved profiles of constant radius in planes perpendicular to said spiral.

16. The arrangement for projecting pictures, comprising screen means having a reflective surface optically smooth along concave lines extending in one general direction and corrugated in a direction perpendicular to said lines, means for simultaneously projecting a plurality of pictures from different points to form overlapping images on said surface, means for continuously displacing said pictures for projecting a picture successively from said different points, and means for maintaining the projection of said picture on said screen means while said picture is continuously moved.

17. The arrangement for projecting pictures, comprising screen means having a reflective surface optically smooth along concave lines extending in one general direction and corrugated in a direction perpendicular to said lines, means for simultaneously projecting a plurality of pictures from different points to form overlapping images on said surface, said points being displaced relatively to each other in a direction substantially parallel to the general direction of said lines, means for continuously displacing said pictures for projecting a picture successively from said different points, and means for maintaining the projection of said picture on said screen means while said picture is continuously moved.

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