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(54) **GOBO APPARATUS USING A COLLIMATED LIGHT SOURCE**

(71) Applicant: **Avid Labs, LLC**, Fort Wayne, IN (US)

(72) Inventors: **Joel A. Nichols**, Columbia City, IN (US); **Benjamin Powers**, Fort Wayne, IN (US); **Samuel Morrison**, Fort Wayne, IN (US)

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(51) **Int. Cl.**

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F21V 11/00	(2015.01)
F21V 17/00	(2006.01)
F21W 131/406	(2006.01)

(52) **U.S. Cl.**
CPC ***F21V 11/00*** (2013.01); ***F21V 17/002*** (2013.01); *F21W 2131/406* (2013.01)

(58) **Field of Classification Search**
CPC F21V 9/00–35; F21V 11/00; F21V 17/002; F21W 2131/406
See application file for complete search history.

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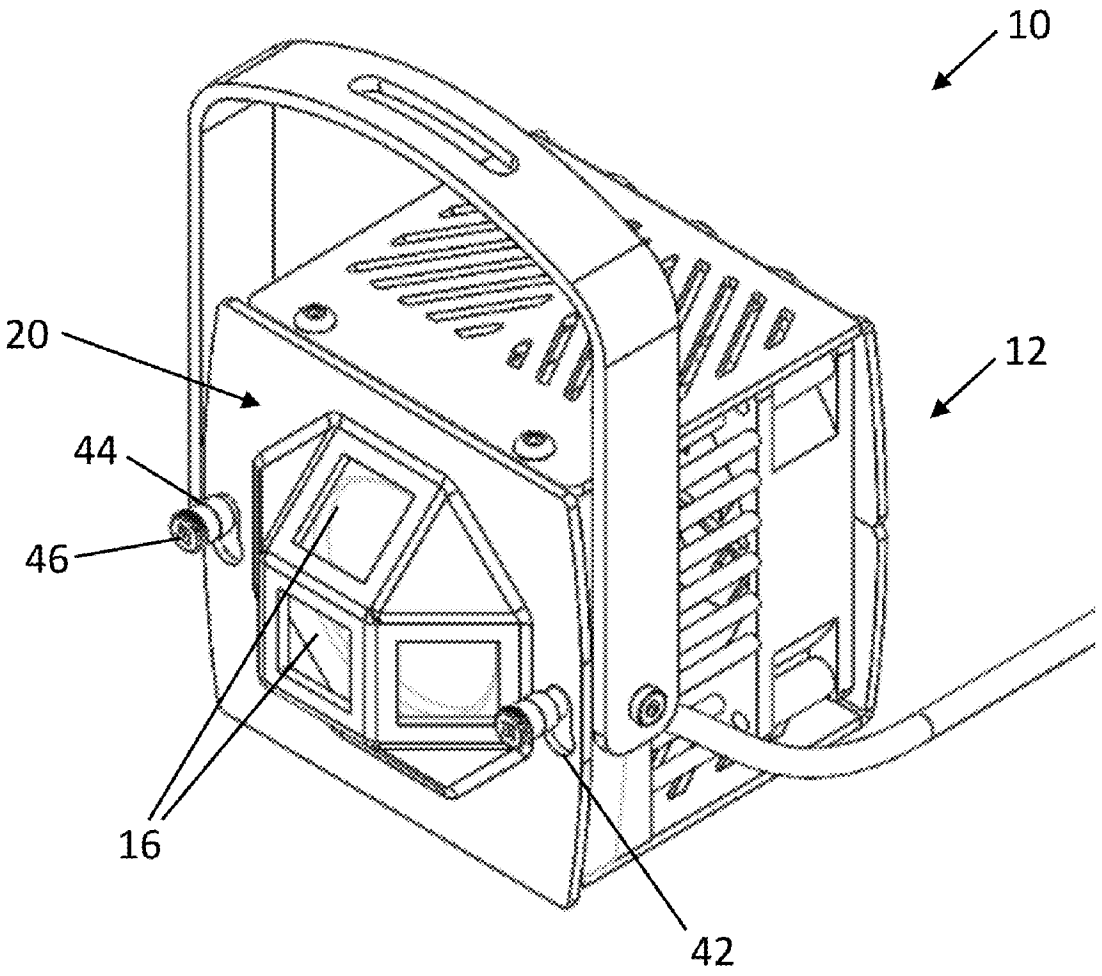
Primary Examiner — Sean P Gramling

(57) **ABSTRACT**

A gobo apparatus including a housing and a collimated light source disposed within the housing. The collimated light source is configured to emit collimated light. The collimated light source defines a light source axis and a light source plane. The gobo apparatus further includes at least one gobo connected to the housing. The at least one gobo is oriented non-perpendicularly to the light source plane.

18 Claims, 8 Drawing Sheets



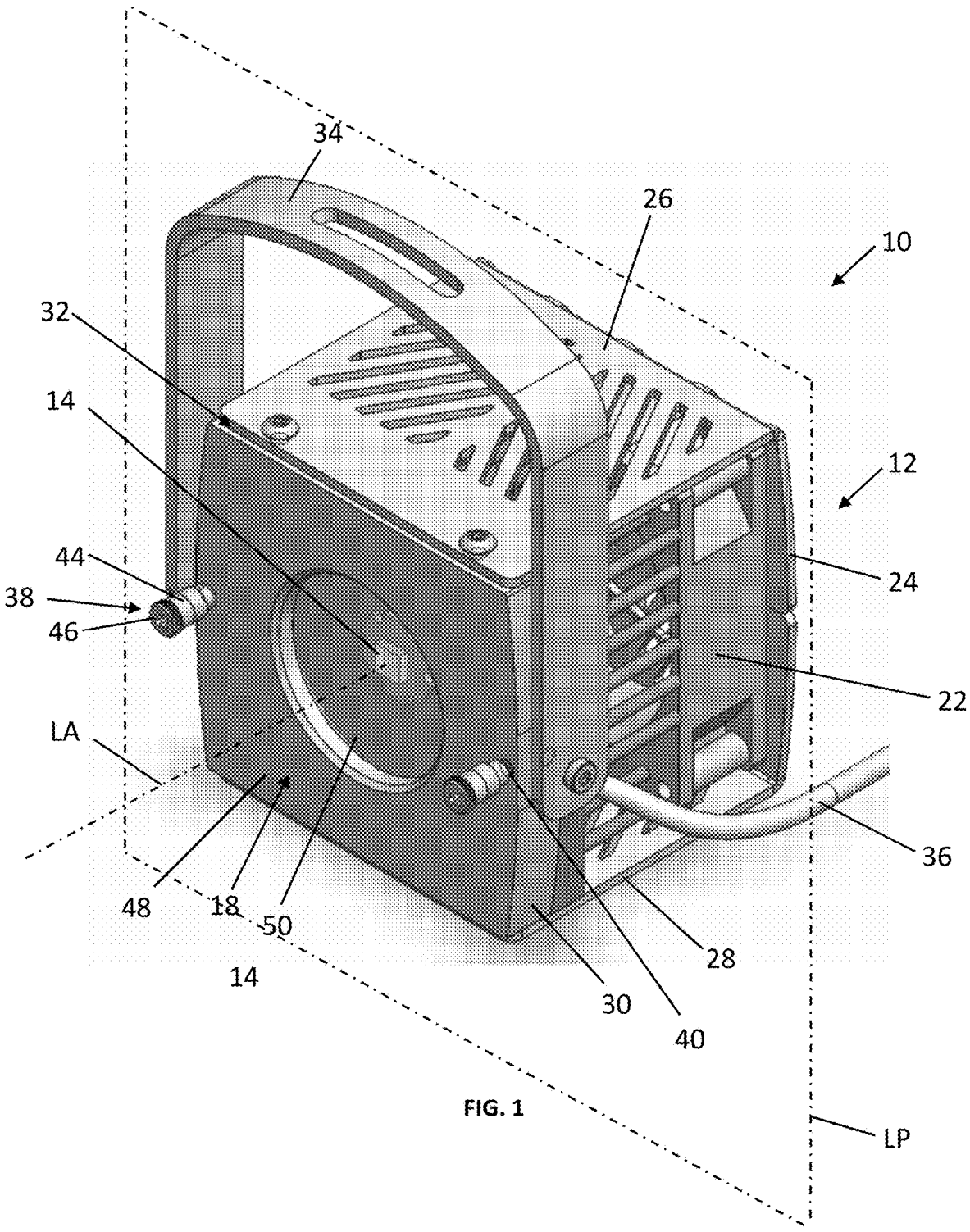


FIG. 1

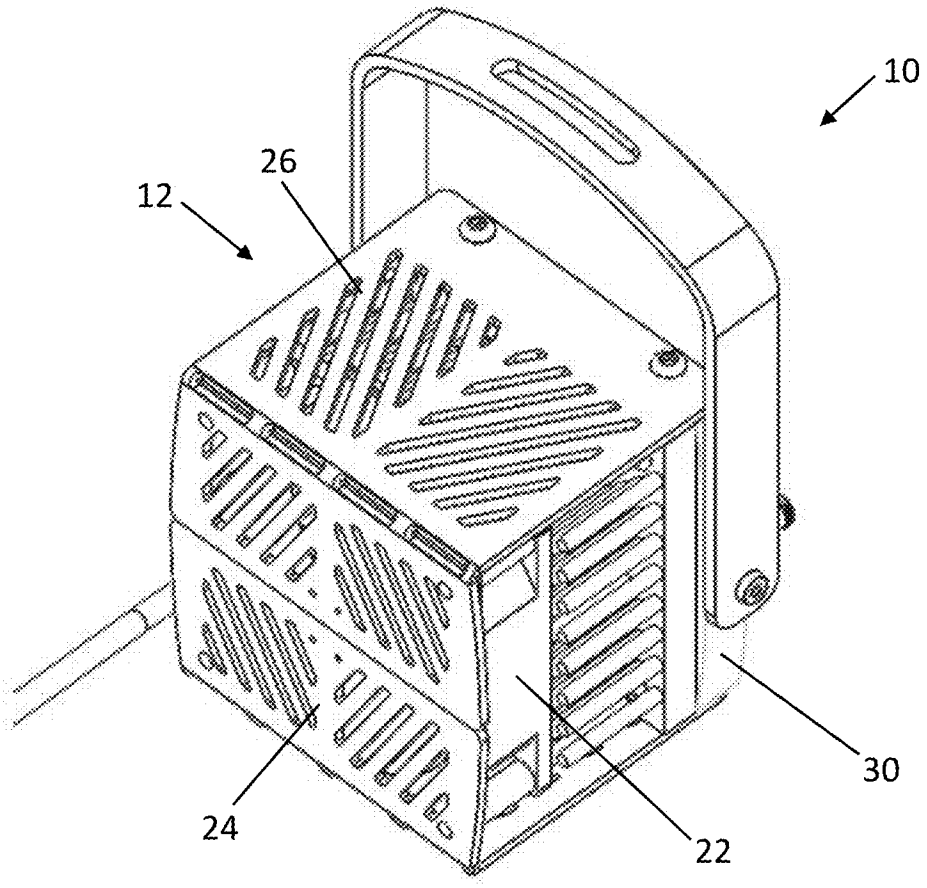


FIG. 2

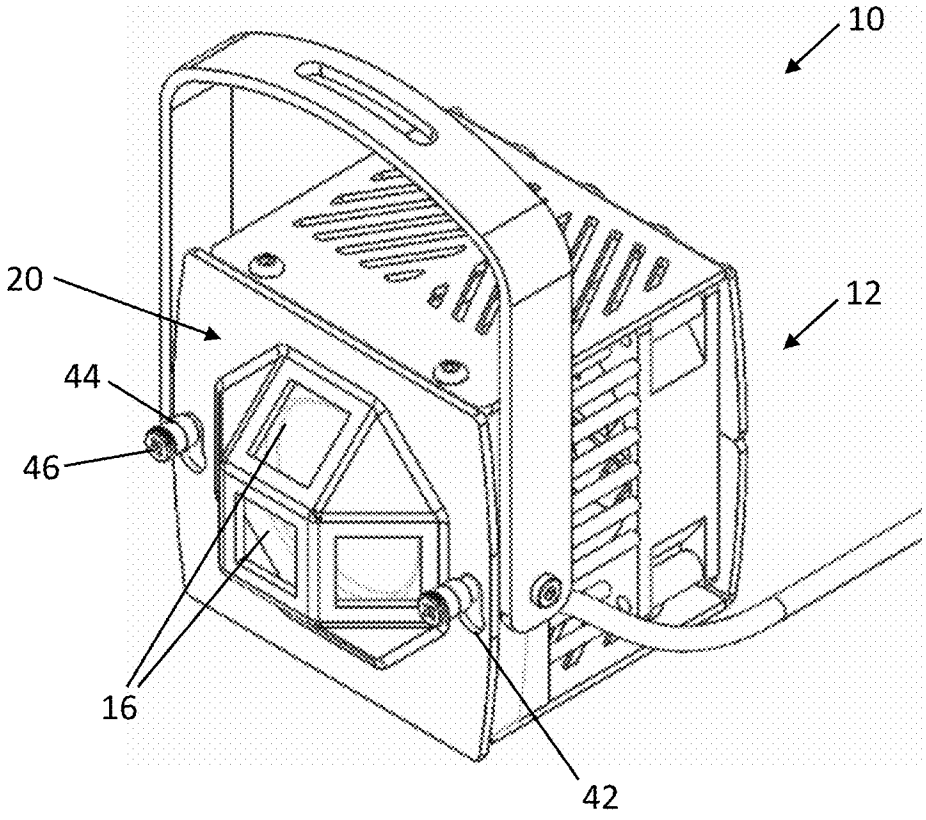


FIG. 3

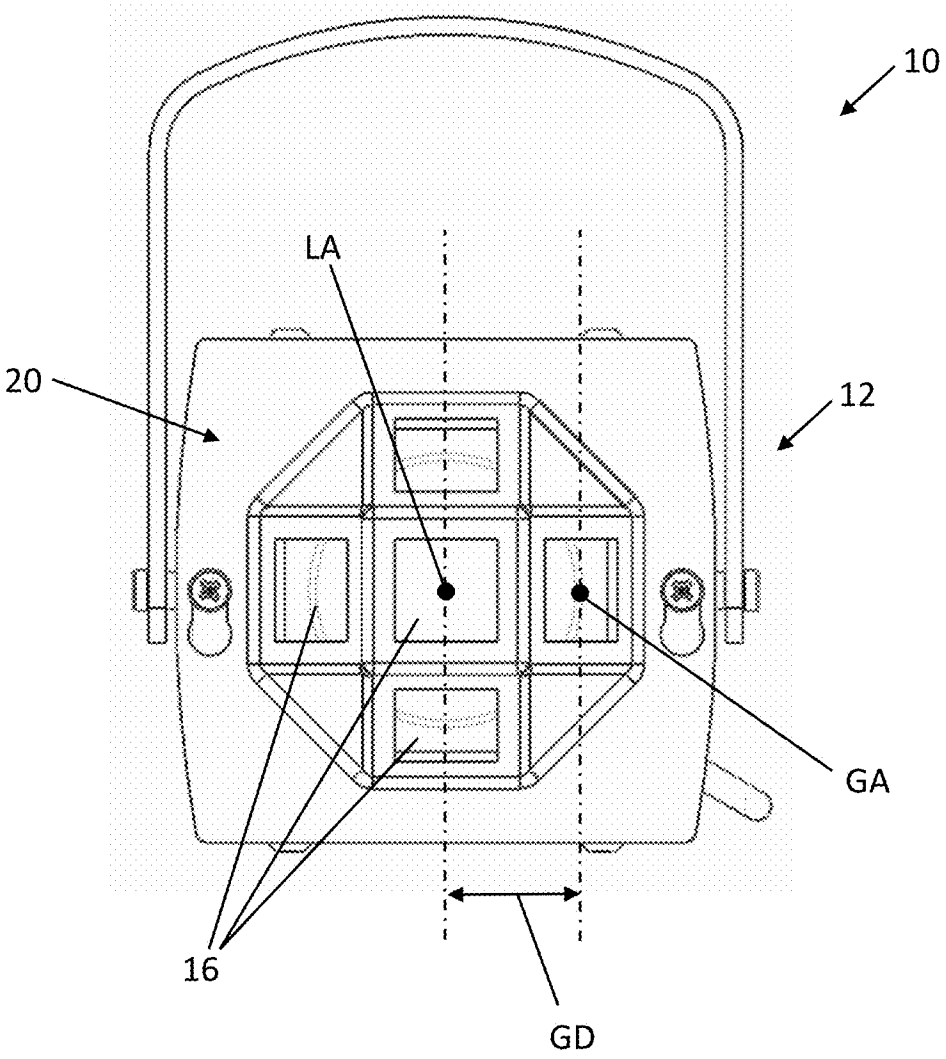


FIG. 4

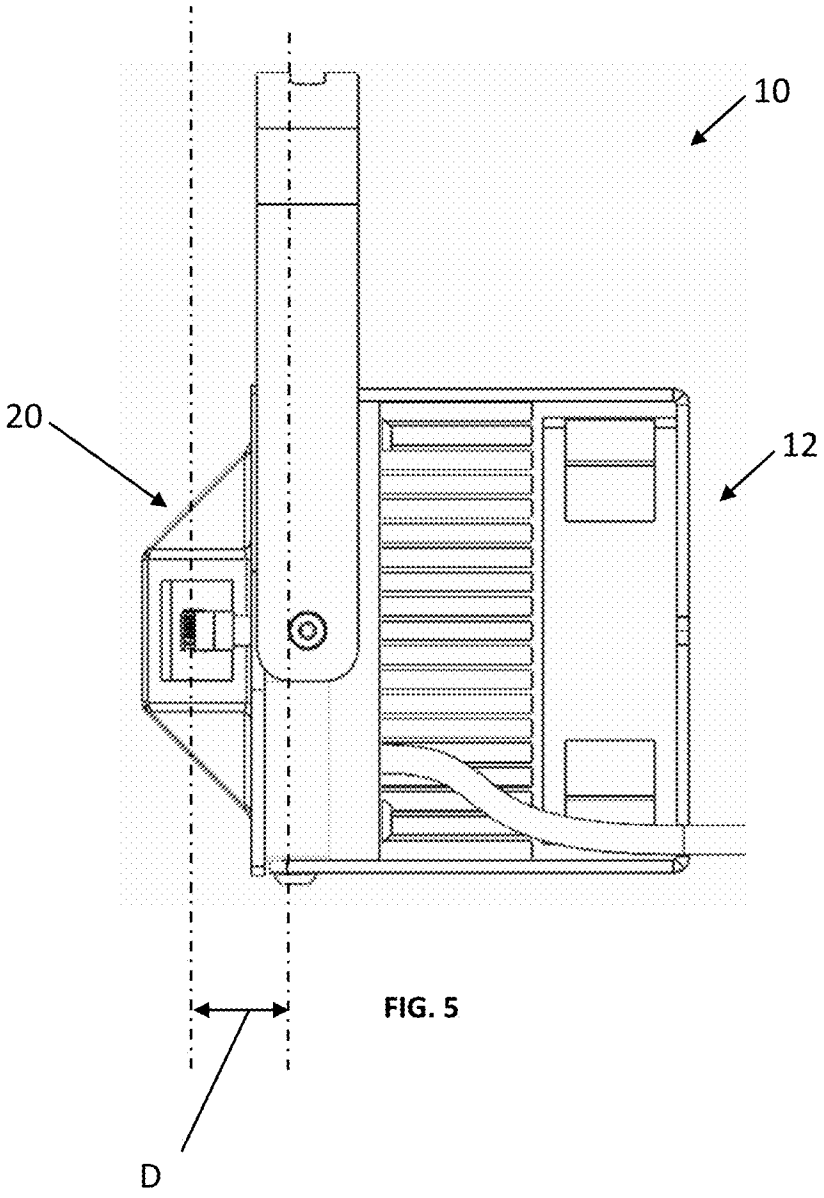


FIG. 5

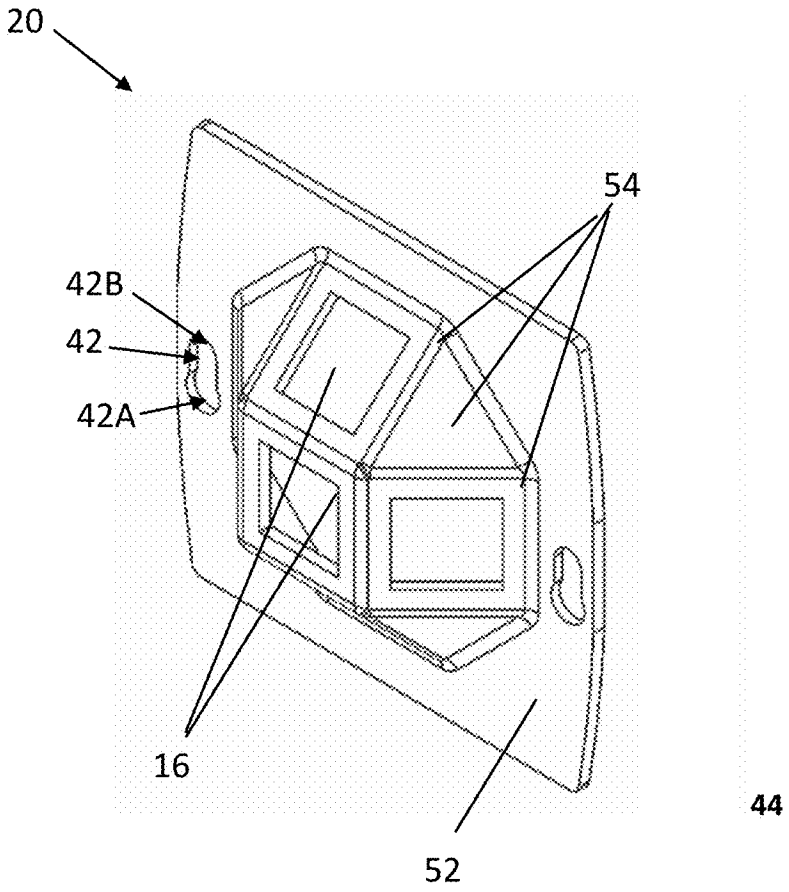


FIG. 6

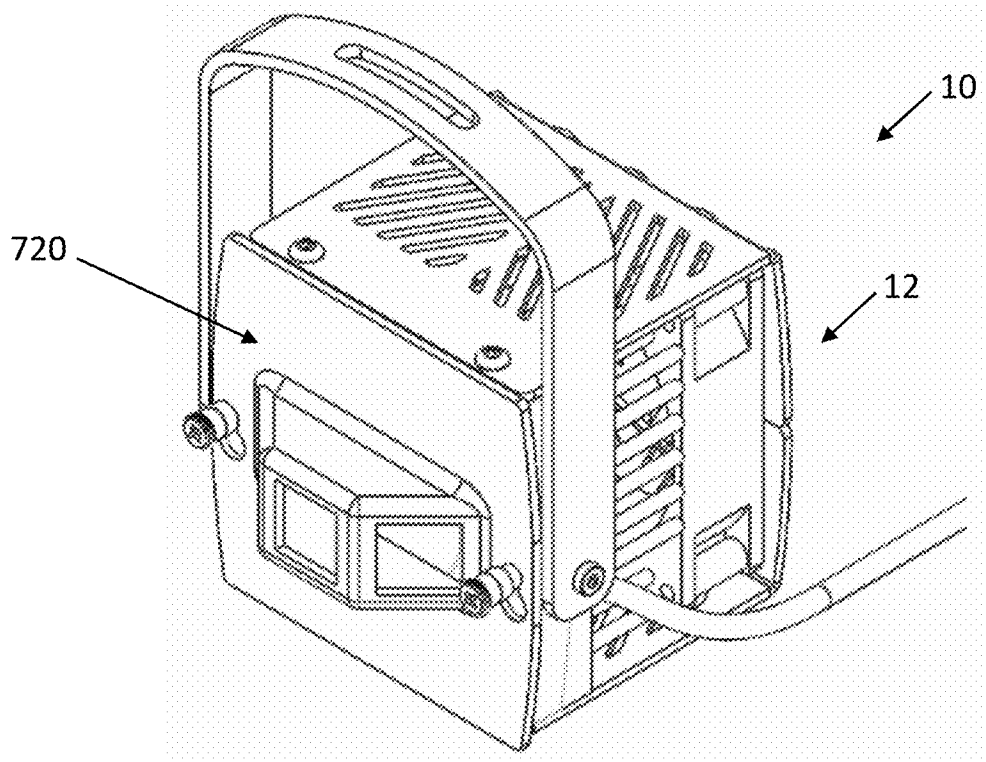


FIG. 7

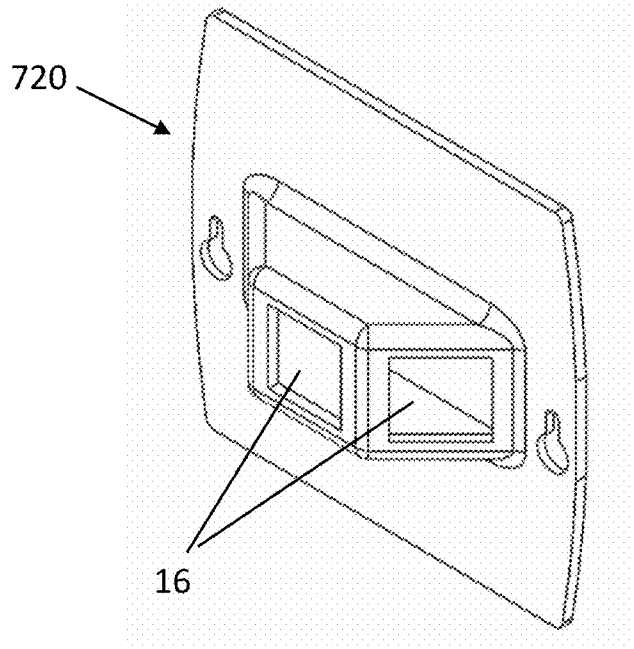


FIG. 8

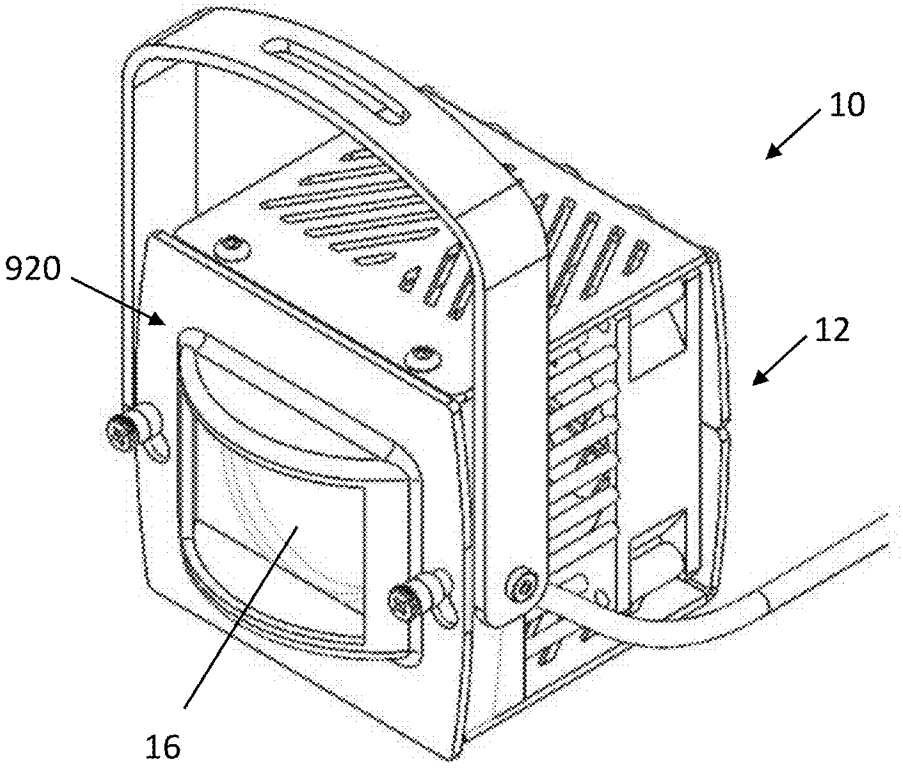


FIG. 9

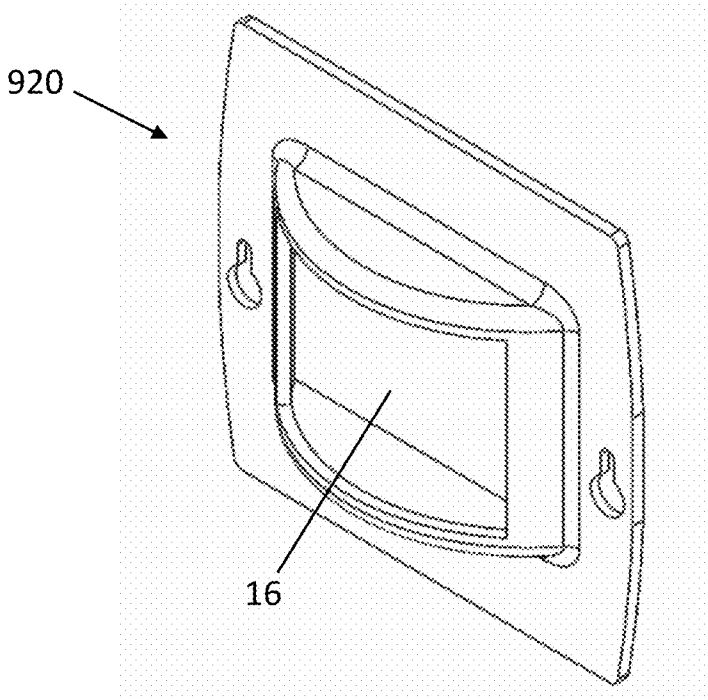


FIG. 10

GOBO APPARATUS USING A COLLIMATED LIGHT SOURCE

FIELD OF INVENTION

This disclosure relates generally to aesthetic lighting equipment. More specifically, it relates to lighting equipment with gobos.

BACKGROUND

A gobo is an object placed inside or in front of a light source to control the shape of the emitted light and its shadow. For studio photography purposes, the term "gobo" has come to refer to any device that casts a shadow, and various pieces of equipment that go in front of a light (such as a gobo arm or gobo body). In theatrical lighting, however, the term more specifically refers to a device placed in 'the gate' or at the 'point of focus' between the light source, called a lamp, and the lenses (or other optics). This placement is important because it allows a pattern with crisp, sharp edges to be projected onto a surface on the stage.

One common issue with using gobos is blurry or unfocused patterns. For example, gobos placed after the optics do not have the option of such fine focus and are more precisely called "flags" or "cookies". In general, refocusing the pattern projected by a gobo can be an arduous or outright impossible task given the constraints of the installation location, the position of the gobo relative to the light source, and/or projection of the light pattern onto a non-planar or angled surface. Hence, it is generally not possible to reposition or repurpose a particular lighting device with a gobo without dedicating a significant amount of time in recalibrating the light source, lenses, and/or gobo to achieve a desired and in focus pattern.

What is needed is improved lighting equipment including a gobo which is easier to install and calibrate.

SUMMARY

According to one embodiment, a gobo apparatus includes a housing and a collimated light source disposed within the housing. The collimated light source is configured to emit collimated light. The collimated light source defines a light source axis and a light source plane. The gobo apparatus further includes at least one gobo connected to the housing. The at least one gobo is oriented non-perpendicularly to the light source plane.

According to another embodiment, a gobo apparatus includes a housing having mounting features and a collimated light source disposed within the housing. The collimated light source is configured to emit collimated light. The collimated light source defines a light source axis and a light source plane. The gobo apparatus further includes an optical device removably connected to the housing by the mounting features. The gobo apparatus further includes a first head and a second head. Each head includes at least one gobo that is oriented non-perpendicularly to the light source plane. The at least one gobo is configured to project a focused pattern when the collimated light passes therethrough. Each head is configured to be removably connected to the housing by the mounting features such that the first and second heads are interchangeable with one another.

According to yet another embodiment, a method includes an initial step of providing a gobo apparatus. The gobo apparatus includes a housing, a collimated light source disposed within the housing and configured to emit collimated light. The collimated light source defines a light source axis and a light source plane. The gobo apparatus further includes a first head and a second head. Each head includes at least one gobo that is oriented non-perpendicularly to the light source plane. The at least one gobo is configured to project a focused pattern when the collimated light passes therethrough. Each head is configured to be removably connected to the housing by the mounting features such that the first and second heads are interchangeable with one another. The method includes a further step of connecting the first head onto the housing. The method includes a further step of removing the first head from the housing. The method further includes a step of connecting the second head onto the housing, wherein the focused pattern of the at least one gobo of the second head is automatically in focus.

DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. **1** is a front perspective view of an embodiment of a gobo apparatus which has a housing and an optical device;

FIG. **2** is a rear perspective view of the gobo apparatus of FIG. **1**;

FIG. **3** is a front perspective view of the gobo apparatus of FIG. **1** with the addition of an interchangeable head, the head includes multiple gobos for projecting respective patterns;

FIG. **4** is a front view of the gobo apparatus of FIG. **3**;

FIG. **5** is a left side view of the gobo apparatus of FIGS. **3-4**;

FIG. **6** is a front perspective view of the head of FIGS. **3-5** in isolation;

FIG. **7** is a front perspective view of another embodiment of a gobo apparatus which has a housing, a collimated light source, and head with multiple gobos;

FIG. **8** is a front perspective view of the head of FIG. **7** in isolation;

FIG. **9** is a front perspective view of another embodiment of a gobo apparatus which has a housing, a collimated light source, and a head with a curved gobo; and

FIG. **10** is a front perspective view of the head of FIG. **9** in isolation.

Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate embodiments of the invention and such exemplification are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION

The following detailed description and appended drawing describe and illustrate various exemplary embodiments of the invention. The description and drawings serve to enable one skilled in the art to make and use the invention, and are not intended to limit the scope of the invention in any manner. In respect of any methods disclosed and illustrated, the steps presented are exemplary in nature, and thus, the order of the steps is not necessary or critical.

As used herein, the term visible light refers to the spectrum of light which the human eye can see without the aid of some device. The term collimated light or collimated

beam of light refers to parallel rays of visible light which minimally spreads as it propagates from the light source. The term focused pattern refers to a single shape or design or a grouping of shapes or designs that are projected using one or more gobos. As used herein, the phrase "in focus" means the pattern is illuminated as desired without significant blurriness.

Referring now to the drawings, and more particularly to FIGS. **1-5**, **7**, and **9**, a gobo apparatus **10** is shown. The gobo apparatus **10** generally includes a housing **12**, a collimated light source **14** disposed within the housing **12**, and at least one gobo **16** removably attached to the housing **12**. The gobo apparatus **10** projects a focused pattern, via the at least one gobo **16**, onto a desired surface.

Achieving a desired pattern that is in focus is quite a challenge in prior art lighting equipment. Such prior art lighting equipment must generally be positioned at a particular location and distance from a desired surface to achieve a focused pattern. Additionally, prior art gobos must generally be positioned at a precise axial distance from the light source, be coaxial to the light source, and must be perpendicular to the light source to a achieve a focused pattern. If any one of those variables are slightly off, the pattern will be warped and/or out of focus.

In contrast to prior art lighting equipment, the gobo apparatus **10** can easily project a focused pattern with minimal to no adjustments by the user. Due to the collimated light passing through the gobo **16**, the pattern remains in focus irrespective of an axial distance D between the collimated light source **14** and the gobo **16** (FIG. **5**), a position GD of a gobo axis GA of the gobo **16** relative to a light source axis LA of the light source **14** (FIG. **4**), and an orientation, i.e., angle, of the gobo **16** relative to a light source plane LP. The axial distance D between the gobo **16** and the light source may be approximately ⅛-12 inches (1.5-305 mm). The gobo axis GA of a given gobo **16** may be coaxial with the light source axis LA or separated by a distance GD which does not exceed the bounds of the housing **12**. The orientation of the gobo may comprise any angle or curvature which is non-parallel to the light source plane LP, such as for example approximately 45 degrees, plus or minus 20 degrees.

In one embodiment, the gobo apparatus **10** may not include an optical device and/or a head for mounting the gobo(s) **16**. Due to the collimated light, there is no need for a lensing system and/or a corresponding head, which is located at an optical center and at a particular focal point, in order to focus the light to obtain a focused pattern from the gobo **16**.

In another embodiment, the gobo apparatus **10** further includes an interchangeable optical device **18** and an interchangeable head **20** upon which the at least one gobo **16** is secured. The interchangeable optical device **18** and head **20** allow the user to easily and efficiently switch patterns without need to change or adjust the housing, the light source, a position and/or orientation of the optical device **18** and/or the interchangeable head **20**.

The housing **12** houses the light source **14** and mounts the gobo **16**. The housing **12** includes an internal frame **22**, a back wall **24** composed of one or more panels, top and bottom walls **26**, **28**, side walls **30**, and an open front end **32** opposite the back wall for accommodating the head **20** (FIGS. **1-2**). The side walls **30** may or may not be open side walls to allow access to the internal frame **22** and provide additional ventilation. A handle **34** can be pivotally connected to both side walls **30** by fasteners, such as screws (unnumbered). A power cable **36** for powering the light source **14** can be attached to the internal frame **22** and extend out of the housing **12** at one of its sides. The housing **12** may or may not include a fan for cooling the light source **14** (not shown). The housing **12** may be composed of any suitable material, such as plastic and/or metal.

The housing **12** may also include mounting features **38** for dually mounting the interchangeable optical device **18** and head **20** onto the housing **12**. The mounting features **38** can be rigidly or removably connected to the internal frame **22** or the side walls **30** of the housing **12**. The mounting features **38** can extend forwardly beyond the side walls **30** of the housing **12**. The mounting features **38** may extend through corresponding mounting features **40** in the optical device **18** (FIG. **1**) and corresponding mounting features **42** in the head **20** (FIG. **3**).

The mounting features **38** can be in the form of protrusions, hollow stems **44**, and/or fasteners **46**. The protrusions can be in the form of rigid posts extending outwardly from the internal frame **22**. The fasteners **46** can be in the form of pegs or screws that connect to corresponding receiving holes in the internal frame **22**. Additionally, each fastener **46** can extend through a hollow stem or sleeve **44** that directly contacts each respective mounting feature **40**, **42** of the optical device **18** and the head **20**. Each stem **44** can be two-tiered having a first annular portion and a second annular portion with a diameter that is less than the diameter of the first portion (FIG. **5**). The first and second annular portions of the stem **44** can correspond in size and shape of the mounting features **40**, **42** of the optical device **18** and the head **20**.

The light source **14** is configured to emit collimated light. The light source **14** can be mounted on a designated mount or head which in turn is connected to the internal frame **22** (FIG. **1**). The light source **14** defines a light source axis LA which extends axially from a center point of the light source **14** (FIG. **1**). The light source axis LA can be coaxial with a centerline of the housing **12**. The light source **14** also defines a light source plane LP, which is the plane in which the light source **14** resides. The light source plane LP can be parallel to the rear wall **24** of the housing **12**.

The light source **14** can be in the form of a laser-based light-emitting diode (LED). Alternatively, the light source **14** can be configured as a laser, an incandescent light, or a radiation source such as an IR or UV light source for emitting non-visible light. The light source may or may not include a designated collimator for collimating the light emanating from the light.

The optical device **18** is removably connected to the housing by the mounting features **38** of the housing **12**. The optical device **18** is located in between the housing **12** and the head **20** (FIG. **3**). The optical device **18** includes a body **48** and a transparent barrier **50** connected to the body **48** (FIG. **1**). More particularly, the body **48** defines a planar wall with a cutout and the transparent barrier **50** is disposed within the cutout of the body **48**. The transparent barrier **50** may in some embodiments be a simple glass plate with no lensing properties. The transparent barrier **50** may in alternative embodiments function as a lens to direct the light emanating from the light source **14**. For example, in an embodiment wherein the transparent barrier **50** functions as a lens, the lens may narrow the light from the light source **14** from approximately 120 degrees down to 60 degrees. The transparent barrier **50** may be substantially parallel to the light source plane LP. The transparent barrier **50** may be alternatively configured as a reflector.

The mounting features **40** of the optical device **18** are located next to the sides of the body **48**. The mounting

features **40** are in the form of through holes for receiving the mounting features **38** of the housing **12** therethrough. The through holes **40** of the body **48** may or may not be threaded. As assembled, the body **48** of the optical device **18** can be seated within the open front end **32** of the housing **12** such that the top, bottom, and side walls **26**, **28**, **30** extend at least partially over the body **48**.

The head **20** is removably connected to the housing **12** by the mounting features **42** of the housing **12** (FIG. **3**). The head **20** is disposed in the open front end **32** of the housing **12**. The head **20** includes multiple gobos **16** in a multiplane configuration. Each gobo **16** is configured to project a pattern onto a desired surface. The pattern projected by the gobo **16** will remain in focus, due to the collimated light, even if the entire assembly of the gobo apparatus **10** is moved relative to the surface upon which the pattern is projected and if the gobo **16** is moved axially, rotated, and/or tilted relative to the light source **14**. The gobo **16** can be oriented non-perpendicularly to the light source plane LP and/or positioned off-center from the light source axis LA. Alternatively, the gobo **16** can be coaxial with the light source axis LA and oriented non-perpendicularly to the light source plane LP. The gobo **16** can be stationary or movable. For instance, the gobo **16** can be movable, such as rotatable, by the user or by one or more servo motors attached to the housing **12** and the gobo(s) **16** and/or head **20**. Additionally, the gobo **16** can be planar, curved, and/or faceted and still project a focused pattern due to the collimated light.

Generally, the head **20** includes a planar portion **52** removably connected to the housing **12** and at least one non-planar portion **54** extending from the planar portion **52** which mounts the at least one gobo **16** (FIG. **6**). In other words, each gobo **16** is connected to a non-planar segment **54** of the head **20**. As shown in FIGS. **1-6**, the head **20** can include five gobos **16** respectively connected to five non-planar portions **54** and each having a differing angle relative to the light source plane LP. The planar portion **52** can be in the form of a wall that is perpendicular to the light source plane LP. As assembled, the back of the planar portion **52** can contact the optical device **18** and the top, bottom, and side **26**, **28**, **30** walls of the housing **12**.

The non-planar portion(s) **54** of the head **20** are non-perpendicular to the light source plane LP, thus orienting the gobo(s) **16** thereon non-perpendicularly to the light source plane LP. The non-planar portions **54** of the head **20** can be monolithically formed with the planar portion **52** of the head **20**. As shown in FIGS. **3-6**, the non-planar protruding portions **52** can include nine non-planar wall segments **54** and five gobos **16** respectively disposed in the five differing wall segments **54**. The outermost, center wall segment **54** can include a gobo **16** that is coaxial with the light source axis LA and perpendicular to the light source plane LP. The four surrounding wall segments **54** can each include a gobo **16** that is off-axis relative to the light source axis LA and non-perpendicular to the light source plane LP. Each gobo **16** on each surrounding wall segment **54** can be positioned such that its center point is located at a distance GD away from the light source axis LA. Four wall segments **54**, in between the wall segments **54** with the gobos **16**, may not include gobos **16** and may serve as structural wall segments.

The mounting features **42** of the head **20** are located next to the lateral sides of the planar portion. Each gobo **16** can be movably, e.g., rotatably and/or adjustably, connected to the housing **12** by way of the head **20**. For example, the mounting features **38** of the housing **12** and the mounting features **42** of head **20** can allow the gobo **16** to be adjustably connected to the housing **12** without removing the gobo **16** from the housing **12**. Adjusting the position of the head **20** will not diminish a focus of the pattern projected by the gobo(s) **16**.

In one embodiment, each mounting feature **42** of the head **20** comprises a mounting slot **42** that corresponds to a respective mounting feature **38** of the housing **12**. Each mounting slot **42** can have a key-hole design which a first, annular portion **42**A and a second, channel portion **42**B (FIG. **6**). The first portion **42**A has a width that is wider than the width of the second portion **42**B. The second portion **42**B of each mounting slot **42** is configured to contact a respective mounting feature **38** of the housing **12** and allow the head **20** to slide relative to the housing **12**, thus allowing the position of the gobo(s) **16** to slide up or down relative to the light source axis LA. Thereby, when assembled, the first portion **42**A of the slot **42** can be fitted around the first annular portion of the stem **44** and fastener **46**, and thereafter the second portion **42**B of slot **42** can be slid onto the second annular portion of the stem **44**. As each fastener **46** is tightened, the lip (unnumbered) in between the first and second annular portions of the stem **44** can abut against the front of the planar portion **52** of the head **20** and secure head **20** onto the housing **12**. To adjust a position of the head **20**, the user can loosen the fasteners **46** and slide the head **20** up or down as it remains connected to the housing **12** and thereafter retighten the fasteners **46** to resecure the head **20** onto the housing **12**. As can be appreciated, moving the gobo(s) **16** relative to the housing **12** will not alter the focused pattern projected by the gobo(s) **16**.

Referring now collectively to FIGS. **1-10**, there is shown various exemplary embodiments of possible interchangeable heads **20**, **720**, **920** with differing configurations of gobos **16**. Each head **20**, **720**, **920** can be easily (dis) connected to the housing **12** for easily and efficiently interchanging various gobos **16** to achieve a desired pattern that is automatically in focus.

Referring specifically to FIGS. **7-8**, the interchangeable head **720** can include three gobos **16** disposed in three respective and differing planes relative to the light source plane LP. Each gobo **16** is connected to the head **720** and configured to project a respective pattern. The center gobo **16** is coaxial to the light source axis LA and perpendicular to the light source plane LP. The two opposing gobos **16** are each located off-axis to the light source axis LA and non-perpendicular to the light source plane LP.

Referring specifically to FIGS. **9-10**, the interchangeable head **920** can include a single curved gobo **16** disposed in a curved, non-planar portion that protrudes outwardly from the planar portion of the head **920**. The curved gobo **16** is configured to project the focused pattern, irrespective of its curvature. The center point of the single curved gobo **16** can be coaxial to the light source axis LA.

In use, the user can initially mount the gobo apparatus **10** onto a desired wall or structure. More particularly, the user may attach the handle **34** of the housing **12** onto the wall or other structure. For instance, the gobo(s) **16** may be used to project the focused pattern, e.g. lettering, onto a floor or pathway. Hence, the off-axis or curved gobo(s) **16** can suitably distort the pattern such that when the pattern is projected onto the floor or pathway the pattern is not distorted or out of focus.

After installation of the gobo apparatus **10**, the user may direct the gobo apparatus **10** such that the light source plane LP is oriented non-perpendicularly to the surface on which the focused pattern is projected onto by the gobo(s) **16**. The user may attach a desired interchangeable head **20**, **720**, **920** onto the housing **12**. Thereafter, to interchange the pattern,

the user may remove the first interchangeable head from the housing **12** and subsequently connect a second interchangeable head onto the housing **12**. Due to the collimated light source, the pattern of the first and second interchangeable heads will automatically remain in focus.

While illustrative arrangements of the invention have been described with respect to at least one embodiment, the arrangements and methods can be further modified within the spirit and scope of this disclosure, as demonstrated previously. This application is therefore intended to cover any variations, uses, or adaptations of the arrangement and method using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which the disclosure pertains and which fall within the limits of the appended claims.

What is claimed is:

1. A gobo apparatus, comprising:
a housing;
a collimated light source disposed within the housing and configured to emit collimated light, the collimated light source defining a light source axis and a light source plane;
at least one gobo connected to the housing, the at least one gobo is oriented non-perpendicularly to the light source axis; and
a head removably connected to the housing; wherein
the at least one gobo is connected to the head; and
the head comprises:
a planar portion removably connected to the housing, the planar portion is perpendicular to the light source axis; and
at least one non-planar portion extending from the planar portion,
wherein the at least one gobo is connected to the non-planar portion of the head.

2. The gobo apparatus of claim **1**, wherein:
the at least one gobo comprises a plurality of gobos, each gobo having a differing angle relative to the light source axis; and
at least one of the plurality of gobos is oriented non-perpendicularly to the light source plane.

3. The gobo apparatus of claim **2**, wherein:
a first gobo of the plurality of gobos is perpendicular to the light source axis and coaxial to the light source axis;
a second gobo of the plurality of gobos is non-perpendicular to the light source axis and off-center from the light source axis; and
a third gobo of the plurality of gobos is non-perpendicular to the light source axis and off-center from the light source axis.

4. A gobo apparatus, comprising:
a housing;
a collimated light source disposed within the housing and configured to emit collimated light, the collimated light source defining a light source axis and a light source plane;
at least one gobo connected to the housing, the at least one gobo is oriented non-perpendicularly to the light source axis; and
a head removably connected to the housing; wherein
the at least one gobo is connected to the head;
an optical device is removably connected to the housing and located in between the collimated light source and the head; and
the optical device comprises a body and a transparent barrier disposed within the body, and the transparent barrier is perpendicular to the light source axis.

5. The gobo apparatus of claim **4**, wherein:
the at least one gobo is configured to project a focused pattern when the collimated light passes therethrough irrespective of an axial distance between the collimated light source and the at least one gobo, a position of the at least one gobo relative to the light source axis, and an orientation of the at least one gobo relative to the light source plane.

6. The gobo apparatus of claim **4**, wherein:
the at least one gobo is positioned off-center from the light source axis.

7. The gobo apparatus of claim **4**, wherein:
the at least one gobo comprises a curved gobo.

8. The gobo apparatus of claim **4**, wherein:
the at least one gobo is coaxial with the light source axis.

9. The gobo apparatus of claim **4**, wherein:
the housing comprises mounting features which dually mount the optical device and the head.

10. The gobo apparatus of claim **9**, wherein:
the head comprises corresponding mounting features that correspond to the mounting features of the housing; and
the mounting features of the head are configured to allow the head, and the at least one gobo therewith, to be movably connected to the housing without removing the head from the housing.

11. The gobo apparatus of claim **10**, wherein:
the mounting features of the head comprise a pair of mounting slots; and
the mounting features of the housing comprise a pair of fasteners respectively extending through the mounting slots and removably securing the head onto the housing.

12. The gobo apparatus of claim **11**, wherein:
each mounting slot comprises a first portion and a second portion, the first portion being wider than the second portion; and
the second portion of each mounting slot configured to allow the head to slide relative to the housing.

13. The gobo apparatus of claim **4**, wherein:
the housing comprises a back wall and an open front end opposite the back wall, wherein the head is disposed in the open front end of the housing.

14. The gobo apparatus of claim **2**, wherein:
the at least one gobo is movably mounted to the housing; and
the at least one gobo is configured to be movable relative to the housing without diminishing a focus of the focused pattern.

15. The gobo apparatus of claim **2**, wherein:
the at least one gobo is adjustably mounted to the housing; and
the at least one gobo is configured to be adjustable relative to the housing without diminishing a focus of the focused pattern.

16. The gobo apparatus of claim **5**, wherein:
the housing is configured to be mounted on a wall or a structure such that the light source plane is oriented non-perpendicularly to a surface on which the focused pattern is projected onto by the gobo and the focused pattern remains in focus due to the collimated light emanating from the collimated light source.

17. A gobo apparatus comprising:
a housing having mounting features;

a collimated light source disposed within the housing and configured to emit collimated light, the collimated light source defining a light source axis and a light source plane;

an optical device removably connected to the housing by the mounting features; and

a first head and a second head, each head comprising at least one gobo that is oriented non-perpendicularly to the light source axis, the at least one gobo is configured to project a focused pattern when the collimated light passes therethrough, and each head being configured to be removably connected to the housing by the mounting features such that the first and second heads are interchangeable with one another.

18. A method comprising:

providing a gobo apparatus comprising a housing, a collimated light source disposed within the housing and configured to emit collimated light, the collimated light source defining a light source axis and a light source plane, a first head and a second head, each head comprising at least one gobo that is oriented non-perpendicularly to the light source axis, the at least one gobo is configured to project a focused pattern when the collimated light passes therethrough, and each head being configured to be removably connected to the housing by the mounting features such that the first and second heads are interchangeable with one another;

connecting the first head onto the housing;

removing the first head from the housing; and

connecting the second head onto the housing, wherein the focused pattern of the at least one gobo of the second head is automatically in focus.

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