J. W. LEGG.

PROJECTION LIGHT UNIT.

APPLICATION FILED MAR. 31, 1915.

1,325,254.

Patented Dec. 16, 1919.

3 SHEETS—SHEET 1.

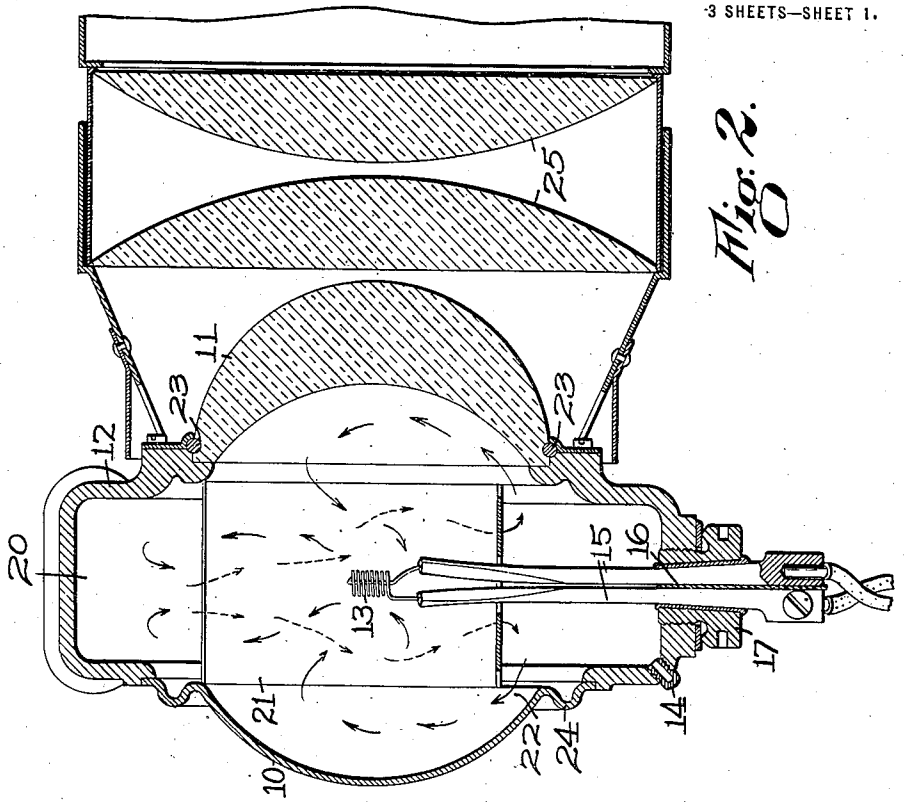


Fig. 2.

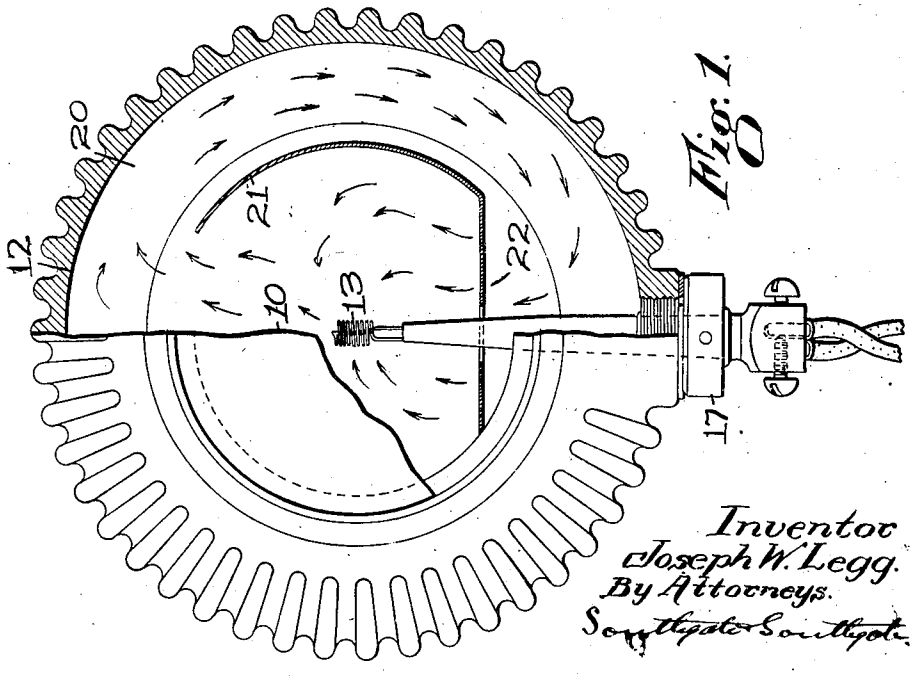


Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 3.

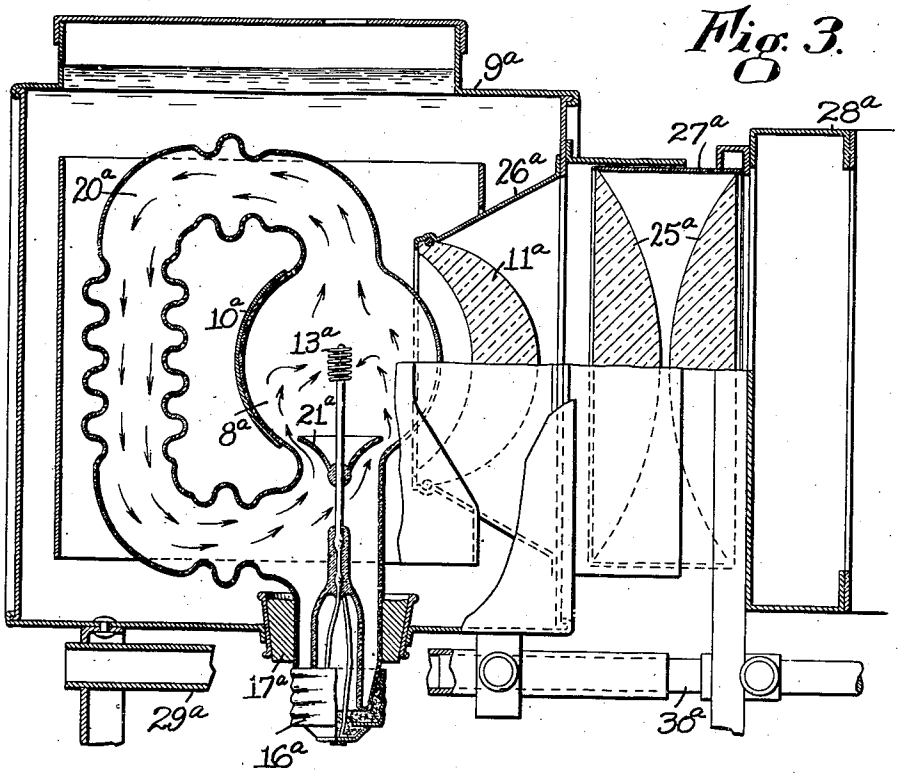
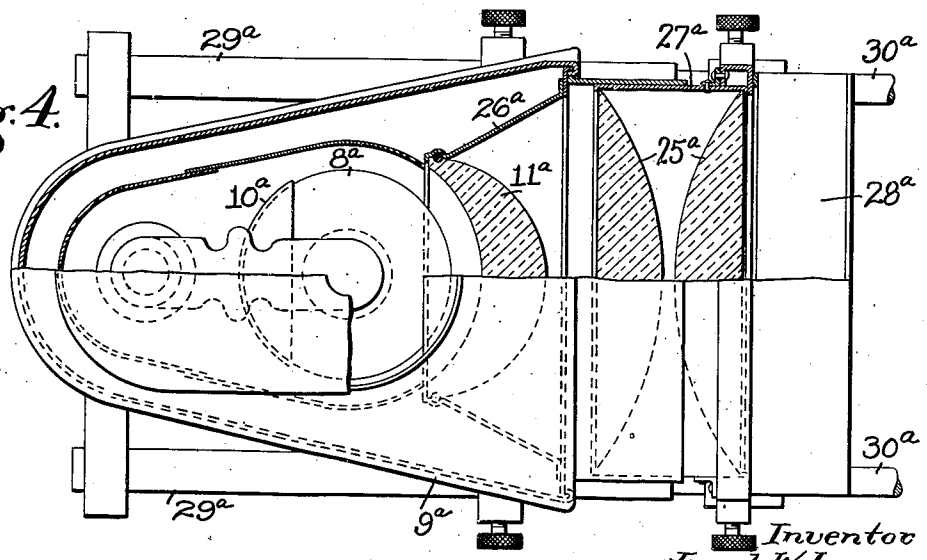


Fig. 4.



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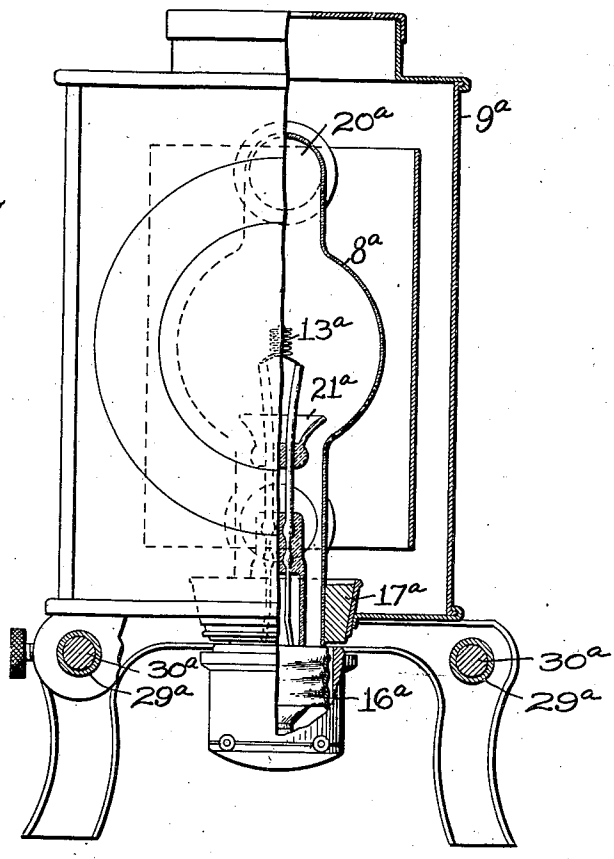
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3 SHEETS—SHEET 3.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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PROJECTION LIGHT UNIT.

1,325,254. Specification of Letters Patent. Patented Dec. 16, 1919.

Application filed March 31, 1915. Serial No. 18,284.

To all whom it may concern:

Be it known that I, JOSEPH W. LEGG, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Projection Light Unit, of which the following is a specification.

This invention relates to a high efficiency incandescent filament gas-filled projection light unit and the principal objects thereof are to provide a unit especially for this purpose, and also capable of other uses, in which the principle of the gas-filled lamp now in use can be employed with a very much increased effectiveness; to provide means whereby with the projection of a relatively great proportion of the light to the desired point, there shall be a relatively small proportion of heat given off at the filament so that one of the serious objections to the use of the arc type of lamp is obviated; to provide an arrangement whereby the heated gas around the filament will be conducted away and returned in a comparatively cool condition and yet it will be kept away from direct contact with the filament on its return so as to avoid sudden cooling thereof; to provide simple and effective means whereby the usual opaque deposit that is produced on the inner walls of the globe or container in this type of lamp will be projected into an external space where the collection of the deposit will not affect the efficiency of the lamp and to cause the current of cool gas to spread out along the surfaces of the globe when it returns thereto, whereby the wall of the globe or container through which the light is projected can be located comparatively near the filament so that a relatively large proportion of the luminous rays from the filament can be utilized; to provide an improved form of globe or container in which the rays of light that are normally thrown backwardly can be projected forwardly without causing any interference of these with the direct light rays; to provide means whereby the filament can if desired be withdrawn and replaced and the lamp refilled with inert gas so as to permit of running the lamp at a relatively high efficiency at the expense of the length of life of the filament; to provide an improved lens construction in coöperation with the lamp and its filament; and to provide improvements in various details of construction and combinations of parts as will appear.

Reference is to be had to the accompanying drawings, in which—

Figure 1 is a front elevation of a lamp unit constructed in accordance with this invention;

Fig. 2 is a central longitudinal sectional view thereof showing also ordinary condensing lenses with which it is adapted to be used;

Fig. 3 is a view similar to Fig. 2 showing a modification;

Fig. 4 is a top view of the unit shown in Fig. 3 with one half in horizontal section; and

Fig. 5 is an end view of the same with one half in central transverse section.

Referring first to the form shown in the first two figures, a light unit is shown in which the main container or globe is formed on two sides by a spherical mirror 10 and a meniscus convex lens 11 of hemispherical form. These are mounted on the sides of a metal casing 12 which constitutes the supporting means. The mirror and lens inclose a substantially spherical space which forms the main body of the lamp and is provided with a high candle power filament 13 of well known type located at the center of the sphere. This filament preferably is of high current consumption and adapted to be operated at a reduced voltage for the purpose of permitting the use of a very small concentrated filament of high efficiency.

The container or globe is filled with an inert gas such for example as nitrogen. It may be filled and emptied through a metallic tube 14 adapted to be pinched together and soldered or welded after the container is filled with gas.

The filament is provided with terminals or leading in wires 15, which are tapered at the lower ends and separated by an insulation strip 16 of any desired insulating material. They are insulated and driven into a tapered hole in a screw plug 17 which is provided with a gasket and all made gas tight of course.

It is well understood that in lamps of this kind, as for example the improved Mazda lamps, a brown deposit of tungsten nitrid forms on the upper portion of the globe and impairs the light. For the purpose of avoiding this difficulty special means is provided which also acts to assist in keeping the gas cool. It is for this purpose that the casing 12 is provided with an annular passage 20 therein communicating with the spherical space at the top of the latter. This permits the gas to rise into the top of the annular space and it is then forced to descend in this space. This allows the gas to cool and upon cooling it descends to the bottom of the spherical space.

With this current of gas it will be seen that most of the deposit is made on the inner walls of the top of the annular space 20. This largely avoids the deposit on the mirror 10 and the inside of the lens 11. For the purpose of more fully accomplishing this result, a deflecting plate 21 is shown of a material, such as mica, which will guide and deflect the convection currents but will transmit radiant heat and light. It is open at the top to provide a space through which the gas and dark particles of the deposit can enter the annular space. But at the bottom it is bent so as to provide side passages 22 through which the gas coming in from the annular space will be caused to spread outwardly and pass along the surfaces of the lens and mirror, thus cooling these surfaces and assisting in keeping the deposit away from them. It also has the further effect of preventing the discharge of these cooler gases directly on the filament and unduly cooling it.

It will be noticed that the outer wall of the annular space is corrugated. This is for permitting cooling, and in case it is made of thin materials, to allow for expansion and contraction. However, it is preferred to make it of cast aluminum or some other metal not easily affected by the air or gases used. In this case the metallic mirror is welded to the body of the casing and the lens is fixed in by a cement ring 23 or in any other desired manner. It is to be noted also that the metallic mirror is provided with a corrugation at 24 to permit of expansion and contraction without unduly straining the joint.

The lens itself is an important feature because it is designed to correct itself for spherical aberration. For this purpose its inside surface is a section of a true sphere concentric with the filament and mirror. Its outside surface is in the form of a complete hemisphere with its center at a definite distance from the filament. This distance, in order to secure the above mentioned result, is made equal to the quotient of the radius of the hemisphere by the index of refraction of the material of the lens as compared with air. The focusing of the light rays can be controlled by moving the light unit as a whole relative to the regular condensing lenses 25 of the projector.

In the form shown, the lens will take a beam at an angle of 50° from the axis and bend it to 30½° from the axis and deliver it to an ordinary 4½″ diameter condensing lens 25. This increases the available light substantially 158% over that that would be obtained from the bare filament. With the spherical mirror 10 added, considering it even with the low efficiency of 55%, four times the efficiency of the bare filament is obtained for projection purposes even with the ordinary condensing lenses.

The radiating surface of the metal container and mirror is nearly equal to that of an ordinary one-thousand candle power nitrogen-filled tungsten filament lamp but the convection currents in this unit distribute the heat so generally over the radiating surface that even a greater candle power filament can be used without overheating the container in any one place. However, an ordinary spherical globe, containing a four-thousand candle-power filament of this type would be much too large to sufficiently approach the regular condensing lens. Even if this were possible the bare filament would require nearly four times as much power and would give off nearly four times as much heat.

It will be understood that the object of making the filament renewable is to make it possible to run the filament at a higher temperature than is customary. This greatly increases the efficiency but at the expense of the life of the filament, which would be impractical with a non-renewable filament lamp. This higher temperature obtained by running the filament at a greater current and voltage permits of the use of a much more concentrated filament per candle power and a decrease in the number of watts consumed per candle power. This arrangement is of practical advantage in some cases, as for instance in moving picture houses, because the cost of renewal would be much less than the cost of an equal candle-power-hour consumption of carbons in an arc light unit, besides furnishing a perfectly steady even illumination requiring no attention.

This unit will operate even more efficiently on alternating current circuits than with direct currents, hence no motor generator or mercury arc rectifier is needed and one of the advantages of this invention is that they can be dispensed with and replaced by a small transformer at a great reduction of expense.

This light unit emits no less radiant heat energy per candle power delivered than an ordinary nitrogen-filled lamp, but it has a much smaller proportion of heat due to the heating of the gas. It has a great advantage over the arc lamp because the latter emits a great deal of radiant heat energy which excessively heats the lenses and the film or lantern slides. This unit also furnishes a perfectly steady, even illumination and requires no attention.

In the form shown in the last three figures, many of the features above described are provided, but in this case an outside casing 9^a is employed adapted to contain water. In this is arranged the globe 8^a having a mirror 10^a on one side and provided with a passage 20^a by which the gas can be cooled and returned to the lamp. A deflector 21^a is shown for directing the cooled gases along the surfaces of the globe 8^a and away from the filament 13^a. The lens 11^a is just like the lens 11 but is spaced from the globe so as to provide an annular cooling space for the water which surrounds all the parts above described inside the casing 9^a. This lens is fixed in a holder 26^a forming a part of the casing. The ordinary lenses 25^a are mounted in a holder 27^a which is movable independently of the casing 9^a. I also provide a casing 28^a for the lantern slide holder.

In this case the filament is not shown as readily renewable but is mounted in a plug 16^a at the bottom which is provided with a packing 17^a which is water tight. A tube 29^a and rod 30^a are shown adjustably mounted in connection with each other, the tube being connected with the casing 9^a and the rod with the casing 28^a to provide the necessary focusing adjustment. In this case the principles above mentioned, or most of them, are also employed including the corrugation of the tube 20^a to provide for contraction and expansion and to some degree to allow radiation for cooling purposes.

Although I have illustrated and described only two forms of my invention, I am aware of the fact that many modifications can be made therein by any person skilled in the art without departing from the scope of the invention as expressed in the claims. Therefore, I do not wish to be limited to all the details of construction herein shown and described, but what I do claim is:—

1. A projection unit comprising a gas-filled container having a filament therein and provided with an opening over said filament for permitting the passage therethrough of any deposit from the filament, means for creating a current of the gas through said opening to facilitate the deposit of particles through said opening for the purpose of keeping it away from the main walls of the container, and means below said filament for directing the cooler portion of the current of said gas away from the filament and along the walls of the container, the last named means being capable of transmitting radiant heat and light.

2. A projection unit comprising a container having a filament therein and provided with an opening at the top, and a corrugated longitudinally expansible bypass extending from said opening around to the bottom of the container.

3. A projection unit comprising a container provided with a substantially spherical body and having a filament located at the center thereof and provided with two semicircular passages extending around said body from the top to the bottom and opening out from the top of the spherical body and into the bottom thereof, whereby heated gas will rise in the top of said container and pass around the same in said passages to be cooled and will enter the bottom of the spherical portion of the container below the filament.

4. A projection unit comprising a container provided with a substantially spherical body and having a filament located at the center thereof and provided with two semicircular passages extending around said body from the top to the bottom and opening out from the top of the spherical body and into the bottom thereof, whereby heated gas will rise in the top of said container and pass around the same in said passages and enter the bottom of the spherical portion of the container below the filament, and a deflector of heat resisting material within the container passing around the sides thereof and across the bottom, the bottom being flattened to permit the entrance of the cooled gas along the side walls of the container and the top being open to permit the escape of the heated gas into said passages.

5. A projection unit comprising a container provided with a body having a filament and provided with a semi-circular passage extending around said body from the top to the bottom, whereby the heated gas will rise in the top of said container and pass around the same in said passage and enter the bottom of the spherical portion of the container below the filament, and a deflector of non-conducting material within the container passing around the sides thereof and across the bottom, the bottom being bent to permit the entrance of the cooled gas along the side walls of the container and the top being open to permit the escape of the heated gases into said passage.

6. A projection unit comprising a metallic casing of a general circular form provided with an annular passage around the exterior

thereof and having inside said casing but at the opposite sides thereof respectively a spherical mirror and a spherical lens substantially concentric with each other, said annular passage being open at the top of the space between the mirror and lens to receive the heated gas and also having side openings at the bottom for discharging the cooled gas along the walls of the mirror and lens, and a filament at the center of the lens and mirror.

In testimony whereof I have hereunto set my hand.

JOSEPH W. LEGG.