March 7, 1933. W. F. HENDRY 1,900,109

HIGH INTENSITY GASEOUS DISCHARGE TUBE

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Fig. 1.

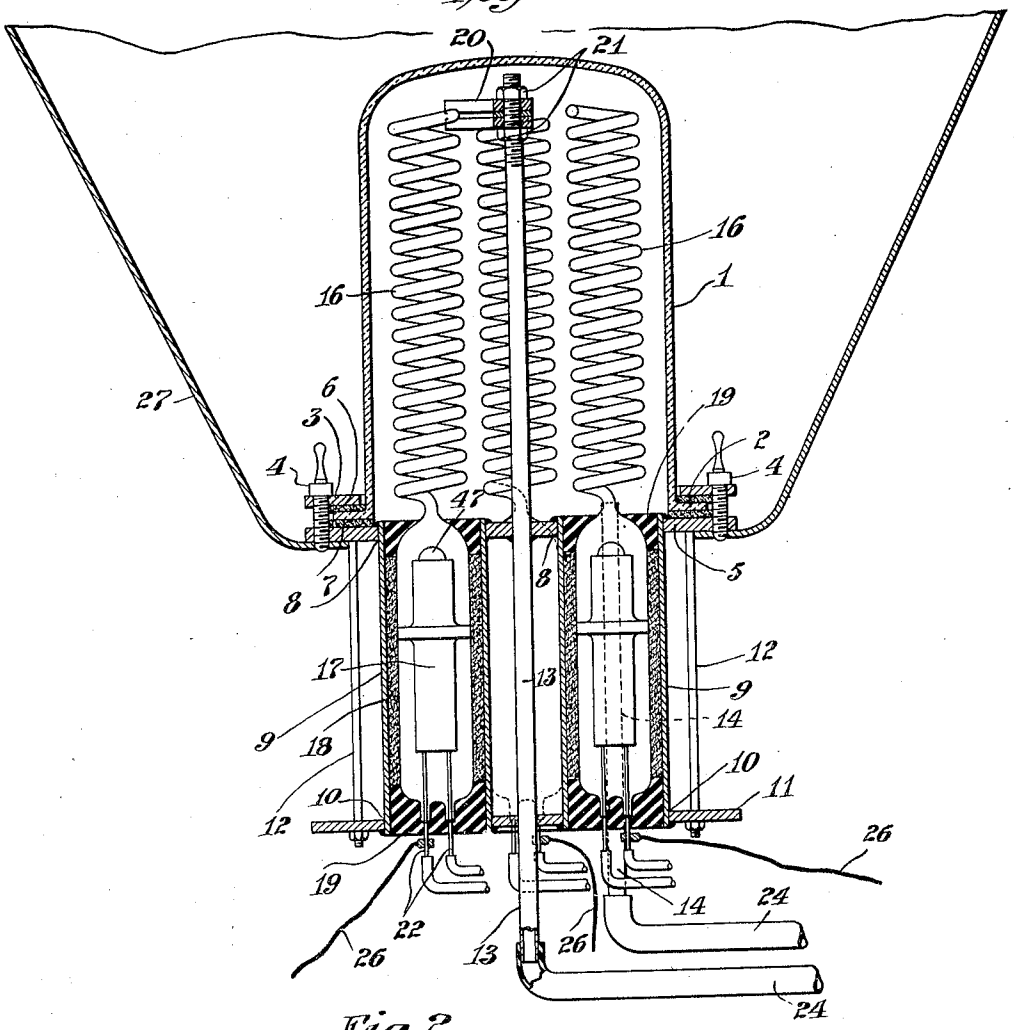

Fig. 2.

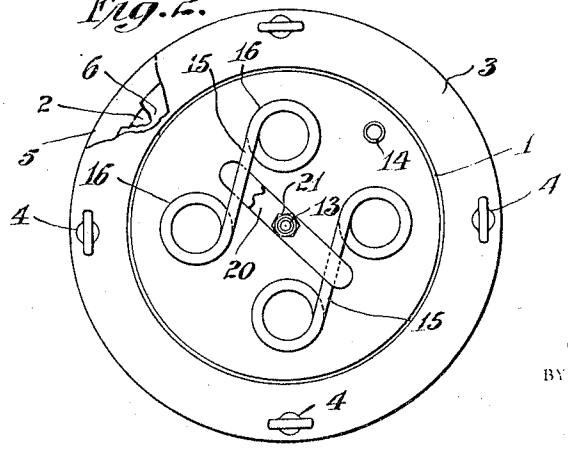

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Fig. 3.

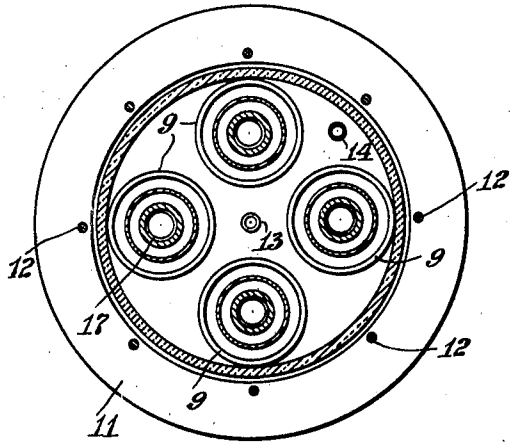

Fig. 4.

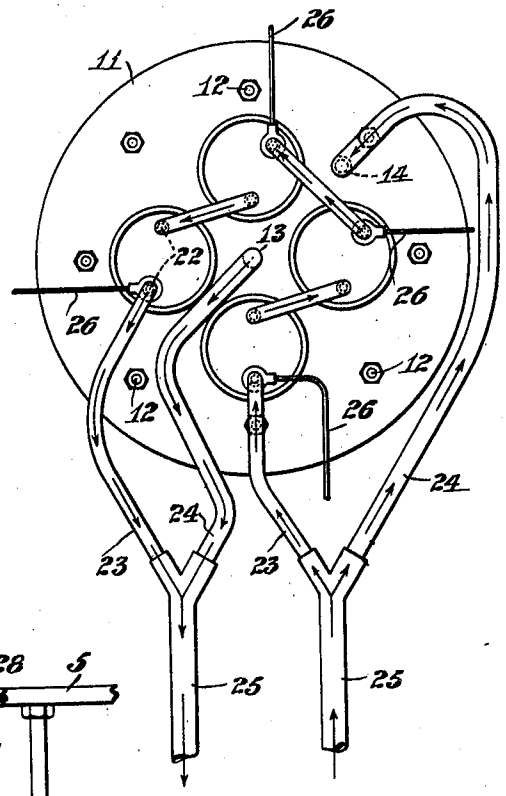

Fig. 5.

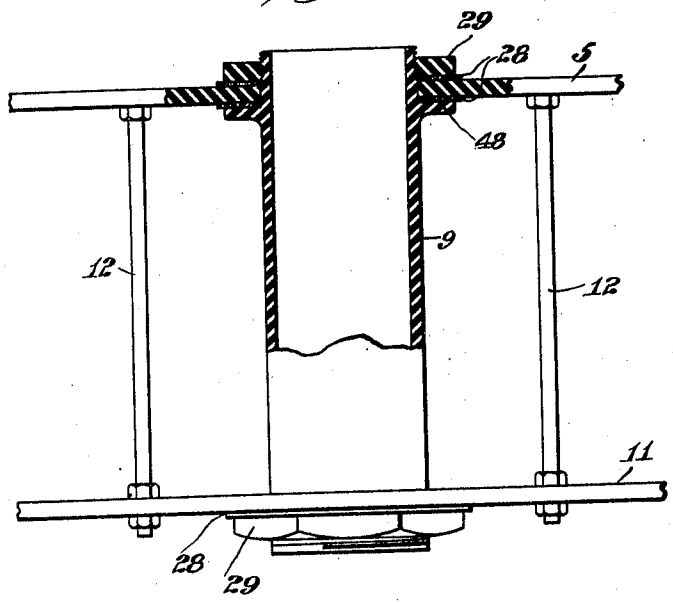

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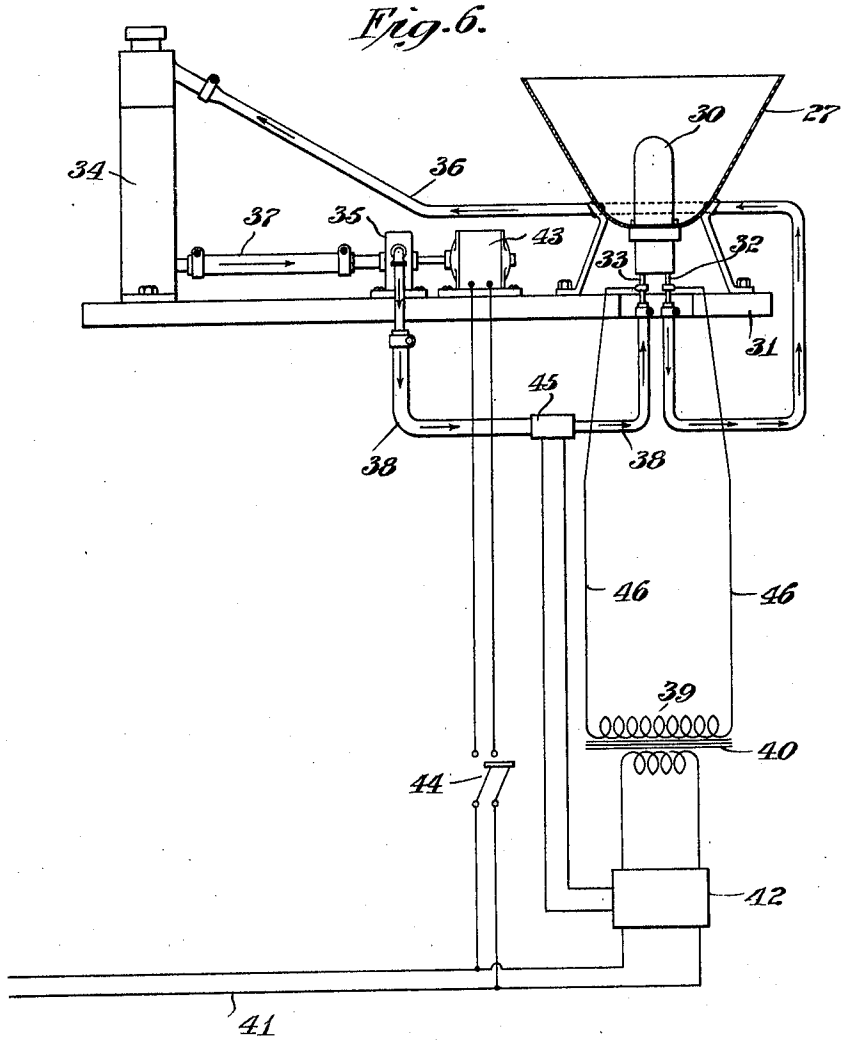
Fig. 6.



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UNITED STATES PATENT OFFICE

WILLIAM F. HENDRY, OF OSSINING, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO MANHATTAN ELECTRICAL SUPPLY COMPANY, INC., OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY

HIGH INTENSITY GASEOUS DISCHARGE TUBE

Application filed January 3, 1928. Serial No. 244,229.

This invention relates to illuminating devices and pertains more particularly to luminous gaseous discharge tube units of the high intensity type.

An object of the invention is the provision of a luminous tube, of the type wherein an electric discharge is passed through a gaseous atmosphere, constructed in the form of a compact unit. More specifically it is an object of the invention to construct a gaseous discharge tube light in the form of a compact unit, so fashioned that a minimum amount of light is obstructed by the various parts of the unit, and of such design that units can readily be interchanged whenever desirable.

Another object is the provision of a compact gaseous discharge light unit capable of emitting an intense light and suitable for use in conjunction with a reflector, as a search light or directive beacon.

A further object of the invention is the provision of a water cooling system and a cooperating current supply system for use with a light unit of the above mentioned type. According to this feature of the invention, I so arrange the component parts of the water cooling and current supply systems, that the current can be supplied to the lamp unit only while the cooling water is passing therethrough in its proper manner.

For the construction of such light units used as beacons or searchlights, lamps of concentrated form and high brilliancy are needed. I have disclosed in my copending application Serial No. 241,062, filed December 19, 1927, a gaseous discharge tube unit capable of operating at high efficiency and suitable for use as a beacon. This tube is provided with water or other fluid cooling arrangements and a special electrode structure which permits the operation of the tube at high current densities in such manner as to give a very brilliant light. This type of tube is very useful for certain types of work. However, when such a tube is used with a reflector of relatively small dimensions there is a disadvantage that certain parts of the tube unit tend to obscure the reflected, or directly projected light rays. The reason for this is that when such a light tube is mounted longitudinally along the axis of the reflector the electrode structure in one end of the tube is directly in the path of the light rays, and while the tube may be mounted crosswise of the axis of the reflector such arrangement has the disadvantage that the light source is spread out over a considerable portion of the reflecting surface, and has the further disadvantage that it is somewhat difficult to mount a tube in this position so that it can be readily removed from the reflector as a unit.

In accordance with the present invention, I provide an improved form of light unit constructed broadly along the lines of the unit disclosed in the above mentioned application, but structurally modified so as to overcome the above objections. By coiling the gas containing light tube of such a unit in the form of a doubly bent helix, or similar shape, I am able to position the two electrode portions of a tube unit out of the path of the light rays generated by the unit. Furthermore, with such an arrangement, I am able to bring all of the current carrying wires and cooling water pipes out at the same end of a lamp unit, which is an advantage in the connecting up of the unit and is also economical in space. According to the present invention, I construct lamp units of this type in such manner that they can readily be taken apart for the convenient replacement of the various parts thereof. That is to say, I construct a lamp unit in such manner that the water jacket can readily be taken off so as to permit the removal of old gas tube units and the substitution of new ones. This is an advantage as when it is necessary to repair a tube, which may have become worn out through use or damaged, it is very easy to take the unit apart and place therein a new element to replace any element which has been damaged, instead of practically reconstructing the whole tube, as was in many cases necessary with the old type of tube. When a reflector is used, it is desirable that the lamp unit be readily removable so that upon failure of a unit a new unit can be inserted quickly so that service will be interrupted only a short time.

As I contemplate that light units of the above mentioned type will be used as beacon

lights where it is imperative that the light shall not be interrupted, I provide a special arrangement of cooling system. With these tubes, as a cooling fluid is needed for their operation, and as the unit would be almost immediately destroyed should the supply of cooling fluid fail, I have provided an individual source of cooling fluid for use with each lamp unit, or group of units. While water from the city supply may be used for the cooling of these lamp units, it is possible that such supply might fail at a critical moment, requiring the shutting down of a lamp which was needed. In order to avoid this possible stoppage of the operation of a lamp due to failure of the cooling water supply, I provide a local individual water supply including means for circulating the water, cooling the water and recirculating it through the lamp in a continuous cycle, so that the continuity of operation of the lamp will not be dependent upon some outside source of cooling water. Furthermore, as the lamp, due to its heavy current carrying capacity, will be almost immediately damaged, if not destroyed, upon the failure of the cooling water supply or upon the stoppage of a circulation thereof, I provide an arrangement whereby the current supplied to the lamp unit is immediately cut off upon the failure of the cooling system. Conversely the system is so arranged that current can be supplied to the lamp unit only after the cooling system has been put into operation. This phase of the invention is applicable not only to lamp units having a local source of cooling fluid but also to units supplied with cooling water from the city mains, or any other source.

The above mentioned, and other objects and advantages, and the manner of attaining them will appear more clearly from the following description of a preferred embodiment of the invention, taken in conjunction with the accompanying drawings.

Referring to the drawings, Fig. 1 illustrates in vertical cross-section a lamp unit constructed in accordance with my invention.

Fig. 2 is a plan view of the lamp unit shown in Fig. 1.

Fig. 3 is a horizontal sectional view taken substantially midway between the plates 5 and 11 as seen in Fig. 1.

Fig. 4 is a view looking at the bottom of the unit shown in Fig. 1.

Fig. 5 shows a modified structure of a portion of the light unit shown in Fig. 1.

Fig. 6 shows a lamp unit having a local cooling water supply and a safety switch for controlling the current supply.

In the drawings, reference numeral 1 indicates a bell-jar like receptacle or bowl of glass or other light transmitting material having a flange portion 2 to which is clamped, by means of a ring 3 and thumb screws 4, a base plate 5. Placed between the ring 3 and the flange 2, and the base plate 5 and the flange 2, are two gaskets 6 and 7 respectively, which serve to make a water tight joint between the bowl 1 and the base plate 5. Positioned within each aperture 8 cut in the base plate 5, is a cylindrical tube 9 which is secured to the base plate in water tight fashion. Attached to the bottom of tube 9, by means of suitable apertures 10 therein, is a spacing plate 11, which plate is properly spaced from, and supported by base plate 5, through the agency of a plurality of rods 12 inserted between the base plate and the spacer plate. Passing upwardly through the center of the spacing plate and base plate is a tube 13 which serves to conduct water from the inside of the bowl 1. Water is passed into the bowl 1 by means of another tube, 14, which also passes through the spacing plate and base plate. These two tubes are united with the base plate in some suitable water tight fashion, as by soldering. Positioned within the bowl 1 are a plurality of helically coiled gas filled light tube units 15, each comprising a pair of columns 16 terminating in large electrode containing portions 17 which are positioned within the tubes 9. Packed between each of the portions 17 and the cooperating tube 9 is a quantity of heat insulating material 18 which may be asbestos or the like. This packing serves to center the electrode containing portions 17 in the tubes 9 and also serves to keep the walls of these portions hot in order that the gases occluded by any sputtering of the electrode material will be given off as much as possible thereby reducing the attenuation of the gaseous atmosphere. As is well known, sputtering of the electrode material of such a tube forms a metallic coating inside the tube walls adjacent to the electrodes. This metallic coating contains occluded gases which can be liberated, to a certain degree, by the application of heat. As I provide means for preventing heat radiation from the glass wall of the tube, a certain portion of the gas occluded by the sputtering of the electrode material will be liberated as an incident of the operation of the tube, due to the heat generated thereby. In the two ends of each of the tubes 9 is placed a quantity of sealing material 19, such as sealing wax or other compound which may be applied in any suitable manner, as by flowing in in a molten condition. Serving to support the light tube units 15 is a clamping member 20, which is secured to the end of the tube 13 by means of nuts 21. The tube 13 is threaded for a portion of its length so that the clamping member 20 may be adjusted to the height of the particular light tube unit which it is intended to support. Where a pair of tube units 15 are employed and these units happen to be of different heights, two clamping members 20 may be

employed, one for each unit. Positioned within the enlarged portions 17 of the tube units are suitable electrodes 47 which are preferably of the water cooled type such as is disclosed in my copending application Serial No. 241,062, filed December 19, 1927. Extending out through insulating compound 19 at the bottom of the tubes 9 are tubes 22 which serve to conduct cooling fluid to and from electrodes. Attached to the various tubes 22 and to the tubes 13 and 14 are suitable rubber connecting pipes, the function of which will be explained more fully hereinafter.

Tubes 9 and plates 5 and 11 may be constructed of metal, such as brass, in which case the tubes can be secured to the plates by means of solder, or the tubes might be held in position by means of screw threads placed on the tubes and the cooperating plates. The plates 5 may advantageously be polished or coated with reflecting material in order to reflect the light rays striking thereon. Instead of making the plates and tubes of metal, they might be made of insulating material such as bakelite, lavite, or other similar material, in which case it might be desirable to secure the tubes to the plates by means of suitable flanges, 48, on the tubes, gaskets, 28, and nuts, 29, as indicated in Fig. 5.

The construction of the base plates, spacer plate and tubes of insulating material has the advantage that all parts of the tube, carrying high potential current, are completely insulated from one another and from surrounding objects. This arrangement is of particular interest as by means of it the operator of such a unit is protected against accidental contact with the high potential used to energize the tube. By virtue of this arrangement, taken in conjunction with a circuit arrangement to be disclosed hereinafter operation of the unit is made very safe and substantially fool-proof.

While I prefer to use a ring member 3 for clamping the bowl 1 to the base plate 5, the ring might be dispensed with and C clamps substituted therefore.

Referring more particularly to Fig. 4, the manner of conducting the cooling fluid to and from the lamp unit will be made plain. Each of the electrode containing portions of the light tube unit is provided with a pair of tubes 22 for conducting the cooling fluid to the electrodes. These pipes 22 may be connected in series in the manner indicated in Fig. 4 so that the water flows through the electrode structures successively in the direction indicated by the arrows on the drawings or may be connected in parallel if desired. As the tubes 22 are made of metal so as to seal thru the tube wall and to serve as lead-in wires for the electrodes of the light tube units, the pipes for carrying water from one of these tubes 22 to another is made of insulating material, such as rubber, so that there will be no short circuiting of the current supplied to the electrodes. It will be noted that in Fig. 4, pipes 23, for conducting the water which flows through the electrode structures, are shown as coupled in parallel with the pipes 24 which conduct the water into and out of the bowl 1 and to a pair of water mains 25 which serve to conduct water to and from the lamp unit as a whole. While the water may be circulated in either direction, I prefer to circulate it in such manner that tube 13 is the outlet, as in this manner all air is removed from the bowl, when the lamp is operating in an upright position. Attached to one of the tubes 22 of each one of the electrode portions of the light tube units is a conductor 26. These conductors are interconnected in such maner that the light tube units operate either in series or in parallel with each other and are connected to a suitable source of potential in a manner to be described more fully hereinafter. Where two or more tube units are employed they may be either connected in series or parallel as desired for any particular installation.

In Fig. 6, reference numeral 30 indicates a water-cooled light unit such as shown in Fig. 1, positioned within a reflector 27 and mounted on a base plate 31. This unit 30 is supplied with cooling water through a pair of tubes 32 and 33, which are connected to a cooling radiator 34, and circulating pump 35, by means of hose connections 36, 37 and 38. The two tubes 32 and 33 are intended to represent schematically all of the various pipes supplied by the two mains 25, as shown in Fig. 4 and it is to be understood that instead of using merely two tubes 32 and 33 that there may be as many or more used, than shown in Fig. 4, connected in the manner described heretofore. Likewise for the sake of convenience these two tubes 32, 33 have been indicated as two terminals for conducting current to the lamp unit 30, the two tubes having connected thereto the secondary 39 of a step-up transformer 40 which is connected to a current supply line 41 through an automatic circuit breaker 42. The pump 35 is driven by a motor 43 which is supplied, through a switch 44, with current from line 41. The circuit breaker 42 is of the well known type wherein the line circuit is closed or opened by means of a relay, through the operation of a remote control button. In this figure the remote control button for opening or closing the circuit breaker 42 is indicated at 45 and is, in the present case, a pressure operated switch responsive to either an increase in pressure of the water in hose connection 38 or decrease in pressure therein, above or below certain predetermined limits.

The operation of the system is as follows: Upon closure of the switch 44, line current is

supplied to the motor 43 which drives the pump 35 and starts circulating water, contained in the radiator 34 and the rest of the system, circulating. The water is drawn by the pump 35 from the radiator 34 through the hose connection 37 and forced through the hose connection 38 to the lamp unit 30, and back to the radiator through the hose of connection 36. As the path of the water through the light unit 30 is devious and somewhat constricted there is necessarily an appreciable pressure in the hose connection 38. Interconnected in this connection 38 is the pressure operated switch 45 which may be of any ordinary type such as the Bourdon tube type or diaphragm type. This switch is interconnected with the electromagnetic circuit breaker 42 in a well known manner so that when the water pressure in the hose connection, upon starting of the motor 43 and the pump 45, rises to a certain predetermined value the electromagnetic circuit breaker 42 is energized and the circuit to transformer 40 closed. The circuit of transformer 40 now being closed, the current is supplied to the lamp unit 30 and the operation thereof initiated. Should the pressure in the connection 38 drop, due to a failure of the water supply, the switch 45 will immediately operate to open the circuit breaker 42 and cut off the current supplied to the light unit 30. Likewise, should the water pressure in the connection 38 rise above a certain predetermined value, due to clogging of the circulating system, the switch 45 will also operate to open the circuit breaker 42 in the manner heretofore described. By this arrangement operation of the lamp unit 30 is permitted to occur only when the cooling water is circulating through the system in the proper manner. Should sediment or mineral deposits clog the pipes of the cooling system in such manner as to reduce the flow of cooling water therethrough to a dangerous minimum, the circuit breaker 42 will be opened and the current to the said unit cut off. Likewise should the circulation of the water fail due to an insufficient supply of water in the radiator 34, or due to clogging of the intake of the pump 35, and the circulation of the water reduced to a dangerous value, the circuit breaker 42 will likewise be opened and the current to the lamp cut off. Furthermore, with this interconnection between the water circulating system and the current supply system, it is insured that the current shall not be turned on to the light unit before the cooling water circulating pump is started. The human element is thus eliminated and operation of the lamp unit made practically fool-proof. In order to insure the greatest certainty of operation of the switch 45 I have placed it in the connection between the pump and the lamp unit. The switch might be placed in either of the hose connections, 36 or 37, if desired, but in this case the pressure on the switch would be very much less, due to the water pressure drop in the lamp unit. Likewise the pump 35 might be placed in the hose connection 36 but this arrangement would cause the pump pressure to be applied to the radiator 34.

As with this type of lamp unit relatively high potentials, in the neighborhood of several thousand volts, are applied to the light tube it is necessary to take precautions so that persons operating the unit will not be injured by the contact with live wires or exposed parts of switches and the like. With the system which I have described above, the secondary wires 46 of the step-up transformer 40, which carry the high potential, are connected directly to the terminals of the light unit without any interposed switch. These wires can therefore be enclosed within a protective sheath or conduit throughout their entire length from the transformer to lamp unit. The potential supplied by the line 41 may be of ordinary low commercial potential and such potential will be the only potential to which the operator of the lamp unit is exposed. The only switch which the operator has to operate is the motor switch 44 and this is connected to the low potential line. As the lamp unit in itself is insulated and as the two wires 46 and 47 may be totally enclosed in an insulating sheath and the transformer also enclosed in a protective housing or vault, the dangers incident to the operation of the lamp unit are reduced to a minimum.

While I have illustrated this lamp unit as containing a pair of light tubes 15 it is to be understood that more of such tubes may be utilized within the bowl, or if desired one unit alone may be used. As the lighting tube of this unit is coiled into a concentrated shape, it is possible to utilize a unit very effectively with a reflector such as 27. This lamp is particularly advantageous for use with a reflector as the light emitted from the lamp is obscured only slightly, as there is practically no opaque material positioned in in the front end thereof. As the light emitted from the unit is extremely brilliant due to the concentrated form of construction, it is possible to place the unit substantially at the focal point of a reflector, and hence to obtain maximum efficiency of reflection with a reflector of given size.

The specific form of the invention above disclosed is intended merely for the purpose of illustration and not in a limited sense, it being obvious that various modifications and adaptations such as would occur to one skilled in the art, may be made without a departure from the spirit of the invention, as set forth in the appended claims.

What I claim is:

1. In a high intensity lamp unit, a base plate, a glass bowl secured to said base plate

in water tight fashion, a coiled gas filled tube positioned within said bowl, electrodes for said tube, and means for circulating a cooling fluid through said bowl.

2. In a high intensity lamp unit, a base plate, a glass bowl clamped to said base plate in water tight fashion, a helically coiled gas filled tube positioned within said bowl and having electrode containing portions extending through said base plate, and said base plate having tubes extending therethrough for conducting a cooling fluid into and out of said bowl.

3. In a high intensity lamp unit, a glass bowl, a coiled electrical discharge tube positioned within said bowl, a base plate clamped in water tight fashion to the open side of said bowl, a plurality of openings in said base plate through which the terminal portions of said tube project, and means for circulating a cooling fluid through said bowl.

4. In a high intensity lamp unit, a glass bowl, an electrical discharge tube positioned within said bowl, a base plate secured to said bowl, an opening in said base plate, a tube positioned in said opening, a terminal portion of said electrical discharge tube positioned within said tube and surrounded by heat insulating material packed between the said portion and the wall of the said tube.

5. In a high intensity lamp unit, a glass bowl, an electrical discharge tube coiled in the form of a helix and positioned within said bowl, a closure secured to said bowl, a standard within said bowl attached to said closure and serving to support the said helix and prevent the same from vibrating.

6. A high intensity lamp unit according to claim 5 wherein the said standard is made in the form of a tube for the passage of cooling fluid.

7. In a luminous electrical discharge tube, fluid cooled electrode positioned within said tube and heat insulating means placed around the portion of said tube adjacent to said electrode.

8. In a high intensity lamp unit, a glass bowl, a helical coil gas-filled electrical discharge tube bent in the form of a hairpin positioned within said bowl, a closure for said bowl, and means for circulating a cooling fluid through said bowl.

In testimony whereof, I have signed my name to this specification this 30 day of December 1927.

WILLIAM F. HENDRY.