Feb. 4, 1969 KORO HAYASAKA ETAL 3,426,234

EXPLOSION-PROOF FLUORESCENT LAMP APPARATUS

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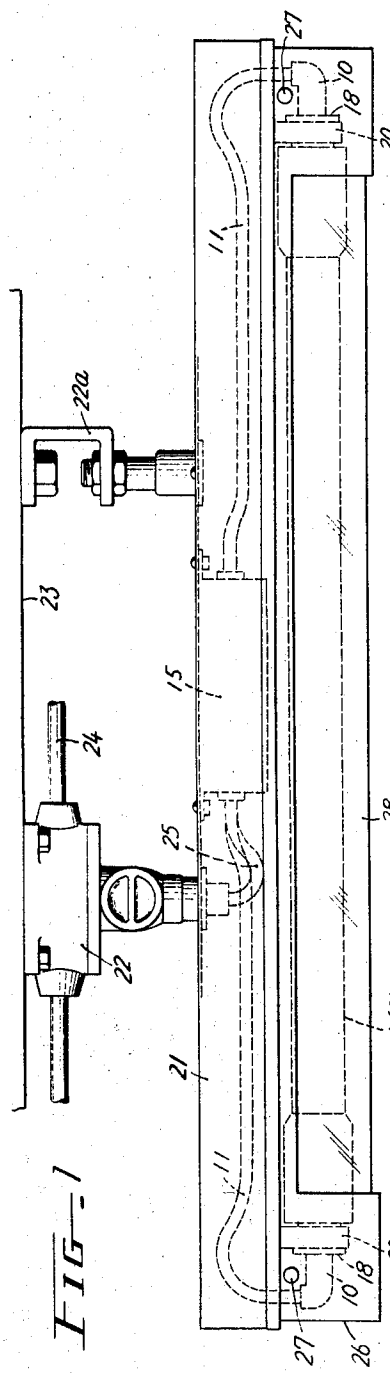


FIG-1

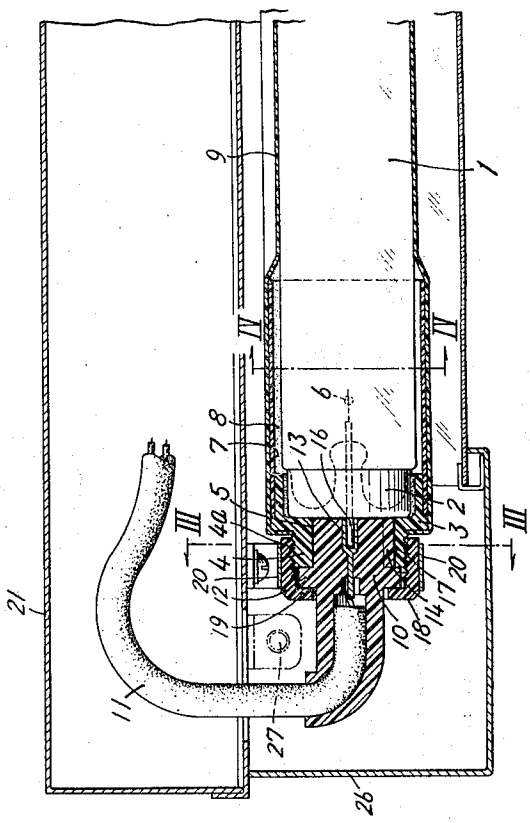


FIG-2

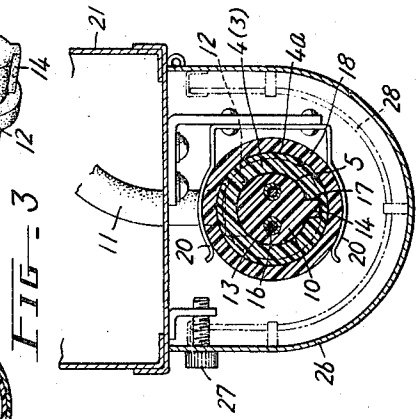


FIG-3

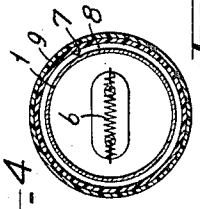


FIG-4

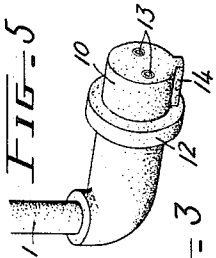


FIG-5

INVENTOR

Koro Hayasaka et al.

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EXPLOSION-PROOF FLUORESCENT LAMP APPARATUS

Koro Hayasaka, Tokyo, Fukuji Sato, Yokohama-shi, and Tosio Hattori and Takeshi Sato, Tokyo, Japan, assignors to Kabushiki Kaisha Aiden, Tokyo, Japan

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U.S. Cl. 313—312 12 Claims
Int. Cl. H01j 5/02, 19/54, 1/62

ABSTRACT OF THE DISCLOSURE

A lamp having a lamp tube covered with a light permeable covering tube which is in contact with the entire tube except in the region of the filaments at the ends of the tube where sleeves mounted on end caps shield the covering tube from the filaments and also form with the lamp tube, and covering tube, an enclosed air space.

This invention relates to fluorescent lamp apparatus and associated techniques.

The present invention has as objects thereof the provision of an explosion-proof fluorescent lamp apparatus which can be safely used in an inflammable explosive gas atmosphere and the provision of techniques to prevent lamp breakage and corrosion and to facilitate assembling and disassembling operations.

According to the present invention, the glass tube of a lamp is covered throughout almost the entire length thereof by a transparent or semitransparent synthetic resin tube, an air space being formed outside of the glass tube. Furthermore, the lamp has metallic lamp caps each having an end cap integrally combined therewith and having an outwardly extending tube forming therein a socket receiving mouth, a socket connected through a leading wire to a ballast being inserted in and mechanically combined with said receiving mouth to provide for electrical connection with the lamp. The lamp thus formed is attached through supporting clip means to a lamp casing.

One embodiment of the invention will next be explained with reference to the accompanying drawing in which:

FIGURE 1 is a side view of a fluorescent lamp apparatus according to the invention;

FIGURE 2 is a sectional side view of one end portion thereof;

FIGURE 3 is a sectional view taken along line III—III in FIG. 2;

FIGURE 4 is a sectional view taken along line IV—IV in FIG. 2; and

FIGURE 5 is a perspective view of a socket portion of the apparatus.

More particularly, the apparatus in the drawing comprises a glass tube **1** forming a lamp with metallic lamp caps **2** (FIG. 2) at both ends thereof. An end cap **3** is mounted on and integrally combined with each cap **2** by an adhesive agent or cement. Each cap **3** has an outwardly and axially extending tube **4** or cylindrical projection with a socket receiving mouth **5** therein. Each end cap **3** including its tube **4** is made of an anticorrosion, non-inflammable or substantially incombustible, electrically insulative material such as vinyl chloride or the like.

There is provided, at each end portion of the glass tube **1** and for surrounding its filament **6**, a sleeve **7** made of a hard material such as polycarbonate fixed at its outer end in cantilever manner to the end cap **3** so that there is formed an air space or air chamber **8** between the glass tube **1** and the sleeve **7**. Extending over and in close contact with the glass tube **1**, the sleeves **7** and the end caps **3**, is a transparent or semitransparent (light permeable) synthetic resin covering tube **9** to render the lamp explosion-proof.

Elbow shaped sockets **10** each have a lead wire **11** embedded therein and connected to a ballast **15**. Each socket **10** has a flange **12** radially projecting from the outside surface thereof. Each socket **10** is inserted into the socket receiving mouth **5** of the corresponding end cap **3** with tubular terminal **13** thereof engaged with and connected to terminal pins **16** of the lamp. The inserted relation between the two is, in the preferred case, regulated in that the socket **10** is provided on its outer surface with a projection **14** engageable in a groove **17** in the inner surface of the receiving mouth **5**. Thus, engagement between the terminal pieces **13** and the terminal pins **16** is thereby facilitated and insured. For avoiding possible danger due to use of a lamp other than the explosion-proof type of this invention, the engaging construction between the socket **10** and the lamp can be of a particular and exclusive conformation.

The lamp is made explosion-proof in that any air gap or clearance formed between parts **4** and **10** can be readily held, in this construction, to a volume below 2 cc. The socket **10** is fixedly coupled to the lamp, in the illustrated example, in that a cap nut **18** having a flange **19** engaging with the outer surface of the flange **12** of the socket **10**, is in threaded engagement with a thread **4***a* formed in the outer surface of the tube **4** of the end cap **3**. This connecting mechanism can be of various other types such as those including screws, pins or the like.

The lamp thusly connected to the socket **10** is held by its cap nuts **18** by a lamp casing **21** by means of a pair of resilient or elastic clips **20**. The lamp casing **21** is attached to a fixed surface such as as a ceiling by means of a pair of attaching elements **22** and **22***a*, and a lead wire **25** from an electric source line **24** passing through the element **22** is connected to the ballast **15** mounted in the lamp casing **21**.

A casing closure **26** is disposed below the lamp casing **21**, and is hingeably attached thereto at one side edge portion for being freely closed and opened. Closure **26** is locked in its closed position by means of screws **27**. A semicylindrical transparent plate **28** of glass, synthetic resin or the like is attached to the closure **26** to protect the lamp. The lead wires **11** and **25** are preferably, for example, vinyl cab type cables.

In the apparatus as illustrated, the lamp can be easily separated for replacement since the lamp can be removed together with the sockets **10** from the clips **20** and then the cap nuts **18** removed from the end caps **3**. The lamp can be easily assembled for use in the same manner.

According to the invention as has been noted, the fluorescent lamp is covered throughout almost the whole length thereof by the synthetic resin tube **9** so that damage of the lamp and corrosion of the metallic lamp caps is prevented. Moreover, no pieces are scattered even if the glass tube **1** were to be broken. Even if the glass tube **1** is cracked, penetration of ambient air or gas through the resulting cracks is prevented.

The capacity of the air space **8** formed outside of the glass tube **1** is determined so that, if the glass tube **1** is cracked or broken, the air within the air space will enter the interior of the glass tube **1** and be sufficient so that the electric discharge is stopped and the filament is burned out or lowered in temperature. Thereby, external inflammable gas is prevented from catching fire. The use of the sleeve **7** not only facilitates the formation of the air space **8** but also prevents the covering tube **9** from being deteriorated by heat to insure keeping the shape of the space **8**. The tube **9** moreover can be provided if necessary with

an inner face having, for example, axial hairline channels to enable air to travel from space **8** to cracks in tube **1** at locations between the spaces.

Additionally, according to the present invention, the lamp is provided at each metallic lamp base with the end cap **3** having the guide tube **4** with the receiving opening **5** and the socket **10** is mounted and connected therein. Accordingly, the electric connecting portion constituted by the engagement between the terminal pieces **13** and the terminal pins **16** is covered completely and any gap therein will have a volume below 2 cc., so that even if a spark is produced at the connecting portion, the same does not leak to the outside, thus making the use of the lamp completely safe. Additionally, the connection thereof is not loosened even by external shock or vibration and the assembly and disassembling thereof can be effected very easily. Thus, there is obtained a completely explosion-proof fluorescent lamp apparatus by the use of the explosion-proof fluorescent lamp and the socket mechanism.

As for the materials to be used for the covering tube **9**, the invention proposes synthetic resins such as, for example, as follows:

(1) Polyvinyl chloride
(2) Polyvinyl acetate
(3) Polyethylene
(4) Fluorocarbon
(5) Polyacetal
(6) Polycarbonate
(7) Silicon
(8) Polypropylene
(9) Methacrylate

It is preferred that the covering tube **9** be brought into contact with the periphery of the glass tube **1** by the shrinkage in the course of application of heat.

It has been experimentally ascertained that a volume of air space **8** of from about 10 to 20 cc. is enough to accomplish the purpose of burning out the filament not only for lamps of the 20 watt type but also for lamps of the 40 watt type. The burning out of the filament is essential when the lamp is of glow-start type. The burning out of the filament, however, is not always necessary since only the stopping of the electric discharge is necessary if the lamp is of the manual-start or rapid-start type. For this latter purpose, only a volume of the air space of about 1 cc. is sufficient since about 1 cc. or less is sufficient to cause a stopping of the electric discharged. Thus, the volume of the air space **8** may be widely changed, but in practice the same would be from about 10 to 20 cc. for both 20 watt and 40 watt lamps.

What is claimed is:

1. Lamp apparatus comprising a lamp tube having opposite ends and including an electrically operated filament at each end, a lamp cap at each end of the tube by which electrical connection is made with a respective filament, end caps each including a first portion encircling and mounted on one of said lamp caps, a sleeve supported on each end cap and encircling and spaced from the lamp tube at a respective end thereof, a light permeable protective covering tube encircling said lamp tube, said covering tube being in peripheral contact with the outer surface of the lamp tube between the sleeves and encircling said sleeves at the ends of the lamp tube to form enclosed air spaces at said ends, and electrical connection means engaged with the end caps for connection with said filaments.

2. Apparatus as claimed in claim **1**, wherein each end cap includes a cylindrical projection extending axially from the corresponding lamp cap.

3. Apparatus as claimed in claim **1**, wherein said sleeves are rigid and isolate the covering tube from said filaments thereby shielding the covering tube from said filaments.

4. Apparatus as claimed in claim **1**, wherein the covering tube is of synthetic resin.

5. Apparatus as claimed in claim **2**, comprising locking means detachably locking the electrical connection means to each said projection.

6. Apparatus as claimed in claim **5**, comprising spaced supporting means detachably accommodating said locking means at opposite ends of the lump tube.

7. Apparatus as claimed in claim **5**, wherein the electrical connection means includes elbow shaped members having thereon radial flanges which are sandwiched between the locking means and cylindrical projections and electrical conductors extending through said members.

8. Apparatus as claimed in claim **6**, comprising a support casing including a hinged semicylindrical plate within which said lamp tube is accommodated, said supporting means being mounted on said casing.

9. Apparatus as claimed in claim **6**, wherein the covering tube is cupped around said end caps at the ends of the lamp tube.

10. Apparatus as claimed in claim **5**, wherein the sleeves are mounted in cantilever manner on the first portions of said end caps.

11. Apparatus as claimed in claim **5**, comprising cooperating orientation means on said connecting means and cylindrical projections.

12. Apparatus as claimed in claim **5**, comprising cooperating pin and socket means on said connecting means and lamp caps.

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JAMES W. LAWRENCE, *Primary Examiner.*

PALMER C. DEMEO, *Assistant Examiner.*

U.S. Cl. X.R.

24—11.4; 313—109; 339—5