July 18, 1967 R. W. IRELAND 3,331,674

FLUORESCENT LAMP BULB SPIRAL GROOVE FORMING DEVICE

Filed Nov. 29, 1963

FIG. 1.

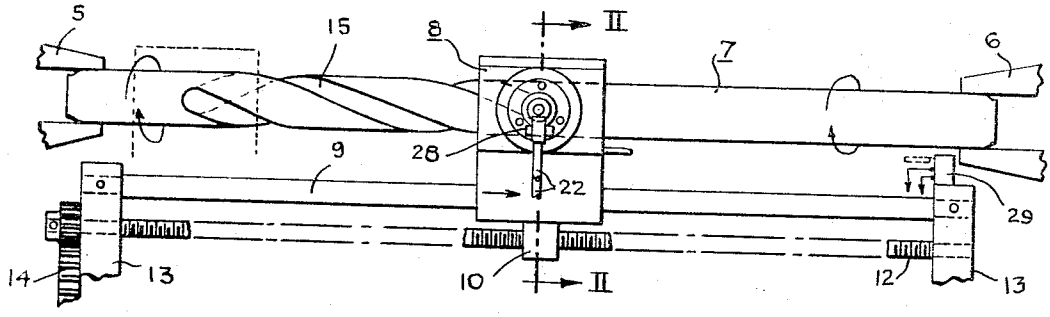


FIG. 2.

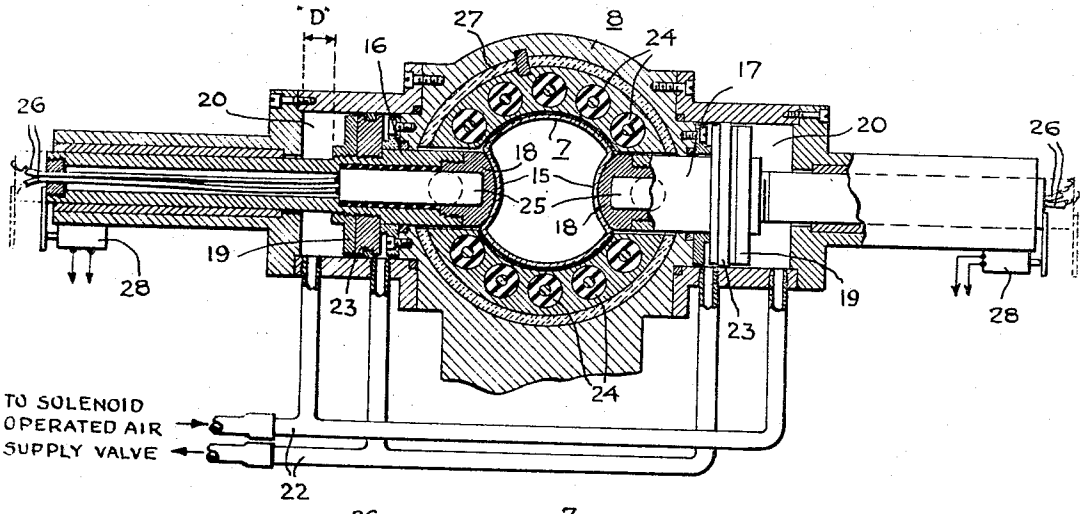
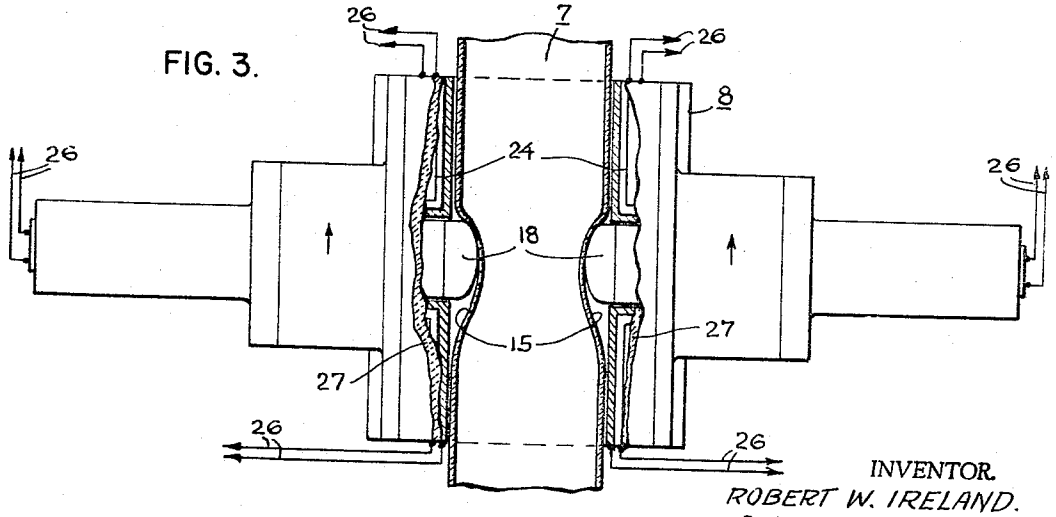


FIG. 3.



INVENTOR.
ROBERT W. IRELAND.
BY
ATTORNEY

United States Patent Office

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FLUORESCENT LAMP BULB SPIRAL GROOVE FORMING DEVICE

Robert W. Ireland, Mountain Lakes, N.J., assignor to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

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The present invention relates to apparatus for the forming of a spiral groove in the tubular vitreous envelope for a fluorescent electric lamp.

In order to increase the light output from a tubular fluorescent lamp it is now well-known in the art that by increasing the over-all length of the discharge path the total light output from such lamp is thereby increased. This desideratum has been heretofore accomplished in several ways, one of which comprises the formation of opposed indentations extending in a spiral path substantially from one end of the tubular envelope to the other. It is the formation of these spiral grooves at a relatively high production rate with which the present invention is concerned.

It is accordingly the object of the present invention to provide an apparatus for the forming of spiral grooves substantially from one end of the tubular vitreous envelope for a fluorescent lamp to the other.

Another object of the present invention is the provision of an apparatus for forming opposed spiral grooves which extend substantially from one end to the other of a tubular vitreous envelope for a fluorescent electric lamp.

The foregoing objects of the present invention, together with other objects which will become apparent from the following description, are accomplished by the provision of an apparatus wherein the tubular vitreous envelope for a fluorescent lamp is rotated about an axis in a predetermined plane. During such rotation the tubular vitreous envelope is heated to a sufficiently high softening temperature that a die engaging such envelope and with relative movement therebetween, causes the formation of opposed grooves in the envelope substantially from one end thereof to the other.

The present invention may be more readily understood by reference to the accompanying drawing wherein:

FIGURE 1 is a fragmentary side elevational view of the groove-forming apparatus of the present invention,

FIG. 2 is a cross-sectional view taken on the line II—II of FIG. 1,

FIG. 3 is a fragmentary top plan view partly in section and showing the flow of the softened vitreous tubing about the groove-forming die during its movement longitudinally of the rotating tubular vitreous envelope.

Referring now to the drawing in detail the apparatus as therein shown comprises a pair of clamps **5** and **6** securely gripping each end of a tubular vitreous envelope **7** for a fluorescent lamp. Since these clamps **5** and **6** are suitably rotated by driving mechanism (not shown) such envelope **7** is rotated clockwise, as viewed from the right-hand end, in the direction as indicated by the arrows in FIG. 1. A grooving die **8** surrounds the tubular vitreous envelope **7** and is movable longitudinally thereof on a pair of supporting tracks **9** by threaded engagement of a die extension **10** with a threaded shaft **12** secured along with the supporting tracks **9** to suitable brackets **13**. This

threaded shaft **12** is rotated by suitable gearing **14** which may be driven by the same source as that for rotating the clamps **5** and **6**. Accordingly, upon rotation of the threaded shaft **12** the die **8** is moved longitudinally of the tubular envelope **7**, in the direction indicated by the arrow from its starting position as shown by the dotted lines in FIG. 1 adjacent one end of the envelope, to substantially the opposite end thereof, at which time rotation of the envelope **7** and threaded shaft **12** ceases. The envelope **7** with the grooves **15** formed therein is then removed from the clamps **5** and **6** and the die **8**, and the latter returned to its starting position preparatory to the insertion of another envelope **7** therein for grooving.

By reference now more specifically to FIG. 2, it will be noted that the groove-forming die **8** is provided with a pair of oppositely disposed coaxially reciprocal pistons **16** and **17**, the outmost ends **18** of which depress the heat-softened tubular vitreous envelope **7** to form the grooves **15**, as seen in FIG. 3, as the envelope rotates and the die travels along the supporting tracks **9** and threaded shaft **12** in the direction indicated by the arrows in FIG. 3. The inner ends of the pistons **16** and **17** are provided with enlarged heads **19** which are reciprocally movable in the respective cylinders **20**. In order to cause the simultaneous movement of the pistons **16** and **17** toward and away from each other each cylinder **20**, on opposite sides of each enlarged piston head **19**, is carried through suitable conduits **22** to be connected to a source of fluid pressure, such as air, or the like, upon energization of a solenoid-operated air-supply valve (not shown). Since the total over-all movement of these pistons **16** and **17** are accordingly limited to the distance "D" shown in FIG. 2, which in turn is dependent upon the threaded position of the cylinder sealing-ring **23**, this determines the depth of the resulting groove **15**.

For the purpose of heating the tubular vitreous envelope **7** to a temperature approaching its softening point, it will be noted that the die **8** is provided with a plurality of electrical heating elements **24** peripherally disposed about its center opening and through which the vitreous envelope **7** passes. Likewise each piston **16** and **17** is provided with electrical heating elements **25** centrally disposed therein, with all such heating elements being connected to a suitable source of electrical energy by means of conductors **26**. In order to minimize heat loss by conduction and radiation the grooving die **8** is provided with a heat-insulating liner **27**, as shown in FIGS. 2 and 3. A pair of serially connected normally-open switches **28** (FIG. 2) are provided for connecting the driving motor (not shown) to its electrical supply source for causing rotation of the clamps **5** and **6** and hence the vitreous envelope **7** as well as the threaded shaft **12**, at the proper time.

In addition, a normally-closed switch **29**, also connected in the energizing circuit for the driving motor, is mounted on the bracket **13** adjacent the end of the envelope **7**. Accordingly, when the grooving die **8** reaches the limit of its travel upon completely grooving the vitreous envelope **7**, such die **8** causes opening of the switch **29** with attendant deenergization of the driving motor and cessation of rotation of the grooved envelope **7** and threaded shaft **12**. During operation of the apparatus a predetermined fluid pressure is applied to the pistons **16** and **17** through conduits **22** of sufficient magnitude to press the groove **15** in the vitreous envelope

7 when heated to its softening temperature but which is of insufficient magnitude to cause cracking of the unheated envelope. Thus as the vitreous envelope 7 is being heated by the elements 25 the piston ends 18 are gradually forced their maximum depth into the vitreous envelope 7 as it softens. Thereupon the movement of the pistons 16 and 17 causes closure of the normally-open serially connected switches 28 which starts the driving motor with attendant rotation of the heated vitreous envelope 7 and the threaded shaft 12, until such rotation is stopped by opening of the switch 29 upon the grooving die 8 reaching the limit of its travel and at the same time the solenoid-valve is operated to cause retraction of the plungers 16 and 17 from the groove.

It should thus become obvious to those skilled in the art that an apparatus has been herein shown and described for the forming of a spiral groove in a tubular vitreous envelope for a fluorescent lamp. Moreover, in the specific modification of the present invention such grooving actually comprises a pair of oppositely disposed spiral grooves extending substantially from one end of such vitreous envelope to the other end of a predetermined depth.

Although one specific modification of the present invention has been shown and described, it is to be understood that still further embodiments may be made without departing from the spirit and scope of the appended claims.

I claim:

1. An apparatus for the forming of a spiral groove in a tubular vitreous envelope for a fluorescent lamp comprising:

(a) means for supporting said vitreous envelope at each end thereof,

(b) electrical heating means surrounding said envelope and operable to raise said vitreous envelope to a softening temperature,

(c) a grooving die disposed about said envelope and provided with projection means for grooving the heat-softened vitreous envelope,

(d) and means operable to simultaneously cause rotation of the end supporting means and envelope carried thereby and movement of said die longitudinally of said heat-softened envelope to form a spiral groove extending substantially from one end thereof to the other.

2. An apparatus for the forming of a spiral groove in a tubular vitreous envelope for a fluorescent lamp comprising:

(a) means for supporting said vitreous envelope at each end thereof,

(b) a grooving die including heating means surrounding said envelope for heating said envelope to a softening temperature, said grooving die having fluid pressure actuated projections engaging the heat-softened envelope,

(c) and means operable to simultaneously cause rotation of the end supporting means and envelope carried thereby and movement of said die longitudinally of said heat-softened envelope to form a spiral groove extending substantially from one end thereof to the other.

3. An apparatus for the forming of a spiral groove in a tubular vitreous envelope for a fluorescent lamp comprising:

(a) means for supporting said vitreous envelope at each end thereof,

(b) a grooving die surrounding said envelope having projection means subject to fluid pressure to force said projection means into engagement with said envelope,

(c) a plurality of heating elements carried by said die and peripherally disposed about said envelope to heat the latter to a softening temperature with attendant movement of said pressurized die projections to form indentations in said heat-softened envelope,

(d) and means operable to simultaneously cause rotation of said envelope and movement of said die longitudinally thereof to progressively heat said envelope to a softening temperature with said die projections converting the initial indentations therein into spiral grooves extending substantially from one end of said envelope to the other.

4. An apparatus for the forming of a spiral groove in a tubular vitreous envelope for a fluorescent lamp comprising:

(a) means for supporting said vitreous envelope at each end thereof,

(b) a grooving die surrounding said envelope provided with projections movable into engagement with said envelope,

(c) a plurality of heating elements carried by said die and peripherally disposed about said surrounded envelope to heat the latter to a softening temperature,

(d) fluid pressure means connected to the movable projections of said die and operable to force the end of such projections into the heat-softened wall of said envelope as the latter is raised in temperature by said heating elements,

(e) and power means operable to simultaneously cause rotation of said envelope supports and the envelope carried thereby together with movement of said die longitudinally of said envelope to progressively heat the latter to a softening temperature with said die projections forming spiral grooves in said envelope extending substantially from one end thereof to the other.

5. An apparatus for the forming of a spiral groove in a tubular vitreous envelope for a fluorescent lamp comprising:

(a) means for supporting said vitreous envelope at each end thereof,

(b) a grooving die surrounding said envelope provided with projections movable into engagement with said envelope,

(c) a plurality of heating elements carried by said die and peripherally disposed about said surrounded envelope to heat the latter to a softening temperature,

(d) fluid pressure means connected to the movable projections of said die and operable to force the end of such projections into the heat-softened wall of said envelope as the latter is raised in temperature by said heating element,

(e) power means adapted to simultaneously cause rotation of said envelope supports and the envelope carried thereby together with movement of said die longitudinally of said envelope to progressively heat the latter to a softening temperature with said die projections forming spiral grooves in said envelope extending substantially from one end thereof to the other,

(f) and means associated with said die and operable by movement of the pressurized projections thereof to cause the operation of said power means.

6. An apparatus for forming a spiral groove in a tubular vitreous envelope for a fluorescent lamp comprising:

(a) means for supporting said vitreous envelope at each end thereof,

(b) a grooving die disposed about said envelope and including a pair of oppositely disposed fluid pressure controlled, coaxially reciprocable pistons movable into engagement with said envelope,

(c) a plurality of electrical heating elements within said die peripherally disposed about said envelope and adapted to heat the latter to its softening temperature,

(d) a source of fluid pressure connected to the coaxially reciprocable pistons of said die and operable

to force the end of such pistons into the heat softened wall of said envelope as the latter is raised in temperature by said heating elements,

(e) means associated with said pistons for selectively controlling the depth of penetration of said pistons into said envelope and hence the depth of said groove,

(f) and power means adapted to simultaneously cause rotation of said envelope supports and the envelope carried thereby together with movement of said die longitudinally of said envelope to progressively heat the latter to a softening temperature with said die pistons forming spiral grooves in said envelope extending substantially from one end thereof to the other.

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DONALL H. SYLVESTER, *Primary Examiner.*

S. LEON BASHORE, *Examiner.*

A. D. KELLOGG, *Assistant Examiner.*