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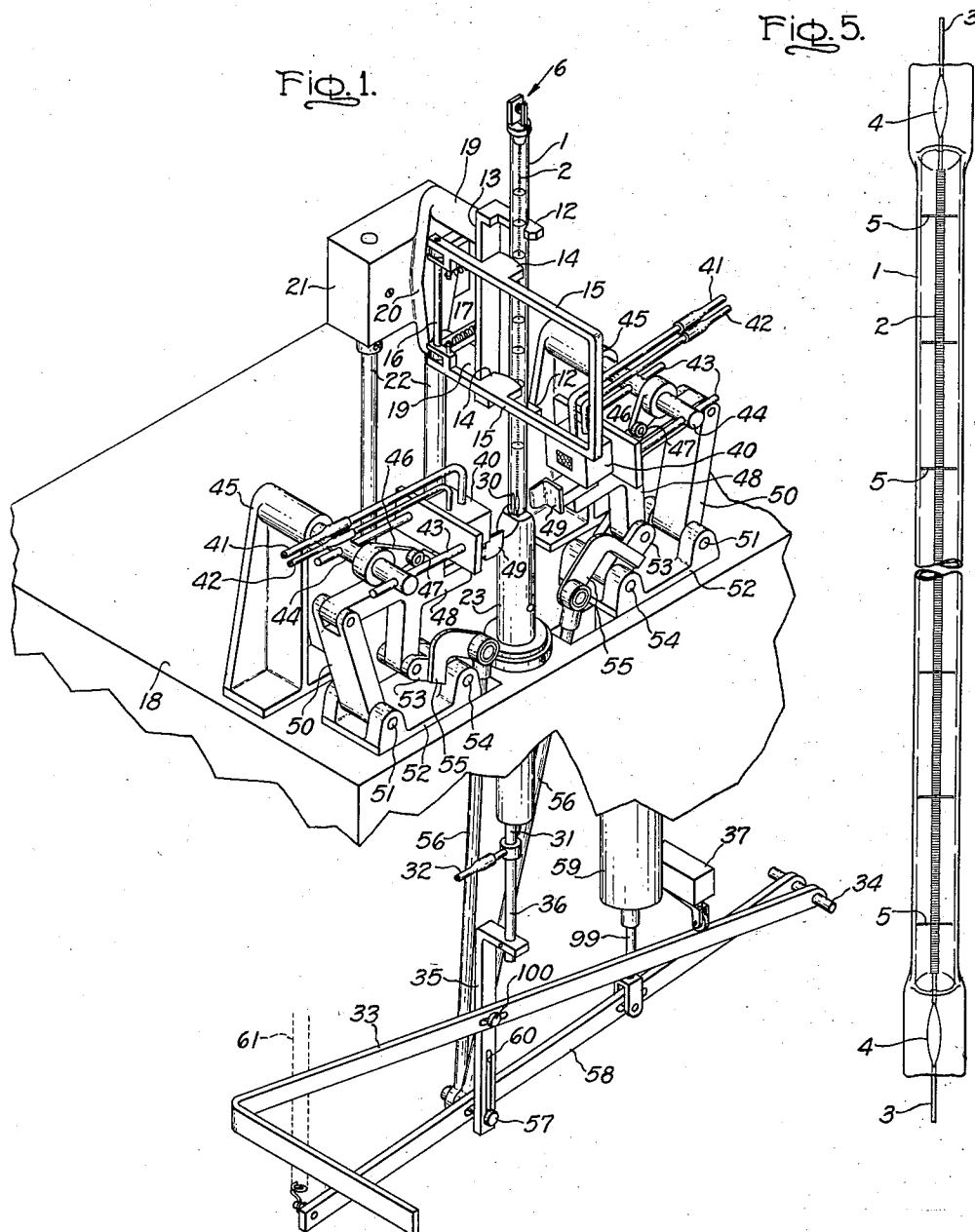
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ELECTRIC LAMP GAS FILLING AND SEALING METHOD AND APPARATUS

Filed Jan. 28, 1958

2 Sheets-Sheet 1



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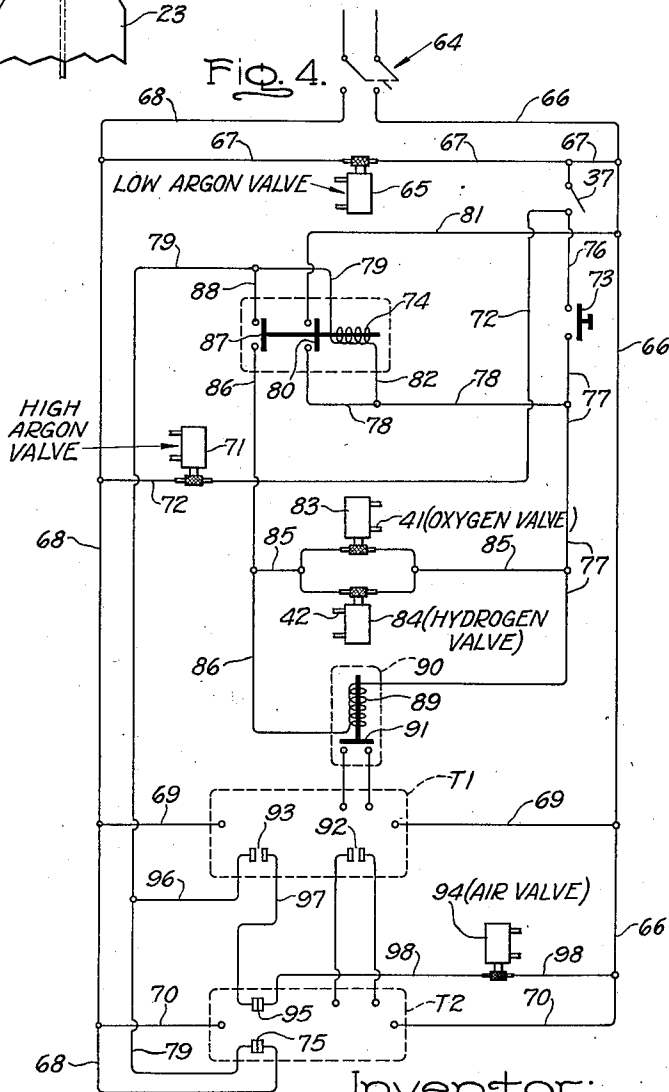
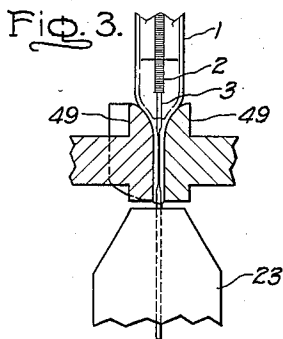
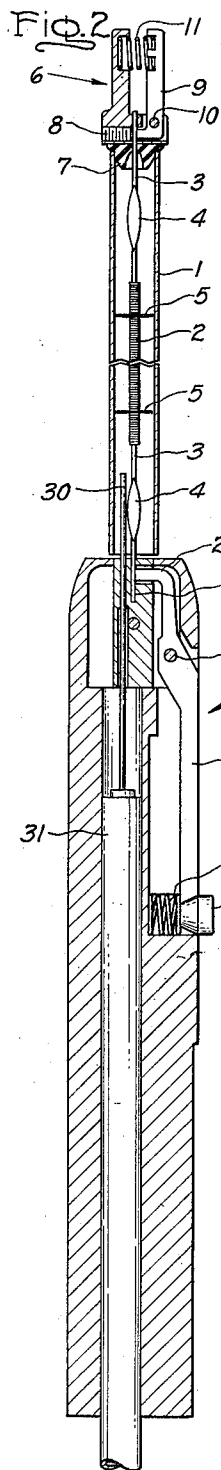
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2 Sheets-Sheet 2



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ELECTRIC LAMP GAS FILLING AND SEALING METHOD AND APPARATUS

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4 Claims. (Cl. 53—7)

My invention relates to a method and apparatus for gas filling and sealing electric lamps and similar devices.

In the manufacture of electric lamps having a sealed envelope of vitreous material and containing a filament or other electric energy translation element, it has been standard practice for many years to first assemble the filament and envelope with lead-in conductors connected to the filament and extending exteriorly of the envelope through a seal portion thereof and with an exhaust tube connecting with the interior of the envelope. The envelope was then exhausted and usually filled with an inert gas through the said exhaust tube which was then closed or tipped off by fusion to seal the envelope. More recently, certain types of tubular lamps have been made by simply flushing the envelope through a laterally extending exhaust or supply tube with an inert gas and then sealing the respective ends of the envelope and tipping off the supply tube, the exhaust step being eliminated.

It is an object of the present invention to provide a method and apparatus for flushing and sealing lamp envelopes without employing an exhaust or supply tube, thereby eliminating the usual tip left by the residue of such tube and also effecting a substantial reduction in time and materials.

In accordance with one aspect of my invention, I achieve the above object by virtue of an apparatus employing a lead wire holder or chuck for supporting one or more lead-in wires extending from an end of a lamp envelope suitably supported relative thereto, and by incorporating in association with the holder or chuck a hollow needle adapted to be inserted into the end of the lamp envelope and connected with a supply of inert gas to flush or purge the interior of the envelope. I further provide means to heat the end of the envelope to a plastic condition, and pinching jaws arranged to close and seal the end of the envelope about the lead-in wires, together with means whereby the said needle is retracted from the end of the envelope just prior to the closing of the jaws thereupon.

Further features and advantages of my invention will appear from the following detailed description of a species thereof and from the drawing wherein:

Fig. 1 is a perspective view of apparatus comprising my invention;

Fig. 2 is an elevation, in section, of a lead wire holder or chuck, and showing a lamp assembly in sealing relation thereto;

Fig. 3 is a fragmentary elevation, partly in section, of portions of the lead wire chuck and pinching jaws in sealing relation to an end of the lamp envelope;

Fig. 4 is a schematic wiring diagram of electrically actuated components of the apparatus; and

Fig. 5 is an elevation of a completed lamp as assembled in the apparatus.

The apparatus is illustrated herein as employed in the manufacture of tubular lamps of the double-ended type. The assembly of lamp parts prior to sealing, as illus-

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trated most clearly in Fig. 2, comprises a tubular envelope 1 of quartz, for example, and a filament assembly consisting of a coiled tungsten filament 2 having attached to each end thereof a lead-in conductor consisting of a molybdenum wire 3 having an intermediate flattened portion 4. The filament is provided with a plurality of spaced discs 5 of tantalum and of slightly smaller diameter than the inside diameter of the envelope, and which are secured to the filament to serve the dual functions of supporting the elongated filament in spaced relation from the walls of the envelope and also serving as a getter in the finished lamp to absorb traces of deleterious gases.

The filament assembly is held in place in the vertically disposed envelope by an apertured cap 6 which is threaded over the lead wire 3, and the upper end of the envelope is closed off by a rubber stopper portion 7 of the cap. The lead wire 3 is gripped between an adjustable screw 8 and the end of a clamping lever 9 which is pivoted on a pin 10 and held in a normally closed position by the expansion of a spring 11.

The lamp assembly is mounted in the apparatus by inserting the envelope 1 into a holder comprising notched jaws 12 (Fig. 1) carried by a bracket 13. The envelope is clamped in the jaws 12 by cooperating jaws or pads 14 on the arm portion 15 of a U-shaped bracket which has its ends pivoted on a pin 16 which is mounted in extensions of the bracket 13, the arms 15 being biased to closed position by springs 17 connected between pins on bracket 13 and on said arms. The said bracket 13 is supported in any suitable manner from a table top 18, as by pins or studs 19 extending from an arm 20 secured to a block 21 mounted on posts 22 extending from the table 18.

The lamp envelope 1 is placed in the holder jaws 12, 14 with its lower end adjacent the upper end of a lead wire holder or chuck 23 which is mounted on table 18 in vertical alignment with said jaws. The operator then grasps the lead wire 3 at the lower end of the envelope with a pair of tweezers and threads it into an axial aperture 24 (Fig. 2) in the upper end of the chuck 23. While inserting the lead wire into the chuck, the operator holds the upper end 25 of a clamping lever 26 in open position by pressing against a button 27 on the lower end thereof to pivot the lever about a pin 28 against the action of a spring 29 which normally biases the lever to a closed position. The operator then pulls the envelope 1 down within the jaws 12, 14 to bring the lower end of the envelope to within a few millimeters of the top of the chuck 23 as shown in Fig. 2.

The lamp envelope 1 is flushed and purged by a flow of argon gas through a hollow needle 30 which is mounted on a tube 31 for vertical and longitudinal reciprocation in the chuck 23 and is supplied with argon through a conduit 32. The needle 30 is raised into the envelope by upward pivotal movement of a lever 33 to the position shown in Fig. 1. The lever 33 pivots about a pin 34 to carry upward a bracket 35 which is connected thereto by a pin 36 and which is fastened to a shaft 36 which is connected to the tube 31 carrying the needle 30. The upward movement of lever 33 also actuates a normally open microswitch 37 which actuates a solenoid valve to turn on the high pressure flow of argon gas through the conduit 32 and needle 30. The flowing argon gas displaces the air from the envelope 1 in a stream flowing out the upper end of the envelope while cap 6 is momentarily raised. With its replacement to normal closed off position, the argon gas is then forced out the lower end of the envelope.

The lower end of the envelope 1 is then heated by flames from opposed burners 40 which are supplied with oxygen and hydrogen through conduits 41 and 42. As herein illustrated, the burners are each carried by a pair

of rods 43 which are mounted on a shaft 44 which pivots in a bracket 45 mounted on the table 18. The burner is in each case supported by an arm 46 which is fixed at one end to shaft 44 and carries at its other end a roller 47 which rests on a T-shaped cradle 48 constituting part of the pinching jaw mechanism.

After a predetermined period during which the lower end of the envelope is heated to plasticity by burners 40, with argon continuously flowing through needle 30, the said needle is retracted downwardly into the chuck 23 and the end of the envelope is pinched and sealed about the lead wire 3 by a pair of opposed pinching jaws 49.

The pinch jaws 49 are each carried by a cradle member 48 which is pivotally connected at its back end to one end of a link 50 which is pivoted at its other end on a pin 51 journaled in a bearing plate 52 on the table 18. The depending stem or arm portion of the T-shaped cradle 48 is pivotally connected to one end of a link 53 which is pivoted on a pin 54 journaled in the plate 52. The pinch jaws 49 are closed when the cradle 48 is rocked upwardly and forwardly by an arm 55 which is attached at one end to the link 53 and is pivotally connected at its other end to the upper end of a connecting rod 56 which is connected at its lower end to a pin 57 which engages a slot in the lever 58.

The lever 58 is pivoted on the pin 34 and is swung downwardly by an air cylinder 59 to pull down the rods 56 and thereby cause the pinch jaws 49 to close. At the same time, the pin 57, by engagement with the lower end of a slot 60 in the bracket 35, pulls the bracket downward to thereby retract the argon needle 30 just before the jaws 49 close upon the envelope 1. Also at the same time, the high pressure flow of argon is shut off when lever 33 is pulled down by bracket 35 to release the switch 37. Upon subsequent release of air pressure in the cylinder 59, the lever 58 is pulled upward by a spring 61 to cause the pinch jaws 49 to open; however, the argon needle 30 remains in its retracted position as the pin 57 slides upwardly through the slot 60 in bracket 35.

After the seal has been completed, the lamp is quickly removed from the holder jaws 12, 14, turned end-for-end, reinserted in the jaws 12, 14, the cap 6 is removed, the then lowermost lead wire 3 is threaded into the chuck 23, the envelope 1 is pulled down close to the chuck 23, and the operations of flushing, heating and pinching are repeated to form the finished lamp shown in Fig. 5 with both ends sealed to enclose the argon gas as the final filling gas.

Fig. 4 is a schematic diagram showing means for semi-automatic operation of the apparatus. With the apparatus at rest, wherein the jaws 49 are open and the needle 30 is retracted into the chuck 23, the operator closes the main switch 64 whereby a solenoid valve 65 is energized via conductors 66, 67 and 68 and is opened to admit a low pressure flow of argon gas to the conduit 32 and needle 30. At the same time, electronic timers T1 and T2 are connected into the circuit across main conductors 66 and 68 via respective conductors 69 and 70.

After the lamp assembly, including envelope 1 and attached cap 6, has been inserted in the holder jaws 12, 14 and the lower lead wire 3 clamped in chuck 23, the needle 30 is raised to the position shown in Figs. 1 and 2 by pivoting upward the lever 33 to raise the bracket 35, rod 36 and tube 31 carrying the needle 30. This movement of the lever 33 closes the microswitch 37 which energizes a solenoid valve 71 via conductor 72 to start a high pressure flow of argon through the conduit 32 and needle 30 to purge the air which flows through the envelope.

The operator then closes a push button switch 73 to energize the coil 74 of a holding relay through normally closed contacts 75 in timer T2; the circuit is made from main conductor 66 through conductor 67, switch 37, con-

ductor 76, switch 73, conductor 77, conductors 78 and 82, coil 74, conductor 79 and contacts 75 to main conductor 68. The contact 80 of the holding relay is thereby closed to maintain its coil 74 energized by way of main conductor 66, conductor 81, contact 80, conductors 78 and 82, coil 74, conductor 79, contacts 75 and main conductor 68.

At the same time that the holding relay 74 is energized, the flow of oxygen and hydrogen is started to the burners 40 by energization of solenoid valves 83 and 84 (Fig. 4) in the supply lines 41 and 42, the burners being ignited by pilot flames (not shown). The circuit to solenoid valves 83 and 84 is completed via conductors 66, 67, switch 37, conductor 76, switch 73, conductors 77, 85, 86, contact 87 of relay 74 and conductor 88; the circuit is maintained, after energization of relay coil 74, by the closure of its contact 80 to form a shunt circuit around switch 73 via conductor 81, contact 80, and conductor 78. Also at this time, the coil 89 of a relay 90 is energized by way of conductors 77 and 86 to close its contact 91 and thereby start the timer T1.

At the end of the predetermined time setting of the timer T1 its pairs of contacts 92 and 93 are closed. The closing of contacts 92 starts the timer T2. The closing of contact 93 actuates a solenoid valve 94 in the air line to the cylinder 59 by way of contacts 95 in timer T2 and conductors 96, 97 and 98. The actuation of air cylinder 59 causes the pinch jaws 49 to close upon the heated lower end of the envelope and seal it as shown in Fig. 3; it also effects retraction of the argon needle 30 from the envelope 1 just before the jaws 49 close upon it. The closing of the jaws 49 occurs when the rod 99 (Fig. 1), connected to the piston of air cylinder 59 and to lever 58, is depressed to pivot the lever 58 downward and pull the connecting rods 56 downward to cause the jaws 49 to be closed through arms 55, links 53 and arms 48. The downward pivoting of lever 58 also pulls downward the bracket 35 which is connected to needle 30 by rod 36 and tube 31. The high pressure supply of argon gas through needle 30 is terminated when lever 33 is pulled down by virtue of its connection to bracket 35 by pin 100 to thereby release the microswitch 37 and de-energize the solenoid valve 71. However, the low pressure flow of argon continues to provide a protective non-oxidizing atmosphere around the portion of lead wire 3 outside the envelope 1.

At the end of the predetermined time setting of the timer T2, its contacts 75 are opened to thereby de-energize the system including the coil 74 of the holding relay. Accordingly, the burners 40 are extinguished by virtue of de-energization of the oxygen and hydrogen solenoid valves 83 and 84, the relay 90 is de-energized, and the contacts 95 in timer T2 are opened to de-energize the solenoid valve 94 in the supply line to air cylinder 59 to thereby permit the lever 58 to be raised by spring 61 to open the pinch jaws 49. During the upward return of lever 58, the bracket 35 remains downward since pin 57 slides upward in slot 60 so that the argon needle 30 remains down.

The envelope 1 is then quickly removed from holder jaws 12, 14 and inverted and replaced in those jaws; the cap 6 is removed from the then lower end of the envelope 1, the then lower lead wire 3 is inserted and clamped in the chuck 23, the argon needle 30 is raised by pulling upward the lever 33, and the flushing and sealing cycle is repeated as described above. When these operations are performed within about 10 to 15 seconds there is not sufficient time to permit the heated portion of the envelope 1 to cool sufficiently to draw in an appreciable amount of air, so that the subsequent purging by flow of argon through needle 30 assures a purified atmosphere of argon in the envelope which is retained therein to constitute the permanent gas filling after the second end of the envelope has been sealed.

The finished lamp appears as shown in Fig. 5. However, it will be understood that, particularly when shorter

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envelopes 1 are employed, the apparatus may be employed to flush and seal single-ended envelopes having only one end thereof open.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In apparatus for flushing and sealing an electric lamp assembly, the combination of a chuck member adapted to hold a lead-in conductor, means to support a vitreous lamp envelope in alignment with said chuck and with an end thereof enclosing the portion of said conductor projecting from said chuck, means adjacent said chuck for heating the said end of the envelope to plasticity, pinching jaws mounted adjacent said chuck, a hollow needle mounted in said chuck for reciprocable movement into and out of said end of the envelope, means connecting said needle to a supply of flushing gas, and means for actuating said needle and said pinching jaws in synchronism to cause said needle to be retracted from the envelope into said chuck and to then immediately cause said jaws to close upon said end of the envelope to compress and seal it about the said lead-in conductor.

2. In apparatus for flushing and sealing an electric lamp assembly, the combination of a chuck member adapted to hold a lead-in conductor, means to support a vitreous lamp envelope in alignment with said chuck and with an end thereof enclosing the portion of said conductor projecting from said chuck, means adjacent said chuck for heating the said end of the envelope to plasticity, pinching jaws mounted adjacent said chuck, a hollow needle mounted in said chuck for reciprocable movement into and out of said end of the envelope, a supply of flushing gas adapted to be connected with said needle, means for moving said needle out of said chuck to project into an envelope held by said support means, means operable upon movement of said needle into the envelope to effect connection of said supply of gas with the needle, and means for actuating said needle and said pinching jaws in synchronism to cause said needle to be retracted from the envelope into said chuck and to

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then immediately cause said jaws to close upon said end of the envelope to compress and seal it about the said lead-in conductor.

3. The method of gas filling and sealing an electrical device comprising an envelope of vitreous material having an open end which comprises holding a lead-in wire to extend into said envelope through said open end thereof, inserting a hollow needle into said envelope alongside said lead-in wire, flowing an inert gas through said needle into said envelope to flush the interior thereof and expel the air therefrom, heating the said end of the envelope to a plastic condition, and then retracting the needle from said envelope and immediately pinching the heated end to compress and seal it around said lead-in wire with the inert gas retained in the envelope.

4. In apparatus for flushing and sealing an electric lamp assembly, the combination of holder means adapted to support a lead-in conductor, support means for supporting a vitreous lamp envelope in alignment with said holder means and with an end thereof enclosing a portion of said conductor projecting from said holder means, heater means adjacent said holder means for heating the said end of the envelope to plasticity, pinching jaws mounted adjacent to said holder means, a hollow needle, means mounting said needle adjacent said holder means for reciprocable movement into and out of the end of said envelope, means connecting said needle to a supply of flushing gas, and means for actuating said needle and said pinching jaws in synchronism to cause said needle to be retracted from said envelope and to then immediately cause said pinching jaws to close upon said end of the envelope to compress and seal it about the said lead-in conductor.

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