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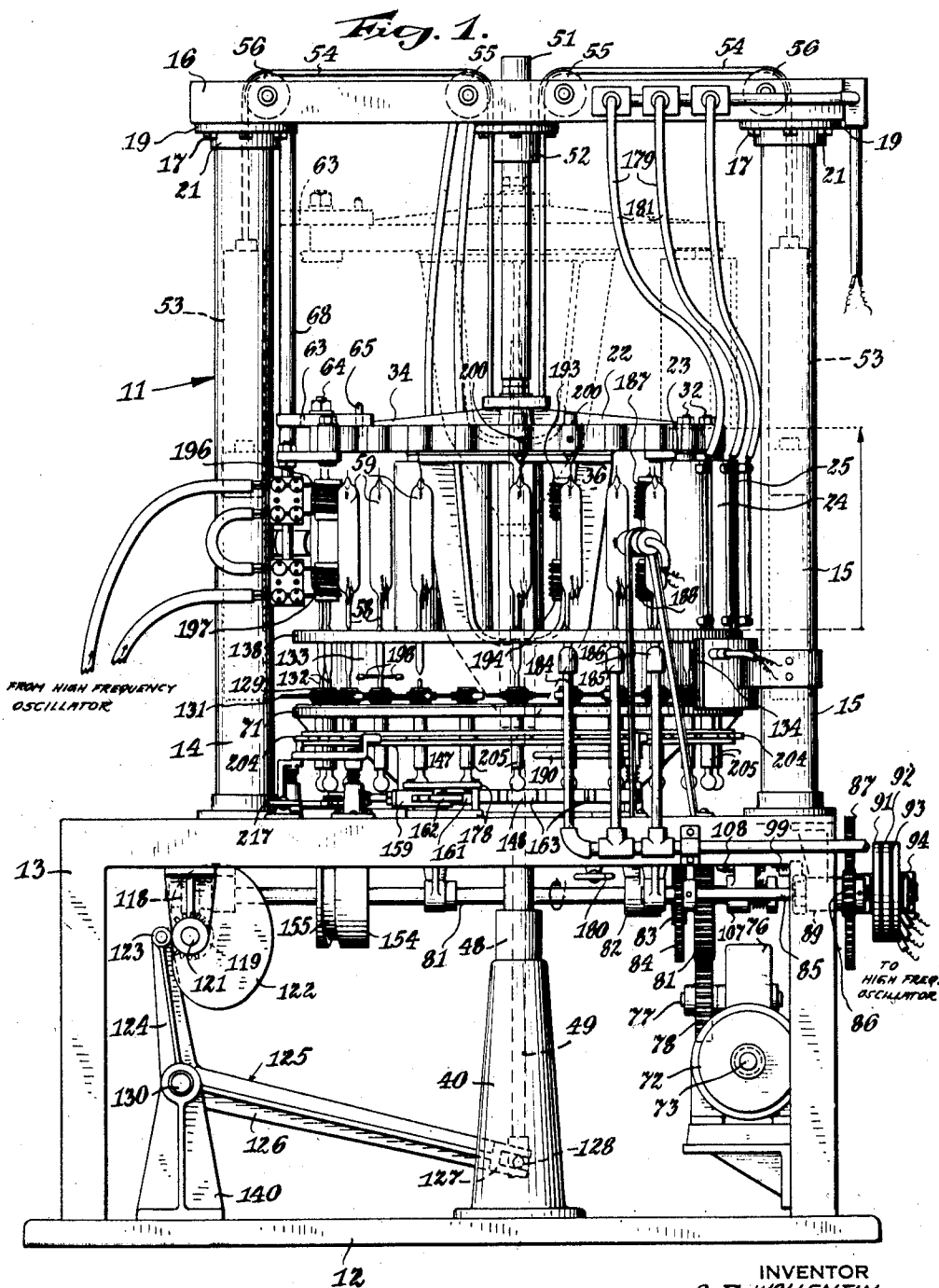
O. R. WOLLENTIN ET AL

2,264,496

VAPOR LAMP EXHAUST MACHINE AND METHOD

Filed Sept. 12, 1939

5 Sheets-Sheet 1



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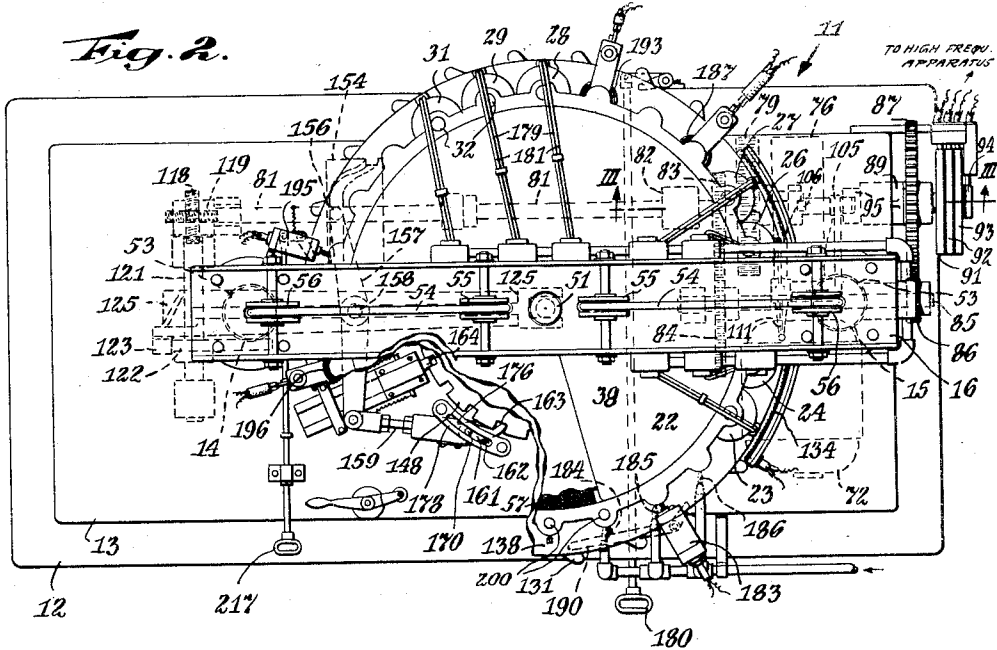
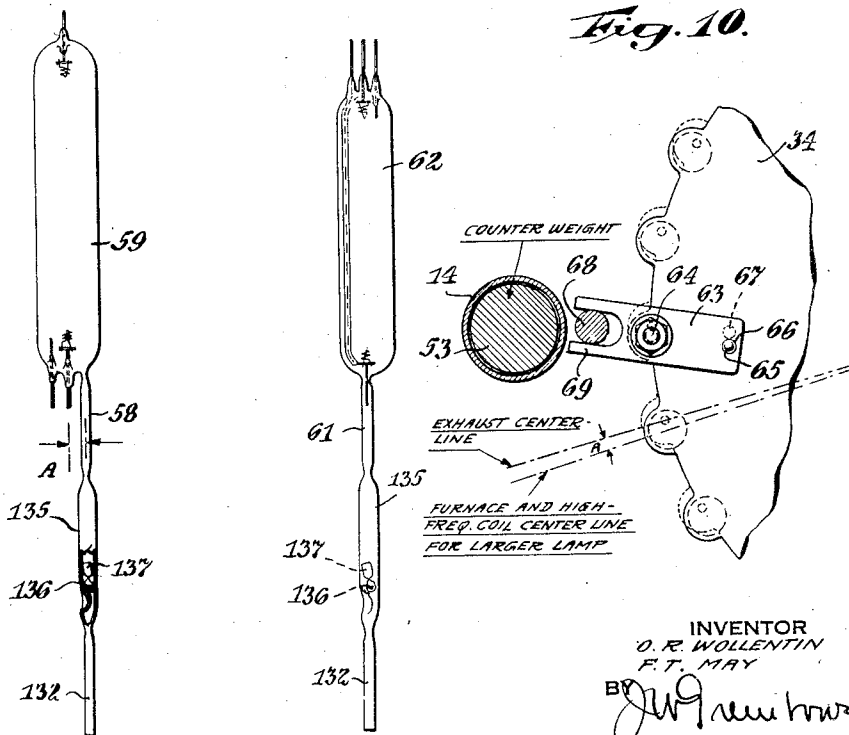


Fig. 8.

Fig. 9.

Fig. 10.



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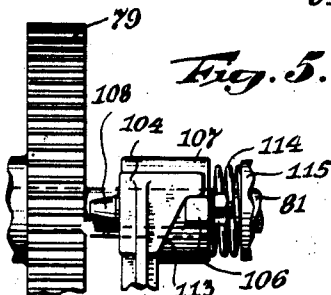
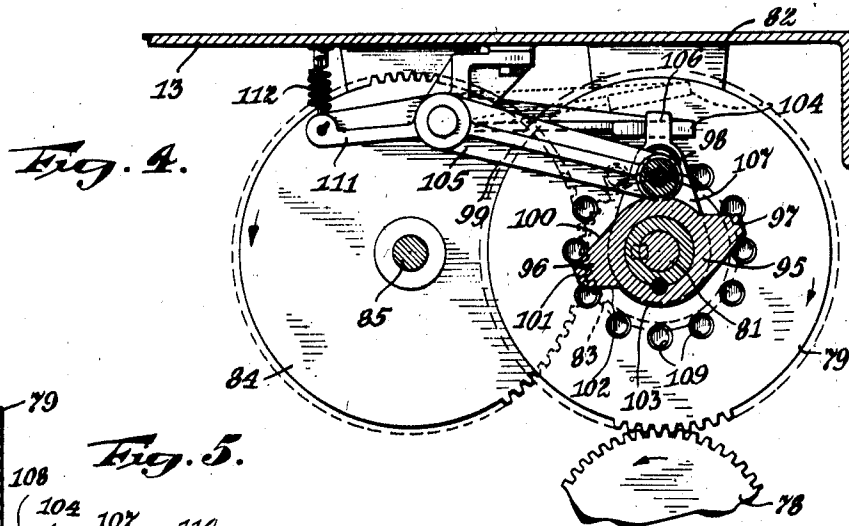
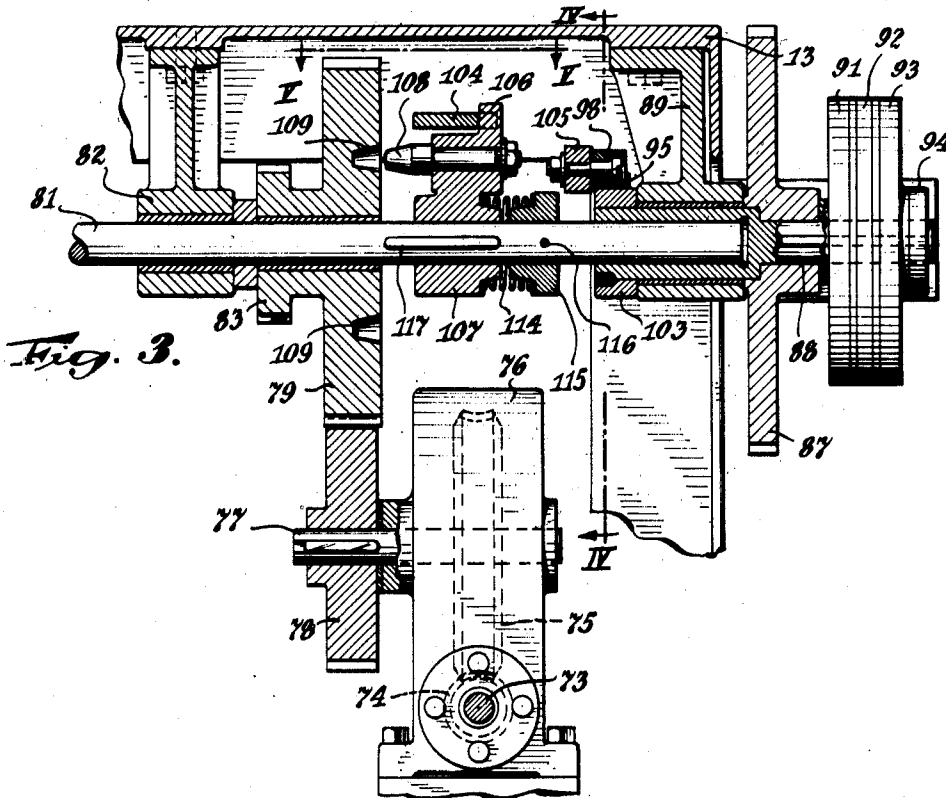
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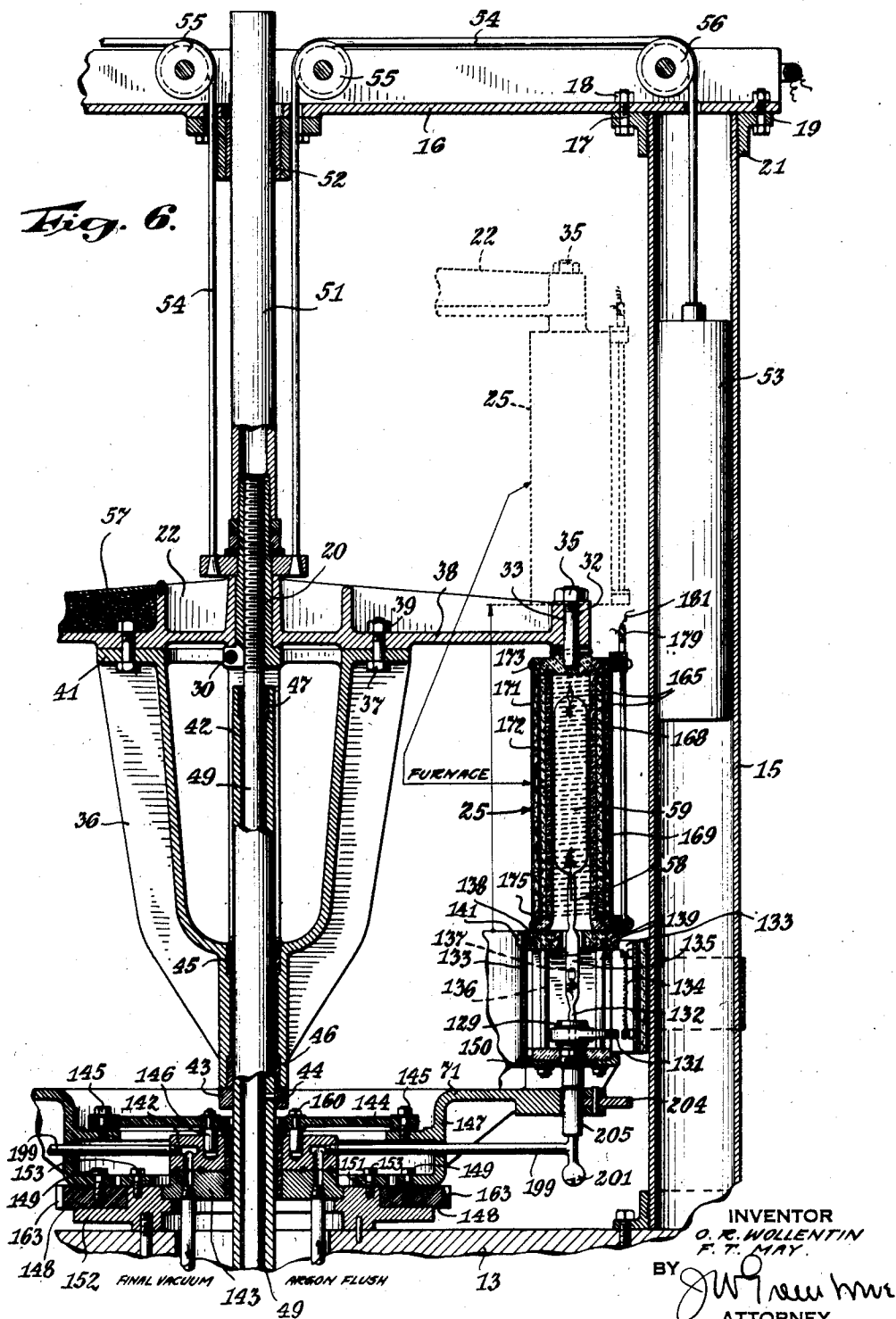
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VAPOR LAMP EXHAUST MACHINE AND METHOD

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Fig. 6.



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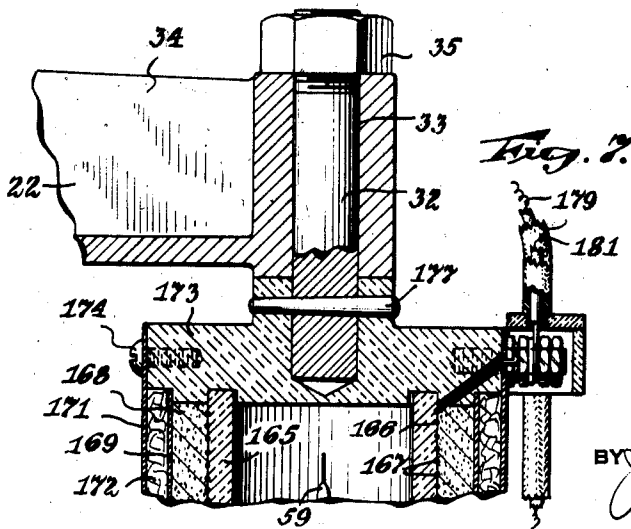
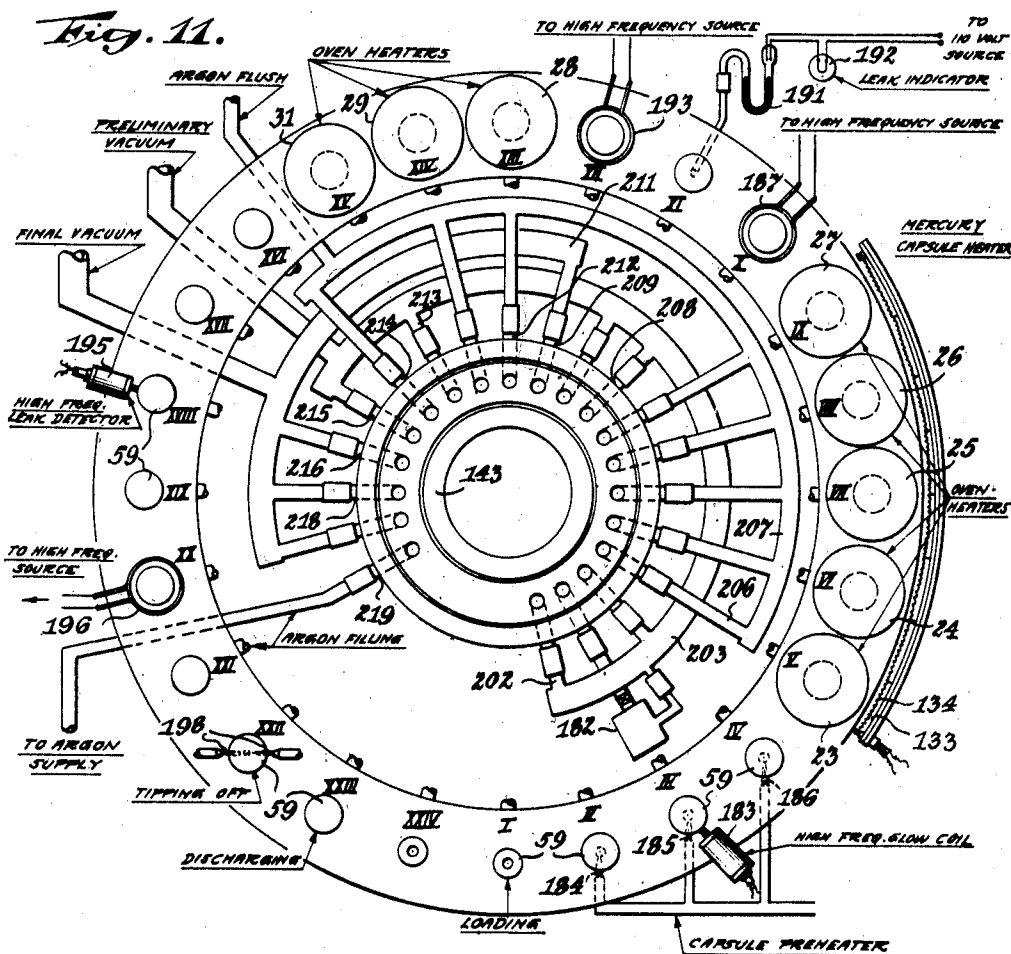
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UNITED STATES PATENT OFFICE

2,264,496

VAPOR LAMP EXHAUST MACHINE AND METHOD

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Application September 12, 1939, Serial No. 294,468

19 Claims. (Cl. 176—2)

This invention relates to a machine for exhausting vapor lamps, and especially high-intensity mercury vapor lamps, thereby avoiding a large amount of the manual labor previously necessary in the manufacture of such devices, as well as speeding up production.

An object of our invention is a machine for exhausting vapor lamps automatically, from the time they are put in the machine to the time they are removed ready for introduction of the mercury filling.

Another object of our invention is the provision of a simple compensating device in a vapor lamp exhaust machine to allow for the production of more than one type or size of lamp.

A further object of our invention is the provision of a mercury vapor lamp exhaust machine having electric ovens of a special design and exceedingly efficient, thereby not only conserving power, but making more comfortable operating conditions.

A still further object of our invention is the provision of a mercury vapor lamp exhaust machine having new and desirable features, such as a compact spider lifting arrangement, rapid indexing while the machine is going at slow speed, control for the high frequency heating apparatus, compression rubbers for the exhaust tubes, means for heating the mercury capsule at the same time the main envelope is being exhausted, change gears, and counterbalance mechanism for the spider.

Other objects and advantages of the invention, relating to the particular arrangement and construction of the various parts will become apparent as the description proceeds.

Referring to the drawings;

Figure 1 is an elevational view of a machine embodying our invention.

Figure 2 is a plan of the machine shown in Figure 1, with parts broken away to more clearly illustrate the construction.

Figure 3 is an enlarged transverse sectional view on the line III—III of Figure 2, in the direction of the arrows.

Figure 4 is a fragmentary vertical sectional view on the line IV—IV of Figure 3, in the direction of the arrows.

Figure 5 is a fragmentary plan on the line V—V of Figure 3, in the direction of the arrows.

Figure 6 is a fragmentary vertical sectional view on the axis of the machine spider, with parts in elevation.

Figure 7 is an enlarged fragmentary vertical

sectional view of the upper portion of the furnace, as shown in Figure 6.

Figure 8 is an elevational view of one form of high intensity mercury vapor lamp.

Figure 9 is a corresponding elevational view of another form of high intensity mercury vapor lamp, also adapted for manufacture on our machine.

Figure 10 is an enlarged fragmentary plan of a portion of the spider, as shown in Figure 2, illustrating the details of the compensating device.

Figure 11 is a diagrammatic plan view of the machine, indicating what operation is performed at each station.

Prior to our invention, vapor devices such as high intensity mercury vapor lamps were exhausted on trolley exhaust positions at the relatively slow rate of less than five lamps per hour, employing all hand operations for flushing and gas filling. In accordance with our invention, we provide a preferably twenty-four port exhaust machine with three high frequency heating positions, eight oven heaters, and flushing and gas-filling positions. The machine has been developed and is in satisfactory operation, turning out about two lamps per minute.

Referring to the drawings in detail, we see in Figure 1, an elevational view of the complete machine 11, comprising a base 12, supporting a table 13 from which hollow standards 14 and 15 extend. The upper end portions of the standards 14 and 15 are united by a transverse frame element 16, secured to said standards as by means of bolts 17 and nuts 18, said bolts passing through the upper flanges 19 of connecting elements 21 threaded to the upper ends of said standards 14 and 15.

Movable vertically between the standards 14 and 15, is a spider 22, carrying a plurality of oven heaters, designated by the reference characters 23, 24, 25, 26, 27, 28, 29 and 31, as by means of a stud 32, extending from the upper portion of each and passing through a corresponding aperture 33 in the upper element 34 of the spider 22, and secured thereto by means of a nut 35. The spider is desirably secured to a lower or guiding member 36, as by means of bolts 37 passing through the web 38 of the spider 22, and the underlying flange 41 of the guiding member 36 and held in place by nuts 39.

The spider 22 and associated guiding member 36, reciprocates vertically on a hollow standard 42 securely fastened to a pedestal 43 extending from the base 12, and are limited in their downward movement by having the lower portion en-

gage a collar 43 secured to said standard, as by means of set screw 44. The guiding member 36 is provided with wear inserts 45 and 46, slidable on the outside of the standard 42, and said standard, in turn, carries wear insert 47 and the pedestal 40 carries wear insert 48, on which slide a spider actuating rod 49, threadably secured to a headed bushing 20 in said spider 22, locked in place with respect thereto by a bolt 30, and serving as a connecting element between the spider 22 and the upper guiding rod portion 51 thereof, extending upwardly and slidably engaging a wear member 52, supported on the frame element 16.

To facilitate vertical reciprocation of the spider 22, that element is provided with counterweights 53 connected thereto by means of flexible cords or chains 54, passing over guiding pulleys 55 and 56. In order to make the spider slide freely on its vertical guide elements without binding, the same is equalized by counterweight 57, as it will be noted that without such a counterweight the furnaces 23 to 29, inclusive, and 31, would make the spider overbalanced at one side.

Reference to Figures 8 and 9 will show that the exhaust tube 58, of the larger or 400 watt mercury vapor device 59, is positioned off axis by a distance A, as compared with the exhaust tube 61 of the smaller or 250 watt mercury vapor device 62. Inasmuch as such devices are supported during their passage through the machine entirely by their exhaust tubes, it is necessary to have adjusting means for the spider so that the ovens and other devices carried by said spider will properly index at will with one type or the other of said lamps.

This compensating device is shown most clearly in Figure 10, and consists of a plate 63 carried on a stud 64 extending from the upper portion 34 of the spider 22, and carrying pin 65 which is adapted to fit in either one of two holes 66 and 67, so spaced that when said pin is in one hole, for example, 66, the spider is so positioned with respect to the guide rod 68 embraced by the bifurcated end 69 of said plate 63, that the exhaust center line of the machine is spaced behind the furnace and high frequency center line a distance A corresponding with the distance A in Figure 8, so that the machine is adapted to take the type of lamp designated by the reference character 59, and when the pin 65 is in the other hole 67, the spider is correspondingly moved so that the machine is then adjusted for taking the other type of lamp designated by the reference character 62. Said adjustment is thus effected because the circumferential movement of the spider, at the radial distance corresponding with the position of the lamps being manufactured, corresponds with the distance A, shown in Figure 8, or the amount the exhaust tube is offset from the axis, in one type of lamps as compared with the other.

It will be understood that the function of the spider 22 is to raise the heaters 23 to 29, inclusive, and 31, while the plate 71, carrying the lamps 59 or 62, as the case may be, is moving from one station to the next, or in the present case $\frac{1}{4}$ of a revolution, or 15° , and then lower the ovens over the lamps in their new positions. Mechanism is provided in our machine for not only automatically raising and lowering the spider and the oven heaters carried thereby, but also for advancing the lamp-carrying plate 71 the 15° prior to the descent of said ovens at the end of this movement. The mechanism for accom-

plishing this automatic actuation will now be described.

Figure 1 shows an electric motor or other prime mover 72, the armature shaft 73 of which, carries a worm 74, as shown in Figure 3, engaging a worm gear 75 in a gear box 76. The gear 75 is fixed on a shaft 77, one end portion of which extends out of the box 76 and has fixed thereon a spur gear 78 constantly meshing with a desirably larger spur gear 79, rotatably mounted on a shaft 81, carried in a bearing 82 supported from the table 13. The gear 79 has a preferably smaller gear 83, desirably integral therewith, which gear meshes with a relatively large gear 84, fixed on a jack shaft 85, as shown in Figure 1. The jack shaft also fixedly carries a relatively small spur gear 86 which meshes with a relatively large spur gear 87, fixedly mounted on a shaft 88 carried in a bearing 89, supported from the table 13, the inner end of said stub shaft 88 (Figure 3) being hollow to provide an end bearing for the shaft 81. Said stub shaft carries contact segments 91, 92, 93 and 94, for energizing the respective high frequency coils at the desired times, as will be described more in detail hereinafter.

The stub shaft 88 carries a cam 95 (Figure 4) at its inner or hollow end, said cam desirably having a pair of arms 96 and 97, which sequentially engage a roller 98 on a lever arm 99, which rides up on the curved side 100 of each arm until it reaches and passes over the high dwell 101, and then drops off the sharp side 102 thereof, to the low dwell portion 103 of the cam, and then repeats the operation on the next arm. When the roller 98 is engaged on the low dwell 103, the arm 104 of the crank device 105, on which it is mounted, lies back of an arm 106 of a clutch device 107, and holds the clutch tooth 108 thereof, out of engagement with one of a series of clutch pockets 109 in the spur gear 79.

In order that the clutch arrangement may be operative, the crank device 105 has another arm 111, resiliently urged toward the upper wall of the table 13 by means of spring 112, thereby urging the roller 98, carried by the arm 99, into engagement with the cam 95, and thus causing the arm 104 to move behind the arm 106, so that the latter, during rotation with the gear 79, will ride on the inclined surface 113 (Figure 5) on the arm 104, and cause the clutch tooth 108 to be drawn out of engagement with the gear 79 by moving it to the right, as shown in Figure 3, against the resistance of the actuating spring 114, acting between it and an associated collar 115, secured to the shaft 81 as by means of pin 116. The shaft is caused to turn with the clutch device 107, by the feather 117 on which the device rides during its reciprocation to and from the associated gear 79.

The other end of the shaft 81 carries a spiral gear 118, meshing with a spiral gear 119 (Figure 2) on a shaft 121 disposed therebelow, and at right angles thereto. Said shaft 121 carries a cam 122, generally heart shaped, as illustrated most clearly in Figure 1, which cam engages a roller 123 carried by the arm 124 of a bell crank 125, pivoted at 130 to a pedestal 140, the longer arm 126, of which is connected to the lower end of the actuating rod 49, as by having its bifurcated end 127 receive a cross pin 128 thereof, so that as the shaft 81 is periodically actuated by the corresponding engagement of the clutch tooth 108 in a pocket 109, the spider 22 and ovens are raised to expose the lamps being evacuated,

allow them to pass from one station to the next, and are then lowered until the lamps are again covered by the ovens.

While this operation of raising and lowering the ovens is taking place, the plate 71 carrying the lamps being evacuated, is being advanced one notch or 15° at a time by means of ratchet and pawl mechanism, to be later described.

The heads 129 are desirably of the type provided with compression rubbers, as described and claimed in the Lockwood and Mullan application, Serial No. 192,740, filed February 26, 1938, and owned by the assignee of the present application. These heads are each provided with an operating handle 131 for effecting engagement or release of the associated exhaust tube 132 of the lamp being manufactured, as well as a cut-off valve 204 for compressing or releasing a connecting rubber tube as will be clear from a reference to said application. The heads have associated therewith reflectors 133 (Figure 6) preferably formed of aluminum, which are for the purpose of conserving and distributing the heat from the resistance heater coils 134, which are employed for baking out the auxiliary envelope portions 135, each of which contains a mercury capsule 136 and breaker element 137.

One aluminum reflector 133 is secured to an upper frame member 138 mounted on the head-carrying plate 71, as by means of bolts 139, screws 141 being desirably employed for that purpose, as well as to the plate 71 by screws 150.

The carrying plate 71, as shown in Figure 6, is desirably secured to the upper element 142 of a valve for effecting the exhausting, flushing, and gas filling of the lamps being manufactured, the lower element 143 of said valve being shown diagrammatically and more in detail in Figure 11.

Although we have shown, for the sake of clearness, a relatively simple valve structure whereby the ports are all at the same radial distance from the axis of rotation, yet it will be understood that we may use an improved valve structure in which the ports are staggered, as described and claimed in the Mullan Patent No. 2,113,798, of April 12, 1938, owned by the assignee of the present application.

The securing of the plate 71 to the upper valve member 142 may be as shown most clearly in Figure 6, that is, by means of an intermediate valve drive bar 144, the outer portions of which are secured to the inner peripheral portion of the plate 71 by bolts 145, and the inner peripheral portion of which drives the upper valve element 142, by means of pins 146, secured to the bar 144 by nuts 160.

In order to provide for driving the plate 71 and, at the same time, hold the upper valve section 142 tightly engaging the lower valve section 143, said plate desirably has a ratchet ring 148 secured to a depending angular extension 147, as by means of bolts 149. The ratchet ring 148 is held in place by an annular member 151 secured to a ratchet plate bearing member and lower valve element support 152, as by means of bolts 153, and of such a size that its outer peripheral portion overlies the inner peripheral portion of the ratchet ring 148, thereby holding the parts in assembled relation while allowing for rotation of the plate 71, and the associated ratchet ring 148 on the supporting element 152.

The driving shaft 81, as shown in Figures 1 and 2, carries a wheel 154 having a cam groove 155, in which travels a roller or projection 156

on one end of a lever 157, pivoted, as indicated at 158, the other end of said lever pivotally carrying a ratchet plate operating device 159, on the free end of which is mounted a pawl 161, pivoted at 170, and actuated by a spring 162, so that it normally tends to engage in one of the notches 163 in the ratchet wheel 148. The notches are spaced at 15° intervals, so that every time the cam 154 makes one revolution, the pawl 161 pushes the ratchet plate 148 fifteen degrees ahead or counterclockwise, as viewed in Figure 2. The pawl-carrying end of the device 159 is guided in any desired manner, as by having the end portions of the pivot 170 slidably mounted in slots 176 in a guiding device 178 mounted on the table 13.

A latch device 164, normally engaging one of the ratchet notches 163, is desirably provided to prevent undesired movement of the ratchet plate 148, said device 164 being desirably releasable by the pawl-carrying arm of the lever 157, in order to allow for movement of the ratchet plate 148 when the pawl 161 is being moved to the right, as viewed in Figure 2.

The construction of each of the ovens, furnaces, or heaters 23 to 29, inclusive, and 31, is desirably identical so that the details of construction of only one will now be described, with special reference to Figures 6 and 7.

Each oven comprises a central tube 165, desirably formed of alundum or other similar refractory material, the outer surface of which is grooved, as indicated at 166, to provide a helical track for receiving a heating wire 167. This heating wire may be of any approved high resistance metallic material, such as nichrome, and may be so wound on the tube 165 that substantially uniform heating conditions prevail inside of said tube.

Outside of the tube 165 is packed loose insulating material 168 which is desirably magnesium oxide filler. Holding the insulating filler is a hollow metal cylinder 169, desirably formed of "apollo" metal or aluminum. As a final outer casing, we desirably provide a sheet of "apollo" metal or aluminum 171, and between the sheets 169 and 171, is desirably placed aluminum foil 172, crinkled and packed lightly. The outer casing 171 has its end portions secured at the top to a head or top flange member 173, desirably formed of electrobestos or similar refractory material, as by means of screws 174, and at the bottom (Figure 6) to an annular member 175 of similar material in a similar manner, said members 171, 173 and 175 serving to hold the associated members 165, 169 and the loose insulating material together.

The assembled oven is suspended from the spider 22, as by means of the stud 32, the lower end of which is secured to the cap or flange 173, and by means of tapered pin 177, the upper end of said stud carrying a nut 35 for tightening the heater element in place. Energy is supplied to the heating coil 167 by means of suitable electric cables 179 and 181.

Referring to Figure 11, it will be seen that we have provided for loading the lamps at station I, from which station each lamp travels to station II, where it is given a preliminary evacuation. Station III carries a leak detector 182, which may be of the type described and claimed in the Fagan Patent No. 1,933,322, of October 31, 1933, owned by the assignee of the present application. A high frequency coil 183 is also desirably provided for indicating visually, by the color of the

discharge in the lamp, whether or not it is free from leaks. Capsule preheaters, in the form of small gas flames 184, 185, and 186, are also desirably provided at stations II, III and IV.

The resistance heater coils 134 desirably extend from stations V to IX, inclusive, in order to provide for heating the capsule, capsule breaker, and extension 135, containing these elements, as much as possible without breaking the capsule during the heating of the main envelope of the lamp enclosed in one of the ovens, as shown most clearly in Figure 6.

At station X is provided a pair of high frequency coils 187 and 188, said coils desirably operating in series and energized from a suitable high frequency source through slip rings 91 and 94, the ring 94 having an energizing segment so disposed that the lamp is treated by high frequency induction only after it has been moved to position, and the spider 22 lowered so as to encircle it with the coils.

At station XI, is provided a mercury manometer 191 and a leak detector 192, which may be in the form of a pirani tube. This leak detector is desirably so connected that the exhaust port for evacuating the lamp, is closed at this station if a leak is indicated, thereby preventing contamination of the vacuum on account of said leak.

At station XII is provided another pair of high frequency coils 193 and 194, operated from slip rings 92 and 94, so that when the coils are lowered over a lamp at this station, they are energized from a suitable high frequency source to effect the desired electrode treatment.

At stations XIII, XIV and XV, there are more ovens, and at station XVIII another leak detector 195 is provided. The final high frequency treatment is given at station XX by coils 196 and 197, actuated by slip rings 93 and 94 from a suitable source of high frequency current. At station XXII, tipping off fires 198 are provided.

Operation

We will now describe in detail, the operation of manufacturing a high frequency mercury vapor lamp, from the time it enters until the time it leaves the disclosed machine embodying our invention.

A lamp 58 or 62, as the case may be, is placed with its exhaust tube 132 in a head 129, (Figure 6) and the lever 131 so actuated that the compression rubber in said head grips said exhaust tube and connects it to the exhaust pipe 199, desirably provided with a trap 201. In order to insure proper disposition of the entire lamp, gauges 200 are provided, with which the middle upper lead of each lamp is centered, (Figure 1) the exhaust tube portion 58, if necessary, being softened to allow for the desired adjustment.

The exhaust pipe 199 connects with the upper valve member 142, and, as the motor 72 rotates the shaft 81 slowly and intermittently, in accordance with the previous description of the operating mechanism, the spider 22 is raised and, when in raised position, the pawl 161 moves the ratchet wheel 148, and upper valve member 142, fifteen degrees to cause the lamp to advance from loading station I to station II. (Another lamp is then positioned at station I.)

Upon this movement of the upper valve member 142, the exhaust pipe 199 is connected through the preliminary vacuum pipe 202 (Figure 11) to the preliminary vacuum manifold 203, so that the lamp is here given a preliminary exhaust, while, at the same time, the envelope extension 135, con-

taining the mercury capsule 136 and breaker 137, is given a moderate preheating by fire 184.

Upon another full turn of the shaft 81, the spider 22 with its ovens and associated apparatus, such as the high frequency coils, is again raised and lowered, while the lamp is moved to station III, where the preheating of the part 135 is continued by the fire 185, and the lamp subjected to a leak test by devices 182 and 183, so that it may be rejected if found defective at this point, and/or the exhaust connection thereto closed by operating the closing lever 204, by means of the shut off handle 190, to compress the connecting rubber 205, and thereby avoid contaminating the vacuum to that extent.

Assuming, however, that the lamp is free from leaks, it then passes on in the same manner to station IV, where the preheating of the part 135 and preliminary exhaust is continued.

Upon passing on to station V, the oven 23 is lowered over the lamp, the exhaust operation, however, being discontinued and said lamp being flushed with argon at a pressure of about one atmosphere through pipe 206, connected to argon manifold 207. The argon flushing is continued, as indicated in Figure 11, while the lamp is successively treated at stations VI to IX, inclusive, in heaters 24, 25, 26 and 27, whereupon the lamp then passes to station X where the argon is evacuated through the pipe 208 connected to preliminary vacuum manifold 203, and, at the same time, the high frequency coils 187 and 188 are energized to thereby heat the lamp electrodes to the desired degree of temperature and degasify and activate the same.

At station XI, the preliminary exhaust is continued while, at the same time, the lamp is tested by the mercury manometer and leak detector for rejection and/or closing of the exhaust and flushing connection thereto, if found defective, by operation of the shut off handle 190.

At station XII, the lamp is connected to the final vacuum line through pipe 209 from final vacuum manifold 211, at the same time the electrodes are further baked out by the high frequency coils 193 and 194.

At station XIII, the lamp is again given an argon flush through pipe 212, while heated in oven 28. The heating and flushing is continued at station XIV, in oven 29. At station XV, in oven 31 the flushing is discontinued and the lamp again connected to preliminary vacuum manifold 203, through pipe 213.

At station XVI, the lamp is given another similar argon flush, from manifold 207 through pipe 214, while it is allowed to cool.

At station XVII, the lamp, while cooling still further, is connected to preliminary vacuum manifold 203 through pipe 215.

At station XVIII, the lamp is connected to the final vacuum manifold 211, through pipe 216, while subjected to high frequency leak detector 195, for rejection and/or closing of the exhaust and flushing connection thereto, if found defective, by operation of the shut-off handle 217.

At station XIX, the final evacuation is continued through pipe No. 218, and at station XX, the final evacuation is completed while the electrodes are subjected to final high frequency treatment in coils 196 and 197.

At station XXI, the final argon filling the pressure of which is suitably controlled, preferably about 20 mm. of mercury, and visually indicated, is supplied through pipe 219, and at station XXII, the lamp is tipped off. At station XXIII, or

XXIV, the lamp is removed from the apparatus.

From the foregoing disclosure, it will be seen that we have devised a machine and method for exhausting and filling the envelopes of vapor lamps automatically from the time each is inserted in the proper position in the machine to the time it is discharged therefrom after being tipped-off, ready for subsequently breaking the mercury capsule and introducing mercury thereinto. The machine not only provides for heat-treating the main envelope of each device, but also the auxiliary envelope in which is contained the mercury capsule and breaker, during predetermined rest periods.

We have also provided a special type of electric oven, for use in the machine, which is exceedingly efficient and not only conserves power, but makes for more comfortable operating conditions. We have also provided a compact spider-lifting arrangement, and for rapid indexing while the machine is going at slow speed, control for the high frequency heating apparatus, change gears, and counterbalance mechanism for the spider.

Although a preferred embodiment of our invention has been disclosed, it will be understood that modifications may be made within the spirit and scope of the appended claims.

We claim:

1. A machine for manufacturing vapor lamps, comprising a conveyor carrying a plurality of heads, each of which is adapted to receive the exhaust tube of a lamp being manufactured, said conveyor being rotatable about a normally vertical axis, a spider carrying a plurality of ovens and reciprocable axially of said conveyor, so as to periodically raise said ovens from lamps and lower them over succeeding lamps upon corresponding movement of said conveyor, and means for coordinating the movement of said conveyor and spider, whereby said conveyor is automatically moved a distance corresponding with the distance between successive ovens, while the ovens are in raised positions thereabove, so that, when lowered, said ovens will receive succeeding lamps in the process of manufacturing, said means comprising a motor driving gearing and a clutch normally held out of engagement with a driving gear, and operated by a cam, so that at predetermined intervals said clutch is engaged to cause a raising movement of the spider and associated ovens, a quick movement of the head from one position to the next, while said ovens are raised, and a lowering of said ovens over the succeeding lamps, the rest periods between clutch engagements providing treating periods for said lamps.

2. A machine for manufacturing vapor lamps, comprising a conveyor carrying a plurality of heads, each of which is adapted to receive the exhaust tube of a lamp being manufactured, said conveyor being rotatable about a normally vertical axis, a spider carrying a plurality of ovens and reciprocable axially of said conveyor, so as to periodically raise said ovens from lamps and lower them over succeeding lamps upon corresponding movement of said conveyor, and means for coordinating the movement of said conveyor and spider, whereby said conveyor is automatically moved a distance corresponding with the distance between successive ovens, while the ovens are in raised positions thereabove, so that, when lowered, said ovens will receive succeeding lamps in the process of manufacturing.

3. In a machine for exhausting vapor lamps, a spider adapted to raise and lower ovens from and onto lamps being manufactured, a vertical guide disposed along one side of said spider and serving to prevent rotation thereof, a compensating device secured to said spider, and having a bifurcated end embracing said guide, and a pin on the inner end of said compensating device, fitting in one of a plurality of holes in said spider, in order to swing the latter about its axis of reciprocation, and adjust the position of the ovens carried thereby in accordance with the type of lamps being manufactured.

4. A machine for manufacturing vapor lamps, comprising a conveyor rotatable from station to station, a spider, ovens carried by said spider and reciprocable axially of said conveyor, a motor for driving said machine, and driving mechanism between said motor and conveyor and between said motor and spider, said mechanism comprising a shaft carrying a cam, a pawl operated thereby a ratchet secured to said conveyor and engaged by said pawl for station to station rotation, and a cam geared with respect to said shaft for raising and lowering said ovens by means of said spider, while the conveyor is moved from one station to the next, and means for intermittently moving said shaft, in order to allow predetermined periods of rest between said movements, comprising a gear wheel normally loose thereon, and operated by said motor, a cam also loose on said shaft, reduction gearing between said gear wheel and cam, and a clutch operated by said cam to cause said loose gear wheel, when the clutch is engaged, to turn said shaft for one revolution, and then disengage until again operated by said cam.

5. A machine for manufacturing vapor lamps, comprising a conveyor carrying a plurality of heads, each of which is adapted to receive the exhaust tube of a lamp being manufactured, said conveyor being rotatable from station to station about a normally vertical axis, a spider carrying a plurality of ovens and reciprocable axially of said conveyor, so as to periodically raise said ovens from lamps and lower them over succeeding lamps upon station to station movement of said conveyor, and means for raising and lowering said spider, comprising an actuating rod extending therefrom beneath said conveyor, a bell crank connected to the bottom of said actuating rod and having an arm extending upwardly, a cam engaging said arm, a shaft on which said cam is fixed, a drive shaft geared thereto, a clutch on said drive shaft, a drive gear normally rotatable on said shaft, and a cam rotated at slow speed to cause the clutch to intermittently operatively connect said drive gear to said drive shaft to raise and lower said spider during one revolution of said drive shaft.

6. In a machine for manufacturing vapor lamps, a conveyor carrying a plurality of heads and rotatable about a normally vertical axis, and a spider reciprocable on said axis, said spider comprising a generally circular member carrying a plurality of ovens at one side and balanced by a counterweight at the other side, a guiding member secured to the lower surface of said spider, a hollow standard passing axially through said conveyor and on which said guiding member and spider reciprocate, and an operating member for said spider passing through said hollow standard, driving means secured to said operating member at its lower end, and lifting counterweights attached to the upper portion of

said spider by means of flexible elements passing over pulleys at the top of said machine.

7. A machine for manufacturing vapor lamps, comprising a conveyor carrying a plurality of heads, said conveyor being rotatable around a normally vertical axis, a ratchet ring secured to the lower portion of said conveyor, a latch device normally engaging said ratchet ring to hold said conveyor indexed with respect to lamp-treating stations, pawl mechanism engaging said ratchet ring for moving said conveyor from station to station, said mechanism being connected to said latch device so as to release the latter prior to forward movement of said pawl mechanism for moving the conveyor from one station to the next, and cam means for intermittently actuating said pawl mechanism.

8. The method of manufacturing vapor lamps, comprising moving each lamp envelope, with associated extension containing a mercury capsule and breaker, and exhaust tube depending therefrom, and giving the envelope a preliminary exhaust and moderately preheating its extension, moving the lamp and continuing the exhaust and preheating of the extension, subjecting the lamp to a leak test, moving it and continuing the preheating of the extension and preliminary exhaust, moving it and baking, while discontinuing the exhaust operation and flushing with an inert gas, similarly treating said lamp after several succeeding moves, moving it and evacuating the inert gas while treating the lamp electrodes by high frequency induction, moving the lamp while continuing the exhaust and testing for leaks, moving and subjecting said lamp to final exhaust and, at the same time, further baking the electrodes by high frequency induction, moving the lamp and, again flushing with inert gas and baking, continuing said baking while being gas filled, baking while subjecting to preliminary exhaust, flushing said lamp with inert gas while allowing it to cool, giving said lamp a preliminary exhaust, and then a final exhaust while testing for leaks, continuing the final evacuation, giving the electrodes the final high frequency treatment while continuing the final evacuation, giving the lamp the final inert gas filling, and tipping off said lamp.

9. The method of manufacturing vapor lamps, comprising giving each lamp envelope a preliminary exhaust and moderately preheating an associated extension containing a mercury capsule and breaker, continuing the exhausting and preheating of the extension, subjecting the lamp to a leak test, baking said lamp while the same is flushed with an inert gas, evacuating the inert gas while baking the lamp electrodes, continuing the exhaust while testing for leaks, subjecting to final exhaust while further baking the electrodes, again baking while flushing with inert gas, baking while subjecting to preliminary exhaust, flushing with inert gas while allowing the lamp to cool, giving said lamp a preliminary exhaust and then a final exhaust while testing for leaks, giving the electrodes the final baking while continuing the final exhaust, giving the lamp the final inert gas filling, and tipping off.

10. In a machine for exhausting vapor lamps, a spider adapted to raise and lower ovens from and onto lamps being manufactured, a compensating device secured to said spider, and having a bifurcated and embracing a fixed member on the machine, and means to adjust the position of said device to swing the spider about its axis of reciprocation, and adjust the position of the ovens

carried thereby in accordance with the type of lamps being manufactured.

11. A machine for manufacturing vapor lamps, comprising a conveyor rotatable from station to station, a spider, ovens carried by said spider, a motor for driving said machine, and driving mechanism between said motor and conveyor and between said motor and spider, said mechanism comprising means for moving said conveyor from station to station and for raising and lowering said ovens by means of said spider, while the conveyor is so moved, and means for intermittently moving said mechanism shaft, in order to allow predetermined periods of rest between said movements.

12. A machine for manufacturing vapor lamps, comprising a conveyor carrying a plurality of heads, each of which is adapted to receive the exhaust tube of a lamp being manufactured, said conveyor being rotatable from station to station about a normally vertical axis, a spider carrying a plurality of ovens and reciprocable axially of said conveyor, so as to periodically raise said ovens from lamps and lower them over succeeding lamps upon station to station movement of said conveyor, and means for raising and lowering said spider.

13. In a machine for manufacturing vapor lamps, a conveyor carrying a plurality of heads and rotatable about a normally vertical axis, and a spider reciprocable on said axis, said spider comprising a generally circular member carrying a plurality of ovens at one side and balanced by a counterweight at the other side, a guiding member secured to the lower surface of said spider, and a hollow standard passing axially through said conveyor and on which said guiding member and spider reciprocate.

14. A machine for manufacturing vapor lamps, comprising a conveyor carrying a plurality of heads, said conveyor being rotatable around a normally vertical axis, a ratchet ring secured to the lower portion of said conveyor, a latch device normally engaging said ratchet ring to hold said conveyor indexed with respect to lamp-treating stations, and pawl mechanism periodically releasing said latch device and engaging said ratchet ring for moving said conveyor from station to station.

15. The method of manufacturing vapor lamps having electrodes, comprising giving such lamp a preliminary exhaust, continuing the exhausting, subjecting to a leak test, baking while flushing with an inert gas, removing the inert gas while baking the lamp electrodes, continuing the exhaust while testing for leaks, subjecting to final exhaust while baking the electrodes, flushing with inert gas, baking while subjecting to preliminary exhaust, flushing with inert gas while allowing the lamp to cool, and giving said lamp a preliminary and then a final exhaust while testing for leaks.

16. The method of manufacturing vapor lamps comprising giving each lamp a preliminary exhaust and moderately preheating a mercury-containing extension, continuing the exhausting and preheating of the extension, subjecting the lamp to a leak test, baking while the lamp is flushed with an inert gas, evacuating the inert gas while baking the lamp electrodes, continuing the exhaust while testing for leaks, subjecting to final exhaust while further baking said electrodes, again baking while flushing with inert gas, baking while subjecting to preliminary exhaust, flushing with inert gas while allowing the lamp to cool,

and giving said lamp a preliminary exhaust and then a final exhaust while testing for leaks.

17. A machine for manufacturing vapor lamps comprising a conveyor carrying a plurality of heads, each of which is adapted to receive the exhaust tube of a lamp being manufactured, said conveyor being rotatable about a normally vertical axis, a spider carrying a plurality of ovens, each of which comprises a central tube formed of refractory material, the outer surface of which is grooved to provide a helical track, a high resistance heating wire disposed in said track, means for connecting said wire to a source of power, heat insulating material disposed outside of said tube, a hollow cylinder surrounding said tube and holding said insulating material in place, an outer casing of aluminum foil, crinkled, packed lightly, and disposed between said outer casing and hollow cylinder, and upper and lower heads covering said cylinder and casing, means supporting said oven from said spider through said upper head, said spider being reciprocable axially, so as to periodically raise said ovens from lamps, and lower them over succeeding lamps, upon corresponding movement of said conveyor, and means for coordinating the movement of said spider, whereby said conveyor is automatically moved a distance corresponding with the distance between successive ovens, while the ovens are in raised positions thereabove, so that, when lowered, said ovens will cover succeeding lamps in the process of manufacturing.

18. A machine for manufacturing vapor lamps comprising a conveyor carrying a plurality of heads, each of which is adapted to receive the exhaust tube of a lamp being manufactured, said conveyor being rotatable from station to station about a normally vertical axis, a spider carrying a plurality of ovens, each of which comprises a central tube formed of refractory material, the

outer surface of which is grooved to provide a helical track, a high resistance heating wire disposed in said track, means for connecting said wire to a source of power, heat insulating material disposed outside of said tube, a hollow cylinder surrounding said tube and holding said insulating material in place, an outer casing, heat insulating material disposed between said casing and cylinder, and upper and lower heads enclosing said tube, cylinder, and casing, said spider being reciprocable axially of said conveyor, so as to periodically raise said ovens from lamps, and lower them over succeeding lamps, upon station to station movement of said conveyor, and means for raising and lowering said spider.

19. A machine for manufacturing vapor lamps, comprising a conveyor rotatable from station to station, a spider, ovens carried by said spider and reciprocable axially of said conveyor, a motor for driving said machine, and driving mechanism between said motor and conveyor and between said motor and spider, a worm carried by the armature shaft of said motor, a worm gear driven by said worm, a spur gear fixed on the same shaft as said worm gear, a drive shaft comprising part of said driving mechanism on said machine, and means for intermittently moving said shaft and allowing periods of rest between movement, comprising a gear wheel rotatable on said shaft and driven by said spur gear, a cam mounted on said shaft, reduction gearing between said gear wheel and cam, a clutch also mounted on said shaft and alternately engageable and disengageable with respect to said gear wheel when actuated by said cam, said gear wheel when engaged, turning said shaft a predetermined amount and operating the mechanism of said machine, and said clutch then disengaging for a rest period.

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