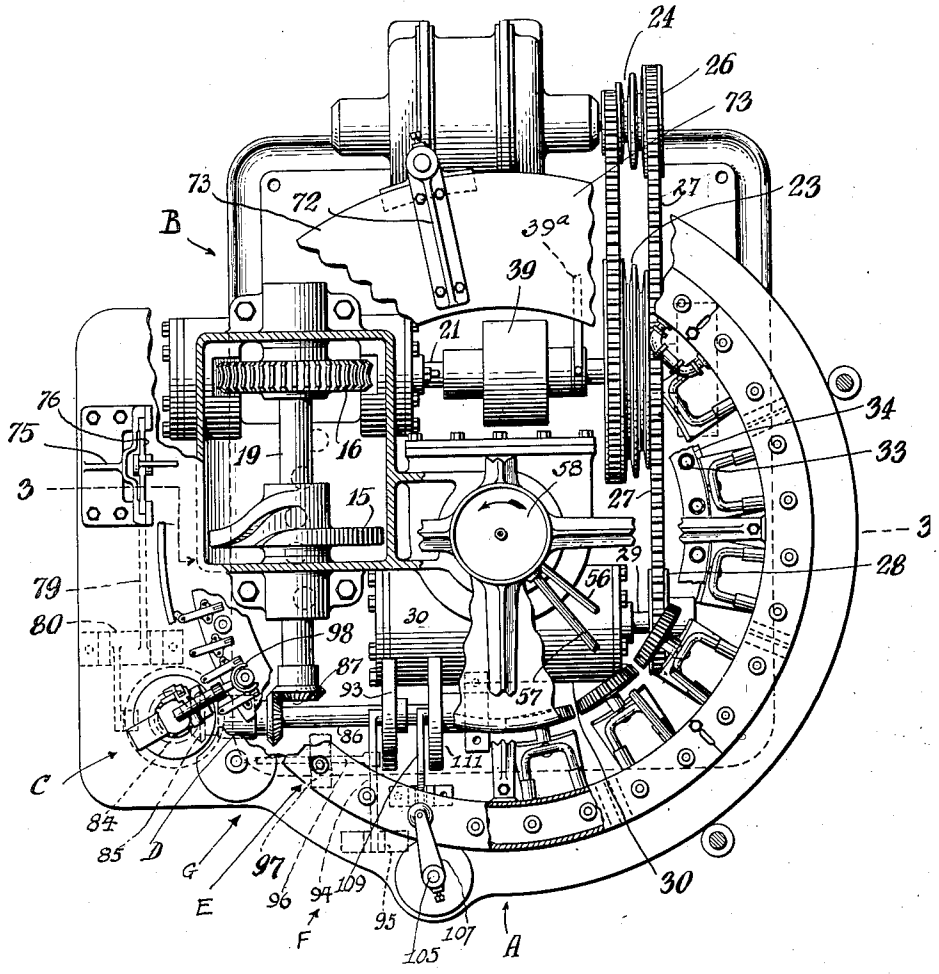
July 24, 1934. A. B. DUMONT ET AL 1,967,571

EXHAUST MACHINE

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Fig. 1.



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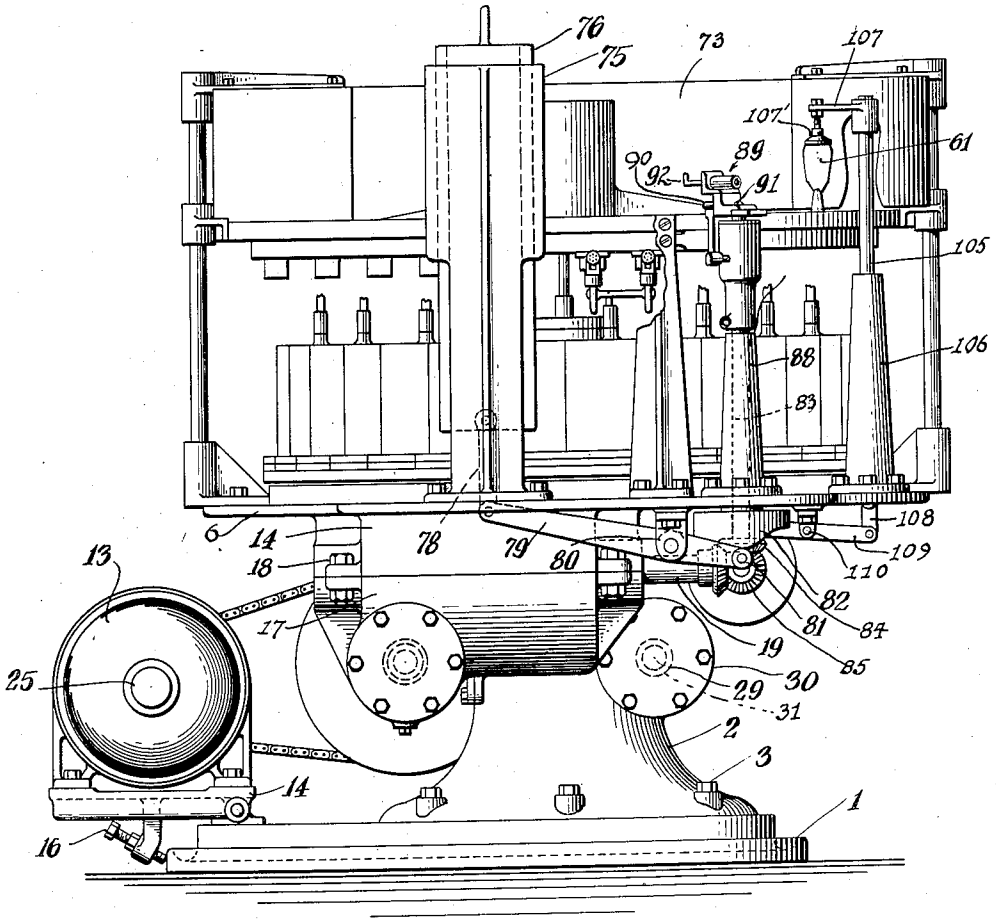
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EXHAUST MACHINE

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Fig. 2.



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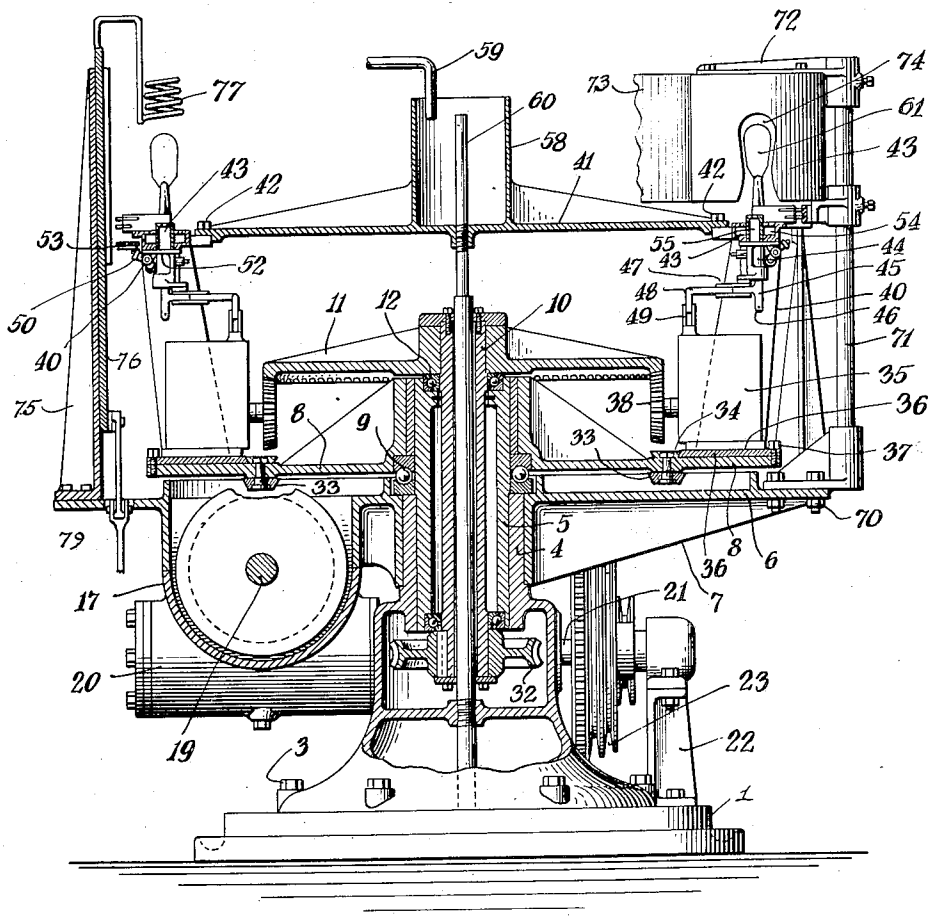
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EXHAUST MACHINE

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Fig. 3.



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EXHAUST MACHINE

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Fig. 4.

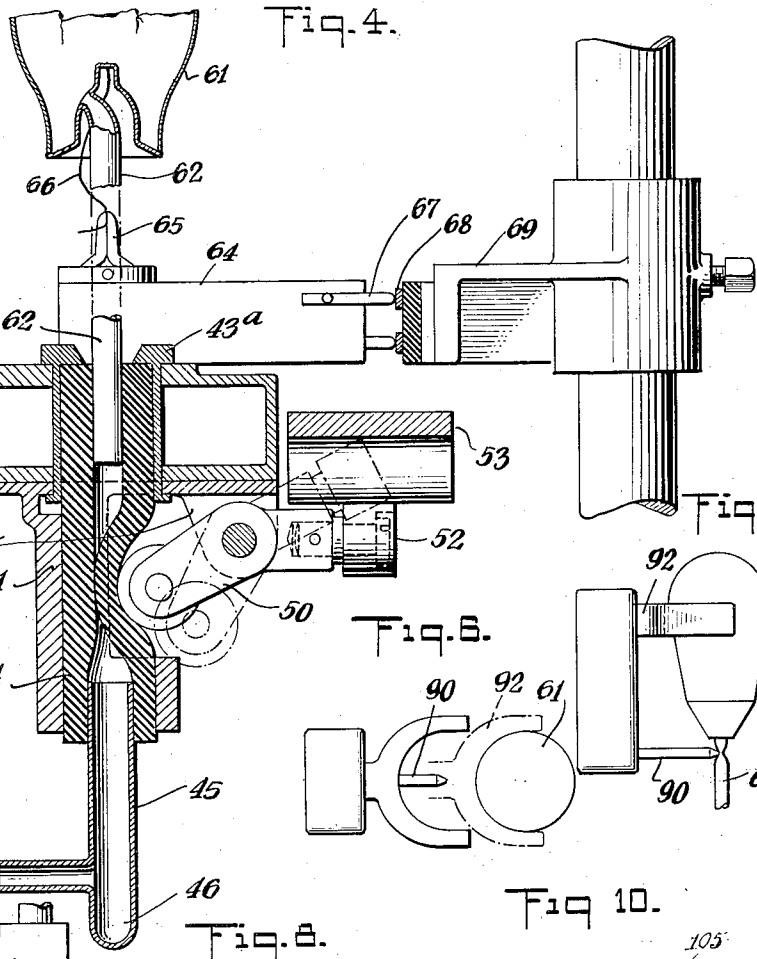


Fig. 5.

Fig. 6.

Fig. 9.

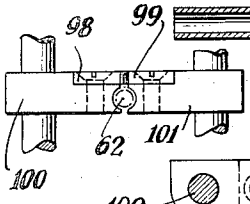


Fig. 8.

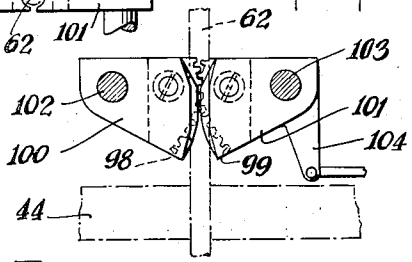


Fig. 10.

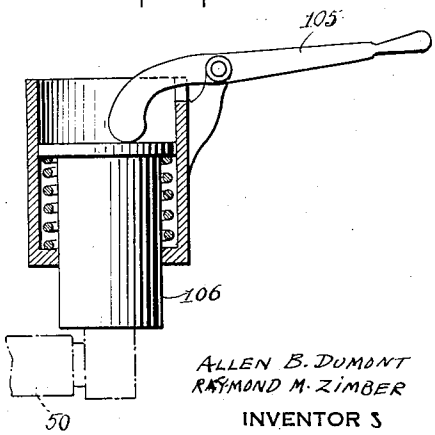
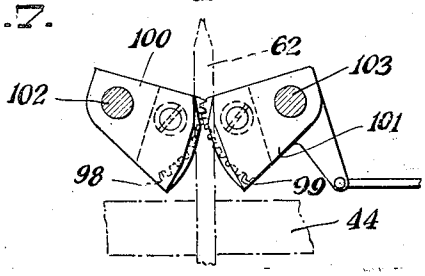


Fig. 7.



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1,967,571

UNITED STATES PATENT OFFICE

1,967,571

EXHAUST MACHINE

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Application October 31, 1929, Serial No. 403,689

6 Claims. (Cl. 250—27.5)

This invention relates to machines for exhausting and sealing, and with particularity to methods and means for evacuating and sealing containers such as lamps, audions, vacuum tubes and similar devices.

The main object of the present invention is to provide a machine whereby lamps or vacuum tubes may be efficiently exhausted in a minimum of time.

Heretofore machines have been devised for exhausting lamps, audions, etc., but the time of exhaust has been materially limited. In one type of exhaust machine the lamps or tubes to be exhausted are mounted on a traveling platform and a plurality of stationary pumps are adapted to be connected to the respective tubes at different positions of the platform. Because of the fact that the pumps are stationary, a valve arrangement must be employed between the pumps and the platform carrying the tubes. It has been found that such valves are a constant source of trouble requiring careful adjustment, which necessarily interferes with the continuity of working of the machine. Furthermore, the pumps must be connected to the respective tubes through relatively long conduits or couplings, thus increasing the overall volume that must be pumped before the requisite degree of vacuum in the tubes is reached, and increasing the frictional losses in the exhaust line. As a matter of fact, because of the disposition of the pumps with respect to the rotary head, a great number of joints must be provided therebetween, and these joints are likewise a source of leakage and increase the overall time required for proper evacuation.

Accordingly it is another object of this invention to overcome the above disadvantages by providing a machine wherein the pumps are connected directly to the lamps or tubes to be exhausted, without employing commutating valves or the like and with the use of relatively short couplings between the tubes and the exhaust pumps. In achieving this latter object it is proposed to arrange the tubes in groups of one, two or more to a group and to provide a pump for each tube group which pumps are adapted to travel with the tube during the exhausting operation.

Another source of trouble causing interference with the continuity of operation of the prior art machines is traceable to the fact that all the pumps are connected to a common valve. Consequently, if for any reason a leak should develop, either as a result of a defective tube, a defective coupling, a defective pump, etc., the entire machine may be put out of operation and before the defective line or tube can be "pinched-off" the vacuum in the remaining lines may be destroyed, requiring a corresponding re-pumping after the defect is located and remedied. These and other disadvantages are overcome by the present invention, since each tube or group of tubes has a pump individual thereto. Consequently, if a leak should arise, it affects merely the particular tube associated with the defective line, which may be "pinched-off" without stopping the machine.

In the prior art machines employing stationary pumps, relatively intricate and expensive transmission mechanism is required for driving each individual pump. In accordance with the present invention it is proposed to use common driving mechanism for all the pumps and to provide direct connection between the main or power gearing and the pump gearing proper, thus eliminating the usual belts, chains, etc. required for each pump, and enabling all the pumps to be operated at a substantially uniform speed.

In the usual type of exhaust machine the tubes in moving from one station to another for heating, bombarding, etc. are cut off from the pump. In accordance with the present invention the tubes are subjected to continuous exhaustion from the time they are first placed into the machine until actually sealed off.

Another object of the invention is to provide an arrangement whereby a pump may be accurately and rapidly mounted in position without necessitating any belt adjustments or other coupling adjustments. As a result of this feature a defective pump may be removed and replaced by a new pump in the minimum of time.

Another feature of the invention relates to a tube evacuating machine wherein the tubes are mounted on a rotatable platform which also carries a plurality of pumps.

Another feature of the invention relates to the manner of operating a plurality of pumps from a single shaft by mounting said pumps at equal distances from said shaft and providing a single driving member in continuous driving relation with all the pumps.

Another feature relates to a machine having a traveling platform carrying a plurality of pumps, and means for stopping the movement of the platform without stopping the operation of the pumps.

Another feature relates to the manner of "pinching-off" an exhaust line after a sealing

operation is completed by employing a fixed circular track and a novel form of "pinch-off" device which is capable of selective manual control as well as automatically.

A further feature relates to the manner of mounting an exhaust pump so that a minimum length of exhaust line and a minimum number of joints are employed between the pump and tube to be exhausted. As a result of this feature, the time of exhausting is reduced, since the losses due to leakage, volume, and friction in the exhaust line are reduced to the minimum and the exhaust line itself is of a minimum length.

A further feature relates to an automatic exhaust machine of the rotary head type having novel means for producing step-by-step or indexing movement of the head to advance the tubes from station to station.

A still further feature relates to an exhaust machine which is compact, occupies a minimum of floor space and wherein the operating parts are within easy access for repair, replacement, etc.

A further feature relates to an exhaust machine of the rotary head type wherein the entire operating mechanism is confined within the outer periphery of the head, thus giving easy access to the machine from all sides and reducing the chance of injury to the persons attending the machine.

A still further feature pertains to the organization, arrangement and relative location of parts which go to make up an efficient and economical machine for exhausting lamps, tubes, audions or similar devices.

Other features and advantages of the invention not specifically enumerated will be apparent after a consideration of the following detail descriptions and the appended claims.

Referring to the drawings;

Figure 1 is a top plan view of the machine with parts thereof broken away to show the interior construction more clearly;

Fig. 2 is a left hand view in elevation of the machine of Fig. 1;

Fig. 3 is a partial sectional view along the line 3—3 of Fig. 1;

Fig. 4 is a detailed view showing the manner in which the tubes are connected to the exhaust lines and the mechanism for effecting the "pinch-off";

Fig. 5 is a schematic view showing the relation between the "exhaust-tube" and the sealing burner;

Fig. 6 is a schematic view showing how the sealing burners are moved toward and away from the "exhaust-tube";

Fig. 7 is a detail view of the means for removing the unused part of the sealed-off "exhaust tube";

Fig. 8 is a view of the mechanism of Fig. 7 showing the gripper jaws engaging the "exhaust-tube";

Fig. 9 is a top plan view of Fig. 8; and

Fig. 10 is a view of the means for selectively or manually controlling the "pinch-off" mechanism.

Referring more particularly to Figs. 1, 2 and 3, the numeral 1 represents a suitable base having a hollow pedestal portion 2, and adapted to be secured to the floor by bolts 3. The pedestal 2 at its upper end 4 carries on its interior the bearing sleeve 5, while secured to the rim of the pedestal is a circular table or spider 6 having reinforcing ribs 7. Supported on table 6 for rotation about the vertical axis of the machine is a platform 8, which is preferably mounted for anti-frictional rotation about the sleeve 5, as indicated by the ball bearing race 9.

Passing centrally through member 6 is a hollow shaft 10 having secured to its upper end the circular rack or gear 11, which is mounted for anti-frictional rotation on the recessed upper end of member 5, as indicated by numeral 12. Gear 11 is adapted to be continuously rotated, while platform 8 is adapted to be rotated in a step-by-step manner to advance the tubes from station to station. The power for rotating members 11 and 12 is derived from a motor 13, mounted on frame 14, which is pivotally attached to the base 1. An adjusting screw 16 is provided for adjusting the position of motor 13 on the base.

Table 6 is provided with a downwardly depending semi-cylindrical flange 14 serving as partial housing for the shrouded cam 15, and the worm gear 16. The other part of the housing is in the form of a semi-cylindrical casting 17, adapted to be united to the housing portion 14 by bolts 18. The ends of the housing portions 14 and 17 when thus assembled provide bearings for the shaft 19 which carries the cam 15 and the worm gear 16. The casting 17 also has formed integrally therewith another cylindrical housing 20, the end walls of which carry bearings for the shaft 21, which latter shaft at its left hand end is provided with a worm (not shown) to engage the worm wheel 16. The right hand end of shaft 21 is supported in a bearing pedestal 22 and carries a set of three stepped pulleys 23, a similar set of pulleys 24 being provided on motor shaft 25. As will be seen from Figure 1, an additional pulley 26 is affixed to shaft 25 and through the intermediary of belt 27 drives a pulley 28, attached to shaft 29, which is suitably journaled in the end walls of the housing 30. Shaft 29 carries a worm 31 driving the worm wheel 32 which is keyed to the hollow shaft 10.

As shown in Fig. 3 the rotatable platform 8 carries a plurality of rollers 33, a pair of rollers being provided for each position to which the head is adapted to be indexed. This indexing or step-by-step movement of platform 8 is controlled by the cam 15 which engages in succession each of the rollers 33. While adjacent rollers are engaging the straight part of the cam the platform 8 is maintained stationary and accurately in its indexed position.

As shown in Figs. 1 and 3, the top face of platform 8 is provided with an angular flange or ridge 34, through which the cam rollers 33 extend. The purpose of flange 34 will be described hereinafter. Mounted on platform 8 are a series of pumps 35 each preferably containing a preliminary or backing unit and a final evacuating unit, although these pumps may be of any well known construction capable of producing the requisite degree of vacuum. Each pump is affixed to a base plate 36 which has its front edge curved to correspond with the curvature of flange 34, this front edge being also inclined or chamfered to fit below the corresponding inclined edge of flange 34, as shown clearly in Fig. 3. A bolt 37 passes through the base 36 for securing the pump in its proper position. By this arrangement the pump is accurately centered and rigidly maintained in position and all that is necessary to remove a pump is to loosen the bolt 37 and slide the pump off platform 8. When a pump has been thus fastened in position the pump

driving gear is in proper engagement with the main gear 11 and each pump is continuously operated at the same time it is being carried around on platform 8.

In certain cases it may be found desirable to stop the indexing movement of the head without stopping the pump. For this purpose a suitable clutch 39 is interposed between the motor and shaft 21, the operating lever for this clutch being indicated by numeral 39A.

Platform 8 has attached thereto a plurality of vertical brackets 40 which support at their upper ends a circular spider 41 so that the latter rotates as a unit with platform 8. Fastened to the rim of spider 41 by suitable bolts 42 is an annular water conduit 43 having a plurality of exhaust openings through which pass the cylindrical metal members 43A which are preferably welded to the upper and lower faces of conduit 43 (Fig. 4). There are shown in the drawings two exhaust openings for each pump but it will be understood that any number of exhaust openings may be provided for the individual pumps. As shown in Figs. 3 and 4, each exhaust opening is connected to the associated pump through a rubber "pinch-off" tube 44 which passes through the metal member 43A. The lower end of each "pinch-off" tube is connected to a coupling 45, having a well portion 46 therein, the tube 45 in turn being coupled to a pump through couplings 48 and 49. Associated with each tube 44 is a "pinch-off" lever 50 which is pivotally mounted in a bracket 50A formed on the cylindrical member 51. Member 51 has one side cut away to receive the end of lever 50. At the proper point in the operation of the machine, namely at the "pinch-off" position, the outer end 52 of lever 50 engages a fixed track 53 whereby the inner end of lever 50 presses against the rubber tube 44, as represented by the full-line position (Fig. 4). Lever 50 is so designed that when thus forced to the "pinch-off" position it remains in such position by a jamming action and thus the lamp or audion remains disconnected from the pump until lever 50 is again moved to its original position, as represented by the dotted lines (Fig. 4).

For the purpose of protecting the rubber connections from the heat generated during the operation of the machine the conduit 43 is connected by inlet and outlet pipes 56 and 57 (partially shown in Fig. 1) to the water reservoir 58. Supply pipe 59 leads into reservoir 58 and overflow pipe 60 extends centrally through the bearing 10 to a suitable outlet (not shown). Each lamp or audion 61 to be exhausted is mounted with its exhaust tube 62 extending into the rubber coupling 44. Associated with each coupling 44, and mounted on the manifold 43 are a pair of brackets 64 each carrying a clip 65 to receive one of the filament leads 66 of the lamp or audion 61. Pivotally mounted on the outer end of each bracket 64 is a spring pressed brush 67 adapted to contact with a corresponding conducting rail 68 preferably insulatingly mounted on the arms 69. The rails 68 may extend entirely around the circumference of spider 41 or may be continuous only at those points where a circuit is to be closed through the lamp filament, as is well known in the art. The rails 68 may be made in sections having different supply voltages connected thereto so that the filament is raised or lowered in temperatures at the proper or desired points in the evacuation process. Secured to table 6 by bolts 70 are a set of uprights 71 to which are attached the arms 69 for supporting the filament tracks 68 described above. Also supported on the upper ends of members 71 are inwardly extending arms 72 from which the oven 73 is supported. Oven 73 may be of any well known construction adapted to be heated by gas or electricity. It also may take the form of a continuous coil adapted to be energized by high frequency currents by means of which the metal parts of the tube 61 may be heated. As indicated in Fig. 1 the oven 73, or other heating arrangement extends only partially around the circumference of the machine, namely from point A to point B. The end walls of the oven are cut away as indicated by numeral 74 to allow the bulbs 61 to pass freely into and out of the oven. For the purpose of completing the exhaustion, it is the usual practice to provide a so-called "flash" material on the interior of the bulb and to explode this material at the proper point in the exhaustion process by means of high frequency current. In the present machine this flashing is effected by means of coils 77 which are connected to a suitable source of high frequency oscillation (not shown). The coils 77 are adapted to be lowered over each bulb 61 very shortly after the latter leaves the oven 73. For this purpose there is attached to table 6 a bracket 75 in which is slidably mounted the plate 76 carrying at its upper ends the high frequency bombarding coils 77. Slide 76, together with coils 77 is held normally in raised position out of the path of the bulbs by means of cam 82. For the purpose of lowering the coils about a bulb when the latter reaches the bombarding position, there is attached to the lower end of slide 76 a link 78 attached to lever 79 which is pivoted in a bracket 80 affixed to the lower face of table 6. The opposite end of lever 79 carries a roller 81 which bears against cam 82 under control of the weight of the slide 76. For the purpose of rotating cam 82 the latter is attached to a shaft 83 which carries bevel gear 84, cooperating with corresponding bevel gear 85 on shaft 86. Shaft 86 is driven through bevel gears 87 from shaft 19. It will be understood that cam 82 is so designed that the slide 76 is normally in raised position and is lowered to the bombarding position only when a tube leaves the oven.

After the bulb and its metal parts have been thus bombarded, suitable means must be provided for sealing off the exhaust tube 62. For this purpose there is mounted on the table 6 a hollow standard 88 through which passes the shaft 83 described above. Shaft 83 carries at its upper end a tipping torch assembly represented generally by the numeral 89. This tipping torch is preferably of the type disclosed in copending application Serial No. 408,193, and comprises a pair of gas burners 90 mounted on a bracket 91 which is normally held out of the path of the bulbs 61 and is adapted, as indicated by the full lines (Fig. 6) at the proper time, to be moved inwardly toward the bulb whereby the bulb envelope is supported on the arms 92 and the fires 90 surround the exhaust tube 62 as represented in Figs. 5 and 6. For a detailed description of the manner in which this tipping torch is thus moved and functions, reference may be had to the application referred to hereinabove, Serial No. 408,193.

After the lamp or audion has been "sealed-off" the arms 92 are rotated as described in application Serial No. 408,193 to permit the lamp to drop into a suitable conveyor. However, there still remains in the coupling 44 the unused por-

tion of the exhaust tube 62. The machine is so designed that after the "sealing-off" operation, and the remaining exhaust tube indexed to position G, a pair of jaws engage the exhaust tube and withdraw it from the coupling 44. Thus as shown in Fig. 1, shaft 86 carries a cam 93 for operating a lever 94 having one end pivotally mounted in bracket 95. Lever 95 in turn operates another offset lever 96 pivoted in a bracket 97.

Supported on table 6 in a suitable bracket (not shown) and at the point D, are a pair of gear sectors 98 and 99 having attached thereto a pair of gripper jaws 100, 101. Sectors 98 and 99 are mounted for rocking movement on the shafts 102 and 103, and are normally in the position represented in Fig. 7, thus providing a space between jaws 100 and 101 to receive the unused length of exhaust tube 62. As the spider is indexed this unused length of tube enters between the jaws 100 and 101. Thereupon the lever 96, which is suitably linked (not shown) to an extension 104 on jaw 101, causes the latter to be rotated upwardly. Due to the engagement between the sector teeth jaw 100 is likewise rotated upwardly whereby the tube 62 is firmly gripped and the further upward rotation of the jaws pulls the tube 62 out of the coupling 44 and ejects it from the machine. Under control of cam 93 the jaws 98 and 99 are thereupon returned to their downward position (Fig. 7) ready to engage the next exhaust tube to be ejected.

In order that the bulbs may be in the exact position for each of the operations, it is necessary that some means be provided for accurately regulating the height of the bulb with respect to the spider 41. For this purpose there is provided what may be termed a height-gauging mechanism, comprising a shaft 105 mounted for sliding motion in the hollow pedestal 106 attached to table 6. Shaft 105 carries at its upper end arm 107 and a member 107' adapted to engage the top of each bulb 61 and force the bulb downwardly the proper distance. To effect this latter operation shaft 105 is connected through a link 108 to a lever 109 which is pivotally mounted below the table 6 at the point 110. The opposite end of lever 109 rides on the cam 111 attached to shaft 86, it being understood that cam 111 is so designed that member 108 is normally maintained in an elevated position and is lowered to effect the positioning of the bulb at the proper time.

From the foregoing detailed description it is believed that the method of operation of the machine will now be understood. It will be assumed, therefore, that the machine is about to be started by setting the motor 13 in operation. Bulbs 61 are plugged into the rubber couplings 44 at the points E and F (Fig. 1) which may be termed the loading positions of the machine. The platform 8 and spider 41 are thereupon indexed to the next or bulb height gauging position wherein the cam 111 effects a downward movement of member 108 and forces the bulb into the coupling 44 to the proper distance. Immediately thereafter the member 108 is again raised to clear the path of the bulb 61, whereupon the head is indexed to the next position, represented by the letter A, where it is about to enter the oven 73. Just before the bulb enters the oven the associated "pinch-off" lever 50 is operated to the position shown in dotted lines (Fig. 4) to complete the exhaust line to the associated pump. If at this instant the bulb or line should develop a leak, the attendant will at once be apprised of the fact either as a result of the peculiar sound of the pump or by means of any well known leak detector. In such a case the attendant manipulates lever 105 (Fig. 10) which causes the movable track section 106 to be positioned in the path of the "pinch-off" lever 50 causing the defective bulb to be cut-off from the associated pump. Due to the jamming action between lever 50 and the rubber coupling 44 hereinabove described, the attendant may release lever 105 and member 106 but the defective bulb remains "pinched-off". It will be understood that instead of the attendant manually operating the lever 105 the latter may be operated automatically under control of any well known leak detector when a bulb develops a leak. Furthermore the movable sections 106 may be provided at a plurality of points around the rotating head, if desired.

While passing through the oven the metal and glass parts of the bulb are heated in a well known manner to free the same from gasses and to expedite the exhaustion, whereupon the head continues to be indexed in a step-by-step manner until the above assumed tube 61 leaves the oven at the point B. Shortly thereafter the cam 82 allows the lever 79 and the slide 76 to move downwardly so that the high frequency coils 77 surround the bulb 61 to subject the latter to the flashing operation. After the flash is completed the coils 77 are again raised to clear the tube and the head continues to be indexed until it reaches the sealing-off position, represented by the letter C (Fig. 1). In this position the tipping torch assembly 89 which is normally out of the path of the traveling tubes, is moved inwardly until the curved arms 92 engage the bulb 61, as is schematically illustrated in Figs. 5 and 6 of the drawings. When the torch assembly has been thus moved inwardly towards the bulb, the sealing fires 90 are effective in fusing the exhaust tube 62. As the tube 62 begins to fuse, the bulb portion 61 is moved slightly upwardly by member 92 in the manner described in detail in application Serial No. 408,193, in order to effect a separation of the fused portions of tube 62. Thereupon the tipping torch assembly 89 is moved backwardly out of the way of bulb 61, as indicated by the full lined position in Fig. 6, and the head continues to be indexed to the next or unloading position represented by the letter D. While moving from position C to position D the coupling 44 is "pinched-off" as described above. In the unloading position D the sealed tube 61 is ejected by a rotation of the assembly 89, and the head is thereupon indexed to the next position wherein the unused portion of the exhaust tube is removed from the coupling member 44 as hereinabove described.

While the tube is being moved from the loading position to the unloading position the members 67 (Fig. 4) are in engagement with the conducting rails 68 whereby the filament is lighted either continuously or intermittently during the evacuation, and at the required temperature.

While the above method of operation is given in connection with one tube, it will be understood that the machine is being continuously loaded at the points E and F and that each of the tubes undergoes the successive operations above described.

While in the foregoing specification specific apparatus is disclosed for the purpose of carrying out the features of the invention, it will be

understood that broadly the invention is not limited thereto but is capable of embodiment in other forms of apparatus. For example, while the pumps are shown as driven by common gears, it will be understood that any equivalent driving mechanism such as a continuous chain or belt, common to all the pumps, may be employed. Furthermore, the gear 11 may be replaced by an electrical commutator to which each of the pumps is connected by means of suitable brushes. In this modification it will be clear, of course, that each pump will require an individual electric motor for driving. Other changes will be apparent to those familiar with the art.

What is claimed as new and useful is:

1. In a machine of the character described a movable platform, a bulb mounted on said platform for evacuation, means for automatically adjusting the height of said bulb, a pump for said bulb adapted to be moved therewith and a single motor for moving said platform and for operating said pump and adjusting means.

2. In a machine of the character described the combination of an article to be exhausted, means for moving said article in a step-by-step manner to a height gauging position, and then to a bombarding position, and a means for continuously subjecting said article to exhaustion while moving to, from and through said positions.

3. In a machine of the character described the combination of a bulb to be exhausted, means for moving said bulb in a step-by-step manner to one position in which its height is automatically adjusted and then to another position in which it is heated and then to another position for bombardment and means for continuously subjecting said bulb to evacuation.

4. In a machine of the character described the combination of a bulb to be exhausted, means for moving said bulb in a step-by-step manner to a height adjusting position, then to a heat treating position and then to a sealing-off position, and means for subjecting said bulb to an uninterrupted evacuation.

5. In a machine of the character described the combination of a bulb to be exhausted, means for moving said bulb in a step-by-step manner first to a height adjusting position, then to a heat treating position, then to a bombarding position and then to the sealing off position, and means for subjecting said bulb to an uninterrupted evacuation while moving to and from each of said positions.

6. In a machine of the character described for evacuating incandescent filament bulbs, the combination of a rotatable platform carrying a plurality of pumps, a single motor for rotating said platform and simultaneously driving said pumps, conductive tracks surrounding a portion of said platform, a plurality of bulb holders on said platform, a plurality of sets of contact clips carried by said platform for completing a circuit to the bulb filaments, a set of brushes carried by said platform adapted to contact with said tracks to supply current to said filament, and means for subjecting said bulb to a high frequency field while current is flowing through said filament.

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