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EXHAUST MACHINE FOR LAMP AND RADIO BULBS AND THE LIKE

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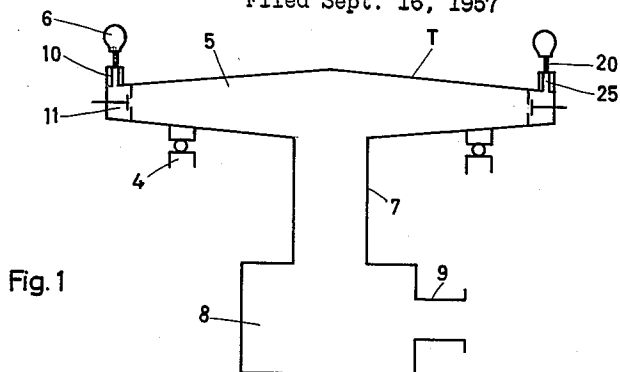


Fig. 1

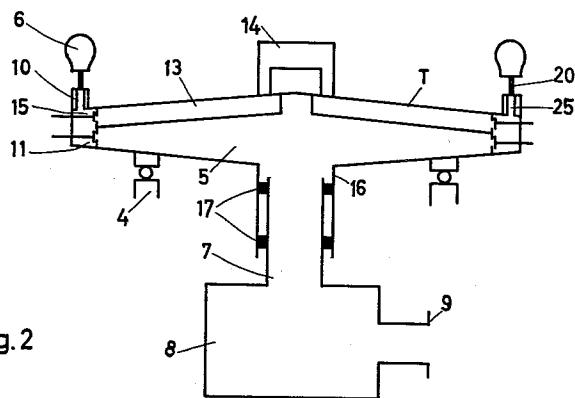


Fig. 2

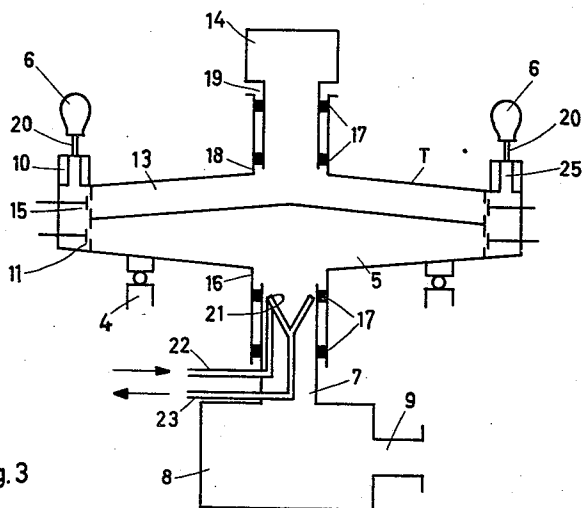


Fig. 3

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EXHAUST MACHINE FOR LAMP AND RADIO BULBS AND THE LIKE

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2 Claims. (Cl. 141—65)

In mass production of incandescent electric lamps, radio tubes and the like, it is common practice to employ an exhaust machine having a plurality of bulb receivers or exhaust heads to which non-evacuated bulbs are applied successively to pass through various operating stations inclusive of evacuation and sealing and finally removed in the same successive order, there being a plurality of bulbs in transit simultaneously. Oil-air pumps for producing so-called high vacuum are used in most cases for effecting the evacuation of the bulbs during part of the cycle of travel in the machine and in many instances what is known as a backer or fore-pump is used at an early part of the cycle for obtaining a preliminary or partial evacuation of each bulb before that bulb reaches a station at which the high-vacuum pump is effective thereon. Exhaust machines of the character indicated are generally of the automatic type in which the bulbs to be exhausted are located in heads on a rotating turret or on a conveyor and have a transition therewith either continuously or intermittently. As the pumps used in the past were bulky and heavy, they have in most instances been mounted on a stationary part of the machine. Connection from the pump or pumps in these prior art machines to the rotating or traveling portion thereof is made across a rotating or sliding valve consisting of a pair of ground-in plates which have ports that sequentially register at the station or place where the evacuation is to occur. But vacuum-tight ground-in plates are very expensive and it is also quite difficult to keep them vacuum-tight. The oil necessarily used between the plates results in impurities in the pipes or ducts and in the bulbs being exhausted because of back-flowing vapors. Furthermore, the numerous long pipe-lines or ducts that have to be used in these prior-art machines are another drawback involved therein due to creation thereby of flow resistance.

There have been instances of machines providing a special vacuum pump on the rotor or turret individual to each head and bulb placed in that head, so there consequently are as many pumps as there are heads to thereby avoid the need for ground-in plates. The cost, however, for such a machine is very high due to its requirement for so many vacuum pumps, and furthermore, such machines involve difficulties with placement of the pumps, with inadequacy of pumps of such small size capable of being carried by the movable part of the machine, and with obtaining and maintaining satisfactory lead-in connection for the required mechanical and electrical energy thereto.

An object of the invention is to provide for exhaust of a maximum number of bulbs in a machine by a pump without requiring ground-in plates in transmitting the suction of the pump to the bulbs.

Another object of the invention is to provide a machine wherein the desired evacuation of a maximum number of bulbs is completed within the time interval of transition of a bulb from loading to unloading position with employment of a high-speed high-vacuum pump and without presence of ground-in plates.

A further object of the invention is to provide a vacuum chamber in the machine contiguous to the bulb-receiving heads the volume whereof is far in excess of the total volume of bulbs being evacuated.

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A broad aspect of the invention is to maintain any pressure increase introduced in the vacuum chamber of the machine, due to evacuation of a bulb or bulbs, insignificant in comparison to the status of evacuation or vacuum in said chamber.

A purpose of the invention is to utilize a high-speed high-vacuum pump with the load equalized to be approximately constant.

The invention also contemplates a construction permitting mounting of the pump on the rotating or otherwise moving portion of the machine if so desired.

Also it is within the scope of the objects of this invention to provide for use of a backer or fore-pump if desired for preliminary evacuation.

A constructional feature of the invention is to provide contiguous chambers for evacuation by the backer or fore-pump and the high-speed high-vacuum pump respectively both of which have large capacity comparative to the bulbs being evacuated.

In addition to the foregoing object, a structural feature attained is provision of selective utilization of the vacuum of either of said chambers for each bulb during its cycle of transition.

Closely related to the foregoing structural features is the further proposal to provide the said chambers axially of and as part of the rotor or turret of a rotary type machine, one chamber above the other, and if so desired to mount the backer pump on said turret to rotate therewith.

Other objects, advantages and beneficial structural features of the invention will appear to persons skilled in the art to which the invention appertains as the description proceeds, both by direct recitation thereof and by implication from the context.

Referring to the accompanying drawing in which like numerals of reference indicate similar parts throughout the several views;

FIGURE 1 is a representation of an exhaust machine of rotary type embodying my invention;

FIGURE 2 is a view similar to FIG. 1, additionally showing provision for preliminary exhaust of bulbs by a backer or fore-pump; and

FIGURE 3 is another view of similar character and showing provision for applying the pumps to non-rotating portions of the machine.

In the specific embodiment of the invention illustrated in said drawing, there are shown as stationary parts of machine in each view, supports 4 which guide the illustrated rotating turret T. For using the present invention it is of no importance whether this turret T is advanced continuously or intermittently. Therefore, any particulars of this driving mechanism are omitted, especially since both types of drive are well known in the art. In all views of the drawing, said turret T provides a chamber 5 coaxial therewith and constituting a large tank diametrically across and included within the turret and extending proximate to the periphery thereof so that the chamber will have a very large volume as compared to the total volume of bulbs 6 to be evacuated, and this large volume amounts, for instance, to twenty to a hundred or more times the volume of all bulbs 6 carried by the turret at the same time. At the bottom of the turret leading from the vacuum chamber 5 thereof, is a hollow connection 7 to a vacuum pump 8.

While the present invention is not directed to novel constructional features of the pump 8, it is intended that a high-speed high-vacuum pump of adequately large capacity shall be used to maintain the turret vacuum chamber 5 in a state of maximum evacuation during operation of the machine even though air will of necessity be drawn into the chamber from the bulbs and to some extent from the bulb-retaining heads 10 of the machine if the bulbs

are loose therein and more especially at the moment of removal from or insertion into a head. A very satisfactory pump for fulfilling the stated requirements is one developed in recent time that produces a very strong suction and high vacuum, and is known in the trade as a Root's blower or Kinney vacuum pump, and shown for instance in U.S. Patent 1,623,315 issued April 5, 1927 to J. R. Kinney. Such a pump, in cooperation with the described features of this invention, makes possible a particularly reliable and quick evacuation. A further advantage of use of the mentioned Root's blower is the fact that the high efficiency desired is obtained even though the pump has a smaller volume or bulk and less weight than other known vacuum pumps of similar blower output. It may also be said that the efficiency of a Root's blower, especially if it is of multi-stage construction, may be satisfactorily employed without a preliminary or fore-vacuum pump, but if desired an appropriate preliminary booster or fore-pump may be used and applied in the construction of FIG. 1, to a pipe connection 9 shown at the side of the Root's blower or pump 8. The showing of FIG. 1 contemplates that the pump 8 will be directly fixed with respect to the rotor or turret T and rotated therewith, and of course if a fore-pump is applied to the main pump 8, it will also rotate. In view of the small bulk and light weight of the pump or pumps thus used, the mounting thereof upon and rotation of the same with the turret is feasible and not objectionable and is desirable.

On the peripheral margin of turret T is arranged a circular series of receivers or heads 10 for the bulbs 6 which are held therein by tubulations 20 constituting usual parts of bulbs of this character. Said heads have direct connection with the turret chamber 5 and therefore no pipe lines or tubing are required from said chamber to the heads. The direct connection of said heads to the vacuum chamber of the turret avoids necessity for ground-in plates to establish communication with the source of vacuum. A peripheral section of the vacuum chamber under each head is partitioned off from the main portion of that chamber providing a feeding space 25 individual to each head, and in the partition there is a valve 11 proximate to each head to serve as a closure to conserve the vacuum in the main chamber against the outer atmosphere in case of a loose bulb 6 or no bulb in the head, or in case of any other contingency admitting air undesirably to the partitioned-off section or feeding space 25. Said feeding spaces 25 furthermore beneficially function as pockets for catching and retaining slivers of glass or other extraneous solid matter and consequently provide protection therefrom for the pump. It is not necessary that valves 11 close absolutely tight because small quantities of in-flowing air will be readily sucked off by the vacuum pump 8, which has, as above stated, a high blower output whereby no notable increase in pressure in the vacuum chamber 5 occurs. The said valves 11 for each feeding space 25 can be operated in accordance with known valve-operating practice and each is individually arranged to close in event of a loose bulb in the head associated with that particular feeding space and valve or in event of no bulb being present therein, by any desired mechanical, electrical or pneumatic control means, it being preferable to utilize such a means which will close the valve automatically if necessary.

The turret may have such number of bulb-receivers or heads 10 as desired in the manufacture of the machine, and as an arbitrary example of a usual size of machine forty-eight may be stated as a number employed. The bulbs 6 are applied, at what may be called the front of the machine, one at a time, with tubulation 20 of the bulb introduced into and held by the bulb-receiver or head 10 on the turret at the loading station of the rotative cycle of said turret, and then as the turret continues to rotate the bulb is evacuated and subjected to other operations thereon and finally near its approach to the loading station is sealed off in accordance with usual practice and arrives

at the front of the machine at the unloading station where it is removed from the head 10. In the example given, from the unloading station to the loading station there will be approximately one forty-eighth of the complete cycle, and in that distance of travel of the head thereat the sealed bulb 6 is removed and a new or non-evacuated bulb 6 applied to the head. This same cycle of operation is repeated as each header revolves from the unloading station to the loading station and then through the rotative cycle back to the loading station. During that rotation, the bulbs and contents may be heated in order to more thoroughly expel remainders of gas and water vapor and may also be subjected to commonly employed gettering or flashing as part of the operations of treatment recognized in the art as desirable or necessary in manufacture of lamps, radio tubes and the like of which the bulb is a part. It is permissible, by the disclosed construction, to remove a bulb at the unloading station and immediately apply a new bulb to the same receiver or head 10 in communication with the vacuum chamber 5 with the valve 11 open so exhaust of the bulb begins without delay in view of the fact that the vacuum chamber 5 has very large capacity or volume and its pressure will increase very little by air admitted during the exchange of bulbs. This is even more true in view of use of pump 8 of the character above described which makes it possible to promptly reduce the pressure in the vacuum chamber to the maximum evacuation pressure in the length of time transpiring while the turret is advancing one forty-eighth of its complete cycle.

The invention also contemplates utilization of a preliminary exhaust of the bulb before connecting it directly with the main exhaust of the high-vacuum chamber 5. Such a construction is shown in FIGS. 2 and 3 which have a fore-vacuum chamber 13 above and coaxial with the main vacuum chamber 5, said fore-chamber also extending proximate to the periphery of the turret. A preliminary vacuum or fore-pump 14 mounted at the top of the turret T is in direct communication with said fore-vacuum chamber 13 and maintains a desired degree of evacuation therein. As shown in FIG. 2, this fore-pump 14 may conveniently be mounted directly upon the turret to rotate therewith.

As in the construction of FIG. 1, the showing of FIG. 2 provides a circular series of receivers or heads 10 on the peripheral margin of the turret T and also shows a peripheral section of the turret under each head as partitioned off from both the main vacuum chamber 5 and from the fore-vacuum chamber 13 providing a feeding space 25 individual to each head. Valves 11, as before, proximate to each head serve as closures for openings from the main vacuum chamber into said feeding space proximate to each head 10. Other valves 15 are provided for the said feeding space proximate to each head to serve as closures for openings thereinto from the fore-chamber 13. Operation of these valves may be by suitable mechanical, electrical or pneumatic means as will be understood by persons skilled in the art. Since the bulb receiver or head 10 opens to the feeding space 25 of the turret, and both the main vacuum chamber 5 and the fore-vacuum chamber 13 have valved communication with said feeding space, a bulb 6 mounted in said head by the bulb tubulation 20 may be subjected initially to vacuum from the fore-vacuum chamber and subsequently to the vacuum of the main chamber by appropriate manipulation of the respective valves to those chambers, which may be done by the aforesaid appropriate mechanical, electrical or pneumatic means.

In the example shown in FIG. 2, the high-vacuum high-speed or main pump 8 is again preferably a Root's blower or Kinney pump having connection at the bottom of the turret for evacuating the main vacuum chamber 5. In this instance, pump 8 is shown as having a fixed position, not rotating with the turret. The suction connection 7 of this pump is cylindrical and mounted in telescoped

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relation to a hollow cylindrical connection 16 rotatable thereon, said connection 16 being integral with and depending coaxially from the turret. Appropriate ring gaskets 17 are provided between the lapping ends of said connections 7 and 16 capable of withholding external atmospheric pressure but permitting rotation of the turret and its connection 16 upon the stationary connection 7, and accordingly constituting a stuffing-box type rotatable vacuum seal between the stationary pump and the rotatable turret. Seals of the stuffing-box type can be manufactured much simpler and can be kept tight easier than aforementioned ground-in plates used hitherto in rotating exhaust machines.

It may also be pointed out that if desired, the above-described preliminary or fore-pump, like the main pump, may also be mounted stationary with the turret rotating with respect thereto. Such a construction is shown in FIG. 3. There, at the top of the turret coaxial therewith and in direct communication with the fore-chamber 13 thereof, is a hollow cylindrical connection 18 in overlapped or telescoped relation to a fixed hollow cylindrical connection 19 depending from the stationary fore-pump 14. Ring gaskets 17 such as above described are interposed in tight relation between said connections 18, 19 constituting a stuffing-box type of vacuum seal permitting rotation of the turret T. In this showing, also, another rotatable stuffing-box type of seal exemplified by gaskets 17 is provided between depending hollow cylindrical connection 16 from the main vacuum chamber 5 and the hollow cylindrical connection 7 upstanding from the high-vacuum high speed Root's blower 8 corresponding to the showing in and description of FIG. 2. The upstanding cylindrical connection 18 at the top of the turret T and the depending cylindrical connection 16 at the bottom of the turret are of course axially aligned so as to permit rotation of the turret with respect to the stationary connections 19 and 7 fixed respectively with respect to the fore-pump 14 and the main pump 8.

If it is desired that the bulbs 6 should be filled with gas after having been exhausted of air as above described, then this filling may be done simply in the machine of this invention by provision of another tube coming from a gas-supply reservoir feeding a third chamber similar to chambers 5 and 13 and similarly provided with valves into the partitioned-off section or feeding space 25 corresponding to the showing of valves 11 and 15. Such arrangement makes use of the common feeding space for each head not only for the fore evacuation and main evacuation, but also for the gas supply to the bulbs. Or, as an alternative construction, instead of the fore-pump being used in either FIG. 2 or 3, the gas supply may be introduced into chamber 13 thereof to gain entry to the partitioned-off section or feeding space 25 at properly timed portion of the rotative cycle of the turret. Of course the valve or valves for the vacuum are closed when the valve admitting the gas is open.

As can be seen clearly in all embodiments of the invention, the connection between the vacuum chambers 5 and 13 and the respective pump thereto common for all bulbs mounted in the several heads, consists of only a short and adequately large passageway direct from the pump to the chamber and offers practically no flow resistance to the air or other gas being evacuated, so the full force of the evacuation is applied to the feeding space 25 and to the tubulations 20 of the bulbs 6 introduced into and held by the respective heads or receivers 10 therefor. While those tubulations 20 are unavoidably relatively small, the fact that the full evacuation force applies directly thereto results in rapid and effective evacuation of the bulbs.

One example of use of the exhaust machine of this invention is for incandescent lamps, and with respect thereto a final vacuum of about 10^{-2} mm. Hg is ordinarily considered sufficient, and by the disclosed construction and use of the Root's blower or Kinney pump discussed

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above, this desired final vacuum may be obtained remarkably quickly. It may also be here emphasized that the said vacuum is obtained free of contamination of oil either in the vacuum chambers or in the feeding spaces contiguous to the tubulation of the bulbs. It also may be said that the constructions shown wherein a fore-pump is used, that such fore-pump may also be a Root's blower. By use of an exhaust machine in accordance with the disclosed construction, disturbing and objectionable back-flowing of oil gases, such as occurs in prior art machines, is absolutely prevented and requires no use of cold-traps for elimination of oil.

However, should a cold-trap be insisted upon as a precaution or for other reason, the structure of my invention is readily adaptable thereto, and for illustrative purposes a cold-trap is shown in FIG. 3. The embodiment selected to show such a cold-trap comprises pipe coils 21 arranged in the nature of a baffle within the passageway of connection 7 between vacuum chamber 5 and the main vacuum pump 8. That baffle is in the path of gases being sucked off and functions to condense the same as they flow past and against the baffle. A cooling brine or other cooling medium should flow through the baffle pipe coils 21, and for that purpose a supply pipe 22 thereto and a discharge pipe 23 therefrom are shown leading to and from said coils passing transversely through one side of stationary connection 16.

The invention claimed is:

1. An exhaust machine for evacuating a number of bulbs each having a tubulation, comprising a generally circular enclosure rotatable about an axis, said enclosure providing a large tank vacuum chamber therein of generally circular contour coaxial with said enclosure and extending diametrically across said axis, said enclosure also constituting a rotatable turret having loading and unloading stations and intermediate stations therebetween at some of which at least exhaust of the bulbs is effected, a pump fixed on said enclosure for maintaining a vacuum in said tank chamber, and a plurality of heads next to the periphery of and carried by said enclosure, said chamber having a series of valve seats each opening next to and into a respective one of said heads, each of said heads adapted to mount a bulb by its said tubulation, a series of valves, one for each of said valve seats, each said head having direct communication with said tank chamber by unseating the respective valve therefor, said turret transferring said bulbs sequentially step-by-step from said loading station to said unloading station, said tank chamber having a volume in excess of the total volumes of all of said bulbs, said pump rotating with said turret and having exhaust capacity sufficient to maintain a substantially constant vacuum in said tank chamber notwithstanding admission of air to said vacuum tank chamber from each bulb inserted in a head at the loading station at each step of rotation of said turret, whereby the pressure in said tank chamber increases only so little that the pump will continue to operate within the pressure range of its greatest suction work, said vacuum tank chamber being located in close proximity both to said pump and to all of said tubulations.

2. An exhaust machine for evacuating a number of bulbs each having a tubulation, comprising a generally circular enclosure rotatable about an axis and providing two coaxial tank vacuum chambers therein of generally circular contour coaxial with said enclosures, one of said tank chambers being located above the other and both of said tank chambers extending diametrically across said axis, said enclosure also constituting a rotatable turret having loading and unloading stations and intermediate stations therebetween at some of which at least exhaust of the bulbs is effected, a vacuum pump fixed on said enclosure above and exhausting the upper said one of said tank chambers, and a second vacuum pump coaxially of and below said enclosure exhausting

the lower one of said tank chambers, said enclosure being rotatable with respect to said second vacuum pump, and a plurality of heads next to the periphery of and carried by said enclosure, each of said heads adapted to mount a bulb by its said tubulation, each of said heads having one opening and valve seat between said head and the upper one of said tank chambers and having a second opening and valve seat between said head and the lower one of said tank chambers, valves for said seats adapted to be individually unseated for selectively applying the vacuum of said two tank chambers to the head the opening to which is controlled by the unseated valve, said turret transferring said bulbs sequentially step-by-step from said loading station to said unloading station, each tank chamber having a volume in excess of the total volumes of all of said bulbs, said vacuum pump fixed on said enclosure rotating with said turret and having exhaust capacity sufficient to maintain a substantially constant vacuum in said upper vacuum tank chamber not withstanding admission of air to said upper tank chamber from each bulb inserted into a head at the loading station at each step of rotation of said turret, said lower vacuum pump having exhaust capacity suffi-

cient to maintain a substantially constant vacuum in said lower vacuum tank chamber notwithstanding admission of air through any valve seat thereto the valve whereof is unseated, whereby pressures in each of said vacuum tank chambers increases only so little that each of said pumps will continue to operate within the pressure range of its greatest suction work.

References Cited in the file of this patent

UNITED STATES PATENTS

10	1,298,569	LeRossignol	Mar. 25, 1919
	1,445,811	Wetmore	Feb. 20, 1923
	1,623,315	Kinney	Apr. 5, 1927
	1,710,428	Mey	Apr. 23, 1929
15	1,967,571	Dumont et al.	July 24, 1934
	2,349,303	Pelosi	May 23, 1944
	2,386,298	Downing et al.	Oct. 9, 1945
	2,791,245	Alcott	May 7, 1957

FOREIGN PATENTS

20	133,740	Germany	Sept. 2, 1902
	463,507	Great Britain	Apr. 1, 1937
	669,875	Germany	Jan. 6, 1939