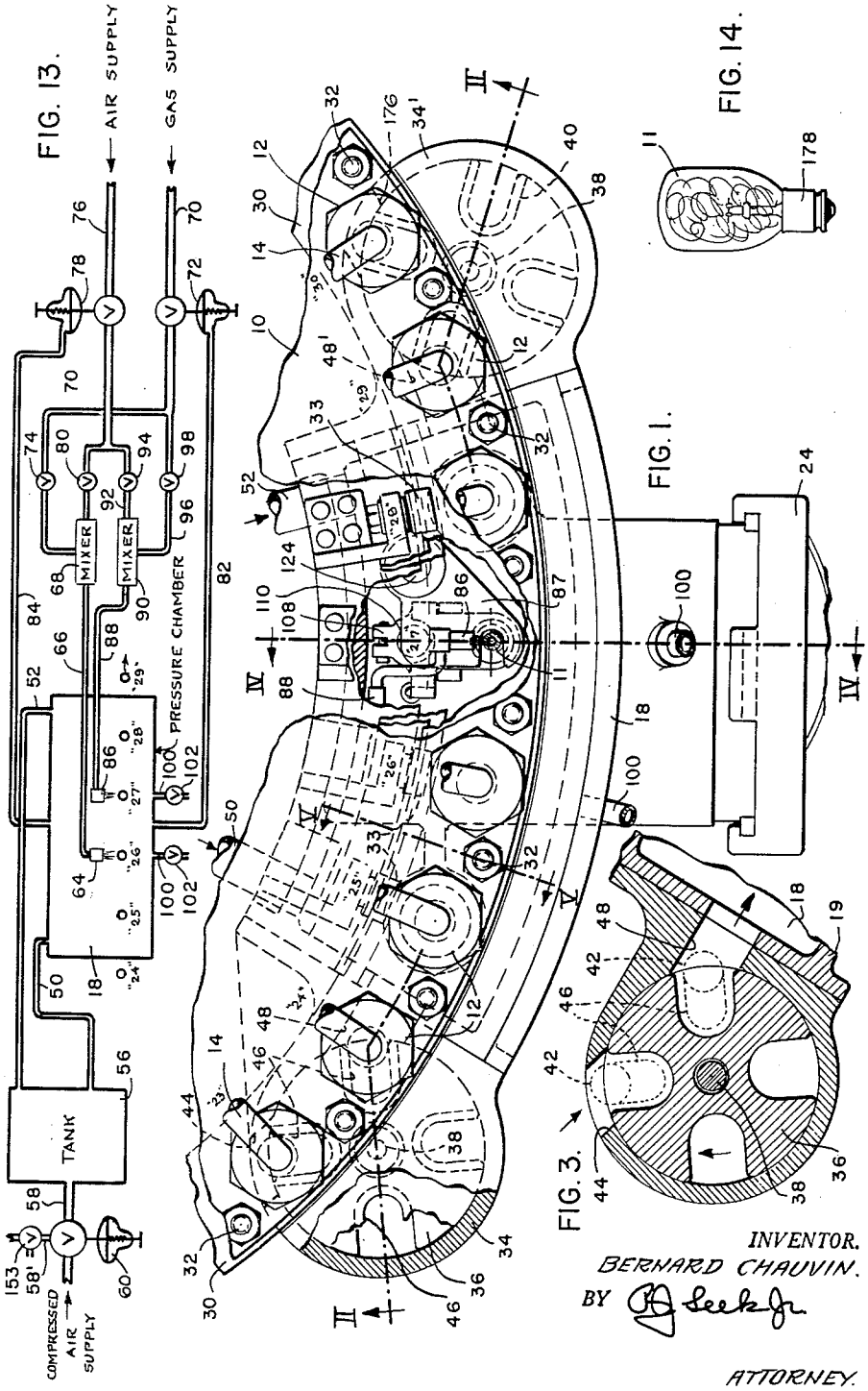
June 14, 1960 B. CHAUVIN 2,940,231

APPARATUS FOR SEALING OFF VESSELS

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APPARATUS FOR SEALING OFF VESSELS

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FIG. 2.

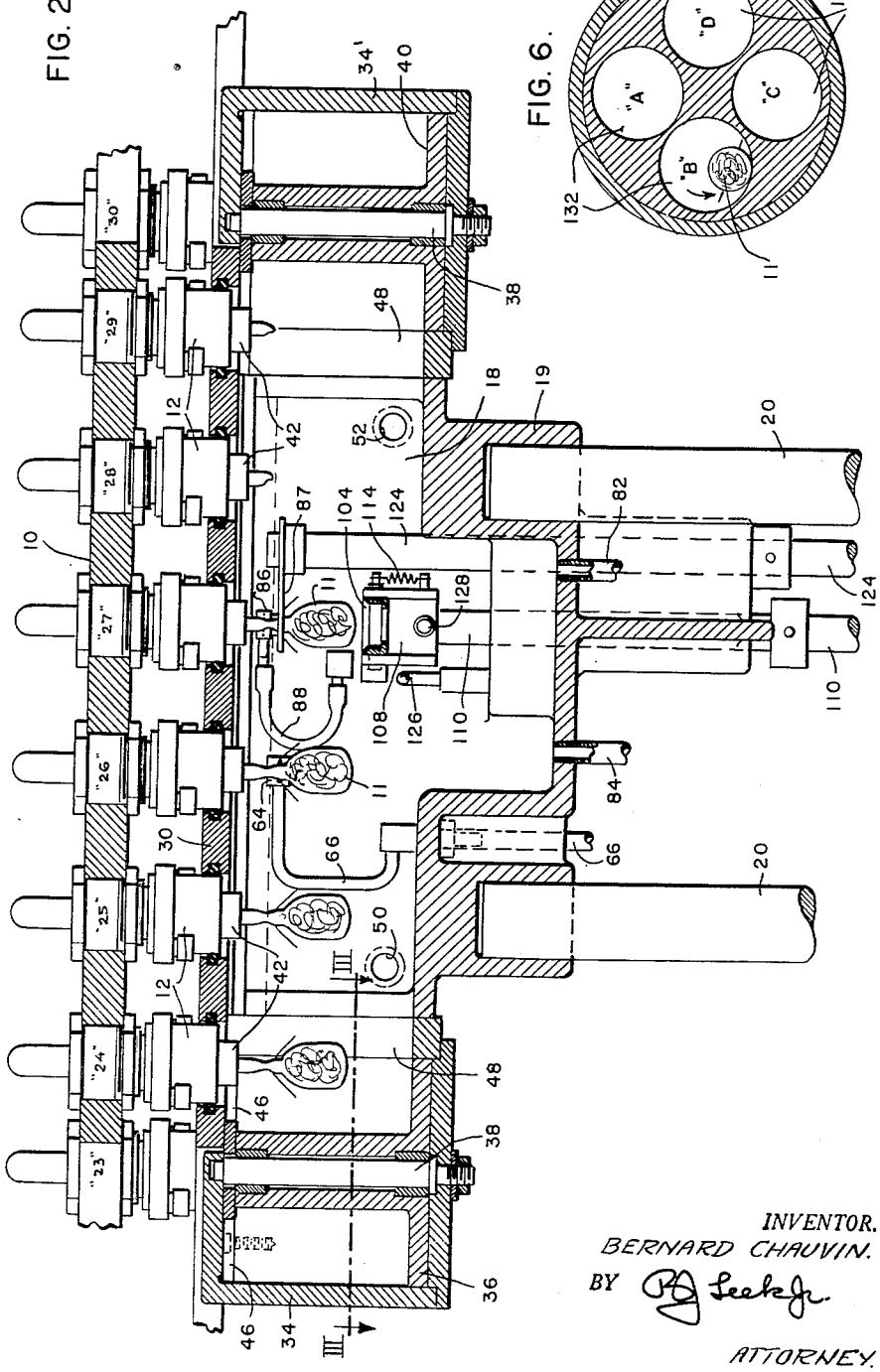


FIG. 6.

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FIG. 5.

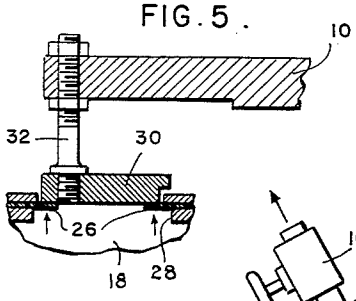


FIG. 4.

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FIG. 7.

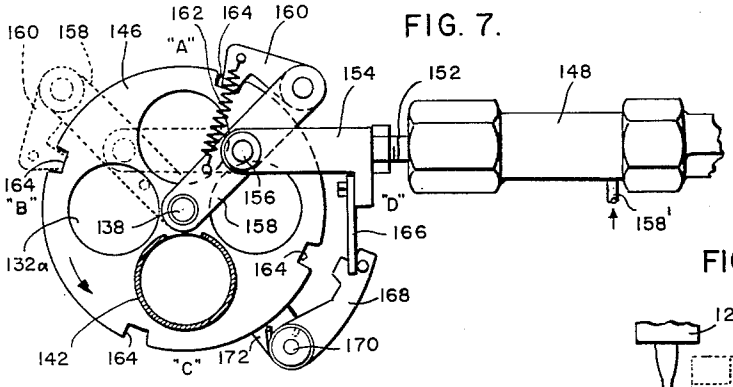


FIG. 8.

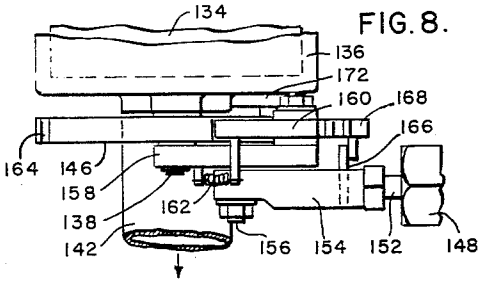


FIG. 9.

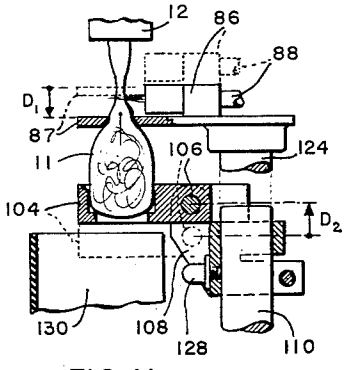


FIG. 10.

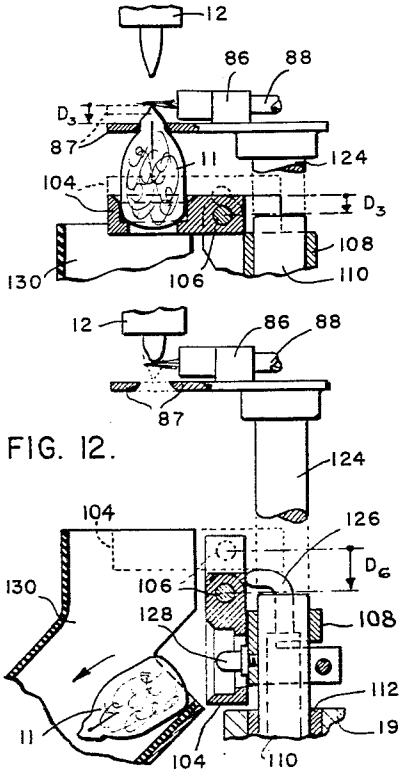
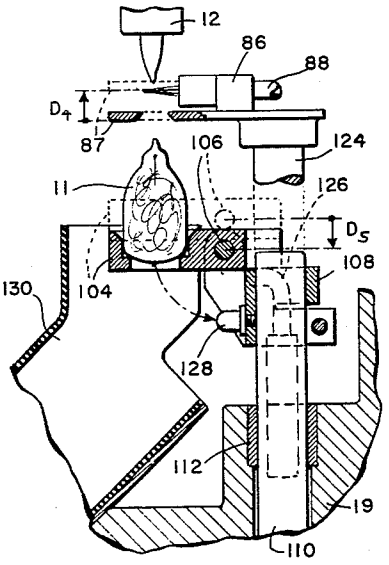


FIG. 11.



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United States Patent Office 2,940,231 Patented June 14, 1960

2,940,231

APPARATUS FOR SEALING OFF VESSELS

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Filed Aug. 19, 1958, Ser. No. 756,008

12 Claims. (Cl. 53—91)

The present invention relates to the sealing-off of vessels containing gas at a pressure higher than atmospheric and, more particularly, to apparatus for sealing off exhaust tubes of incandescent lamps or photoflash lamps containing gas as such pressures.

Heretofore, the exhaust tubes of such incandescent lamps or photoflash lamps have been sealed off or tipped off at the end of the exhaust operation by a method and apparatus of the type shown in U.S. Patent No. 2,273,445, issued February 17, 1942, to M. E. McGowan et al., and assigned to the same assignee as the present application. In such apparatus a chamber is formed about an exhaust tube of a lamp at the tipping-off station by sliding counterpart compartments (which open toward one another) into abutting and hermetic engagement to hermetically enclose a portion of the exhaust tube adjacent the tipping-off point. After compressed air has been introduced into the chamber at a pressure equal to the gas pressure in the incandescent lamp or photoflash lamp, a burner contained in each compartment cooperates with the burner in the other compartment to effect the tipping-off operation on the exhaust tube.

While such method and apparatus are satisfactory for a low production rate in the order of about 600 incandescent or photoflash lamps per hour, an increase of such production rate to the current rate of about 1200 lamps per hour leaves about three seconds for the numerous required operations, such as indexing of a head into the tipping-off station, the formation of the compartment about the exhaust tube, the introduction of the high-pressure air into (and the build-up of) the pressurized ambient atmosphere in the compartment, the tipping-off operation and the retraction of the compartments. Such time is obviously inadequate to perform these many necessary individual operations. In addition, the present utilization by the industry of higher fill pressures in the neighborhood of 800 to 1500 millimeters of mercury adds to the minimum time required for the tipping-off operation.

To further complicate the problem of minimum required time, the lamp industry is currently using a method of tipping off the exhaust tubes, which method utilizes a pressure within the chamber desirably higher than the fill pressure within the lamp, so that upon softening of the exhaust tube by the tipping-off burners, the greater pressure within the chamber causes an inward collapse of the exhaust tube at the tipping-off point and also prevents blow out of the exhaust tube. A more serious problem involved in the use of this current method and apparatus is the frequent extinction of the flames of the tipping-off burners during each pressurizing of the chamber and the necessity of continually manually adjusting the gas and air mixture being fed to such burners.

It is the general object of the present invention to avoid and overcome the foregoing and other difficulties of and objections to prior art practices by the provision of apparatus for tipping off exhaust tubes of vessels, such as photoflash lamps, containing gas at a pressure higher than

atmospheric which apparatus is operable efficiently at present high-speed production rates.

A specific object of the present invention is the provision of a pressure chamber disposed about the tipping-off station and several adjacent stations of a conventional exhaust machine, which chamber cooperates with the turret of the exhaust machine to hermetically seal such photoflash lamps therein during the tipping-off operation of the exhaust tubes of the lamps so that the ambient chamber pressure surrounding the lamps will be higher than the fill pressure within the latter.

Another object of the present invention is the provision of a pressure chamber adapted to cooperate with the heads of the exhaust machine to permit the ingress and egress of the heads into the pressure chamber with a minimized loss of the chamber pressure.

A further object of the present invention is the provision of a pressure chamber adapted to permit the discharge of the tipped-off lamps therefrom with a minimized loss of the chamber pressure.

Another object of the present invention is the provision of means for automatically regulating the flow of gas and air to the tipping-off burners disposed within the pressure chamber, which regulating means is responsive to changes in the pressure within the pressure chamber during the pressurizing and the normal operation of the latter to automatically adjust such flow of gas and air to the tipping-off burners and thereby maintain the tipping-off flames of such burners relatively constant.

The aforesaid objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by providing apparatus for tipping off exhaust tubes of photoflash lamps containing gas at a pressure higher than atmospheric and comprising a pressure chamber about the tipping-off station and adjacent stations of the exhaust machine, which chamber hermetically seals the photoflash lamps from the atmosphere and surrounds the lamp with an ambient pressure greater than the fill pressure of the lamps, and means responsive to changes in the pressure within the pressure chamber for automatically adjusting the flow of gas and air to the tipping-off burners disposed adjacent such tipping-off station.

For a better understanding of the present invention reference should be had to the accompanying drawings wherein like numerals of reference indicate similar parts throughout the several views and wherein:

Fig. 1 is a fragmentary plan view of a portion of the turret of an exhaust machine for exhausting photoflash lamps and the tipping-off apparatus of the present invention, which apparatus includes a pressure chamber provided with an entrance rotor and exit rotor and having the top portion of the pressure chamber broken away to show the tipping-off mechanism.

Fig. 2 is a longitudinal vertical-sectional view along the line II—II of Fig. 1, taken in the direction of the arrows and showing the turret, the exhaust heads thereon and the pressure chamber in which are disposed preheating means, the tipping-off mechanism and a portion of the discharge mechanism for removing the tipped-off lamps from the pressure chamber.

Fig. 3 is a fragmentary horizontal-sectional view of the entrance rotor to the pressure chamber taken along the line III—III of Fig. 2 in the direction of the arrows.

Fig. 4 is a vertical-sectional view along the line IV—IV of Fig. 1 in the direction of the arrows and showing the turret, an exhaust head which has just indexed into the tipping-off station within the pressure chamber, the pressure chamber, the tipping-off mechanism and the discharge mechanism for removing the tipped-off lamp from the pressure chamber.

Fig. 5 is a fragmentary vertical-sectional view of a

sealing ring carried by the turret and utilized for making a substantially hermetic seal with the pressure chamber, taken along the line V—V of Fig. 1 in the direction of the arrows.

Fig. 6 is a horizontal-sectional view of a discharge rotor of the discharge mechanism taken along the line VI—VI of Fig. 4 in the direction of the arrows.

Fig. 7 is an end view along the line VII—VII of Fig. 4 in the direction of the arrows, of the indexing mechanism for the discharge rotor of the discharge mechanism.

Fig. 8 is an elevational view of the indexing mechanism of Fig. 7 when viewed from the top portion of Fig. 7.

Fig. 9 is a fragmentary view, similar to Fig. 4, and showing first the position of the tipping-off fork and tipping-off burners of the tipping-off mechanism after the tipping-off fork has been moved downwardly to engage the neck portion of the photoflash lamp and, secondly a discharge nest of the discharge mechanism after such nest has been moved upwardly to receive the photoflash lamp, thereby securing such lamp therebetween.

Fig. 10 is a view similar to Fig. 9 and showing the position of the tipping-off fork, tipping-off burners and discharge nest after they have moved downwardly to stretch the plasticized portion of the exhaust tube and affect the tipping-off of the photoflash lamp.

Fig. 11 is a view similar to Figs. 9 and 10 showing an intermediate position of the parts after the tipping-off mechanism has been retracted to the position shown in Fig. 4, and the discharge nest and the photoflash lamp carried thereby have been moved downwardly into engagement with a stop means preparatory for the pivotable movement of the discharge nest to cause the discharge of such photoflash lamp.

Fig. 12 is a view similar to Figs. 9 through 11 and showing the position of the discharge nest after it has been pivoted into its lamp-discharge position due to the continued downward movement of the reciprocating means for the discharge nest and action of the stop means, and the discharge of the photoflash lamp from the discharge nest by engagement thereof with a knock-out pin.

Fig. 13 is a schemmatic view showing the pressure-compensating means for the pressure chamber and the control means for controlling the flow of gas and air to the preheating and tipping-off burners.

Fig. 14 is a side-elevational view of a finished photoflash lamp.

With specific reference to the form of the invention illustrated in the drawings, and referring particularly to Figs. 1 and 2, the reference numeral **10** designates a turret of a conventional exhaust machine (of the type shown in U.S. Patent No. 2,113,798, issued April 12, 1938, to D. Mullan) which machine is utilized for the exhausting, high-pressure filling and tipping off of sealed-in photoflash lamps **11**. This turrent **10** is adapted to support a plurality of, for example thirty-two, exhaust heads **12** (of the type shown in the aforesaid patent). The turret **10**, the exhaust heads **12** and the sealed-in lamps **11** carried thereby are indexed through a like number of work stations in the conventional manner by an indexing mechanism (not shown) but of the type shown in U.S. Patent No. 2,569,852, issued October 2, 1951 to J. H. Green.

As shown best in Fig. 4, a sealed-in photoflash lamp **11** is secured in a conventional compression rubber assembly of the exhaust head **12** and the hollow interior of such head is connected by a sweep **14** to a conventional exhaust valve (not shown) but of the type shown in the above-mentioned U.S. Patent No. 2,113,798. This exhaust valve is operable in the conventional manner to alternately connect the sweep **14** either to an exhausting system (not shown) or to an oxygen-fill supply system (not shown). After the sealed-in lamp **11** is loaded at station "1" (not shown) such lamp is evacuated from station "1" through station "21" (not shown) by connection of the sweep **14** (through the above-mentioned exhaust valve) to the exhaust system. At station "22" (not shown) the sweep **14** is connected by operation of such exhaust valve to the oxygen-fill supply system and the evacuated lamp **11** filled to a pressure in the range of about 950–1050 mm. of mercury.

Referring to Figs. 2, 3 and 4, it will be noted that a pressure chamber **18** is provided within an arcuate segmental box or casting **19** which is mounted on a pair of columns **20** upstanding from a bed-plate **22** of the exhaust machine and that such pressure chamber **18** (Figs. 1 and 2) is disposed about work stations "25" through "28" of such exhaust machine. As shown in Fig. 1, this casting **19** which hermetically encloses the pressure chamber **18** from the ambient atmosphere, is provided with a removable window **24** (hermetically sealed thereto) to facilitate observation of the preheating operation at station "26" and the tipping-off operation at station "27" of the exhaust machine. This pressure chamber **18** is pressurized by means, to be described later, to a pressure in the range of about 1050–1150 mm. of Hg. Along its top surface, as viewed in Fig. 4, the casting **19** has resilient sealing plates **26** mounted thereon and each plate **26** projects inwardly from either side of an annular clearance slot **28**, provided in such top surface. This clearance slot **28** is adapted to permit passage of oxygen-filled lamps **11** along their path of movement through stations "25"–"28". These resilient sealing plates **26** are held in hermetic engagement with a circumferential sealing ring **30** (Fig. 5), extending around the periphery of the turret **10** and mounted thereon by means of bolts **32**, by the above-atmospheric pressure within the pressure chamber **18**. To prevent the pressure within the pressure chamber **18** from breaking the hermetic seal between the sealing plates **26** and the sealing ring **30**, a thrust roller **33** (Figs. 1 and 4) is mounted on the top of the casting **19** at stations "25" through "28". These thrust rollers **33** engage the top surface, as viewed in Fig. 4, of the right-hand portion of sealing ring **30**.

Secured to opposite end portions of the casting **19** (Fig. 1) are an entrance-rotor housing **34** and an exit-rotor housing **34'** which form a part of entrance means and exit means, respectively, and which permit the exhaust heads **12** and the sealed-in lamps **11** to move into and out of the pressure chamber **18** with minimum loss of pressure therefrom. The rotor housing **34** surrounds stations "23" and "24" at the left-hand end of the casting **19**, as viewed in Fig. 1, and the rotor housing **34'** is associated with stations "29" and "30" at the right-hand end of such casting **19**. To provide means for permitting the indexing of the exhaust heads **12** and the oxygen-filled lamps **11** carried thereby into the pressure chamber **18** with a minimum loss of pressure within such pressure chamber **18**, an entrance rotor **36** is mounted on a freely rotatable shaft **38** (Figs. 2 and 3) journalled in the entrance-rotor housing **34**. For the purpose of permitting the egress of such exhaust heads **12** from the pressure chamber **18** (after the tipping-off operation), an exit rotor **40** is similarly mounted on another shaft **38** journalled in the exit-rotor housing **34'**.

As an exhaust head **12** and the oxygen-filled lamp **11** carried thereby are indexed from station "22", the oxygen-filling station, to station "23" (Fig. 1), an annular hub portion **42** on the bottom of such exhaust head **12**, as viewed in Fig. 4, passes through an entrance slot **44** (Fig. 3) in the entrance-rotor housing **34** and moves therethrough into one of four hub-receiving slots **46**, quadrantally and radially disposed in the entrance rotor **36**. It will be appreciated from a consideration of Figs. 1 and 3, that by the time the exhaust head **12** and the oxygen-filled lamp **11** have arrived at station "23" the hub portion **42** has entered the hub-receiving slot **46** in the entrance rotor **36**. During the next index of the exhaust machine the above-mentioned hub portion **42** moves from station

"23" to station "24" and the hub-receiving slot **46** engaged by such hub portion **42** moves therewith, thereby causing the entrance rotor **36** to rotate 90° in clockwise direction, as viewed in Fig. 3, and causing the hub-receiving slot **46** and hub portion **42** at station "24" to move into registry with an entrance slot **48** leading to the interior of the pressure chamber **18**. During such indexing movement the next exhaust head **12** (previously at station "22") positions itself in another hub-receiving slot **46** in the entrance rotor **36** which has been moved into registry with the entrance slot **44** in the entrance-rotor housing **34**, as viewed in Fig. 3. When the turret of the exhaust machine is indexed again, the exhaust head **12** and oxygen-filled lamp **11** at station "24" pass through the entrance slot **48** into the pressure chamber **18** and move from station "24" (Fig. 1) to station "25", an idle station within the pressure chamber **18**.

It will be appreciated from a consideration of Fig. 3, that the peripheral spacing between adjacent hub-receiving slots **46** is such that at no time during the rotation of the entrance rotor **36** is there a path of communication between the pressurized interior of the pressure chamber **18** and the entrance slot **44** in the entrance-rotor housing **34**, thereby minimizing pressure losses within such pressure chamber **18** during the introduction of an exhaust head **12** and the oxygen-filled lamp **11** into the pressure chamber **18**. Further, since two hub portions **42** are always in engagement with two of the hub-receiving slots **46**, the entrance rotor **36** is locked in position between indexes of the exhaust machine.

Pressure-compensating means

To provide pressure-compensating means for maintaining the pressure within the pressure chamber **18** in the range of about 1050–1150 mm. of mercury, such pressure chamber **18** is connected by air lines **50** and **52** (Figs. 1, 2, 4 and 13) to a pressure-compensating tank **56** (Fig. 13), suitably having about four or five times the volume of the pressure chamber **18**. Due to the large volume of the pressure-compensating tank **56** any decrease in the pressure within the pressure chamber **18** is readily compensated for by admission of compressed air through the lines **50** and **52** into such pressure chamber **18**. Compressed air is fed from a compressed air supply (not shown) into the pressure-compensating tank **56** through an inlet line **58** and admission of compressed air into the pressure-compensating tank **56** is automatically controlled by a pressure-responsive valve **60**, and is thereby responsive to any change in the pressure within the tank **56**.

During the next index of the turret **10**, the above-mentioned exhaust head **12** at station "25", the idle station, is indexed with the oxygen-filled lamp **11** carried thereby to station "26", the preheating station, where a section of the exhaust tube of the oxygen-filled lamp **11**, which is to be tipped off, is heated by a preheating means to a temperature of about 650° C. to render such section red hot. This preheating of the exhaust tube conditions the tube for tipping off at the succeeding tipping-off station "27" and reduces the time required for such tipping-off operation. It has been found that heating of such section to the above-mentioned temperature range softens the latter sufficiently so that when the exhaust head **12** is indexed to station "27" such tube wavers slightly.

Preheating means

To provide preheating means for heating the above-mentioned section of the exhaust tube at station "26", preheating burners **64** (Figs. 2 and 13) are mounted on a rigid gas-air line **66** adjacent the normal axial position of the exhaust tube when an oxygen-filled lamp **11** is at station "26" and such preheating burners **64** are directed at the section of such tube which is to be preheated. These preheating burners **64** are connected by the gas-air line **66** to a gas-air mixture **68** (Fig. 13). To provide

gas to this gas-air mixer **68**, a gas line **70** extends from a gas supply (not shown) through a pressure-responsive valve **72** and a manually preset valve **74** to the gas-air mixer **68**. In like manner, an air line **76** connects an air supply (not shown) through another pressure-responsive valve **78** and another manually preset valve **80** to the gas-air mixer **68**.

To provide control means associated with the above-mentioned gas and air supply systems, which control means is operable in response to changes of pressure within pressure chamber **18** to regulate such supply of gas and air to the gas-air mixer **68** and hence to the burners **64** (thereby maintaining the thermal output of said burners constant and preventing extinction of the flames of said preheating burners **64**), the pressure-responsive valves **72** and **78** are connected by bleeder lines **82** and **84** respectively to the pressure chamber **18**. Thus, any change in the pressure within the pressure chamber **18** causes the pressure-responsive valves **72** and **78** to automatically adjust the flow of gas and air to the gas-air mixer **68** to achieve the desired above-mentioned result.

During the next index of the turret **10**, the exhaust head **12** and the oxygen-filled lamp **11** carried thereby are moved from station "26", the preheating station, to station "27", the tipping-off station where the lamp **11** is tipped-off and discharged from the pressure chamber **18**, as now related.

Tipping-off mechanism

At station "27", tipping-off burners **86** (Figs. 1, 2, 4 and 13) and mounted on a reciprocable tipping-off fork **87**, are directed at the preheated section of the exhaust tubulation, and are connected by a gas-air line **88** to another gas-air mixer **90** (Fig. 13). As shown in Fig. 2, a portion of the gas-air line **88** within the pressure chamber **18** is desirably flexible to permit the joint reciprocation of the tipping-off burners **86** and tipping-off fork **87**. This gas-air mixer **90** in turn is connected by an air line **92** through a manually preset valve **94** to a branch connection of the air line **76** and by a gas line **96** through another manually preset valve **98** to a branch connection with the gas line **70**. It will be appreciated from a consideration of Fig. 13 that the flow of gas and air to the mixer **90** is automatically controlled by the pressure-responsive valves **72** and **78** (when changes in pressure within the pressure chamber **18** are transmitted by the bleeder lines **82** and **84** respectively to such valves **72** and **78**) thereby maintaining the thermal output of the tipping-off burners **86** constant to heat the tubulation to about 1000° C. and preventing extinction of the flames of said tipping-off burners **86**.

In order to provide venting means for the removal of the combustion gases produced by the preheating burners **64** and the tipping-off burners **86** from the pressure chamber **18** (which gases naturally rise to the top of such pressure chamber, as viewed in Fig. 4), vent lines **100** are mounted in the top of the casting **19** (Figs. 4 and 13) and connect vent openings **101** in such casting **19** through bleeder valves **102** to the atmosphere. It will be appreciated that the above-atmospheric pressure within the pressure chamber **18** will cause the expulsion of the combustion gases, which collect near the top of such pressure chamber **18**, through the vent holes **101** (which are aligned with the burners **64** and **86**), the lines **100** and the bleeder valve **102**, which are only slightly opened. The relatively small loss of compressed air through the venting means from the pressure chamber **18** will of course be compensated for by the operation of the above-described compensating means.

As shown in Figs. 2 and 4, a discharge nest **104** is pivotably mounted at **106** (below and in axial alignment with the oxygen-filled lamp **11** and the tipping-off fork **87**) on a yoke **108** affixed to a plunger **110** which is reciprocable in suitable bearings **112** provided in the casting **19**. The

discharge nest **104** is biased by a spring **114** (Fig. 2) into the normally horizontal lamp-receiving position shown in Fig. 4. To provide reciprocating means for the yoke **108**, the lower end of the plunger **110**, as viewed in Fig. 4 is connected by a link **116** to a cam lever **118** pivoted at **120** on a bracket upstanding from the bed-plate **22** and the other end (not shown) of the cam lever **18** is held in engagement by a spring **122** with a cam (not shown) on the main drive shaft (not shown) of the exhaust machine.

Since the reciprocating means for the tipping-off fork **87** and the tipping-off burners **80** is essentially the same as the reciprocating means for the yoke **108**, it is deemed sufficient to say that the tipping-off fork **87** is mounted on another plunger **124** (Fig. 4) which is reciprocable in the casting **19** by conventional linkage similar to that connected to the plunger **110**.

After the exhaust head **12** and the oxygen-filled lamp **11** have indexed into station "27", the tipping-off station, the preheated section of the exhaust tube is further heated by the tipping-off burners **86** above the preheat temperature of about 650° C. As shown in Fig. 9, the tipping-off burners **86** and the tipping-off fork **87** are then moved downwardly a distance D_1 (from the dotted-line position shown therein to the solid-line position shown in such figure) so that the tipping-off fork **87** engages the neck portion of the oxygen-filled lamp **11** (during the continued heating of the tube by the tipping-off burners **86**). Simultaneously, with this downward engaging movement of the tipping-off fork **87**, the discharge nest **104** is moved upwardly a distance D_2 (from the dotted-line position to the solid-line position, shown in Fig. 9) to receive the oxygen-filled lamp **11**.

Thereafter, as shown in Fig. 9–11, the tipping-off burners **86** continue to heat the heated portion of the exhaust tube which has now been heated to a temperature of about 1000° C. and is in a plasticized condition. The tipping-off fork **87** and the discharge nest **104** with the lamp **11** held therebetween are lowered a distance D_3 (from the dotted-line position shown in Fig. 10 to the solid-line position shown therein) to stretch the plasticized portion of the exhaust tube and permit the tipping-off burners **86** to sever such stretched portion from the remaining portion held in the exhaust head **12** and to form a rounded tip on the tipped-off portion of the exhaust tube remaining with the tipped-off lamp **11**.

Either simultaneously or separately, as desired, the tipping-off fork **87** is moved upwardly a distance D_4 and the tipped-off lamp **11** held in the discharge nest **104** is moved downwardly a distance D_5 (from the dotted-line positions, shown in Fig. 11, to the solid-line positions shown therein) at which solid-line position the right-hand portion of the pivoted spring-biased discharge nest **104** comes into engagement with a stationary stop **126**, mounted in and projecting from a suitable opening in the casting **19**. Thereafter, the further continuous downward movement of the yoke **108** and the plunger **110** a distance D_6 (from the dotted-line position shown in Fig. 12 to the solid-line position shown therein) causes the discharge nest **104** with the tipped-off lamp **11** to pivot 90° in counterclockwise direction about its pivot **106**, as viewed in Fig. 12, against the restraining action of the spring **114** (Fig. 2) from the dotted-line position to the solid-line position, shown in Fig. 12. Near the end of such pivoting movement the bottom of the seated tipped-off lamp **11** engages a knock-out pin **128** affixed to and projecting from the yoke **108**, thereby unseating such lamp **11** from the discharge nest **104** and causing it to fall downwardly into an adjacent guide chute **130** mounted in a hermetically sealed bore provided in the bottom portion of the casing **19** (Fig. 4). The tipped-off lamp **11** drops downwardly under the force of gravity through the guide chute **130** into a discharge mechanism secured by means of its discharge-rotor housing **136** to the bottom portions of the casting **19**, as viewed in Fig. 4, and below the bottom of the guide chute **130**.

Discharge mechanism

This discharge mechanism (Figs. 2, 4, 7 and 8) is similar in construction to the entrance and exit means affixed to the casting **19** and has a discharge rotor **134** affixed to a shaft **138** extending through and journalled in the bottom portion of the discharge-rotor housing **136**. To permit entrance of the tipped-off lamp **11** from the guide chute **130** into one of four quadrantally disposed lamp-receiving apertures **132** in the discharge rotor **134** (Fig. 6) the casting **19** is provided with discharge aperture **140** (Fig. 4).

In order to cause indexing of the lamp receiving aperture **132** from (for example) position "A," its lamp receiving position in alignment with the bottom of the guide chute **130**, as viewed in Fig. 4, into position "C," its lamp discharging position (two indexes away) in alignment with a discharge chute **142** mounted on a bracket **144** upstanding from the bed-plate **22**, the drive shaft **138** which carries the discharge rotor **134** is connected to a drive disc **146** (Figs. 4, 7 and 8). This drive disc **146** has quadrantally disposed bulb-feeding apertures **132***a* which align themselves at position "C" with the lamp-receiving apertures **132** and is driven by an indexing mechanism.

This indexing mechanism (Figs. 4, 7 and 8) has an air cylinder **148** pivotably mounted at **150** on the bracket **144**, the spring-biased piston rod **152** of which air cylinder **148** carries an operating rod **154** connected at **156** to a lever **158** freely rotatable on the shaft **138**. The outer or free end of the lever **158**, as viewed in Fig. 7, carries a driving pawl **160** normally biased by a spring **162** in one of four notches **164**, quadrantally disposed in the periphery of the drive disc **146**.

When compressed air in the branch air line **58'** (Fig. 13) enters the right-hand end of the cylinder **148**, as viewed in Fig. 7, at a time determined by conventional means (such as a cam on the main drive shaft, not shown of the exhaust machine) and an air valve **153** (Fig. 13), the movement of the piston rod **152** and the operating rod **154** to the left (against the action of the spring biasing, not shown, on such piston rod **152**) causes the lever **158** and the driving pawl **160** and hence the drive disc **146** to rotate 90° in counterclockwise direction from the solid-line position, shown in Fig. 7, to the dotted-line position shown therein, with attendant movement of the discharge rotor **134** affixed to the shaft **138**, and the lamp-receiving aperture **132** therein, from position "A" (Fig. 7), the lamp-receiving position, to position "B," an intermediate position. During such movement of the operating rod **154** to the left, an arm **166** carried by the operating rod **154** permits a torsion-spring-biased latching pawl **168** (mounted at **170** on a lug **172** projecting from the discharge rotor housing **136**) to move into engagement with the periphery of the drive disc **146** and (when the driving pawl **160** arrives at the dotted-line position, shown in Fig. 7) to engage the then adjacent notch **164**.

When the flow of compressed air to the cylinder **148** is cut off by further operation of the above-mentioned cam and air valve **153** and the piston rod **152** and operating rod **154** are retracted to the right, as viewed in Fig. 7 (by the action of the spring biasing, not shown, on such piston rod **152**), the latching pawl **168** prevents rotation of the drive disc **146** in clockwise direction and permits the spring-biased driving pawl **160** to retract from the dotted-line position to the solid-line position shown therein, preparatory for the next indexing movement of the indexing mechanism to move the lamp **11** and the lamp-receiving aperture **132** from position "B" to position "C," the lamp-discharging position.

When the tipped-off lamp **11** arrives at position "C" it falls by gravity through a guide aperture **174** provided in a bottom projection, as viewed in Fig. 4, of the discharge-rotor housing **136**, through the aligned guide aperture **132***a* in the drive disc **146** and into the discharge chute **142**.

Thereafter, the indexing mechanism (not shown) for the exhaust machine successively indexes the exhaust head **12** (still carrying a portion of the exhaust tubulation of the tipped-off lamp **11**) from the station "27" through station "28" (Fig. 1), and idle station, and into station "29" where the hub portion **42** of such exhaust head **12** passes through an entrance slot **48'** in the exit-rotor housing **34'** and into a hub-receiving slot **46'** in the exit-rotor **40** at station "29." The exhaust head **12** is then indexed to station "30" causing 90° clockwise rotation of the exit rotor **40**, as viewed in Fig. 1, and thence to station "31." During the latter index, such exhaust head **12** leaves the exit means to the pressure chamber **18** through an exit slot **176** (Fig. 1) provided in the exit-rotor housing **34**, with a minimum loss of pressure from the pressure chamber **18**.

Thereafter, the discharge tipped-off photoflash lamp **11** is provided in the usual manner with a base **178** to become a finished photoflash lamp, as shown in Fig. 14.

It will be recognized by those skilled in the art that the objects of the present invention have been achieved by the provision of apparatus for tipping-off the exhaust tubes of vessels, such as photoflash lamps, containing gas at a pressure higher than atmospheric. Such apparatus is operable at high-speed production rates and cooperates with the turret of the exhaust machine to hermetically seal such photoflash lamps within a pressure chamber of the apparatus during the tipping-off operation of the exhaust tubes of such lamps, so that the ambient pressure surrounding the lamps will be higher than the fill pressure of the latter. In addition, the apparatus is operable to cooperate with the exhaust heads of the exhaust machine to permit the ingress and egress of such exhaust heads into the pressure chamber with a minimum loss of pressure within the latter. The apparatus is further operable to permit the discharge of the tipped-off photoflash lamps from the pressure chamber with a further minimum loss of pressure therefrom. Further, the apparatus is equipped with means for automatically regulating the flow of gas and air to the tipping-off burners disposed within the pressure chamber and such means is responsive to changes in the pressure within the chamber to automatically adjust such flow of gas and air to the tipping-off burners, thereby maintaining the tipping-off flames of such burners relatively constant.

While in accordance with the patent statutes one best known embodiment of the invention has been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

I claim:

1. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having a predetermined pressure therewithin, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, said chamber being operable by movement of said head to permit ingress of such vessel thereinto with a minimum loss of pressure within said chamber, tipping-off means disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping off of the exhaust tube of such vessel while in said chamber, and control means connected to said tipping-off means and said chamber and operable in response to changes in pressure within said chamber to maintain the thermal output of said tipping-off means constant.

2. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto, means connected to said chamber for introducing a compressed fluid to said chamber, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with minimum loss of pressure within said chamber, tipping-off means disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping off of the exhaust tube of such vessel, and control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to maintain the thermal output of said tipping-off means constant.

3. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto, supply means connected to said chamber for introducing compressed air to said chamber to provide a predetermined pressure within said chamber, compensating means connected to the supply means and said chamber to rapidly adjust the pressure within said chamber to the predetermined pressure when such chamber pressure falls below such predetermined pressure, control means connected to said compensating means and operable in response to changes in pressure within said compensating means to maintain such pressure relatively constant, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with minimum loss of pressure within said chamber, tipping-off means disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping off of the exhaust tube of such vessel, and control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to maintain the thermal output of said tipping-off means constant.

4. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto, means connected to said chamber for introducing compressed air to said chamber to provide a predetermined pressure within said chamber, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with minimum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping-off of the exhaust tube of such vessel, supply means connected to said burners for supplying gas and air to the burners, and control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners.

5. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto, means connected to said chamber for introducing compressed air to said chamber to provide a predetermined pressure within said chamber, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to de-

liver a vessel to the tipping-off position within said chamber, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with maximum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping off of the exhaust tube of such vessel, supply means connected to said burners for supplying gas and air to the burners, control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners, and discharge means disposed adjacent the tipping-off position of said apparatus and operable to receive the tipped-off vessels and discharge the latter from said chamber with minimum loss of pressure within said chamber.

6. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto and an exit therefrom, means connected to said chamber for introducing compressed air to said chamber to provide a predetermined pressure within said chamber, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with a minimum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping off of the exhaust tube of such vessel, supply means connected to said burners for supplying gas and air to the burners, control means connected to said supply means and to said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners, and means disposed at the exit to said chamber and operable by movement of said head to permit egress of said head out of said chamber with minimum loss of pressure within the chamber.

7. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto and an exit therefrom, means connected to said chamber for introducing compressed air to said chamber to provide a pressure within said chamber higher than the pressure within said vessel, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with minimum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping-off of the exhaust tube of such vessel, supply means connected to said burners for supplying gas and air to the burners, control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners, discharge means disposed adjacent the tipping-off position of said apparatus and operable to receive the tipped-off vessels and discharge the latter from said chamber with minimum loss of pressure within said chamber, and means disposed at the exit to said chamber and operable by movement of said head to permit egress of said head out of said chamber with minimum loss of pressure within the chamber.

8. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto and an exit therefrom, means connected to said chamber for introducing compressed air to said chamber to provide a pressure within said chamber higher than the pressure within said vessel, an exhaust head adapted to receive an exhaust tube and operable to move into slidable engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, said head being hermetically sealed to the chamber when the head is in engagement with the latter by the pressure within the chamber, thrust means disposed on the chamber and engageable with the head while the latter is in the tipping-off position to prevent the pressure within the chamber from breaking the hermetic seal between the chamber and the head, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with minimum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping off of the exhaust tube of such vessel, supply means connected to said burners for supplying gas and air to the burners, control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners, discharge means disposed adjacent the tipping-off position of said apparatus and operable to receive the tipped-off vessels and discharge the latter from said chamber with minimum loss of pressure within said chamber, and means disposed at the exit to said chamber and operable by movement of said head to permit egress of said head from said chamber with minimum loss of pressure within the chamber.

9. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto and an exit therefrom, means connected to said chamber for introducing compressed air to said chamber to provide a predetermined pressure within said chamber, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, an entrance rotor disposed at the entrance to said chamber in hermetic engagement with the entrance, said entrance rotor being provided with slots which are engageable by said head and being operable by movement of said head when said head engages one of said slots to permit ingress of such vessel thereinto with minimum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping-off of the exhaust tube of such vessel, supply means connected to said burners for supplying gas and air to the burners, control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners, discharge means disposed adjacent the tipping-off position of said apparatus and operable to receive the tipped-off vessels and discharge the latter from said chamber with minimum loss of pressure within said chamber, and an exit rotor disposed at the exit to said chamber in

hermetic engagement with said exit and operable by movement of said head to permit egress of said head out of said chamber with minimum loss of pressure within the chamber.

10. Apparatus for tipping off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping off position of the apparatus and having an entrance thereto and an exit therefrom, means connected to said chamber for introducing compressed air to said chamber to provide a predetermined pressure within said chamber, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with minimum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping off of the exhaust tube of such vessel, supply means connected to said burners for supplying gas and air to the burners, control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners, guide means disposed within said chamber adjacent the tipping-off position of said apparatus and operable to receive the tipped-off vessels, a discharge rotor provided with a plurality of apertures, one of which apertures is always in registry with said guide means to receive a tipped-off vessel from the latter and is hemetically sealed to said chamber, means connected to said discharge rotor for moving said aperture and said tipped-off vessel to a discharge position to permit discharge of said tipped-off vessel from said aperture with a minimum loss of pressure within said chamber, and means disposed at the exit to said chamber and operable by movement of said head to permit egress of said head out of said chamber with minimum loss of pressure within the chamber.

11. Apparatus for tipping-off an exhaust tube of a vessel containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto and an exit therefrom, means connected to said chamber for introducing compressed air to said chamber to provide a predetermined pressure within said chamber, an exhaust head adapted to receive an exhaust tube and operable to move into hermetic engagement with said chamber and to deliver a vessel to the tipping-off position within said chamber, means disposed at the entrance to said chamber and operable by movement of said head to permit ingress of such vessel thereinto with minimum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping-off of the exhaust tube of such vessel, supply means connected to said burners for supplying gas and air to the burners, control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners, a tip-off fork and a nest disposed within said chamber at the tipping-off position and operable during the tipping-off operation to move into a vessel-supporting position and to stretch the exhaust tube at the tip-off point to seal off the latter, said nest being further operable to move the tipped-off vessel to a discharge position, discharge means disposed adjacent the discharge position of said nest and operable to receive the tipped-off vessel from said nest and discharge the latter from said chamber with minimum loss of pressure within said chamber, and means disposed at the exit to said chamber and operable by movement of said head to permit egress of said head out of said chamber with minimum loss of pressure within the chamber.

12. Apparatus for tipping off an exhaust tube of a photoflash lamp containing gas at a pressure higher than atmospheric, comprising a pressure chamber disposed about a tipping-off position of the apparatus and having an entrance thereto and an exit therefrom, means connected to said chamber for introducing compressed air to said chamber to provide a pressure within said chamber higher than the pressure within said lamp, an exhaust head adapted to receive an exhaust tube and operable to move into slidable engagement with said chamber and to deliver a lamp to the tipping-off position within said chamber, said head being hermetically sealed to the chamber when the head is in engagement with the latter by the pressure within the chamber, a thrust roller disposed on the chamber and engageable with the head while such head is in the tipping-off position to prevent the pressure within the chamber from breaking the hermetic seal between the chamber and the head, an entrance rotor disposed at the entrance of said chamber in hermetic engagement with the entrance, said entrance rotor being provided with slots which are engageable by said head and being operable by movement of said head when said head engages one of said slots to permit ingress of such lamp thereinto with minimum loss of pressure within said chamber, a plurality of burners disposed adjacent the tipping-off position of such apparatus and positioned to effect the tipping off of the exhaust tube of such lamp, supply means connected to said burners for supplying gas and air to the burners, control means connected to said supply means and said chamber and operable in response to changes in pressure within said chamber to regulate the supply of gas and air to said burners thereby maintaining the thermal output of said burners constant and preventing extinction of the flames from said burners, a tip-off fork and a nest disposed within said chamber at the tipping-off position and operable during the tipping-off operation to move into lamp-supporting position and to stretch the exhaust tube at the tip-off point to seal the latter, said nest being further operable to move the tipped-off lamp to an unloading position, guide means disposed within said chamber adjacent the unloading position of said nest and operable to receive the tipped-off lamp from said nest when the latter is in the unloading position, a discharge rotor provided with a plurality of apertures, one of which apertures is always in registry with said guide means to receive a tipped-off vessel from the latter and is hemetically sealed to said chamber, means connected to said discharge rotor for moving said aperture and said tipped-off lamp to a discharge position to permit discharge of said tipped-off lamp from said aperture with a minimum loss of pressure within said chamber, and an exit rotor disposed at the exit to said chamber in hermetic engagement with said exit and operable by movement of said head to permit egress of said head out of said chamber with minimum loss of pressure within the chamber.

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