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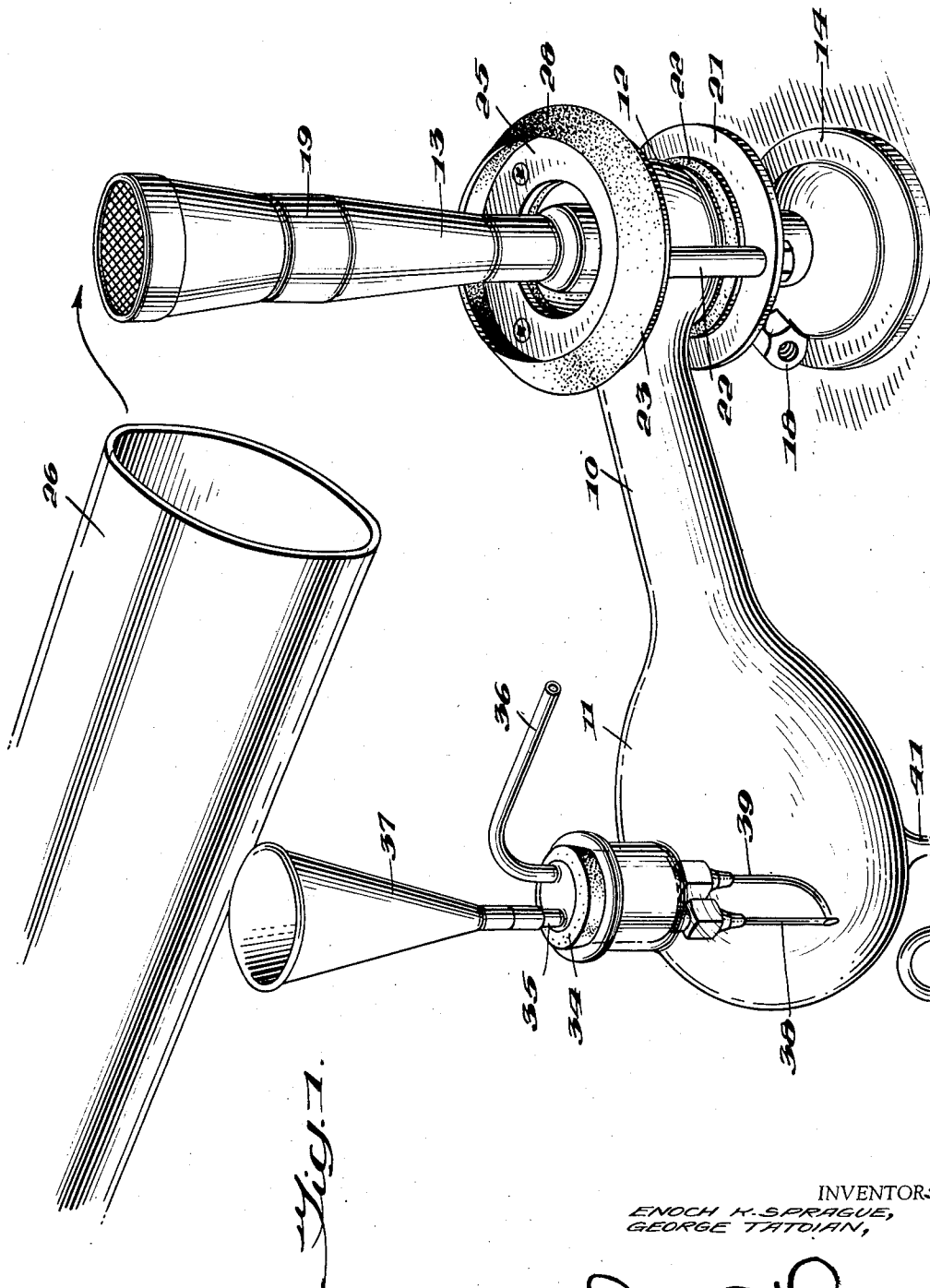
E. K. SPRAGUE ET AL

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SEALING ARRANGEMENT FOR FLAME PHOTOMETER

Filed Aug. 31, 1953

3 Sheets-Sheet 1



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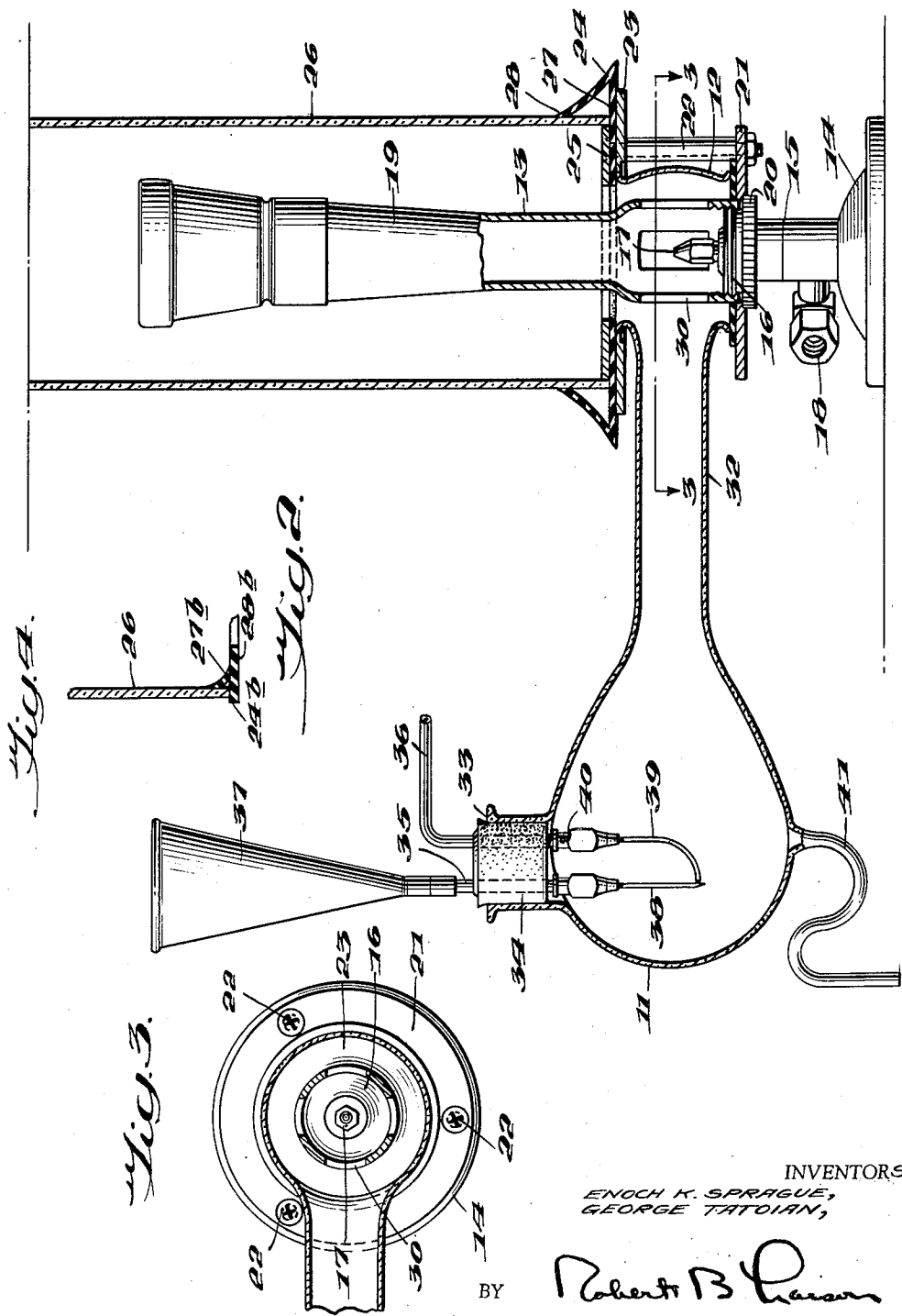
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SEALING ARRANGEMENT FOR FLAME PHOTOMETER

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3 Sheets-Sheet 2



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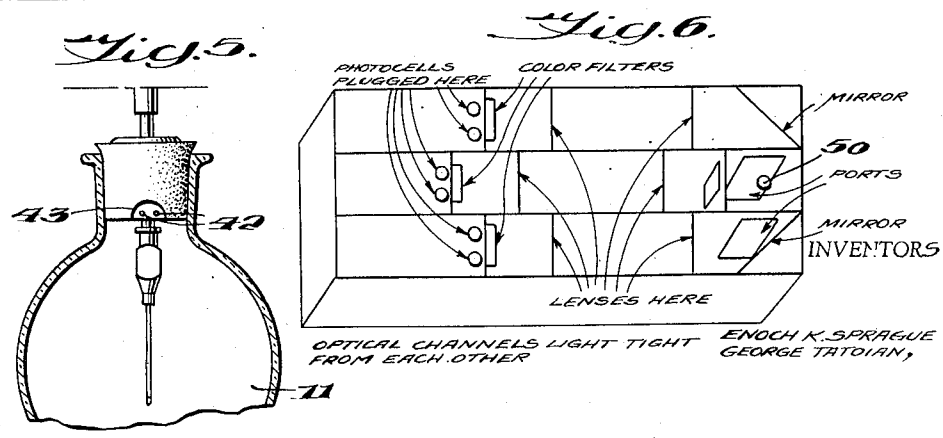
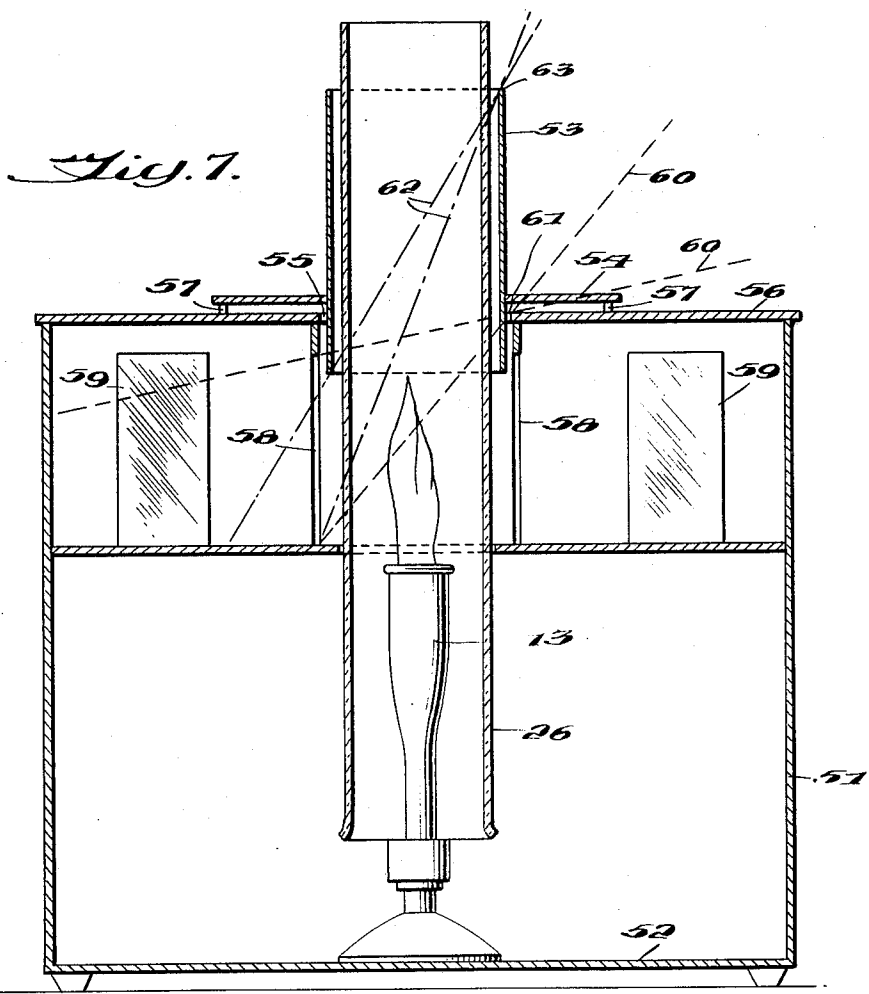
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SEALING ARRANGEMENT FOR FLAME PHOTOMETER

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This invention relates to flame photometers, and more particularly to sealing arrangements in flame photometers to prevent contaminated air from interfering with the analysis operation, and light "trapping" to prevent variables due to strong light from outside the photometer entering the burner system.

In analysis by flame photometry, samples to be analyzed are put into aqueous solution by a suitable method and then atomized. The atomized substance is aspirated into the base of a gas burner, an open Meker-type burner being commonly used. There the vapor is carried into the flame where spectral lines of the metals in solution are excited. The light characteristics of the metallic element which is arising from the excited spectra is then filtered free of other radiation and analyzed by known methods.

The greatest weakness in flame photometric analysis is in the group of variables produced by the flame of the burner, which, of course, is the medium by which the spectra of the elements under investigation are excited. It can readily be seen that drafts, dust, smoke, etc. may be combusted or excited in the flame, or will otherwise cause flame variations which contribute materially to instability of the analysis.

Recognizing the weakness of the existing photometers, the inventors developed a "sealed burner" system which includes as an essential element a transparent chimney surrounding the burner. The principal feature of the system is that, from the time the solution is atomized to the time the atomized solution leaves the system at the top of the chimney, there is no opportunity for foreign particles to enter the system and disturb the analysis.

It is an object of the present invention to provide a sealing arrangement which will prevent any foreign particles from entering the system at the base of the glass chimney.

It is a further object of the invention to provide additional sealing arrangements for the other elements in the device to insure a completely sealed burner system.

It is still a further object of the invention to provide a light trap for the photometer apparatus which will prevent substantially all extraneous light rays from striking the light cells.

These and other objects will become apparent from the following detailed description of the invention, having reference to the accompanying drawings, in which—

Figure 1 is a perspective view of the flame photometer showing the chimney partly removed from the photometer;

Figure 2 is a sectional view in elevation through the center of the photometer;

Figure 3 is a sectional view taken along the lines 3—3 of Figure 2;

Figure 4 is a fragmentary sectional view of another embodiment of the seal at the base of the chimney;

Figure 5 is a fragmentary view showing an alternative embodiment of a stopper and delivery tubes;

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Figure 6 is a diagrammatic perspective view of the photometer casing; and

Figure 7 is a sectional view of the photometer apparatus showing the light trap arrangement.

Referring to the drawings, the photometer consists of a flask 10 having an atomizer chamber 11 at one end where atomization is to take place and an enclosure 12 at the other end partly surrounding a Meker-type burner 13.

The burner is of the well-known type consisting of a base 14, a cylindrical stem 15 terminating at the upper end in male threads 16; a burner spud or gas tip 17 is mounted on top of the cylindrical stem 15 and is supplied with gas through gas supply tube 18. A burner tube 19 is threaded on male threads 16. The upper portion of cylindrical stem 15 has a knurled flange 20 mounted integral therewith, and a brass ring 21 is removably mounted on the knurled flange 20. Brass ring 21 is securely clamped between knurled flange 20 and burner tube 19 forming an air-tight joint.

On the upper surface of ring 21 is disposed a rubber gasket 22 which forms a seal between flask enclosure 12 and the ring 21.

Extending upwardly from ring 21 are three clamp studs 23 equally spaced around the ring. Each stud has surrounding it a rubber cylindrical member acting as a support for an upper brass ring 23.

An upper cuff gasket 24 (to be more fully described below) is disposed on the upper surface of ring 23 and is secured thereto by a clamp ring 25. The cuff gasket 24 engages the upper edges of enclosure 12 and forms an air-tight seal therewith. The tightening of bolts 22 clamps together with air-tight joints the whole unit consisting of the lower ring 21, gasket 22, enclosure 12, ring 23, gasket 24, and clamp ring 25.

A Pyrex chimney 26 rests on the flat portion of cuff gasket 24 and forms a seal therewith.

This seal, however, is easily broken by tilting chimney 26 only slightly. Such a breaking of the seal is undesirable and, therefore, a double seal is provided. The second part of the seal consists of an extension 28 of flat portion 27 of seal 24. The extension is directed upwardly and inwardly, and at its upper edges, forms a circle of a diameter less than the outside diameter of cylinder 26. Thus, when cylinder 26 is placed in operating position, the upper edge of extension 28 forms a second seal with the side surface of the cylinder.

Alternative forms of the double seal, of course, can be devised but without departing from the scope of this invention. One such form is shown in Figure 4 in which the upper extension forms a seal with the inner surface of cylinder 26 rather than the outer surface as in the embodiment previously described.

Ports 30 are formed in the tube 19 through which atomized vapor and air for burner combustion reaches and mixes with the gas issuing from burner spud 17 in combustion or burner tube 19. A portion of the secondary air passes between ring 25 and tube 19, bleeding supplementary air for proper combustion on top of the grid of tube 19.

The solution is atomized in the atomizer chamber 11 of flask 10 and passes through passage 32 to the enclosure 12 where it is aspirated into the flame issuing from tube 19.

The atomizing chamber 11 has an upper opening 33 closed by a stopper 34. There are two holes in the stopper 34, one containing a solution tube 35 and funnel 37, and the other containing an air delivery tube 36. Both tubes terminate in atomizer needles 38 and 39. Air needle 39 extends downwardly and is bent toward the solution needle 38 so as to be in position to direct a blast of air around the opening of needle 38. The air is received

from a compressed air supply which is connected to air delivery tube 36.

The air for the burner is received from the compressed air supply. Not enough air would be delivered from atomizer needle 39 and, therefore, additional air is supplied through two small holes 40 formed in the lower part of the air tube 36. These holes are about $\frac{1}{32}$ of an inch in diameter. Variation of this arrangement is shown in Figure 5 and provides holes 42 in the metal base of the atomizer assembly at a point about $\frac{1}{4}$ inch above the holes previously indicated and with a U-shaped slot 43 in the rubber gasket to permit air issuing from these holes to escape downward into chamber 11.

The bottom of the atomization chamber is formed with a drain trap 41 to drain off any solution not vaporized.

The operation of the photometer is broadly well known and is as follows:

Samples to be analyzed are put into aqueous solution by a suitable method and then poured into the inlet funnel 37 passing through the atomizer needles 38. The sample is atomized by means of compressed air supplied through tube 36 and air needle 39. The atomized vapor is aspirated through passage 32 and into the base of the gas burner 13 where the vapor is carried into the flame issuing from tube 19. Thus, the spectral lines of the metals in solution are excited. The light characteristics of the metallic element which is arising from the excited spectra is then analyzed in known manner, as it is observed through transparent chimney 26.

It is to be noted that, from the time the solution is poured through inlet funnel 37 until the time that the burnt gases leave the transparent chimney 26, the only gases which can reach the process are those supplied through air tube 36. Because of the applicants' novel sealing arrangements, it is impossible for any foreign matter to interfere with the analysis. It is equally important to observe that, even though chimney 26 may be tipped or not set in place quite properly, a complete seal will nevertheless be maintained by the "cuff" 28 on the gasket 24.

Figures 6 and 7 illustrate the light trap arrangement which is used to prevent substantially all of the extraneous light rays from entering the photometer casing, which extraneous light rays would interfere with the photometric analysis.

Figure 6 is a diagrammatic illustration of the photometer casing and shows the relative locations of the important elements of the optical system. The flame is located at 50 and the light emanating from the flame passes through the three ports surrounding the flame. The light passing through the two side ports is reflected by mirrors along the optical channels at the sides of the casing, through lenses and color filters to the photocells. The light passing through the center port is directed immediately through its associated lens and color filter to the photocell. The object of the light trap feature of the invention is to prevent any light not emanating from the flame from entering the optical channels.

Figure 7 is a sectional view of the end of the photometer casing looking toward the right of Figure 6. The section is taken through the burner assembly. The burner 13 is centrally located between the side walls 51 of the casing 52 and is surrounded by the transparent chimney 26.

A metal light trap 53 is mounted on a Transite trapping plate 54 and surrounds the chimney 26. An annular space 55 remains between the light trap 53 and the top 56 of the casing to permit the escape of hot air from the interior of the casing. The escape of the hot air is further permitted by spacing the trapping plate 54 away from the top of the casing by spacers 57.

As indicated above, the light rays from the flame pass through ports 58 where they are reflected by mirrors 59 into the optical channels.

The broken lines of Figure 7 demonstrate the effective-

ness of the light trap. The dash lines 60 show the maximum amount of light passing through a point 61 on the edge of the hole in the top of the casing which can pass through a port 58. It will be observed that a large quantity of this light will be reflected by the mirror 59 into the optical channel of the photometer apparatus.

The broken lines 62, on the other hand, indicate the largest quantity of light which can pass through a point 63 on the upper edge of the light trap through the point port 58. It will be observed that none of the extraneous light rays impinges directly on the mirrors 59.

The optical channels have a camera black finish inside the photometer apparatus and, therefore, the light striking the floor or sides of the optical channel is absorbed and consequently does not interfere with the photometric analysis. As a basis of comparison, it is estimated that, with the light trap, the light entering the ports is probably in multi-lumens while, without the trap, the light entering the port may be several hundred lumens.

It is to be understood that, while the preferred embodiment has been described, there are numerous variations which can be made in the present invention without departing from the scope of the invention as described in the following claims.

We claim:

1. In a flame photometer having a burner, a flat ring surrounding said burner and a chimney removably supported by said flat ring; a flexible seal between said ring and chimney, comprising, a flat disk-like portion having a hole centrally thereof through which said burner extends, said disk-like portion being disposed between said ring and the base of said chimney, and a second portion integral with and extending from said disk-like portion upwardly and against the cylindrical surface of said chimney to press around a circumference.

2. In a flame photometer according to claim 1, and a flat washer member surrounding said burner for clamping said seal to said ring, said member having an outer diameter less than the inside diameter of said chimney.

3. In a flame photometer according to claim 1, in which said second portion extends from the outer periphery of said disk-like portion upwardly and inwardly to engage the outer surface of said chimney.

4. In a flame photometer according to claim 1, in which said second portion extends upwardly from said disk-like portion and is inclined outwardly to engage the inner surface of said chimney.

5. A flame photometer comprising a burner having a spud and a burner tube, said tube having at least one aperture to permit the passage of a vapor through to said spud, a flask terminating at one end with an enclosure for said spud and burner tube, said enclosure having upper and lower openings surrounding said burner, first sealing means forming an air-tight connection below said aperture between the lower opening of said enclosure and said burner, a transparent chimney surrounding said burner tube, second sealing means forming an air-tight joint between said transparent chimney and the upper opening of said enclosure, and means for introducing solution to be analyzed into the other end of said flask.

6. A flame photometer according to claim 5, said second sealing means comprising a flat disk-like portion having a central hole through which said burner tube extends, the lower surface of said disk-like portion forming an air-tight seal with the edge of the upper opening of said enclosure, said transparent chimney being disposed on the upper surface of said disk-like portion to form an air-tight seal therewith, and a second portion extending from the outer periphery of said disk-like portion upwardly and inwardly to engage the outer surface of said transparent chimney.

7. In a flame photometer having a burner, a spud, and a burner tube, said tube having at least one aperture to permit the passage of a vapor through to said spud, a

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transparent chimney surrounding said burner tube, and a flask terminating at one end with an enclosure for the lower portion of said burner tube, said enclosure having upper and lower edges forming upper and lower openings surrounding said burner; a sealing arrangement comprising, a first rubber gasket on the upper edge of said upper enclosure opening forming a seal between said enclosure and said transparent chimney, a plate mounted integral with said burner tube below the aperture thereof, a second rubber gasket disposed between the lower edge of said lower enclosure opening and said plate, and means clamping said flask enclosure, gaskets, and plate together, whereby the passage from said flask to the top of said transparent chimney is air tight.

8. In a flame photometer according to claim 7, in 15

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which the outer edge of said first gasket terminates in a frusto-conical portion extending from the outer edge upwardly and inwardly to engage the outer surface of said transparent chimney, thereby maintaining a seal even when the base of said chimney is not flush with said gasket.

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