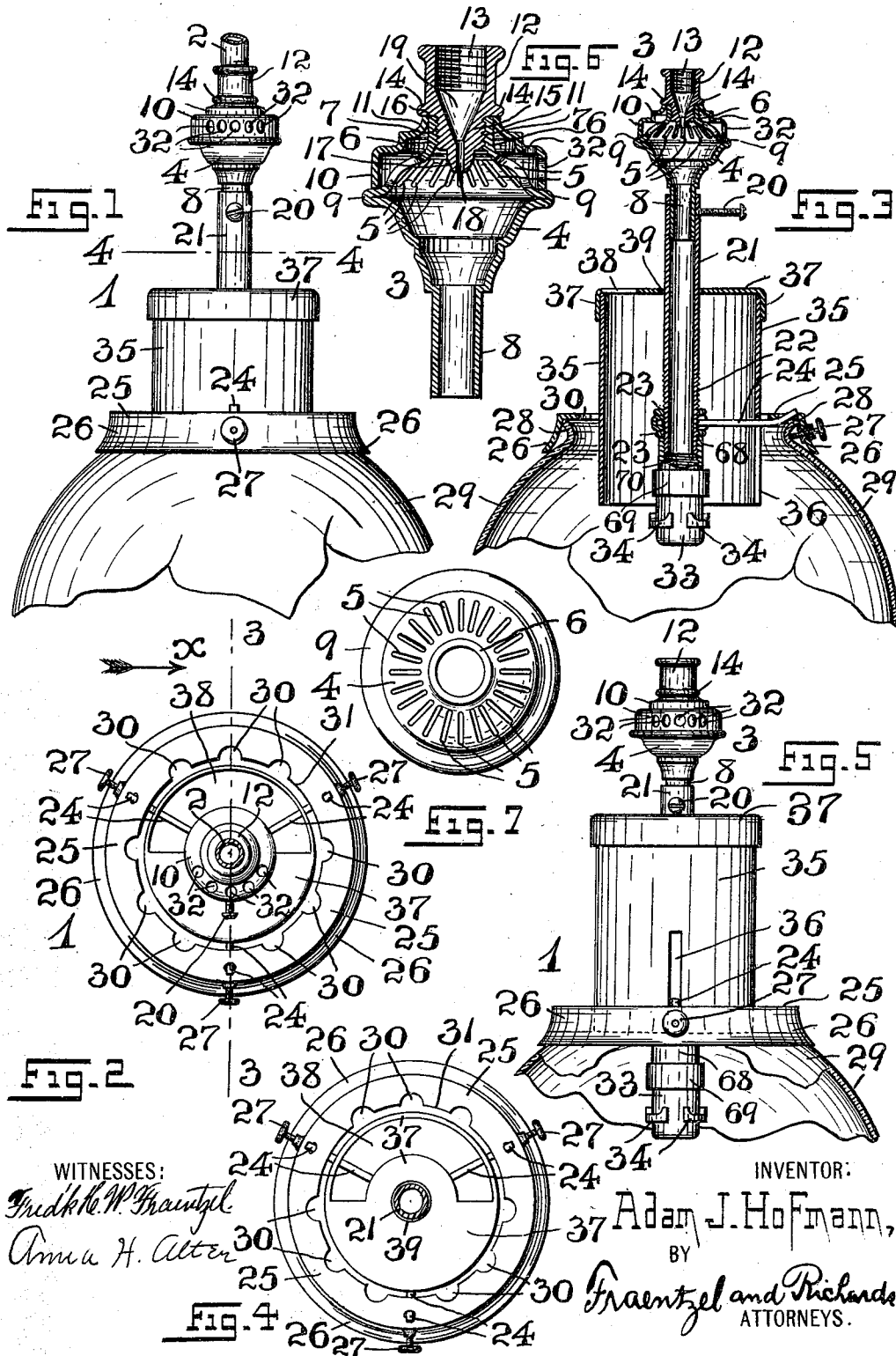


A. J. HOFMANN.
 INVERTED INCANDESCENT GAS LAMP.
 APPLICATION FILED MAY 4, 1909.

979,855.

Patented Dec. 27, 1910.

3 SHEETS—SHEET 1.



WITNESSES:
 Friedrich W. Fraentzel
 Anna H. Alter

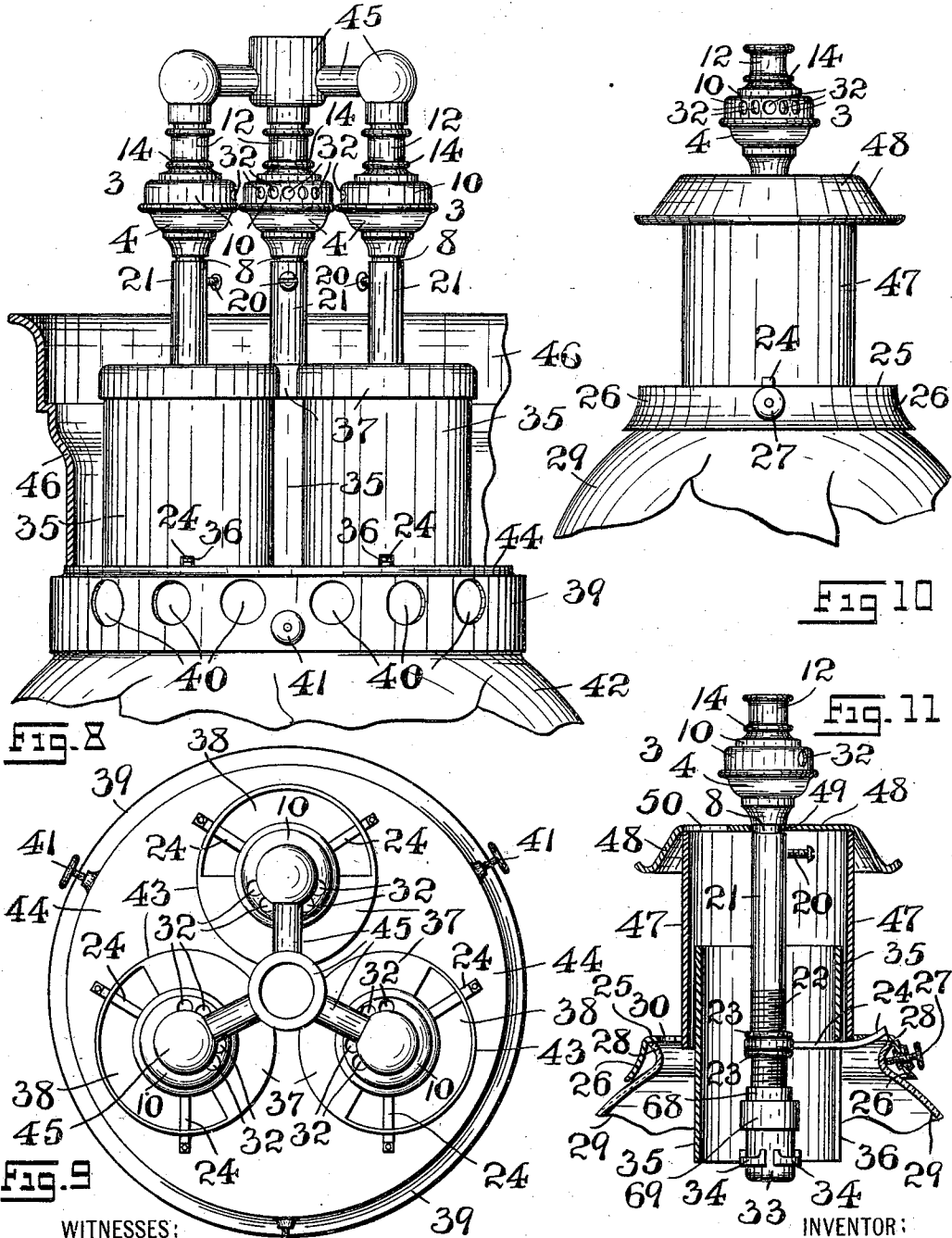
INVENTOR:
 Adam J. Hofmann,
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3 SHEETS-SHEET 2.



WITNESSES:
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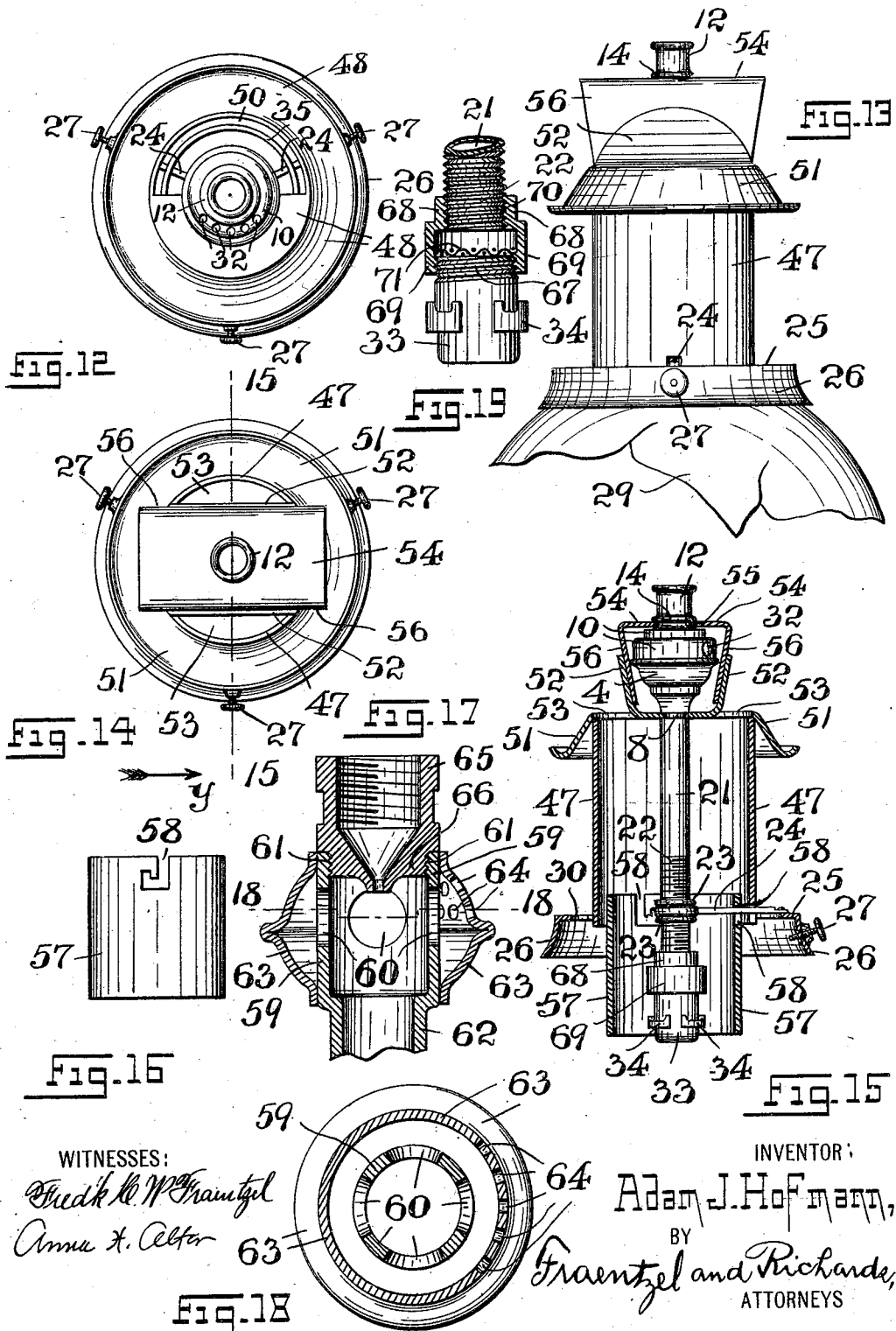
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3 SHEETS—SHEET 3.



WITNESSES:

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UNITED STATES PATENT OFFICE.

ADAM J. HOFMANN, OF NEWARK, NEW JERSEY.

INVERTED INCANDESCENT GAS-LAMP.

979,855.

Specification of Letters Patent.

Patented Dec. 27, 1910.

Application filed May 4, 1909. Serial No. 493,851.

To all whom it may concern:

Be it known that I, ADAM J. HOFMANN, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Inverted Incandescent Gas-Lamps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

The present invention has reference, generally, to improvements in that class of lamps and burners therefor, known in the art as inverted incandescent or glow-lamps; and, this invention relates, more particularly, to a novel construction of apparatus and means which is especially adapted for use with inverted incandescent or glow-lamps, with a view of providing a simply constructed device and a novel arrangement and combination of devices and parts, for the purpose of producing a proper and more efficient mixture of the air and gas, and to prevent any contamination of the properly mixed air and gas with the heated gases and air arising from the globe within which the burner is arranged.

The invention has for its principal object to provide an inverted incandescent gas-lamp and burner or burners therefor, surrounded by a globe, the burner or burners being each practically surrounded by a removable and center-draft producing element or chimney provided with means for throwing or forcing the hot air or consumed gases away from contact with the fresh supply of air or oxygen which enters the mixing chamber or bunsen of the gas-conveying-tube, so as to convey a non-contaminated mixture of air and gas to the burner-tip and the mantle suspended therefrom.

The invention has for its further object to provide a novel mixing chamber or element provided in one side only with a series or multiplicity of air-inlets or perforations and a draft-producing element or chimney, arranged below the said bunsen, which draft-producing element or chimney has a partially closed top or end, the closed por-

tion of said top or end being located beneath the perforated or air-inlet side of the mixing-chamber or bunsen, while the open or outlet-portion of said top or end of the draft-producing element or chimney is located beneath the closed and off-side of the mixing chamber or bunsen, so that the hot consumed gas will pass out of the said center-draft producing element or chimney upon that side of the bunsen directly opposite and away from the air-inlets or perforations, so as not to contaminate the fresh supply of air or oxygen, thus resulting always in a perfect mixture of the air and gas.

The invention has for its further object to enable the use of a number of center-draft elements or chimneys of the general construction and character herein-above specified adapted for use with an inverted incandescent gas-lamp comprising a cluster or a multiplicity of burners.

Other objects of this invention not at this time more particularly enumerated will be clearly understood from the following detailed description of the present invention.

With the various objects of the present invention in view, the said invention consists, primarily, in the novel inverted glow or incandescent gas-lamp of the general character hereinafter set forth; and, the invention consists, furthermore, in the novel arrangements and combinations of the several devices and parts, as well as in the details of the construction of the same, all of which will be more fully described in the following specification, and then finally embodied in the clauses of the claim which are appended to and which form an essential part of the said specification.

The invention is clearly illustrated in the accompanying drawings, in which:—

Figure 1 is a side elevation of an inverted incandescent gas-lamp embodying the principles of the present invention, with a portion of the glass globe; Fig. 2 is a top or plan view of the parts shown in said Fig. 1, with the globe omitted from said view; and Fig. 3 is a transverse vertical section of the parts shown in said Fig. 1, said section being taken upon a vertical plane represented by the line 3—3 in Fig. 2, looking in the direction of the arrow *x* in said figure. Fig. 4 is a horizontal section taken on line 4—4 in said Fig. 1; and Fig. 5 is a view similar to

that represented in Fig. 1, with the portion of the globe indicated in vertical cross-section, and showing the center-draft element or chimney in its raised position. Fig. 6 is a transverse vertical section, on an enlarged scale, of the chambered mixing device or bunsen; and Fig. 7 is a plan or top view of the inner chambered member of said device. Fig. 8 is a part sectional representation and part side elevation, with a portion of the glass globe, of an inverted incandescent gas-lamp provided with a cluster or multiplicity of burners and their center-draft elements or chimneys, embodying the principles of the present invention; and Fig. 9 is a plan or top view of the parts represented in said Fig. 8, with the globe omitted from said view. Fig. 10 is a side elevation of an inverted incandescent gas-lamp of a modified construction, but still embodying the principles of the present invention; Fig. 11 is a transverse vertical section of the same, the mixing device or bunsen, the gas-conveying tube, and the burner-tip, however, being shown in elevation; and Fig. 12 is a plan or top view of the said lamp. Fig. 13 is a side view of another modified form of inverted incandescent gas-lamp made according to the present invention; Fig. 14 is a plan or top view of the same; Fig. 15 is a transverse vertical section of the form of inverted incandescent gas-lamp represented in said Figs. 13 and 14, said section being taken on line 15—15 in Fig. 14, looking in the direction of the arrow y, with the mixing device or bunsen, the gas-conveying tube, and the burner-tip of said lamp shown in elevation; and Fig. 16 is a side elevation of the form of center-draft element or chimney employed in the form of lamp illustrated in said Figs. 13, 14, and 15. Fig. 17 is a vertical cross-section of a modified form of mixing device or bunsen, said view being made on an enlarged scale; and Fig. 18 is a horizontal section of the same, said section being taken on line 18—18 in said Fig. 17. Fig. 19 is a detail view partly in elevation and partly in section of the burner-tip, a portion of the gas-conveying tube, and metallic sleeve for attaching the burner tip to said tube.

Similar characters of reference are employed in all of the above described views, to indicate corresponding parts.

Referring now more particularly to Figs. 1 to 7 inclusive, the reference-character 1 indicates a complete inverted glow or incandescent gas-lamp, showing one embodiment of the present invention. The reference-character 2 indicates the screw-threaded end-portion of a gas-pipe upon which is mounted the air and gas-mixing device or bunsen 3. This device consists, essentially, of a suitably shaped and ornamental hollow or chambered body or element, as 4, the upper portion of which is provided with a multi-

plicity of openings or air-inlets 5, of any suitable configuration, said portion being also provided with a tubular neck-portion or member 6, which is internally screw-threaded, as at 7, and as more clearly illustrated in Fig. 6 of the drawings. Suitably connected with and extending from the lower portion of said hollow or chambered body or element 4 is a tubular member 8 which communicates with and provides an exit or outlet from the interior of said body 4. Resting or mounted upon an annular bead-like portion 9 of the said hollow or chambered body or element 4 is a suitably formed and ornamental cap or shell 10 which is formed with an annular mouth or neck-like part 11, said part being fitted over the outer and upper portion of the tubular neck-portion or member 6, in a concentric manner as clearly illustrated in Figs. 3 and 6 of the drawings, the upper marginal edge of the mouth or neck-like part 11 being flush with the upper marginal edge of the tubular neck-portion or member 6, as clearly shown. The reference-character 12 indicates a suitable union or connecting member, which is formed with an internally screw-threaded portion 13 for the attachment of the said member to the screw-threaded portion of the gas-pipe 2. The said union or member 12 is also provided with an annular projection or bead 14 and with an externally screw-threaded lug or extension 15, which is screwed into the internally screw-threaded neck-portion or member 6, the said annular projection or bead 14 and the annular shoulder 16 formed by the reduced lug or extension 15 resting directly upon the annular marginal edge-portion of the tubular neck 6 and the annular mouth or neck-like part 11. Connected with and extending from the lower surface of the said reduced lug or extension 15, so as to project into the extension or chamber of the body or element 4, is a reduced projection or teat 17, the same being provided with a reduced duct or outlet 18 which is in communication with the upper and screw-threaded tubular portion of the union or connection 12 by means of a tapered or inverted cone-shaped portion 19. Suitably and preferably adjustably connected with the said tubular extension or outlet 8, by means of a set-screw 20, is a gas-conveying tube or pipe 21, the lower outer cylindrical portion thereof being provided with a screw-thread 22, substantially as shown in Fig. 3 of the drawings. Suitably secured and held in place on the said screw-thread 22, by means of a pair of suitably formed nut-like elements 23, is a suitable spider comprising a series of radially extending arms or supports 24 which are adapted to hold or engage with a globe-supporting ring 25. This ring, as will be seen from an inspection of the several figures of the drawings, is

provided with a downwardly extending and preferably outwardly flaring flange 26, in which are arranged a number of holding screws 27 adapted to be brought in retaining engagement with the usual supporting or fastening flange 28 of a suitable globe 29. The said supporting ring 25, in order to increase the opening for the admission of air into the said globe 29, may also be formed with arc-shaped cut-away portions 30 which form a part of the marginal edge 31 of the said ring, as more particularly illustrated in Figs. 2 and 4 of the drawings.

In order that the previously mentioned mixing device or bunsen may be provided with a direct passage-way for the outside air or oxygen into the inner portion or chamber of the body or member 4, to be intimately mixed therein with the gas, the previously mentioned cap or shell 10 is provided with a multiplicity of perforations or openings, as 32, these openings 32 being arranged on one side of the said cap or shell only, substantially in the manner indicated in Figs. 1, 2 and 5 of the drawings, and for the purposes to be presently more fully set forth.

Suitably secured upon the screw-threaded portion 22, at a point below the lower nut-like element 23, is a burner tip 33, of any suitable construction, said tip being provided upon its outer periphery with suitably formed supporting lugs or projections 34, for the reception and support thereon of a suitably formed and well-known construction of supporting ring or hanger for the usual mantle of an inverted or incandescent gas lamp, the said supporting ring and mantle, however, not being shown in the accompanying drawings.

In order to provide for a proper circulation of air within and through the bottom-closed globe 29, and to remove the hot and consumed gases from within the glass globe, and furthermore, to produce a center-draft and direct supply of the needful oxygen or air about the mantle, I have provided a suitably formed circulating-element or chimney 35, the same being made in the form of a hollow member, preferably a cylinder or a tube, and being provided with a series of vertically extending openings or slots 36, corresponding in number to the number of spider-arms 25, so that the said element 35 can be properly mounted upon the said spider frame, as will be clearly evident. The upper open portion of the body of the said circulating element or chimney 34 has suitably arranged and secured thereon a flanged head or member 37, a portion of which is provided with a suitably formed marginal opening 38, and with a centrally disposed opening 39 for concentrically and slidably arranging the said circulating element or chimney upon the gas conveying-tube 21, substantially in the manner illus-

trated in the several figures of the drawings.

The position of the outlet or opening 38 in the cap or end-member 37 of the said circulating element or chimney 35 is such, that the said opening is located to the one side of the mixing device or bunsen, directly opposite the location of the fresh air openings or inlets 32, as more particularly illustrated in Fig. 2 of the drawings. This arrangement and construction of the center-draft element or chimney 35 allows for a free access of air into and through the bottom closed globe 29, through the central opening and cutaway portions and supporting ring 25, and thereby providing a constant influx of fresh air or oxygen to the burner tip and mantle, while the expended hot air and gases are drawn up into the said element 35 and out of the opening 38 in its closing end or flanged head or member 37; and, such hot air and gases are forced away to one side, opposite from that side of the mixing device or bunsen in which the inlets or perforations 32 are located, so that there will be no contamination of the said hot air or expended gases with the fresh air or oxygen which is being admitted into the mixing chamber or bunsen. In consequence thereof a proper and efficient mixture of the fresh air or oxygen with the gas will be produced, which is carried down through the pipe or tube 21 to the bunsen-tip 33, to be ignited at that point. The position and arrangement of the said screw 20 is also such that it will act as a stop to the upward sliding movement of the said circulating element or chimney 35, as indicated in Fig. 5 of the drawings, when the said element or chimney 35 is raised for the purpose of more readily attaching the mantle to or removing it from the supporting lugs or projections 34 of the burner-tip 33, as will be clearly evident.

In Figs. 7, 8 and 9 of the drawings is shown an inverted incandescent gas-lamp provided with a cluster or a multiplicity of burners and center-draft elements or chimneys and a multiplicity of mixing devices or bunsens, of the same construction and arrangement of parts as those described in connection with and illustrated in Figs. 1 to 7 of the drawings. In this construction of burner, the reference-character 39 indicates a suitably flanged ring which is provided in its flange with air inlets or openings 40, and has a number of holding screws 41 for the suspension from said ring of a closed glass globe 42. In its upper and closed surface 44 the said ring 39 is provided with a series of openings 43, corresponding in number and location to the number and positions of the circulating elements or chimneys 35, the said elements or chimneys being slidably arranged in the said openings, and upon the respective gas-

conveying tubes 21, in the manner hereinabove described. The various unions or connecting members 12 of the several mixing devices are suitably connected with a gas-conveying fixture, as 45, substantially as shown in said Figs. 8 and 9 of the drawings. If desired, a suitably formed and ornamental shell or ring 46 may be placed upon the said supporting ring 39, substantially as indicated in Fig. 8 of the drawings, said ring 46 serving as a finish, and hiding from view the various circulating elements or chimneys 35. Instead of providing the center-draft or circulating element or chimney 35 with a flanged head or member 37, in the manner indicated in Fig. 3 of the drawings, there may be mounted upon the spider-arms 24, in the manner illustrated in Fig. 11 of the drawings, a second cylindrical body or tube 47. This cylindrical body or tube has its lower portion arranged over the upper portion of the circulating element or chimney 35, its upper portion extending for some distance above said circulating element or chimney 35, and having its upper open portion surmounted by a suitably formed hood or cap 48. This hood or cap 48 is provided with a centrally disposed opening 49 by means of which it is arranged upon the tubular member 8 of the chambered or hollow body 4 of the mixing device or bunsen 3, said hood or cap 48 resting preferably upon the upper marginal edge-portion of the gas-conveying tube 21. The said hood or cap 48 is also provided in one side with an opening 50, the position of said outlet or opening 50 being such, so that the opening is located at the one side of the mixing device or bunsen directly opposite the location of the air openings or inlets 32, as will be clearly evident from an inspection of the modification of inverted gas-lamp represented in said Figs. 10 and 11 of the drawings, for the purposes hereinabove described.

Referring now to the modification illustrated in Figs. 13, 14 and 15 of the drawings, it will be seen, that the said cylindrical body or tube 47 may be provided upon its upper open portion with a hood or cap 51, out of the upper surface of which are forced two oppositely placed and upwardly extending ears or members 52, so as to provide the said hood or cap with a pair of oppositely located openings or outlets 53 through which the hot air and expended gas may escape. The said ears 52 preferably incline outwardly and upwardly and form suitable deflectors, as will be clearly evident. A correspondingly formed protector 54 having a central opening 55 is suitably mounted upon the upper portion of the cap or shell 10 of the mixing device or bunsen, said protector having a pair of longitudinally extending and downwardly projecting

sides 56 which are suitably embraced by and secured between the previously mentioned ears 52. The protector or guard, thus provided, is open at its ends so as to provide a direct passage-way or duct for the admission of fresh air or oxygen through the openings or perforations 32 in the shell or cap 10 and into the mixing device or bunsen, for the purposes previously stated. In this construction, if desired, I may employ a draft-element or chimney 57 which is formed in its upper portion with suitably constructed L-shaped slots 58 for suspending the said element or chimney 57 from the spider-arms 24.

In Figs. 17 and 18 is illustrated a modified form of mixing device or bunsen embodying the principles of the present invention. This mixing device, consists, essentially, of a main tubular-member 59 which is provided in this case with an arrangement of four inlet-openings 60, usually of a circular configuration. The upper open portion of this tubular member is internally screw-threaded, as at 61, and connected with its lower open end-portion is a tubular member 62 with which may be connected, in the manner previously described, the gas-conveying tube 21. Surrounding the said tubular member or element 59, and suitably secured thereto, in a fixed position, is a hollow ornamental shell 63 which is formed in one of its sides with suitably disposed openings or air-inlets 64, for the purpose of admitting and supplying fresh air or oxygen through the said openings or perforations 64 and into the inner chambered portion of the shell 63, so that the supply of fresh air will enter through the openings 60 into the mixing chamber of the tubular element or member 59 in which the air is thoroughly mixed with the gas coming from the union or connection 65. This union or connection is similar in its construction to the union or connection shown in the previously described figures of the drawings, and the same is provided with a screw-threaded part, as 66, by means of which it is screwed into the internally screw-threaded upper portion of the said tubular member or element 59. In all other respects the said union or connection 65 is the same as the construction of union shown in Fig. 6 of the drawings; it will be understood, however, that any other suitably constructed union or connection may be employed, if desired.

As shown more particularly in Fig. 19 of the drawings, the previously mentioned burner-tip 33 which is made of a fire-clay, or similar vitreous material, is provided upon its outer and upper portion with an external screw-thread 67 upon which is screwed the internal screw-threaded portion 69 of a union or connecting sleeve 68, said union or sleeve being formed in its upper

and inner portion with another screw-thread, as 70, for the screwing into the same of the lower screw-threaded end-portion 22 of the gas-conveying tube 21. A wire-gauze 71 may also be arranged within the lower portion 69 of said union or sleeve 68, as shown.

The purpose of providing the burner-tip 33 upon its outer surface with the screw-thread 67 is so that the union or sleeve 68 can be screwed over the end of the burner-tip, thereby obviating the possibility of splitting the calcined burner-tip; and, the said sleeve 68, even in case that the said burner-tip should become split or cracked, still serving as a means for holding the parts together and causing the burner tip to retain its shape.

From the foregoing description of my present invention, it will be clearly understood that I have provided a novel and simple construction of inverted glow or incandescent gas-lamp, with which can be efficiently used a bottom-closed globe, and the air or draft circulating element or elements being constructed and arranged in such a manner, so that a proper circulation of the air is produced around the mantle of the burner, while at the same time any hot air or expended gases are withdrawn or forced from within the globe to the exterior of the gas lamp without interfering with the supply of fresh air or oxygen which is being constantly admitted into the mixing device or burners.

I am fully aware that various changes may be made in the general arrangements and combinations of the devices and parts, as well as in the details of the construction of the same, without departing from the scope of my present invention as described in the foregoing specification, and as defined in the claims which are appended to the said specification. Hence, I do not limit this invention to the exact arrangements and combinations of the devices and parts as described in the said specification, nor do I confine myself to the exact details of the construction of the said parts as illustrated in the accompanying drawings.

I claim:—

1. An inverted incandescent gas-lamp comprising a mixing device provided with air-inlets, a gas-conveying tube extending from said mixing device, a burner-tip mounted upon the lower end of said tube, a globe-supporting ring, a globe suspended from said ring, and an air-circulating element surrounded by said ring, said ring having an inwardly extending portion provided with recesses forming air-inlets for permitting an influx of air into said globe, said circulating element being provided at one side only with a hot-air outlet for forcing the expended gases from within said globe

to one side and away from the air-inlets of the mixing device, so as to prevent the contamination of the fresh air by said expended gases.

2. An inverted incandescent gas-lamp comprising a mixing device provided with air-inlets, a gas-conveying tube extending from said mixing device, a burner-tip mounted upon the lower end of said tube, a series of spider-arms radiating from said tube, a globe-supporting ring mounted upon said arms, a globe supported from said ring, and an air-circulating element surrounded by said ring, said ring having an inwardly extending portion provided with recesses forming air-inlets for permitting an influx of air into said globe, said circulating element being provided with means for forcing the expended gases from within said globe to one side and away from the air-inlets of the mixing device, so as to prevent the contamination of the fresh air by said expended gases.

3. An inverted incandescent gas-lamp comprising a mixing device provided with air-inlets, a gas-conveying tube extending from said mixing device, a burner-tip mounted upon the lower end of said tube, a series of spider-arms radiating from said tube, a globe-supporting ring mounted upon said arms, a globe supported from said ring, and a cylindrical center-draft producing chimney provided with vertical slots fitted over said spider-arms and surrounded by said ring, said ring having an inwardly extending portion provided with recesses forming air-inlets for permitting an influx of air into said globe, said chimney being provided with means for forcing the expended gases from within said globe to one side and away from the air-inlets of the mixing device, so as to prevent the contamination of the fresh air by said expended gases.

4. An inverted incandescent gas-lamp comprising a mixing device provided in one of its sides with air-inlets, a gas-conveying tube extending from said mixing device, a burner-tip mounted upon the lower end of said tube, a globe, a cylindrically formed air-circulating element slidably arranged upon said tube, and an end-cap upon the upper end-portion of said circulating element, said end-cap being provided with an opening diametrically opposite to the air-inlets in said mixing device for forcing the expended gases from within the globe to one side and away from the air-inlets of the mixing device, so as to prevent the contamination of the fresh air by said expended gases.

5. An inverted incandescent gas-lamp comprising a mixing device provided in one of its sides with air-inlets, a gas-conveying tube extending from said mixing device, a burner-tip mounted upon the lower end of

said tube, a globe-supporting ring, a globe suspended from said ring, a cylindrically formed air-circulating element slidably arranged upon said tube and encircled by said
 5 ring, said ring being provided with recesses forming air-inlets for permitting an influx of air into said globe, and an end-cap upon the upper end-portion of said circulating element, said end-cap being provided with
 10 an opening diametrically opposite to the air-inlets in said mixing device for forcing the expended gases from within the globe to one side and away from the air-inlets of the mixing device, so as to prevent the con-
 15 tamination of the fresh air by said expended gases.

6. An inverted incandescent gas-lamp comprising a mixing device provided in one of its sides with air-inlets, a gas-conveying
 20 tube extending from said mixing device, a burner-tip mounted upon the lower end of said tube, a series of spider-arms radiating from said tube, a globe-supporting ring mounted upon said arms, a globe supported
 25 from said ring, a cylindrically formed air-circulating element mounted upon said spider-arms and encircled by said ring, and an end-cap upon the upper end-portion of said circulating element, said end-cap being
 30 provided with an opening diametrically opposite to the air-inlets in said mixing device for forcing the expended gases from within the globe to one side and away from the air-inlets of the mixing device, so as to
 35 prevent the contamination of the fresh air by said expended gases.

7. An inverted incandescent gas-lamp comprising a mixing device provided in one of its sides with air-inlets, a gas-conveying
 40 tube extending from said mixing device, a burner-tip mounted upon the lower end of said tube, a series of spider-arms radiating from said tube, a globe supporting ring mounted upon said arms, a globe supported
 45 from said ring, a cylindrically formed air-circulating element, said element being slidably arranged upon said tube and being formed with slots mounted upon said spider-arms, said element being encircled by said
 50 ring and said ring being provided with recesses forming air-inlets for permitting an influx of air into said globe, and an end-cap upon the upper end-portion of said circulating element, said end-cap being provided
 55 with an opening diametrically opposite to the air-inlets in said mixing device for forcing the expended gases from within the

globe to one side and away from the air-inlets of the mixing device, so as to prevent the contamination of the fresh air by said
 60 expended gases.

8. In an incandescent gas-lamp, a gas-conveying tube and a burner-tip upon its lower end-portion, of a mixing device connected with said tube, said device comprising
 65 a chambered body formed with a screw-threaded neck, and said body being formed with openings for the admission of air into the interior of said body, a cap-shaped shell surmounting said body, said shell being
 70 provided in one side with air-inlets, and a screw-threaded pipe-connection connected with said neck for the attachment of a gas-pipe to said mixing device, combined with a globe suspended from said gas-conveying
 75 tube, and an air-circulating element, said circulating element being provided with means formed at one side only with a hot-air outlet for forcing the expended gases from within said globe to one side and away
 80 from the air-inlets in said cap-shaped shell of the mixing device, so as to prevent the contamination of the fresh air by said expended gases.

9. In an incandescent gas-lamp, a gas-
 85 conveying tube and a burner tip upon its lower end-portion, of a mixing device connected with said tube, said device comprising a chambered body formed with a screw-threaded neck, and said body being formed
 90 with openings for the admission of air into the interior of said body, a cap-shaped shell surmounting said body, said shell being provided in one side with air-inlets, and a screw-threaded pipe-connection connected
 95 with said neck for the attachment of a gas-pipe to said mixing device, combined with a globe suspended from said gas-conveying tube, a cylindrical center-draft producing chimney, and an end-cap upon the upper
 100 end-portion of said chimney, said end-cap being provided at one side only with an opening diametrically opposite the air-inlets in said cap-shaped shell of the mixing device, so as to prevent the contamination of
 105 the fresh air by said expended gases.

In testimony, that I claim the invention set forth above I have hereunto set my hand this 29th day of April, 1909.

ADAM J. HOFMANN.

Witnesses:

FREDK. C. FRAENTZEL,
 FREDK. H. W. FRAENTZEL.