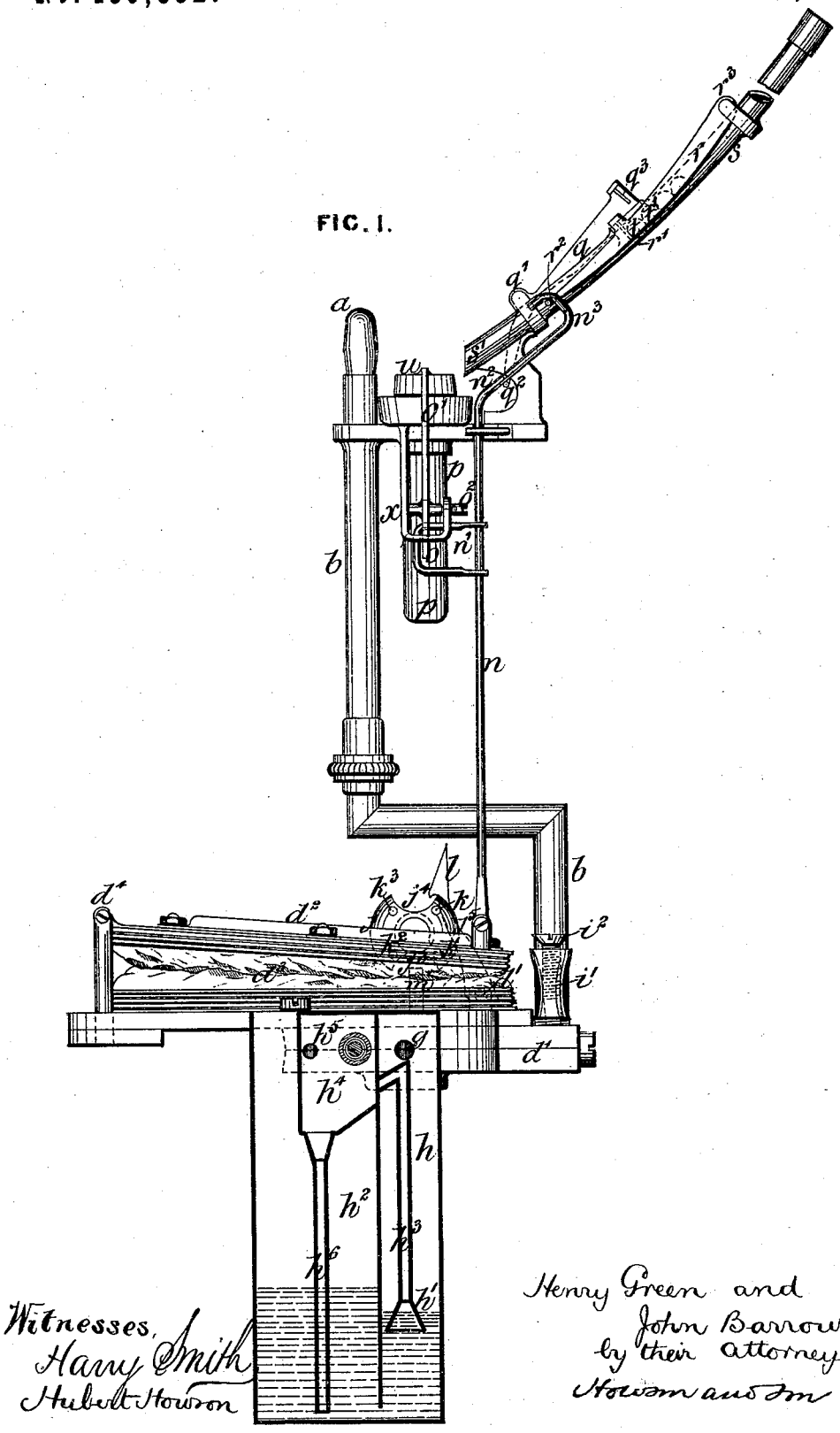
3 Sheets—Sheet 1.

H. GREEN & J. BARROW.

APPARATUS FOR LIGHTING AND EXTINGUISHING GAS.

No. 169,352. Patented Nov. 2, 1875.

FIG. 1.



Witnesses,
Harry Smith
Hubert Howson

Henry Green and
John Barrow
by their attorneys,
Howson and Son

3 Sheets—Sheet 2.

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FIG. 3.

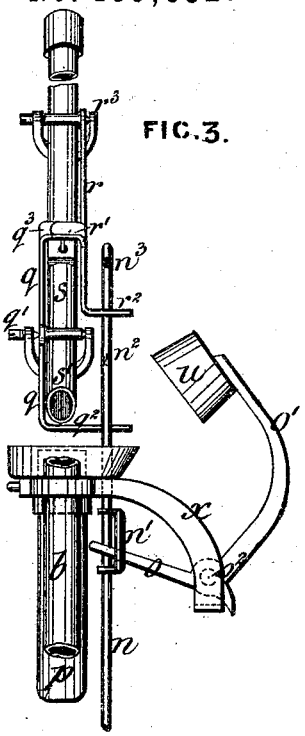

FIG. 2.

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3 Sheets—Sheet 3.

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FIG. 4.

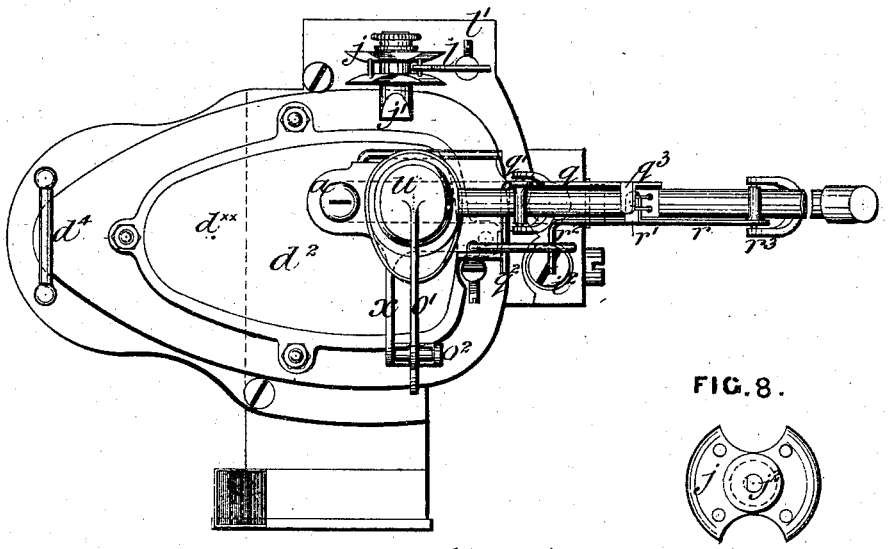

FIG. 8.

FIG. 5.

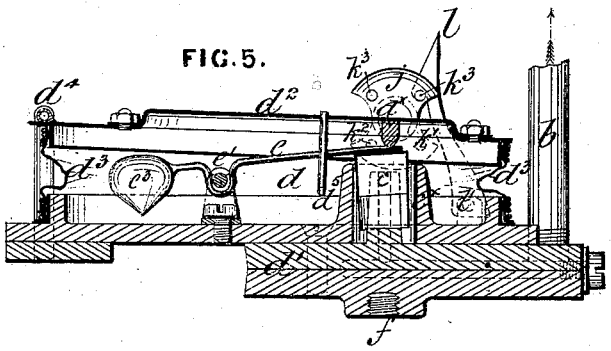

FIG. 9.

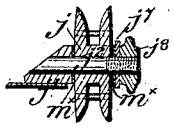

FIG. 10.

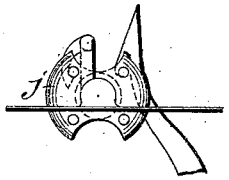

FIG. 6.

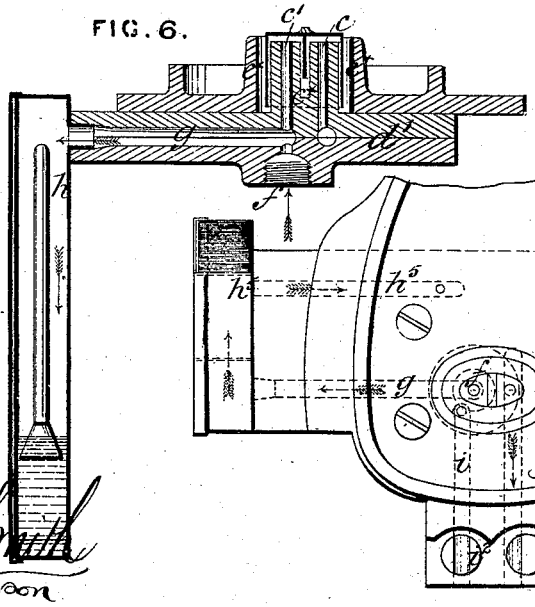

FIG. 7.

Witnesses,
Harry Smith
Hubert Howson

Henry Green and
John Barrow
by their attorneys
Howson and Son

UNITED STATES PATENT OFFICE.

HENRY GREEN, OF PRESTON, AND JOHN BARROW, OF CLAYTON, GREAT BRITAIN.

IMPROVEMENT IN APPARATUS FOR LIGHTING AND EXTINGUISHING GAS.

Specification forming part of Letters Patent No. **169,352**, dated November 2, 1875; application filed September 17, 1875.

To all whom it may concern:

Be it known that we, HENRY GREEN, of Preston, in the county of Lancaster, Kingdom of Great Britain and Ireland, gas engineer, and JOHN BARROW, of Clayton, near Manchester, in the same county, manufacturing chemist, have invented improved means and apparatus for opening the supply of gas to burners, igniting the gas, and extinguishing the lights, of which the following is a specification:

This invention is designed to furnish practicable and reliable means of enabling gas to be readily turned on and ignited, and the light to be afterward extinguished, as may be required, at any burner, or at a number of burners or places simultaneously, or nearly so. For this purpose, to each lamp or burner we apply a small collapsible vessel or chamber, worked by changing the gas-pressure, and connected to and operating a valve, to effect the opening and closing, as required, of an orifice or gasway communicating with the burner, said collapsible vessel being provided with a governing weight or body, to prevent the expanding or opening out of the collapsible vessel by the gas until, for that purpose, a predetermined pressure of gas, exceeding the ordinary maximum working pressure in the mains, and sufficient to displace said governing weight or body, shall have been put on, and having its action so governed by a cam arrangement that, notwithstanding any variation in pressure that may occur within the ordinary working limits after the gasway to the burner has been opened, a constant flow of gas to the burner shall be maintained until, on the gas-pressure being temporarily augmented beyond the ordinary maximum working pressure, and subsequently reduced, the position of the cam or holding device, hereinafter described, whereby the collapsible vessel has been held in its partially-expanded position, is changed, leaving the collapsible vessel or chamber free to collapse or close up, and thereby to cut off the gas-supply.

We effect the ignition of the gas by bringing together in a uniting chamber or vessel, arranged in juxtaposition to the gas-burner orifice, or to orifices in a messenger-pipe, suitable chemical agents, one such agent being in a liquid state in the uniting-chamber, into which the other chemical agent or mixture is introduced in the form of a pill or ball, which is decomposed on meeting the liquid agent, and by their action produce the requisite flame for igniting the gas issuing from the burner.

In order to enable others skilled in the art to make and use our said invention, we now proceed to describe the manner of performing the same, reference being had to the accompanying sheets of drawings and the figures and letters marked thereon.

The same letters of reference are used to denote equivalent parts in each of the several views.

Figure 1 is a side elevation, partly in section, of an apparatus according to our invention, showing the positions of the parts which obtain when communication between the burner and the gas-main is closed. Fig. 2 is a similar view, showing the positions of the parts which obtain when the collapsible vessel is fully expanded by the gas-pressure. Fig. 3 is an elevation at right angles to Fig. 2. Fig. 4 is a plan. Fig. 5 is a longitudinal vertical sectional view of the collapsible vessel and its appurtenances. Fig. 6 is a transverse section of part of the same. Fig. 7 is a plan, showing the arrangement of the gas-passages. Figs. 8 and 9 are detail views of the cam arrangement for regulating the collapsing of the collapsible vessel, and holding it at the proper times in a partially-expanded position.

a is the burner, to which gas is conducted by a pipe, *b*, communicating with a nozzle, *c*, terminating within the collapsible vessel or chamber *d*, composed of a base, d^1, made for convenience in parts screwed together, as shown, and a crown-plate, d^2, hinged at d^4, joined together by a flexible connecting piece or band, d^3, which may be of leather. The base d^1 is, by preference, cast in three pieces, two of which parts have channels, which, when the two parts are put together, form passages, this being a more ready and cheap mode of

construction than drilling holes in a solid casting. Within the chamber d is a lever, e, having its fulcrum at e^1, an inverted cup-shaped valve, e^2, at one end, and a weight, e^3, (or it may be a spring operating in the same direction as the weight shown,) at the other end, said weight causing that arm of the lever which carries it to preponderate slightly over the other arm, thus keeping the central division of the valve above the level of the mercury or sealing-liquid in the cup or vessel $c^\times$, containing the nozzles c c', except when the cap is held down by the crown-plate d^2, to which an arm or hook, d^5, is attached, for insuring the raising of the central division of the valve out of the sealing-liquid when the collapsible vessel is expanded or opened out by gas entering from the supply-pipe. f is the entrance for gas, fed by a supply-pipe from the main. c' is the orifice or nozzle communicating with the supply-pipe, which also communicates, by a passage, g, with the compartment h of a trap, constructed as shown, and operating as hereinafter described, for opening or closing the gasway to the collapsible vessel d when the gas-pressure in the main is temporarily increased sufficiently to overcome the resistance of a body of water or liquid in the trap, and thereby to gain admission to the chamber d. The weight of the water to be displaced in the trap must slightly exceed the maximum ordinary working pressure, so that no gas shall enter the collapsible vessel except when the pressure in the mains is increased beyond said limit. As the gas enters the collapsible vessel at a pressure exceeding the resistance offered by the crown-plate d^2, the vessel is expanded. By this arrangement, when the collapsible vessel d is collapsed or closed, communication is cut off between the nozzles or orifices c c' by the central division of the valve e^2 (seen best in Fig. 6) dipping into the sealing-liquid in $c^\times$; but when the collapsible vessel is expanded by the gas-pressure, the valve, being raised sufficiently to withdraw its central division from the sealing-liquid, unseals the nozzles or orifices c c', and permits gas to flow from c' to c, and thence to the burner. Mercury or other sealing-liquid is supplied to the cup or vessel $c^\times$ through the passage i and pipe i^1, the latter being supplied with a screwed stopper, i^2, which may be screwed in more or less, for regulating the level of the sealing-liquid in the pipe or vessel $c^\times$. Gas entering the apparatus through f and g, and flowing into the compartment h of the trap, as described, presses therein against the surface h^1 of the water or liquid, which is forced up into the compartment h^2 until the surface h^1 is depressed, by a pressure exceeding the ordinary working pressure, below the orifice of the bell-mouthed tube or conducting-passage h^3, whereupon gas flows by the tube h^3 into the compartment h^4, and thence by the passage h^5 enters the collapsible vessel d, which is thereby opened out or expanded, so that the weighted end of the lever e, previously held up by the pressure against the valve of the internal projection $d^\times$ of the crown-plate d^2, is now left free to descend and raise the partition of the valve above the level of the mercury, thus placing the nozzles c c' in communication with each other, so that gas entering at g will flow through c' and c to the burner a.

On the extra pressure being taken off, the surface of the water or liquid in the compartment h will rise, so as to again seal the mouth of the tube h^3, and the gas remaining in the vessel d will escape therefrom by the small orifice $d^{\times\times}$. The lower edge of the rim of the valve, by always dipping into the sealing-liquid $c^\times$, effectually prevents the escape of gas into the main body of the collapsible vessel. h^6 is a pipe for returning to the reservoir any water that may splash or be forced up the tube h^3 into the chamber h^4. When the gas-supply is to be either turned onto the burner and ignited, or cut off and extinguished, a slight augmentation for a few seconds of the gas-pressure in the mains beyond the ordinary maximum working pressure will suffice, which augmentation is effected by means of a regulator or governor at the gas-works, or elsewhere, as is well understood.

The collapsible vessel is caused to remain in a partially-expanded position by a mechanical device consisting of a grooved cam, j, carried by a small bracket, j^1, on the crown-plate d^2, and having its axis at j^2. This cam is formed with two notches, j^3 j^4, and provided with four pins, k k^1 k^2 k^3, or cross-pieces, traversing the groove in its periphery, which pins or cross-pieces operate in conjunction with a pawl, l, working on a pin, l'. Attached to the base d^1 of the collapsible vessel is a pin or stop, m, Fig. 1, operating in conjunction with the cam j, into one or other of whose notches j^3 j^4 this pin m enters when the collapsible vessel d is collapsed or closed. In Fig. 1 the collapsible vessel is shown in this position, with the pin or projection m in the notch j^3. On now expanding the vessel the cross-pin k of the cam i will enter the bend of the pawl l, thereby partially rotating the cam, so that on the gas-pressure being again reduced the descent of the crown-plate d^2 will be arrested by the pin or projection m coming in contact with the part j^5 of the cam j, which will keep the collapsible vessel partially expanded, so that gas may continue to flow to the burner a until, on its being desired to shut off the gas from the burner, the pressure is again temporarily augmented beyond the ordinary maximum working pressure, as before, whereupon the cam j will, by the action of the pawl l, as before, be again partially rotated until its notch j^4 is brought into position to receive the pin or projection m. On the extra pressure being now taken off, the crown-plate d^2 will descend,

pushing down the end of the lever with the valve, which will thereupon seal the nozzle or orifice *c*. The cam *j* is prevented from being accidentally turned back by the arrangement shown in Figs. 8 and 9, wherein $m^{\times}$ $m^{\times}$ are washers of leather or other flexible substance, fitting on the axis j^2, one at each side of the cam *j*. j^7 is a metal washer, having through it a hole corresponding to the section of the axis j^2, which at this point is of the form shown in full lines at j^2 in Fig. 8, to prevent the metal washer from turning. j^8 is a nut, by which the whole may be tightened up more or less, to adjust the amount of "braking" action upon the cam j^2. To the crown-plate d^2 is hinged or jointed a wire or rod, *n*, cranked, or provided with a loop at n^1, bent like an elbow at n^2, and terminating in a hook, n^3 n^4. Through this wire or rod motion from the crown-plate d^2 is communicated to the lever $o\,o^1$, whose fulcrum is at o^2 in the bracket *x*, for raising the cover *u* of the uniting-chamber *p* (which contains the liquid chemical agent) out of the mercury or other sealing substance contained in the channel surrounding the upper part of said chamber, and to a lever, *q*, and an arm, *r*, to regulate the feeding one by one at the proper times, from the pipe or receptacle *s*, through the nozzle *s'*, to the uniting-chamber *p*, of the pills or balls *t t'*, composed of suitable chemical ingredients, for generating the necessary flame for igniting the illuminating-gas issuing from the burner.

The lever *q*, which has its fulcrum at q^1, is bent at one end, q^2, and carries projections or stopping-pins q^3, which enter orifices in the pipe or receptacle *s*. Into a similar orifice enters a projection or stopping-pin, r^1, carried by the arm *r*, which is bent at r^2, and has its axis at r^3. That arm of the lever *q* carrying the stopping-pins q^3 is made to preponderate over the other arm of the lever. Assuming the parts to be in the relative positions shown in Fig. 1, on the collapsible vessel *d* being now expanded, as already described, the loop n^1, coming in contact with the arm *o*, will, through it and the arm o^1, uncover the uniting-chamber *p*, while, as the part n^2 of the wire rises and releases the part q^2 of the lever *q*, the stopping-pins q^3 will descend between the pills *t t'*, and, by the continued upward movement of the wire *n*, its part n^3, coming in contact with the part r^2 of the lever *r*, will raise the stopping-pin r^1, thus allowing the pill *t* to descend by the nozzle *s'* into the liquid chemical agent in the uniting-chamber *p*, and, by the action of the chemical agents thus brought together, generate the necessary temporary flame to ignite the gas issuing from the burner *a*. On now removing the extra pressure the collapsible vessel *d* will partially collapse sufficiently to close the uniting chamber *p* by its stopper, but not to cause the actuation of the lever *q*, and, as already explained, the collapsible vessel will be kept sufficiently expanded to allow of the continued flow of gas to the burner *a*, until the pressure is again temporarily augmented and subsequently reduced, as previously described. This last-mentioned reduction of pressure, besides cutting off and extinguishing the gas, will bring about the descent of the wire *n*, thereby drawing down the part q^2 of the wire *q*, and raising the stopping-pins q^3, so that the pill *t'* may take the place of that shown at *t* in Fig. 1, and so on. The hook n^4 insures the descent at the proper time of the lever *q*.

The chemical agents we use for generating the necessary flame to ignite the gas issuing from the burner *a*, as hereinbefore described, are such as are well known to chemists as producing flame when brought together, the one chemical agent being, however, according to our invention, used in the form of a liquid in the uniting-chamber, and the other chemical agent or mixture in the form of pills or balls. These pills or balls may be made of chlorate of potash mixed with sulphur or with sugar, or with other suitable organic substances, and used in conjunction with ordinary rectified sulphuric acid as the liquid agent.

In practice we have used pills or balls composed of a mixture of sixty parts, by weight, of chlorate of potash, twenty-seven parts, by weight, of common white sugar, and a sufficient quantity of flour paste to form the mixture into pills or balls. We have also used pills or balls composed of fifteen parts, by weight, of chlorate of potash, five parts of sulphur, one part of rosin, four parts of nitrate of potash, one part of carbon, and a sufficient quantity of flour paste to form the mixture into pills or balls.

We have used the foregoing in conjunction with the ordinary rectified sulphuric acid of commerce.

Although in the drawings we have shown the nozzle and valve inside the collapsible vessel, which arrangement we prefer, it will nevertheless be obvious that they may be arranged outside.

It will be evident, also, that the arrangement of apparatus shown in the drawings may be in other ways modified to suit circumstances, without departing from the distinctive character of our invention. Thus, for example, the hydraulic trap, the nozzle *c'*, and the lever *e* may be dispensed with. In this case gas from the mains passes direct into the collapsible vessel *d*, whence a single nozzle surrounded by a cup of mercury or other sealing-liquid (like that shown at $c^{\times}$ in Fig. 5) communicates with the burner. The crown-plate d^2 carries an inverted cup-shaped valve, (of which the crown-plate itself may form part,) the lower edge of whose rim dips into the sealing-liquid, so that the nozzle is hermetically sealed when the collapsible vessel is in its collapsed state. The crown-plate is weighted to resist the maximum ordinary working press-

ure; but when a pressure beyond that is put on, the collapsible vessel will be expanded, thereby unsealing the nozzle and allowing gas to flow to the burner. A second pawl, as shown in Fig. 10, may be used in lieu of the arrangement shown in Figs. 8 and 9, to prevent the turning back of the cam.

In another modification of our apparatus the crown-plate d^2 carries two cup-shaped valves of different depths, operating in conjunction with a couple of nozzles surrounded by mercury, so that during the temporary augmentation of the gas-pressure beyond the maximum ordinary working pressure the rims of both of the valves will be out of the mercury, and the nozzle leading to the main burner, as well as the nozzle leading to a perforated messenger-pipe, will be open for the flow of gas passing through the main body of the collapsible vessel *d;* but when the temporary extra pressure is removed the crown-plate d^2 will fall, so that the deep rim will dip into the mercury and seal the nozzle leading to the messenger-pipe, in which position the crown-plate d^2 will be retained with the shallower rim still above the level of the mercury, so that the nozzle leading to the burner will remain open for the flow of gas to the burner until the extra pressure is again put on and taken off, as before explained, whereupon the collapsible vessel will close or collapse, so that both rims will enter the mercury and seal the two nozzles.

Another plan is to allow the gas to flow direct into the collapsible vessel *d*, invert the nozzle leading to the burner, and on one end of the lever *e* (made stouter than shown in the drawings) place a cup-shaped valve charged with mercury. In this case the crown-plate d^2 is weighted by flat pieces of lead or other convenient means, so as to very slightly exceed the maximum working pressure of the gas in the mains. The opposite end of the lever *e* to that carrying the valve is slotted at one end, to allow of the free passage within certain limits of a pin or stud attached at its upper end to the crown-plate d^2 of the collapsible vessel, and formed or provided at its lower end with a head or projection, for lifting the end of the lever or tumbler *e* when the collapsible vessel *d* is expanded or opened out by gas entering from the supply-pipe. When the collapsible vessel *d* is collapsed or closed the slotted end of the lever *e* is depressed by its own weight, thereby sealing the nozzle or orifice by the mercury contained in the cup carried by the other end of the lever; but when the collapsible vessel is expanded by the gas-pressure the slotted end of the lever, being raised, depresses the cup of mercury, thereby unsealing the nozzle or orifice, and permitting gas to flow to the burner. Mercury is supplied to the cup through a nozzle-shaped pipe carried in the crown-plate just above the cup, and furnished with a stopper.

It will be obvious that in carrying out our invention the cam may be attached to the base-plate of the collapsible vessel, the pawl *l* and adjusting-pin *m*, or its equivalent, being attached to, and carried by, the crown-plate d^2, and that the crown-plate, instead of being hinged, may be made to work in guides; but we prefer to hinge it to insure perfect working of the cam.

Our method of igniting gas by the use of chemical agents may be advantageously employed in connection with lamps or burners, to which the supply of gas is regulated by taps or cocks in the ordinary way. In such cases we arrange a uniting-chamber, *p*, in juxtaposition to each burner, as shown in Fig. 1; but, there being no collapsible vessel, we connect the lower end of the wire *n* to one arm of a bell-crank lever working on a fixed stud or pin, in the ordinary way, and provided with a spring to retain it normally in such position as to keep the wire *n* in its lowest position, from which it is raised as required, for operating the cover *u* and pill-feeding levers, by pulling a wire attached to the other arm of the bell-crank lever, in a manner that will be readily understood without further description.

We are aware it has before been proposed to automatically open the gasway to the burner, ignite and shut off gas by changing the pressure of gas in the mains; also, that the application of hydraulic sealing for regulating the opening and closing of the gasway to the burner is not new. Moreover, we lay no claim to novelty as respects the use for producing flame of the chemical agents hereinbefore referred to, except when the solid agents are formed into pills or balls, which may be delivered one by one into the liquid agent contained in the uniting-chamber, as hereinbefore described.

What we claim is—

1. The combination, with a collapsible vessel, an inlet for gas, an outlet to a burner, and a valve for closing as required the communication between said inlet and outlet, of a governing weight or body for precluding the expansion of the collapsible vessel until a predetermined pressure of gas exceeding the ordinary maximum working pressure, and sufficient to displace said governing weight or body, shall have been put on, and a cam arrangement for retaining the collapsible vessel in a partially-expanded state, to permit the continued flow of gas to the burner, notwithstanding such variations as may occur in the gas pressure within its predetermined ordinary working limits.

2. The combination, with a gas-burner, of a uniting-chamber for containing a liquid chemical agent, a receptacle or reservoir for containing pills or balls composed of suitable chemical ingredients, and apparatus, operating as hereinbefore described, for regulating the

delivery of said pills or balls, one at a time, into the uniting-chamber, as required, to produce the necessary flame for igniting gas issuing from the burner.

3. The combination, with the collapsible vessel *d*, valve e^2, and orifices communicating, respectively, with the gas-supply and with the burner, of the hydraulic trap, for governing the admission of gas into the collapsible vessel *d*, and the cam device *j m*, for retaining the collapsible vessel *d* in a partially-expanded state, said device being arranged to allow the vessel *d* to collapse or close as required, all substantially as hereinbefore described and illustrated.

4. The combination of the collapsible vessel *d*, operated and regulated as described, the rod *n*, the lever $o\ o^1$, and cap *u*, for covering and uncovering the uniting-chamber, and the lever $q\ q^2$ and arm *r*, for regulating the delivery of pills or balls into the uniting-chamber, as above set forth, for the purpose specified.

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