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PATENTED OCT. 1, 1907.

E. H. ELTON & R. STEPHENS.
APPARATUS FOR LIGHTING AND EXTINGUISHING GAS LAMPS.

APPLICATION FILED AUG. 6, 1907.

3 SHEETS—SHEET 1.

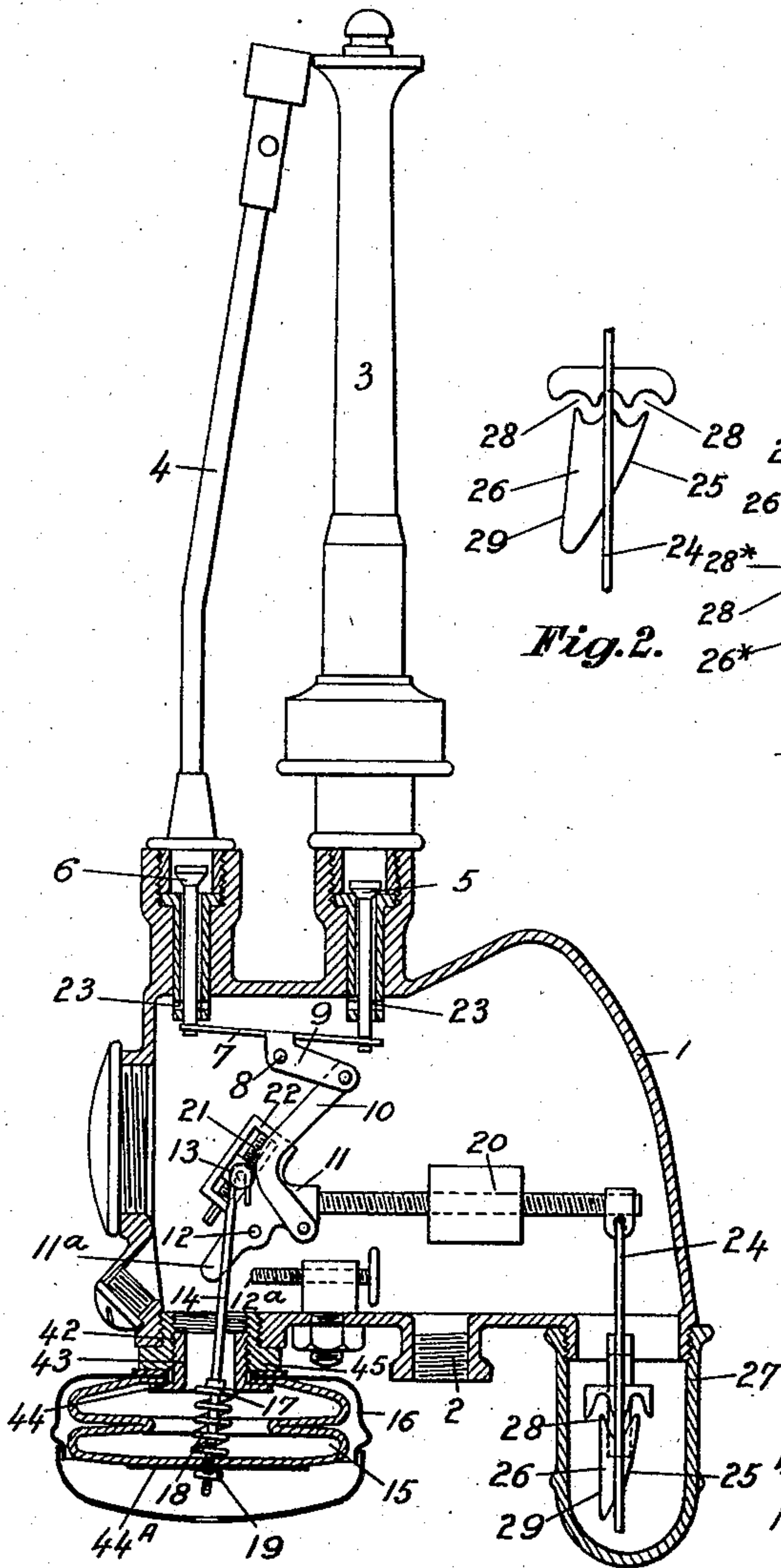


Fig. 1.

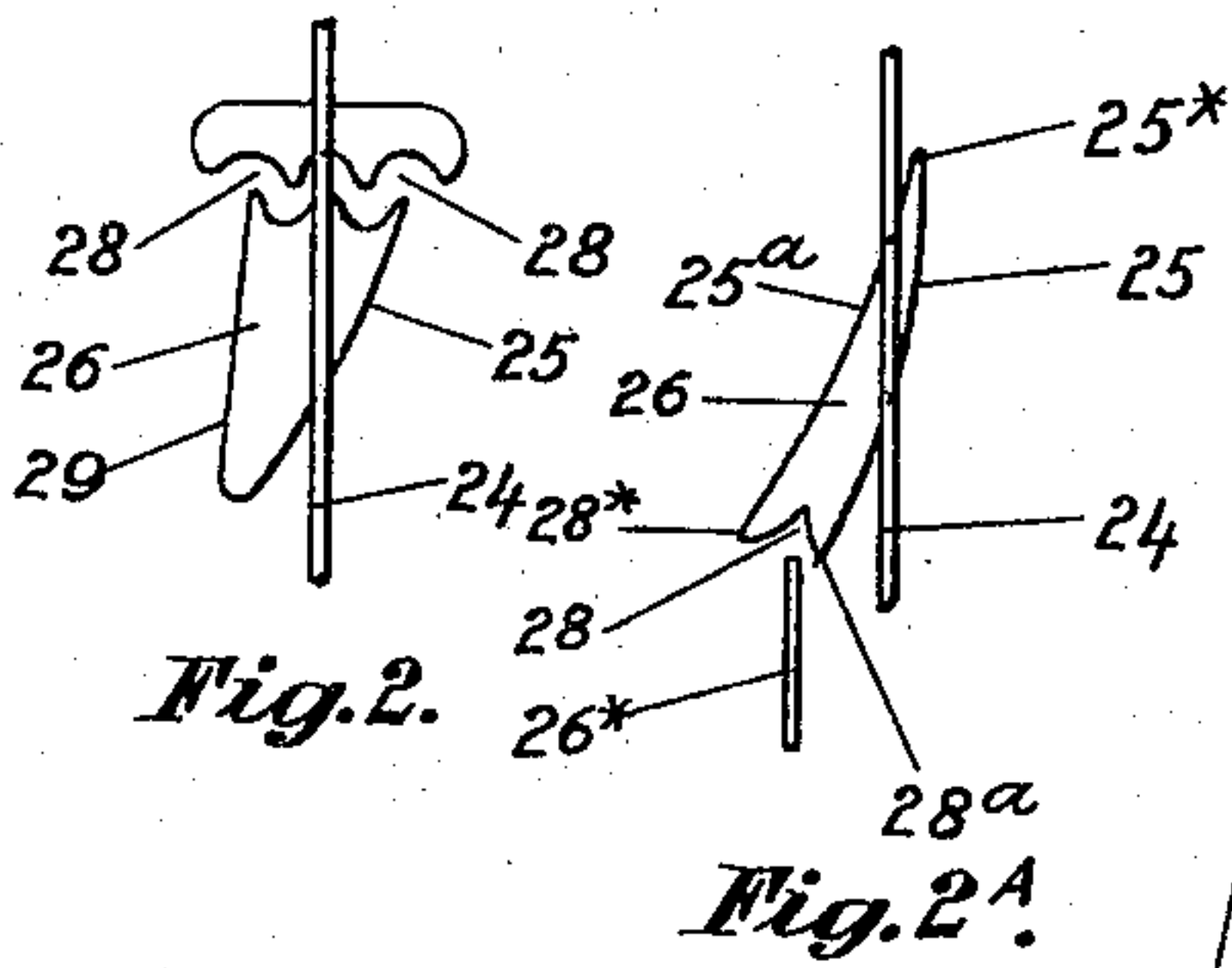


Fig. 2.

Fig. 2A.

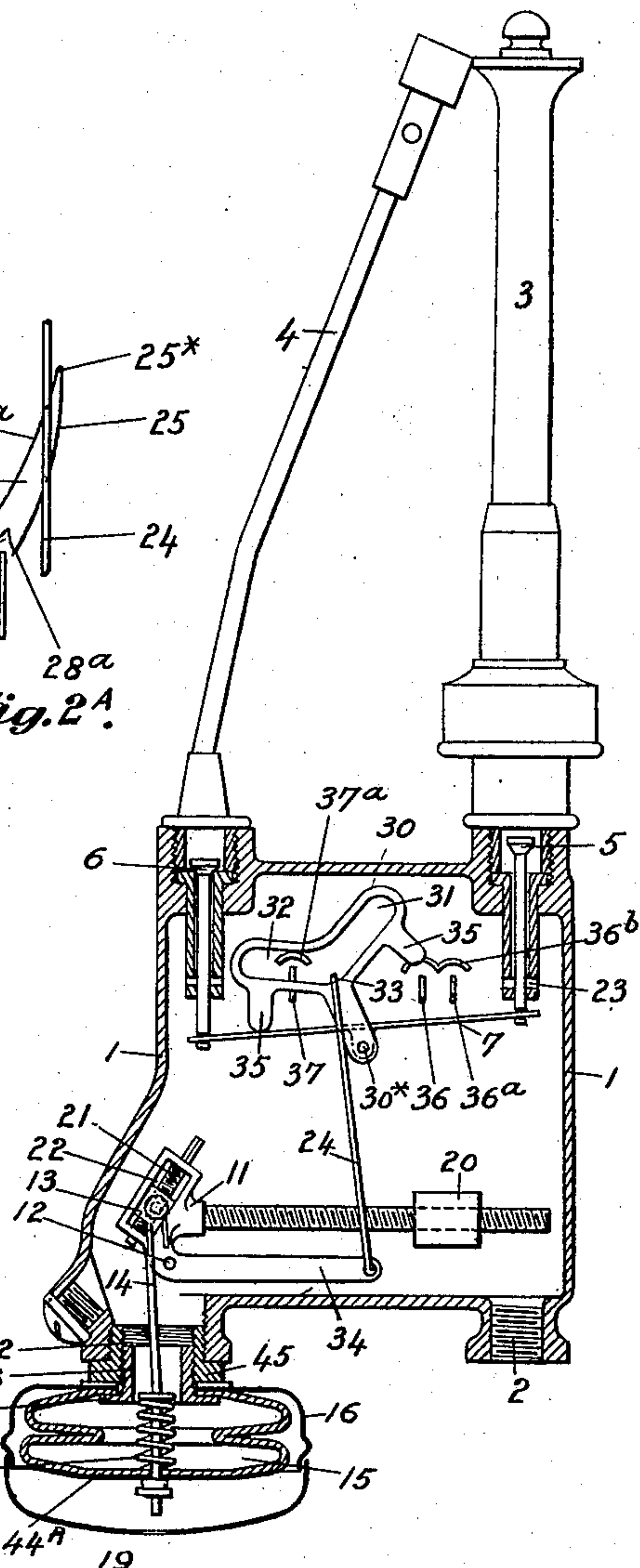


Fig. 3.

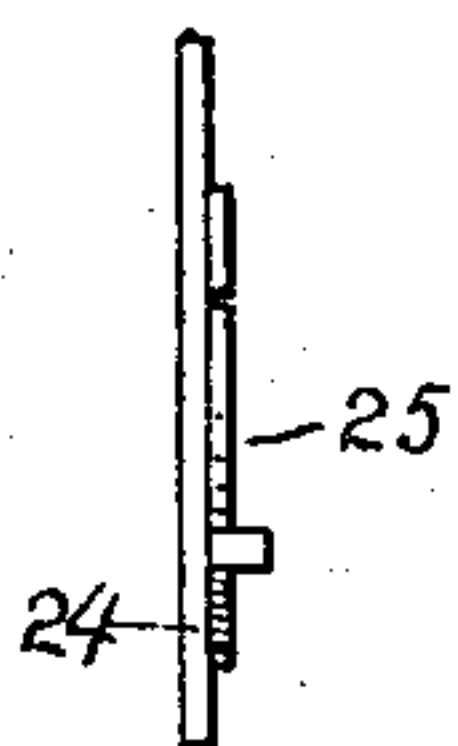


Fig. 1A.

Witnesses
Stanley Wood
Edward N. Sarton

Inventors
Edmund Harry Elton
Richard Stephens
by Spear, Middleton, & Spear
Attorneys

No. 867,488.

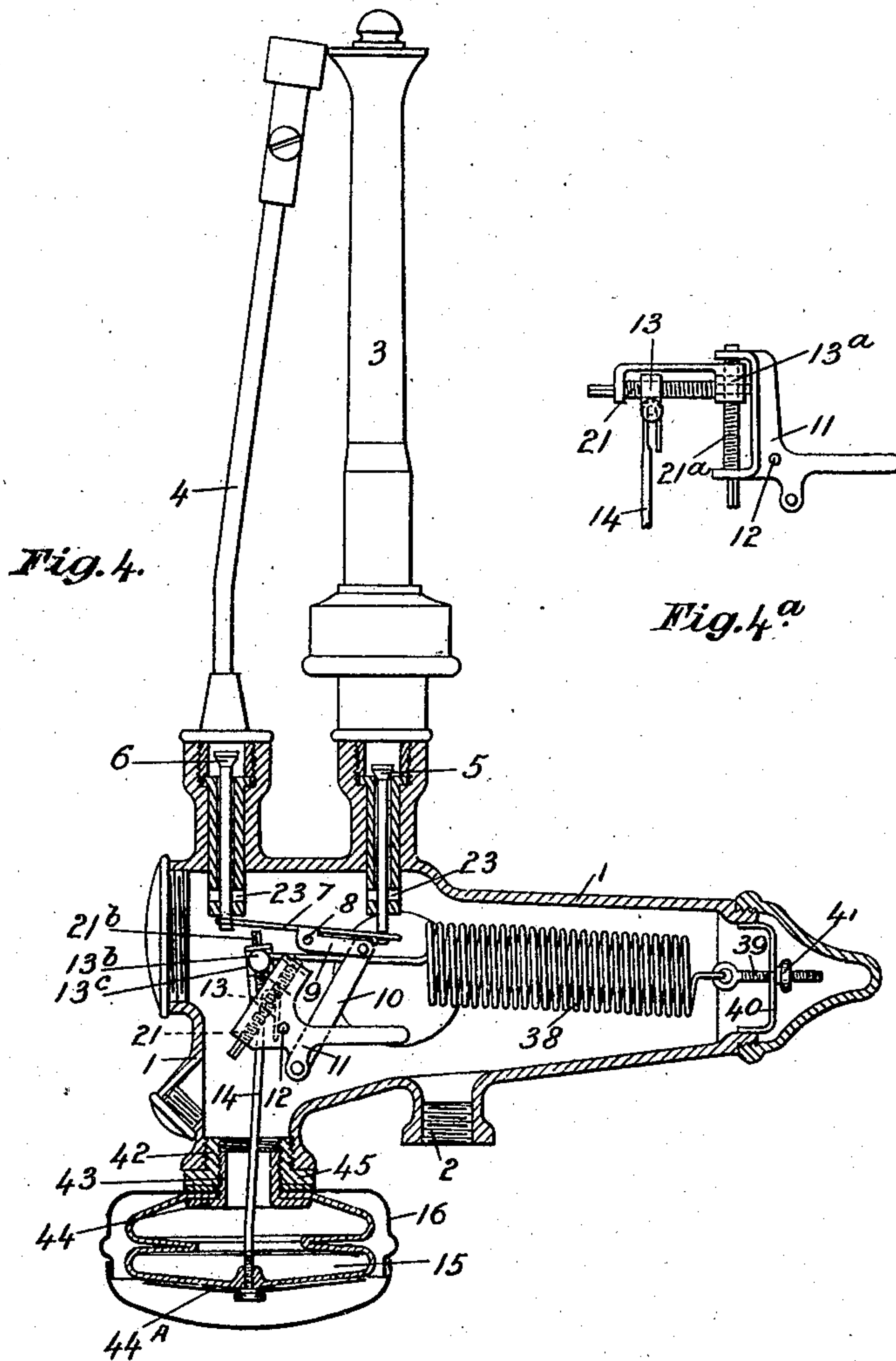
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Witnesses
Stanley Wood
John H. Standwich.

Inventors
Edmund Harry Elton
Richard Stephens.
by Spear, Middleton, Donaldson & Spear
Attorneys

No. 867,488.

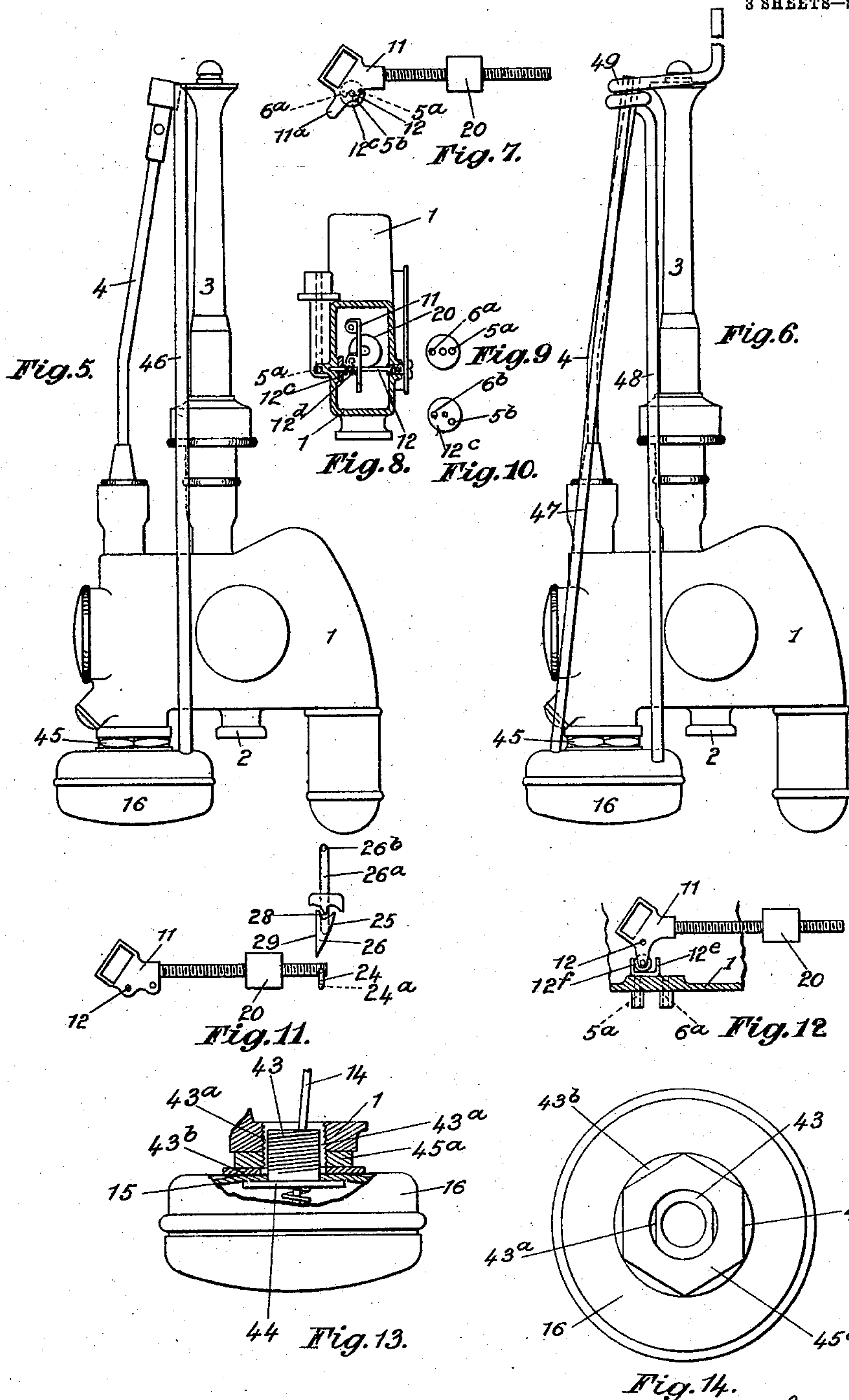
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3 SHEETS—SHEET 3.



Witnesses
Stanley Wood
John H. Strickland

Inventors
Edmund Harry Elton
Richard Stephens
by
Spear, Middleton, Donaldson & Spear
Attorneys

UNITED STATES PATENT OFFICE.

EDMUND HARRY ELTON AND RICHARD STEPHENS, OF CLEVEDON, ENGLAND.

APPARATUS FOR LIGHTING AND EXTINGUISHING GAS-LAMPS.

No. 867,488.

Specification of Letters Patent.

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REISSUED

To all whom it may concern:

Be it known that we, EDMUND HARRY ELTON, a subject of the King of Great Britain and Ireland, residing at Clevedon Court, Clevedon, Somersetshire, England, and RICHARD STEPHENS, a subject of the King of Great Britain and Ireland, residing at 9 The Triangle, Clevedon, Somersetshire, England, have invented certain new and useful Apparatus for Lighting and Extinguishing Gas-Lamps, of which the following is a specification.

This invention relates to apparatus for lighting and extinguishing gas lamps by variation of pressure in the gas mains. According to this invention the said lamps are each provided with a pilot light, for lighting the main burner, and there is provided in the pipe or passage by which the gas from the main communicates with the burner a closed chamber, containing, or in communication with, a bellows, or flexible diaphragm in, or on, which the gas pressure admitted to the said chamber acts and through it and through a weighted lever, or system of levers, causes a valve or valves to be operated so as to admit gas, and cut off the supply of gas alternately, to the main burner and to the pilot light of the lamp, the said valve or valves being so arranged and operated that when the main burner is alight, the pilot light is extinguished, and vice versa. The valves, according to one arrangement, are connected to or acted on by a lever which lever is within the closed chamber and is provided at its free end with an adjustable weight, or in conjunction with the said lever a spring may be employed by means of which the pressure of gas required to operate the valves can be regulated as desired. This lever is connected to the bellows, or flexible diaphragm, by an adjustable screw connection, and according to the distance this connection is from the fulcrum of the lever, so will depend the pressure required to operate the valve or valves to effect the lighting and extinguishing of the lamp burner or vary the difference of pressure required for lighting and extinguishing the burner.

The adjustment of the connection of the bellows, or flexible diaphragm, to the lever to which the valves are connected can be effected by screw and nut arrangement carried by the lever and instead of an adjustable weight, or spring, the said lever may be provided with a screw adjustment to vary as required the pressure necessary to operate the valves.

A separate valve may be provided for each of the passages, to the main burner, and to the pilot light or a single valve of any suitable construction may be provided for governing the two passages in such manner that when the gas pressure on the main rises to a predetermined point the gas will be admitted to the main burner and when the pressure is reduced below the predetermined point the supply of gas to the main burner will be cut off.

If it be desired to light the main burner at high pressure and to retain it alight while low pressure is extinguishing other main burners and eventually to extinguish the aforesaid main burner at low pressure preceded by a temporary high pressure there may be loosely hung from the lever to which the bellows or diaphragm is attached a swinging arm, the lower end of which is arranged to engage a fixed catch or projection. This arm is provided for the purpose of retaining the burner alight when the gas pressure is reduced, for example when the pressure increases, the bellows, or diaphragm, will raise the said arm so that its lower end will slide up an inclined surface of the fixed catch to above the upper end thereof, then if the pressure is reduced the lower end of the arm will descend into contact with the upper surface of the fixed catch and thereby keep the valve in the passage communicating with the main burner open, then to extinguish the light the pressure is again raised thereby raising the arm which will then swing and pass off the top surface of the fixed catch so that when the pressure is again reduced the arm will descend together with the lever below the fixed catch and thereby close the valve leading to the main burner and open the valve of the passage leading to the pilot light. The fixed catch may be provided with a number of stops in different positions so that any one of a number of lamps or one series of a number of series of lamps, can be lighted and extinguished separately. It is obvious that instead of making the arm to swing on the lever, the arm may be rigidly connected to the lever and the catch be made movable as hereinafter described.

Instead of connecting the valves to the lever to which the bellows, or diaphragm, is attached, the valves may be connected to a rocking lever, having therein inclined slots or a double inclined slot, one of the inclined slots being arranged on each side of the fulcrum of the said lever. In these inclined slots or the double inclined slot enters a projection from an arm or link pivoted to the lever which is connected to the bellows, or diaphragm, so that the lamp can be both lighted and extinguished at high pressure, and the said slotted lever can be provided or combined with catches, or stops, for the projection on the pivoted arm or link to engage with, so that any one of a number of lamps, or the lamps of any area of a number of areas of lamps, or one or more lamps of a cluster of lamps, can be separately lighted or extinguished.

The diaphragm, bellows, or bag, or the like, on which the gas pressure acts, may be carried, or inclosed, in a casing which may be fixed to the chamber containing the valves by means of a clamping screw and nut, or the like, so as to be capable of being readily removed for repairs, or renewal, and if desired, the said diaphragm, bellows, bag, or the like, can be secured

in its case by the same screw and nut, or the said flexible diaphragm, bellows, or the like, can be attached to its case by a sufficiently strong adhesive material which will secure it in position, but which will admit
5 of its being easily detached when required.

There may be a small pipe or other connection provided leading from the interior of the case protecting the diaphragm, to the open air so that in the event of the diaphragm being injured or worn the gas would
10 leak through it, the said gas could be lighted by hand or automatically by extending the pipe up to the pilot burner when its ignition would indicate that the diaphragm had become defective.

In a cold climate means may be provided to maintain the apparatus warm, for example a small tube heated by the gas, may be arranged in proximity to the apparatus to warm the diaphragm chamber.

In order that our invention may be clearly understood we will further describe the same with reference
20 to the accompanying drawings premising however that we do not restrict ourselves to the precise construction and arrangement of parts described and illustrated.

Figure 1 represents in sectional elevation the general construction and arrangement of one form of apparatus
25 according to our invention as applied to a single lamp the main burner of which is caused to be lighted by high pressure of gas and caused to be extinguished by low pressure; Fig. 1^a is a detail view of the rod 24 and its projection. Figs. 2 and 2^a are side views of modified details. Fig. 3 is a view similar to Fig. 1 of a
30 modified form of the apparatus. Fig. 4 is a view similar to Figs. 1 and 3 but showing a further modification. Fig. 4^a is a detail view of a modified part. Fig. 5 is an elevation showing an attachment for indicating
35 leaks in the bellows. Fig. 6 is a similar view showing a warming attachment. Figs. 7 to 10 respectively are detail views of modified forms of valve mechanism. Fig. 11 is a view of a further modification of the check mechanism. Fig. 12 is a detail view of a further
40 modification of valve mechanism. Figs. 13 to 14 are detail views in part sectional elevation and plan of a modification of the manner of connecting the bellows and casing.

1 is a closed chamber connected by screwing or
45 otherwise to the gas supply pipe in connection with the gas main the said gas supply pipe communicating with the interior of the chamber 1 by the passage 2. To the chamber 1 is connected the main burner 3 and the pilot burner 4 of the lamp, the passages for the gas from the
50 chamber 1 to the said main and pilot burners being governed respectively by valves 5 and 6 connected to, or operated by, the opposite ends of a lever 7 fulcrumed at 8 to the interior of the chamber 1 or the passages to both of the burners may be governed by a slide valve
55 as shown in Fig. 12 or other convenient valve as shown in Figs. 7, 8, 9 and 10 hereinafter more particularly described.

Projecting from the lever 7 is an arm 9 to the outer end of which is connected one end of a link 10 the other
60 end of the said link being connected to a lever 11 fulcrumed at 12 to the interior of the chamber 1 and provided at one end with a stud 13 to which is connected, by a rod 14 the bellows, or flexible diaphragm 15, on
65 phragm is preferably inclosed in a casing 16 and connect-

ed to and communicating with the interior of the chamber 1.

The rod 14 is provided with a collar or shoulder 17 between which and the bellows or flexible diaphragm is interposed a spring 18 the tension of which can be regu-
70 lated by a nut 19 screwed into the end of the rod 14 which projects to outside the bellows, or flexible diaphragm and through a concave washer or plate 44^a interposed between the nut 19 and the bellows or diaphragm so as to support and steady the said bellows, or
75 diaphragm, the said spring 18 also maintaining the diaphragm 15 in correct position against the said concave washer or plate 44^a. The pressure of gas entering the closed chamber 1 and acting on the bellows or diaphragm 15 causes through the rod 14 the lever 11 to
80 rock on its fulcrum 12 and raise the opposite end of the said lever which is screw threaded and provided with an adjustable weight 20 which can be adjusted to govern as required the pressure necessary to operate the valves
85 5 and 6. When the pressure of gas in the chamber 1 acting on the diaphragm 15 is sufficient to overcome the counterbalance weight 20 the lever 11 will be caused to rock on its fulcrum 12 and through the connecting link
90 10 and lever 7 open the valve 5 in the passage leading to the main burner 3 and close the valve 6 in the passage leading to pilot burner 4. When the pressure of gas in the chamber 1 is reduced the weight 20 will cause the lever 11 to rock on its fulcrum 12 in the opposite di-
95 rection and through the connecting link 10 rock the lever 7, close the valve 5 of the main burner and open the valve 6 in the passage leading to the pilot burner.

In Fig. 1 is shown an arrangement whereby the extent of travel of the lever 11 on the fulcrum 12 can be governed by means of an adjustable stop 12^a against
100 which a projection 11^a on the lever 11 comes into contact to arrest the descent of the tail end of the said lever when the pressure of gas is raised to light the lamp so that the difference between the lighting and extinguishing pressures can be altered as required; for instance it is obvious that the further the lever 11 moves on its ful-
105 crum 12 the more power the pressure of gas has on the diaphragm because the pin or stud 13 which connects the diaphragm to the lever moves more to one side of the fulcrum 12 of the lever and so by adjusting the stop 12^a the pressure for extinguishing the main burner can
110 be regulated without altering the pressure for lighting as the lever always returns to the same place for lighting. Clearance between the lower end of the valve spindles 5 and 6 and the lever 7 permits of the required play
115 necessary for the lever 11 in this arrangement of adjustment. Instead of or in addition to the adjustable weight 20 the pressure of the gas required to operate the valves may be regulated by varying as required the distance of the adjustable stud 13, to which the flexible
120 diaphragm 15 is connected, from the fulcrum 12 of the lever 11, and this adjustment of the stud 13 can be effected by turning the screw 21 in the screw thread on the stud 13 which is fitted to slide but prevented from
125 turning in an angular slot 22 in the end of the lever 11. Or the arrangement shown in Fig. 4^a may be employed in which arrangement an internal screw thread is provided in the stud 13 in which works a screw 21 attached at its inner end to the adjustable stud 13^a in which an ad-
130 justing screw 21^a works so that by means of the said screws 21 and 21^a the position of the stud 13 can be ad-

justed nearer to or further from the fulcrum 12 of the lever 11 so as to vary as required the pressure of the gas on the diaphragm necessary to operate the valves.

The gas passages from the chamber 1 to the burners 5 are provided with holes 23 through which the gas passes.

If the main burner 3 is required to be lighted at high pressure and to be retained alight while a low pressure is extinguishing other main burners and eventually to be extinguished at a reduced pressure preceded by a temporary high pressure there is suspended from the weighted arm of the lever 11 a swinging rod or plate 24 having thereon a lateral projection which when the lever arm 11 is raised by the gas pressure acting on the bellows, or diaphragm, passes up an outwardly inclined surface 25 of a piece 26 fixed in the interior of the chamber 1 and inclosed in an extension 27 connected thereto, the lateral projection on the swinging rod or plate rising above the upper end of the piece 26 so that when the pressure of gas is slightly reduced the lateral projection will descend into a notch or recess 28, the upper end of the said piece 26 to maintain the valve 5 open and the burner remains alight. To extinguish the burner the pressure is slightly increased so as to lift the lateral projection on the rod or arm 24 out of the recess or notch 28 which lateral projection will then swing to outside the notch or recess 28 so that when the pressure of gas is reduced the lateral projection will descend the opposite or straight side 29 of the piece 26 ready for relighting the burner, which is now extinguished by the descent of the lever 11 reversing the position of the valves 5 and 6.

It will be understood that some of the parts illustrated in Fig. 1 are not essential to all lamps and may be dispensed with according to requirements, for instance, if it be desired to light the main burner 35 when the gas pressure is raised and to extinguish the same when the gas pressure is first reduced, the swinging arm 24 and the adjustable stop 12^a are dispensed with, the adjustment for altering the difference between lighting and extinguishing pressures being made by the screw 21. In this case the end of the valve 6 would fit closely into the groove in the end of the lever 7, similarly as shown in respect to the valve 5. Or by dispensing with the screw 21 and the swinging arm 24 and making the stud 13 a fixture 45 in a position to make a given difference of pressure and having only the end of the valve 5 fitting loosely into the end of the lever 7, the end of the valve 6 resting upon the other end of the lever 7, the said main burner will light when the gas pressure is raised 50 and will be extinguished when the gas pressure is first reduced, the adjustment for altering the difference between lighting and extinguishing pressures being made by the adjustable stop 12^a. Or again, by dispensing with the adjustable stop 12^a, and retaining the screw 21, for altering the adjustment of pressure of the gas as aforesaid, and having the end of the valve 5 fitting into the end of the lever 7, the valve 6 resting upon the other end of the lever 7, the main burner of the lamp will light when the gas pressure is 60 raised and with the use of the swinging arm 24 and catch 26 the burner will be retained alight during the first reduction of pressure of the gas, the said main burner being eventually extinguished by a slight temporary increase of pressure and a subsequent reduction of pressure.

The fixed piece 26 may be provided with two or more notches or recesses in the upper end thereof, as shown in the detached view Fig. 2 or one or more notches in the lower end thereof as shown in Fig. 2^a so that one of a number of lamps or a series of lamps 70 of a number of series of lamps can be lighted leaving the other lamp or lamps of a series of lamps extinguished, or both lamps or the series of lamps of a number of series can be lighted and be kept alight if desired. The suspended rod or plate 24 carried by 75 the weighted lever is raised by the pressure of gas acting on the bellows or diaphragm which causes the lateral projection on the suspended rod to slide up the inclined side of the piece 26 and then by reducing the pressure of gas causes the lateral projection to 80 engage the first notch or recess in the upper end thereof so as to retain open the valve of the lamp or series of lamps required to remain alight, then, by again increasing the pressure of gas, the lateral projection will be again raised into position, then by 85 again reducing the pressure of gas the lateral projection will enter the next notch or recess in the upper end of the fixed piece 26 and retain open the valve for admitting the gas to the other lamp or lamps of the other series of lamps, then when it is desired to 90 extinguish the lamps the pressure of gas is again increased thereby causing the lateral projection on the swinging rod to pass out of the second recess so that on the pressure of gas being reduced the said projection on the swinging rod 24 will descend and through 95 the lever 11 to which the swinging rod is attached and the lever 7 carrying the valves 5 and 6 reverse the position of the said valves so as to extinguish the main burners of the lamps and open the valves of the pilot burners. 100

In the modification shown in Fig. 2^a the notch or recess 28 is in the lower end of the fixed piece 26 and the projection on the lower end of the rod or plate 24 is in the position ready for lighting. When the pressure is raised the projection on the rod 24 rises up 105 the inclined surface 25 of the fixed piece 26 till it passes over the point 25^x the lamp being then lighted. When pressure is lowered the external projection on the rod 24 descends the inclined surface 25^a and swings clear of the point 28^x against the stop 26^x. 110 The lamp is now out. If the pressure is again raised the lateral projection on the rod 24 rises into the notch 28 and prevents the lamp from lighting as it would otherwise do. When the pressure is again lowered the lateral projection descends and swings 115 clear of the point 28^a into the position for lighting the lamp. Obviously the fixed piece 26 may also be provided with notches at the top as shown in Fig. 2, as well as at the bottom, the object of a notch or notches in the top being to prevent the lamps going 120 out and the object of the notch or notches on the bottom of the fixed piece to prevent the lamp from lighting. One use of the notch or notches on the bottom of the fixed piece is as follows.—Say in a given town the lamps are lit at 8 o'clock in the evening at a pressure of 30 tenths. and are put out at a pressure of 15 tenths at midnight but at 5.30 in the morning in consequence of having to supply gas fires the pressure is raised higher than 30 tenths which was the lighting point, let us say to 40 tenths, this would 130

light all the street lamps if it were not for the arrangement of the fixed piece 26 with the notch or notches at the bottom.

Fig. 11 illustrates the hereinbefore mentioned qualifications, for retaining alight the main burner of the lamp while low pressure is extinguishing other main burners, in which the arm 24 with lateral projections 24^a thereon is rigidly connected to the lever 11 and the catch 26 is movable in respect thereto, the said catch being rigidly secured to a swinging arm 26^a fulcrumed at 26^b to the interior of the closed chamber 1.

Similar parts to those illustrated in Fig. 1 are marked with like letters of reference, and but for the difference that the arm 24 is rigid and the catch 26 is movable the operations are similar.

Fig. 3 illustrates an arrangement adapted both to light and to extinguish the main burner of the lamp by temporary high pressures of the gas; in combination therewith are shown stops and guards whereby any one of the number of lamps, or the lamps of any area of a number of areas of lamps, or one or more lamps of a cluster of lamps, can be separately lighted or extinguished. Referring, for the time being, to the first mentioned arrangement, *i. e.* lighting the main burner of the lamp at the first temporary high pressure of the gas, and (after the pressure of the gas has been reduced) extinguishing the said lamp at the next temporary increase of pressure, instead of attaching the valves 5 and 6 to a lever connected by a link 9 to the lever 11 to which the bellows or diaphragm is secured as hereinbefore described with reference to Fig. 1, the lever 7 which operates the valves 5 and 6 of the lamp may be mounted on the same pivot as a rocking lever 30 having therein a double inclined slot 31, 32, in which engages a pin or projection 33 on the upper end of a rod 24 which is connected at its lower end to an arm 34 of the weighted lever 11 which is pivoted at 12 to the interior of the chamber. The one end of the lever 11 which is connected to the bellows or flexible diaphragm is provided with an adjustable connection 13 in an inclined slot 22 like that described with reference to Fig. 1 the said connection being adjustable by means of a screw 21 nearer to or further from the fulcrum 12 of the lever 11 and so regulate the pressure required to operate the valve.

The projection 33 on the upper end of the rod 24 extends through the slot in the rocking lever 30 and when the rod 24 is raised by the pressure of gas acting on the bellows or flexible diaphragm the projection 33 will tilt the rocking lever 30 on its fulcrum 30^x until it has passed its center of gravity, whereupon it causes one of the projections 35 to suddenly act upon the lever 7 and turn it on its fulcrum so as to open or close (according to the direction in which the rocking lever is tilted) the valve 5 in the passage leading to the main burner of the lamp. When the rocking lever 30 is in the position shown in the drawing the valve 5 is opened, the projection 33 on the rod 24 being then in the portion 32 of the inclined slot in the rocking lever. To close the valve 5 the pressure of the gas is temporarily slightly increased so as to raise the projection 33 in the portion 32 of the inclined slot and tilt the rocking lever 30 on its fulcrum 30^x until it has passed its center of gravity and caused the projection 35 thereon to suddenly act upon the lever 7 to turn it on its fulcrum 30^x

so as to close the valve 5 of the passage leading to the main burner and opening the valve 6 of the passage leading to the pilot burner of the lamp. When the pressure of the gas is reduced the projection 33 on the rod 24 falls in the portion 31 of the inclined slot in the rocking lever 30, in a position to reverse the direction of the tilt of the said rocking lever when the rod 24 is again caused to be raised by the next temporary increase of gas pressure. Referring now to the combination of this arrangement with the stops and guards for the purpose hereinbefore mentioned, when it is desired to retain the main burner alight, while temporary increase of pressure is extinguishing other main burners, one or more stops such as 37 and guard 37^a may be provided, the said stop, or stops, 37 and guard 37^a preventing the projection 33 acting, for the time being, upon the portion 32 of the inclined slot in the rocking lever 30. Should it also be desired to retain the main burner extinguished while increase of pressure is lighting other main burners, a similar stop or stops such as 36, 36^a and guard 36^b may be provided, the said stops 36 and 36^a and guard 36^b similarly preventing the projection 33 from acting upon the portion 31 of the inclined slot in the rocking lever 30. The drawing illustrates by way of example, a lamp that is retained alight while a temporary slight increase of gas pressure has extinguished others, and eventually upon another temporary slight increase of pressure the said lamp is extinguished and the lamp is prevented from lighting until after one set of a series of lamps, and then another set of a series of lamps have been caused to be lighted by intermittent increases and decreases of gas pressure.

The parts being in the position as indicated in the drawing, to extinguish the light of the main burner the pressure of the gas is temporarily slightly increased (extinguishing other main burners) causing the projection 33 on the arm 24 to be raised above the stop 37 and against the guard 37^a and falling on the opposite side of the slot 37 upon the pressure of the gas being reduced. When the pressure of the gas is again temporarily increased the projection 33 will be caused to rise and tilt the rocking lever 30 on its fulcrum 30^x until the said lever has passed its center of gravity and consequently falling causes the projection 35 thereon to suddenly act upon the lever 7 and turn it on its fulcrum 30^x to close the valve 5 of the passage leading to the main burner 3 and open the valve 6 in the passage leading to the pilot burner 4 of the lamp. Upon the reduction of the pressure of the gas the projection 33 on the rod 24 falls into the portion 31 of the inclined slot of the rocking lever 30 in proximity to, or bearing against the stop 36.

To light the main burner 3 of the lamp, after two sets of lamps have been lighted, the pressure of gas is temporarily increased (causing the first required set of lamps to be lighted) so as to raise the rod 24 and cause the projection 33 thereon to pass above the stop 36 and against the guard 36^b. Upon the pressure of the gas being reduced the arm 24 falls, and the projection 33 thereon bears against the second stop 36^a. On again increasing the pressure of the gas, (thereby lighting the second required set of lamps) the projection 33 will pass above the stop 36^a and against the guard 36^b and fall on the rearward side of the said stop

36^a when the pressure of the gas is again reduced. The arm 24 is now in a position that on the next increase of the pressure of gas the said projection 33 will tilt the rocking lever 30 into the position shown in the drawing and thereby through the lever 7 reverse the positions of the valves 5 and 6 the passage leading to the main burner of the lamp being then opened and the passage to the pilot burner closed.

Instead of the lever 11 provided with an adjustable counter pressure weight as hereinbefore described there may be substituted therefor a spring 38 as shown in Fig. 4 the said spring being connected at one end to a boss 13^b on a stud 13^c adjustable on a screw 21^b. The said screw 21^b is carried in a bracket attached to the stud 13, the latter stud being adjustable on the lever 11, and connected to the bellows or diaphragm 15 by the rod 14 as hereinbefore described. By the use of this combination of adjustable stud connections the differences in the gas pressures required to light and to extinguish the main burners of the lamp may be regulated to any desired degree. When the stud 13^c carrying the boss 13^b to which the end of the spring 38 is connected is near the fulcrum 12 of the lever 11 the lamp is lighted at say 20 tenths and is extinguished at 10 tenths, and when the said stud 13^c is further from the said fulcrum 12 the lamp is lighted at say 70 tenths and is extinguished at say 60 tenths.

For permanently adjusting or setting the tension of the spring 38 to suit the various working pressures used in different districts the opposite end of the said spring is or may be provided with or connected to a screw 39 passing through a fixed part 40 in the closed chamber 1 and provided with a nut 41 by means of which the tension of the spring can be increased or decreased according to the pressure of gas required to operate the valves.

The bellows or flexible diaphragm 15 and the inclosing casing 16 may be connected to the closed chamber 1 in the manner shown in Figs. 1 and 4 the said connection comprising a socket 42 screwed into an opening in the said closed chamber into which socket 42 is screwed a hollow ferrule 43 between the flange 44 of the ferrule 43 and the flange 45 on the socket 42 are interposed the edges of the opening in the casing 16 and of the bellows or flexible diaphragm 15 so that by screwing the ferrule 43 into the socket 42 the bellows and its casing will be securely connected to the closed chamber 1.

Figs. 13 and 14 show in part sectional elevation and plan respectively a preferred arrangement for connecting the said bellows or flexible diaphragm 15 and its inclosing casing 16 to the closed chamber 1. An externally screwed ferrule 43 with flattened parts 43^a has a flange 44 over which flange is stretched the bellows or flexible diaphragm 15. In the top of the upper portion of the inclosing casing 16 is a hole, of a size equal to and conforming in shape to the cross section of the screwed ferrule 43 with its flattened parts, permitting the said ferrule entering but preventing the same from turning therein, so that when the upper portion of the casing 16 is placed in position over the bellows or flexible diaphragm 15 and a washer 43^b with a suitably shaped hole superposed, the whole can be locked securely together by a clamping nut 45^a, leav-

ing a portion of the screwed ferrule 43 protruding which can be screwed into the opening in the closed chamber 1. By this arrangement the inclosing casing 16 can be used as a means for turning the screwed ferrule 43 for connecting to, or disconnecting from, the closed chamber 1, consequently obviating the need of a spanner, the liability of twisting of the bellows or diaphragm 15, or the interference of the adjustment thereof, being prevented by the flattened parts 43^a, of the screwed ferrule 43 engaging the correspondingly shaped holes in the inclosing casing 16 and washer 43^b. Or instead of connecting the bellows in the manner described the said bellows may be connected to its casing by adhesive material so as to be capable of being readily detached when required. The casing 16 may be made in two parts separable one from the other to afford ready access to the bellows without detaching the casing from the chamber 1.

To the casing 16 may be connected a pipe 46, Fig. 5, leading up to the pilot burner 4 so that in the event of the bellows 15 becoming leaky gas will pass through the pipe 46 and be automatically ignited by the pilot burner thereby notifying that the said bellows is defective.

In Fig. 6 is shown an arrangement of tubes for maintaining the apparatus warm in cold climates which arrangement comprises circulation pipes 47, 48 connected to the casing 16 and leading therefrom up to the pilot burner 4 round which the pipe 48 is arranged as a coil 49 and passes thence to the flame of the main burner 3 so that heat is transmitted from the pilot or the main burner to the air circulating through the pipes 47, 48 and thus maintains the apparatus warm. The circulation is produced by the action of the heat from the by pass burner or main burner on the upper end.

Figs. 7 to 10 show the modified arrangement hereinbefore referred to wherein a single rotary disk valve is employed for opening and closing the passages leading to the main burner and pilot burner of the lamp. Fig. 7 being a side view of the weighted lever 11 carrying the rotary disk valve 12^c; Fig. 8 is a cross sectional view of the closed chamber 1 showing the said rotary disk valve in position therein, Fig. 9 is a face view of the seating for the disk valve 12^c, showing the passage 5^a, and 6^a leading to the main burner and pilot burners respectively, and Fig. 10 is a face view of the rotary disk valve showing the ports 5^b and 6^b. The weighted lever 11 is rigidly secured to a spindle 12 suitably mounted in the casing 1, the said spindle having a square or other suitably shaped portion upon which is mounted, and turns therewith the rotary disk valve 12^c. The said rotary disk valve is slidable along the squared portion of the spindle 12, and is kept in sufficiently close contact with its seating by a spring 12^d interposed between the said valve and the weighted lever 11. It is obvious that when the said weighted lever is down, as shown in these detail figures, the port 6^b in the rotary disk valve 12^c is coincident with the passage 6^a in the closed chamber 1 leading to the pilot burner of the lamp, and the said rotary disk has closed the passage 5^a leading to the main burner of the lamp; and when the said weighted lever 11 is raised the port 5^b in the said rotary disk valve is then coincident with the passage 5^a of the closed chamber 1 leading to the main burner

of the lamp and the said rotary disk has closed the passage 6^a leading to the aforesaid pilot burner of the lamp.

Fig. 12 illustrates a further modification of a single slide valve for opening and closing the passages leading to the main and pilot burner of the lamp. The weighted lever 11 being in the position shown in the drawing, the passage 6^a leading to the pilot burner of the lamp, is open to the interior of the closed chamber and the passage 5^a, leading to the main burner of the lamp, is closed; when the said weighted lever is caused to be raised on its fulcrum 12 it slides through a friction roller 12^f, the valve 12^e on its seating opening the passage 5^a leading to the main burner and closing the passage 6^a leading to the pilot burner.

We are aware that it has already been proposed to operate the valves of main and pilot burners of gas lamps, to cause the said burners to be alternately lighted and extinguished by varying the pressure of the gas, and that such apparatus have been provided with (1) a bell or diaphragm in combination with lever mechanism, (2) a spring or a balance weight adjustably screwed to the end of a lever for determining the operating pressure, (3) cams in connection with a projection on a reciprocating piece for controlling the movements of the bell (4) a swinging rod mounted on a bell to operate a notched rocking lever controlling the gas valves, and we do not broadly claim any of these features generally or apart from our improvements.

What we claim as our invention and desire to secure by Letters Patent is:—

1. An apparatus of the class described comprising a gas chamber having a gas supply inlet, a main and a pilot burner connected to said chamber, a valve controlling the passage to each burner, a rocking lever adapted to open and close said valves in alternation, adjustable reacting means acting upon said lever tending to keep the valve of the main burner normally closed, and a flexible expansible element having connections for overcoming the tension of said reacting means to positively rock said lever and reverse said valves on increase of pressure within the chamber, substantially as described.

2. An apparatus of the class described comprising a gas chamber having a gas supply inlet, a main and a pilot burner connected to said chamber, a valve controlling the passage to each burner, a rocking lever adapted to open and close said valves in alternation, a second rocking lever having a link connection with said first named lever, adjustable reacting means tending normally to rock said levers in one direction and to keep the valve of the main burner normally closed, and an expansible diaphragm connected to said second lever and adapted under pressure of gas to rock said levers against the force of the reacting means, substantially as described.

3. An apparatus of the class described comprising a gas chamber having a gas supply inlet, a main and a pilot burner connected to said chamber, a valve controlling the passage to each burner, a rocking lever adapted to open and close said valves in alternation, a second rocking lever having a link connection with said first named lever, adjustable reacting means tending normally to rock said levers in one direction and to keep the valve of the main burner normally closed, and an expansible diaphragm, an adjustable connection between said second lever and expansible diaphragm, substantially as described.

4. An apparatus of the class described comprising a gas chamber having a gas supply inlet, a main and a pilot burner connected to said chamber, a valve controlling the passage to each burner, a rocking lever adapted to operate said valves in alternation, a second rocking lever having a link connection to said first named lever, a weight adjustably mounted on one arm of said second lever and

tending to rock said lever to keep the main burner normally closed, an expansible element adapted to be operated by increase of pressure within the chamber to rock said second lever against the action of the weight, and a connection between said second lever and expansible element, substantially as described.

5. An apparatus of the class described comprising a gas chamber having a gas supply inlet, a main and a pilot burner connected to said chamber, a valve controlling the passage to each burner, a rocking lever adapted to operate said valves in alternation, a second rocking lever having a link connection to said first named lever, a weight adjustably mounted on one arm of said second lever, an expansible element adapted to be operated by increase of pressure within the chamber to rock said second lever against the action of the weight, and a connection between said second lever and expansible element, and an adjustable stop for limiting the movement of said second lever, substantially as described.

6. An apparatus of the class described comprising a gas chamber having a gas inlet, a main and a pilot burner connected to said chamber, valves controlling the passages to said burners, a rocking lever adapted to open and close said valves in alternation, reacting means tending normally to close the valve to the main burner and open that to the pilot burner, an expansible diaphragm adapted under pressure of gas in said chamber to overcome the action of said reacting means, and a check device comprising a swinging element connected to one of the movable parts and a fixed element, one of said elements having a notch and the other a projection adapted to rest in said notch to permit a variation in pressure without corresponding movement of the valves, substantially as described.

7. An apparatus of the class described comprising a gas chamber, having a gas supply inlet, a main and a pilot burner connected to said chamber, valves controlling the passages to said burners, a rocking lever arranged to open and close said valves in alternation, a pivoted lever having a link connection to said first named lever and having a horizontally extended arm, a weight adjustably mounted on said arm, a diaphragm arranged to be operated by pressure of gas within the chamber and operatively connected to said second named lever, a rod depending from the free end of said horizontally extended arm, and having a lateral projection, a vertical plate arranged in the path of said projection and having an inclined side and notched upper end, and a deflecting element arranged over said notched upper end and having inclined deflecting surfaces, substantially as described.

8. In an apparatus of the class described, a gas chamber having a gas inlet, main and pilot burners connected therewith, valves controlling the passages to said burners, reacting means located within the chamber tending normally to close the valve to the main burner and open that to the auxiliary burner, a casing, a flexible diaphragm located in said casing, means connecting both said casing and diaphragm to the gas chamber, and connections between said diaphragm and reacting means whereby expansion of gas in the chamber overcomes said reacting means and reverses the valves, substantially as described.

9. In an apparatus of the class described, a gas chamber having a gas inlet, main and pilot burners connected therewith, valves controlling the passages to said burners, reacting means located within the chamber tending normally to close the valve to the main burner and open that to the auxiliary burner, a casing secured to the gas chamber and communicating therewith, an expansible element within the casing and arranged to be expanded by the pressure of gas in the chamber, connections whereby the expansion of said element shifts the valves against the action of the reacting means, and a gas pipe connecting with said casing and terminating in lighting proximity to one of the burners for indicating leakage in the expansible element, substantially as described.

10. In an apparatus of the class described, a gas chamber having a gas inlet, main and pilot burners connected therewith, valves controlling the passages to said burners, reacting means located within the chamber tending nor-

5 mally to close the valve to the main burner and open that to the auxiliary burner, a casing secured to the gas chamber and communicating therewith, an expansible element within the casing and arranged to be expanded by the pressure of gas in the chamber, connections whereby the expansion of said element shifts the valves against the action of the reacting means, and means for circulating heated air in proximity to said parts for keeping them warm in cold weather, substantially as described.

In testimony whereof we have hereunto signed our 10 names to this specification in the presence of two subscribing witnesses.

EDMUND HARRY ELTON.
RICHARD STEPHENS.

Witnesses:

I. L. OSBORN,
E. M. TOLERTON.