(No Model.)

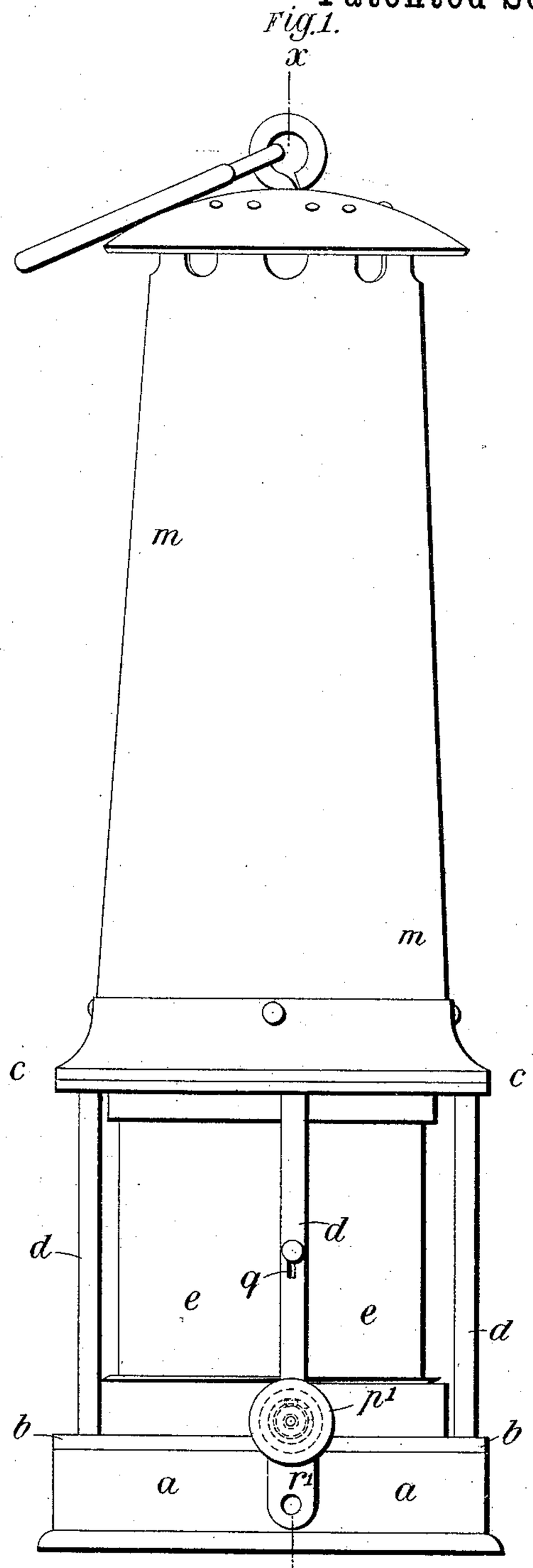
5 Sheets—Sheet 1.

# J. THORNE.

## SAFETY LAMP.

No. 437,061. Patented Sept. 23, 1890.

*Fig. 1.*

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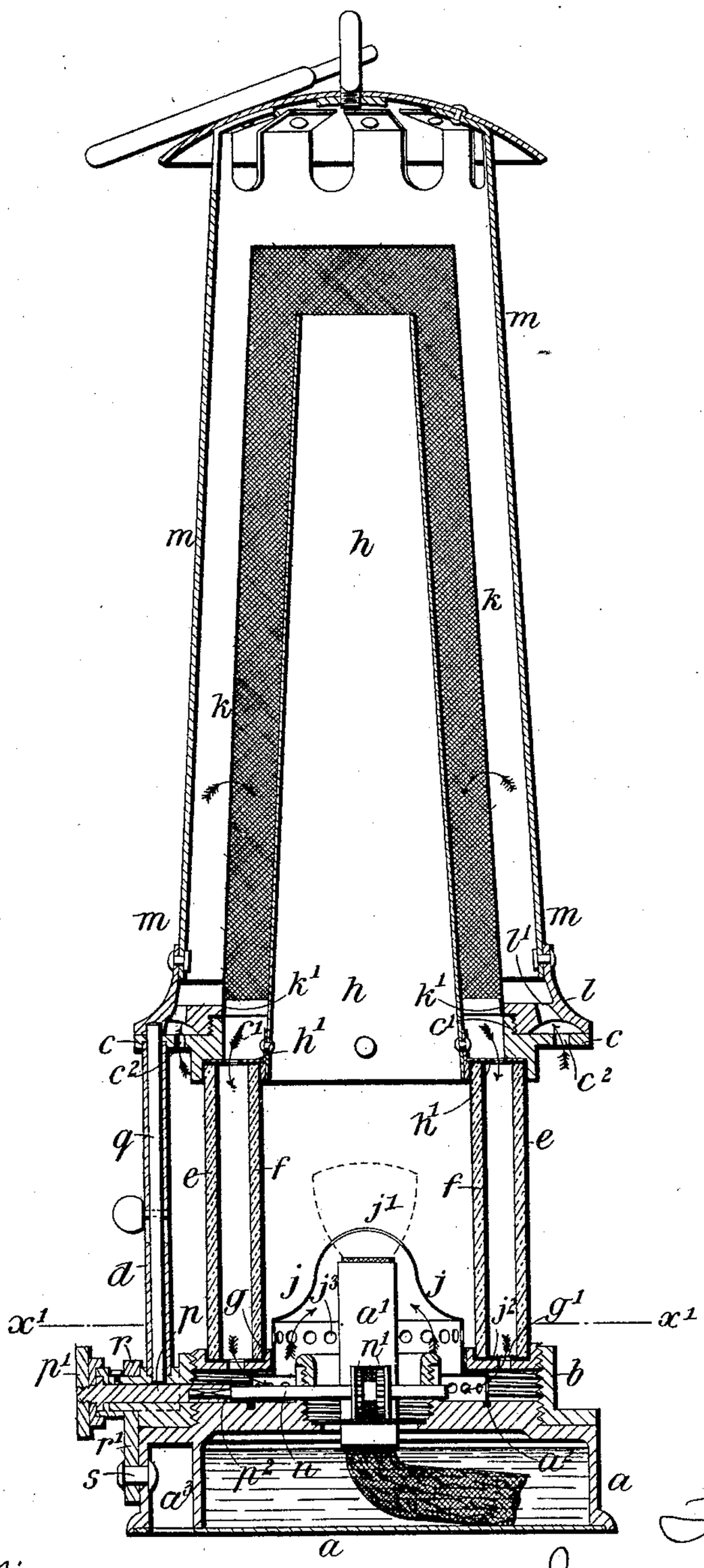
(No Model.) 5 Sheets—Sheet 2.

# J. THORNE.

## SAFETY LAMP.

No. 437,061. Patented Sept. 23, 1890.

*Fig. 2.*

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(No Model.)

5 Sheets—Sheet 3.

# J. THORNE.

## SAFETY LAMP.

No. 437,061.

Patented Sept. 23, 1890.

*Fig. 3.*

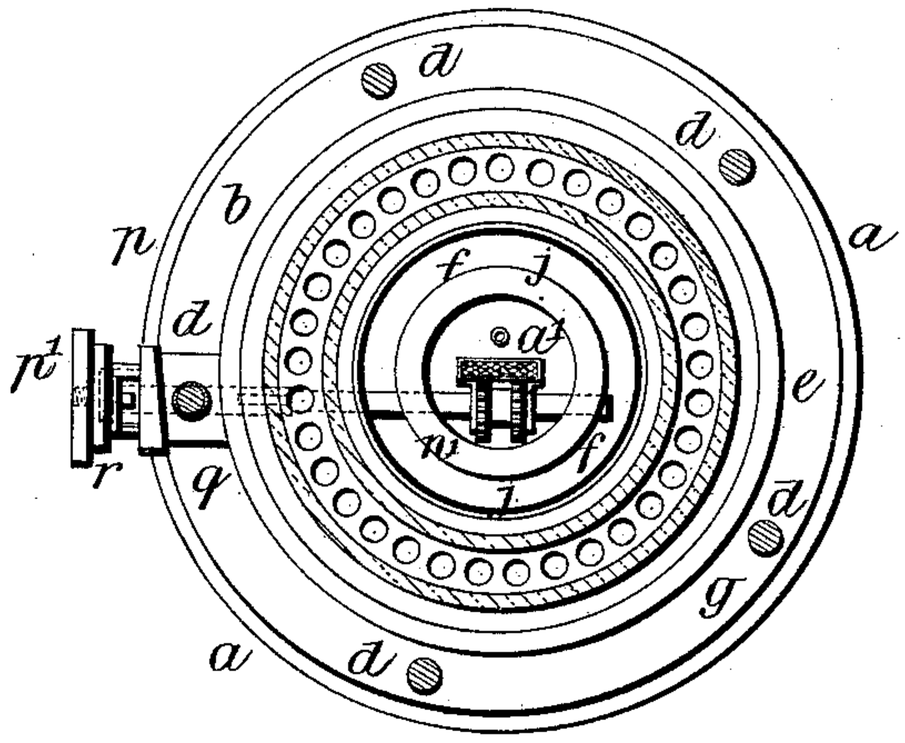
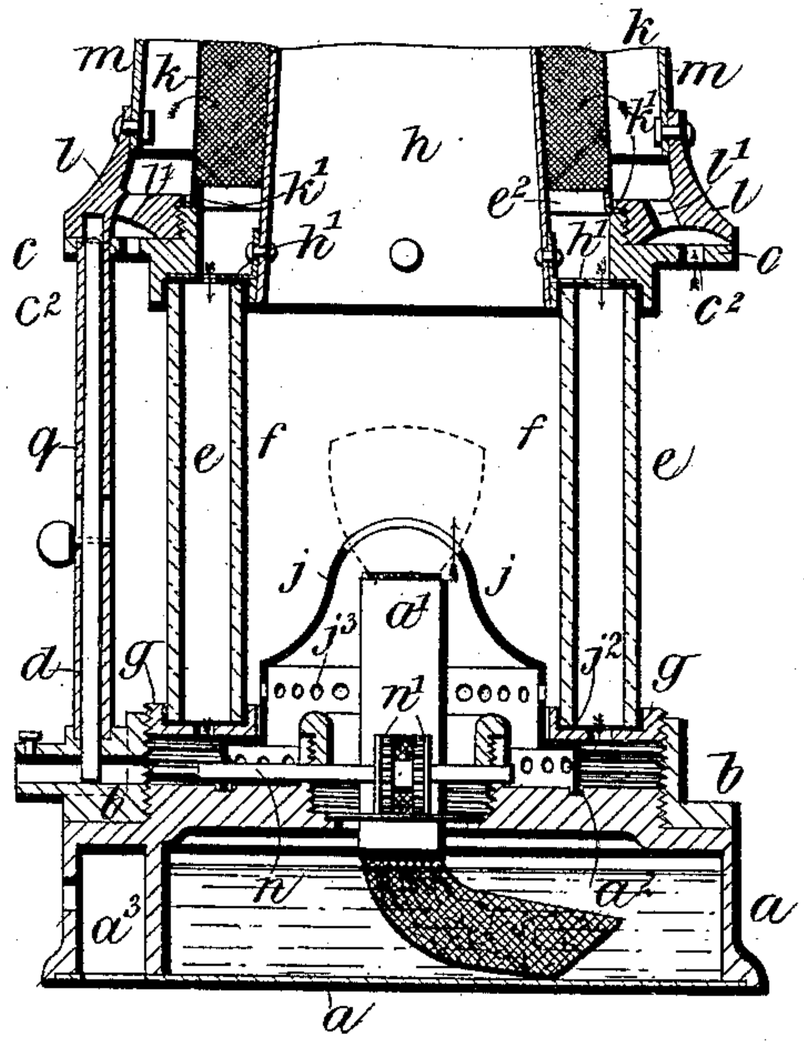



*Fig. 4.*

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(No Model.) 5 Sheets—Sheet 4.

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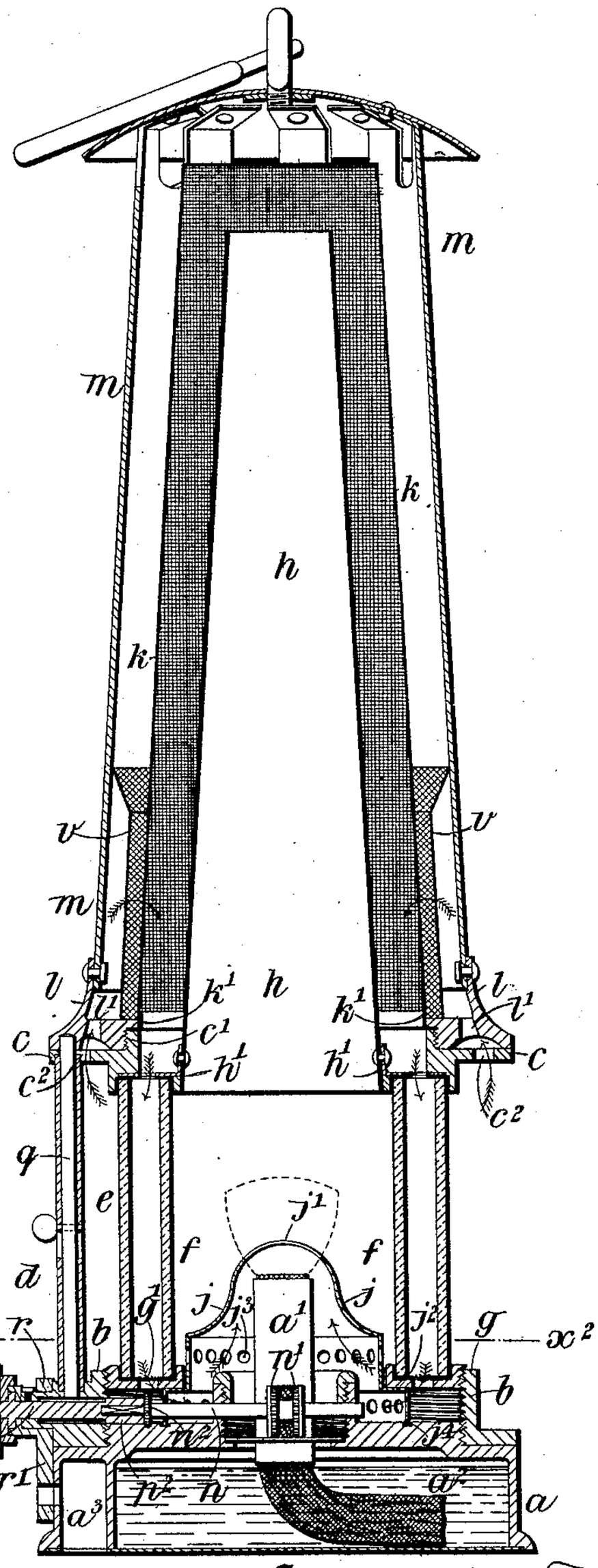
## SAFETY LAMP.

No. 437,061. Patented Sept. 23, 1890.

*Fig. 5.*




*a*

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(No Model.)

5 Sheets—Sheet 5.

# J. THORNE.

## SAFETY LAMP.

No. 437,061. Patented Sept. 23, 1890.

*Fig. 7.*

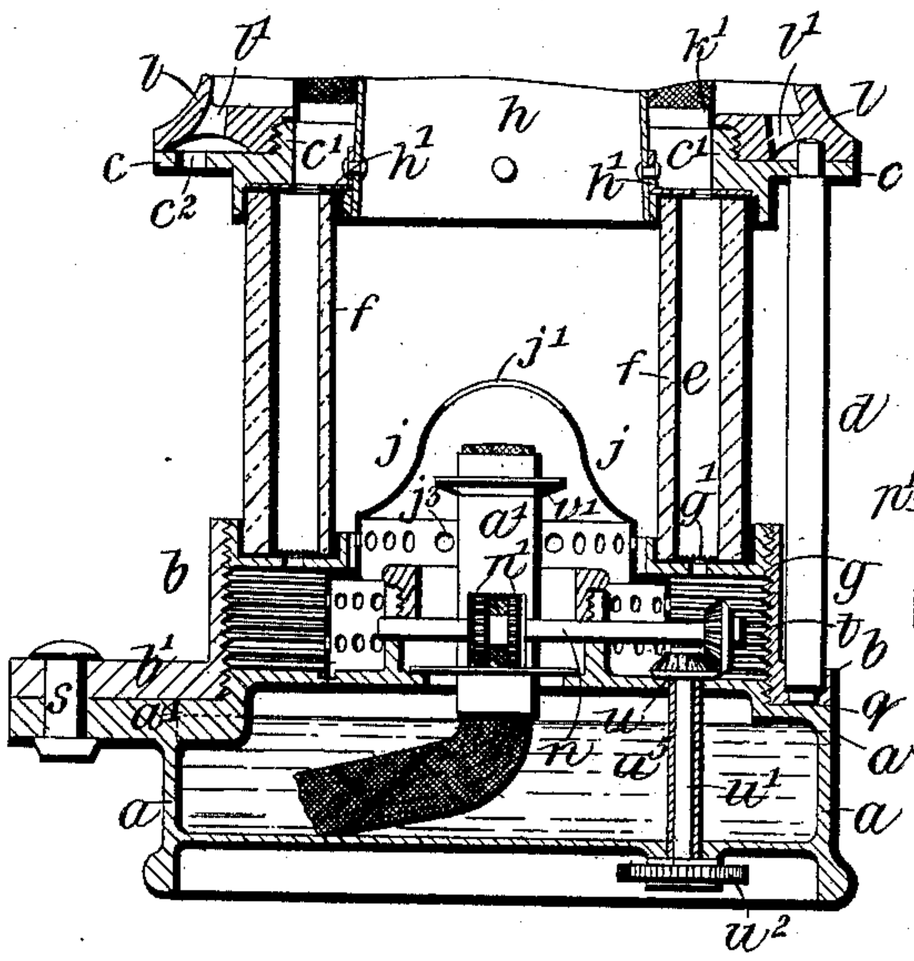



*Fig. 6.*

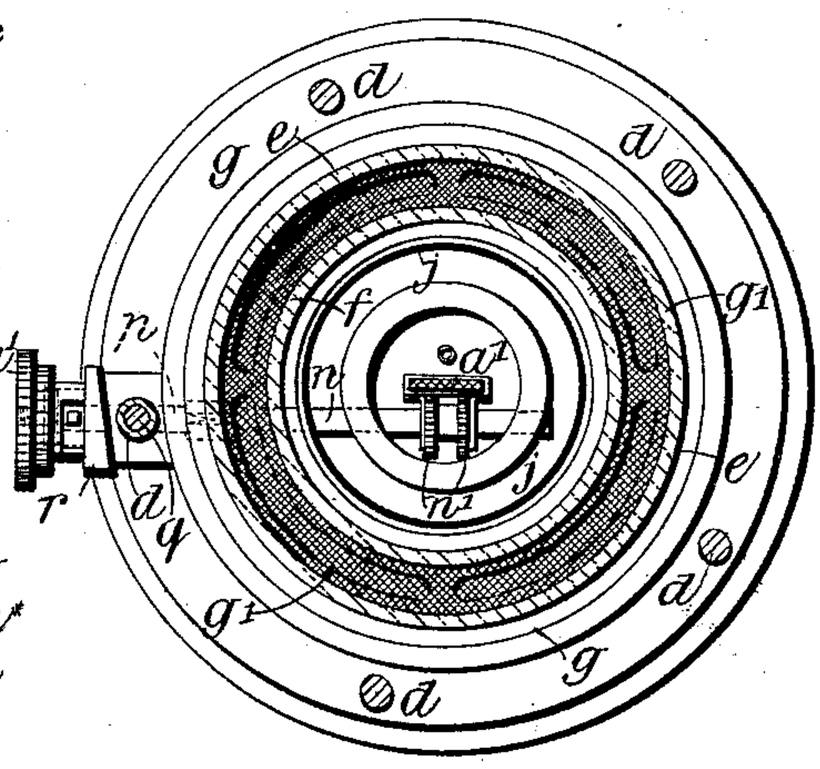
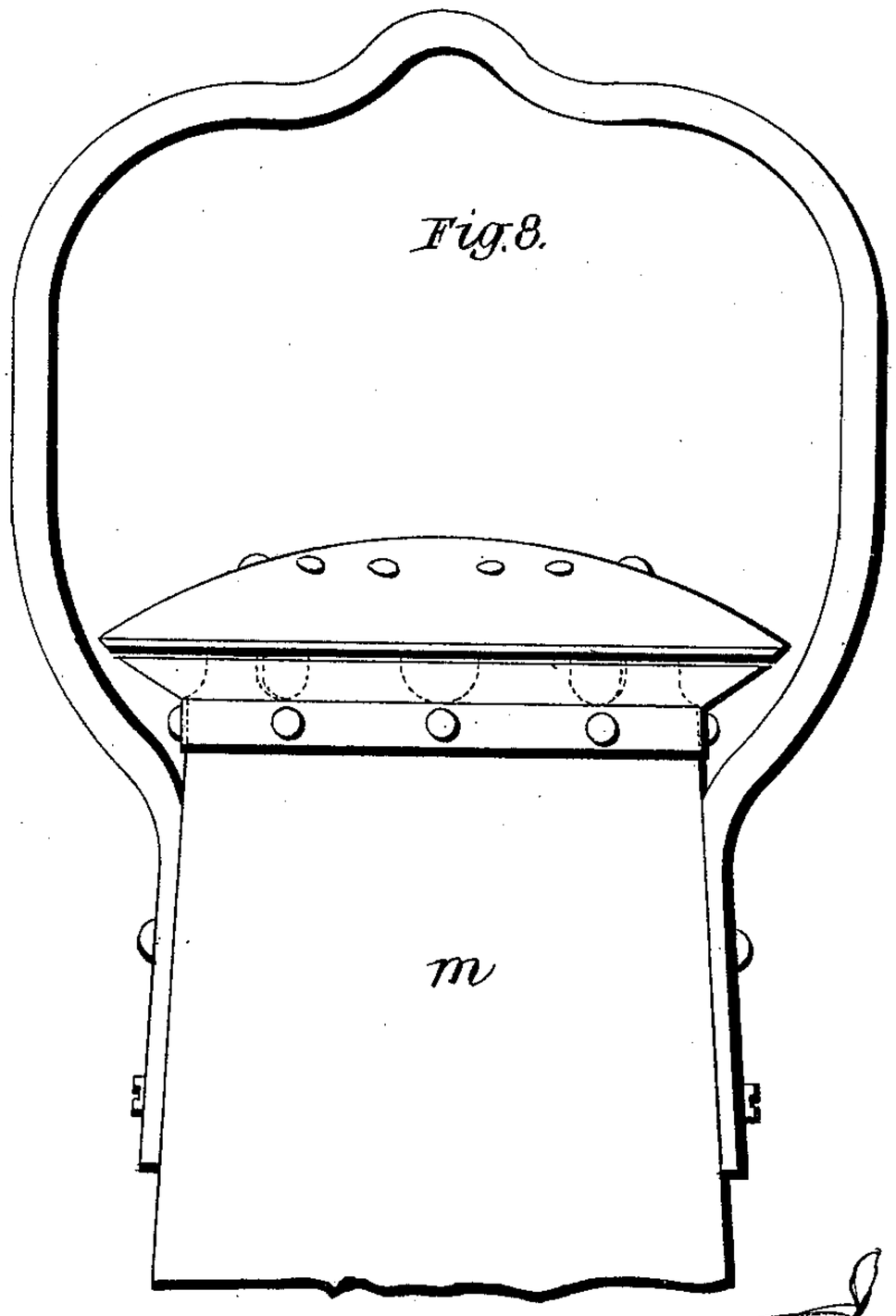



*Fig. 8.*

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# UNITED STATES PATENT OFFICE.

JAMES THORNE, OF LONDON, ENGLAND.

## SAFETY-LAMP.

SPECIFICATION forming part of Letters Patent No. 437,061, dated September 23, 1890.

Application filed January 25, 1890. Serial No. 338,160. (No model.) Patented in England February 16, 1889, No. 2,779.

*To all whom it may concern:*

Be it known that I, JAMES THORNE, a subject of the Queen of Great Britain, and a resident of London, England, have invented certain new and useful Improvements in Safety-Lamps, (for which I have obtained a patent in Great Britain, No. 2,779, bearing date February 16, 1889,) of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to safety-lamps; and its chief objects are to provide for increasing the illuminating-powers of such lamps and to obviate more effectually than heretofore the liability to explosions of fire-damp in coal-mines.

One of the most important features of my said invention is the construction of the lamp in such a manner that I am enabled to employ therein with great advantage a lamp-cone—that is to say, a conical or other suitably-shaped casing—which surrounds the wick-tube or burner of the lamp, and which is formed with an elongated aperture for the passage of the flame of the lamp and with suitable orifices around its base for the supply of air. This lamp-cone concentrates the flow and increases the supply of air to the flame, and thus promotes the combustion of the illuminant, so that very heavy mineral oils can be used in the lamp, and the lamp will give a bright steady light, which will be comparatively unaffected either by strong currents of air in which it may be used or by dust or by the ordinary handling of the lamp or by the inclination thereof, but which can nevertheless be very readily extinguished, if necessary, without opening the lamp.

I am aware that attempts have heretofore been made to construct safety-lamps with ordinary lamp-cones and with other devices for deflecting or concentrating the air supplied to the flame, so that mineral oils might be advantageously used in such lamps.

In my improved lamp provision is made for so directing and controlling the flow of the air requisite for supporting combustion that it must pass through wire-gauze, then downward between two hollow glass concentric cylinders, then through a horizontal perforated metal plate arranged beneath the said glass cylinders, and then upward within and through the said lamp-cone. In cases where the lamp has to be used in mines where the velocity of the air-currents is great—or, say, over twenty feet per second—I provide my lamp with an annular piece of wire-gauze above or below the said perforated plate, so that any back current or draft must pass through the annular piece. The liability to ignition of the fire-damp in a mine by back-draft from the lamp is thus obviated. In some cases two wire-gauze rings may be employed—one above and the other below the glass cylinders. I also provide a taper chimney or flue for the escape of products of combustion. This chimney or flue extends upward within the metal cap or bonnet nearly to the top thereof. Therefore the ingress for the supplied air and the egress for products of combustion, although both in the upper part of the lamp, are nevertheless separate and distinct from each other.

Another important feature of my said invention is the construction of the lamp so that the oil-reservoir or base and the upper part thereof, comprising the ordinary metal cap or bonnet and the ordinary wire-gauze cylinder or cylinders, can be readily removed to permit the cleaning of the inner glass cylinder and the metal chimney or flue, or for other purposes, without disturbing the joints at the top and bottom of the said glass cylinders. Moreover, by reason of the improved construction of my lamp, it is self-extinguishing in an explosive mixture of fire-damp and air, any inflammable mixture entering the lamp-cone being ignited by the flame of the lamp and consumed before it reaches the chimney, and the said flame and that of the inflammable mixture so ignited being automatically extinguished without the possibility (under any circumstances at all likely to occur in the working of coal) of igniting the inflammable mixture outside of the lamp, even when this mixture is passing at a high velocity.

Another feature of my said invention is the provision of improved devices, hereinafter described, for locking the lamp, which devices are so arranged that the various parts of the

lamp must be properly fitted and secured together before the lamp can be locked.

My said invention, moreover, comprises other improvements, hereinafter described.

In the accompanying drawings I have shown how my said invention may be conveniently and advantageously carried into practice.

Figure 1 is an elevation of one form of my improved lamp. Fig. 2 is a vertical section on the line *x x*, Fig. 1, the lamp being shown locked. Fig. 3 is a horizontal section on the line *x' x'*, Fig. 2. Fig. 4 shows a portion of Fig. 2, the lamp being shown unlocked, as hereinafter described. Fig. 5 is a vertical central section, and Fig. 6 a horizontal section on the line $x^2$ $x^2$, Fig. 5, illustrating various modifications of my invention. Fig. 7 is a vertical central section illustrating further modifications thereof. Fig. 8 shows a device for preventing the inrush of air at the top of the lamp.

Like letters of reference indicate corresponding parts throughout the drawings.

*a* is the oil-reservoir, which forms the base of the lamp. The frame of the lamp comprises upper and lower rings or annular pieces *b c*, firmly connected by means of rods or pillars *d*, or the said rings may be connected by other suitable means. The lower ring *b* is screwed upon the oil-reservoir *a* in such a manner that it can be readily unscrewed therefrom, except when the lamp is locked, as hereinafter described. Between the said rings or annular pieces *b c* are firmly secured two hollow glass cylinders *e f*, one of which is arranged within the other, a suitable annular space being left between the said cylinders for the passage of air, as hereinafter described.

The ends of the said cylinders are ground truly parallel, and the said cylinders are securely held in place by a perforated ring or annular plate *g*, screwed into the lower ring *b* of the lamp-frame, washers, of asbestus or other suitable material, being placed at the ends of the said glass cylinders to insure tightness of the joints.

The lamp is provided with a long conical or taper chimney or flue *h*, with a comparatively small aperture at the top. This chimney or flue is made with a perforated flange *h'*, whereby it is securely held between the upper ends of the glass cylinders and the upper ring or annular piece *c* of the lamp-frame. The perforations in the said flange of the chimney and those in the annular plate *g* at the lower end of the glass cylinders open into the annular space between the said glass cylinders. The said chimney should be suitably proportioned to produce the requisite draft through the lamp without permitting the passage of flame into the wire-gauze cylinder.

The lamp-cone *j* is placed upon the oil-reservoir *a*, and surrounds the wick-tube or burner *a'*. The lower edge of the said cone is preferably fitted into a circular groove $a^2$ in the top of the oil-reservoir. The said cone is similar to those usually employed in petroleum-lamps, having formed in its upper end a central elongated hole *j'*, through which the flame of the lamp will pass; but the said cone is made with a shoulder or flange $j^2$, against which bears the inner edge of the annular plate *g* when the parts of the lamp are fitted together, thus firmly holding the said cone in its place. Beneath the said shoulder or flange the said cone is perforated to permit the passage into the same of the air requisite for supporting the combustion of the illuminant. In order to increase the supply of oxygen to the flame just after it has been lighted and before a draft has been created down between the cylinders *e* and *f*, I provide the cone with an annular series of perforations $j^3$, located within the inner cylinder *f*, and whereby the oxygen contained within the said cylinder is utilized while the downdraft between the glass cylinders is being created. The combustion of the illuminant is greatly increased by the said lamp-cone, so that a strong bright light will be produced, which, by reason of the rapid flow of air between the flame and the edge of the elongated hole *j'* in the said cone, will not be materially affected by the ordinary rough handling of the lamp.

When it is desired to withdraw the glass cylinders for cleaning or other purposes, the said annular plate *g* must be removed from the lower ring or annular piece *b*. It is not, however, necessary to remove the said annular plate or disturb the joints at the ends of the glass cylinders in order to trim or clean the lamp, as access to the wick-tube or burner *a'* and also to the interior of the chimney can be readily obtained by unscrewing the oil-reservoir from the lower ring *b*.

*k* is a wire-gauze cylinder which is placed over and around the metal chimney or flue *h*. This cylinder is formed with a flange *k'* at its lower end, whereby it is clamped between a screw-threaded extension *c'* of the upper ring or annular piece *c* and a flanged ring *l*, which is screwed thereon, so that it can be readily detached therefrom except when the lamp is locked, as hereinafter described. By this arrangement the wire-gauze cylinders can be readily removed and replaced without disturbing the aforesaid glass cylinder. The said flanged ring *l* has firmly secured thereto the metal cap or bonnet *m*, which incloses the wire-gauze cylinder *k*.

The upper ring or annular piece *c* of the lamp-frame is perforated with a circular series of holes $c^2$, and the said flanged ring *l* is formed with suitable apertures *l'*. The air for supporting combustion enters through these holes in an upward direction between the metal cap or bonnet *m* and the wire-gauze cylinder *k*. It then passes through the wire-gauze and downward through the holes in the flange *h'* of the metal chimney or flue *h* and between the two glass cylinders *e f*, then through the perforated annular plate *g*, and into and through the lamp-cone *j*.

The air is conducted by the lamp-cone di-

rectly to the flame of the lamp. Therefore any inflamable mixture of fire-damp and air entering the lamp will burn and cause an elongation of the flame of the lamp, thus indicating the presence of danger; or should there be sufficient fire-damp mixed with the air to form an explosive mixture it will explode within the lamp-cone with just sufficient force to extinguish the flame, so that no gas will be left burning within the lamp, and an explosion cannot be caused by the lamp under any circumstances likely to occur in the working of coal.

For adjusting the wick a spindle *n*, provided with one or more toothed or roughened wheels *n'*, is employed. The spindle extends through one side of the lamp-cone *j*. A spindle *p*, provided with a milled head *p'* and with a socket $p^2$, is passed through a hole in the lower ring *b* of the lamp-frame and engages with the spindle *n*, so that the wick can be adjusted or the flame extinguished from the lamp without the necessity for opening the same.

To provide for securely locking the parts of the lamp when properly fitted together, so that the opening of the lamp cannot be effected without the certainty of detection, the following devices are employed, viz: One of the pillars *d* of the lamp-frame is made hollow or tubular and a bolt *q* is fitted therein and is adapted to enter a hole in the flanged ring *l*, forming the base of the metal cap or bonnet *m*, thus preventing the unscrewing of the said ring and cap or bonnet from the upper ring *c* of the lamp-frame. The said bolt is arranged, as shown, directly above and at right angles to the hole formed in the lower ring *b* for the reception of the spindle *p* of the wick-adjusting device, so that when this spindle is in place the said bolt *q* cannot be withdrawn from the flanged ring or base *l* of the cap or bonnet *m*. Moreover, by reason of the engagement of the said spindle *p* with the spindle *n*, the lower ring *b* of the lamp-frame cannot be unscrewed from the oil-reservoir *a* until the said spindle *p* is withdrawn. It will therefore be seen that the parts of the lamp must be properly fitted together and the bolt *q* caused to engage with the flanged ring *l* before the hollow spindle *p* can be inserted. I sometimes provide the spindle *p* with a pin or stop for preventing its complete withdrawal from the ring *b*, thus avoiding loss of the said spindle.

Any suitable device is provided for preventing the unlocking of the lamp except by an authorized person. A convenient device for this purpose consists of a bayonet-joint in which the spindle *p* is fitted to rotate, but is restrained from endwise movement. The movable part *r* of this bayonet-joint is provided with an arm *r'*, having a hole formed therein. A corresponding hole is formed in the part $a^3$ of the oil-reservoir or base *a* of the lamp in such a position that when the said bayonet-joint is closed a lead rivet *s* can be passed through these two holes and secured therein by clinching or sealing in the ordinary manner, thus preventing the opening of the said bayonet-joint without destruction of or injury to the said rivet or seal. Other devices may, if desired, be used for fastening the said bayonet-joint in the closed position.

I find it advantageous, as before mentioned, to provide my lamp with a horizontal ring or annular piece *g'*, Fig. 5, of wire-gauze, beneath the glass cylinders *e f*. This ring is secured between the said glass cylinders and the perforated ring or annular plate *g*, as shown. In some cases a horizontal ring of wire-gauze may be employed above as well as below the said glass cylinders. If desired, the lamp-cone *j* is connected by a hinge-joint $j^4$ to the oil-reservoir *a*, as shown in Fig. 5.

In some instances I provide a shield or guard *v*, of wire-gauze, in the lower end of the metal cap or bonnet *m*, as shown in Fig. 5, to prevent the too rapid ascent of the air entering the cap or bonnet *m* through the holes in the ring *l;* or in place of the said shield or guard I employ a ring of wire-gauze secured within the metal cap or bonnet and surrounding the wire-gauze cylinder *k* or any other equivalent device.

The metal chimney or flue is preferably made taller than those heretofore employed in ordinary safety-lamps and of the taper or conical form shown in the drawings, in order to increase the draft and consequently the illuminating-power of the lamp and the steadiness of the flame.

I sometimes make the wire-gauze cylinder so that it extends above the lower edges of the lateral apertures at the top of the bonnet *m*, as shown in Fig. 5. I am thus enabled to use a long chimney without greatly increasing the height of the lamp.

The spindle *n* of the wick-adjusting device is preferably provided with a milled head $n^2$ to facilitate the adjustment of the wick when the lamp is open.

The lamp shown in Fig. 5 is in other respects constructed in a substantially-similar manner to that described with reference to Figs. 1 to 4.

When my improved lamp is constructed, as above described, with a ring of wire-gauze beneath the glass cylinders, this ring and the taper chimney or flue are sufficient without the wire-gauze cylinder *k* to prevent the passing of the flame so as to cause an explosion. Therefore should the said wire-gauze cylinder be omitted the lamp will still be safe.

In Fig. 7 I have shown another modification of my invention, wherein the vertical bolt *q* is held in its locking position by a shoulder $a^*$ on the oil-reservoir or base *a*, and the lower ring *b* of the lamp-frame is locked to the said reservoir by an ordinary locking device comprising arms $a^4$ *b'*, projecting from the oil-reservoir and from the said ring *b* and provided with corresponding holes to receive a lead rivet *s* or the like. A hole or depres-

sion is formed in the shoulder $a^*$ of the oil-reservoir in such a position that by turning the lamp-frame through a certain angle in unscrewing it from the oil-reservoir the bolt $q$ will be brought in line with the said hole or depression, and can therefore be moved downward to unlock the ring $l$ from the ring $c$; or the parts are so constructed that the oil-reservoir may be removed to permit the unlocking of the ring $l$. In the lamp shown in Fig. 7, moreover, I employ a modified arrangement of the wick-adjusting device. The spindle $n$ has fixed thereon a bevel-wheel $t$, which is geared with another bevel-wheel $u$, fixed upon a vertical spindle $u'$, extending through a tube $a^5$, fixed in the oil-reservoir. This spindle has fixed upon it below the said oil-reservoir a milled head or wheel $u^2$ for turning it. I sometimes provide a lip or flange $v'$ on the wick-tube $a'$ to prevent extinction or diminution of the flame by rapid currents of air passing through the lamp-cone—for example, when the lamp is used in strong uphill currents. This arrangement or other suitable means for preventing extinction or diminution of the flame is essential to the proper working of the lamp when the wire-gauze cylinder is omitted.

To prevent the extinguishing of the flame by drafts or currents entering through the openings in the cap or bonnet $m$, through which the products of combustion escape, the upper part of the said cap or bonnet is provided with a flanged ring $w$, inclining upward and outward from the body of the cap or bonnet around the said openings, a narrow space only being left between the edges of the ring $w$ and the top flange of the cap or bonnet $m$, as shown in Fig. 8.

It will be seen that any back-draft from my improved lamp must, as above stated, pass through the wire-gauze. The lamp can therefore be used with safety in dangerous mines. Moreover, it can be used in a strong current of explosive mixture without explosion thereof, and, although the light will not be extinguished when the lamp is subjected to strong currents of air in a mine, it can nevertheless be extinguished intentionally, if necessary, by suddenly or rapidly raising and lowering it in the air in a vertical position, and thereby causing a concussion of the supplied air. It will be seen, moreover, that, as above stated, the ingress for air and the egress for the heated products of combustion, though both in the upper part of the lamp, are separate and distinct from each other.

By constructing the lamp in the manner above described I provide for enabling it to be used with very heavy mineral oils of a specific gravity of, say, .83 and upward, and having a flashing-point from 250° to 300° Fahrenheit, thus effecting considerable economy, while insuring great safety in the use of the lamp.

To insure the favorable working of the lamp, the cone $j$, glass cylinders $e$ $f$, and chimney $h$ may be proportioned and arranged in relation to each other substantially as shown in the drawings.

The oil-reservoir is sometimes provided with an extension for permitting the filling of the same without disconnecting the parts of the lamp, the said extension being formed with a hole which is closed by a cap or plug.

It is obvious that the construction of the improved lamp can, if desired, be somewhat modified without departing from the nature of my said invention.

What I claim is—

1. A safety-lamp comprising concentric glass cylinders between which the supplied air flows in a downward direction, a ring of wire-gauze fitting against the lower ends of the said glass cylinders and permitting the passage of air into the space beneath it, while preventing the transmission of flame to the space between the said glass cylinders, means for retaining the said wire-gauze ring and the cylinders in place, and a lamp-cone inserted in the lower end of the inner glass cylinder and provided with holes for the flow of air into it from the space beneath the wire-gauze ring and with a second series of holes within the inner glass cylinder for supporting the initial combustion, substantially as and for the purposes set forth.

2. In a safety-lamp, the combination of concentric glass cylinders between which the supplied air flows in a downward direction, a ring of wire-gauze fitting against the lower end of the said glass cylinders, a perforated annular plate beneath the said wire-gauze ring for retaining the same and the glass cylinders in place, and a lamp-cone inserted in the inner glass cylinder and provided with a shoulder upon which the perforated plate rests and with a vertical portion below said shoulder perforated for the admission of air to the flame, substantially as and for the purposes set forth.

3. In a safety-lamp, the combination of upper and lower rings which are united by pillars, a metal cap or bonnet detachably secured to the upper ring and an oil-reservoir detachably secured to the lower ring, concentric glass cylinders located between the said rings and between which the supplied air flows in a downward direction, an annular perforated plate screwed into the lower ring, whereby the said glass cylinders are firmly held between the upper and lower rings, thus permitting the removal of the bonnet and of the oil-reservoir without disturbance of the joints at the ends of the said cylinders, and a lamp-cone inserted within the inner glass cylinder and provided with a shoulder which bears against the under side of the said annular plate and with perforations below the said shoulder, whereby all the incoming air or inflammable mixtures of gas and air are compelled to pass through the said lamp-cone, substantially as and for the purposes set forth.

4. In a safety-lamp, the combination, with

a vertical bolt for locking the cap or bonnet to the upper part of the lamp-frame, of a wick-adjusting spindle formed in two parts, one of which is adapted to be inserted into and removed from a hole in the lamp-frame extending beneath the said vertical bolt and to engage with the other part of the said spindle for the purpose of locking the oil-reservoir to the lower part of the lamp-frame, substantially as hereinbefore described.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES THORNE.

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