(No Model.) 2 Sheets—Sheet 1.

H. A. EARLE & E. GOLTSTEIN.

ELECTRIC ARC LAMP.

No. 294,455. Patented Mar. 4, 1884.

Fig. 1.

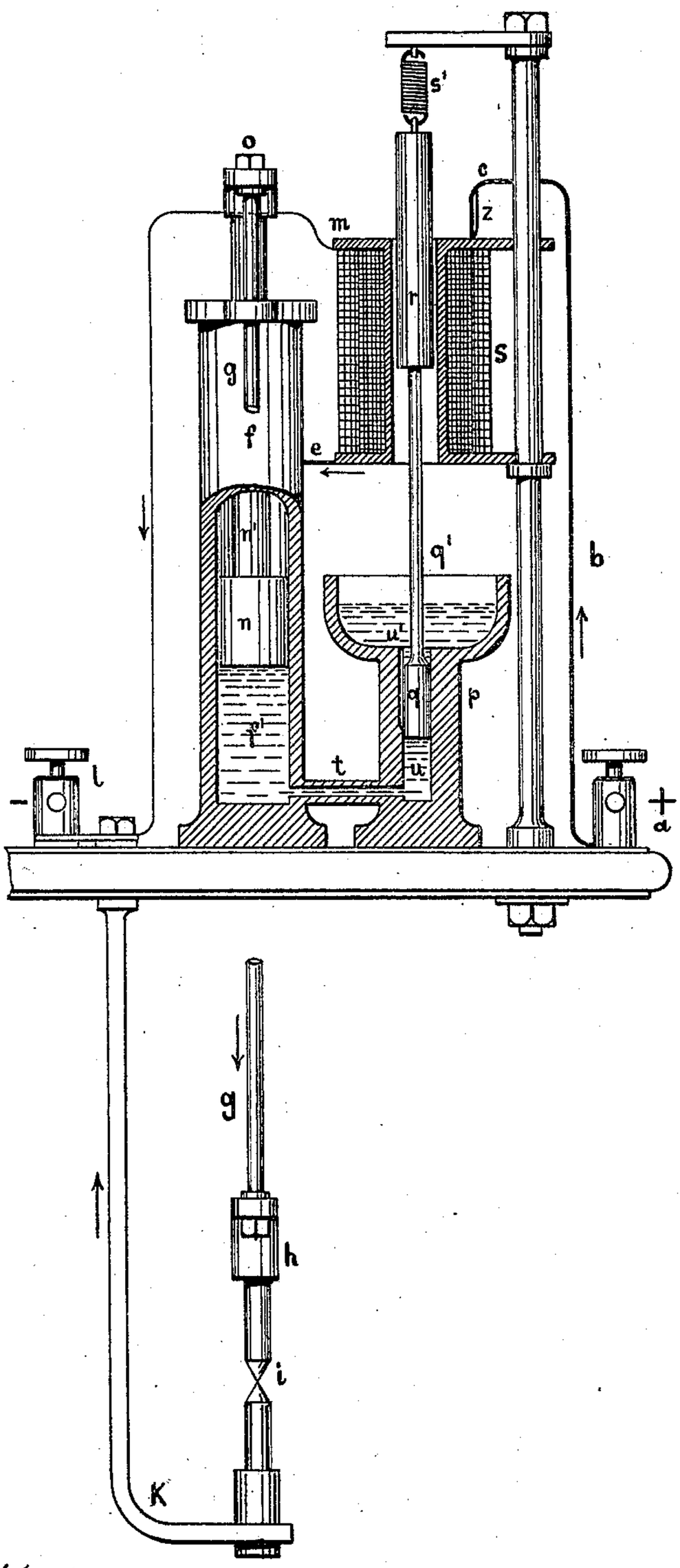
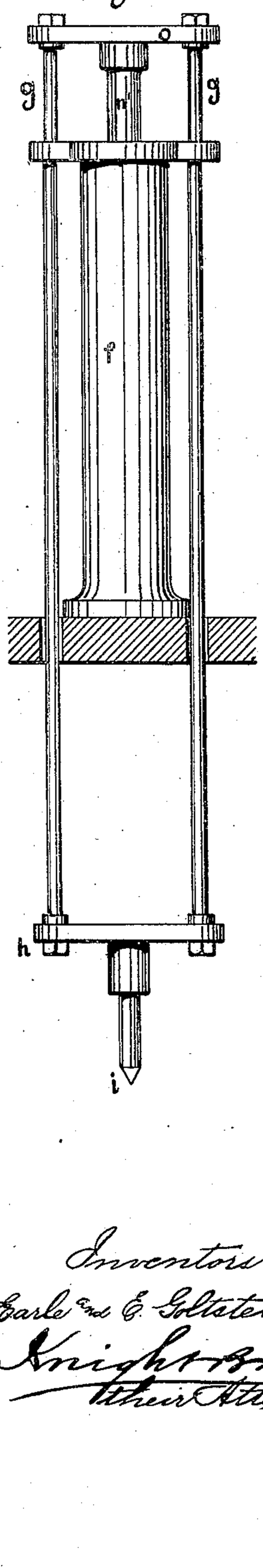


Fig. 2.

Fig. 3.



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Geo. L. Wheelock

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By Knight Bros
their Attys.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

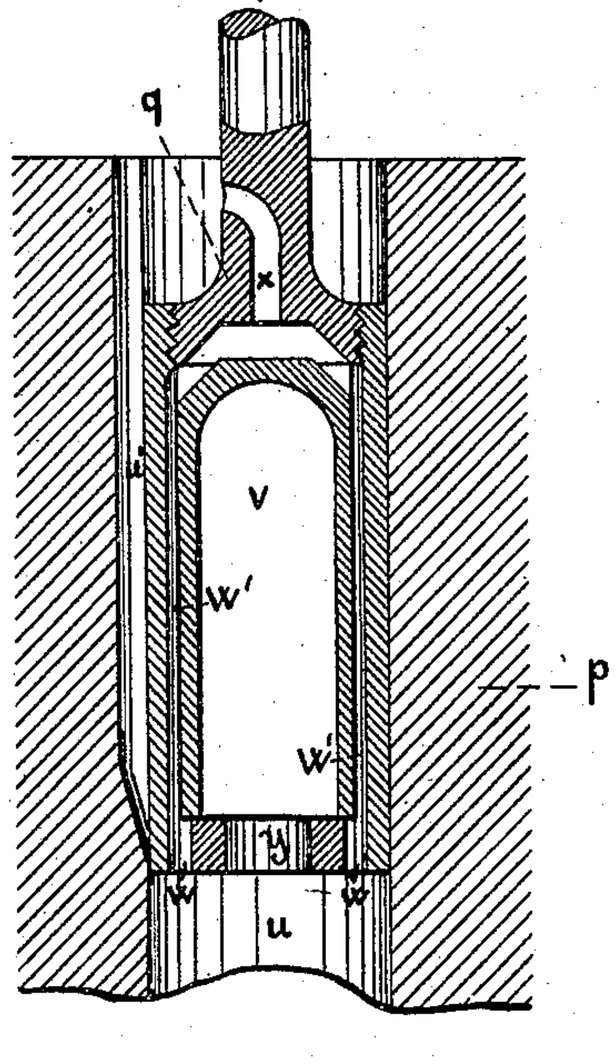


Fig. 6.

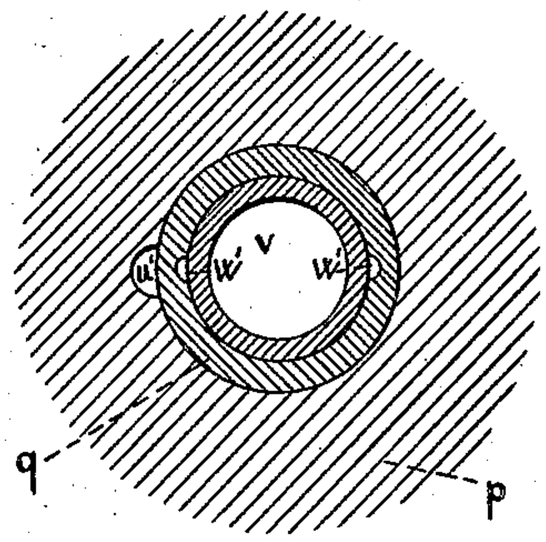


Fig. 5.

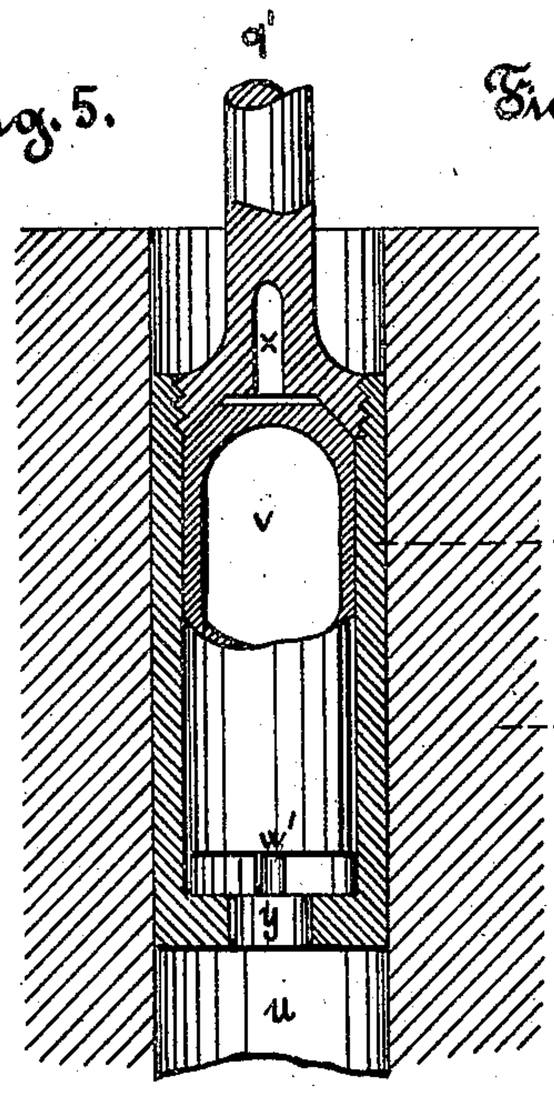
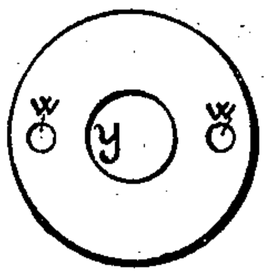


Fig. 7.



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UNITED STATES PATENT OFFICE.

HARDMAN ARTHUR EARLE, OF LONDON, ENGLAND, AND EWALD GOLTSTEIN, OF HANOVER, PRUSSIA, GERMANY.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 294,455, dated March 4, 1884.

Application filed December 4, 1883. (No model.)

To all whom it may concern:

Be it known that we, HARDMAN ARTHUR EARLE, residing in London, Kingdom of Great Britain and Ireland, and EWALD GOLTSTEIN, residing in Hanover, Kingdom of Prussia, have invented new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

Our invention relates to electric-arc lamps in which the distance of the carbons from each other is regulated by the flow of a liquid controlled by the electric current; and the chief improvement consists in operating, by means of the current, a piston adapted to exercise a pressure on the liquid, and thereby to separate the carbons when the lamp is switched into the circuit, the piston acting subsequently as valve to limit the flow of the liquid according to the length of the luminous arc.

A lamp comprising our improvements is represented by Figure 1 of the annexed two sheets of drawings in sectional elevation. Fig. 2 is a bottom view of the cross-piece *o*. Fig. 3 is an end elevation of the cylinder *f* and parts to which the upper-carbon holder is attached. Fig. 4 is a vertical section of a portion of cylinder *p* and piston *q* drawn to a larger scale. Fig. 5 is a like section taken at a right angle to the section Fig. 4. Fig. 6 is a horizontal section through the cylinder *p*, and Fig. 7 a bottom view of the piston *q*.

The holder *h* of the upper carbon is connected by means of the rods *g g* and the cross-piece *v* to the rod *n'* of the piston *n*, working in a cylinder, *f*. This cylinder communicates at *t* with the small cylinder *p* or regulating-cylinder carrying at its top a cup or reservoir, *q'*, and provided with a channel, *u'*, leading from a point of its side to the reservoir. The said channel may be cut into the wall of the cylinder, as shown in Figs. 1, 4, and 6, or it is made to pass through the metal thereof. Within the cylinder *p* there is a piston, *q*, adapted to open and close the channel *u'*. This piston is joined to the iron bar *r*, suspended to the spring *s'*, and constituting the movable core of a solenoid or spool, *s'*, inserted into the circuit of the lamp. According to the drawings, a differential solenoid is employed, consisting of two spools, one for the main current and the other for a shunt-current, the wire of the latter, which forms a circuit of high resistance, being coiled in the opposite direction to the main wire. The main spool is connected by the wire *b* with the positive terminal *d*, and by the wire *e* with the cylinder *f*, whence the main current is transmitted through the suspension-rods *g*, which are in contact with *f*, as well directly as by the piston *n*, to the upper carbon, and from there through the lower carbon and its holder *k* to the negative terminal *l*. The wire *z* of the shunt-current spool branches off from the main wire *b* at *c* and runs from *m* to the negative terminal. The space between the pistons *q* and *n* is filled with glycerine or other suitable thick liquid. The core *r* and the piston *q* are so balanced by the spring *s'* or in other appropriate manner, and the parts are so adjusted that when the lamp is burning and the arc is of the proper length the main current will draw the core *r* down by so much as is required to cause the piston *q* to keep the channel *u'* closed. The piston *n* and the upper carbon will then be stationary; but when the distance between the carbons becomes too great and the resistance in the arc increases, a greater portion of the current goes through the shunt-circuit, the energy of the main spool being thereby weakened. The core *r* will then be slowly drawn upward by the spring *s'*, while at the same time the weight of the large piston *n* and of the parts attached to it, acting through the liquid on the piston *q*, push the latter in the same direction. The piston *q* having come in a position as to open the channel *u'*, liquid flows from the cylinder *f* through *u* and *u'* into the reservoir *q'*, in consequence whereof the piston *n*, with the upper carbon, will sink and the proper distance between the carbons will be restored. On switching the lamp into circuit the carbons, being in contact with each other, offer no resistance. The current, passing entirely through the main spool, will therefore at this moment act with its full force to draw the core *r* inward and to push the piston *q* down into the cylinder *p*, so as to raise the piston *n* and the upper carbon. The arc is thereby immediately formed.

Instead of two spools combined to a differential solenoid, a single spool or solenoid, or

other known means adapted to operate according to the variations in the strength of the current on the piston *q*, may be employed.

When the carbons are consumed and the lamp is to be provided with new ones, the holder *h* must be raised, together with the piston *n*. A way must then be opened for the liquid to pass from the reservoir *q'* back into the cylinder *f'*. For this purpose the piston *q* is made hollow, and within the same there is a hollow cylinder, *r*, forming a valve. The cavity of the piston communicates at the top by the channel *x* with the reservoir *q'*, and at the bottom by holes *w* with the space *u* below the piston. In the wall of the piston there are grooves *w'* running out into the holes *w*. The said channel *x*, the grooves *w'*, and holes *w* thus form a passage from the reservoir to the cylinder *f* while the valve is open. When the lamp is burning, the pressure of the liquid, which is free to act on the valve *v* through the hole *y*, keeps the valve closed; but when the holder *h* and the piston *n* are pushed upward, the latter, by its sucking action, causes the valve to drop, so as to open the passage through the piston, and then draws the liquid from the reservoir into the cylinder *f*. The said passage may, however, also be arranged in any other manner, so as to form a communication between the reservoir and the spaces *f'* and *u*, containing the regulating-liquid, and the valve may be of any suitable description.

We claim as our invention—

1. In an electric-arc lamp in which one of the carbons is carried by a piston, *n*, working in a cylinder, *f*, containing a liquid, the combination, with the said cylinder, of a regulating-cylinder, *p*, having the channel *w'* of a piston, *q*, working in *p*, and of means adapted to operate according to the variations in the strength of the current on the piston, so that it will be pushed inward within the cylinder *p* when the lamp is switched into circuit, substantially as and for the purpose described.

2. The combination, with the cylinders *f* and *p*, containing liquid, reservoir *q'*, pistons *n* and *q*, and means for operating the piston *q* according to the variations in the strength of the current, of a channel establishing communication between the reservoir *q'* and the space occupied by the liquid in *f* and *p*, and of a valve adapted to close the said channel, substantially as and for the purpose specified.

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

HARDMAN ARTHUR EARLE.
EWALD GOLTSTEIN.

Witnesses:
HENRY SPRINGMANN,
B. ROI.