

(No Model.)

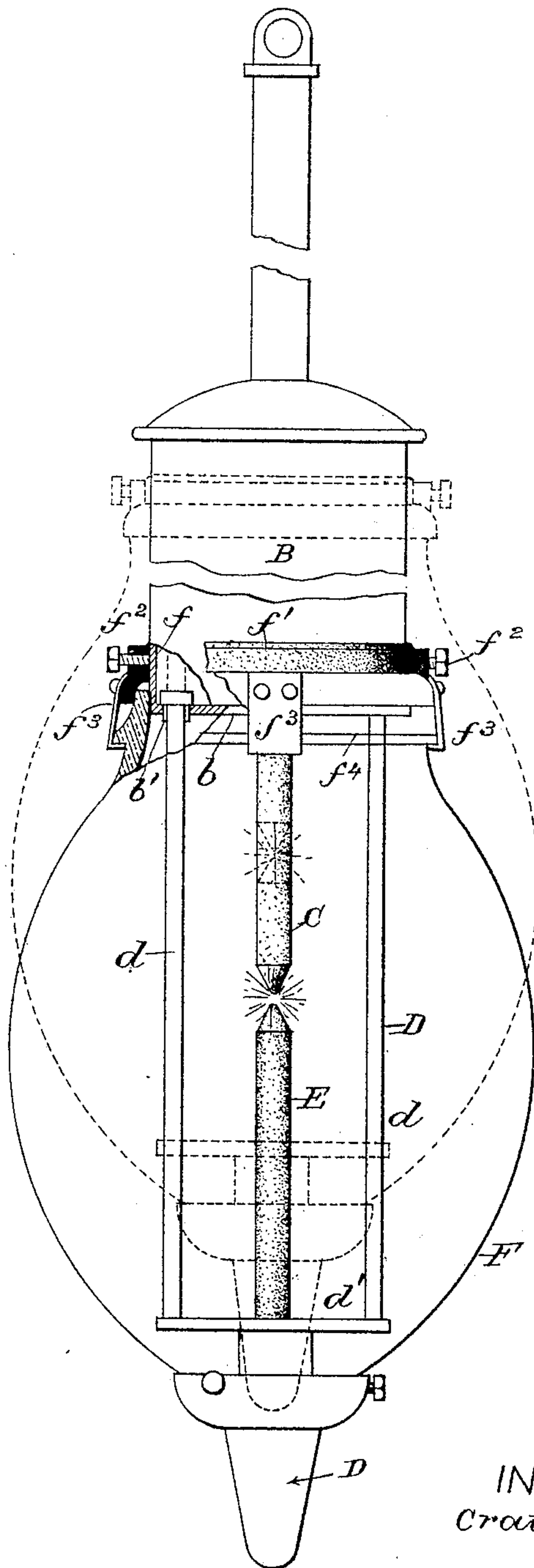
4 Sheets—Sheet 1.

C. R. ARNOLD.  
ELECTRIC ARC LAMP.

No. 455,087.

Patented June 30, 1891.

Fig. 1.



ATTEST:

*J. A. Hurdle*  
*John H. Hurdle*

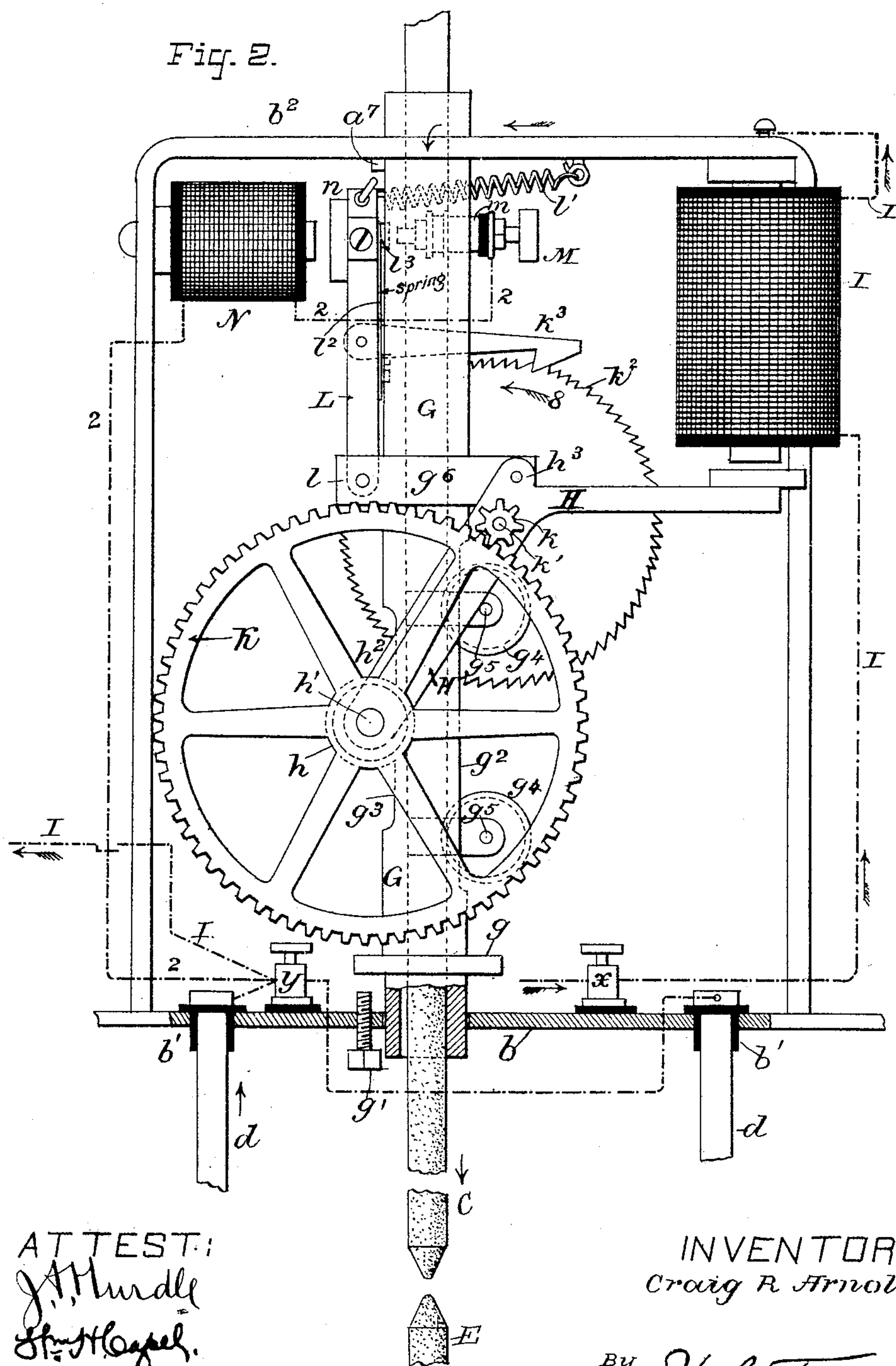
INVENTOR:  
Craig R. Arnold

By *H. C. Townsend*  
Attorney

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ATTEST:  
J. A. Mudd  
St. H. Capel.

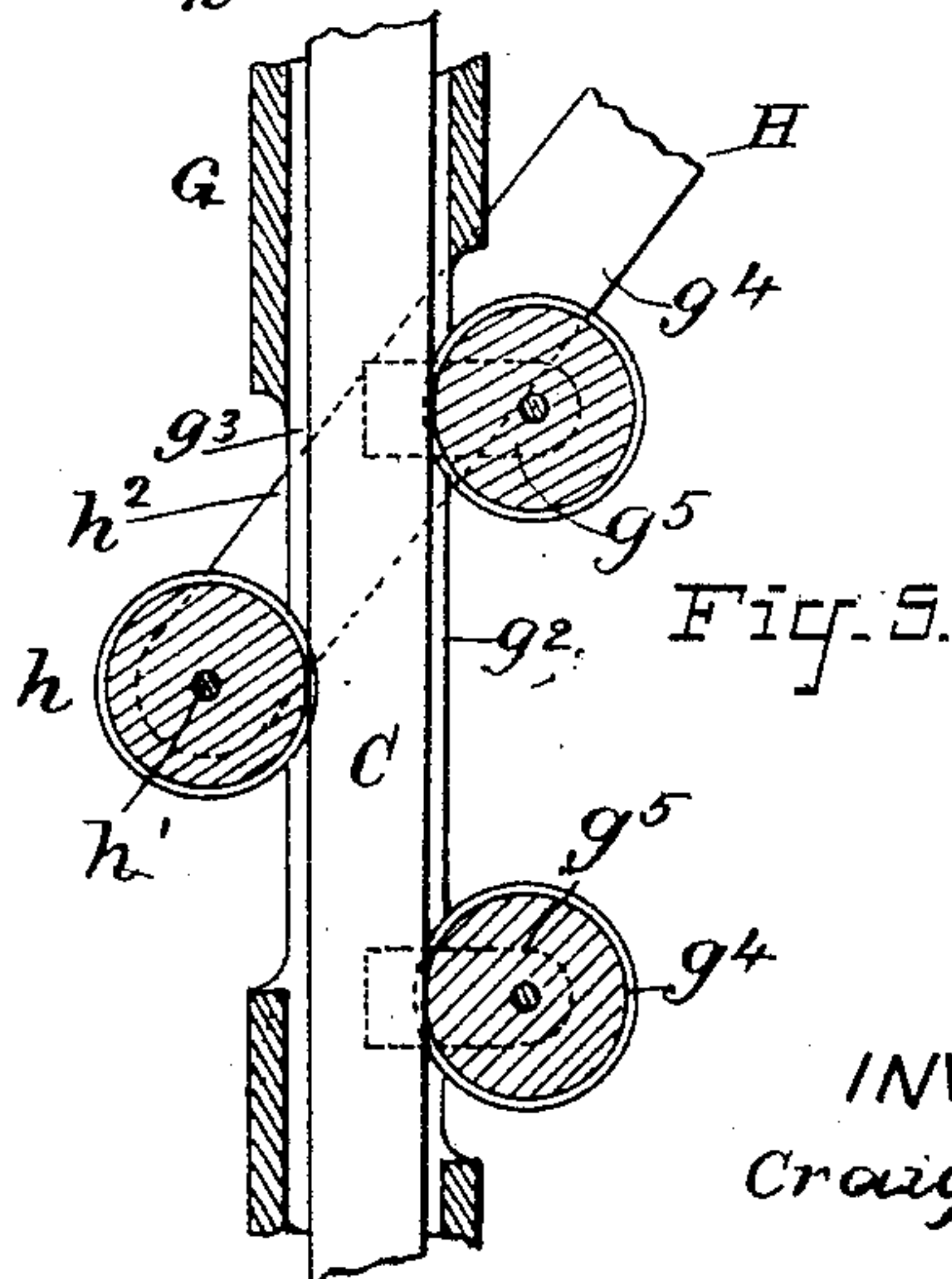
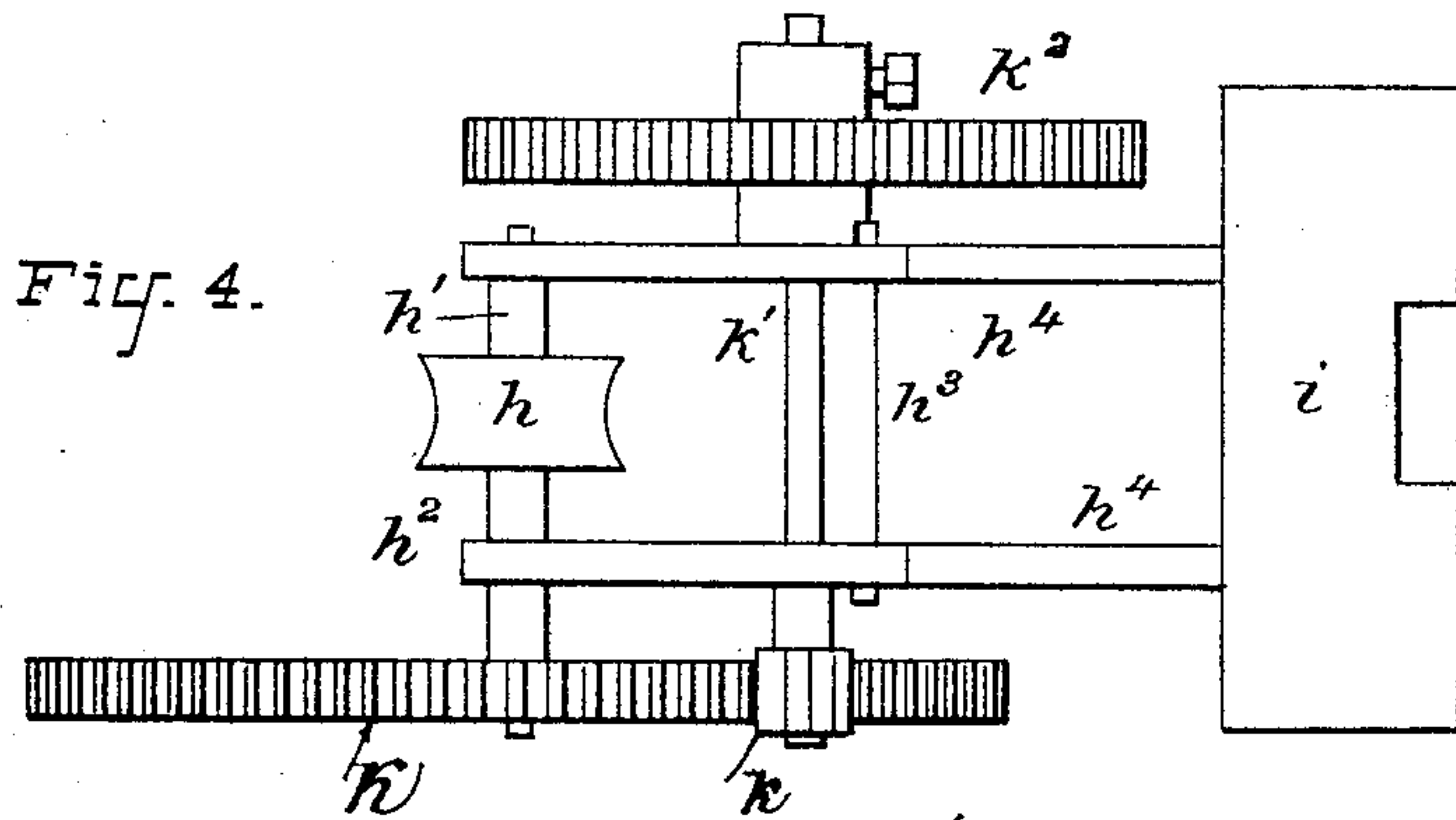
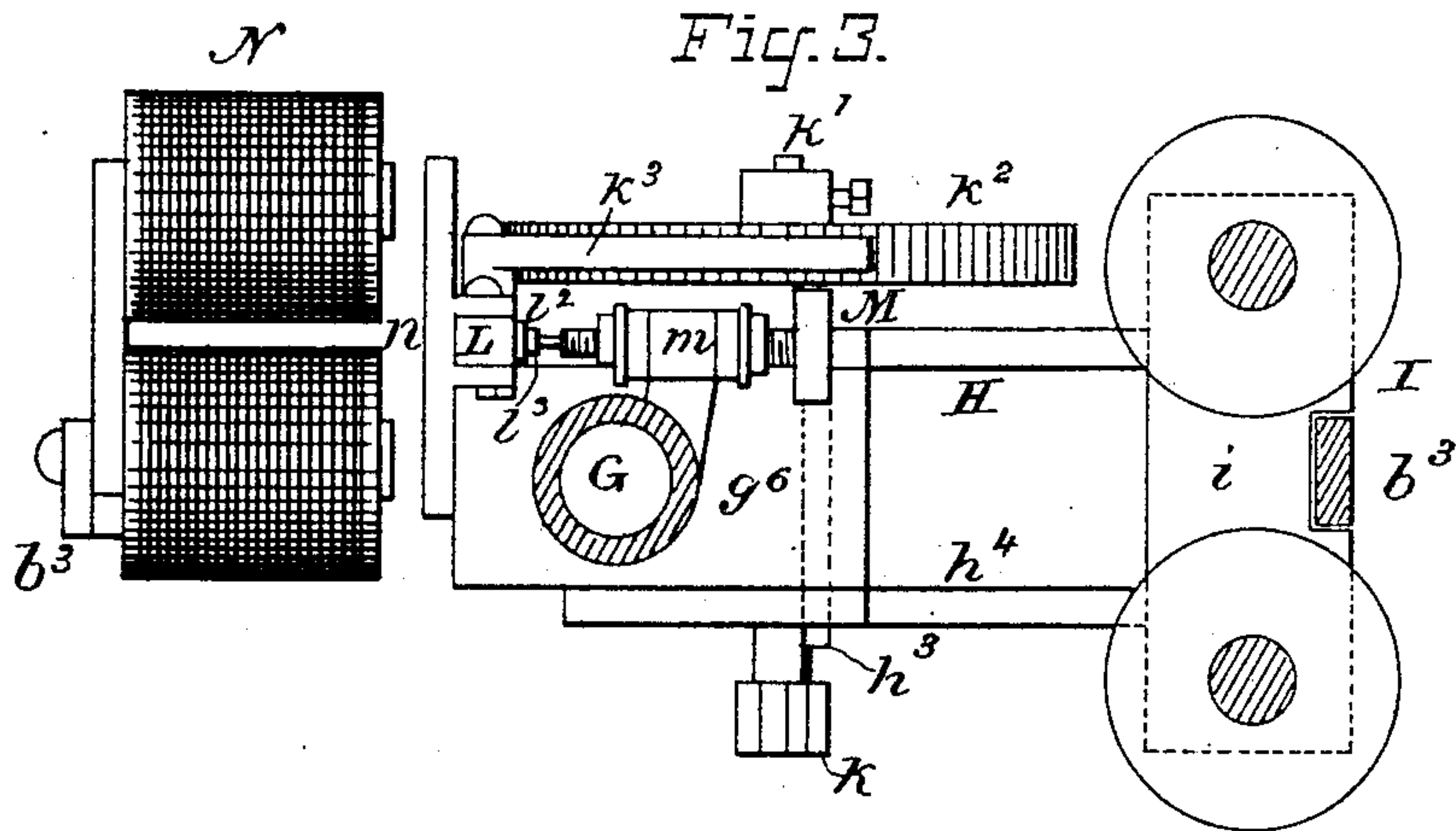
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ATTEST:  
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J. H. Capel

INVENTOR:  
Craig R Arnold

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Attorney

(No Model.)

4 Sheets—Sheet 4.

C. R. ARNOLD.  
ELECTRIC ARC LAMP.

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Patented June 30, 1891.

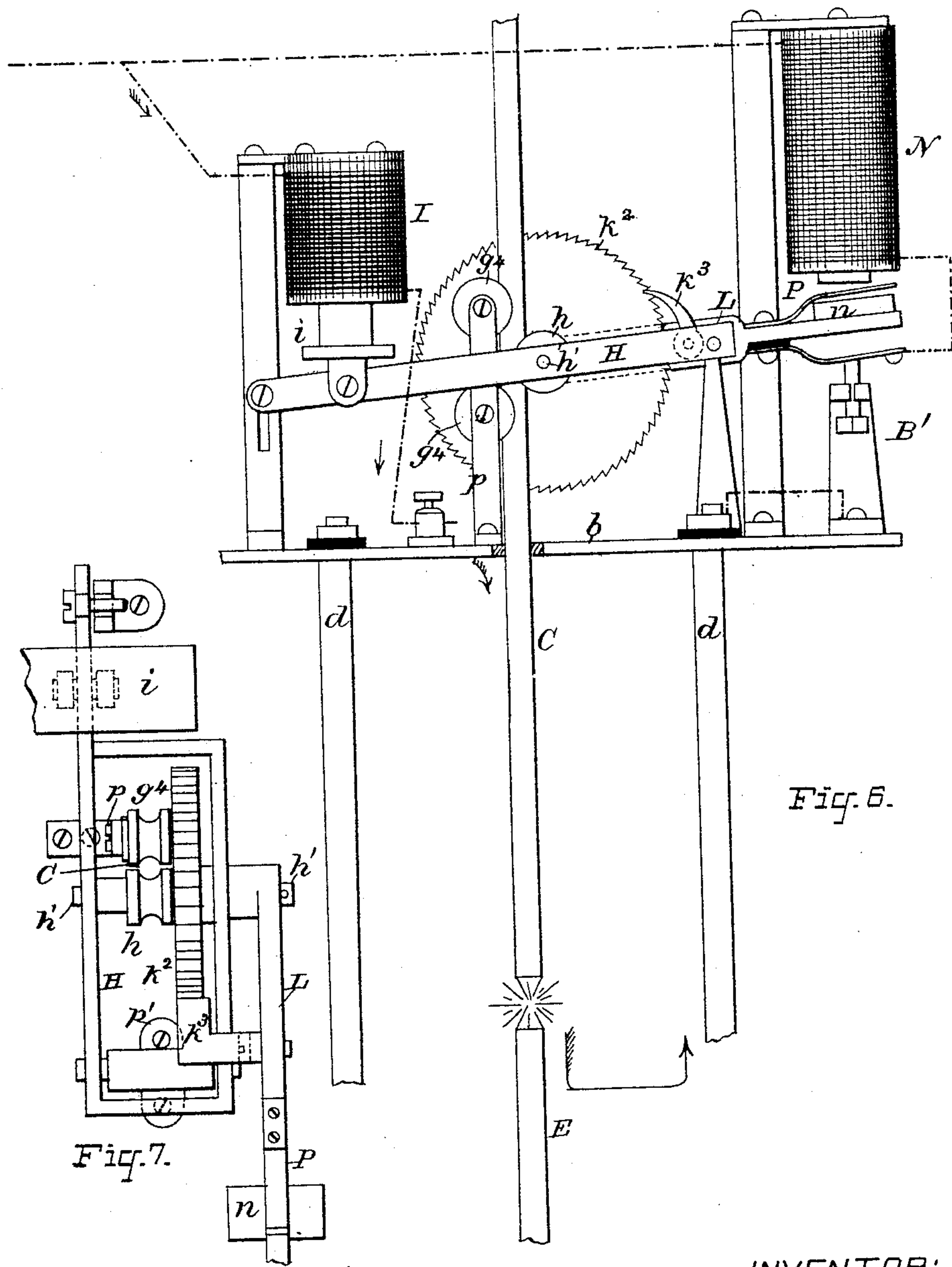


Fig. 6.

Fig. 7.

ATTEST:  
*J. A. Mudd*  
*Wm. H. Capel*

INVENTOR:  
*Craig R. Arnold*

By *H. L. Townsend*  
Attorney



# UNITED STATES PATENT OFFICE.

CRAIG RITCHIE ARNOLD, OF CHESTER, PENNSYLVANIA.

## ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 455,087, dated June 30, 1891.

Application filed May 28, 1890. Serial No. 353,409. (No model.)

*To all whom it may concern:*

Be it known that I, CRAIG RITCHIE ARNOLD, a citizen of the United States, and a resident of Chester, in the county of Delaware and State of Pennsylvania, have invented a certain new and useful Electric-Arc Lamp, of which the following is a specification.

My invention relates to electric-arc lamps; and it has for its objects to effect a material saving in the use of carbons or provide for the employment or consumption of partially-consumed, broken, short, or different lengths of upper carbons, and, second, to provide simple, effective, compact, and durable regulating devices for the lamp, whereby the arc between the carbons is duly established and maintained and a delicate and practically-imperceptible feeding is assured for the carbons as they are consumed.

My invention accordingly consists of the combination, construction, and arrangement of parts comprising an electric-arc lamp, as hereinafter described and claimed, having reference, particularly, first, to a sliding frame or support for the lower carbon and the shade or globe for the lamp, whereby both said carbon and globe are susceptible of being simultaneously raised above the position which they occupy when carbons of the normal length are employed, whereby they may be both adjusted to cause the lower carbon to meet the upper one or vary the plane for the arc and both carbons still be surrounded by the shade or globe, and, second, to a freely suspended or supported slotted tubular upper-carbon holder having on one side a pair of independently-journaled rollers and on the opposite side a movable roller having bearings in a frame pivoted to said holder and supporting an armature for an electro-magnet included in the line-circuit, and gear-wheel and step-by-step mechanism for said movable roller, which mechanism is operated by a lever and circuit-breaker supported upon said holder and actuated by electro-magnetic appurtenances in a derived or shunt circuit, whereby the arc-establishing mechanism and feeding devices for the carbons and the upper-carbon holder are combined and secured together in a freely-supported condition.

My invention consists, also, in special combinations of devices and improvements in details of constructions hereinafter described, and more particularly specified in the claims. 55

Figure 1 of the accompanying drawings is a sectional elevation of an electric-arc lamp, showing the sliding support or frame for the lower carbon and the globe or shade. Fig. 2 is a sectional elevation, drawn to an enlarged scale, of the arc-establishing and carbon-feeding mechanism or the regulator. Fig. 3 is a horizontal cross-section of same on line 1 1. Fig. 4 is a detail plan, and Fig. 5 is a broken section, of the clutch and adjacent parts. Fig. 6 is an elevation of a modification of construction of the regulating devices, and Fig. 7 is a sectional broken plan of same. 65

In the drawings, A, Fig. 1, represents an electric-arc lamp comprising a casing B, containing the regulating devices, as hereinafter described, for the upper carbon C, and a support or frame D for the lower carbon E and globe or shade F, which is secured to said frame by set-screws, as shown, or otherwise, as desired. 75

The frame D is composed of the usual vertical rods  $d$  and lower cross-bar  $d'$ , or is made in the usual or other suitable manner, except that the rods  $d$  are not fastened or rigidly connected to the base  $b$  of casing B, but are loosely attached thereto, so as to slide in their bearings or openings  $b'$  in base B. They are preferably insulated from the base, as shown. 85

The upper edge  $f$  of globe F is made large enough to embrace or surround the casing B, as shown, and said edge enters or is covered by a sliding or loose collar or sleeve  $f'$ , surrounding casing B and guided thereon. The latter is held in its adjusted position by means of set-screws  $f^2$ , and is provided with downwardly-projecting spring fingers or clamps  $f^3$  for engagement with an outside shoulder  $f^4$  on globe F to connect frame D and its attached fixtures to sleeve  $f'$ . The frame D being supported by or suspended from sleeve  $f'$  is susceptible of being vertically raised or lowered whenever it is desirable to do so, and is maintained in any position within its limits of motion by adjusting the set-screws  $f^2$  of sleeves  $f'$ , and as the globe F is fastened 100



to frame D both move together to maintain the globe in its normal position around the carbons without necessitating special or independent adjustment of the globe whenever the frame D is adjusted. The lower carbon E may therefore be raised to meet or make contact with a short, partially-consumed, or different lengths of upper carbon, or the plane or height for the arc may be altered as desired by one adjustment of frame D, as indicated in dotted lines, Fig. 1.

The arc establishing and maintaining mechanism or the regulator for the lamp, is more plainly shown in Fig. 2.

G is a tubular holder or guide having bearings in base  $b$  and top  $b^2$  of frame  $b^3$  of casing B, as illustrated, or otherwise, as desired, and forming a guide in which the carbon slides and is sustained or guided.

The holder G has near its lower end an annular shoulder or flange  $g$ , and in line with it in base  $b$  is a set-screw  $g'$ , which, in connection with the stud  $a^7$  on the holder G, adapted to strike the top of casing B, determines the extent of lift of said holder.

The holder G has partial oppositely-located slots  $g^2$  and  $g^3$ . (See Fig. 5.) Into slot  $g^2$  project grooved rollers  $g^4$ , journaled in brackets  $g^5$ , projecting from holder G. These rollers  $g^4$  are placed above one another and align, as more plainly shown in Fig. 5. In line with slot  $g^3$  is a roller  $h$ , fixed on a shaft  $h'$ , having its bearings in the lower end  $h^2$  of a tilting frame or support H, which is pivoted at  $h^3$  to an oblong or other suitably-shaped collar or platform  $g^6$ , secured to or forming a part of holder G or other vertically-movable support. The roller  $h$  thus mounted may be moved laterally to or from the carbon, so as to clutch or grasp the same or to allow it to feed.

The frame H is provided with outwardly-extending or other suitably-shaped arms  $h^4$ , upon which is secured an armature  $i$  for an electro magnet or magnets I, included in the main or line circuit 1 1, and preferably in the direct circuit with the carbons and the arc through connection with the metal frame of the lamp, as indicated. On one end of shaft  $h'$  of roller  $h$  is mounted a gear-wheel K, which meshes with a pinion  $k$  on shaft  $k'$ , having its bearings in pivoted frame H. On the opposite end of shaft  $k'$  is secured a ratchet-disk  $k^2$ , having a pawl  $k^3$ , pivoted to a lever L, which in turn is fulcrumed at  $l$  on collar  $g^6$  or other support, moving vertically with G, and is provided with a retracting-spring  $l'$ , arranged in any desired manner, or as indicated. Lever L is also provided with a flat spring  $l^2$ , having an electrode  $l^3$ , which normally rests upon or is in contact with said lever and the point or end of an adjusting-screw M, supported upon but insulated from a bracket  $m$ , as shown, formed on or secured to holder G. The lever L carries an armature  $n$  for the electro-magnets N, included in a derived or shunt circuit 2 2 around the arc. Said lever L, spring  $l^2$ ,

and adjusting-screw M form a circuit-breaker P for making and breaking said derived or shunt circuit whenever magnets N attract armature  $n$  and oscillate lever L.

The line enters the lamp by way of post  $x$ , suitably located, thence passes to magnets I, to frame  $b^3$ , to holder G, to carbons by way of rollers  $g^4$ , lower-carbon frame  $d$ , post  $y$ , flexibly connected to frame, and out to next lamp or to the line. The derived or shunt circuit is by way of lamp-holder G, lever L, spring  $l^2$ , contact  $l^3$ , screw M, magnet N, and to post  $y$ .

The operation of the regulator is as follows:

The set-screw  $g'$  is adjusted in relation to collar  $h$  or holder G, as before explained, to govern the play of the holder, and therefore the extent of lift of said holder, and consequently the length of arc between the carbons. The roller  $h$ , when the lamp is not in use, is normally away from the upper carbon or out of slot  $g^3$  and armature  $i$  away from the magnets I. The passage of a current through magnets I causes them to attract their armature  $i$  and produce an oscillation of frame H on its pivotal support to first cause roller  $h$  to enter slot  $g^3$  of holder G and contact with and force the upper carbon against the oppositely-located rollers  $g^4$  to form a grip for said carbon, as shown in Fig. 5. As soon as the grip is effected further tilting of frame H and side movement of its roller  $h$  are prevented, or they are rigidly locked to holder G. Consequently a further attraction and movement of armature  $i$  lifts said holder, its attached parts, grip, and upper carbon vertically to produce a separation of the carbons and establish the arc between them, the position of the frame against its upper stop being duly maintained as long as the current continues to pass to the lamps or to magnets I. If such current at any time ceases to pass to magnets I, they are de-energized, whereupon the weight of the armature end of frame H reversely oscillates the latter to effect a movement of roller  $h$  away from the upper carbon or a release of the grip on said carbon to permit it to drop to its normal position when the current is not passing, and the frame or support G settles down on stop  $g'$ .

When the arc is established, as above described, and the carbons burn away or the length of the arc becomes abnormal, the current is shunted to magnets N in sufficient amount to cause them to attract their armature  $n$  against the influence of retractor  $l'$ , which is set to hold the armature back while the arc is normal, thereby moving lever L and pawl  $k^3$  to step ratchet-disk  $k^2$  and rotate gear-wheels  $k$   $k$  and roller  $h$  in the direction indicated by arrows  $z$ , so as to move the upper carbon downwardly or feed it toward the lower carbon. The described movement of lever L breaks the shunt-circuit, which is instantly restored by the reaction of spring  $l'$ , reversely moving said lever.

The automatic action of making and break-



ing the shunt-circuit continues as long as the magnets N are active or while the arc is abnormal and produces a constant oscillation of lever L and stepping of ratchet-disk  $k^2$  for effecting a continuous feeding of the carbon C until the arc is restored to its normal condition.

As the stepping of ratchet-disk  $k^2$  is a positive action, the feeding of the carbons is a forced one and does not depend upon the action of gravity. It is apparent, therefore, that the above-described regulator provides a positive, steady, delicate, and almost imperceptible feed for the carbons while burning or being consumed. Instead of using the step-by-step appliances for effecting a feeding of the carbons, any other desired or suitable devices may be substituted therefor and placed in gear with the shaft  $k$  or directly with roller  $h$ . If desired, the tubular holder G may be dispensed with, (see Figs. 6 and 7,) in which case the rollers  $g^1$  are journaled to a fixed bracket or support  $p$ , secured to base  $b$ , and the frame H, with its rollers  $h$ , is pivoted to a bracket  $p'$ , similarly secured. The circuit-breaker P and pawl  $k^3$  are attached to lever L, which is fulcrumed on roller-shaft  $h'$ , to which is attached the ratchet-disk  $k^2$ , the result being the same in this case as in that already described, except that a more rapid feeding of the carbons is effected.

The grooves of the rollers  $g^1$  and  $h$  may be smooth, milled, or roughened, as desired, or said rollers may be otherwise constructed, as required.

What I claim as my invention is—

1. In an electric-arc lamp, a lower-carbon holder and globe or shade therefor, both supported on a sliding or adjustable frame or carrier adapted to be raised or adjusted above the position occupied when carbons of normal length are employed, and means for setting or fixing the frame and supported carbon and globe in any desired vertical position.

2. In an electric-arc lamp, the combination, with the lower-carbon holder and the globe or shade for the lamp, of a vertically-sliding frame or support carrying both the holder and the shade, and clamping devices adapted to fix or hold the said frame in any desired vertical position, according to the length of the carbon or the plane or height of arc desired.

3. The combination, in an electric-arc lamp, of a frame D, carrying the lower carbon, a globe or shade supported by said frame, a sleeve sliding on the lamp-casing and attached to the upper edge of the globe, and a clamp for fixing the said sleeve in any desired vertical position on the casing.

4. In an electric-arc lamp, the combination, with the lower-carbon holder, of side rods adapted to slide vertically in the base of the lamp, a globe-holder connected to the frame supporting said carbon-holder and carrying a globe surrounding said side rods, and a vertically-adjustable sleeve or support connected to the upper edge of said globe and

provided with means for fixing or adjusting it in any desired vertical position.

5. In an electric-arc lamp, a frame D, supporting the lower-carbon holder and attached to vertically-sliding side rods  $d$ , sliding in the base of the lamp, a globe or shade attached to said frame, a sleeve sliding on the lamp-casing and supporting the globe from its upper edge, and clamping devices for fixing the sleeve in any desired vertical position.

6. An electric-arc lamp having a freely-suspended guide-frame for the carbon-holder, a grip-roller sustained on a tilting lever H, an armature fastened to said lever, feeding mechanism mounted on said frame for rotating the grip, a derived-circuit magnet and circuit-breaker therefor, and an armature for said magnet connected to said feed mechanism, substantially as and for the purpose set forth.

7. An electric-arc lamp having a freely-suspended guide-frame for the carbon-holder, a movable grip-roller sustained on a tilting lever pivoted to said frame, feed mechanism for rotating the grip, a derived-circuit magnet, an automatic circuit-breaker therefor, and an armature for said magnet connected to said feed mechanism, substantially as and for the purpose described.

8. The combination of the tube G, having rollers  $g^1$ , pivoted frame H, having roller  $h$ , and ratchet-disk  $k^2$  in gear with said roller, and pawl  $k^3$ , lever L, and a circuit-breaking device P, as and for the purpose described.

9. In a regulator for an electric-arc lamp, the combination of a guide-frame for the carbon movable longitudinally in the direction of lift and feed of said carbon, a roller-grip adapted to engage directly with the carbon and mounted on a tilting frame carried by the guide-frame, whereby it may be moved to and from the carbon, a main-circuit magnet for actuating the tilting frame and guide-frame, a derived-circuit magnet, an armature-lever therefor supported on the guide-frame, and a step-by-step feed actuated by said armature and connected to the grip-roller for rotating the same.

10. The combination, in an electric-arc lamp, of a tubular holder or guide G, guided in the base of the lamp and in the top of the lamp-frame, two rollers pivoted on said guide or tube and projecting through slots in the same against the carbon or carbon-holder, a second roller projecting through a slot in said guide and carried by a tilting lever connected with an armature for a main-circuit magnet, a gear-wheel mounted on the shaft of said second roller and meshing with a pinion on the second shaft carried by the frame or guide, a ratchet-wheel on said second shaft, and a step-by-step actuating-pawl for the latter also mounted on the frame or guide, as and for the purpose described.

11. The combination, substantially as described, of the vertically-movable frame carrying a fixed roller or rollers, a grip-roller carried by a lever pivoted on said frame, a



main-circuit magnet I, secured at one side of  
the lamp-frame and having an armature  
mounted on the lever carrying said roller, a  
fixed derived-circuit magnet N, an armature-  
5 lever therefor mounted on the movable frame  
and connected to actuating devices for turn-  
ing the movable roller step by step, and a  
circuit breaker or controller for said derived-  
circuit magnet, as and for the purpose de-  
10 scribed.

12. The combination, substantially as de-  
scribed, of the movable frame G, a grip-roller  
carried by a lever mounted on said frame, a

main-circuit magnet having an armature se-  
cured to said lever, a derived-circuit arma- 15  
ture-lever also mounted on said frame, and  
an actuating-pawl connected to said arma-  
ture-lever and serving to turn the grip-roller  
step by step, as and for the purpose described.

Signed at Chester, in the county of Dela- 20  
ware and State of Pennsylvania, this 29th  
day of April, A. D. 1890.

CRAIG RITCHIE ARNOLD.

Witnesses:

JNO. LENTZ GARRETT,  
LETTIE D. ALLMOND.