(No Model.) 4 Sheets—Sheet 1.

E. THOMSON.

ELECTRIC ARC LAMP.

No. 488,585. Patented Dec. 27, 1892.

Fig. 1.

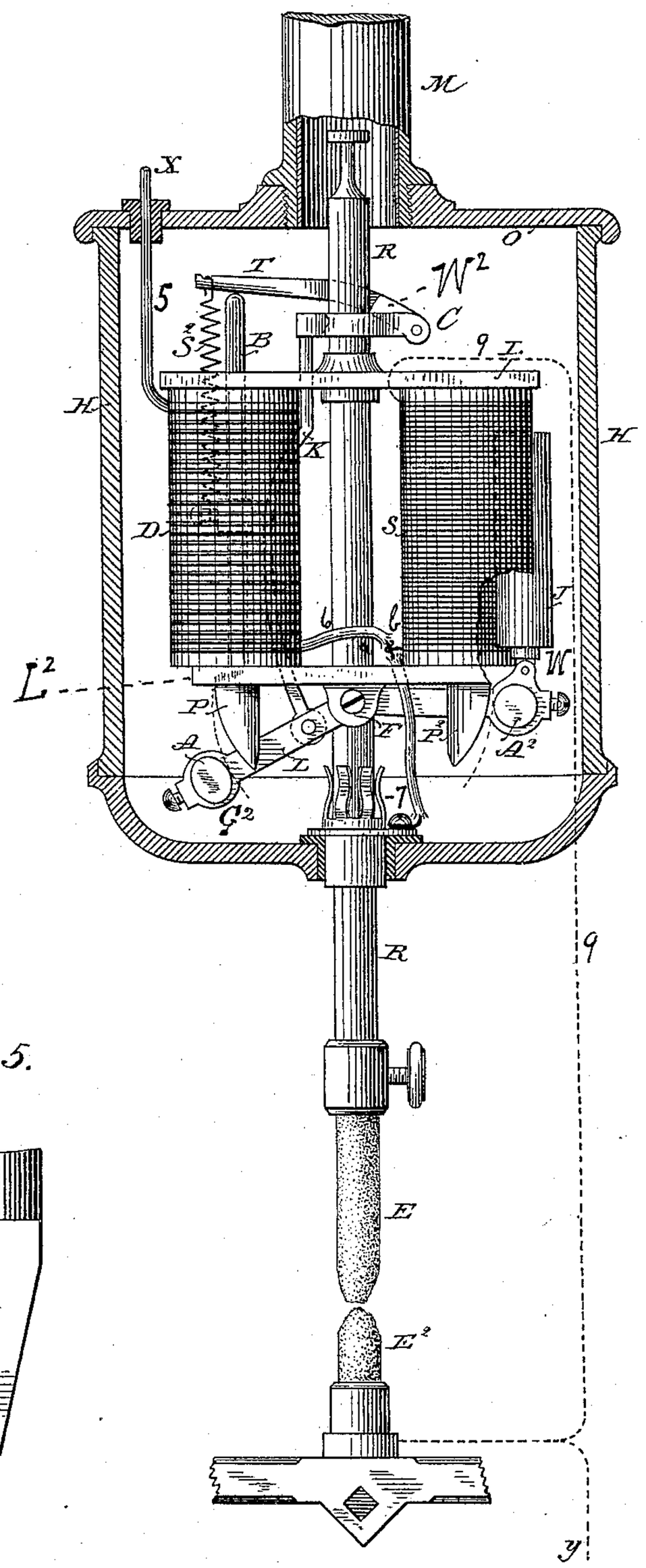


Fig. 5.

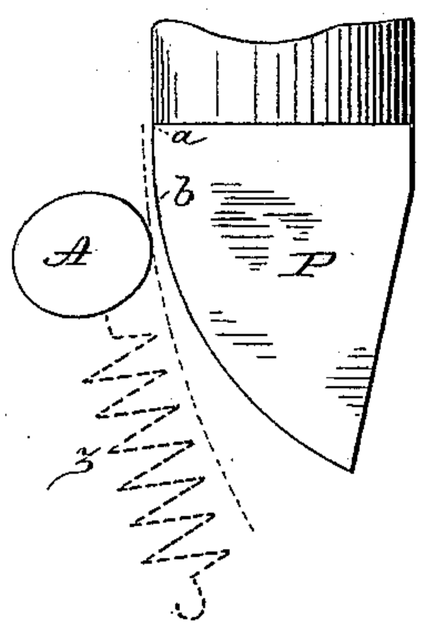
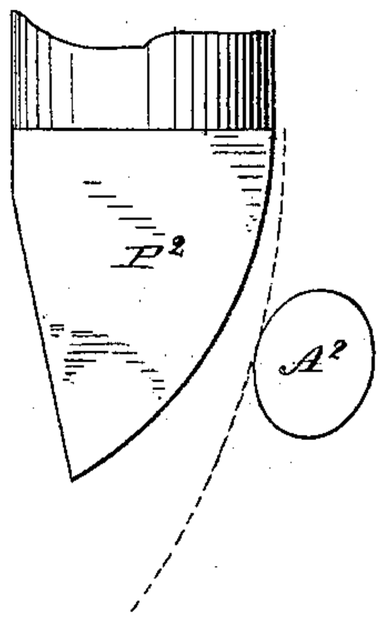


Fig. 6.



Witnesses:
Ernest Abshagen
Thos. Dooney.

Inventor:
Elihu Thomson
By his Attorney: H. C. Townsend

(No Model.) 4 Sheets—Sheet 2.

E. THOMSON.

ELECTRIC ARC LAMP.

No. 488,585. Patented Dec. 27, 1892.

Fig. 2.

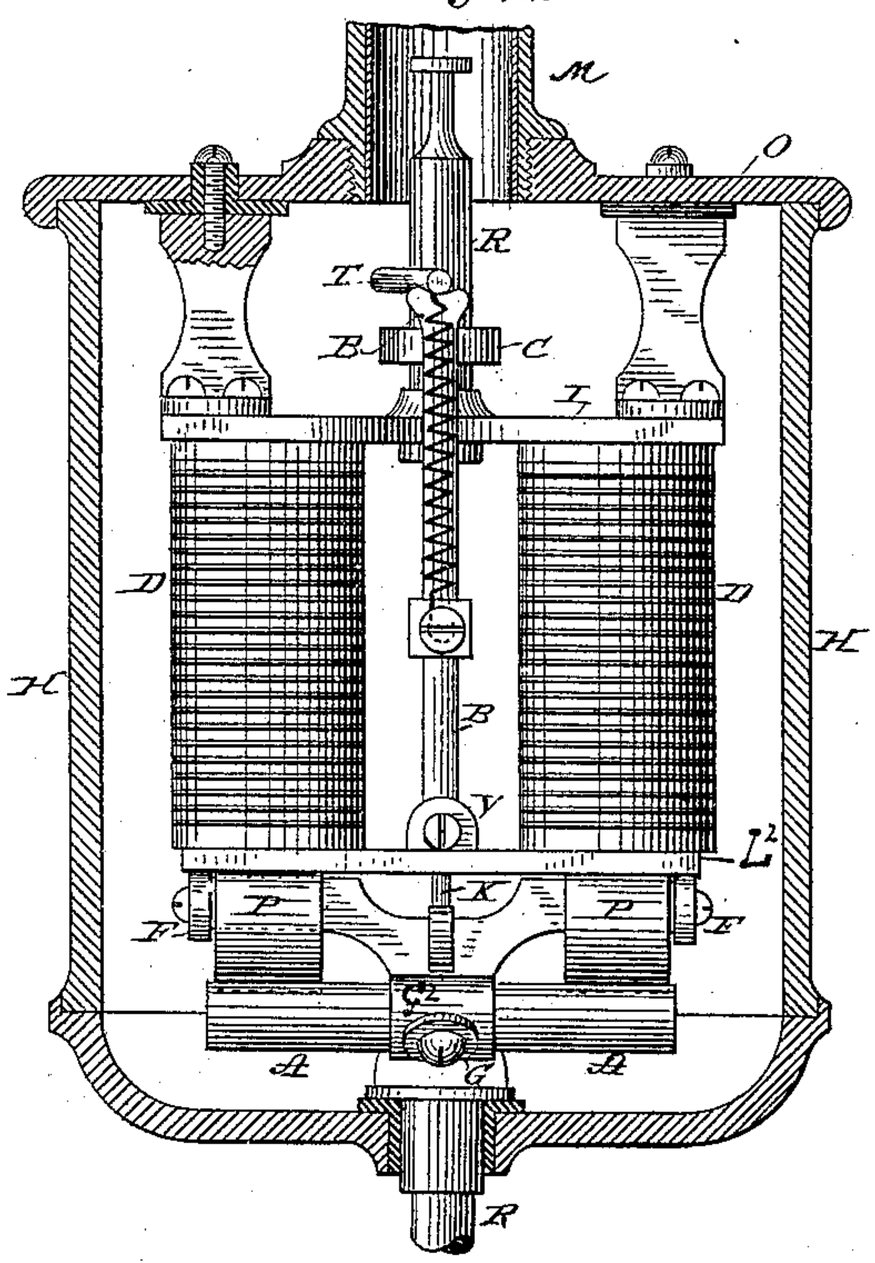


Fig. 3.

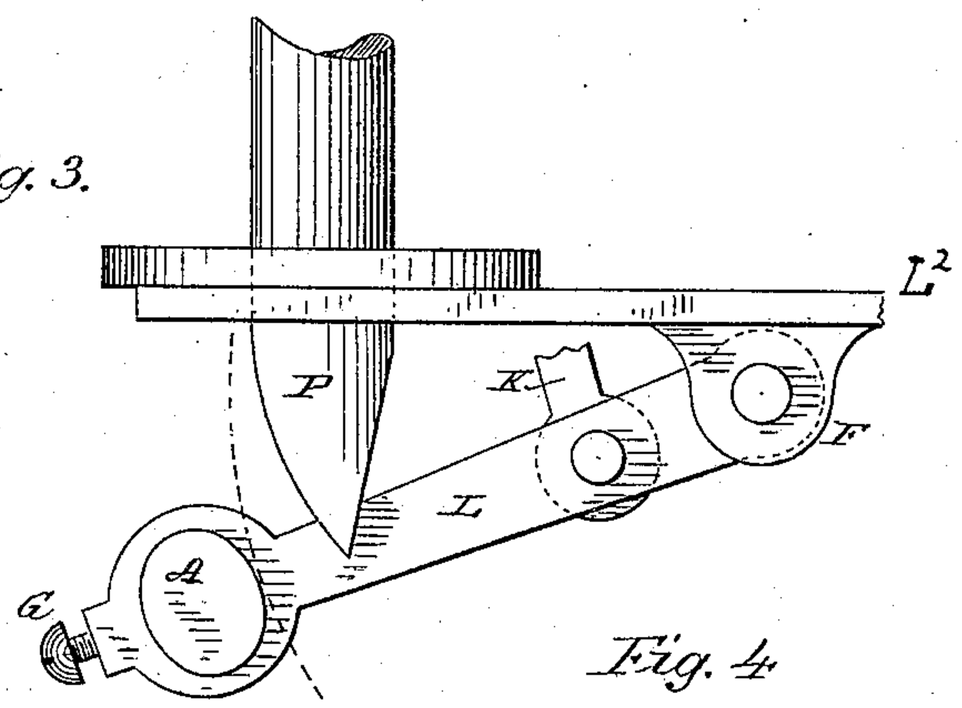
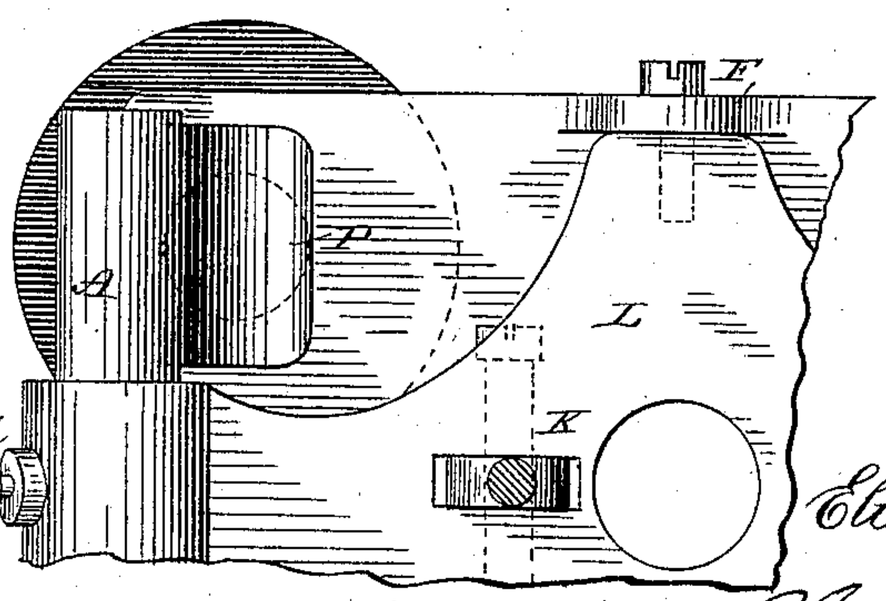


Fig. 4



Witnesses:
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Thos. Dromey.

Inventor:
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(No Model.) 4 Sheets—Sheet 3.

E. THOMSON.

ELECTRIC ARC LAMP.

No. 488,585. Patented Dec. 27, 1892.

Fig. 7.

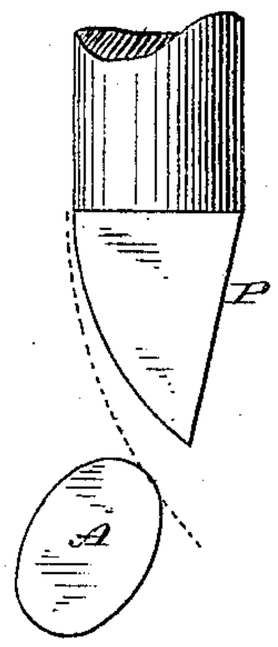


Fig. 9.

Fig. 8.

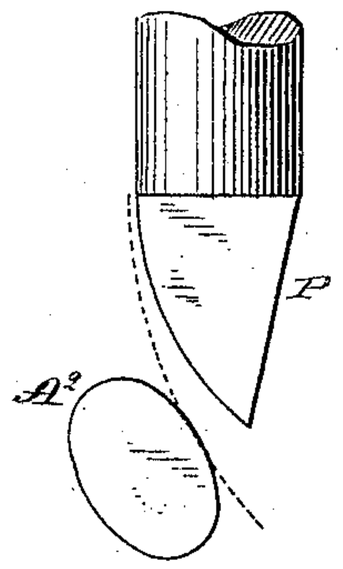


Fig. 10.

Fig. 11.

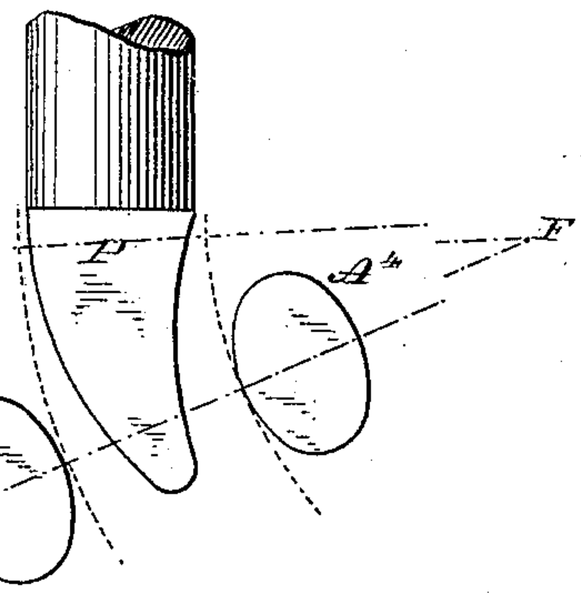


Fig. 12.

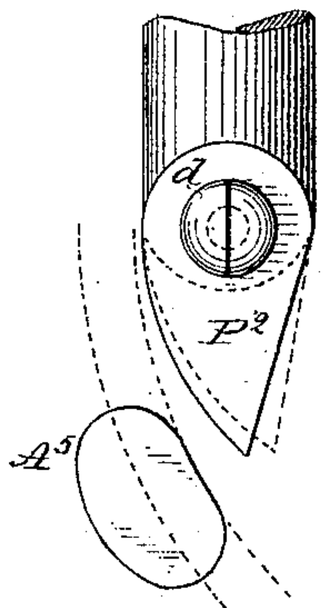


Fig. 13.

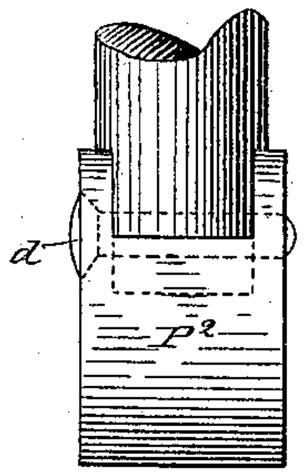
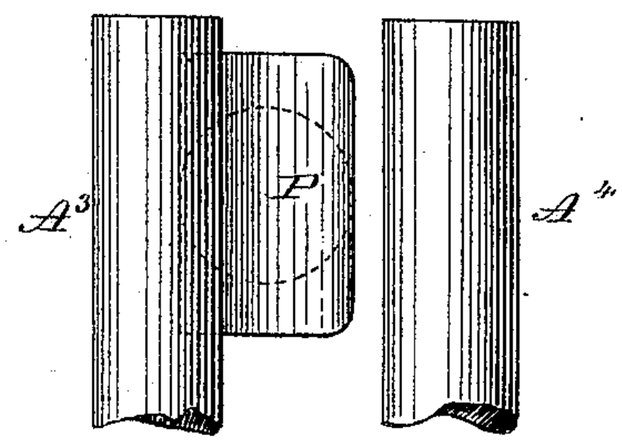
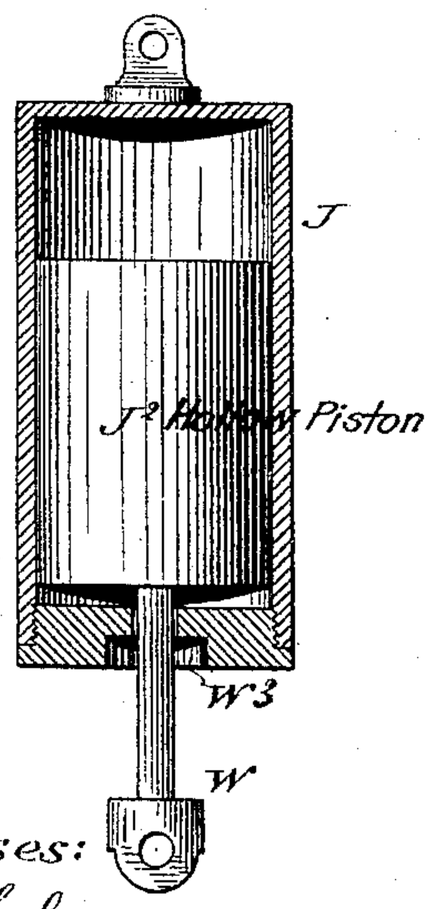
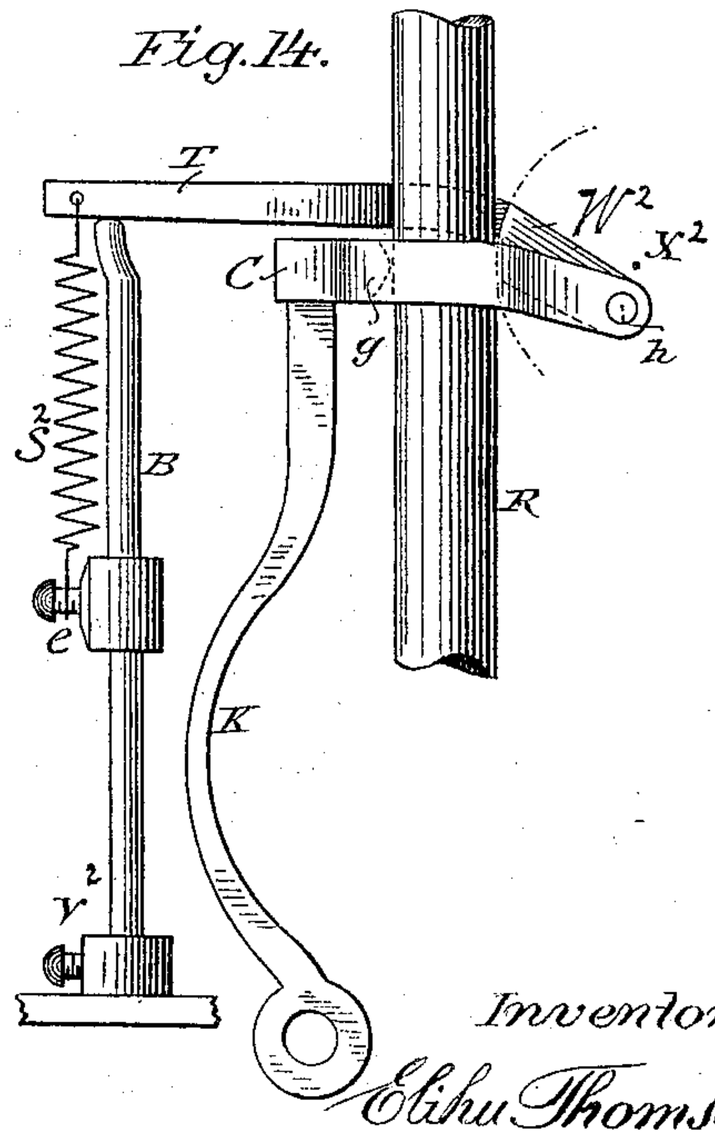


Fig. 14.







Witnesses:
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Thos. Dewey

Inventor:
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By his Attorney: A. G. Townsend

(No Model.) 4 Sheets—Sheet 4.

E. THOMSON.

ELECTRIC ARC LAMP.

No. 488,585. Patented Dec. 27, 1892.

Fig. 15.

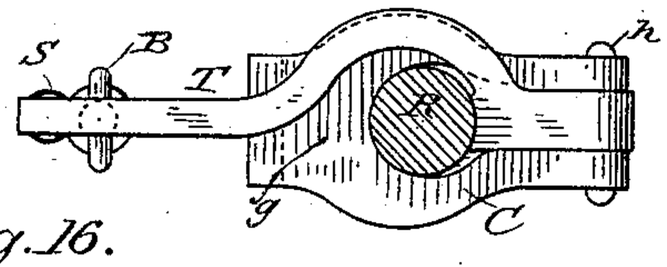


Fig. 16.

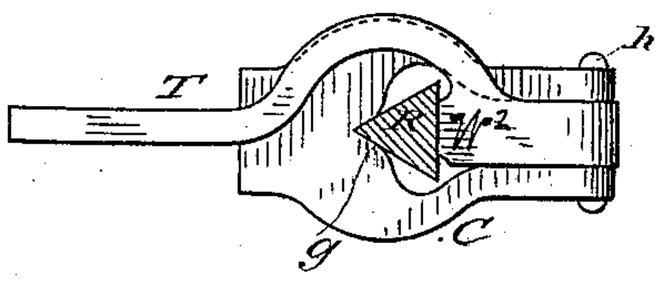


Fig. 17.

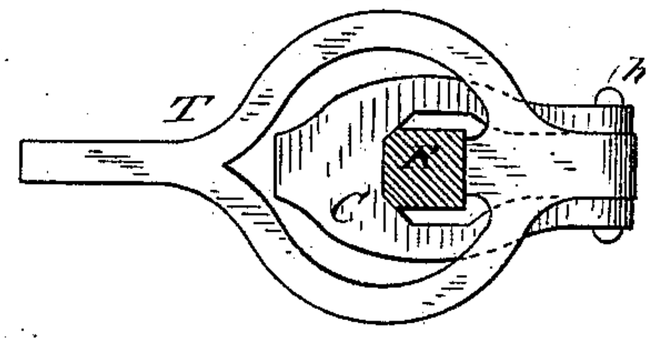


Fig. 18.

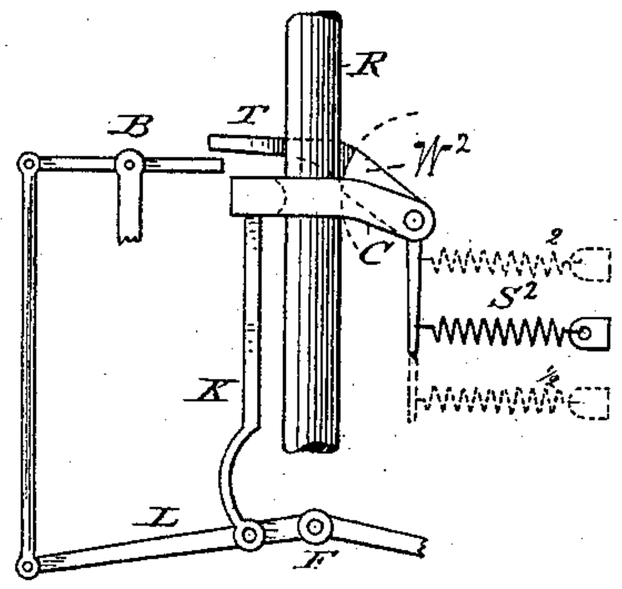


Fig. 19.

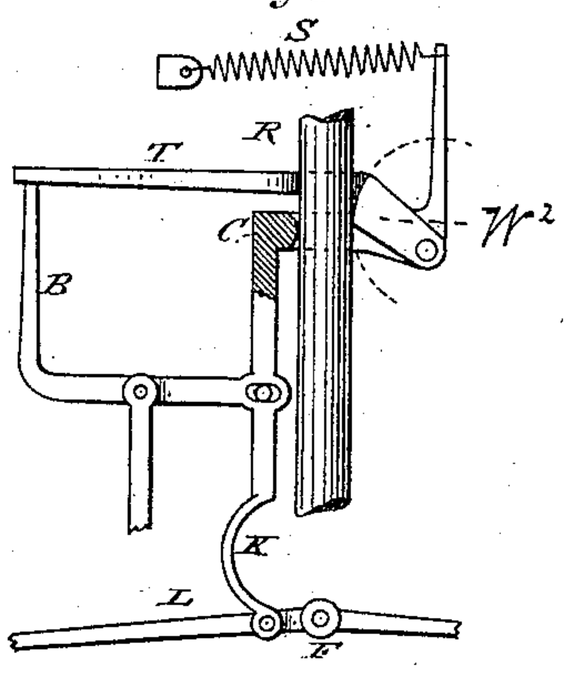


Fig. 20.

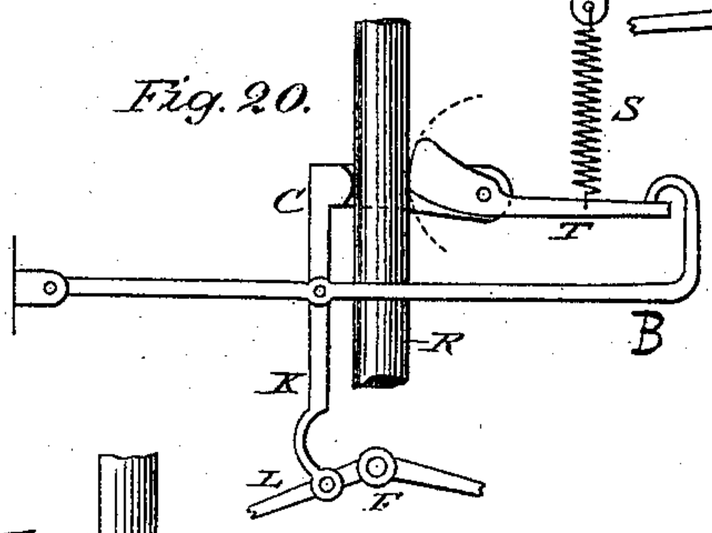
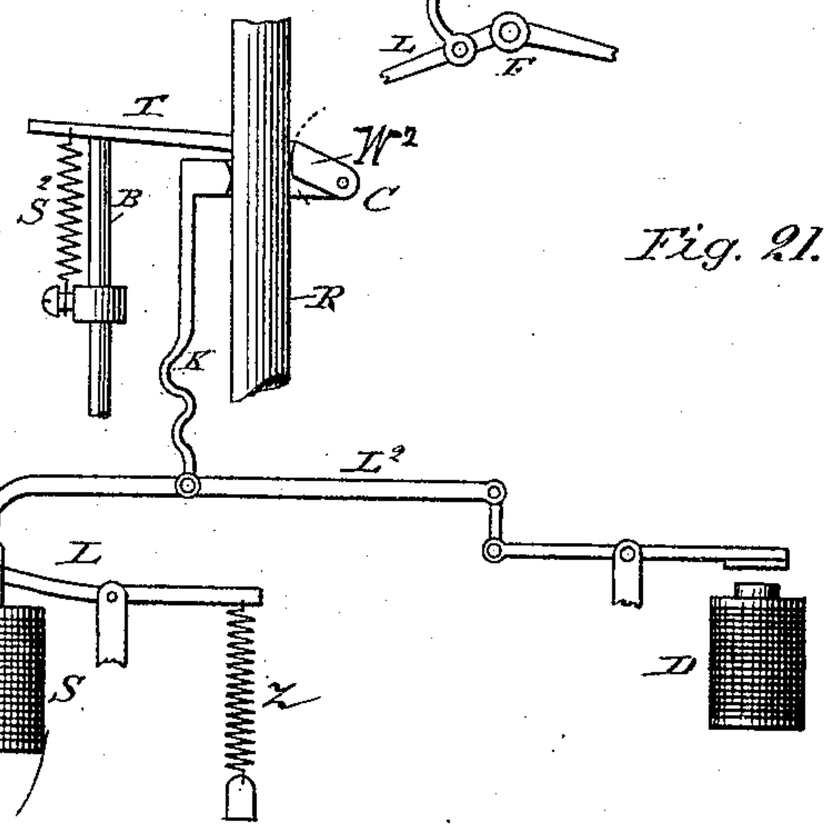


Fig. 21.



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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF NEW BRITAIN, CONNECTICUT, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF BOSTON, MASSACHUSETTS.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 488,585, dated December 27, 1892.

Application filed July 2, 1883. Serial No. 99,764. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of New Britain, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Electric Lamps, of which the following is a specification.

My invention relates to certain details of construction of electric lamps, and its object is to secure by mechanical means without the use of clock work or retarding mechanism an automatic friction, or self regulating feed for the carbon rod.

The object of my invention is more especially to secure ease and certainty of operation, and to these ends my invention consists in certain improvements in the form of the magnet system and in the construction and proportions of the clutch mechanism engaging with the carbon-rod or equivalent, the nature of which will be hereinafter more fully described and will be specifically stated in the claims.

In the accompanying drawings, Figure 1. shows in elevation a lamp embodying the features of my present invention. Fig 2. is a side elevation of the same taken at right angles to Fig. 1. Figs. 3 and 4. show in detail, in side view and plan, looking upward, the form of magnet pole and armature that I employ. Fig 5. shows in side view the armature and magnet pole for the main circuit magnet of a differential electric lamp and Fig. 6. the pole and armature of the derived circuit magnet. Figs. 7. 8. 9. and 11. are modifications of the magnet poles. Fig. 10. is a side view of the magnet pole shown in Fig. 9. Fig. 12. is a view of the pole and armatures of Fig. 11. looking upward. Fig. 13. shows in vertical section the form of dash pot that I prefer to employ. Fig. 14. shows in side view the clutch. Fig. 15. is a top view of the same. Figs. 16 and 17. show in plan modified forms of clutch. Figs. 18. 19. and 20. show modified dispositions of the clutch releasing stop and actuating devices therefor. Fig. 21. illustrates the application to the clutch of another magnet system.

Referring to Figs. 1 and 2. H. indicates the lamp frame or case, O. the cap piece therefor, and M. the usual tubular extension in which the carbon rod works, and which is by preference insulated on its interior surface by an enameled coating or other insulating material to prevent electrical contact of the carbon rod with the tube. A plate I. hung from the cap-piece O. supports the electro magnet of the lamp and other working parts.

D. D. indicates the direct magnet, and S. the derived circuit coils. These magnets are supported from the plate I. and their poles are connected by a plate L^2. of some non-magnetic material from which is supported a lever L. pivoted at F. and carrying armatures A. A^2. one for the main circuit magnet and the other for the derived circuit magnet. Lever L. imparts motion through a bent spring connection K. to a peculiarly proportioned clutch C. the distinctive characteristics of which will be described farther on.

J. indicates a dash-pot connected with lever L. and serving to prevent or check sudden movement of the parts. The plate I. before mentioned is preferably of iron, and serves as the connecting piece between the two cores of each magnet D. D. or S. S.

The circuits through the lamp are those usual with lamps having a differential magnet system, and are as follows: Starting from point X the main conductor 5. is joined to the main circuit magnet D. the other terminal of which magnet is connected by wire 6. with a spring contact 7. bearing on the carbon carrier. through which and the carbons E. E^2 the current passes to point *y*. The derived circuit magnet S. is in the circuit 9. taken from point *b*. on the main circuit wire 6. and rejoining the main circuit at point *y*. as usual. I have shown in Fig. 1. the magnets D. D. and S. S. as acting differentially on opposite sides of the pivot F of lever L. This however, is not essential to the working of the other parts of my invention, as the magnets might also act independently upon the clutch as described in other applications filed by me and as illustrated in one form in Fig. 21.

The peculiarities of the magnet system herein shown are especially designed to secure long range of movement for the armature and to also provide an adjustment whereby

any desired variations of attractive force in various positions of the armature may be obtained.

In Figs. 3 and 4. the pole P. of the magnet is shown as made with a rounded attracting face presented to the rounded side of the armature A. and the pivot F. for the lever L. is placed so that the armature A. will swing in the path shown in dotted line, never touching the pole P. but gradually approaching said pole less and less rapidly as it nears the extreme of its upward movement, I prefer to make the outline of the armature oval or irregular so that the magnetic effect may be varied by adjustment of the armature on or around its longitudinal axis, thus varying the form thereof as presented to the attracting pole P. and varying the curve of attraction as the magnet raises the armature. For this purpose the armature is mounted in a sleeve G^2, in which it may be turned around its longitudinal axis, and fixed so as to present any desired form to the pole P. by means of a set screw G. In the differential system I prefer to give the pole P. of the direct magnet a decreasing pull or lessened force as the armature approaches it while the pole P^2 of the derived circuit magnet S. is given a uniform pull or attraction for the same current in all positions of the armature. The difference in the shape of the poles by which this difference may be secured is illustrated in Figs. 5 and 6. The part of the pole P. is made flat or nearly straight at *a*. *b*. so as to be nearly parallel with the dotted curve of the armature's swing near the extreme upward limit of its motion. while the curve of the pole P^2. for the derived circuit magnet and the curve of its armature's motion are such that the armature constantly approaches the pole as shown. From this construction it results that as the lever moves under the influence of an increased current in the derived circuit magnet; the armature of the main circuit magnet is drawn down, but owing to the peculiarity mentioned, is placed in a position where it may exert a stronger retractive effect upon the lever. By employing a main circuit magnet that has a decreasing pull as it moves toward the magnet, excessive or violent movement in raising the carbon to form the arc is avoided. Other advantages from the combination will occur to those skilled in the art and versed in the practical operation of arc lamps. It is sufficient to say that in practice I find this combination exceedingly effective in securing a steady and sensitive action of the lamp, a gradual and delicate feed of the carbons, and an avoidance of sudden movement or fluctuations in the position of the carbons with relation to one another.

I do not wish to be understood as limiting myself to the particular form of magnet herein described, as any magnet that is properly constructed to have a decreasing pull as the armature or equivalent part moves forward under the influence of the current in the magnet coils, may be used in the place of that shown and described, my invention consisting broadly in the combination of a main circuit magnet formed or constructed in any manner known in the art to have a decreasing pull, and a derived circuit magnet that is suitably formed to have a uniform pull. Both poles can, however, be made like pole P^2. provided there be a restraining spring applied so as to act in opposition to the pull of the direct magnet pole P. as indicated at Z. This spring will, by the increased retractive force that it acquires on being extended, make the effect of P. in moving the armature A. a slightly decreasing one.

The oval or irregular outline given to the armatures permits of an adjustment of the balance *v*. between the magnets D. and S. when such balance is but approximate at first. This adjustment is secured by turning the armatures about their longitudinal axes as before described, so that they will present different exterior forms to the active surface or attractive face of the poles. Figs. 7 and 8. show examples of this adjustment; in Fig. 7. the armature is so adjusted as to present a short curve to the pole, while in Fig. 8. it presents a longer curve. An equivalent variation of magnetic effect. for obtaining a difference of pull between the pole and armature, as well as varied effects in different positions of the armature may be obtained by the arrangement shown in Figs. 9 and 10. In this case the pole P^2. is made adjustable upon a screw pin *d*. so that the proximity of the poles to the armature A^5. may be varied as indicated by the dotted line. By giving the pole P^2. a swinging movement on the pin *d*. and, when desired, a lateral play upon the support, all desired or necessary adjustments of the parts may be secured. Such lateral play may be given by making a loose fit of the pin in the pole.

Fig. 11. shows a pole piece of proper shape for use with two armatures A^3. A^4. moving in the arc of the circle around point F. and on lines indicated by the dotted arcs. The action is the same as in the instances already described the space between the armatures and the attracting pole faces undergoing a narrowing at a lessened rate as the armatures approach the poles.

The general construction of the clutch is clearly shown in Figs. 1. 14. and 15. Although I have described in prior applications in general terms a clutch of the substantial construction herein shown, I purpose in the present instance to give to the parts certain definite proportions which I find desirable in securing a uniform action in slowly feeding the carbon rod, and in also attaining great delicacy of operation with regard to the force necessary to produce a feed.

In constructing a clutch having the general mechanical principle of action of the clutch heretofore invented by me, it is necessary in order to obtain the best operation that the traverse or movement of the parts necessary

in order to obtain a release or feed of the carbons should be as small as possible, while at the same time in order to effect a release with certainty and delicacy of action the mechanical force required to produce such release when the clutch impinges against its stop should also be small. These two qualities are in a measure inconsistent with one another, a small traverse of the parts to produce a release, implying in this construction the exercise of considerable force to overcome the action of the spring which holds the clutch in engagement, because a small traverse of the regulating lever to effect this result requires that the releasing stop should impinge against the arm at a point not far from the fulcrum of the jaw and of necessity there is a mechanical advantage in favor of the spring and against the effecting of a release. On the other hand if ease of release be only kept in view the traverse necessary to effect a release becomes so great as to destroy the efficiency. It is also desirable that the clamping toe while being efficient in preventing a downward movement of the carbon rod at the proper time, should as little as possible have a wedging tendency and should be capable of releasing the rod on the exercise of a very small force on the releasing arm, against the action of the spring which holds the clamping toe against the rod. Having regard to these various requirements I have found by actual tests and after various experiments that the proportions and constructions hereinafter described are those well adapted to securing ease of release, delicacy of action, and at the same time certainty of operation.

C indicates the clamp body, W^2. a clamping jaw provided with an extension T. and pivoted in said body. S^2. a spring that tends to hold the jaw W^2. engaged with the carbon rod, and B. the releasing stop which is mounted in plate L^2. and may be set at any desired height by means of the set screw V^2. The spring S^2. is secured at one end to a collar indicated at *e*, which may be adjusted and set in any position on the rod D. so as to give to spring S^2. the desired initial tension. The clutch body C. is made to encircle or partly encircle the carbon rod R. as shown and has a small rounded bearing surface at *g*. Fig. 14. upon the opposite side of the carbon rod from pivoted jaw or clamp W^2. The latter is shown as pivoted upon a pin *h;* it is provided with a gripping surface described upon an arc forming a portion of a circle struck from a point X^2. nearly or quite vertical above the pivot *h*. and removed from said pivot approximately a distance equal to one-third the distance of said pivot from the side of the rod R. nearest it; the distance of pivot *h*. from the side of R. against which the jaw W^2. bears is approximately one-third to one-quarter the distance from said pivot to the point on the extended arm T. at which said arm comes into contact with the releasing stop B. The spring S^2. is attached to T. as near to the stop B. as practicable, and the elastic force of such spring as exerted upon the arm T. is substantially one-third to one-half the weight of the rod R. together with its appurtenances such as carbon clamp, and carbon. The stop B. may be set to release the clutch at any convenient point, but such adjustment will not disturb the adjustment of spring S^2. since the two are moved together. The bowed connection K. is curved so as to give it a slight elasticity and forms an improved elastic connection which has broadly been made the subject of prior application filed by me.

In Figs. 16. and 17. the form of the rod R. is slightly different; in Fig. 16. it is angular and the body C. is provided with a corresponding angular bearing recess. In Fig. 17, the general form of the rod is square.

The dash pot that I prefer to use is shown in Fig. 13. and consists of closed case J. closed at its top, in the interior of which is a long piston J^2. made hollow for lightness. The connecting head W. of the piston rod which is connected with lever L. Fig. 1. is made to close the end of the case J. as a valve at W^3, when the dash pot piston J^2. is in its upper position in the case when the lamp is out of use, thus effectually excluding dust from the interior of case J. The neck of the case J. is open only when in use and its upper end being shut no dust is liable to enter.

Several mechanical equivalents of the clutch are shown in Figs. 18. 19. and 20. In Fig. 18. the arm T. is shortened, and the spring S^2. is connected to a downwardly projecting arm through which it may be attached at any desired point, in such way as to produce upon the arm T. the same mechanical effect as the spring of Fig. 13, applied to give the relative force above defined. The shortening of the arm T. is compensated for by making the stop B. movable upward by lever L. and link connection so as to exert a lifting force upon T. as K. descends. K. may be also brought nearer to the fulcrum F. for the same purpose. The parts are so proportioned that the lever L. is called upon to exert the same force in relieving the clutch as it does in Fig. 13. so that in either case a given variation of the magnet strength will actuate the mechanism. In Fig. 19. the arm T. is lengthened and the stop B. made movable upward as K. descends but at a rate determined by the mechanical effect to be produced, so that the force exerted by the lever L. in releasing the clutch will be the same as in the preceding cases. In Fig. 20. the parts are a little differently arranged, but the same proportions to produce the same mechanical effects are to be observed.

The operation of the lamp Fig. 1. is as usual. On passage of current the armature A. is attracted closing the clutch C. and forming an arc, but its movement is restrained by the armatures A^2. acted upon by the pole of the derived circuit magnet. When the arc is lengthened by consumption of the carbons, the armature A^2. overcomes armature A. and

lowers the clutch till the arm T. comes against the stop B. when by virtue of the proportions of parts as set forth a slow slip or feed takes place and is maintained. An effective and practical feed may be produced by the arrangements herein described without resorting to clock work mechanism, or dash pot retarding devices attached to the carbon carrier or geared with it. I believe that I am the first to effect such a result.

My invention is not confined to what is known as the differential magnet system, and may be applied through a magnet system such as shown in Fig. 21. and as is substantially shown in other applications for patents filed by me. In this case the direct magnet D. is an ordinary magnet acting to raise one end of a bar L^2. with which the spring lifting arm K. is connected, its action in this particular taking place without any movement on the part of the armature for the derived circuit magnet S. whose armature is connected to the opposite end of the bar L^2. The clutch C. is thus lifted so as to form the arc and is held in such position until the arc lengthens, when the derived circuit magnet moves its armature against the action of a spring Z. and lowers the end of L^2. to which it is pivoted, so as to lower the clamp and cause a feed of the carrier to take place. This action takes place independently of the magnet D. whose armature remains attracted after it has been drawn down so as to form the arc. No claim is made herein to such combination of independently acting magnets, as it forms the subject of another application for patent already filed by me.

What I claim as my invention is:

1. The combination in an electric lamp, of a derived circuit magnet and a main circuit magnet pulling against one another on the same regulating lever said derived circuit magnet having a uniform magnetic power for the same strength of current in all positions of its parts while the magnetic power of the main circuit magnet decreases as the armature approaches the end of its movement under the influence of the current in the said magnet coils, as and for the purpose described.

2. The combination in a differential lamp, of a main circuit magnet whose pole piece has an attracting face curved as described, so that near the extremity of its armature's movement it will cease to approach the pole, and a derived circuit magnet having a curved attracting pole and armature swinging past the face thereof, the curve of the attracting face being made in the manner desired so that the armature shall gradually approach the pole through its whole range of movement, as and for the purpose described.

3. The combination with the feed controlling devices in an electric lamp, of a governing electro magnet having curved attracting pole, and an armature therefor arranged to swing in a curved path whose general direction is parallel to that of the attracting pole face, said armature being adjustable about an axis parallel with the attracting pole face but transverse to the path described by the armature, whereby its form and mass as presented to the pole may be varied.

4. The combination with the carbon carrier for an electric lamp, of a clamp body surrounding the carrier, a pivoted clamping jaw pivoted on said body, and a clamp face or surface on the jaw curved on an arc of a circle drawn from a center nearly or quite vertical above the pivotal point of the jaw.

5. The combination with the carbon carrier, of a pivoted clamp jaw having a clamping surface curved on the arc of a circle described from a point vertically above the pivotal point, and removed therefrom approximately one third of the distance of said pivotal point from the side of the carbon carrier.

6. The combination with the clamp and its operating armature of the intermediate elastic bowed connecting piece K, as and for the purpose described.

7. The combination with the carbon adjusting mechanism of the inverted air dash pot cylinder connected therewith, a fixed or stationary piston and rod, and a valve upon the piston rod and exterior to the cylinder for preventing ingress of dust when the lamp is out of action.

8. In an electric arc lamp, a pivoted clamping jaw having a curved biting surface curved on the arc of a circle described from a center above the pivotal point of the jaw, and having a radius less than the distance of the pivot from the surface with which the jaw engages.

Signed at New Britain, in the county of Hartford and State of Connecticut, this 29th day of June, A. D. 1883.

ELIHU THOMSON.

Witnesses:
W. O. WAKEFIELD,
JAMES F. MEECH.