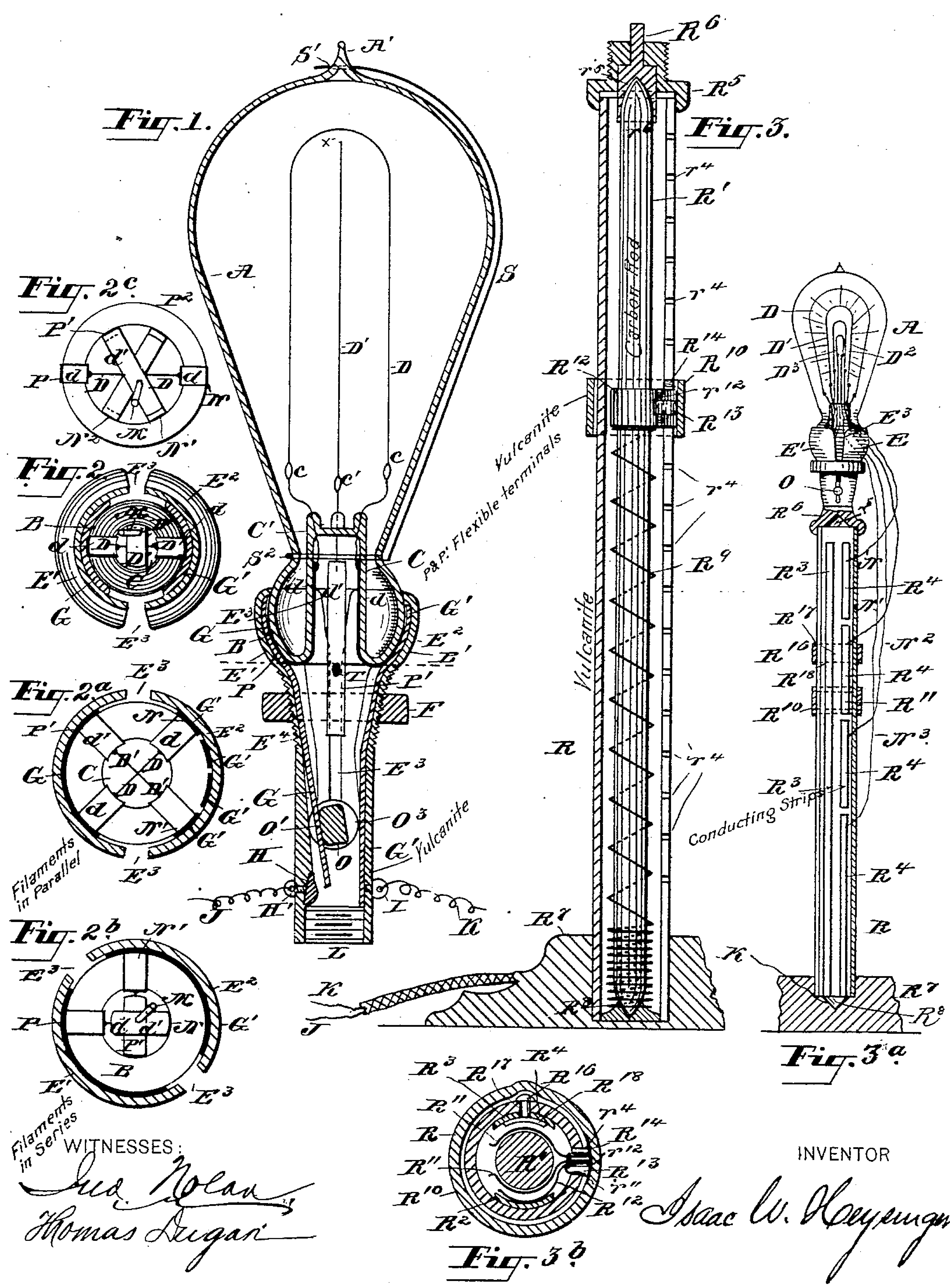
(No Model.)

2 Sheets—Sheet 1.

I. W. HEYSINGER.

ELECTRIC INCANDESCENT LAMP AND ATTACHMENTS.

No. 389,888. Patented Sept. 25, 1888.



WITNESSES:

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(No Model.)

2 Sheets—Sheet 2.

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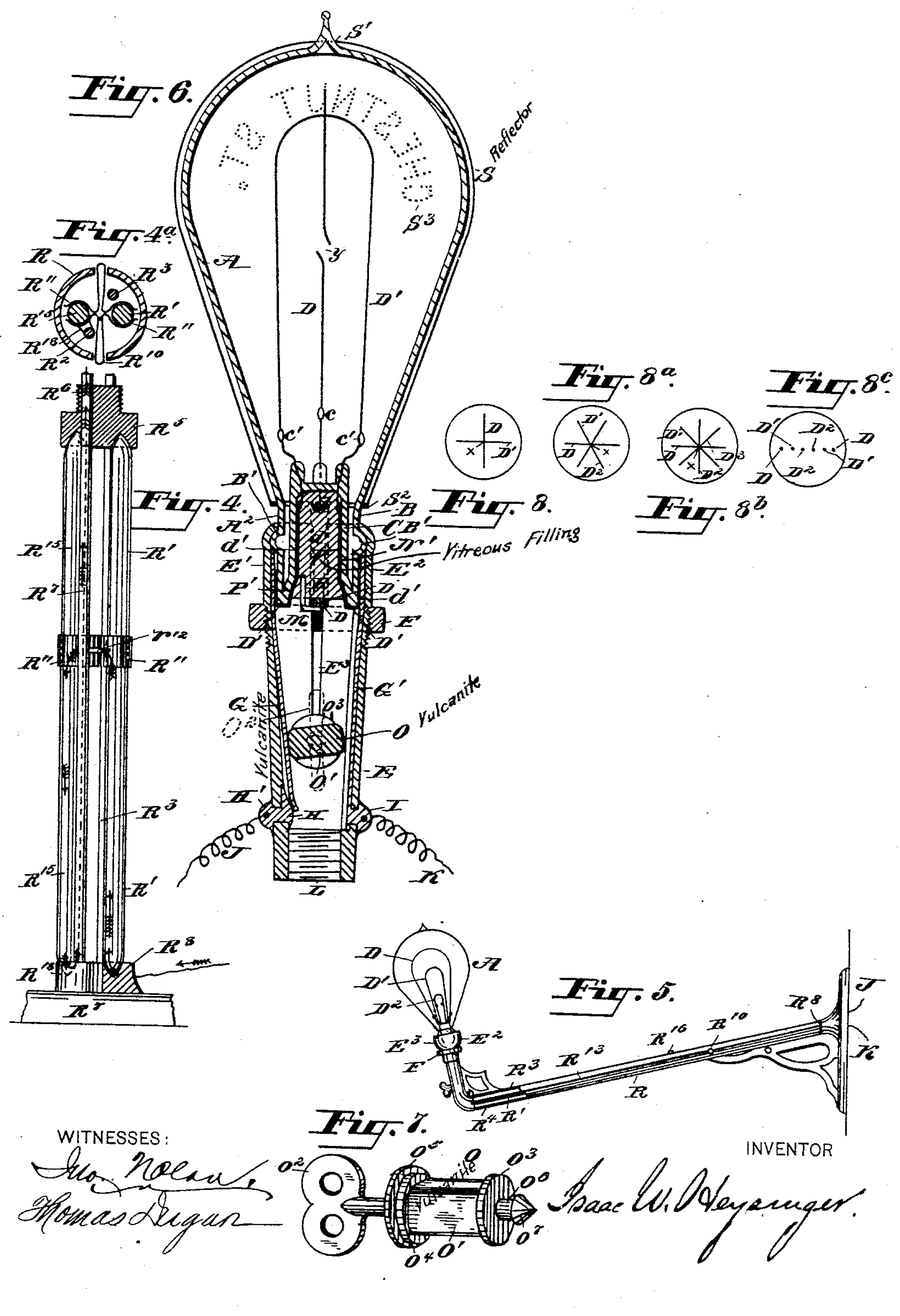

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ELECTRIC INCANDESCENT LAMP AND ATTACHMENTS.

SPECIFICATION forming part of Letters Patent No. 389,888, dated September 25, 1888.

Application filed March 31, 1887. Serial No. 233,110. (No model.)

To all whom it may concern:

Be it known that I, ISAAC W. HEYSINGER, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have made certain new and valuable Improvements in Electric Incandescent Lamps and Attachments, of which the following is a full, clear, and exact description, reference being had to the drawings accompanying and forming a part of this specification, in which—

Figure 1 is a vertical transverse section through a lamp and holder embodying my invention, and showing, also, the key O. Figs. 2, 2^a, 2^b, and 2^c are views from beneath the lamp, showing the arrangement of the flexible current-connections. Figs. 3 and 3^a are vertical sections of the rheostatic lamp-stand applied to table use. Fig. 3^b is a cross-section of Fig. 3 through the slide R^{10}. Figs. 4 and 4^a are nearly similar views of a stand having a double rod of carbon to multiply the adjustable resistances. Fig. 5 is a side view of a lamp, current-arrester, and adjustable resistance-rod, showing my invention as applied to a wall-bracket. Fig. 6 is a view similar to Fig. 1, except that a fixed joint is used instead of a ball-and-socket joint. Fig. 7 is a perspective view of the current-arresting key which turns on or off the electricity from the lamp. Figs. 8, 8^a, 8^b, 8^c show the arrangement of the duplicate carbon filaments in various ways.

The lettering in all the figures is uniform.

The first part of my invention consists in providing the glass bulb or body, which in an incandescent electric lamp is exhausted of air and contains the illuminating carbon filament or filaments, with a spherical neck beneath, through which neck pass the positive and negative conducting wires to supply the carbon filament with electricity, and fitting the said spherical neck to an oppositely-concaved holder, the concavities of the two sides being closed upon the spherical neck, so as to give a ball-and-socket motion and permit the lamp to be rotated upon the said ball-and-socket joint, so as to deflect the same from an axial line, and in so applying the conducting-wires of the lamp to the holder that connection shall not be necessarily broken when the lamp is tilted to one side or the other upon said joint.

The second part of my invention relates to the specific mechanical devices by which I make the lamp detachable from its socket, in which I use a vertically-cleft holder for the neck of said lamp, the inner sides of the opposite segments being provided with internal conducting-surfaces and the outside of the neck with conducting-surfaces connected with the carbon filament or filaments, the said conducting-surfaces of the lamp and of the holder being held in apposition by the drawing together of the cleft opposite sides of the holder against the said neck, and also in the use of mechanical means for insuring this contact to complete the circuit in the lamp.

The third part of my invention consists in providing an electric incandescent lamp, consisting of an exhausted bulb elongated in its axial direction, having one end devoted to the radiation of light from a looped or horseshoe-shaped carbon filament, the said filament doubled upon itself so that the positive and negative connecting-wires shall enter the bulb at the same end of the bulb side by side, with more than one carbon filament extending from the same neck up into the body of the lamp, the loops at the bent ends of the horseshoe crossing each other without contact, and the negative connection passing out at the said neck alongside the positive connection, so that connection may be made from a single socket with any carbon in the series of those contained within the body of the lamp, and also in making the said lamp thus provided with a multiple series of carbons readily detachable from its socket, so that any carbon in the series may be put into circuit and any other thrown out of circuit, and the said carbons may be made incandescent either by parallel currents or in series, as may be desired; also, in the special construction of the conducting-wires of the said filaments where they project from the said neck, whereby the same may be bent by hand into various positions, in which, when the said lamp is inserted in its socket, one, all, or none of the carbons may be in circuit, as may be desired.

The fourth part of my invention consists in the construction of a special rheostat, which I use with my lamp to regulate the intensity of the light, and which consists of one or more rods of carbon and one or more parallel conducting wires or rods extending up to the lamp from a stand, bracket, or other support, and having a slide of conducting material adapted to be moved longitudinally along the said carbon-resistance rod or rods, so as to bring a greater or less length of the same into the circuit, the said slide being electrically connected with one of the conducting-wires of the main supply system preferably through a parallel conducting rod extending from the wire of the main circuit alongside the carbon rod or rods, the slide serving as a movable bridge to connect the conducting rod or strip and the carbon-resistance rod or two carbon rods together, so that as the said slide is moved to or fro along the same it will cut out or insert more or less of the said resistance rod or rods, the current being thus differentially regulated as the slide is moved along the rod, the slide being connected with a thumb-piece preferably to operate the same; also, in providing, when desired, a duplicate return-wire, one part continuous and one part sectionally divided, and connecting the same by a sliding bridge, so that, different carbon filaments being connected with the different sections, as the cut-off slide is moved to or fro, it will cut out or insert the carbon filaments of the lamp successively with relation to the circuit, and in the special construction and arrangement of the parts, as will be hereinafter described.

The fifth part of my invention consists in the use of a current arresting or supplying key, which controls the insertion of the lamp in the circuit, in which the key is provided with a sectionally-angular periphery and a spring contact-piece resting against the angular sides of the key alternately, the said sides being so constructed that one face will hold the spring-piece in contact with a circuit-wire and complete the circuit, and, when the key is partially rotated, a succeeding face, lying nearer the axis of the key, will cause or allow the spring contact-piece to be withdrawn, so as to cut the lamp out of circuit, the rotation of the key alternately breaking or making contact, and also the special construction hereinafter described.

Referring to the drawings, in Fig. 1 is shown an ovoidal glass bulb, having a contracted part, A^2, below, and expanded beneath the neck to form a nearly spherical body, cut away transversely below and hollow within, having hermetically sealed within it, to its lower periphery, the internal tube, C, which extends up through the neck and at its upper end has a number of platinum wires hermetically sealed through the same, so as to project into the bulb A above, and also project below into the cavity of the tube C, which is open from beneath, where its outer margin has been fused fast to the lower edge of B.

To the upper ends of the platinum wires are attached, at *c c c′ c′*, carbon filaments, which extend up into the body of the bulb A, and are bent back in the form of a horseshoe, (so called,) so that the opposite ends of each filament have their terminals presenting into the neck B, which occupies one end of the bulb A. In Fig. 1 I show two of these horseshoe-shaped filaments, which occupy vertical planes at right angles to each other, so that their terminal wires *d d d′ d′* would present at the four corners of a square figure, when looked at from beneath the neck B, as is clearly shown in Fig. 8. In Fig. 8^a I show three such filaments, and in Fig. 8^b four, occupying intersecting vertical planes, their terminals forming the angles of a regular polygon in each case, having the positive and negative poles at opposite sides of the same. In Fig. 8^c I show these multiple filaments arranged in the same plane; but I do not consider this position of the filaments so good for general use, though it may have certain advantages for special purposes, as will be hereinafter explained.

The platinum wires (see Figs. 1 and 6) inside the tube C are soldered or otherwise attached to flat strips of copper, P N P′ N′, which are made comparatively broad, but very thin and non elastic, so that they may be readily bent inward or outward. They project from the lower or open end of C, around the sides of the tube, and I usually fill the open tube C with an insulating and heat-resisting substance, as shown at V, Fig. 6, which serves to hold the flat copper strips in place without contact, and also forms a seat for the little piece of bent wire M, (see Figs. 2, 2^b, 2^c, and 6,) which holds the copper strips when not in use. Instead of this clip M, I sometimes bend the flat strips of copper together; or if they are quite inelastic they will lie flat of themselves, though some slight elasticity is found in all copper, and is useful in insuring accurate contact when the strips are bent out to complete the circuit. The strips of copper P N, thus projecting to a considerable distance from the open end of C, are all bent inward to overlap each other, as shown in Figs. 2 and 2^c, and the clip or turn-button M holds them flat against the insulating substance V, Fig. 6, which fills the tube C, except the two opposite strips P N, which are bent outward and upward around the lower part of the neck B, as shown in Figs. 1 and 6. When these are put into a suitable clamp, as the neck is inserted therein contact will be made with any contact-pieces on the inside of said clamp, and a current will pass through one jaw of the clamp, through P *d c* D, and back through N, and find exit through the opposite jaw. The construction of this holder is shown in Fig. 1. It consists of an elongated tube, of vulcanite or other suitable substance, properly insulated, which is split vertically on the two opposite sides, as shown in Figs. 2, 2^a, and 2^b. This vertical cleft extends down far enough to allow the sides to open and close, and the opposite jaws at their upper ends are concaved to fit the sphere of the neck B. At F, Figs. 1 and 6, is a slide or screw collar, which engages with a tapered screw upon the holder E, so that as the collar is screwed up or down it will bring the opposite jaws E′ E^2 firmly together, or allow them to be opened to admit the neck B of the lamp A. On the concave inner sides of these adjustable jaws E′ E^2 are conducting-strips G G′, (see Figs. 1, 6, 2, 2^a, and 2^b,) which extend down vertically through the holder, but are insulated from each other, being firmly secured to the inner sides of the opposite jaws and preferably concaved to conform to the internal curvatures. I usually form my vulcanite holder upon these as a core or part of the core in the process of manufacture. At the lower parts of these conductors G G′ connection is made with the electric-supply service. It is now obvious that if the lamp A be inserted by its neck B into the socket E′ E^2, and the collar F be screwed up, the jaws will be brought down upon the spherical neck B, and the flat strips P N, lying upon the outer and under sides of the said neck, will be forcibly compressed against the inner sides of the conductors G G′, and the lamp will be put into the circuit if the supply-wires are charged with electricity.

It is also evident that the lamp-body A may be tipped to one side or the other, so as to stand at various angles with its support without breaking electric contact, and also that an accidental blow, which would break the glass body of a fixed lamp, would merely push the present one aside in its ball-and-socket joint. When the carbon filament D, Fig. 1, has been exhausted or broken, as is shown at *y* in Fig. 6, it will only be necessary to turn down the collar F, take out the lamp, bend the flat strips P′ N′ outward, and reinsert the lamp, when the filament D′ will take the place of the exhausted carbon, and the life-time of the lamp will be doubled. So, also, with the carbons D^2 and D^3, Fig. 8^b, to whatever number the lamp may contain. As the carbons are exceedingly thin, the loss of light by mutual obstruction is practically imperceptible, especially as their glossy surfaces reflect a large proportion of the light thrown upon them. Since the insertion of the filaments is an extremely small part of the total cost of an incandescent electric lamp, with its cost of material, except the carbons and wires, the manipulations, testings, &c., and bulk and weight, the same whether one or more carbons be used, and since the most serious inconvenience in incandescent lighting is now the loss of lamps by exhaustion, it will be readily seen that the lamp herein described presents many advantages in use.

The copper strips P N P′ N′ P^2 N^2 may also be used in other ways, as shown in Figs. 2, 2^a, and 2^b. In Fig. 2 the clefts between the jaws E′ E^2, and more especially between the concave conductors G G, are much enlarged. In such construction the lamp A can be turned down laterally to a right angle with its original axis, and the strips P N and P′ N′ may be left turned outward, as shown in Fig. 6, only P′ and N′ being in contact with G and G′, so that a rotation of the lamp A in its socket will bring into circuit the opposite strips, P N; but as it is often desirable to change the plane of the carbon without disturbing the contacts I usually prefer to make G G′ large enough to allow for such turning of the lamp in its socket.

In Fig. 2^a P N and P′ N′ are both in parallel circuit, which will double the volume of light, but leave no spare carbon, while in Fig. 2^b the strips P N P′ N′ are so bent as to put the two carbons D and D′ into circuit at the same time, but in series, so as to double the resistance and correspondingly diminish the intensity of the incandescence. The flexibility and adjustability of the strips P N P′ N′ P^2 N^2, &c., permit various modifications, which will readily suggest themselves when desired.

In Fig. 6 is shown a lamp substantially similar to that shown in Fig. 1, except that the ball-and-socket joint has been replaced by a cylindrical neck, B, and socket E′ E^2, and a bead, B′, formed upon the cylinder B to correspond with an internal groove in the jaws. This will hold the lamp securely in one position, which, for many purposes, may be desirable. I sometimes also dispense with the bead B′, and hold the neck in its socket by a secure clamping alone of the screw F. It is seen that when the collar is withdrawn the jaws stand apart to give ready entrance to the neck of the lamp. Of course they may be partially closed when the collar is withdrawn; but I prefer to have them stand apart until brought together by the movement of the collar along their external sides.

It will be seen that my lamp is made entirely of glass, fused into one body, except the insulating substance V in the open tube C, which may be dispensed with if desired. The neck, however, may be made separately and afterward attached, though in the form shown it is cheaper to make, lighter, less liable to heat, and more sightly and desirable.

It may be well to state that should the carbons accidentally touch no short-circuiting would result if all the insulations are perfect, as the extra carbons are entirely cut out, and one or the other poles, P P′ P^2 or N N′ N^2, may be permanently in contact with each other without interference, the current merely passing over the carbon having both poles in contact; but it is practically much better to keep them separate to avoid accidents of insulation, and for other reasons.

In Fig. 3 is shown a stand upon a table, and in Fig. 5 a branch arm extending out from a wall, both of which are adapted for use with my improved lamp by their construction, as will be now explained. In Figs. 3, 3^a, and 4 the lamp-stand rests by its base R^7 upon a table, and has an upright, R, to the upper end of which the lamp support or socket R^5 E is attached. (See Fig. 3^a.) The upright R is preferably hollow, like a tube, slotted longitudinally, Fig. 3^b, and to the concave inner sides are attached on opposite sides of the tube two longitudinally-extended conducting strips or rods, R^2 R^3, one of which is attached at its lower end to the positive supply-wire of the circuit, but disconnected at the top, and the other to the negative wire of the supply-circuit at one end and to the negative pole of the carbon of the lamp at the other. Occupying the middle of the tube is a rod of carbon, R′, electrically connected at its upper end, R^6, with the positive pole of the lamp, but not in contact with the strips R^2 R^3 at any part of its length. Clasping this carbon rod R′ on the two sides are two curved spring-fingers of conducting metal, R^{11} R^{11}, which are free at one end but soldered or riveted together at their opposite ends, where the combined ends pass through the slot and are attached to the thumb piece or slide shown in Figs. 3, 3^a, and 3^b as a ring encircling the tube like the slide of a propelling-pencil and in Figs. 4, 4^a, and 5 as a laterally-projecting stud or plate, R^{10}. To the spring-piece of R^{11} R^{11} is also attached a third flat spring, R^{12}, which, instead of clamping inward against the carbon rod R′, springs outward to slide along in contact with the positive strip R^2. It is now obvious that a current passing up the strip R^2, which is a good conductor, will cross over the bridge formed by the springs R^{12} R^{11} R^{11} to the carbon rod R′, which forms its only outlet, the conducting-strip being insulated at the top and the carbon rod at the bottom. On reaching the carbon rod R′ it will flow up through the same with a resistance proportionate to the length of carbon in the circuit—that is to say, when the slide R^{10} is at the upper end of the support the contact of the springs R^{11} R^{11} will be with the metal r^6 of the terminal R^6, and the current will pass with only the resistance of a copper conductor; but as the slide R^{10} is slipped downward the springs R^{11} R^{11} R^{12} will slide along the contacts R^2 R^7, gradually lengthening the carbon rod in the circuit until, when the slide has reached the base R^7, the whole carbon rod will resist the passage of the current, and the lamp above will be extinguished or have its illumination greatly diminished, in accordance with the length and thickness of the carbon rod R′.

I usually use a simple arc-light carbon, having, however, no metallic surface, which makes a cheap and effective resistance. The eye readily determines the proportionate movements of the slide without the use of an index or other indication, as half-way down means half the quantity of electricity, and in the same proportion for other distances. I show at R^9 a light coiled spring, which rests against the under side of the springs R^{11} R^{11}, so that on a lamp-stand the upward pull of the slide may not tip over the lamp, and when I use such spring R^9, I usually notch one side of the slot at r^4 r^4 r^4 r^4, &c., and provide a small spring, R^{13}, Figs. 3 and 3^b, which, by impinging against the opposite side of the slot, will serve to twist the thumb-piece R^{10} and throw the stop R^{14} into the catches r^4, from which it is disengaged by a slight rotation of the thumb-piece R^{10} upon the rod R′; but in Figs. 3^a, 4, and 5 I do not use such spring R^9, but rely on the friction of the springs R^{11} R^{11}.

In Figs. 4 and 4^a I show two carbon rods, R′ R^{15}, and the course of the current is shown in Fig. 4. It passes up from the block R^8 into the rod R′, crosses over the bridge R^{11} r^{12} R^{11}, down rod R^{15}, and then turns and passes up the copper rod or strip R^{17}, through the connection R^{18}. The negative current returns through R^3. The carbon rods are insulated above at R^5, and their connections are insulated below. The case of the stand is not shown in Fig. 4. It will be seen that each movement of the slide R^{10} in Fig. 4 doubles the insertion of the resistance-bars R′ R^{15}.

Instead of two rods I sometimes use three, four, or more, and I use this sliding rheostat for other purposes besides the regulation of electric lamps, and I vary the construction at pleasure without departing from the principles herein explained.

The heat due to resistance of the current passes off by the atmosphere through the slots in which the slides reciprocate. The negative conducting-wire of this regulator I make either single, as shown in Fig. 4, or double, as shown in Figs. 3^a and 3^b. When made double, one side, R^3, Fig. 3^a, is made continuous from end to end, and is electrically connected below with the negative supply-wire of the circuit K, and insulated above by the insulating-block R^5, and the parallel wire or strip R^4 is divided into sections R^4 R^4 R^4 R^4, each of which is insulated by attachment to the insulating-support R, and each of which is connected electrically with the negative jaw of the lamp-holder E^2, which contains a conductor divided into as many separately-insulated segments as there are blocks or sections in R^4. In Fig. 2^a will be seen four of these segments, all marked G′. In Fig. 3^a the outside wires N N′ N^2 N^3 represent these connections; but in practice they are not such external wires, but are internal strips not visible, being shown as they are in the figure to render the description more clear. These strips, one continuous, R^3, and one divided, R^4, are connected by a transverse spring slide or bridge, R^{18}, and this extends to the outside of the case R by a projection, R^{17}, and a stud, R^{16}, (see Fig. 3^b,) or the projection may be a ring, as shown in Fig. 3^a.

The little spring-slide R^{18}, as shown in Fig. 3^b, may pass through the ring R^{10}, its motion being independent of R^{10}; or, if constructed as shown in Fig. 3^a, the ring R^{16} cannot be moved down without carrying before it the resistance-slide R^{10}. The lamp shown in Figs. 3^a and 5 contains a number of carbon filaments, arranged in the same plane, as shown in Fig. 8^c. The carbon filaments, however, are each one-fourth shorter than the next outer one, so that each will present one-fourth less resistance—approximately speaking, of course. It will now be seen that if D, Fig. 3^a, is connected by its negative pole with N and the upper section of R^4, D′ with N′ and the next lower section of R^4, D^2 with N^2 and the next section of R^4, and D^3 with N^3 and the lower section of R^4, when the sliding bridge R^{18} is pushed down it will successively bring D, D′, D^2, and D^3 into circuit, and the incandescence will appear in each filament successively and disappear in the same order, and as the slide R^{18} is run up or down it will, so to speak, run the gamut of illumination through all the filaments; but as the slide R^{10} is run down it will correspondingly insert resistances. If then the slide R^{16}, Fig. 3^a, be moved down, it will carry before it the resistance-slide R^{10}, and the light in the outside filament will gradually diminish until the bridge R^{18} has passed onto the second section of R^4, when the incandescence will be transferred to the second filament, and the outer one will cease to glow; but the second filament is shorter than the outer one just in proportion to the current cut out by the interposed resistance of R′; hence, the second filament will glow with an equally bright light, but the light will be much smaller. As the slides pass down over the next break in R^4, another filament, D^2, still shorter, will be brought into circuit with the same brightness, but smaller size, until at last when the whole carbon rod, or nearly the whole, is inserted, the incandescence will be in the little central loop, D^3, which may be no bigger than a spark. As the slides are moved up together, the process will be repeated until the full power of the current is obtained in the outer filament. If the slide R^{16}, Fig. 3^a, is left behind and the slide R^{10} moved, the same filament will continue to glow, but with a gradually-diminished brilliancy, as the slide R^{10} descends; or if, as in Fig. 3^b, the thumb-piece R^{16} be passed under the ring R^{10} and moved down, the current will be shifted to the different filaments successively, but the strength of the current will remain the same, so that each carbon filament, as it is shorter in length, will glow more strongly. It will be seen that the resistances are inserted at the positive pole, but the sectional current-shifter is in the negative branch; but these may be reversed, if desired, or both may be put into one side or the other. When the strips R^2 R^3 R^4 are attached to the inside wall of the case R, (see Fig. 3^b,) the whole case, of course, should be made of vulcanite, ebonite, or other insulating material to avoid deflection or short-circuiting of the current.

In Fig. 5 is shown a wall-bracket lamp having the resistance-slide R^{10} and shifting-slide R^{16}, the mechanism above described being contained within the tube R, access to the interior of which is had through the longitudinal slot, as seen in front of the tube in the figure. The current is instantly turned on or off by by means of the cut-off or current-arrester O, which I will now describe.

In Fig. 1 the parts are seen in vertical section, in Fig. 6 partly in outline, and the key O is shown in perspective in Fig. 7. Referring to Fig. 1, the conducting-strip, which lines the concave side of the jaw E′ and makes contact with the pole P of the carbon D, is prolonged downward to form part of a flat spring, G^2, which projects out into the body of the tube E. At the point where this spring would strike the tube E, if bent backward against the inside thereof, is a contact-piece, H, which is connected with the pole J of the circuit. In Fig. 6 this spring G^2 is shown thus bent back, so that contact is made and the current passes through the filament D′ of that figure. To operate this spring G^2, I use a rotating key, O, which is passed transversely through the tube E and fitted to rotate therein, the axis of the key being parallel with the flat side of G^2. An easy way to seat this key is to have the clefts E^3 E^3 of the socket extend downward to cut into the circles occupied by O^3 O^4, Fig. 7, so that when the screw-collar F is turned down the jaws E′ E^2 may be pulled apart to open the holes E^4, Fig. 1, and allow the key O to be inserted, the headed pinion O^6 O^7 being caught by the springing together of the jaws, and the collar F, when screwed up slightly, will hold the key securely in place. The key O, or at least its thumb piece, should be of insulating material—vulcanite, for instance. Against the side of this key, within the tube E, the spring G^2 engages. At this part the stem of the key is made rectangular in cross-section, though another form of polygon will serve; but I provide a stem of rectangular section having its sides O′ longer than those O. I also round the corners somewhat. When the key is turned, so that its long side O′ is in contact with the spring G^2, the spring will lie much nearer the middle line of the tube E than when its short side O is presented to the spring. So when the key is turned into the position shown in Fig. 6, which corresponds to a gas-key with the gas turned on, the spring G^2 will have its end firmly compressed against the contact-piece H, and the current of electricity will be turned on; but a quarter-revolution of O will bring the long side of the rectangle against the spring, and the spring will then by its own elasticity spring back from H and contact will be broken. Another quarter-turn will complete the circuit, and another quarter-turn cut it off, and so on in either direction alternately.

As shown in Figs. 1 and 6, I make this contact-plate H with a broad, flat, internal face, against which the free end of the flat spring G^2 is compressed and bent under pressure, so that when released the disconnection will be gradual until contact is finally broken, whereby a gradually-increasing resistance is interposed and sparking is to a considerable extent avoided. The flat-faced spring G^2, also resting against the contracted neck O O′ of the key, between the enlarged journals O^3 O^4, holds the key in place in its socket as the different faces of the neck rotate against the same.

It will be seen that the key cannot get out of order by rotating it in a wrong manner, and that any turn will serve equally well, while the spring G^2 not only carries or breaks the current, but also, by its pressure against the flat sides of the key, makes it move in a quick, positive way and holds it securely in any position to which it may be turned.

While the strip G is thus adapted to make or break circuit, the opposite strip or strips G′ extend down continuously to I, Figs. 1 and 6, and connect with K, as shown.

In my invention I do not rigidly confine myself to the specific construction herein given, but modify the same as circumstances may require in each particular case, without departing from the principles herein shown, described, and claimed.

Having now described my invention, what I claim, and desire to secure by Letters Patent, is—

1. An electric incandescent lamp consisting of an exhausted glass bulb contracted at one end and provided with an enlarged spherical neck below said contraction, said neck integral with said exhausted bulb, through which said neck pass into the body of the lamp current-conducting wires hermetically sealed therein, said wires supporting the extremities of the carbon filaments within said lamp and adapted to be connected electrically with an electric circuit, in combination with a spherically-concave socket fitted to said spherical neck of said exhausted bulb, said socket provided with expanded internal conductors in an electric circuit, and said current-conducting wires of said bulb externally connected with said expanded conductors within said socket, the upper margin of said socket and the lower surface of said exhausted bulb having sufficient space between to permit said bulb to be laterally deflected in said socket, upon said socket as a pivot, said bulb seated in said socket by said spherical neck integral therewith, substantially as and for the purposes described.

2. In combination with an electric incandescent lamp having exhausted bulb A, tapered at one end to a contraction, A^2, and having the spherical neck B attached to said contraction, and provided with an inwardly-extended closed tube or chamber, C, hermetically sealed to the body of said lamp, and with two or more pairs of conducting-wires, *d d d′ d′*, extended into the same, and supporting two or more horeshoe-shaped carbon filaments, D D′, within said bulb A, occupying intersecting vertical planes, and two or more pairs of conductors, P N P′ N′, outside said lamp, occupying similar intersecting planes, adapted to be electrically-connected with the supply-wires of a circuit, the holder E, having opposite spherically concave jaws E′ E^2, provided, respectively, with spherically-concave and internally-smooth-faced positive and negative contacts G and G′, connected with said circuit and adapted to engage with the conductors P N P′ N′ when the lamp is inserted with its neck in said socket, the said concave jaws adapted to be closed upon said spherical neck and clamp and hold the same in various positions of adjustment without disconnecting said contacts, and, by the rotation of said lamp in said socket without removing the same, to insert a new carbon filament presenting the same plane of incandescence, substantially as described.

3. The lamp-body A, exhausted of air and having carbon filaments within the same electrically connected externally with the flat flexible conducting-strips P N, projecting from the lower end of the supporting-neck B of said lamp body A, in combination with a hollow socket, E, consisting of opposite jaws E′ E^2, separated from each other by vertical clefts E^3 E^3, to permit the same to open and to be closed upon the said neck B to grasp and hold the same, said jaws E′ E^2 having contact-pieces G G′ upon their inner faces, adapted to engage with the strips P N when the same have been bent outward around the free edges of the neck B, and said neck inserted in said socket, together with the collar F, adapted by its motion upon the socket E to cause the said jaws to grasp or release the said neck B, substantially as described.

4. An electric incandescent lamp having an exhausted glass bulb, free at its upper end and supported by a single projecting neck below, adapted to be supported by a socket electrically connected with the opposite wires of an electric circuit having two or more curved carbon filaments extended up into the body of said lamp, and connected with two or more pairs of terminal conducting-strips extended through said neck and projecting therefrom, said terminals being flexible, substantially inelastic, and adapted to be flexed outward and around the edge of said neck to make contact with the external terminal-conductors of an electric circuit, said strips of said lamp not in contact folded inward to prevent contact with said conductors of said electric circuit, substantially as and for the purposes described.

5. In combination with the bulb A, neck B, and chamber C, filled with insulating material V, the flat soft-metal conducting-strips P N P′ N′, projecting externally from said neck and internally connected with the ends of the carbon filaments D D′, two of said strips bent outward to make connection with the wires of an electric circuit, and the other strips folded inward out of contact and held in place by the clip M, substantially as described.

6. The socket-piece E of an electric lamp having jaws E′ E^2, separated from each other by the vertical clefts E^3 E^3, said clefts extended downward into the circular opening O^4 of said socket-piece, in which the key O is transversely seated and rotated upon its axis, in combination with said key O, having enlarged head O^7, and contracted neck O^6, so that said key may be inserted in said seat when said jaws are spread apart and held securely in place when the same are brought together, and held in place by suitable clamping mechanism, substantially as described.

7. The transversely-polygonal electric key O O′, said key composed of insulating material, having thumb-piece O^2, enlarged cylindrical journals O^3 O^4, and contracted neck O O′, uniting said journals, the whole adapted to be inserted in its seat in the lamp-support E through a transverse cylindrical socket in the same, said key journaled to rotate upon its axis in said support E, in combination with the conducting-spring G, bearing against the contracted neck of said key and operating to hold the same in place and to make or break electric contact as the said key is rotated, substantially as described.

8. The resistance stand or bracket consisting of a hollow case, R, of insulating substance, slotted longitudinally at one side, R^{13}, having within said case a longitudinal resistance-rod of carbon, R′, electrically connected at r^5 R^6 with one wire of an electric circuit, said hollow case being provided inside with an elongated conducting-strip, R^2, parallel with R′ and separated therefrom, said strip connected below with the opposite wire J of said electric circuit, in combination with a sliding thumb-piece, R^{10}, of insulated material, adapted to be moved to and fro along said slotted case R, and provided with broad-faced spring-fingers R^{11} R^{11} to clasp the rod R′, and an oppositely-acting spring, R^{12}, to bear against the said strip R^2, said springs R^{11} R^{11} R^{12} being made of conducting material electrically in contact to form a bridge and conduct the current from the strip R^2 to the resistance-rod R′, and thence through the circuit above, the thumb-piece R^{10}, attached to the springs R^{11} R^{11} R^{12} through said slot, and adapted to be moved to and fro along said hollow case R, and by the bridge within the same interpose a greater or less length of resistance-rod R′ in said circuit, substantially as described.

9. The longitudinal resistance-stand having a sliding thumb-piece, R^{10}, external thereto and supporting an internal bridge connecting a conducting-strip and a carbon resistance-rod within said stand through a longitudinal slot in the same, substantially as herein shown and described, the notches r^4 r^4 r^4 r^4 upon one side of said slot, and the catch R^{14} upon the said thumb-piece inserted in said notches by the impingement of spring R^{13} against the same, in combination with a spring, R^9, operating to force the said slide to the top of the said stand when the said catch R^{14} is disengaged from said notches, substantially as described.

10. In combination with the longitudinally-divided return-conductor R^4 and continuous conductor R^3, connected with one of the wires of an electric circuit, R^4 and R^3 being united by the sliding electric bridge R^{15}, and the variably-inserted resistance R′, operated simultaneously by the thumb pieces R^{10} and R^{16}, the incandescent-lamp filaments D D′ D^2 D^3, attached thereto, said filaments having successively different lengths or illuminating powers and connected by the poles P P′ P^2 P^3 with the resistance R′ and by the opposite poles, N N′ N^2 N^3, with the sectionally-divided conductor R^4, the whole so constructed and connected that when the slides R^{10} R^{16} are moved along the conductors R^3 R^4 the resistance will be increased or diminished by the insertion of a greater or less resistance-rod, and a new filament of correspondingly less or greater length or conducting power will be inserted in the circuit as the slide R^{15} passes from one section of R^4 to another and the preceding filament be cut out, substantially as herein shown and described.

11. In combination with an electric-lamp support, E, having opposite insulated grasping-jaws, E′ E^2, adapted to hold the lamp-body A, said jaws provided with vertical conductors G G′, extended downward upon opposite sides of said support from the said jaws E′ E^2 to the wires J K of an electric circuit, one of said vertical conductors, G, formed into a spring, G^2, of conducting material adapted to make or break connection with the contact-piece H, the switch-key O, occupying the middle of said vertical support and provided with a polygonal neck, O O′, having longer and shorter sides alternately, said spring-conductor G^2 resting against said polygonal neck and forced against said contact-piece H when the neck of said key is turned transversely and removed from said contact when said key is partially rotated upon its axis, said contact H having a broad surface presented to the flat extremity of said spring G^2, and said spring forming an elongated contact gradually reduced as the same is released from said plate H, substantially as and for the purposes described.

12. In combination with the incandescent electric-lamp filaments D D′ D^2 D^3, adapted to be put into an electric circuit through the wires N N′ N^2 N^3, a stand or bracket of insulated material having a continuous conducting-strip, R^3, and parallel therewith, a series of divided conducting-strips, R^4 R^4 R^4 R^4, successively connected each with one of the wires N N′ N^2 N^3, and said lamp-filaments D D′ D^2 D^3 connected with the opposite wire of said electric circuit, together with a slide, R^{16}, adapted to be moved along said insulated stand or bracket and provided with a conducting-bridge extended from the strip R^3 to the series of divided strips R^4 in succession, so as to make electric contact therewith as the said slide is moved along the said stand or bracket, and thus successively insert and cut out the electric-lamp filaments D D′ D^2 D^3, substantially as described.

13. In combination with the exhausted transparent glass body A of an electric lamp, and contracted neck B and expansion B′, formed integral with said lamp-body A, said body having an incandescing electric filament within the same and external conductors extended through said neck, the socket E, provided with electric contacts adapted to engage with

the conductors of said lamp when the same is inserted in said socket, and having opposite cleft grasping-jaws standing normally apart to admit the easy insertion of the neck of said lamp, and provided with an external collar movable along said jaws and operating by its retraction to permit the said jaws to spread apart to receive the said neck of said lamp-body and forcibly compress the said jaws together upon said neck when moved forward upon said holder, substantially as described.

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