No. 720,792. PATENTED FEB. 17, 1903.

J. ELLMORE.

STRUCTURAL IRON.

APPLICATION FILED FEB. 7, 1902.

NO MODEL. 2 SHEETS—SHEET 2.

FIG. 3.

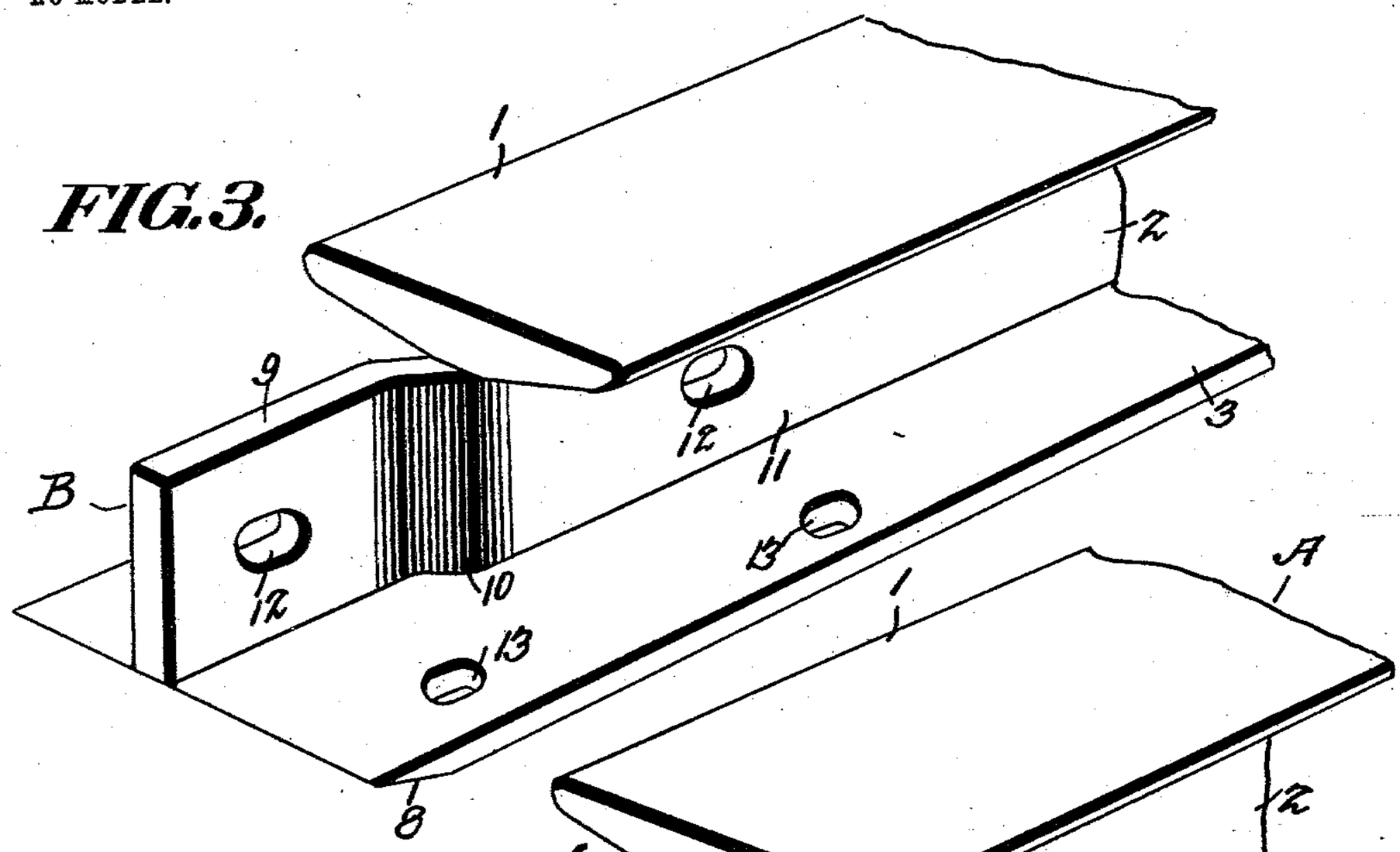


FIG. 4.

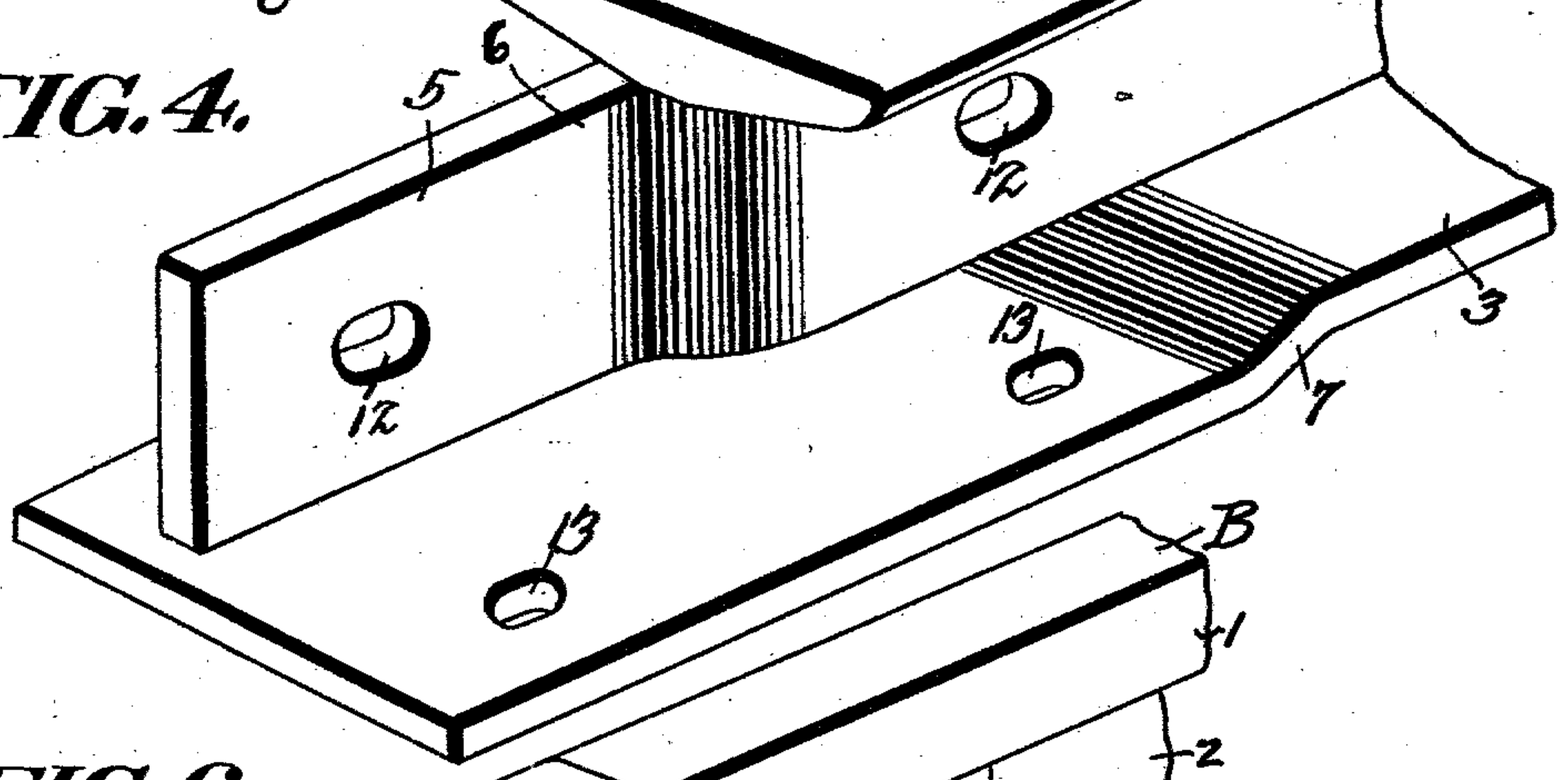
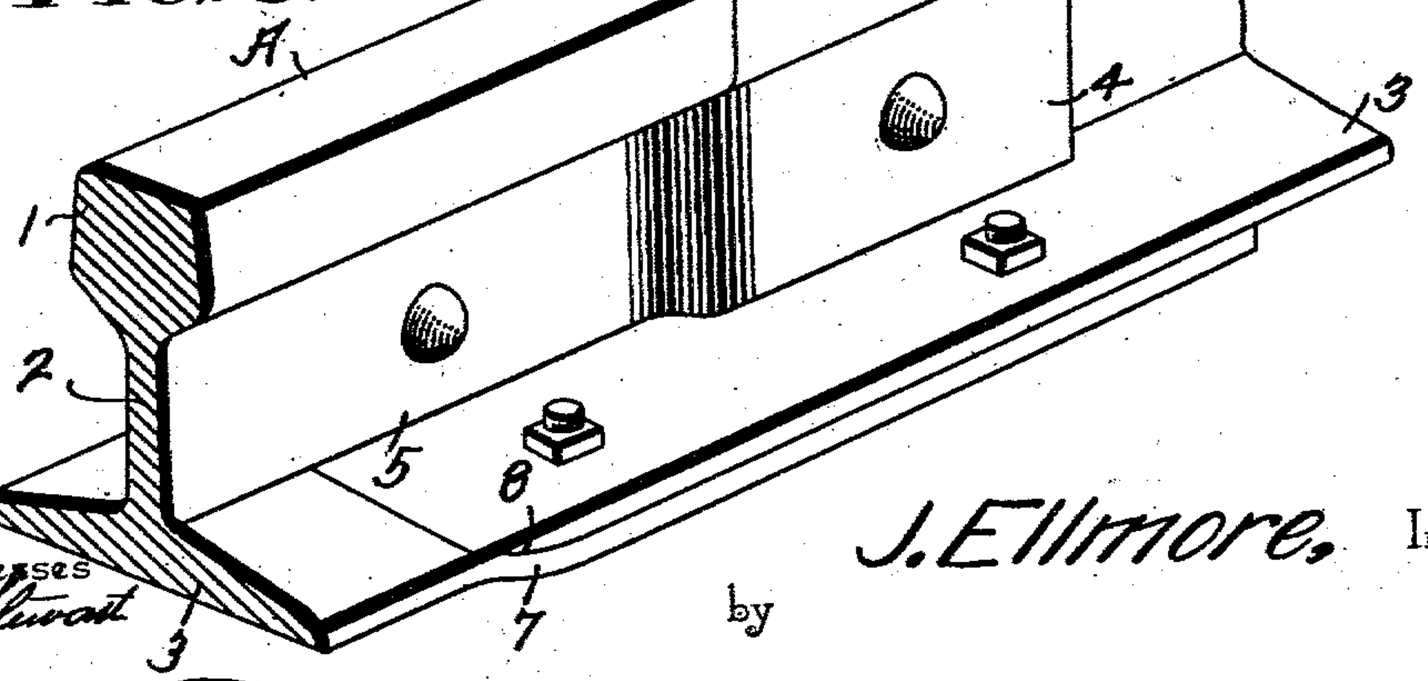


FIG. 6.



Witnesses
C. F. Stewart
R. M. Elliott.

J. Ellmore. Inventor.

by

A. G. Hollee Attorney

No. 720,793. PATENTED FEB. 17, 1903.

F. FANTA.

APPARATUS FOR REINFORCING AND STANDARDIZING FILAMENTS OF GLOW LAMPS.

NO MODEL. 2 SHEETS—SHEET 2.

APPLICATION FILED JULY 11, 1901.

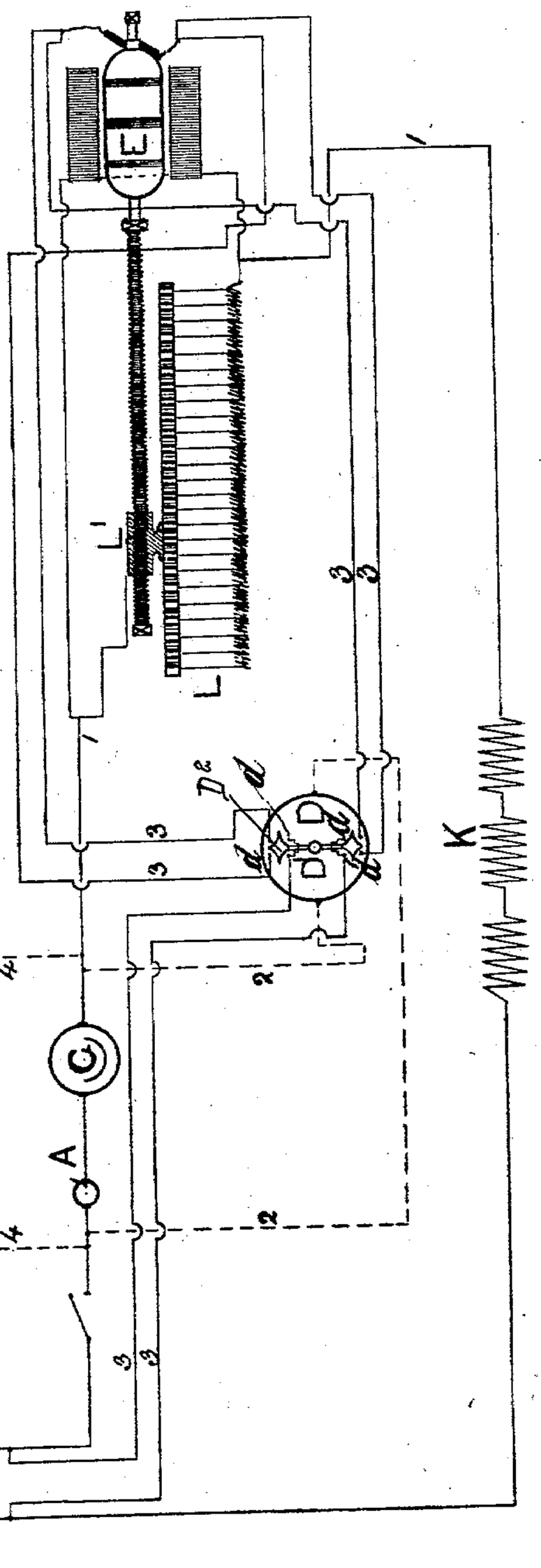


FIG. 3.

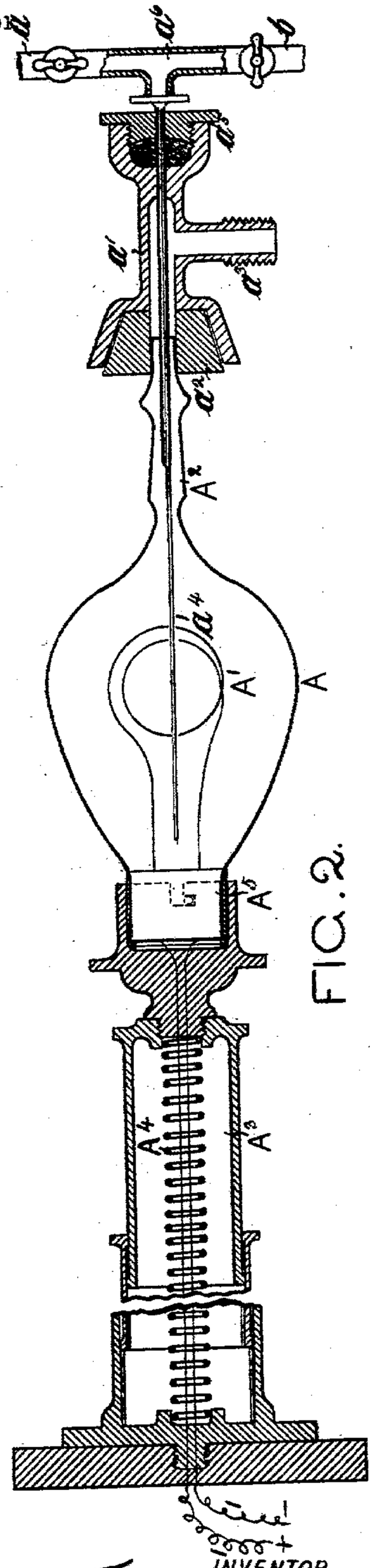


FIG. 2.

WITNESSES:
Isabella Waldron
Adelaide C. Gleason.

INVENTOR.
Ferdinand Fanta
BY
Richardson & Co
ATTORNEYS

UNITED STATES PATENT OFFICE.

FERDINAND FANTA, OF LONDON, ENGLAND.

APPARATUS FOR REINFORCING AND STANDARDIZING FILAMENTS OF GLOW-LAMPS.

SPECIFICATION forming part of Letters Patent No. 720,793, dated February 17, 1903.

Application filed July 11, 1901. Serial No. 67,890. (No model.)

To all whom it may concern:

Be it known that I, FERDINAND FANTA, a subject of the King of Great Britain and Ireland, residing at London, England, have invented a new and useful Improved Apparatus for the Reinforcing and Standardizing of Filaments of Glow-Lamps, of which the following is a specification.

This invention relates to apparatus for the reinforcing of carbon filaments of electric glow-lamps (while fixed in the globe in which the filament is to be eventually used) either for the purpose of regenerating to predetermined voltages and lighting power a used and deteriorated filament without removal from the old bulb or for building up a filament in the course of manufacture of a new lamp, and thus to bring it up to the predetermined voltage and lighting power in the bulb in which it is afterward to be used, according to processes the subject-matter of a copending application for Letters Patent in the United States of America of May 26, 1900.

The apparatus consists of means, in combination and specific electrical connecting circuits by which a mechanical circulation of gas, air, or a mixture of them may be continuously circulated into and out of a glow-lamp bulb, traversing the bulb and the filament from end to end, and which apparatus is also adapted without removal of the lamp from its air-tight connection to constantly withdraw gaseous products therefrom and to effect a vacuum in the said bulb before sealing; and, further, this apparatus is designed finally to photometrically determine absolutely and certainly the voltage and lighting power of the filament of the bulb during such continuous and controllable reinforcement in an unsealed globe to insure that the finished glow-lamps when sealed and exhausted are of an absolute uniformity when required or are of any required definite and predetermined voltage and lighting capacity.

Though the flashing of carbon filaments in hydrocarbon vapor and the photometrical test of such filament after it has been removed from the flashing-chamber and fixed in a sealed lamp *in vacuo* are already generally used in practice, such flashing or reinforcement cannot be carried out in the lamp in which the filament is to be ultimately used by reason of its obscuration, nor is such flashing and reinforcement as generally practiced a continuous and controlled process, nor can the filament be photometrically tested continuously during reinforcement, so as to determine the amount or duration of a continuous reinforcement by such combination of appliances as are at present known, and it is to render such processes feasible and practicable that I have designed the combination of appliances the subject of the present invention.

Figure 1 is a general diagrammatic view of the combination of the whole plant employed. Fig. 2 is a detail in vertical section of the mode of attachment of the bulb to the apparatus, with means for ingress and egress of the circulating air or gases. Fig. 3 is a diagrammatic view of the arrangement of circuits, indicating and controlling instruments, and resistances to enable the accurate estimation and duration of the reinforcing process to produce a standardized or definite result. Fig. 4 is a sectional detail of the control-valves employed upon the ingress and egress pipes to the glow-lamp globe.

The main features of the plant are two supply-mains *a* and *b* to the glow-lamp globe A, the one, *a*, direct from the compressed-air pumps B, and the other, *b*, from the compressed-air supply through various receptacles, carbureting appliances, and pressure-regulating valves to the glow-lamp globe, and, further, a return vacuum-main *c* to the vacuum-pumps C from the said glow-lamp globe. Further, the filament within the glow-lamp to be regenerated, reinforced, and standardized is connected by a main electrical circuit 1 1 to a source of sufficient electric energy, and on which main circuit are three subsidiary shunt-circuits, one, 2 2, for the operation of a compensating and automatically-adjusting voltmeter D, the second, 3 3, for the operation of resistance-regulating motor E, and the third, 4 4, for energizing an indicating voltmeter F, showing, together with an ammeter G in series with the filament, the exact condition of the current passing through the filament of the glow-lamp A. In addition to this is a photometric bench or device H, with a standard lamp or source of light J, which may be a Pentane or Colza light, but which, if an electric lamp, is rendered incandescent on an independent circuit by a current of known and controlled constant value.

The globe A, having its filament A′ perma-

nently fixed therein (as would be the case had the globe A and filament A′ been in previous use) or ready for immediate use after regeneration or reinforcement to standard section, and having a tube elongation A^2 at its upper end, is placed in a telescopic holder A^3, pressed upward by spring A^4. The electrical connections with the filament A′ are made by the usual bayonet-socket joint A^5 to the main regenerating-circuit 1 1. The upper end of the tube A^2 is adapted to enter into and make a hermetical joint upon a fixed holder a', having an india-rubber stopper a^2. To this socket is a branch exit a^3 to the vacuum-pump, and within this holder a' is an internal capillary tube a^4, reaching down to the bottom of the globe A and passing through a gland a^5, through which the tube a^4 can be withdrawn a sufficient distance to free the lamp A for sealing and removal. The tube a^4 communicates alternatively with the hydrocarbon-gas main b or direct-air main a by the T-piece a^6, each main being controlled by a cock. The compressed air is supplied by compression-pumps B, of any suitable make, and when not used direct through the main a, as pure air for the removal of internal carbonaceous deposit in the lamp during application of external heat is passed to the air-receptacle B′, thence through a pressure-regulating valve b', of usual construction, as shown in detail in Fig. 4, to a carbureter B^2, containing liquid gasolene or other suitable liquid hydrocarbon. The carbureted air is thence passed through a second pressure-regulating valve b^2 into a series of further liquid-washers of gasolene B^3 to insure absolute saturation and purity of the carbureted air, and thence by a final pressure-regulator b^3 to the internal tube a^4 within the glow-lamp globe A. A continuous circulation of the hydrocarbon gas with a given percentage of air is constantly maintained through the globe A during the passage of electricity through the filament, as hereinafter more fully described, and is caused to pass uniformly over the whole surface of the filament by being extracted through the outer tube A^2 and the passage a^3 from the upper holder a' by means of vacuum-pumps C and a connecting-main c. It is obvious that by this arrangement of apparatus either air alone or an admixture of air and hydrocarbon gas can be alternatively or continuously passed through the bulb A so long as and when such circulation is required during the cleaning of the bulb and the after regeneration or building up of the filament by incandescence in a hydrocarbon atmosphere continuously replenished and of which the burned products or depleted atmosphere is simultaneously removed. It is obvious also that by the supply of compressed air at pressure and by the control of the air and the mixed carbureted air by the pressure-regulator valves and by the forcible suction of the vacuum-pumps C any desired pressure or tenuity of the mixed air and hydrocarbon atmosphere within the globe, or any desired variation in its proportions of air and hydrocarbon vapor, may be controlled and attained, which control is necessary for the proper carrying out of the regeneration or building up of the filament continuously, and to suit the variable conditions of more or less irregularly worn filaments, their ultimate incandescence under various required voltages, and alterations of conditions as to capacity of globes to filaments of various required incandescence and voltage, all of which variable conditions have to be considered and dealt with in carrying out the desired process with the aforesaid plant.

The arrangement of electrical circuits is as follows in order to deal with the following problem: It is desired to pass a current of a certain calculated voltage through the filament of the globe A while the said filament is surrounded by a constantly-flowing current of mixed hydrocarbon gas and air, and it is essential that such current shall be automatically maintained at that calculated and required voltage during the whole process of building up the filament in face of the constantly-increasing suction and consequent loss of resistance of the said filament during such building. This continuous maintenance of the reinforcing-current at a constant voltage is necessary because the incandescence of the filament in its hydrocarbon atmosphere is being constantly compared during such reinforcement with a standard light or lamp J at a calculatod ratio of incandescence to allow for the fact that the filament of lamp A is incandescing in an unsealed bulb in an atmosphere of hydrocarbon and air, while the filament of J is incandescing *in vacuo*. The reinforcing or building up of the filament in A is to be proceeded with rapidly and continuously at a constant calculated voltage until the process is completed by comparison with the standard light J or lamp *in vacuo*. The actual condition of the current passing through the filament in A is shown in the usual way by an ammeter G in series or main and by an indicating voltmeter F in a shunt-circuit 4 4. The main reinforcing-circuit 1 1 has main definite regulating-resistances inserted at K and passes also through a series of controllable resistances L and a sliding switch L′, so controlled as to travel in either direction upon the resistances L by a motor E. In a shunt-circuit 2 2 from the main is a voltmeter D, adjusted so that the index-pointer D′ can be brought to a required position—say vertically—relatively to fixed contacts $d\ d\ d\ d$, of which there are a pair on either side of each end of the index-pointer D′. In order to set this index-pointer in the required vertical or zero position for any required voltage of current, it is obvious that the instrument, with its connections or circuit 2 2, may be revoluble about its axis while the contacts remain stationary, and thus the index-pointer D′ can be brought to

required position between contacts whatever desired voltage of current it may be required to be uniformly maintained. The heads of the index-pointer D′ terminate in insulated double lateral metallic wedges D^2, which are adapted to bridge alternatively between two pairs of the contacts *d d*, according to the direction of movement of the index-pointer D′ either way following a rise or fall in the first predetermined voltage of the current in the main reinforcing-circuit 11. The electric motor E is in a third shunt-circuit 3 3, leading to two pairs of the contacts *d d*. From the other contacts *d d* the circuit 3 3 is duplicated, so that the current is reversed through the motor E according to the obliquity on either side of vertical position of the index-pointer D′. The operation of the sliding switch L′ in either direction by the rotation of the motor E either way thus serves to put in or take out further resistances L in the main circuit to exactly compensate for a rise or fall of the voltage in the main circuit, which is thus maintained automatically constant.

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

1. In combination, an electric glow-lamp with a filament therein, a communicating tube thereto, a holder adapted to make electrical connections to the filament, and having a distinct ingress to and separate egress from said globe for gaseous supply, mechanical means for forcing air, hydrocarbon gas, or a mixture of both into said electric-glow-lamp globe, means for carbureting the supply of air to the globe, mechanical means for withdrawing the same from said globe, pressure-regulating devices on the supply-pipes to control the pressure of the gas in the globe, distinct electrical circuits to the filament of said electric glow-lamp to be regenerated and to a standard electric glow-lamp, means in said circuits to indicate the condition of the current passing through the filaments, an automatic device in the circuit through the regenerating-filament to maintain the voltage on that circuit constant, and means for a continuous photometric test of incandescence of filament in gaseous atmosphere during reinforcement to determine the point of cessation of building up of the filament.

2. In combination, an electric-glow-lamp globe with a filament therein, a tube communicating with the upper part of the globe, a spring-holder adapted to make electrical connection to the filament, a capillary tube passing so as to slide through the upper part of the holder, and passing through said globe-tube to the farthest end of the globe-tube from its point of entry, a side exit from the upper part of the holder communicating with said globe-tube, mechanical means for forcing air, hydrocarbon gas or a mixture of both into said electric-lamp globe, means for carbureting the supply of air, mechanical means for withdrawing the same simultaneously from the globe, pressure-regulating devices on supply-pipes, electrical circuits to the filament of said glow-lamp, means in said circuit for indication of current, an automatic device in said circuit to maintain constant voltage, and photometric means to determine incandescence of filament and cessation of reinforcing-current.

3. In combination, an electric glow-lamp with a filament therein, a tube communicating therewith, a holder adapted to make electrical connections to the filament and having a distinct ingress to and separate egress from said globe for gaseous supply, an air-compressor, alternate connections from said compressor direct to said globe and a carbureting device, cocks controlling the same, carbureting and washing devices in alternative air-supply, pressure-regulating valves between the air-chamber and carbureter, between the carbureter and washer, and between the washer and lamp-globe, mechanical means for withdrawing gases from the globe, distinct electrical circuits to the filament of said electric glow-lamp to be regenerated and to a standard electric glow-lamp, means in said circuits for indication of current, an automatic device in the circuit through the filament to be regenerated to maintain constant voltage, and photometric means for determining the incandescence of the filament and cessation of reinforcing-current.

4. In combination, an electric glow-lamp with a filament therein, a tube communicating therewith, a holder adapted to make electrical connections to the filament and to admit ingress of gases to and egress thereof from said lamp, mechanical means for supplying gases to said lamp, means for withdrawing the same, electrical circuits to the filament of said glow-lamp, means in said circuit for indication of the current, adjustable resistances with sliding switch on said circuit, an adjusting voltmeter in shunt-circuit from the main, insulated metallic bridges on the ends of the index-pointer of said voltmeter, fixed pairs of contacts on either side of each end of said index-pointer, circuits in shunt from the main connecting to said contacts, a motor in said shunt-circuit adapted to be reversed by alternative circuits closed by the movement of the index-pointer of said adjusting voltmeter, a screw-spindle between the motor and sliding switch in the main circuit on adjustable resistance, and photometric means for determining the incandescence of the filament and cessation of the reinforcing-current.

In witness whereof I have hereunto set my hand in presence of two witnesses.

FERDINAND FANTA.

Witnesses:
RICHARD A. HOFFMANN,
CHARLES CARTER.