

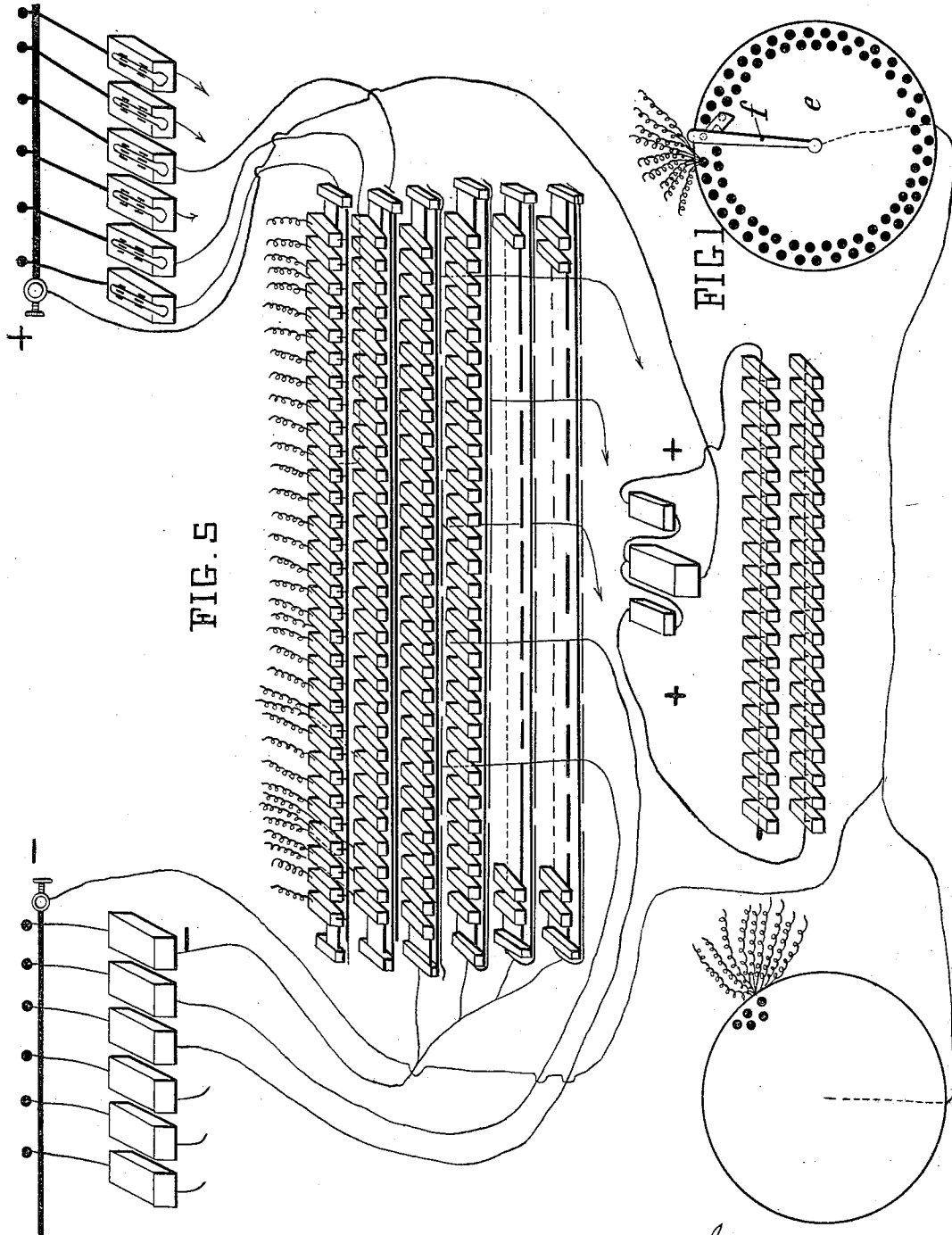
(No Model.)

8 Sheets—Sheet 1.

P. C. E. CHAMPION.
ELECTRICAL PYROTECHNICS.

No. 465,981.

Patented Dec. 29, 1891.



Witnesses,
R. C. Mitchell
Henry E. Gooding

Inventor,
P. C. E. Champion
by Briesen & Knapp
his Attorneys.

(No Model.)

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Fig. 2.

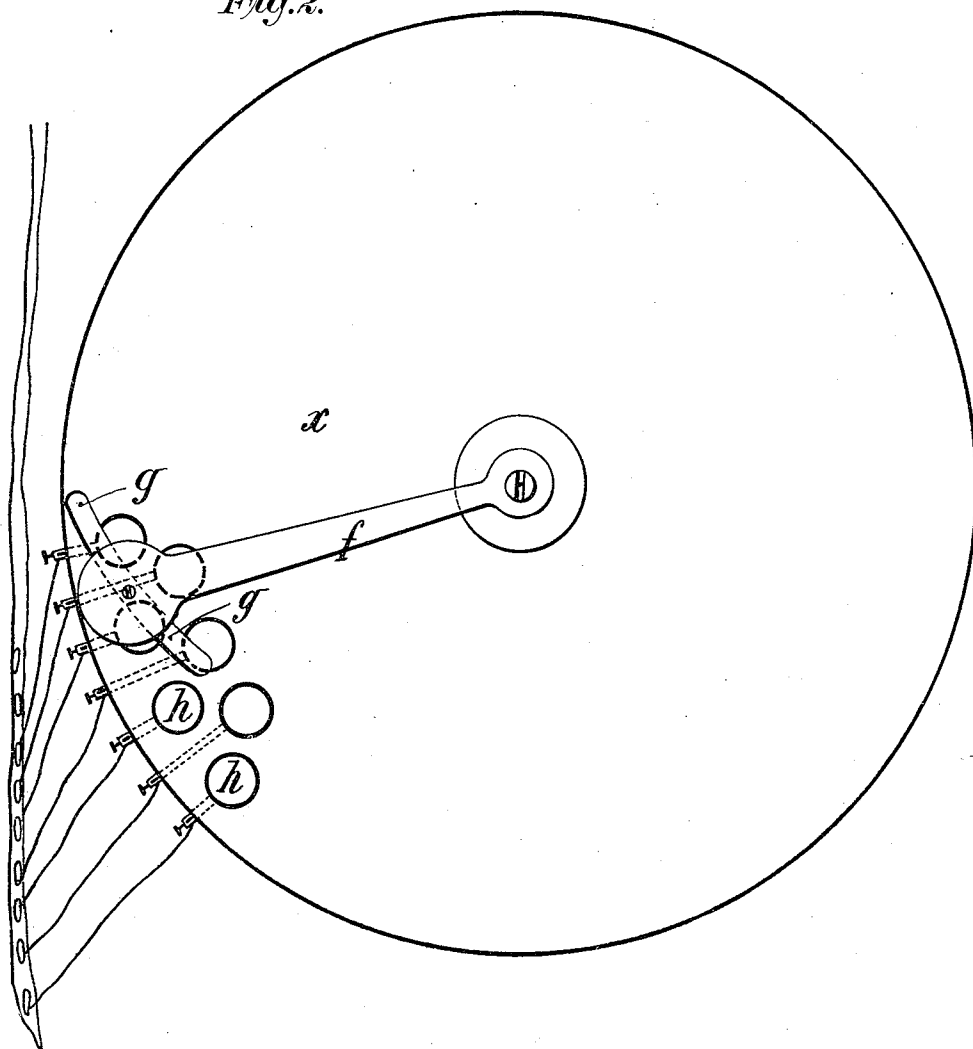
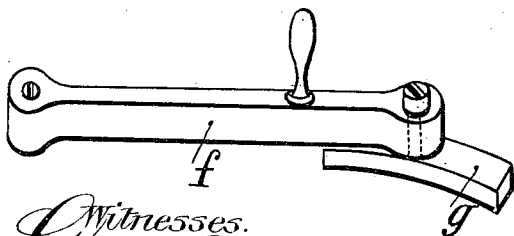
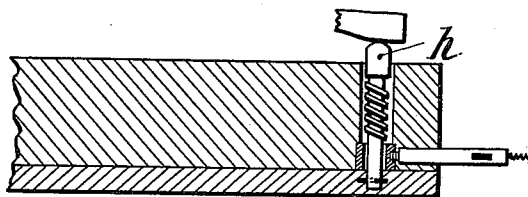


FIG. 3.



Witnesses.
Gustave Dittenole
R. C. Mitchell

FIG. 4.



Inventor
P. C. E. Champion
by Briesen & Knauth
his Attorneys.

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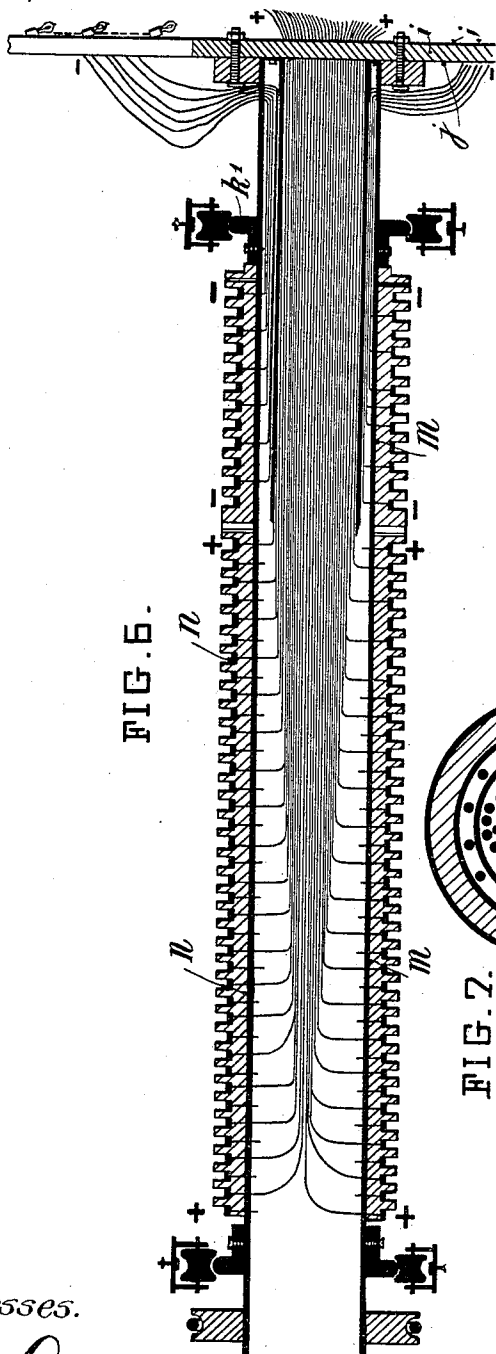


FIG. 6.

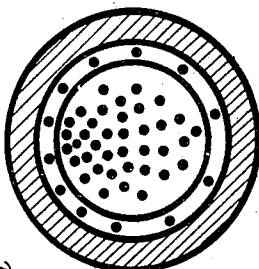


FIG. 7.

Witnesses.

Gustave Dietrich

R. C. Mitchell

Inventor

Pierre C. E. Champion

by Briesen & Knaut

his Attorneys.

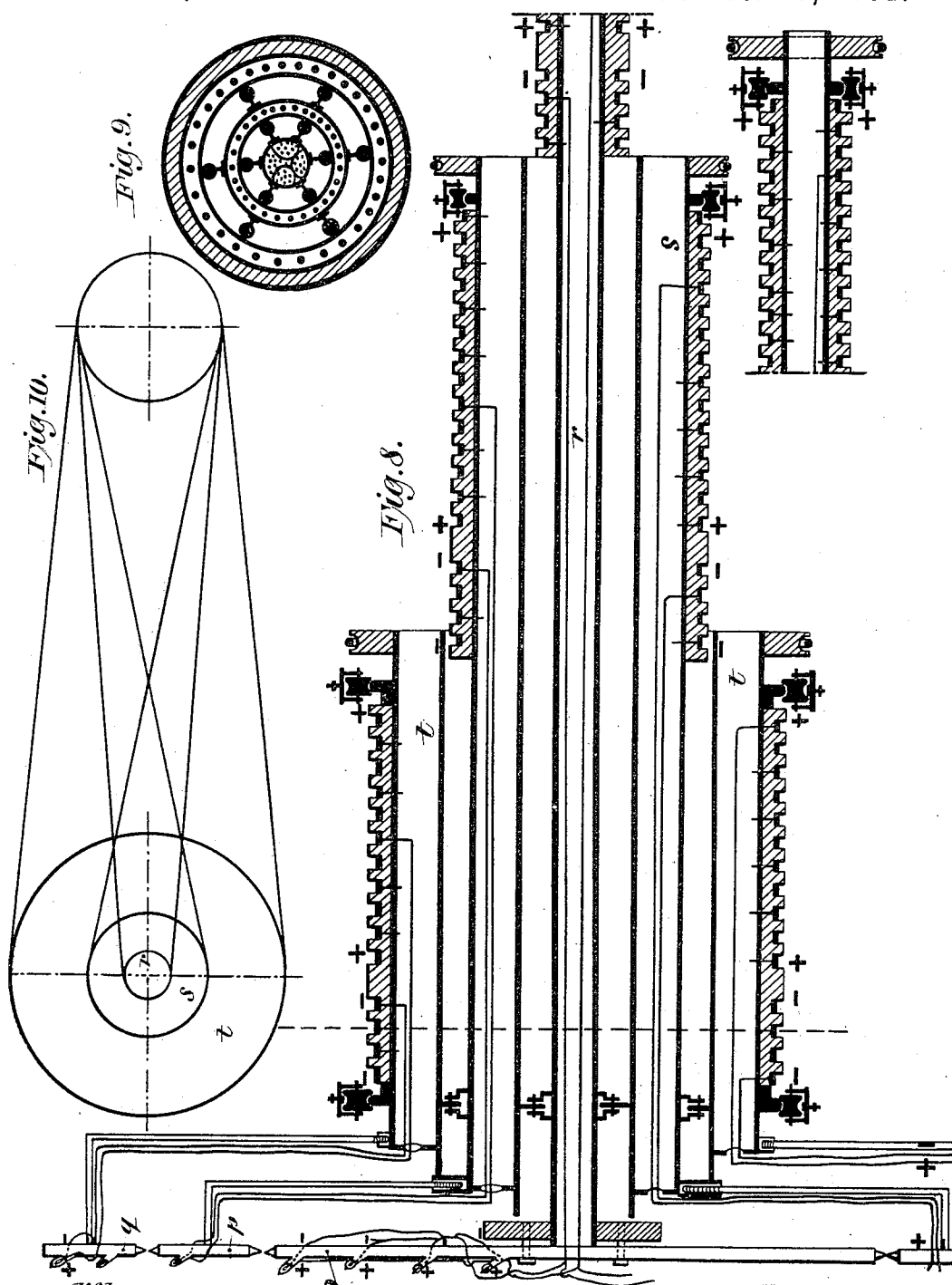
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Witnesses
Gustave Dutench.
H. C. Mitchell.

Inventor
P. C. E. Champion.
by Briesen & Knaut
his Attorneys.

(No Model.)

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P. C. E. CHAMPION.
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Fig. 18.

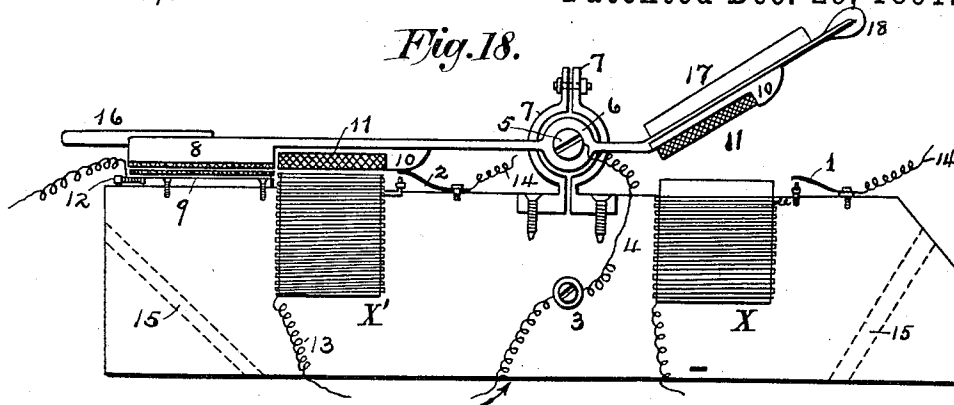


FIG. 11.

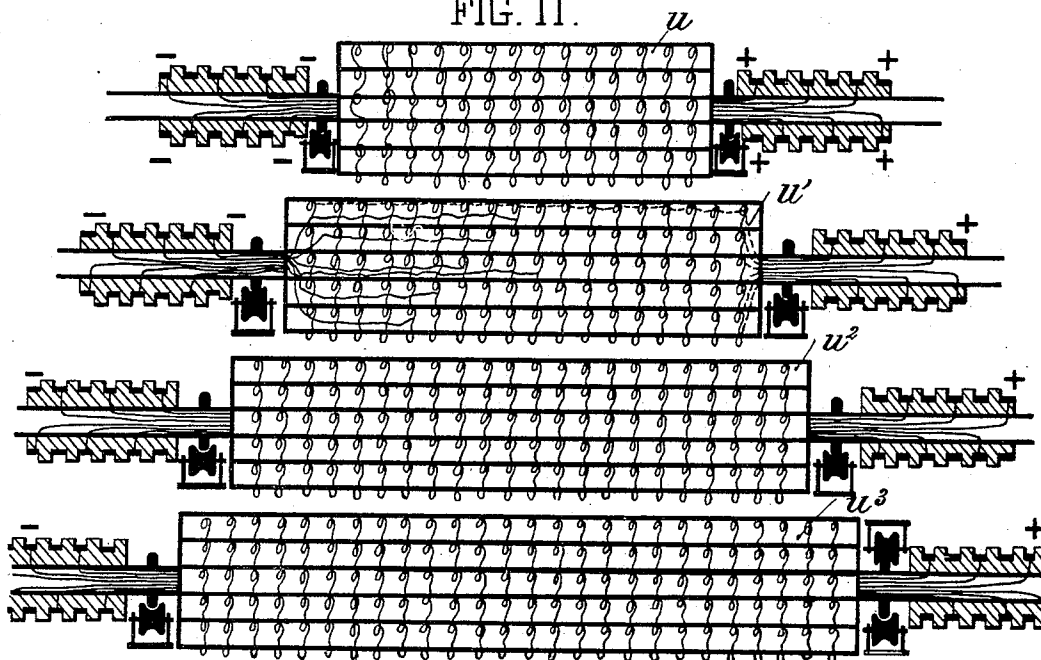
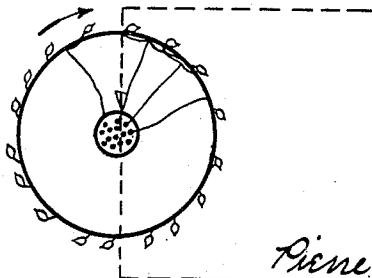


FIG. 12.



Witnesses
Gustave Dittich
R. C. Mitchell

Inventor
Pierre C. E. Champion
by *Briesen & Knauth*
his Attorneys.

(No Model.)

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P. C. E. CHAMPION.
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FIG. 13.

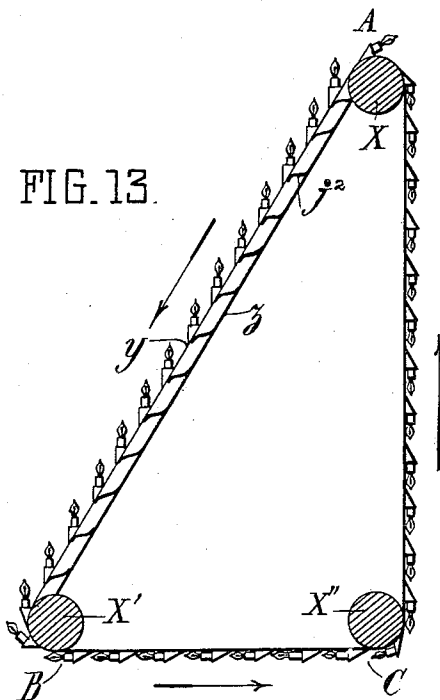
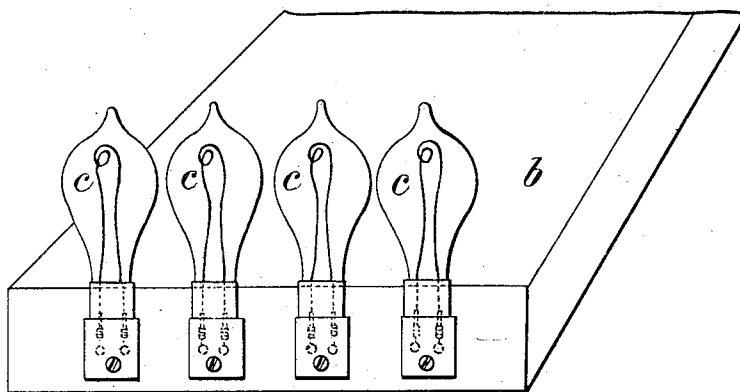


FIG. 16.



Witnesses.
R. C. Mitchell
Henry E. Eversding

Inventor.
Pierre C. E. Champion
by *Briesen & Knaut*
his Attorneys.

(No Model.)

8 Sheets—Sheet 7.

P. C. E. CHAMPION.
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FIG. 17.

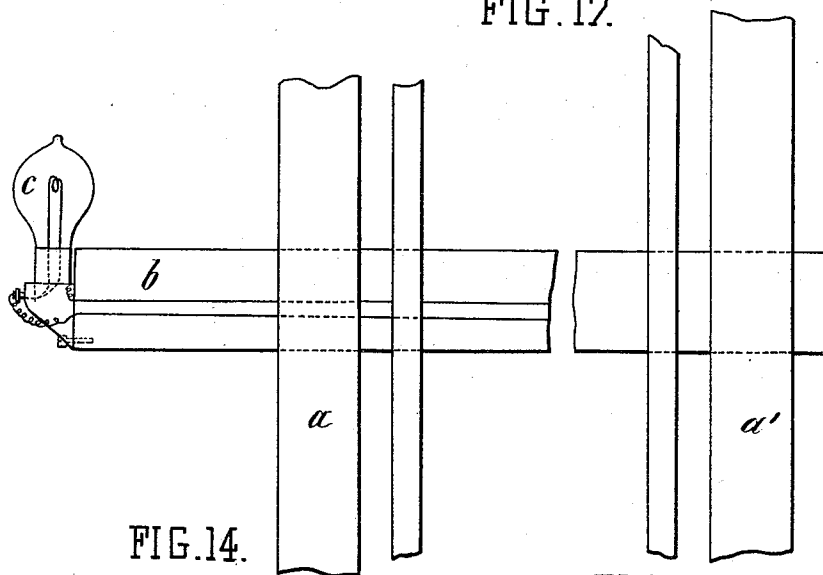


FIG. 14.

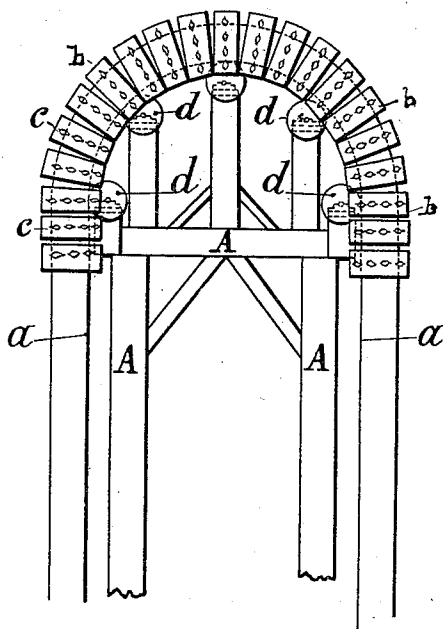
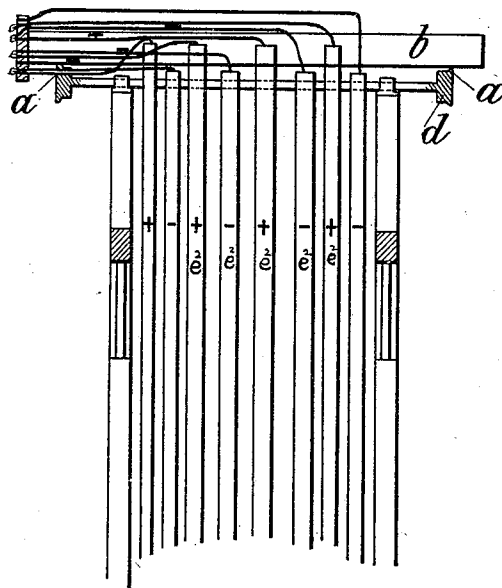


FIG. 15.



Witnesses.
R. E. Mitchell.
Henry E. E. ending.

Inventor
P. C. E. Champion
by Briesen & Knauth
his Attorneys.

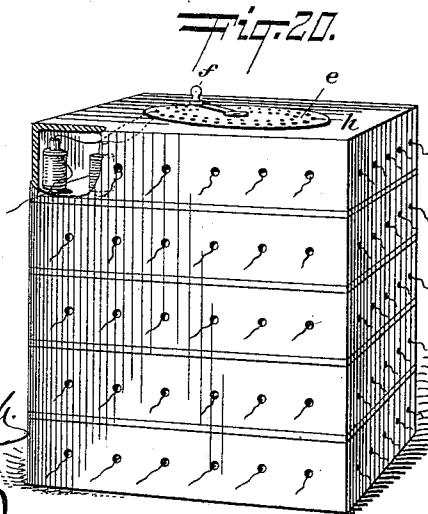
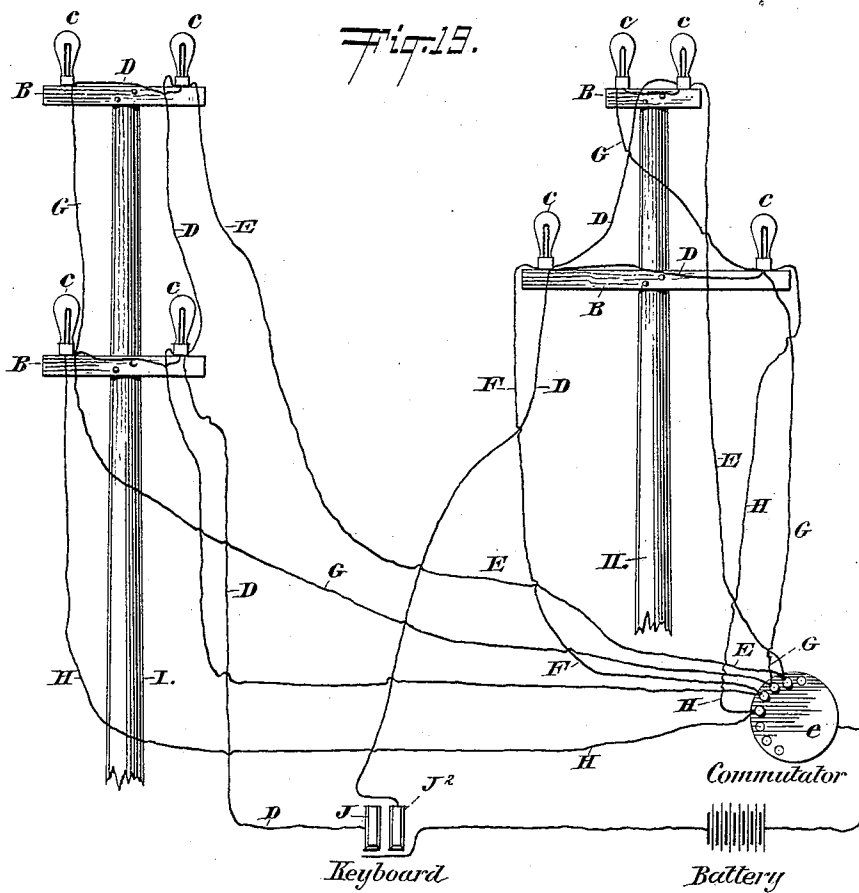
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Patented Dec. 29, 1891.



WITNESSES:

WITNESSES:
Gustave Dietrich.
L. M. Wachschlager.

INVENTOR

Pierre, C. E. Champion,
Briesen & Knautz
his ATTORNEYS.

UNITED STATES PATENT OFFICE.

PIERRE CHARLES EUGENE CHAMPION, OF PARIS, FRANCE.

ELECTRICAL PYROTECHNICS.

SPECIFICATION forming part of Letters Patent No. 465,981, dated December 29, 1891.

Application filed May 15, 1891. Serial No. 392,811. (No model.)

To all whom it may concern:

Be it known that I, PIERRE CHARLES EUGENE CHAMPION, of the city of Paris, France, have invented Improvements in the Application of Electricity for the Production of Pyrotechnic and other Similar Effects, of which the following is a full, clear, and exact description.

This invention relates to the production of pyrotechnic effects by means of electricity.

In accomplishing my invention I make use of a key-board and commutator in conjunction with incandescent or analogous electric lights arranged in series. The combination of these devices and the appearance of motion imparted to the lights, either separately or in groups by means of special mechanism hereinafter described, will enable all the luminous effects heretofore obtained by ordinary pyrotechnic compositions to be realized.

The invention also includes the mechanism and arrangements whereby the effects of light and movement are obtained.

My invention can also be used for the production of pyrotechnical effects in combination with gunpowder or pyrotechnic composition, wherever this can be done without danger, for the production of combined effects.

Among the various pyrotechnical devices which may be produced by means of my invention may be mentioned serpents or rockets, simple or multiple Catherine wheels, cascades, girandoles, fountains, and, in short, all the large pyrotechnical pieces which have heretofore been stationary as to position, but which by my invention may be animated with any movements suited to the general effect to be produced. I will describe some of these pieces with reference to the accompanying drawings, forming part of this specification, in which I have represented some examples, reserving, however, the option of making such changes therein and in the applications thereof as will not involve a departure from the principal object or spirit of my invention.

In the drawings, Figure 1 is a plan view of my circular commutator, and Fig. 2 is a detail of part thereof on a larger scale. Fig. 3 shows the handle or key of the commutator. Fig. 4 is a cross-section through one of the

contacts of the commutator. Fig. 5 is a perspective view of the general arrangement of my switch key-boards for operating the various pyrotechnical pieces. Fig. 6 is a longitudinal section of a simple Catherine wheel, and Fig. 7 is a cross-section of the same. Figs. 8 and 9 are similar sections for a multiple Catherine wheel having three revolving annuli, and Fig. 10 is a diagram showing the transmission of motion thereto. Figs. 11 and 12 show an elevation and section of a four-cylinder cascade. Fig. 13 shows a simple cascade. Figs. 14 and 15 represent a girandole, and Figs. 16 and 17 show details of construction thereof. Fig. 18 is a longitudinal section of one of the contacts or keys of the switch key-board. Fig. 19 is a diagrammatic view of the electrical connections and circuits, by means of which the effects of a serpent or rocket may be produced. Fig. 20 is a perspective view of a reel-box and commutator.

A serpent or rocket by my system is composed of vertical, inclined, straight, or curved lines (with or without horizontal return) of parallel lamps or lamps in series of 2, 3, 4, or 5, according to the length of the serpent or rocket.

In Fig. 19 I have illustrated the electrical connections and the arrangement of incandescent lights in conjunction with the key-board and commutator, whereby the effect of a serpent or rocket may be produced. In this figure the lamps *c* are arranged parallel to each other or in series upon suitable cross-bars *B*, placed upon posts *I II*. A wire *D*, common to all the lamps of one post *I*, is attached to one key *J* of the key-board and to one pole of each of the lamps of one post. The other poles of the lamps on such post *I* are connected by separate wires *E F G H* to separate contact-pieces of the commutator *e*. The corresponding poles of the lamps on the other post *II* connect by wire *D* with their own key *J²* of the key-board and by wires *E F G H* with the same contact-pieces of the commutator to which the other wires *E F G H* respectively go. The same plan is followed with any suitable number of posts. The wire *D* extends also from the key-board to the battery or other source of electrical energy and to the commutator. It will be understood,

therefore, that one key *J* of the key-board is connected by one common wire *D* to one pole of all the lamps upon one post, while each contact of the commutator is connected by
 5 separate wires running to one pole of one lamp of each post. Hence by depressing a key of the key-board one post is brought into circuit, and by then actuating the circuit-closer of the commutator all the lamps of that
 10 post are successively brought into action.

The commutator is more fully shown in Figs. 1 to 4. In these figures *e* is the disk, in which are mounted the spring-raised contacts
 15 *h*, connected with the various lamps. *f* is the lever-handle or key carrying an oblique segmental or other shaped contact *g*, whose length and obliquity depend upon the number of lamps on one post which it is desired to render incandescent at the same moment, (three
 20 in the example shown in Fig. 2.) By rotating this handle *f* with sufficient speed over the circle of contacts *h* the effect of a serpent or rocket or other pyrotechnic figure is produced, the lamps being lighted one, two, or three at
 25 a time in consecutive order from the bottom upward, according to the inclination of the segment, if the illusion of a rocket is to be produced. At the moment when the last lamps of the series are lighted the bouquet or bouquets of the serpent or rocket
 30 are lighted either by the same or another commutator. These bouquets may be composed of a group of lamps of the same or different colors suitably arranged to represent any
 35 given subject—as, for example, birds, flowers, figures, or diverse objects. It will be understood, therefore, that in the production of pyrotechnic effects, whether in the form of rockets, serpents, wheels, and the forms hereinafter described, I arrange the lights or
 40 lamps in one or more series and interpose between the source of electricity and these lights a commutator and a key-board. The key-board is connected to the source of electricity and has each key connected by a common wire to each lamp in one series, and the
 45 commutator has each contact connected by separate wires to a single lamp in all the series and is also connected with the source of electricity. By manipulating the key-board one or more series of lamps successively or
 50 simultaneously may be brought into circuit, and by manipulating the segment of the commutator separate lamps in these series so brought into circuit by the key-board are successively lighted.

Instead of the serpent or rocket extending only in the upward direction, it may be carried horizontally at its upper part on one or
 60 more lines extending in various directions and arranged so as to return above the heads of the spectators, and similarly in the case of the bouquets. In this case the same point of departure may be common to all the horizontal
 65 members of the serpent or rocket. It will be understood that these horizontal lines of lamps are mounted on a frame-work, the

whole being supported by a cable stretched between suitable supports, such as masts, trees, columns, or walls, &c.

When the lamps are in groups of four or five in series, it is necessary, in the case of serpents or rockets of more than thirty yards long, to couple two lamps in one of the derivations, with three lamps in the following
 75 derivation—that is to say, if the first wire supplies lamps 1 2 3 and 6 7, for instance, the second wire will supply lamps 4 5 and 8 9 10, and so on, with the object of avoiding in the case of breakage of the filament of any
 80 one lamp the extinction of five consecutive lamps, which would cause a break of continuity of about two feet, more or less.

Having described the construction of the serpents or rockets, the bouquets, and the
 85 commutator, I will now state that the wires are conveniently carried on reels carried in a box, from which they are conveniently uncoiled. I have illustrated a form of reel-box
 90 in Fig. 20. These coils have a uniform length of about one hundred yards, each of the wires communicating with one of the pins or contacts of the commutator *e* of the serpent or
 95 rocket, the top of this coil-box forming the base of one or more commutators.

In Fig. 5 I have shown the key-board for serpents or rockets and for their bouquets, which will be specially described hereinafter. By providing three or more banks of keys the effect of rockets or serpents may be produced,
 100 and by operating them inversely the effect of a rain of fire may be produced, if the lines of lamps are sufficiently close together and are approximately parallel.

I will now describe the construction of the
 105 Catherine wheels, which may be fixed or rotary, simple or multiple, and by means whereof very powerful luminous effects may be produced. As the stationary Catherine wheels are very little used, it is unnecessary to describe them, as they come within the category
 110 of stationary pieces or form part thereof. Fig. 6 is a section of a simple Catherine wheel formed of a single rotary disk. This disk *i* has a sheet-iron central portion covered with
 115 two insulating-plates of wood *j, j*. It is fixed upon a tubular shaft of iron about one or two inches in diameter and a yard long, supported by flanges or rings *k'*, running on friction-rollers and provided at its rear end with a
 120 grooved pulley, upon which runs a belt driven from a corresponding pulley on the dynamo. On the outer surface of the disk *i* are mounted in the form of radii or of concentric circles
 125 incandescent lamps arranged parallel or in series. When the diameter of the Catherine wheel exceeds eight feet, it is preferred to apply to the disk a solid plate for receiving the lamps. Along the length of the hollow
 130 shaft are series of holes or slits, through which pass the leading wires conveying the current to the lamps of the Catherine wheel, these wires also passing through an annular wooden sheathing *m* and being connected to rings of

copper or brass *n* in said sheathing *m*, and insulated from one another and from the shaft by said sheathing *m*. An electric brush bears constantly on each brass ring, so that whatever may be the motion of the Catherine wheel each brush, when brought into electrical contact by the key-board and commutator, transmits the current to the corresponding ring, wire, and lamps.

In order to obtain from a simple Catherine wheel all the possible effects, it would be necessary that the lamps should be in multiple and that each lamp should be operated by a special commutator. As this is not always possible, the lamps are divided in mounting them into groups of colors and arranged in series, if necessary, at opposite points of the Catherine wheel, so as to avoid considerable gaps in the case of breakage of the filament of any one lamp.

Figs. 8 and 9 show a multiple Catherine wheel with triple revolving annuli. The construction is similar to that of the Catherine wheel with a single disk. *o* is the central disk surrounded with two concentric rings *p* and *q*. The disk *o* is mounted on a central shaft *r*, while the two rings are respectively mounted on concentric hollow shafts *s* *t*, all three shafts being supported by friction-roller bearings, as in the former case, the arrangement of the wires being also similar, and each of these shafts *r* *s* *t* having a driving-pulley, which is driven by an open or crossed belt from a corresponding pulley on the dynamo, as represented in the diagram Fig. 10. Around the whole of the contiguous peripheries of the disk and rings are projecting points so arranged as to pass one another during the rotary motion in such a way that a powerful discharge of sparks will be produced between them.

Figs. 11 and 12 represent a cascade of multi-colored fires produced by lamps mounted on revolving disks, cylinders, or arms. *u* *u'* *u''* *u'''* are cylinders of wood mounted on horizontal shafts, each shaft being constructed in the manner before described in respect of the Catherine-wheel shaft, the poles being at opposite ends of the shafts, which are driven by belts from the dynamo. The connections with the positive poles determine the lighting in lines of the lamps situated on the halves of the cylinders which are presented to view, while the lamps which are situated at the rear of the longitudinal vertical plane are extinguished by the intervention of segments or gaps in the commutator-disks.

Fig. 13 represents a simple cascade formed by lamps carried upon an endless apron *y*, running over guide-rollers *X* *X'* *X''*, the side of the apron presented to view being inclined. *Z* is a metallic web in communication with the wires of the commutators and upon which rub brushes *j*, communicating with those of the lamps which are presented to view, the remainder being extinguished.

A simple girandole is shown in Figs. 14, 15,

and 16, and consists of a double endless belt *a*, whereon are mounted at sufficiently short intervals cross-pieces *b*, each carrying a certain number of lamps *c*, according to the desired width of the girandole. At the upper and lower ends of the frame-work *A* are mounted guide-rollers *d*, arranged in a semicircle, around which the belt *a* passes. Motion is imparted to the belts and lamps by rotating the guide-rollers.

Fig. 15 is a cross-section of the apparatus, showing the position of the wires. The wires coming from the commutator connect with metallic strips *e*², either by means of brushes or otherwise, and from each strip a single wire runs along the cross-bar *b* to a lamp and back again to another strip. By suitably operating the commutator, to which all the wires are led, all sorts of beautiful luminous effects may be produced by lighting up the lamps by groups, lines, or colors.

It will be evident that the invention is not limited to the particular applications described, as all sorts of pyrotechnic devices, however complicated, may be easily imitated.

I will now describe the mechanism by which the illumination of the various pieces is controlled. It consists of a series of keys disposed like those of a piano and forming as many commutators or separate contacts. Fig. 5 shows the general arrangement for controlling several different set pieces in combination with a series of serpents or rockets. Fig. 18 shows one of these keys or commutators, having perfect contacts produced by electro-magnets and wire-cloth pads specially constructed for application to pyrotechnical purposes. 1 and 2 are the contacts for closing the circuit in each of the electro-magnets *X* and *X'*, 13 and 14 being respectively the points of ingress and egress of the currents for exciting the electro-magnets. The illuminating-current enters the commutator at 3, passes through wire 4 to the contact 5, movable about the axis 6 of the commutator, which is surrounded by a collar 7, forming a bearing. 8 is a metal arm furnished at its lower face with a copper-wire-gauze pad. 9 is a second pad of copper-wire gauze, the two constituting the upper and lower contact-plates of the commutator, and the latter being connected with a terminal 12, at which the current passes out. The armatures of the electro-magnets *X* *X'* are covered with an insulating-plate 10, so as to separate the parts of the commutator, in which pass the current of the armatures 11, attracted by the electro-magnets. 16 is the key, of ivory or other insulating material. The lever 18, raised in the position shown, carries a weight 17 to balance the key, which is depressed under normal conditions, as shown.

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

1. The combination of series of electric lamps with a key-board and a commutator and with a conductor from a series of lamps

to the key-board and with the conductors E F G H, &c., from each of the lamps of one series to the commutator, corresponding lamps of the different series connecting with like contacts of the commutator, substantially as herein shown and described.

2. The combination of one or more rotating carriers, mechanism, substantially as described, for rotating the same, with series of electric lamps *c* secured to said carriers and with series of conductors from said lamps, rotating sheathing *m* and insulated conducting-rings *n* thereon, and with brushes bearing on said rings and connecting with the source of electricity, all arranged as specified.

3. The combination of series of concentric carriers *o p*, each carrying series of electric-lights *c*, with conductors to the respective lights, with mechanism for rotating the said carriers and their lamps independently one of the other, and with mechanism, substantially as described, for conveying the electric fluid to the lamps in the desired succession, the said carriers *o p* having on their contiguous peripheries projecting points and being combined with conductors, all arranged so that when the points on the respective carriers pass one another sparks will be created, as specified.

4. In a key-board, the combination of the electro-magnets X X', their armatures 11, insulating-plates 10 thereon, both said armatures being attached to a single swinging bar 8, all arranged so that when one armature is in contact with its electro-magnet the other

is out of contact, and vice versa, one arm of said bar 8 being weighted, and with the conductors 14, 13, 4, and 12, all substantially as and for the purpose herein shown and described.

5. In a commutator, the combination of the disk *e*, having series of spring-raised contacts *h*, with the lever *f* and with the segmental arm *g* thereon, the lower face of said arm being oblique, all arranged so that by rotating the handle *f* several of said contacts *h* will be simultaneously and successively depressed, all arranged substantially as described.

6. In apparatus for creating pyrotechnic effects with the aid of electricity, the combination of a source of electricity, a commutator and a key-board, with a series of conductors and series of electric lamps on carriers, each of the contacts of said commutator being in electrical communication with one lamp of each series, and each key of said key-board being in electrical communication with all the lamps in one series, and with mechanism, substantially as described, for rotating the lamp-carriers, as specified.

The foregoing specification of my improvements in the application of electricity for the production of pyrotechnic and other similar effects, signed by me this 21st day of April, 1891.

PIERRE CHARLES EUGENE CHAMPION.

Witnesses:

ROBT. M. HOOPER,
ALBERT MOREAU.