No. 672,452. Patented Apr. 23, 1901.

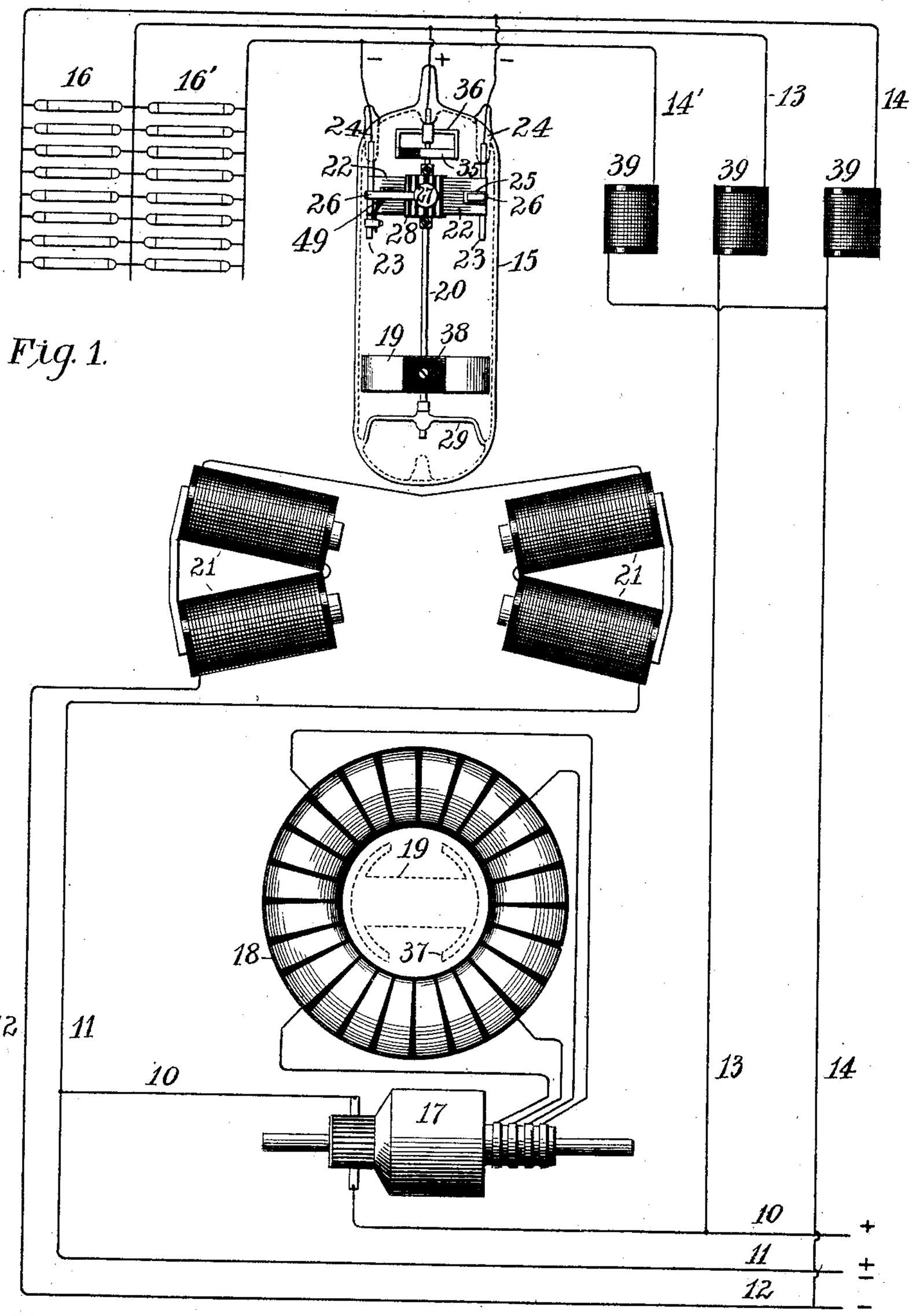
D. McF. MOORE.

ELECTRIC LIGHT APPARATUS.

(Application filed Apr. 15, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



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Attorney

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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

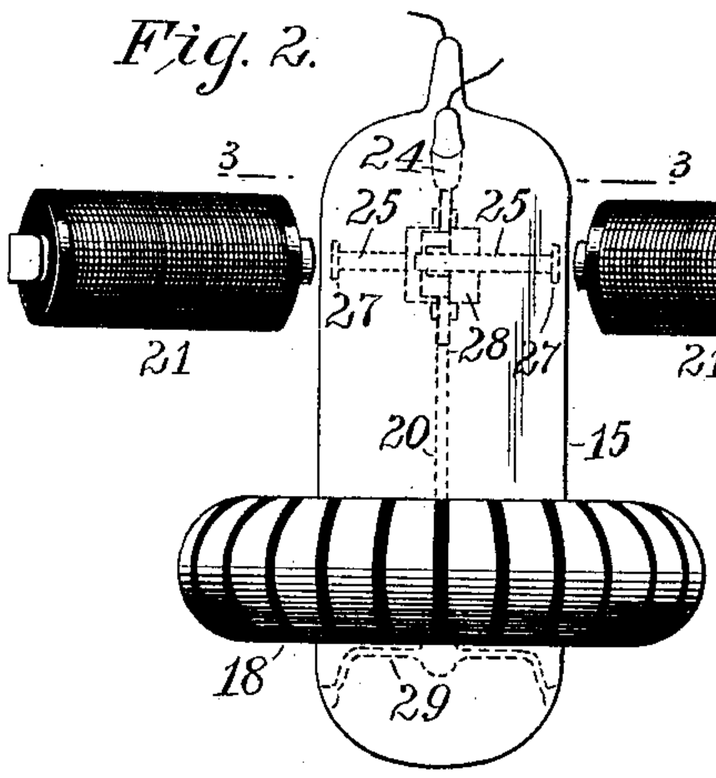


Fig. 4.

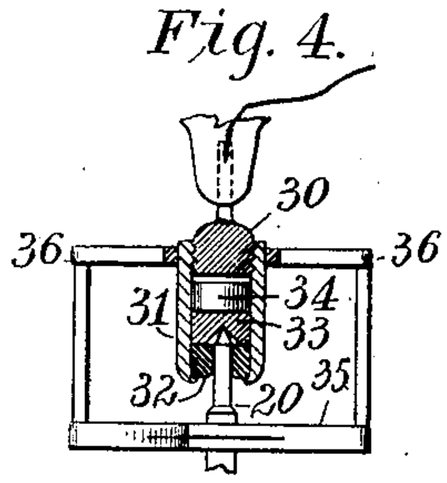


Fig. 3.

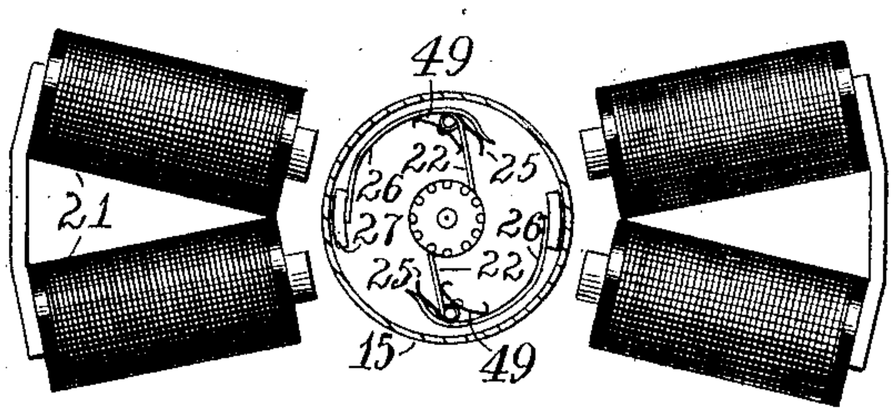


Fig. 5.

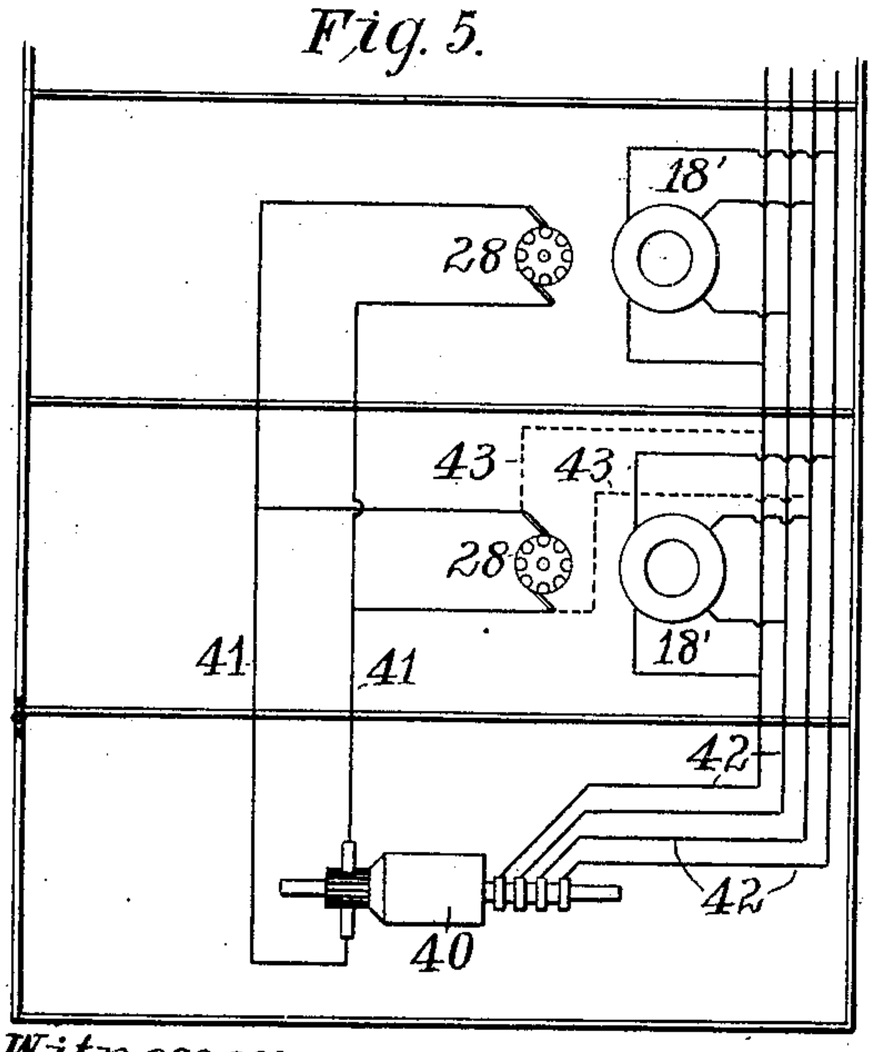
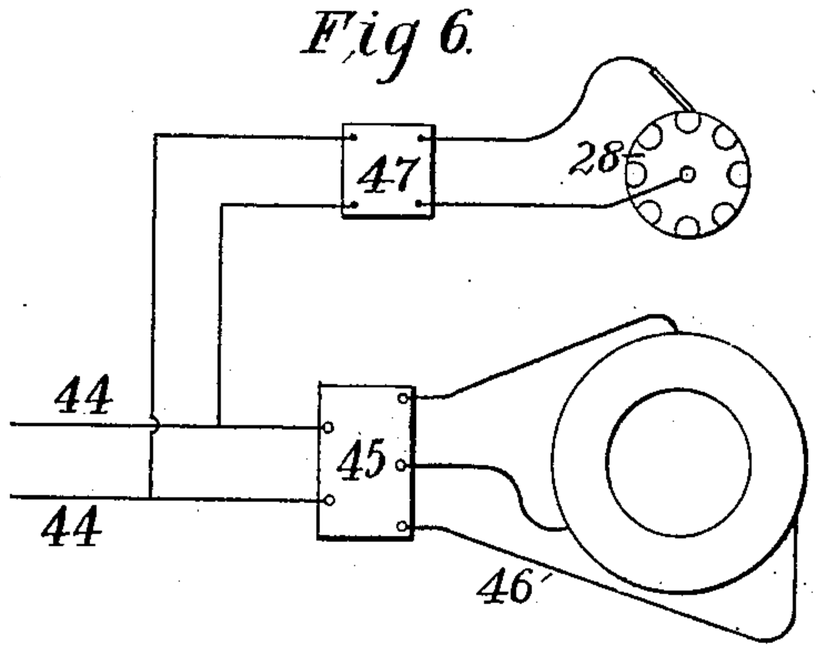


Fig 6.



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(No Model.) 4 Sheets—Sheet 3.

Fig. 7.

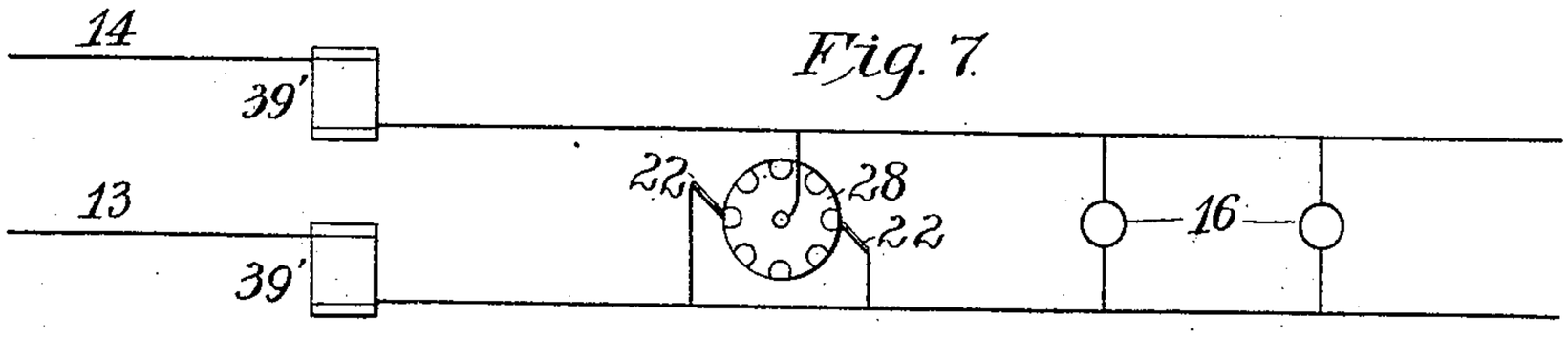

Fig. 8.

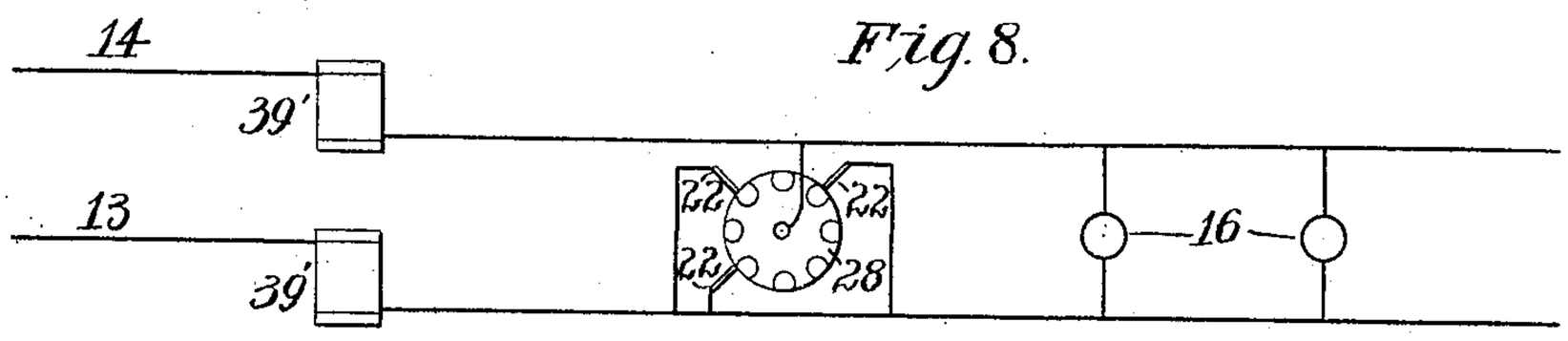

Fig. 9.

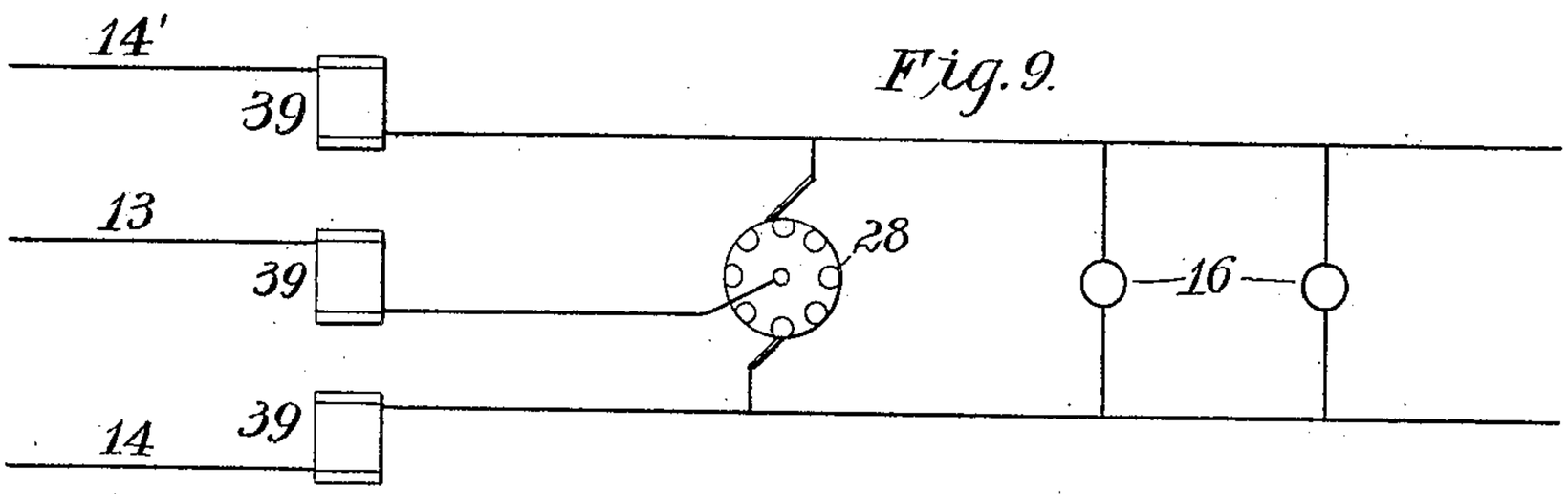

Fig. 10.

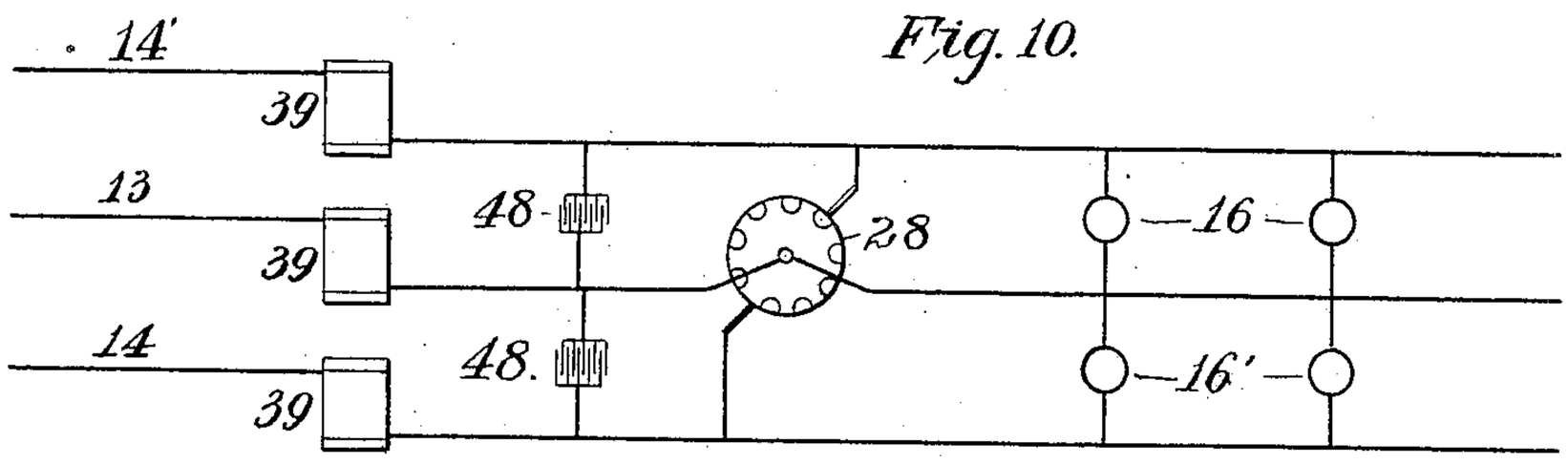

Fig. 11.

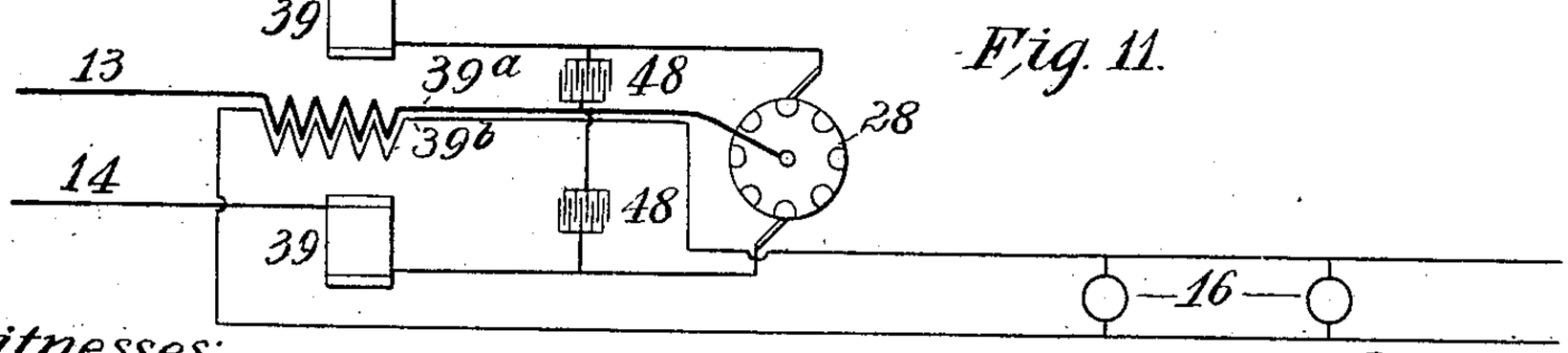

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Fig. 12.

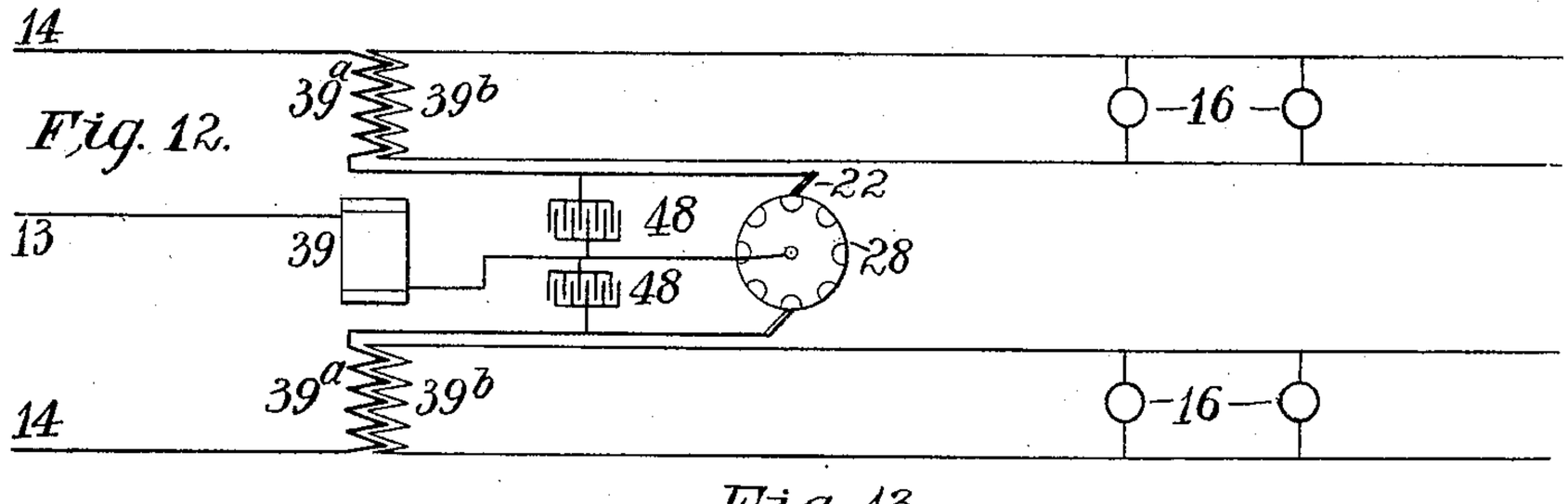


Fig. 13.

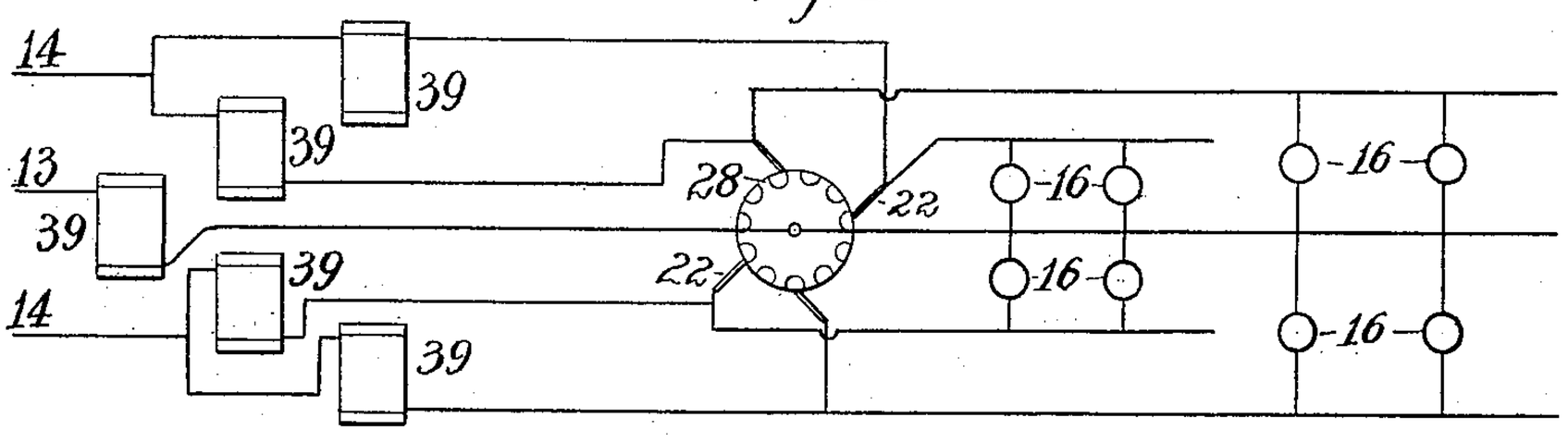


Fig. 14.

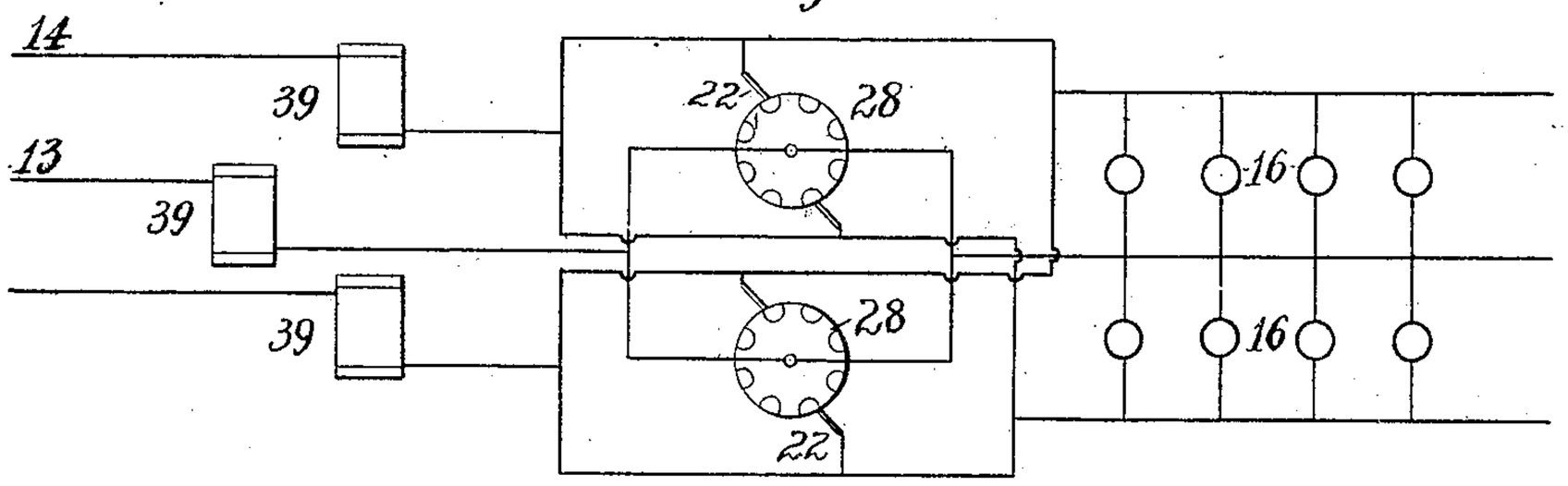
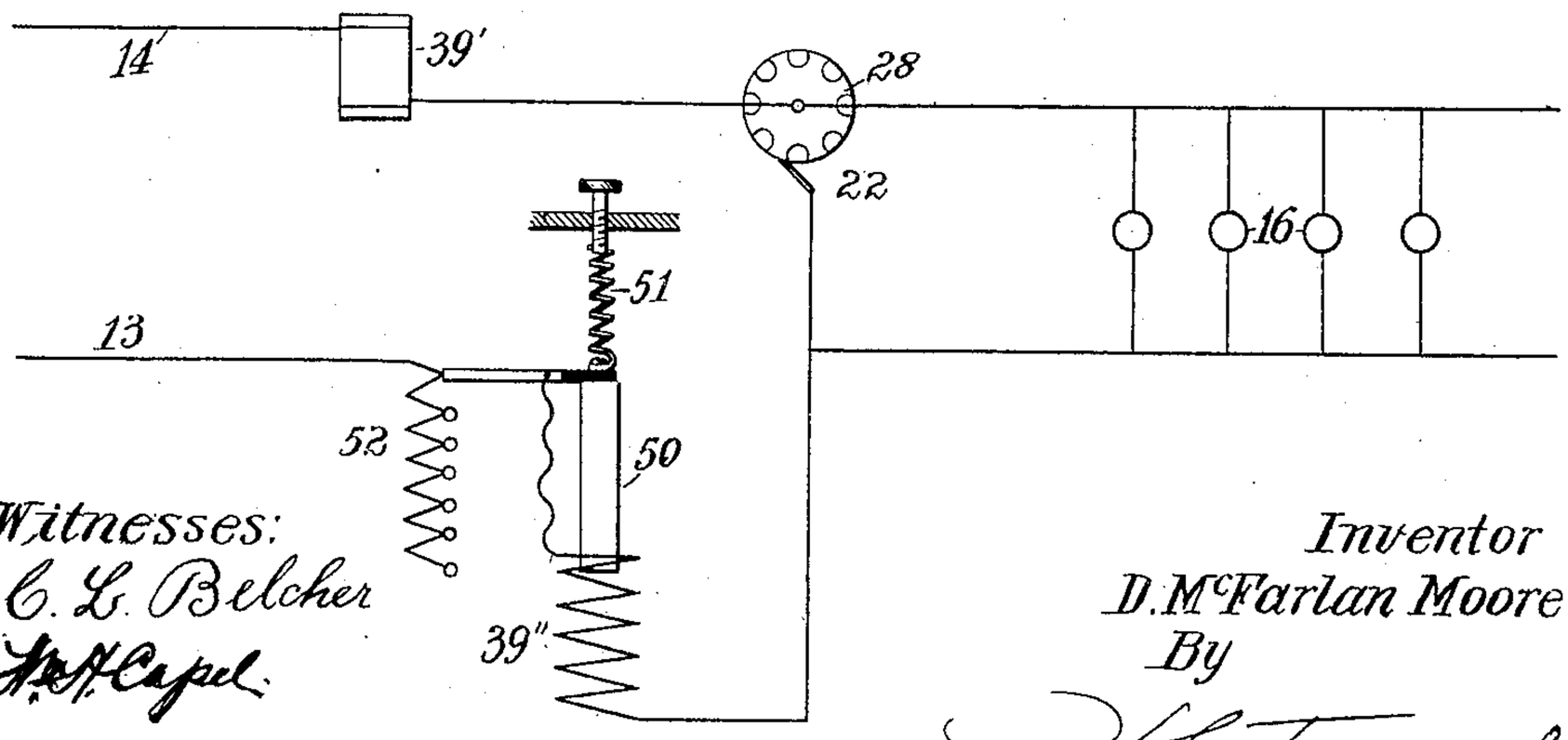


Fig. 15.



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UNITED STATES PATENT OFFICE.

DANIEL McFARLAN MOORE, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE MOORE ELECTRICAL COMPANY, OF NEW YORK, N. Y.

ELECTRIC-LIGHT APPARATUS.

SPECIFICATION forming part of Letters Patent No. 672,452, dated April 23, 1901.

Application filed April 15, 1898. Serial No. 677,706. (No model.)

To all whom it may concern:

Be it known that I, DANIEL MCFARLAN MOORE, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have invented a certain new and useful Electric-Light Apparatus, of which the following is a specification.

My invention relates to apparatus for producing luminous effects, Roentgen rays, and similar effects by electric vibrations, waves, or disturbances generated by repeatedly interrupting a circuit of self-induction, the electromotive forces or disturbances thereby generated being utilized directly or indirectly in another circuit or path, termed a "working" circuit, to produce the desired effect by means of a vacuum-tube or similar device.

One object of the invention is to construct systems of this sort which shall serve for isolated plants or for use on existing circuits.

Another object of the invention is the improvement in the apparatus included in these systems.

With these objects in view the invention consists in the construction, combination, and arrangement of parts hereinafter fully described, and set forth in the claims.

In the accompanying drawings, which form a part of this specification, Figure 1 is a diagrammatic representation of the system embodying the invention. Fig. 2 is a side elevation of the rotary circuit-interrupter. Fig. 3 is a section through the interrupter, taken in the horizontal plane indicated by line 3 3, Fig. 2. Fig. 4 is a vertical central section through the upper jeweled bearing of the rotator-shaft. Fig. 5 diagrammatically represents one mode of equipping an isolated plant. Fig. 6 represents one way of adapting the invention to an alternating-current system, and Figs. 7 to 15 represent several variations in the connections and arrangements of the circuits of induction and of the circuits into which they discharge.

Vacuum-tube lighting by this invention may be readily effected upon any of the existing systems of current distribution. Fig. 1 shows it adapted to the ordinary three-wire system. Therein 10 11 12 indicate the line-wires, and 13 and 14 the conductors leading to the interrupter 15 and to the lights 16 and 16′. In the circuit of wires 10 and 11 is a rotary transformer 17, from which current is fed to the rotary ring-field 18, which, as indicated in Fig. 2, encircles the rotator in the plane of the armature 19, which is mounted on the shaft 20 of the rotator. Then in the circuit of wires 12 and 11 are the pairs of magnets 21, which are located in the plane of the contact-brushes.

The contact-brushes are represented at 22, and preferably consist of several plates or tongues hinged upon or otherwise suitably connected to posts 23, which are secured in suitable projections from the walls of the glass receptacle of the rotator, as indicated at 24. Upon the back of the brushes 22 are preferably mounted springs, as 25, against which rest the ends of armature-levers 26, the armatures 27 of which are mounted upon the free ends of the levers near the walls of the rotator receptacle or case. These armatures are in the fields of the magnets 21, and through the instrumentality of said magnets and the armature-levers 26 the brushes are held in close engagement with the circuit-breaking wheel 28. The application of magnetic pressure to the inclosed contact-brushes is fully disclosed in my application for patent, Serial No. 615,970, filed December 17, 1896, and the circuit-breaking wheel here illustrated is fully disclosed in my application, Serial No. 643,337, filed July 3, 1897, and consists of a metallic cylinder having porcelain plugs inserted therein and the whole ground down to expose as much of said plugs as is necessary.

It will be noticed that the projections 24 for supporting the brush-bearing posts 23 have complementary parts exterior to the rotator-receptacle for the purpose of making a more thorough seal for said post and wires leading thereto.

Considerable trouble has been experienced in the construction of a rotary interrupter because of the necessary accuracy with which the bearings for the rotary shaft must be constructed and mounted within the vacuous receptacle; but these difficulties have been overcome in the present form of rotator, and the amount of metal within the vacuous chamber has been reduced to the minimum.

The construction by which this is accomplished is that illustrated. Therein the lower bearing for the shaft 20, which by preference is an ordinary jeweled step-bearing, is mounted at the center of a spider or bridge 29, formed, preferably, from glass rods bowed or bent, as indicated, to allow for expansion or contraction and having the ends of its legs secured in or to the walls of the receptacle. The upper bearing for the shaft is formed upon a stem, as 30, which is secured or anchored in the wall of the receptacle. To this stem is attached a tubular socket 31, having within its lower end a hollow vitreous plug or bushing 32, centrally located for the insertion of the upper end of the shaft 20. Above this plug and resting upon it is the bearing-jewel 33, and between this jewel and the stem 30 there is preferably placed a weight 34 for holding the jewel upon the shaft. For this weight may obviously be substituted its equivalent—a spring. By this means the shaft 20 is insulated from the metal parts of the bearing, thereby preventing any sparking between it and said parts. Current is conveyed to the shaft from the metal parts of the bearing, preferably by springs 35, which are mounted upon arms 36, secured, substantially as indicated, to the socket 31.

The rotary field 18 exterior to the vacuous receptacle and the armature 19 within said receptacle constitute the motor by which the circuit-breaking wheel 28 is rotated. This armature may be in any suitable form, but preferably consists of the arc-shaped portions 37, represented in dotted lines within the field 18, said portions being connected by the cross-piece 38, which is suitably secured to the shaft 20. Current is supplied to the rotator from wire 10 over conductor 13, connected to the stem 30, and is taken from the break-wheel over brushes 22 and the conductors 14 or 14′, the latter uniting with the former, as indicated, and to the main 12.

The vacuum tubes or lamps or such other translating devices as may be seen fit to use upon this system are located beyond the rotator connections and in multiple between the conductor 13 and the conductors 14 and 14′. At the opposite side of the rotator connections there are located in the conductors 13, 14, and 14′ self-induction coils 39, wherein the inductive resistance upon opposite sides of the break in the interrupter is equalized, to the end set forth in my application, Serial No. 615,971, filed December 17, 1896.

In the adaptation of the invention to an isolated plant a multiphase generator is preferably employed, which may be located, for instance, in the basement of the building, as at 40, Fig. 5, and a rotator placed upon each one of the floors of the building, two such floors being represented in the drawings and the rotators designated, diagrammatically, simply by the rotary fields 18′ and circuit-breaking wheels 28. Said rotary fields are connected to the generator substantially as indicated—that is, by running a series of conductors 42 up through the building and tapping therefrom to the rotary fields. The lighting-circuits in a system thus installed may be taken from an independent source or from the direct-current side of the generator, as indicated by wires 41, or from alternate ones of the conductors 42, leading from the multiphase side of the generator, as indicated by the dotted lines 43. In the first two instances the conductors, as 41, would be led up through the building and branches therefrom lead to the circuit-breaking wheel 28, as indicated, while in the last instance the branches to the circuit-breaking wheel would be taken directly from the motor-conductors 42.

If it is desired to operate the system from alternating-current mains, an arrangement substantially as indicated in Fig. 6 may be adopted. Therein the alternating mains are indicated at 44. A suitable static transformer is employed, as indicated at 45, from which the circuit is led to the rotary field 18′ of the interrupter, as indicated. Any other form of transformer may be used at 45 that will give the desired rotation of field-currents in the ring-field 18′. The lighting-circuit may be supplied from the branches 46, which lead to said field, as in Fig. 5, or they may be supplied from an independent source or from the alternating mains by means of a transformer, as indicated at 47.

The operation of the system is as follows, reference being had to Fig. 1: The rotary transformer 17 causes the sections of the rotary field to be energized successively, thereby rotating the armature 19 and the break-wheel 28 at a very high speed, the contact between the brushes and the break-wheel being constantly maintained by the magnet 21. Horseshoe-magnets are preferably employed for this purpose, as indicated, thereby preventing the passage of magnetic lines of force through the receptacle, as would be the case were single-pole magnets used. Upon the interruptions in the circuit at the break-wheel the kick of coils 39 or the current resulting from the self-induction of said coils flows through the tubes 16 16′, thereby illuminating them. The interruption of the circuit or circuits of induction may take place simultaneously or successively, accordingly as the brushes are arranged to bear upon the break-wheel.

Figs. 3 and 7 to 15 show various arrangements of brushes. Said figures show likewise various arrangements for the circuits of induction and lighting circuits. In Fig. 7 the contact-brushes 22 are arranged to break circuit simultaneously, thereby dividing up the tendency to spark by increasing the extent of conducting-surface between the brushes and the break-wheel and providing for a division of the circuit leading to the break-wheel. In Fig. 8 the brushes are arranged to break circuit successively, thereby multi-

plying the number of discharges into the lamps 16, the arrangement shown in this figure giving three times the number of discharges into the lamp-circuit for one revolution of the break-wheel to what is obtained in the arrangement shown in Fig. 7. In Fig. 9 the brushes are also arranged to break circuit successively. Here the arrangement of circuits is such that a three-wire system similar to that shown in Fig. 1 shall discharge into a single lamp-circuit or bank of lamps, instead of into a series of such circuits, as in Fig. 1, thereby giving a high frequency. In Fig. 10 substantially the same arrangement of circuits of induction and lamp-circuits is shown as in Fig. 1, save that condensers at 48 are shown bridging the circuits of induction leading to the break-wheel for steadying the disruptive or self-inductive discharges from the coils 39. In Fig. 11 substantially the same arrangement of circuits of induction exists as in Fig. 10. In the arrangement here shown, however, the lighting-circuit is supplied from the secondary winding 39^b of an induction-coil whose primary is 39^a and which is located in the middle conductor of the three-wire system. A secondary, as 39^b, may be placed upon the coils 39 instead of upon the coil 39^a. In that case two light-circuits or banks of lights may be operated from this system. This arrangement is illustrated in Fig. 12. These figures show the arrangement of circuits in which the condenser is of the greatest utility.

By multiplying the number of brushes upon the break-wheel in the three-wire system of Figs. 1 and 10 the light-circuits supplied from the same interrupter may be increased, or this same object may be effected by adding more break-wheels to shaft 20. The former arrangement is illustrated in Fig. 13, wherein it may be seen that the brushes 22 break circuit successively and current is supplied to four banks of lights.

To increase the frequency of interruptions in the circuits of induction two rotators may be used, as indicated by the break-wheels 28 in Fig. 14. Therein the interrupters are in parallel and are to be rotated in unison and the break-wheels so adjusted that they shall alternate in the interruption of the circuit. It will also be noted that the light-circuits are so arranged that each interrupter controls both banks of lights and may direct the self-inductive discharges through them simultaneously, as in said figure, or successively, depending upon whether or not the brushes on each break-wheel break circuit simultaneously or successively. Obviously these two break-wheels may be together in the same chamber and operated by the same motor or they may be in separate chambers and their motors run in unison.

As the system of lighting herein disclosed is intended for general use and on various circuits, it is well to provide some automatic regulation for the current supplied to the break-wheel or, in other words, for the current supplying the circuit of induction. Such regulation may be effected in various ways, one of which is illustrated in Fig. 15, wherein one of the self-induction coils, as 39″, is in the form of a solenoid and has a core, as 50, suspended in the axis thereof by a spring attached to an adjusting-screw 51, the end of the core slightly entering the coil. Should an excess of current start over conductor 13, the core will be drawn down into the coil and the flow of the current retarded. In addition to the impedance to the current caused by the insertion of the core the movement of the core may be utilized to throw a resistance into the circuit 13, as shown at 52, an arm on the core traversing a series of resistance-coils as the core moves up or down. If desired, the descent or return of the core 50 may be retarded by connecting a dash-pot thereto in any of the well-known ways.

The invention claimed is—

1. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, the combination with a circuit of induction, of a circuit-breaking wheel having two or more brushes or contacts arranged to successively break the circuit of induction momentarily and maintain it closed in the interims a discharge-circuit common to said brushes, and vacuum-tube lamps in said discharge-circuit.

2. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, the combination with a circuit of induction, of rotary circuit-interrupting devices in a vacuum, having two or more sets of contacts each connected to the same circuit of induction or branch thereof, said sets of contacts being arranged to break circuit simultaneously for the purpose of dividing up the interrupted current and thereby lessening the destructive effects upon the vacuum.

3. In an apparatus for generating electric waves, vibrations or disturbances, suitable for producing light, Roentgen rays or similar effects, the combination with a circuit of induction, of a circuit-interrupting device included in a vacuum and arranged to break the circuit of induction simultaneously at two points within the vacuum for the purpose of diminishing the destructive effects on the vacuum due to the disruptive action therein.

4. In an apparatus for generating electric waves, vibrations or disturbances, suitable for producing light, Roentgen rays or similar effects, the combination with a circuit of induction, of a circuit-interrupting device operating in a vacuum and arranged to break a circuit of induction simultaneously at two or more points in multiple for the purpose of decreasing the damaging effects of the disruptive action upon the vacuum.

5. In an apparatus for generating electric waves, vibrations or disturbances, suitable for

producing light, Roentgen rays or similar effects, a circuit-interrupter having two or more points of interruption controlling respectively branches of a circuit of induction, and a condenser for each branch connecting it to the common return.

6. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, a circuit-interrupter having two or more points of interruption within a vacuum, a branch circuit for each point of interruption and a condenser connected between each branch and the common return exterior to the vacuous chamber.

7. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, a circuit-interrupter having two or more points of interruption controlling separate branches of a circuit of induction, and an induction-coil the primary of which receives the discharges of said circuit.

8. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, the combination with a circuit-interrupter having a number of points of interruption each controlling a separate branch, of a circuit of induction, a common return, a corresponding number of discharge-circuits connected to said branches and also having a return connected to the return for the branches of the circuits of induction, and self-inductive coils placed respectively in said branches and in the common return.

9. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, a circuit-interrupter having a number of points of interruption controlling separate branches of the circuit of induction, a self-inductive coil in each branch, and a common discharge-circuit into which the discharges from the said branches are fed.

10. In an apparatus for generating electric waves, vibrations or disturbances, suitable for producing light, Roentgen rays or similar effects, a circuit-interrupter having a number of points of interruption controlling separate branches of a circuit of induction, a self-inductive coil in each branch and in the common return, and a discharge-circuit common to the branches.

11. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, a source of continuous current supplying a rotary circuit-interrupting device included in a vacuum and adapted to break circuits of induction fed from said continuous-current supply, and a multiphase secondary circuit of said transformer supplying the rotary field arranged exterior to the interrupter-inclosure for producing rotation of the parts within the vacuum.

12. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, the combination substantially as described, of a multiphase and continuous-current generator, distributing-circuits leading from the multiphase side of the generator, a series of rotary circuits leading from the multiphase side of the generator, a series of rotary circuit-interrupters each operated by a rotary field supplied from said circuits, and circuits of induction supplied from the continuous-current side of the generator each circuit including one of the interrupters and being governed thereby.

13. In a rotary circuit-interrupter, the combination with a vacuous glass receptacle, of a rotary shaft therein carrying the break-wheel, a bearing for the upper end of said shaft secured in the wall of the receptacle, and a bearing for the lower end of the shaft supported on a glass spider or bridge spanning the receptacle.

14. The combination with the vacuous receptacle and the rotary shaft therein, of a step-bearing for said shaft and a spider of glass supporting said bearing at its center, and having its legs bent and integrally secured in the walls of the receptacle.

15. In a rotary interrupter inclosed in a vacuous receptacle, an arched or bent glass support for the shaft of the interrupter.

16. The combination with the vertical shaft, of the upper bearing therefor, consisting of an insulating-bushing in which the end of the shaft turns, the jewel-bearing resting upon the end of the shaft, and means for holding the jewel in place, substantially as set forth.

17. The upper bearing for the armature-shaft consisting of the stem anchored in the wall of the receiver, the socket mounted thereon, the bushing in the lower end of said socket, the jewel-bearing located above said bushing, and the weight resting upon said jewel, as and for the purpose set forth.

18. The rotary circuit-interrupter consisting of the vacuous glass receptacle the vertical rotary shaft therein having its bearings anchored in the walls of said receptacle, the brushes mounted on one of said bearings and engaging the shaft, the break-wheel on said shaft, the depending rods anchored in the wall of the receptacle, the contact-brushes mounted on said rods and engaging the break-wheel, the armature secured to said shaft, and magnetic means exterior to the receptacle for rotating the armature.

19. The combination with a vacuous chamber and a rotary break-wheel therein of brushes bearing on said wheel and having armatures connected therewith, and horse-shoe-magnets exterior to said chamber each magnet being located to include one of said armatures in its field for the purpose of maintaining and regulating the pressure of the brushes upon the break-wheel.

20. The rotary circuit-interrupter consisting of the vacuous glass receptacle, the ro-

tary shaft therein, the break-wheel carried by said shaft, the rods anchored in and depending from the wall of the receptacle, the brushes pivoted thereon and bearing upon the break-wheel, levers also pivoted upon said rods and bearing at one end upon the brushes and carrying armatures at the other end, and magnets exterior to the receptacle for attracting said armatures to hold the brushes upon the break-wheel.

21. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light or other effects, the combination with branches of circuits of induction, and means for rapidly interrupting the same, of working or discharge circuits connected across from said branches to the common return for the circuit of induction.

22. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light or other effects, the combination with two or more branches of circuit each including a self-inductive device and means for interrupting its circuit, of discharge-circuits connected between said branches and their common return.

23. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light or other effects, the combination with two or more self-inductive branches, of means for rapidly interrupting their connection with a common return, and discharge-circuits connected between said branches and said common return.

24. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light or other effects, the combination with two or more self-inductive branches and means for rapidly interrupting their connection with a common return, of a discharge-wire leading from each branch, and translating devices or circuits connected in multiple between each of said discharge-wires, and the common return for the self-inductive circuits.

25. The combination with the conducting-shaft, of the metal support therefor carrying a brush or brushes which bear on the shaft, and a non-conducting bushing receiving the end of the shaft.

26. The combination with the interrupter-shaft of metal parts forming a bearing therefor, a brush or brushes bearing upon the shaft and supported by said metal parts whereby current is led to the shafts, and an insulating-bushing between the shaft and metal parts, as and for the purpose described.

27. In an apparatus for generating electric waves, vibrations or disturbances suitable for producing light, Roentgen rays or similar effects, a circuit of induction having a multiple break the individual breaks of which are in series with one another, and a discharge-circuit in shunt to said breaks collectively.

Signed at New York, in the county of New York and State of New York, this 25th day of March, A. D. 1898.

DANIEL McFARLAN MOORE.

Witnesses:

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DELBERT H. DECKER.