4 Sheets—Sheet 1.

E. J. MOLERA & J. C. CEBRIAN.

System of Lighting.

No. 214,835. Patented April 29, 1879.

Fig. 1.

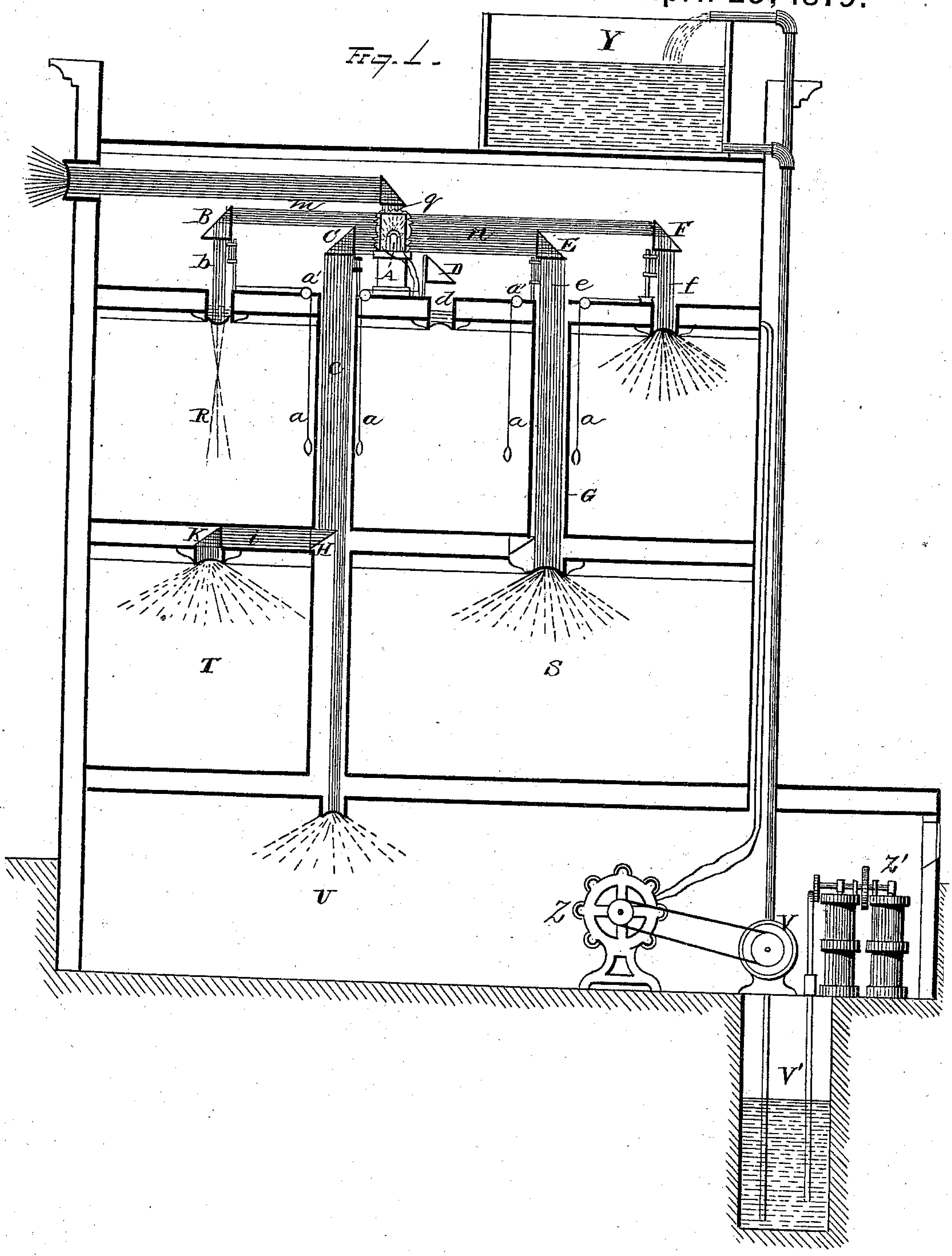

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Fig. 2.

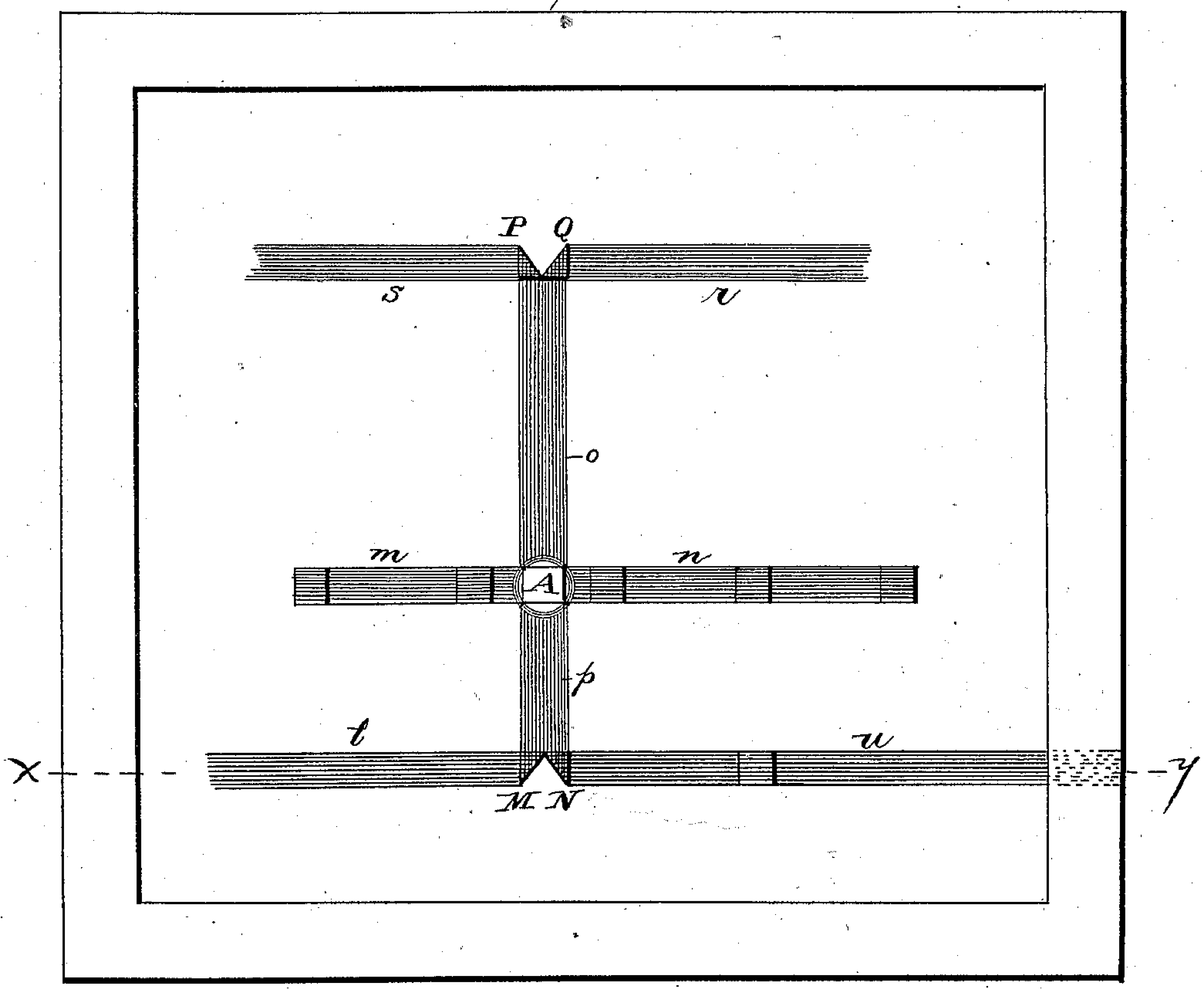

Fig. 3.

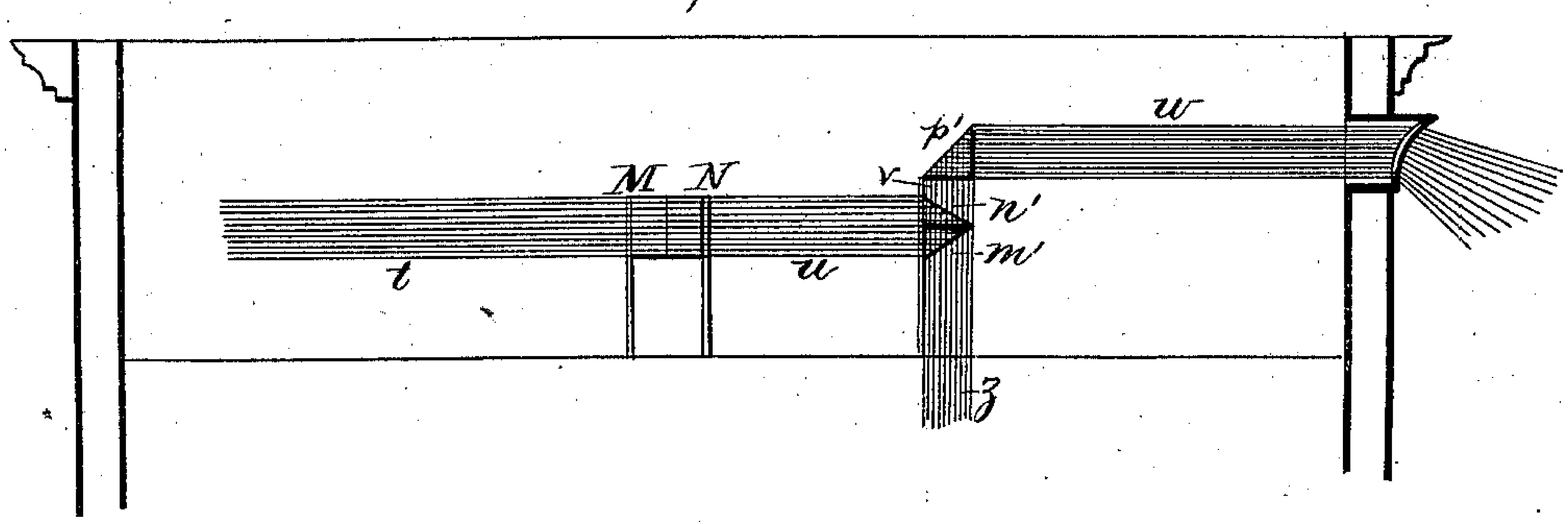

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Fig. 4.

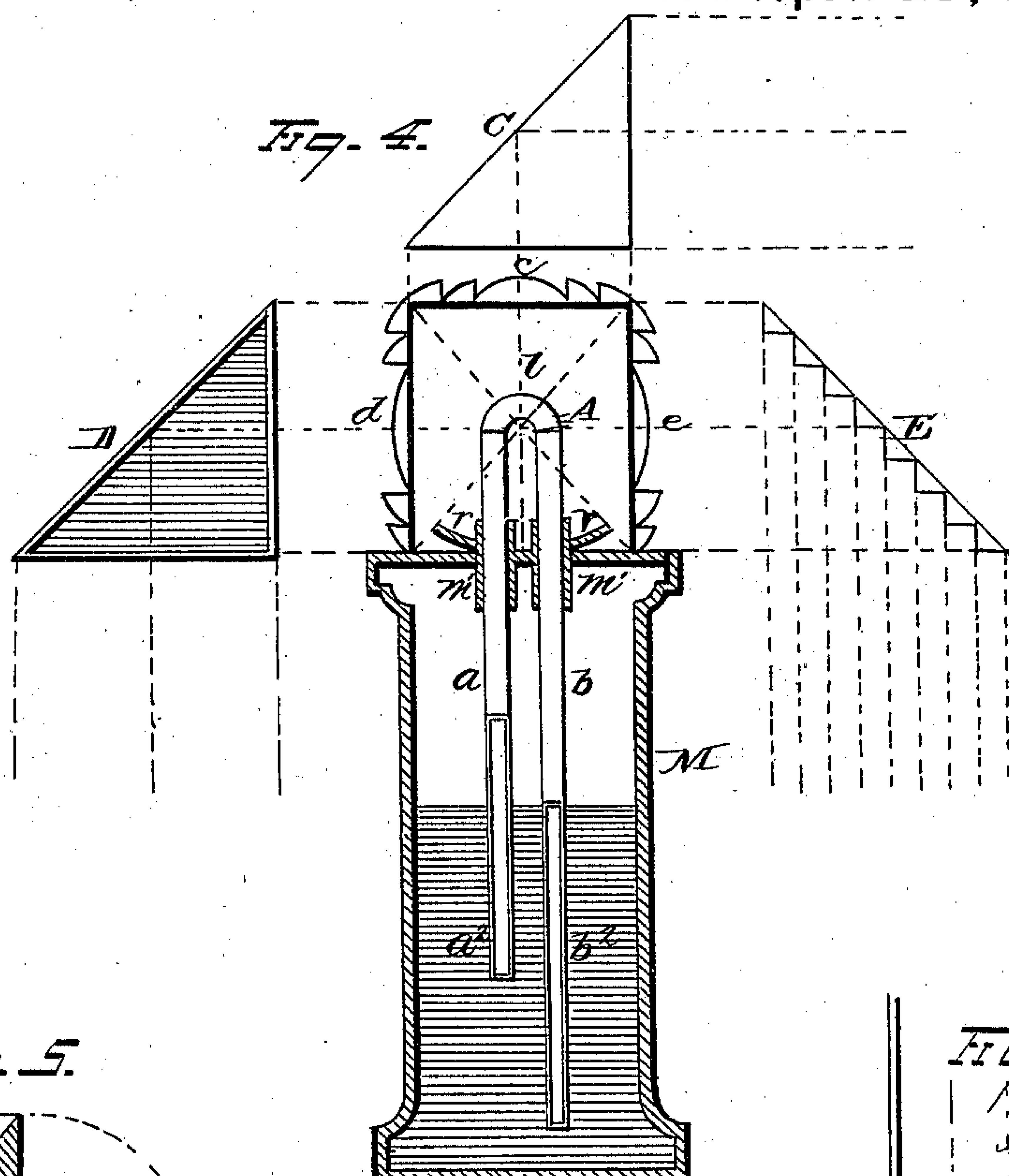


Fig. 5.

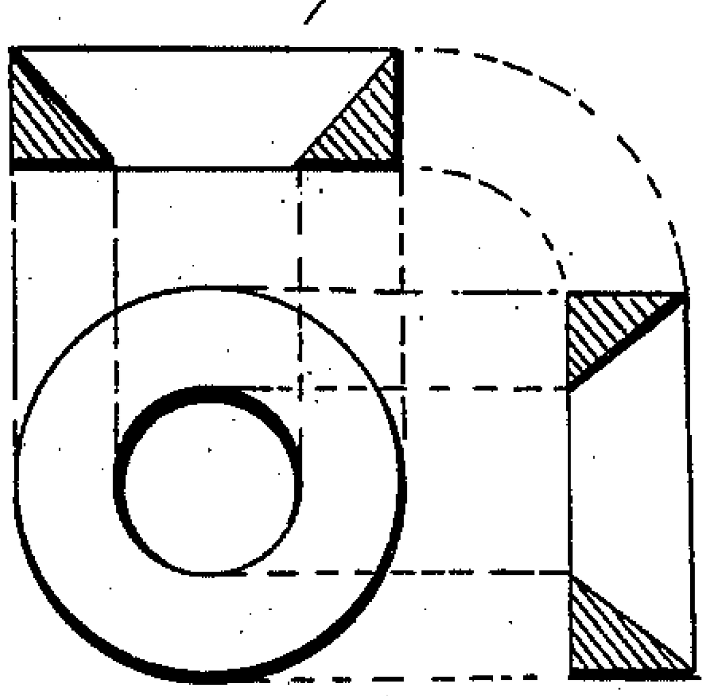


Fig. 6.

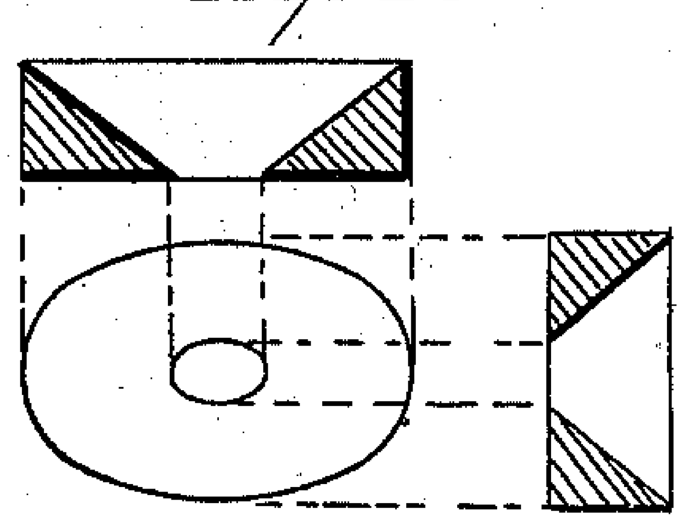


Fig. 7.

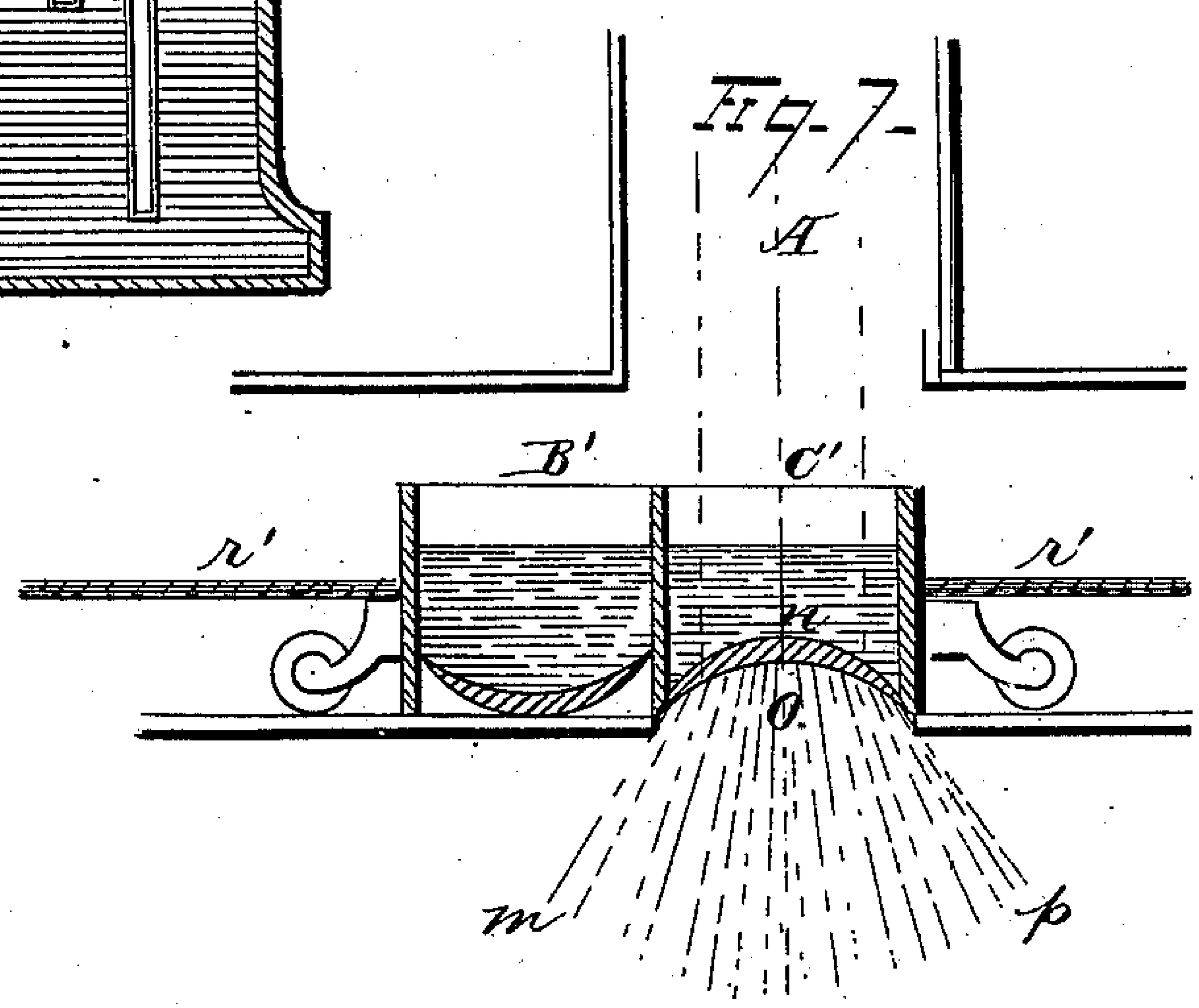
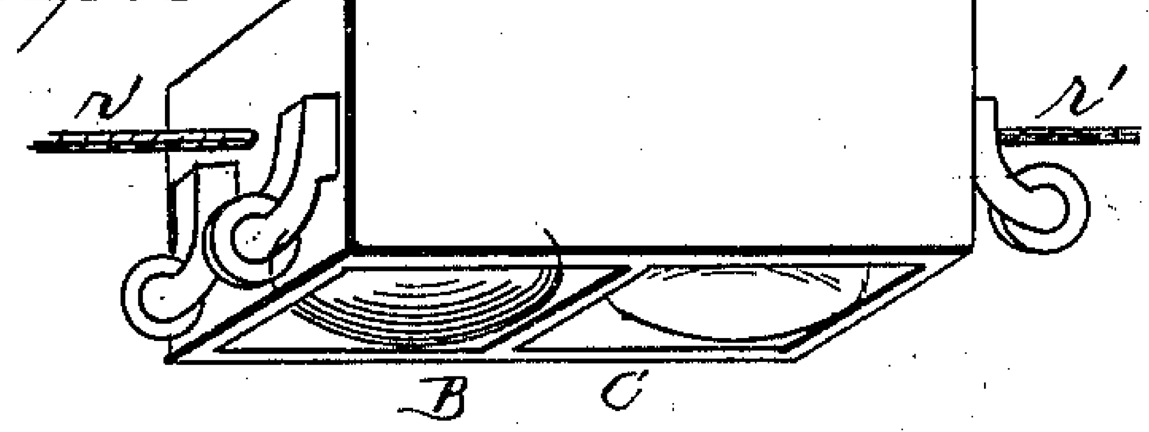


Fig. 8.



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System of Lighting.

No. 214,835. Patented April 29, 1879.

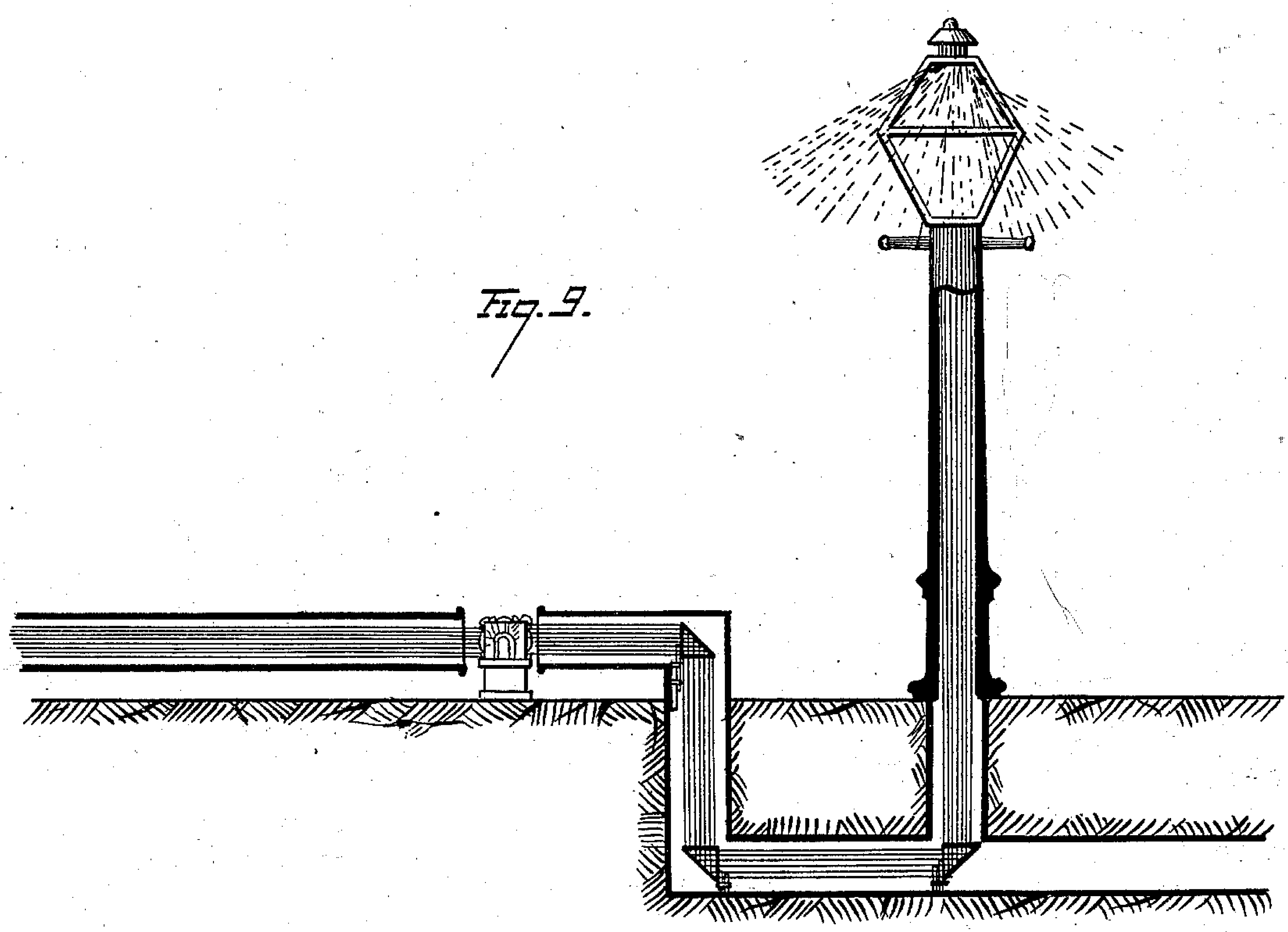

Fig. 9.

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UNITED STATES PATENT OFFICE.

EUSEBIUS J. MOLERA AND JOHN C. CEBRIAN, OF SAN FRANCISCO, CAL.

IMPROVEMENT IN SYSTEMS OF LIGHTING.

Specification forming part of Letters Patent No. **214,835**, dated April 29, 1879; application filed July 25, 1878.

To all whom it may concern:

Be it known that we, EUSEBIUS J. MOLERA and JOHN C. CEBRIAN, of San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Systems of Lighting; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

Our invention relates to a system of lighting, and is designed to provide an improved process and apparatus whereby illumination is obtained by transmitting beams of light from a suitable source in respectively different lines of direction to the several points at which the light is desired for use.

This system of lighting is adapted for any kind or source of light, and is especially intended for the strong artificial lights, such as the electric, calcium, and zirconia lights.

Heretofore the electric light, although intrinsically much cheaper than gas-light, has not obtained in general use for several reasons, prominent among which is its characteristic of intense brilliancy, which is oppressive to the human eye. It is found, however, that in attempting to reduce this insufferable brilliancy the proportionate cost of the electric light is largely increased, which results from three reasons: First, the less the intensity of the light, the greater is the proportion of the motor required in developing the electric current; second, the more an electric current is subdivided, the larger is the percentage of its waste; third, the regulator required by all electric lights costs more in proportion as the intensity of the light is reduced; also, when the electric and other strong lights are applied for scenic effect in theatrical performances and analogous cases, where different and varied shades and degrees of illumination are required, a difficulty has been experienced by reason of the insufficiency of the means employed to accomplish the purpose in view.

Some of the objections above noted as to the use of the electric light do not apply to the calcium, zirconia, and other strong lights, which, however, in addition to such defects as they may have in common with the electric light, are subject to others peculiar to themselves.

Our invention is intended to obviate these objections to any of the above-named lights, and to provide a system of lighting whereby a more or less extensive illumination may be most advantageously obtained.

The invention consists, first, in a method of forming and transmitting luminous beams respectively composed of parallel rays from a suitable source, and independently varying the size of said beams, so as to cause the same to be applied for use in greater or less volume of light at any one point; second, in a method of collecting all the light emanating from a suitable source, conducting the same in beams respectively composed of parallel rays through different paths, changing or adjusting said paths, as desired, and finally passing the light out for use in pencils of converging or diverging rays; third, in the combination, with apparatus which form and transmit a luminous beam having parallel rays, of an adjustable prism adapted to refract said beam, so that its path may be changed in part or in whole, as desired; fourth, in the combination, with apparatus which form and transmit a luminous beam having parallel rays, of adjustable convex and concave lenses adapted to pass said beam out for use in either a convergent or divergent luminous pencil, as desired; fifth, of a series of lenses and prisms which form and transmit luminous beams respectively composed of parallel rays from a suitable source, in combination with a series of convex and concave lenses, which latter are adapted to be moved or interchanged at will, so as to cause the several beams to pass out for use through either the convex or the concave lenses; sixth, of a chamber formed of lenses and reflectors, which inclose a suitable source of light, and pass the latter out in beams respectively composed of parallel rays, in combination with adjustable prisms adapted to intercept, in part or in whole, as desired, the several beams of light which emerge from said chamber; seventh, of a series of lenses and adjustable prisms, which form and transmit luminous beams respectively composed of parallel rays in different lines of direction from a suitable source, in combination with a series of interchangeable convex and concave lenses and media or substances adapted to intercept said beams, or a part thereof, and thereby color or modify the same; eighth, in the combination, with apparatus which form and transmit a luminous beam having parallel rays, together with adjustable means to change the path of said beam, of movable substances or media adapted to intercept said beam, in whole or in part, and color or modify the light of the same; ninth, in combination with an angular passage capable of transmitting light from a suitable source to any given point or points, an adjustable device located at or suitably near to the angle of said passage, and adapted to direct the light, in whole or in part, into the branch or branches of the same; tenth, in the combination, with a series of tubes capable of transmitting light from a suitable source in a prescribed line or lines, of adjustable devices adapted to change the direction of the light, in whole or in part, within said tubes.

Referring to the drawings, Figure 1 is a view representing our invention as applied to a building having two stories, an attic, and a cellar. Fig. 2 is a plan view of the attic. Fig. 3 is a detail vertical sectional view through line *x y* of Fig. 2. Fig. 4 is a similar view, representing, in a larger scale, the disposition of the light at A in Fig. 1, and also our floating regulator for the carbon lights, in instance of electric light. Figs. 5 and 6 represent modifications of the prismatic devices. Figs. 7 and 8 are detail sectional views, representing one manner of employing the lenses which finally apply the beams of light for use. Fig. 9 illustrates the principle of that part of our invention which relates to conducting beams of light through inclosed passages to the several places at which the same may be desired for use.

It is supposed in these figures that an electric light is used and placed in the attic at A. The light is inclosed by five Fresnel lenses, which will concentrate the light in five beams of parallel (or nearly parallel) rays of light, *m n o p q*, which, in our drawings, are at right angles. The beams of light *m n*, Fig. 1, are intersected at different heights by the rectangular prisms B C D E F, which will bend said beams downward into several vertical partial beams, *b c d e f*. The beam *b*, for instance, will pierce through an opening in the ceiling of room R and illuminate it. The beam *e* will go through an opening in the partition-wall G down to the ceiling of room S and will illuminate it. The beam *c* will be partially intersected by prism H, and will be bent horizontally into the beam *i*, going along the space of the floor between the beams in the ceiling of room T. A prism at K will bend the beam *i* again downward, and it will illuminate the room T. The other portion of beam *c* will go downward and illuminate the cellar U. If the prism H had been placed lower down, the beam *c* would have been bent toward the room T, entering it through an opening in the wall instead of an opening in the ceiling. If the prisms mentioned are suitably adjusted, we may collect in a room the light of two or more rooms, or we may diminish the intensity of said light or leave any of the rooms in the dark. For instance, if prism C is raised by means of a cord, *a*, and pulleys a^1, or by any other means, it will reflect a larger portion of the beam *m*, or the whole of it; then the light of R will decrease or disappear, and the lights at T and U will increase. If said prism C is lowered, the reverse will happen—the light at T and U will decrease and that of R will increase; and when C is put down altogether, T and U will be left in the dark. In the same way, by moving the prism H sidewise, we may send part of the light of T to U, and vice versa, or we may leave one of them in the dark. A corresponding motion of the other prisms will produce similar effects in other rooms.

Fig. 2 shows how the two beams of light *o p* are intersected by the standing prisms P Q M N and divided into four beams, *s r t u*, parallel to *m n*, and will be handled in a way similar to the latter ones.

Fig. 3 is a vertical section through the beam *t u* of Fig. 2. At *m′ n′ p′* there are three prisms so disposed that the beam *u* is divided into the vertical downward beam *z* and the vertical upward beam *v*, which is bent again horizontally into the beam *w*, which may be sent outside the house—to light the street, for instance.

The vertical upward beam *q* of Fig. 1 may be treated similar to the vertical upward beam *v* of Fig. 3, as shown of Fig. 1, or might be used any place higher up than the attic. After having shown how the light may be distributed, to complete our system, it remains to be seen how the last beams of light may be handled. They come into the places to be lighted in beams of rays practically parallel; then they are intersected by convenient lenses, which we will call "secondary lenses." According to the shape, curvature, and inclination of these lenses, the beam will be concentrated into any desired place, and even into a point, as in room R, Fig. 1, or it will be diffused into a diverging cone, as shown in the other rooms of the same figure, and it may be sent to the floor alone, or to a wall, or up to the ceiling, or up to a certain height alone—to a working-table, for instance, to a sewing-machine, &c.

In combination with the lenses or prisms, we may use some substances calculated to modify the light in any of its chemical and physical properties. For instance, if, together with a lens or prism, we use a substance that allows the rays of light to pass and absorb all the heat—as a solution of alum, for instance—then we may exclude the heat of the light from one or more rooms or places. If we use, instead, a fluorescent substance for the extra violet rays of light—as a solution of sulphate of quinine, for instance—we will increase the brilliancy of light. If we use a substance that allows the rays of heat to pass and not the luminous rays—as a solution of iodine in carbon bisulphide, for instance—we can obtain a certain amount of heat in the room. If we want the light of a certain color, as sometimes is needed in certain ophthalmic diseases and for some operations of industry, we may easily obtain it by using a proper substance instead. All these substances we are mentioning now, and any other for similar purposes, may be placed at any point of the course of the beams of light, although it seems that the most convenient and proper place is in connection with the secondary lenses, and even with the prisms.

We have illustrated in Figs. 1, 2, and 3 how a source of light, A, may be divided, subdivided, and distributed into any variable number of small beams of light, going upward, downward, and sidewise, all parallel or at right angles to each other; but by changing the inclination of the primary lenses, and of any or all the prisms, or by changing the apertures of the prisms, we may bend the beams of light in all possible directions, and send them into any inclination whatever.

We may have the light in the attic or cellar, or in a middle floor. It may also be placed outside the building, as the beams of light may be sent underground through convenient pipes, tubes, or boxes, or may be sent above ground in a similar way, or through the free space to the building or place to be lighted.

The streets, for instance, may be lighted either by beams coming out of the buildings, or by underground pipes of light. Hollow lamp-posts, for instance, will carry partial beams of light upward, and by some of the ways herein explained these partial beams of light will be fashioned or handled to any purpose required. We represent in Fig. 9 of the drawings an illustration of the manner of use of this part of our invention. In instance of a mine, we may place the light on the surface or underground, and by a judicious combination of the elements and the system herein described we may send beams and cones of light into any gallery, well, incline, &c. Again, if in Fig. 1 we suppose a certain shade combined with one of the prisms or lenses, the light in the corresponding room or rooms will therefore be modified accordingly, and not in the other rooms. Consequently, if in a theater or any other building convenient movable shades are combined with the lenses or prisms which light the audience and the stage, all kinds of variable scenic effects can be produced at will.

It will be observed that by keeping the source of light away from the place to be lighted we avoid all the inconveniences and dangers arising from its proximity, such as smoke, smell, noise, heat, the foul gases of combustion, liability to catch fire, &c.; and therefore this system may be applied to all dangerous processes of industry, as powder-making and others, and consequently our system is not only applicable to the few instances of lighting herein named as illustrations, but to any and all purposes of lighting.

It will also be observed that by handling the beams of light by the ways herein explained nearly all losses by diffusion may be avoided, even without the use of deflectors.

The fundamental details of our system are as follows: In Fig. 1 we represent the light A as produced by a magneto-electric machine, Z, placed in the cellar; but it may be placed anywhere else, inside or outside said building, and be connected to A by means of electric wires. We also represent the case of a magneto-electric machine being moved by a hydraulic motor of a constant pressure.

Y is the tank on top of the building. Its water is led into a water-wheel, V, of any description, and then falls into a well, V′. A pump of any construction, and moved by any kind of motor, Z′, raises the water back from the well to the tank Y. The water-wheel V transmits its motion to Z.

Any irregularity of the motor Z′ will produce a small difference of level in tank Y, and therefore the work of the magneto-electric machine Z will not be as irregular as if moved directly by motor Z′. Another advantage of this arrangement is, that if the tank Y is left full every time that the lights are put out, by simply turning a water-cock conveniently placed we may set wheel V in motion instantly, and therefore we may have the lights lighted at a moment's notice, without waiting for the motor Z′ being started; but it is well understood that this hydraulic motor may be substituted by any other kind of motive power or any combinations of motors; also, the magneto-electric machine Z may be substituted by any other means of producing an electric light; also, the electric light A may be substituted by any other kind of light, as calcium, zirconia, or any other; and in all cases the previously-explained disposition or system of illumination may be adopted.

We further desire to be understood in that we lay no claim to the hydraulic-motor device in combination with a magneto-electric machine in this patent, but reserve all right of invention therein for a separate application for Letters Patent hereafter to be made.

Even the solar light may be handled in a manner similar to that just previously described for accomplishing the purpose in view.

The solar light has to be concentrated in a focus or beam by means of proper reflectors or lenses, or both, or any other way; and the beam or focus of light thus obtained is operated upon as we have herein explained.

Fig. 4 shows in a larger scale the disposition of the light at A of Fig. 1, and also a regulator for the electric candles. M is a hollow stand partially filled with some liquid. *a* and *b* are the two carbons—for instance, the positive and the negative. They are guided vertically at m'. They are set on two floats, a^2 b^2, and these floats are made so that any portion of their length displaces a quantity of liquid whose weight is equal to the weight of an equal length of the carbons. When any carbon burns out any portion of its length its float will raise up an equal portion to regain its equilibrium, and therefore both carbons will keep their burning ends constantly at the same height, and the focus of the electric light will be stationary. If a kaolin candle or any other kind of candle is used, a float made on the same principle will answer the same purpose; but it is well understood that in our system of lighting any other kind of electric regulator may be used instead of the floating one just described; and we also desire to be understood as laying no claim to said regulator in this patent, but reserve all right of invention therein for a separate application for Letters Patent hereafter to be made by us.

In the same figure, (4,) *l* is the electric arc. *c d e* are the sections of the primary lenses. Their curvature and the number of their steps will vary according to the size of light or their own. Each of them may be made solid or hollow, or filled with liquid of one piece or of several pieces, or else they may be substituted by any kind of lenses or combination of lenses that will collect the light in beams of parallel (or nearly parallel) rays of light. There may be five lenses, as represented, or any other number, and at any inclination whatever, according to the requirements of each case. At the bottom, *r r*, a reflector is used to collect all the rays of light inside of cone *r l r*, which are sent up to the lens *c* to be used afterward. Said reflector may be substituted by several reflectors sending the rays to any lens. Said reflectors may be used at the bottom or in some other point, or said reflector or reflectors may be dispensed with, because the cone *r l r* is made very small, or for any other cause. The space inclosed by the primary lenses and reflectors *r* we will call the "chamber of light," and said chamber may have one or more openings. At C D E are shown three shapes or kinds of prisms. C is solid, made of glass or any other convenient or proper substance. D is a hollow box of similar material, or filled with any convenient liquid, in which case we may easily use any of the substances of the kinds hereinbefore mentioned in order to modify the light. E is made of a series of smaller prisms having a common face, or put and kept together in any wise in a shape similar to the drawings. The common face may be substituted by a series of smaller ones placed all parallel to each other. They may be each solid or hollow. All the prisms used in our system may be made of any angle or aperture, although the rectangular shape is the most convenient on account of the small percentage of light lost by refraction and of the purity of the color of light. All these prisms may also be substituted by properly-inclined mirrors of any convenient size, material, or construction. They also may be substituted by conical lenses, formed by the revolution of the section of such prisms, or by a lens whose transverse section is the section of any such prisms as we have shown orthographically projected in Figs. 5 and 6; and said prisms may also be substituted by any combination of optical prisms, or by any geometrical bodies generated by the sections of such prisms, or by any combination of both. All said prisms may be set stationary, or in any way movable, and their motion produced by any means whatever, and in all cases they may form a part of our general system of lighting.

Figs. 7 and 8 show one way of using the secondary lenses to finally apply the beams of light to practice. B′ and C′ are two cylindrical boxes, kept in a frame of any form whatever. Their bottoms are of glass—one concave, the other convex—and they are filled with some liquid. The figures show the case applied to the lighting of a room from its ceiling. If the box C′ is in line with the opening O and the beam of light A, then this beam of light will be diffused in the cone *m n p*, whose aperture may be made wider or narrower, according to the curvature of the glass at C′. If the box B′ is placed in the line A O, then the light will be concentrated into a converging cone.

The boxes B′ C′ may be filled with any material for the purpose of modifying the light, as hereinbefore explained. In these figures the boxes B′ C′ are supposed to be placed between the spaces of the ceiling-beams, or in a pipe or box for the purpose; but they may be placed in any other way by means of cords r' r', by pulleys and rollers, or by any other means. They may slide sidewise, so as to be able to have in the same room two or more alternate shapes of light, if required. These secondary lenses may be made of any convenient material, and of any curvature or any combination of curvatures, varying with the purposes required, and the substances that modify the properties or circumstances of light, whether solid or liquid, may be made of any shape and size whatever, and stationary or movable.

Having fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a system of lighting, a method of forming and transmitting luminous beams respectively composed of parallel rays from a suitable source, and independently varying the size of said beams, so as to cause the same to be applied for use in greater or less volume of light at any one point, substantially as set forth.

2. In a system of lighting, a method of collecting all the light emanating from a suitable source, conducting the same in beams re-

spectively composed of parallel rays through different paths, changing or adjusting said paths as desired, and finally passing the light out for use in pencils of converging or diverging rays, substantially as set forth.

3. In an illuminating apparatus, the combination, with suitable devices for subdividing the main body of light into any desired number of beams, each composed of parallel rays, of suitable means arranged to intercept the several beams of light and direct them to any desired points, substantially as set forth.

4. In a system of lighting, the combination, with apparatus which form and transmit a luminous beam having parallel rays, of an adjustable prism, or its equivalent, adapted to refract said beam, so that its path may be changed in part or in whole, as desired, substantially as set forth.

5. In a system of lighting, the combination, with apparatus which form and transmit a luminous beam having parallel rays, of adjustable convex and concave lenses adapted to pass said beam out for use in either a convergent or divergent luminous pencil, as desired, substantially as set forth.

6. A system of lighting consisting of a series of lenses and prisms, which form and transmit luminous beams respectively composed of parallel rays from a suitable source, in combination with a series of convex and concave lenses, which latter are adapted to be moved or interchanged at will, so as to cause the several beams to pass out for use through either the convex or the concave lenses, substantially as set forth.

7. In a system of lighting, a chamber formed of lenses and reflectors which inclose a suitable source of light, and pass the latter out in beams respectively composed of parallel rays, in combination with adjustable prisms, or their equivalent, adapted to intercept, in part or in whole, as desired, the several beams of light which emerge from said chamber, substantially as set forth.

8. In a system of lighting, a series of lenses and adjustable prisms, or their equivalent, which form and transmit luminous beams respectively composed of parallel rays in different lines of direction from a suitable source, in combination with a series of interchangeable convex and concave lenses, and media or substances adapted to intercept said beams, or a part thereof, and thereby color or modify the same, substantially as set forth.

9. In a system of lighting, the combination, with apparatus which form and transmit a luminous beam having parallel rays, together with adjustable means to change the path of said beam, of movable substances or media adapted to intercept said beam, in whole or in part, and color or modify the light of the same, substantially as set forth.

10. In a system of lighting, the combination, with an angular passage capable of transmitting light from a suitable source to any given point or points, of an adjustable device located at or suitably near to the angle of said passage, and adapted to direct the light, in whole or in part, into the branch or branches of the same, substantially as set forth.

11. In a system of lighting, the combination, with a series of tubes capable of transmitting light from a suitable source in a prescribed line or lines, of adjustable devices adapted to change the direction of the light, in whole or in part, within said tubes, substantially as set forth.

In testimony that we claim the foregoing we have hereunto set our hands this 11th day of July, 1878.

EUSEBIUS J. MOLERA.
JOHN C. CEBRIAN.

Witnesses:
THOMAS D. GRAHAM,
F. O. WEGENER.