(No Model.)

C. E. BUELL.

ELECTRIC ILLUMINATION.

No. 344,344. Patented June 29, 1886.

Fig. 2.

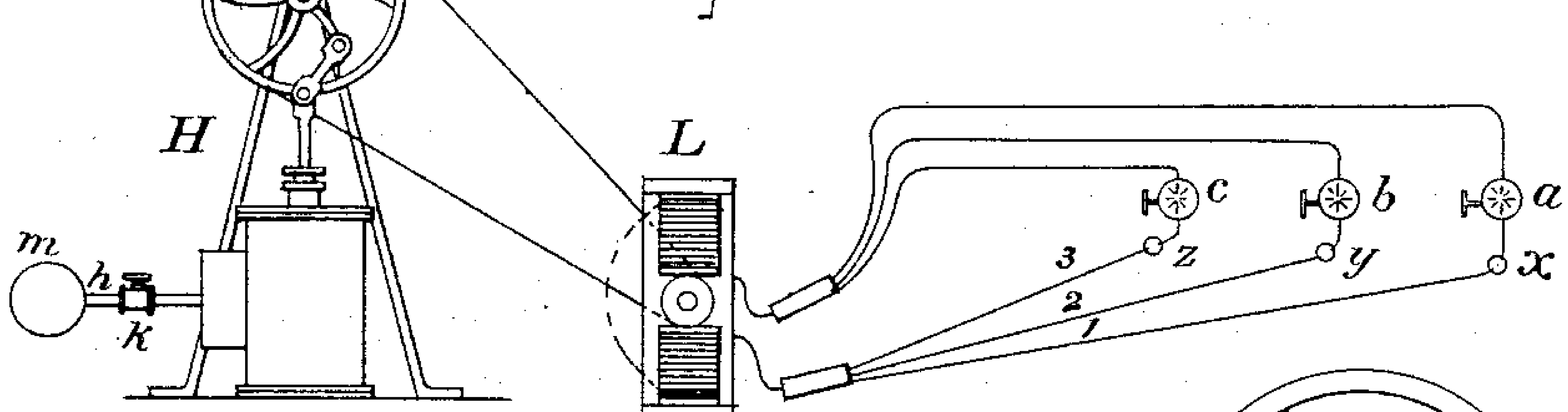
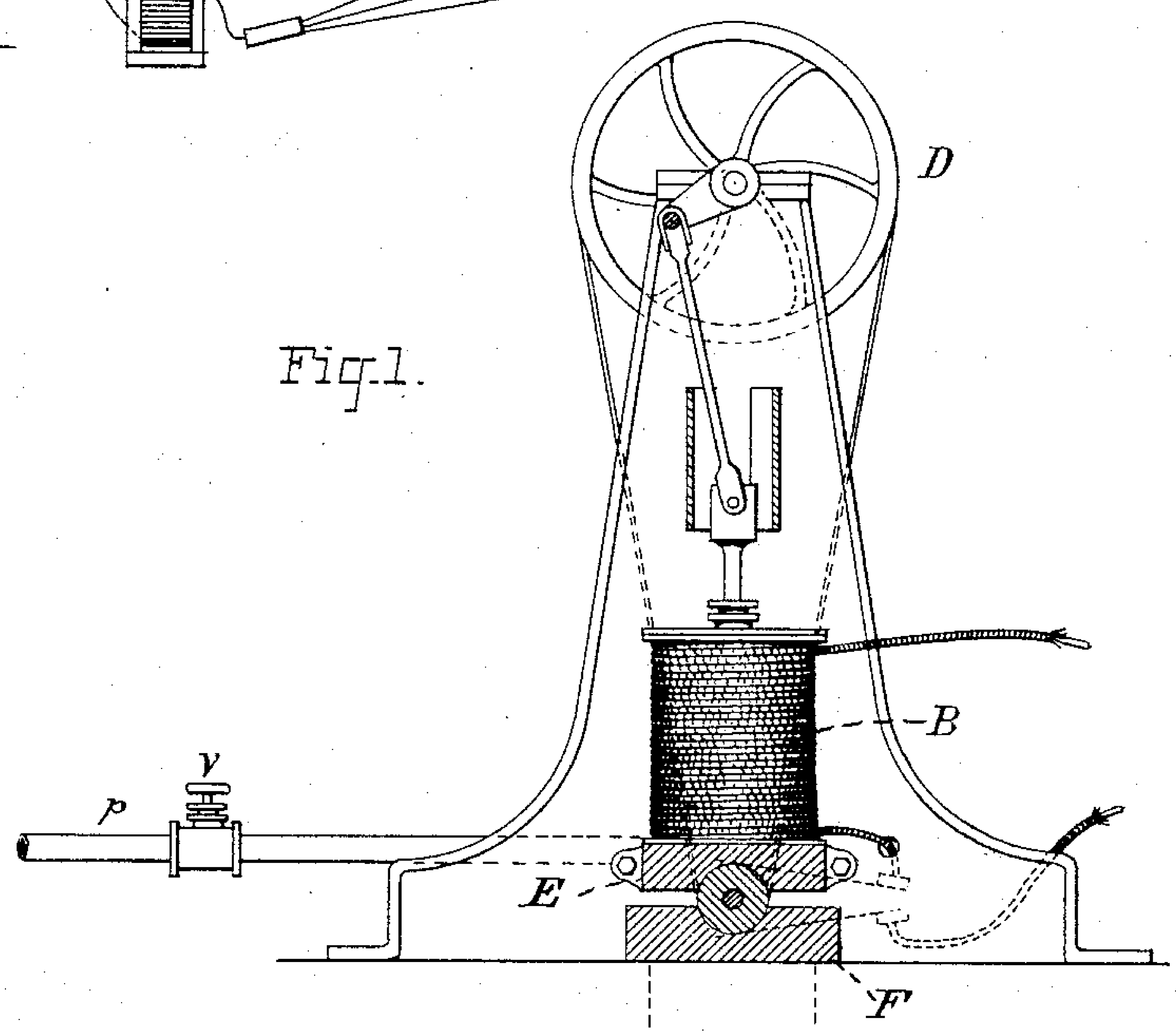


Fig. 1.



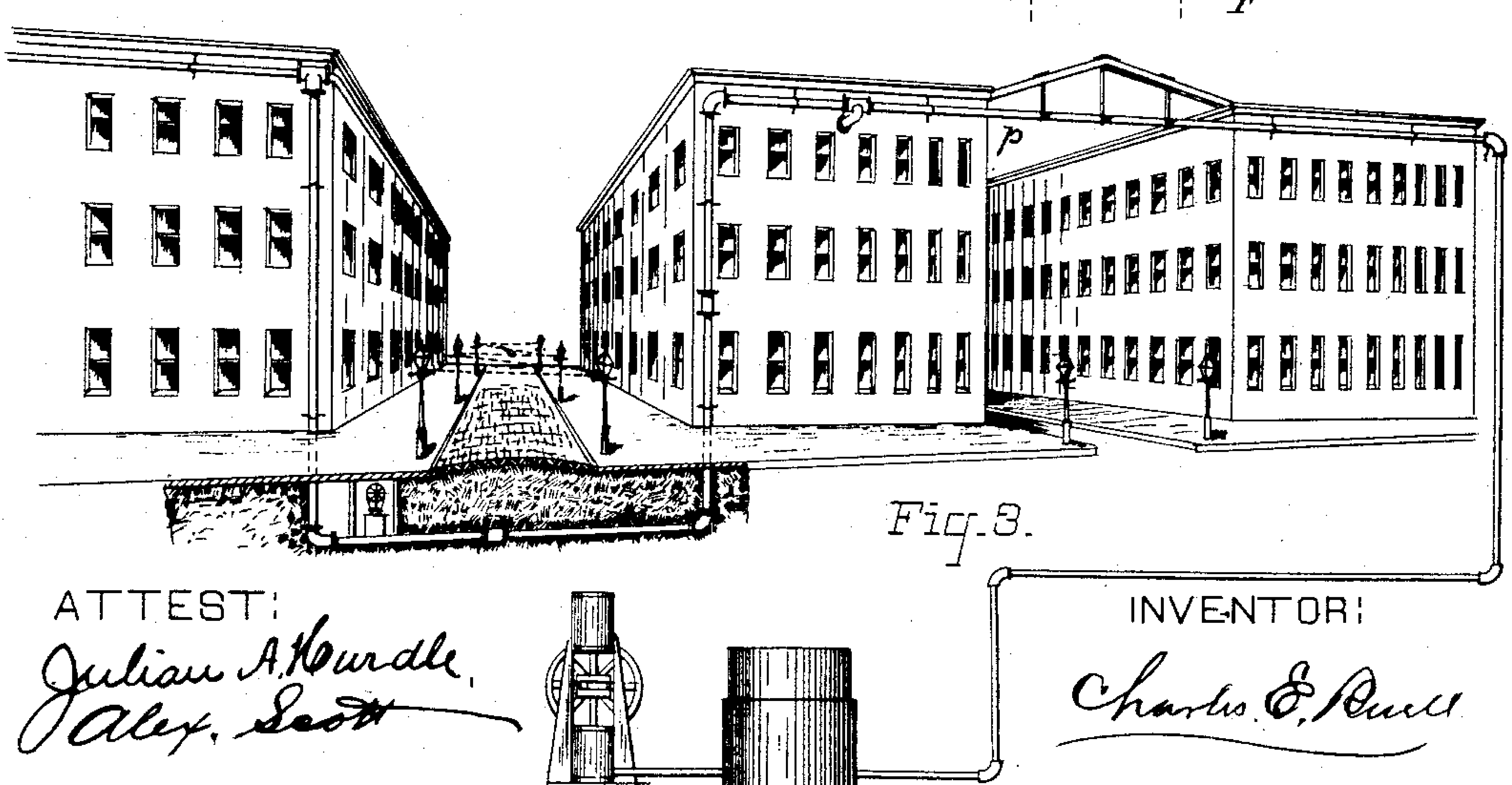


Fig. 3.

Central Station.

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[redacted]

UNITED STATES PATENT OFFICE.

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ELECTRIC ILLUMINATION.

SPECIFICATION forming part of Letters Patent No. 344,314, dated June 29, 1886.

Application filed February 12, 1881. Serial No. 25,980. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. BUELL, a citizen of the United States, residing at New Haven, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Electric Illumination; and I 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 appertains to make and use the same, reference being had to the accompanying drawings, and to the letters or figures of reference marked thereon, which form a part of this specification.

My invention relates to a method or system of supplying and maintaining electric lights for household or outdoor illumination; and it consists, in general, in a new and improved system of generators, lights, circuits, and supplied power designed to do away with the practical difficulties and extreme expense attendant upon the employment of the methods hitherto used or suggested, and thus to bring the electric light into general use in large communities as a substitute for gas.

Two general plans have heretofore been proposed for accomplishing the above object, and making a practical success of electric illumination.

The various areas or buildings to be lighted have been supplied with electricity through wires charged by dynamo-electric generators run by steam-engines located within the immediate area to be illuminated; or, central supply-stations have been established and the electric currents generated thereat on a large scale have been transmitted to the remote points, to produce the required light through main and branch conductors. In the first-named system the cost of skilled attendance to control the engines, the expense of water and fuel to run the engine, the valuable space required (when the system is used in crowded cities) for the engine, its boilers, water and coal supply, and its constantly-accumulating ashes and waste matter, and the added risk due to the presence of fire on the premises, together with the great outlay for equipment, make it impracticable. In the second-named system similar difficulties are encountered. Owing to the great loss experienced when currents of large quantity are sent to a great distance over ordinary conductors, it becomes necessary, if the electricity is to be suppled on a large scale, to use conductors of very great size, and therefore large cost, while, if it is attempted to use the system of electrical supply in which currents of great tension are employed serious difficulties are met with in the matter of properly insulating the conductors. These difficulties compel the placing of the central supply-stations at brief intervals throughout cities and towns, with a consequent increase in the expense due to a multiplication of expensive machinery, rental of buildings, skilled attendance, consumption of material, supervision, &c., attendant upon a complication of systems. With either plan the want of storage capacity is a fatal obstacle to a successful introduction of electric illumination, so far as economy is concerned.

The object of my invention is to supply the streets, areas, blocks, or buildings of a city or town in a practicable manner with any desired quantity of electricity for the purposes of electrical illumination, plating, &c., avoiding the risk, inconvenience, and expense incident to other systems.

A second object of my invention is to adapt my system to such day uses as the running of elevators and light machinery and for ventilation and refrigeration, as to further reduce the expense of maintaining and supervising the system.

I accomplish these objects by the employment of compressed air conveyed in suitably-placed pipes and mains from a central or main compressing-station to combined air-motors and electric generators of suitable construction, arranged to supply a number of independent conducting-wires, each containing an electric light of any known form, all as will be more fully hereinafter set forth.

The employment of compressed air as a means of transmitting power to very long distances has been demonstrated to be practicable, and, as over other means, has the striking advantage that the energy observable at the point of conversion, even when placed miles away from the compressing-station, is but slightly less than that indicated at the source of supply. Whatever loss may occur is due only, when the pipes are properly constructed, to friction, and to the shrinkage of the air by cooling. The loss of pressure due to the last cause is wholly compensated for in my system by the passage of the air into the motor at a higher temperature.

The economy of storing power at a convenient point with little or no rent, and where water can be had without expense, and with the large saving which attends the running of large engines as compared with the same power developed in a great number of small boilers not only in the quantity of fuel consumed, but in the repairs and attendance, is obvious. The safety of such a power distributed among the blocks and buildings of a city, and the sanitary advantages of the ventilation which accompanies the use of the volume of pure air, is another advantage attendant upon my system, while the possibility of employing the system for running elevators and other analogous uses during the daytime, and for propelling dynamo-electrical machines at night, and thus dividing the expense of maintaining and supervising the system, makes the cost of illumination but a small fraction of that required in other systems.

Although any of the ordinary air-engines or motors can be employed with dynamo-electrical generators belted or geared to them for supplying electric currents, I prefer to use a motor and dynamo-machine combined, as advantages are gained which will be more fully stated hereinafter. The pipes used as main pipes I place upon the sides or roofs of the buildings which require illumination, the mains being secured by straps and bolts, and, when desired, by props or supports. These pipes can be carried across streets and open spaces by being supported on pillars; or they may be carried upon or beneath the surface of the ground. The electrical generators and the motors for propelling them are, by preference, placed in the upper story of blocks or buildings as the atmosphere, by reason of its greater freedom from moisture, is more favorable to working air-motors and to the generation and retention of electrical currents.

By carrying the mains over the roofs or along the sides of houses important advantages are gained. The pipes are easy of access for the purpose of repair. They may be placed in position at comparatively small expense, and they are in convenient location for tapping for the purpose of carrying branches into buildings where the use of the air-motor and electric illumination are desired.

The electric generators and the air-motors when placed in the upper rooms of a building work with much greater efficiency.

A well-known source of difficulty in the operation of air-motors is the formation of ice at the exhaust-ports—a difficulty that is largely enhanced when the motor is run in location where there is much moisture in the atmosphere. This difficulty makes it undesirable to place the motor in cellars or underground apartments, while it is impracticable to place it in ordinary locations, owing to the value of space. The presence of moisture in the atmosphere also interferes with economical working of the dynamo-generator and supply of electricity, as in such a condition of the atmosphere there is a greater loss due to "escape." To overcome these difficulties, and to attain the advantages before mentioned, I have placed the motors and generators on the upper floors of the building to be supplied, and carried the air-pipes along the sides or tops of the buildings.

In supplying the electric current to the lamps I use independent conducting-wires, each containing a lamp or lamps controlled by suitable switches or cut-offs. With generators of low internal resistance and of the mutual accumulation type, such as are now ordinarily used, this plan has decided advantages. The cutting out of any one circuit will not affect the others, since thereby the total outside resistance to the generated current is correspondingly increased, and the amount of current generated is correspondingly diminished. The result is that the current in any one circuit is approximately a constant, and is the same whether it alone be closed, or whether one or all of the other circuits be also closed. By taking advantage of these facts and multiplying the conducting-wires which make up the circuits charged by each dynamo-machine, machines which develop quantity-currents may be used and the greatest possible number of lamps be maintained with a given power. To perfect these circuits, no superfluous resistances are used, but the simplest form of incandescent carbon lamp is introduced into the circuit. By this arrangement the electrical system is self-regulating, and no special devices are required to change the strength of the field of force, speed of rotation, &c., when lamps are cut in and out.

The lamps can be suspended or attached to brackets or chandeliers, and the supporting-arm or chandelier serve as a return-circuit for several lamps.

Figure 1 is a side view of a combined dynamo-electric generator and motor. The cylinder B of the air-motor is of cast-iron, and is wound with insulated copper wire. Its supporting-head E is also of cast-iron, and constitutes the pole of the electro-magnet. It is suitably shaped for the reception of a revolving armature of any well-known construction, which is driven by a pulley belted to the fly-wheel D of the air-motor. The coils of wire upon the cylinder B are so connected as to make it the field-of-force electro-magnet of the generator. The head-block E, constituting the pole of the field-of-force magnet, may be shaped in any of the ordinary ways. A similar head-block, F, can be placed opposite E, and may be the terminal of a similarly-wound cylinder, which can serve as an air-holder from which the working-cylinder is supplied. The combined motor and dynamo, as shown, is an upright upon an iron frame, and supplied by the pipe *p*, connected to the compressed-air main, and provided with a cock, *v*, for controlling the supply of air. The valve motion is not shown, being of the well-known construction employed in steam-engines. The ordinary commutator and electrical connections are to be used and require no description. The piston head and rod should be of composition metal, or some other non-magnetic material, so that it may move freely in the cylinder and not be affected by the magnetism of the field of force, or disturb the constancy of the field. This form of motor and dynamo-electric machine requires very little space, and is of simple construction. There is always a large amount of heat developed in the conversion of power into electricity, which manifests itself in the generator by heating the various parts of the machine. This heat, which is normally lost, is utilized in this machine to heat and expand the air as it enters the motor, thus compensating in great degree for the energy lost in the heat of compression at the compressing-station and subsequent cooling and shrinkage of the compressed air. Furthermore, the constant admission and expansion of the air prevents the too great heating of the cylinders, and thus a double advantage is derived by these interactions.

Fig. 2 represents a station and its independent circuits. The air-motor H, supplied from the main *m* by the branch pipe *h*, is belted to the dynamo-electric machine L, which supplies the independent circuits 1 2 3, in which are interposed the lamps *a b c*. Each circuit is to be provided with a suitable switch or cut-off, *x y z*, conveniently located. In this arrangement each circuit may be opened and closed without affecting the current strength flowing in the others.

In Fig. 3 the compressed-air mains *p* are shown as carried along the sides of the houses to be supplied and near their roofs; and this figure also shows the central station and the air compressor and holder connected with the mains. At street-crossings the mains are carried across by suitable supports, or are conducted down the sides of the houses, and then beneath the surface of the ground. The mains may be placed upon the tops of the houses, if desirable; but in either location they are close to the points where the motors are to be placed, and can be tapped without disturbing traffic and tearing up streets and sidewalks, while at the same time the branch pipes required are of much less length than would be the case if they were placed beneath the surface of the ground in the roadway. The advantages attending this location of the mains and the motors have been already referred to.

The general advantages of my system are many. It is much more economical than any of the systems of electrical illumination hitherto proposed; it provides a means of ventilation and refrigeration; it allows of the use of the motors employed for running the dynamo-electric machines for other industrial purposes, such as running of elevators, sewing-machines, printing-presses, &c.; it possesses the important advantage over other systems, even if used for electric illumination only, of storage capacity; it allows of the use of steam or other power on the largest scale possible; it obviates the danger from fire in crowded localities, as the steam engines and boilers may be located at distant points without a sacrifice of economy in the transmission of the power to long distances; it requires no special provisions for regulating the strength of the generated current, and it requires no large outlay for electrical-conducting mains.

As a system, it is novel and accomplishes results hitherto unforeseen and unattained.

What I claim is—

1. The combination, substantially as described, with an air-compressing apparatus, of a main for conveying the compressed air therefrom to an air-motor, an air-motor whose cylinder forms the core of the field-of-force magnets of a dynamo-electric generator, said dynamo-electric generator, and an electric lamp circuit or circuits charged thereby.

2. The combination, substantially as described, of air-compressing apparatus located at a central station, mains for conveying the compressed air to various outlying stations, an air-motor at each outlying station whose cylinder forms the core of the field-of-force magnets of a dynamo-electric generator, and an electric lamp circuit or circuits charged thereby.

3. The combination, with a dynamo electric generator and the revolving armature thereof, of a compressed-air motor whose cylinder forms the core of the field-of-force magnets of the dynamo-electric generator, whereby the air in the cylinder is caused to cool the generator and enable it to attain a higher speed without injury, while at the same time the temperature of the air in the cylinder is raised, and its expansive and propelling power is increased.

CHARLES E. BUELL.

Witnesses:

GEO. F. GRAHAM,

WM. M. SMITH.