THREE SYSTEMS OF ELECTRIC DISTRIBUTION.

Whatever effect patent litigation may have on the business side of an invention, it certainly is beneficial from a scientific point of view, as it brings out clearly and concisely the principles involved in such inventions. A case in point is the suit of the Edison Electric Light Company against the New Haven Electric Company, the subject being the three-wire system of electrical distribution.* Without going into the merits of the case, we extract from the testimony some diagrams and condense some of the descriptive matter to illustrate as clearly as possible three methods of electric distribution. The experts in the case have not only provided very clear electrical diagrams, but have furnished water analogues for each of the cases.

In Fig. 1 is illustrated the series system commonly employed in electric arc lighting, E being the engine; G, the dynamo or generator; p and n, the positive and negative conductors; and I, I^1, I^2, I^3, the arc lamps. In this case, as will be seen, the current passes from the dynamo through all the lamps in series.

Fig. 1

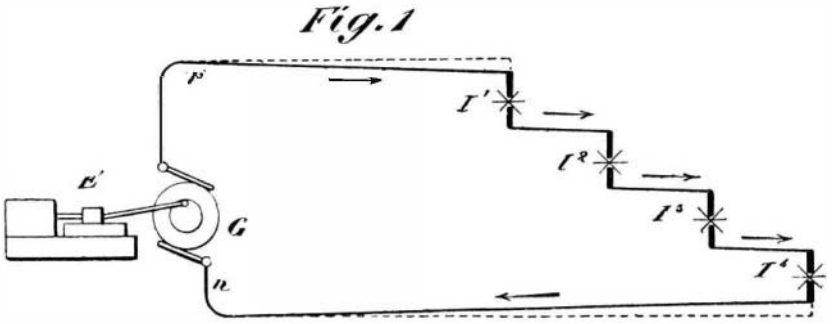


Fig. 2

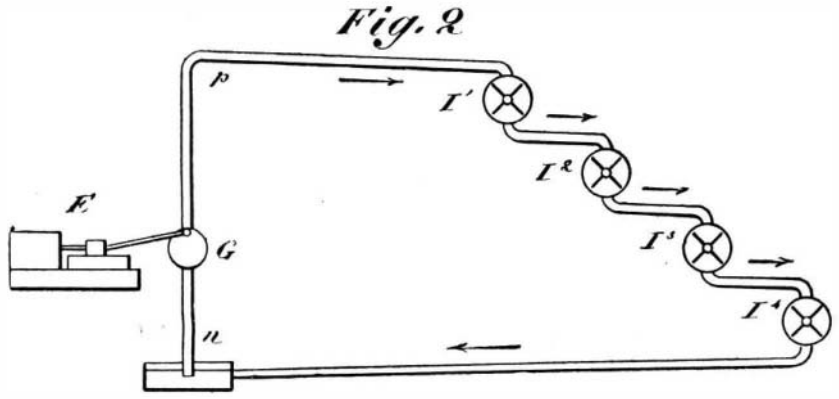


Fig. 3

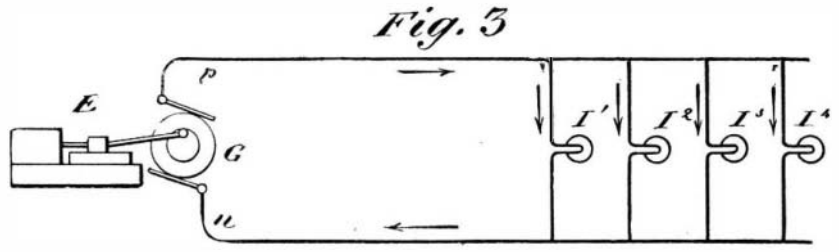
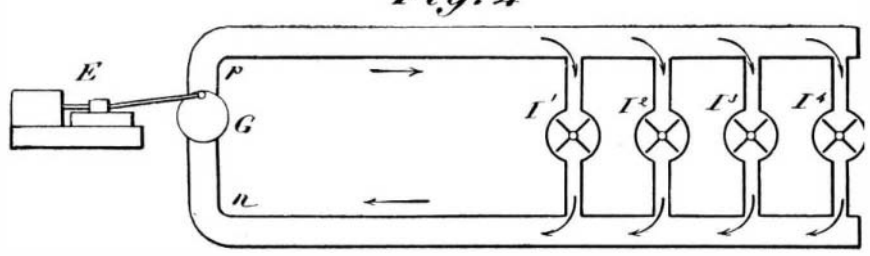


Fig. 4



tive pipe, with a fall of potential due to the amount of energy absorbed in the motors.

In Fig. 5 are shown two like multiple arc systems placed parallel with each other, with the positive conductor of one system adjoining the negative conductor of the adjacent system, the arrows indicating the direction of the current in each system. It will be seen that if the same amount of energy is absorbed in each of these two systems, the negative conductor, n^2, of the upper system must carry a negative current exactly equal to the positive current carried in the conductor, p^1, of the lower system, and the currents in these two conductors, being equal and opposite, would neutralize each other if carried on the same conductor, as indicated in Fig. 6, in which the negative conductor, n^2, and positive conductor, p^1, are merged in one. With the generators, G^1 and G^2, arranged in series, the electromotive force is 220 volts, which is suited to two 110 volt lamps in series. So long as equal resistances are placed in the two parts of the three-wire circuit, the central wire remains neutral, and no current passes in either direction; but as soon as this balance is disturbed by turning off or adding one or more lamps, a current due to the difference in resistance of the two branches passes over the neutral wire. This system is aptly, though not perfectly, illustrated by the water analogue shown in Fig. 7.

In this case, two generators or pumps, G^1, G^2, circulate

Fig. 5.

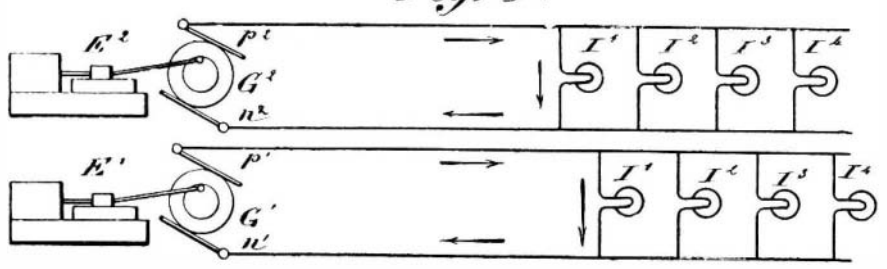


Fig. 6

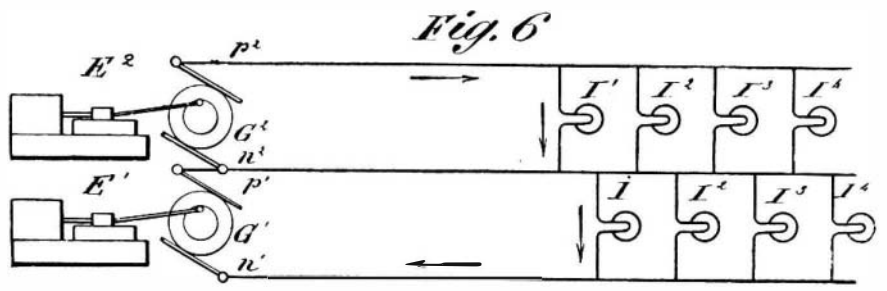


Fig. 7

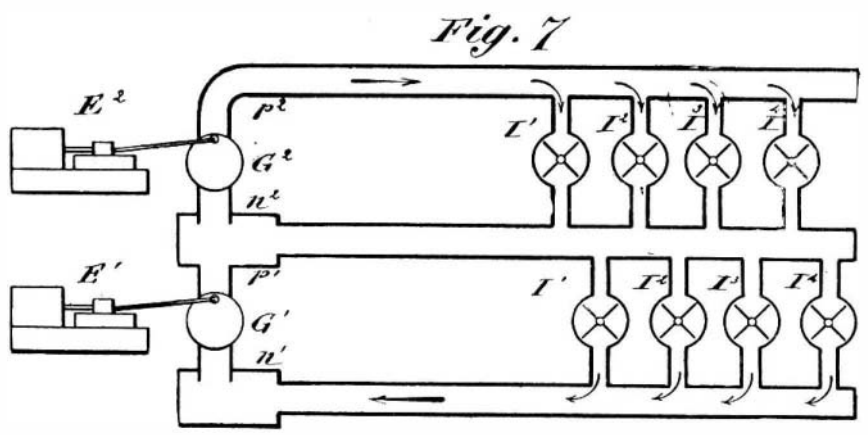


Fig. 1.—Arc Lamps in Series. Fig. 2.—Water Analogue of Series Arrangement. Fig. 3.—Incandescent Lamps in Multiple Arc. Fig. 4.—Water Analogue of Multiple Arc Arrangement. Fig. 5.—Two Multiple Arc Circuits arranged parallel. Fig. 6.—Two Multiple Arc Circuits merged into the Three-Wire System. Fig. 7.—Water Analogue of the Three-Wire System.

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In Fig. 2 is given the water analogue, in which E is the engine G the rotary pump, p and n the positive and negative pipes conveying the water, I, I^1, I^2, I^3, I^4, water motors arranged in series and operated one after the other by the water passing from the motor, I, to the motor, I^1, to the motor, I^2, thence to the motor, I^3, and to the motor, I^4, each motor using its proportion of the energy.

In Fig. 3 is represented the usual multiple arc or parallel arrangement of incandescent lamps, E, as in the other case, being the engine; G, the generator; p and n, positive and negative conductors; and I^1, I^2, I^3, I^4, lamps taking the current from the positive conductor and delivering it with a certain fall of potential to the negative conductor.

In Fig. 4 is illustrated the water analogue of the multiple arc system, E being the engine, G the generator or pump, I^1, I^2, I^3, I^4, water motors taking water from the positive pipe and delivering it to the negative pipe, with a fall of potential due to the amount of energy absorbed in the motors.

In Fig. 5 are shown two like multiple arc systems placed parallel with each other, with the positive conductor of one system adjoining the negative conductor of the adjacent system, the arrows indicating the direction of the current in each system. It will be seen that if the same amount of energy is absorbed in each of these two systems, the negative conductor, n^2, of the upper system must carry a negative current exactly equal to the positive current carried in the conductor, p^1, of the lower system, and the currents in these two conductors, being equal and opposite, would neutralize each other if carried on the same conductor, as indicated in Fig. 6, in which the negative conductor, n^2, and positive conductor, p^1, are merged in one. With the generators, G^1 and G^2, arranged in series, the electromotive force is 220 volts, which is suited to two 110 volt lamps in series. So long as equal resistances are placed in the two parts of the three-wire circuit, the central wire remains neutral, and no current passes in either direction; but as soon as this balance is disturbed by turning off or adding one or more lamps, a current due to the difference in resistance of the two branches passes over the neutral wire. This system is aptly, though not perfectly, illustrated by the water analogue shown in Fig. 7.

In this case, two generators or pumps, G^1, G^2, circulate the water in the system, the upper outside pipe representing the positive conductor, the lower pipe representing the negative conductor, and the central pipe the neutral conductor. Upon each side of the neutral pipe, and communicating with the outside pipes, are motors corresponding to the lamps in the electric circuit. So long as the quantity of water consumed by the motors on both sides of the central pipe remains the same, the water circulates by passing forward through the upper pipe, through the motors and transversely through the neutral pipe, and returning by the lower pipe; but so soon as the equilibrium is disturbed by shutting off one or more of the motors on one side of the system, the water which would have been required to run that motor must return to the pumps through the neutral pipe, or be forced outward through the neutral pipe, according as the positive or negative current is shut off.

The Edison company hold that the three-wire system effects a theoretical saving of 62½ per cent and an actual saving, due to the use of smaller neutral conductors in the feeding portions of the system, of at least 75 per cent in the cost of conductors. The conductors formerly represented the largest item in the cost of the completed plant.

The value of the invention is shown by the fact that almost immediately after the introduction of the three-wire system the electric lighting business increased enormously, and electric lighting was placed on a basis which enabled it to compete successfully with gas at the lowest price.

* For access to the record of this case we are indebted to Mr. R. N. Dyer, attorney for the prosecution.

How to Purify Mercury.

The method of cleaning mercury adopted at the Physikalischtechnische Reichsanstalt, at Berlin, is described in the *Zeitschrift fur Instrumentenkunde*. The raw material, says *Nature*, is brought in iron bottles from Idria. It is filtered and dried, and twice distilled in a vacuum to get rid of the heavy metals. Great care is taken to eliminate fatty vapors derived from greased valves and cocks, which is accomplished by means of a mercury pump working without a stopcock. Finally, the electro-positive metals, such as zinc and the alkalies, are separated by electrolysis. The mercury is precipitated from a solution of mercurous nitrate obtained by the action of nitric acid on excess of mercury. The solution, together with the impure mercury acting as an anode, is contained in an outside glass vessel, into which a current from a Gulcher thermopile is conducted by an insulated platinum rod. The cathode rod dips into an interior shallow glass vessel, in which the pure mercury is collected. On careful analysis it was found that no perceptible non-volatile residue was left by 200 grammes of the purified metal. Thus the mercury is well fitted for use in standard barometers and resistances.

Gigantic Flag Poles.

Ten large logs which will be used for flag poles for the Washington State building at the World's Fair, says the *Spokane Review*, will be carried to Chicago on a train of three sections, each consisting of fourteen cars. With the exception of the two largest of the logs, they will be placed two together on the cars. The length is equal to that of seven flat cars, and but two of the cars will carry the weight. The two largest of the logs, however, owing to their great weight, cannot be carried in this manner, and each will therefore have a string of cars to itself. The two end cars of each section will support the load upon a raised block working on a pivot, this arrangement being necessary to provide for curves. It is stated that when some curves on the road are passed, the middle of the load will be entirely clear of the car.