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THE SAWYER-MAN ELECTRIC LAMP.

The practical usefulness of the electric light for illuminating open spaces and wide areas has been amply demonstrated by the various devices for using the electric arc already widely employed. Hitherto, however, it has not been found economical, or even possible, as we understand it, to construct a lamp or candle, based on the electric arc, that would answer the requirements of ordinary domestic and industrial lighting, where a moderate amount of light, well distributed, easily manageable, and of perfect steadiness and softness, is needed. The electric arc seems, from its very nature, to present insuperable obstacles to the economical production of a large number of small lights in a circuit; in other words, such lights as we require in our dwellings, offices, factories, shops, and the like. And if there were no other means of obtaining light from electricity, the probability of the displacement of gas by it, for the purposes of general illumination, would hardly be worth considering.

The production of light through the incandescence of a pencil of carbon or metal, forming part of an electric circuit and highly heated by its internal resistance to the passage of the electric current, offers an entirely different field for exploration; and though it has long been apparently closed by the failure of early attempts to obtain an electric light by such means, the achieved success of Messrs. Sawyer & Man, not to speak of the reported success of Mr. Edison, clearly indicates that this is the line along which the practical solution of the problem of household illumination by electricity is to come. The lamp, to be described further on, lacks only the practical demonstration of its economy by protracted use on a large scale, to compel acceptance as a successful solution of the problem.

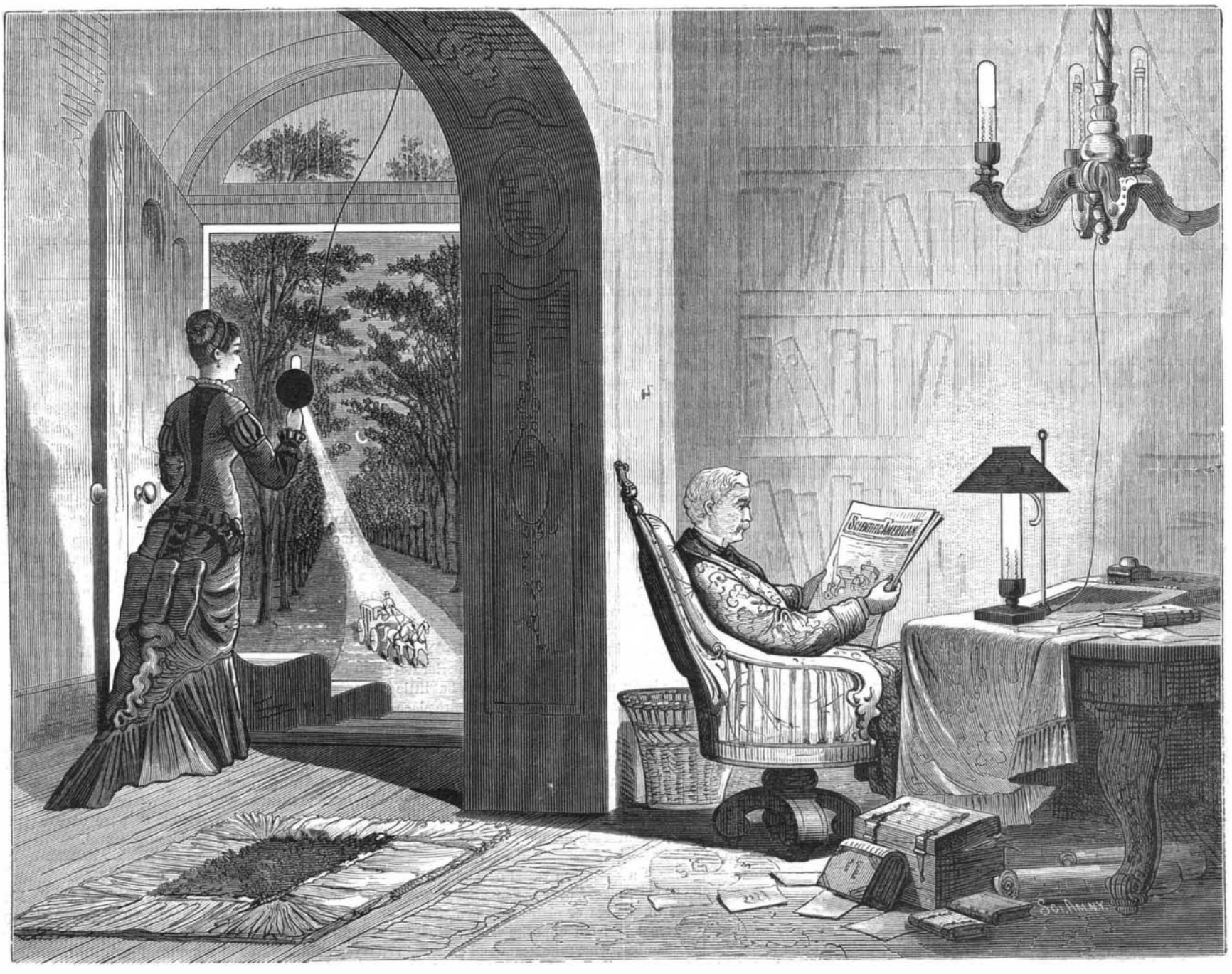
So long ago as 1845, an American inventor, Mr. King, patented here and in England a lamp (said to have been invented by J. W. Starr) involving this principle. His light was produced in a vacuum, to prevent the oxidation of his incandescent carbon or metal, and was extremely promising for its beauty, brilliancy, and steadiness. But it failed to be permanent and economical from various defects and deficiencies, some of which have been removed by the increased power and economy of modern dynamo-electric machines, and by recent advances in the art of subdividing the electric current, but the most of them by the inventions and discoveries covered by Messrs. Sawyer & Man's patents.

The economical division of the current, or more correctly the light produced by a single current—popularly believed to be very difficult if not practically impossible—had been successfully worked out by several American investigators. As long ago as 1875, Mr. Moses G. Farmer, now Electrical Superintendent of the U. S. Naval Torpedo Station, at Newport, R. I., subdivided the electric current, produced by a small machine, into forty-two different branches, putting a light to each branch. Mr. Sawyer's system appears to be able to do the same indefinitely through the maintenance of a uniform resistance throughout the circuit and equal resistances in the several parts of the circuit, as will be shown further on.

The adaptability of this form of electric lighting to the needs of household illumination is indicated in Fig. 1. The light produced is pure, strong, and yet soft, like sunlight. It is, moreover, steady and cool. It is not influenced by air currents; and it does not vitiate the air by poisonous products of combustion, nor by withdrawing the vitalizing oxygen. The lamp takes up less room than the glass shade of a gas jet, and no more than the chimney of an oil lamp. To a limited extent, also, it is portable, and may be used as a drop light. The general appearance of the lamp is shown in Fig. 2 (page 354). The light is produced by the incandescence of the slender pencil of carbon placed as shown in the engraving. The light-giving apparatus is separated from the lower part of the lamp by three diaphragms, to shut off downward heat radiation. The copper standards lower down are so shaped as to have great radiating surface, so that the conduction of heat downward to the mechanism of the base is wholly prevented. The structure of the base, full size, is shown in Fig. 3 (page 355). No detailed description of this portion will be required, further than to say that the electric current enters from below, follows the line of metallic conduction to the "burner," as shown by the arrows, thence downward, on the other side, connecting with the return circuit. The light-producing portion is, of course, completely insulated, and also sealed at the base, gas tight.

A fatal defect in all previous lamps depending on incandescent carbon has arisen from what has been called the "vaporizing" of the carbon. This Mr. Sawyer holds to be an absurdity, since the carbon is not even fused. The wastage of the carbon in mercurial vacuums, and in atmospheres of compound gas, is due, he holds, to chemical decomposition. Many gases, indifferent to carbon at ordinary temperatures, attack it destructively at temperatures obtained in the electric lamp; and the process is continuous, the carbon taken from the burner being redeposited on the glass case, and the gas left free to continue its depredation. Mr. Sawyer claims to have overcome this difficulty by his method of charging the lamps with pure nitrogen, and by providing for the fixing of any residual oxygen left in the lamp. In this way an unwasting carbon is secured. Another stumbling block on which other workers in this field

[*Continued on page* 354.]



THE SAWYER-MAN ELECTRIC LIGHT.

THE SAWYER-MAN ELECTRIC LIGHT

[*Continued from first page.*)

have come to grief, has been the crumbling or disintegration of the carbon burner, due to sudden heating when the lamp is lighted. This is avoided in the Sawyer-Man lamp by an ingeniously devised switch, shown in Fig. 4. By this means it is impossible to turn the current on or off suddenly, to the disruption of the carbon. This, however, is not the only nor the chief advantage of the switch. It is, indeed, the key to the entire problem, the indispensable condition, Mr. Sawyer holds, of practical electrical distribution.

It is well known that an electric current will exactly and readily divide among circuits of equal resistance. Accordingly, if the resistance of a subcircuit be maintained constant, no matter what may be going on in it, whether a lamp is not lighted at all, or lighted to a mere taper, or to any intermediate stage up to full brilliancy, it is obvious that no other lamp or lamps in that circuit will be affected. The operation of the switch, in securing such uniform resistance, is shown in the accompanying diagram, Fig. 5 (page 355).

The lamp has, let us say, a resistance of 0·95 of an ohm. Therefore if one lamp is out there should be a resistance of 0·95 of an ohm in its stead. This is the shunt resistance, B. The current enters at the "+" point, and leaves at the "—" point. The contact piece, A, bearing upon the two studs, 1, 1, all the current passes out by way of B. When A is moved to the studs, 2, 2, the current divides, ¼ going through the lamp, the other ¾ by way of B, and the resistance of the combined circuit is $0{\cdot}31\frac{2}{3}+0{\cdot}95=1{\cdot}26\frac{2}{3}$ in the shunt; and $1{\cdot}9+0{\cdot}38+25\frac{1}{5}+18\frac{3}{3}+0{\cdot}07\frac{5}{2}+0{\cdot}06\frac{1}{3}$+(the lamp) 0·95=3·8. The resistance of the circuit is, therefore, $\frac{1{\cdot}26\ 2{\cdot}3\times3{\cdot}8}{1{\cdot}26\ 2{\cdot}3+3{\cdot}8}=0{\cdot}95$ of an ohm, and so on. In short, the resistance of the circuit is constant at 0·95, no matter what may be the change in the proportion of the current given the lamp, as may be seen by making the required calculation for each pair of studs. The varying resistances required to give the best effect have been worked out by practical trial. The effect of ¼ the current through the lamp is to make the carbon a dull red. On studs 3, 3, one half the current passes through, and the carbon becomes a bright red. On studs 4, 4, the lamp gets ⅝ of the current, and becomes white hot. On 5, 5, the lamp gets ¾ of the current, and begins to assume the intense limpid incandescence of the sun; and the light increases rapidly with subsequent changes until the whole current goes through the lamp.

Thus it is seen that the greater part of the illumination is the product of a small part of the current. When the light is well on, a very slight increase in the current increases the light enormously. It is here that the great loss occasioned by dividing a fixed current among several lamps finds its explanation. A current that suffices in one lamp to produce a light, say of 100 candles, will, if divided between two lamps, give in each perhaps no more than 10 candles, or even 5, making a loss of 90 candles in the sum total. But if the current be doubled, each lamp will give a light of 100 candles, and the sum total will be 200 candles instead of 10. Having brought a candle or a system of candles up to the point of feeble incandescence, a (proportionally) small addition to the current will make them all brilliant. If at 6,000° Fah. a given carbon will produce a light of 3 candles, at 12,000° it will give 9 candles, and at 24,000° it will give 81 candles; the illuminating power increasing with vastly greater rapidity than the temperature.

The wires supplying the current may be run through existing gas pipes, each lamp being provided with a switch placed conveniently in the wall; and by simply turning a key the light is turned up or down, off or on. So long as the house is connected with the main it makes no difference to the producer whether all the lights are on or off, since the resistance of the entire (house) circuit must be overcome; though it will to the consumer, since a meter records the time that each lamp is on, and the charge is rated accordingly. If the Dynamo-Electric Light Company can supply the illuminating force so cheaply that the constant and brilliant illumination of all the rooms of a house can be secured at no greater cost than the partial and intermittent illumination now had from gas, it is obvious that the electric light will score an important point. The cost of lamps and switches, it is claimed, will not exceed that of gas fixtures.

The meter above referred to is shown in Fig. 6. It is a simple clock arrangement, with an attachment designed to throw the dial hands into connection when a light is on. From each switch a pair of conducting wires are run to opposite studs on the wooden disk shown at the top of the figure. When no current passes through the lamp the revolving spring shown in front of the studded disk turns without making any record. When the current is on, one electric connection at each revolution is made through the pins assigned to the particular lamp, the armature of the magnet is moved, and the recording wheel is advanced one notch. This meter does not measure the quantity of electricity passing, but only the time a lamp is on. If two or any larger number of lamps are on, an equal number of connections are made at each revolution of the wheel, and the record wheel is advanced to correspond. This registration is, of course, a mere matter of business detail. In view of the well-founded popular dislike to gas meters, however, it would seem to be desirable to dispense with such devices entirely; and the nature of electric distribution appears to favor other and less objectionable modes and means of determining the financial relations of producers and consumers.

Figs. 7 and 8 indicate the method proposed for general distribution. Where the main is tapped for a sub-circuit, a shunt is introduced so as to throw so much of the current as may be needed into the derived circuit. The resistance of say 100 added lamps will be about 100 ohms. By giving to the shunt a resistance of one ohm, $\frac{1}{100}$ of the current will be diverted, and the lamps supplied. When a large number of lamps are required in a circuit, a combination of the two plans indicated is employed.

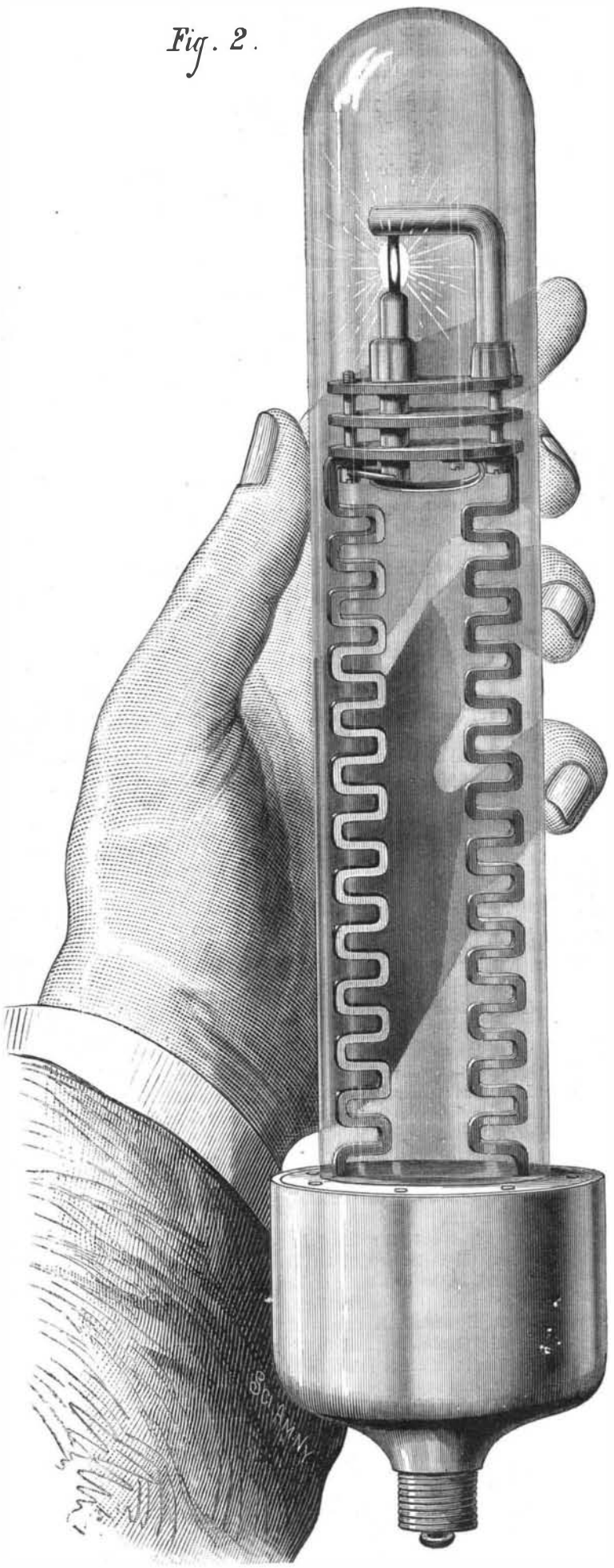
The diversion of any portion of the electric supply into an added circuit, whether one house or a group of houses, necessarily increases the aggregate resistance of the electric district, and calls for more work from the generator. To meet such contingencies automatically, Messrs. Sawyer & Man have invented and patented a regulator, which responds instantly to any increase or diminution in the demand, thereby securing an absolutely uniform volume of current.

This regulator so controls the steam or other power actuating the generator of electricity, that the amount of power supplied is increased or diminished in exact proportion to the demand, either by changing the volume of steam produced, or by coupling on or detaching different generators or parts of a single generator in circuit.

With regard to the cost of this mode of electric lighting no positive figures can be given. It is claimed to be entirely demonstrated that one horse power will give by the Sawyer-Man system of incandescence a light of 30 five foot gas burners an hour. Where large powers are employed the cost of steam power, every item included, is commonly rated at one cent per horse power per hour. The cost of 150 feet of gas at New York rates is 41 cents, which would make the gas over forty-fold dearer than the Sawyer-Man light. Mr. Sawyer does not stand on this estimate, however, holding that even if the electric light should prove in practice on a large scale to be ten times as costly as calculation indicates, it will yet easily compete with gas, the light furnished being so much better and purer.

It is promised that facilities will soon be offered for the photometric test of a large number of lights, in a circuit, with dynamometric tests of the power employed in generating the electric supply. This, as already noted, is all that the system lacks to prove itself an accomplished economical fact.

Fig. 2.



THE SAWYER-MAN ELECTRIC LAMP.

New Inventions.

Mr. Austin Connelly, of Hoboken, N. J., has patented an improved Faucet and Bushing, which consists of a faucet provided with a flanged nut for locking it into a permanent bushing screwed into the head of the cask or barrel, and a piston for removing the plug from the bushing, and other details of construction which cannot be fully explained without an engraving.

An improved Furrow Gauge Staff for Dressing Millstones has been patented by Mr. H. D. Altfather, of Maquoketa, Iowa. This invention is intended to provide, for the purpose of gauging the furrows of a millstone, an improved gauge staff by which all the furrows may be quickly gauged, and then cut exactly alike in width and depth.

Mr. Michael Dillmeier, of Dobbs Ferry, N. Y., has patented an improved Cigar Slitter. This is a simple and convenient pocket instrument for making a longitudinal slit in the mouth end of a cigar a little distance from the point, for making vent for the smoke.

An improvement in Packages for Bleaching and Packing Rosin has been patented by Mr. Addison D. Cutts, of Screven, Ga. This is a bilgeless barrel or package consisting of two longitudinal independent semicircular wooden sections, having semicircular end heads, and secured together by end hoops.

An improved Self-Feeding Water Trough has been patented by Mr. Alvin M. Brown, of Nettleton, Mo. This apparatus is so constructed as to keep a trough or tank supplied with water automatically for watering cattle for railway uses and other purposes.

Mr. John L. Nothaf, of Denison, Texas, has patented a Riding Saddle having an improved saddle tree, dispensing with the leather straps hitherto required for the girth-rigging, and affording a stronger and more durable rigging, that leaves the top and sides of the tree perfectly smooth.

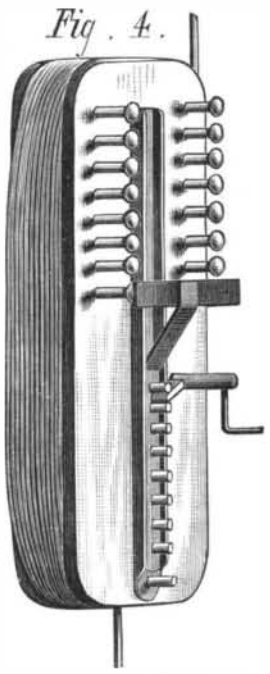
An improved Harness Pad has been patented by Mr. A. L. Johns, of Fort Wayne, Ind. This pad has several novel features and is easily manufactured.

Mr. George W. Hooker, of Grand Rapids, Mich., has patented an improved Sled Brake, by which the sleigh may be fully controlled, as the brake is readily applied to the ground and taken off as required; and the invention consists of fulcrumed dogs that are operated by a crank shaft and hand lever arrangement.

An improved Steam Cooking Apparatus has been patented by Mr. Martin Curtin, of Houston, Texas. This is an improvement in the class of culinary apparatus in which the heat of steam in pipes or tubular jackets is made to cook food without the direct action of fire by radiation, conduction, or convection.

Mr. Joseph R. Morris, of Houston, Texas, has devised an improved Table, designed to be heated by steam to keep the meat and other articles at the proper temperature. It consists more particularly in an arrangement of the steam heating apparatus that will admit of its application to dining tables, and will allow the plates of the diners and such of the dishes as may be desired being kept at the required temperature, without necessitating the heating of all the articles on the table.

Fig. 4.



THE SWITCH.

An improved Buckle Tongue Cover for Harness has been patented by Mr. Marshall R. Dowlin, of North Adams, Mass. The buckle tongue guard is made of one piece of leather, provided with two loops on the same side, and connected by an intermediate strip.

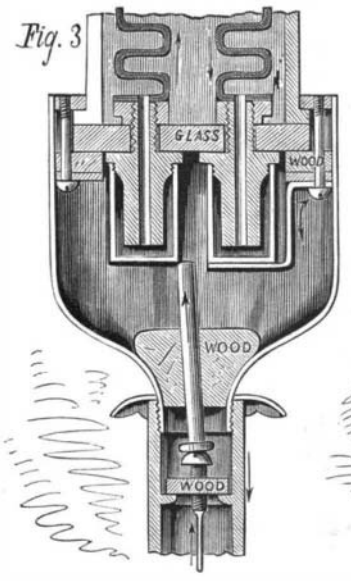
Mr. Peter Nussbaumer, of St. Louis, Mo., has patented an improved Vent Spike and Valve for Beer Barrels. This is a device for piercing the bungs of beer barrels, etc., for the purpose of admitting air to the interior, to allow the liquid to be drawn off at the faucet when the pressure of the gas in the barrel is not sufficient to cause the liquid to flow.

Simultaneous Inventors.

The Philadelphia *Ledger* thinks that inventors need not be jealous of rival discoverers, and suggests what we have often seen in our long experience with this class of persons, that the same inventions often emanate from different sources about the same time. The editor says:

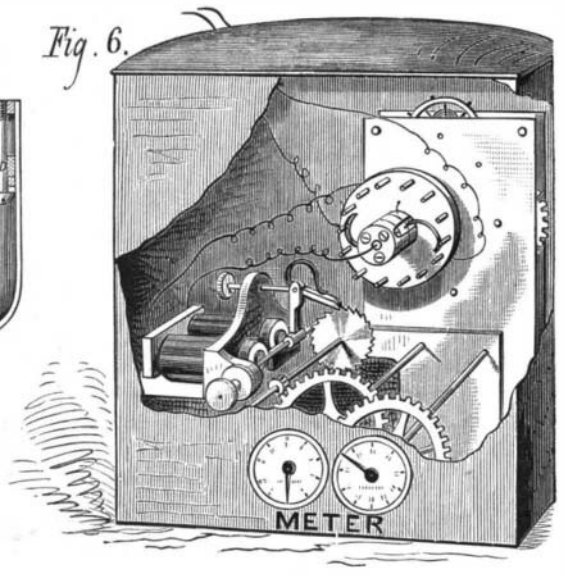
"The discovery of discoverers is a well-known stage in the process of making public any new invention. From the statue to 'Ether' on Boston Common, which is popularly supposed to represent your choice among the men—one, both or all of whom gave the world its great anæsthetic—down to the rivalry of carbon button makers, Edison and Hughes, over the microphone, an instrument which has magnified in its own way the small proportions of the disputed point, even to the active Miss Hosmer herself, who has furnished motives for two claimants to announce themselves, whatever may be proved of the dynamics of her magnet, there need not always be suspicion of anything more than simultaneousness in honest claims. The air is charged with electric and magnetic hints, and, while so many minds are quick at seizing and following these, the wonder is not so much in the plurality of claimants, but rather that a discovery ever announces itself in singleness, when in workshops and laboratories patient investigators, to all of whom the same appliances are open, are making good use of the world's sum of knowledge. Mr. Gary, of Boston, however, who also has been prospecting in the magnetic field, and has been working ten years over it, has the manliness to say there may be other ways of arriving at his conclusion (that force and motive power may be produced from permanent magnets, with or without the aid of an electric battery); but that, if Miss Hosmer has made the discovery in his way, and before he did, he is ready to take a back seat. If she has made it later, but in a better way, his discovery will yield in competition to hers; if by an equally good though different road, there is room enough in the world for both of them. This has a refreshing sound about it, in contrast to the shrill warfare which some scientific opponents indulge in, and predispose one to read with interest what Mr. Gary says for himself."

Fig. 3



BASE OF SAWYER-MAN LAMP.

Fig. 6.



THE SAWYER-MAN METER.

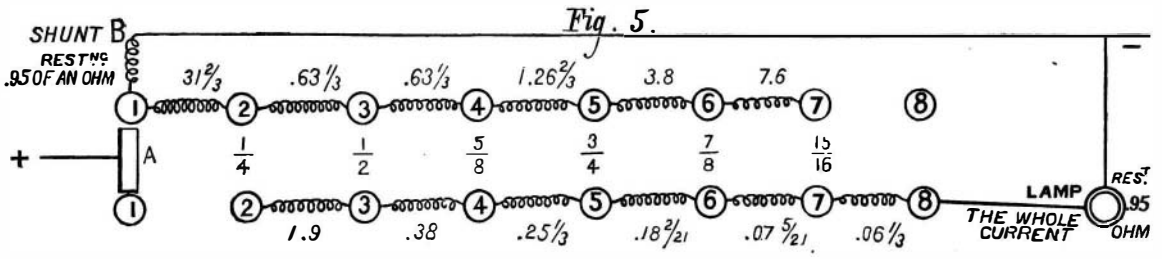
Who Shall Do It?

The problem of labor and overproduction in some departments is thus sensibly treated in the Philadelphia *Ledger:* Agricultural enthusiasts foretell the time in this country when the tea plant will equal the railway plant in value; and, indeed, there seems to be nothing but time and opportunity needed to demonstrate that the United States can grow all its beverages and its condiments, and produce, with its varied range of soil and climate, all of the staple luxuries as well as the staple necessities of food. It seems likely that the grave problem of overproduction in mechanical industries will be settled in this way and no other. No man can wear seven shirts at once nor warm himself at seven fires, nor run his locomotive on seven rails, but when all the surplus shirt makers and spinners, miners and manufacturers get to work on the soil, on the French system of high cultivation in small plots, when these begin to raise their own coffee and chocolate, oil and wine, raisins, silk and sugar, tea and molasses, in proper localities, as well as their own pork and beans, potatoes and mutton, cheese, wool, corn, hemp, and chickens, they will have at least enough to satisfy the appetites of their families and their need of exchange. Food is the first necessity, then clothes, shelter, and fuel, and the folks who raise their own food are secure that far. It will be a long time before this country sees an overproduction in all kinds of food. There are not enough oranges grown in Florida until they can be sold as cheaply in Minneapolis as they now are in Philadelphia, and when the money that is now sent abroad to buy silks, and coffees, and teas, is distributed among cultivators at home, the Grangers can afford to subsidize and extend the railroads, instead of cutting their throats. The country is like an overgrown boy in some respects of population; the jacket and trowsers of a few years back will not cover its robust proportions, and the old industries that held the population busy, cotton, woolen, iron, and the few staple foods, are showing all their seams strained to the utmost to maintain their laborers. What is needed is not to patch the old jacket, but to put the nation in new clothes that will hold it, with more breadth of cut and amplitude of pattern, and the agricultural industries, in wider range, offer this room to grow and spread in.

In a country less favored than ours, where the range of soil and climate limits the farmer and planter to a few products, emigration has been the one answer of England, and high cultivation that of France; but the United States is limited to neither, although it may find a hint in both. It must be that the overpopulation of some cities and districts must emigrate, not necessarily to far distances, but to such small farms or plantations as will furnish first their food and afterwards their other needs.

It would be a confession of weak intelligence and of little faith for any appreciable number of people in the United States to assume that a dead lock was reached in industrial development solely because the tremendous development of mechanical industries has outgrown and left behind all others and has outstripped the present needs. With the magnificent undeveloped resources of the country, after the inevitable pause of amazement and relaxation that we have passed through, there must be a redistribution and a readjustment. Who is to start on these new roads? Who is to teach the manual skill required, the judgment, the knowledge of soils, of chemistry, of weather, that will be needed to grow the new products? They cannot be picked up in a day, nor can Americans raise tea and coffee, cultivate silkworms, and so on, as they go offhand into a clerkship or a mill. Quite as much as industrial schools to teach boys to make nails and understand looms and manage machinery is it needed to teach the future farmers and planters the practical science and the theoretical also of agriculture. If a certain proportion of the population is to be occupied in this industry, it is wise not to spend time over logarithms or steam engines, but over the chemistry and the art of farming. It is just as well to take a broad look while we are about it, and if there are too many men now at work in the mines and factories and railroads, why set all the boys to learn how to make iron, and to make surveys, and study the mechanical industries and handicrafts? Some of these at least should be learning in the direction of the future, rather than of the overgrown present. But every farmer is the better for learning how to handle tools, and, so far as the industrial training is applied towards manual deftness, it can be the foundation for the farmers too. From the standpoint of the public schools, as well as the labor market, it is wise to consider all these things.

Fig. 5.



PRINCIPLE OF SWITCH.

Fig. 7

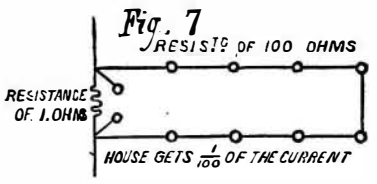


Fig. 8.

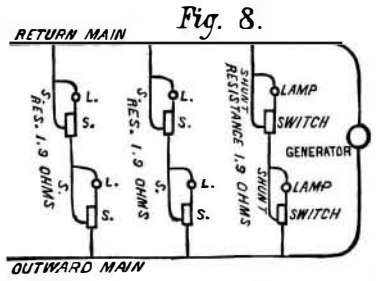


Fig. 7.—DERIVED CIRCUIT. Fig. 8.—BRANCHED CIRCUIT.

New Mechanical Inventions.

Mr. Thomas Dehart, of Meadows of Dan, Va., has patented an improved Water Wheel, which is cheap, compact, and capable of utilizing the water power effectively without liability to stoppage or interruption by obstructions.

Mr. Andrew I. Hogan, of La Clede, Ill., has patented an improved Machine for Cutting Basket Splints. This is an improvement on the machine for which letters patent No. 200,912 were granted to the same inventor March 5, 1878. With this machine the ends of the shingles or box splints or veneers may be cut off squarely at the same time that they are cut from the block, and by the same movement of the gate or knife frame.

Mr. Horace Woodman, of Saco, Maine, has devised an Improved Shuttle Motion for Looms. This invention relates to that class of looms wherein all of the parts of the loom are driven by mechanism that imparts to them positive motions. In this class of looms it is necessary to have two dwells, one in the movement of the shuttle and one in the movement of the lathe. The dwell in the shuttle movement is, in this case, secured by the relative position and proportion of the cranks and connecting rods employed to throw the shuttle. The working parts of the shuttle shifting mechanism consist simply of the two latch springs and the two inclined planes on the shuttle. In locking and unlocking the shuttle both springs are employed.

An improved Calculating Machine has been patented by Mr. Willgodt Odhner, of St. Petersburg, Russia. This is an instrument for assisting in calculating, it being adapted to add, subtract, multiply, and divide numbers, without any other labor on the part of the operator than that required to set and rotate certain numbered and counting wheels, and to adjust a slide carrying a series of recording wheels. The details of construction of parts cannot be well understood without an engraving.

Mr. William T. Carter, of Village Springs, Ala., has patented an improved Harvester Thrasher, which will thrash the grain while standing in the field. It is simple in construction, convenient, and effective.

Mr. Aaron Brosius, of Fort Wayne, Ind., has patented an improvement in the class of Vehicles formed of endless oval or elliptical frames or tracks and flexibly connected trucks traveling around the tracks. Vehicles of this class are especially adapted for use in localities where the soil is soft and the roads liable to be muddy or sandy, since the trucks are not caused to move or advance like an ordinary carriage wheel through the stratum of soil, in which they become more or less embedded when supporting the weight of the vehicle, but are successively lifted out of the soil and carried around over the body of the elliptical track as the vehicle advances.