MAKING INSULATED WIRES FOR ELECTRICAL USES.

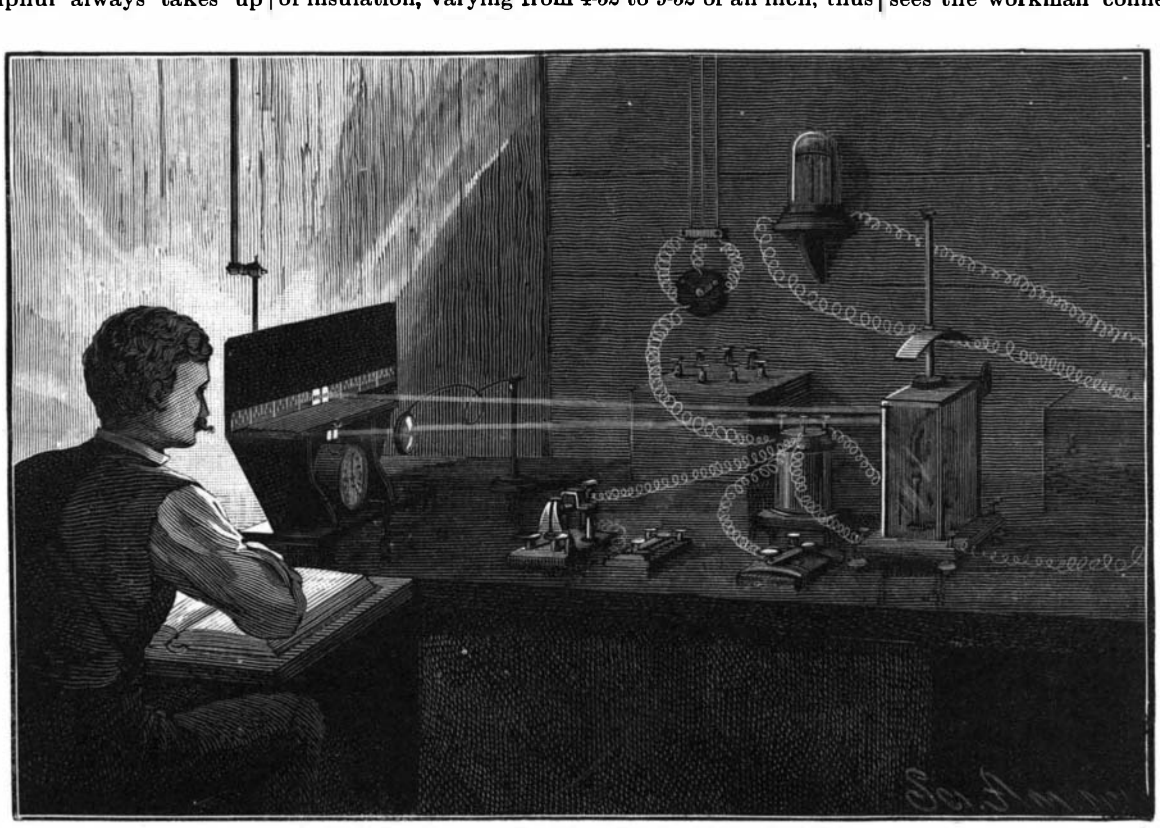
The number of extensive industries which have been developed within a very recent period, growing out of the improvements which have brought electricity into such common use, is something remarkable. An industry of this kind is portrayed in our first page illustrations, representing the factory and different departments of the Okonite Company, of New York, for the manufacture of telephone, telegraph, and electric light wires and cables, for aerial, submarine, and underground use.

The firm name is that of the compound used in covering the wires, a composition which is the result of a long series of experiments and tests to obtain something which, with superiority of insulation, would have great durability, toughness, and resistance to the decomposing influence of the elements. In its composition and manufacture the processes followed are somewhat similar to those employed in the making of vulcanized rubber products, such as belting, hose, etc., in which, according to the article to be made, the rubber is mixed with different ingredients, in varying proportions, which the manufacturers have proved of value in their long experience, but the knowledge of which they retain as among the secrets of their special trade, being the result of something over thirty years' experience with the compound. In the manufacture of okonite, however, still different ingredients are used, which give it an exceedingly high insulation resistance, equaling, if not surpassing, the best gutta-percha.

As in the manufacture of vulcanized rubber, it is even more important in making okonite that the sulphur used should be free from acid, and from the moisture which acid sulphur always takes up rapidly on exposure to the atmosphere. Great care is taken in this particular, all the sulphur used being carefully tested, and the mixtures to be worked into the rubber being accurately weighed. The working of the raw rubber, from the first step in its cleansing up to and through the mixing machines and the calenders, is a labor requiring great thoroughness in every detail, and the employment of a great deal of powerful machinery, for it must be worked through and through the different machines many times in order to secure the most intimate mixture and exclude all bubbles and prick holes. These operations, however, are only those incident to the usual manufacture of vulcanized rubber, except that the large rolls of rubber-like prepared okonite, rolled to a thinness ordinarily less than that of a sheet of blotting paper as they come from the last calendering machine, must be of the most perfect manufacture. These strips are usually about three feet wide, and are rolled up with a thickness of duck to support the thin sheet of okonite and prevent its surfaces from sticking together, these rolls being then taken to the wire-covering room, shown in one of our views.

As the okonite is put on the wire before vulcanizing, being then vulcanized in position, a perfect evenness of covering being necessary, an ingenious method of manipulation has been devised for this end. On one of the long tables in the covering room are smoothed out long strips of thinly rolled pure tin, some fourteen inches wide, which are brushed over with a sort of thin varnish, to insure perfect freedom from any dust or dirt, and to prevent the okonite from sticking to the tin. Over these strips the okonite is rolled out to entirely cover the tin, to the size of which it is trimmed, and make a long, smooth band of thin okonite, with a thin tin backing. These bands are then drawn through a cutting machine, by which they are cut into narrow, tape-like strips, and automatically wound upon a reel with many divisions, each tape-like section into its especial division. Thus prepared, the tape-like sections being afterward joined at their ends as the whole are placed on a single reel, the okonite is ready for use in covering the wire. The reel carrying the tin-backed narrow strip of okonite, its width and the thickness of okonite being dependent on the size of wire to be covered and its intended use, is then mounted to feed out in connection with another reel or drum carrying the wire, these reels being located at some distance from the covering machines, so that the wire and covering may be allowed to feed without appreciable tension. At the covering machine they come together and pass through dies, the wire being thereby so thoroughly wrapped around by the okonite and its tin backing as to make the covered wire look like a wire of tin of several sizes larger, so perfect is the covering. The necessity of doing this work thoroughly is obvious when it is remembered that the now covered wire has yet to go into the vulcanizing oven, where it is subjected to a temperature of 275° F. for an hour, the heating being effected by turning the steam directly into the vulcanizers. Any flaw in the tin covering of the okonite would thus be likely to cause pricks or other defects in the okonite. In one of the views may be seen a representation of these vulcanizing chambers, of which there are several of various sizes in the factory, and the large drums in the foreground, on which the wire is wound as it comes from the covering machine, these drums being mounted on low carriages so that they can be conveniently moved about the floor, or rolled from their carriages into the vulcanizing chamber.

After vulcanization, the tin covering or wrapper has to be removed from the okonite-covered wire, and this is effected by passing it through a stripper, the operation, as well as that of covering, being effected with a rapidity which hardly seems possible until one has seen it actually accomplished, each conductor, whether it be for a single line wire or one of even hundreds of conductors in a large cable, being thus thoroughly and evenly covered with a strong and durable insulating covering. The company afford any size of wire or insulation, although they use a standard of regular thicknesses of insulation for the usual sizes of wire, as, for instance, No. 18 wire, according to the Birmingham wire gauge, is furnished with six different thicknesses of insulation, varying from 4-32 to 9-32 of an inch, thus giving a wide variety of goods for customers to select from in all the regular grades.



TESTING OKONITE INSULATED WIRE.

The wire, having been provided with its insulating covering and tested, is ready to go either to the braiding room, the fireproofing room, or the cabling department. The company make silk or cotton braided lamp cord, and all similar goods, with double conductor twisted or braided parallel, and flexible cords and cables with any number or size conductors for elevator and analogous uses.

The company makes also a less expensive aerial wire, known as the Candee aerial wire, which has given such universal satisfaction that it has required the placing of a great number of new braiding machines within the last three months. The wire after having been braided is then to the treating room, where, after treatment in their special compound, it is returned for an additional braid and again treated, thus insuring a thorough saturating of the braid; after this is completed it is sent to the polishing room, when it is ready for shipment.

In the cabling room shown in one of the views are small machines for putting several conductors together in one wrapper, and larger machines for uniting these several strands as it were in a large cable. The strands are fed from spools or reels through apertures in a revolving disk or plate, the reels having a double motion, so that the wires will not be twisted as the cable is formed, the conductors being covered with an extra insulating wrapper and then strongly bound together as the operation proceeds with an insulating material composed of two or four layers of strong tape, with okonite composition between the same, to protect it from injury during handling and use, and an additional protection from dampness or water.

When the cables are to be armored, as is the case in the work for electric light, submarine use, and submarine telegraph cables, where many conductors are cabled together, they are covered with a packing of jute cord to protect the armoring wires from injuring the conductors before being sent to the armoring room. The large machine here used is adapted to put around a cable any number of strands of galvanized wire which may be required, the number actually used ordinarily varying from fourteen to twenty-five. The wire is held on spools, revolved by gear wheels, as the machine revolves, the cable passing up through a die plate in the center, through which also passes the armoring wire, being firmly twisted around the cable by the rotation of the machine, while the revolution of the wire-holding spools prevents the twisting of the wire itself. As the cable is armored, it passes over suitable pulleys and is wound directly on large drums, in convenient form for shipping, these drums with their load of cable sometimes representing a weight of several tons each.

Perhaps the most important consideration of all, however, to a customer purchasing such insulated wire, is the question as to the absolute perfection of the insulation. Of this fact, which might be very readily doubted by one who had only gone thus far through the process of its manufacture, it is only necessary to inspect for a few moments the work of the testing room, where all the wires and cables are tested, to be abundantly satisfied. In this room are two of Thompson's reflecting galvanometers with an expert operator, there being just outside the room large tanks of water, convenient to a table to which the coils of wire to be tested are brought, and placed in water and allowed to remain three days. The operator sees the workman connect the coil with the instrument, and then determines the resistance of the wire. If there be any defective spot in the insulation, the current is short-circuited by the water and the defect at once noted by the instrument, its exact location being found on slowly withdrawing the coil. In testing cables after the conductors are all put together, the operation is proceeded with in more detail, according to well known methods of charging the wires for a minute or so, the system being so perfect that any fault can always be definitely located within a few inches.

For making connections and splices, the company manufacture a special okonite tape, which is a thin tape of okonite with a slight cloth backing. The latter is only employed to separate the layers, and must be removed before using, when, the joint being cleaned, the okonite is pressed well over it, and a little heat, as from a lighted match, applied, thus making a joint which is thoroughly waterproof and a perfect insulating medium.

The tenacity and toughness of okonite, rendering it non-liable to destruction by reason of abrasion or rubbing, and the fact that it is not susceptible to extreme ranges of temperature, have made this insulator highly popular among all users of electrical supplies, and the company have the highest indorsements as to its value from many of the largest users of insulated wire here and abroad. Okonite wire has been subjected alternately to a temperature of 20° below and 350° above zero, the tests being repeated a number of times, the result showing no apparent change in the quality of the wire.

Recent tests made by the United States government of okonite No. 16 Birmingham wire show an insulation resistance of 2,000 megohms per mile. A report from Capt. A. E. Black, commanding submarine defenses of the Clyde, Scotland, while giving many specific details, says. "We have found the coating to stand a great deal more rough handling than other wires which have come under our notice; in fact, seems to equal, if not surpass, the best gutta-percha wire." An exceedingly favorable report was also received, concerning tests at Portsmouth, England, from the Lords Commissioners of Admiralty, while Commander Goodrich, inspector of ordnance at the torpedo station, Newport, R. I., states as follows in regard to hot air tests: "A piece of okonite wire being suspended in the air over a steam boiler, leaving it untouched for a month, showed an insulation resistance at the end of the time too great to measure, approximating 3,500 megohms per mile." Mr. George A. Hamilton, electrician of the Western Union Telegraph Co., having tested several thousand miles of okonite wire, says:

"I have yet to learn the first case of deterioration of the core that has passed under my inspection."

Among the larger users of okonite cables are the following:

Western Union Telegraph Co., all parts of the country, New York; New England Telephone and Telegraph Co., Boston; Metropolitan Telephone and Telegraph Co., New York; Delaware and Atlantic Telephone Co., Philadelphia; New York and New Jersey Telephone Co., Brooklyn; Bell Telephone Co. of Canada, Montreal; City of Brooklyn; Thomson-Houston Electric Co.; City of Cleveland, O.; City of Chicago; Underground Electric Light and Power Co., Philadelphia; United States Torpedo Station, Newport, R. I.; Commercial Cable Co., New York, and many others, including most of the licensees of the American Bell Telephone Co.

Mr. Charles A. Cheever is the president and Mr. Willard L. Candee treasurer of the Okonite Company, whose general office and storeroom is at No. 13 Park Row, New York, the factory we illustrate being at Passaic, N. J.

Aluminum in Flowering Plants.

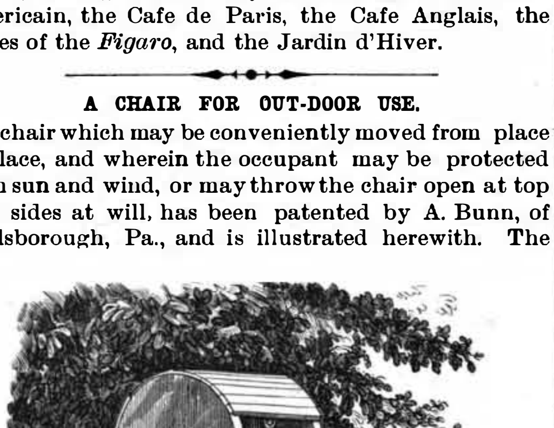
At a recent meeting of the scientific committee of the Royal Horticultural Society, Professor Church called attention to the apparently general presence of aluminum in flowering plants. He said it was known to exist in the Lycopodiaceæ; it had been shown by a Japanese chemist to be present in the Japanese lacquer tree (*Rhus vernix*), and it had been found by himself in cherry tree gum, gum arabic, tragacanth, etc.; it had been stated also in the *Analyst* for January to be invariably present in the gluten of wheat in the form of phosphate. Professor Church assumes that it is probably absorbed accidentally by the roots, and that it plays no part in vegetable physiology.

Motive Power by Compressed Air.

M. Victor Popp is making good progress with his system of distributing compressed air for motive power purposes. The works for compressing the air in the Rue St. Fargeau, at Menilmontant, are of considerable magnitude. They cover an area of 15,000 square meters, of which an extent of 2,000 meters is roofed over. There are already fixed and in operation seven steam engines of 400 h. p. and two of 100 h. p. each, a total of 3,000 h. p. The conduits have already been laid over the whole area comprised between the line of the boulevards and the Rue de Rivoli. These are sometimes laid in trenches cut for the purpose, and sometimes in the sewers. The total length of pipes laid was, at the end of last December, a little over thirty miles. This source of power is used for working electric light machinery in a large number of establishments, among which may be mentioned the Cafe-Americain, the Cafe de Paris, the Cafe Anglais, the offices of the *Figaro*, and the Jardin d'Hiver.

A CHAIR FOR OUT-DOOR USE.

A chair which may be conveniently moved from place to place, and wherein the occupant may be protected from sun and wind, or may throw the chair open at top and sides at will, has been patented by A. Bunn, of Birdsborough, Pa., and is illustrated herewith. The

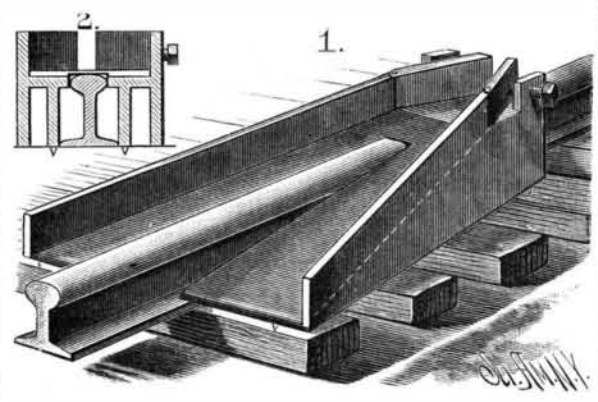


BUNN'S COVERED CHAIR.

curved side pieces constitute the legs of the chair and support the frame, being secured together by cross pieces, which support the seat. The front is inclosed from the seat to the bottom, and is fitted with a foot rest, which may be withdrawn. The side walls have openings to serve as windows, and have sliding panels, and there is a sliding top corresponding with the curved top of the chair. The chair is mounted on wheels to facilitate moving it from place to place, a pin fitted in the frame being adapted to engage with the wheel spokes, to prevent the chair from moving of its own accord when placed upon an inclined surface.

AN IMPROVED CAR REPLACER AND PORTABLE SWITCH.

A simple and durable appliance for replacing on the tracks derailed cars or locomotives, or for transferring them from a main track to a spur track, has been patented by Mr. Thomas Holliday, and is illustrated herewith, Fig. 2 being a cross sectional view. An upper plate is supported by two outer plates at about the height of the tread of the rail above the ties, the outer plates flaring outward and inclining downward as they recede, interior plates being also arranged under the first named plate, and inclining downward. To the upper inclined edges of the two pairs of plates are secured top plates having flanges on their outer edges, which are continued at their upper ends by adjustable deflect-



HOLLIDAY'S CAR REPLACER AND PORTABLE SWITCH.

ing plates, arranged in connection with set screws, by which they are moved toward or from a central space between the edges of the plates, just wide enough to admit the tread of the rail. That the device may be held against accidental displacement when adjusted, downwardly extending spurs are arranged at one or both ends of the replacer. In replacing a derailed car the device is applied just in advance of the wheels of the car, the construction permitting the car to be replaced from either side of the track and guided properly to the rails by the deflecting plates.

For further particulars in reference to this invention address Mr. Thomas M. Murphy, Sanborn, Dakota Ter.

Cobwebs and how they are made.

Every one has noticed the cobwebs which hang upon each shrub and bush, and are strewn in profusion over every plat of grass on a fine morning in autumn; and, seeing, who can have failed to admire? The webs, circular in form, are then strung thick with tiny pearls of dew, that glitter in the sun. No lace is so fine. Could any be wrought that would equal them in their filmy delicacy and lightness, it would be worth a prince's ransom. But for such work man's touch is all too coarse. It is possible only to our humble garden spider, known to scientific people by the more imposing name *Epeira diadema*. These spiders belong to the family of *Arachnidæ*; and the ancients, who were great lovers of beauty, observing their webs, invented the pretty fable of Arachne.

Arachne was a maiden who had attained to such expertness in weaving and embroidering that even the nymphs, leaving their groves and fountains, would gather to admire her work. They whispered to each other that Minerva herself must have taught her; but Arachne had grown vain as she grew dexterous, and, overhearing them, denied the implication with high disdain. She would not acknowledge herself inferior even to a goddess, and finally challenged Minerva to a trial of skill, saying: "If beaten, I will bear the penalty." Minerva accepted the challenge, and the webs were woven. Arachne's was of wondrous beauty, but when she saw that of Minerva she knew that she was defeated; and, in her despair, went and hanged herself. Minerva, moved by pity for her vain but skillful opponent, transformed her into a spider; and she and her descendants still retain a portion of her marvelous gifts of spinning and weaving.

Now, let us see how the garden spider uses its inherited talent. Each individual is endowed with a spinneret, or natural spinning machine, through which can be drawn innumerable strands, so fine that they can be seen only under a powerful microscope (Leeuwenhoeck claims that it takes four millions of these strands to make a thread as thick as a hair from a man's head).

First, our spider begins to draw from out her spinneret a cord of as many of these strands as seems to her good, and fastens it to some leaf or twig, then runs on another leaf, spinning all the while; fastens again to that; and to another and another; continuing until a circle is formed inclosing as large a space as she designs for the outer boundary of her web. Then she passes back and forth over her work, adding fresh threads, and strengthening this outer line, which she secures to every possible object. Finally she stops, fastens her thread with special care, and begins to run around the circle, spinning as she goes; but now carrying her fresh thread carefully raised upon one hind foot, thus keeping it from touching the older strands and becoming glued to them. When half way round she stops, pulls her thread tight, fastens it very strongly, and a firm line is drawn straight across the center of the circle.

She runs down this center line to the middle, fastens another thread to it there, carries it to a new point upon the outer edge, fastens it, and we now see that she is engaged in making those lines in the web that look so like the spokes of a wheel. She repeats this operation again and again, until all the radii or spokes are formed. When they are done she carefully tests each thread by pulling, to make sure that it is firm and strong; and, if one proves unsatisfactory, she either strengthens or remakes it altogether.

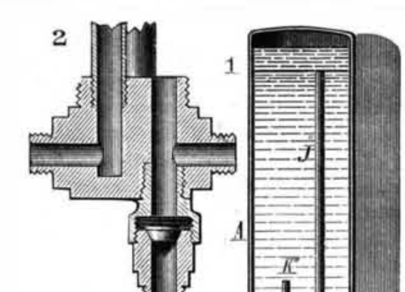
Now that the main lines are built, our spider goes once more to the center point, and begins to spin again —this time in circles—fastening to each radius as she passes. At first these circles, or more correctly spirals, are placed quite close together, but she leaves ever a wider and wider space between, as she approaches the outer edge. The outer circle and the radii were spun of a silk which becomes dry directly after leaving the spider's body, is of great strength, and very firm; but these spirals are formed of a substance which differs essentially. When first drawn from the spinneret it is extremely glutinous—a most important property, as by this it is enabled to adhere tenaciously to the radii—and it is, besides, so highly elastic as to be capable of being pulled far out of place without breaking.

When the spirals are finished, the spider returns again to the center, and proceeds to bite off the points of all the radii close to the first encircling line, by which she much increases the elasticity of her web. It is in or beneath this central opening that the spider usually sits and watches for the coming of her prey.

But while these circular creations are perhaps the most beautiful, they are by no means the only cobwebs. You have probably seen, or rather felt, the long gossamer threads that sometimes draw across the face, as one walks beneath the trees on a summer evening. At certain seasons they are very numerous. They float in the air; they fall upon the grass; they gather on the trees. These are all cobwebs. They are made by spiders, and in a manner so marvelous as to be almost incredible. The spider spins the silk from its spinneret, pushing it off into the air. It is so light that it does not fall; it rather rises in the air. It grows a longer and longer thread, until it is carried by some current against an object, often at a surprising distance, to which it attaches itself. This spider's slack rope is quite strong enough to serve the little spinner as a bridge, over which it can pass at its pleasure. Indeed, in the tropics, spider's webs are found of gigantic size, sometimes even spanning streams; and of a strength so great that humming birds are caught and held by them, as flies are by the cobwebs of our own land.—*S. L. Clayes, Swiss Cross.*

A PIPE COUPLING FOR KITCHEN BOILERS.

A pipe coupling especially adapted for use in connection with the ranges of kitchen boilers, whereby only a single opening in the boiler is utilized through the coupling to connect the various pipes to the boiler, is illustrated herewith, and has been patented by Mr. James Hollinger, of No. 2163 Second Avenue, New York City. The coupling, shown in plan and section in Figs. 2 and 3, is screwed into the bottom of the boiler, and has a vertical passage receiving the



HOLLINGER'S PIPE COUPLING FOR BOILERS.

screw-threaded end of the water supply pipe, E, in which is a valve to prevent back flow of water. From a side port leads the pipe, H, for conducting cold water to the range, I being the return pipe, communicating with a vertical passage, to which is secured the pipe, K, projecting a short distance up into the boiler, for directing the hot water upward. J represents a pipe reaching nearly to the top of the boiler and communicating through a horizontal outlet port with the pipe, M, leading to a sink or other place of use. By this arrangement the water drawn out is taken from the top of the boiler, where it is the hottest.