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## EIGHT LIGHT DYNAMO.

BY GEO. M. HOPKINS.

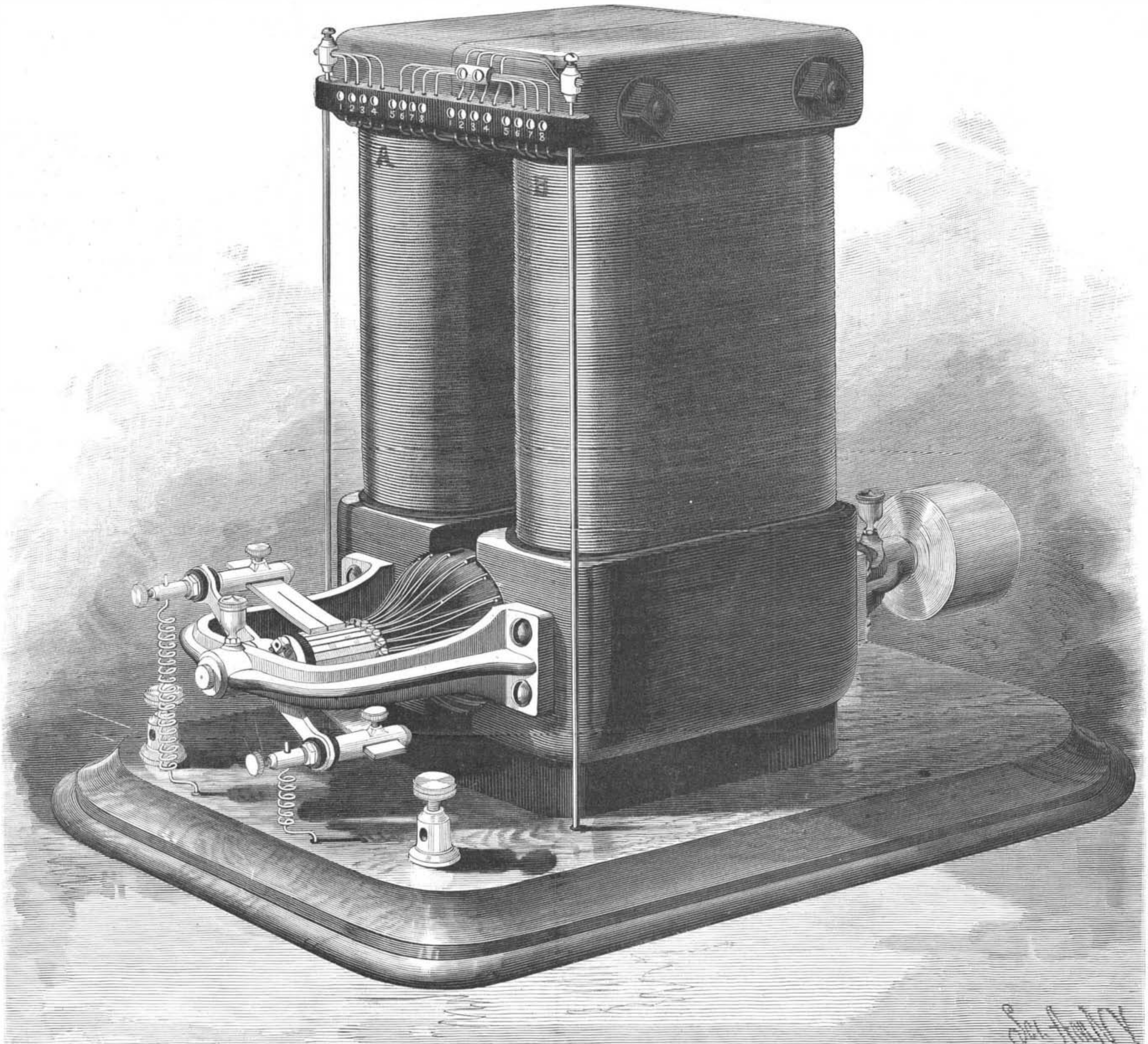

Fig. 1.--EIGHT LIGHT DYNAMO.

Unfortunately for the tyro in electrical matters, no rule or set of rules exists in the literature of dynamo-electric machinery which would enable him, with entire confidence of success, to plan a new form of dynamo, or even to attempt to construct any one of the well-known forms. The available information generally fails in some minor details, thus, in some degree, obscuring the whole subject, and awakening doubts as to the best course to pursue. One might follow such information as closely as possible, and proceed so far as to make an operative machine, and yet it might happen that no current could be evoked from it, simply for the want of specific knowledge as to how to secure the first increment of magnetism necessary for starting the inductive process.

The writer knows a case in point where good workmanship, proper proportions, and correct connections failed of giving any results whatever. Naturally, rewinding was resorted to, but to no purpose. Other experiments were tried, with no better results. But, finally, acting upon a hint given by a builder of dynamos, the maker of the machine was out of his difficulty almost in an instant.

It is not the purpose of the present paper to treat on dynamos in general, but to give, as fully as possible, specific information as to the construction of a small dynamo-electric machine capable of supplying a current for eight sixteen-candle power incandescent fifty volt lamps, or a larger number of smaller incandescent lamps of suitable resistance, or an arc lamp of ordinary power. The armature speed is 2,200 revolutions per minute, and the machine running normally requires one horse power to drive it. The machine weighs 130 pounds, and occupies a floor space of 8 × 18 inches.

The dimensions of the machine are tabulated below:

| | | |
|---|---|---|
| Height of field magnet | 13 | inches. |
| Length of field magnet waist | 6⅞ | " |
| Width of field magnet waist | 5⅝ | " |
| Thickness of field magnet waist | 1⅝ | " |
| Depth of polar extremities from waist to base | 4½ | " |
| Width of polar extremities | 6¾ | " |
| Thickness of polar extremities | 3 | " |
| Diameter of bore of polar extremities | 3⅝ | " |
| Thickness of yoke | 1⅞ | " |
| Diameter of bolts passing through the yoke | ⅝ | " |
| Length of armature shaft | 18 | " |
| Diameter of armature shaft | ⅝ | inches. |
| Diameter of armature shaft bearings | ½ | " |
| Length of parallel faces of armature | 6¾ | " |
| Diameter of iron rings of armature core, outside | 3 | " |
| Diameter of rings of armature core, inside | 1⅞ | " |
| Thickness of rings | 5/32 | " |
| Number of iron rings on armature core | 39 | |
| Diameter of wooden armature core | 1⅞ | " |
| Length of wooden armature | 6⅝ | " |
| Length of armature core | 6⅝ | " |
| Number of divisions of the armature core | 24 | |
| Number of divisions of the commutator cylinder | 24 | |
| Length of commutator cylinder | 2 | inches. |
| Width of brushes | 11/16 | " |
| Size of wire on armature, No. 20 Am. W. G. | 0·027 | in diam. |
| Length (approximate) of wire in each armature coil* | 25 | feet. |
| Number of convolutions in each layer | 8 | |
| Number of convolutions in each coil | 16 | |
| Number of layers in each coil | 2 | |
| Number of coils in each space of the armature | 2 | |
| External diameter of armature | 3⅜ | inches. |
| Weight of wire on armature | 2¼ | pounds. |
| Diameter of pulley on armature shaft | 3½ | inches. |
| Width of pulley on armature shaft | 2⅛ | " |
| Width of driving belt | 2 | " |

(*Continued on page* 261.)

* This quantity varies a few inches with the different coils.

## Correspondence.

### Assimilating Oil through the Pores.

*To the Editor of the Scientific American:*

In your issue of March 26 is advice to one who wishes to gain in fat and strength. Let him take a warm bath, thoroughly "opening" his skin, then rub dry with warm, rough towels in a heated room, and when actually dry, let him rub in, thoroughly, any pure oil—cod liver preferably, but olive will do—all over his body. He will find that thus ten times more will become assimilated than his weak stomach can possibly digest. Give the stomach rest and a chance to recuperate, while letting the skin do its work. I. C. HOFFMAN.

Jefferson, Wis., March 28, 1887.

### Change of Gauge on the Dayton and Ironton Railway.

*To the Editor of the Scientific American:*

For some months past, since the C., H. & D. R.R. gained control of the Dayton & Ironton Railway, formerly a part of the Toledo, Cincinnati & St. Louis narrow gauge, preparations have been in progress for changing from narrow to standard gauge.

The road runs from Dayton, O., through Xenia, Washington C. H., and Chillicothe, tapping some of the finest farming region in the State, to Coalton, Wellston, and Ironton, making a mileage of 167 miles to be changed, and giving a new outlet to the coal and iron regions of Jackson and Lawrence counties.

The road has long been an eyesore to the country through which it passes, but will now be a great aid in developing in it. The locomotives were busy hauling all the narrow gauge cars to the Dayton end of the road, the last train passing over the road Saturday morning, April 2.

Immediately on the passing of this train, the section men, under orders, commenced the work of changing the railway and road crossings, and spreading out stringers on the bridges, thus making everything ready for the change of gauge.

Early Sunday morning, April 3, the work of changing the gauge was commenced, with a large force of men, many of whom were borrowed from other roads.

The spikes for the outside of new gauge were driven in every third or fourth tie, and spikes were distributed along the roadbed for the inside.

About every other spike on the old gauge was drawn and the others loosened.

When the change was in progress, one gang of men pulled the outside spikes and another gang threw the rails out to new spikes, while still another gang put in the inside spikes.

The change occupied on an average about six hours for a section.

On Sunday night the first standard gauge train was run over the road, and on Monday morning the regular trains were started.

A force of hands will be kept at work putting the road in standard shape.

Steel rails are laid to Washington C. H., a distance of forty-seven miles, and the steel for the remainder will be laid at once.

The road when completed will be a valuable acquisition to the C., H. & D. management.

C. E. FOWLER.

Chillicothe, O., April 4, 1887.

### How to Protect New York Harbor in Thirty Days.

*To the Editor of the Scientific American:*

First, make arrangements for the manufacture of a lot of tubes similar to the pneumatic dynamite guns which have been tried recently, only they need not be so accurate nor effective, and, to simplify matters, steam may be used instead of compressed air, and if they were made so as to have an effective range of one-half, or even one-fourth, of a mile, they would do. Then take a sufficient number of scows and cover them with iron, lying at a very small angle with the water, and with the lower edge submerged. (If they lack bouyancy, it may be obtained by bolting timber to the lower edge of the armor, or even under the scow.) We will now arm each scow with, say, three tubes, and put on a steam boiler, or, if obtainable, air compressing machinery, and moor them one-half mile apart across the mouth of the harbor, with one tube pointing outward and one to each side. These will form our floating batteries.

We may now take all the boats which we think are quick enough of motion, and put in a close deck below the water line in the forward part and fill with cork, etc., and, by the addition of sloping armor, make impromptu Destroyers, without the submarine gun, which we will replace with one of our tubes.

These boats would be probably slow of action and easily run down, as compared with the real Destroyer; but in thirty days we could fix enough of them to load several ironclads with all the dynamite they could carry—in a state of combustion.

These boats might be held in reserve till the ironclads had passed our floating batteries—if they got past, which they probably would not, as the scows might be easily connected by cables, along which a torpedo could be run to any intermediate point, and the armor could be made thick enough to withstand any gun made, as no mobility is required.

As to protection against small boats, they would be simply burglar proof safes or rafts, so that a small number of men with small arms could keep off any number of boats, even if they could not drop a bomb into them, and thus demoralize them.

These impromptu arrangements need be kept up but for a very short time, as Captain Ericsson, the inventors of the Peacemaker and other submarine boats, torpedoes, etc., would not be idle, and, in fact, I doubt not but Captain E. wouldhave a complete and effective Destroyer ready in thirty days, and after the first one was made, he would turn them out much faster than all the foreign navies could furnish ironclads. G.

### The Eye Camera.

At a recent meeting of the Photographic Section of the American Institute, Dr. Maurice N. Miller, of the University of the City of New York, entertained the audience for an hour. The camera to the construction and application of which he wished to call attention was not a patented instrument. The camera he alluded to was the human eye. The eye was guarded as jealously and protected as carefully as the most fastidious photographer cared for his camera. The horny box, consisting of seven separate pieces, was described, as well as the wonderful means for cleaning the front surface of the optical apparatus by means of the tears.

The exposing apparatus was shown to consist of a peculiar muscular arrangement, by means of which the individual had perfect control over the admission of the light rays.

Reference was then given to the arrangement for position.

Delicate cords (muscles) were attached to the eye camera, traction upon which enabled the owner to select the field of view.

Dr. Miller then described the walls of the eye. In stead of the usual form of camera box, the eye camera was spherical.

The walls were made in three thicknesses—the outer to give strength; the middle one black, to prevent reflection and loss of light; and the inner coat, the screen or retina. The reflective media were described as a system of lenses, so arranged with reference to curvature and refractive index as to form the most perfect image on the screen. The diaphragm (the iris) was mentioned as the most perfect in form, capable of adjustment in size, according to the requirements of the individual.

Focalization in the eye was accomplished by a most wonderful condition, that of flexibility in the crystalline lens.

The curvature of the front surface of the biconvex lens could be altered at the will of the individual operator, according as near or far distant objects were to be focused. The screen of the visual apparatus was described at some length.

The Dotcor said that the part upon which the images were formed was practically an expansion of the optic nerve. That as the nerve coming from the brain entered the orbit from behind, it penetrated the two outer coats and then spread out, and by millions of minute interwoven threads formed a sheet or screen upon which the image was formed.

It was curious that, notwithstanding its structure, the nerve was not itself sensitive to light. The Doctor then described the rods and cones by blackboard drawings, and indicated how these minute elements were set in vibration by the light rays, which motion was eventually recognized by the brain as light or color.

Some very interesting facts were then brought out in connection with the physiology of vision. Dr. Miller said that experience only enables us to erect in the mind the inverted pictures of the eye. The remarkably small size of the retinal image was illustrated. The Doctor said that the diameter of the image of an object six feet square when placed forty rods away was only about one-fiftieth the diameter of a human hair. Again, that the picture on the retina of a man half a mile distant, while perfectly distinct, was so small that if the man should move six feet across the line of vision the image on the retina would travel less than one ten-thousandth of an inch; that the entire picture upon the retina was less than half an inch in diameter; and that the angle of the field of view included in a single distinct picture was only about ten degrees.

A NEW METAL INDUSTRY.—*Kuhlow's* say that in Germany gold, platina, and silver strips are welded, after the mosaic style, upon a metal ground, prepared by the incandescent process, then compressed by means of powerful presses, and finally elongated by rolling into long sheets or strips. These sheets, which are now of all colors—yellow, red, green, white, gray, and black—are made into scarfs and neckties, which, being indestructible, are considered of some practical worth. This novelty, it appears, has found great acceptance abroad, numerous orders for export having been received by the manufacturers, who are chiefly in the Pforzheim and Baden districts.

### EIGHT LIGHT DYNAMO.

(*Continued from first page.*)

| | |
|---|---|
| Size of wire on field magnet, No. 18 Am. W. G. | 0.033 in. diam. |
| Number of parallel wires on each leg of field magnet | 4 |
| Number of layers of wire on each leg of field magnet | 8 |
| Number of layers for each wire | 2 |
| Weight of wire on field magnet | 17 pounds. |

The field magnet is made of two like parts of soft, gray cast iron, joined at the center of the yoke, and bound together by two bolts, as shown in Fig. 1. The adjoining surfaces of the yoke are accurately faced, so that when clamped together, the connected halves of the magnet will be practically the same as if made integrally.

The bore of the polar extremities of the magnet is 3⅝ inches in diameter, and the sides of the magnet around the bore are faced in the lathe to form a true support for the bronze yokes supporting the ends of the armature shaft. These yokes are bored to receive the armature shaft, and faced in the lathe upon the surfaces abutting against the sides of the magnet. The yokes are secured in their places on the magnet with their centers coincident with the axis of the bore of the magnet.

The armature shaft is fitted so as to revolve freely on its bearings, and there is a clearance between the periphery of the armature and the magnet of about one-eighth inch.

Upon the portion of the armature shaft lying between the poles of the field magnet is placed the cylinder, of seasoned hard wood of the size above given. Upon this wooden cylinder are placed the thirty-nine iron rings or washers, with intervening paper rings of the same size and about one thirty-second inch thick. The iron rings are drilled at diametrically opposite points to receive the brass rods by which the entire series is held together. The arrangement of the parts of the core of the armature is shown in Fig. 2, in which

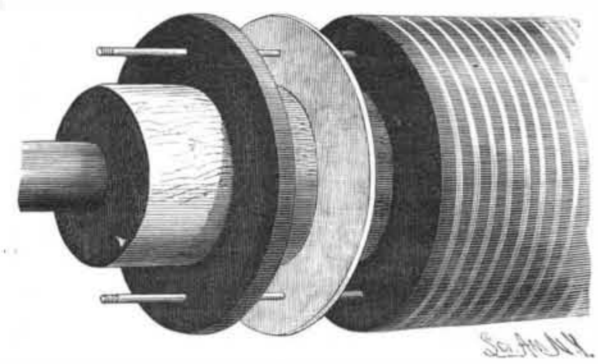

Fig. 2.—PARTS OF ARMATURE CORE.

some of the iron rings have been separated, to more clearly illustrate the construction.

The series of iron rings is secured to the wooden cylinder and the shaft by two pins passing through the rings, the wooden cylinder, and the shaft.

The edges of the end rings are rounded, to prevent them from cutting the insulation of the wires. In two of the rings, at each end of the armature core, are formed twenty-four equidistant radial slots, *b* (Fig. 3), one-eighth inch deep and one-sixteenth inch wide. The armature core thus formed is covered over its entire surface with adhesive tape, such as is commonly used by wire men for covering joints in conductors. The tape is wound spirally on the periphery of the core, and is arranged radially on the end of the core. It is also wound spirally upon the shaft one and three-eighths inches in each direction from the ends of the armature core. Into the radial slots, *b*, are driven small wedges, *a*, of hard rubber, which are allowed to project three-sixteenths inch beyond the periphery of the core.

The winding of the armature is most readily done in a lathe, as shown in Fig. 3. The armature shaft with a dog attached is supported between the centers of the lathe, with dog in engagement with the face plate. A spool of No. 20 wire* is supported in a convenient position at the back of the lathe, and after bending the end of the wire around one of the wedges, leaving about 4 inches projecting beyond the wedge, the winding is begun. The wire is carried by one hand along the surface of the armature core and through the space between two wedges at the opposite end of the core, corresponding with the space in which the coil was started. The other hand grasps the face plate of the lathe, and as the wire is carried across the end of the armature core, the face plate is dexterously turned through a half revolution, bringing the opposite side of the core uppermost. The wire is then laid between the two pairs of wedges diametrically opposite those embracing the wire on the other side of the armature. The wire is carried across the commutator end of the armature core, and the armature is returned to the position of starting by returning the face plate to its first position and the wire is laid alongside of the portion first laid on. The wire is carried lengthwise around the armature in this manner until eight parallel convolutions have been laid on. This layer of wire will extend

* The wire used is the best cotton covered magnet wire.

across the space between two of the wedges. In Fig. 4 the inner layer, B, is represented as being raised from the core, to more clearly show the position of the wire on the armature, and the inner and outer coils are widely separated; but it will of course be understood that these wires are to lie as closely as possible to the core in the working machine. The beginning or inner terminal, E, of the coil, B, is represented in black. In practice, this end of the wire is always coated with colored varnish as soon as the coil is complete, and before the two ends of the coil are twisted together, as they always are temporarily, for convenience in winding, so that there cannot be a mistake as to which are the inner and outer ends of each coil.

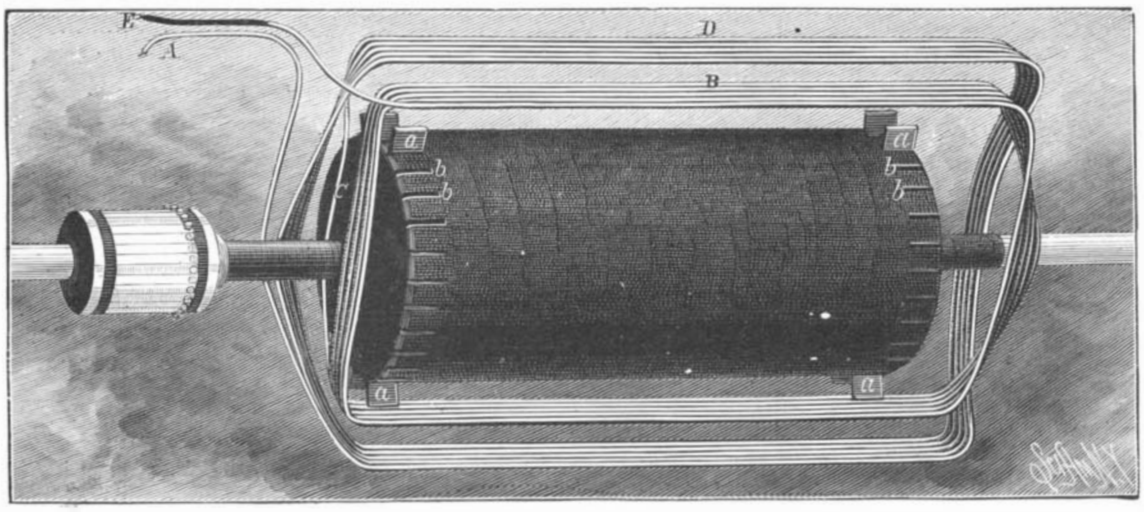


Fig. 4.—THE FIRST COIL ON ARMATURE.

After winding the inner layer of the first coil, the winding is continued, forming the outer layer, D, on top of the inner layer, by winding in the same direction, but returning by the successive coils of the second layer toward the point of starting. When the outer layer is complete, the wire is cut, leaving a projecting end about 4 inches long. The colored or inner end of the wire is now twisted with the outer or uncolored end. In this manner, the first coil is placed in the spaces 1, 1, of the armature. It will be observed by reference to Figs. 4 and 5 that the two halves of each coil are arranged across the end of the armature on opposite sides of the shaft. This secures a compact end and a minimum amount of dead wire.

After placing one coil in spaces 1, 1, in the manner described, spaces 2, 2, are filled in the same way, then 3, 3, and so on, until twelve coils are wound upon the core. These coils half fill all of the pairs of spaces 1, 1, 2, 2, 3, 3, etc., to 12, 12, with terminals, A, E, projecting from each space around one-half of the periphery of the commutator end of the armature, the end of the armature presenting an appearance which would be indicated by Fig. 5, if the coils, G F, were omitted. When the armature is half filled, the winding is continued in exactly the same manner and in the same direction as before, forming a coil of two layers, F, G, in spaces 1, 1, on top of the first coil, B, D, leaving projecting terminals, as in the case of the first series of coils. Then a similar coil is formed on top of the coil in spaces 2, 2, and so on, until each pair of spaces contains two coils, one superposed on the other, every coil being formed of two layers of wire, with eight strands in each layer.

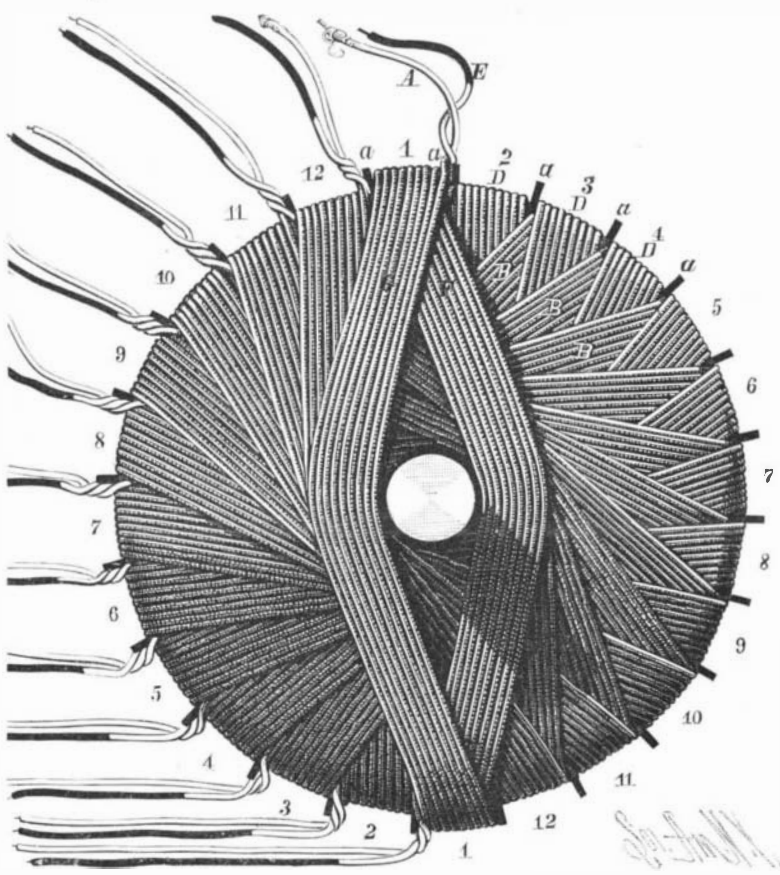

Fig. 5.—STARTING THE OUTER SERIES OF COILS.

It is advisable, before winding the outer series of coils, to bind the inner series close to the core by a winding of stout linen thread at three equidistant points in the length of the armature. As a guard against the possibility of short circuiting, the terminals of each coil, where they are in contact with each other or with other portions of the wire, should be provided with an extra wrapping of cotton. The armature thus constructed is known as the Siemens or Hefner-Alteneck armature.

There is another method of constructing the core of the armature which yields good results, but is, in some respects, inferior to the one described. The armature shaft carries a spool of wood or other non-magnetic material, upon which is wound varnished soft iron wire—the wire being used instead of the iron rings. The commutator cylinder, the method of connecting the terminals of the armature coils with the bars of the commutator cylinder, the brushes, the field magnet winding, the connections, and other features will be illustrated and described in the next issue of this journal.

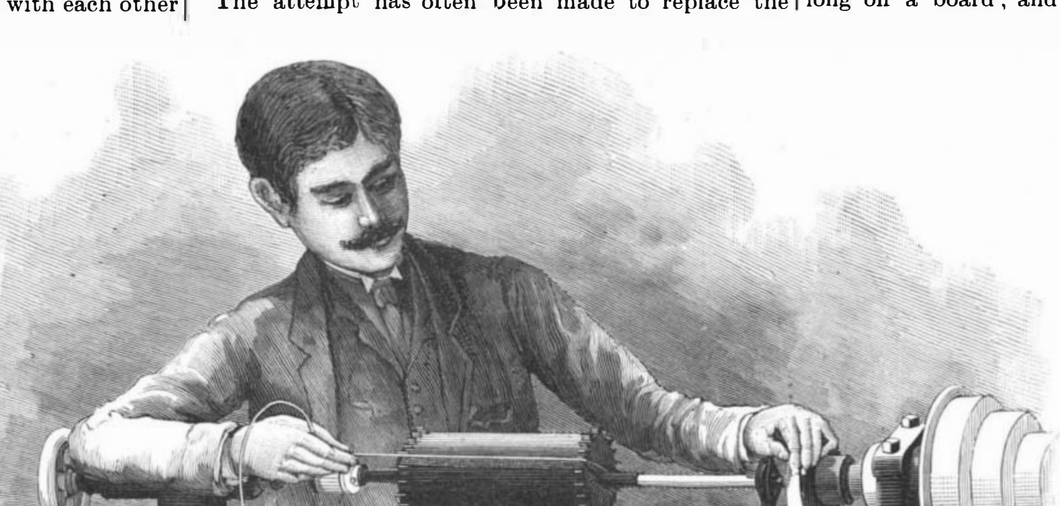

Fig. 3.—METHOD OF WINDING.

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Twenty-four per cent of Norway is forest.

### Wire Drawing without Pickling.

It is well known that in the manufacture of iron wire, the layer of oxide formed on the surface of the red-hot metal has to be removed by passing it through a bath of dilute sulphuric acid, an operation necessary for each reheating. The consumption of acid amounts to about 25 or 30 kilogrammes (55 to 66 lb.) per ton (2,204 lb.) of wire produced; the bath contains 1 per cent or 1·2 per cent of acid, and the rest is water. The objection to this process not only is the expense due to the use of acid, but the time required for the pickling, which requires two or three hours, and the annoyance of dealing with and disposing of the acid liquors.

The attempt has often been made to replace the pickling in acid by other processes. The oldest is one proposed by Betz in 1877, which consisted in subjecting the iron wire to successive bendings in all directions to break the scale of oxide. This was effected by passing the wire through a series of grooved rollers placed at varying angles with each other. In Von Becke's process the wire was subjected to friction, an effectual operation, but injurious to the product. An American machine, invented by Adt, subjects the wire to torsion by imparting a helicoidal motion to grooved rollers through which it passes. This apparatus gives good results. It does not quite do away with acid, but saves nine-tenths of it. The Altpeter and Bansen processes act upon the section of the wire, transforming it from round to oval, by cylinders arranged like those of universal plate rolls. The change of section does no harm if a final drawing is yet to take place, but this process leaves attached a great part of the oxide.

Wedding has recently proposed a plan, also mechanical, but based on another order of ideas. He stretches the wire while still hot to its limit of elasticity, giving it a tension of 62 to 64 kilogrammes per square millimeter (85,000 to 88,000 lb. per sq. in.). The thickest layer of oxide falls off, and the thinnest ceases to be adherent, so that a slight treatment by the Adt or Betz machine removes all scale completely, especially if water is used—preferably hot—so as not to harden the surface of the metal. The reheating is done in a lead bath. On this subject the *Bulletin de la Société des Ingenieurs Civils* remarks that the use of a lead bath would be inadmissable where the wire was to be galvanized, because the traces of lead which might remain adhering to it would ultimately interfere with the adherence of the zinc.—*Revue Industrielle.*

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### Ruskin Vanquished by a Mason's Trowel.

Mr. Ruskin, in the latest volume of his autobiography, says the *American Architect*, relates his experience at manual labor: "When I had to direct road making at Oxford, I sate myself, with an iron masked stone breaker, on his heap, to break stones beside the London road, just under Iffley Hill, till I knew how to advise my too impetuous pupils to effect their purposes in that matter. I learned from an Irish street crossing sweeper what he could teach me of sweeping; but found myself in that nearly his match, from my boy gardening; and again and again I swept bits of St. Giles' foot pavements, showing my corps of subordinates how to finish into depths of gutter. I worked with a carpenter until I could take an even shaving six feet long off a board; and painted enough with properly and delightfully soppy green paint to feel the master's superiority in the use of a blunt brush. But among all these and other such studentships the reader will be surprised, I think, to hear, seriously, that the instrument I finally decided to be the most difficult of management was the trowel. For accumulated months of my boy's life I watched bricklaying and paving; but when I took the trowel into my own hand, abandoned at once all hope of attaining the least real skill with it, unless I gave up all thoughts of any future literary or political career."

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### The Ice Palace at St. Paul.

A correspondent says the ice palace is still 60 feet high, and presents the appearance of a picturesque ruin. It is slowly melting, and occasionally an ice block comes tumbling down.