EDISON DYNAMO AND MOTOR.*

The steel armature shaft is 16½ inches long and ½ inch in diameter at the journals, and $\frac{11}{16}$ inch in diameter between the journals. The larger part of the shaft is 9½ inches long. Sufficient end chase is allowed in the armature journals to cause the surfaces to wear smoothly.

On the central portion of the armature shaft is placed a wooden sleeve, $1\frac{1}{16}$ inch in diameter; on this are mounted the thin sheet iron disks forming the armature core. These disks are 2⅛ inches in diameter. They are arranged in series of five, with tissue paper between the disks, and between the series of five are placed several thicknesses of paper. Enough disks are clamped together on the shaft to make this portion of the core 3½ inches long. The cast iron disks between which the sheet iron disks are placed are ¼ inch in thickness and 2⅛ inches in diameter. One of them is fixed on the shaft, the other being held in place by a hexagonal nut screwed on the shaft. The cast iron disks have their outer corners rounded, and in the edge of each are formed thirty-two equidistant radial slits $\frac{1}{32}$ inch wide. In these slits are inserted slips of vulcanized fiber for separating the different pairs of coils during the operation of winding.

It is impossible to describe the Edison winding without depending mainly on the diagrams, Figs. 1 and 2. There are two series of coils; that is to say, there are two coils in each division of the arma ture. There are thirty-two bars in the commutator, which are numbered consecutively from 1 to 32.

The armature core and shaft are thoroughly insulated by means of paper coated with an adhesive varnish. Jute string ribbon is wound on the face of the core as a further protection.

The wire used on the armature is No. 21 copper wire, double covered; the inner covering being of silk, the outer of cotton.

Leaving an end out for connection with the commutator coil, No. 1 is begun at 1 and wound in four layers, with six convolutions in each layer, the outer terminal coming out at 1'. These ends are marked respectively 1 and 1' in such a manner as to avoid any possibility of the detachment of the marks. If this caution is observed, much trouble may be avoided. A good way to mark them is to place a tag of parchment, or parchment paper, on each end of the wire, with the number marked on.

After winding coil No. 1 the armature is turned half way over and coil No. 2 is wound and marked in the same way, with 2 on the inner end of the coil and 2' on the outer end. The coil is then reversed and coil No. 3 is wound and its ends are marked in the same way, and so on until the first series of coils is finished, the last coil of the series being marked 16 and 16'.

The first coil of the outer series is No. 17-17'. This wound on the top of coil No. 1. The armature is turned over and No. 18 is wound on the top of No. 2, and so on until all of the outer coils are in place.

Before winding, the inner end of each wire is wrapped

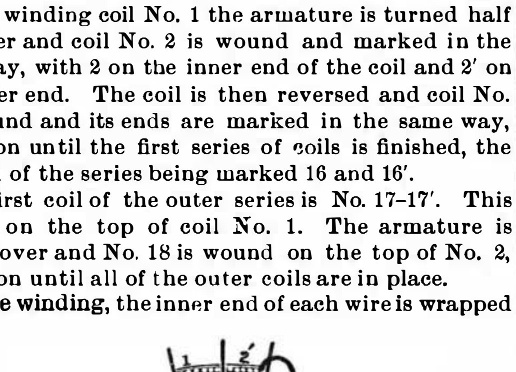


Fig. 2.—THE FIRST TWO COILS AND COMMUTATOR CONNECTIONS.

in jute string ribbon to a point within the end of the armature core, and it is further protected by a wrapping of thin adhesive tape. The outer end of the coil is covered in the same way.

About three pounds of No. 21 wire are required for the armature. The length of wire in the first inner coil is 26 feet 6 inches. The length of wire in the last outer coil is 35 feet.

The commutator cylinder† is formed of 32 bronze bars having beveled ends and radial arms for receiving the wires. These bars are clamped in position on a sleeve having an under-cut flange, by a countersunk washer and a nut screwed on the sleeve. Mica is inserted between the commutator bars, between the bars and the sleeve, and between the ends of the bars and the flange and the washer. The radial arms extending from the commutator bars each have a slot in the end for receiving the terminals of the coils.

The coil terminals are arranged in groups of 16, the wires of each group being parallel. The terminals are carried around and attached to commutator bars which are about 45° from the planes of the coils to which they belong, thus making the winding more symmetrical and at the same time permitting of a better arrangement of the brushes.

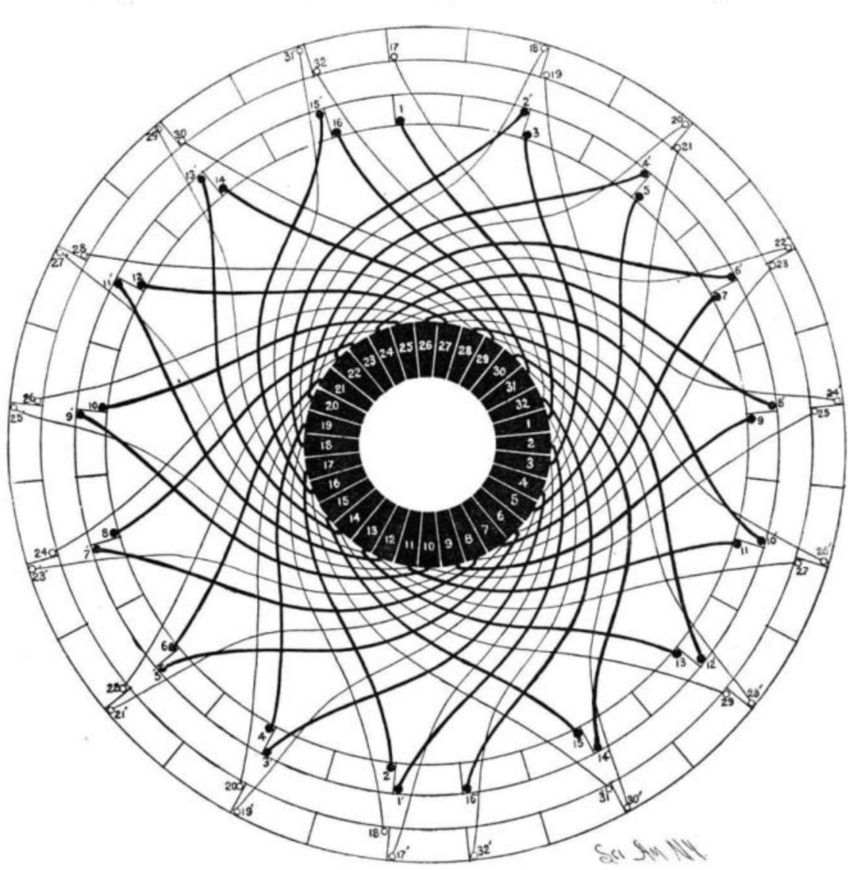


Fig. 1.—DIAGRAM OF WINDING OF EDISON ARMATURE.

The coil terminals are inserted in the slots of the arms of the commutator bars and soldered with soft solder, the connections being made in accordance with the diagram, Fig. 1.

The wires, where they cross at the back and front end of the armature, are separated by sheets of mica. Where the winding crosses at the rear end of the armature the wires are spread out so that they are only one layer deep.

When the winding of a coil is finished, the terminal is fastened by stout threads inserted in the coil before winding the last three convolutions, and tied after the coil is complete.

A vulcanized fiber collar, a little larger in diameter than the commutator, is slipped over the commutator bars and placed against the radial arms of the bars as shown. The edge of the collar is grooved and a canvas cover is fastened to the collar by tying it in the groove. It is then drawn over the terminals and fastened by the first ring of binding wire on the armature. At the opposite end of the armature a similar collar and cover is provided.

Before covering the terminals with the canvas they are wound with twine, to give the end of the armature a symmetrical shape. The winding is varnished with shellac before its cover is applied, and the cover is varnished after it is secured in place.

The binding rings are formed of brass wire, wound tightly over a layer of mica interposed between the wire and the binding. The binding wire is secured by clips and soft soldering.

The brush yoke is provided with wooden handle by which it may be moved and a binding screw by which it is clamped in the position of use. In mortises in the ends of the yoke are placed insulating blocks, in which are inserted the brush-holding studs. These studs are each provided with a nut for clamping the brush holder cables which communicate with the leads at the side of the pole pieces.

On each brush-holding stud is placed a sleeve fastened with a set screw, also a loose sleeve connected with the fast sleeve by a spiral spring concealed within it. The loose sleeve is furnished with a brush clamp for holding the brush, which bears on the commutator cylinder with a yielding pressure. The brushes are formed of spring copper wires fastened together at their outer ends with soft solder.

A jig goes with each machine for clamping the brush and guiding the file while renewing the brush ends.

The speed of the motor on a 125 volt circuit is 2,400 revolutions per minute. The speed at which the armature is to be driven in order to generate a current having an E. M. F. of 125 volts is 2,730 revolutions per minute.

Since the first part of this article appeared in our issue of July 25, we have received a letter from the Edison General Electric Company, stating that the machine here described, according to the new rating, which went into effect June 15, is a 0·5 kilowatt machine, which, when used as a generator for supplying lights, will generate sufficient current to bring to full candle power nine 16 C. P. 112 volt lamps, and when used for power it is a ½ H. P. motor at a rated volt. It is guaranteed to give 0·47 H. P. at ⅞ of its rated volts.

We are also reminded by this letter of the fact we neglected to state in our former article, which is that this form of machine is a type which was brought out in 1885, and is known as the Standard dison machine, which is made in several sizes. Each size is identical, in its general construction, with the machine described, and any of the machines can be used either as a dynamo or motor.

* Continued from page 54.

† For further points on commutators see SUPPLEMENT, 690.

Protection against Lightning.

Prof. Henry A. Rowland, of the Johns Hopkins University, is reported as follows in the Baltimore *Sun*, in an interview on the subject of protecting buildings against lightning.

"Recent scientific study has swept away some of the old notions about conductors. The method now considered the best for the protection of buildings is to provide a metal roof, with an ample number of metal conductors leading to the ground, which will receive and carry off the electric bolts from the clouds. Copper is the best material, but tin or iron will answer the purpose, and I always suggest the placing of the conductors at the corners of a building, so that all parts will be equally protected.

"Though rods may be used, rain spouts will answer the purpose equally well. The physical laboratory of the Johns Hopkins University is protected from lightning by the roof and spouting. You can safely class all patented lightning rods as being of little value beyond conducting rods that any man can put up himself, because the simple principle underlying all is that the lightning will follow the best conductor. The idea so largely adopted in the erection of lightning rods, that a small band of glass will prevent the electric current from passing to a better adjacent conductor, seems playful. While it is true that lightning is attracted to an elevated point or angle, when you cast your eyes over a city like Baltimore and see the large number of such points and angles, the use of pointed rods fades into insignificance as compared with the method of roofing with a good conductor. This was well illustrated by the incident of lightning striking the great monument in Washington several years ago.

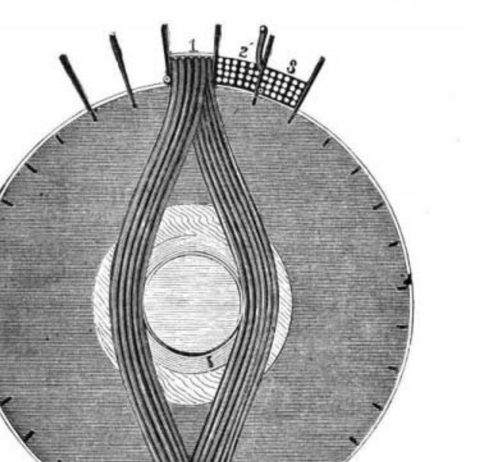


Fig. 3.—ARRANGEMENT OF THE LAYERS AT END OF ARMATURE CORE.

The monument is capped with a piece of aluminum, which has metallic connection with the ground by means of the ironwork of the interior, but the lightning did not strike the top of the cap. It descended to some copper fixed in the side of the pyramidal top, some distance from the apex, burst a portion of the stone, and, running along the copper into the interior, leaped without any metallic connection to the iron framework and passed to the ground. A framework of copper rods covering the angles and crossing the sides of the immense cap was recommended by me at that time for the future protection of the monument, and has probably been constructed. The ground connection was to be through the internal ironwork spoken of. Somewhat similar to these methods is that of the Peabody library. The iron shelving connected with the metallic roof, and resting on a stone foundation which might be shattered by a stroke of lightning, has been connected with the ground by metal conductors, and no danger from lightning is apprehended.

"Lightning has no fixed portion of a building to strike. The stroke may fall at the center of a roof, and while it runs along the surface of a body, the body may be broken or crushed by the enormous pressure brought to bear upon it, in the same manner that an explosion of dynamite or nitro-glycerine would cause a fracture. I have some fragments of a church spire struck by lightning which are bound together in their former relative positions, but exhibiting all the fractures produced by the concussion. There is a vast difference between the quantity of electricity and what is known as electrical pressure. This is illustrated in a simple manner by the compression of air. A small quantity of air can be compressed to the same degree to obtain as great an expansive force as a large quantity. The quantity of electricity in a stroke of lightning is not nearly as much as passes along almost any electric wire on the street, but the voltage or electrical pressure of the street wire is rarely 3,000. A volt is the basis on which the pressure is estimated. The voltage of the lightning stroke is roughly estimated at 6,000,000,000 volts. In addition to this appalling difference it may be said that the current of the wire is constant and continuing, while the lightning dart is delivered in the one two-hundredth part of a second. Such an astounding force is capable of doing many strange things."

In speaking of places of safety during an electrical storm, Dr. Rowland said that probably as safe a place as any other would be an iron bedstead, provided the

Fig. 6.—THE BRUSH YOKE.

ground connection is perfect, this being in line with the above theory, that the lightning would follow the best conductor.

The Prince Edward Island Tunnel.

The greatest public work the Canadian government has now in contemplation is the construction of a railroad tunnel under the Straits of Northumberland, connecting the shores of New Brunswick with those of Prince Edward Island. At the request of the Dominion government Sir Douglas Fox has made a report on the cost and feasibility of the work, of which the following is a brief summary:

The greatest depth of water is 96 ft. at high water, with a rise of tides of 6 ft. at springs and 3 ft. at neaps, and the speed of the current does not exceed three knots, with two hours of slack water at each tide. The distance from shore to shore is given at about 13,200 yds., or say from shaft to shaft 13,500 yds., exclusive of land approaches on either side, of which about 2,000 yds. would be in the tunnel. The shores on either coast are well adapted for railroad approaches, varying from 15 to 35 ft. in height above high watermark, with a mean altitude of 25 ft., the soil being largely red clay. The higher land on the Prince Edward Island shore falls away toward the interior, which will shorten the approach on that side. It is considered that about 5½ miles of railroad, including some 2,000 yards of tunnel, as before mentioned, will be necessary beyond the shafts to connect the tunnel with the respective systems of railroad, which, however, are of a different gauge, viz., 4 ft. 8½ in. in New Brunswick and the Dominion generally and 3 ft. 6 in. in Prince Edward Island.

From the above it will be seen that the length of tunnel from shaft to shaft would be 7·67 miles, while, with the connections to the present railroad on each side, the whole tunneling required would be over 9 miles.

The estimates are as follows:

In the dry portions of the work, a tunnel of brickwork, in cement, averaging 1 ft. 6 in. in thickness (the

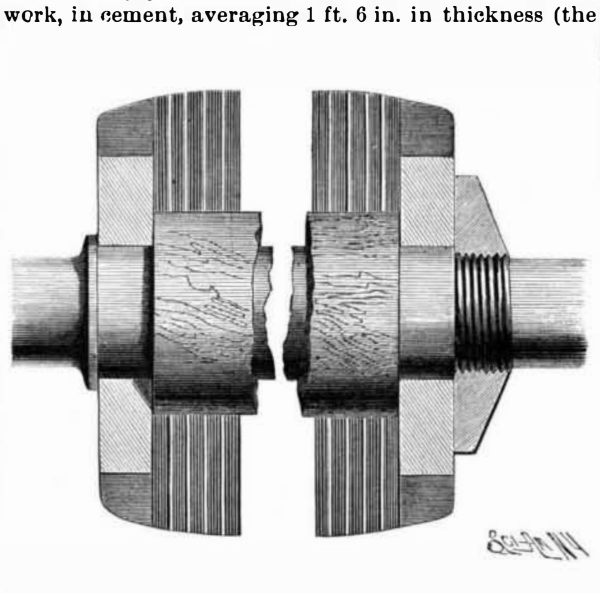


Fig. 4.—THE ENDS OF THE ARMATURE CORE.

bricks being of local manufacture), and where feeders occur, with cast iron casing 1¼ in. in thickness, with 6 in. flanges, laid with steel rails weighing 50 lb. to the yard, is estimated to cost £66 10s., nearly, per lineal yard, or say £897,500 from shaft to shaft, or with the land tunnel and contingencies a total sum of £1,075,200.

Should it be decided that the tunnel must be of sufficient dimensions for a railroad of the 4-8½ gauge, and that the railroads of the island shall be altered to that gauge, a tunnel of 16 ft. in diameter would appear to just accommodate passenger and freight cars of the normal Canadian and American type, but not drawing room and sleeping cars, nor some of the cars running upon the Intercolonial railroad. This size does not allow of a very satisfactory permanent way, nor does it provide proper space for the platelayers. Such a tunnel constructed in the shale, of brickwork in cement, 1 ft. 10½ in. in thickness, and where feeders occur with cast iron casing, 15 in. in thickness, with 9 in. flanges, and laid with steel rails weighing 70 lb. to the lineal yard, is estimated to cost £122 10s., nearly, per lineal yard, or say £1,652,500 from shaft to shaft, or with the land tunnel and contingencies a total sum of £1,971,800.

Sir Douglas Fox is of opinion that to properly accommodate the Canadian and American rolling stock the tunnel should have an internal diameter of not less than 18 ft. Such a tunnel, constructed as specified for the 16 ft. tunnel, is estimated to cost £140 per lineal yard, or say £1,890,000 from shaft to shaft, or with land tunnel and contingencies a total sum of £2,225,500.

It is recommended that, before inviting tenders for the main work, a shaft placed at Carleton Point, so as to be afterward available for permanent pumping and ventilating purposes, should be sunk well into the red clay shale, which lies above the carboniferous sandstone. Borings similar to those taken at the Sarnia tunnel (viz., from a vessel or platform through 16 in. wrought iron pipes, so as to insure cores of sufficient size and undamaged being brought to the surface) should be made across the straits and down to the carboniferous bedrock. With this information obtained, much closer tenders may be expected for the construction of the tunnel.

When the work is resolved upon, immediate steps should be taken: 1st. To connect the existing railroads with the tunnel work.

2d. To establish brickyards at the nearest available site where good clay free from lime is to be found. The quantity of bricks required will vary from 30 to 60 millions, according to the size of the tunnel.

3d. To erect dwellings, stores, etc., for the staff and workmen.

4th. To put down the permanent pumps and provide the necessary plant for temporary purposes.

5th. To install the necessary electric plants and motors.

6th. To provide and fix the compressed air machinery.—*Railroad Gazette.*

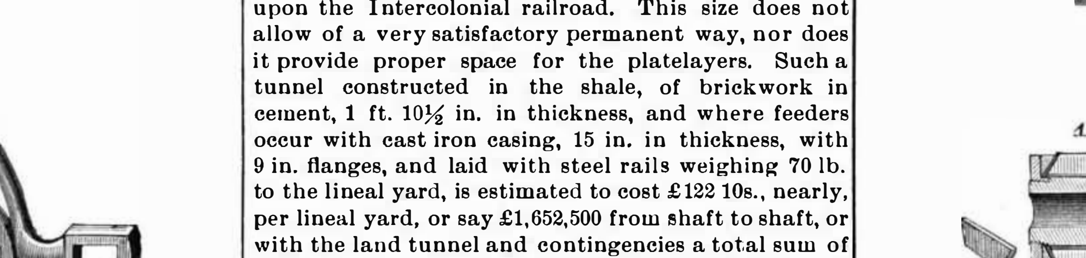


Fig. 5.—THE ARMATURE WITH PARTS BROKEN AWAY.

Canaigre, a New Tanning Material.

Canaigre, a tanning material which has recently been introduced, forms the subject of an article by Von W. Eitner, in *Der Gerber*. It appears that this product is the root stock of a polygonaceous plant which grows extensively on the shores of the Rio Grande, and covers large plains in Texas and New Mexico. The stem and branches of the shrub are annual, but the root is perennial, and in the second and third years attains a thickness of 1½ inches; at this stage of its growth it is richest in tanning material (28 per cent), while in the fourth year it begins to deteriorate. The fresh roots contain some 57 per cent of water and have to be dried before they are exported, so that they appear in the European markets either split up into slices or as thin whole roots, of which the tegument is brown and more or less furrowed. The external layers of the flesh of the root are red-brown in color, while the interior are bright yellow. Besides tannin, a considerable quantity of starch and some other extractive matters are contained in the roots, which can be easily powdered and rapidly exhausted.

According to the author's experiments, canaigre appears to be a valuable tanning agent; it is said to tan as quickly as japonica, at the same time imparting a fine, pure orange color to the goods, not to be imitated by any other tan stuff. The resulting leather is plump, but not unduly swelled; the grain remains soft and at the same time tough. This tanning agent is said to be especially valuable for upper leather, also for saddlery and fancy leathers, making, in fact, a leather well adapted for stuffing and finishing; as a substitute for sumac, and for mixing with bark (on account of its

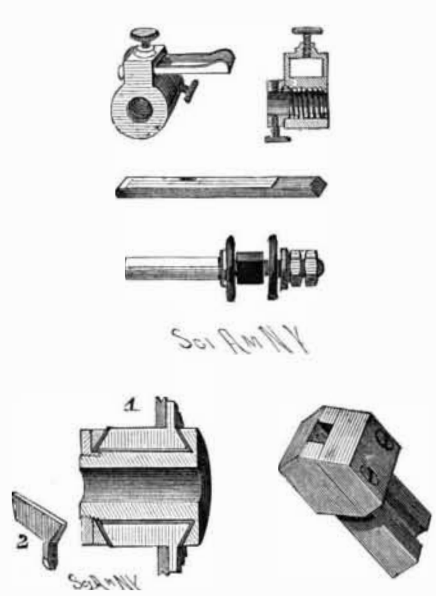


Fig. 7.—DETAILS OF THE BRUSH HOLDERS, THE COMMUTATOR CYLINDER, AND BRUSH HOLDING JIG.

color), it is again very useful. It is best adapted for use when coarsely ground.

The present price of canaigre is £18 per ton, in Vienna; this will not be prohibitive if the claims of the author as to its capabilities be substantiated. For it contains some 22 per cent of easily extracted tanning stuff, and one ton of canaigre will play the part of four tons of oak bark and four and a half tons of pine bark in tanning upper leather.

The cultivation of canaigre is very similar to that of the potato. The harvest can be taken every two or three years, and the plant thrives in sandy soils, which are practically useless for other purposes.

Trade Schools Useful.

The editor of the *Builder and Wood Worker* believes in trade schools. It gives a young man, in a few months, he says, instruction that it would take him the same number of years to "pick up" haphazard in a shop, and accompanies this instruction with a technical and scientific teaching of the whys and wherefores of his work that the shop seldom or never furnishes. At the same time, it enables him to reach the stage at which he attains a value as a mechanic that much earlier than if he went into a shop as a boy. He can commence with the trade schools in his seventeenth or eighteenth year, and would be just as far as the shop boy o... ompleting his trade school course, with the incalculable advantage, if he has wisely used his time, of possessing the foundation for an education that will ever help him.

To make tin foil labels adhere to tin collapsible tubes, use a mixture of the best fish glue and gum arabic dissolved in water. A little glycerin may be added to advantage.

Ruins of the Panama Canal.

A correspondent of *Engineering News* reports as follows:

The bulk of our observations were made from the rear platform of a rapidly moving train; but the facts were had from Mr. Lefevre, the general agent of the Pacific Mail Steamship Company, a man who has spent years upon the Isthmus and was familiar with every foot of the way.

The first signs of the artistic work and extravagance of the French canal builders were met with in coming into Panama Bay, past the famous Sanitarium of Toboga. There a city of hospitals has been built, with bright red-tiled roofs and massive retaining walls peeping out of park-like grounds threaded with walks and drives for the director-general and his subordinates. A costly roadway connects this sanitarium with Panama. As the latter city is approached, another hospital, or a mass of hospital buildings, looms in sight, situated on the high ground back of the town, and built and adorned even more elaborately than those at Toboga. By an oversight of the engineers they were planned and constructed before any arrangement had been made for carrying the sewage through the city of Panama, which lies between the hospitals and the bay. When this time came, the citizens, who seem to believe in keeping their own sewage within the city limits, grew virtuously indignant at the proposition of the hospital authorities to carry the sewage through the town; and they had goodly reason. The tide at Panama is over 20 feet, and when this goes out it leaves exposed broad flats of mud that now cry out to the high heavens in their foulness.

Almost immediately upon leaving the city on the Panama Railroad you come in sight of the canal works. The towers of Belgian and French dredges appear above the trees in now detached and partly filled-up channels that were once sections of the sea level canal. A little further east, and you come to an almost continuous line of villages for laborers that were never occupied, storehouses, sidings filled literally with miles of dump cars, locomotives, and other machinery, past stacks of Decauville railway track and the small iron dump cars to fit them, and the endless variety of material that went to make up the plant of the most extravagantly equipped public work the world ever saw. Near Tavernilla we saw a line of steam cranes, almost buried in the jungle, that we have undoubted authority for saying have occupied this same siding for years; they were never used. On another siding we saw about 60 clumsy locomotive boiler steam drilling machines, with the drill frames rigidly attached alongside the boiler. These too had been there for years, and had never been fired up, for the proper reason that they were utterly worthless for work on the Panama Canal.

All of the machinery in sight was well cared for, and outwardly looked well enough with black paint and white-leaded bright work. They had been put in this condition just previous to the visit of the last French commission, and it is said that $20,000 per month is now being spent in keeping them in a presentable shape. Yet a mechanical engineer, who examined some of this machinery with a view of possible purchase, informed us that when he attempted to open the doors to look into a boiler, these fell off, a thin shell of rust covered with paint. Inside, the boiler was so scaled with rust that he thought that a good blow with the fist would have punched a hole through the plates almost anywhere. When Mr. Lefevre was asked why this plant was not gathered up and shipped out of this moist, iron-destroying climate, the reply was that we evidently knew little of Panama Railway freight rates. The transportation charges would have eaten up all the profits, even if the machinery were bought at old-iron prices.

The buildings along the line of the canal number thousands, though comparatively few seem to have been occupied. These houses are constructed of wood, with corrugated iron roofs; but cheap as some of them looked otherwise, they were generally propped up on pillars of stone masonry laid in cement mortar, that cost more money at times than the building they supported.

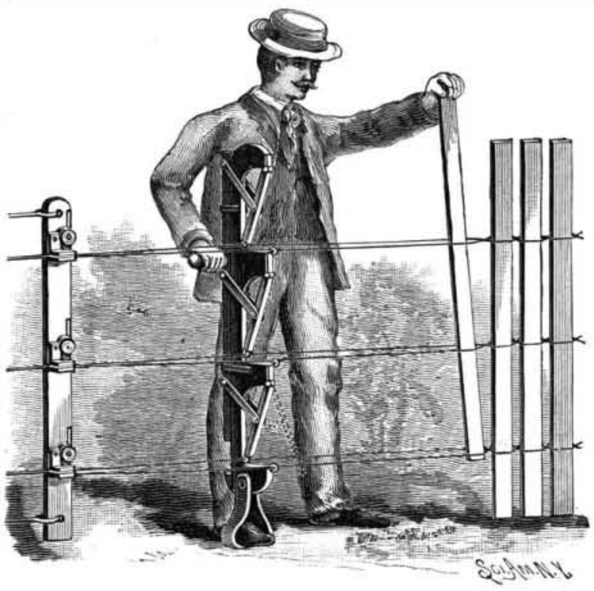
On the line of the canal a large amount of work has undoubtedly been done, and some of the cuts are deep and wide and the spoil banks are high. But it is just as evident that an immense amount of work yet remains to be done before even a lock canal can be built.

Parts of the canal once excavated at great cost are almost completely filled up again, and in other places the banks have washed in and the channel is obstructed. Nearer Colon, channels that once admitted vessels of 14 feet draught 14 or 15 miles inland are so blocked up in places that a canoe alone could navigate them. On the eastern or swampy side th appears to be a quagmire of unknown depth, and it is little wonder that the deposit from the conveyer pipes of the dredges forced up the soil in the line of the canal being excavated.

FOR a good recipe that will stick muslin to bunting, boil together 2 parts shellac, 1 part borax, and 16 parts of water. The surface must not be greasy.

A LIGHT AND SIMPLE FENCE MACHINE.

An easily operated device, patented by Mr. E. S. Lafferty, by which fence wires are quickly crossed after the insertion of each picket, the wires being, at the same time, held under proper tension, is represented in the accompanying illustration. A movable post has at its lower end a stirrup, for convenience in holding the post in proper position, and at the outer edges of lugs or projections, one above another, at one side of the post, are eyes, through each of which passes one of each set of wires for holding the pickets in position, the other wire of each set passing through corresponding eyes on levers fulcrumed to the lugs. The levers are adapted to swing transversely across the fixed eyes



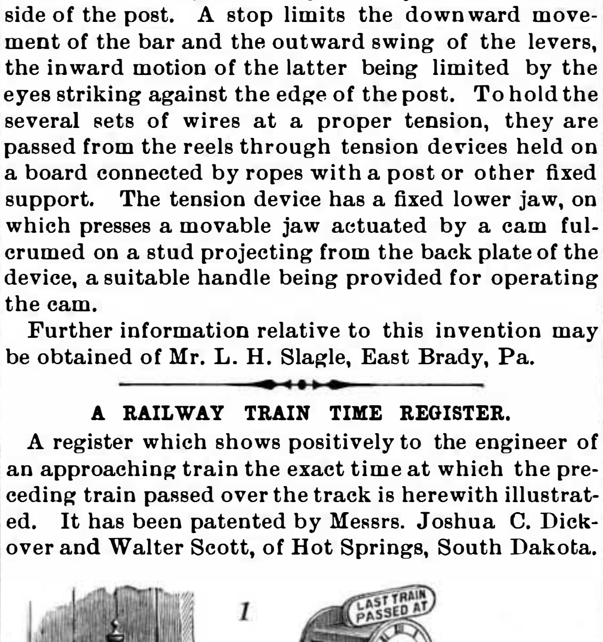
LAFFERTY'S MACHINE TO WIRE FENCE PICKETS.

on the lugs of the post, the wires carried by the levers being thus moved alternately from one side to the opposite side of the other wires. Each of the levers is pivotally connected by a link with a bar having a handle and sliding vertically in keepers on the front side of the post. A stop limits the downward movement of the bar and the outward swing of the levers, the inward motion of the latter being limited by the eyes striking against the edge of the post. To hold the several sets of wires at a proper tension, they are passed from the reels through tension devices held on a board connected by ropes with a post or other fixed support. The tension device has a fixed lower jaw, on which presses a movable jaw actuated by a cam fulcrumed on a stud projecting from the back plate of the device, a suitable handle being provided for operating the cam.

Further information relative to this invention may be obtained of Mr. L. H. Slagle, East Brady, Pa.

A RAILWAY TRAIN TIME REGISTER.

A register which shows positively to the engineer of an approaching train the exact time at which the preceding train passed over the track is herewith illustrated. It has been patented by Messrs. Joshua C. Dickover and Walter Scott, of Hot Springs, South Dakota.



DICKOVER & SCOTT'S RAILWAY TIME SIGNAL.

The minute hand arbor of the clock within the station projects through the back of the clock case, and to it is attached one end of a spindle which carries at its opposite end a pinion engaging a spur wheel of a mechanism for connecting the time movement with a spring-actuated dial mechanism at the side of the track. This mechanism is in a double frame exposing opposite clock dials, and minute hand arbors in the frame impart motion to the hour hands through dial wheels in the usual way. These arbors have crown pinions engaged by a spur wheel on an arbor of the connecting mechanism, and one of the crown pinions is engaged by a spur wheel on a mainspring arbor to which is attached one end of a clock spring, the other end being attached to the frame. A stud projects from the spur wheel of the connecting mechanism, shown in Fig. 2, and upon its arbor is an angled arm to which is pivoted a right-angled lever, a sleeve mounted on the arbor being in the path of the longer arm of the lever. Beneath this mechanism, on the base of the instrument, is mounted an electro-magnet, the armature lever of which is divided into two arms, one of which engages the sleeve on the arbor while the other engages a toothed wheel of the dial mechanism, a retractile spring attached to the armature lever and to the frame normally holding the lever away from the magnet. Under one of the track rails is placed a bow spring carrying a contact point electrically connected through a battery cell with one terminal of the magnet, and below the movable contact point of the spring is a stationary contact point electrically connected with the other terminal of the magnet. On the passing of a train the spring beneath the track rail is depressed, bringing the contact points together and closing the circuit with the magnet, when the latter attracts the two-armed armature lever, whereby the sleeve is moved on the arbor of the connecting mechanism and a toothed wheel of the spring-actuated dial mechanism is released, whereby the hands on the dials are carried forward to indicate the time shown by the clock at the moment the contact points touch. When the train has passed the circuit is broken, the retractile spring then withdrawing the armature lever, and the indicating mechanism remains quiet, but the spur wheel of the connecting mechanism is constantly carried forward by the clock, the stud on this wheel limiting the movement of the indicating mechanism when the latter is again started by the passing of a following train.

The Chemistry of the Ocean.

The study of the 685 densities of the water of the sea made during the expedition of the Challenger, and the report of 108 series, of which each extended from the bottom of the ocean to the surface, the discussion of the results of the deep soundings obtained by Pola in 1890, the various theories relative to the chalk formations by chemical action, with the necessary intervention of living creatures, and, finally, the different observations of oceanic analysis with which M. J. Thoulet has been occupied for several years past, relative to the existence at the bottom of the ocean of two belts of water, one in repose, and the other in motion, are all in accordance with the following hypothesis:

The surface of the ocean, submitted to climacteric changes, is in a state of heating and evaporation more or less intense. The variations which result in the real density and in the chemical composition of the waters, joined to the mechanical action exercised by the wind, give in the place of horizontal marine currents those more or less vertical, which cross between these where they overlie each other, with extreme quickness and in different directions. These together constitute oceanic circulation, which is effected almost entirely in a very shallow belt, about 500 fathoms in depth. The substances, only slightly soluble, contained in the waters of the seas, and brought to the ocean by the fresh waters which are far more dissolvent, attain at a certain depth their limit of solubility and form precipitates. Becoming solid, they descend vertically, penetrate into the still belt, and at last reach the soil at the bottom. Surrounded by immovable water, they dissolve and increase the proportion of salt contained in the deepest stratum of the water, and that immediately in contact with the soil. They then spread, and with extreme slowness, increase the saline quality of the adjacent waters, and at the same time extend to the stratum next to the soil which is not saturated, and consequently continues to dissolve the new material which arrives without cessation. The submarine soil is then a kind of center of chemical activity, fed by fresh material from the surface, and radiating slowly toward the surface.—*Public Opinion, Revue Scientifique.*

American Exhibitors at the International Electrical Exhibition at Frankfort-on-the-Main, Germany.

The United States are represented at the Frankfort Electrical Exhibition by a number of leading firms. The Thomson-Houston Company, Lynn, Mass., exhibits its dynamos, electromotors, and mining machines. The Edison Company, on account of having transferred its patents to the Berliner Allgemeine Elektrizitats Company, is not directly represented, but through the last mentioned firm. The phonograph is shown by the Edsion United Phonograph Company, of New York. The Westinghouse Company exhibits its well known steam engines, and another type of American engines is shown by the one belonging to the Thomson-Houston Company, and manufactured by McIntosh, Seymour & Co., Auburn, N. Y. Instruments are represented by the Weston Electrical Company, New York, and electrical elevators by the American Otis Elevator Company, New York.