THE

CANADIAN MAGAZINE

OF

SCIENCE AND THE INDUSTRIAL ARTS.

Patent Office Record.

Vol. XIX. JULY, 1891. No. 7.

ONTARIO'S NEW MINING LAWS.

The mining laws of the Province of Ontario were amended in some important particulars during the Session which ended on the 5th instant. Three measures were introduced at an early period of the Session, one of which provided for the staking out of mining claims, another for the reserving of minerals in all future sales of public or agricultural lands, and a third for amending in some particulars the general Mining Act.

The first of these Bills appears to have been carefully framed, and had it become law, we are disposed to think that it would have been gladly accepted by the class whose interests it was intended to serve, viz.: the mining prospectors. In some respects, perhaps, it should have gone more largely into detail, and we think also that the working conditions were out of proportion to those required of persons who might acquire locations in another way. But these are matters which could have been worked out in committee, and was it not for the general anxiety of the Legislature to bring its labors to a close, owing to the lateness of the Session, the Bill could no doubt have been framed into a law. The Commissioner of Crown Lands has, however, had the benefit of a free discussion of its provisions, and he will, it may be assumed, have less hesitancy in dealing with it more vigorously next year.

The Act which amends the Public Lands Act is a veritable "looking backward," for it returns to the policy which prevailed in the olden time in the Province of Ontario with respect to the Crown's interest in patented lands. It provides that in any letters patent for lands hereafter granted for agricultural purposes all mines, minerals and mining rights are reserved to the Crown, unless otherwise provided in the patent, and are a property separate from the soil. The Act declares that they shall "continue to be the property of the Crown and be public property, independent from that of the soil above it," unless the proprietor of the soil had acquired it from the Crown as a mining location or otherwise. It will be remembered that previous to the Act of 1869, all ores of gold and silver in lands patented in Ontario were reserved to the Crown in the grant; but by that Act all such rights or claims on the part of the Crown were abandoned. The present Act proposes that henceforth the Crown shall part with its surface rights only, reserving to itself every other ore and mineral as well as gold and silver. We do not notice that any provision is made for the sale of the property so reserved to any other party, nor to the right of such party to go upon the land and sink shafts or otherwise explore for minerals or operate the mines; and this looks like an important omission. It does not, however, appear to be the intention to apply this provision of the Public Lands Act generally, for it is provided that the Governor-in-Council may by order set apart any tract of the Province not being mineral lands, in respect of which the grants or patents shall expressly vest in the grantee the minerals and mining rights, or such of them as may be specifically mentioned in the order or patent. Of course, it will be understood that the reservation applies to future sales under the statute, and is in no sense retroactive.

The amendments to the General Mining Act deal with five different subjects, viz.: the prices of mining locations; conditions of occupation; royalties upon ores or minerals payable to the Crown; leasehold tenure of mining lands, and the establishment of a Bureau of Mines.

The Act of 1869 underwent but one alteration from that year to the present, and that consisted in raising the price of mining locations from $1 to $2 per acre. The activity in mining operations during the past two or three years, and notably the boom created by the discovery of great bodies of nickel ore in the country north of Georgian Bay, appears to have convinced the Government that an increase in price could be borne by the parties anxious to invest in mining lands, and that a step in this direction was desirable in the public interest. Accordingly, we find that the new Act makes a very substantial advance in selling prices; but, unlike the former provision, the figures are graduated on a basis of assumed values. Thus, in the whole of that part of the Province above the French and Mattawa rivers and Lake Nipissing, in the districts of Nipissing, Algoma, Thunder Bay and Rainy River, the prices of mining lands or locations are fixed as follows:

If within a surveyed township and within 12 miles of any railway	$4 50	per acre.
If within twelve miles of any railway, but in unsurveyed territory	4 00	do
All other mining lands in surveyed territory..	3 50	do
All other mining lands in unsurveyed territory	3 00	do

As regards all Crown lands sold as mining lands or locations, and lying south of the French and Mattawa rivers and Lake Nipissing, the following prices are fixed :—

If within a surveyed township, any part of which lies within 12 miles of any railway	$3 per acre.
If situate elsewhere	2 per acre.

But it is provided that where any locality is shown to be rich in minerals, the Governor-in-Council may set apart the whole or any part of it, and fix the price per acre at any greater sum as above specified, or may temporarily withdraw it from sale altogether.

Some consideration, however is shown to parties who had been prospecting for minerals, or who had paid money on locations before the withdrawal of lands in the Sudbury district from sale last year ; for it is provided that in certain cases, such parties may acquire grants of farming lands at the old prices and subject to the old conditions.

But the person who desires to obtain a mining location is not obliged to purchase it at the foregoing figures ; he may, if he sees fit, acquire the right to hold and work the property under a lease for ten years, instead of a tenure in fee simple, with right of renewal for a further term of ten years at the same rental if the covenants and conditions have been performed. The rental is $1 per acre for the first year, and twenty-five cents an acre per annum thereafter, for lands above Lake Nipissing and the French and Mattawa rivers, and sixty cents an acre the first year and fifteen cents an acre per annum thereafter for lands situated elsewhere—the rental in all cases to be payable yearly in advance. It is further provided, that at the end of the second term of ten years, if the covenants and conditions have been fulfilled, the lease may be renewed for a term of twenty years on such conditions and at such rent as the regulations shall provide, and so on from time to time at the expiration of every twenty years. It is also provided that the lessee may become the purchaser of the land, if he has complied with the conditions, in which case the sum paid for the first year's rental is to be treated as part of the purchase money ; that the lease may be forfeited if default is made in payment of rent ; and that in case of forfeiture or non-renewal of the lease the lessee may remove any mining plant and machinery which he may have placed upon the premises, if so agreed upon in the lease.

As regards conditions of occupation it is provided that, whether the land is held in fee simple or under lease, the occupier shall expend in stripping or in opening up the mines, in sinking shafts or in other actual mining operations, at the rate of $4 per acre during the first seven years where the location exceeds 160 acres, and $5 per acre where it is less. In default of such expenditure the tenure is to become absolutely forfeited in the case of a leasehold, and in the case of the grantee or owner the mineral right is to revert to the Crown, saving only his interests in the soil as agricultural land, distinct from the minerals.

The provision respecting royalties applies alike to occupation in fee simple and leasehold, but only as regards ores or minerals taken from lands sold, granted or leased by the Crown under the amended Act. The royalties are to be calculated upon the value of the ores at the pit's mouth, and are fixed as follows, viz. : Silver, nickel or nickel and copper, 3 per cent. ; all other ores except iron are to be subject to such royalty, not exceeding 3 per cent., as may be imposed from time to time by Order in Council, and iron ore not exceeding 2 per cent. But "to assure speedy development," it is provided that the royalty thus reserved is not to be imposed or collected upon any ores until after seven years from the date of the patent or lease, except as to mines known to be rich in nickel, and as to those not until after four years. It is reasonable to assume that the lawmakers of Ontario are desirous of promoting a speedy development of the mineral resources of the Province. One can hardly suppose that there is a member of the Legislature on either side of the Chamber, no matter whether out of or in the Cabinet, who favors a policy of tardy development of the industry. Yet the very language of the statute implies that the royalties are calculated to hinder development ; for it is specifically declared that the object of postponing their operation is "to assure the speedy development" This, indeed, is a *rara avis* in the phraseology of an Act of Parliament.

The only remaining subject dealt with in this Act is a Bureau of Mines established in connection with the Department of Crown Lands, and with the object of promoting the mining interests of the Province. The head of the Bureau is to be known as "Director of the Bureau of Mines," and it is provided that he is to have all the powers, rights and authority which an inspector or local agent has or may exercise in any mining division or locality, and such other powers, rights and authority for the carrying out of the provisions of the Act as may be assigned to him by regulation for that purpose. In a word, he has scope enough for the doing of useful work, and we are confident that in Mr. A. Blue the government has found a Director possessing the ability and the energy to undertake it and do it.—*The Canadian Mining and Mechanical Review.*

A FLY ON THE WING.

There are many insects which one would little suspect to be furnished with apparatus suited to swift and more or less continuous flight. House flies frequent the inside of our windows, buzzing sluggishly in and out of the room. But what different creatures are they when they accompany your horse on a hot summer's day. A swarm of these little pests keep pertinaciously on wing about the horse's ears ; quicken the pace up to ten or twelve miles an hour, still they are there ; let a gust of wind arise and carry them backward and behind, the breeze having dropped, their speed is redoubled, and they return to their post of annoyance to the poor horse even when urged to its fastest pace says the *New York Ledger*.

But this example gives only a partial proof of the fly's power of flight, as the following will show : The writer was travelling one day in autumn by rail at about twenty-five miles an hour, when a company of flies put in appearance at the car window. They never settled, but easily kept pace with the train ; so much so, indeed, that their flight seemed to be almost mechanical, and a thought struck the writer that they had probably been drawn into a sort of vortex, whereby they were carried onward with but little exertion on the part of themselves. But this was soon disproved. They sallied forth at right angles from the train, flew to a distance of thirty or forty feet, still keeping pace, and then returned with increased speed and buoyancy to the window.

To account for this, look at the wings of a fly. Each is composed of an upper and lower membrane, between which the blood vessels and respiratory organs ramify so as to form a delicate network for the extended wings. These are used with great quickness, and probably 600 strokes are made per second. This would carry the fly about twenty-five feet, but a sevenfold velocity can easily be attained, making 125 feet per second, so that under certain circumstances it can outstrip a race horse. If a small insect like a fly can outstrip a race horse, an insect as large as a horse would travel very much faster than a cannon ball.

THE INTERIOR OF THE EARTH.

One of the most interesting questions relating to our planet, says Professor G. P. Serviss, is that of its interior constitution. Observations made in deep mines and borings indicate that the temperature increases as we go downward at the average rate of 1° Fahr. for every 55 feet of descent, so that, if this rate of increase continued, the temperature at the depth of a mile would be more than 100° higher than at the surface, and at the depth of 40 miles would be so high that everything, including the metals, would be in a fluid condition. This view of the condition of the earth's interior has been adopted by many, who hold that the crust of the earth on which we dwell is like a shell surrounding the molten interior. But calculations based upon the tidal effects that the attraction of the sun and moon would have upon a globe with a liquid interior have led Sir William Thomson and others to assert that such a condition is impossible, and that the interior of the earth must be solid and exceedingly rigid to its very centre. To the objections that the phenomena of volcanoes contradicted the assumption of a solid interior, it is replied that unquestionably the heat is very great deep beneath the surface, and that reservoirs of molten rock exist under volcanic districts, but that taking the earth's interior as a whole, the pressure is so great that the tendency to liquefaction caused by the heat is overbalanced thereby. The whole question, however, is yet an open one, as the *Indian Engineer* wisely observes.

MAKING GLASS FOR MOSAIC WINDOWS.

The glass-worker has only begun his work when he has the molten "metal" simmering in his crucibles. It must undergo many subsequent manipulations before it is available for the purpose of art. Some of these, from a technical point of view, seem retrogressional. It has been found that the rich color effects in glass of the middle ages are largely due to imperfections in the material. Its lack of homogeneousness, its unequal thickness, and uneven surfaces contribute largely to its beauty. The modern product is too uniform to be brilliant; it transmits the light with too great regularity. Intentional imperfections are, therefore, introduced into the process, and the products, in consequence, are much more satisfactory to the artist. This work of individualizing the product has now been so far systematized that several special brands of art glass are recognized in the markets. The so-called antique glass in both white and colors, is made precisely like the ordinary sheet window glass, except that the surface of the glass is made full of minute blow-holes, which produce almost an aventurine effect, and add greatly to its brilliancy. In the cathedral glass the surface is rendered wavy and uneven, so that the transmission of light shall be correspondingly irregular. In the flash glass ordinary sheets are covered with a thin plating of colored glass, a process which permits a very delicate color tone, and materially decreases the expense, where a costly glass, such as ruby, is needed to give the color. In mosaic work it is now generally preferred that the glass shall not be at all transparent, since the effect is much richer. Most of the glass is therefore cast—as rough plate is cast.

THE EMPLOYES' TIME REGISTER.

The accompanying illustrations relate to an excellent system of recording and registering the time, attendance, or performance of employés, which is being introduced by the Automatic Time Stamp & Register Company, of 71 Sudbury street, Boston. It is extremely simple in plan and execution, and so completely answers the requirements of its intended service that its adoption in manufacturing and other establishments where the arrival and departure, or performance, of employés is a matter of importance to be noted and registered with infallible accuracy, cannot fail to prove advantageous. The system and its operation will be understood from the following description:

It comprises a card-delivering device which must be used in conjunction with a second device which is adapted to receive the cards, and which is provided with suitable mechanism wherewith to print upon them the exact time—year, month, day, hour and minute of their reception. Fig. 1 is a view of the first device, which consists of a locked box of thin metal, mounted on a wooden base. In this the cards —numbered consecutively, and weighted so as to hold them securely—are placed. At the bottom of this box, in front, is a slit just large enough to allow one card to be delivered at a time; and directly opposite is an opening through which a thin blade of metal may be introduced, which, by forcing against the bottom, and whenever the box is pushed inward, shoves the card forward through the slit and into the hand of the operator.

The second portion of the mechanism consists of the card-receiving and printing device. It is shown herewith in Fig. 3. It is formed of an iron case, hinged at the back, and at the top is provided with a slot for receiving the cards. The front of the case is also hinged, and in its upper part is fixed a circular piece of glass. In this box is contained an automatic timing and dating mechanism so disposed that the hands and face of the stamp-clock are visible through the glass, while the printing devices may be inspected by swinging the case on its hinges, removing the inking device and card guides, and lowering the stamping platen. The lever which operates the stamping platen terminates in a hook which projects through the front of the case, thus permitting the stamp to be worked from the outside.

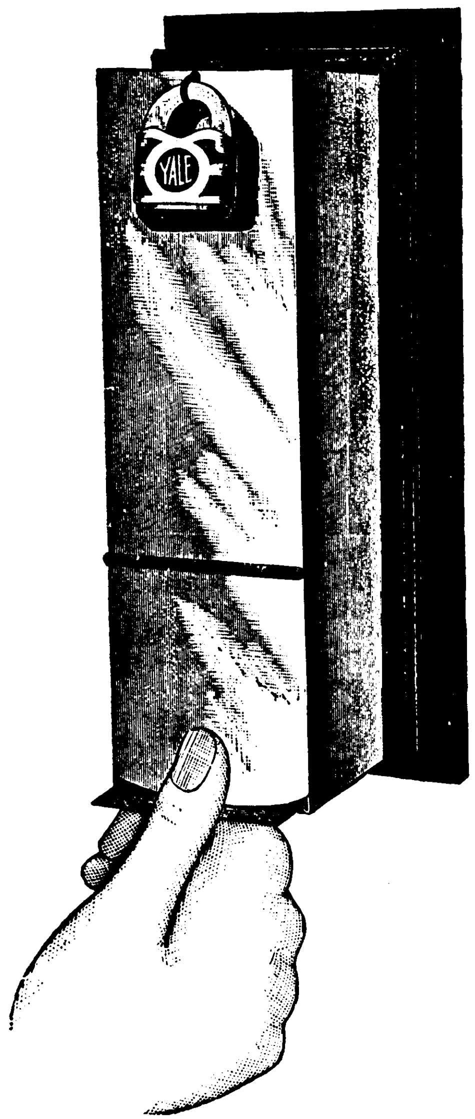


FIG. I.—CARD DELIVERY BOX.

The mode of using the apparatus is as follows: The employé who wishes to register his arrival or departure, obtains a card from the card-box before described. He writes his name on this, drops it into the slot at the top of the registering case, where it will be supported in proper position to be printed upon, and then pulls the hook, by which the card is printed, and, when the hook is released, caused to fall to the bottom of the box, from which it can be removed only by the official in possession of the key to the door of the case.

The stamping platen may carry any desired types, as a matter of course, and the system here described may be modified in detail to be adapted to any special requirements. So, for example, where all employés are required to arrive and depart at the same time, a plain, numbered card will answer the purpose. When they come and go irregularly, cards printed with the words "In" and "Out" will be substituted, and the employé will be required to sign his name under "In" when arriving and under "Out" when leaving; or, in lieu of this, two delivery boxes, with one set of cards in one and another in the second, may be used, as may be found most convenient.

A modification of the system consists in the substitution, for the box registers, of an employés time-registering desk. This is mounted on a locked cabinet enclosing a roll of paper which passes over a writing tablet and between the platen and impression die of the stamp, suitable provision being made by

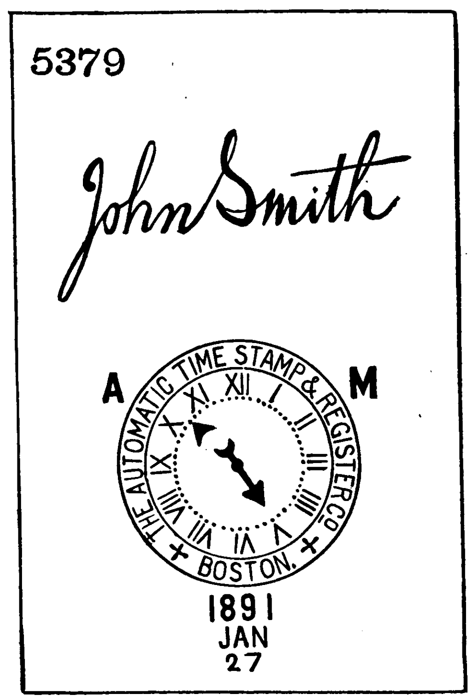


FIG. 2.—SPECIMEN REGISTER.

which the operator may sign his own name upon the paper. In this case the employé operates the register by a blow on the stamp handle, and after each operation the paper is moved forward to expose an unused portion of its surface. The appearance of such a register is shown in Fig. 2.

Without dwelling at too great length on minor details, it may be said that these have been so carefully thought out, that the possibility of "beating" the register is practically eliminated. The manifold advantages of such a system, combining the automatic and autographic features here described, are too obvious to need special enumeration. The apparatus is furnished with an accurate time-keeper, is well and substantially constructed and highly finished.

The company has issued a fully-illustrated pamphlet describing the system and the mechanical devices

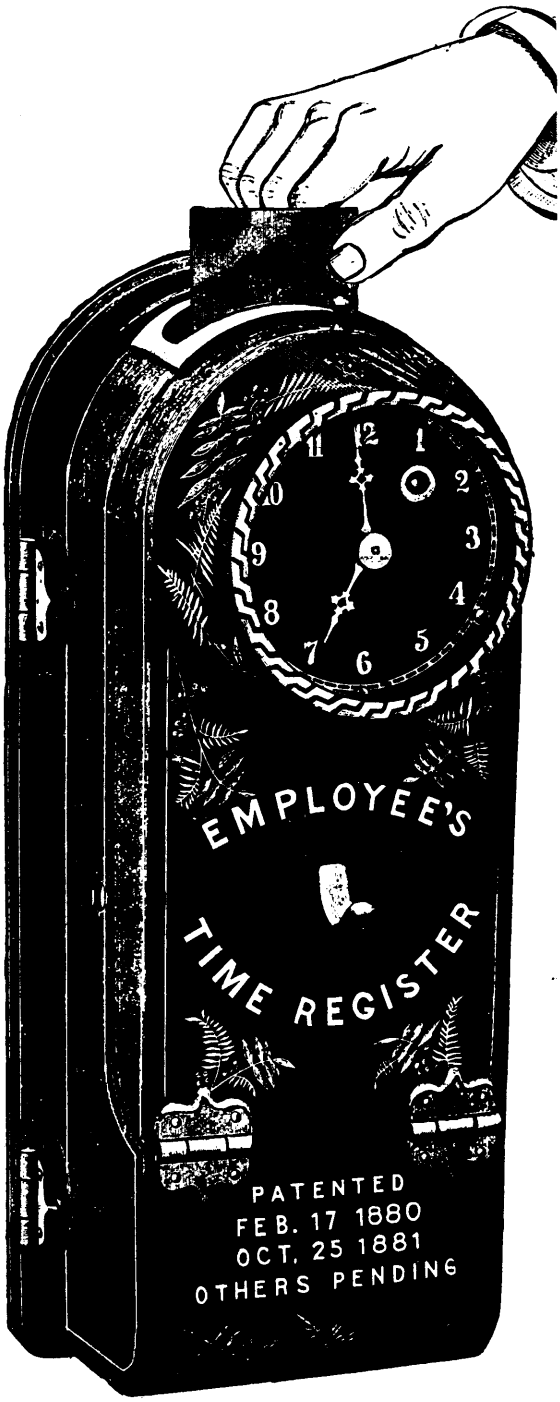


FIG. 3.—REGISTERING DEVICE.

in detail, and giving full instructions as to the mode of setting up, adjusting and using the apparatus, which will be sent to inquirers on writing to the company's address above given.

It is estimated that in the year 2000 no less than 1,700,000,000 people will be speaking the English language, while only 500,000,000 will be speaking other European tongues. English is thus indisputably the langnage of the future.

THE ATLANTIC RACE.

In our issue of the 27th ult. we considered some of the probable characteristics of "The Ships of the Future," looking chiefly at the subject from the point of view of construction. There can be little doubt that the race across the Atlantic will be one of the most important factors in the production of the first-class passenger ship of the future, and in the development of its construction and increase of its speed. Since the first of the Atlantic "greyhounds" was built, and accomplished the voyage from Liverpool to New York in seven days, shipbuilders have always kept in view the problem which they were certain would soon be placed before them, of designing and building ships which would accomplish the voyage more quickly, and from time to time various designs were reported to have been made which were intended to be great advances on all that preceded them. But the British shipowner in naturally very cautious, and rightly so, and although each succeeding ship has been to a certain extent an improvement on all those which preceded it, there has been no great departure from ordinary practice. The following table shows the advance which has been made in size and power since the "Arizona" was launched :—

	Length in Feet.	Beam in Feet.	I.H.P.
Arizona	465	46	6,000
Servia	530	52	10,500
Alaska	520	50	10,500
Aurania	470	57	10,000
Umbria	520	57	12,500
Etruria	520	57	12,500
City of New York	560	63	18,000
Teutonic	582	57	16,000
City of Paris	560	63	18,000
Majestic	582	57	16,000

The newer of these are "six day" boats. When one of the earlier "greyhounds" was launched, Sir William Pearce stated that, although these ships were great advances on the predecessors, he believed that the voyage could be made in very much less time, and he hoped that the owners of the leading lines would see it to be to their advantages to provide vessels of the newest style. each a distinct advance so far as speed was concerned on anything then afloat. This is precisely what has happened, but, as we have stated, in a very cautious and tentative manner, for the money invested in a first-class Atlantic steamer is not a trifle with which hasty and ill-considered experiments may be made.

But now it seems as if a greater step is about to be taken, and that both in this country and in America attempts are to be made to produce "five day" boats. The new Cunard liners and the vessels to be built by the Barrow Company are "dark horses," as no particulars have as yet been made public regarding them beyond the fact that they are to surpass their predecessors in size and speed. In America, however, the same reticence has not been kept with regard to the intentions, or rather the wishes, of the projectors of the lines which are beginning to spring up under the joint influence of the subsidy and the McKinley Act, but it is doubtful whether they have considered all the factors of the problem and the difficulties to be overcome. A "five days'" voyage means an average speed of 25 knots an hour, which is by far the largest step in advance which has yet been taken, and which will consequently require a very great increase in power. If the vessel were made an express boat, it would require to have engines indicating at least 25,000 horse-power, while, if it carry the usual amount of cargo for a first-class passenger ship, it will require about 5,000 horse-power more. The proper policy, in our opinion, to pursue in this matter is for shipowners to give up the idea of carrying cargo in these boats, so that they may be able to start on the return voyage after having sufficient time to coal and take in new passengers, but without the delay attendant on taking in cargo. The cost of such vessels would be very great, and, in order that they may be commercially successful, time must be economised to the very greatest extent possible. With regard to the construction of the hull and the engines, it is probable that there would not be much variation from those at present in use, although weight would be economised as much as possible, both in the design and by the greater use of alloys. From the paper read recently by Mr. Biles before the Institution of Naval Architects, we learn that American shipbuilders and engineers have made great progress during late years, but we doubt if they are able to construct successfully such ships as we have been considering. To say the least, it would be a very risky experiment. The lead must, in any case, be taken by the managers of the British yards, and, having regard to recent progress we look forward with confidence to the near future, in the expectation of seeing vessels which will be capable of making the Atlantic passage in five days.—*Industries.*

A POSTAGE STAMP IN THE SLIT.

Facts are stranger than fiction, as has been illustrated many times. It is a fact, which went the rounds of the papers, some years since, that a country girl on her arrival in London forthwith wrote a letter home, to inform her anxious parents of her safety in Modern Bablyon. She proceeded along High Holborn, in search of the West Central branch post-office, as she had been directed. She noticed another girl dropping some letters into a pillar letter box, on the way, and when the new arrival reached the spot, the other girl having ran off after dropping in the letters, she examined the receptacle for the letters. Surely enough, she noticed that letters would be collected from there at short intervals, then she reasoned that it was useless to proceed farther in quest of the post-office to which she had been directed, and forthwith she put her mouth to the letter slot and called out, " A stamp, please." The request was repeated, but no response came from the inside. Presently a policeman approached, to investigate. He took in the situation at once, and instead of explaining her mistake to the lass from the country, he " let on " that he had come in response to her call, and sold her a stamp, which he happened to have in his pocket.

That was a good joke. Now, however, what that girl imagined is about to become an accomplished fact, if the following statement in the " mechanics " column of a recent issue of *Invention* is strictly correct. Our British contemporary says :

The Postmaster-General has given permission for an experiment to determine whether postage stamps can be supplied to the public by means of an automatic machine attached to the ordinary pillar boxes. The Stamp Distribution Syndicate, Limited, of Mansion House Chambers, Queen Victoria streeet, have brought out an instrument, constructed partly on the principle of the automatic machines with slots for pennies now so familiar in the streets, with which they hope to meet a very general need. In appearance their machine resembles an ordinary small sweetmeat machine, stands about 18 in. high, and is a few inches square. It can be fastened to a pillar box without difficulty. A person desiring to purchase a penny postage stamp drops a penny into the slot at the front of the machine, a drawer at the bottom comes out, and the purchaser pushes it in again. At once a small white envelope comes out at the back, containing a memorandum book with a penny postage stamp with a small slit in the cover. That, in brief, is the machine. Naturally the question arises, will it answer? Can one be sure of getting a stamp for a penny, and can the stamp be obtained by tricks with zinc or iron discs? The directors of the syndicate claim to have overcome all these difficulties. They have adopted in their machine a principle by which absolutely nothing but a penny will permit the machine to work, and another by which, if the supply is exhausted, no one can put a penny into the machine. The principle was put thoroughly to the test on Wednesday at the post-office buildings, Mount Pleasant, by representatives of the press, with the most satisfactory results. The Postmaster-General has been so impressed by the machine and its utility that, as already said, he has given permission for a complete and practical trial, and forthwith the machines will be attached to about a dozen pillar boxes in London. Should the experiment be successful, machines will be attached to all the pillar boxes, and so it will become possible to buy a stamp at the pillar boxes at all hours of the day and night, Sunday included. It may be explained that the Postmaster-General concedes the use of the pillar boxes free for the benefit of the public and in respect to the more ready distribution of stamps, while the syndicate hope to recoup themselves out of advertisements to be interlarded in the pocket memorandum book bearing the stamp.—*American Engineer.*

THE SYSTEM OF MILITARY DOVECOTES IN EUROPE.

In the organization of the system of military dovecotes, the locations of the stations are, almost all of them, decided upon in advance. It is a question, in fact, of connecting the fortresses of the frontier with each other and with a central station. There is generally no difficulty with fortresses that are almost always so near each other that ordinary pigeons can easily effect a passage from one to the other. The same is not the case with the central station, at least in great empires, such as Russia, Germany, etc. In this case it is necessary to establish relay stations between the frontier and the centre of the system.

One has, in fact, to stand between two dangers, viz., on the one hand, of having journeys to be made that exceed the strength of the average of pigeons, and, on the other, of too greatly multiplying the stations and consequently the loss of time that always occurs at the start, when the bird is taking its bearings, or on reaching home, when it is hesitating to enter its cote. The superiority of communications by pigeons over other methods of transmitting dispatches increases with the distance. Thus a direct train takes thirteen hours to make the 300 miles that separate Paris from Lyons—a distance that can be traversed in eight or nine hours by a pigeon.

It is generally admitted that it is possible, almost to a certainty, to make an ordinary pigeon (such as those with which the military cotes are stocked), provided that it has been carried away, accomplish a journey of from 30 to 90 miles in a single stage, and that, too, in a space of time varying from one hour to four hours. The nature of the country has a great influence upon the facilities of the trip, not only on account of the obstacles presented by chains of mountains, but also by the delays and dangers that pursuit by birds of prey cause the messengers to undergo. A journey of 180 miles over a level country will be more easily made than one of 60 over a hilly one.

So, in the details given further along as to the various systems, we shall see that, by way of exception, it has been possible to carry the distance between two stations up to 180, and even 240 miles.

When stations have to be established upon mountains, it is necessary to install them, not upon the highest points, even though they would thus have the advantage of being discernible, but in the valleys and at the side of the roads, for it is through the necks where these valleys and roads end that the pigeons always endeavor to cross chains of mountains, provided the latter exceed the mean altitude of flight.

In certain countries, the military pigeons are carried away only at the beginning of spring, just as are the ordinary carriers, the sole objective of which is contests in the races of autumn. This is an error, for, in time of war, it is necessary that the messengers of the fortresses shall be habituated to brave inclement weather. The Societe Estafette Lyonnaise, this past winter (1890–91), made an experiment in this direction. It lost 43 per cent of the pigeons, but the number of these that arrived permits of the hope that, with proper precautions, this service will enter into practice. Further along, we shall see that what took place at the time of the siege of Paris confirms this favourable opinion.

In every station there must be as many dovecotes or at least as many distinct parts of a dovecote, as there are corresponding stations, so that it shall be always the same pigeons that are carried away in the same direction.

At the age of six months, these pigeons come to know their way so well that, for distances of 120 miles, there is, taking into consideration storms, the shot of hunters, and the claws of rapacious birds, one chance in three that they will reach their destination. In order to be sure that a dispatch will be transmitted, it will suffice, then, to confide it to three messengers or to four at the most, during unfavourable winds or weather. From this it results that if we wish to be able to send a message every day during an investment of six months or 180 days, it will be necessary to have an effective force of 180 by 4, or 720 pigeons for each station with which it is desired to communicate, the distance of such stations being less than 120 miles. If the distance is greater than this, we can no longer depend upon six months' old pigeons, whose strength and rearing are generally inadequate, but it will be necessary to have recourse then to pigeons of one, two, three, and even four years, when the journey to be accomplished reaches 240 miles. It will be well at the same time to increase the number of carriers of the same dispatch. As a general thing, it is necessary to employ one pigeon more for each extra 30 miles, so that, for example, for 150 miles we would let loose 5 pigeons of from 1 to 2 years; for 180 miles, 6 pigeons of from 2 to 3 years; for 210 miles, 7 pigeons of from 3 to 4 years; and for 240 miles, 8 pigeons of from 3 to 4 years.

These figures are only approximate, for the value of a pigeon does not always depend upon its age. One that is excellent for service in rainy weather may be worth nothing in a wind, and *vice versa.* It is, therefore, of prime necessity that the keepers of military dovecotes shall make it a point to know personally all the birds in their charge, and to take note of their aptitude.

The installation of military dovecotes is about the same throughout Europe. Sometimes they are established in isolated pavilions and sometimes in the upper stories of magazines or barracks.

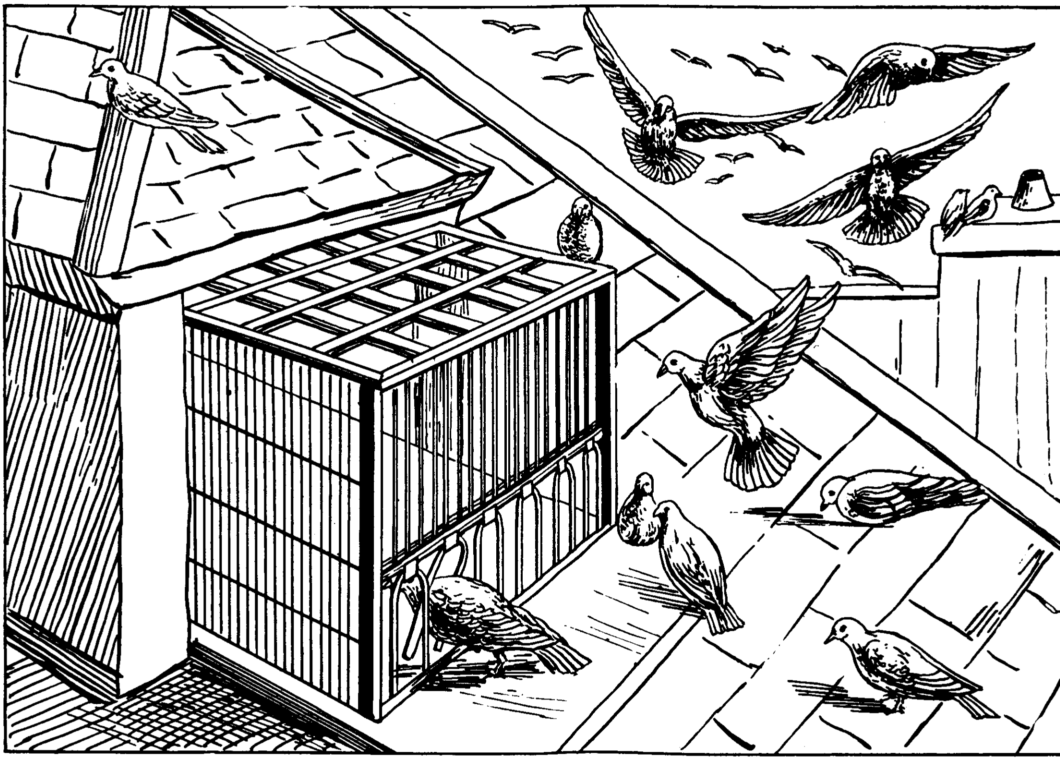
The cut represents the military dovecote of Grenoble that I have had installed in the upper story of a tower of the ancient wall built in 1401. Attention should be especially directed to the safety of the birds, which should be carefully protected against the attack of cats, rats, or other carnivorous animals.

Each dovecote should be provided with several compartments. First, there is the apartment for paired pigeons, in which the birds generally remain when they re-enter the cote. Each pair has its own cage, the height and length of which is twenty inches, while the width is from twenty-four to twenty-eight inches. Two plaster nests are placed in each cage, one of which will serve for the young, while the other will contain the eggs.

Just alongside there should be a second apartment, fitted, or not, with cages. The pigeons are confined in this in the month of October, the epoch at which the males should be separated from the females. A little further along is the infirmary, into which all sick pigeons are put, so that they may not communicate the disease with which they are afflicted to the other birds.

Finally, the entrance cage completes the installation of every dovecote. Generally, this cage is placed at the window of the apartment for paired birds and communicates therewith. Little swinging wickets allow the birds to go in and out. A bar put in place by the keeper prevents the wickets from moving in both directions at certain moments, and then permits the birds only to enter the cote.

In order to give the pigeons more air, and, at the same time, to allow the keepers to seize them easily, rooms are selected that have a sufficiently high ceiling,



ENTRANCE CAGE OF A FRENCH MILITARY DOVECOTE.

and in these are established, at a height of six feet, a second and open ceiling of laths, which prevents the birds from flying out of reach of the hand.

Clay and bits of wood are placed within reach of the piegons in order to permit them to build their nests. In the interior of the cote there are wooden trays for seeds, and leaden troughs, or small apparatus of special form, for water. The food consists of vetches, beans, and Indian corn. Cereals, hempseed, and a little salt may also be given. The birds complete their ordinary fare by swallowing grains of sand or small pebbles.

Three meals a day are served to them in summer—one at 5 o'clock in the morning, one at noon, and one at 6 o'clock in the evening. In winter they are fed but twice a day—at noon and at 5 o'clock. It costs from 25 to 30 cents per month to keep each pigeon.

Thus treated, the birds reach their complete development in three years, and are capable of performing good service as messengers until the age of fifteen or sixteen years. They have been known to attain a longevity of twenty years, but it is between the ages of two and six years that they display all their qualities.

For carrying the pigeons away from the military dovecotes, it is well, the first year, to adopt the following rule:

The distance of a letting loose of the birds will be obtained by adding to the distance of the preceding one a half of such distance, being expressed by the formula

$$Dn = Dn - 1 + \frac{Dn - 1}{2}$$

Thus the first turning loose being say 10 miles, the second will be $10 + 5 = 15$ miles, the third will be $15 + 7\frac{1}{2}$, and so on up to 120 or 180 miles, that is to say, up to the distance that the messengers are never to exceed.

As soon as a mobilization of the army has been decreed, there will be taken from each cote all the pigeons that are carried in the direction of the neighbouring places, and these will be conveyed respectively to such places along with the men who are accustomed to care for them, and who must remain there until the cessation of hostilities.

All these permutations must be effected on the same day, so that every lot of pigeons shall find the place free on arriving.

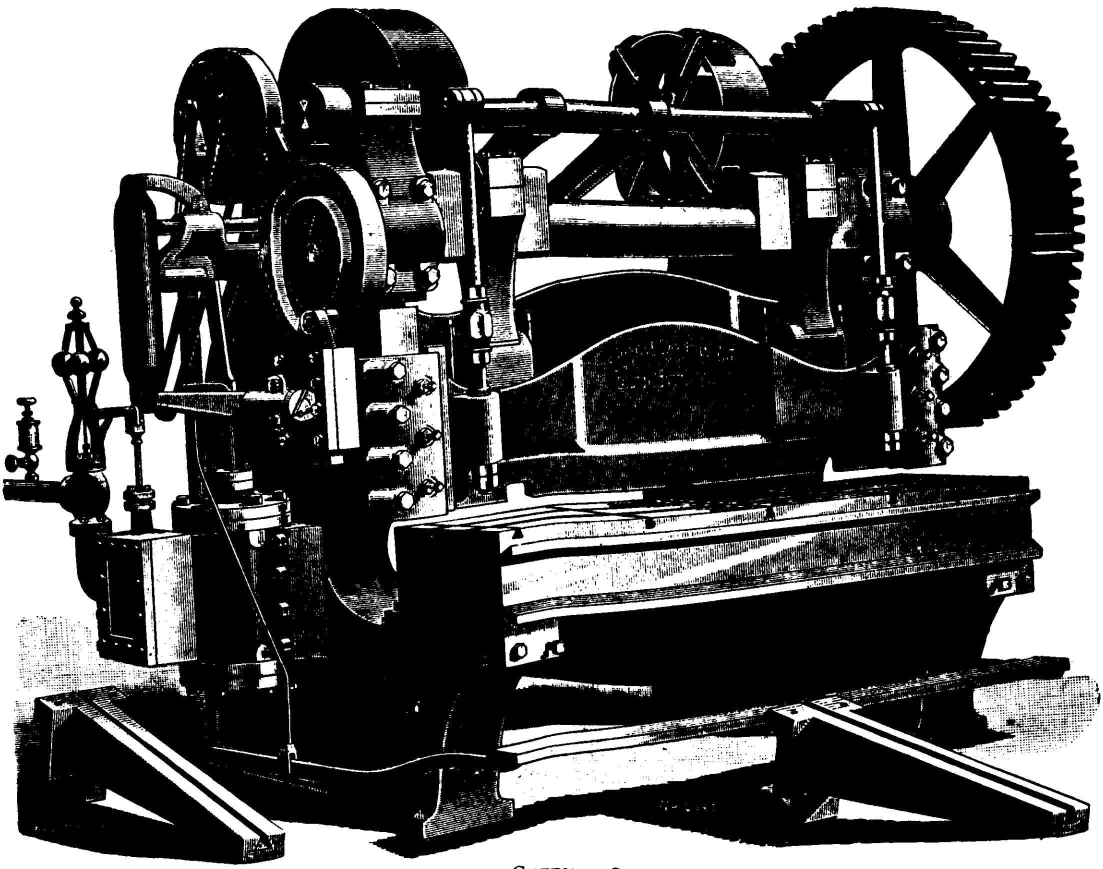
In a succeeding article I shall give a few as complete details as possible as to the systems of military dovecotes of the principal powers of Europe.

Such data, however, will be merely approximate, since it is for the interest of every state not to allow its neighbours to become too accurately informed as to what is going on within its borders, and not to divulge its processes.—*Lt. Col. De Rochas, in La Nature.*

THE BLISS STEAM PLATE SHEAR.

The heavy cutting shear illustrated herewith is a new machine recently designed by the E. W. Bliss Company, Limited, of Brooklyn, N. Y. It is for cutting a three-fourth inch plate. The principal new feature it possesses is the device used for starting and stopping the machine.

Shears of this character have heretofore been sup-



Heavy Cutting Shear.

plied with a clutch on the main crank shaft, on which shaft, when the clutch is in operation, the driving gear runs loose. The improvement consists in keying this gear rigidly to the crank shaft and placing a friction clutch upon the pinion or fast-speed shaft. The shifting bar operating this clutch is connected with a lever and counterweight, shown at the left-hand side of cut. On the main crank shaft is a cam operating a slide working in vertical guides upon the housing. The mechanism is so arranged that when the cranks are in their upper position, so that the shear knives are open to receive the work, a latch in the slide acts to raise the counterweight and hold the friction clutch out of gear, thus allowing the cutter bar to stand at rest. Depressing the treadle throws the latch out of gear, allowing the weight to drop, which action throws the clutch into operation and starts the machine. When the crank shaft has made one revolution the cam above referred to depresses the slide, thus lifting the counterweight and stopping the machine.

As these motions are very easy, there is said to be no shock or jar in starting, and as the train of gearing is at rest when the cutter bar is not moving, the shaft is held securely with the cranks at their top center, with no tendency to drop back or ahead, even though no counterweight is used to balance the cutter bar.

The cutting blades are 8 feet 4 inches long, and there is sufficient gap in the housings to allow a plate 36 inches wide being split through the center. Immediately in front of the cutter bar is a clamping bar, which, when the machine is started, automatically descends and securely holds the work in place while the shearing is taking place.

The machine is geared about 20 to 1, and is driven by a plain side-valve engine, 12x15 inches, which is attached directly to the housing. The crank shaft is of hammered steel, with cranks forged solid and slotted out. In order to compensate for wear of the blades, the lower one is supported on a long wedge, by setting up on which the cutting edge of the blade is kept level with the table. The upper blade is adjusted downward by lowering the cutter bar bodily. The machine weighs complete about 45,000 pounds.

BLACK WALNUT.

Black walnut is rapidly becoming exhausted, and there seems to be nothing in this country to take its place. No other tree is so valuable. It grows rapidly, will thrive in any soil and is very hardy, requiring very little care because no animal and but one insect feed upon it. It has a value but little known, which is, that the European or French walnut, as it is called, grows firmly upon it, and is easily grafted. It can in that way be made to yield a fortune, if cultivated on a large scale. In twenty years it will more than pay all expenses and interest; and in fifty years the trees would be worth at least $40,000 an acre.

LAYING UP BOILERS.

BY STEPHEN CHRISTIE.

The season for laying up boilers, those for heating especially, is now at hand; and often are idle for five months. Opinions differ as to which is the most practical way. Some insist on keeping water in boiler, hand holes and man holes, and aver that it is the most reasonable way, as the water will preserve the iron. Others will run the water out, that is, all that will run off, leaving hand holes and man holes closed, without any attempt to dry boiler out. A few will blow out the boiler under pressure; as they reason, it will blow out all water, and the heat of brick work will dry the inside.

There is room for argument against any of the above methods. To leave water in boiler so long is serious; besides, the effect of rust caused by the water on top part if not exposed to water, of shell inside, and on braces, the iodin of iron or acids in water will settle in spots and cause deep pitting, often necessitating the removal of tubes and frequently of plates in boiler. Those who just run the water out, as much as will leave, subject the boiler to corrosion, that insidious canker to boiler, when no effort is made to have boiler dry, as many take very little trouble to see if it is so.

The blowing out form has many advocates, but is very severe on boilers, especially those of the horizontal tubular form, or those set in brick work. The contraction and expansion is too great, to expect good results; and aside of that fact it only tends to harden any deposit that may be left in boiler, and that will generally accumulate to point near blow-off, causing bags, burns or fractures, if attempts were made to steam up before cleaning, and often these deposits are in places impossible to clean thoroughly.

The above systems are in vogue among those plants where unskilled labor is used to operate same, and the wonder is why many more accidents do not occur, than are recorded. The thinking class of people, who own such generators, have periodical inspection, and are virtually looked after by insurance inspectors as they are interested in them as well as owners of same.

TO LAY UP A BOILER PRACTICALLY.

Run water out and clean out boiler thoroughly, replace hand hole and man hole plate, and according to surface (inside) put in some kerosene oil, if a ten horse power boiler, 2 galls., this is, put in before water is admitted; then as water is rising, the oil will float and cover such parts as it raises. When full, slowly let the water out; thus it will cover same points again covering all places impossible to see. The oil being light will penetrate cracks of scales. The oily substance, what there is, will have a tendency to preserve the inside from rust. Leave hand hole and man hole covers off. If blow-off is situated so as to get to end of same, the remaining oil can be saved. Before placing boiler in commission again be sure and give a thorough cleaning, as much of the scale will be found ready to drop off. Considerable saving of fuel and labor can be effected by adopting this plan.—*The American Engineer.*

AN EASTERN SCHEME.

The question of shortening the passage across the Atlantic by starting from a point much further east than any existing seaport, has agitated the public mind for years past. Any one acquainted with the corresponding geographical positions of America and Europe knows that as the British Isles stretch far out into the Atlantic towards America, so does Nova Scotia, with its adjacent island of Cape Breton, extend eastward towards Britain. This has naturally directed attention to the idea of establishing a trans-Atlantic seaport at some point on this eastern extension of North America. Cape Breton has the advantage of being the most easterly, for Newfoundland is too far away for any bridge or ferry service. But to reach Cape Breton, a bridge across the Strait of Canso is, indeed, a gigantic and expensive beginning. The only port of practical value on the east side of Cape Breton is Louisbourg, with a comparatively small harbour. But to reach Louisbourg by a fast line would necessitate a railway across the southern side of Cape Breton, with another expensive bridge across the canal entering Bras D'or Lakes. And after all, the gain from the eastern side of the mainland in Nova Scotia to Louisbourg is only about sixty miles. Accordingly attention has been diverted from the island of Cape Breton to the mainland of Nova Scotia, and it is quite a possibility that a trans-Atlantic port may be founded on the shore of Nova Scotia, opposite to, and sheltered by, the island of Cape Breton. The Strait of Canso forms the highway between the trade of the St. Lawrence and the Atlantic coast, and at the southern end it is proposed to build a city and a port. To this end a company has been formed, called "The Terminal City Company," who intend to run a fast service to Great Britain. The site of the new city is only six miles from Port Mulgrave, where the C.P.R. and I.C.R. end, so that the main transcontinental lines are within a very short distance, and will be easily connected.

Instead of running to Liverpool, it is intended to send the fast steamers to Milford Haven, on the South Wales coast, thus saving a twelve hours' run up St George's Channel, and the distance between Terminal City and Milford Haven is only 2,200 miles, while from New York to Liverpool it is 3,130 miles, thus showing a saving of 930 miles. This, it is claimed, will mean a four days' Atlantic passage. If this can really be accomplished, the fast traffic and mails will naturally come by this route, and Canada will succeed in taking a tremendous amount of European travel and freight from New York; in fact, all the principal traffic, especially of the Western States, will come by this route.

The Strait of Canso, according to the soundings taken by the Imperial Government, and confirmed by recent surveys, is suitable for large vessels, the southern entrance being twelve miles wide, and the water being deep right up to the shore line, just off the existing pier the soundings giving 40 feet. The extreme rise and fall of spring tides, according to the Government survey, is only 4 feet, while at St. John it is 30 feet.

On the opposite shore, in Cape Breton, are extensive and valuable coal beds, eight square miles of which have been given to the Company by the Local Government, while deposits of iron ore are found abundantly close by. There will naturally be a good deal of opposition to the scheme from rival ports, but if the idea can really be proved practical, the advantage to the Dominion at large will immeasurably outweigh any harm done to sister-cities. The natural situation and scientific advantages are great, and it remains to be seen whether they can be utilized.

PARIS, A SEAPORT.

The committee of inquiry for the deepening of the Seine, to enable seagoing vessels to reach Paris, have just sent in, says the Paris correspondent of the *Standard*, a favourable report to the Government. The project on which the inquiry was based consists in the deepening of the channel of the Seine from Rouen to Paris to 6 mètres 20 centimètres, and in the shortening of the distance by water between those two towns by the cutting of two canals joining the extremities of the loops made by the Seine between Oissel and Pont de l'Arche, and between Sartronville and Bezons. The distance by the Seine and these proposed canals from Rouen to Paris would thus be reduced to 182 kilomètres. The Paris seaport would be made between St. Denis and Clichy, and five minor ports would be created at Les Andelys, Vernon, Mantes, Poissy, Achères and Argenteuil.

The cost of the works is put down at 150,000,000 francs, and the company would undertake to execute them, without any subvention or guarantee of interest from the State or from the Paris municipality, in consideration of a concession for ninety-nine years. I would be authorised to charge during that period a maximum toll of 3 francs per ton on the tonnage of sea-going vessels drawing more than 3 mètres of water, and ascending the Seine to Paris. The toll would be proportionate for vessels stopping at the intermediate stations. The Paris Port de Mer Company would also be permitted to charge pilot dues amounting to 25 centimes per ton, and demands to be empowered to charge harbour dues. Boats and barges would be exempt from any sort of toll or tax so long as they continue, as at present, to draw no more than 3 mètres of water and to follow the course of the Seine without using the canals cutting off the loops of the river.

The public inquiry, opened on September 15 and closed on November 15 last, resulted in the sending in of 345,027 notices from private individuals, of which 345,014 were favourable to the principle of Paris being made accessible to sea-going vessels, while only thirteen were opposed to it. Three hundred and forty-four thousand eight hundred and twenty-nine were favourable to the present project, and 198 opposed to it. All the Councils Generals, Municipal Councils, Chambers of Commerce, etc., of the Department of the Seine and other departments interested in the scheme were favourable with the exception of the Western Railway, the Seine Navigation Company, and the Chambers of Commerce of Rouen, Dieppe and Bordeaux. To these opponents must be added the chief engineers for the navigation of the Seine and the General Council of Ponts et Chaussées. But M. Poirrier, senator for Paris, and formerly president of the Paris Chamber of Commerce, who is charged with the report on the inquiry, remarks in that document that the number of objections to the projected enterprise is very small. No one, he says, denies the advantages to be derived from the creation of ports far inland accessible to sea-going vessels. M. Poirrier does not contest the truth of the assertion that Rouen, Havre and Dieppe would suffer from the opening of the proposed Port of Paris, but he thinks that within a short time the development of commerce it would insure would pay those places for the temporary loss they would sustain.

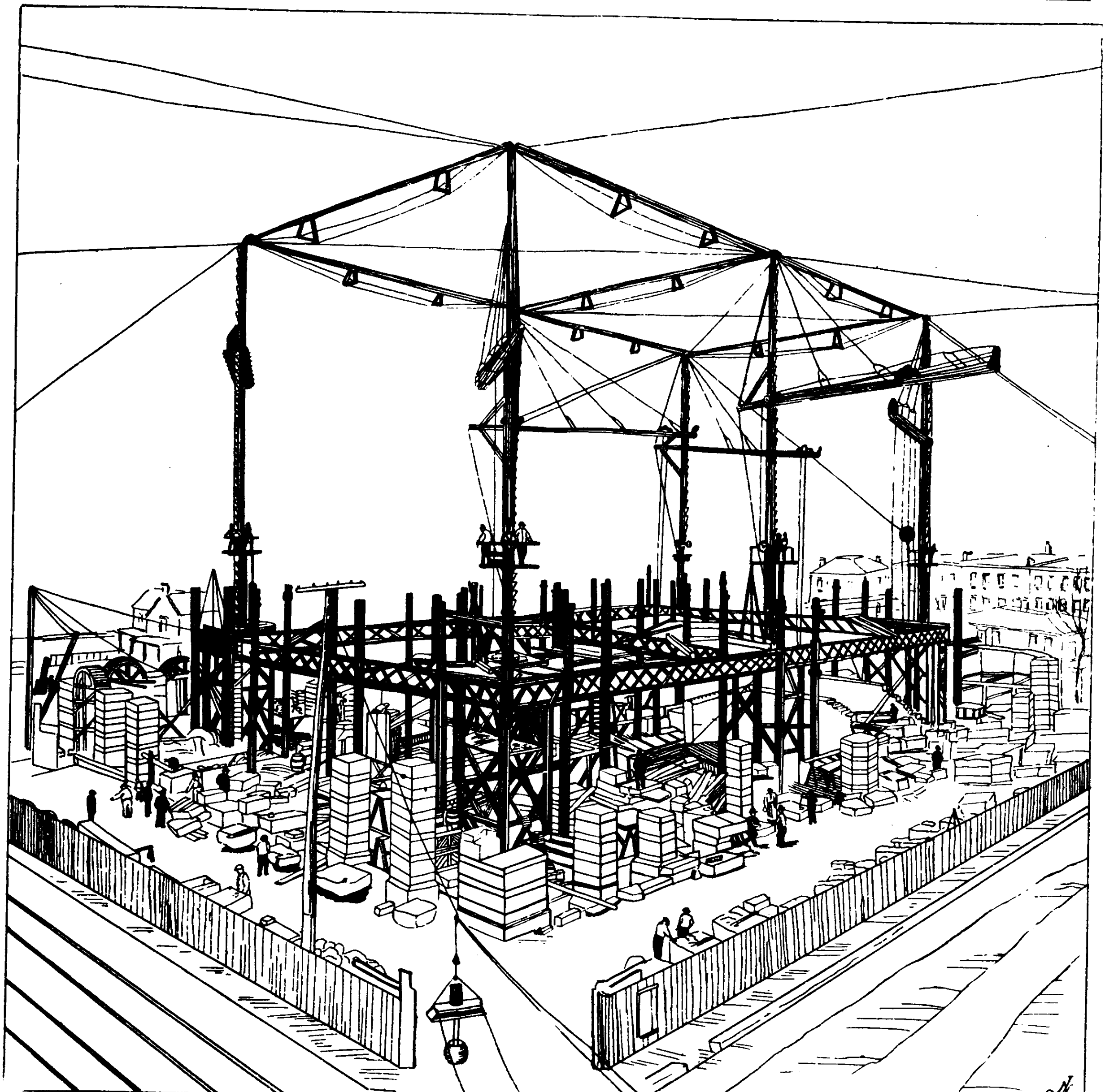
After dealing with the technical objections raised against the project, Mr. Poirrier comes to the financial question. It has been objected that the cost of the works would greatly exceed the one hundred and thirty-five million francs estimated by the promoters, and also the one hundred and fifty million francs to which the promoters' estimate was increased by the Minister of Public Works. Consequently, the company would probably be unable to complete its task; the State would be made responsible were the enterprise declared to be a work of public utility, and, therefore, it would be difficult for the State not to intervene in the case of the discomfiture of the Paris Port de Mer Company. In this report M. Poirrier insists that the Committee of Inquiry does not consider that the declaration of public utility entails any responsibility for the State, and does not see why the State should insist on capitalists being more prudent in their investments than they themselves care to be.

While thus accepting and supporting the scheme for making Paris a seaport, the Committee of Inquiry formulated certain conditions. These were that the works must be executed without interfering with the traffic on the Western Railway; the boats and barges plying on the river must not be subject to any new charges; the loops of the Seine not utilised by the Paris Port de Mer Company must be maintained at the present depth of 3 mètres 20 centimètres; the company must take upon itself the cost of the alteration necessitated in the sewerage works the city of Paris is now carrying out; and, finally, the State should reserve itself the right to purchase the concession of the Paris Port de Mer Company before the expiration of the ninety-nine years.—*Builders Reporter & Engineering Times.*

IMPROVED METHODS OF BUILDING.

The Equitable Assurance Co., of New York, is erecting in Denver a building which is to cost $1,500,000, to be finished by April 1, 1892. It is designed for modern offices, is to be thoroughly fire-proof, and will, when finished, be the finest and most costly building west of Chicago. This great work is being carried forward by the Denver Equitable Building Company, a corporation organized for this special purpose.

In carrying out such a work as this, the first question which presents itself is one of economy of labor. In addition to this, the shortness of the time which is allowed for the completion of the building has a modifying influence on the method of construction. The principal work in the erection of one of these monster buildings is the handling of the thousands



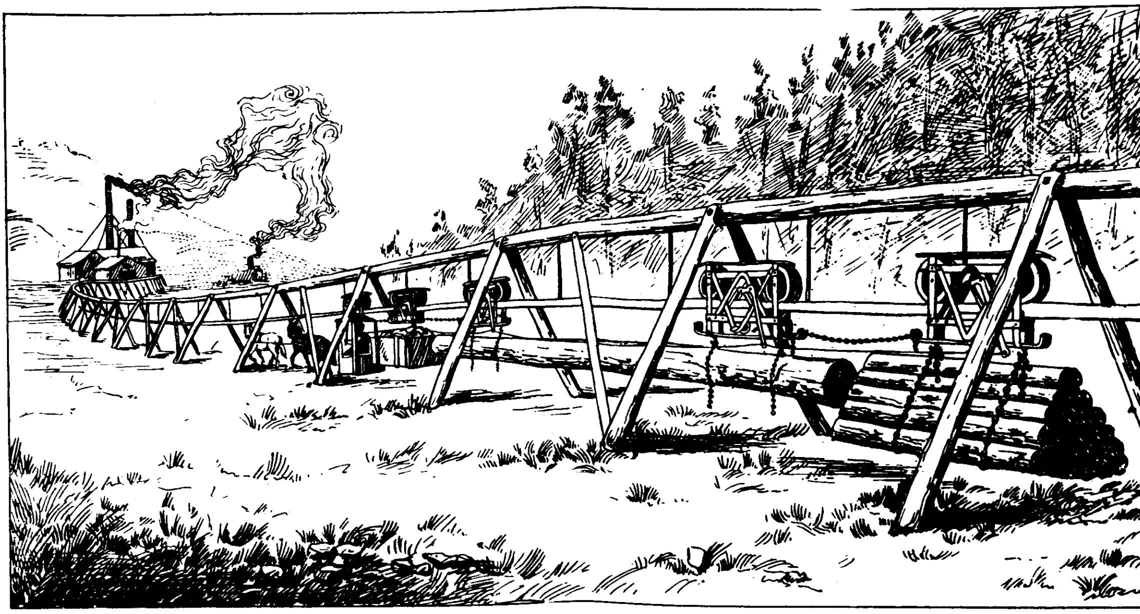
THE GREAT DERRICKS OF THE NEW EQUITABLE BUILDING, DENVER, COL.

of tons of materials which are required in its construction. In this case the building company, after due investigation, decided to employ the Norcross derrick for this purpose. Six of these derricks were erected upon the plot within the outer lines of the building, each having booms long enough to extend twenty-five feet beyond the walls on each side, the whole being capable of covering the entire plot. These derricks are mounted on heavy trestle work, which raises them forty-two feet above the cellar floor, and the booms are so high that it will be unnecessary to remove the derricks before the fifth story is reached.

The masts of the derricks are of Oregon pine, 16 inches square and 75 feet long, and the booms are composed of two pieces of Oregon pine 16 × 18 and 52 feet long. The back straps are of Norway iron, 1 × 6 inches, and the iron suspension rods extending from the tops of the masts to the booms are of 2 inch round iron. The booms are each provided with a trolley by means of which the material may be carried in a horizontal direction. The derricks are turned by men who stand on platforms on the masts, who also operate the trolley by means of chain and worm gear.

The hoisting cables extend to the engine house, which contains six hoisting engines, one for each derrick, each engine being 40 horse power, with a capacity of 7,000 pounds on a single rope. An electric call bell and indicator is provided for each engine, so that the men at the derricks may communicate with the engineer by means of audible and visible signals.

The first work done by the construction company



An Elevated Railroad and Log Carrier for Lumbermen's Use, Etc.

was to put down a 600 foot artesian well in the center of the plot, for the supply of water required for the engines, for building purposes, and for subsequent use. The first two stories of the building are to be of Colorado granite, the balance of Colorado brick. The interior will be constructed with steel beams and fireproof tile arches. The building, together with the plot (125 x 200 feet), will cost $1,880,000.—*Scientific American.*

VALLEY'S RAILROAD FOR LUMBERMEN, ETC.

A railroad of inexpensive construction, and which is designed to be strong and durable, and especially adapted for use in timber lands for getting out logs, or in the neighbourhood of mines, for transporting coal, ores, or refuse, is shown in the accompanying illustration. This road, with a carriage particularly designed for use therewith, having a novel and effective style of brake, forms the subject of five patents issued to Mr. John N. Valley, of No. 643 Jersey Avenue, Jersey City, N. J.

The single rail or track of this railroad is supported by hangers from overhead longitudinally-ranging stringers, which are themselves sustained by downwardly diverging pairs of posts or struts set into (or on) the ground, the tops of these posts being let into opposite sides of the stringer, where they are fastened by a bolt. Where the road curves more or less sharply to the right or left, the adjacent ends of the stringer sections are pivotally connected by means of a pair of links and bolts, but where the road is ordinarily straight, the ends of the sections are simply halved and bolted together. The hangers pass centrally through the timber sleeper, each side of the top outer edge of which constitutes the track, and the lower ends of the hangers are screw-threaded, and carry nuts, on which the sleeper rests. This allows the sleeper to be readily set higher or lower on any particular hanger, to regulate the level of the sleeper and the track rail, by simply screwing the hanger nuts up or down. The hangers are also preferably connected to the stringer by screwing their threaded upper ends into the stringer, thus allowing the hangers to be adjusted higher or lower in the stringer, to supplement the vertical adjustment of the sleeper and rail by the hanger nuts, to level or grade the track.

The carriage designed for use with this railroad is U-shaped in cross section, with upwardly ranging sides supporting the wheels at their upper ends, the frame substantially consisting of two yokes braced and connected together. At or near the top the yokes are connected by side bars bolted or riveted to the legs, and near the bottom they are connected by a tie band extending horizontally entirely around the carriage. At each side the yokes are further braced by two oppositely disposed V-shaped braces, while from near the bottom of the carriage a cross brace extends downwardly and inwardly toward the centre, where it has a horizontal central part on which is bolted a longitudinal drawbar, the upturned ends of which extend beyond the carriage and are adapted to act as buffers, while they are provided with eyes to receive coupling bolts, by means of which several cars may be connected together. To the bottom of the carriage two or more depending hooks are secured for suspending the load, these hooks having each a threaded shank to receive a nut by which the hook is secured in place. At the top of the carriage are longitudinal bars, bent downwardly and outwardly at their ends, and, should the carriage become slightly displaced laterally, the curved ends of these bars will strike the hangers or suspension rods, thus righting the carriage on the track. The axles of the wheels are in the form of bolts, in order to be readily removable for reversing the wheels, as may be desired where the main line of a track is supplied with metal rails, consisting of flat bar iron attached on each side of the top outer edge of the sleeper. In this case the wheel flanges will travel on the inside of the rails, while, with the sleeper alone constituting the track, as would be the case in branch tracks or where the work was light, the wheel flanges would be on its outer side.

This carriage is also provided with a special form of brake, in which the brake shoe extends longitudinally just beneath the track, at the inside of the carriage, and is suspended from a brake lever fulcrumed on the V-shaped brace of the carriage. Vertically extending diverging arms, formed integrally, are bolted to the shoe at their lower ends, the upper end of the arms, at the point of union, being pivoted to a bent portion of the brake lever. The brake shoe is angular, and is adapted to bear against the bottom and one side of the track sleeper. On the inner side of the carriage, opposite the brake shoe, is a beveled surface, whereby, as the brake lever is thrown to bring the shoe against the bottom of the track, the beveled surface of the carriage will cause the shoe also to move laterally, and press likewise against the side of the track.

The construction covered by these several patents admits of considerable modifications, as may be called for on account of the varying nature of the ground in different sections, or the amount and kind of service required. The structure and cars may also be made of metal and wood in such manner as to be serviceable for the transportation of passengers. — *Scientific American.*

COKE AS ENGINE FUEL ON THE B. & O.

BY INSPECTOR T. H. SYMINGTON.

The first steps in any departure from custom in the machinery department of a railroad are generally accompanied by dissatisfaction among the employes, and complaints of the inefficiency of the change. In a great measure the trouble is due to the well-known dislike of both enginemen and firemen for anything new, and also to their fear of incurring conditions that may detract from the efficiency of their engines.

Some time ago the Baltimore & Ohio management decided as an inducement to passenger traffic on its Philadelphia Division, to do away with the smoke and dirt which are always attendant on soft-coal burning. To do this it was decided to burn coke, which, though a troublesome fuel, is entirely free from the objectionable smoke.

After numerous experiments and failures, notwithstanding the strong prejudice of the men against its use, the Motive Power Department now feels confident that certain classes of engines can burn coke successfully under all conditions of service, and under the most adverse circumstances.

At first it was thought that a variable nozzle was absolutely necessary on these coke-burning engines, but after trial those equipped with plain nozzles were found to work equally as well, if not better, and, in most cases, the variable nozzles were removed. On several engines three 2¼-inch thimbles were inserted through the rear end of the boiler so as to admit air above the fire; but these also were found to be unnecessary, and thereafter no changes were made, with the exception of the removal of the brick arch when an engine was changed from a coal burner to a coke burner.

In construction, it was found that the best engines for coke burning were those with large grate area, and with the ordinary extension front. No trouble was experienced from filling up the extension with sparks, as comparatively few particles of coke pass through the tubes and these are thrown from the stack, though not in a state of combustion so as to injure property by fire. The netting should be as large-meshed as possible, for it often gives trouble by gumming over, thus cutting off the draft and preventing the free steaming of the engine. The diaphragm should be arranged as in coal burners, so as to burn the fire evenly from tube sheet to door. Of course the nozzles should be as large as possible, and generally no change was found necessary when changing from coal to coke. The best grate arrangement is one that gives an abundance of air, for the coke being fixed carbon, requires very little if any, air above the fire for its perfect combustion; and should the grates be too close, the gas evolved, instead of being carbonic acid, escapes through the stack as carbonic oxide.

This gas, from its readily combustible nature wastes an enormous amount of heat, and is intensely disagreeable to the lungs.

It is absolutely necessary that the coke should be as free from sulphur and dirt as possible, and there should be no soft, black end caused by the coke being indifferently burnt; nor should it be broken up finely, for, being very light, it is in this condition drawn up against the tube sheet by the draft, and frequently covers the tubes over entirely. The sulphur not only collects over the grates shutting off the air, and burning out the bars, but helps to form the clinker that covers the tube sheet, which is very troublesome to remove, and seriously affects the engine's steaming. The harder the coke is burnt the better does it work as a locomotive fuel, for hard coke is heavy and has more body than that which is only burnt a short while; it is also less liable to be crushed in handling and in transportation. The best coke for the purpose is of bright, glistening silver-grey color; it is heavy and comes in stringy pieces about the size of a husk of corn.

One serious disadvantage from the difficulty of getting pure coke is that the fire has to be drawn at the terminus of every long run, the tubes cleaned out, and the gummy deposit brushed from the netting in the front end. It is a good plan to brush the tubes out after punching them, though this entails a little more time and trouble.

The only extra tools the fireman needs are a scraper with which to clean the tube sheet when clinkered over, and a No. 6 shovel, the ordinary coal shovel being too small to handle coke quickly and effectively, owing to the bulkiness and comparatively light weight of the fuel.

Before leaving the roundhouse the fire should be well under way, and it usually takes about an hour to get it into such shape as to insure steam on a hard run. Should it be necessary to run an engine out before the coke is thoroughly burnt through, it is with the utmost difficulty that any steam at all can be obtained on the run.

Contrary to the original ideas of men, there is no mystery about the fireman's duties in burning coke successfully, for any good coal fireman soon learns the few essential points, and after learning the method generally prefers the coke to coal. The best firemen carry medium-sized, level fires, and by constant attention and frequent light shaking of the grate bars, keep their steam pressure uniform, and prevent the objectionable carbonic oxide gas. Owing to the difficulty of keeping the fire up, however, most firemen prefer not to run the risk of letting their fires get away from them, so carry heavy fires, high near the door and sloping to about 12in. on the drop-gate. By wetting the coke the sharp, cutting dust is prevented from annoying the men on the engine.—*American Engineer.*

WATER AS A LUBRICANT.

Water is a good lubricant if it is rightly applied, says the New York Railroad Men. A knowledge of this fact and the wit to use it at the right moment helped an engineer out of a tight place. He had to take the suprintendent up the road on his engine for an important meeting. The superintendent was in a hurry, and they started out at a pretty lively pace. Everything went smoothly for a while, when the guides on the right hand side began to smoke. The engineer shut off, got down and found that guide in first-class shape as a frying pan, but its efficiency as a guide was seriously impaired. The superintendent got down too, and said "put some water on her quick." "No, sir," was the answer, "if you put water on that guide now you will twist it all out of shape." "What are you going to do?" said the superintendent, "we haven't much more than time to get there now." The engineer said nothing, but he took his wrench and eased off the nuts on the stuffing box studs, enough to allow the steam to blow through past the piston rod. He reasoned that the steam blowing on the hot guide and condensing would cool it just as effectually and much more gradually than eight or ten buckets of water dumped on at once, while the water would at the same time act as a lubricant. They got up and started ahead easy. The engineer watched that guide with some anxiety, for he was not sure of the result. At the end of ten miles he stopped, went down and felt it. With a calm smile and an "I told you so" expression, he pulled out the throttle, drove ahead, and brought the superintendent to his meeting in time.—*Railway Review.*

HOW AN AXE IS MADE.

The first step in the operation of making an axe, is the formation of the axe head without the blade. The glowing flat iron bars are withdrawn from the furnace and are taken to a powerful and somewhat complicated machine, which performs upon them four distinct operations—shaping the metal to form the upper and lower part of the axe, then the eye, and finally doubling the piece over so that the whole can be welded together. A workman stands by, seizing the partially fashioned pieces one after another with a pair of tongs, and hammering the lower edges together. Next the iron is put in a powerful natural gas furnace and heated to a white heat. Taken out, it goes under a tilt hammer and is welded together in a second. This done, one blow from the "drop" and the poll of the axe is completed and firmly welded.

When the axe leaves the drop, there is some superfluous metal still adhering to the edges and forming what is technically known as a "fin." To get rid of this fin, the axe is again heated in a furnace, and then taken in hand by a sawyer, who trims the ends and edges. The operator has a glass in front of him to protect his eyes from the sparks which fly off as the hot metal is pressed against the rapidly-revolving saw. The iron part of the axe is now complete.

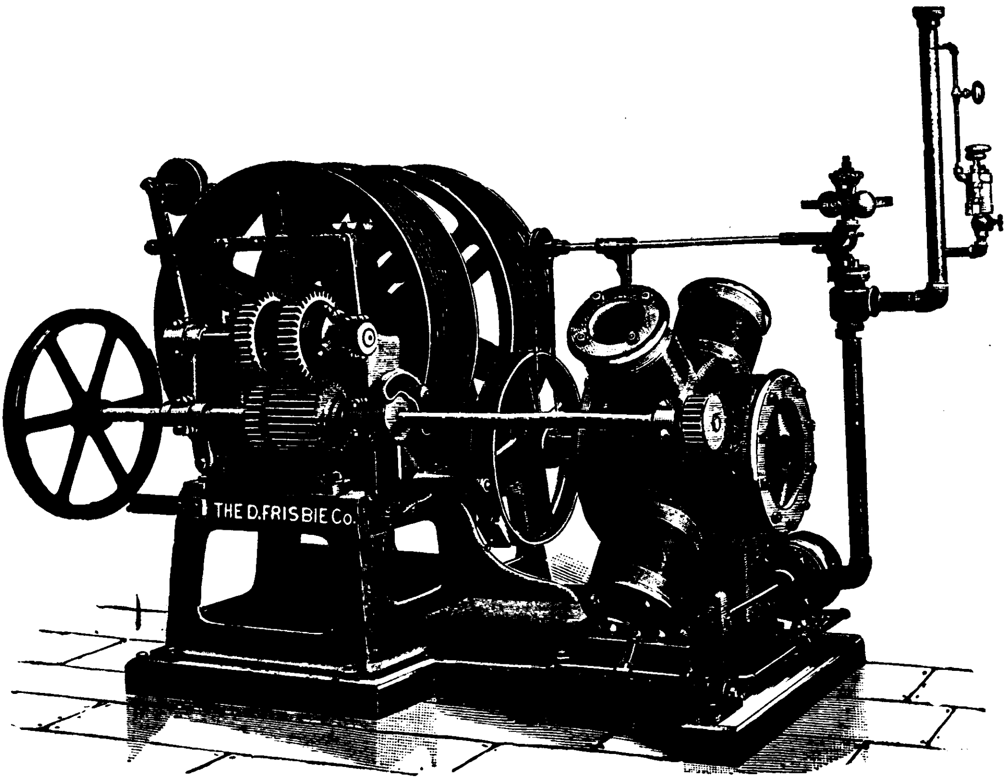
The steel for the blade, after being heated, is cut by machinery and shaped with a die. It is then ready for welding. A groove is cut in the edge of the iron, the steel for the blade inserted, and the whole firmly welded by machine hammers. Next comes the operation of tempering. The steel portion of the axe is heated by being inserted in pots of molten lead, the blade only being immersed. It is then cooled by dipping in water, and goes to the hands of the inspector. An axe is subject to rigid tests before it is pronounced perfect. The steel must be of the required temper, the weight of all axes of the same sizes must be uniform, all must be ground alike, and in various other ways conform to an established standard. The inspector who tests the quality of the steel, does so by hammering the blade and striking the edge to ascertain whether it be too brittle or not. An axe that breaks during the test is thrown aside to be made over.

Before the material of an axe is in the proper shape, it has been heated five times, including the tempering process, and the axe, when completed, has passed through the hands of about forty workmen, each of whom has done something toward perfecting it. After passing inspection, the axes go to the grinding department, and from that to the polishers, who finish them upon emery wheels.—*Manufacturer and Builder.*

IMPROVED PASSENGER ELEVATOR ENGINE.

The accompanying engraving represents a view of an improved passenger elevator engine designed and constructed by the D. Frisbie Company, which is claimed by the manufacturers to possess certain features of merit for its intended service that are peculiar to itself. The reader will be able to form his own judgment upon these points from the following description of the engine and apparatus, which embraces the principal mechanical features:

The engine is of the four-cylinder reversible type, having a constant rotative motion of the crank at the most advantageous angle, and free from dead centers, since two of the cylinders are always at work, taking steam only at their outer ends. The speed attainable is claimed to be unlimited; but, whether running fast or slow, and with any load, from nothing to full capacity of the machine, the motion of the car is always smooth, comparing in this particular with that of the hydraulic elevator.



PASSENGER ELEVATOR ENGINE.

Another important feature of the machine is the steam brake, which acts in connection with the reversing valve simultaneously with the starting and stopping of the engine. The automatic stop motion acts directly on the steam or throttle valve, closing the same at the upper and lower landings. The slack-cable stop acts instantly, stopping the engine in the event of the car meeting any obstruction in its descent. The governor is very sensitive, so that the consumption of steam is always controlled by the load carried; and when the car is not in motion the engine is also at rest, consequently is not consuming steam. The winding drums are connected to the main shaft of the engine by heavy cut-screw gearing, fitted with a patent ball-bearing thrust collar, which reduces the friction to a minimum.

Special attention is directed to the simple and compact form of construction of the engine, there being no strap joints, stuffing-boxes, eccentric rods, belts or binders used, and to the fact that it is fitted with graphite bushings throughout, which require no oil, except that which is used through the cyclinders. It is worthy of notice that builders of double-cylinder engines for elevator work are obliged to double the capacity required to lift the load, for the reason that one of the cranks is as liable to stop on the dead centre as at any other point, and, in this event, one cylinder is left to start the entire load. The elimination, in this engine, of the "dead points," not only gives to it the capacity of doing practically double work, but also to make a large saving in the amount of steam used.

The manufacturers exercise the utmost care in the quality of materials and work entering into their engine, to the end that it may be a safe and efficient elevator machine. As the amount of floor space required is frequently quite an item, especially in a building already constructed, it is in its favor that this engine only requires a space 6 feet square.

WEATHER INDICATIONS FOR OBSERVERS.

Says a weather observer: "When you wish to know what the weather is going to be, go out and select the smallest cloud you see. Keep your eye on it, and if it decreases and disappears it shows a state of the air that is sure to be followed by fine weather; but if it increases, take your overcoat with you if you are going away from home, for falling weather is not far off." The reason is this: When the air is becoming charged with electricity you will see every cloud attracting all lesser ones towards it until it gathers into a shower, and, on the contrary, when the fluid is passing off, or diffusing itself, then a large cloud will be seen breaking into pieces and dissolving.

A MACHINE FOR CUTTING PIPE AND PIPE JOINTS.

The accompanying illustrations relate to a very useful machine devised by F. F. Fenney, an English inventor, for cutting cast-iron gas and water pipe in repairing, making joints, etc., which does expeditiously and satisfactorily what has hitherto required the tedious and expensive method of chipping round and breaking off by hand.

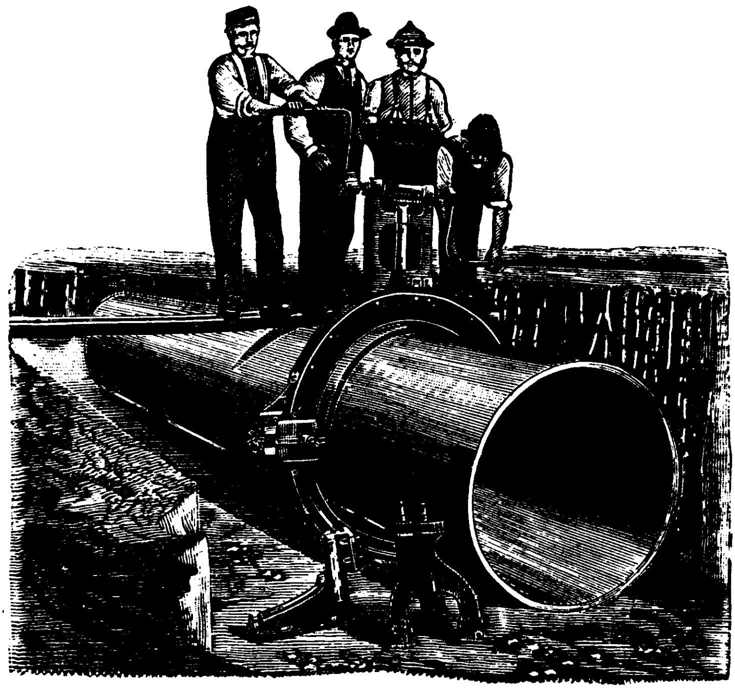


FIG. 1.

By the use of this invention, two men can, when the machine is in place, cut an 18 inch pipe, outside the trench, in less than thirty minutes. When the pipe is in the ground, it is necessary to remove some earth to allow the machine to be placed in position around the pipe. It can then be worked in the trench as shown in Fig. 1. The pipe is then cut without any strain or hammering, and when a valve junction or other fitting requires to be put in, in connection with it, the piece can be cut to the right length before being taken out of the stock. By the method of hand-cutting, the closing piece cannot be cut until after the opening has been made, for the reason that the direction of the break cannot be relied upon in advance. With the use of Mr. Fenney's machine, the pipe can be cut in considerably less than one-quarter of the time by the old method, as no time is taken up in cutting the "closer"; and in addition to the saving of time, the work, it is claimed, is done in a much superior manner.

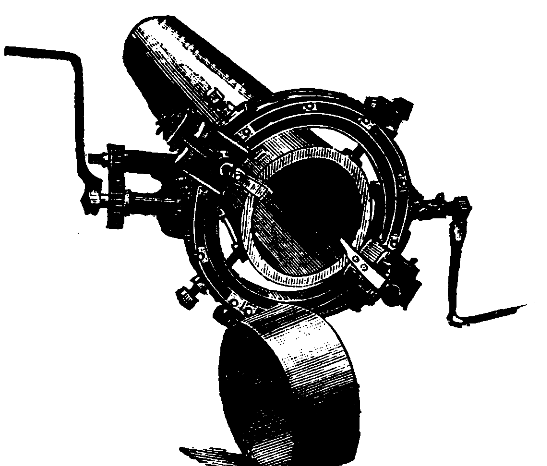


FIG. 2.

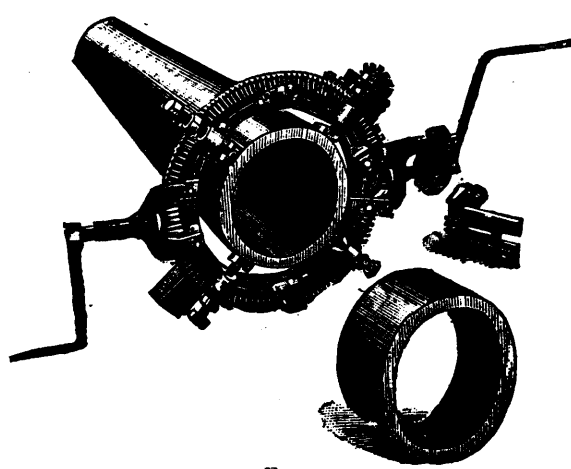


FIG. 3.

All old pipes taken up by the old system, and intended for use again, have hitherto had to be sent to the fitting shop, and turned up, before being used, the cost in loading and unloading, carriage to the works, engineer's charges for turning up, re-loading and return carriage, all being very heavy. Nearly all this can be saved by these machines.

The machine is also useful for cutting out the lead joints for disconnecting pipes, avoiding the waste of about one foot of pipe in each one taken up, by being broken off and left in the socket. The apparatus as shown at Fig. 2, is fixed on an old core bar, which was about 2 inches in thickness and 18 inches external diameter. It was fixed by three inexperienced men, and cut the bar completely through within one hour,

Fig. 3 shows a back view of the machine shown in Fig. 2, and is in all respects similar to that of Fig. 1, except that the large machine requires additional set-screws for fixing it to the pipe.

The utility of this machine has already become generally recognized, and it is coming into general use. The Liverpool corporation has in service one of these machines that cuts pipes up to 44 inches diameter.

A NEW CAR COUPLER.

As every one at all conversant with railways or who reads the records of accidents to the railway employees, knows, a really good coupling for cars is one of the things which have been searched for ever since railways began. The great majority of accidents on railways occur in coupling and uncoupling cars, when the unfortunate brakemen have to get between and risk life and limb in this dangerous work. The devices introduced for working the couplings from the top or sides are numberless, and have hitherto proved practically useless. Then again any new system of coupling that would require to be adopted universally, is practically useless, for any altered form must not only be good in itself, but must be able to be worked with the standard kinds now in use. These points are claimed to be met and surmounted by a new device lately patented by Mr. Walsh, in his Automatic Three-fold Car Coupler. The inventor claims that its own action is by a double horizontal plane coupler, but that by an auxiliary bar it can be used with the Millar coupler which is in pretty general use on passenger cars; while both the principal and auxiliary bars contain provision for use with the common link and pin-coupling found on freight cars. Experts have declared that the Walsh coupler is well perfected in design and meets the wants of railway men. Full sized couplers are now being made which will be attached to ordinary cars and experiments tried in their practical working. These will be looked forward to as tests of the real merit of the invention, and a full report will be given in these pages.

A HOUSEHOLD GAS MACHINE.

The question of lighting country houses is an old problem, and the isolated cases where large mansions have gas-making plant of their own, just show the need for some idea by which a small house can be lighted cheaply and with very little trouble. This problem has at length been solved, apparently very satisfactorily, by what is known as Yarrington's Gas Machine. By it hydrogen gas, after being produced in the usual way from zinc and sulphuric acid, is passed through coal oil, to increase its illuminating power. This, of course, is by no means a new idea, but the trouble hitherto has been how to store the gas as it is produced, and herein lies the beauty of the new machine. Instead of constantly producing gas until the materials are exhausted, Mr. Yarrington, by one extremely simple arrangement, causes the production to cease almost simultaneously with the use of the gas. That is, as soon as the tap is turned off and the use of the gas ceases, the machine automatically removes the acidulated water from contact with the zinc, and gas at once ceases being evolved. The machine remains in this inert condition until the gas is again put into use, and as soon as the tap is opened the machine re-commences making the gas. In this idea lies the whole scheme, and its simplicity and automatic character recommend it as a really practical idea. As to cost, a machine large enough for a large house costs only about $25, so the outlay is not heavy, and the cost of producing the gas is claimed to be under 10c. per thousand. The materials used are perfectly safe, and there is no danger of explosion. The trouble is very small, indeed, and the gas can be used for either illuminating or cooking, so the machine seems as if it had come to stay.

THE PHONOGRAPH IN CANADA.

Edison's Phonograph is now being brought forward as an article of commerce instead of a mere scientific instrument, and any one willing to pay the price can obtain a machine, and as many rollers as he wants. The right of sale in Canada has been purchased by Messrs. Holland Bros. & Young, and already they have succeeded in placing several phonographs. A stock will be carried in Montreal, which will be worked as the headquarters for the Dominion.

SCIENCE IN SOAP BUBBLES.

There is scarcely anything in the world which seems more utterly ouside the realm of law than a soap bubble. The delicate film, with its exquisite floating colors, its power of instantly vanishing, leaving no trace behind, hardly seems as though it could form a link in the inexorable chain of cause and effect which we call physical law.

The atmospheric pressure on a bubble six inches in diameter is over 1,500 pounds, and yet the fragile film lies safely between the opposing forces of nature —the pressure of the outer air, the spring of the inclosed cushion within it, the downward pull of gravity, the upward push of the buoyant atmosphere, and the molecular forces in film itself—so long as the bubble lasts; it is because of an exquisite adjustment of all the forces, physical and molecular, concerned in its existence.

This is, of course, the merest commonplace, and yet it is one of the commonplaces of nature, which, however well we may know them, never cease to be wonderful when they are in any degree realized. There are other laws governing films which are no less wonderful, though they are less familiarly known. A heap of bubbles blown while the pipe is dipped under the surface of soapy water, looks like a chaotic huddle of bubbles of all sizes and many shapes; but, upon careful examination, it is found that never more than three films meet at an unsupported liquid edge, and never more than four edges meet at a liquid point, and that the angles are always equal—that is, films will not meet each other at an unsupported edge or point at an angle smaller than 120°—one-third of a circle.—*From "The Laws of Films," by Sophie Bledsoe Herrick, in the Popular Science Monthly.*

ELECTRICAL

Last month a description was given in our columns, of the two large dynamos recently constructed in Switzerland as being the largest direct current ma chines in the world; but we see by the New York electrical papers that a much larger dynamo of 1000 horse-power has been designed by Mr. F. L. Wilson of the Wilson Aluminum Co. It will be remembered that the dynamos for the Aluminum Industry Co. of Switzerland were 600 horse-power each. The one for the Wilson Aluminum works was constructed in Brooklyn, N. Y., and is to be used for metallurgical work.

The unmistakeable dislike which New Yorkers have for the trolly system of electrical street railways seems rather absurd. Without any experience they condemn it as being both unsightly and dangerous. In fact many of the erroneous opinions regarding the system are facticious, originating in ignorance and prejudice. The N. Y. *Tribune* is one of the loudest in condemning the system. We are indeed glad to see that the New York electrical papers are doing noble work in correcting popular prejudices and inculcating reasonable views of the utility and safety of the much abused trolly.

A description given further on of the electric launch "Electron," recently successfully tried on the Hudson River, will be found suggestive of what is being practically done in electricity. We are indebted to the *Electrical Age* for this interesting article, and only wish we could report a similar experiment on our fair river St Lawerence. At present, however, there seems to be no likelihood of anything of the kind; not because we have not facilities enough for the launching of the boat, but because it would be so difficult to recharge the secondary cells necessary for running the motor. Why does not some enterprising person open an electric boat house at Lachine with small electric launches for hire by the hour, day or season? He could have a small dynamo and oil engine for the purpose of charging the storage cells, and there is no doubt that the enterprise would be sufficiently profitable.

The monopoly that the American Bell Telephone Co. has in the United States is something suprising, but when the patent by which that company is protected becomes known, *i. e.*, "the transmission of waves of sound electrically," one is not only surprised but indignant that such a monopoly should have been possible. For what does it mean? It means an unlimited control of everything that has to do with electrical telephones while it generally results in a careless and badly managed service. This is shown very forcibly in New York, the principal city of the United States, where the telephone service is needlessly expensive. In fact it is a luxury only to be indulged in by the rich; for the exorbitant price, one hundred and forty-four dollars per year, places it out of the reach of the ordinary householder, while a large number of the business firms prefer to do without it. How different it is in Montreal! The telephone here is not a luxury to be indulged in only by the rich. The moderate sum of twenty-five dollars per year, together with a careful and efficient service, makes it almost a necessity in the household, while no business firm can afford to do without it. But how did this happy state of affairs come about? The American Bell Telephone Co. applied to the Canadian patent office for the same patent as that which they had previously obtained in the United States. It was granted to them, under the usual condition that they should commence to manufacture in Canada within one year. The company, instead of doing this, brought on parts of the instruments from the States and put them together here. Mr. W. C. Hibbard of the late Hibbard Electrical Manufacturing Co., well known in this city, commenced to manufacture telephones. The Bell Telephone Co. accordingly appealed for an injunction against Mr. Hibbard, who in turn stated that the above company had not been manufacturing within the true sense of the law. It is hardly necessary to say that Mr. Hibbard won the case, causing the patent to become invalid; and now in Canada, instead of the Bell Telephone Co. having such a platinum-pointed monopoly as in the United States, which in nearly every case results in poor service, it is obliged to compete with other companies, and their instruments with other instruments made by the local electrical supply houses. It may hence easily be understood why it has been said both in the States and abroad, that Montreal has the finest telephone service in the world.

ELECTRICITY IN DOMESTIC LIFE AT THE WORLD'S FAIR.

One of the many interesting electrical features of the World's Fair at Chicago is to be an electric house; that is, a small house furnished with every electrical convenience that man's ingenuity has been able to devise to relieve the cares of the housewife in domestic life. Indeed, electricity is to be made to do about everything. It will cook for the family in an electric range placed at the top of the house, and the food is to be let down to the dining-room by means of an electric dumb waiter. After the meal the soiled dishes are to be washed by an electric dish-washer, with the capacity of 10,000 pieces per day. The rubbing up of the silver knives will also be done by this subtle force, not to mention the ordinary washing and ironing, scrubbing the floors, cleaning the woodwork and windows. The various apartments will be heated and ventilated by electric radiators and fans.

The sanitary conditions will be of the finest, as the sewage and waste generally will be destroyed by an electric current. This last is a welcome application of electricity, for at present it is a puzzling question to know what to do with the sewage of a large city. The master of the house is to have an electric writing telegraph, and needless to say, a telephone and a phonograph, with mailable cylinders, in order that he may communicate with his business friends. The parlor will be supplied with a phonograph ready to record speeches and songs: also electric musical boxes and a musical telegraph. Even the famous prima donna Patti will be there—in figure—to sing her sweet songs by means of a phonograph concealed in her body, not to mention the fact that the figure will be made to reproduce the movements of the singer. It is hardly necessary to say that there will be an electric door bell, an electric burglar alarm, and incandescent lamps which will be turned on at any place where the burglar may enter. In fact the lamps may be turned on all over the house from any one place.

THE ELECTRICAL CONVENTION AT MONTREAL.

The forthcoming Convention of the National Electric Association of the United States which is to be held in Montreal, promises to be the most important exhibition of electrical apparatus that has ever been held on this continent, and the journals across the line are already recognizing this fact. Although many of the large cities of the States put forward their claims to be the place of meeting, yet Montreal has secured the honor, chiefly through the indefatigable efforts of Mr. A. J. Corriveau, who has been elected one of the principal officers of the Association, a position hitherto unoccupied by any Canadian. The Association was originally formed for the mutual benefit of the Central Station men, and the questions discussed relate to all the details connected with the construction, maintenance and working of electric plants. It now includes almost every electric firm in the States, and the present Convention will be the 13th held by the Association. The Citizens' Committee, of which Professor Bovey is President, and Mr. Frank R. Redpath chairman, has secured the Victoria Skating Rink for the Exhibition, but this is likely to prove too small, as already three-quarters of the floor space has been taken by exhibitors and applications are still coming in. Among the exhibitors are the Edison and Thomson-Houston Companies, who will occupy large spaces and exhibit all the wonders of electricity, such as the arc and incandescent lamps, and the same with the alternating system; motors of all kinds; electric car apparatus; electrical apparatus for mining, such as drills, hoists, and locomotives; electric elevators for passengers and freight; machines for welding metals by electricity; meters for measuring electric currents; telephones; microphones; phonographs; and all electrical apparatus and contrivances known at the present time. Among the gentlemen who are expected to be present and take part in the meetings are Mr. Edison; Prof. Thomson, of the Thomson-Houston Co.; Prof. Slattery of the Fort Wayne Electric Co., and inventor of the alternating system known as the Slattery induction system; Prof. Weston; Prof. Crocker, of the Crocker Wheel and Motor Co.; Mr. Tesla, who will give a public lecture illustrated by experiments, and others well known in the electric world. The exhibition will be open from 7th to 16th September, and the Convention will take place on the 8th, 9th, and 10th September, the meetings being open to the public. During the convention, a Conversazione will be held at McGill University, and garden parties and other attractions will be provided for the visitors.

The importance of the meeting to both Montreal and Canada generally can hardly be over-estimated, and the result ought to be that a great impetus will be given to the spread of electricity in both manufactures and business. At present enormous water power is running to waste in all directions, which might easily be utilized in many ways. Electricity in this Province particularly is almost unknown outside of the large towns and the cities, but there is no reason why the bountiful sources of water power should not be utilized and electric plant become as common here as it is among our neighbours across the line.

EXPLANATION OF ELECTRICAL WORDS, TERMS, AND PHRASES.

(From Houston's Dictionary.)

Balance, Wheatstone's, Slide Form of—A balance in which the proportionate arms of the bridge are formed of a single thin wire, of uniform diameter, generally of German silver, of comparatively high resistance.

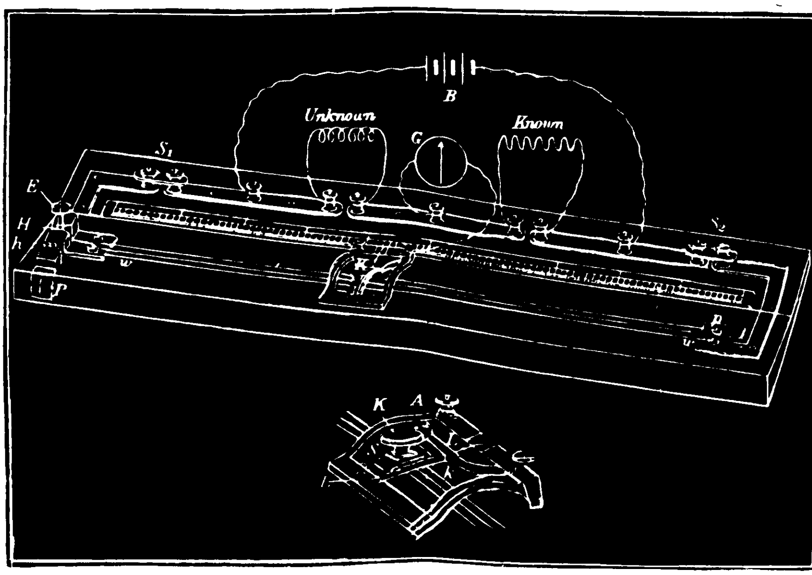


FIG. 45.

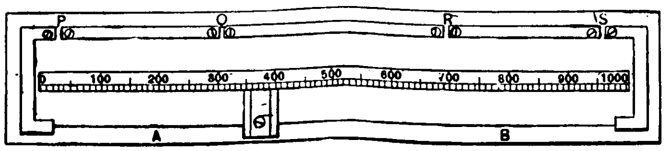


FIG. 46.

A *Spring Key* slides over the wire ; one terminal of the key is connected with the galvanometer and the other with the wire when the spring key is depressed. As the wire is of uniform diameter, the resistances of the arms, A and B, Fig. 46, will then be directly proportional to the lengths. A scale placed near the wire serves to measure these lengths. A thick metal strip connected to the slide wire has four gaps at P, Q, R and S.

When in ordinary use, the gaps at P and S are either connected by stout strips of conducting material or by known resistances, in which case they act simply as ungraduated extensions of the slide wire, and, like lengthening the slide wire, increase the sensibility of the instrument.

The unknown resistance is then inserted in the gap at Q, and a known resistance, generally the *resistance box*, in that at R. The galvanometer has one of its terminals connected to the metal strip between Q and R, and its other terminal to the sliding key. The battery terminals are connected to the metal strips between P and Q, and R and S, respectively.

These connections are more clearly seen in the form of bridge shown in Fig. 45. The slide wire *w w*, consists of three separate wires each a metre in length, so arranged that only one wire, or two in series, or all three in series, can be used. Matters being now arranged as shown, the sliding key is moved until no current passes through the galvanometer.

The sliding bridge is not entirely satisfactory, since the uncertainty of the spring-contact causes a lack of correspondence between the point of contact and the point of the scale on which the index rests.

The loss of uniformity of the wire, due to constant use, causes a lack of correspondence between the resistance of the wire and its length. With care, however, very accurate results can be obtained.

Barad.—A unit of pressure recently proposed by the British Association.

One barad equals one dyne per square centimetre.

Barometric Column.—A column, usually of mercury, approximately thirty inches in vertical height, sustained in a barometer or other tube by the pressure of the atmosphere.

The space above the barometric column contains a vacuum known as the *Torricellian vacuum.*

Bath, Electro-Therapeutic—A bath furnished with suitable electrodes and used in the application of electricity to curative purposes. Such baths should be used only under the advice of an intelligent physician.

Bathometer.—An instrument invented by Siemens for obtaining deep-sea soundings without the use of a sounding line.

The bathometer depends for its operation on the decreased attraction of the earth for a suspended weight, that takes place in parts of the ocean differing in depth. As the vessel passes over deep portions of the ocean, the solid land of the bottom, being further from the ship, exerts a smaller attraction than it would in shallow parts, where it is nearer ; for, although in the deep parts of the ocean the water lies between the ship and the bottom, the smaller density of the water as compared with the land causes it to exert a smaller attraction than in the shallower parts, where the bottom is nearer the ship. The varying attraction is caused to act on a mercury column, the reading of which is effected by means of an electric contact.

Battery, Dynamo—The combination or coupling together of several separate dynamo-electric machines so as to act as a single electric source.

The dynamos may be connected to the leads either in series, in multiple-arc, in multiple-series, or in series-multiple.

Battery, Electric—A general term applied to the combi-

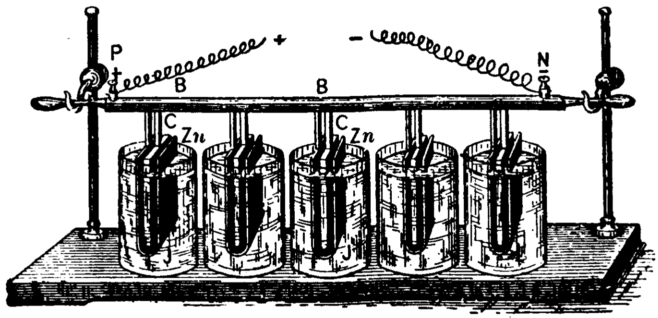


FIG. 51.

nation, as a single source, of a number of separate electric sources.

The separate sources may be coupled either in *series*, in *multiple-arc*, in *multiple-series*, or in *series-multiple*.

Battery, Leyden Jar—The combination of a number of separate Leyden jars so as to act as one single jar. A Leyden

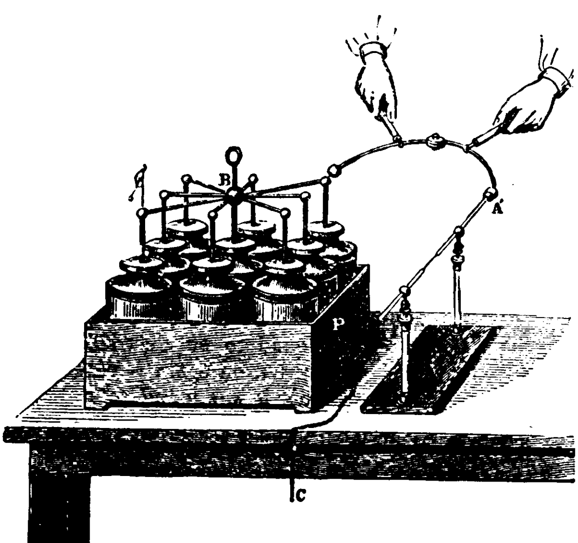


FIG. 49.

battery is shown in Fig. 49, where nine separate Leyden jars are connected as a single jar by joining their outer coatings by placing them in the box P, the bottom of which is lined with tin foil. The inner coatings are connected together by the metal rods B, as shown.

A *discharging* rod A′ may be employed for connecting the opposite coatings. The handles are made of glass or any good insulating material.

Battery, Magnetic—The combination, as a single magnet, of a number of separate magnets.

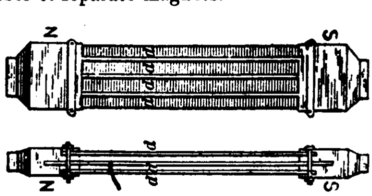


FIG. 50.

A magnetic battery, or compound magnet, is shown in Fig. 50. It consists of straight bars of steel, *p p p*, with their similar poles placed near together, and inserted in masses of soft iron, N and S, as shown.

Battery, Plunge—A number of voltaic cells connected so as to form a single cell or electric source, the plates of which are so supported on a horizontal bar as to be capable of being simultaneously placed in, or removed from, the liquid.

The plunge battery shown in Fig. 51 consists of a number of zinc-carbon elements immersed in an electrolyte of dilute sulphuric acid, or in *electropoian liquid*, contained in separate jars, J, J.

Battery, Primary—The combination of a number of primary cells so as to form a single source.

The term *primary battery* is used in order to distinguish it from secondary or storage batteries.

Battery, Secondary—The combination of a number of secondary or storage cells so as to form a single electric source.

Battery, Selenium —The combination of selenium with another element to form an electric source when acted on by light.

Battery, Split—A voltaic battery connected in series, and having one of its middle plates connected with the ground.

By this means the poles of a battery are maintained at potentials differing in opposite directions from the potential of the earth.

Battery, Thermo-Electric — The combination, as a single thermo-electric cell, of a number of separate thermo-electric cells or couples.

Battery, Voltaic, Closed-Circuit—A voltaic battery which may be kept constantly on closed circuit.

The gravity battery is a closed-circuit battery. As employed for use on most telegraph lines, it is maintained on a closed circuit. When an operator wishes to use the line he opens his switch, thus breaking the circuit and calling his correspondent. Such batteries should not polarize.

Battery, Voltaic, Open-Circuit—A voltaic battery which is normally on open-circuit, and which is used for comparatively small durations of time on closed circuit.

The Leclanché-cell is an excellent open-circuited battery. It has a comparatively high electro-motive force, but rapidly polarizes. It cannot therefore be economically used for furnishing currents continuously for long durations of time. When left on open circuit, however, it depolarizes.

Battery, Voltaic—The combination, as a single source, of a number of separate voltaic cells.

Battery, Water — A battery formed of zinc and copper couples immersed in ordinary water.

Any voltaic couple can be used, the positive element of which is capable of being slightly acted on by water. When numerous couples are employed considerable difference of potential can be obtained.

Water batteries are employed for charging electrometers. They are not capable of giving any considerable current, owing to their great internal resistance.

SIMPLE RULES FOR MEMORIZING ELECTRIC AND MAGNETIC ACTION.

BY S. T. MORELAND.

The purpose of this article is to give simple and easily remembered rules for determining, (1) the direction in which a magnetic needle will be deflected by a given electric current; (2) the direction of an electric current when the deflection of a magnetic needle is known; (3) the direction of the current produced in a conductor which cuts magnetic lines of force having a given direction. It is believed that the rules here given are simpler than those heretofore published. For understanding the rules the following assumptions must be borne in mind :—

1. That end of a freely suspended magnet which points north is called the north end of the magnet; by some called the north-seeking end.

2. The direction of a current of electricity is from carbon to zinc *outside* a cell composed of these elements.

3. The direction (sometimes called the *positive* direction) of a magnetic line of force, is the direction in which the north end of a magnetic needle points when placed on the line of force.

The rules, which will be explained and illustrated below, are as follows :—

Rule I. To find the deflection of a magnetic needle, grasp the current-carrying wire with the *right* hand, the outstretched thumb pointing in the direction of the electric current, then the fingers will go around the wire in the direction of the magnetic lines of force, and on whatever side of the wire a magnetic needle be placed its north end will be deflected in the direction in which the fingers go around the wire.

Rule II. To find the direction of a current, grasp the current-carrying wire with the *right* hand so that the fingers go around the wire in the direction in which the north end of a magnetic needle is deflected; the direction of the outstretched thumb is the direction of the current.

Rule III. To find the direction of the current produced when a conductor cuts magnetic lines of force, place the *right* hand with the fingers pointing in the direction of the lines of force and the palm so turned as to be struck by the moving conductor; then the outstretched thumb will give the direction of the current produced.

Rule I. may be verified by passing a current-carrying wire in a vertical direction through a horizontal platform on which a short magnetic needle, delicately pivoted, may be placed and its deflections observed. Suppose a current flowing up through the wire: Grasping the wire with the right hand, the thumb pointing up, the fingers will go around the wire in the direction in which the north end of the needle points. Apply the rule to the usual case of a wire in a horizontal position and lying in the magnetic meridian. Let the current flow from south to north, geographically speaking; then grasping the wire with the right hand, the outstreched thumb pointing north, we have the following cases :—

(*a*) *Above* the wire the fingers go towards the east; hence, if the needle be placed *above* the wire its north end will be deflected to the east.

(*b*) On the east side of the wire the fingers go *down;* hence, on that side the north end of the needle will go *down.*

(*c*) *Under* the wire the fingers go towards the west; hence, *under* the wire the north end of the needle will be deflected to the west.

(*d*) On the west side of the wire the fingers go *up;* hence on the west side of the wire the north end of the needle will be deflected *up.*

Rule II. may be verified by the vertical wire used to verify Rule I. As an example suppose a horizontal wire in the magnetic meridian carrying a current to be above a magnetic needle, and that we find the north end deflected to the east. To find the direction of the current, grasp the wire with the right hand in such manner that on the *under* side of the wire the fingers go towards the east; the outstretched thumb will be towards the south, and this will be the direction of the current. In the case of any coil of wire carrying a current, the direction in which the north end of the needle is deflected indicates the direction in which the lines of force pass through the coil, and if any part of the coil be grasped with the right hand so as to make the fingers pass through the coil in the direction of the lines of force, the outstretched thumb will point in the direction of the current.

Rule III. may be verified by means of a magnetic field where the direction of the lines of force are known, and a movable conductor forming part of a circuit including a suitable galvanometer. The rule is based on the very valuable suggestion, due to Mr. E. R. Carichoff, electrical engineer, that, just as a whip wraps around a rigid rod when it strikes one, so a line of force seems to wrap around any conductor which it strikes, and if we know the direction in which the lines wrap around the conductor we can tell the direction of the current by Rule II. Now the hand behaves just as the whip does; if we strike a rod with the palm of the hand (at right angles or nearly so to its length) the fingers will wrap around the rod, we have then only to put the right hand in the position of the lines of force, the fingers pointing in the direction of the lines and the palm turned so as to receive the moving conductor in order that the fingers may wrap around the conductor, the outstretched thumb will give the direction of the resulting current.

As an example, take a movable wire lying east and west and forming a part of a circuit, and suppose the wire moved *up.* The earth's lines of magnetic force go towards the north; the fingers of the right hand are therefore pointed north, and since the wire is to be moved up, the hand must be placed above the wire with the palm *down;* the outstretched thumb will then point west and this will be the direction of the current. If the wire be moved *down,* the fingers being towards the north, the hand being *below* the wire with the palm *up,* the thumb will point east and the direction of the current will be to the east.

It ought to be remarked that we do not suppose that a line of force which strikes a conductor actually wraps around it; on the contrary, we suppose the lines of force to cut across the conductor, *but the effect so far as the conductor is concerned is as if they wrapped around it.*

This use of the right hand is not the same as the use made of it by Prof. Jamieson in his excellent little books on Magnetism and Electricity, but the rules here given grew out of the reading of those books and the suggestion already mentioned, given me by Mr. Carichoff.—*Electrical Engineer.*

A YACHT PROPELLED BY ELECTRIC POWER.

On the afternoon of June 11th a strange-looking craft made an exhibition trip up the Hudson River and attracted much attention from river pilots and the people along the docks. What attracted their attention was not the shape of the boat —for that was not unlike that of any other of its size—but the fact that she was passing through the water at a rapid rate, while the familiar accessories of a steam craft were missing. There was no smoke funnel, nor escaping steam; in fact there was no external evidence of the power that propelled the boat. She had two sail spars, but the sails were furled; what power, then, was used to drive her? was the question asked by those on shore. Electric power was suspected, and such it was.

The name of this unique craft unlocks the secret of her power; it was the electric propeller "Electron." On the date mentioned a trip was made up the river a short distance in order to demonstrate to a few invited persons, including a representative of the *Electrical Age*, the practicability of propelling a boat by electricity.

The "Electron" is a trim craft with an iron hull, 75 feet long and 13 feet beam, and is of the screw propeller type. She was built by James Bigler, the well-known steamboat builder, Newburgh, N. Y., who was on board during the trip.

Her power plant consists of 376 accumulator cells made by the Electrical Accumulator Company, of Philadelphia, and a motor made by the Electro-Dynamic Company of Philadelphia.

The motor is of 15 horse power, shunt wound, and runs at three speeds, viz.: low, 400 to 500 revolutions a minute; intermediate, 700 revolutions, and high, at 1,300 revolutions. Carbon brushes are used, and the armature is of the Gramme ring type.

The motor is placed in the bottom of the yacht, and is coupled directly to the propeller shaft, but electrically insulated therefrom. In fact the entire motor is insulated from the boat.

The captain, or pilot, has full control of the power apparatus, all of the switches and controlling devices being placed in the pilot house. This contains a reversing switch, which is connected with the armature, for the purpose of reversing the direction of the revolutions of the shaft; a 9-point rheostat switch, by the operation of which resistance is thrown in and out of circuit as desired; a double pole motor and charging switch on a common base, and a cell switch which effects the different combinations of cells. On the first point of the latter switch all of the cells are in series; on the second point they are divided into groups of 2 in multiple and 2 in series, and on the third point all of the groups are in multiple. There is also in the pilot house a voltmeter and an ammeter, both of the Electro-Dynamic Company's make, the latter being always in circuit. The voltmeter is so connected that the voltage can be taken across the cells and also across the charging circuit. A 4-point lamp switch is also placed within easy reach of the pilot. By means of this switch the lamps can be cut in on any one of the groups of cells, in this way equalizing the discharge of the cells.

An automatic break switch is to be put in later, for the purpose of automatically breaking the charging circuit when the line pressure falls below a predetermined point.

The accumulators are arranged in 4 tiers on each side of the boat, with ample space between to enable easy examination of the cells. This arrangement is an extremely convenient one, admitting of easy examination of each cell. The batteries are placed below the floor, along the bilge of the boat, thus being out of the way and yet convenient to get at. Besides, it brings the weight below the water line, where it is most needed. As a result of this the boat is, in the language of the sailor, quite "stiff," and possesses good heavy weather qualities for so small a craft.

The motor is placed in the after cabin, underneath the floor in the manner already described. At full speed the motor takes 376 volts; at the medium speed 188 volts, and at the slow speed 94 volts. Okonite wire is used throughout.

The propeller is 26 inches in diameter, with a lead of 15 inches. It is intended, however, to replace this with one of 27 inches in diameter and 12 inch lead, which will increase the speed of the boat with the same power. When this change is made it is calculated that the yacht will make from 9 to 10 miles an hour on the medium speed of the motor and from 12 to 13 miles with the motor going at the top speed.

The propeller is made of phosphor bronze, which metal is used almost altogether for propellers, on account of its great strength.

The "Electron" is to be used as an excursion yacht this season at Atlantic City, N. J., and will sail about the inlet. On pleasant days she will make ocean trips. She is to be run by the Atlantic City Steamboat Company. Mr. James M. Bigler is at present in command of the "Electron," and handles the boat from the pilot house with great facility. The electric plant is in the charge of Mr. W. E. Harrington, superintendent and managing electrician of the Atlantic City Electric Railway.

The charging current will be taken from the wires of the Atlantic City Electric Railway. On the trip the entire absence of jarring and grinding of machinery was very noticeable and the boat forced her way through the water as quietly and easily as a sail boat. There was none of the shaking so common on steam vessels and as far as this trip goes to show, the "Electron" is a triumph in navigation by electric power.

The promoters of this enterprise are to be congratulated on their success and, no doubt, the performance of the "Electron" this summer will be watched with a great deal of interest by electrical engineers. It is an experiment, of course, but there is no gainsaying the fact that so far success has attended the performance of the vessel and its power plant.

At normal consumption of current the accumulators will give sufficient power to run the yacht from 10 to 12 hours on one charge.—*Electrical Age*.

ELECTRIC NOVELTIES.

The electric current is now rendering a variety of useful services to man, and is justly entitled to be considered one of the most potent factors in the evolution of modern civilization. Where and when the limit to its usefulness is likely to be

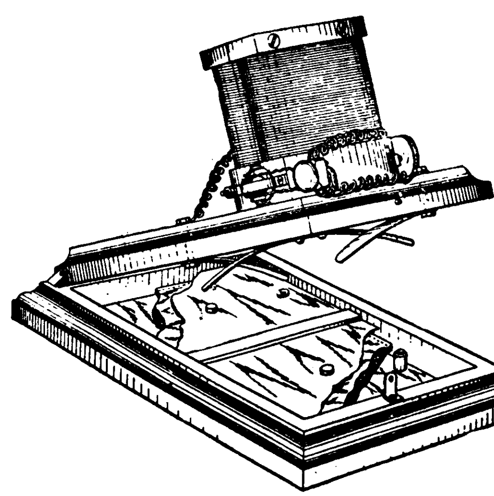


FIG. 1.

found or reached, it is impossible to declare; for scarcely a day passes but some new device is placed on the market, and the subtle force is impressed into a new service. Capital is being

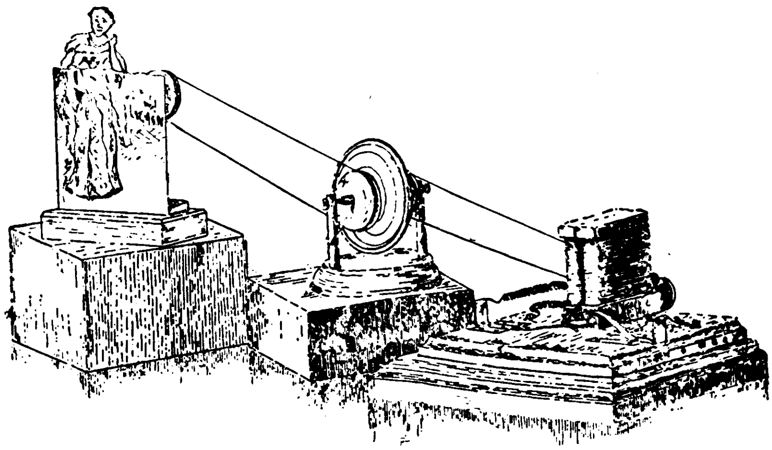


FIG. 2.

rapidly invested, and money made in thus increasing the usefulness of electricity, at the same time adding to the general sum of human convenience and happiness.

But since there happens to be a very large proportion of the human race which has not yet entered upon the stern conflicts and the troubles of life, "the little men and little women," our children, still to be considered and catered for, it is not to be wondered at that they, too, are to have a share in the wonderful achievements of modern electrical science—with what success to the caterers, a glimpse at the bustle and stir going on day after day in several electrical factories where this class of work, electrical toys, is being wrought, will convince.

Prominent among these companies is the Electro Novelty Co., whose well-equipped factory is on Knapp Street, Boston, whose specialties are "Simplex" electric engines and toys of various kinds to be operated by the same.

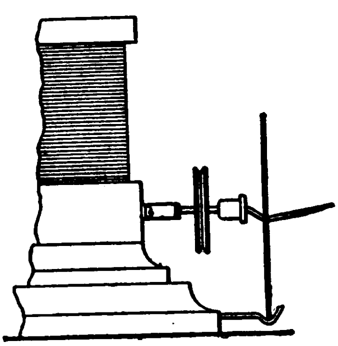


FIG. 3.

This company has been organized by gentlemen well known in the electrical field, and the devices they are manufacturing have been designed by them.

The Simplex electric engine may be considered the foundation of their business, for by its use all the other devices are operated. It is a diminutive motor operated by a primary battery of quite unique design, enclosed in the pliuth or bed plate on which the engine stands.

Fig. 1 shows this little engine slightly tilted up from the bed plate, being secured at one end by a pair of hinges, and showing the principle of construction adopted in making the battery. As will be seen, the carbon and copper plates lie in the shallow dish or saucer submerged in the necessary solution, contact being made by means of brass springs, as shown under the engine. Though the dish, or cell, as it should correctly be called, is very shallow and the carbons and zincs flat and thin, with one charge of solution the engine will run for five hours. The design of the motor or engine, as will be seen, is somewhat similar to certain well-known types. The field magnets are elongated castings standing on end, the poles being towards the bottom of the magnets. The armature revolves in a field near the bed plate, thereby insuring stability in running. At the end of the armature shaft is secured a pulley of small diameter.

So finely constructed are these small engines, that for most purposes the driving belt is little more than a piece of ordinary black sewing thread, which is strong enough to operate the mechanical figures which may be connected.

Fig. 2 shows such a figure. It is that of a Japanese maiden strumming on a guitar. The right arm of the figure is loose at the shoulder and connected with a slender crank on the pulley round which the driving cord runs. When in operation this arm has the natural movement of a real live player. As will be seen in this cut, the speed is regulated by a countershaft and pulley, though many of the toys are operated directly from the driving wheel on the end of the armature shaft.

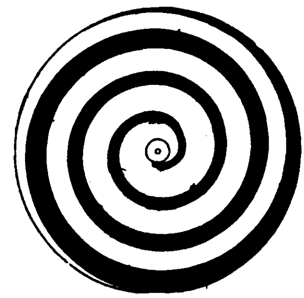


FIG. 4.

The company has quite a large variety of funny mechanical figures which are thus operated, and for which there is setting in an enormous demand from all parts of the country. They provide unlimited amusement for the children ; and even adults cannot always restrain themselves from smiling as they watch the violin playing of a cat, the wry faces of an industrious cobbler as he stitches away at a pair of boots, as the irrepressible drummer raises his hat with one hand, shakes his customer with the other, and seems to be asking in the blandest manner for an order, the butcher chopping sausage meat, etc.

Some very pretty chromatropic effects and geometrical illusions are likewise produced by means of discs covered with various figures and different colors or having a spiral line drawn upon them from the centre.

Fig. 3 is a side view of one of the Simplex engines having one of these cardboard discs mounted on the armature shaft, while Fig. 4 is a front view of a disc having a spiral drawn upon it, which when revolving on a centre gives a very singular effect.

These specialities are decided novelties in every way; the engine and battery are unique in design, small, compact, and well made. They are bound to sell by thousands the coming fall and winter. Already the demand exceeds the supply, and the company is kept busy right along. They promise many other novelties in the toy line ere long.— *Modern Light and Heat.*

ELECTRICITY FOR POWER PURPOSES IN THE CITY OF MONTREAL.

BY W. B. SHAW.

The electric motor, such an excellent source of power, and which has already become a fast favorite in the neighbouring republic, is slowly but surely coming into vogue in this city, therefore a few remarks on motors in general, and the localities where power is available for the same, may not be out of place at this time.

In the writer's opinion motors over 25 H. P. cannot compete financially, (in this city at all events,) with steam power: but for those desiring to rent less power, nothing better can be had (looking at the question from other points than the financial), than the motor. The seller in most cases will instruct the user how it is handled, and no doubt give a couple of inspections gratis; at first, to see that his or their instructions are being faithfully carried out. Coal; water; boiler; engine; engineer, and stoker, are all displaced by the motor. The motor in all cases is purchased by the user. The writer has never heard of any motors being leased.

Carbon brushes are for various reasons strongly recommended. A new set of brushes may be required yearly, but apart from that and the cost of the electricity, the only other expense is the oil for lubricating. Needless to say, this must be of the best, as a motor is a high speed machine.

Voltage means pressure; therefore low voltage, say 110, is preferable. As voltage increases so, as a rule, does speed of motor, as well as the risk, although the limit between comparative safety and otherwise, may be placed at 550 volts. The following table, showing what motors are in use and where located, may prove of service.

Voltage.	Make.	Used for.	Locality.	H. P. of Motor.	Motor installed by.	Power furnished by.
250	Edison.	Elevator.	Victoria sq.	?	Edison G. E. Co.	Perrault P't'g Co.
250	Thomson.	Printing.	Craig st.	3	Royal Elec. Co.	Royal Elec. Co.
110	Sprague.	Elec. Goods Manuf'g.	"	5	T. W. Ness.	Gazette P't'g Co.
110	"	Brass Finishing.	"	5	T. W. Ness.	"
250	Eickmeyer.	Elevator.	Notre Dame st.	?	Miller Bros. & Toms.	Royal Elec. Co.
220	Thomson-Houston.	Plate Glass Grinding.	St. Paul st.	10 ?	Perault P't'g Co.	Perrault P't'g Co.
250	Thomson.	Printing, also hoist.	St. James st	?	Royal Elec. Co.	Royal Elec. Co.
250	"	Jewellers' Work.	"	2	"	"
250	"	Confectioners' Work.	"	3	"	"
110	"	Cash System.	St. Catherine st.	5	"	H. Morgan & Co. Private plant.

The following first class motors besides those already mentioned, also appealing for public favor, are:

"Connecticut,"
"Perret,"
"Crocker-Wheeler."

By the foregoing table a general idea may be gained as to where electric power is procurable.

The alternating current, such as is supplied to various stores by meter for incandescent lighting, cannot be used for power purposes. A small specially wound motor of ⅛ H. P. for driving a ventilating fan, however, is practicable. The arc light circuit in the streets will not be opened for power purposes.

To drive a motor over ⅛ H. P. by means of batteries is practically impossible. A well known firm received a letter to the following effect:— "I am a baker and wish to run a 5 H. P. motor; as I am building new premises please say how much room I should leave in same for Leclanché batteries to run it." If a person will consider for one moment the cost of energy which is produced by the action of chemicals on zinc, he will immediately realize the absurdity of talking "horse-power" in connection therewith.

The 110 and 220 volt motors are supplied by contract at so much per annum. The 250 volt, although at present on contract, will be soon placed on the meter system. The charge will be 7½ c. per H. P. per hour. A good motor will draw current (amperes) in proportion to its load, so that customers must not calculate metered power as follows:

1 hour = 7½ c. per H. P.
1 day: 10 hours = 75 c. per H. P.
300 working days: 1 year = $225 per H. P.

On these terms, electricity would be indeed expensive, but the above would *only* hold good where the motor is run to its full capacity and had on a steady load all day. But as a piece of machinery is stopped, the motor draws less current, consequently the meter will register less.

Shunt wound motors are as a rule most generally used. To take a motor and attempt to run it on same conditions as a dynamo for producing power, is not a success, although the contrary holds goods, that a dynamo will run well when used as a motor.

We trust the foregoing may prove acceptable to those interested in electricity as a motive power in the city of Montreal.

THE USE OF SLATE FOR ELECTRICAL PURPOSES.

BY T. J. MURPHY.

If the electrical industry has found new uses for mica, porcelain, lava and other known insulators, it has certainly done wonders for the producers of slate. Formerly this article had its greatest sale for mantels, lamp bases and washtubs, to say nothing of the ordinary school slates; but recent experiments show that a species of slate quarried in Vermont is among the best known insulators where a large area is to be covered, such as switchboards and the like; it is even displacing the use of hard rubber and fibre for many smaller articles, on account of the various styles of finish which can be given to the slate, such as imitation of all the different kinds of wood, blood-stone, Tennessee marble, hard rubber—either dull or polished—the slate retaining its moisture resisting and fireproof properties, for which it is superior to any other material now in use.

Slate one inch thick weighs about 14 pounds per square foot, and when it is of the select quality is easily drilled and tapped so that machine screws can be used. Recently a New York construction company drilled 12,000 one-fourth inch holes in a piece of slate containing only 22 square feet, ⅝ of an inch thick. It withstood shop handling and transportation, and considering that the holes were only one-fourth of an inch apart it speaks well for the strength of the slate.

The best slate for electrical purposes, as stated, is found in Vermont, where, probably owing to the absence of iron ore and other metals, the slate is much purer than that quarried elsewhere. Soft slate has a slightly greenish color, although it is frequently found in "purple stock" and other colors.

It is found that "marbleizing" slate adds to the moisture resisting qualities of it, besides giving it an artistic effect, which is greatly increased when moldings are used in connection with it. It has also been found that Pennsylvania slate, besides containing iron, is harder to drill, and there is consequently a more rapid wearing away of the edge of the drill, and careful tests have demonstrated that the selected Vermont slate is the best for electrical purposes. The Manhattan Building, on Wall street, New York City, is equipped with a fine slate switchboard, built by the Eureka Electric Company, which has also furnished one to the Gerlach Apartment House, on West 27th street. The American Bell Telephone Building, in Boston, has recently added a slate switchboard, built by the Western Electric Company, and the Manhattan Electric Company, New York City, has placed in position an incandescent switchboard in the station at 30th street and Avenue B, the board being built by V. Prentis, 303 Kent avenue, Brooklyn. This gentleman formerly used Pennsylvania slate, but found it so expensive, on account of the cost of drilling, that he concluded to make a change. He secured some Vermont slate and found that he could drill it in about one-half the time, and it was also found to test up better.

Where switchboards are made in sections it is well to make a drawing or give the exact dimensions, and indicate where screw holes are to be, so that the switchboard can be drilled before marbleizing, although it can be drilled afterward if care is taken to start the drill on the marbleized side, for if drilled in from the back the finish is liable to be cracked off very much like a veneer.

After slate has been quarried and sawed into marketable thickness, which is generally about one inch, it is "flowed," *i.e.*, a composition paint is poured over the surface. It is then put in a kiln or heating oven and kept for several hours at a temperature of about 150 degrees. If it is to be of a higher finish a second coat is given to it, and it is again baked the same as before. It is then rubbed with fine pumice stone until a smooth surface is had, after which a coat of fine varnish is applied and it is baked once more. In fact, the finishing of it is very much similar to the finish given piano cases, only, of course, not so highly polished. The slate can be bevelled or any of the ordinary forms of moldings can be given to the edge. Frequently a separate molding of a different finish is placed around the board to frame it.—*Electrical World.*

AN ELECTRIC CARRIAGE.

A novelty among vehicles in this country—an electric carriage—is now being constructed at the factory of M. W Quinlan in Brookline, from plans drawn from a photograph of a similarly propelled carriage in present use in London. Because of the very limited information furnished by these plans the work of construction which has been going on for some weeks was made necessarily slow and it is thought that it will take several weeks more to complete it.

Being simply an experiment, no attempt was made to make something in which people could ride; and in appearance, therefore, it is nothing more than a large box with a seat for the steerer on the forward end, as in any ordinary wagon.

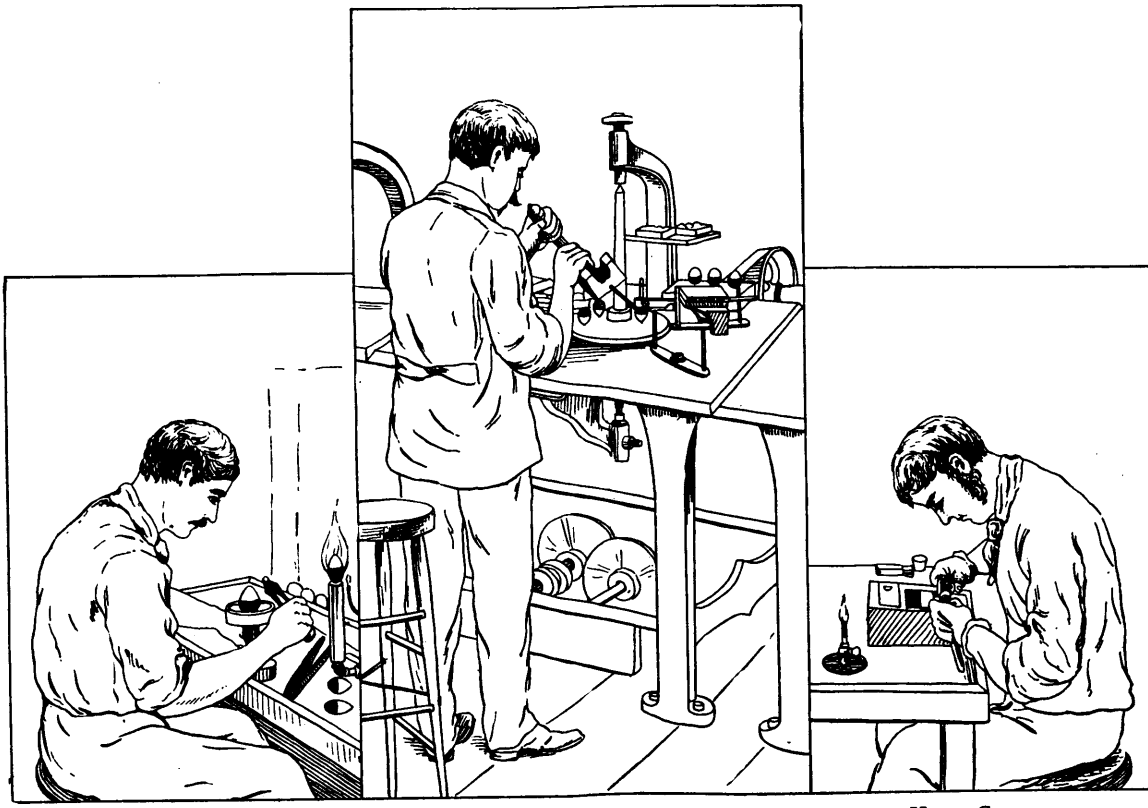
The body was built by A. M. Wood of Beverley street, Boston, and is made of seasoned hickory. The springs and axles are from the works of the Tomlinson Spring Company of Newark, N. J., and though strong and heavy, are of the ordinary pattern. The Holtzer-Cabot Electrical Company made the battery, which contains thirty-two cells and is placed in the rear end of the body. The motor is one of foreign manufacture, and is located between the hind springs where it is attached to the body by two hinge clasps in such a manner as to allow it to swing when the motion of the carriage is irregular, although this swing is regulated by a connecting rod between the axle and motor. The driving shafts of the motor extend on either side beyond the springs, and are fitted with cog-wheel attachments which connect by an endless chain to larger cog-wheels on the inner side of the rear wheels, and thus propulsion is furnished. The steering apparatus is situated on the left side of the coach platform, and the steering is done by a ratchet attachment underneath the platform. In case of accident to the motor, shafts can be fitted to the carriage and horses attached. When completed, the whole will weigh about twenty-five hundred pounds. All the electrical work is done by the Holtzer-Cabot Company, under whose supervision the carriage is building, although it is understood that several others are interested in its success.—*Boston Transcript.*

DIAMOND CUTTING BY HAND AND MACHINE.

Modern diamond cutting is an art which for many generations was practically confined to one city, Amsterdam. In India the natives cut the gems, but they did not follow the rules of shape which have found acceptance with the Caucasian nations. Some twenty years ago the industry was introduced in this country. This was at about the time of the discovery of the South African diamond fields. Mr. I. Herrmann, a jeweler of this city, succeeded in finding among the Dutch who had immigrated to this country a number of diamond workers who from force of circumstances had abandoned their trade and had adopted other occupations. He opened a shop in this city, where much work was done.

The industry spread more or less, and is now firmly established in several places in the United States. The jewelry firm of Tiffany & Co., of this city, among others, have in operation a shop in which diamonds are cut and polished from the rough, and are recut when the original cutting as performed in Amsterdam or elsewhere has not left them of satisfactory brilliance. The work is in charge of the foreman, Mr. Geo. H. Hampton, to whom we are indebted for attentions shown in connection with this article.

The operations of shaping a diamond are three, and may be four, in number: cleaving, cutting, setting and polishing. Each operation is a trade by itself, and very few ever learn to do more than one or two of the four steps. Cleaving is often dispensed with; the other three are necessary. The favorite shape into which every stone of any value is worked is the brilliant. This consists approximately of two truncated pyramids placed base to base. The line dividing the two pyramids is called the girdle. The upper portion is the crown, with a



CLEAVING. POLISHING ON HORIZONTAL WHEEL. HAND CUTTING.

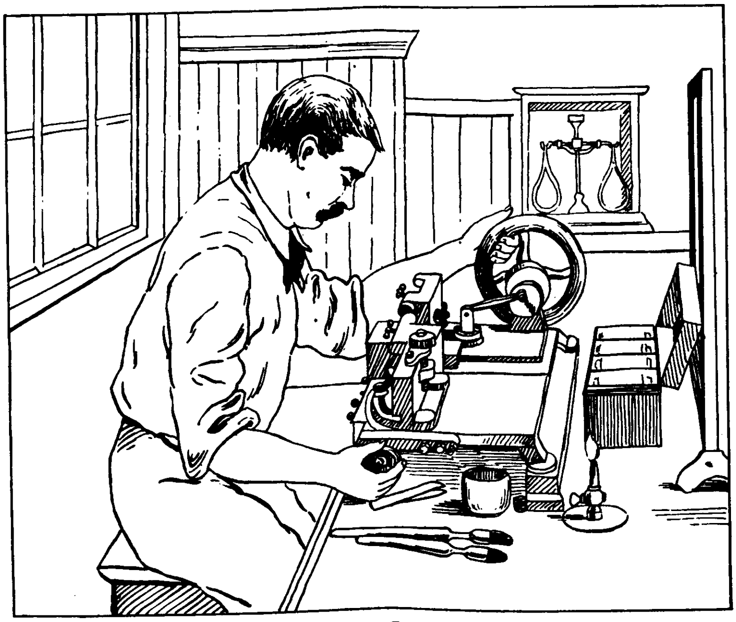
flat face called the table on top. Below the girdle is the collet. If properly cut, this shape brings out the fullest possible brilliancy of the gem. So important is this quality, that it was deemed advisable to recut the Kohinoor diamond to develop its brilliancy, although many karats were lost in the operation.

Cleaving consists in splitting off pieces of a diamond. By inspection striations can be detected in the rough gem by which its cleavage plane is determined. The stone to be thus treated is mounted in cement upon the end of a wooden handle. Upon a second handle a sharp-edged fragment such as has been cleaved from another diamond is mounted. The diamond has a little notch made in it by the cleaver pressing and rubbing against it the edge of the fragment. This marks the place for starting the cleavage. A cutting box is used in making this notch. This is shown in the illustration in use for regular cutting. It is a small metal box from whose edge two brass pins or studs rise, against which the spindle-shaped handles are pressed in the cutting operation. The cleaver holds a handle in each hand, pressing them against the pins and edges of the box. The ends carrying the diamonds project over the box. He then scratches or cuts a notch at the desired place. Next, placing the handle carrying the diamond to be cleaved on its end upon the table, he holds a blunt-edged knife of steel firmly upon the notch and gives the back of the knife a gentle tap with an iron rod. The piece at one blow splits off and leaves a bright face. Considerable skill and judgment are needed to perform this critical work, but it is by no means such a mystery as it has been represented to be.

The cutting operation is conducted with heavier handles over the cutting box just described. One diamond is rubbed against another, both cemented on the ends of handles, over the box, and the abrading goes on rapidly. Here a peculiar skill is needed to give the right stroke. Without it true cutting will not be effected. The left hand stone is the one which receives the final cutting ; the right hand stone gets its first rough shaping only. The box has a movable receptacle below to receive the dust. A fine wire gauze screen is above it, to catch any cement which may fall.

A machine has been introduced for performing this work which is in constant operation in the Tiffany shop. It is essentially a planing machine. It contains a fixed adjustable abutment and a reciprocating abutment forming a species of slide rest. These correspond to the right and left hand handles of the hand cutter. The diamond receiving its final cutting is secured by cement in a cup with spindle, which spindle is inserted into a hole in the left hand carriage or reciprocating slide rest. The right hand abutment receives a second cup, with the cutting diamond held in it by cement. Quadrant adjustments and feed screws are provided for shifting the fixed abutment in any desired direction. By turning the hand wheel back and forth through a small arc of a circle, the carriage with the diamond to be cut is made to reciprocate back and forth. By the feed screws the other diamond is brought into contact with it and the cutting begins. A face is rapidly worn upon the stone. The operator feels as well as sees the progress of the work.

As one face is done the cup is removed, the cement is softened by heat, and the stone is turned so as to present another face or corner to be operated on. In this way the gem is soon brought into its approximate shape. The machine is the invention of Charles M. Field, of Boston, Mass., and is only the third in use. It does not entirely supplant hand cutting, as much trimming and shaping of the girdle or outline of the stone is still done by hand. Although designed



The Field Diamond Cutting Machine.

to be driven by power, this is not found practicable, because the cutting, as already explained, is partly a matter of feeling as well as of sight.

Having been roughly shaped by cutting, and perhaps also by cleaving, the diamond has next to be set in alloy for polishing. A brass cup with a copper wire handle called a "dopp," is used for this purpose. An alloy of lead and pewter is used to fill it and is built up in acorn shape. When of the consistency of putty, like plumbers' solder when a joint is being wiped, the diamond is inserted in the apex. With a stick, or with the fingers, the hot metal is wiped away so as to give the right exposure.

After cooling it goes to the polisher. The wire stem of the "dopp" is fastened in the end of a wooden clamp. The operative in the upper central figure is seen holding one and examining the diamond in the "dopp." The clamp is next placed on the table steadied by a couple of pins secured thereto. A horizontal disk of iron cut or scratched in approximately radial grooves is mounted in the center of the table, and rotates at a speed of 20,000 to 25,000 revolutions per minute. The speed is so high and the motion so steady that the disks seem motionless. As the clamp is placed on the table, the diamond at its end rests upon the disk. The latter is charged with olive oil and diamond dust from the cutting boxes. After a few seconds the polisher removes the clamp and examines the stone. By pushing the cup he bends the wire one way or the other, so as to get a proper bearing. One or two trials are made. When all is right some lead weights are placed upon the clamp and it is left to itself. The polishing, which is really cutting to a considerable extent, now goes on, and lasts for a variable time, according to the work to be done.

The polisher becomes very expert in seeing what is going on by inspecting the diamond, as well as in detecting by the feel of the clamp how the diamond is resting on the disk. Even the bending of the wire of the dopp requires considerable skill.

The modern system of diamond cutting is said to have originated in 1456, with Louis Bergnen, who established a regular guild of diamond cutters at Bruges in 1470. Since then the art gradually centered itself in Amsterdam, and now only is beginning to spread to other cities.—*Scientific American.*

POLISHING WOOD WITH CHARCOAL.

A method of polishing wood with charcoal, which is much used by French cabinet-makers, is thus described in a Paris technical journal:—

All the world knows of those articles of furniture of a beautiful dead-black color, with sharp, clear-cut edges and a smooth surface, the wood of which seems to have the density of ebony. Viewing them side by side with furniture rendered black by paint and varnish, the difference is so sensible that the considerable margin of price separating the two kinds explains itself.

The operations are much longer and more minute in this mode of charcoal polishing, which respects every detail in carving, while paint and varnish would clog up the holes and widen the ridges. In the first process they employ carefully selected woods, of a close and compact grain, then cover them with a coat of camphor dissolved in water, and almost immediately afterward with another coat, composed chiefly of sulphate of iron and nut-gall. The two compositions, in blending, penetrate the wood and give it an indelible tinge and render it impervious to the attacks of insects. When these two coats are dry, they rub the surface of the wood at first with a very hard brush of couch-grass (chien dent), and then with charcoal of substances as light and friable as possible, because if a single hard grain remained in the charcoal, this alone would scratch the surface, which they wish to render perfectly smooth. The flat parts are rubbed with natural stick charcoal, and the indented portions and crevices with charcoal powder. Alternately with the charcoal, the workman also rubs his piece of furniture with flannel soaked in linseed oil and the essence of turpentine. These pouncings repeated several times cause the charcoal powder and the oil to penetrate the wood, giving the article of furniture a beautiful color, and a perfect polish, which has none of the flaws of ordinary varnish.