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BLUNDERS IN ELECTRIC LIGHTING.

We have long been of opinion that electric light Corporations do not exercise sufficient care and caution in the locating and erecting of stations where the conversion of steam power into electric energy is intended to take place.

It is pretty generally admitted that the great drawback to the more general use of electric light in preference to gas for illumination is its cost; hence the importance and absolute necessity of studying the greatest possible economy in the production of this popular and beautiful light.

When we see in the principal cities of Canada, stations erected at great cost and elaborately furnished with steam boilers and numerous engines running at from 6 to 8 lbs. of fuel per horse-power per hour, we cannot be blamed for criticising a state of affairs which is highly damaging to the best interests of electric lighting and ruinous to the stockholders.

Apart from the serious loss attending the application of so many small high speed running engines, we would refer to the greater violation of the first principles of steam engineering, economy.

The present age has demonstrated beyond a doubt that, if economy is wanted, circumstances and conditions must be obtained to admit of the application and use of compound condensing engines, so as to get the maximum of power at the least possible cost. Now there is no reason why in the majority of our cities these conditions should not be fulfilled, and we think it is high time to at once shape for such a course.

It is all very well to say that, in the States, this and the other thing exists; but that is no excuse. We have in Canada engineers who have had fully as good an education and experience as our cousins—indeed, the most of our engineers are gentlemen of high standing, who have had experience both in Europe and the States, and their opinions are entitled to the highest respect.

Take, for example, the electric lighting stations in the two first cities of Canada, viz., Montreal and Toronto. We find to our astonishment that electric light stations are located in some very undesirable and inconvenient nook, and, notwithstanding the fact that an inexhaustable source of water lies near them, also numerous locations suitable for electric light stations, where steam appliances could be arranged to run easily at one-third the present cost, old-fashioned and very expensive courses are adopted.

The reason, perhaps, for all this is the fact, consulting engineers are rarely, if ever called in to assist those less able to decide on such important matters.

It is high time that such false pride and reserve were abolished, and the services of our consulting engineers valued.

Parties should recognize that the obtaining of special advice and assistance from consulting engineers is attended with very satisfactory results, and, without it, blundering and loss will, more or less, take place.

Another evil has crept into electric light stations, that of having reserve engines to take the place of those liable to break down. The same might be said with more force of the dynamos.

It is also urged that a number of small, high speed engines is better far than one really good engine. Now, we believe this to be a fallacy, ruinous in the extreme, and it cannot stand analyzing.

The same ideas were for many years persisted in other departments of mechanical application; but they had to be given up on the ground of folly and expense.

It is an old story, this double reserve application, and we hope and believe, in the interests of electric lighting, that it will be abandoned.

Our readers will, perhaps, think we are taking radical ground, but we are willing to stand by it all and defend our position against the assaults of criticism and discussion: so for the present we will close and keep our reserve powder dry.

THE signal officer on the summit of Pike's Peak says the highest velocity of the wind ever recorded there was 110 miles per hour, when the instruments broke and cord wood began flying down the mountain. The guide adds that seventy-five miles per hour would lift a mule out of the trail.

THE IMPORTANCE OF TRAMWAYS.

Tramways are of the greatest importance in large centres of population as a cheap, convenient, and ready means of communication from one part of a city to another, both as to long and short distances. The experience where tramways have been laid down shows that they tend not only to increase the value of property in the city, but also in suburban districts. They promote the extension of such suburbs by leading to the erection of residences for the wealthier citizens, and also dwelling-houses for the working-classes in healthier localities ; and in this respect their value as a sanitary agent cannot be over stated. The facilities afforded by the extension of tramways, allowing people to travel quickly and cheaply to and from the busier parts of the city, as well as their tendency to spread out the population, and thus prevent over-crowding (which is one of the sanitary difficulties of all large towns) render them of great public benefit commercially and sanitarily.

Besides their value in cities, there can be no doubt whatever that they will gradually come to be of equal importance for country districts. By the adoption of tramways on many of our turnpike roads where villages have become dormant or deserted owing to railway communication being too far distant to preserve the life which once existed, vitality would be restored; and the time will soon come when they will be laid down along all the important turnpike and public roads in the country. Tramways laid on such roads at a slight cost per mile, and worked by mechanical power, would not only give communication at a cheap rate, but be sure to pay those who embarked their capital in such an undertaking.

Besides the saving of the difference in the cost of laying down a perfect tramway on turnpike roads, as compared with a railway, the elaborate and expensive machinery for working the latter would be dispensed with. No stations or their necessary attendants would be needed, as the tramway train would be worked solely by the conductor, coming back very much to the system of the village carrier and the stage coach, with the improved means of locomotion ; and now that engines can be got to work gradients of 1 in 13, the traffic over even the worst of our highways could be profitably and expeditiously carried on, and a stimulus would be given to the agricultural, commercial and manufacturing interests of the country to an extent even greater than has been the case by the introduction of railways.

Another important advantage in having tramways on our turnpike roads would be that the expense of maintenance for ordinary traffic would be merely nominal, and that question which exercised the minds of landlords and tenants so much when the prudence of abolishing tolls was before the country, would be practically solved, as the expensive machinery of the old toll system would not only be saved, but the tax for maintaining such roads would be greatly reduced, and the development of tramways along roads, and even into farm steadings, with their cheap means of transit, would do more than anything else that has yet been devised to encourage the improvement of land that at present lies waste, unsheltered, undrained and badly cultivated, and which, no doubt, affects prejudicially our climate and seasons, and brings upon our agricultural communities such depressions as have, during these past years, been experienced.

Another valuable adaptation of the tramway system would be, in our great North-West, its convenience and suitabillty over the ordinary railway system, as feeders to the main trunk lines, would be enormous. It would open up the country districts cheaper and quicker than any other known system, and give farmers advantages similar to those situated nearly on the main road.

If this view of the question were properly considered by the Government, and acted upon, the North-West, in all corners, would soon become habitable, instead of a howling wilderness or prairie.

ELECTRIC CABLES.

The attempts which are made to devise a practical and cheap system of underground telegraphs continue to be numerous, but the actual progress which is made is not very marked. A history of underground telegraphs would indeed be a long list of failures, commencing in 1837 with the so-called "fossil" telegraph of Wheatstone, which consisted of bare wires placed in grooves in lengths of oak scantling. Most of these failures have not been due so much to actual defects in the inventions as to the inability of the inventors to push their commodities, owing to force of circumstances. The use of gutta-pecha shows no signs of falling off, and no substance has yet been brought into the market which has been proved to be a substitute for it.

Great attention is now being paid, says the *Electrical Review* (London) to lead-covered cables, the insulation of the latter, as in the Berthoud-Borel system, being due to resinous substance, which are far cheaper than gutta-percha. Provided the lead covering remains intact, there is no reason whatever why such cables should not remain good for an indefinite period. In certain soils lead is practically imperishable ; but, again, where the clay is present, rapid decay occurs. About ten years ago a cable consisting of a cotton-covered wire placed in a lead pipe, the latter being filled with paraffine wax, was laid in Windsor Park in a clay soil ; in a very short time this line became defective, and on examination it was found that the lead covering had been eaten into holes, which, by admitting moisture, rendered the wire useless ; in this case the paraffine wax was not able to effectually coat the copper core. Excellent as paraffine wax is as an insulator, it has the great defect that it shrinks very considerably on cooling, and is therefore extremely liable to crack ; indeed, most substances of this nature possess this element of uncertainty, and when used as insulators they practically can only be relied upon as "separators" to prevent metallic contact between the latter and a metal sheathing, the sheathing being the medium which keeps moisture out.

Lead, as a protecting covering, necessarily means considerable weight, and as a means of preserving single wires could hardly be adopted to any great extent. Multiple cables would have more chance of success, though the fact that the units of which they are built up are practically inseparable is a disadvantage ; and, moreover, if moisture does penetrate, it means that nearly all, if not all, the wires will become defective. For very special purposes, however, the lead-covered cables should prove to be all that can be desired. The use of paraffine oil as an insulator in the Brooks system has yielded excellent results, and is an undoubted success, but we are inclined to think that more satisfactory results might be obtained from a semi-fluid material, *i e.*, one which would not be liable to become dispersed by leakage ; but which would at the same time have the property of settling down if by any chance it were disturbed, and thus sealing up accidental faults. There seems at present but little chance of india-rubber or gutta-percha being superseded for submarine purposes, but the employment of a cheap yet efficient substitute of these materials would probably give a renewed impulse to such telegraphy, and would richly reward the inventor.—*Ex.*

MRS. LOUISA REED STOWELL has just been elected a member of the Royal Microscopical Society, of London, England. Mrs. Stowell is the third lady ever elected to this Fellowship. She is the only lady instructor in the University of Michigan, and is the author of several treatises on microscopical subjects.

SMOKE-PREVENTION AND BETTER COMBUSTION OF FUEL.

We present to our readers a sketch received from a subscriber of a plan for arranging a steam boiler so as to minimize the forming of smoke, and at the same time create the better and more complete combustion of fuel in the furnace.

The method is not entirely new to us, but may be interesting to many. The object of the designer is to permit fresh hot air on the top of the fire, the supply of which can be regulated at pleasure by means of a damper in the inner pipe, which runs from the top of the chimney through smoke-box into the perforated brick chamber on top front of fire.

If the designer would also arrange to feed this air through the bottom of the fire-grates, it would in many cases be an advantage. The idea of closing the draft over bridge wall when the coal is put on, and so force the current through the grate bars downwards and thence into the main flue below the boiler, is not likely to prove a good one, because the heat would be certain to burn the grate bars and damper without accomplishing any good result in the combustion.

We would rather depend upon the fireman to gradually feed the coal and use the hot air on the top judiciously in securing good results.

We give the design as interesting with others already known to steam-users.

COMBINED PORTABLE PUMPING AND DRIVING ENGINE.

We illustrate a new portable pumping and driving engine which has been introduced by the makers and patentees, Messrs. John and Henry Gwynne, of 89 Cannon Street, and Hammersmith Iron Works, London. The novelty of the arrangement consists in placing the engine on a platform in front of the firebox of a horizontal multitubular boiler; and it is claimed that the plan possesses certain advantages over the usual arrangement. We will briefly describe the principal features. 1. It can be used either for pumping or for doing any kind of work performed by an ordinary portable ngine. When not required for raising water, the centrifugal pum , as shown in our illustration, is replaced by a driving pulley fixed on the crankshaft. For the pumping engine the makers have adopted their well-known "Invincible" pump, which overhangs the bedplate, and is arranged so that the branches may be swivelled to suit different sites where the machine may be required to work. 2. It is claimed that by removing the engine from the top of the boiler, the expansion or contraction of the plates is not interfered with, nor is there any tendency on the part of the tubes or rivets to work loose. Further, in the new arrangement, the axis of the crankshaft is in line with the barrel of the boiler, or at right angles to the axle of the carriage wheels; consequently these latter act as an anchor, preventing any tendency on the part of the engine to roll, and insuring a tight belt. A description of the engine itself is unnecessary here, as for years it has been well known for its suitability for working at high speeds. The whole arrangement is such that at any time the engine can be removed from the boiler and used as an ordinary vertical engine. The boiler is fired from the side, and is provided with a full compliment of the best fittings. The boiler and all working parts of engine are of steel.—*Lon. Eng.*

Economical Steam Tramway.—The half year's working account of the Dewsbury, Batley, and Birstal Tramway, the first ever constructed in England, and worked by Merryweather 7 inch engines, shows the total cost of the running of the engines to be 2·57d. per mile, and the total expenses of the whole establishment, including locomotive charges, 5·16d. per mile. This is one of the most economically worked lines in England.

UNDERGROUND HAULING ENGINE WITH DOUBLE DRUMS.

The illustration is presented as giving a neat and compact design for the purposes the engine is intended to be used for. The frames are made of wrought iron plate to which the hoisting drums are attached while the engine is place between the two frames.

STEAM BELL FOR LOCOMOTIVES.

The secondary railways of the rural districts of Austria have neither gates nor guards at crossings, and are as open as tramways. It is therefore necessary to take special precautions to prevent accidents and give warning of the approach of a train at a sufficient distance from the crossing. For this purpose preference is given to bells rather than to whistles, as the latter have the inconvenience of frightening horses. The annexed figure shows the arrangement of the steam bell adopted upon Austrian locomotives. It is of the simplest construction possible. It consists of a cylindrical cast iron reservoir, A, slightly tapering at its upper part and closed by a valve, B, upon which is fixed, at the end of a lever, a hammer, D, which strikes the bell, C. The steam enters through a small lateral tube situated at the lower part of the reservoir. As the aperture to which the valve, B, is applied has a much larger diameter than the steam tube, it results that the steam escapes from the cylinder more rapidly than it enters. Every time the valve opens, the pressure lowers and causes it to fall back, and the hammer is thus made to strike the bell. The valve is provided internally with a collar that allows it to travel a certain distance before the steam can escape, and to thus regulate the fall of the clack and the density of the blow. The latter is still further increased by means of a spring which prolongs the lever, and acts at every rise of the valve in such a way as to accelerate the fall. The starting and stoppage are effected by the simple maneuver of a cock; but since a certain condensation occurs in the cylinder, A, every time the bell is rung, this cock is so arranged that in a position of rest it shall establish a communication of the cylinder, A, with the exterior, through a small aperture, and thus allow all the water of condensation to flow out.

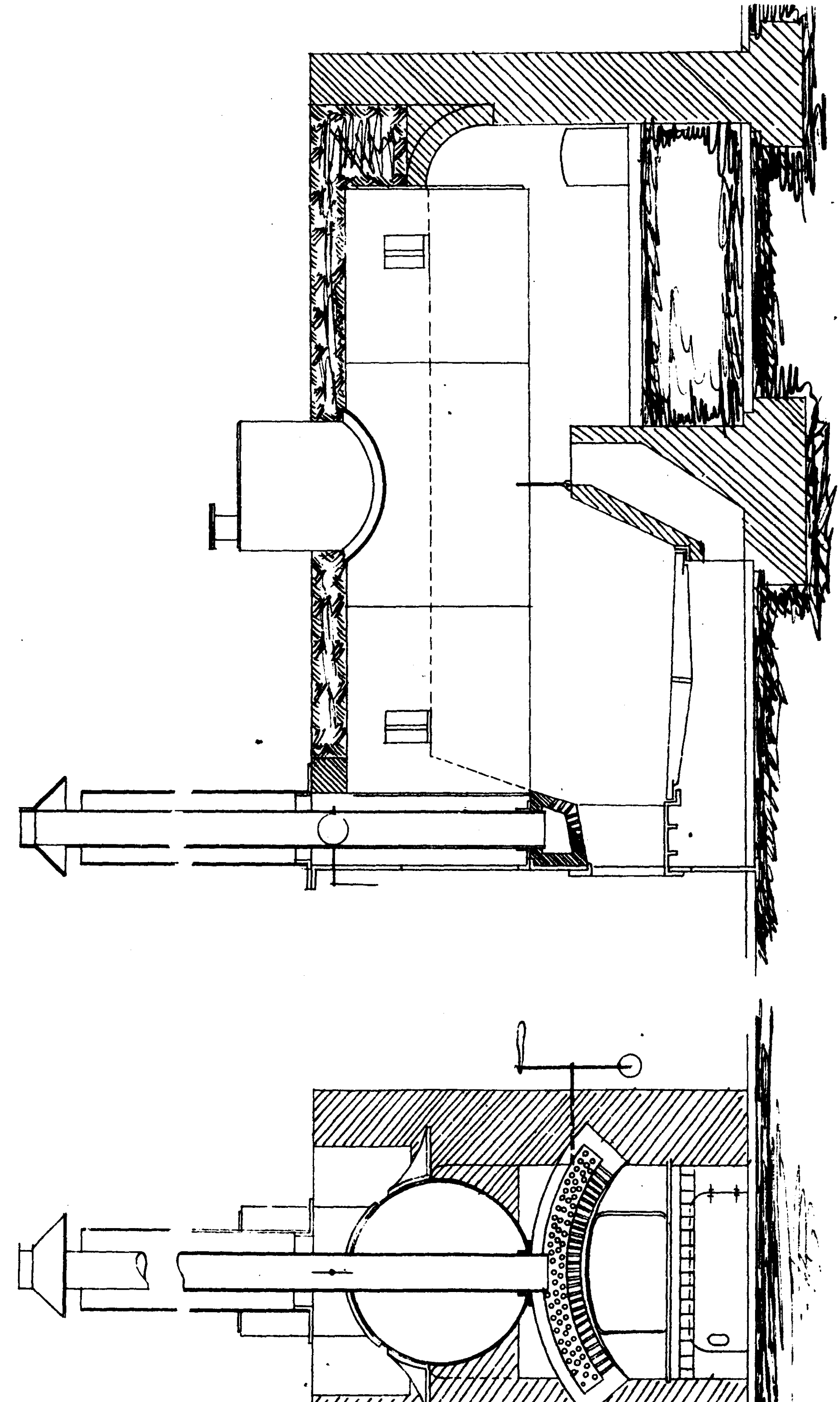
Upon varying the pressure and the aperture of the cock, the number of blows per minute may be made to vary between 130 and 240.—*La Nature.*

CHEAPENING THE COST OF SUGAR.

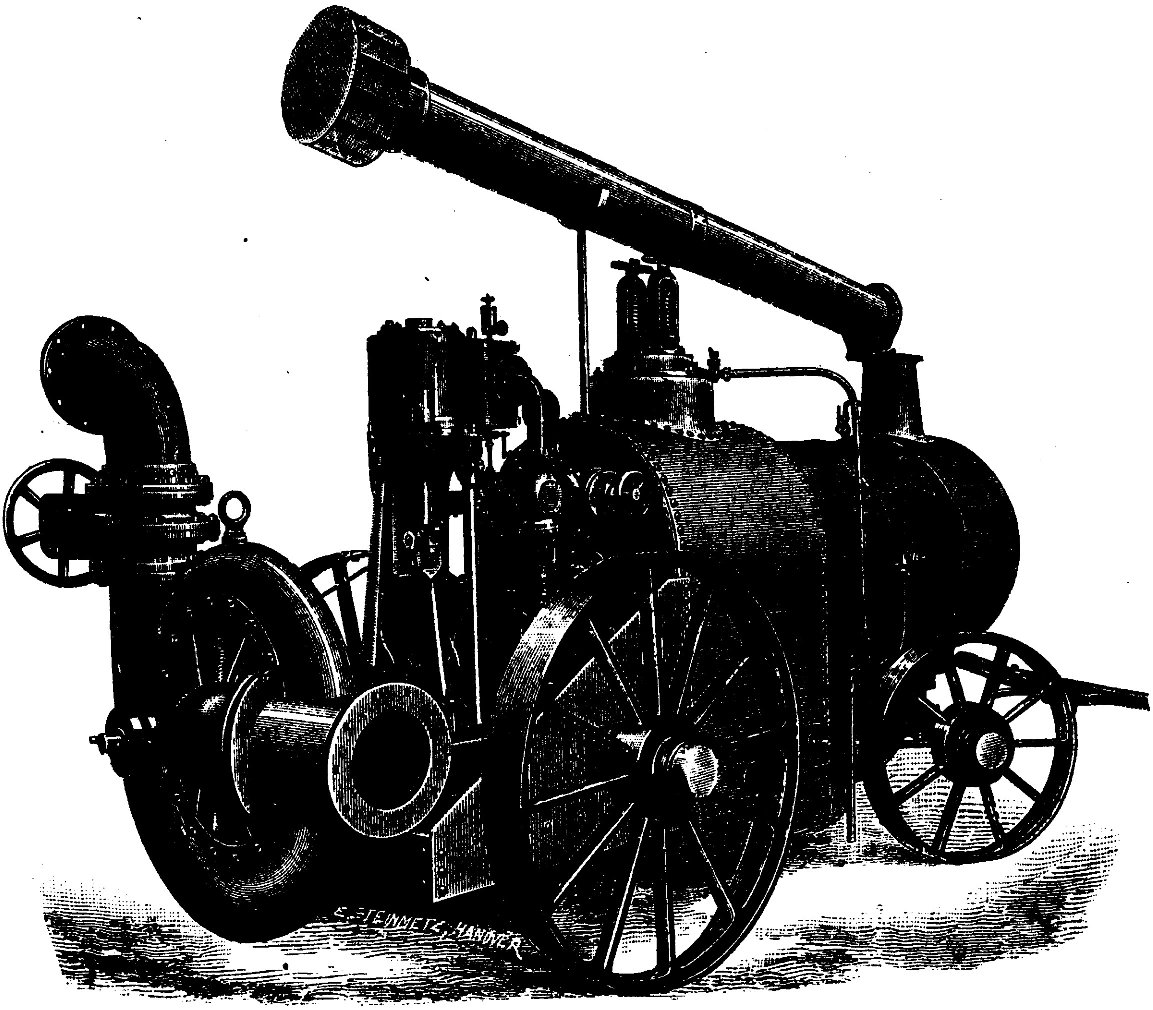
If the reported new process in the manufacture of cane sugar, said to have been introduced by ex-Gov. Warmoth on his Louisiana plantation, shall prove to be all that is claimed for it, sugar-making in that State will have a new lease of existence. The new process consists of shredding the cane into small fibers before it is pressed. In this condition the juice is more thoroughly expressed, and the yield of sugar increased. It is stated that 195 pounds of sugar has been extracted from a ton of cane which, under the old process, yielding only 138 pounds—an increase of about 40 per cent. It is possible, therefore, that by means of shredding their cane, the planters may be able to maintain themselves against the great fall in prices caused by the production of cheap beet sugar in Europe. At a meeting of planters held at New Orleans last summer, it was stated that the cultivation of the cane in Louisiana must be abandoned, unless some process be discovered that would cheapen the cost of making sugar one cent a pound; that might save it, but nothing else would. If the shredding process shall fulfill, the promises made for it, the cheapening will be more than this; it will be one and a half two cents a pound—and this saving will be of immense advantage to the planting interest of the State.—*Republican.*

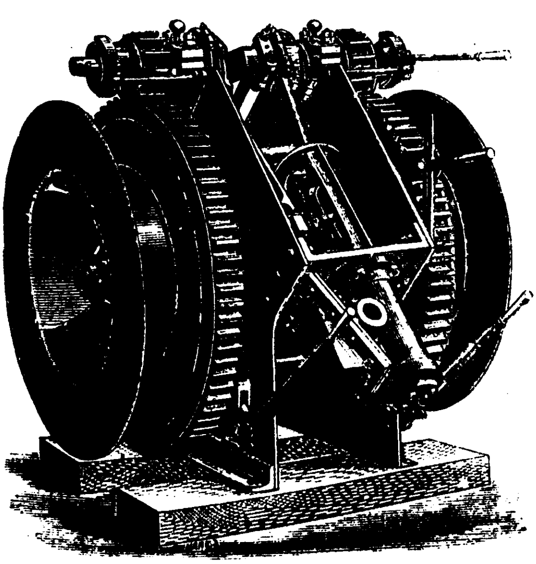
Olive Oil.—If fatty oils are cooled down to —20°, and kept at this temperature for three hours, they assume very different degrees of hardness, olive oil being the hardest. To determine this point the author uses a cylindrical iron rod, 1 centimeter in length, and ending below in a cone. Upon it is exerted a pressure measured in grammes until it penetrates into the oil with its entire length. The best olive oil required a pressure of 1,700 grms., while cotton oil required only 25 grms.—*Serra Carpi.*

LOCOMOTIVE BOILER.

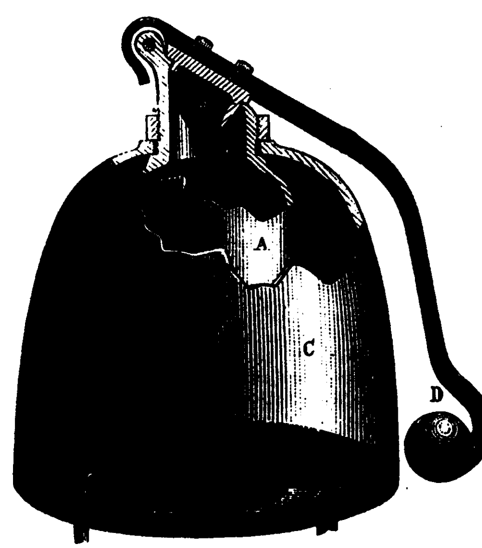


PUMPING AND DRIVING ENGINE.





UNDERGROUND HAULING ENGINE WITH DOUBLE DRUMS.



LOCOMOTIVE STEAM BELL.

THE PLANING MILL FOREMAN.

The position of foreman in a planing mill is like the position of one of the variable stars, and has never been defined with any positive certainty. This is the result of several causes, over some of which he has no control, and some he controls enough by his own actions to keep him very busy every moment of the day and sometimes long into the night.

The conditions which he can not control may sometimes come from circumstances, as, say, when a firm made a small beginning and were doing but little, he did most of the work, like grinding knives and filing saws, and put in all the time he could feeding the machines; and, in fact, was a man of all work and done his best for the interest of his employers, as every foreman should. As their business increased, so did his, and they thought he could still grind knives, feed machines and file saws as he always had done, notwithstanding they had perhaps doubled their business and were still increasing it; and he, wanting to keep his position and show his good will by keeping things going, never suggests, or if he does is told "well, perhaps we'll see about it," and continue to keep him on the treadmill, never thinking nor caring to lighten his burdens by giving him help that is really necessary to carry on the business properly.

Some firms think that all the work they get out of a foreman is clear gain, no matter how much some parts of the machinery about the mill get out of order, or how much it costs to repair, or replace, as the case may be; if they can keep the foreman busy about any of the drudgery of the mill they are happy and think they are putting just as much money in their pockets as it would cost to hire a man to do this work, and let the foreman take care of the machinery under his charge. Let us take one little instance where a foreman just ground knives. (This is not an imaginary case of Jones, Smith & Co.

He is running a machine feeding 80 feet per minute, 40 feet of 6 inch flooring, 2,400 feet per hour; work driving; a set of knives to be ground or another mill must stop, and nobody can grind but the foreman. Well, at it he goes, and by the time he has got through a good full hour has been used up, and very often a great deal more; and it has cost the company as much to grind a set of knives as they could get for planing 2,400 feet of 6-inch flooring. They have got that amount of work out of the foreman and are happy. Have they saved anything? They could have hired a man to work for ten hours for what it has cost them to grind that set of knives, and still have nine hours of his labor besides.

The foreman of a repair shop to a wealthy and prosperous New England railroad, went to the superintendent about buying some necessary machines for the shop and advocated buying cheap machines. After hearing the foreman (they are called *master car builders* now) through, the superintendent turned to him and said: "You are holding a cent so near your eye you can't see a dollar." This expression goes a great ways, and is realized in a thousand shops and mills in the country, and this case of the foreman who stopped his machine to grind knives, was just a single one of hundreds of cases where a firms holds a penny so near their eye that it is impossible to see the dollar close to it, or, to quote the old adage, are "penny wise and pound foolish." A foreman if he *knows* his business can *always* find plenty to do to keep him out of mischief, even if he does not stand and feed a machine every moment when not doing some necessary repairs.

As I have said, a foreman's position in a planing mill is not well defined. Each individual firm have very different ideas of what he ought to do, and hence the great difference in what is to be supposed his duties. If a foreman's lot is often hard, and he seems to be almost broken down under it, in many instances he is the only one to blame. He has begun with the idea that nobody in this great round world can file a saw, or mend a belt, or grind a knife, or sharpen a cutter, but his own great self. He is the embodiment and exponent, the "Alpha and Omega." Well, he gets into the harness and gives the proprietors to understand that HE is the all in all, and no one can do anything in the way of sharpening and filing but himself; and they, poor souls, think that what he tells them is law and gospel because they do not themselves know the difference. They have crawled, as sailors say, into the cabin windows, and have not worked their way up through their business, never having been initiated into the mysteries of filing and grinding and the many different duties required of a foreman. So they are incompetent to judge properly what his real duties are, and never care as long as their business is able to give them good fat dividends every six months or a year. In this way many well-meaning and really good foremen take upon themselves burdens they have no need to carry, and burdens that the proprietors never ask them to take, only they shoulder them without being asked to, and grumble because they voluntarily carry them. I believe a foreman should know his business thoroughly in every part, even if he has some one to grind and mend belts and set up machines, or put on knives, or do anything that is necessary. He should not only be able to intelligently direct how the different and necessary work should be done, but he should be able and willing (if occasion requires) to do all those things and do them well; and under no consideration should a man allow himself to accept the position of foreman unless he can do well all the work about the mill. I do not mean to say that a man holding the position should be a blacksmith or machinist, and yet one, or even both, of these trades are very good things to have in a foreman. I have read of cases where one was a blacksmith and could go to the furnaces under the boilers and weld up bars of iron and bolts, but out this way we use shavings and sawdust for fuel and it is hard work to get a welding heat from these materials. Aside from this, it is a rare thing for a man to be able to do the forging or bolt making for a mill, and yet I know and am personally acquainted with a man who went into a mill when it first started and grew up with it, who can go to the forge and make any tool or cutter except a planer knife, that is used about the mill; and not only that, but by his advice the firm bought a first-class lathe, and he can do any job of turning that is needed if it is not too large to get into the lathe. There is no kind of work about the establishment he cannot do. He is as perfectly at home on a mortising or tenoning machine as on a moulding machine, which is his favorite. He is master of any kind of a planing machine, and not only keeps it in order but has added several things of value.

Such men as these are very rare and hard to get hold of, but once in a while they are to be had for what they are worth. This firm made him a partner in their business, thus binding him to them by cords of self-interest. While it is a very desirable thing to have in a foreman, no firm can expect to get these qualities in every man who takes charge of the work in a planing mill. They should require, however, a good practical knowledge of each machine under his care, so he can take it apart and put it together without any trouble; and should any part need to go to the shop for repairs, he can tell just what wants to be done to it, so the machinist who does the job can go at it intelligently. A machinist may know how to turn up a cylinder and balance it all right, but very often they do not need this work. The cylinder may have got stuck in a heavy cut, and the feed forced the piece under it so as to spring one or the other end of the shaft, and all that is needed is to hang it up by the centers in a lathe and take the spring out of it, when it will go along all right, and there is no need of putting a tool to it. All kinks like this the foreman should understand and be able to explain. Another thing, too, he should know, and that is how to handle the men he has got charge of. Every man under him is different and he should know these differences to perfection, so he can work them to the best advantage. Perhaps some of your readers would like to know what I think a foreman's duties are, and how he should be treated by the firm who employ him. I will try to tell you next month.—*J. T. Langdon, in the Wood-Worker.*

COTTAGE COSTING $1,400.

We take the following description of a design from Leffel's House Plans, to the publishers of which we are also indebted for our illustrations.

It would be a lamentable circumstance if, in building a house to cost less than $1,500, it were necessary to forego all thought of beauty, taste, or any of those conveniences of arrangement which people of larger means regard as indispensable. But there is no occasion for lamentation, for no such necessity exists. There are undoubtedly many thousands of instances in which the considerations we have named have been sacrificed in building houses of moderate cost, sometimes from total ignorance in regard to them, sometimes from a mistaken belief that they are unattainable short of double or treble the expenditure. There is, we confidently claim, no need that this poor and barren style of architecture should be endured because the builder has not $3,000 or $5,000 at his command. For less than half of the former sum he may, with due intelligence and good advice, provide himself with a home which will not make him uncomfortable either in body or in mind by any defects of external appearance or interior arrangement.

As will be seen by the elevations, the design is plain. What little ornamentation is used about the exterior of the building is formed directly out of the material of which it is constructed, in such a manner as to add very little to its cost. The arrangement of the first floor is such as to make communication with all the rooms, as well as the stairs, convenient from the front door. A hat and coat rack is also provided for. Communication with the cellar and with the back yard is had from the passage between the kitchen and dinning-room. The attic affords considerable room for storage purposes, windows being introduced to admit light and to keep the second-story rooms cool in summer. The cellar extends under the entire house, and is 6½ feet in the clear; the cellar wall is 18 inches thick, starting 8 inches below the cellar floor. The chimneys are built of hard, burned brick, the flues 8 by 8 inches, and smoothly plastered inside. Each chimney is provided with sheet iron thimbles and caps, one to each room. The chimneys are flashed with tin at their junction with the roof; the gutters, spouts, etc., are of good quality tin.

All the walls and ceilings of the first and second floors are plastered three coats. The frame is of good quality spruce or hemlock; the sills, 6 by 8 inches; studs for corners, doors and windows, 4 by 4 inches; and all others 2 by 4 inches; the joists for first and second stories, 2 by 10 inches; and for the attic floor, 2 by 8 inches, placed 16 inches between centers, with one course of bridging in the centre; the rafters, 2 by 6 inches, 2 feet between centers.

The exterior, with the exception of the gables and spaces between first and second story windows, is covered with ⅞-inch drop siding. The gables are finished with matched and headed stuff, and cut shingles, as shown on the elevation. The spaces between the first and second story windows are finished with matched and beaded stuff, with rosette in the centre. The outside base, corner boards and casings are 1¼-inch stuff, and the verge board 1⅜-inch, the entire exterior being covered with No. 2 Michigan pine. The first and second floors, and porch floor, are laid with No. 2 pine flooring, and the attic floor with common pine boards.

This plan, which received the first prize in the *Mechanical News* house plan competition (in the class of houses costing from $500 ts $1,500) was furnished by William C. Bartell, of Tiffin, O. The estimates of cost, which appear in the main reasonable, make the total expenditure in building this house $1,388.16. Necessarily the items must vary according to the locality, but the plan can, we believe, be carried out in a satisfactory manner for $1,500 in any part of the country.—*Ex.*

THE NEW "PEERLESS" SAW MILL

The accompanying illustration represents the new "Peerless" Saw Mill, manufactured by Wm. S. Robert & Co., 717 North Second Street, St. Louis, Mo. This mill is constructed with the greatest of care, and is designed to supply a demand for mills possessing all the qualities and accuracy of the large mills, but adopted for use with portable engines. The manufacturers' reputation and experience of twenty-five years is ample assurance to purchasers that every claim will be sustained. It is put upon the market as one of the best and cheapest mills made in the United States.

The mill frame is made of seasoned pine, with heavy cast-iron ends. It is arranged to carry saws from 48 to 54 inches diameter, and when specially ordered, can be built for saws up to 60 inches diameter, or for a double mill. The mandrel is three inches in diameter, extending outside of frame, with main pulley 24x10½ inches, and with patent adjustable boxes. Has improved friction feed works, operated by a single lever and eccentric box. The intermediate pulley is hung on swinging shaft, extending from outside frame to center piece, making it present its full face to friction pulleys, and work in absolute line with same. This device is found on the "Peerless" only. Patent adjustable saw guide is furnished with each mill, with heavy iron sole plate under same, to adjust on. Examine cut and see the advantages obtained by the revolving wedge and lumber rollers over the ridged castings usually furnished on this size of mills. The feed of the "Peerless" is so arranged that one man can run the mill and set the head blocks without changing position. The carriage is made in two lengths, of 12 feet each, and has an iron-band whole length for head blocks to rest on or move on; is thoroughly made, and supported by 12 8-inch rollers connected together in pairs, with 1½-inch iron axles running in babbitted boxes, with oiling device; with the carriage is furnished wrought iron "T" and flat rail of suitable length, together with wrenches, oil can, feed belt and upset. Each mill is furnished with two "Peerless" head-blocks, complete.

The capacity of the "Peerless" is from 3,000 to 10,000 feet of lumber per day, according to timber and management.—*Ex.*

DURABLE TIMBER.

One of the properties conducive to durability in timber is its odoriferousness; woods which are so being chiefly the most durable. Close and compact woods, which make the most charcoal, are more permanent than open and porous qualities. The chestnut has rather more carbonaceous matter than oak, and, therefore, by reason of it, is more durable. Experiment has, however, shown the error of relying too much on these broad theories. One writer alludes to an experiment made to determine the comparative durability of woods. Planks of trees 1½ inches thick, of from 30 to 45 years' growth, were exposed to the weather 10 years. Cedar and chesnut were perfectly sound, spruce and fir sound, larch sound in heart, silver fir in decay, Scotch fir decayed, beech sound, walnut in decay, sycamore much decayed. birch quite rotten.

We must accept even these facts with caution. The questions whether the planks had been cut the same length of time, how they had been dried or seasoned, and the position they had occupied, are pertinent to the inquiry. The same wood often shows varying degrees of durability, owing to the position of the tree. If grown in moist and shady parts, the wood is inferiour to that which grows in an exposed situation open to the sun and air. Some timber is more durable in wet ground or immersed in water; such are elm, beech, alder; while others, such as ash, oak, and fir, are more durable in dry situations. The increase in strength due to seasoning of different woods is given as follows: White pine, 9 per cent.; elm, 12·3 per cent.; oak, 26·6 per cent.; ash, 44·7 per cent.; beech, 61·9 per cent.

The comparative value of different woods, showing their crushing strength and stiffness, is: Teak, 6,555; English oak, 4,074; ash, 3,571; elm, 3,468; beech, 4,079; mahogany, 2,571; spruce, 2,522; yellow pine, 2,193; sycamore, 1,833; cedar, 700.

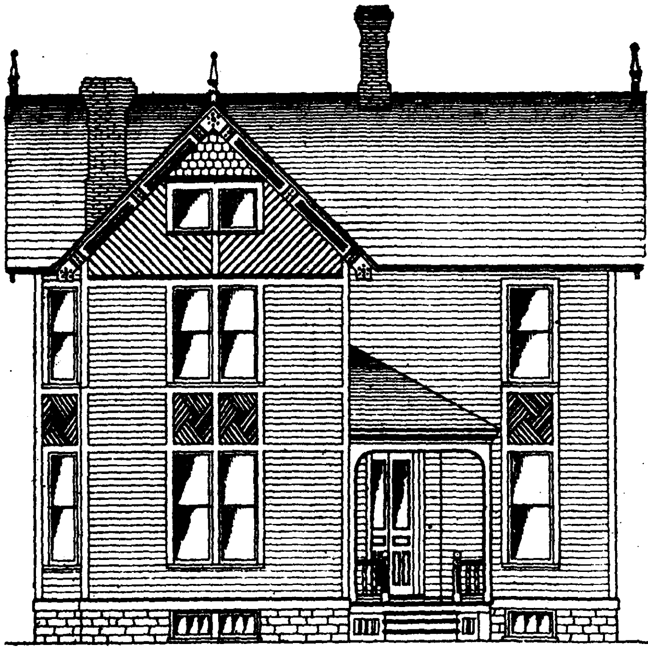
Regarding the relative degrees of hardness, shell-bark hickory stands highest; calling that 100, white oak is 84; white ash, 77; dogwood, 75; scrub oak, 78; white hazel, 72; apple, 70; red oak, 69; beech, 65; black walnut, 65; yellow oak, 60; white elm, 58; hard maple, 56; wild cedar, 55; yellow pine, 54; chestnut, 52; white pine, 30.

For furniture, hard birch, ebony, mahogany, maple, sycamore, and walnut are commonly used; while for turnery, acacia, hard hawthorn, holly, hard laurel, lignum vitæ, poplar, sassafras, sycamore, and yew are employed. For very great hardness, ironwood, hornbeam, almond, hard beech, teak, thorn, are serviceable. Myrtle, lime, box, olive, pear-tree, sycamore, kauri wood, pine, and holly are also very even, close grained, and hard.—*Building News.*

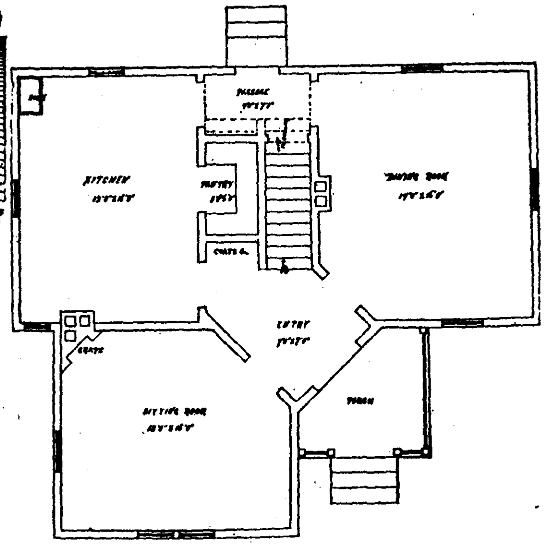
SHOP REMEDIES.

A series of lectures by resident physicians and surgeons is being delivered in an Eastern city with the object of giving instruction in "first aid to the injured," including accidents by scalding, burning, cutting, bruising, loss of members, and other accidents. The project of instruction comprehends, for its pupils, members of the police force, nurses, vehicles, superintendents and foremen of machinery establishments, and the public generally. There is a large amount of common sense knowledge, involving some appreciation of the facts of human bodily structure, that is generally accorded to the medical profession, but which should be the common property of all. It is this source of knowledge that this movement is intended to impart. There can be no doubt that lives have been lost for want of prompt remedies in extreme contingencies, as in suffocation by drowning, asphyxiation in foul air, and syncope in fits. In most cases, the spectators are willing, and even anxious, to aid, but have not the requisite knowledge to make their aid useful.

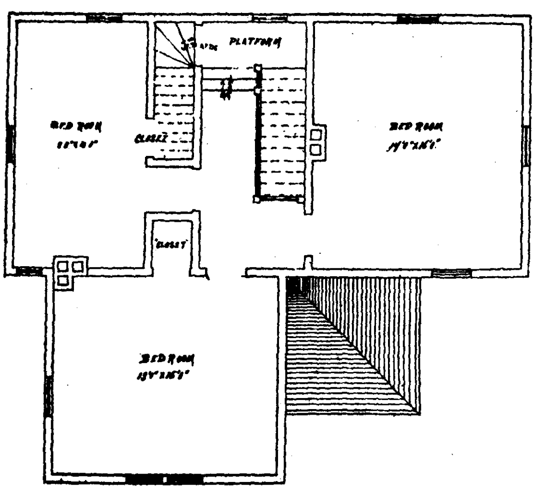
Probably no occupation—saving that of the railroad engineer and fireman—is so liable to serious accidents as that of the machinist; and every shop ought to have its remedies for accidents; and if such instruction as is being given in Hartford,



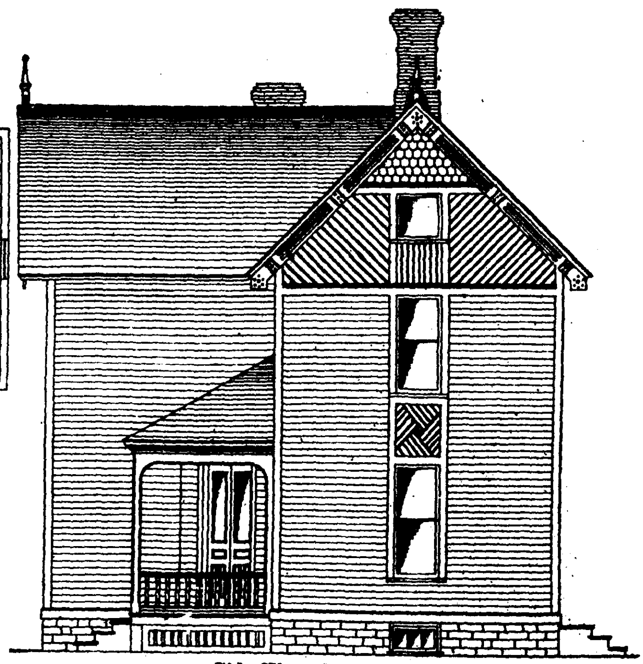
Front Elevation.



Plan of First Floor.

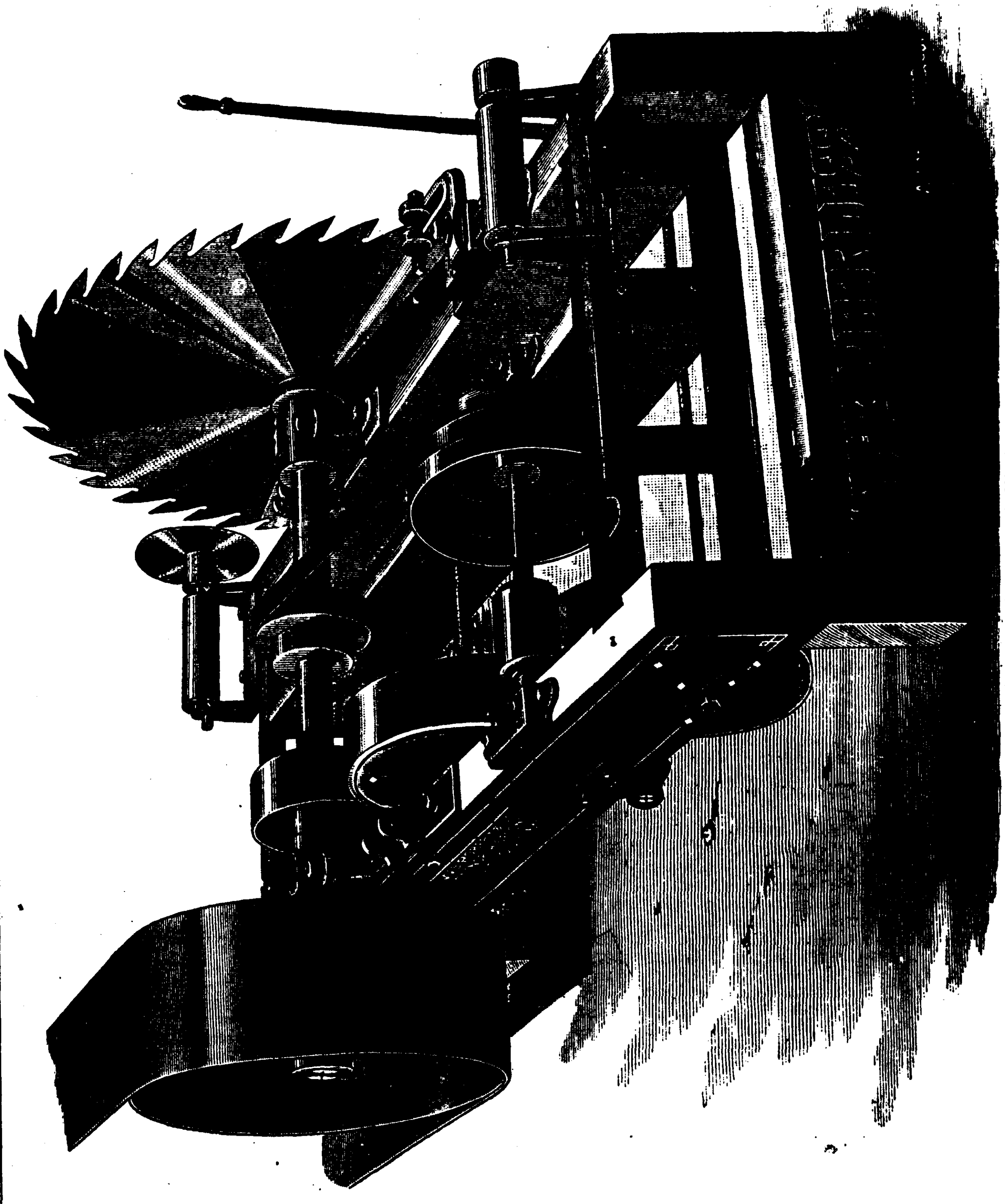


Plan of Second Floor.



Side Elevation.

DESIGN FOR COTTAGE, COSTING $1,400.



THE NEW "PEERLESS" SAW MILL.

Conn., this winter is available, some authorized men, foremen, bosses, contractors, and ready men should be sent to the lectures, or they should be given elsewhere. The chances of injury in a shop where machinery are used are greater than the opportunities of immunity from injury ; machine has no conscience, no compassion, no consideration ; the victim of its clutches is a victim without hope of redemption. If the shop or manufactory is provided with meausurably safe appliances, there is still left the possible contingencies of personal injury ; for belts, and pulleys, and connecting gear wheels with shearing, tearing cogs, cannot always be covered against ignorant meddling or unconscious contact.

There should be kept in every shop some ready appliances for accidents, when preventives against accidents are not sufficient. Most shops have their own local remedies, better at home than elsewhere, and generally favourably regarded where tested. So it would be improper to advertise any one remedy as better than another. But there are general remedies, of which there can be no question. A tincture of arnica is known, the world over, as a remedy for bruises, burns, scalds, and fresh wounds, as an external application ; so is the salve of diachylum used in all portions of the country. There is also a common sticking plaster that may be bought in sheets or rolls, which is very useful in cuts and bruises. This is not the "court plaster" in common toilet use, but a solid basic linen, with a healing spread on it, that may be obtained at any apothecary's shop. Many ghastly wounds that would leave, in healing, livid and offensive scars are reduced and made merely trifling in character by timely application of adhesive plaster. There should be, in every shop, and manufactory, some ready means of prompt attention to wounds, and men should be designated to antedate the arrival of the surgeon. There are plenty of such men in our shops, amply competent for the occasion if selected for the work.—*Ex.*

CHINESE IRON FOUNDRIES AND RICE-PAN CASTINGS.

As a notable example of the patient, plodding ingenuity shown by the Chinaman in some of his trades and industries may be cited the manufacture of the very thin cast-iron rice-pan which may be seen in almost any cook-house in Hong Kong. The principal seats of this industry are at the towns of Sam-tiu-chuk and Fatshan. This latter town is distant but some twelve miles, in a south-westerly direction, from the provincial capital of Canton, and has, from the extent and importance of its trade and manufactures, notably its great trade in iron goods, tools, and hardware, been aptly termed the Birmingham of China. The previously mentioned towns of Sam-tiu-chuk is inhabited principally by Hakkas, and is one of the principal towns of the sparsely populated and mountainous district of Kweishin. The iron used is obtained by smelting the magnetic oxide which is found in large masses in the mountains surrounding the town. The ore is broken up and smelted with charcoal in a primitive smelting furnace or cupola some 8 feet high ; the cupola is cone-shaped, having its apex or smaller diameter at the bottom ; the single tuyere-pipe is of earthenware, the opening for emission of the blast being placed downward. The furnace itself is of earthenware, or rather puddled and dried clay, kept from falling to pieces and strengthened by hoops and longitudinal straps of iron ; the whole is lined with clay several inches thick ; the internal diameter at the bottom may be about 2 feet, or perhaps a little more, and at the top about 3½ feet ; inside depth, about 6 feet.

The blast is produced by a rude, yet most ingeniously contrived, bellows, formed of a wooden box some 5 feet long by 3 feet in horizontal and 1½ feet in vertical section. This box is divided longitudinally into two compartments, each 18 inches square in vertical section, in each of which compartments a piston works ; the valves are so arranged that one piston is effective in the up stroke ; the other in the down, or rather return, stroke—for the machine is arranged horizontally. It will be seen, however, from this arrangement, as there is no air-chamber, that the blast is not perfectly continuous, there being a slight cessation at the end of each stroke before the return stroke can be effective. The fuel used is charcoal, and the furnace being first heated by starting a fire with fuel alone is then filled up with alternate layers of charcoal and ore in small fragments. The blast is urged, and after a sufficient time has elapsed the molten metal is drawn off from a top-hole at the bottom, in the usual manner, and cast into ingots, which when intended for export, are afterwards reheated in an open forge and beaten into blooms of about 6 pounds in weight ; these may occasionally be seen for sale in the iron-dealers' shops in Hong Kong, and when made from genuine native iron fetch a very high price indeed, as much as $4 per picul, or even more, being sometimes paid for the best quality made from the black or magnetic oxide. The Fatshan iron, which to a great extent, comes from Yintak (a town on the West River), is smelted from hematite (the red oxide), but mixed to a considerable extent with gangue, rarely pure, and of varying and uncertain chemical composition. The iron smelted from this latter ore, although far more valuable in the native estimation than foreign imported iron, does not realize so high a price in the market as the other.

For making the very thin rice-pans, which are cast without handles, pure native iron alone can be used, as, being smelted with charcoal, it has the property, when melted, of being more fluid than iron smelted with coal, or, it may be, that the iron itself, being uncontaminated with sulphur or phosphorus, possesses the property of greater fluidity on this account. The moulds in which the pans are cast require weeks of tedious and patient labor to bring them to perfection. They are composed of two parts—an upper and a lower—and are made of carefully puddled clay, the upper portion about 1½ inch, and the lower somewhat thicker ; the lower or under half is full of round holes about 1½ inch in diameter, which pierce about two-thirds the thickness of the mould ; these holes are made in order to allow the clay to dry thoroughly ; the moulds are turned true on a revolving potter's table of the usual pattern, and when quite dry receive a final coating of fine moulding-sand, and are made perfectly smooth. The two portions of the mould are then luted together with clay and placed in a large round oven some 6 feet or more in diameter. The pans are cast bottom upwards, each mould having a runner, but no riser ; the upper portion of the mould has three little legs in order to support it when drying, previously to the two moulds being luted together. After being placed in the oven, which is some 2½ feet deep, the moulds are surrounded with charcoal, which is fired, and the ovens closely covered with a curiously constructed earthenware, or rather dried clay, cover, kept together, as in the case of the furnaces or cupolas previously mentioned, with bands and straps of iron. The process is so fixed that by the time the moulds are at a bright red heat, or almost white heat, the iron in the cupola is melted and ready for tapping ; the molten metal is then run into ladles made for the purpose, and quickly poured into the moulds. When these are all filled, the cover of the oven is re-adjusted, and the whole left to anneal or cool gradually.

The great secret about this process, which enables the Chinese founders to cast their iron pans of such large diameter, yet so thin and light as to scarcely thicker than a sheet of paper, appears to be the use of highly heated moulds, and pure iron smelted with charcoal. When the ovens and their contents have cooled down—which takes about two days—the luting attaching the upper portion of the mould to the lower is carefully removed, and, the moulds being separated, the pan can be extracted ; when the operation has been successful the same mould can, with a little touching up, be used several times. The pans now have each attached to its bottom a runner or lump of iron of greater or less size, which from the extreme thinness of the pans, making them but little less brittle than earthenware, requires the greatest care in its removal ; these runners are carefully sawn off, the use of the more expeditious coal chisel being more likely to cause fracture than the slower, but steadier, saw ; the edges are smoothed down, and the pan is ready for the export market. Handles are attached to these pans by the retail dealers, who bore holes near the rim of the pan and attach small ribbons of iron for the purpose of handles.

The pans made at Fatshan differ from the preceeding in being cast with handles attached near the rim to the inner surface of the pan, which necessitates the breaking of the mould at each casting, it being rare for the same mould to be serviceable a second time. The Fatshan pans are also usually cast much thicker and heavier than those of Sam-tui-chuk, and occasionally as large a proportion as one-third of foreign cast iron, generally Kentledge or ordinary pig iron, is mixed with the native iron for casting. In other respects the process followed at both places is the same. The Fatshan pans being thicker, are the more durable of the two, while the thinner Kweishin pans are the more popular with poor people, because, being thinner, a less quantity of firewood is required to heat them through. The manufacture of iron rice pans is, in

Kwangtung Province, a Chinese Government monopoly, which is farmed out by the Salt Commissioner, and by him licenses are granted to the local iron founders on a payment of a heavy fee. Considerable care has to be used in packing the pans for export, in order to prevent breakage, which, however, frequently occurs when any considerable number of pans is shipped to Australia or other distant ports. An attempt was made some years back to cast rice pans in Hong Kong, but the locality chosen—Shau-kiwan—being an unhealthy one, many of the workmen died, others left the place sickly and fever-stricken, and the concern, from this cause mainly, proved a failure.

PYROMETERS.

Mr. W. R. Browne, writing in *Nature*, gives an interesting historical sketch of the advances made in pyrometry :

The accurate measurement of very high temperature, he observes, is a matter of great importance, especially with regard to metallurgical operations ; but it is also one of great difficulty. Until recent years the only methods suggested were to measure the expansion of a given fluid of gas, as in the air pyrometer ; or to measure the contraction of a cone of hard, burnt clay, as in the Wedgewood pyrometer. Neither of these systems were at all reliable or satisfactory. Lately, however, other principles have been introduced with considerable success, and the matter is of so much interest, not only to the practical manufacturer, but also to the physicist, that a sketch of the chief systems now in use will probably be acceptable. He will thus be enabled to select the instrument best suited for the particular purpose he may have in view.

The first real improvement in this direction, as in so many others, is due to the genius of Sir William Siemens. His first attempt was a calorimetric pyrometer, in which a mass of copper at the temperature required to be known is thrown into the water of a calorimeter, and the heat it has absorbed thus determined. This method, however, is not very reliable, and was superceded by his well known electric pyrometer. This rests on the principle that the electric resistance of metal conductors increases with the temperature. In the case of platinum, the metal chosen for the purpose, this increase up to 1400° C. is very nearly in the exact proportion of the rise of temperature. The principle is applied in the following manner : A cylinder of fire-clay slides in a metal tube, and has two platinum wires 1-100th inch in diameter wound round it in separate grooves. Their ends are connected at the top to two conductors, which pass down inside the tube and end in a fire-clay plug at the bottom. The other ends of the wires are connected with a small platinum coil, which is kept at a constant resistance. A third conductor starting from the top of the tube passes down through it and comes out at the face of the metal plug. The tube is inserted in the medium whose temperature is to be found, and the electric resistance of the coil is measured by a differential voltameter. From this it is easy to deduce the temperature to which the platinum has been raised. This pyrometer is probably the most widely used at the present time.

Tremeschini's pyrometer is based on a different principle, viz., on the expansion of a thin plate of platinum, which is heated by a mass of metal previously raised to the temperature of the medium. The exact arrangements are difficult to describe without the aid of drawings, but the result is to measure the difference of temperature between the medium to be tested and the atmosphere at the position of the instruments The whole apparatus is simple, compact, and easy to manage, and its indications appear to be correct, at least up to 800° C.

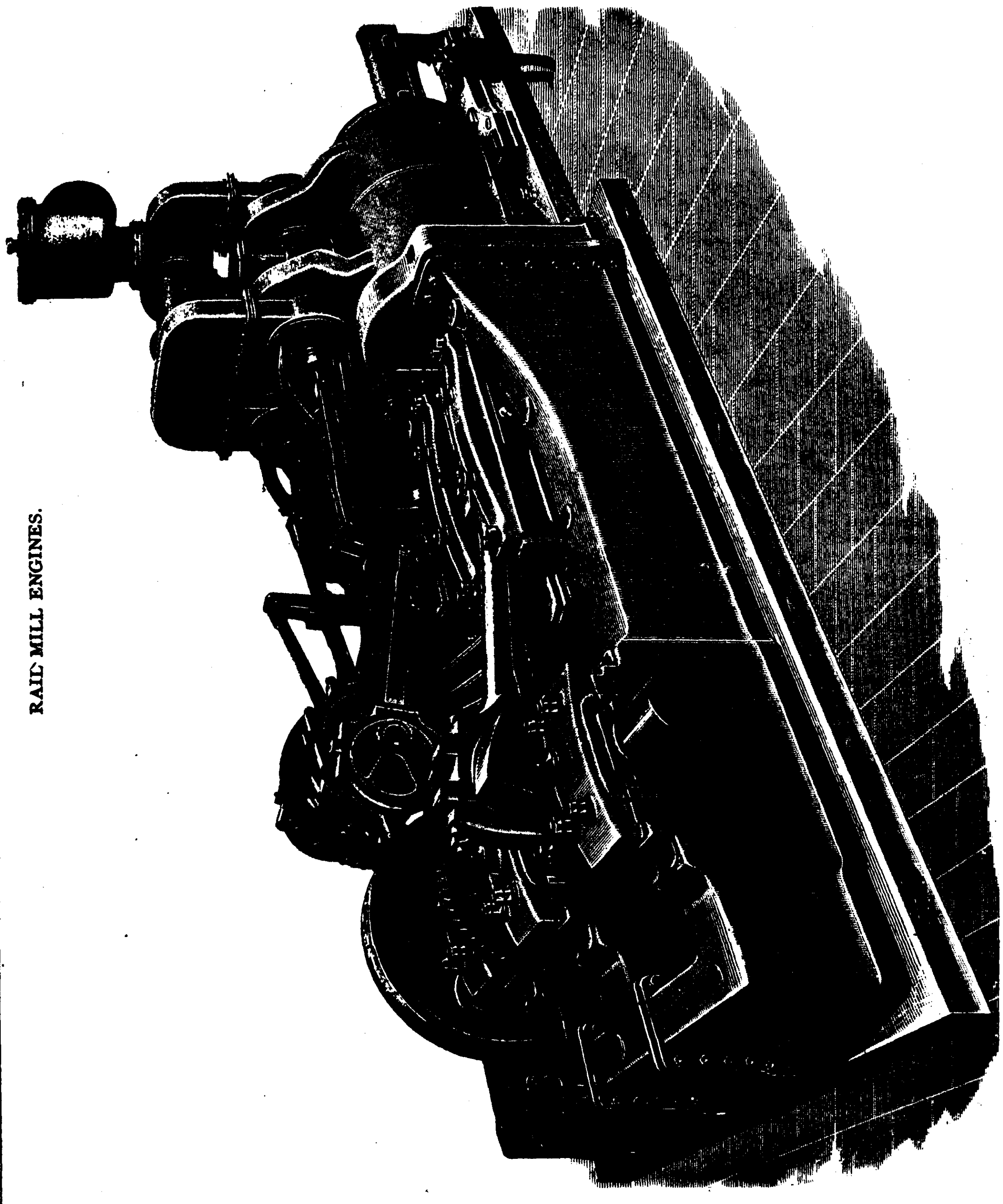
The Trampler pyrometer is based upon the difference in the coefficients of dilatation for iron and graphite, that of the latter being about two-thirds that of the former. There is an iron tube containing a stick of hard graphite. This is placed in the medium to be examined, and both lengthen under the heat, but the iron the most of the two. At the top of the stick of graphite is a metal cap, carrying a knife-edge, on which rests a bent lever pressed down upon it by a light spring. A fine chain attached to the long arm of this lever is wound upon a small pulley ; a larger pulley on the same axis has wound upon it a second chain, which actuates a third pulley on the axis of the indicating needle. In this way the relative dilatation of the graphite is sufficiently magnified to be easily visible.

A somewhat similar instrument is the Gauntlett pyrometer, which is largely used in the north of England. Here the instrument is partly of iron, partly of fire-clay, and the difference in the expansion of the two materials is caused to act by a system of springs upon a needle revolving upon a dial. The Ducomet pyrometer is on a very different principle, and only applicable to rough determinations. It consists of a series of rings made of alloys which have slightly different melting points. These are strung upon a rod, which is pushed into the medium to be measured, and are pressed together by a spiral spring. As soon as any one of the rings begins to soften under the heat, it is squeezed together by the pressure, and, as it melts, it is completely squeezed out and disappears. The rod is then made to rise by the thickness of the melted ring, and a simple apparatus shows at any moment the number of rings which have melted, and therefore the temperature which has been attained. This instrument cannot be used to follow variations of temperature, but indicates clearly the moment when a particular temperature is attained. It is, of course, entirely dependent on the accuracy with which the melting points of the various alloys have been fixed.

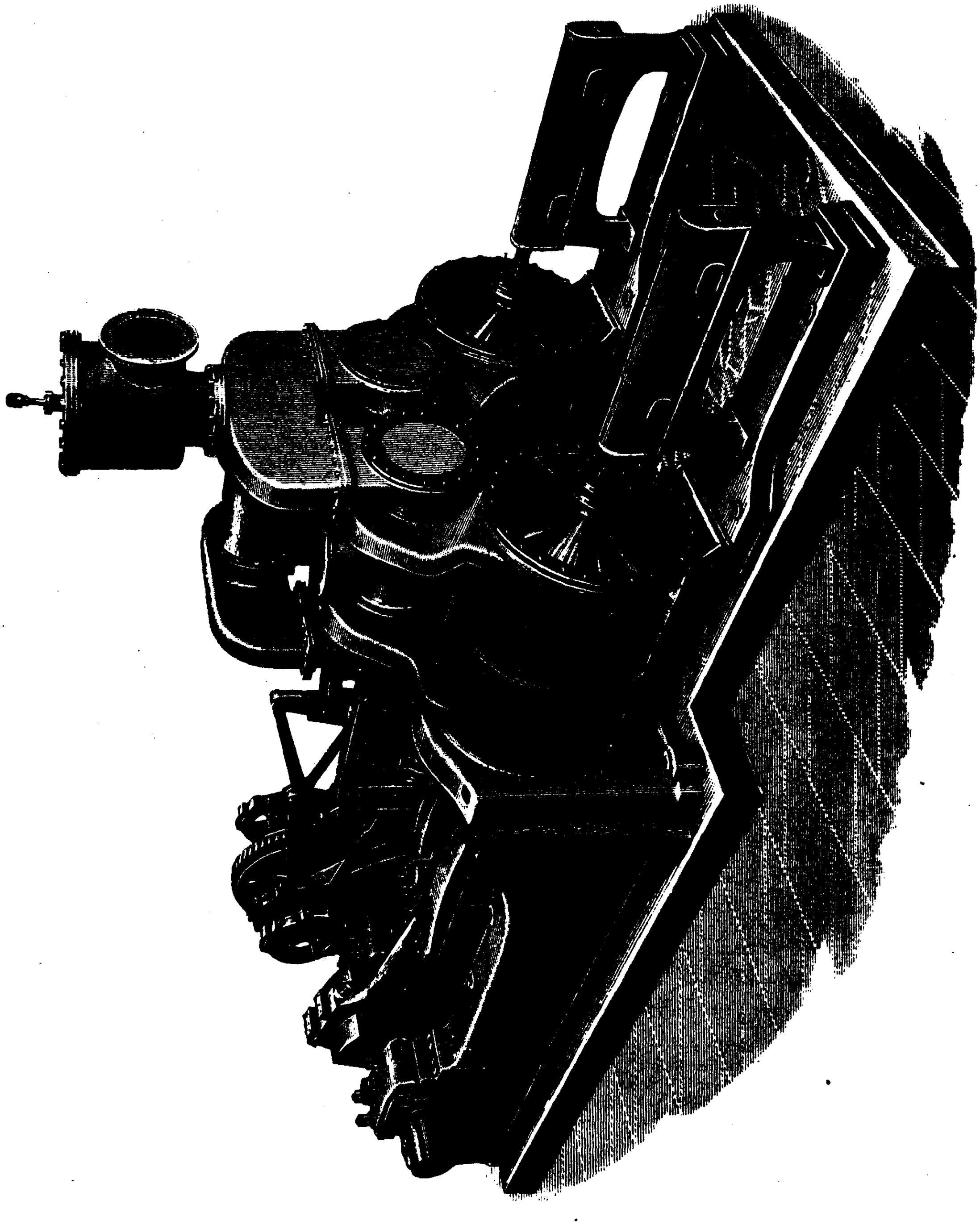
Yet another principle is involved in the instrument called the "thalpotasimeter," which may be used either with ether, water or mercury. It is based on the principle that the pressure of any saturated vapor corresponds to its temperature. The instrument consists of a tube of metal partly filled with liquid, which is exposed to the medium which is to be measured. A metallic pressure gauge is connected with the tube and indicates the pressure existing within it at any moment. By graduating the face of the gauge when the instrument is at known temperatures, the temperature can be read off directly from the position of the needle. From 100° to 200° F. ether is the liquid used ; from thence to 680° it is water, and above the latter temperature mercury is employed.

Another class of pyrometers having great promise in the future is based on what may be called the "water-current" principle. Here the temperature is determind by noting the amount of heat communicated to a known current of water circulating in the medium to be observed. The idea, which was due to M. de Saintignon, has been carried out in its most improved form by M. Bouiler. Here the pyrometer itself consists of a set of tubes, one inside the other, and all inclosed for safety in a large tube of fire-clay. The central tube or pipe brings in the water from a tank above, where it is maintained at a constant level. The water descends to the bottom of the instrument and opens into the end of another small tube called the explorer (*explorateur*). This tube projects from the fire-clay casing into the medium to be examined, and can be pushed in or out as required. After circulating through this tube the water rises again in the annular space between the central pipe and the second pipe.

The similar space between the second pipe and the third pipe is always filled by another and much larger current of water, which keeps the interior cool. The result is that no loss of heat is possible in the instrument, and the water in the central tube merely takes up just so much heat as is conducted into it through the metal of the explorer. This heat it brings back through a short india-rubber pipe to a casing containing a thermometer. This thermometer is immersed in the returning current of water and records its temperature. It is graduated by immersing the instrument in known and constant temperatures, and thus the graduations on the thermometer give at once the temperature, not of the current of water, but of the medium from which it has received its heat. In order to render the instrument perfectly reliable, all that is necessary is that the current of water should be always perfectly uniform, and this is easily attained by fixing the size of the outlet once for all, and also the level of water in the tank. So arranged, the pyrometer works with great regularity, indicating the least variations of temperature, requiring no sort of attention, and never suffering injury under the most intense heat ; in fact, the tube, when withdrawn from the furnace, is found to be merely warm. If there is any risk of the instrument getting broken from fall of materials or other causes it may be fitted with an ingenious self-acting apparatus shutting off the supply. For this purpose the water which has passed the thermometer is made to fall into a funnel hung on the long arm of a balanced lever. With an ordinary flow the water stands at a certain height in the funnel, and while this is so the lever remains balanced ; but if from any accident the flow is diminished, the level of the water in the funnel descends, the other arm of the lever falls, and in doing so releases two springs, one of which in flying up rings a bell, and the other, by detaching a



RAIL MILL ENGINES.



RAIL MILL ENGINES.

counterweight, closes a cock and stops the supply of water altogether.

It will be seen that these instruments are not adapted for shifting about from place to place in order to observe different temperatures, but rather for following the variations of temperature at one and the same place. For many purposes this is of great importance. They have been used with great success in porcelain furnaces, both at the famous manufactories at Sèvres and at another porcelain works in Limoges. From both these establishments very favorable reports as to their working have been received.—*Ex.*

THE COMPARATIVE VALUE OF LABOUR.

The future commercial position of England depends upon her power to undersell other nations in neutral markets. The frontiers of each European country are so defended by protective tariffs, which exhibit a tendency to increase rather than diminish, that it is idle to suppose we shall ever be in a position to compete with the native manufacturers on better terms than we do now, and, indeed, he must be of a sanguine disposition who believes that we can maintain our present footing. As wealth and population accumulate, and means of communication improve, knowledge and skill tend to become equalised, and the advantages which have hitherto existed in a pre-eminent degree in Great Britain become more or less diffused in other countries. We may not be ready to admit that English enterprise, energy, and skill will ever, taken as a whole, be equalled in other lands, but they do not form the only elements in obtaining commercial supremacy. The price of material and the cost of labor are most important factors, and there is an uneasy feeling that the falling off in the value of our exports is due to the ill-advised action of the workmen in seeking to limit the hours of labor and to raise unduly the standard of wages. So long as the British workman is able, by his superior skill or strength, to turn out as much work for a given sum in wages and a given outlay for plant, as the foreigner, the capitalist can scarcely lay the blame of failing trade on his shoulders. But the great question is, can he do this? An answer to this question has been essayed by Mr. J. S. Jeans, the able secretary of the Iron and Steel Institute, in a paper read before the Statistical Society on December 16th; and he finds that in most occupations the native workman can produce a greater output than any of the rivals. But all through his paper Mr. Jeans never ceases to insist upon the paucity of the materials at his command in making the comparison, and the numberless causes which conspire to falsify the conclusions to which the figures apparently point. Beginning with the cotton trade, which, he says, employs a larger number of hands than any other industry except agriculture, he divides the number of spindles in each country by the number of people employed and gets the following result:

Great Britain	83
United States	66
Germany	46
France	24
Russia	20
Austria	20
India	20
Average	54

But this, as he points out, makes no distinction between the employed and unemployed spindles, and what is of more importance, it classes all spindles as alike. But coarse spinning requires far more "minding" than fine spinning, and at the same time demands less skill. Now in India there is nothing but coarse spinning, and in the United States and the Continent the average "counts" are decidedly below our own, so that it is certain that the 54 per cent. superiority the Table gives to Great Britain over the average, would be considerably reduced if the inquiry could be carried further. In 1851 the number of spindles per operative in this country was 63, in 1861 it was 67, in 1871 it was 77, and in 1875 it was 79. How much of the increase is due to improved machinery and how much to greater skill it would be difficult to tell, but it is certain that it must be divided between the two. The number of spindles in each mule has steadily increased, and at the same time the keen competition of later years has enforced a sharper discipline in the mills and the exhibition of greater assiduity and attention.

In the wool and worsted industries we do not head the list, which stands thus:

TABLE I.

Country.	No. of Operatives.	No. of Spindles.	No. of Spindles to each Workman.	No. of Looms.	No. of Looms to each Workman.
United Kingdom	265,269	6,408,695	24	143,337	0.5
France	110,904	3,037,837	28	78,676	0.7
United States	86,504	1,756,746	30	55,625	0.4

Let us now follow the author into his statistics of the iron and coal trades. There again we are met with difficulties from the mining operations being carried on under vastly different conditions in various parts of the world, in thick veins, thin veins, shafts, galleries, drifts, and open cuttings. These are not equally averaged in all countries, and it would require a knowledge of all the local circumstances before the figures of the following Tables could be turned to much practical account.

TABLE II.—Total Number of Miners Employed in the Iron-stone Mines of different Countries, with the total Production of Iron Ore, and the Average Annual Output per Miner in each country.

—	Year.	Number of Miners in Iron Mines.	Total Production of Iron Ore.	Average Annual Output per Miner.
			tons.	tons.
England	1881	26,110	14,591,000	559
Scotland	1881	10,473	2,595,000	248
Ireland	1881	504	260,000	516
United Kingdom	1881	37,087	17,446,000	470
Germany	1882	38,783	8,263,000	213
United States	1880	31,412	7,162,000	228
France	1881	8,623	3,032,000	352
Austria	1880	4,414	628,000	142
Luxembourg	1881	3,423	2,161,000	631
Spain	1882	14,795	3,565,000	240

TABLE III.—Total Number of Persons Employed in the Production of Coal in Different Countries, with Aggregate Quantities Produced, and Average Annual Output per Person Employed.

Country.	Number of Persons Employed in and about Coal Mines.	Aggregate Output of Coal.	Average Annual Output per Person Employed
		tons.	tons.
England and Wales.	381,763	133,233,000	349
Scotland	53,741	20,823,000	387
Ireland	844	127,585	151
United Kingdom	436,352	154,184,000	353
United States:			
Bituminous	100,116	37,400,000	374
Anthracite	70,748	25,550,000	361
Germany*	186,335	48,688,000	261
Austria:			
Brown coal {	35,990	5,378,604	149
	27,165	7,905,000	291
Italy	—	—	—
France	106,410	19,765,983	186
Belgium (Liége)	23,456	3,823,000	163
India	3,763	—	—
Nova Scotia	3,455	1,124,000	325
Victoria	—	—	—
New South Wales	4,857	1,485,000	306

This part of the subject concludes with an extract from a paper contributed by Mr. Charles O. Bridge to the Institution of Civil Enginners, giving the amount of work done in a given time, and the cost per unit of work done, by natives of different countries at heavy manual employments, such as that required on earthwork, bricklaying, masonry, and painting. In each case the Englishman beats other Europeans, as regards the amount, in the proportion of 100 to 80 or 90, but as regards the cost, the foreign labour is the cheaper in about the same proportions.

Having settled, as far as the material at command permits, the relative capacities of various races of labourers, Mr. Jeans turns to their average earnings. He shows that for fifteen of

*In Germany, and to a large extent also in France, a considerable staff is employed about the mines in washing the coal, which does not apply, at any rate not to anything like the same extent, in other countries. Were these workmen left out of the account, the average output would, of course, be higher.

the leading occupations followed in each country, and embracing in the United Kingdom 4½ millions male operatives out of a total of 6 millions engaged in agriculture and industry, being 70 per cent. of the whole, and in the United States nearly 5 millions out of a total of 7⅓ millions similarly engaged, or 69 per cent. of the whole working population, the average weekly wages of male adults were as under:

	s.	d.
United States (Massachusetts)	55	6
" Kingdom (Lancashire)	30	0
Germany (Westphalia)	21	6
France	18	9

giving to the United States a position superior to that of Great Britain by 84 per cent., and better than that of Germany and France by 162 per cent. and 205 per cent. respectively; while Great Britain comes out as 42 per cent. better than Germany, and 58 per cent. superior to France.

Next he endeavours to arrive at the average earnings of the labouring classes, dividing them into five classes, and the aggregate yearly sum paid in this country and America. With this point we have, as engineers, little to do, and pass on to the next which deals with the rate of increase of wages in different countries. Beginning with agricultural labour, which represents the minimum value of all adult male labor, it is found that during 80 years, from 1770 to 1850, wages advanced only 2s. 4d per week, or 32 per cent., whereas in the next 28 years the amount of increase was 4s. 5d., or 46 per cent. Taking the four countries of England, France, Germany, and America, the increase has been as follows since 1850.

TABLE IV.—Wages Paid to Agricultural Labourers at different Periods.

Country.	Average Weekly Wages Paid in the Years			Percentage Increase 1880 on 1850.
	1850.	1870.	1880.	
	s. d.	s. d.	s. d.	
England (Cheshire)	9 7	15 0	17 6	65
France (general average)	9 0	12 6	14 0	55½
Germany (Hesse)	7 6	10 6	12 6	50
United States (Massachusetts)*	16 0	20 0	25 0	56½

This shows that agricultural wages have risen in this country by a greater proportion than elsewhere. It did not need statistics to show that a great increase has taken place, because the influx of the country people into the towns and the immense emigration, must have told upon the supply, but it is somewhat of a surprise to learn that this movement has been greater here than elsewhere. The severe labour disputes which have prevailed in Lancashire during the last few years, have turned a good deal on the question whether the operatives have or have not shared in the general prosperity of the last thirty years. As a reply to this Mr. Lord prepared for the Manshester Chamber of Commerce a Table of local average wages for the years 1850 and 1883, showing that there had been a percentage increase of 40 per cent. during the time. The following is the Table.

TABLE V.—Average Increase of Wages paid in Manchester District between 1850 and 1883.

——	Average Increase of Wages	Total Number Employed in United Kingdom.
Cottton trade	40.70	523,754
Bleaching, &c	50.00	39,691
Calico printing	50.00	39,318
Fitters, turners, &c	10.30	78,828
Smiths	24.00	147,456
Carpenters and joiners	50.00	295,958
Bricklayers	46.00	129,966
Masons	34.00	131,476
Plasterers	31.00	34,662
Labourers	32.00	771,501
Mechanics	77.09	36,481
Average increase	40.00	2,220,091

Mr. Jeans points out as a curious coincidence that this Table shows an average increase of wages that almost exactly corresponds with that brought out by a comparison of the total amount paid in wages in the industries of the United States for almost the same dates. During the same interval French statistics show that in 23 leading industries employing 1,497,000 workmen out of a total of 1,554,000 ascertained to be employed in industry by the census of 1876, the average advance in Paris was 53 per cent., and in the provinces 65 per cent, Similar statistics from other European countries are wanting, but the following Table of wages taken from the official reports of our active little rival, Belgium, is of interest.

	Francs per Day.
At blast furnaces	3.09
In rolling mills	3.81
" steel works	3,58
" lead and zinc works	2.75
" coal mines	3.09

thus giving an average of 2s. 6d. per day, or 15s. per week for a total of 132,000 employés, which is a very considerable proportion of the whole industrial population of Belgium. In the United Kingdom the average wages paid in the same occupations will probably be 50 or 60 per cent. higher, and we have already seen that in the United States they are 93 per cent. higher.

This is a vast subject, and will have to be attacked on many sides before it is completely elucidated. Mr. Jeans has done good service in gathering together so much information to serve as a nucleus to which others may add their contribution. In the above Tables those relating to the cotton trade seem to promise the most likely field of exploration for subsequent research. It would not be difficult to find mills filled with new English machinery in various European countries engaged on precisely similar classes of work, and from their output and wages' sheet, to institute an exact comparison between the actual and comparative values of the various labourers. The calculation would not be complicated with items for rent or fuel, and the results would be perfectly trustworthy. Again, a series of coal mines might be found of about equal depths and working similar beds, which would afford another basis, and so on. The doctrine of averages is true on a wide enough basis, but a single country does not always afford this, and in such a case particular instances chosen with knowledge and discrimination, are more reliable. It is, of course, difficult to find suitable people to afford the information, but if an important body, such as the Statistical Society, were to apply to the many English managers in Continental works, they would acquire a vast amount of information which would be most valuable in supplementing that laid before them by Mr. Jeans.—*Lon. Eng.*

STRAY THOUGHTS FOR ENGINEERS.

Be punctual. Punctuality is one of the prime essentials of an engineer, not only in starting but in attending to the numerous little details which pertain to his office.

Be neat. An engine room need not look like a slush hole because coal, and iron, and oil, are used in and about it. Have your surroundings neat and comfortable if you have to make them so yourself. You, as well as every body who comes near your engine, will enjoy it better, and it will be a material advantage to you in getting another situation if it becomes desirable.

Have your safety valve so arranged that it may be easily tried, and lift it at least once a day to see that it is not stuck.

When possible the engine and boiler room should be adjoining but separated by a light partition. The dirt, dust and ashes from the boiler not only counteract any effort to keep the engine room clean, but work into the bearings and working surface of the machinery itself.

Keep your shovel and bar handles clean. It is easier to wash the shovel and wipe the iron tools once a day than to wash your hands every time you handle them.

Test your gauge cocks frequently to see that they are clear and free from desposit. Do not trust the glass gauge or low water alarms too implicity. The discharge from the cocks should be carried away by a suitable conductor and not left to deface the boiler front.

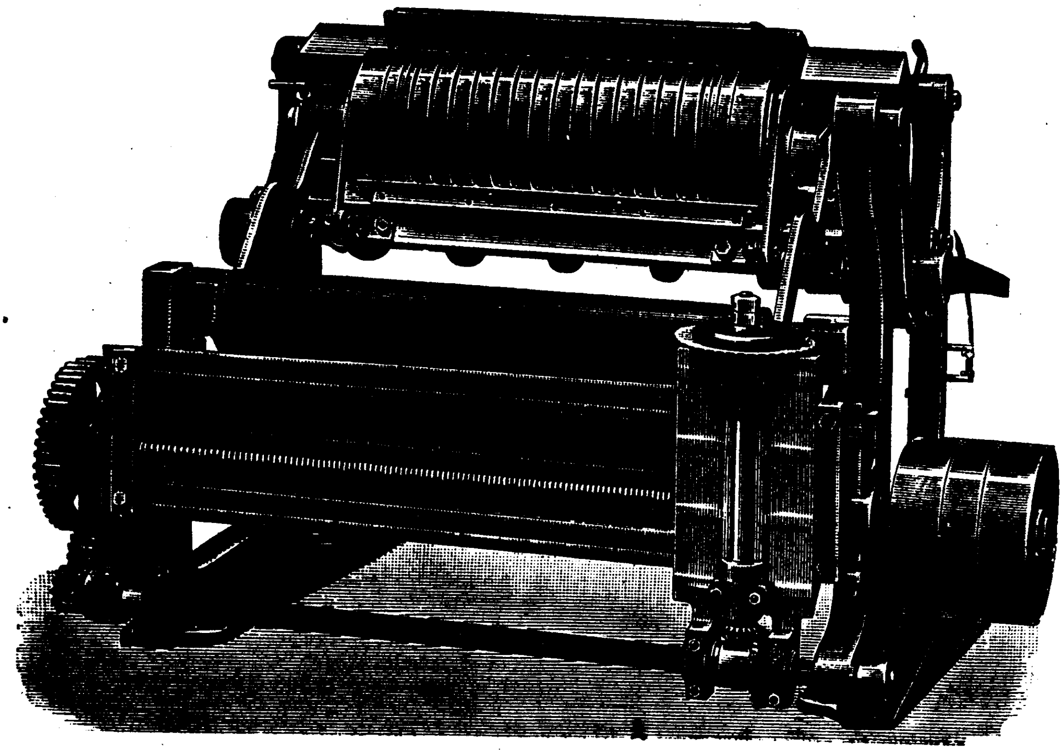
Fly-wheels should be caged in. A neglect of this precaution may be the cause of an expensive accident or loss of life.

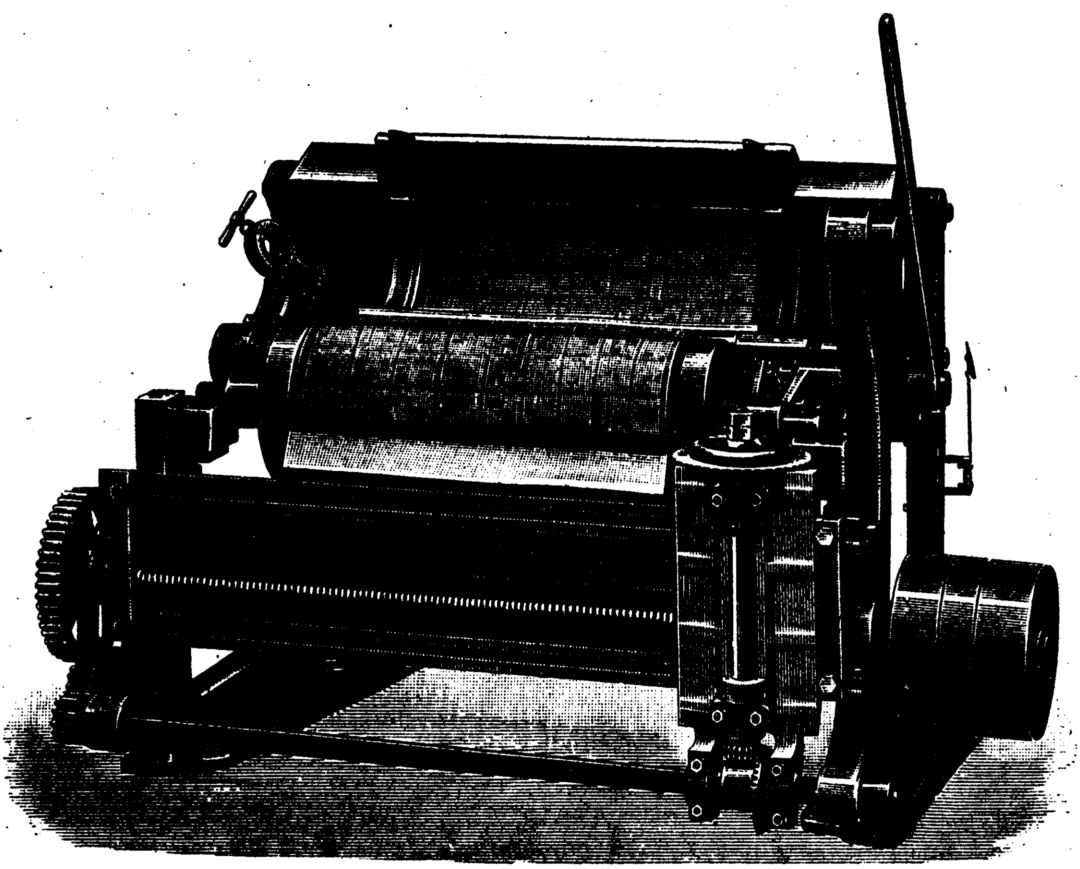
Have your steam supply pipes large enough and as direct as possible. When elbows must be used those made with a long sweep are preferable. Exhaust pipes are generally too small. The easier you can get rid of the steam after it has done its work, the better.

* With board.

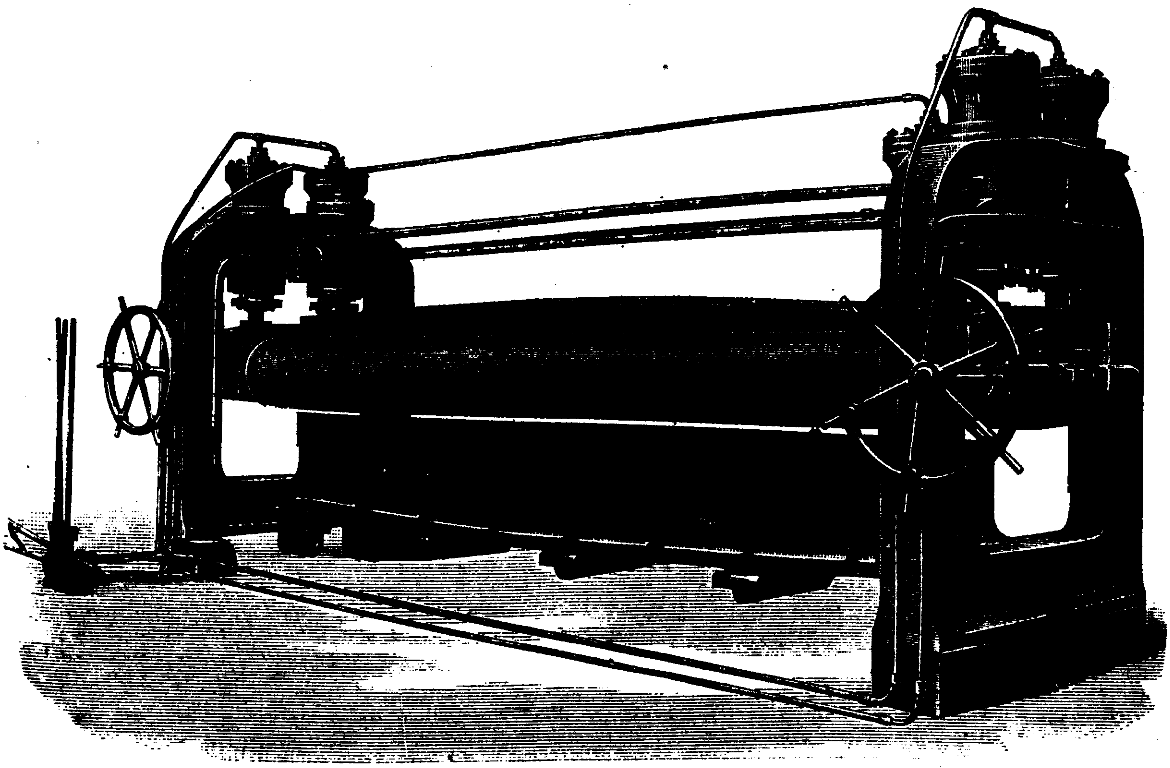
MACHINE FOR PREPARING STEREOTYPE PLATES.

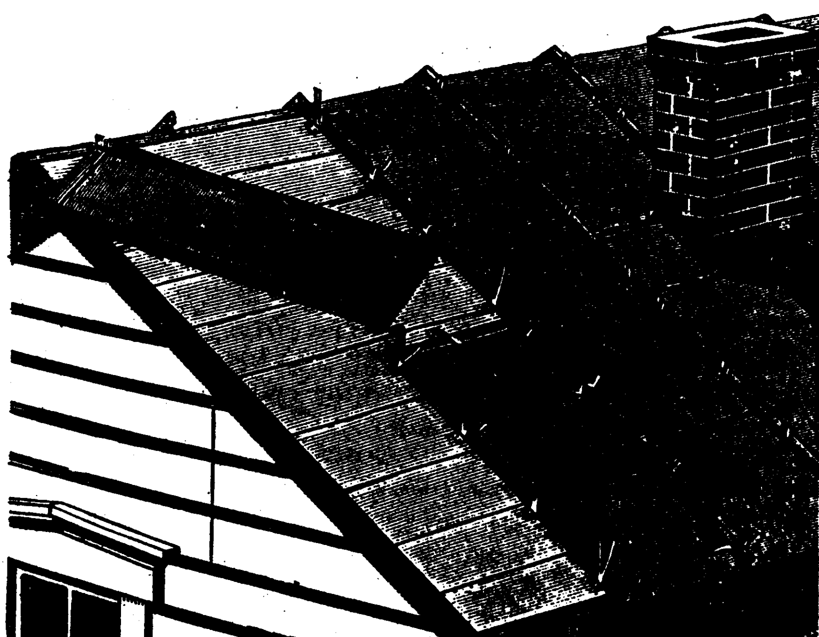
CONSTRUCTED BY MR. A. SAUVÉE, ENGINEER, LONDON.





REEL PLATE BENDING MACHINE.





IMPROVEMENT IN METAL ROOFS.

When the boiler is left for the night with fire under it, shut off the step valve in the feed pipe and the glass gauge.

Do not blow out a boiler under other than a very slight pressure, and let your brick work become cooled before your boiler becomes empty, otherwise the heat will harden the scale if it is not sufficient to injure the boiler itself.—*Ex.*

STEREOTYPE PLATE

We illustrate above, by two perspective views, a machine for preparing sterotype plates for newspaper printing, invented by Mr. Albert Sauvée, of 22 Parliament-street, Westminister. The upper figure shows the machine as it appears when all is ready for running the metal, and the lower shows the box open with the core removed, carrying with it the stereo plate, and leaving the matrix in the casting box. The flexible paper-maché impression of the type set up by the compositors is laid in the carved casting box, and the cylindrical core, which is carried by two arms, is then moved into its place, leaving an annular space between it and the matrix, and into this the metal is run. This space is bounded on the lower edge and at the ends by the sides of the box, but is open along the upper side for the metal to be poured in. It therefore follows that while the stereo plate is exactly of the required dimensions on three of the edges, the fourth carries a runner or git which must be cut off to bring that side to the proper form. To effect this the core is moved out of the box, and as the plate embraces more than half the circumf-rence of the core, it is carried with it, and is placed with its runner near to a circular cutter mounted on a vertical shaft fixed in a sliding frame. When the belt is moved on to one of the fast pulleys, the cutter is set in motion by means clearly shown in both views, and at the same time the saddle in which it is carried is drawn along the front of the machine by the leading screw. By this means the superfluous portion of the plate is removed. To prevent the teeth of the cutter being damaged by coming in contact with the core, there is formed in the latter a groove at the place where the cut is to be made. During the casting operation this groove is filled by a metal strip carried by two arms pivotted eccentrically to the core, and when the core is moved from the position shown in the upper figure to that in the lower, this strip sinks deeper into the groove and leaves a clearance for the teeth of the cutter, which can penetrate completely through the stereo plate without hurt either to themselves or the core. The rotary cutter can be carried in either direction across the machine, and as it approaches the end of its travel, the saddle moves the belt on to the loose pulley, and thus stops the motion. All the arrangements have been specially devised to save time in the casting of the plates, and we understand that when the men are accustomed to the working of this casting box, the time occupied in preparing the paper maché matrix, putting it in the casting box and getting the plates out ready to put on the machine, does not exceed from 6 to 6½ minutes. As time is of the utmost value in the bringing out of a newspaper, we have no doubt this new casting box will prove very useful to newspaper proprietors.—*London Eng.*

HYDRAULIC KEEL PLATE BENDING MACHINE.

The growing practice of constructing ships on the longitudinal double-bottom system with flat keel plates, has involved the use of keel plates bent to various angles from the channel form at the extreme ends of the vessel to nearly flat amidships, each plate being bent at a gradually increasing angle along its length. To accomplish this bending by hammering the heated plates into specially made cast-iron molds, proved a very troublesome and highly expensive process, and to obviate this difficulty the machine illustrated was designed.

The engraving referred to represents one of Scriven's hydraulic keel plate bending machines which has recently been constructed by Messrs. Scriven & Co., of Leeds, for the Imperial Russian Government. This machine is adapted to operate on plates 20 ft. long, 5 ft. wide, and 2 in. thick. For plate keel ships the machine will bend both sides of the plate at one heat and one operation with any degree of twist to the same shape. The machine will also bend a plate on one side only to a right angle or any greater angle, and with any degree of twist for bar keel ships. The machine has a top and bottom beam in the centre to hold the plate, and a roller on each side to bend it. The ends of the rollers are fixed to carriages which have a vertical motion in the end frame actuated by hydraulic cylinders; the roller ends have also a horizontal adjustment by right and left-handed screws, so that the rollers can be brought nearer to or further from each other. To bend the plate the rollers are adjusted at each end horizontally to give the correct bend; the plate is then placed on the bottom beam and clamped down by the top beam which is actuated by hydraulic cylinders. The bending rollers are then lowered on to it by the hydraulic cylinders which actuate the carriages in the end frames, and bend the plate. The plate when bent is withdrawn through the end frames. The hydraulic valves controlling the various motions are all at one place, so that one man can perform the whole operation of bending. The machine is made in various sizes, and to drive by belt or to act by hydraulic pressure. These machines are now in successful operation at yards of several leading private firms and at Govermment establishments.—*Lon. Eng.*

IMPROVEMENT IN METALLIC ROOFS.

In the accompanying illustration is shown a novel invention in metal roofs, of which Mr. A. Northrop, of Elyria, Ohio, is the patentee. This invention relates to the manner of securing the metal sheets to the roof boards or rafters, as the case may require, in such a way that, in case of damage to the roof, any portion may be removed with ease and without damage to or interference with adjoining portions, or the whole may be taken off and used again without damage to the individual or several sheets composing it.

Metal sheets, having their sides or long edges bent up, are joined at their ends to one another by the ordinary folded seam. Between the side seams of the sheets is placed one or two strips of metal, having their lower ends secured to the roof boards or rafters by a nail, and standing between the upward bent portion of the sheets. It is then bent downward over the upward bent edges of the sheets. Next, over these upward bent edges is placed a cap or saddle piece, and then the ends of the strips are again bent up and over the cap, completing the side seam and forming a firm and strong rib. The caps are made by cutting strips of metal across the end of a sheet, instead of lengthwise, as they are not as liable to break in bending them as when cut and bent with the grain of the sheet. This makes short but strong caps, and the fastening strips are placed at every intersection of the caps. The side seam is then finished by closing tight with mallet and seaming head.

By this means no holes are made in any of the metal sheets except, perhaps, at the edges of the roof. In case, also, that a sheet should become injured, broken or punctured, it may be easily taken out and repaired and replaced, or another one put in its place, as, by turning up the ends of the strips, the caps may be taken off, the broken sheet removed and replaced, the cap put on, and the ends of the strip bent over again—this without disturbing any of the surrounding sheets.—*Ex.*

REMOVING PAINT FROM IRON WORK.—In repainting iron work it is necessary to remove the old coats which have been put on; to do this A. J. Bishop, master mechanic of the Cleveland and Indianapolis railroad, recommends the use of the following wash, which he has found effective:

"In making tests to obtain proportions and results of difference strengths of potash and lime, I obtained the following 1 pound lime, 4 pounds potash, and 6 quarts water. I am satisfied that this proportion is about right. These tests were made with crushed potash.

"The average time required to remove paint from two pairs of drivers has been, for two men, seven hours, while the time for scraping would reach three and four days for the same work. The paint has been removed from a tank by two men, in seven hours, and other parts of a locomotive in a proportionate length of time, while with heat for burning same, or scraping cold, the time is beyond comparison.

"There are some objections to potash, as it may injure the hands or clothes of the user, but to avoid this I have made use of hemp packing fastened to a stick, two and a half or three feet in length. This gives the workman plenty of distance from his work, and he does not injure himself or his clothes, and also gives him a good swap or brush with which to apply the potash.

The *Mechanical Engineer* says that by going over the surface with diluted acid all the potash will be killed.

NEW LINCRUSTA-WALTON.

Nothing has been so noticeable during the last few years in England, and especially in London, as the marked improvement which has taken place in building and decoration. Much of the progress, so far as decoration is concerned, may be traced to the invention of a new material, known as Lincrusta-Walton. The recently-built mansions of the West-end, many new country-seats, hotels, restaurants, public halls, and theatres have been beautified with this material, more effectively, permanently, and cheaply than could have been done by any other system of decoration. It is difficult to say where and in what forms it may not be met with. Railway-carriages and ships' saloons have it in the form of panels; it may be seen made into screens, picture rails, window-cornices, finger-plates, toilet table and dinner mats, friezes, dadoes, and ceilings. What appear to be delicate pine or old-oak carvings in the style of Grinley Gibbons, turn out to be productions of the Lincrusta-Walton Company's works at Sunbury-on-Thames; and often a greatly-admired ceiling, or frieze, or dado, in the elaborate and artistic style now met with, is also indebted for its beauty to Mr. Fred Walton's invention. That a material giving such satisfactory results in this country and on the Continent would be welcomed in the Colonies and in India and other distant countries there can be no doubt. Indeed, this system of decoration possesses especial and peculiar advantages for use in new lands. No highly-paid artisans or designers are required to arrange it or fix it. It can be sent from London ready for immediate attachment to walls, ceilings, doors, etc., it may be compactly packed without danger of breakage, and it is unaffected by changes or extremes of temperature. With a view, therefore, of directing the attention of our readers in the Colonies and abroad, and of the shippers, to the general advantages which have commended the use of Lincrusta-Walton at home, and which are quite as applicable in other countries, we propose to give some account of the samples which we recently saw at the Company's London show-rooms, 9 Berners Street, and of the latest improvements which the inventor introduced.

Lincrusta-Walton may be briefly described as a result of the invention of linoleum, of which Mr. Fred Walton was also the inventor. There was a decided requirement before its appearance for a material in relief for mural decoration— a material which should be capable of receiving and retaining impressions from a matrix, which should also be plastic when required to mould it and rigid after it was once formed, and which should be of a flexibility sufficient to admit of its being fixed upon some base such as canvas, and made up in continuous length. It was also required that the new relief wall decoration should be of a permanent nature, not easily damaged, and superior to the effects of the atmosphere. These conditions the inventor of Lincrusta-Walton, which at first was known as "Linoleum Muralis," has successfully attained. The material with which he fulfils them is a mixture of linseed oil and fibre rolled on to a textile fabric, and subjected to the pressure of machinery and matrices, which stamp out the various designs in a greater or less relief, as may be desired. The present name denotes its general appearance and nature with considerable exactness, *lin* being derived from *linum* (flax) the chief ingredients being solidified linseed oil, and *crusta* (relief). The inventor's name is most appropriately added to prevent other firms using the word "lincrusto" after the first patent shall have expired.

First among the advantages of Sincrusta-Walton are those of a sanitary character, and in these it has no rival. Unlike stucco, plaster, or cement, it does not absorb moisture or infectious germs, and doubtless this quality, among many others, led the jurors of the recent International Health Exhibition to award it the gold medal, the highest distinction in its class. Impervious to moisture, and of a firm surface and unchangeable colour, Lincrusta-Walton is easily kept clean by washing it from time to time. Those, therefore, who want something that will wash and bear scrubbing could not have a better or more durable material on their walls. Another quality coming under the category of hygienic is its non-conductivity. Rooms with damp walls are rendered warm and healthy by its application; and even new and moist walls may be covered with it without waiting, as is the case when wall-papers are adopted, for the house to be thoroughly dry. Its durability will be understood when the nature of the materials of which it is composed is considered. It is not too much to say that, unless wilful damage or fire be encountered, Lincrusta-Walton is everlasting. It has been put upon damp walls in England four years ago, and is as good and artistic now as it was then. The chipping-off of corners and parts of decorations, a common occurrence with carton pierre, etc., is unknown with Lincrusta-Walton, which has a peculiar toughness, somewhat resembling that of indiarubber or guttapercha. The finest and most elaborate patterns, however, are produced to the minutest details, giving a richly-modelled surface as far superior, from an artistic point of view, to a "dead blank" wall as a plain sheet of paper is to one covered with a beautiful engraving. The half-tones and shadows which have so delightful an effect in oak carvings are fully brought out in Lincrusta-Walton decorations, giving this material an undisputed position of artistic superiority. Even when it is without any elaborate designs, or designs in relief, but merely with a plain surface, this wall-covering possesses sanitary, economical and artistic advantages which ordinary papers or painted walls can lay no claim to whatever.

Recently the inventor has perfected a system of superimposing by means of machinery, different colours in the patterns—an improvement effected at a nominally additional cost, which materially increases the value of Lincrusta-Walton from an artistic point of view. The four colours in which is it is made —medium buff, green, drab, a red and a deep brown—have heretofore been diversified by hand-work, gilt and silver leaf being frequently added. By the new process, however, a diversity of shade is obtained without such labour, and with results even more satisfactory. By this means the designs are naturally brought out much more clearly than if but one shade of colour be seen. Many new patterns were shown us during our visit to the show rooms. We have no hesitation in saying that the designs for 1885 will surpass any that have hitherto been brought out. They are moro elaborate, more highly finished, and, thanks to the new process, more artistic in effect, with scarcely any noticeable increase in price. Turkish, Persian, Gothic, Moresque designs, imitations in hammered metals, old oak carvings, lace, tapestry, and canvas patterns, are all produced with extraordinary fidelity. The general use of Lincrusta-Walton are also extending, and this is a field in which the application of the material is indefinite. As a substance upon which artists may paint more easily and effectively than on canvas, as panels for the decoration of plain wooden doors and mantel-pieces, as covering for ordinary ceilings when they begin to crack, as novelties in screens, mats, work-boxes, picture and photo frames, mantel-ornaments, showing bronze, silver, and gold effects, and in innumerable other ways, Lincrusta-Walton may be utilized, both with immediate economy and lasting artistic results. It is to the commercial success of the material that attention should be especially drawn. No other substance answering similar purposes can compete with it in price. It is one, therefore, which decorators and others abroad to whose notice it has not yet come should be prepared to introduce, the demand for which is likely to be as permanent as it will be large.—*Ex.*

A MODEL FAST CRUISER.

A practical turn has been given to the criticism on the navy by the submission to the Admiralty of a design for a barbette cruiser, the chief attributes of which are great speed, powerful guns, long steaming power, and unusual buoyancy. The designer is Mr. Pearce, of Fairfield Shipbuilding Yard; and although the vessel is a novelty when compared with the war ships of the present day, it is in reality nothing more than a development of the fast American liners, and an adaptation of their hull and machinery to the express purpose in view. The essence of the design lies in the speed, and it is concerning this quality that the designer can speak with authority. It has unfortunately happened in the immediate past that defective sailing qualities have been the chief characteristic of the British navy. Not only are the vessels unable to go fast but they are capable only of steaming the shortest distances. Mr. Pearce's design contemplates a speed of 21½ knots per hour, or about 25 ordinary miles, and a coal capacity for steaming as far as the West Indies and back at a speed of 12 knots per hour. This high and enduring speed will be given in conjunction with great offensive power and great staying power. The design contemplates the vessel being pierced by 100 shots and still being able to use her guns or steam off at full speed.

What may be described as the vitality of the ship, its power of endurance, and its maintenance as a floating object is secured by an elaboration of the cellular system of construc-

DYNAMO MACHINES.

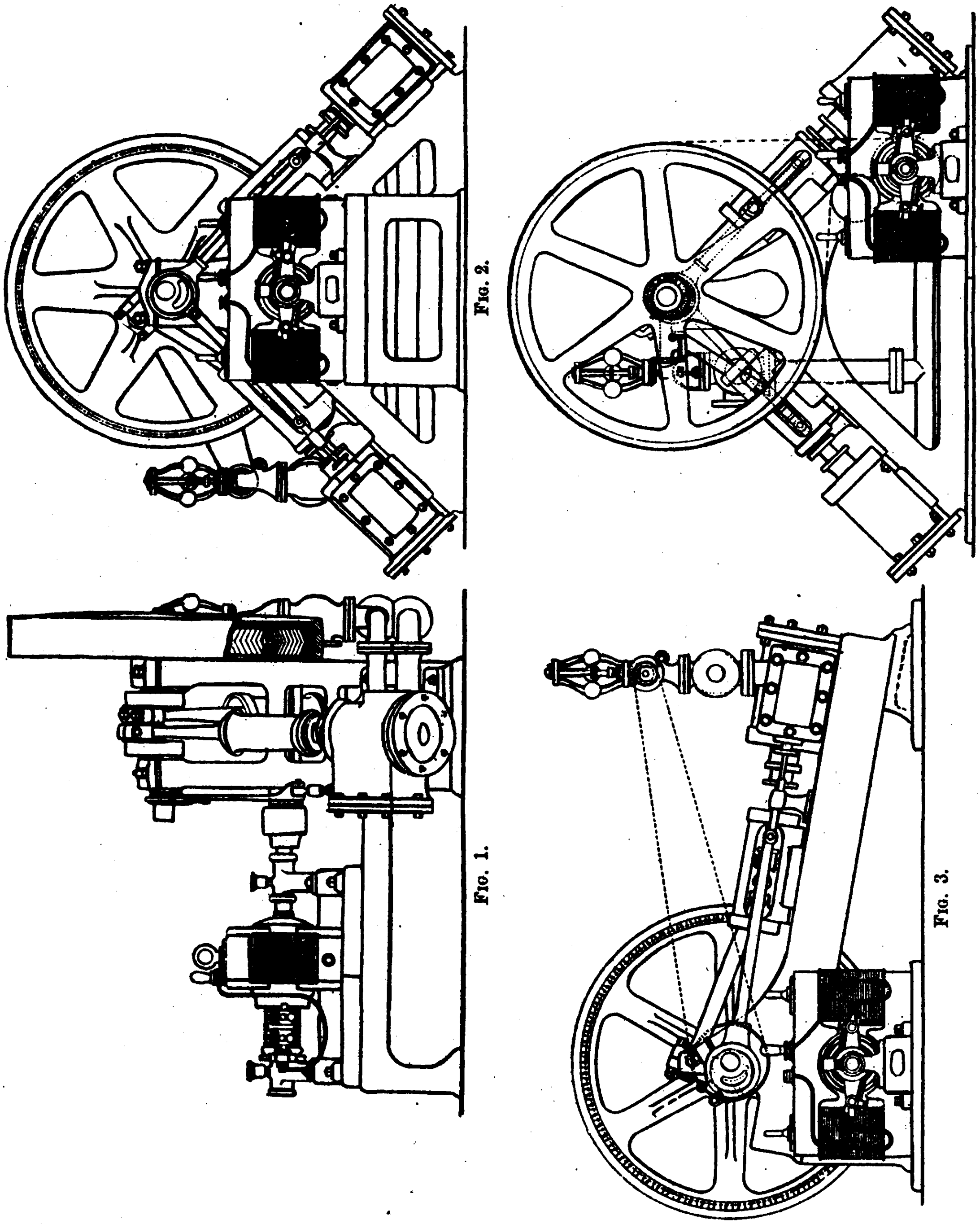


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

DYNAMO MACHINES.

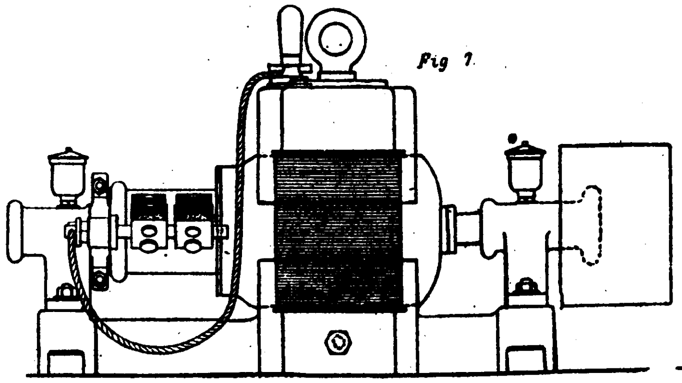


Fig 7.

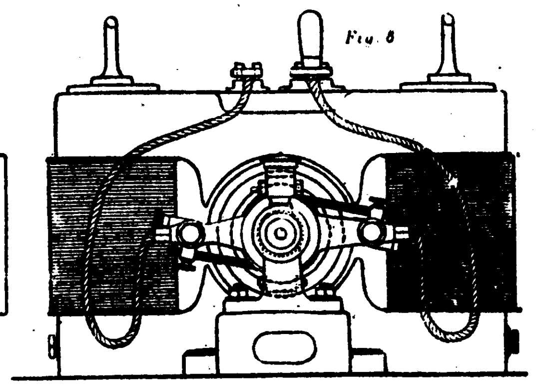


Fig. 8

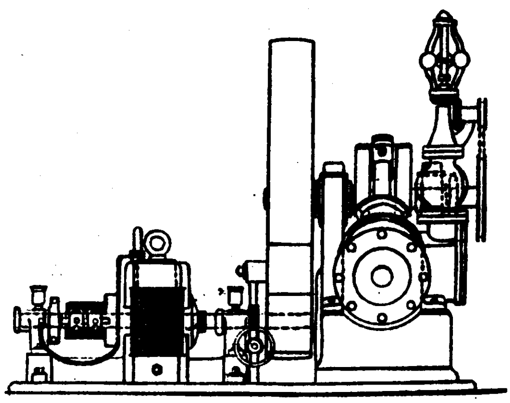


Fig. 5.

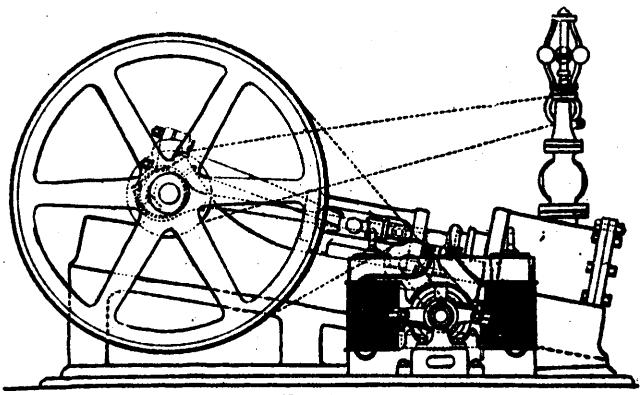


Fig. 6.

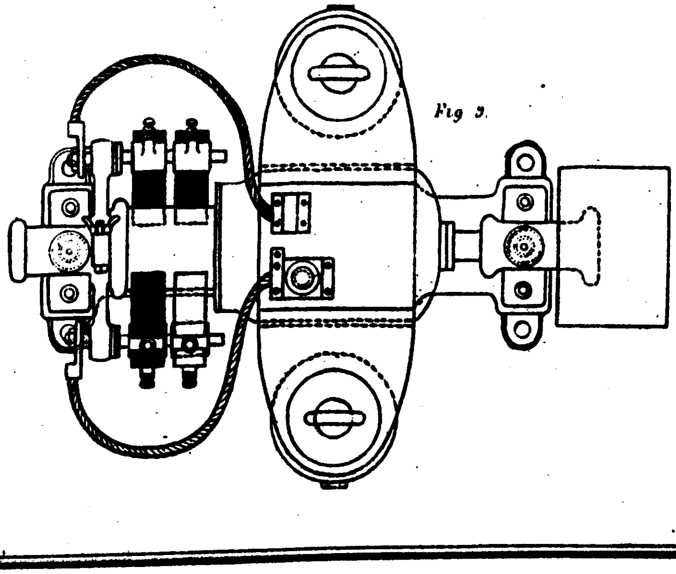


Fig 9.

tion. The hull would consist of 122 water tight compartments. A bulkhead would extend down the center of the vessel for its whole length of 410 feet, and three transverse bulkheads would, with the center bulkhead, divide the vessel into eight main water tight compartments. Each of these transverse bulkeads would run from the skin of the vessel to the bulwarks, and would be carried up and be joined to a deck of steel. The foremost of these transverse bulkheads is in the form of a collision bulkhead, the second runs from the after end of the engine room by a middle line bulkhead, and the third runs up from the stuffing box carrying the screw shaft in the stern. This will give six large water compartments and four small.

Those at the fore part and those at the stern will contain nothing of vital moment either to the buoyancy or the locomotion of the vessel. The four other compartments will contain two complete sets of boilers and engines, each with its screw shaft and screw propeller, and each set being completely cut off from the other by the middle bulkhead running the whole length of the vessel. The mechanical arrangements are designed upon the basis of the possibility of the whole of one side of the ship being disabled without resulting in the destruction of the vessel. Not only would she float, but she would float well, and would still have the means of a comparatively high speed. But in addition to these separate water tight compartments, the vessel is still further protected by the hull being divided up into an extremely large number of small compartments. The whole of the hull has a double skin, and the girders joining the inner and outer skin form water tight compartments throughout the entire hull.

The steel deck covering in the six large water tight compartments, is 3 inches thick, and is placed 5 feet 6 inches below the water line. It forms an arched roof, inclosing all the vital parts of the vessel—the engines, boilers, and screw shaft; and the means of access to the engine room is by a protected coffer dam running to the upper deck. The coal bunkers for serving the vessel are placed all along the sides of the ship, and occupy a space of from 10 feet to 15 feet in thickness. These coal bunkers are also divided at intervals of from 16 to 20 feet with bulkheads, primarily for the purpose of keeping the coal from shifting, but also for restricting the passage of water in the event of a ball having penetrated the compartment. There would thus be around the inner water tight compartments containing the vital parts of the ship a double skin, consisting of a great number of compartments, all of which might fill without sinking the vessel. The inside of these bunkers measures about 80,000 cubic feet; any one of them may be penetrated and filled with water in addition to coals without endangering the life of the vessel, and there is no projectile yet in existence that would penetrate through this double outer skin, the inner armor of coal, and the inner skin to the inmost compartment. It is not proposed to put any armor on the bottom of the vessel, simply because the chances of attack from that quarter are practically reduced to nothing by the high speed.

The engines and boilers have been designed with a view to procure the maximum of power with the minimum of weight. The engines themselves would be constructed mainly of steel and manganese bronze, and in form they would be almost identical with those of the fastest American liners now afloat. In conception they would be precisely similar to those of the Alaska, the Oregon, and the Umbria, produced by the same builder, and the arrangement would be similar to the set of twin engines and twin screws recently dispatched to Italy from the Fairfield works for the Francesca Morosini, now being built by the Italian government at Venice.

The engines of the Francesca Morosini are calculated to develop 2,000 horse power more than any vessel at present in Her Majesty's navy, and for their power they are the lightest engines ever built. The engines, boilers and propellers being an exact duplicate, wholly independent of each other, and each incased in their own water tight compartments, the use of sails becomes unnecessary, and there would be nothing required for purposes of locomotion to show itself above the deck. A military mast, however, forms part of the design, made of steel and hollow in the middle to permit the ascent and descent of marines for the purpose of working the machine guns placed upon the large military top. The main means of offense, however, is provided by a couple of barbettes. These are to be armor plated with steel plates of 11 inches, giving 13 inches thickness on a horizontal line.

The scheme contemplates the placing of 110 ton breech loading guns in each barbette, or two 65 ton guns. Arrangements are also proposed for placing eight 6-inch long range guns—four on each side of the vessel—amidships. Guns of this capacity would carry a distance of five miles, and given five miles as the utmost range, and given also a speed of 25 ordinary miles per hour, it will be seen that two minutes after a shot had been fired the vessel could be steamed to a distance of six miles from the object of attack, and quite out of range of the enemy's guns. The magazine and shell rooms are to be placed directly under the barbettes, with a hydraulic lift between them and the guns. Another element of attack consists in the torpedo room, which it is proposed to place in the forward part of the ship and in direct communication with the ejection tube. The precise dimensions of the proposed cruiser are:

Length, 410 feet; breadth, 64 feet 3 inches; and depth, 38 feet 6 inches. The displacement at a draught of 28 feet feet would be 10,500 tons, and at a draught of 26 feet 6 inches, 9,600 tons, with an indicated horse power of 18,000. The plan, without complete specification and a model, is now being considered by the Admiralty.—*London Times.*

THE MEMBERSHIP OF TRADE ORGANIZATIONS.

An estimate, partly on official figures, is given in the current number of the *North American Review* by Richard J. Hinton, of the trades and labor organizations in the United States, with the following result—(o) official; (e) estimated:

INTERNATIONAL BODIES.

Trades Organizations.	Membership.
Iron and steel-workers	42,000 (e)
Engineers (British)	5,000 (e)
Carpenters (British)	7,000 (e)
Typographical Union	11,930 (o)
Seamen's Union	7,000 (e)
Cigarmaker's Union	14,000 (o)
Coopers' Union	7,000 (e)
Bricklayers and masons	12,000 (o)
Granite cutters	6,000 (o)
Glass workers	7,000 (e)
Furniture-workers	9,000 (o)
Locomotive engineers	12,200 (o)
Locomotive firemen	12,000 (o)
Railroad conductors	7,000 (e)
Railroad brakemen and employes	18,000 (e)
Knights of Labor (federation)	150,000 (e)
International Workingmen's Association	20,000 (e)

NATIONAL BODIES.

Iron molders	14,000 (e)
Brotherhood of Carpenters and Joiners	7,000 (o)
Plasterers	7,000 (e)
Plumbers	3,000 (e)
Tinsmiths	3,000 (e)
Laborers (chiefly building trades)	25,000 (e)
Horse-shoers (includes blacksmiths)	19,000 (e)
Boiler-makers and iron ship-builders	17,000 (e)
Stationary engineers	1,700 (e)
Metal workers	8,000 (e)
Ship carpenters	2,000 (o)
German Typographical Union	3, 00 (e)
Telegraphers, operators and linemen	10,000 (e)
Coal miners, state and national	60,000 (e)
Progressive cigar makers	9,000 (o)
Mule-spinners (cotton factories)	5,000 (e)
Cotton weavers (cotton factories)	5,0 0 (e)
Silk weavers	1,200 (e)
Tailors, N. U	18,000 (e)
Upholsterers	3,500 (e)
Harness-makers	1,500 (e)
Paper-hangers	3,500 (e)
House-painters	10,000 (e)
Shoemakers, lasters, etc	12,000 (e)
Bakers	2,500 (e)
Brewers	2,000 (e)
There are small trades, locally organized, chiefly in the large cities, whose number is difficult to ascertain, and many of whom are federated with trade assemblies and Central Labor Unions. They may be understated at	75,000 (e)
The Socialist Labor Party (American) and the Social Democrats may be estimated at	25,000 (e)
Total estimate	611,530

—*Ex.*

The complection of the Mackey-Bennett cable makes the total length of submarine cable, according to the *Electrician*, about 68,000 miles. Each cable contains an average of 40 strands of wire, so that altogether there are over 2,500,000 miles of wire used in their construction, or ten times the distance from the earth to the moon. Practically all of this has been laid within the last twenty-five years; the greater part within a decade.

DRIVING DYNAMOS.

We illustrate several systems of driving dynamos devised and carried into execution by Messrs. Mathers and Platt, of Salford Iron Works, Manchester. Figs. 1 and 2 show an arrangement for driving a dynamo by helical wheel gearing. The engine is one of Mather and Platt's usual double-cylinder diagonal engines with cylinders 8 in. in diameter and 10 in. stroke. As will be seen, the bed is of a rigid form and suitable for an engine running at a high speed. The crank is of the ordinary double-sweep form and the crossheads and slides are cylindrical. The engine is fitted with the well-known Mather and Platt patent metallic piston, and it is regulated by a Pickering governor attached to the steam supply pipe and driven from the crankshaft by a pair of bevel wheels.

The engine has long brass bearings, the crankshaft bearing on the driving side being made extra long. The flywheel is formed into an internal spurwheel with double helical teeth, the boss of the wheel being turned and let into the crankshaft bearing, which is bored out to receive it. By this means the strain on the crankshaft is one of torsion only, and the wheels are more rigid and are kept in their proper relative positions so that the teeth are always in full gear. This wheel gears with a pinion keyed on a shaft carried through the engine bed, and which is coupled direct to the dynamo shaft by means of a flexible coupling. It will thus be seen that any slight irregularity or jar in the engine or first pair of wheels is lost in the shaft and coupling before reaching the revolving armature of the dynamo, which is of the greatest importance on account of its weight and speed, and from the fact that any springing of the shaft, however small, is intensified by the unequal magnetic stresses which are at once brought into action. The wheels of the engine and dynamo are in the proportion of 6 to 1, the former making 175 revolutions per minute. In an internal wheel the friction is less than in ordinary spur gearing, as the stresses are more nearly tangential to the pitch line of the wheels. There is very little wear in the wheels, and no parts requiring replacement. When the wheels are once set they require no further adjustment or attention. By using double helical teeth in connection with an internal wheel the number of teeth in gear at any instant is increased, so that a finer pitch can be used, which reduces the noise so as to be almost unnoticeable. The engine is shown in the engravings driving one of Mather and Platt's new compound wound dynamos for 150 to 200 twenty-candle power lamps, giving 100 volts electromotive force at 1050 revolutions per minute. Fig. 3 illustrates the same system of driving applied to a similar dynamo, but the engine in this case is of the single-cylinder oblique type. The cylinder is 10 in. in diameter by 12 in. stroke. The wheels are the same proportion as before, viz., 6 to 1, and the engine makes 175 revolutions per minute. The crankshaft is of the best hammered scrap and is carried in long adjustable brass bearings. The connecting-rod is also of wrought iron having adjustable brasses at both ends and is connected to the crosshead by a steel pin. The slide is of cast-iron bored to suit the circular crosshead. The engine is fitted with a Mather and Platt patent piston, with a steeel piston-rod, and the regulation is effected, as in the first case, by a Pickering governor driven by a strap from the crankshaft. The driving is effected through a shaft and flexible coupling just as in the previous arrangement.

Fig. 4 illustrates an arrangement of short-belt driving applied to the same dynamo and diagonal engine described with reference to Figs. 1 and 2. The engine is the same as before described, except that in the place of the helical gearing the flywheel is turned for belt driving. The proportion of the wheels and the speed of the engine are the same as before. In order to give the strap more grip on the pulley of the dynamo a very effective arrangement is used. This consists of the swivelling arm which carries at one end a pulley riding loose on a stud. The lower end of the arm is formed into a wheel quadrant gearing into a worm carried on a spindle at the end of the bed of the dynamo. By turning a handwheel keyed on the end of the worm spindle, the arm, and with it the pulley, is raised or lowered, and thus the strap is wrapped less or more round the pulley as required, giving a neat and effective strap driving in a small space. By this arrangement a long strap is unnecessary, and less strain is put on the driving side of the strap and also on the dynamo shaft, by giving more pulley surface to the belt. Figs. 5 and 6 show the above arrangement of belt driving applied to the same dynamo, but with the single cylinder engine before described in place of the diagonal engine.

The advantages of these methods of driving are not confined to ship lighting. In mills and workshops it is often desirable to place the dynamo in the engine-room, so that it may require no further attendance than from the man in charge of the main engines. The space is usually in such cases very confined, excluding the possibility of driving by a long belt. The method last described has been very effectively employed by Messrs. Mather and Platt in installations at the Theatre Royal and Comedy Theatre in Manchester for driving two 250-lamp Edison-Hopkinson dynamos. It may also be advantageously used with gas engines for house lighting, as it enables the engine and dynamo to be fixed on a single bedplate.

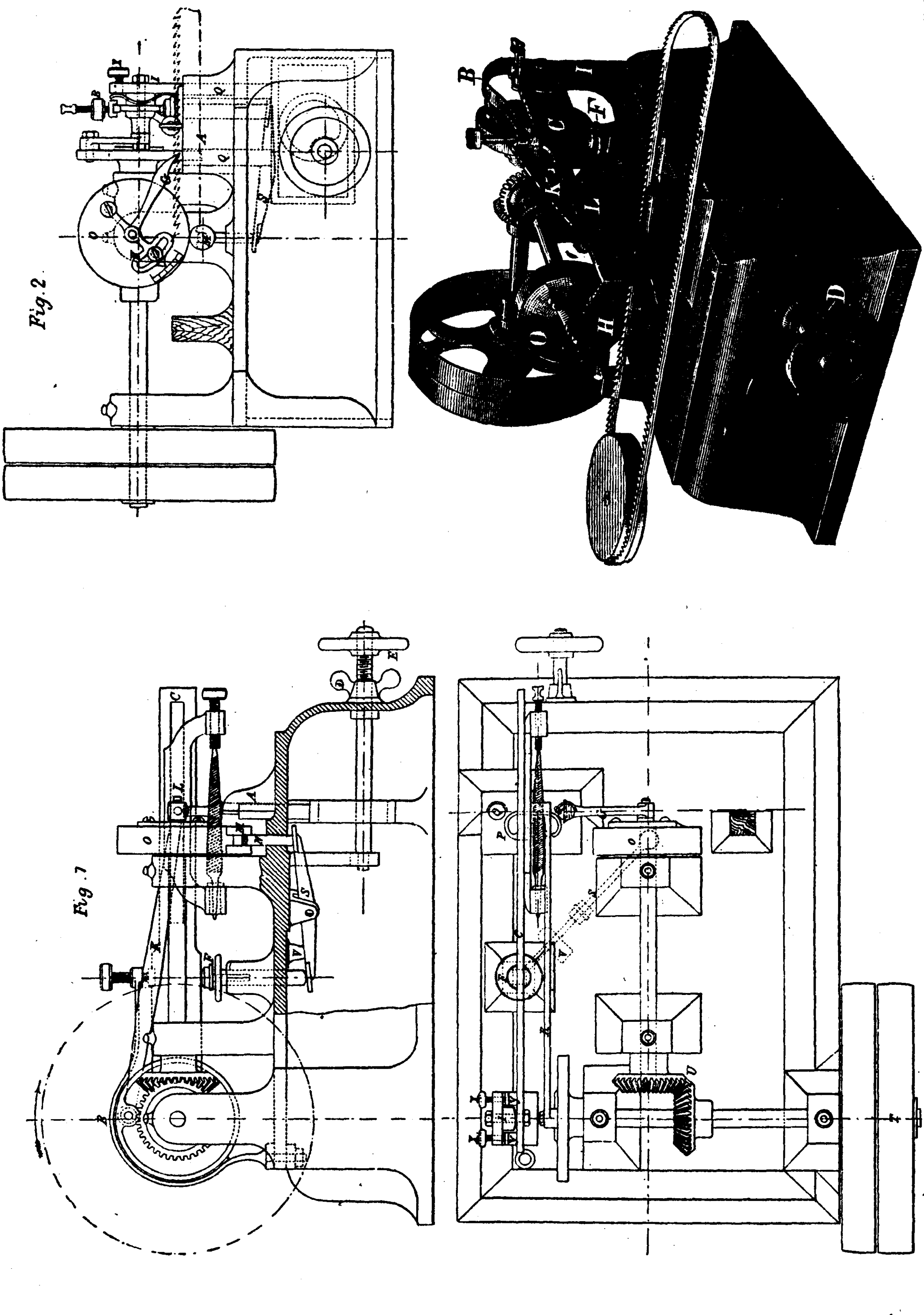
Figs. 7 to 9 illustrate a new form of dynamo manufactured by Messrs. Mather and Platt. This machine is a modification of the original gramme generator, carried out on the same principle as Dr. John Hopkinson's reconstruction of the Edison dynamo. The mass of iron in the magnets and core of the armature is very largely increased, and the length of the magnetic circuit is shortened. The machine has a double magnetic circuit which, though slightly diminishing the efficiency, greatly increases its compactness and symmetry of form. The cores of the magnets are made of wrought iron, and are let into cast-iron pole-pieces, which have an increased section over the wrought iron. The lower pole-piece is extended to form the bed of the machine, thus securing great compactness, and keeping the centre of gravity of the moving parts as low as possible. The armature of the machine has a free space left along the shaft to secure internal ventilation, and the commutators are large compared with the general dimensions, in order to diminish the sparking by giving as large a surface of contact as possible between the brushes and commutator bars. The commutators of all the machines have forty bars of toughened brass, and are insulated with mica.

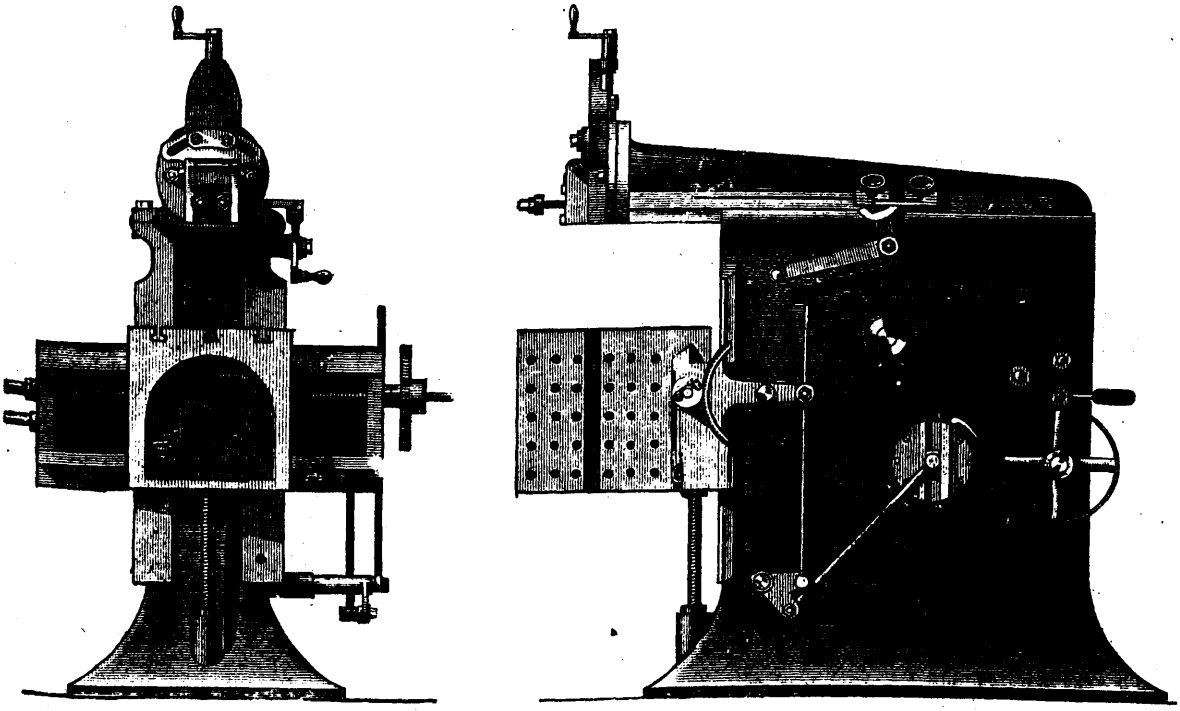
In the machines for 100 lamps and for high outputs, there is a double brush on each rocking bar capable of separate adjustment with an elastic forward thruss and butt contact. The machines are all compound wound for constant potential at the terminals, the series coils being external to the shunt coils. These arrangements have increased the efficiency of the machine, so that those of the new type are not much inferior in efficiency to the Edison-Hopkinson machine, which has probably very nearly the highest duty attainable. The perfect ventilation and low resistance of the armature enables these dynamos to carry a large load in proportion to their size without heating. In fact, the load on the armature is determined by quite other considerations than that of heating. Each machine is provided with a switch board carried on the upper yoke, and fitted with a main plug switch and suitable terminals.—*Eng.*

LIGHTHOUSE ILLUMINANTS.

It will be remembered that last year a Committe was appointed by the Board of Trade to consider the important question of the best light for lighthouses, but it fell to pieces owing to the secession from it of the representatives of the Commissioners of Irish Lights. They found that there was a majority, consisting of the Trinity House representatives, who would not admit into the proposed experiments the trial, to its fullest extent, of a system of gas-lighting which had proved to be very useful in Ireland. Mr. Chamberlain, on the dissolution of the Committee, put the whole matter into the hands of the Trinity House for investigation, placing at their disposal a large sum of money for the purpose of making the necessary experiments. The Trinity House, thus relieved from the constraint of their sister Board, proceeded with the work. They selected the South Foreland, where there are two lighthouses, as the scene of their operations. They erected three temporary lighthouse-towers, and placed upon each of them a lantern of the regular lighthouse size. In one lantern they fixed the most modern lenticular apparatus for the electric light, and applied in its focus a more powerful electric light than had ever before been shown in a lighthouse. It is produced by the combined action of three electro-magnetic machines, manufactured by M. de Meritens, of Paris. These machines are driven by the steam engines which work the dynamos for the ordinary lighthouse light of South Foreland. In the second lantern they erected a quadriform gaslight on the system introduced by Mr. Wigham into the Irish lighthouses. Each of the four burners consists of a group of jets, and they produce unitedly a light of very great power. The gas for these lights is manufactured on the premises in special apparatus erected for the purpose.

BAND SAW SHARPENING MACHINE.





Bridgeport Twenty-Inch Shaper.

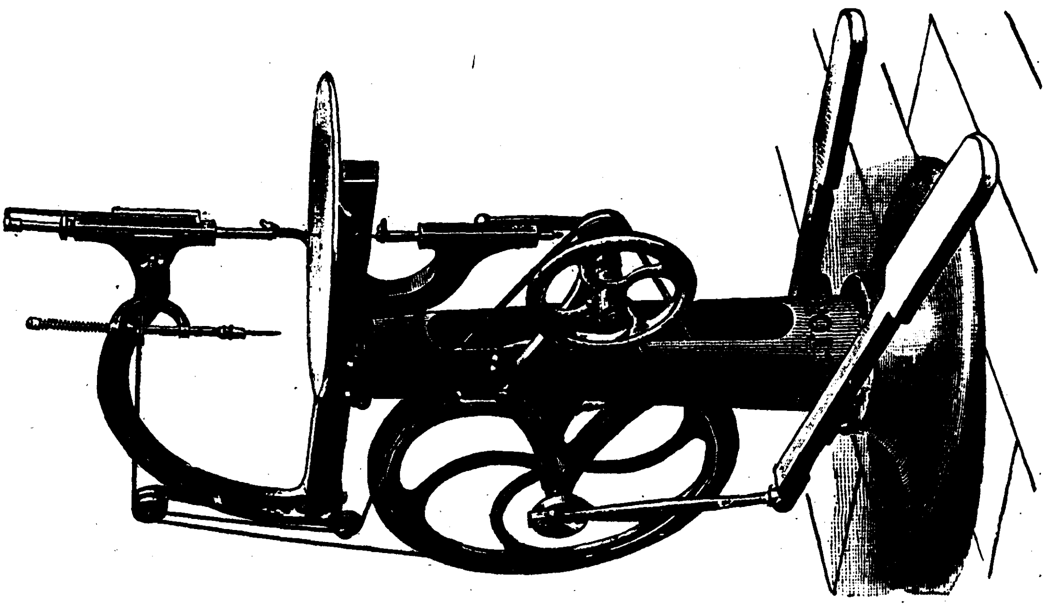


Fig. 1.—The Victor Scroll Saw.

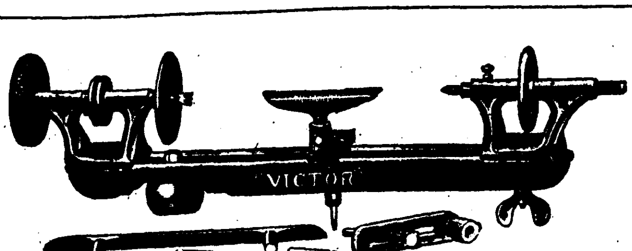


Fig. 2.—The Victor Lathe Attachment.

In the third lantern a triform oil-apparatus was placed. Each of the three oil-lights is in the focus of a lens much larger than any hitherto used in lighthouses. The united height of these three lenses is much greater than that of the four lenses of the quadriform gaslight, and the light transmitted is the greatest ever produced from oil in a lighthouse. Thus equipped the Trinity House began their experiments. They purchased the right of way for miles across the Downs, and built at various distances from the lights, wooden huts for the accommodation of the skilled observers they employed. The distances between the temporary lighthouses and these huts were carefully measured and staked out. Mr. Vernon Harcourt, F.R.S., was appointed by the Board of Trade to superintend the photometric measurements of the respective lights, and the ordinary light-keepers of the Trinity House service were placed in charge of the huts. Besides all this, telephonic communication was established between the huts, the temporary lighthouses, and the engine-rooms. Last April the lights were lighted for the first time, and a Committee of the Elder Brethren proceeded to inspect them at one of the huts.

The electric light was found to be by far the brightest light; next to it came the gas light, and then the oil. Almost every night from that time to the present these three lights have been exhibited; and all who choose to look could see the effect, which was indeed exceedingly interesting. It is no secret that, while on every occasion when the weather was clear, the order of merit was as above; yet on the occurrence of fog the electric light, which in clear weather had been so superior to the others as to have been pronounced almost too dazzling for practical use, faded away and became less visible than either of the other two lights. This failure of the electric light to make itself seen in a fog is, of course, fatal to it as a lighthouse light; and, if these experiments have had no other effect than to prove the assertion that had been repeatedly made by one or two scientists as to this defect in the electric light, they will not have been made in vain. The comparison between gas and oil, however, still remains to be determined, and the Trinity House have made a great number of photometric experiments on this branch of the subject. They have erected the longest photometric shed in the world, and have tested the burners patented by their engineer, Sir James N. Douglas, against those of Siemens, Wigham, and Sugg. The whole subject is of enormous importance to the maritime community, and no doubt the Trinity House will issue a carefully prepared report; But it will, we think, be advisable that the Trinity House should once and for all clear up the point as to the cause of the accession of the Irish Light Commissioners. It will be incumbent upon them to show that the system of lighting which the Commissioners required should be tried in the experiments has been so tried, and has had fair play, and that the burners of their own engineer have also been placed upon terms of absolute equality with those of rival manufacturers. In the face of the question asked a few weeks ago in the House of Commons—as to Sir James Douglass having sold for a large sum of money his patent right in certain burners to a company in which he holds a great number of shares, while still retaining his position in the Trinity House as engineer-in-chief—it is all the more necessary for the Elder Brethren to make it plain that every system of lighting has been fairly and fully tried to its utmost limit.

The "further correspondence" on this matter, which has just been issued as a Parliamentary paper, is scarcely reassuring. Being put on their mettle by Professor Tyndall's letter, the Elder Brethren of the Trinity House came out hot and strong as the champion of their engineer, and they can hardly be said to assume that independent tone which would be desirable. No pains are spared to depreciate Mr. Wigham's inventions, and as to the Galley Head light, to which Dr. Tyndall refers as unapproached as regards "power and distinctiveness," they remark that "it is impossible to say whether those whom it so greatly impresses have considered what would follow if such lights were multiplied, and whether, among many such, the identification of one from another would become difficult." That is to say, that if powerful lights are multiplied, it will be a disadvantage to the sailor. To the ordinary mind such a condition of things would seem to be a positive advantage to the mariner. The Elder Brethren of the Trinity House, according to their own statement, are very anxious to secure economy in the administration of public money, and their preference for oil as opposed to gas is due to their belief that, while capable of as great efficiency, it is less costly than gas, although less convenient in manipulation. This, at any rate, is what they told the Board of Trade a year ago. Perhaps they have by this time discovered, as a result of the trials mentioned above, that oil is by no means capable of as great efficiency as gas as a lighthouse illuminant. As to the relative merits of the inventions of Mr. Wigham and Sir James Douglass, the Elder Brethren enter into a long explanation, in the course of which they again trot out this plea of economy. They argue that it has yet to be proved that electricity is not the lighthouse illuminant of the future, and that, therefore, to pay a high price to Mr. Wigham for his invention, or, indeed, to adopt that of Sir James Douglass, would be a mistake. This was the opinion of the Elder Brethren twelve months ago, and reads very prettily. But the recent trials must have convinced even the Trinity House that the electric light may be said to be almost out of the race at present. Altogether we cannot regard the defence which the Elder Brethren put forward as particularily ingenuous. The report from the Scotch Lighthouse Board has a much better ring about it. They take no one-sided view of the case, and they insist upon the necessity of honest and straightforward experiments, which will once and for all settle the difficulty. On the whole, it would appear that there is now some prospect of this squabble being brought to a termination, and, irrespective of the claims of this or that inventor, it is eminently desirable in the interests of the sailor that the best possible light should without further delay be provided for his guidance.—*Ex.*

COLOR BLINDNESS.

During the past few years the attention of scientists has been largely drawn to the investigation of this peculiar trait. As a result color blindness is no longer regarded as a phenomenal curiosity. It is recognized as a congenital and hereditary defect in the structure or condition of the optic nerve. The delicate cones and rods as they are technically termed which form the final terminal elements of the optic nerve fibres of the retina, while working in unison as a whole, each has its own separate work to perform. The cones gives us perception in color, the rods gives us perception of shape. There may be a defect in one without imparing the sense of the other. Thus a man may be color blind and still be able to distinguish form. There are three primaries, red, green and violet, and there are three distinct retinal color zones. It is only in the center of the retina that we have perfect perception. There we have all three of the primaries, in the zone outside of that, we see only green and violet; in the third zone still further beyond we see only violet and blue. It is necessary in order to get a perfect view of anything to bring it directly under the center of the retina. Color blindness is generally confined to the two primaries, green and red. To this fact might be traced many of the disasters which have occurred where signal lights are used. It will undoubtedly become necessary when this defect is more universally understood to require a certificate of perfect chromatic perception from all employes desiring positions where signal lights are used. Color blindness is much more prevalent among males than it it is among females. B. Joy Jeffreys, M.D., of Boston, while testing nearly 200,000, found 805 color blinds among 19,198 males, and only 12 defective in the cromatic sense among 14,940 females. This is a much smaller per cent. than other examiners have found. The difference has nothing whatever to do with the sexual opportunities for handling colors, but is solely due to the absence of that perceptive faculty in the retinal structure. It is impossible to try and educate the sense, as there is nothing to begin work upon.—*Ex.*

THE LIMITS OF HEARING.—Attention has been directed of late to the experiments made by M. Panchon on the limits of hearing, the results being communicated to the French Academy of Sciences. The notes were produced by a powerful siren of the kind invented by Cagniard-Hatour, and actuated by steam. It seems that the highest audible notes produced in this way had 72,000 vibrations per minute. M. Panchon had also vibrated metal stems fixed at one end and rubbed with cloth powdered with colophony. In diminishing the length of the stem the sharpness of the note is increased. Curiously enough, he finds that the length of stem giving the limiting sound is independent of its diameter; and for steel, copper and silver, the lengths are in these ratio to the respective velocities of sound in these metals—that is, as 1,000 for copper, 1,002 for steel, and 0,995 for silver. Colophony appears to be the best rubbing substance.

VICTOR SCROLL SAW AND LATHE ATTACHMENT.

We illustrate herewith another style of scroll saw manufacturing Co., of Senaca Falls, N.Y. The present machine is suitable either for light or heavy work, and cutting with the greatest precision from the lightest and most delicate work up to thickness of 3 inches.

The Victor (Fig. 1) has an adjustable tension in connection with the upper spindle, which may be varied to suit the requirements of the operator. It is designed to use regularly 8-inch saw blades, but can be adjusted to use 5-inch blades for fine work, if desired. The iron tilting table is 18 inches in diameter, and can be changed to any angle for sawing inlaid work; the table and all finished parts are nickle-plated. It has an adjustable upright drilling attachment, provided with an Empire drill chuck which will hold from 0 3-16th inch twists drills. It has a large dust blower, which keep the lines of the work free from sawdust. The driving wheel is heavy, 24 inches in diameter, and the driving belt is ½ inch V shape, giving strong power without slipping or lost motion. It has a double foot treadle, with a walking motion, by which much greater power can be obtained with less fatigue than with other forms. The average rate of speed when sawing is about 1,000 strokes per minute. The height from the floor to the top of the table is 40 inches; this enables the operator to run the machine with both feet, sitting; or with one foot, standing. For steam power the manufacturers furnish light and loose pulleys arranged to connect to the driving wheel shaft on either side, leaving a treadle connected on the other side. Weight of machine, complete, 250 pounds; crated, ready for shipment, 325 pounds.

The Victor lathe attachment (Fig. 2), to be used in connection with this machine, is a strongly built well finished piece of mechanism, with planed ways, etc. It can be easily attached to either the Victor or the Empire machines, in the same manner as the table. The average rate of speed is about 4,000 revolutions per minute; length of bed, 26 inches; distance between centers, 15 inches; swing, 6 inches. The head has a hollow steel spindle, nicely fitted with a face plate, spur center, cup center, and two point centers. On the outside is fitted a 4-inch solid emery wheel, for grinding and polishing tools, metals, etc. The tail shock has a steel screw spindle, with hand wheel, etc. With the lathe the company furnish a set of extra cast-steel turning tools, with 6-inch blades sand hard wood handles.—*Ex.*

BRIDGEPORT TWENTY-INCH SHAPER.

This tool, which is of novel design, has just been added to the Bridgeport list. The shaper is convenient to operate, and is made in a way likely to secure durability in service. Careful attention has been given to the arrangement of parts and distribution of metal to secure the maximum of strength and solidity. The sliding surfaces are broad and carefully fitted by scraping. The cutter bar is operated by a rack and pinion, thereby securing a uniform movement throughout the entire length of stroke, and quick return. The running gear is the same as in the Bridgeport 16-inch planer, and is driven by two belts, cross and open, one on each side of the machine. By the employment of an improved belt-shifting device, the driving belt is removed to the loose pulley before the reversing belt is started, thereby avoiding jar and friction. Rack and gears are cut in the most approved form; and the shafts are of steel with long journals of good diameter.

The cutter bar has an extreme stroke of 24 inches, and can be adjusted to any point desired while in operation. By direct connection with the main shaft a positive feed is obtained, varying from 1-100th to 1-4th of an inch.

The shaper is made by E. P. Bullard, 14 Dey Street, New York.

CANCER IN HORSES.—The *Indian Medical Gazette* says: *Melanotic cancer* is an ordinary cause of death in Bengal among gray and white horses. We can scarcely drive through Calcutta without seeing animals having the characteristic globular tumors beneath the skin.

—THERE is an elementary and a scientific knowledge of things and their is an elementary and a scientific stage of instruction. He who teaches in the elementary stage does not need that comprehensiveness of view that another must have who shall teach successfully in the higher stage.—*G. P. Brown, in Ind. Sch. Jour.*

ENCKE'S COMET.

There is an excitement in the celestial court. Encke's comet has arrived, and star gazers are turning their telescopes to the skies in eager haste to obtain a glimpse of the distinguished visitor. Our eccentric guest is not a prince among comets. It is not a *cometa horrendae magnitudinis*, like those members of the family that in the olden times swept over the heavens and threw the beholders into an agony of superstitious terror. It does not burst upon the astonished gaze at noonday with a brilliancy akin to that of the sun; its tail is not turned like a Turkish cimeter, nor does it branch out into six toils, each 6,000,000 miles long. It does not span the celestial vault from horizon to zenith; there is no danger of its being considered the harbinger of war, pestilence, and the day of judgment; and there will be no prayers read in the churches beseeching deliverance from "the Turk, the devil, and the comet."

Encke's comet is interesting chiefly for being the first known comet of a short period, for making the shortest circuit of any member of its class, for performing its revolution within the boundaries of the solar system, and for the reason that it seems to be more amenable to physical law than some of the more imposing members of the cometary family, those vast ethereal creations that visit our domain and then rush off into fathomless space,

"On the long travel of a thousand years."

This comet has a history. It is known as Encke's comet because the distinguished German astronomer was the first to carefully investigate its motion. It was first detected in 1786, again by Miss Caroline Herschel in 1795, again in 1805, but made no estimate of the length of the period. Encke then took up the task, and studied its movements with a thoroughness before unknown. He established beyond a doubt that the comet's orbit was an ellipse, that its period was about 1,212 days, and that it had made four complete revolutions between 1805 and 1818. These facts being sure, there was no difficulty in identifying it with the comets of 1786 and 1795, and in concluding that in the intermediate returns to parihelion its position had been so unfavorable that it was not seen.

Encke predicted its return in 1822, pointed out the position it would occupy among the stars, and also announced that it would be visible only in the southern hemisphere. He had the happiness of seeing his predictions verified by the observations of an astronomer in New South Wales, who followed the comet during its whole visible course.

Since that time this eccentric visitor has not failed to return to perihelion very nearly at the computed time, although at some returns it has been visible only in the southern hemisphere, and at other returns its position has been so unfavorable that the closest scrutiny has been of no avail in picking it up. Encke's comet is a veteran among comets of a short period, reaching next January the centennial anniversary of its discovery. Why should not the event be celebrated? It deserves to be, for this eccentric member of the system is an exceptionally well behaved comet, except in the matter of yielding to the influence of a resisting medium or some other mysterious power. It has neither been turned into a new path by the disturbing form of Jupiter—sometimes its near neighbor—nor has it split in two parts like Biela's comet, nor is it disintegrating into meteors, like Tempel's comet and the second comet of 1862, that lead the long procession of meteors in the November and August meteor zones. The orbit of Encke's comet is an ellipse, inclined at an angle of 13° to the plane of the earth's orbit. At perihelion it is 31,000,000 miles, and at aphelion 377,000,000 miles from the sun. Its perihelion is between the sun and Mercury, and its aphelion is between Jupiter and the asteroids. Its motion is from west to east, and its revolution, in the days of its early history, was performed in about 1,212 days.

Encke's comet is by no means a remarkable one. It is a telescope comet, and consists of a patch of circular light, somewhat condensed toward the centre. Though usually visible only through the telescope, it has been seen by the naked eye. Such was its appearance in 1828, when it was in an exceptionally favorable position for observation, and its light was equivalent to a star of the fifth magnitude. At common times there is little trace of a tail, but, on rare occasions, a slight one has been detected, like a faint brush of light, and sometimes with a second appendage opposite the first. Its tenuity is so great that, at its return in 1878, the centre of the comet passed directly over a star of the tenth magnitude lying in its path. The star was undimmed by the transit of the densest portion

COMPOUND TWIN SCREW ENGINES (7700 I.HP.) FOR THE ROYAL ITALIAN TORPEDO RAM VESSEL "ETNA."

CONSTRUCTED BY MESSRS. R. AND W. HAWTHORN, ENGINEERS, NEWCASTLE-ON-TYNE.

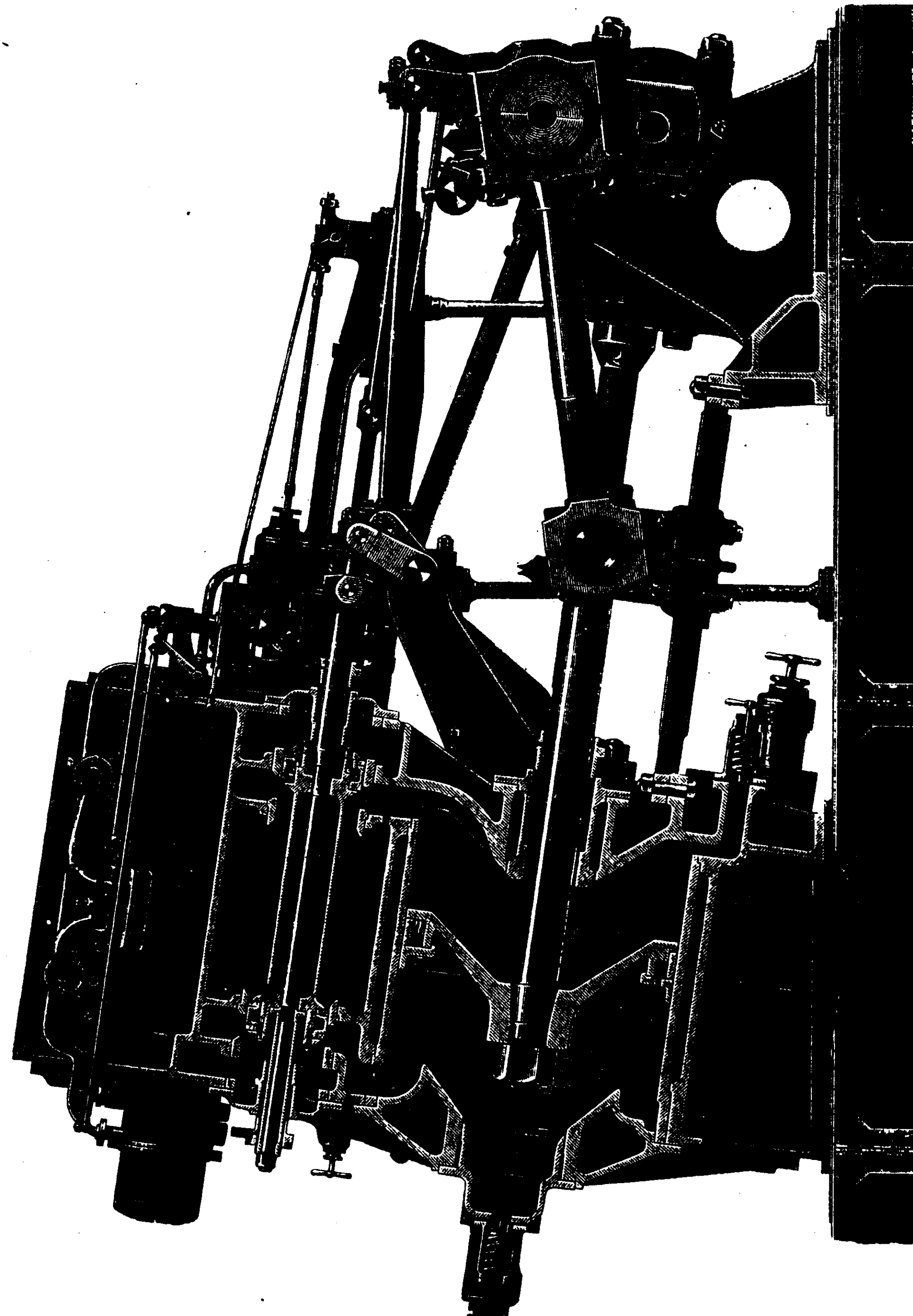


Fig. 1

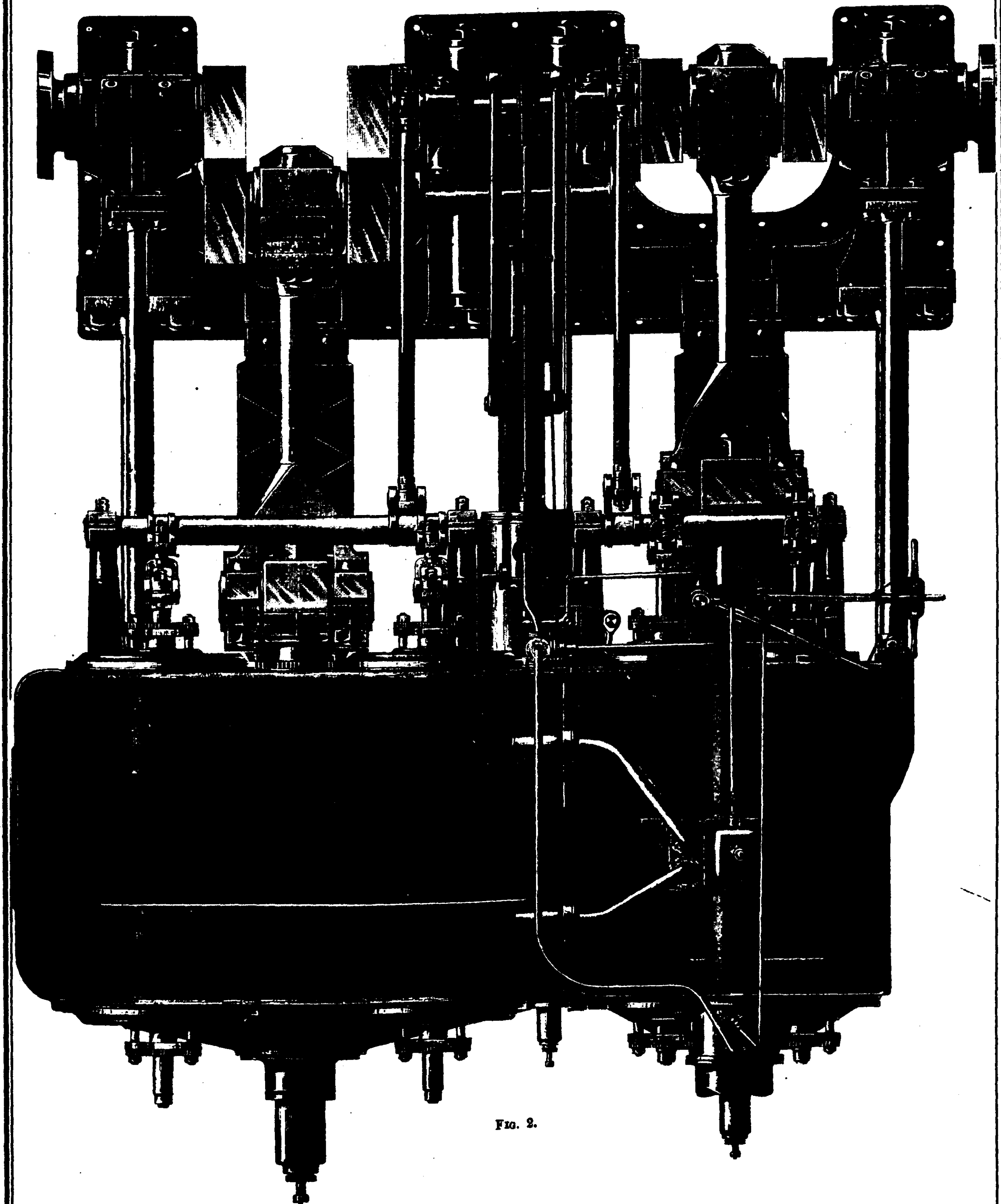


Fig. 2.

of the comet. and shone through the misty medium as brightly as it had before shone against the dark background of ihe sky.

This insignificant mass of nebulosity has been of use to astronomers. When at its nearest point to Jupiter, the mass of the huge planet was more accurately deiermined by means of its "excessive perturbations." In the same way, when it was nearest to Mercury, it was the means of detecting an error in in the mass of the fiery little orb.

But the movements of comets, like "the course of true love, never did run smooth." This member of the family does not complete its revolution on time. Its periodic time is constantly diminishing. Its circuits round the sun grow less and less. The German astronomer did not fail to attack the problem, indeed, he may be said to have devoted the labor of his life to its solution. His conclusion was, that the comet met with a resisting medium in space, a medium too ethereal to disturb such masses as the planets are made of, but powerful enough to affect a body of extreme tenuity like a comet. This theory has its supporters and its opponents, but no other comet, as far as is known, is affected in the same way. The existence of a resisting medium in interplanetary space, and the cause of the retardation of Encke's comet, are still mooted questions that vex the astronomical soul. At any rate, the comet's period is now about 4 days less than it was at the time of its first computation in 1819. The effect of retardation will be to diminish the comet's velocity in its orbit, in consequence of which it wilt be drawn nearer to the sun. The final result will be that, ages hence, the comet will be precipitated into the sun.

Encke's comet, at its present return, was first seen on the 13th of December, by Herr Tempel of the Arcetri Observatory, Florence, and is described as a faint, nebulous-looking object. It was seen on the 17th of December by Professor Young, of the Halstead Observatory. He describes it as faint, slightly elongated, and with a small central condensation. It was then in the head of the Western Fish, and moving slowly eastward. It makes its perihelion passage on the 7th of March, will grow brighter until that time, and wiil soon be visible in small telescopes. The comet was last in perihelion on the 15th of November, 1881. Its period of revolution is now about 1207·86 days, nearly 4 days less than when its orbit was determined by Encke in 1819.

PAPER LUMBER.

Paper board is susceptible of the highest polish, and will take any tint or color. The lumber is made principally of the pulp of wheat, rye and oat straw, and other vegetable fibres, combined with chemical ingredients and cements. It is formed in layers, about one-quarter of an inch in thickness, and these are pressed together by powerful machinery, and thus rendered as hard as the hardest wood, besides being much more dense. The boards are also rendered waterproof in varying degrees, according to the purpose for which they are to be used. The material is as durable as time, and can be sold at a good profit for almost half less than ordinary pine lumber. It will take any finish, and in this respect alone is equal to the finest hardwood. Moreover, it can be marbleized in imitation of any kind of marble, both in respect to a high degree of polish and an exact imitation of grain. It will not warp, and can be rendered perfectly waterproof, if desired, thus making it suitable for burial caskets. It makes just as solid a surface as any wood, and may be made of the hardness of stone. As a substitute for wood in the construction of buildings it possesses qualities of perfect adaptation. It will make the finest material in the world for roofing, not excepting slate or iron. It can be sawed, split or planed, and boards made out of it are perfectly smooth and flat from end to end on both sides, without any knots, cracks, or blemishes of any kind commonly met with in wood.—*Ex.*

TO THE list of novel inventions from the land of wooden nutmegs must now be added paper cigars, large quantities of which have been imported into the Australian colonies. A correspondent describes these as being such an exact imitation of the natural leaf of the nicotian herb, and to be so well flavored, that it takes a magnifying glass to detect the deception. He adds, too, that they burn well and hold their white ash firmly.

STAMPS V. ROLLS IN MILLING SILVER ORES.

Mr. C. A. Stetefeldt, the well-known American metallurgist, has reviewed in the *Engineering and Morning Journal* the recent progress in the milling of silver ores in a paper contributed to Mr. Horatio Burchard's last volume on the statistics of the precious metals, in which he deals with the question of the relative advantages of stamps and rolls. Stamp batteries to-day are very great improvements on what they were a few years ago. The stamped ore, or "pulp," is now taken away by means of conveyors and elevators instead of being fetched by a barrow from a dusty chamber, and suction fans are used to draw off the dust from the battery which used to escape and spread itself over all the machinery. But in spite of all improvements the stamp battery still remains the most troublesome part of the mill plant. In making a comparison Mr. Stetefeldt deals only with the system of rolls known as Krom's rolls. Crushing by rolls had long been in use for purposes of concentration, but Mr. Krom was the first to apply them successfully for crushing ore for subsequent treatment by roasting and amalgamation or lixiviation. He provided the rolls with steel tyres, ran them by pulleys at 100 revolutions per minute, and constructed them in a most substantial manner generally. It is found that ore crushed by rolls is much more uniform in size than ore crushed by stamps, and contains very much less fine powder. It was formerly considered that for purposes of amalgamation ore must be crushed exceedingly fine. This is now known not to be the case, a coarser grain often answering better. In lixiviation of silver ores a large proportion of very fine ore is injurious, as it retards filtration and delays the entire work. Hence it is considered that ore crushed by rolls is in a better condition, mechanically, than ore crushed by stamps. To make the comparison as to relate costs of erecting and working crushing plants of equal capacity on the two systems, Mr. Stetefeldt assumes certain conditions, answering to those which would obtain at some remote district of the west, in regard to cost of fuel, timber, and other materials, and freight He then takes two sets of Krom's 26-in. rolls as being equal in crushing power to a 30-stamp battery with stamps of 850 lb. dropping 7 in. or 8 in., 94 times per minute. For fuel required, amount crushed, &c., data are taken from mills at work. The cost of erection on the spot of the two plants is worked out as 17,118 dols. for stamps and 6180 dols. for the rolls, or a saving of 10,938 dols. by using rolls. Then the wear and tear, repairs, lubricants, &c., are made out as costing 17 dols. per 24 hours for the stamps, and 6.45. dols. for the rolls, showing again a saving of 10.55 dols. per 24 hours by using rolls. Interest and amortisation on the excess of capital required in the original erection of stamps is also taken into account, and is stated to be fairly taken at 15 per cent. per annum, considering the short life of most silver mines. Taking the yearly working days as 350, the interest and amortisation at 15 per cent. on 10,938 dols. come to 4.68 dols. per day at 6 dols. per cord. The various items thus show a daily saving by using rolls as compared with stamps of 27.23 dols., viz :

	Dols.
Wear and tear and repairs	10.55
Interest and amortisation	4.68
Fuel	12.00

Mr. Stetefeldt does not claim the greatest accuracy for this comparison, but says it is the best that can be given at present and proves the superiority of rolls beyond a doubt. Some authorities claim a greater saving than that above given.

A NEW METAL.

A New York scientist claims to have discovered along the Lehigh Valley, a hitherto unknown metal which will some day supplant nikel in general use. He was making an experiment with an explosive substance mixed with pulverized furnace slag, which, on being heated caused an explosion to take place. Upon examining the crucible in which the mixture had been, he found that a chemical process had taken place by which an apparently valuable, but hitherto unknown, metal had eliminated from the slag. It was silvery white in color, of fine, smooth texture and susceptible of a brilliant polish that no exposure will tarnish. It was found to be malleable, ductile, and of great tenacity, showing a tensile resistance of 140,000 pounds to the square inch. Further experiments only confirmed the results of the first trial, and a company has now been organized for the purpose of "working" the large slag banks along the Lehigh Valley for new metal.

THE PNEUMATIC SYSTEM OF THE WESTERN UNION.

A few years since, pneumatic tubes were laid over short routes in this city and in some of the larger cities of Europe, and they operated so successfully in what might be termed the experimental stage as to soon form a most important auxiliary to aid in the transaction of the regular business of the telegraph office. Some plan to facilitate the quick delivery of dispatches to points at some distance from the main office became necessary, since it was impracticable to send them direct to the branch offices nearest their destination, and since messenger service consumed too much time.

In 1876 the Western Union Telegraph Company laid a pair of tubes, having an inside diameter of 2¼ inches, from the general office, corner of Broadway and Dey street, this city, to the Stock Exchange, and a second pair to the Cotton Exchange. One tube was for sending and the other for receiving messages. In 1879 a single tube 1⅝ inches in diameter, was laid to each of the six morning newspapers—the *Times. Tribune, Herald, World, Sun,* and *Staats Zeitung*. Last year four tubes, 3 inches inside diameter, were laid from the operating room at the central office to the basement of a building, erected by and specially adapted to the wants of the company, at the corner of Fifth Avenue and 23d street. Two of these tubes are only used for the transmission of through messages, while the others may be used as direct tubes, or may be connected at will to either of three way stations, located at Nos. 407, 599, and 844 Broadway. The line passes from Dey street, through Broadway to 14th, to Fifth Avenue, to corner of 23d street. It is the intention in time to extend the system so as to take in the principal hotels, depots, etc., and also private residences, if the business of the occupant should warrant it.

It will be seen that this method divides the city, for all practical purposes, into two main or central stations, the communication between which, by means of the tubes, occupies less than three minutes, each connected with intermediate points, and while lessening the amount of messenger service and repeating, also permits the company to better arrange its force of operators by locating a large part in 23d street building.

The tubes are of brass, are of lengths of 20 feet, and are laid in masonry trenches, provided with manholes suitable distances apart. Upon each end of each tube section is a collar, held by the tube being expanded, as in boiler work. The faces of the collars are turned down, and in one is formed an annular groove, in which fits an annular ridge upon the face of the adjoining tube. Thin paper is the packing used. The ends are held together by six bolts passing through loose sleeves placed behind the collars. To provide for expansion and contraction—a most important point, especially in the neighborhood of the steam heating pipes—a slip joint is formed at every 900 feet. The joint is made by slipping the end of one piece of tube inside of the next, which is slightly enlarged to receive it. The inside of the end of the inner tube is ground out to form a sharp edge, which is tempered, so that anything running through will not be likely to get caught. Between the sharpened end and the point where the outer tube is contracted to its normal diameter there is a short space, not exceeding 2 inches in length, where the diameter is so great as to allow the air to shoot past the flange of the passing box; but as the latter is 6¾ inches long and flanged at each end, there will always be one flange in the tube where the diameter is normal. The joint is made air-tight by means of a packing-box.

Leather boxes or carriers were tried, but had not sufficient strength to resist the concussion caused by their stoppage at each end of the line. The form of the boxes now used, made of vulcanized fiber, is clearly shown in the accompanping engraving. They are 2 inches in diameter, and at one end is a thick pad of felt to take up the force of the blow. The cap consists of three pieces—a flanged cap proper, a leather washer a little longer in diameter than the tube and having radial cuts, and a fiber disk. The cap is held on by a wing nut screwing on a rod extending through the box. Each box will hold about 100 messages on the common blanks.

The plant is so constructed that the system can be operated by the exhaust and pressure methods combined, or by the exhaust alone. At each of the main stations are four pumping engines, built by the Knowles Steam Pump Works, placed in pairs and so arranged that each of the engines can be used independently or in combination with any of its neighbors. The steam cylinders are 18 inches in diameter, air cylinders 32 inches, and the stroke 36 inches. The engines are connected with two sets of iron tanks, one being set for air under pressure and the other for vacuum. Pipes lead from the tanks to the underground tubes and to the tubes used for carrying messages to various parts of the building. Each engine is so constructed that it can be used either for pressure or vacuum, this being accomplished by means of two-way valves placed in both the suction and delivery pipes. The speed of the engine when working as a compressor is automatically regulated by a piston operated by the air pressure in the reservoir; this device is independent of the regular speed governor. The method of cooling the air cylinders is most interesting. The cylinder is trimmed and then bushed with a brass cylinder upon the outer surface of which is formed a spiral groove, similar to the thread of a screw. A small pump forces water into the groove at each head, and after traversing around the cylinder several times the water escapes through a passage at the centre. By this plan cold water is applied to the cylinder at each end of the stroke, or at that point where the greatest heat is generated. There are three sets of packing on the cylinder; the centre one is of hemp, and at each end of the stroke, where the piston rests, there is a lubricator that feeds oil to the hemp packing, which distributes it through the cylinder.

At each end of each tube is a receiver, those in the downtown office being placed vertically and those at 23d Street being placed horizontally, owing to the want of sufficient space. The arrangement of pipes and receivers at each station is clearly shown in the engraving. The receivers are 16 inches long, and consist of two cylinders mounted upon a frame, so journaled that either cylinder may be brought in line with the tube through which the messages pass. The cylinders move between face plates placed one on each end of the tube. One cylinder is of the same inside diameter as the tube, so that when placed in line with the latter it will permit the box to pass through. The other cylinder is provided with a door held in place by nuts. Beyond the receiver on the end of that tube through which the boxes arrive is the receiver which is now used to stop the boxes, the use of the other having been discontinued on the through line. This consists of a box 12¾ inches long and 6 inches in diameter. The carrier strikes upon a cushion made of leather stuffed with hair.

At the end of the pneumatic tube proper is a pipe, furnished with a valve, that leads to a larger pipe extending to the vacuum tanks. This valve being opened, it will be readily seen that anything placed in the other end of the tube will be drawn through, (Such good results have been obtained when using a vacuum alone, that both vacuum and pressure are not necessary with the present development of the system.) The momentum of the carrier is depended upon to take it to the receiver at the end of the tube; but should it stick midway, a "coaxer" is brought into operation to help it along. This consists of a small valved tube connecting the vacuum pipe with the delivery tube at a point between the two receivers. By opening this valve the carrier will be brought forward.

At the end of the sending tube is a pipe leading to the pressure tank. When the valve in this pipe and the receiver are closed, the engine at the other end of the line is exhausting the air from the whole length of tube. When the receiver—in this case it is used as a sender—is opened, the fire engine is pumping air through the tube. To send the carrier, the door of one of the cylinders is removed, the cylinder being in line with the tube. The valve is opened and the carrier placed in the end of the tube, when the air catches it and quickly hurries it along its journey. Back of the receiver is a pipe leading to the compressed air reservoir, so that if necessary the speed of the carrier could be increased by forcing air behind it.

To reach way stations along the line, the tubes curve out of the street and up into the operating room. When a box is to be sent to a way station, the operator of that station is notified by an electric alarm. He at once swings the cylinder having a lid in the line; a wire screen in the cylinder stops the carrier. He then swings the cylinder out, when the second cylinder enters the line, which is then unbroken, so that other boxes intended for other stations can pass on.

In some of the European systems the carriers are dispatched in trains at intervals of from ten to fifteen minutes; but in this system the carriers are sent as often as required, so that there is no time lost in waiting. The capacity of a tube is about 1,000 messages, or ten carriers, per minute. Boxes have been sent between the two main offices, a distance of 14,500 feet, in 2 minutes and 12 seconds.—*Ex.*

Miscellaneous Notes.

FURS.—An importer and exporter of furs gives this information: "The house cat is one of the most valuable of fur-bearing animals, and when they mysteriously disappear from the back fence, they often find there way to the furrier. It is an actual fact that over 1,200,000 house cats are annually used by the fur trade. Black, white, maltese and tortoise-shell skins are most in demand. They are made into linings and used in philosophical apparatus. As for skunks, 350,000 were used in this country last season, valued from 50 cents to $1.20. They come from Ohio and New York principally, and, as in pursuit of the tiger and lion, the bravest men are required."

COAL DISCOVERY IN CANADA.—Further particulars as to the recent find of coal at Wapella, in the Canadian North-West, near the settlements of the Gardon-Cathcart and London East-end colonists, show that the seam is at an average depth of 6 feet from the surface of the prairie, and being situated on a side hill the coulee can be mined without any heavy expense. The width in extent of the seam has not yet been tested, but there is every indication of its permanent character. The situation of this new coal discovery within a few yards of the Canadian Pacific Railway, and its short distance from Moosomin, makes it one of the most important adjuncts to the settlement. —*Ex.*

IF any proof were needed, beyond the assurance given us in Scripture, that we are "fearfully and wonderfully made," we have it revealed to us by the patient, learned researches of eminent scientific men. Take, for instance, this novel computation which has been formulated by a distinguished German histologist, who has been at the trouble to calculate the aggregate cell forces of the human brain. The cerebral mass is composed of at least 300,000,000 of nerve cells, each an independent body, organism, and microscopic brain, so far as concerns its vital relations, but subordinated to a higher purpose in relation to the function of the organ; each living a separate life individually, though socially subject to a higher law of function. The life term of a nerve cell he estimates to be about 60 days; so that 5,000,000 die every day, about 200,000 every hour, and nearly 3,500 every minute, to be succeeded by an equal number of their progeny.

PRISONERS IN RUSSIAN MINES.—Where prisoners in Russian mines conduct themselves well they are sometimes permitted to live in small houses near the prison after two or three years incarceration. This privilege is accorded most frequently to married men. Presentations of clothes are often made to help them along. The convicts consist mostly of murderers and robbers, but a very small proportion being political offenders. These latter scarcely ever work in the mines, being kept in a prison apart from the others, and possessing more comforts. The laborers are not at all in harmony with the Nihilists or their principles, and they are kept apart more for the sake of peace than for any other reason. This is the only gold mine in Siberia in which convicts are employed. About one thousand of them are worked in some of the silver mines, under the same conditions as govern the others. A working day usually consists, in summer, from daylight to dusk—6 A.M. to 8 P.M.—with two or three hours intermission for meals. The work for each one is marked out by the superintendent, and the diligent and expert miners are allowed to go home as soon as their daily alloted task is finished. Very little is done in winter on account of the extreme cold and short days, during which time the convicts do not work at all.

IN this busy age of ours it is useful to be remined, now and again, of little things which are well calculated to add to the small sum of human happiness. In point of fact, the happiness or misery of a whole life-time is impinged on trifles. All the poets have borne testimony to this fact. The pratical Elihu Burritt was careful to point out in words of beautiful song that "A pebble in the streamlet scant, had turned the course of many a river." The other day we came across an article on this very subject of an extremely practical kind, and reproduce it for the benefit of our readers:—"Every movement of muscle," and this is worth noting, "whether it accomplishes anything or not, whether voluntary or involuntary, costs an outlay of bodily strength. Every thought also involves an expenditure of strength. Therefore all thoughts involving fret, worry, fear, or borrowed trouble is so much strength unprofitably expended. It will waste you away mind and body. You may always tell a man or woman whose existence has been a life-long fret, by their careworn, hollow, emaciated faces. They are never healthy. Fret kills more people than the cholera. It leaks away strength constantly. At last the weakest organ or function gives way. This we call disease. The doctor comes and gives the disease a Latin name. The disease may attack heart, liver, lung, stomach, kidney. But the real and underlying cause had been at work for years in the patients mind. You can't help fretting, worrying, borrowing trouble? That makes no difference as to result. Merciless nature takes no account of what you can't help. Possibly you cannot help it. Years of habit may have made worrying 'second nature' for you. It may be a habit as hard to break as the 'joggle' of your heel while sitting at the desk. Both movements—the physical one of your foot and the mental one of your mind—may have become involuntary. You might call it automatic mind or body action or automatic exhaustion."

Varieties.

ELECTRIC LIGHT IN AN ENGLISH COLLEGE.—Peterhouse College, Cambridge, is said to be the first college to adopt the electric light. Not only are the courts of the college, the hall, combination room, and chapel lighted by electricity, but the rooms of the undergraduates and the master's lodge as well. It owes its introduction to Sir William Thomson who, at his own expense, has supplied the necessary apparatus.

A NEW METAL.—"Idunium" is the name proposed by Professor Websky for the metal just discovered by him as one of the components of native vandate of lead. The mineral is rather a scarce one, of a yellow color, and contains several other metals, of which zinc, iron and arsenic are among the most prominent. Idunium resembles vanadium in several respects, both physically and chemically, while the only oxide hitherto examined forms stable salts with alkaline bases, and thus would appear to possess distinctly acid properties.

SCIENCE destroys some of the most cherished popular delusions. Catgut is derived from sheep; German silver was not invented in Germany, and it contains no silver; Cleopatra's needle was not erected by her nor in her honor; Pompey's pillar had no historical connection with the personage; sealing wax does not contain a particle of wax; the tuberose is not a rose, but a polyanth; the strawberry is not a berry: Turkish baths did not originate in Turkey, and are not baths at all; whalebone is not bone, and contains not any of its properties

EXPERIMENTS have lately been made by the French Government with a new kind of siege gun of prodigious power. It is described as made of steel, and nearly 30 feet long, and the tube is strengthened with ten coils of plated steel wire one millimeter, or .039 inch. in diameter. The composition is such that the canon, after a few discharges, becomes elongated by three millimeters. The weight of this gun is fifty tons, and it projects a shell weighing 297 pounds, capable of penetrating armor plates nearly six inches thick at a range of seven and one-half miles.

THE AMOUNT OF WATER ABSORBED IN TREES.—In the official report of the Geological Survey of Wisconsin is an account of the determinations made by Dr. J. M. Anders, of the amount of water pumped from the earth by trees. He finds that the average exhalation from soft, thin-leaved plants in clear weather amounts to about 1½ ounces troy, per day of twelve hours, for every square foot os surface. Hence a moderate-sized elm raises and throws off 7¾ tons of water per day. In the report the facts are applied to what is going on in America, where certain inland fertile districts are becoming converted into deserts by wholesale clearings: and in other places, such as the plains of Colorado, where only five or six years of irrigation and planting has already produced a measurable increase of rainfall. It is maintained that the deserts of Syria and Africa are the results of cutting down trees, and that original luxuriance may be restored by skilful replanting.—*Boston Journal of Commerce.*