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The Canadian Patent Office Record and Mechanics' Magazine

Vol 1.—No 12. MARCH, 1874. Price in Canada $1 50 per An.
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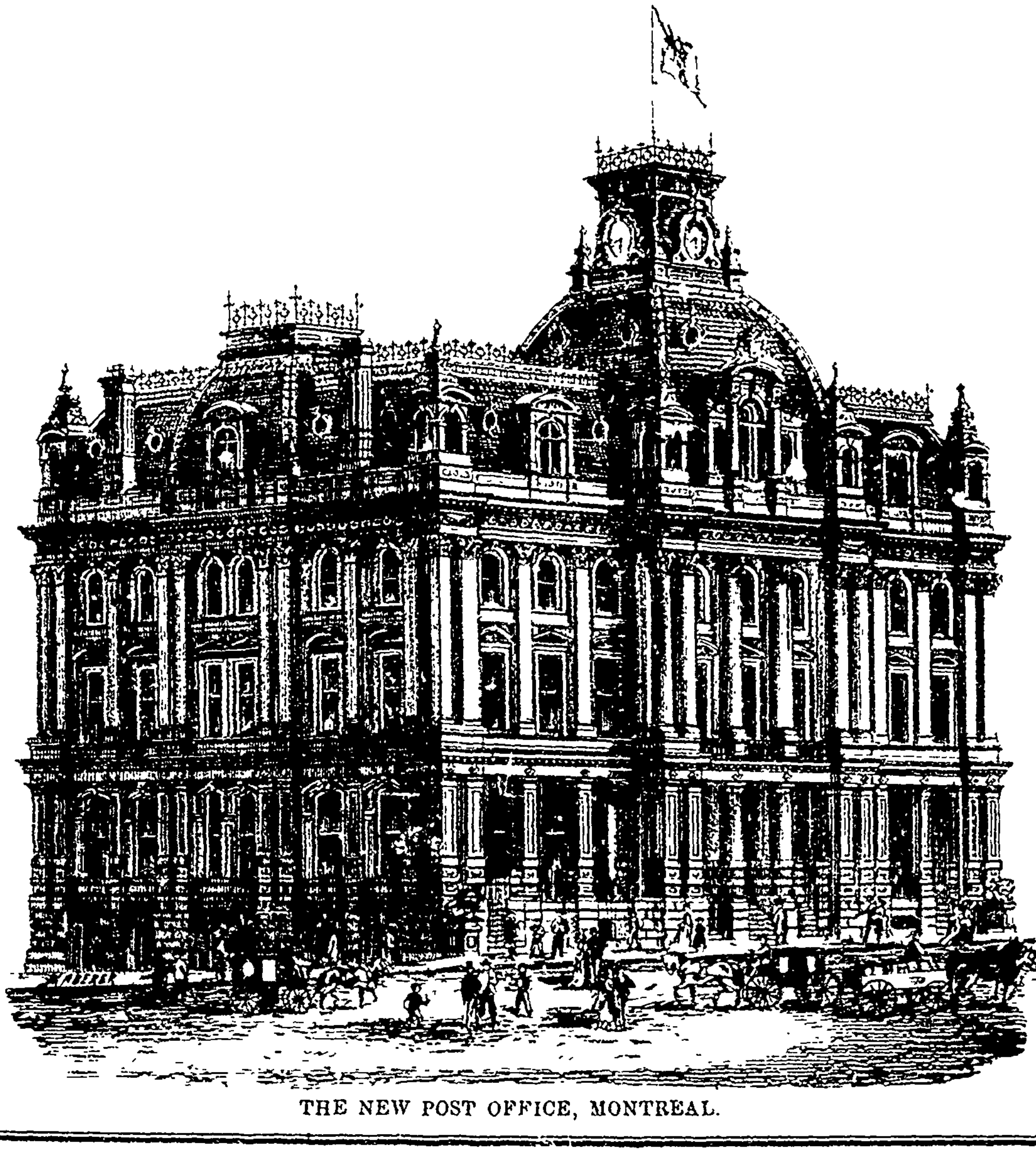


THE NEW POST OFFICE, MONTREAL.

THE NEW POST OFFICE, MONTREAL.

This extensive building is being erected by the Dominion Government on the site of the old Banque du Peuple, St. James Street, corner of St. François Xavier Street, and adjoining the Montreal Bank. The foundation was, it will be remembered, laid by the Hon. the Minister of Public Works. The structure is to have 120 feet frontage on St. James Street, and 92 feet frontage on St. François Xavier Street, the whole being built of Montreal grey stone, the internal faces having an air space and brick lining for protection against dampness.

The façade on St. James Street will have an imposing appearance, the ground floor story being in the Doric style, and the second and third stories having full carved Corinthian columns, pilasters and window dressings of a rich design. On St. James Street front there will be an arcade or portico for summer and winter entrance, with the latest improvements for the convenience of the public, with letter and paper slides inside and out of the building. The façade on St. François Xavier Street will be in keeping with St. James Street front, this façade having Corinthian pilasters, and being finished in every other respect similar to the main front. The other fronts will be of a plainer character. The top cornice for the two principal fronts is of a rich finish, with ornamental facia with pateras, dental blocks and carved modillions with panelled and moulded top finish to the roof. The roof as well as the towers will be in the French style, with crescent work for top finish; the centre or main tower terminating above the Mansard roof with a cornice and cresting work, will have a clock shewing three faces. This clock will have scroll and ornamental finish. The angle pedestals above the cornice including returns, as also chimney stacks, will be highly moulded and finished with top finials. The main lucarnes or dormer windows including the circular roof-lights, &c., will be of a neat style, giving an imposing appearance. The interior will be finished in keeping with the general design, and will have the latest and most approved arrangements for the public, and the Post-Office officials and employees. There will be strong fire-proof safes for all documents, letters, papers, &c., and hydrants and hose will also be provided in the building. The basement story will be occupied by the newspapers and mail-bags department, also keepers' apartments, coal cellars, furnaces, &c., &c. The ground or principal floor, will be occupied by the Post Office department, including Post Masters' offices, Assistant Post Master, &c, &c. The second story will be occupied by Post Office Inspector, and others, leaving a third story to be laid out hereafter as occasion may require. The contractors are Messrs. Allord & Dufort, and the architect is H. M. Perrault, Esq., of this city.

THE MEASUREMENT OF FLOWING WATER.

There is probably no point which has occasioned more dispute and litigation than the conflicting rights of persons entitled to take water power, in certain proportions, from a common source, where the demand exceeds the supply. The experiments, conducted by mathematicians and philosophers, have been, many of them, conducted on a small scale, and the results are not regarded as entirely conclusive, as the causes of contraction and other phenomena in a vein of water an inch in diameter would hardly bear the same proportion to the waters of a river discharged through a sluice. As a consequence, persons having charge of large works have endeavoured to form rules based on their own experience. English engineers, on their own account, have made many experiments to determine the difference between the theoretic discharge (computed by the laws of gravitation) and the actual discharge, as modified by friction, lateral retardation, reaction of adjacent fluid, and other causes of diminished velocity and volume, and consequently of quantity. The French Government also, some twenty-five years ago, appointed a commission to determine the question, and elaborate experiments on a very extensive scale were made by competent engineers, and the results of these experiments have brought the question within narrow limits.

In the "Philosophical Transactions" of the Royal Society of London, we have the following conclusions, which have been deduced from the experiments just referred to: 1. That the quantities discharged in equal times, are as the areas' orifices. 2. That the quantities discharged in equal times under different heights, are to each other nearly in the compound ratio of the areas of the apertures and of the square roots of the heights. The heights are measured from the centres of the apertures. The mean result, also, of several experiments, all the openings being formed in brass plates 1-20 of an inch thick, showing that, for round, triangular, and rectangular holes, the average of the numbers showing the proportion, between the theoretic discharge of the water calculated as a falling body, and the actual discharge as measured, was 6 1, and for the rectangular holes it was 6. It has also been found that the effect of gravity may be represented by 64 feet 4 inches, or 64 3—that is, the height in feet through which the body falls, being multiplied by 64 3, will give the square of its velocity in feet per second. For the actual discharge per second in cubic feet, multiply the product of the altitude or head of water in feet, the area of the orifice in square feet, and the time in seconds, by 64 3, then extract the square root, and multiply by 6. It is found also, that with small orifices the effect of a high head is to contract the vein and to diminish the discharge, so that the nearer the orifice can be brought to the surface, and yet the water be kept running with a full stream and without causing any eddy or depression of the surface, the greater will be the discharge. But with larger apertures, as, for instance, one with 3¼ feet in length by 1⅝ feet in width, or 5¼ square feet of area, the discharge increases with the increase of head.

As to the discharge of water from open notches in dams it is found to be equal to ⅔ of the discharge from an orifice of the same size with a full stream under the same head. The proportion between the theoretic and the actual discharge from the open notches varies with the depths, the factors used being less with the greater depths. An English handbook of tables gives 214 cubic feet per minute as the quantity which would run over every foot in width of a regular notch 1 foot in depth from the water's surface. The amount discharged depends very much on the form of the notch or aperture. A plain rectangular notch, cut with square edges in a three inch plank, will discharge very much less than one which has its inner edges bevelled or rounded off in the parabolic form of the contracted stream or vein of water. If the aperture be small, the difference may amount to a fourth of the whole quantity. Care should also be taken to form the wing-walls to sluices with curved or trumpet-shaped approaches, conformed to the natural contraction which may be produced by the overflow or sluice way.

To obtain the quantity which passes through a parallel channel in a given time, the sectional areas should be multiplied by the mean velocity, the latter element being obtained by adding the velocity of the water at the surface and that at the bottom of the current and dividing the sum by two. As it may not be convenient, in every case, to ascertain the velocity at the bottom, the mean velocity may be determined, with accuracy sufficient for practical purposes, by ascertaining the surface velocity in inches per second in the middle of the stream, and the mean velocity will be equal to this velocity less the square root of this velocity *minus* five. If, for example, the surface velocity in the stream is equal to 36 inches per second, the mean velocity will be found by subtracting 5 from 36, leaving 31, then extracting the square root of 31, which is 5 5, and subtracting this last figure from 36, giving 30 5 inches per second for the mean velocity. Multiplying this number by 60 and dividing by 12, or, which is the same thing, multiplying it by 5, will give the velocity in feet per minute. In the case just supposed the velocity per minute will be 152 5 feet. If, then, the water course be 4 feet wide and 2 feet deep, the amount of water discharged per minute would be 152 5 x 8 or 1,220 cubic feet.

When the overfall is a thin plate, it will discharge a greater proportionate quantity when the stream is only one inch deep than with greater depths. When the overfall is of two inch plank, the flow of water is more retarded, a greater head is requisite, and the maximum discharge is given by a head of seven inches. When the length of the overflow plank is ten feet, the coefficient is greater with a depth of five inches, and when wing boards are added, causing the stream to converge toward the overfall at an angle of 64°, the coefficient is greater even when the head is less, showing the utility of proper wing walls on sluices.

To determine the height of the waterfall in a running stream a small temporary dam, unless one exists, must be made, so as to secure a still surface. Take two poles sufficiently long to reach from the bottom of the water to the required line level. Make a plain mark or notch on both sticks, at a distance from the upper end equal to the distance of the intended line level above the water, marking that distance in feet and inches. Push the poles down through the water into the earth at the bottom until the notches are both at the level surface of the water, care being taken to have the poles plumb and at a convenient distance apart. Sight across the tops of these two, and set as many more as may be desired to run the line of level to the desired point, and the tops, being ranged accurately by the first two, will show a water level so many feet above that of the water. It is estimated that this is a more accurate way than the use of the ordinary spirit level.—*Boston Lumber Trade.*

CURIOUS STORY OF A QUICKSILVER FIND.

The California Borax Company once had a good business in borax and sulphur, but the competition of other and more available fields gradually drove them out of the business, and for the past five or six years the California Borax Company has rested from its labours at Borax Lake. It has preserved its organisations and its property, and yet was held at little worth by stockholders beyond the value of the real estate and the privileges owned by the company. During the renewed search for quicksilver, stimulated by the recent advances in the price of the article, the lucky thought struck some one to assay the dark porous, coke-looking rock which covered much of the ground of the California Borax Company. The result of that first assay was so encouraging that other samples were assayed, with still more gratifying results.

The facts were made known confidentially only to seven capitalists and friends, who made the California Borax Company an offer for their entire property. During the negotiations nothing was dropped which could put the Borax Company on its guard. On their side they had what they once believed astounding wealth in borax and sulphur, but these dreams of perpetual dividends had been dissipated for years, and an offer equivalent to 10 dollars a share for the stock all round seemed a very good chance of washing their hands of an unproductive property.

The sale was completed to the entire satisfaction of the vendors; but no sooner was it concluded than they learned that they had sold for a mere song what is believed to be the richest and most promising quicksilver mine in the world. It is needless to say there was much dissatisfaction on one side and corresponding elation on the other. Those who were out thought that the "ins" should have given them a show, and the "ins" said that the Borax Company should have informed themselves of what their property was worth—the old company could not expect the lucky finders of the treasure to go to the directors and say: "Gentlemen, you have quicksilver at Borax Lake, and are neglecting a fortune." To make the matter more vexatious, some of the Borax Company have been intimately connected with quicksilver mining, and ought to have made the discovery themselves, but do not appear to have given it a thought. Yet, where there were large quantities of borax, of sulphur, of soda, soda springs, and medicated waters, was not the unlikeliest spot in California to look for cinnabar.

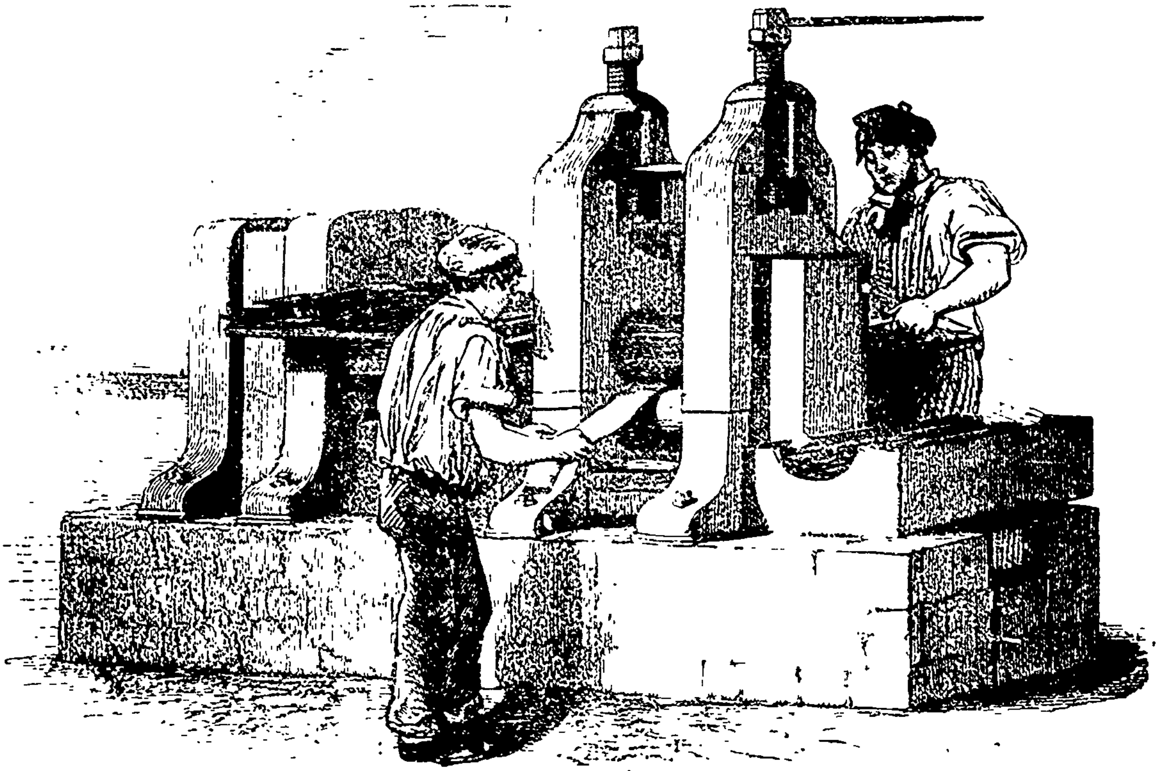
The sulphur banks are found to contain, by assay, forty, fifty, and in some cases sixty per cent. of the valuable liquid metal. The assays of ore, taken almost promiscuously from chunks of the material of which these banks are composed, yield more than the selected ores of the New Almaden ever did even in its best days. Add to this, that the prices which now rule in the quicksilver market are double, or more than double, what the New Almaden got for its production when a little of its stock was a small fortune. Two car loads of this sulphurous ore have been brought to San Francisco, and will shortly be reduced, which will solve the last problem. Can the ore be easily reduced, or is it rebellious? The assayers and analysts say, that from the facility with which it assays, so far from being rebellious, it will, in their judgment, prove as easy to work for quicksilver as it is for sulphur. The new owners are in high spirits, and will, as soon as they have satisfied themselves with the preliminary experiments, erect first class reduction works, furnaces, etc., and go into the business on the largest scale.

The prospect of a large increase in the production of quicksilver is good news for miners, especially American miners, for unless new and important discoveries had been made, either the business of silver mining must stop at its present limits, or the price advance to that point which would prevent all milling of low grade ores. This question of quicksilver for the future, says the *Post* of San Francisco, is one that has harrassed the miners for years, and during the past few months the advance in price has made it assume the most formidable proportions. The question of who is the seller and who the buyer is secondary. The fact that hundreds or thousands of tons of ore yielding from forty to sixty per cent of metal are lying in loose banks in Lake county, ready for shipment to any reduction works that can resolve them into a merchantable article, is the important fact. New Almaden only produced 11,042 flasks in 1873, and New Idria and the Redington 11,708 flasks between them. All the other quicksilver mines in the State, including Cerro Bonito, San Luis Obispo county, which produces about fifty flasks per week, do not produce over 500 flasks per month. The New Almaden yielded, in 1865, with forty-seven per cent. ore instead of five per cent., which it is now working on 47,194 flasks. If the Borax Lake answers to its present promises it will, when fully developed, and the requisite works erected, yield 100,000 flasks a year, and be a far more valuable property than all the present quicksilver mines in the world.

The area of the Borax Company's estate, which it has now parted with, is 4000 acres, well wooded, finely watered, and with nine miles of frontage on the lake. There are many buildings on the ground, but most of them have gone to wreck for want of occupation. The site is very beautiful for residences, hotels, and sanitaria, and when the mining business makes ample returns, there is no doubt the company will build up a town that, while profiting by the business of the mines, will become a pleasant and fashionable resort.

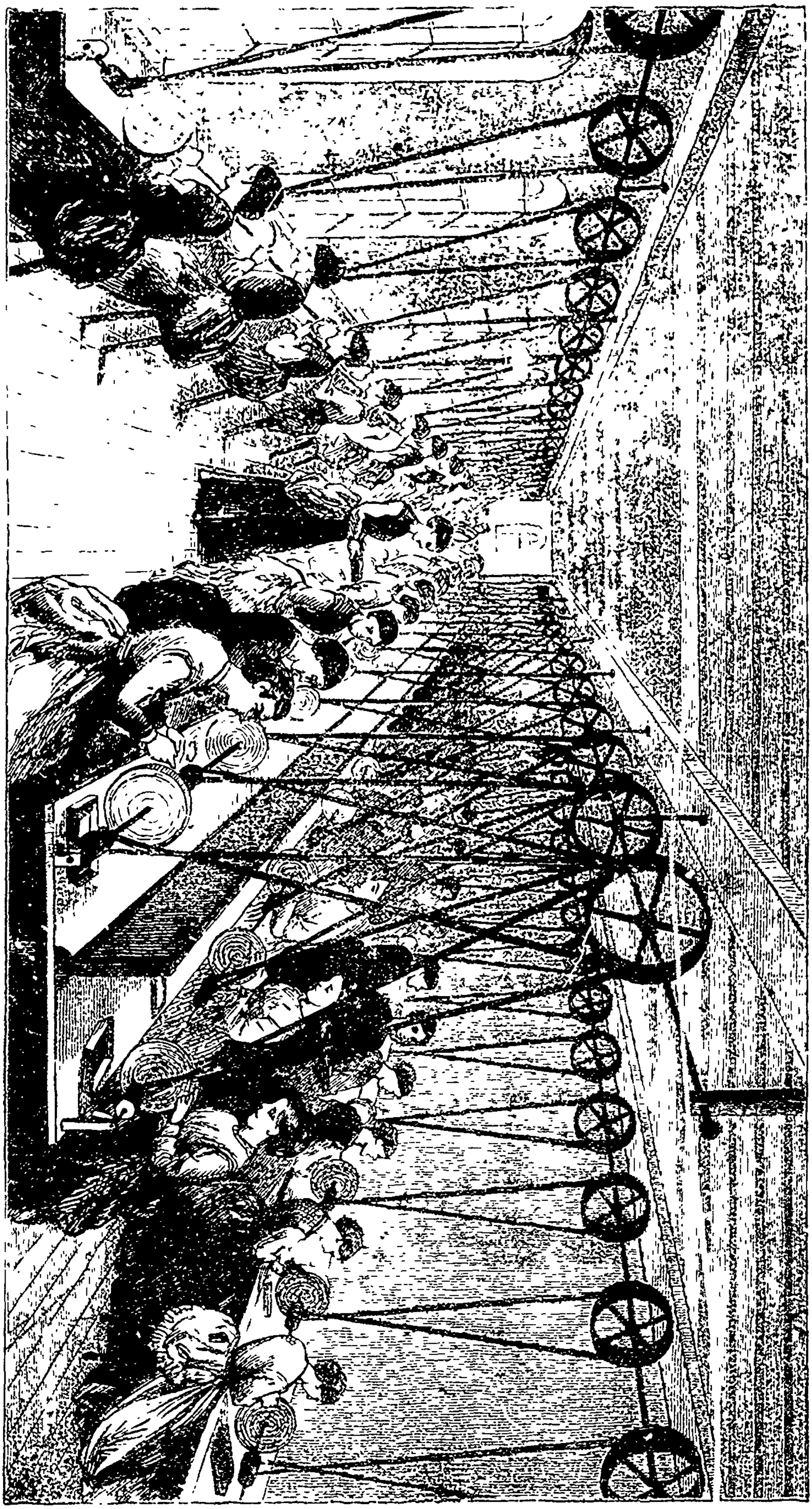
It may be remembered that some years ago the American baby jumper attracted considerable attention in England, becoming rather popular with many people; but one after another of those worthy gentlemen whom one does not like to have to see professionally, but to whom one flies in sickness, pronounced against it, and its popularity fled. A few weeks ago, however, Mrs. Catherine Tardy, of Paterson, New Jersey, applied for a patent for what she calls an "improved baby-exercising corset." Her account of the invention is thus worded :—"This is a device which will enable mothers, nurses, and others having the care of children to let them exercise by moving their limbs without creeping about the floor. It consists of an improved baby-exercising corset formed of two parts, connected in front by a cord or lace, and in the rear by cords, straps, or ribbons, and provided with long loops at their upper edges. The long loops enable the attendant to support the child while standing in an erect position." Of course, like all inventors, Mrs. Tardy hopes to make a little fortune out of her device; but from what we know of the medical profession, though lazy nurses may approve of the corset, the gentlemen of the pill and draught will ignore the nurses, and try to protect the rising generation from compressed lungs and bandy legs.

By a series of experiments Mr. Robert Hunt has succeeded in proving that heat does not continue increasing in proportion to depth. Down to 100 fathoms it certainly does so, to the extent of 1 deg. for every 50 ft. But in the second 100 this falls to 1 deg. in 70 ft.; and in the third to 1 deg. in 85 ft. It follows that since great depths do not necessarily involve excessively high temperature, coal working can be carried on below the level previously considered possible. This is practically proved at Charleroi, in Belgium, where coals are won without any difficulty at the stupendous depth of 4000ft., or about three-quarters of a mile. By including the quantity remaining in our coal fields down to that level, the supply would probably be sufficient to last for another 1000 years, even at the present rate of consumption. But it is quite possible that before long considerable saving will result from more economical methods of burning fuel. The quantity of coals required to produce a ton of pig iron fell to 51 cwt. in 1872 from 60 cwt. in 1871—which implied a saving of 9 cwt. per ton on a total production of nearly seven millon tons.



MANUFACTURE OF STEEL PENS (FIG 1)—ROLLING THE STEEL

(FIG 2)—BRONZING THE PENS.



(FIG. 3.)—GRINDING THE PENS.

STEEL PEN MAKING.

The manufacture of this most useful article is quite modern. No research has yet discovered that any of the nations of antiquity had anticipated Birmingham in making the discovery of how to convert a piece of steel into a pen as flexible and free in action as one made of the feather plucked from the wing of a goose The ancient stylus was doubtless made of metal, but this was a far different instrument from the steel pen of to-day. The steel pen, is as it were, a thing of yesterday. A few years cover its introduction and its history, its rudimentary stage, up to its present state of comparative perfection. It was in Birmingham that it first became known, and this town is at the present time the great seat of its manufacture. It is, in fact, a specially Birmingham industry. In an introductory article, we gave the brief history of its invention and introduction, and we now propose to explain the method of its production. For this purpose we select the well-known works of Messrs. Hinks and Wells, of Buckingham Street, and with our readers' permission, will act as *cicerone*, and describe for them the many processes through which this useful and extraordinary cheap article has to pass before it is fit for the market.

The works of Messrs. Hincks and Wells are large and commodious, and occupy the four sides of an irregular quadrangle, with a splendid frontage to the street. We first enter a shed on the ground, in which we find a large quantity of steel sheets, some 18 inches broad, and 6 feet long. This is the best kind of Sheffield steel, and comes from the famous house of Jessop. The first process is to cut this into slips of the required width, varying from 1¾ to 4½ inches, according to the length of pen to be made from it. This was formerly done by hand-shears, of the ordinary kind, and exactitude could not be relied on. But Mr. Hincks soon discovered a method of acquiring this, and provided a shears by which it has been secured. He has since adapted this invention so as to be worked by steam, and now the cutting is carried on with equal rapidity and certainty. In the power-worked shears a provision is made by which any accident to the cutter is rendered impossible. At front of the shears is placed a slightly raised metal bar which which prevents the workman from pushing the sheet of steel under the cutter so near the edge as to endanger his fingers. No workman has had a finger cut since the introduction of this machine. The strips thus cut are placed in boxes of cast metal, and then put into a "moffle," in which white heat is produced, and the slips are thereby properly annealed. It takes about twelve hours to effect this. The slips are next put into revolving barrels, and, by being rapidly turned round, are denuded of all superfluous matter, as the scales produced by annealing and any rough edges left by the shears. From this operation they are taken to the rolling room. This is the usual process of metal rolling. Each machine is managed by a man and a boy. The strip of steel is passed under metal cylinders, which revolve on each other, and the strip comes out much thinner and much longer each time it passes under the rollers. We attempted to take up one of these strips after it had passed through a machine, but were glad to let it drop again, or we should have burnt our fingers, although it was was quite cold when it was put in Each strip passes through several differently graduated rollers until the metal is of the precise thickness, or rather thinness required. Some of these 18-inch strips are rolled out until their length has increased to nearly 6 feet. We give an illustration of this process.

The rolled out strip is then taken to the "cutting-out room." This work is done by women who sit before benches on which are placed the cutting-out presses. The strip is passed rapidly under the press, and a bit of flat steel in the shape of the future pen is at each movement cut out. Two pens are cut out of the width in a sort of dovetail fashion. Some estimate may be formed of the speed with which this work is done from the fact that a good worker will cut out 200 gross, or 48,800 pens a day. But even this speed is not sufficient for the increased demand, and Mr. Hincks has invented and introduced a machine, which is worked by steam, by which the number of pens cut out at once is doubled, and the speed considerably more than doubled. It is pleasant to watch the quickness and accuracy with which this most obedient "slave of the pen" works out the intention of his masters. The bits of flat metal thus produced are called "blanks," and are next taken to the piercing-room. Here, again, women are the workers, and hand-presses the machines used. Each "blank" is separately placed on a steel die under the press, and by the usual half-circular pull the tool is pressed into the "blanks," and the side slits and the centre, which give flexibility to the pen, are cut at one and the same stroke.

At this stage the very nature of the steel has to undergo a change. It is now soft, and capable of being bent into any shape. Before the next operation of bringing it nearer to a real pen can be performed, it must however be made softer, and its present pliancy be considerably increased. It is, therefore, sent to another department, placed in a burning hot oven, and once more annealed. All this the much suffering pen endures with the utmost complacency. As soon as the process of extra softening is done, the pierced, flat bits of steel are taken into the "marking room." This process has been well described by the hand of a master. "Proceeding," he says, "with these softened pens to the 'marking room,' the ear of the visitor is aroused by a continuous volley of sharp heavy sounds. An animated scene presents itself. Upon each side and down the middle of the room are arranged a multitude of young women at work, each of whom raises a weight by the action of the foot, and suddenly allows it to fall on the pen. The rapidity of this process is equal to that of cut blanks, each girl marking many thousands of pens in the day. When it leaves the hand of this operator, the beak of the pen is stamped either with the name of a retail dealer at home or abroad, a national emblem, a piece of questionable heraldy, or the representation of some notability, foreign or domestic, according to the fashion of the day. The distinctive marks of this manufactory number about 7,000."

Up to this time the future pen is only a flat bit of steel, with side slits, centre perforation, and mark, stamped upon it. It has next to take the shape of a pen. This is called "raising." Each pen is placed in a groove under a hand-press, and a convex tool of the required shape pulled down sharply on it. It is thus forced into the groove, or mould, and comes out in one of the infinite forms in which pens are now made.

Still it is not a writing instrument. There is no slit in it, the nib is one solid bit of steel. Before this most important operation can be performed the nature of the metal has once more to be changed. It has to endure another ordeal of heat. From soft the metal has before been made softer; it has now to be "hardened," and then to be "tempered" before it can be submitted to the delicate manipulation of slitting So having been cut, side-slitted, marked, and raised, they are again taken to the muffle. Here they are packed in small round iron boxes, shut in, thrust into the oven, heated to a white heat, quickly pulled out again, and then plunged into a bath of oil. When taken out of this unpleasant place the poor bits of steel are as brittle and fragile as so many bits of glass. You can crumble them up between your fingers as easily as a Rupert's drop This of course has to be completely changed, and the pantomime has to undergo another transformation. This poor bit of fragile steel has to be "tempered," made pliable, flexible, and elastic. So now, after being thoroughly cleansed of the impurities of the oil bath, a large number are emptied into an iron cylindrical vessel, and placed over a fire. A boy turns it round, and a man standing before the mouth-end of the vessel, stirs the pens when necessary as they are carried round and round by the motion. This is one of the prettiest actions to watch in the process. You see a perfect transformation taking place under your eyes; for under this action the colourless bits of metal assume many of the tints of the rainbow, and are turned either a bright bronze or a lovely blue, according to the tint they are to have when engaged in their mission of peace.

Still they are not ready for "slitting." They have to be "cleaned" and then "ground." The cleaning process is effected by placing them in large tin cans, with a little sawdust mixed with them, and then turning them round and round by steam Of course the action of the pens on each other, with the help of the sawdust, produces the desired effect This process is called "scouring." It has now to be ground. Every steel pen has to be ground before it can be slit. "If," said Mr Hinks, as he showed us this process, "you were going to make a quill pen, you would, before you made the slit, scrape it on the back, with your penknife." Grinding does for the steel pen what this scraping does for the quill. It makes it ready for the "slit." This grinding is done with almost unexampled rapidity. A girl takes up the pen by a pair of nippers, holds it over a small revolving wheel, called a "bob" and covered with leather and emery; and almost before we can see the process it is ground in two ways—one across the back of the pen, and another from the top to the point. This important part of the work done, our pen is at last ready for the process of slitting.

Our illustration will afford a much more graphic idea of the process than words can give. Although so important in its results, it is one of the easiest and lightest parts of pen making. The utmost accuracy is required, but this is secured by the tools, which are made with mathematical precision. The girl at each press has simply to place the pen in the groove, to give the press handle a light pull, the tool descends, and the pen is slit. Now the pen is complete. After passing through more than a dozen changes in its curious career, it is now a perfect instrument, which will obey the will of the legislator, make permanent the ideal thoughts, and give to the "airy nothings," as moulded by the imagination of the poet, a "local habitation and a name"—is prepared, in short, to perform its wondrous art in that development and progress of the world which we rightly name civilisation.

The pens thus finished, as far as their making is concerned, have now only to be sorted, according to their quality, carded, or put in boxes of a gross each, and then packed and sent to their destination through the different parts of the world. It is very rare that pens are carded now; the favourite and most useful method of packing is in boxes, and a gross is weighed, not counted, and so uniform are they in substance that the number and the weight invariably agree.

We have now given a brief description of the various processes through which every pen has to pass before it reaches the public a veritable steel pen. It is marvellous that an article which requires such careful preparation can be produced at such exceedingly low prices. It is estimated that something like £3 000 worth of pens are made in Birmingham every week. Upwards of 4,000 persons are employed in the trade, and millions of grosses are made in a year.

In the manufactory we are now visiting the utmost care is taken of the health and comfort of the workpeople. The works were specially built for the trade and the kindly forethought of Mr. Hincks has introduced every modern improvement in the arrangements of his various departments. Long before the Factories Acts were passed their most important provisions had been adopted and carried into practical effect. The nine hours movement was long anticipated, and the hours of labour reduced to that now general number for a working day The rooms are large, lofty, and airy, Mr. Hincks having personally attended to and made provision for the ventilation of each room. This difficult problem has been successfully solved by the introduction of a blow-fan, which is worked by steam. The hot air is by this instrument forced into a large tube at the top of the room, and thence carried outside the building. Thus an even and pleasant temperature is secured. The same provision has been made in the annealing and tempering departments, and in that part of the works, where, in consequence of the materials employed, peculiarly offensive smells were, and still would be, produced but for this provision, the air is clear and comparatively pure. In one case this result has been effected after much thought, trouble, and many experiments. In a sort of chimney stack a large blow-fan has been placed towards the top. The immense action of this fan forces all the bad hot air out of the shop, a sliding door is shut, and the men work in comfort in a department which was replete with noxious and deleterious effluvia. So great was the effect formerly produced by the acid vapours that their watch cases became quite black and their watches spoiled by its malign influence. We thought what must have been the condition of the men's lungs when breathing such air. Thanks to this careful foresight, we, although strangers and not to the manner born, felt not the slightest inconvenience while remaining in this department. It must also be remembered that an enormous number of young women are employed in such rooms as those use for cutting out, grinding, and slitting, and but for this system of complete ventilation much injury would be done to their health and well-being. When Lord Napier of Magdala visited these works the coolness and purity of atmosphere in these crowded hives struck him as one of the most remarkable successes of the proprietor, and elicited his frequent and hearty admiration.—*Iron.*

THE Pembroke *Observer* says:—Mr. Johnston has completed his survey of the southern side of the Ottawa, and is now prosecuting a similar survey on the north side, with a view to ascertaining which is best adapted for the location of the proposed canal.

GUATTARI'S PNEUMATIC TELEGRAPH.

We illustrate in the engraving on page 363 a new system of pneumatic telegraph, now being introduced into England.

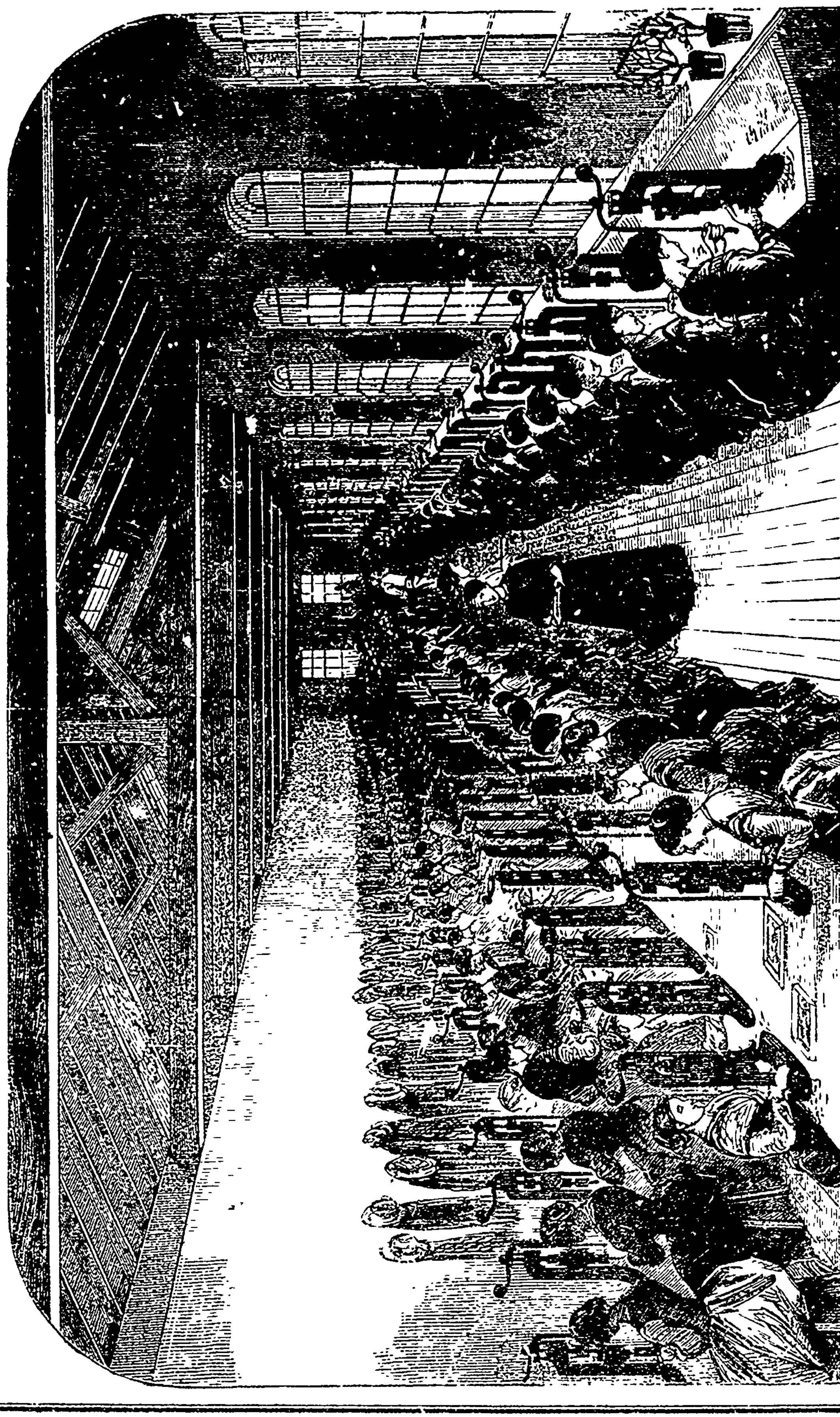
Very little explanation is required to render the construction of this very simple and efficient apparatus intelligible. The principle involved is that a little bellows is provided, through which a small puff or spurt of air, to use the inventor's words, may be sent through a pipe. At the end of the pipe is fixed a small elastic bag of india-rubber, very thin; this bag is lightly compressed between two plates by a small spring, when the bellows are closed the little bag is distended and forces the discs apart. One of the discs is supported or a lever, which either causes a hammer to strike a bell, or a small escapement lever moves, which at each motion pushes a wheel over one tooth, and thereby advances a hand one letter on a dial. The result is that for every stroke of the little bellows the hand moves from one letter to another, and thus a message can easily be spelt out. An ingenious key or cock is used, which answers the purpose of a telegraph shunt.

Fig. 1 shows a small domestic apparatus constructed for houses and distances in general not exceeding 175 yards, it must be attached to the wall or partition by means of the screws X. It contains no clockwork, and the key B has four movements; two to the right to work the bell, *i.e.*, one to give a signal and one to receive it, and at the same time to place the hand of the dial on the cross, and two to the left *i.e.*, one to send a message and one to receive it. The ordinary position of the turning key B is always on the point *d* of the plate bearing the inscription receiving bell. The person who is going to send a message has first to place B of his instrument on the point *c* of the plate bearing the inscription transmitting bell, then by moving the handle C of the bellows from the right to the left, he sends a current of air through the conducting tube into the instrument in connection with his own and makes the bell of the former ring. Then he has to place the turning key B at once on the point *d* of the plate bearing the inscription receiving bell, and by the ringing of his own bell he will be informed that his correspondent is ready to receive the message.

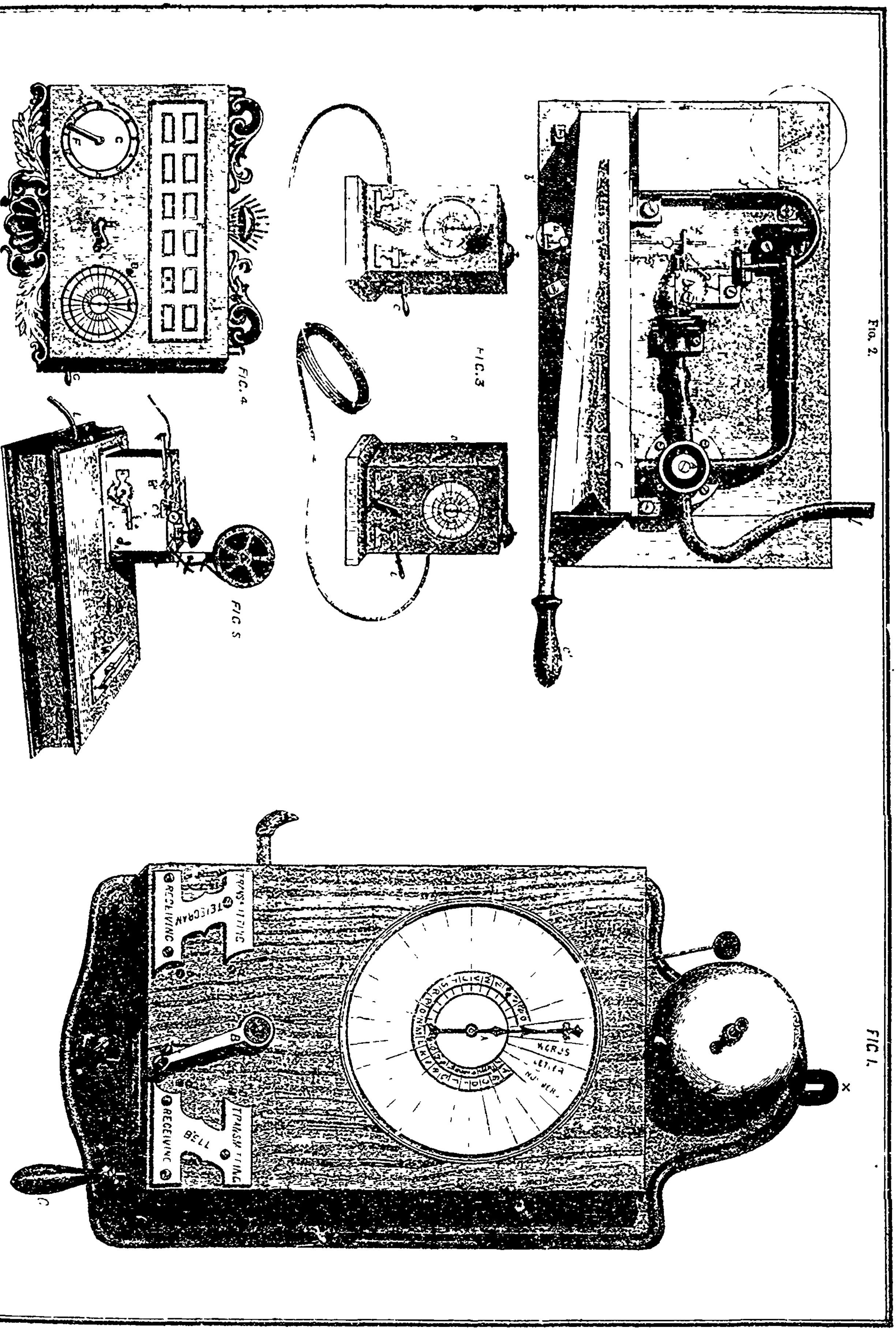
Fig 2 shows the interior of the clockwork intrument, *c* is the bellows and *c* the handle working them. The mechanism for receiving signals consists of the branch tube *m*, terminating in an enlarged head, over which a very thin membrane or diaphragm *x* of sheet india-rubber is stretched This membrane closes the end of the tube *m* and becomes inflated, each time the air in tube *l* is compressed (tubes *l* and *m* being in communication) by the operator working the bellows of the instrument at the distant station. The movements of the diaphragm are transmitted by means of a rod *n* terminating at one end in a disc bearing against the diaphragm *x*, and abutting at the other extremity against the projection *o* of the anchor escapement, whereby the latter is actuated and the needle is rotated step by step over the dial. *q* is a diaphragm closing the end of tube *p*; and *i* is a rod similar to the diaphragm *x* and rod *n* above described, the rod *i* being made to abut against a detent, controlling the arrangement of alarum or bell-striking mechanism, so that on the detent being raised the mechanism is released and the alarm sounded. The detent is operated (tubes *l* and *p* being in communication through cock A) by the compression of the air in tube *l*, produced by the instrument at the other station.

Fig. 3 shows two clockwork instruments combined. The distance between them may be as much as 400 yards. The arrangement is very similar to that just described, the pneumatic bellows, however, starting and checking a train of wheelwork driven by a spring or a weight. The clockwork assists the effect of the air considerably, and makes the movements of the mechanism more sensitive. The key B has two movements only *i.e.*, one to the right suited to give and and to receive the signal by the bell, and one to the left for sending and receiving the message. The normal position of the key B is on the plate bearing the inscription "Bell;" the call having been heard and responded to, it is to be turned on the plate bearing the inscription "Telegram." By working the handle C of the bellows, the hands on the dials of both instruments in correspondence are made to move simultaneously, thus transmitting the message.

Fig. 4 shows an adaptation of the system to hotels. For this purpose the principal apparatus is constructed in such a manner as so indicate on the table E a given number of cy-



THE MANUFACTURE OF STEEL PENS Fig 4 —SLITTING THE PENS.—(See page 359)



GUATTARI'S PNEUMATIC TELEGRAPH.—(See page 360.)

phers or names, which refer to the places with which a correspondence is established It contains a dial instrument without clockwork, and is connected with the various dial instruments of the corresponding stations by means of conducting tubes. These instruments without clockwork serve for distances not exceeding 150 yards, by substituting instruments with clockwork the distance may be increased to 400 yards According to our drawings, twelve stations, No. 1 to 12, can be connected with the head office, and each of these stations can send messages to and receive same from the latter. The bell of the principal instrument serves to call the attention of the attendant at the head office, and whilst it is ringing the number or name of the station from which the call was issued, appears in the blank square of the indicator E. The key H serves to make the number disappear again if the correspondence has come to an end, and reopens at the same time the communication of the bell D. In case no correspondence is carried on, the position of the key F is on No. 0 on the plate G. As soon as a call by the bell has been received, the key F has to be turned on to the number corresponding with the one which appeared in the indicating table E, thus the communication between the dial instrument of the head office and the station whence the call issued is established. The first correspondence having come to an end the attendant at the head office has to turn the key F on to the number referring to the next station having called, and by working the handle C of his instrument indicates to the same that he is ready to receive the message. In order to prevent the hand of his dial moving whilst this signal its transmitted, he has to press the knob B.

Fig. 5 shows an ingenious adaptation of the system to the ordinary recording or printing telegraph instrument It contains clockwork which must be wound up by means of the key J. The clockwork serves to put the bell in motion to call the attention of the attendant and to draw the strip of paper on which the figures are printed. The lever B serves to give the signal of call to the opposite side on transmitting a message, and in order to send the message itself. The despatch is transmitted by figures according to the Morse alphabet. The lines and dots composing this alphabet are produced by pressing the lever B, and by keeping it down a longer or shorter space of time; for instance, a short pressure produces a dot and a prolonged one prints a line. In order to obtain an exact division and print of the various figures some practice is of course necessary By pressing the knob of the lever B, jets of air are sent through the tube L into the receiving apparatus, causing thus the lever C to act. A pressure of the strip of paper against the printing wheel H causes the wheel E, wet with the printing ink, to produce the desired figures. In order to set in motion the clockwork, which serves to unroll the strip of paper, the handle K must be turned to the right. The key D must be placed on Transmitting or Receiving, according to the message, *i.e.*, if one is to be sent or received. The normal position of this key, when the instruments are not in use, is always on Receiving.

We may add in conclusion that we have seen these instruments at work and that they appear to us to fulfil the anticipations of the inventor. They are really ingenious and well thought out. The Alexandra Palace is to be fitted, we understand, with a complete set for communication with the stables, a distance of 780 yards. Mr. Guattari is a gentleman who has devoted many years to the study of pneumatic telegraphy, and we venture to think that he has achieved a fair success.—*The Engineer.*

PECULIARITIES IN THE MANUFACTURE OF SEWING MACHINES.

At a gathering of the employés of the Howe Sewing Machine Company held recently in Glasgow, Mr. F. M. Tower (one of the directors) gave an interesting description of the process of manufacture. After some remarks on other machines, he said the Howe Company had always striven to manufacture every component part themselves, from the wood-work in the table, and the castings from the foundry, down through all the great variety of pieces to the most minute screw pin, or washer. In the ordinary machine for family use there were about 130 distinct pieces, exclusive of table or stand on which it was worked, and which comprised about thirty more. There were duplications of many of these which would bring the whole number required for the machine actually in sewing order up to about 160, or all complete with the stand, close upon 200. Of these 130 distinct pieces twelve only were plain iron castings from the foundry, requiring, however, very numerous cuttings and shapings before they were ready to take their place. Forty pieces more were screws, all varying in shape and size, according to the duty they were to perform. Their manufacture was a most curious and important part of their work, accomplished by means of special tools, not known, except in one other kindred establishment, to exist on this side of the Atlantic. About forty more pieces were punchings from sheet metal, either brass or steel, very many of them afterwards pressed into peculiar shapes, and receiving more or less machinery to suit them to the purpose. About two dozen more pieces consisted of pins, a part of which, under the technical name of studs, formed the bearings of rotation in the sewing machine, for wheels and levers were also among the most difficult and most interesting portion of their work, requiring also special tools known only to themselves and one or two establishments in Europe. About a dozen stamped forgings, requiring also the importation of special stamping machines for their manufacture, went through a great variety of operations before they were fitted to join with the other parts in making the whole machine The weight of the machine in ordinary family use, without the stand, was 18 lb., of which 14 lb. was taken up by the foundry castings alone—twelve in number—leaving, therefore, the remaining 4 lb. to 148 different pieces of metal These were all manufactured within the walls of the company's works, in lots of 10,000, 25,000, or 50,000 at a time, by means and appliances which enabled them to turn them out far better and far cheaper than they could order them elsewhere, the quantity required by their business being such as to justify their obtaining plant and implements necessary for the manufacture. In some smaller pieces the consumption had been known to reach 30,000 or 40,000 per week in the mother establishment in America, and in needles far more than that.

Of the 130 distinct pieces comprising the machine itself, they enumerated 915 separate operations to complete them for the hands of the inspector before they were put together in the form of a complete machine. The whole system of gauging their work when finished, so that all the parts of a kind might be interchangeable, and the different parts might go together when taken at random without special fitting by hand, was another very marked distinction in their system of manufacture Much more so was the plan, pervading their whole establishment, of gauging the work itself while in operation, and all the very expensive apparatus, not only for requiring machinery and steam power to do as much as possible of the work, but for confining the application of power in each instance, so that the work should always be done at the same spot and distance with all exactness possible. It was this beyond all dispute which distinguished their manufacture from any other, and which had been carried further in the manufacture of the Howe machine than in any other industry whatever. Mr Tower also pointed out that another advantage of their system was that it enabled them to employ unskilled labour throughout their establishment Steadiness and fidelity quickly enabled the unskilled labour with smaller outlay of manual effort and nerve to earn far better piece-work wages than the skilled workman under the regulations of his guild or the customs of his trade. If the invention of the sewing machine was a boon to the people, the manner of making it as there carried out was a still greater one, and if it could be transferred to the manufacture of other things would most assuredly make itself felt as such The capacity of the machinery now placed in the large works of the company in the east end of Glasgow, was stated to be the production of from 200 to 250 machines per day.

THE LUNGS OF THE ENGLISH HOUSE OF COMMONS

There are a good many more vaults betwixt the foundations of the Houses of Parliament and the floor of the House of Commons than is dreamt of by honourable members Without a guide it is of no use deliberately trying to find the boiler room. But if he is not looking for it, he may peradventure come unexpectedly upon it at the end of one of the passages There are here four enormous boilers, capable of supplying steam for engines of the aggregate of 480 horse power At present, there being no need of artifical heat in the Chambers, only one boiler is in use, its functions being confined to the culinary department, and to the supply of power to the small engine that works the new ventilating apparatus This latter is planted in chamber adjoining the great vault that underlies the octagon hall of the Houses of Parliament It is through this vault that the supply of air for the House of Commons is originally drawn. Through doors and windows opening on to the southern square the balmy breeze of the Thames floats, and rushes across the hall towards a chamber on the left hand side. Here it is faced by a broad spray of constantly falling water, through which it must pass before entering the chamber, and with which it leaves all possible particles of undesirable dust. Inside the chamber there is nothing on view more striking than a couple of shafts, which, worked noiselessly by a pair of large wheels, work backwards and forwards into something which, if appearances were not deceptive, might be a corn bin. This bin is a chamber eight feet high, and extends the full breadth of the vault, a distance of thirteen feet. It is composed of a series of bands on rails of wood, with india rubber flaps falling down from each, and when shut close fitting inside the bands. As the shaft is driven forward it will be observed that the flaps violently flutter inward, as if a strong wind were blowing against them, and as the shaft returns they close firmly against the wooden rails At the other side of the chamber there is a precisely similar motion, the fresh air from the spray-guarded entrance from the central vault running round hither by a short gallery, and rushing in through the fluttering flaps as the shafts are withdrawn This motion comprehends the prime secret of the ventilation of the House of Commons. Inside the bin is a sort of moveable but close fitting door or shutter, which travels backwards and forwards as the shafts drive it. As they push it forward the air in the bin, having no other means of escape, passes upward through a panel into another bin prepared for its reception The closely-fitting shutter advancing, of course leaves a vacuum behind it, into which the outer air comes rushing through the fluttering flaps, just in time to find itself driven up by the return of the relentless shutter. And so all night long whilst tongues are wagging above the almost silent shutter moves backwards and forwards crushing out the air on one side only to find that a fresh supply has entered by the treacherous flaps, on the other, and constantly discovering that if the bin is to be emptied of air there is yet another journey to be made. The air thus dexterously trapped is breathed out from the upper bin into a gallery, along which it passes till it finds itself right underneath the House of Commons. Thirty feet above the lights of the house shine, twinkling through the close iron grating of the floor, and down through the several iron galleries which cross the great space. It is very silent down here, and we can hear quite distinctly the voice of Mr. Synan, who is apparently demanding justice for the Irish National School Teacher, a class which we gather is expected to exist on a pittance equal to that on which a well-known Irish village pastor was held to be passing rich. "Only £40 a year," says Mr. Synan's voice, which at this distance is singularly soft. "What can you expect for £40 a year?" Climbing up a series of steep iron ladders we come upon the several galleries, and find in each pieces of ice laid on bits of stick. By these the air passing cools itself, and so enters the House of Commons through the grating which extends across the breadth of the floor and follows the track of all the gangways, but is so cunningly hidden by a matting of twine that the casual passer by would never guess that it was there. This is how the fresh air gets into the House. How the vitiated atmosphere gets out is a simpler process, and may be described in fewer words. Along the edge of the ceiling are panels which open upon a space between it and the roof. The used-up air rushes up and through these panels as the sparks fly upwards, and, conducted by flues downward to the basement, is delivered in a gallery which ends in a shaft that opens up to the Clock Tower, a height of 230 feet. Here on an open hearth a great fire brightly burns, and drawing to it the air that fills the gallery, bears it up the shaft and so into the infinity of space.

It is said the laying of iron upon the Grand Junction Railway, will commence at Belleville in June. The old Masonic Music Hall, purchased last season for a passenger station is being fitted up as such, and there is promise of its completion in about six weeks.

THE NEW OPERA HOUSE, PARIS.

Our illustration on page 366 represents a view of the side entrance to the new Grand Opera House of Paris. Upon this remarkable building, on which more than a million of pounds sterling has already been spent, painters, sculptors, metal workers, mosaicists, artists in fact of all kinds, have exhausted their skill, and another monument is added to Paris to assist in attracting to it travellers of all nations. The grand staircase or *l'escalier d'honneur*, now freed of its scaffolding and finished, with the exception of some fine paintings by Mr. Pils, which will fill four compartments of the vaulted ceiling, has extorted admiration from all by its coherent magnificence, and the key-note thus struck is maintained throughout the work. The number of seats provided is but 2,194, but every spectator, in respect of space comfort, elegance, and causes of delight, is treated like a prince.

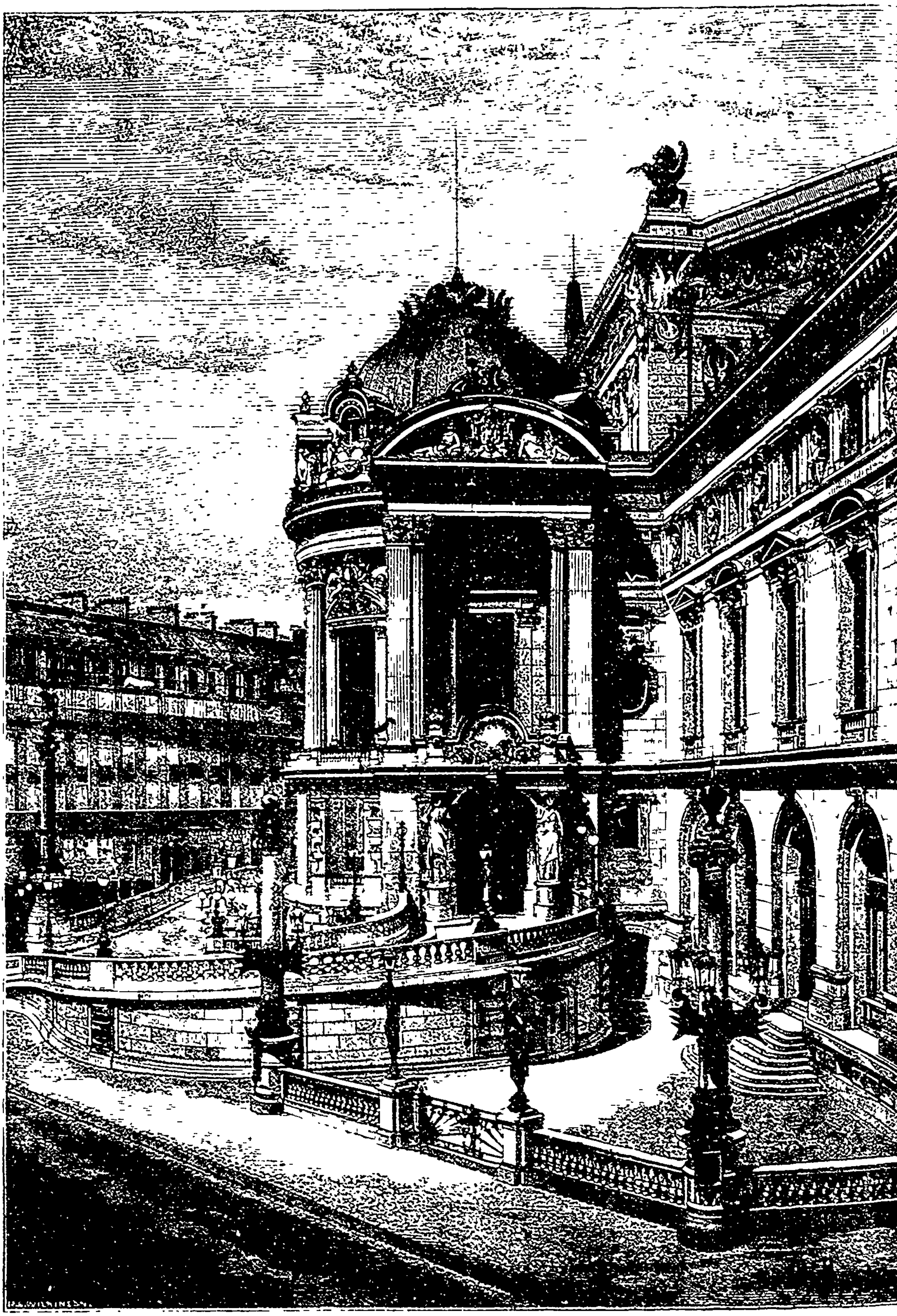
Such works as this, says the *Builder*, to which journal we are indebted for our illustration, of course within certain wide limits, are wise and profitable investments on the part of a country, stimulating artists, encouraging the progress of art, and affording pleasure to millions.

WATER-PRESSURE ENGINE.

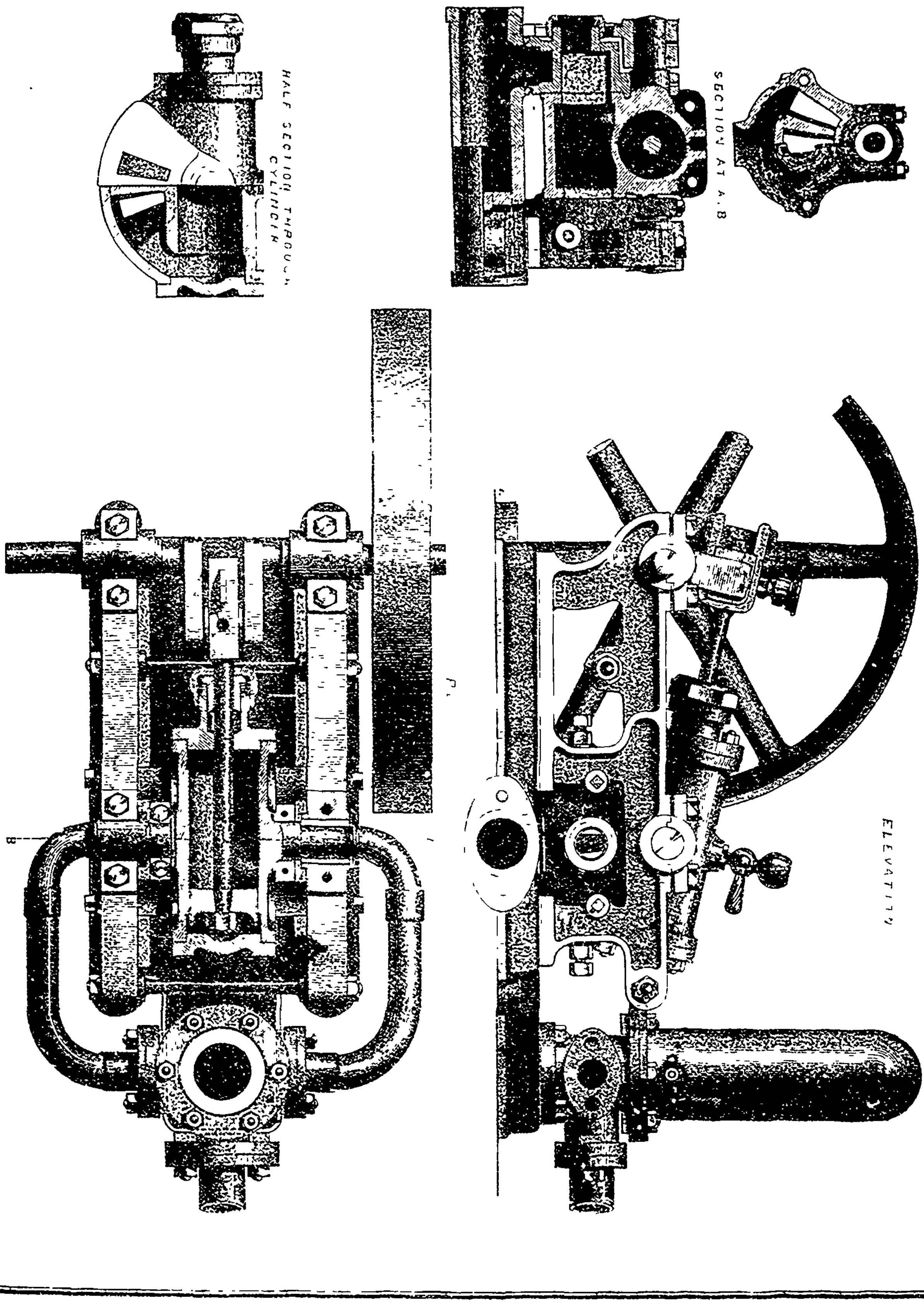
The engine which we illustrate in the engraving on page 367 has been designed chiefly for working machinery hitherto driven by manual labour in towns and other places where steam power is either too expensive or prohibited because of its danger and other inconvenience The introduction of waterworks and conduits with high-pressure water for the domestic supply of towns has made it desirable to obtain a convenient motive power for driving lithographic and printing presses, wood and iron working machinery, pumps for distillery purposes, hoists, and other machinery not requiring very great power. Messrs Wyss and Studer point out that its application is not limited to town industries, but that it may be used advantageously in larger proportions for natural falls of water from twenty metres upwards, at least where the water does not contain pebbles or rough sand It may further be applied for raising and forcing liquids, such as sewage, for cleaning pits, as fire pumps, or for contractors' purposes.

The cylinder of this engine is oscillating, deriving its motion in the ordinary way by the crank being directly connected to the head of the piston-rod, and is supported on its trunnions by fixed bearings cast in one piece, and directly connected with the crank shaft bearings. These two double bearings are bolted upon a foundation plate, supporting an air vessel on its after part. They are further connected by stays, as shown. The cylinder carries at both right and left sides flat faces turned and adjusted truly rectangular to the axis of its trunnions. Into these faces open the ports of the two water passages contained in the lower part of the cylinder body communicating at their other ends with the bore of the cylinder. Adjusted truly to them, and so held up as to be easy but tight against the cylinder faces, are two boxes, one at each side, which receive in the first place the water from the conduits and distribute it by a corresponding port contained in its face alternately to the two cylinder ports, and consequently fore and aft of the piston. A fly-wheel is provided to overcome the dead points which occur at each end of the stroke. The water which has performed its work is expelled by the returning piston back through its passage, and enters the above-named boxes through two separate ports to the right and left of the admission port, whence it flows through suitable conduits to the drain pipe into the sewer, or other receptacle whence it may be used again The screws are used for the purpose of setting and fixing the valve boxes in their proper positions in reference to the cylinder ports. By means of the set screws they are screwed slightly up to the cylinder to make a tight joint between their faces, and still allow of free motion of the cylinder between the boxes. If the engine is used as a steam or air motor the air vessel is, of course, omitted.

Herr V. A. Burkli-Ziegler, town engineer, Zurich, has carried out a set of experiments with one of these engines working with a high water pressure, and has obtained extremely high economical results, the efficiency of the engine approaching, according to his figures, as much as 90 per cent.



THE NEW OPERA-HOUSE, PARIS.—(See previous page.)



WATER PRESSURE ENGINE.—(See page 365.)

MECHANICS' MAGAZINE.

MONTREAL, MARCH, 1874.

ILLUSTRATIONS:

CONTENTS:

THE RESTORATION OF BURNT STEEL.

This subject is just now receiving considerable attention. A correspondent writes to *Iron* as follows:—

" I propose now to explain a simple and efficacious plan of restoring to steel which has once been burnt its usual valuable qualities, and that by the use of a fluid which leaves scarcely anything more to be desired on the score of cheapness and utility.

" I have found that resin oil, with which is intimately mixed one-fourth (more or less) its weight of the residue of paraffin stills, has this wonderful effect upon burnt steel.

" Chisels which have been burnt and rendered useless may be by means of this fluid restored and made as valuable as ever. This fluid, which was many months ago christened 'restitutor chalybis,' may be used as follows:—Burnt steel must be heated red hot, then plunged into the restitutor for a few seconds; then re-heated and cooled in the ordinary, way. The steel after this process is *perfectly* restored.

" Experience in the use of the restitutor will quickly enable persons to give any desired temper to their tools, but it may be stated that tools can be made especially hard by heating them red hot, dipping into the restitutor, then re-heating to a slightly white heat, and immediately cooling in pure water."

Visitors to the Harbour of Montreal may have noticed a recent addition to the steamboats in the "A. G. Nish." This rather peculiar looking boat is the new chain tug. It was built recently by order of the Harbour Commissioners for the purpose of towing vessels up the St. Mary's Current. Previous to the existence of the chain tug much difficulty and expense was incurred by havily laden sailing vessels in reaching the harbour. The new tug, however, seems to work admirably and to be powerful enough to haul up ships that four ordinary tugs could hardly handle. The power is exerted on a submerged chain one end of which is fastened to a wharf above the current. The chain extends along the bed of the channel 7,500 feet to the foot of the current. It is lifted from the bed of the river as the tug advances and passing with four turns round a crank in the bow leaves the boat and again reaches the bottom of the river. The engines were planned and built by Mr. E. E. Gilbert. The total cost of the vessel was but $25,000, and the expense of running her is about $20 a day. The gain of power by use of the submerged chain is stated as follows in *Engineering*.

"The advantages derived from the use of a submerged cable when towing against stream, depend on the actual rate of speed, compared with the speed of the current and on the slip of the paddle wheels when such are used. If, for instance, the speed of the stream is equal to the actual rate of towing while a tug hauling on a submerged cable makes 3 miles in an hour, one working with paddle wheels making 6 miles in the same time, and the resistance being the same, the saving would be $\frac{3}{6}=0{\cdot}5$. If, however, while towing a heavy load at a rate of 6 miles an hour with paddle wheels, the loss through slip equals one-half (and in practice it is often more at low speeds), then the expenditure of power and consequently of coal is as 1 : 0.25. Thus in working on a cable comparatively little power is required, the speed being reduced to a minimum, without those losses which attend such reduction on the usual plan."

MINES OF NOVA SCOTIA.—The Commissioner of Mines has made his report on the mines of Nova Scotia in the year 1873. There were twenty-eight coal-mines in working operation. From these were turned out 1,051,467 tons, of the value of 2,699,347 dols. The price in the course of a single twelvemonth rose from 2 dols. 25 c. (free on board) to 3 dols. 50 c The produce has increased from 673, 242 tons in 1871 to what we have already mentioned in 1873. The Commissioner calculates that in all probability the output for 1874 will amount to at least 1,250,000 tons; in all likelihood it will be much larger. The chief consumption was in the home market, but 266,760 tons were exported to the United States. It is curious to notice that while the United States exported in 1873 to the West Indies 47,708 tons of coal, of which 36,363 tons were bituminous, or what is produced in Nova Scotia, the Nova Scotians managed to send to the same quarter only 1,538 tons, while Great Britain sent during the previous year to these same West Indies 147,997 tons. The gold mining for the year presents no noticeable feature. The yield has been smaller, and the modes of working the mines are still so primitive as to cause no surprise at the comparatively unsatisfactory results. The yield was 11,852 oz., valued at 219 270 dols, from 17,708 tons of quartz. Iron was produced in small quantities. The two iron works of Acadia and Annapolis were not worked continuously, and between them produced only 1,226 tons of pig metal. The total produce of the mines of Nova Scotia in the year was 3,485 tons, of the value of 10,455 dols.

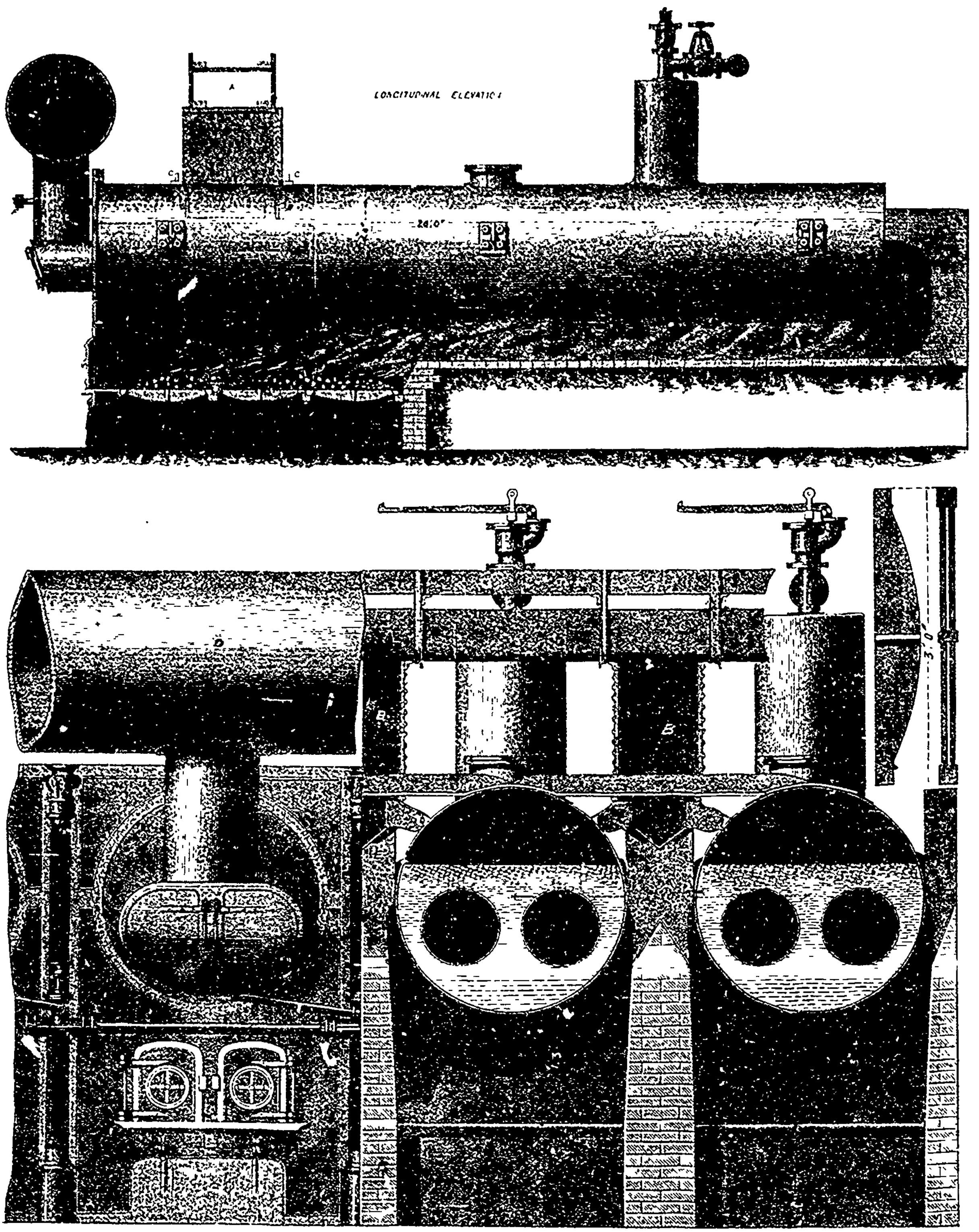
A Bill has been introduced into the New York Legislature incorporating the Niagara River Transit Company, which proposes to construct a second means of international transit at Buffalo either over or under the Niagara river. Twenty years ago it was estimated that a tunnel would cost 1,000,000 dols., but that amount would probably have to be doubled or trebled to-day. The Canada Southern and Great Western Railroads are interested in the construction of some means of transit other than the Suspension Bridge, so that the cost of the tunnel, if the scheme is otherwise practicable, need be no obstacle in the way.

Mr. J. Douglas, jun., of Quebec, has just taken out a patent in the United States for a process of utilising the waste liquors of the ordinary ore-chloridising process, by allowing the insoluble matters contained in the liquors to precipitate, and then evaporating the clear supernatant liquid to obtain the soluble chlorides, which are re-applied in treating fresh ore. In an experiment recently made in a mill at George Town, Colorado, a filtered solution of salts, of 12 deg. Baumé, contained 44 3 7 grains of saline matter in an ounce of solution, the chlorides being chiefly chloride of zinc and undecomposed chloride of sodium. This saline matter, mixed with ore in the proportion of one part of the salt to eight parts of eighty-ounce silver ore, chloridised it as perfectly as when one part of chloride of sodium was mixed with ten parts of ore. In this mill each pan contains seventy-five gallons of liquor, and thirty-five panfuls of this strong saline solution, or 2625 gallons are thrown away daily, and with it 2051 lb. of salts, almost as serviceable for chloridising fresh ore as chloride of sodium. This mill is now preparing to evaporate these waste liquors by means of the waste furnace heat, and the manager thus expects to save, at a trifling cost, more than half the salt heretofore consumed.

"Recent Extraordinary Oscillations of the Waters in Lake Ontario" is the subject of a paper contributed to the last number of *Crookes' Quarterly Journal of Science* by Mr. Richard Edmonds. The phenomena to which he alludes are very noticeable in many places situated on the shores of our great lakes, and many attempts have been made to explain them, but with no great success. This rise and fall of the level of the water is more readily seen in deep bays along the coast, and is a matter of almost constant occurrence. A very remarkable instance, however, occurred near Rochester on the 13th of June, 1872, and is thus described by the local papers: "While some gentlemen of Rochester were in a boat near the beach, where the water is usually two feet deep at least, their boat suddenly grounded, and the waters receding, left her on a sand bank. The gentlemen got out and strolled away, but looking back shortly after, they saw to their surprise the boat dashing about in apparently deep water. Securing the boat with some difficulty, they found her suddenly aground again, and as suddenly floated after a short interval. Becoming now interested in this curious ebb and flow of the lake, they diligently observed it for about three hours. *The ebb and flow occurred every twenty minutes, that is, for ten minutes the water would gradually recede, then commence rising, and continue to rise for about ten minutes. The water rose two feet and three or four inches above the ordinary level, then receded about the same distance below the usual level, making a variation in the height of the water of nearly or quite four and a half feet every twenty minutes.*" It has been attempted to account for this and similar surprising lake undulations by the influence of long-continued winds, or by changes of barometric pressure; but the regularity in th[illegible] nd other cases of the rise and fall seems to some investig[illegible] to point to some less changeable cause. Mr. Edmonds attributes them to earthquake shocks at the bottom of the lakes, and adduces many instances of great waves accompanied by shocks which have been felt on land. He acknowledges that undulatory shocks would not produce the effects observed, but he satisfies himself that a vertical shock passing upwards and striking an inclined portion of the lake bed would give rise to the undulations described in the above extract. We are prepared to grant the existence of those subterranean commotions to a certain extent under our country's soil, and also that many would reach to the height of a lake bottom without being perceived higher up; but we would submit that we have no reason to believe that they are of such constant occurrence as to cause the great number of undulations that are observed in our lakes. The influence of winds and changes in the barometric condition of the atmosphere are far more probable causes of the Great Lake Tides.—*Nation.*

PROGRESS IN TELEGRAPHY—THE DUPLEX SYSTEM.

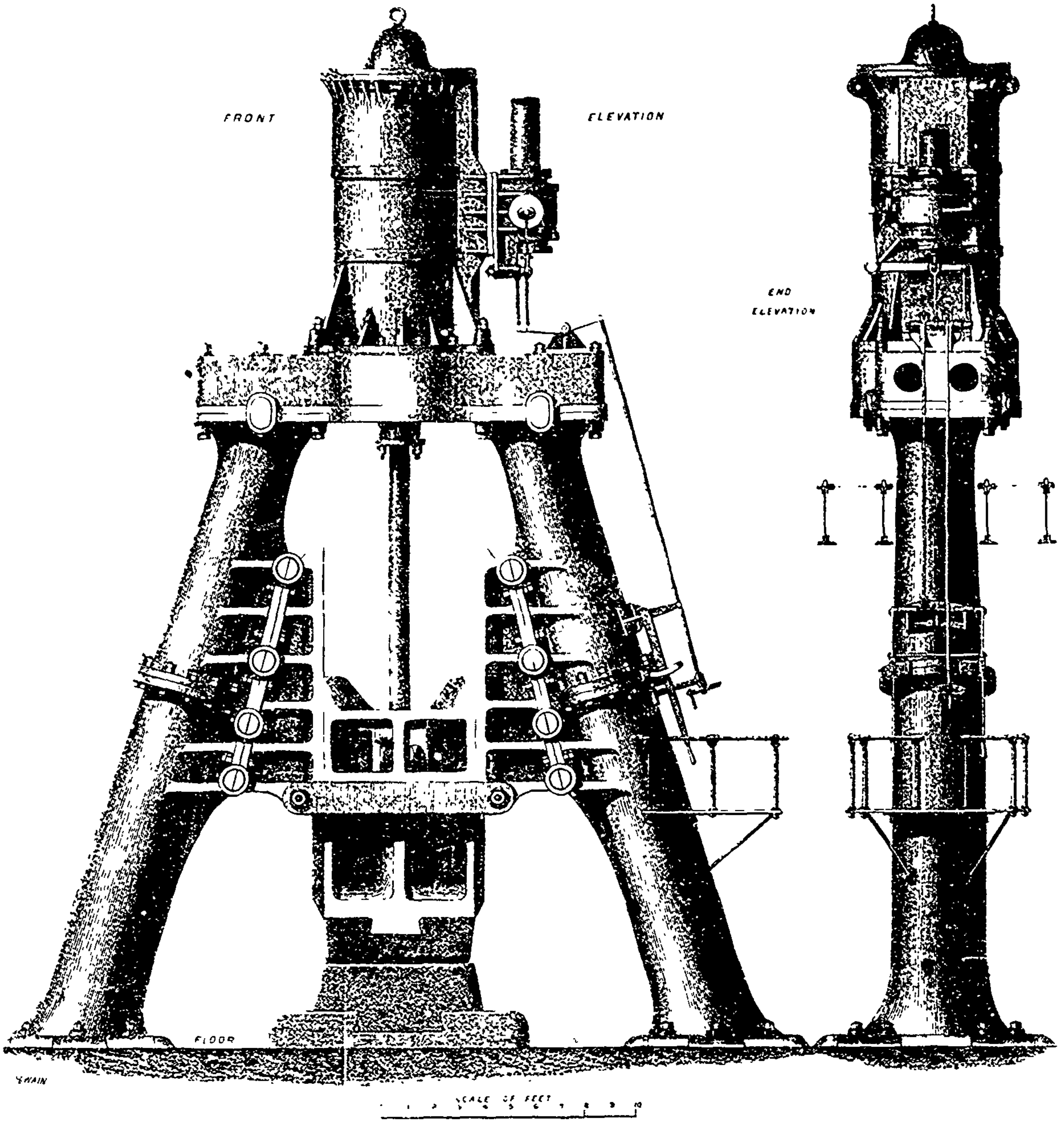
The duplex system is not altogether new, for it had been known for some time that currents travel both ways on the same wire and at the same time; but it had never been usefully applied till Mr. Joseph B. Stearns, having worked out the older ideas and obtained a practical result from them, revived it in an improved form. That Mr. Stearns is fairly entitled to be known as the inventor of the duplex system, few we imagine will dispute; at all events, his merits have been recognised by the American Institute of New York who presented him with their great medal of honour, a medal that is reserved for inventions of special importance. Since the publication of Mr. Stearns' method renewed attention has been drawn to the subject, and more than one method of practically carrying out the plan has been tried, with a very gratifying measure of success. As mentioned above, the principle was discovered by the fact that when two operators dispute for the possession of a circuit, the signals of each are affected by those of the other Thus when the instrument is the ordinary single needle, if the direction of the two currents is the same the needle moves more strongly than usual, while if the currents travel in different directions it scarcely moves. This fact having been clearly apprehended, it became obvious that if the two effects could be separated—the effect of the outgoing current from that of the received current—the signals from he distant station might be read. In testing for resistance a line wire between two stations with the differential galvanometer, it is found that, until the resistance of the rheostat (resistance coils) has been made equal to that of the line, the currents sent move the needle in one direction if the resistance of the rheostat is too small, and in the other, if it is too great. Immediately, however, the two resistances are made equal, currents sent by the key at one station (A) do not move the needle at that station, because the current divides equally between the coil connected to the rheostat, and that connected to the line, these coils being wound in opposite directions counteracting one another; but each of the currents or signals reaches the other station (B), and can be read on the instrument there if it is in circuit. If B, then holds down his key, his current will either aid or oppose the current sent by A, on the line, but has no effect on that passing through the rheostat. A.'s galvanometer will therefore move, because the balance has been disturbed. Now, if instead of a steady current, B sends the dot and dashes of Morse, the balance at A. will be disturbed by each current, and the signals of B. will consequently be legible to A But B. cannot read the signals sent by A. because the currents he himself is sending pass through his instrument and confuse A.'s signals. If, however B. places a differential in circuit, and obtains a balance by his resistance coils, as if he were testing the wire to A , his signals will not then affect his needle, but A's will move it, as B's signals move A's needle. The reason of this is thus explained by Mr. Culley:—The currents sent by each divide equally between the line and the rheostat, passing through the galvanometer coils in opposite directions. The needle of the sending instrument therefore is removed. But when the distant station sends a current it either aids or opposes the home current, in the first case adding its force to that portion which passes through the coil connected to the line, so that more flows to line than to rheostat, and the needle moves, in the second case it diminishes the current passing to line, and the greater amount then flows through the rheostat, the needle consequently moving in the opposite direction. From this it will be understood that the two currents do not pass one another, as has been imagined, but that when both stations signal at the same time, the current sent by either station acts upon the distant instrument by determining whether the line or the rheostat shall offer the easier path for the currents originated there. The batteries are generally connected so that when both keys are pressed the currents flow in the same direction and assist each other; but opposed batteries may be used



CANADIAN SAWDUST FURNACES.

The system of burning saw-dust which we illustrate on page 370 is that which is followed in the best saw-mills in Canada. All the steam required is raised from saw-dust only, and such waste scraps of wood as will not work into laths. Nothing having a saleable quality is burned.

The engraving shows a portion of a bed of nine boilers, which supply steam to two engines, 21in. cylinder, 36in. stroke, running at sixty revolutions per minute with 60 lb. steam. In our engraving A A is the saw-dust carrier box; B B, saw-dust hoppers; C C. girders to support hoppers; D, smoke pipe to chimney; E E E, sawdust hopper valves; F, feed-water pipes; G G, combined stop valve and expansion joint; H H, dead plates. The action will be easily understood. The saw-dust cut from logs just out of the river, is carried by drags



35-TONS DOUBLE-ACTION STEAM HAMMER AT SIR W. G. ARMSTRONG & CO.'S WORKS, ELSWICK

through the box A A and deliver'd over the valves E E, by opening these, the saw-dust falls on top of the fire and requires little spreading.

In some mills tubular boilers are used with 4in. tubes, the shells being 4ft diameter and 14ft. long. To burn saw-dust with success plenty of boiler power is essential, large grate surfaces, deep furnaces, and the fuel must be fed in from the top.

35-TON DOUBLE STEAM HAMMER.

The visit of the Czar to Woolwich has directed public attention to the use of large steam hammers in the manufacture of heavy guns. It is a matter for some surprise, and bears no small testimony to the skill and energy of those in charge of the gun factories at Woolwich, that they have been able with a hammer weighing no more than fifteen tons to produce such guns as the Woolwich Infant, as in other establishments much heavier hammers have long been at work. At Sir William Armstrong's works, Messrs Thwaites and Carbutt, of Bradford, erected some time since a fine hammer about as powerful as the new Woolwich hammer We illustrate this hammer above The following are the principal particulars.—The diameter of cylinder is 48in., with a stroke of 12ft. clear; distance between standards at base, 20ft.; height under standard, 8ft. 6in.; distance between the hammer guides, 5ft. 6in. The total height of this hammer is 43ft. The hammer itself, exclusive of anvil block and bed-plates, weighs 150 tons. The cylinder and entablature weigh 35 tons. Each of the standards weighs 40 tons, and is made in three pieces, firmly secured and held together with fitted bolts and turned wrought iron hoops shrunk on hot. The reason of these standards being made in three pieces is that if any of the parts give way they can be replaced at much less cost and in shorter time than if the standard was all in one It is well known that in very large castings there is great risk and liability of weak places in the interior of the casting which cannot be detected at first, but soon show themselves when strained by work. The design of the standard, it will be seen from the illustration, is new. It consists of a round pillar of great thickness, with flanges cast on one side to receive the hammer guide. This style of standard was designed under the superintendence of Mr. Rendel, of Sir W. Armstrong and Co., the round pillar being the best form to withstand the torsional strain due to hammering coils out of centre of hammer faces. There is no doubt that it makes a very strong job, and well calculated to withstand severe work.

The piston is cast steel, of V shape, to secure greater strength than if made a plain flat disc. The piston-rod is fixed into spherical washers firmly held into the hammer head with a wrought iron cotter on either side of the rod. Upon the bottom of the hammer head is cast a projection to receive the hammer face. This is contrary to general practice, but is considered an improvement for large hammer heads. The working valve is a circular piston balanced valve, and is easily worked by the attendant upon a raised platform.

PRINCIPLES OF SHOP MANIPULATION FOR ENGINEERING APPRENTICES.

By J Richards, Philadelphia

PLANS OF STUDYING.

By examining applied mechanics and shop manipulation, the learner will see that the knowledge to be acquired can be divided into two departments—special and general: general knowledge, relating to tools, processes and operations, the nature and action of which may be understood from general principles, and without special or experimental instruction; the special knowledge, that which is based upon experiment, and can only be acquired by special, as distinguished from general sources.

To make this plainer it may, for example, be said that a knowledge of how to generate the teeth of wheels and their proportions, as a geometrical problem, is general knowledge that may be learned from books, and understood without the aid of an acquaintance with the technical conditions of either the mode of constructing or the manner of operating wheels; but how patterns should be made for casting wheels, or how wheels should be moulded or fitted, is special knowledge, and must have reference to particular cases.

The proportions of pulleys, bearings, screws, or other regular details of machinery, may also be learned from general rules and principles, but the hand skill that enters into their manufacture cannot be so learned.

The general design, or the disposition of metal in machine framing, can be to a great extent predicated upon rules and constants that have general application, but, as in the case of wheels, the plans of moulding such machine frames are not governed by constant rules or performed in a uniform manner; moulds may be made in various ways, and at a greater or less expense; the metal can be mixed to produce a hard or a soft casting, a strong or a weak one; the conditions under which the metal is poured may govern the soundness or shrinkage—things that are determined by special instead of general conditions.

The importance of a beginner learning to divide what he has to learn into these two departments—special and general—has the double advantage of giving system to his plans, and pointing out such part of his education as must be acquired in the workshop and by practical experience, the time and opportunities that might be devoted to learning the technical manipulations of a foundry would be improperly spent if devoted to metallurgic chemistry, because the latter may be studied apart from practical foundry manipulation, and without special opportunities for observation.

It may also be remarked that the special knowledge involved in applied mechanics is mainly to be gathered and retained by personal observation and memory, and that the first lessons, learned when the mind is interested and active, should as far as possible include whatever is special, in short, no opportunity of learning special manipulation should be lost If a wheel pattern come under notice, examine the manner in which it is framed together, the amount of draught, and how it is moulded, as well as to determine whether the teeth have true cycloidal curves.

Once, nearly all mechanical knowledge was of the class termed special, and shop manipulations were governed by empirical rules and the arbitrary opinions of the skilled; the apprentice entered the shop to learn a number of mysterious operations, which could not be defined upon principles, and only understood by special practice and experiment. The arrangements and proportions of mechanism were also determined by the opinions of the skilled, and, like the manipulation of the shop, were often hid from the apprentice, and what he carried in his memory at the end of an apprenticeship was all that he had gained. The tendency of this was to elevate those who were the fortunate possessors of a strong natural capacity, and to depress the position of those less fortunate in the matter of mechanical "genius," as it was called.

The ability to prepare proper designs, and to succeed in original plans, was attributed to a kind of intuitive faculty of the mind; in short, the mechanic arts were fifty years ago surrounded by a superstition, of a different nature, but in its influences the same as superstition in other branches of knowledge.

But now all is changed; natural phenomena has been explained as being but the operation of regular laws, so has mechanical manipulation been explained as consisting in the application of general principles, not yet fully understood, but far enough so that the apprentice may, with a substantial education, good reasoning powers, and determined effort, force his way where once it had to be begged.

The amount of special knowledge in mechanical manipulation, that which is irregular and modified by special conditions, is continually growing less as generalisation and improvements go on.

The engineering apprentice, in estimating what he will have to learn, must not lose sight of the fact that what qualifies an engineer of to-day will fall far short of the standard that another generation will fix, and of that period in which his practice will fall. This I mention because it will have much to do with the conceptions that a learner will form of what he sees around him. To anticipate improvement and change is not only the highest power to which a mechanical engineer can hope to attain, but is the key to success By examining the history of great achievements in mechanical science it will be seen that their success has been mainly dependent upon predicating future wants, as well as upon the ability to supply such wants, and that the commercial value of mechanical improvements is often measured by conditions that the improvements themselves anticipate, the invention of machine-made drills, for instance, was but a small matter, but the want that has grown up since their existence has rendered this improvement one of great value; moulded bearings for shafts was also a trifling improvement when first made, but it has since influenced machine construction in America in a way that has given great value to the invention.

It is generally useless and injudicious to either expect or to search after radical changes, or sweeping improvements in machine manufacture or machine application, but it is important in learning how to construct and apply machinery that the means of foreseeing what is to come should at the same time be re-studied. The attention of the learner can be directed to the division of labour, improvements in shop system, how and where commercial interests are influenced by machinery, what countries are likely to develop manufactures, the influence of steam hammers on forging, the more extended use of steel when cheapened by improved processes for producing it, the division of mechanical industry into special branches, what kinds of machinery may become staple, such as shafting, pulleys, or wheels, and so on; these are mention' at random, to indicate what is meant by looking to the future as well as at the present.

Following this subject of future improvement farther, it may be assumed that an engineer who understands the application and operation of some special machine, the principles that govern its movements, the endurance of the wearing surfaces, the direction and measure of the strains and who also understands the general principles of the distribution of material arrangement and proportions, that such an engineer will be able to construct a machine, the plans of which will not be materially departed from so long as the nature of the operations to which the machine is applied remains the same.

A proof of this proposition is furnished in the case of standard machine tools, a class of machinery that has received the most thorough attention at the hands of our best mechanical engineers. Standard tools for turning, drilling, planing, boring, and so on, have been changed but little during twenty years past, and bid fair to remain nearly the same in future.

A lathe or a planing machine made by a first-class establishment twenty years ago has, in many cases, the same capacity, and is worth nearly as much in value at the present time as the machines of modern construction—a test that more than any other determines their comparative efficiency and the value of improvements made.

The plans of the framing for machine tools have been altered, and many improvements in details have been added; yet, upon the whole, it is safe to assume that machine tools have reached a state of improvement that precludes any radical changes in future, so long as the operations in metal cutting remain the same.

This state of improvement, which has been reached in machine tool manufacture, is not only the result of the skill expended on such tools, but because they are the agents of their own production; machine tools produce machine tools, and a workman should certainly become skilled in the construction of implements that he uses continually in his own business.

Noting the causes and conditions that have led to this perfection in tool manufacture, and how far they apply in the case of other classes of machinery, will indicate the probable improvements and changes that the future will produce. The functions and adaptation of machinery constitute, as already explained, the science of mechanical engineering. The functions of a machine is a foundation on which its plans are based; hence, machine functions and machine effects are matters to which the attention of an apprentice should be first directed. In the class of mechanical knowledge that has been defined as general, construction comes in the third place; first, machine functions; next, plans or adaptation of machines; and third, construction of machines. This should be the order of study pursued in learning mechanical manipulation Instead of studying how drilling machines, planing machines, or lathes are arranged, and next plans of constructing them, and then the principles of their operation, which is the usual course, the learner should reverse the order, studying first drilling, planing, and turning as operations, next the adoption of tools for the purposes, and third plans of constructing such tools.

Applied to steam engines the same rule holds good. Steam, as a motive agent, should first be studied, then the operation of steam machinery, and finally the construction of steam engines. This is a rule that may not apply in all cases, but will serve to assist the learner in forming plans in most cases, and adopting a regular mode of proceeding in his studies.

To follow the same chain of reasoning further, and to show what may be gained by method and system in learning mechanics, it may next be assumed that machine functions consist in the application of power, and that power should therefore be first studied; of this there can be but one opinion. The learner who sets out to learn even the elementary principles of mechanics without first having formed a true conception or an appreciation of power as an element, is, in a measure, wasting his time and squandering his efforts. Any truth in mechanics, even the action of the "mechanical powers" before alluded to, is received with an air of mystery, unless the nature of power is first understood, practical demonstration a hundred times repeated does not create a conviction of truth in mechanical propositions, unless the principles of operation are understood. An apprentice may learn that power is not increased or diminished by being transmitted through a train of wheels that change both speed and force, and he may believe the proposition without having a "conviction" of its truth He must first learn to regard power as a constant and indestructible element, something which can be weighed, measured, and transmitted, but not created or destroyed by mechanism—then the nature of the mechanism may be understood, but not before.

To obtain a true understanding of the nature of power is by no means the difficulty, for a beginner, that is generally supposed, and when once reached, the truth will break upon the mind like a sudden discovery, and ever afterwards be associated with mechanism and motion whenever seen. The learner will afterwards find himself analysing the flow of water, the traffic in the streets, the movement of ships and trains; or even the act of walking will become a manifestation of power, all clear and intelligible, without that air of mystery that is otherwise inseparable from the phenomena of motion

If the learner will go on further, and study the connexion between heat and force, the mechanical equivalent of heat when developed into force and motion, and the re-conversion of power into heat, he will have commenced at the base of what must constitute a thorough knowledge of mechanics

I am well aware of the popular opinion that such subjects are too abstruse to be understood by beginners—an assumption that is founded mainly in the fact that the subject of heat and motion are not generally studied, and have been too recently demonstrated in a scientific way to command confidence and attention; but the subject is really no more difficult to understand in an elementary sense than that of the relation between movement and force illustrated in the "mechanical powers" of school-books, which no apprentice ever did or ever will understand, except by first studying the principles of force and motion independent of mechanical agents.

It is to be regretted that there have been books especially prepared to instruct mechanical students in the relations between heat, force, motion, and mechanism. The subject is, of course, treated at great length in modern scientific works, but is not connected with the operations of machinery in a way to be understood by beginners.

A treatise on the subject, called "The Correlation and Conservation of Forces," published by D. Appleton, of New York, is perhaps as good a book on the subject as can at this time be referred to. The work contains papers contributed by Professors Grove, Helmotz, Faraday, and others, and has the advantage of arrangement in short sections, that compass the subject without making it tedious.

In respect to books and reading, the apprentice should supply himself with references; a single book, and the best one that can be obtained on each of the different branches of engineering is enough to begin with.

A pocket-book for reference, such as Molesworth's or Nystrom's, is of use, and should always be at hand.

For general reading, nothing compares with the scientific and technical journals, which are now so replete with all kinds of information that, beside noting the present progress of engineering industry in all parts of the world, they contain nearly all besides that the learner will require.

It will be found that information of improvements and mechanical progress that the learner may gather from serial publications can always be exchanged for special knowledge in his intercourse with skilled men, and what the apprentice may read in an hour can often be "exchanged" for experimental knowledge that has cost years to acquire.

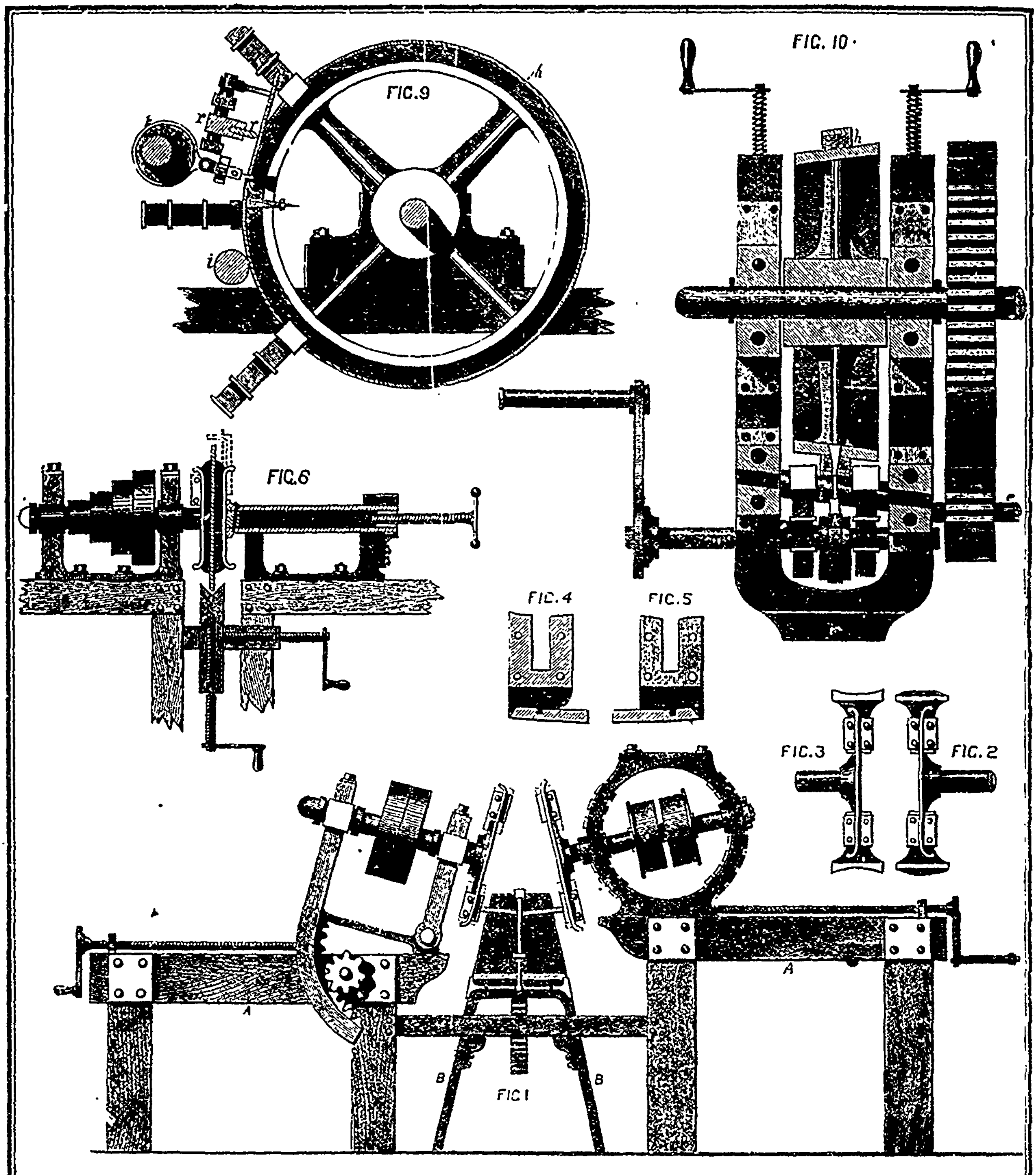
Finally, I will say to the learner, set out *de novo* in your plans, with a determination to succeed, and if your judgment commends it, with originality, only have system and method from the first, avoiding, however, any course that will provoke rivalry or resentment on the part of others around you.

(*To be continued.*)

GAILLON'S PATENT MACHINERY FOR MAKING CASKS.

At page 374 we illustrate improved machinery for making casks, recently patented in England. This machinery is applicable to forming casks of the ordinary shape, but is preferably employed for making casks of a cylindrical shape, the staves being made of a rectangular shape instead of tapering towards the ends, as usual, by which means an economy of wood is effected, the surface of the staves is preferably made flat, but they may be curved if required, and may also be tapered.

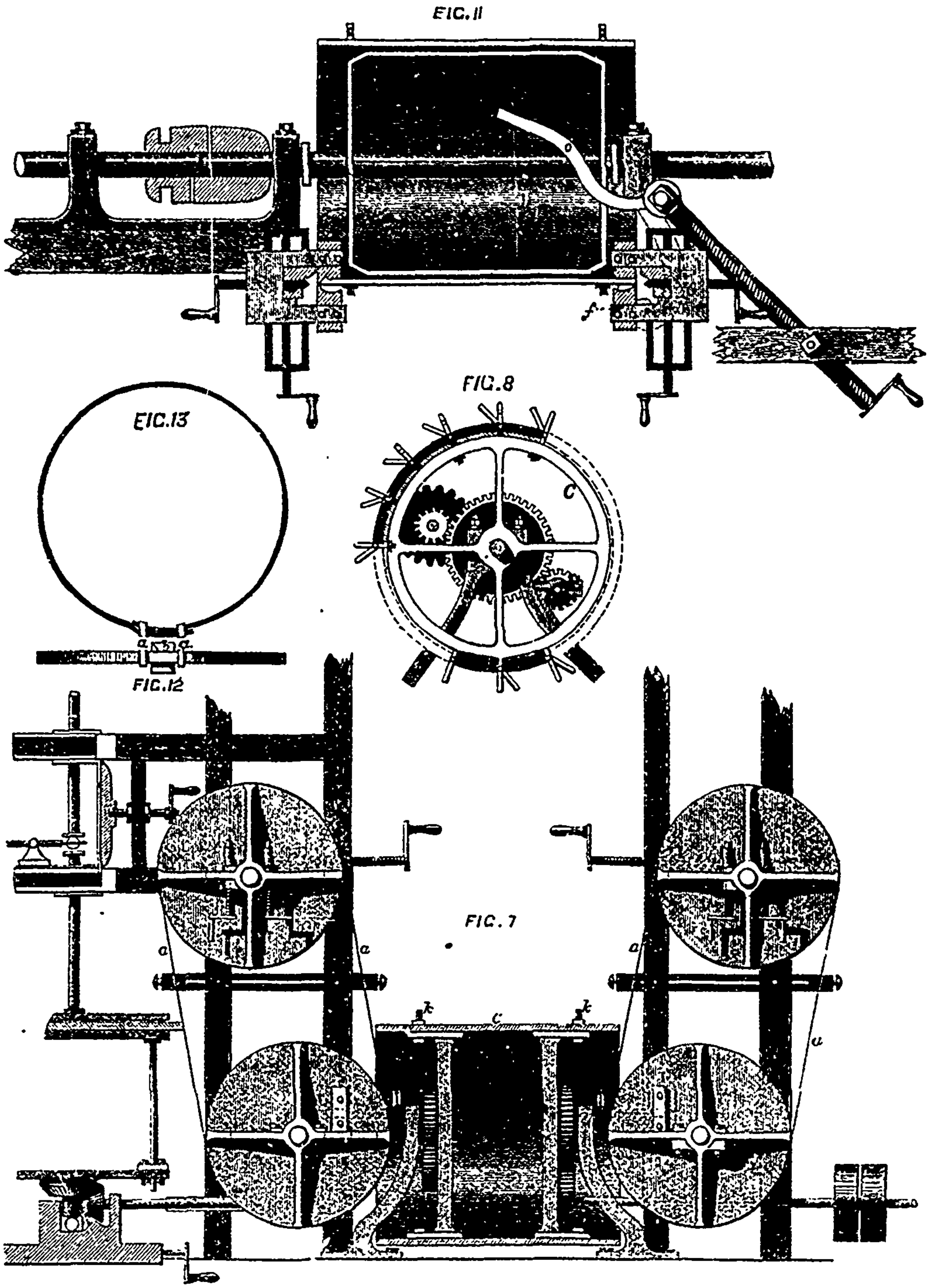
In the illustration page 374, Fig. 1 is an end elevation of a double-faced planing machine or lathe for shaving or dressing the surfaces and beveling the edges of the staves, and also for chiming or dressing and grooving the ends of the staves. This machine is constructed of two spindles or centres, carrying at their ends rotary circular face plates provided with cutters for beveling the edges of the piece of wood, *a*, to form the stave. The bearings of the spindles can be moved towards or from each other on the beds or tables A A, by turning the hand screws as shown. The spindles or shafts must be arranged so that they may be placed at any required angle to



GAILLON'S PATENT MACHINERY FOR MAKING CASKS.

suit the size and bevel of the stave to be made, and two arrangements are shown for thus inclining the shafts In the circular bearing the ends of the centre shaft work in slots, and the shaft is fixed at the angle required by wedges. The other bearing moves on a centre or pivot, and is provided with a toothed quadrant into which gears a pinion By turning this pinion the angle of the bearing may be varied as required. The spindles have fast and loose pulleys for driving the same by means of straps from the driving shaft. The framing B of the carriage may be made of wood or iron The top or bed carries a platform or sliding table, which is curvilinear or square, according to the form of stave to be made. The platform is provided with a hinged rack and lever, or a cramp, for pressing on and fixing one or more staves to be dressed A to-and-fro movement is given to the platform by an endless chain and chain wheel, or a rack or a screw arrangement may be employed.

Figs. 2 and 3 show convex and concave cutters or planes mounted on the face plates for planing or shaving the surfaces of the staves, and Figs. 4 and 5 show cutters for chiming or cutting round and grooving the ends of the staves. This machine works as follows :—The piece or pieces of wood *a*, to form the stave or staves, being fixed on the platform, and the cutters set at the required angle to bevel the edges of the staves



GAILLON'S PATENT MACHINERY FOR MAKING CASKS.

as above described, and also at the required distance apart by means of the screws, the platform or sliding table and the shafts are set in motion, and the staves being drawn along between the revolving cutters the edges of the staves will be beveled thereby. The surfaces of the staves are then planed or shaved by means of the cutters shown in Figs. 2 and 3 respectively, which are substituted for the beveling cutters. The spindles or shafts may now be set in a horizontal position, and the bearings moved sufficiently apart to allow of the stave *a* being placed crosswise on the platform. Then by substituting the cutters shown in Figs. 4 and 5 for the curved cutters, and setting the machine in motion, the ends of the staves will be grooved and dressed or chimed by the cutters as shown. For planing or shaving the surfaces and beveling the edges of the pieces to form the heads of the casks, the machine or lathe shown in Fig. 6 is employed, and is sufficiently clear without further explanation.

Fig. 7 shows a view of a combined machine for cutting round, chiming, or grooving the ends of the staves, and cutting out the heads of the casks at the same time. It is constructed of two parallel endless saws *a a*, having movable bearings actuated by set screws, so that the saws may be inclined as required for cutting the different lengths of staves, and for giving the required bevel to the ends. Between the saws is placed the revolving drum C, having screw levers and racks or cramps for fixing the staves on the drum At the side of the machine is a vertical lathe. The heads to be cut out by the saws are carried between the plates on the upper centre or shaft and the lower support or centre of this lathe. The plates have movable bearings to allow of adjusting the plates at the required distance from the saw, according to the size of the head to be cut out If desired a similar vertical lathe may be placed at the other side of the machine, so that both the endless saws may be used for cutting out the heads of casks at the same time that they cut the ends of the staves. By means of this combined machine it will be easily seen that if the staves are fixed on the revolving drum, and the pieces to form the heads are fixed between the said plates, and if the machine be set in motion the saw will, as the drum revolves, cut the ends of the staves so as to make them of equal length, and will also cut the pieces to form the heads of the casks; and as the drum C revolves the tools or cutters *k* will chime, or turn and groove the ends of the staves after they have been cut by the saws. By removing the drum C, and placing between the saws a carriage and platform similar to that hereinbefore described and shown in Fig. 1, the endless saws may, by being brought nearer together, be used for cutting out the staves lengthwise and with beveled edges. The staves thus cut are chiefly applicable for casks not intended to contain liquids.

Fig. 8 shows an end view of the drum C, with its driving pinion and pinion for driving the cutters.

Figs 9 and 10 show the machine employed for forming hoops for conical casks. This machine is constructed of a conical drum mounted on a shaft provided with a toothed wheel, driven by a pinion on the shaft *e*. The drum shaft works in movable bearings, actuated by hand screws; *h* is a hoop or ring in two parts, fixed by keys on the drum, and varying in diameter according to the size of hoops to be made: *i* is a cylinder placed obliquely so as to be parallel with the periphery of the drum; *k*, eccentric, the ring of which is provided with a punch, and is operated by the lever handle—or by other suitable means—for punching holes in the hoops for the rivets; *r*, shears to cutting the iron.

This machine operates as follows:—The end of the piece of iron to form the hoop is fixed to the ring *h* by a wedge, and the machine being set in motion the iron is carried round the hoop or ring *h*, and passing through the space between the peripheries of the drum *i* and the hoop *h* it is guided by the guide rollers and is formed into a complete circle or hoop, at the same time receiving the conical form necessary to adapt it to the conical form to the cask. The eccentric is then turned by means of its handle, thereby punching the holes in the hoop by means of the punch; the shears or cutter is next operated—by means of an eccentric or a lever—and the hoop, is cut off as seen at Fig. 9, and may be removed from the machine.

Fig 11 shows the lathe employed for turning up, chiming, and grooving the end of the staves after their edges have been beveled only. On the lathe spindle or centre is fixed a drum round which the staves are fixed by movable hoops The movable centre of the lathe is hinged or pivoted at *f*, and is operated by a screw; two slide rests are provided each carrying three tools or cutters. The first cutters serve for turning up the ends of the staves, the second cutters for turning up the outer surface of the ends of the staves, and the third cutters serve for turning up the inner surfaces of the ends of staves and for grooving them at the same time. One of the slide rests is fixed to and moves with the hinged bearing; *o* is a hinged lever arm, which can be raised when required, so as to withdraw with it the staves forming the barrel part of the cask when they have been turned up and grooved at the ends, as above stated, and the barrel is then ready to receive the heads and the hoops to complete the cask.

Figs 12 and 13, plan and elevation of an improved hoop for cylindrical casks. In making these hoops a heel or shoulder is formed near each end of the piece of iron forming the hoop, the said heels or shoulders being reversed; the ends of the iron being overlapped are held together by two straps or loops, *a a*, of iron. When the hoop is placed on a cask it may be tightened as required by driving a key or keys, *d*, in the space between the shoulders or heels. To remove the hoop the keys are driven out so as to loosen the hoop, which can then be removed from the cask.—*The Engineer.*

PICTURESQUE LABOUR AND MACHINERY.

(From the *Builder.*)

The precise position at any particular time of the working, or labouring classes, as they are commonly termed, must of necessity be interesting to architects, and to all who employ, however indirectly, working men. This is interesting, as we say, at all times, but at the present moment it is more especially so, not on account of any particular or important "strike," or dispute, but on the broad ground of the change, the organic change, that would seem to be now going on in the condition of one particular section of labour, and this the more so from its influence on other portions necessarily consequent on such change in this particular one. We allude to the organic change that is taking place in the condition of the agricultural labourer, as he is termed, or the *agricultural* working man. A few thoughts have occurred to us which may *interest* a thoughtful reader here and there. It has a bearing, too, on bricks and mortar, and perhaps fine art, and is worth at any rate a little cogitation.

It would be curious to note, according to date and place, one after the other, the various degrees of estimation in which the "husbandman," or tiller of the ground has been held. He is, perhaps, above most others an *historic man,—nay,* he is yet older than history itself. In the most remote ages we may hear mention made of him, and his praises, and the dignity and importance of his occupation dwelt on in glowing terms.

In the oldest of human records the first man born into the world was a tiller of the ground; and in the most refined, and polished, and artistic of nations, the Greek, cultivation of the earth was an occupation not disdained by the most illustrious of men. How needless to cite instances, for so many are they that to hint at them is almost enough to bewilder the keenest memory with the crowd of images which the bare suggestion calls up. Whole volumes of sweet poetry have come into existence written to the music of the pastoral reed, from the earliest of days down to the present hour. We say, and must repeat, the present hour, for things are indeed about to change in this department of human doings which bid fair to remove the "husbandman" at least from the range and ken of poetic efforts. The useful, and the practical, and the getting the most out of everything by the shortest and cheapest of methods, is over-riding all things, and the word-skill of the poet himself, however keen it may be, must needs fail at last, not from want of power, but from inaccessibility of subject.

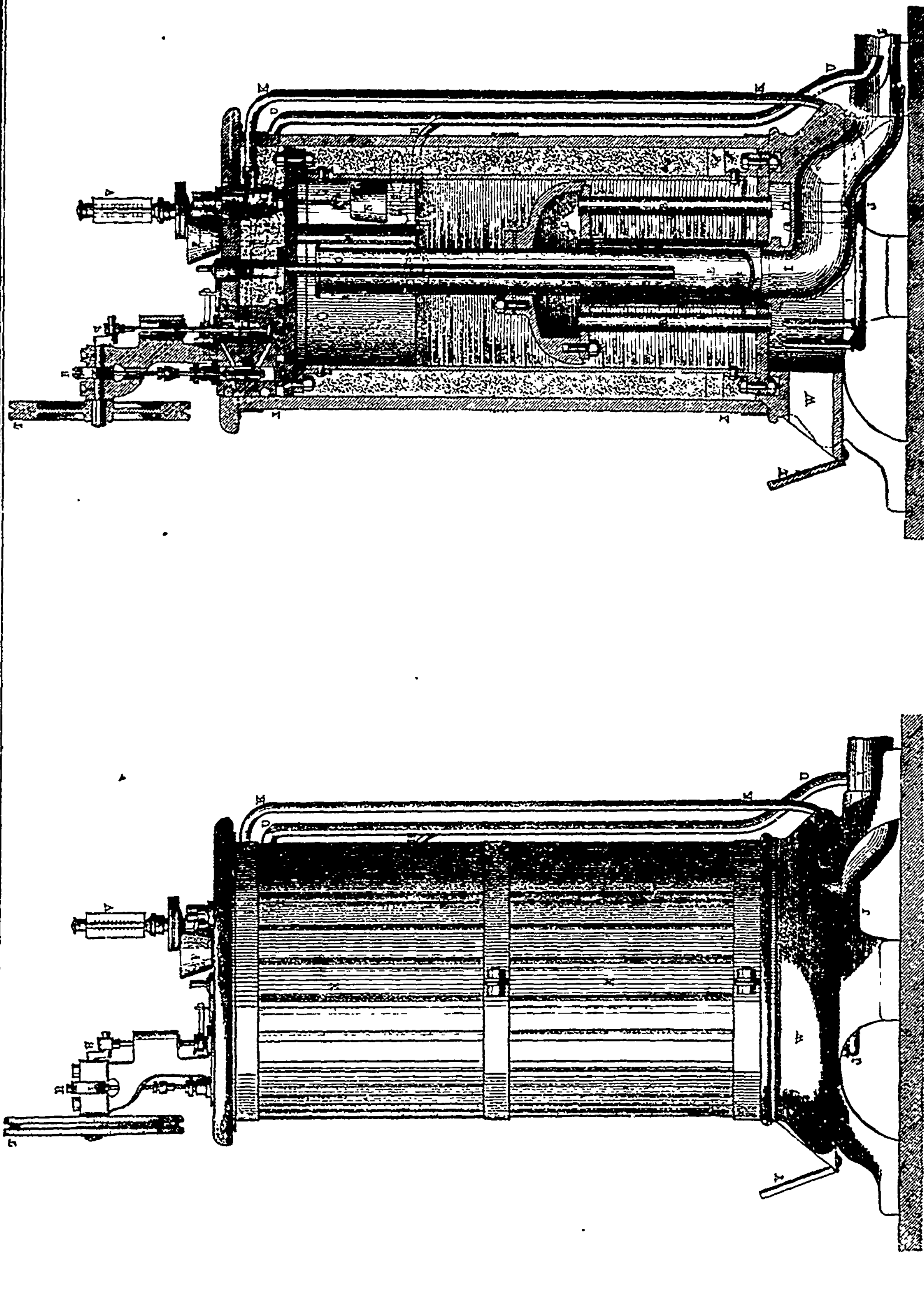
The old-fashioned husbandman, or tiller of the soil, the ploughman, the sower of the seed, and the reaper, all so picturesque, and so full of country life and attractiveness, have as it is more than one-half of them disappeared, we are told statistically, and in but a few years' time they will and must totally disappear, and make way for the "ploughing engine" driven by steam, the sowing-engine, and the reaping-machine Six thousand reaping-machines made in one single year by one firm, to do the work of sixty thousand men. Sixty thousand husbandmen and picturesque tillers of the soil turned to other vocations by the practical and unpaintable, and not to be described, except in a *specification* — "*reaping-machine*" In twelve days only (it has been accurately calculated) 80,000 reapers may do the work practically and well of no fewer than 800,000 poetic-looking husbandmen. All know well of the use made of the ploughman, and the sower, and reaper, by the clever sculptors and wood carvers of the old Gothic days. The Dark-Age cathedrals and churches, here and ever where, are full of them, and a right good and interesting collection might be readily made of these stone and carved wood representations of the agricultural life of the Gothic ages; and not a little light thrown on the forms of the rude implements of the husbandman as then in use. The sculptor could hardly go wrong. The rude machine seemed almost made for the sculptor's use, and the man and the machine seemed made to fit each other, and designed almost to be copied in stone or wood. We are never tired of looking at them, and speculating on their artistic way of work. But compare such things with such terrific-looking engines and masses of machinery as the modern and most approved "ploughing engine." What shall the sculptor or the painter do with it? How mould it into artistic shape? It would seem to be a veritable impossibility to work into a picture a complicated and ponderous mass of new and improved machinery. The rude and rough old "enginery" seemed to fall into picturesque forms of themselves, almost as though they had been designed specially for such artistic purposes. Rough and huge wheels, and ponderous cranks, and huge supporting gear transferred themselves readily to the stone and wood, and became without any inventive effort picturesque and sculpturesque, and "architecturesque." But what can we say of the modern clean-made and delicate and perfectly-moving improved and perfected machinery, all of bright clean metal, and all so accurately fitted together and so polished? To paint it is impossible, and to carve it almost as much so. It is really not a little curious to look into an old worm-eaten book with representations of the old machinery for whatever purpose it may have been made;—all agricultural implements of the roughest and rudest, but yet, by the bye, effective, lifting apparatus used in building operations,—effective as we know by what they have done,—and a host of other strange things all obsolete in this improved mechanical age and country, but wonder-working indeed in their own distant day. There are but few things more singular than this of the old-fashioned mechanical appliances of past days,—see but the work it did, the masses it moved, and helped to mould into form and artistic shape!

But there is another and a more practical view to be taken of this phase of human labour, and it is perhaps yet more curious than that we have been commenting on and wondering at It is the surprising change that is taking place in the condition and prospects of the husbandman or countryman through the power of machinery. Machinery and enginery are, to say plain truth, putting away the poetic husbandman: he is no longer required; the steam-engine, the ploughing-machine, the sewing-machine, and the reaper are gone into the fields, and are driving him out of it. There is really but little now to do but to look on and see how the all-conquering machinery does its clean and quick and effective work. One man can nowadays with a machine, and by dint of but little else than looking on, do the work of multitudes, and apparently rejoice in the feat, the multitudes having more to eat in consequence. The small field is despised, the mighty machine demands a larger and a larger sweep of work; and, what most needs grieve the artistic mind, it rides over all picturesque hedgerows, and fairly "levels" everything. It seems a pity this, the destruction of hedgerows and quaint and picture-making corners; but what is to be done? The times, and the machine, and extending population, and education, and fate itself will have it so. It can hardly be expected that all these influences shall stop and cease to act for the mere sake of furnishing to the picturesque tourist, and to the Gainsborough of the hour, a something to look at, and to love, and to sentimentalise over, and to talk about, and to paint! What is the loss and gain here may exercise the ingenuity of the curious.

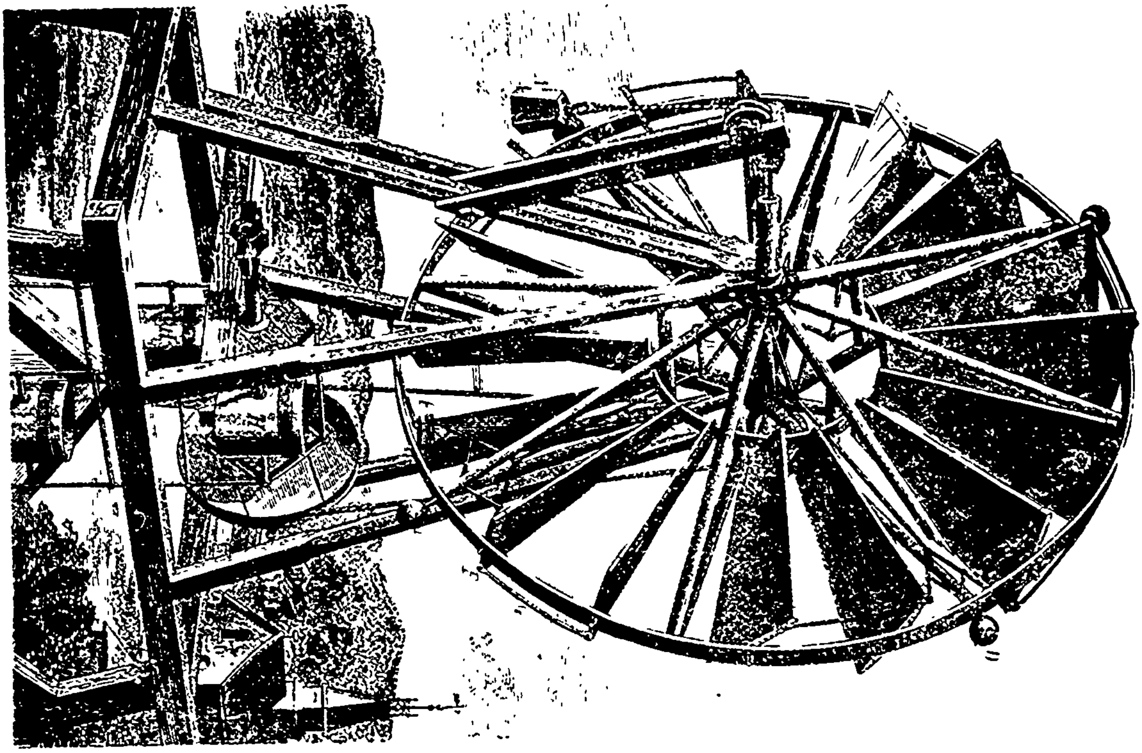
And thus are the picturesque husbandman, and tiller of the soil disappearing from human ken; but this is not all by a long way, for not only is the all-powerful machine driving him out of the green fields, and doing his work for him, but he is, strange to say, running away fast from the fields himself All sorts of vocations, so we are assured, are calling out for him, and enticing him from his rural life and belongings to the cities and towns, and to the work done in them and about them. Mines, manufactories, building in the metropolis, and in large towns, and even watering-places are demanding his help, so that the tiller of the earth, like the earth itself, is the real source which supplies the world with what it needs primarily. Out of the earth all things come. And this is the country supplying the town with its needful quantity, if not quality, of labour; and thus leaving the poor earth itself to the tender mercies of the insensible machine,—the machine, *per se*, with the human element of labour or work at a minimum, if there can be said to be any human work at all in it. We have said nothing, as being may be a little out of place, of that great coming "exodus of labour" which is to be soon inaugurated, and which promises to provide in distant lands an El Dorado of plenty for the favoured husbandman. But why, looking to facts, provided so kindly for him only? The cottager truly may at times need help, even in the most favoured localities; but there are cottagers, and plenty of them, in great London, in Liverpool, and in all other great towns we ever saw, and their inmates are to the full,—does Mr Arch know it?—quite as helpless as ever their country cousins can be. Nothing can well surpass the interior of a town cottage. This is, indeed, an architectural and building subject, and not a little important, for nothing can surpass the evil arrangements and surroundings of a London cottage and its inmates, and this may bring us to another strange result of this change in the condition and doings of the primitive husbandman or countryman. It is the probable effect on the labourer in towns, and the consequent change even in his prospects. The British labourer, it would seem, has a capital prospect before him if he will but be content to stay at home and bide his chance. The ground is clearing for him day by day, intelligence is spreading, and the clever workman, whether of town or country bringing up, is pretty certain of occupation, so that for the mere hewers of wood and drawers of water there is a plenty to do, and ample room to do it in Their prospects are improving, and competition is not so keen, or, at any rate, will not be so in the future All this, we are confidently assured, is so, and it is not a little curious to think of the causes which have brought all this about. Labour, mere labour, is the simplest and commonest of all human vocations. The labourer is always ready at call, and his simple work is soon learnt, whether in town or country, whether in a ditch, or in helping to build up or to pull down a house. A strange enough fate is the "labourer's" He fits into all positions, from high poetry to the merest commonplace. If the painter wants a picturesque figure anywhere, why, the labourer is always ready for him, properly clothed in picturesque diversity of costume both in shape and colour If but a crowd be required in the dim background, how could it be made up without the groups of working men,—labourers always, somehow or other, to be found everywhere hanging idly about? Practically, not poetically, what is the poor labourer to do when the mighty "machine" has totally run him down? He must cultivate himself, and become a professional man: learn to look after machines,—perhaps invent them. Well, thus we all go on advancing. Thus it has been, and thus it will be.

A NEW DOMESTIC STEAM ENGINE.

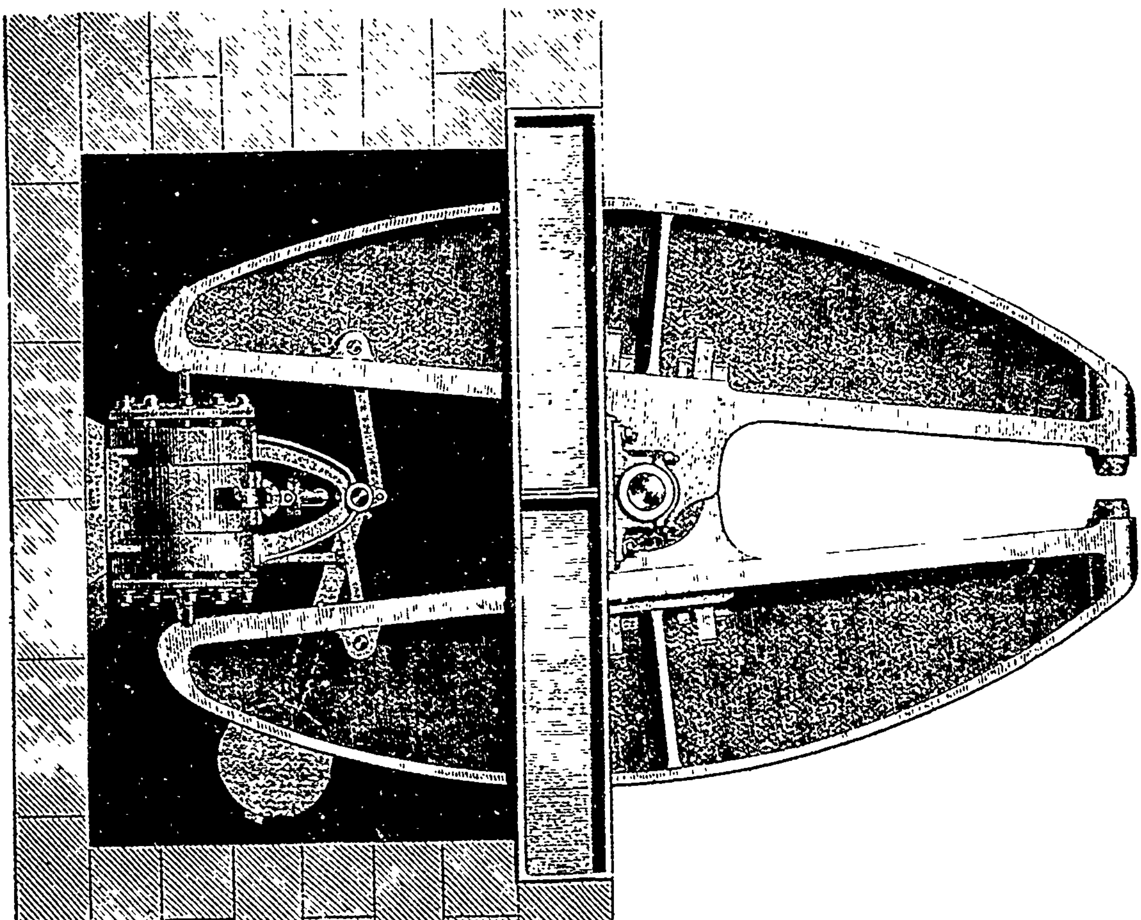
M. Fontaine has recently received a prize of $200 from the French Société d'Encouragement, for the invention of the domestic steam motor represented in the annexed engravings. The boiler of the device contains enough water to furnish some 42 foot pounds, during the continuous period of work of a woman—some four or five hours, and the design is to renew the supply during meal hours, allowing such interval for the generation of steam, ready to begin work again. The device is composed of a generator—an engine and a gas furnace with automatic register. The engraving shows the exterior of the invention, and also a sectional view. A is the body of the boiler, in the lower side of which are twenty-four copper tubes B, the upper ends of which enter the smoke box, C. D is a sleeve through which the gases of combustion descend to the chimney, and E is a superheating tube which is closed at the bottom and extends down through the smoke box, as shown. F is the feed water tube, closed by a screw plug, indicated by dotted lines. Water cannot be put into the boiler except when there is no pressure of steam. At G, dotted lines, is a cock which draws off the steam when water is to be supplied, through a pipe, H, and thence into the chimney. I is the flue connecting with the sleeve, D. J is the furnace composed of twenty-five Bunsen burners. The gas, on leaving the meter, goes to the upper part of the machine and enters at L Here it meets a flexible tube, M, which resembles a bellows, and forms a pressure regulator. N is a counterweight suspended to the tube, M, maintaining it at a length corresponding to the desired pressure. When the limit fixed is exceeded, the tube elongates and checks the flow of gas by closing the smaller orifice, L. X is the tube conducting the gas from this apparatus to the burners. Steam is taken from the superheating pipe by the tube, O, and is led to the slide valve, P, which communicates with the cylinder, Q. R is the slide eccentric, S the crank, T the belt wheel, U the exhaust pipe leading to the chimney, V the manometer, and W the supporting legs of the apparatus. X is the wooden envelope, having dilatable joints which surround the boiler and cylinder, and is lined with thick felting. Y is a small inclined mirror, which allows the operator to see a reflection of the gas burners, and so to judge of the heat of the fire.



NEW DOMESTIC STEAM ENGINE.—(See page 377.)



IMPROVED WIND WHEEL AND WATER ELEVATOR.—(See page 380.)



HYDRAULIC RIVETTING MACHINE.—(See page 380.)

Cylinder, valve, chest, slides, and frame of the engine are all cast in a single block, in which the necessary apertures are bored. No cores are used in the moulding. Steam goes to a simple slide valve operated by an eccentric, and is admitted during one-third, and exhausted during five-sixths, of the stroke. The shaft, crank, and eccentric are cast in one piece. All rubbing surfaces are of steel. The piston is made in segments, of cast iron, on the Ramsbottom system, and all the ports are circular.

The object of the device is to do any light work now performed by hand, such as driving sewing or washing machines, turning wringers, operating pumps, etc. Its height from floor to top of fly wheel is about 43 inches, and exterior diameter, 14 inches. *Scientific American.*

HYDRAULIC RIVETING MACHINE.

The use of high pressure steam, especially in marine engines, which has become so universal during the last few years, has required a stronger construction and form of boiler than hitherto employed

In order to retain the large diameter so convenient in marine boilers very strong plates are necessary, and it is now no unusual thing to have boilers in use at sea with plates of 1in. and even upwards in thickness. Such boilers require to be constructed with rivets of sizes that cannot be satisfactorily set up by mere manual labour, and of late years, after many applications of steam and gearing for this purpose, hydraulic power has been employed with the best results.

The first thing that strikes an observer of this new process is the entire absence of that most deafening noise, the usual accompaniment of ordinary riveting, and a little further attention will show that this absence of noise is its least merit By the quiet, steady pressure rivets are enlarged throughout their length and fill up all roughness or irregularities inside the punched holes they enter, so that they remain firmly fixed, even when one or both of the heads are cut off, and must be drilled out altogether should it ever be necessary to remove them. The pressure not only forms heads on the rivets, and effects the above named compression, but it holds them up, and the plates also, close together, until the former are sufficiently cooled to bear the strain, and even draws the plates closer together by subsequent contraction.

The illustration on page 379 shows Messrs. McKay and McGregor's patent hydraulic riveter, which has been for some time in use at the Millwall Docks Engineering Works, London. This machine is one of the most powerful of its class, and gives a pressure of 60 tons upon the rivet, an amount abundantly sufficient for the largest class of boiler work hitherto required for marine engines. Above the machine stands a powerful travelling crane, from which boilers are suspended over it, their (ordinary) horizontal axis of course then being in a vertical position. Circular seams of rivets are brought to the machine by the simple process of turning the boiler round on a swivel and vertical seams by raising or lowering it in the usual manner with mechanical arrangements of this class.

The pressure is derived from an accumulator, and it amounts to 700 lb. per square inch in the present case. This pressure is only admitted into the large cylinder when the dies come in contact with the hot rivet, the "slack" being taken up by the action of a smaller cylinder. By this arrangement a considerable saving of power is effected: for if the large cylinder took its supply and moved the levers their entire distance by accumulator pressure, it is evident that great waste of power would ensue thereby, and in all direct acting steam riveting machines this waste must come from the nature of their construction.

The hydraulic cylinder, and all valves, levers, weights, &c., are placed in a pit below ground, clear out of the way of men working, and safe from frost or accidental injury. Of course the pit is covered over, and in winter carefully protected from cold, and where, as is sometimes the case, these machines stand practically out of doors, a precaution of this kind should never be neglected

The upper end of the powerful cast iron levers which form the most conspicuous part of this machine are perfectly free from all surroundings, except only a conveniently placed handle for starting or reversing; this handle stands behind one of the levers, and therefore does not appear in the present illustration These levers are so strong that any accidental blow given to them can do no harm; and the readiest access is obtained to every part of the machine. Steel dies are simply placed in bored holes, and naturally hold themselves there.

When all is prepared, and a heated rivet in position, a movement of the handle admits high-pressure water to the smaller cylinder, the dies rapidly close upon the rivet, the self-acting valves admit water to the larger cylinder, and without noise or vibration the work is done The dull, heavy pressure crushes together the thick plates, and after holding them and the rivet together for a moment that the latter may cool, the pressure is released, the dies recede, another rivet is soon completed, and a boiler is finished with astonishing ease and rapidity

The distance from the centre shaft on which both levers work to the dies or centre hydraulic cylinder is 6ft. in the present case, so that after deducting the centre bearing, and wrought iron straps to carry the tensile strain, there remains a clear space of 5ft. for boiler plates, and this is found to be ample for the several classes of work for which this particular machine is used.

To all those interested in the development of high-pressure at sea, such a machine as this we have described cannot fail to be most interesting; and still it is only one element in those most numerous facilities we owe to the inventive powers of our mechanical engineers. Such machines as this compensate in some measure for the enhanced value of labour and materials, and no one who has read the pages of this journal can have failed to notice this encouraging fact. No sooner do workshop requirements outstrip existing means of production, than forthwith tools are invented, or new processes discovered and we still retain our control over the inert resistances of material things.—*The Engineer.*

IMPROVED WIND WHEEL AND WATER ELEVATOR.

Irregularity of motion, oscillation of turning table and vane, unavoidable use of small wheels on the main shaft preventing the transmission of quick motion when the same is needed, liability to get out of repair, and excessive cost, are objections to the employment of wind power, which the inventor of the device illustrated on page 379 claims to have overcome. The fans are centrally pivoted to two circles, which constitute portions of the frame of the wheel, and the bearings for the main axle rest upon stationary posts. A is a weight attached to a rod which traverses the shaft and is pivoted in a sleeve which slides back and forth between the arms. To the sleeve are attached jointed rods which are connected with guides, at B. so that, as the sleeve passes back and forth, the rods are given an inward and outward motion. Near the outer extremity of the latter are placed systems of small rods, C, jointed together to form parallelograms, operating on the principle of lazy tongs. From each of these extend three arms, one passing through the outer circle and carrying a ball, D, the second pivoted to the inside corner of one fan, at E, and the third similarly secured to the outer corner of the other adjacent fan, at F. The rods, G, connect these fans with those next to them, so that one shifting rod, with its lazy tongs, governs a set of four fans, which move through the same space at the same time.

In order to stop the windmill, the weight, A, is removed, when the balls tend to bring the portions of the lazy tongs to a position at right angles with the shifting rods, and hence the fans, to a right angle with the wheel. The fans, it is stated, move with equal facility in strong or light winds, no greater force being required to operate them than is necessary to overcome the friction of the different bearings. The power is, besides, through its application diagonally across from the inside corner of one fan to the outside corner of the other, transmitted to the best advantage. For large wheels, we are informed, hydraulic pressure is used to equalize the motion

The water elevator consists of a series of buckets, H, which are pivoted, a little above their centres, between every two links of an endless chain or band which passes over two pulleys, one at the bottom and the other above the well. The bottom of the bucket swings in, and a projection thereon takes against the upper shaft as the vessel is carried over. This causes the latter to empty, with little splash, into the conduit provided, in which the water is conducted to any desired point.

It will be seen that the construction of the apparatus denotes considerable strength, as it is built on the plan of a wagon wheel, the fans serving as spokes. The inventor states that it is almost impossible to blow it to pieces.—*Scientific American.*

SCIENTIFIC NEWS.

It is a well-known fact that gum arabic will not cause some kinds of blotting-paper to adhere. This may be remedied by adding, to eight ounces of the concentrated solution, sixteen grains of al minum sulphate. Alum answers also, but not so well.

As a means of preserving an elevated temperature while filtering solutions, &c., the following hot water funnel may be used. This consists of a thin funnel, with a perforated rubber stopper in the neck, through which the glass funnel is passed, the whole is covered with thick felt; the space between the glass and tin funnel is filled with hot water.

According to a statement by M S. Droux, in the *Annales du Génie Civil*, the use of sodic silicate, in soaps cannot be considered a falsification, as it increases the detersive properties of the soap. It also diminishes the price and makes the loss by drying much less. The neutral silicate containing 19 parts of soda to 81 of silicic acid is preferable to the alkaline silicate containing 30 parts of soda to 70 of silicic acid. The mode of making soaps with sodic silicate is given; 6 to 8 per cent. of the silicate is contained in the finished product.

Incombustible Paper and Ink.—An English inventor has secured letters patent for an incombustible and fireproof ink. The pulp for the paper is composed of vegetable fibre, one part, asbestos, two parts; borax, one tenth part, and alum, two tenth parts. The ink can be used either in writing or printing, and is made according to the following recipe: Graphite, finely ground, twenty-two drachms; copal or other resinous gum, twelve grains, sulphate of iron, two drachms, tincture of nut galls, two drachms; and sulphate of indigo, eight drachms. These substances are thoroughly mixed and boiled in water. The graphite can be replaced by an earthy mineral pigment of any desired colour.

The following method of preserving wooden labels that are to be used on trees or in exposed places is recommended:—Thoroughly soak the pieces of wood in a strong solution of sulphate of iron; then lay them, after they are dry, in lime water. This causes the formation of sulphate of lime, a very insoluble salt, in the wood. The rapid destruction of the labels by the weather is thus prevented. Bass mats, twine, and other substances used in tying or covering up trees and plants, when treated in the same manner, are similarly preserved At a recent meeting of the horticultural society in Berlin wooden labels thus treated were shown, which had been constantly exposed to the weather during two years without being affected thereby.

In continuation of his researches on the phenomenon of flight, M. Marey has made a series of observations which prove how important a part the onward movement of a bird plays in increasing the efficiency of each wing stroke. For supposing that in its descent the wing did not continually come in contact with a fresh volume of air it would act at a disadvantage, because the downward impulse, which at the commencement of each stroke, it gives to the air below it, would make that air so much less efficient a resisting medium, whilst, by continually coming in contact with a fresh body of air, the wing is always acting on it to the best advantage. For this reason, when a bird commences its flight it turns toward the wind if possible, to make up for its lack of motion on starting

The *Straits Times*, a Javanese journal, publishes some novel information on the poisonous properties of the bamboo which heretofore has been considered one of the most inoffensive of vegetables. The natives of Java use the poison against their enemies, and obtain it by cutting the bamboo at a joint, and detaching from the saucer-shaped cavity, formed by the cane at such portions, some small black filaments, which are covered with almost imperceptible needles. The filaments constitute the venom, against which no remedy has been found to act. When swallowed, instead of passing to the stomach, they appear to catch in the throat and work their way to the respiratory organs, where they immediately produce a violent cough, followed by inflammation of the lungs. The poison, tried upon dogs, produces loss of appetite, severe cough, burning thirst, and gradual emaciation. The animal froths at the mouth, and finally dies by suffocation as if under the influence of a deleterious gas.

MISCELLANEOUS.

There are some 264 blast-furnaces in Pennsylvania, about 100 of which are not blowing.

The Martindale Zinc Works, at South St. Louis, have had four furnaces in operation during the past month. These have produced 100¾ tons of zinc.

At Buffalo, New York State, a steel yacht, to be propelled by steam, is now being constructed which, it is thought, will travel at the rate of eighteen miles an hour.

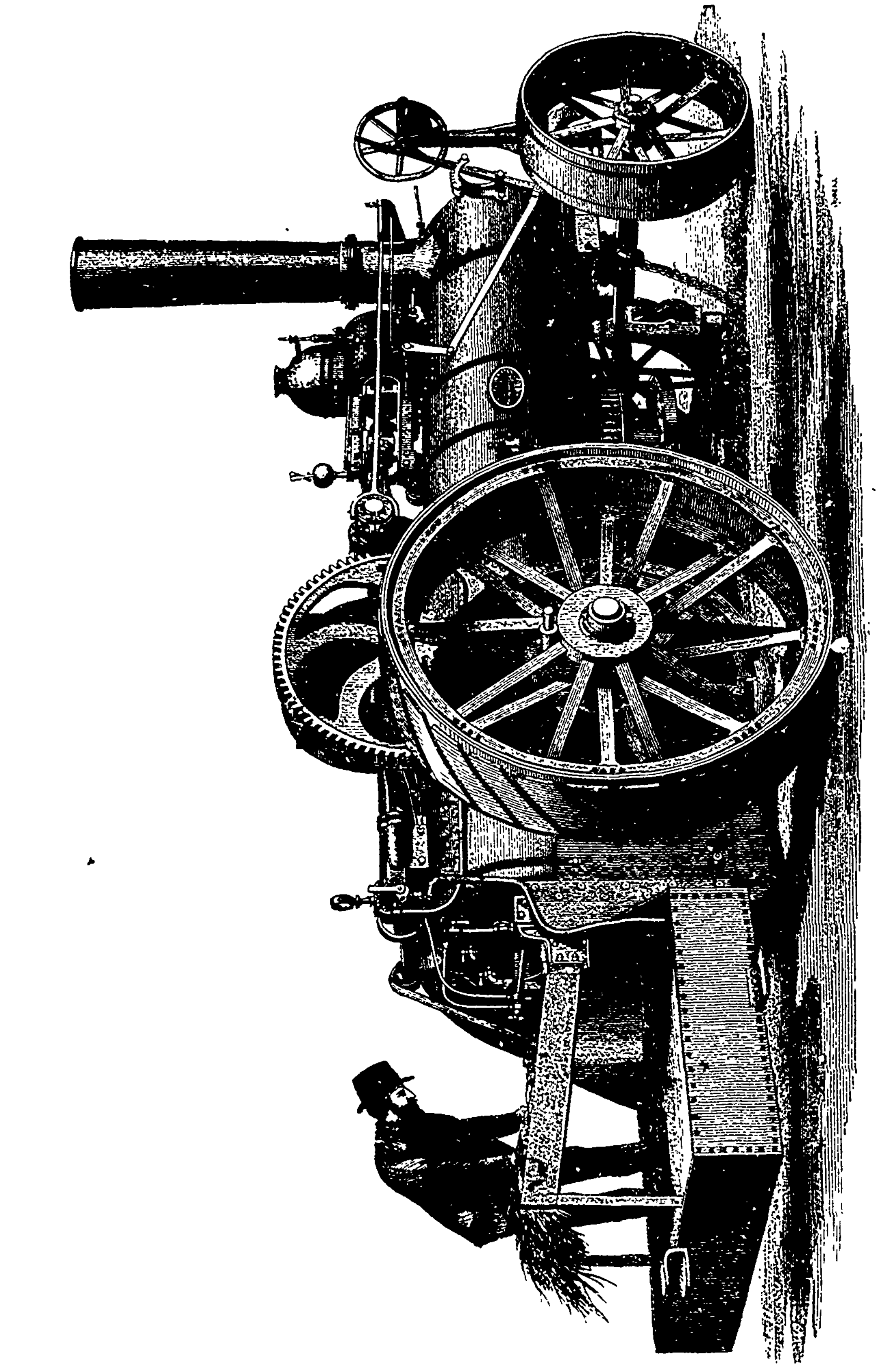
What is believed to be the longest rope in the world has been recently on view at Messrs. Frost's "walk," Shadwell. It is a grapnel rope 10,000 fathoms long, without a splice, and has been made for the Siemens Telegraph Company It is made of three strands, the diameter of the completed rope being 2 in.

It is proposed to roll 60ft rails at the Edgar Thomson Steel Works, U. S., when they are completed, thus saving 50 per cent. of rail ends. The rolling of 30ft. rails was once regarded as a great achievement, and two mills, Montour and Cambria, dispute the honour of the first successful manufacture in this country of rails of that length.

The Statistic of Paper-making.—Some curious statistics relative to paper making have been recently published at Venice. It appears that there are 3,960 paper manufacturers in the world, employing 80,000 men and 180,000 women, besides 100,000 employed in the rag trade; 1,809 millions of pounds of paper are produced annually; one-half is used in printing, a sixth for writing, and the remainder for packing and other purposes. The United States with 3,000 machines produce yearly 200,000 tons of paper, which, for a population of 28,000,000, averages 17 lb. per head; an Englishman consumes 11½ lb; a German 8 lb.; a Frenchman, 9 lb; an Italian, 3½ lb; a Spaniard, 1½ lb; and a Russian only 1 lb. annually, on an average.

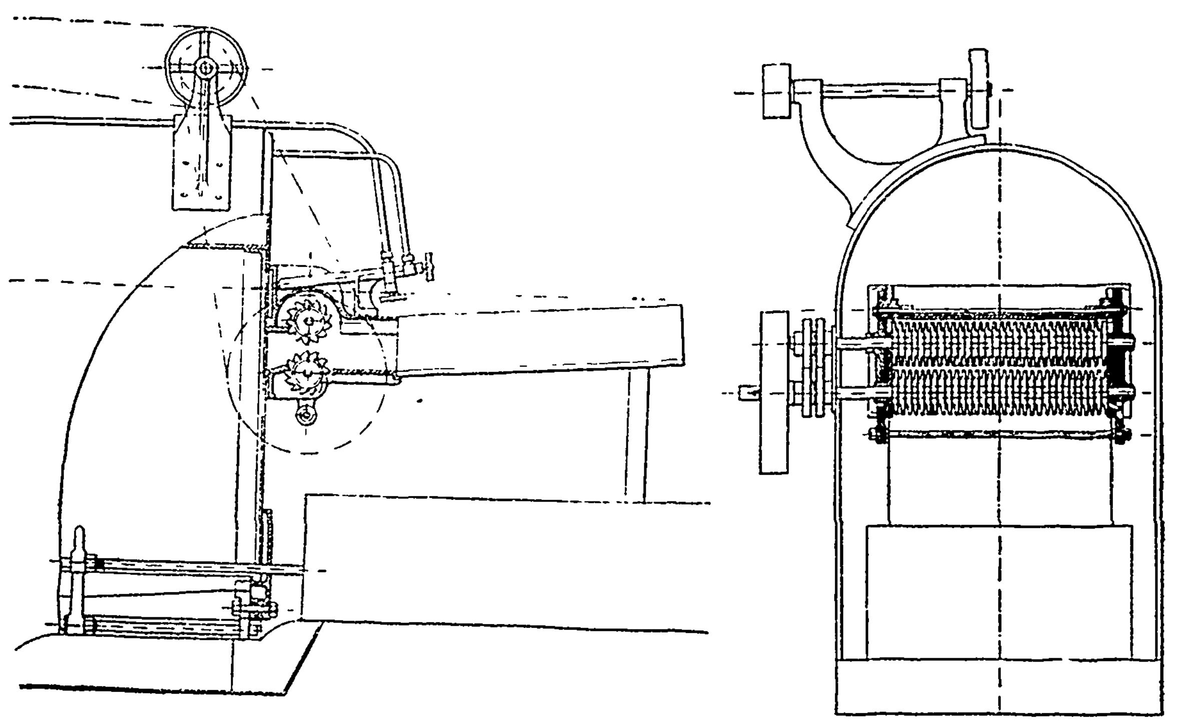
The Northern Pacific Railroad has been completed, equipped and put in successful operation from Duluth, the extreme westerly end of Lake Superior, to Bismark, on the Missouri river, a distance of 452 miles, and from Kalama, on the Columbia river, to Tacoma, on Puget Sound, a distance of 105½ miles. At Kalama communication is extended up the Columbia river a distance of 400 miles by means of the Oregon Steam Navigation Company, thus affording direct means of communication and transportation between the territories of Idaho and Washington and the State of Oregon with the navigable waters of the Pacific. With great care, and after most particular investigation, examination, and surveys, Tacoma has been selected as the Pacific terminus of the Northern Pacific Railroad. It is situated on Commencement Bay, an excellent harbour in Puget Sound, and already has assumed the usual appearance of a growing city. The commodious wharves of the railroad company, the track and railroad connections, are far advanced toward completion, and will afford all the necessary facilities which will be required by the immense business that must centre at this point.

Probably the oldest timber in the world that has been subjected to the use of man, is that which is found in the ancient temples of Egypt It is found in connection with ancient stone work, which is known to be at least 4,000 years old. This wood, and the only wood used in connection with the temples, is in the form of ties, holding the end of one stone to another in its upper surface. Where two blocks were laid in place, it appears that an excavation about an inch deep was made in each block, into which an hour glass shaped tie was driven. It is therefore difficult to force any stone from its possession. The ties appear to have been the tamarisk, or chittim wood, of which the ark is said to have been constructed, a sacred tree in ancient Egypt, and now very rarely found in the valley of the Nile. These dovetail ties are just as sound now as on the day of their insertion. Although fuel is extremely scarce in that country, these bits of wood are not large enough to make it an object with Arabs to heave off layer after layer of heavy stones for so small a prize. Had they been of bone, half the old temples would have been destoyed years ago, so precious would they have been for various purposes.—*Manufacturer and Builder.*

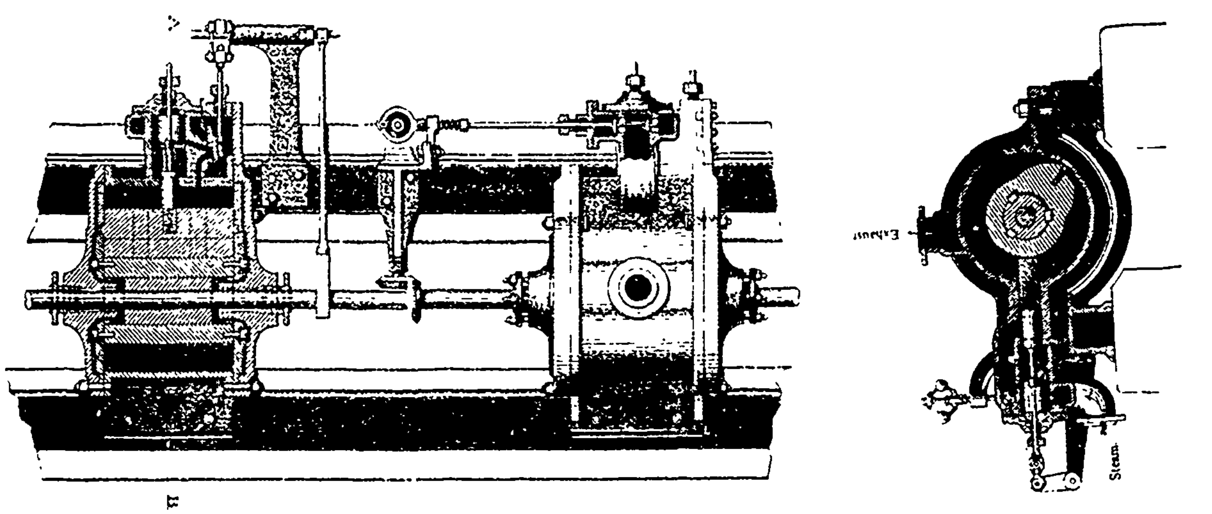


STEAM PLOUGHING ENGINE WITH HEAD AND SCHEMIOTH'S STRAW-BURNING APPARATUS.

CONSTRUCTED BY MESSRS. JOHN FOWLER AND CO., ENGINEERS, LEEDS.



STRAW-BURNING APPARATUS.



SUDLOW'S ROTARY ENGINE.—(See next page.)

STEAM PLOUGHING ENGINE WITH STRAW-BURNING APPARATUS.

We give, on these two pages, views of a 12-horse steam ploughing engine, fitted with a straw-burning apparatus, the engine being one of a pair made a few months ago by Messrs. John Fowler and Co. for use in Russia.

The engine is of the type ordinarily made by Messrs. Fowler for working on the double-engine system, but it is fitted with an unusually large firebox, the front of this box, too, being entirely cut away, while the reversing gear, stop-valve, clutch levers, &c., are all arranged so that they can be worked from the front end of the engine instead of from a footplate at the hind end as usual. The straw is fed into the firebox by the action of a pair of rolls similar to the feed rolls of a chaffcutter, and driven by a belt, as shown. In addition however, to the simple straw-feeding arrangement Messrs. Fowler have provided means for burning a small quantity of petroleum oils, the latter being supplied by a pipe leading from a tank on the top of the boiler and being injected into the firebox by the action of a steam jet, the injector being arranged just above the straw-feeding rolls, as shown by the part longitudinal section on the opposite page. This provision for petroleum burning was made on account of the great power such ploughing engines are frequently called upon to exert, a power which it was deemed somewhat doubtful to be able to maintain by the combustion of straw alone, particularly if the latter was not in good condition. The quantity of *dry* straw used is about 26 lb. per indicated horse power per hour, and as the engines have sometimes to exert 80 horse power, there is naturally a difficulty in consuming the necessary quantity. We may add that the engines are also suitable for burning wood if desired

SUDLOW'S ROTARY ENGINE.

We illustrate on page 383 a novelty in steam-motors—a rotary engine patented by W E Sudlow, of Oldham, and exhibited at the late Peel Park Exhibition at Manchester. Of all mechanical contrivances, perhaps, rotary engines take the first place among problems for which a practical, successful issue has been long, and for the most part, fruitlessly sought. Yet the solution of this intricate subject offers considerable commercial and practical advantages, and we are disposed to think that the engine we illustrate seems likely to prove a successful exponent of these advantages. A rotary engine in its intrinsic principle seeks to use steam power directly as a rotary motion without the intervention of a reciprocating piston. This may seem in theory a very simple problem, but, practically, an engine on this principle is one of the most difficult things to construct in a satisfactory manner.

The essential advantages of a rotary engine over the old piston engine are briefly these:—That the use of all reciprocating parts are, as a rule, an economical disadvantage. This is caused by the fact of all mass requiring power to set it in motion, and afterwards, if that motion is not to be continued in the same direction, an equivalent amount of power has to be applied in the contrary direction to stop the motion.

Now, as a rule, considerable power is required, every stroke, to set the reciprocating part of a piston engine in motion, and then their momentum is wasted upon the crank pin and bearings. Hence an economical loss Again, a steady rotary motion in one direction, we may see at a glance, throws less strain and knock upon bearings than an alternate pull and thrust. Hence a further loss to reciprocating engines by friction, and wear and tear of bearings. Again the avoidance of a jarring reciprocal motion obviates the necessity of a strong frame and very solid foundations, and there are also no connecting rod brasses to watch, to prevent knocking through wear, or to run hot by excessive tightening up. These are benefits of which a practical man can easily judge.

The greatest advantage, however, peculiar to the rotary class of engine is the enormous power which may be developed in a minimum of space, and with a smallest possible amount of material. This is caused by the fact that in reciprocating engines the piston speed is comparatively limited by reason of the motion being continually stopped and reversed. Now speed is power, without any further expenditure of material, and our only limit of speed in steam engines is the velocity with which a supply of steam can travel along passages with full effect. And this velocity is, as far as can be determined, almost infinite. Thus with a piston such as that of a rotary engine, in which the motion is constant, and in the same direction, a very high piston speed is attainable, without shock or jar to the engine or foundation.

A very high rate of expansion can with facility be obtained, with one, two, or three cylinders, set at ½ or ⅓ on the same shaft, or by means of the usual fly-wheel to regulate the speed. The rotation at high speed may be kept up by simply successive puffs, as it were, as the piston passes the sliding-block, the great velocity enabling the steam to be expanded to the limit of useful expansion With high-pressure steam the economy of such an engine should be quite unique, as the travel of piston is equal to about three times the diameter of cylinder.

With all the above detailed advantages attending this form of engine, it may be wondered why rotary engines should not have been, before this, the generally used and favoured form of steam-motor. The reason is simply this; that there are serious practical difficulties to overcome in this form of engine, and the man who may have successfully overcome them will have conferred a great boon on the steam using community in particular and the world at large.

These difficulties are principally (1) to make good steam-tight joints over the large surface of the peculiar piston with the minimum of friction, and (2) to obtain the rapid — nay, instantaneous—withdrawal and replacement of the sliding-block before the advancing piston and immediately after it, not withdrawing before the stroke is complete, nor re entering with any space between it and the piston, as that would represent so much clearance or economical loss.

Now, referring to our illustrations, we shall see that Mr. Sudlow has solved these difficulties in a practical way, with considerable engineering skill. The piston is metallic-packed, with a steel bar on its revolving face. This is held back on its place by a spring, and is kept on to its bearing by the steam pressure being admitted to the back of it. This makes the joint proportional to the pressure, and as the pressure falls the joint is relaxed and there is no undue loss by friction.

The side face joints of the swelling, or piston, are made by discs, which are fixed by set screws to the piston, and therefore revolve with it. The surface on which the joint is made is thus transferred from the large surface of the piston to a narrow ring on the main cylinder, which is an important improvement over ordinary forms of rotary engines.

The unavoidable expansion of the shaft, through heating by the steam, is thoroughly allowed for, without detriment to the engine, by attaching the piston to a feathered boss with three feathers, allowing free longitudinal action. The boss is firmly keyed to the shafting.

The metallic side packing can be easily examined or adjusted by removal of the end covers There are but two bolts to undo and no steam joint to remake.

With regard to the abutment or sliding-block: This is operated in Mr. Sudlow's engine by steam alone, acting by means of a small auxiliary piston attached to the top of the abutment and regulated by means of a slide valve and ordinary eccentric on the shaft.

This valve causes the abutment to rise easily without shock, just as the swelling on the piston reaches it and follows it up. Then the pressure being reversed the abutment is made to ride easily down the opposite incline, and tends to move the piston forward. This causes a noiseless but rapid motion of the abutment without shock or jar, which is an essential mark of a good and practical rotary engine.

A governor is attached, which supplies the steam through a double-beat valve, and which cuts off the steam as soon as the requisite speed is obtained.

We think that this engine, as a whole, is as good and practical a specimen of a rotary engine as we have seen, and we have no doubt that, partially through its agency, the benefits of a good rotary motion will be more fully understood than at present.—*Iron.*

THE NEW STEAM HAMMER AT WOOLWICH.

A stupendous steam hammer newly erected at the Royal Gun Factories, Woolwich, was tried for the first time on Thursday last week, in the presence of the superintendent of the department. At the first trial it moved with the greatest possible ease, and the big steam cranes, on either side, each of which will lift from 80 to 100 tons, swung round with perfect freedom. One of the cranes lifted into its place a huge steam cylinder which is to be employed to lift one of the furnace doors. The enormous power of the new hammer can only be fully realised by seeing it in operation; to say it is the largest and most powerful in the world conveys but a faint idea of its magnitude and capabilities Although it has been described as a 30-ton hammer, the weight of the falling portion is really within a few pounds of 40 tons, and the force of the falling weight is accelerated many times by the use of steam to drive it down from the top. It is estimated that the use of "top steam" is equal to allowing the hammer to fall of its own weight from a height of 80 feet. It has been allowed a striking fall of 15 feet 3 inches, and it has not yet been determined what is the actual force of the blow it will strike. The hammer is 45 feet in height, and covers with its supports a base of about 120 feet square. Above the ground it weighs 500 tons, and the iron used in the foundation below weighs 665 tons It has cost altogether about £50,000, the greater part of which has been paid to Messrs Nasmyth, Wilson, and Co., the patentees and manufacturers.

On the occasion of the trial, one of the furnaces from which the hammer is to be fed was also set to work. It is large enough to make a comfortable dwelling-house, and an omnibus might be driven in at the doorway. The door of this furnace weighs seven tons, and is, as usual, an iron frame filled in with fire bricks, of which it required 1,500 The construction of this furnace has absorbed altogether no fewer than 15,000 bricks, without including the chimney; and the casting of the iron framing and other work connected with the hammer has occupied the workmen of the Dial Square in the Royal Arsenal incessantly for several months. The noise caused by the steam-blast when the hammer was at work could be heard at a distance of two or three miles, but this sound will be absorbed by the use of exhaust boilers.

OVERHEAD STEAM CRANES AT MIDDLESBROUGH DOCKS.

These docks, which have recently been made by the North-Eastern Railway Company to accommodate their greatly increased shipping traffic, possess many points of interest and novelty, prominent amongst which is the system of steam cranes employed.

After careful consideration, on the part of the dock authorities, of the various types of fixed, steam, and hydraulic cranes in general use, it was found that no fixed crane could be kept constantly employed at Middlesbrough, on account of the great variation in the length of the ships, steamers, etc., while, furthermore, as the total area of quay room would be, in the first instance, somewhat limited, the space occupied by a fixed crane would be attended with serious inconvenience. The same objection existed to the adoption of the ordinary construction of portable crane, involving a separate line of rails for them to travel on. There was also the further condition that the cranes must be capable of loading and discharging vessels, the sides of which were fifteen feet to twenty feet above the level of the quay, as rapidly as lighters, which would frequently be twenty feet below the quay level, and that in both cases the driver should have a clear view of his work. Under these circumstances, it was decided to state the leading conditions to various manufacturers of cranes, and invite them to give tenders and prices for what appeared to them best adapted to fulfill these conditions.

The design adopted was that sent in by Messrs. Appleby Brothers, of London; this design, as will be seen from the engraving, consisting of a travelling staging or gantry, on which is mounted a steam crane of the same construction as that sent by the firm to the Vienna Exhibition, and which is in successful use at so many of the docks and harbours in this country and on the Continent.

The travelling staging or gantry of each crane has a span of twenty-three feet centre to centre of rails, one of the latter being laid close to the edge of the quay, and the other in the six feet between rails. The clear height is seventeen feet six inches, which allows the uninterrupted circulation of locomotives, and all kinds of rolling stock on each of the two lines of rails which are spanned by the gantry. The travelling wheels are twelve feet centre to centre. The framing is composed of a pair of timber uprights, braced and strengthened by cast-iron brackets, and two wrought-iron plate girders which are connected to the timber uprights by four wrought-iron plate brackets, strengthened with angle irons. A strong carriage with the necessary roller path and brackets for the gear required to transmit the travelling motion, which will shortly be referred to, is firmly bolted at the extreme end of the girders nearest to the dock, while the girders are planked over so as to form a store for coal and water. The crane and the whole of the superstructure, is designed for a working load of five tons at the maximum radius of twenty-one feet from centre of crane post to the plumb line of the lifting chain, while the crane itself is, as already been stated, of precisely the same construction as those which have given satisfactory working results elsewhere, with apparatus for altering the radius by steam from a maximum of twenty-four feet to a minimum of fourteen feet. The travelling motion is transmitted from the crane engines by suitable gear and shafts to the travelling wheels, and warping drums or capstans are fitted on a counter-shaft on the inner side of each frame, so that these warping drums can be driven independently of the travelling wheels, and they are used for moving the trucks into position below the crane, as they are required for loading and unloading. This simple addition is found to effect a very large saving in manual labour and time, which, it is estimated, amounts to at least £300 per year, because, without this appliance, horses and locomotives must be kept constantly employed, involving working expenses, and wear and tear, in addition to the maintenance of the road, whilst with the capstans the trucks are brought into position by the men employed in stowing and slinging, with no further wear and tear of road than that due to the paying load. As it was decided to adopt this system of crane throughout the dock, the two lines of rails spanned by the gantry are laid with crossings at such intervals as will admit of either line being used for full or empty trucks, or in fact partially for both purposes if desired.

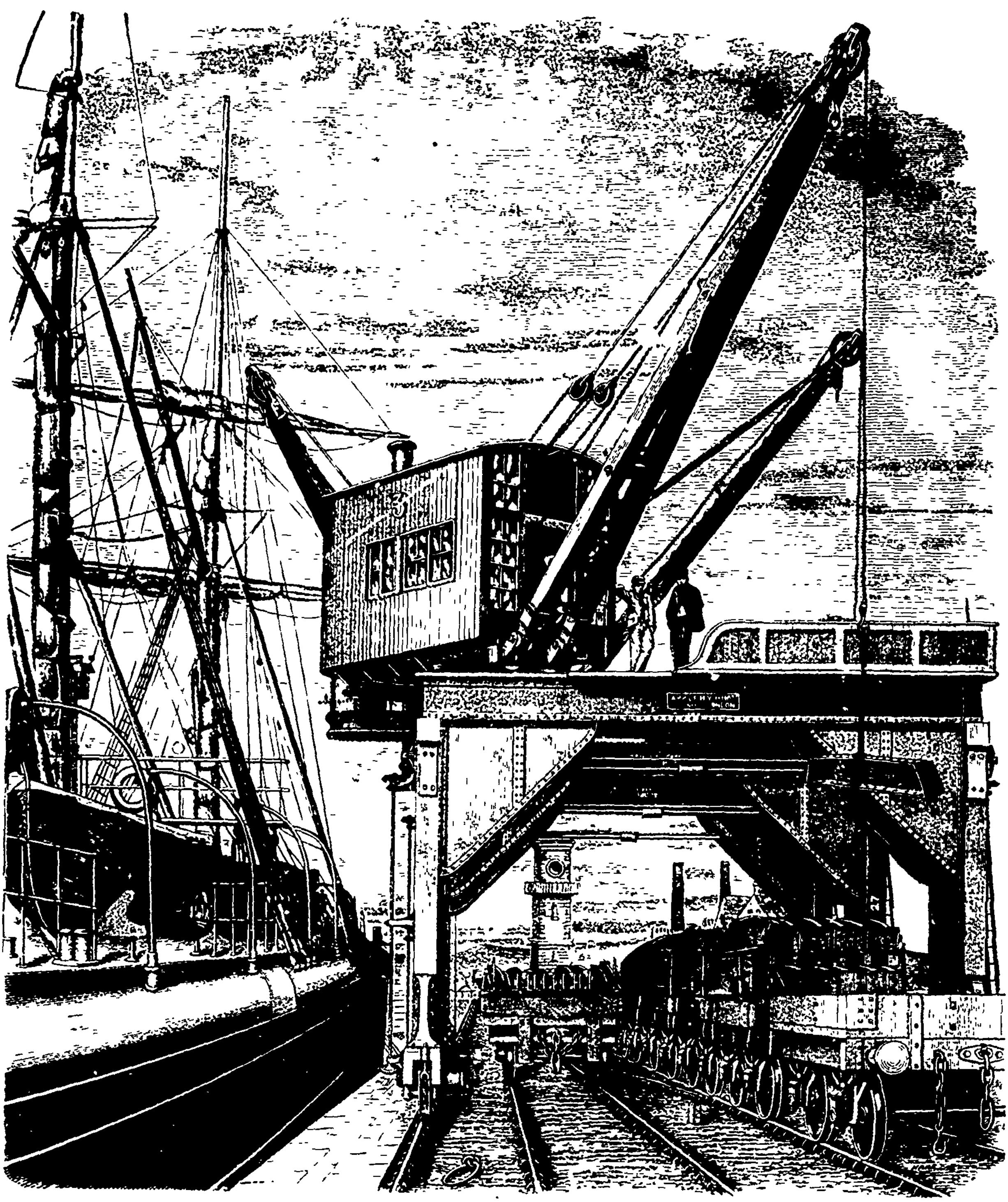
Another great advantage which has been demonstrated by practice is, that the cranes can be so readily concentrated at any point where they may be required, and, indeed, as is shown in the engraving, three of these cranes are brought to load a long screw steamer having three hatchways; this is evidently a most important consideration with owners and shippers, especially under circumstances which so frequently arise where great dispatch is essential. Or two cranes can be brought together for any exceptionally heavy lift. The cranes were tested with the maximum working load of five tons, and subsequently for speed, when each delivered fifty tons per hour from the trucks into the steamer's hatchway.

The arrangement we have described may be modified with advantage, under some conditions, by making the crane portable on its gantry, so that it will travel from end to end, all the other motions being retained, the travelling motion in that case being transmitted through a square shaft with tumbler bearings. This construction is especially valuable for use on a jetty where vessels lay on each side; to suit these conditions the gantry is made to span the whole width of the jetty, and to travel over the ordinary lines of rails and roadway. Another modification of the system consists in having the crane fixed on an ordinary overhead traveller gantry, or it may be made to travel across the gantry; in such a case the fixed staging may be constructed of square timber, or of columns and girders; this class of travelling crane has been rather extensively used in the construction of public works and large buildings.

It might at first sight appear that the road to carry these cranes must be of unusual strength, but on further consideration, it will be seen that this is not absolutely necessary, because the base obtained is so large that there is comparatively little strain on the road; in fact, probably no more than on a line of rails of the ordinary gauge, carrying a portable crane of the usual type, working the same loads at the same radius. Several of these cranes have been in successful operation for some time past, and a number more are in course of construction for the Middlesbrough docks.

The system evidently has great advantages under the condition above-named, as well as for working in crowded railway stations, or in stone quarries, timber yards, etc., and it appears singular that an arrangement at once so simple and efficient, should, until now, not have been brought into more extensive use, especially for dock and railway traffic.

Coal Mines in China.—Some information is given upon this subject in an official report upon the trade of Tamsuy, including Kelung, where coal abounds in great quantities. The system of working these mines—as indeed Chinese mines generally—is exceedingly primitive and imperfect. Places where the mineral is observed cropping out of the hill-side are selected, and an opening 5 ft. high or more by 2 ft. wide is driven horizontally for a distance of some forty yards, terminating in a central chamber, from which workings 100 yards or more in length radiate in a direction which usually inclines slightly upwards. In these workings, which in many cases can only be entered on all fours, the miner carries on the work of excavation, squatting in mud and water, and breathing a most foul atmosphere. One mine usually employs about twelve or fifteen miners, who earn wages equivalent to 1s. 6d. a man per diem, which is an extremely high rate in China. The usual length of a day's work is about eleven hours. The miner is armed with a pick shaped like a sledge-hammer with one head pointed and weighing about 6 lb. The length of the iron head is about 8 in., and of the wooden shaft 2½ ft. The miner's lamp is a saucer of oil with a rush wick laid into it. The coal is drawn along the pit floor to the mouth in a basket about 3 ft. long, fastened on a board with a rattan cord attached by which to haul. Occasionally the board is fastened on rollers, and travels on planks laid down for the purpose of forming a rudimentary tramway. In consequence of the imperfect tools employed great waste occurs through so great a quantity of the coal being reduced to a powder. The ventilation of the mines is left to itself, and it is stated that no system of pumping out the water is employed. The water runs out at the mouth of the mine, and in cases where the galleries take a downward direction, the only resource left is to abandon the working when the water excessively accumulates. Fire-damp is unknown, but accidents often happen in consequence of the side or roof falling in, which from the insufficient way in which they are secured is almost inevitable.



OVERHEAD STEAM CRANES.—(See page 385.)

Generally speaking, it may be assumed that the coal-working at Kelung is little more than a scratching of the surface, and that the real coal-beds may be considered to be practically untouched. The Chinese Government rather put drawbacks in the way of these mines than offer facilities for their working. The owner of land which contains coal is not permitted to open a mine without previously obtaining the sanction of the authorities, which involves great delay and expense, and is after all usually refused. As to the introduction of machinery for the better working of the mines, the proprietors have not sufficient capital to purchase such machinery, nor do they wish to do so. Supposing, however, that they were both able and willing, it is stated that such an innovation, accompanied as it would be by the employment of foreigners, would be the immediate signal for the closing of the mines by the Mandarins, and the not improbable loss of the proprietor's head. The quality of this coal has been favourably reported upon by competent engineers, and it is stated, in fact, on good authority that for household purposes Kelung coal has no superior