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The Canadian Patent Office Record and Mechanics' Magazine

Vol II.—No. 9. DECEMBER, 1874. Price in Canada $2.00 per An.
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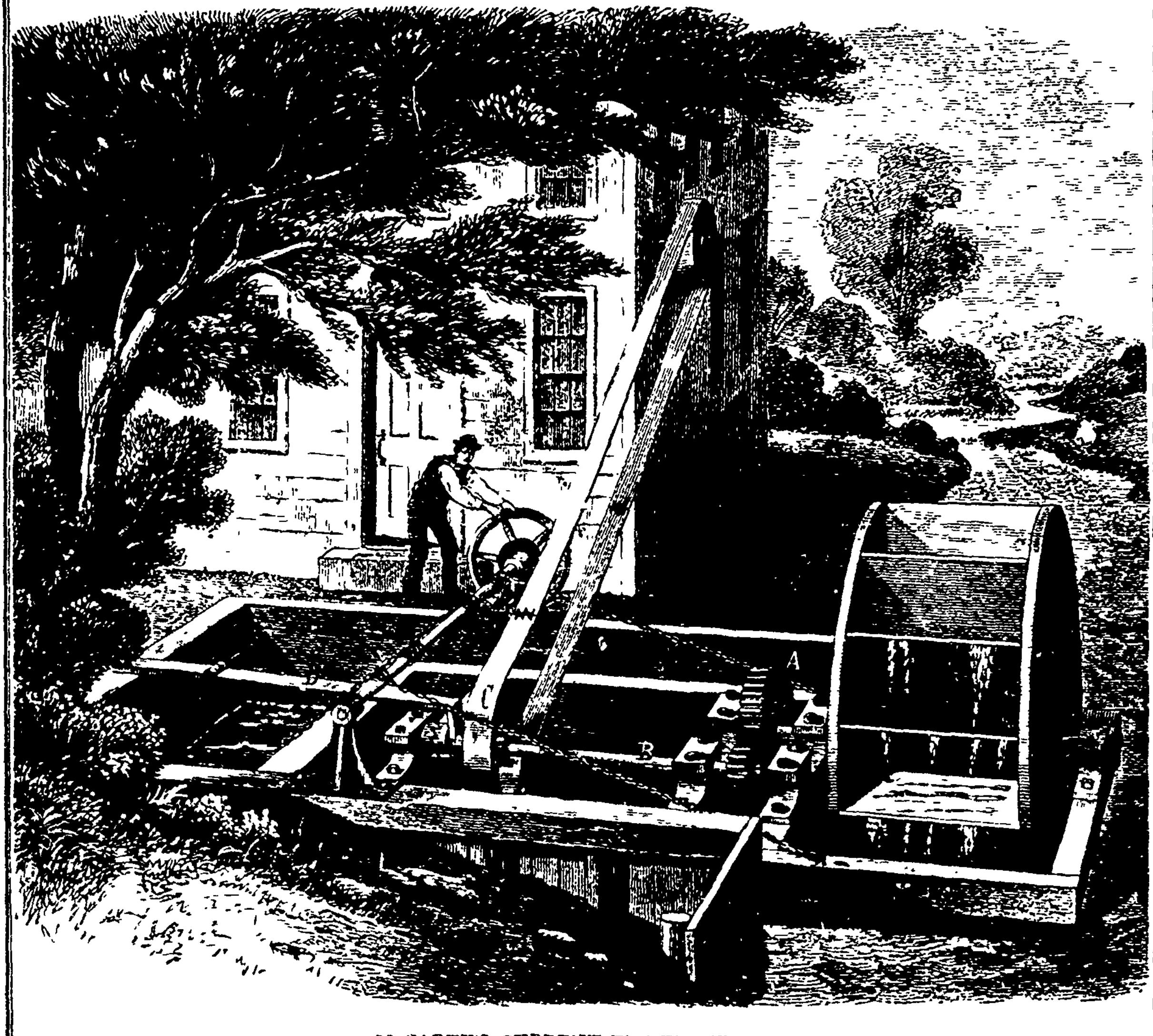


McCARTY'S CURRENT WATER WHEEL.

IMPROVED CURRENT WATER WHEEL.

The means of utilizing the power afforded by the current of a river, where sufficient fall cannot be obtained to run a turbine wheel successfully, have been brought to comparative perfection within a few years by the improvements which have been made in this class of devices. Necessarily, where even the best form of current wheel is used, the application of the power of the stream is made in but an imperfect degree as regards economy, a large proportion of it running to waste, and only the effect of the water directly in contact with the wheel being gained; but as no other expense than that of constructing and setting the wheel is incurred, the investment is often a very profitable one. To obtain all the power which the volume of water in the stream would afford would require the building of a dam, and consequently the employment of capital, frequently to a very liberal extent, in securing the primary facilities for doing business; and where the capital is not at command, or a large business is not contemplated, an ample return may be realized on a moderate investment by putting in a current wheel of the most approved construction. Such a wheel is illustrated in the engraving on the preceding page, which shows a basin made in the bank at right angles with the stream, its sides being protected by planking, for which stone may be substituted if cheaper or more convenient. In this basin floats the raft which carries the wheel, the frame of the raft being so made as to balance the weight of the wheel. The basin or slip is dug deep enough to float the raft and wheel at low water, and extends into the bank a distance equal to the length of the whole apparatus, which may thus be drawn back entirely out of the current. This is a point of special value, as by means of this arrangement the wheel and raft can be withdrawn out of reach of drift wood and thus be protected from injury when the stream is swollen by heavy rain or melting snows.

The wheel, which is an undershot, is shown projecting into the current and in operation, its motion being communicated through the gearing A, to the horizontal shaft B. On this shaft slides a loose pulley, C, having on the left hand side of its hub an annular recess and a clutch, by which, when desired, it is engaged with the shaft B. The annular recess receives one end of the shipper lever D, the other end of which is made fast on the bank, and by means of a hinge the lever is rendered adaptable to the position of the raft at any stage of water. The shaft E, which is rotated by a wheel at one end as shown, has chains wound around it, leading to the opposite ends of the raft; and thus, by turning the wheel toward the bank, the raft is drawn in, while by turning in the other direction it is moved out into the stream. When the raft is run out, the wheel is held in position by a pawl which drops into a recess in the shaft E. The rollers F, on the sides of the raft, only one of which is shown in the engraving, facilitate the moving of the raft by their contact with the planking of the basin, preventing the friction which would result from the raft being forced by the current against the side of the slip.

It will be seen that when the raft is moved out, the lever D will draw the clutch into action, and the motion of the shaft B, received from the water wheel, will be transmitted through the loose pulley, C, and its belt to the machinery of the mill. On the other hand, when the raft is drawn in, the lever D, remaining rigid, will push the parts of the clutch asunder and the loose pulley will cease to turn. By this arrangement, the same appliances by which the raft is moved in and out serve to regulate the transmission of power and the starting and stopping of the machinery.—*Scientific American.*

THE *Builder* has the following: Many have seen working on the Thames a steam dredger, named the *Sampson*, with an endless chain of laden buckets rising at a low level and disappearing at a higher altitude. The *Sampson* of the Thames has, it seems, been moored at Hartlepool, and as it works by tide Sundays are perforce called in as working days. Miners are an inquisitive body of men, and on their leisure day a number watched the *Sampson's* buckets go up and down, and tried to count them. Having reached 1,000, they gave up their task, exclaiming, "Sampson was a strong man, but, by gum, lads, he never lifted so many buckets of mud as this fellow, and kept at it as he does; when will the last bucket stop, eh?"

PROF. FLEEMING JENKIN ON PATENTS AND THE PATENT LAWS.

At the University of Edinburgh, on Nov. 3rd, Prof Fleeming Jenkin delivered to the Engineering class a lecture on Patents and the Patent Laws, of which the following is an abstract:—

In the outset he referred to the vulgar error that a man of mere native shrewdness could make some great discovery in a branch of engineering of which he knew nothing practically or theoretically. Yet a whole tribe of patentees, miscalled inventors, really did exist, who believed that they had almost fortuitously, without effort to themselves, picked up some great nugget which must have lain staring in the face of the practical workers of the ground for years. Two classes of men made valuable inventions, the men who by practical experience in a given manufacture knew the defects of existing mechanism and the requirements of some special manufacture, or the men whose theoretical knowledge of a subject was such that they could understand the conditions of success in a machine or manufacture better than those who had a mere practical acquaintance with the subject. There was a popular idea that if patents cost only a few shillings the poor inventor would be greatly benefited. He thought the cases were very few where an invention of real merit was lost to the inventor in consequence of the expense of a patent. If a poor man could not persuade any one to invest the cost of a patent in his idea, he would certainly find it equally difficult to induce men to invest money in experimental manufacture after he had secured the patent. The real difficulty was the want of money to introduce the invention in most cases, and this difficulty did lead poor men who had valuable patents occasionally to part with them for a price disproportionate to what was ultimately found to be the value of the invention. No doubt, if these men paid less for their patents they would have more money left for experiments, but, on the other hand, it must be remembered that cheapness would lead to the vexatious multiplication of trifling and dishonest patents, and this led to the consideration of the grounds on which patents were granted by the State.

Patents were not granted as rewards of merit, but purely on grounds of public utility. The State followed the simple principle of paying for results, either actual or in prospect. A monopoly for a limited number of years was offered as an inducement to make inventions, to disclose them, and to apply them. All who wished that the patent laws should remain in force ought to contend that without this inducement men would invent less and carry out fewer useful inventions. If they could not persuade the Legislature of this, patent laws would be abandoned, for it was certain that the restrictions they imposed caused some hindrance to the improvement and extension of manufactures. There were many trifling improvements which manufacturers would adopt if they had to pay no royalty, but for which they refused to pay a penny while the patent lasted. The sum of many trifling improvements would often be equivalent to a single great improvement, and by preventing this, patents injured the community. Moreover, many patents were taken out for trifles which were certain to be reinvented by dozens of men as soon as the want for the article was felt. Whenever a manufacturer was stopped by a previous patent from carrying out some little improvement of his own, he began to consider as monstrous the proposition that a man should have a monopoly in an idea merely because he thought of it first. These were excellent arguments against granting patents for trifling or obvious improvements, and these vexatious patents would be much multiplied if their cost were lessened, but they left quite untouched the reasons for granting temporary monopolies of really valuable inventions. The mere publication of an idea was a very different thing from the introduction of a successful invention. It was a mistake to think that when a valuable idea was published capitalists and engineers flew to seize it, and struggled fiercely as to who should have the honour and profit of carrying it into effect. Perhaps if Watt had published the idea of a separate condenser in a scientific journal and stopped there, we might have been without our present form of steam-engine to this day, but if this be thought too daring an hypothesis he (the Professor) could nevertheless insist that the inventor of any invention, however excellent, had to force it upon the public at much expense and much labour and vexation. Very few men indeed would risk money, time, and peace of mind in the struggle but for the hope of a solid reward, and here lay the real justification of the patent laws. They were at liberty to feel some satisfaction at the fact that they did in some cases give a solid reward to men who deserved encouragement, and no one could dispute that the laws, if existing at all, ought to be so framed as to give the greatest chance of a reward to the meritorious.

It was important to every engineer to consider whether the existing laws could be amended, and if so in what manner, and the question was specially interesting now, as there was a rumour that the present Government intended to legislate on the subject. Having stated that in his opinion the existing regulation, by which provisional protection might be had for a moderate sum, was quite free from the objection to making the patent itself too cheap, while it enabled inventors to draw up accurate and complete specifications, the Professor went on to say that the following were the chief reforms in the actual laws which were popularly suggested:—1. That patent cases should be tried by some special tribunal. 2. That patents should only be granted after the Crown had in some manner tested the novelty and importance of the invention 3. That patents should not remain valid unless worked within a certain time. 4. That the rewards for successful inventions should be paid by Government instead of being earned in trade. 5. That the scientific witnesses should be appointed by the tribunal trying the patent case, and not chosen by the two parties to the suit. None of these suggestions, he continued, cut very deeply into the existing laws, but aimed rather at better modes of ascertaining whether a patent was valid or not. They pointed to the following defects in the present method of ascertaining this validity:—1. That the Court sometimes really could not understand the patent, the issues or the witnesses, 2. That patents were often granted for so-called inventions which had been previously patented or disclosed; 3. That patents were often used as mere traps to catch those who really introduced an improvement; 4. That the rewards or profits from patents seemed often to bear a very false relation to their real value, and 5, that scientific witnesses became partisans. All these were real defects, but some of them had roots so deep in the nature of things, that no change of law would much disturb them.

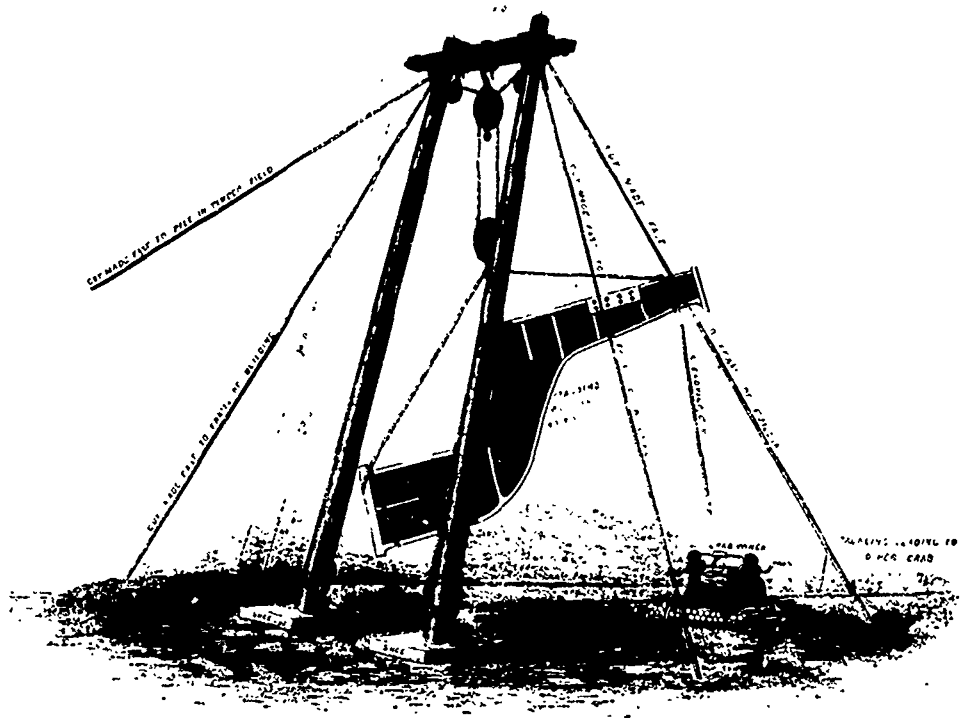
After discussing at some length the proposed reforms and the defects aimed at, the Professor summed up his opinions as follows.—The patent laws should be maintained and need not be greatly modified, that any tribunal or referees appointed to consider the novelty or utility of an application for a patent should only have power to give an *opinion*, and should not be allowed to *decide* whether the patent was novel or useful; that patents need not be made cheaper; that the nominal position of the scientific witness should be made to agree with his real position, and that the reward of the inventor should depend on nothing but the commercial success of the patent.

THE WOOLWICH 35-TON STEAM HAMMER.

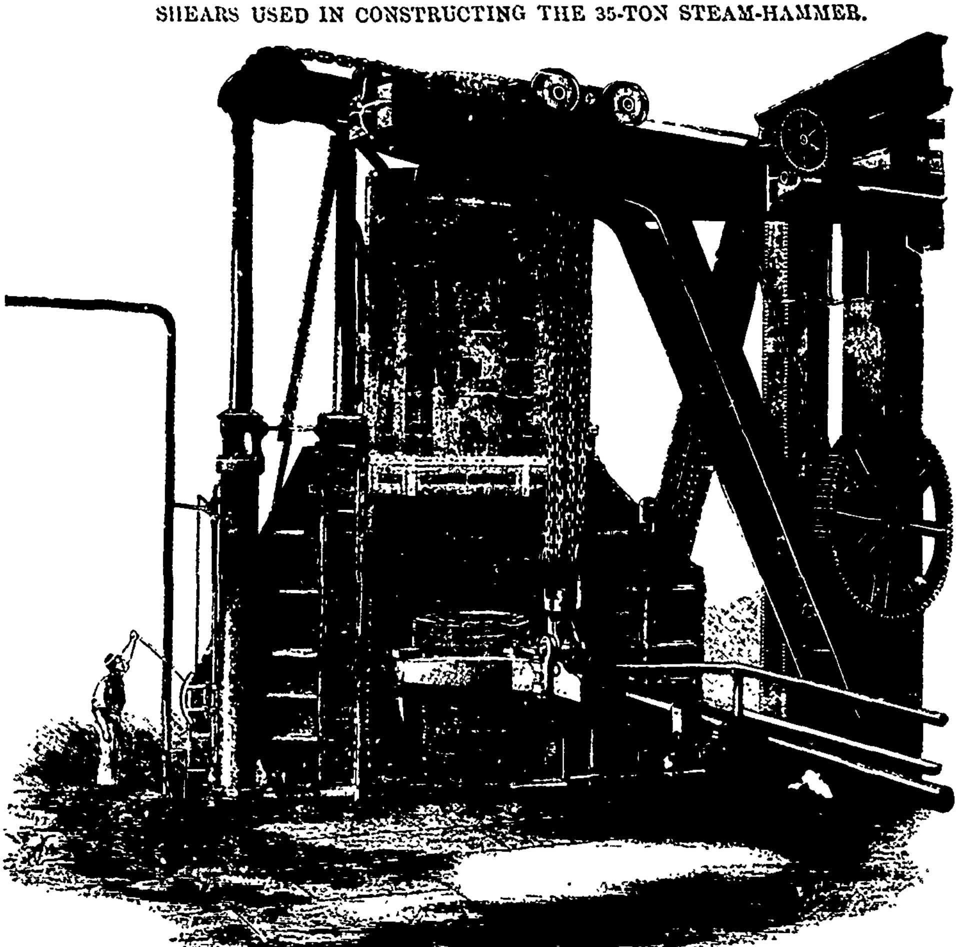
The erection of the 35-ton Nasmyth's steam hammer itself which although performed under the supervision of a representative from Messrs. Nasmyth, Wilson and Co., was nevertheless actually conducted by foremen and artificers of the Royal Gun Factories in the Arsenal at Woolwich, exhibited many points of interest in the contrivances by which it was effected It was an undertaking of some magnitude, as the entire height of the hammer was over 45ft., and it was necessary to raise the various portions, several of which weighed 11 tons each, to a still greater elevation in order to get them into position. A gigantic pair of shear legs was constructed by Mr. Mehew for this purpose (see page 260.) It consisted of two carefully selected fir-poles 74ft. long, having the bottom ends rounded and working in sockets in two large moveable wooden "shoes." The shoes could be shifted about to any required position, but were retained at a normal distance apart of 20ft Near their summits two stout cross-pieces of timber were made fast on either sides of the poles, supported by means of wrought iron bands drawn tight with bolts and nuts, and pins running through the poles beneath. The bands and pins admitted of a certain amount of lateral play between the poles and crosshead. The poles were 16ft. asunder at the crosshead A large block and tackling which had been expressly constructed for lifting portions of the foundations for the 10-ton steam hammer in the gun factories were suspended from the crosshead Two snatch blocks were then secured at each corner of the crosshead above, and two others at the bases of the poles A strong rope being rove through one of the lower snatch-blocks, it passed through the upper corresponding one, thence through the large block and down to another attached to the portion of the hammer required to be lifted, afterwards ascending again through the large block and passing down the second leg of the sheers Both ends of the rope were made fast to crab winches, round which they were coiled. Thus when the cross strain of lifting up the weights came upon the sheers it was counteracted by the tension of the ropes down each leg, that necessarily tending to steady the legs. There was, of course, a tendency to pull the feet of the sheer legs with their shoes out of position, but this was easily overcome by attaching the legs at the bottom to portions of the foundations already fixed in the ground. A baulk of timber placed between these effectually prevented all shifting of the legs Four guy ropes or stays were attached to the poles and crosshead at their point of junction to steady the sheers. One of these was secured to a pile of baulks in the adjacent timber field, whilst the remaining three were attached to various parts of the surrounding buildings. But the strain upon these was very trifling, for the angle which the sheer-legs made with the perpendicular was so slight that when the weight came on them it acted almost in the direction of their length. Hence a means was arrived at for manipulating the huge limbs of the steam hammer, and depositing them in any required position, of the simplest possible character. By loosening and tightening the side guys a lateral movement was obtained, the crosshead admitting of this; and by performing a similar operation with the two back guys, a forward or a backward movement was secured. There were, of course, steadying guy ropes to prevent the castings swaying about. Our engraving shows the plan adopted, as applied to the lifting of a standard weighing upwards of 10 tons. The crab winches were kept in position by being loaded with pig iron, and by being chained to contiguous parts of the building.

The furnaces for the new hammer are of the ordinary reverberatory character, but of quite unprecedented size, in order to contain the enormous forgings which are required to be raised to the welding heat in them. Only one is actually finished and in working order; the second is in course of rapid completion. They possess at the same time certain peculiarities of construction which will be described in due course. They are each built upon a block of concrete 4ft. thick, laid in an excavation dug out for it, and having large slabs of cast iron placed upon the top, so as to distribute the pressure evenly throughout the whole mass. Upon these slabs a series of cast iron standards is erected for the floor of the furnace to rest on, four rows of standards being beneath the hearth, where, of course, the greatest weight, that of the "heat," comes. The hearth has four strong cast iron girders around it, forming a square frame above the standards; and the bottom of the hearth consists of thick cast iron slabs It is sunk about 1ft, so as to admit of a deep bed of fettling being formed within it upon the iron slabs. Girders also run along the sides of the furnace floor for the wall-plates and brick side linings to be built on. These girders rest upon the standards before alluded to. The end walls are built upon large cast iron cross-beams, which are perforated transversely with holes and grooved longitudinally to prevent their twisting and buckling with the heat. The two side walls of the furnace, and one end wall—that over the fireplace—are constructed externally of light plates of cast iron —see page 260—with flanges at the edges to connect them, and ribbed on the outside for strength.

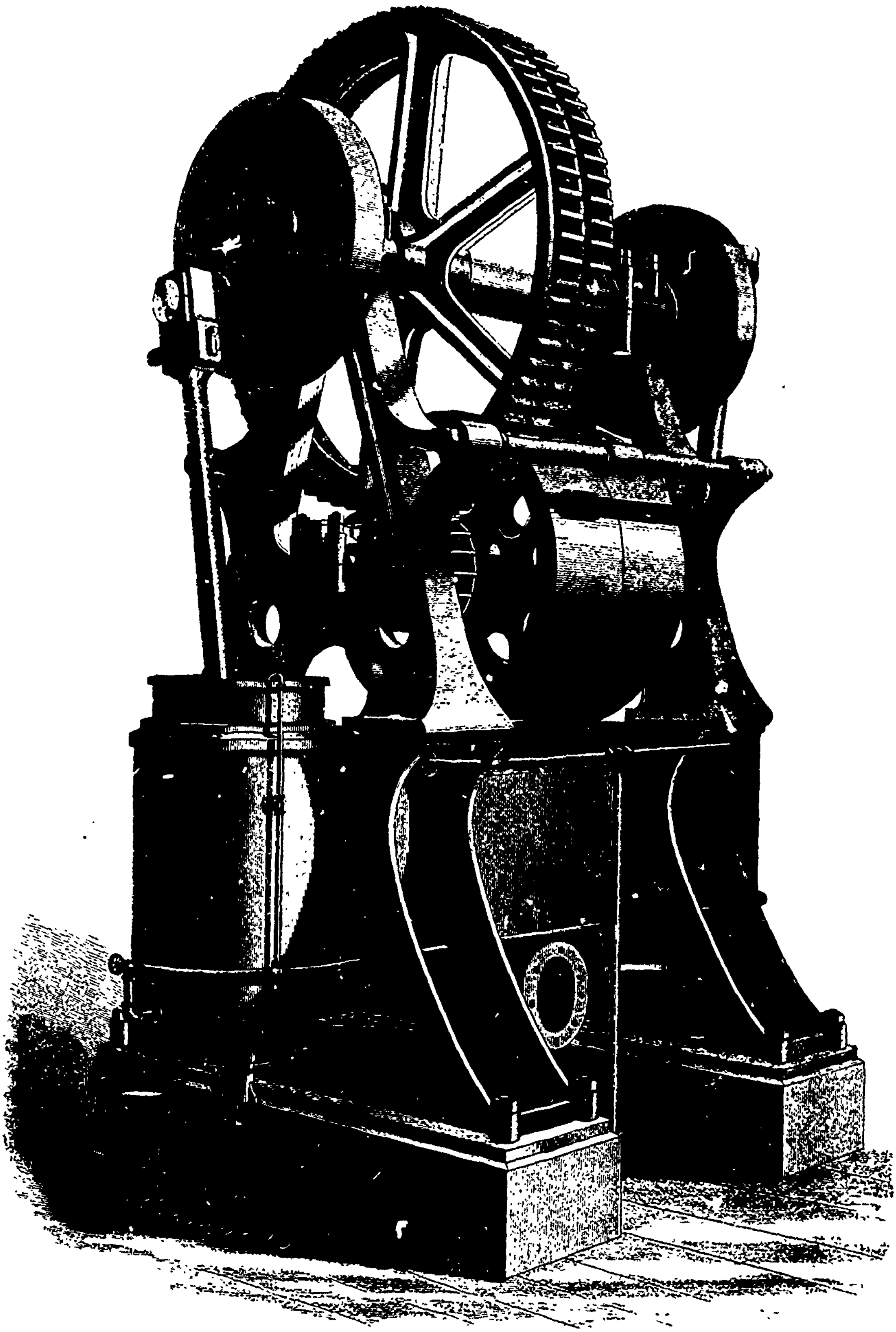
PERTH, Dec 19.—The engineers of the Huron and Quebec Railway are making rapid progress in the survey of the line from Perth, via Franktown and Richmond, to the city of Ottawa It will be an air line for over thirty miles, the greatest cutting being not over five feet. Mr. Fowler, Managing Director, accompanied by Mr. Strong, engineer, carefully examined the line to-day. Nothing will prevent the work being commenced at Perth, east and west, during January or February, and completed to the Kingston and Pembroke Railway in time for the next Provincial Fair at Ottawa. A survey has been made from Perth to the Kingston and Pembroke Railway, in the township of Oro.



SHEARS USED IN CONSTRUCTING THE 35-TON STEAM-HAMMER.



COAL FURNACE, ROYAL GUN FACTORIES, WOOLWICH ARSENAL.



IMPROVED AIR COMPRESSOR.

IMPROVED AIR-COMPRESSORS.

CONSTRUCTED BY THE DELAMATER IRON-WORKS, FROM THE DESIGNS OF MESSRS. REYNOLD AND FISH.

The use of compressed air as a motive power is destined to receive an enormous development as its capabilities and advantages become better understood. What countless wealth is thrown away in the unheeded falls of our rivers and the flow and ebb of the ocean tides, simply because few consider that the power thus wasted could be conveyed to almost any distance, at very trifling cost, by means of compressed air or rope transmission! As long ago as 1837, a series of experiments was made in Coscia, by order of the Italian Government, to determine the resistance of tubes to the flow of air through them; it was found that:

1. The resistance is directly as the length of the tube.
2. It is directly as the square of the velocity of the flow.
3. It is inversely as the diameter of the tube.

And as the volume is directly as the square of the diameter when the velocity is given, it follows that, under a given pressure and velocity, the relative resistance — that is to say, the resistance divided by the power — will vary inversely as the cube of the diameter.

There is, consequently, a great advantage in making the tubes and openings through which the air has to pass as large as possible. Experience has shown that tubes can be made so as to allow of very little leakage. At the Mont Cenis tunnel no leak was ever found in tubes nearly a mile and a half in length, nor did the expansions and contractions of the tubes, due to changes of temperature, appear to affect sensibly the firmness of the joints. On one occasion it became necessary to leave the receivers full of compressed air for twenty-four days; the loss in all that time did not exceed $\frac{5}{1000}$ part of the daily supply.

It is therefore possible to transmit power by compressed air to very great distances with scarcely appreciable loss in its transmission. There is, however, a much more important source of loss than that just mentioned. When air or any other elastic fluid is compressed, there is generated an amount of heat which is the exact equivalent of the force employed in the compression. This heat, in practice, is radiated from the compressor, the reservoir, and tubes, and is lost; when the compressed air has attained the same temperature it possessed before compressing, it has lost in cooling exactly as much power as was expended in compressing it; but since the air still remains under a considerable pressure, if allowed to expand, its temperature falls below that of the atmosphere, and in so doing it develops work, but, inasmuch as the temperature in expansion will not be depressed nearly as much as it was increased in compression, the loss of work will always be considerable, increasing with the pressure to which the air has has been subjected; this loss is moreover susceptible of exact calculation. Taking the case of the Mont Cenis tunnel, where a pressure of six atmospheres was attained, the air, instead of being compressed to one-sixth of its volume, as would have been the case were no heat generated, actually entered the reservoir when its volume had been reduced but 3.6 times, and theoretically, the power available would have been but 60 per cent of that expended; practically, it was somewhat less than this. If the air were compressed to eight atmospheres, there would remain available but 55 per cent., and for about eleven atmospheres of compression but 50 per cent. of the compressing power could be obtained. If the compression is less, say four atmospheres, 67 per cent. would be secured, to three atmospheres 72 per cent. would, according to theory, be available, and so forth; hence we see that where the lower pressures will perform the work to be done, and will not necessitate the use of extra large and costly engines to utilize the power, there is an evident advantage in not using a very high degree of compression.

To this loss of power, practically inherent in compressed air, we must add the loss due to its transmission through tubes, this, where the pressure is not excessive and where the velocity is reduced by the use of large tubes, is a much smaller item of loss than the other; it would not be over one-third or one-fourth of it, and in carrying the air through say 10 to 15 miles of pipe would not exceed say 5 to 8 per cent.

As we have stated it is impossible, under ordinary circumstances, to utilize more than say 50 to 60 per cent. of the power expended in compressing the air, yet, from the fact that compressed air enables us to carry at a small cost the power wasted in waterfalls to points where it can be used with advantage, the loss of 50 per cent. in the motive power is a small matter, and the actual power obtained would cost, in general, much less than if generated with our most economical steam-engines.

The use of compressed air for driving underground machinery, whether it be hoisting-engines, rock-drills, coal-cutters, or other machines, is peculiarly advantageous, for it provides a valuable addition to the ventilation of the mine and reduces the temperature, which in deep mines is so excessive. It can be carried to much greater distances than steam, which, moreover, is very destructive to mine-timber.

One of the chief reasons for the limited application of compressed air to the transmission of power has been the complexity and mechanical defects in the compressing-machines. These defects, however, are being overcome as the attention of our engineers is directed to the subject, and the application of compressed air for the transmission of power will undoubtedly receive an immense extension from the simplification of these machines. We present to our readers on page 261 a cut of one of the most compact, simple, and practical of our air-compressors.

It can be driven by means of a water-wheel, wind-mill, steam engine, or other motor. It occupies a space of but 10 feet 6 inches by 6 feet, 4 inches on the ground plan, and 11 feet, 3 inches in height. The air-compressing cylinders are 20 inches in diameter, 24-inch stroke, and, in this particular machine are driven by a 14-inch belt on a 42-inch pulley, making about 60 revolutions per minute. The air-pistons are trunks connected to the crank-pins by connecting-rods three times the length of the stroke. The cylinder casings, tank, bed plate and housing-brackets are all cast in a single piece, making a very simple and substantial structure. The crank-wheels are turned and balanced; the crank-shaft, which also carries the large spur-wheel, is of wrought iron 7 inches diameter. The teeth of the spur are of small pitch, but are strengthened by a shrouding on each side and by one in the middle, making really two wheels in one casting.

One of the most important features in this compressor is an ingenious contrivance of Messrs. Reynolds & Fish, by which the air-discharge valve drops from its seat as soon as the pressure in the receiver exceeds that for which the weighted lever is set. This puts the compressing cylinders in direct communication one with the other, so that instead of the engine being strained by the full pressure of the steam, and making a useless expenditure of work, the work done is simply moving the pistons back and forth freely in an atmosphere compressed to the same degree on each side of the piston.—*American Artisan.*

HOW TO SEE STEREOSCOPIC PICTURES WITHOUT A STEREOSCOPE.

The ability to see binocular pictures in stereoscopic relief is twofold in its bearings. First: a photographer can examine properly mounted pictures with the unassisted eye with as much pleasure as though he were using a stereoscope, the effects of nearness and distance will be quite as thoroughly appreciated, and, as a whole, the advantage will equal that obtained by proper stereoscopic inspection, keeping out of sight the enlargement obtained by the examination through the eye-piece, the function of which, in this case, is to enlarge pictures as well as to diverge the rays coming from them. Incidentally arising from this is the possession of a power of being able instantly to detect a pair of pictures which have been wrongly mounted. Some time since a well-known wholesale dealer in stereoscopic slides in London was very much surprised when, upon bestowing what he supposed to be a mere cursory glance at a number of stereoscopic pictures sent in for selection by a photographer, we threw a number aside as being unsuited for sale on account of improper mounting, and this gentleman also marvelled when, upon testing each of these condemned pictures in the stereoscope, he found that in every one of them the effect was pseudo-scopic, the near objects being shown as the more distant ones.

Before giving directions with respect to the method by which the eye may be so tutored as to readily discern between the one and the other, we may observe that, if a print from a binocular camera negative be placed uncut in the stereoscope, the effect will be pseudo-scopic that is, relative positions of near and distant objects will be reversed; but, if a print from a negative taken by what is known as a "Latimer-Clark" camera be examined, it will be found quite correct. In the former case the right eye is made to examine the picture intended to be, and which should have been, opposite the left eye, and vice versa. Here is a simple rule to observe:—If the slide holding the sensitive plate has been motionless during the taking of both sides of the picture or during the impressing of both ends of the plate, then the images must be transposed before they can be seen in stereoscopic relief. We are now assuming that ordinary instruments have been used, and do not intend our observations to apply, in anticipation, to other reflecting instruments which might easily be invented, and nearly as easily made, for the purpose of controverting the rule.

But a second advantage arises—and that not merely the ability to discern between correctly and incorrectly mounted pictures and of seeing *both* in stereoscopic relief, but one of which we have frequently found the value when the binocular camera was directed to a view—we allude to the power conferred of seeing upon the ground glass of the camera the precise effect, as respects stereosity, which will eventually be produced. In the course of our experience we have met with very few who were fully alive to this great advantage, or who, being alive to it, could adequately realise it in their own practice. Yet it is true that by a slight optical effort both the images thrown on the ground glass by the lenses of the cameron can be resolved into one, and that image possessing all the relief to be found in nature.

We now come to the means to be employed by which such effects may be secured; and, first of all we shall suppose the case of a person desirous of learning how to see in proper relief a correctly mounted picture.

The first attempt must be made by means of a diagram. Upon a sheet of plain white paper let two simple ink marks, dots or crosses, be made close to the under margin, and about an inch apart. Now, upon another sheet of white paper place any kind of ink mark, and place it at a distance of eighteen or twenty inches from the eyes. Now hold the former paper in such a manner as that it shall be about halfway between the eyes and the other paper, the marks being at the top and the position such as merely to allow the single mark to be seen and no more; in short, so that the two marks on the one sheet and the one mark on the other shall be nearly in a line. Then look intently at the single, or more distant mark, and while doing so, the mind will soon become conscious of the fact that there are *three* crosses or marks now visible upon the nearer paper, which, by the way, may be moved in or out from the eyes till these conscious images coalesce. By a little effort the eyes can soon be diverted from the contemplation of the distant mark to the central one of the three which intervene, and which lies directly in the path of the distant mark.

When after a little practice this can be easily done, then make two marks a little farther apart than those upon which the first attempt was made, increasing, if need be, the distance between the eyes and the sheet containing the single mark. After ten minutes spent in this mode of practice such an amount of control will have been acquired over the muscles of the eyes that a binocular photograph many then be made to take the place of the double-image diagram. But this photograph should be carefully selected, it must have strong leading characteristics, and, above all, its halves must be mounted nearer to each other than is usual. It will be better for the student to select a well-marked picture, cut it through the middle, and make it overlap so as to bring its elementary parts closer together Treat this picture as was done with the diagram. Let it be held up, at a distance of about eighteen inches, against a sheet of paper containing a mark which is more than twice as far from the eyes. Direct the eyes towards the mark and they will imperceptibly observe that there are *three* photographs intervening between the vision and the image. Now without any effort let the eyes be insensibly directed toward the central one of the three pictures, and the instant this is effected the picture stands before them in all the relief of nature, being composed of both the original images We shall not here enter into the philosophic bearings of the act; all we notice is the fact.

When the foregoing effect has been obtained, the eyes will ever afterwards obey the will, and by diverging the axes slightly or, to state it more correctly, by rendering them parallel, stereoscopic pictures may be seen in all their marvellous relief without an instrument.

The converse of this is more easy. The pictures, which must be reversed, are placed directly opposite the eye at a distance of about eighteen inches, and an object of small dimensions, such as a pencil, held between the eyes and the pictures in such a way and at such a distance that when the right eye is directed to the left picture it shall intercept it to some extent, doing the same thing when the right-hand picture is viewed by the left eye. In this position, examine the pencil attentively, and the mind will soon realise the fact that there are three pictures in the background, the centre one of which may, with little effort, be made the subject of examination by the eyes. This method differs from the former, inasmuch as the axes of the eyes converge to such an extent as to cross between the eyes and the picture. No pain or peril whatever to the organs of vision results from the proper examination of images in this manner, although, like everything else, the power is capable of being abused.

NEW PROCESS FOR RENDERING GLASS HAIL AND FIRE-PROOF.

The *Salut Public* of Lyons gives an account of some experiments that have lately been made with a view to testing the value of a process, invented by M. de la Bastie, a manufacturer of Bourg, for strengthening glass so as to render it not only hail-proof, but also to resist the effects of fire and accidents.

These experiments were carried out at the railway station of Point d'Ain at the request of the authorities of the railway company, in order to satisfy them of the value of this invention, which naturally would be of the highest importance to them, were it possible to render less liable to breakage the glass roofs, the repairs of which form a serious item in the expenditure of railway companies.

A sheet of glass 6 millimetres in thickness, held in a wooden frame, was placed on the floor of the room, and a brass ball weighing 100 grammes was left fall on it, from a height which was gradually increased until the glass was broken by the shock. It was found that falling from a height of 24 centimetres the glass was shattered by the ball.

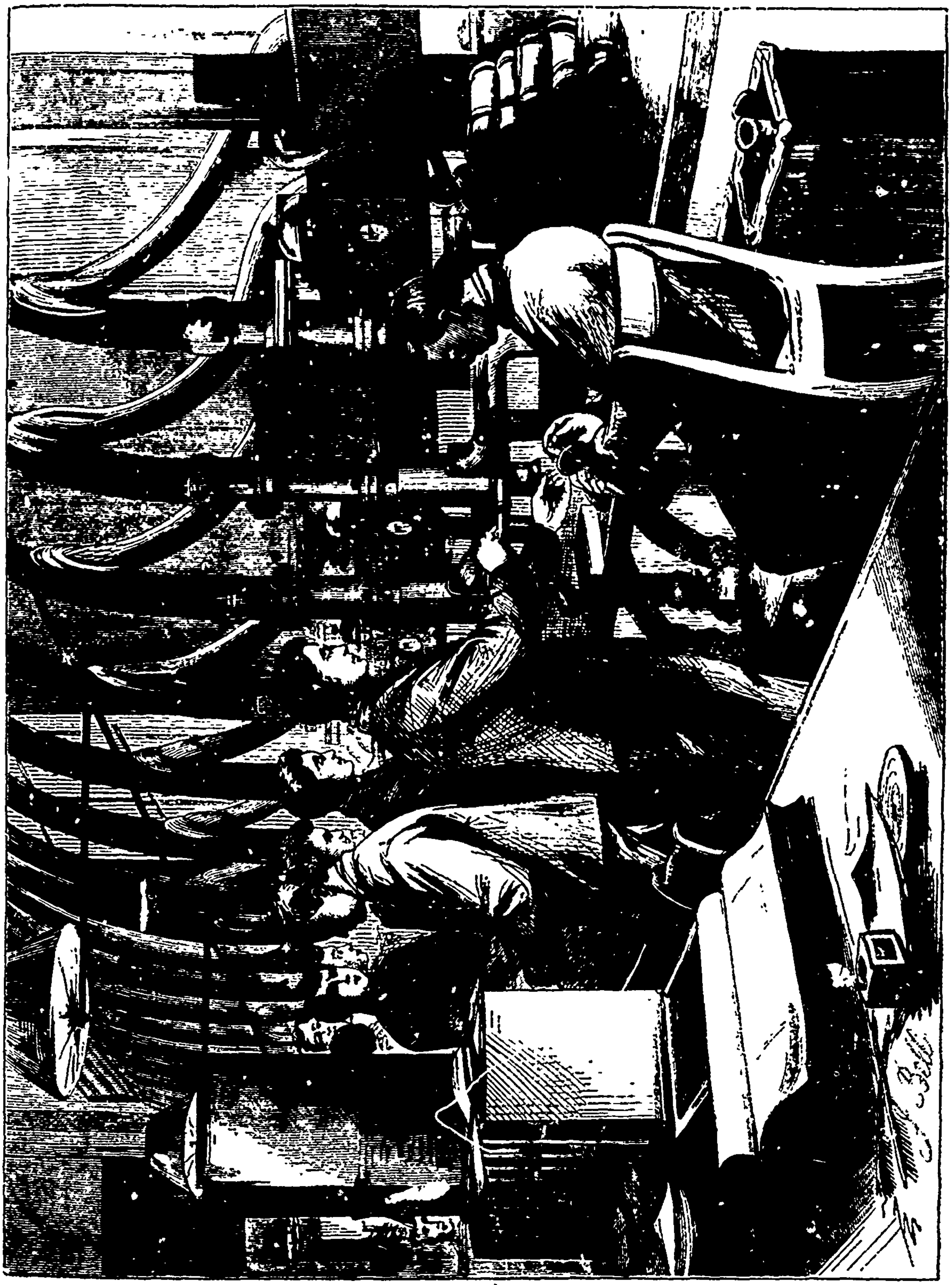
A sheet of glass only half the thickness (viz., 3 millimetres), but which had been prepared by the new process, was then placed in the frame, and the same weight was allowed to fall upon it, gradually increasing the height, but without any effect even when dropped from the ceiling of the room.

The experiment was next continued out of doors, and it was not until the weight have been dropped from a height of 5·75 centimetres, that the plate of glass was broken. Dropped on the ground a sheet of the prepared glass rebounded slightly, and with a sound similar to that of metal when thrown down

Another experiment was made with a view to test its resistance to fire. A slip of common glass was held in the flame of a lamp, and at the end of 24 seconds it snapped in two. The same was repeated with a slip of the prepared glass, but the flame had no effect upon it; and even after plunging the heated glass suddenly into cold water the glass was not broken The importance of such an invention may easily be imagined, and its application in an endless variety of ways will readily suggest themselves not only to engineers, builders, &c, but to persons engaged in almost every class of trade.

Some time ago the English engineers engaged on board the ironclads of the Turkish fleet were dismissed or withdrawn and natives appointed in their room. According to the *Levant Herald* the Turkish mechanics have since come to grief, some having narrowly escaped being "boiled." Those in charge of the *Mahomoudieh*, one of the largest of the ironclads, had received orders to get the ship under weigh. After several fruitless efforts to get the engines to move, growing impatient, says the *Herald*, they began to try the virtue of some of the cocks whose uses they had had no previous opportunity of becoming acquainted with. One of these took the reconnoitring artisans considerably by surprise, answering their researches with a jet of steam which quickly filled the engine room and scalded their hands and faces.

CENTRAL TELEGRAPH OFFICE, GENERAL POST OFFICE, LONDON, ENGLAND.



PNEUMATIC TUBES, CENTRAL TELEGRAPH OFFICE.

CALIFORNIA AT DIFFERENT EPOCHS.

At the meeting of the California Academy of Sciences held at the beginning of the month, Dr. J. G. Cooper, formerly of the State Geological Survey made some interesting remarks on California. After exhibiting on a map of California and Nevada, the portions now land, but covered by salt or brackish water during the epoch just preceding the age of man, Dr. Cooper said that probably much of the coast range was also under water, of which no evidence from fossil remains is left, the strata, if any were deposited, having been washed away. Numerous small fresh water lakes also existed, which have left deposits, especially on the slope of the Sierra Nevada, but not yet surveyed enough to define their limits. The Sierra must then have been much lower to allow these lakes to stand where they would now drain out completely. Most of the States of Nevada and Utah were covered by large fresh-water lakes, filling what is now called the "Great Basin," and which have since evaporated so as to form the salt lakes now existing, by condensation of the salts always contained in lakes and rivers. This is shown by the deposits of freshwater shells at high levels above the present salt lakes, and the absence of salt-water fossils later than the cretaceous in the Great Basin.

In California, the whole great interior basin of the Sacramento and San Joaquin valleys was occupied by brackish water, as proved by the remains of sharks and porpoises found by Professor Blake and others near Kern river. All the principal level valleys now forming the best agricultural lands were also occupied by arms of this inland sea or of the ocean. The gulf of California extended over the desert a hundred miles or more north of its present limits.

The Sacramento basin had other outlets besides the Golden Gate (if that existed at all) through an inlet opening at Russian river, and another through Santa Clara valley into Monterey bay. Thus many islands probably existed which are now joined to the main land, among them the peninsula of San Francisco. Some of the inlets near the coast were occupied by marshes, through which the animals of that period reached the nearest islands, as shown by the remains of the fossil elephant found near San Francisco, near this city. Similar remains found by Blunt and Harford, of the Coast Survey, on Santa Rosa island, show that it was then either joined to the main land by dry ground or marshes, as were probably the whole inner row of islands now forming the south shore of the Santa Barbara channel. The evidence of all these changes is in the remains of marine, land, and fresh-water animals now found in the valleys mentioned, which have become more or less filled up by deposits from the adjoining hills. The following are the most striking forms, described by Professor Leidy in the "Report of the United States Geological Survey of the Territories," issued last year. A tiger (*Felis imperialis*) as large as the Bengal tiger, found in or near Livermore valley. Wolf (*Canis indianensis*) larger than the existing kinds, from same deposit; also found in the tertiary of Indiana, &c. Llama (*Palauchenia californica*) from the foothills of Merced county, larger than the existing camel; also remains of perhaps another species from Alameda county. Buffalo (*Bison latifrons*) found in several parts of California and the eastern States, larger and differing from the living form. Horse (*Equus occidentalis*) of which remains are common in most of the States, though no horses existed on this continent when it was discovered by Europeans. Rhinoceros (*R. hesperius*,) of which teeth were obtained by Professor Whitney, in Sierra Nevada. Elephant (*E. americanus*,) one of the commonest of the great fossil animals throughout the United States. Mastodon (*M. americanus*,) more rare, but also found in many localities. Another species (*M. obscurus*) first found in the Gulf States, and since in the foothills of the Sierra, Alameda county, &c. A great tortoise, equal to the Galapagos species in size, but probably of fresh water, from a lake deposit of Nevada county. Remains of palms and other tropical trees, chiefly from the lake basins of the Sierra.

From these evidences we perceive that the climate of that day was tropical. The country consisted of peninsulas and islands like those of the present East Indies, resembling them also in climate and productions. From the extent of water surrounding them, there was abundant rainfall and luxuriant vegetation, suitable for the animals mentioned. It is not unlikely that some of these animals may have existed before the pliocene epoch as well as in it, but the explanations are still insufficient to decide this.

The termination of this tropical epoch in California was marked by enormous volcanic outbursts, which poured out great streams of lava on the slope of the Sierra Nevada covering entirely large tracts towards the north. At the same time the whole country was apparently raised by the elevation of new mountain ranges, and increase of old ones, causing the lakes to be drained, and their beds filled by washings from the hills, mixed with volcanic materials. This great convulsion no doubt exterminated most of the tropical flora and fauna of California, although some of its representatives might have existed later in neighbouring regions, and their descendants may still be found in tropical America. That all are not extinct is probable from the analogy of tertiary species elsewhere, and from the fact that most of the marine and freshwater shells of the strata deposited at that time are still living, some however, only south of California. Many extinct land animals have been found to have lived in Europe since the appearance of man on the earth, and there is strong evidence in the Calaveras skull and others that the same fact is true of California. It does not, however, necessarily prove that man existed in the pliocene epoch, as his remains may have been buried under volcanic outflows of later date, together with post-pliocene animals, or even bones of pliocene species mixed with them by aid of volcanic convulsions.

The immense period of time that has elapsed since the pliocene epoch is shown by the vast accumulations of volcanic materials poured out by Mount Vesuvius on the top of marine strata of shells, every one of the species still living in the Mediterranean and therefore of late post-pliocene date. Yet history and the evidence of human remains go back through only a thin portion of these volcanic strata. California, before the end of the pliocene, was certainly badly suited for the existence of man. The deposits formed during the convulsive age, to the thickness of hundreds of feet are themselves almost destitute of all fossils, although burying such a rich collection.

While this was going on in California, there was probably a great geological change taking place in other parts of the world, followed by the glacial age. In this, the northern hemisphere down to about lat. 38 deg., was mostly covered by ice, and the great deposit called the "Drift," found in Europe and the Eastern States.

The Geological Survey proved convulsively that this deposit of erratic boulders did not reach over California, and it is doubtful if even as far as Vancouver's Island. Still the influence of the frozen period was no doubt exerted here in the form of extensive glaciers covering the Sierra, at least half way down their western slope, and probably the highest parts of the coast range. Now we have in summer a mere remnant of that great ice-field, which no doubt did a great part in the excavation of the tremendous canons now cut deep below the previous volcanic deposits of the Sierra. There is evidence also in the present existence of far northern land-shells along the whole length of the Sierra Nevada, that the glacial period progresses slowly, allowing them to spread southward before its advance, without being exterminated. In Europe, it has been found that man existed both before and after this period, living, like the present Esquimaux, on the edge of the perpetual snow, and advancing north again as it receded.

The end of the reign of ice brings us to the present epoch, in which there has been very little change in the outlines of the land in California, although some changes in the fauna and flora, as well as climate, which are yet undetermined. The volcanic disturbances have continued with decreasing intensity since the advent of man in the post-pliocene epoch, and may have elevated considerable portions of land, especially southward, followed by increase of dryness, and probably greater extremes of temperature. A rising of land near the Arctic Sea would further decrease the temperature. Judging from the continual discoveries still being made in the study of these latest formations of the earth's surface in Europe and the Eastern States, we may safely say that a vast field still remains open for the investigation of science in California.

The Locomotives of the World.—Dr. Engel, director of the Prussian Statistical Bureau, estimates the number of locomotives in the world at 45,467. Their aggregate force is calculated at 10,000,000 horse power. Such estimates are, however, necessarily rather vague.

PRINCIPLES OF SHOP MANIPULATION FOR ENGINEERING APPRENTICES.

By J. Richards, London.

(Continued from page 231.)

THE ARRANGEMENT OF ENGINEERING ESTABLISHMENTS.

The first and, perhaps, the most important matter of all in founding engineering works is that of arrangement. As a commercial consideration affecting the cost of manipulation, and the cost of handling material, the arrangement of an establishment may determine in a large degree the profits that may be earned, and upon this matter of profits depends the existence of such works.

Aside from the cost or difficulty of obtaining ground sufficient to carry out plans for engineering establishments, the diversity of their arrangement that is met with is no doubt owing mainly to a want of reasoning from general principles in the preparation of plans.

The similarity of the operations carried on in all works directed to the manufacture of machinery, and the kind of knowledge that is required in planning and conducting such works, would lead us to suppose that at least as much system would exist in machine shops as in other manufacturing establishments, which is certainly not the case in America, and hardly the case in Europe.

There is, however, this difference to be considered: that whereas most other establishments are arranged at the beginning for a specific amount of business, machine shops generally grow up around a nucleus, and are gradually extended as their reputation and the demand for their productions increase; besides, the variety of operations required in an engineering establishment are apt to lead to a confusion in arrangement, which is too often promoted, or at least not prevented, by the want of a true estimate of the cost of handling and moving material.

The material consumed by an engineering establishment consists mainly of iron, fuel, sand, and lumber. These articles or their product is, during the processes of manipulation continually approaching the erecting shop, from which finished machinery is discharged after its completion. This constitutes the erecting shop as a kind of focal centre of the works, which should be the base of a general plan for arrangement. This established, and the foundry, smithy, finishing and pattern shops, regarded as feeding departments to the erecting shop, it follows that the connexious between the erecting shop and the other departments should be as short as possible, and such as to allow free passage for the material and communication between the managers and workmen. These conditions would suggest a central room for erecting, with the various departments for casting, forging, and finishing, radiating from the erecting shop like the spokes of a wheel, or, what is nearly the same, branching off at right angles on either side, and at one end of a hollow square, leaving the fourth side of the erecting room to front on a street or road, permitting free exit for the machinery when completed.

By an arrangement of this kind the material is received on the periphery, as we may say, the product discharged in the centre, and the communication between departments is the most direct that it is possible to have. By observing the plans of the best establishments of modern arrangement, especially those in Europe, the apprentice will see that this system is approximated to in many of them, especially in establishments devoted to the manufacture of some special class of work.

Handling and moving material is in fact the leading object to be considered in the arrangement of engineering works. The constructive manipulation can be watched and estimated, and faults detected by comparison, but handling, like the designs for machinery, is a more obscure matter, and may be greatly at fault without the defects being apparent to any but those who are highly skilled.

Presuming an engineering establishment to consist of one-story buildings, and the main operations to be conducted on the ground level, the only vertical lifting to be performed will be in the erecting room, where the parts of the machine are assembled. This room should be reached in every part by an overhead travelling crane, that can not only be used in turning, moving, and placing the work, but in loading it upon cars or wagons.

Castings, forgings, and general supplies of the erecting room can be easily brought from the other departments on trucks without the aid of the motive power; so that the erecting and foundry cranes will do the entire lifting duty required in any but very large establishments.

The auxiliary departments, if disposed about an erecting shop in the centre, should be so arranged that material which has to pass through two or more departments can do so in the order of the processes, and without having to cross the erecting shop. Casting, boring, planing, drilling, and fitting for examples, should follow each other and the departments be arranged accordingly.

Whenever a casting is moved twice over the same track or moved and returned over the same course, it shows fault of arrangement, and useless expense. The same rule applies to any kind of material. A great share of the handling about an engineering establishment is avoided if the material can be received on a higher level than the working floors, if, for instance, coal, iron, and sand is received from railway cars at an elevation sufficient to allow it to be deposited where it is wanted by its gravity, it is equivalent to saving the power required to raise it again to such a level if the material was delivered on the ground, for if the coal, iron, or sand, is not to be raised it has to be moved horizontally, and piled up, which amounts to the same thing in the end.

It is not proposed to consider the details of shop arrangement further than to furnish a clue to the general principles that should be consulted in devising plans of arrangement.

Such general principles are much more to be relied upon than even experience in the arrangement of shops, because all experience must be gained in connexion with special conditions that often warp and prejudice the judgment and lead to errors in forming plans where the conditions are different from those where such experience was gained.

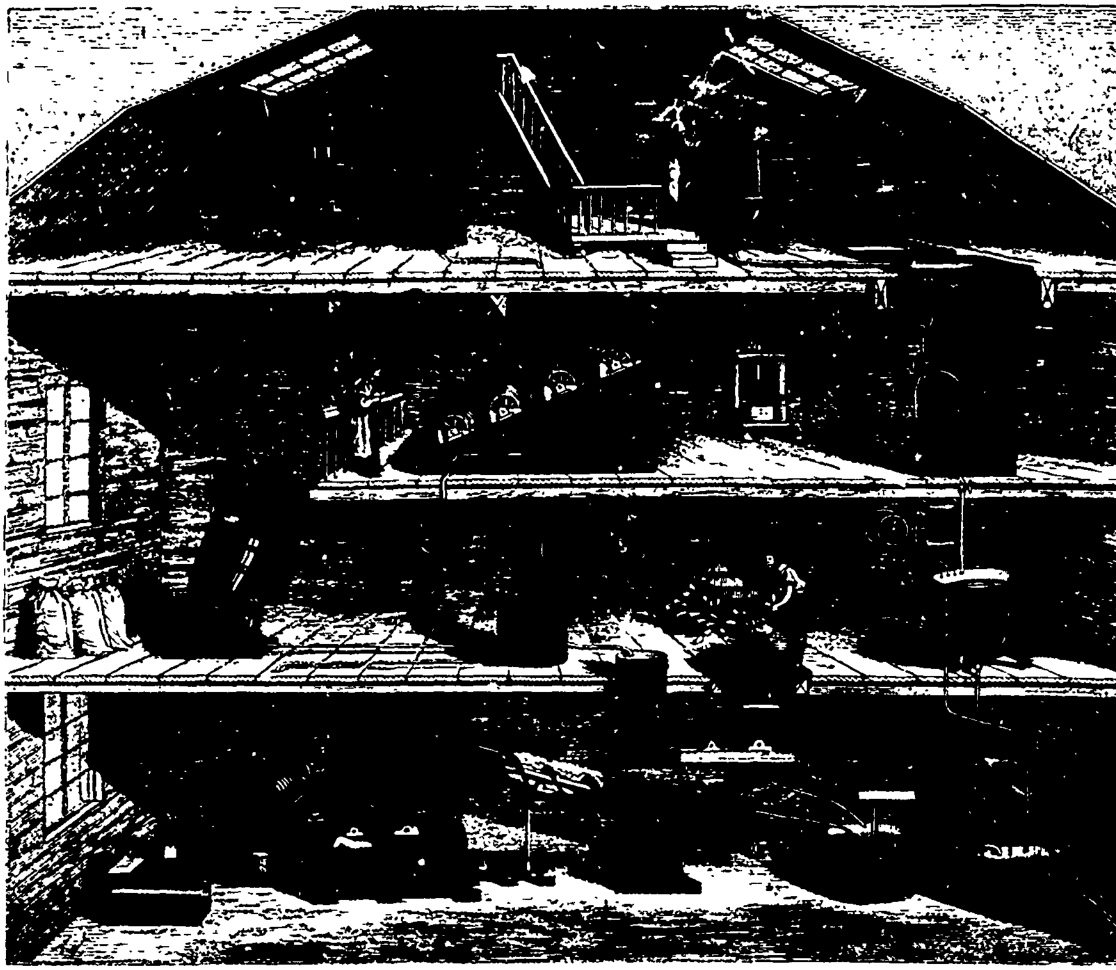
(To be continued.)

EDLUND'S THEORY OF ELECTRICITY.

The Swedish physicist, Professor Edlund, has lately published, in Stockholm, a small work in which he expounds his theory of electric phenomena. The following short account of the principles of this theory (which we take from *Les Mondes*), may not be unacceptable.

We are to suppose the existence of a matter, subtle and elastic in the highest degree, expanded everywhere, not only in vacuum, but in the parts of space occupied by ponderable matter; and that two molecules of this ether, placed at a distance from each other, are mutually repelled along the line of their connection, and in inverse ratio to the squares of the distances. The electric ether, then, resembles an ordinary gas. As regards the relation of ether to the rest of matter, we have merely to suppose that, in the bodies called good electric conductors, the ether which they contain, or at least a part of this, is displaced easily from one point to another. It is supposed that, as is the case with ordinary gas, the molecules of electric ether move easily, and can be displaced with little force. If the ether is in a material body which is a non-conductor of electricity, this mobility is arrested, and it depends on that of the molecules of the material body. If this non-conducting body is a gas, or a liquid with perfect fluidity, the particles of ether conserve their mobility; they are then transported along with the particles of the gas or the liquid. From this mobility of the molecules of ether it necessarily follows that the hydrostatic pressure must be equal in all directions, as in liquids and ordinary gases. We may, then, apply to the ether the principle of Archimedes, that a body introduced into a fluid loses a quantity of weight equal to the weight of the fluid displaced; though, naturally, the question here is not about gravity, but about repulsion between the molecules of ether. A great deal of light has been thrown on the application of this principle by some of the well-known diamagnetic experiments of Plucker. He found that a magnetic body having a magnetic force inferior to that of the liquid in which it is held in suspension, is repelled by the poles of the magnet, and that a diamagnatic body suspended in a magnetic liquid is more strongly repelled by the same poles than if it were in a fluid of gaseous matter less magnetic.

A molecule of ether is at rest from the moment when it is equally repelled on all sides. A material body cannot move



BEET SUGAR FACTORY.—(See page 274)

under the effect of an electric action if the ether which it contains is repelled on all hands in an equal manner. If the repulsion be less at one side than at the other, the body will move, if it be free, in the direction determined by the resultant of the repulsive forces. If we wish to determine the movement produced in a body, B, by the fact of another body, A, being situated in its neighbourhood, we may, without restricting the solution of the problem, consider A as fixed and immovable, and B alone as free It would then be necessary to take the following circumstances into consideration:

1. The action directly exerted between the ether of A and that of B.

2 The action, on the ether of B, of all the surrounding medium, with exception of the ether contained in A.

3 The action of the ether A on the ether which, if B were removed, would be found in the space actually occupied by B.

4. The action of the whole surrounding medium, with exception of the space occupied by A, on the ether which, in the case of B being removed, would be found in the space occupied by B.

We thus evidently take all the active causes into consideration. The first two cases have reference to the effect of the whole mass of surrounding ether on the ether of B, the last two express, on the other hand, the same effect on the ether which, if B were removed, would be found in the place actually occupied by it Now, taking the algebraic sum of the two first, and subtracting the sum of the two last, we have, in conformity with Archimedes' principle, the expression of the movement generated in B. This is shown by numerous applications.

Mineral Resources of British Columbia.—In the year ending the 30th of June, 1874, the exports from British Columbia were of the value of $2,061,743, the gold dust and bars exceeding a million. The gold exports in the three months ending the 30th of September, 1874, amounted to $407,734; and in September alone, $190,000; and these statements are exclusive of gold shipped in private hands. A nugget weighing over 46 oz., and worth upwards of $700, was recently taken out of Dease Creek; it is stated that this is the largest nugget that has been found in British Columbia. The local Government have sent a party to explore and prospect the head waters of the Stickeen. The north east end of Vancouver's Island is thought to be rich in minerals, as well as in cedar, fir, and white pine, as Mr. J. Coon has ascended Nimpkish river, eight miles to a lake fifteen miles in length, crossed the lake, and ascended Camascena river, finding gold diggings that will pay 3 dollars a day to the hand. On the lake a coal seam was seen, and copper and iron were met with everywhere.

The New Glasgow *Chronicle* is pleased to be able to say that operations are to be immediately commenced on the railway from New Glasgow to the Straits of Canso Messrs. Schreiber and Burpee, who have been in Halifax for some days arranging final details with the Local Government, went over to Prince Edward Island on Monday, to settle up their business in connection with the Island Railway. Next week they expect to transfer their "plant" to New Glasgow, when active operations will immediately commence. Engineers arrived here on Monday, and are now engaged in locating the line.

THE CANADA BIRCH.

MECHANICS' MAGAZINE.

MONTREAL, DECEMBER, 1871.

ILLUSTRATIONS:

CONTENTS:

SNOW ROADS.

In our last we gave an illustration of a good form of snow-plow for country roads and a short description of the best method of constructing it. It seems to us, however, that no farmer should need a snow-plow except to clear out his own private roads on his farm. Snow roads, we mean public roads, in Canada and also in the States, we believe, are left, if not entirely, at any rate, almost entirely to the traffic which passes over them, to be kept in order. In pretty public spirited localities the leading man in the village may often be seen out after a heavy snow-fall, with his plough and a good pair of horses, hard at work for the general good, or perhaps, the young men who have spent a few hours loafing round the biggest stove in a village store may volunteer a scratch team among them and start out, as soon as the storm begins to break, to track out the stage road to the next village. This is all very well in its way, but our roads, so important an element in our civilized condition, should not be left to such hap-hazard improvement. It seems to us just as necessary for the municipalities to look after the roads in winter as in summer, and we are convinced that it would be a great boon to the travelling public if a track large enough for two teams to pass without turning out were kept open always over all our public roads. Heavy storms are not so frequent as to render this matter one of very great expense. While on this subject we feel compelled to enter our most emphatic protest against the action of those municipalities which are so obstinately persisting in adhering to the old style of single track. It can hardly be the expense of altering the shafts, for this would be as nothing to each individual farmer compared to the advantage he would derive from the improved roads. It seems to us to be but another instance of that stupid conservatism which was so well exemplified in the case of the farmer who always balanced the bag of grain on one side of his horse's back by an equally heavy bag of stones on the other. Persistence in this system is especially annoying sometimes, as occurred recently in a parish not far from Montreal. Beyond this parish were others which had adopted the double track, and it only remained for this parish to adopt it too, to give them all a good road into the city. When the matter came up before this corporation they negatived the movement almost unanimously. It seems to us that the matter is a subject for provincial legislation. No one doubts the superiority of the double track on the one hand, or the necessity for a uniformity of road on the other and there is little doubt but that success and credit would attend the attempt at provincial legislation in its favour.

As most, if not all, of our readers are aware, the telegraph system of Great Britain is now in the hands of the government and forms a part of the post-office system. A large new building has recently been erected for the department in London, and our illustrations on pages 264 and 265 show two interiors of this building. The extent of the work may be judged from the following description which we extract from the columns of the *Illustrated London News*,

There are 1210 instrument clerks, of whom 740 are females, and there are about 270 messengers. This does not include the engineering staff, or that of the Controller. Between five and six hundred instruments are here kept at work, and the wires therewith connected within and beneath the building have an aggregate length of nearly three hundred miles. Besides this electric apparatus there are twenty-six lines of pneumatic tube, with air pumps worked by three powerful steam-engines, for conveying messages bodily, by means of atmospheric power, between the principal City offices and the West Strand office, opposite Charing-cross Station, and the Central Telegraph Office.

"It seems natural, in the first place, before we examine the instruments and their use, to look at the source of the electric fluid which constitutes their power. This is supplied by the galvanic apparatus in the battery-room, on the ground floor of the building. Here are many cup-boards with shelves, upon which stand rows of earthenware jars, called Daniell's battery cells. Each contains a roll or hollow cylinder of copper, immersed in a solution of sulphate of copper, and an inner bath of sulphuric acid, with pieces of zinc or spelter. Several cells are usually joined to work together, the number being greater or less, for the generation of a more or less powerful current. This will depend on the distance to be traversed, the amount of work to be performed, and the season or the weather. As many as forty cells may be in joint use for a Liverpool message, or sixty for one to Edinburgh; but there is more "leakage" at some times than at some others. The square boxes or jars, which yield a larger amount of electric force than the round ones, are employed for the Wheatstone instruments, as these, we shall presently see, convey many more words in a minute. The engineer's foreman, who has charge of the Battery Room, informed our reporter that the contents of an ordinary cell would be decomposed, by constant working, in one week. But the material is not lost; the copper, when again restored by an easy process to the condition of solid metal, is of extreme purity, and is readily purchased by the manufacturers of telegraph wire. All wires are supplied to Government by contract, but the copper and zinc battery-plates come from a Government manufactory in Gloucester-road, Camden Town. The wires used here are copper, sheathed in gutta-percha. For the electric transmission of time signals, which require a very powerful single shock, not a long-continued stream of force, a special battery is used. This is the Le Clanché battery, formed by placing rolls of carbon, instead of copper, between the solution of peroxide of manganese, in the inner cell, and that of chloride of ammonia, in the outer cell. The Battery Room contains, in all, 23,000 cells, but many of these are worked in sets or groups, more or less numerous, connected with the same wire. There are, as we understood, about one thousand separate batteries here. The efficiency of any one of them can be tested in a moment, by the superintendent in the instrument-gallery above.

The south-west is partly devoted to newspaper despatches and reports, and to the special "racing circuits;" the extra force of spare instruments, on Wheatstone's automatic system, is placed here, for use on particular occasions. The two eastern galleries are mainly occupied by the metropolitan telegraphs. They contain 263 instruments, of which 21 are duplex, 101 Morse printers, and 100 single needles. The central hall contains the instruments which are connected with the different provincial circuits of England. The provincial telegraph business employs 205 instruments at the Central Office; and of these 57 are Wheatstone's automatic, 20 are duplex, 7 are Hughes's type-printers, and 97 are Morse printers. But on the south side of the central hall are the pneumatic despatch-tubes for sending telegrams bodily, through an underground tube, to or from the more important London offices. On the west side is a tall and wide frame, called the test box, exhibiting in its front a great number of metal knobs and wires; these afford means of establishing an electric communication with any station throughout the kingdom. They derive their power from 4000 cells in the Battery-Room. The battery test box, above referred to, and the sympathetic clock, with the chronifer, or regulator of clocks, are situated also here, between the two western galleries. The total floor space is 50,000 square feet; the mahogany desk space extends in length three quarters of a mile."

Any of our readers who has ever enjoyed a tramp through a Canadian hard-work forest will acknowledge at a glance the faithful delineation of the Canadian birch on page 269.

To any who have ever enjoyed hard times in the woods, as we have, it will be suggestive of many a comfort—of fires lighted by the aid of its bark in spite of long continued rain, of extra plates and dishes which when used might be thrown away and so relieve the tired sports man from the nasty work of washing dishes. It is suggestive too of the frail but, safe in skilful hands, birch-bark canoe, and one or two of our readers may have seen an Indian bulletin in hieroglyphics on its papery inner surface. We were out once in the early fall with a sportsman whose love of picturesque knew almost no greater treat than to set fire to the tattered, hanging, bark and watch the flames rush up the tall trunk, and out along the knotted branching stems. He repeated the experiment, however, once too often for our peace of mind. On this occasion as the fire began first to lick along the branches we were astonished to hear shrill and painful cries. The next moment a mother bird fluttered from her nest in a forked twig of the tree and perching on a neighbouring limb responded in mournful long-drawn notes to the gradually fading shrill cries of her brood. We felt almost as sorry for the fisherman as for the bird. He had no idea that any birds bred so late in the season and the pained look in his face and his restless slumbers that night bore witness to a sorrow that will surely last longer than that of the poor mother bird.

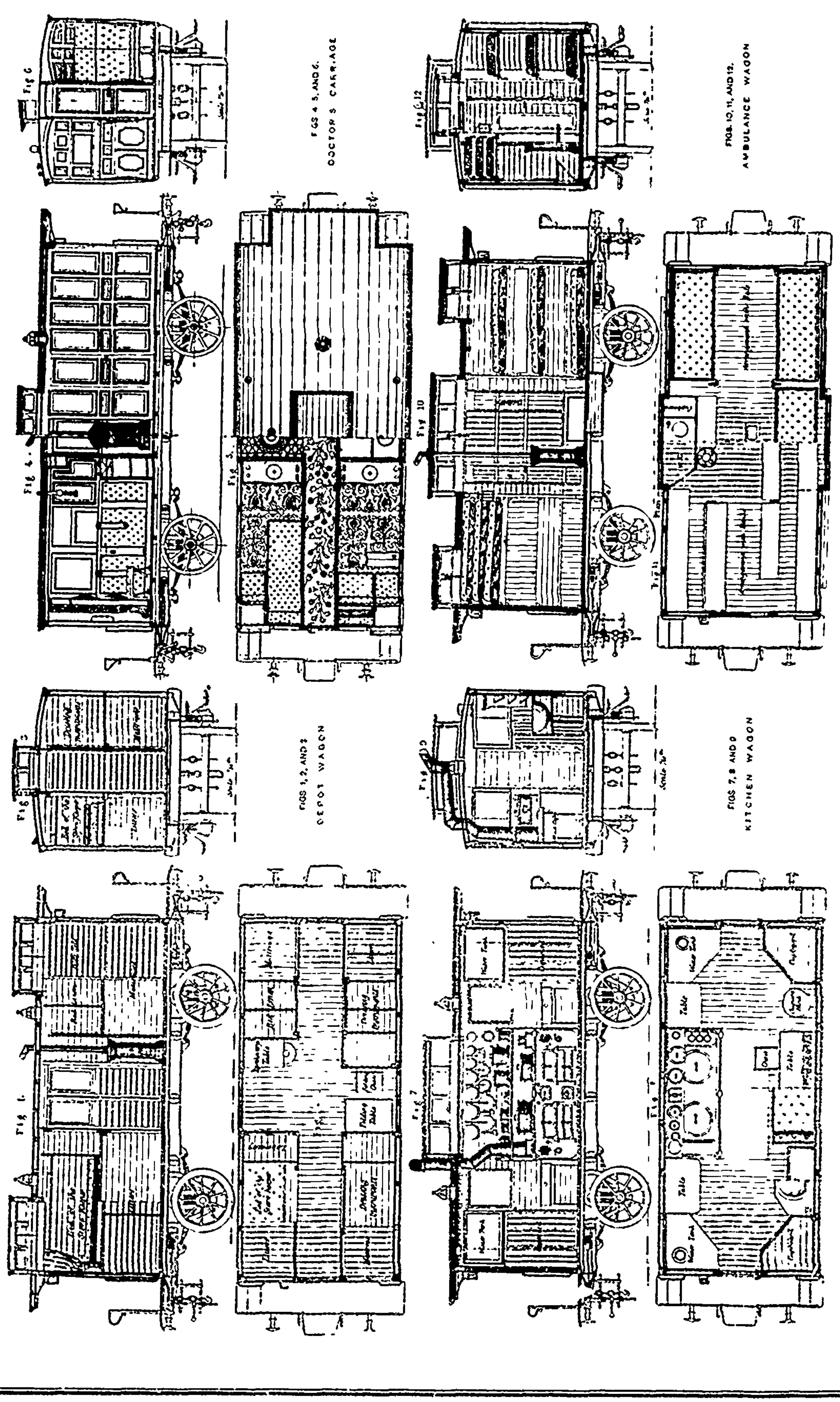
We conclude, in this number, our illustrations of tobacco manufacture as carried on in France. There, as here, it will be perceived that all, except the heaviest work, is done by women. The French people are great smokers, and consequently the industry has attained immense proportions, and the machinery used in the manufacture is said to be of the most skilfully constructed description. The revenue derived from this article alone amounts annually, in France, to at least $60,000,000; the number of cigars annually consumed is estimated at 875 millions. In the largest establishments, where the operatives number many hundreds in each, nearly all the work is done by machinery, even to the damping which has been till lately universally done by hand. In our illustrations, this month, on pages 284 and 285 we show the packing in small paper packets of smoking tobacco, scaferlati as it is called, and the manufacture of cigarettes.

Some time ago, we described and illustrated a device, the invention of Mr. Boys of Ontario, for utilizing the motions of a ship, rising and falling and rolling with the waves, in propelling her through the water. A Mr. Deverill of Victoria, Australia, has recently patented a similar invention. The results of the experiments were recently detailed before the Royal Society of Victoria. It would appear from these experiments that the duration of the voyage was 2,026 hours, the number of rolls being 1,764,088, and of pitches 1,011,137. The approximate number of compound oscillations was 14 per minute, ascertained by means of a pendulum, and some other instruments, which we believe are now in the possession of Mr. Bessemer.

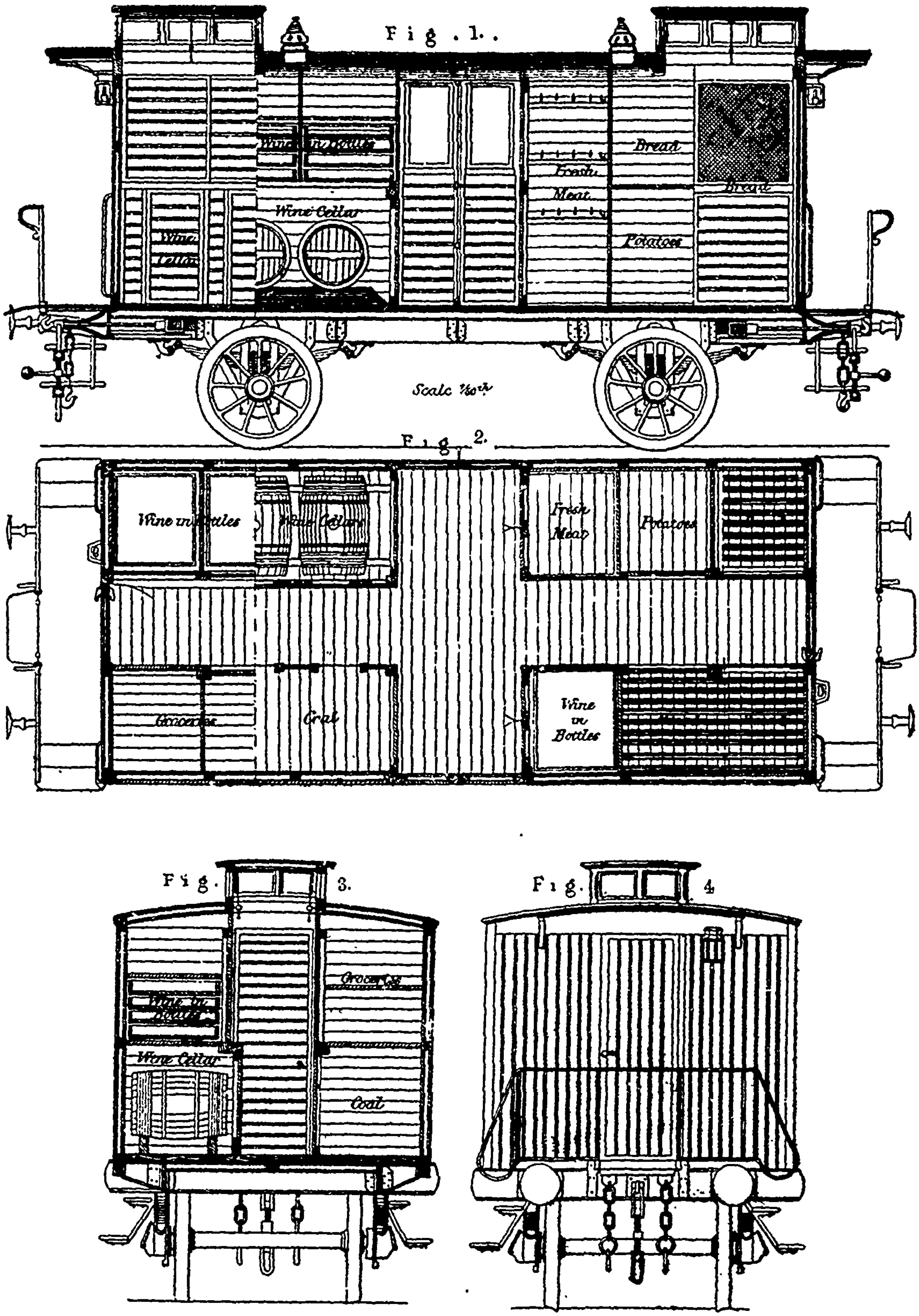
Reports as to the success of the various parties observing the transit of Venus are rapidly coming in. At Madras and in Japan, the observations were more or less interfered with by clouds. At Shanghai the sun was obscured during the whole period of transit. The observations in India and in Egypt were very successful. At Cairo one hundred photographs were taken. The Khedive is said to have lent every possible aid to the observers.

Preparations for the Arctic Expedition about to be sent out by the government of Great Britain, are being rapidly pushed forward. The arrangements are under the chief superintendance of Rear Admiral Sir Leopold M'Clintock who is well known as an Arctic navigator. Two ships have already been selected for the expedition and are being fitted, and an official has left Portsmouth for Scotland to examine the whalers to be selected for the expedition.

The production of beet-sugar seems to occupy somewhat the same position in some parts of France, that the production of cheese has of late assumed in the Eastern townships of this Province. Our illustration on page 268 represents a sugar factory on about the same scale as our cheese factories. The factory illustrated is one that was much admired at a recent exhibition of agricultural products and implements at the Champs-Elysées, and is the result of the experience of M. Peltier a celebrated French producer of agricultural implements. By its means the labour of six or eight unskilled men can easily produce 700 or 800 kilogrammes of sugar daily.



FRENCH AMBULANCE CARRIAGES.



FRENCH AMBULANCE CARRIAGES.

REVIEWS.

We have received a copy of an Italian periodical, *Le Industrie, L'Agricoltura*, which is devoted to the interests of mechanical matters and agriculture. This publication is a very neatly got up and well printed weekly The number we have received contains part of an interesting article on a new machine for the measurement of the thicknesses of silk and other threads. The article is illustrated by numerous drawings.

VICK'S FLORAL GUIDE.

We have received the number for January, 1875, of this periodical. It is at least as beautifully got up as its predecessors and is full of interest to all who devote themselves, much or little, to horticulture. We are glad to see that it will appear in future every three months instead of semi-annually. The nurseries at Rochester N. Y. of which the guide is a partial catalogue are the finest on the continent, and their products, in seeds &c. are implicitly relied on by horticulturists in the United States and Canadas.

RAILWAY AMBULANCE CARRIAGES.

The want of proper ambulance carriages during the Franco-German War led, after its conclusion, to a careful consideration of the best means for accommodating and transporting the sick and wounded, and the "Société Française de secours aux Blessés" has designed the Sanitary Train, the vehicles of which we illustrate this month on pages 272 and 273, this train having been constructed by the French Rolling Stock Construction Company at Ivry. The train is composed of twenty-four vehicles, namely:

1. A depôt wagon containing drugs, linen, wrappers, mattresses, stretchers, surgical instruments, and accessories.
2. A carriage to accommodate four doctors.
3. A cooking wagon.
4. A store wagon, for wine, food, and fuel.
5. Twenty wagons for wounded; it being possible to make various changes in these vehicles, according to requirement.

The carriages are all arranged with end entrances, with a central passage from end to end, so that a means of circulation throughout the train is provided, platforms being provided at both ends of each vehicle to complete the communication.

The depôt wagon, illustrated by Figs. 1, 2, and 3 on page 272 contains, as just stated, all the *matériel* required by the doctors and surgeons, with mattresses, blankets, &c. Besides the end doors, this car has two side doors for the entry or removal of stores, the end openings being only employed for communication. The interior arrangement is extremely good, the stores are placed in drawers and other suitable receptacles, all being thoroughly classified and numbered in such a way that immediate access to any of the contents can be obtained. A desk for the storekeeper is placed beside one of the side entrances. Both desk and seat are made to slide, and are upon hinges, so that they can be instantly removed when access to the vehicle from the side is desired. A small recess in one of the corners of the carriage, and sheltered by a curtain, forms the bed of the storekeeper. The end platforms are lighted by means of a lantern placed at each extremity under the roof, and the interior of the carriage is illuminated by means of two ordinary roof lamps. The end doors can be locked both from inside and outside by means of a key which serves for each vehicle in the train.

The doctors' carriage (shown by Figs. 4, 5, and 6 on page 272,) is fitted up with much taste and luxury, and is applicable under ordinary conditions as a special saloon carriage. The interior is divided into six distinct compartments, namely, four separate rooms for the doctors, a water-closet, and a small closet containing the warming apparatus. These compartments are arranged symmetrically on each side of the carriage, so that a clear passage is left down the centre. Each of the four apartments is fitted with a bed, and serves at the same time as a workroom. On one side of the carriage is hinged a small table, fitted with writing materials, &c. There are besides two chairs, which can be opened, and converted into a comfortable bed. Each compartment contains a suspended moderator lamp; an aneroid, a thermometer, and an alarm clock, and to each door is attached the name of the occupier, and a notice of the hours during which he is on duty.

The heating apparatus is upon a new system, that of Girandeau and Talbert. This apparatus is cylindrical in form, containing a fireplace at its lowest part, and a reservoir of water above, connected with a series of circulating tubes laid under the floor of the carriage. A small pipe led from the reservoir into the tanks supplying the lavatories, slightly warms the water used to supply the latter.

The kitchen carriage, illustrated by Figs. 7, 8, and 9 on page 272, has been arranged with very considerable care. It contains a range suitable for cooking for from four to five hundred persons, and of course is provided with all necessary utensils, which are carefully secured in their proper places, so that they shall not be disturbed by the oscillation of the vehicle when in motion. In each corner is a large reservoir for water fed from a pipe led up to the roof. Beneath the reservoirs are cupboards holding table utensils, and beside the reservoirs are large copper basins for washing up these utensils.

The interior arrangement of the store wagon—of which views are shown by Figs. 1 to 4 on page 273 corresponds somewhat with that of the depôt carriage. It contains drawers to hold a large number of bottles, a coal chest, cases for bread, meat and ice safes, and suitable hooks for suspending carcasses. This vehicle has also two side doors to permit the loading and unloading of goods.

The twenty hospital wagons (one of which we illustrate by Figs. 10, 11, and 12) are arranged either with superimposed berths for the wounded, with seats for convalescents, as a dining-room carriage, or filled with suspended stretchers. Each of these arrangements can be easily and quickly transformed to any of the above-mentioned forms. The wagons can be employed as ordinary freight wagons having side doors, they are peculiar however in being made with double walls in order to preserve an equable temperature within the carriage, part of the space between the walls being employed to stow away the benches forming seats for convalescents. The beds are arranged in two or three tiers, the maximum number being fifteen. They consist simply of wooden frames, and sacking carrying the mattress; the frames are attached to hooks in the side of the carriage, and to suitable posts, reaching from the floor to the roof, but which are very easily removed.

Each wagon has a heating apparatus and water-closet, and the lighting is effected by the lamps attached to the posts carrying the beds. Sliding doors serve to give free admission to stretchers, on which wounded patients are placed.

When arranged to afford dining accommodation each wagon contains six tables, the legs of which are locked to the floor, but arranged so as to be easily removed. The tables give accommodation for 30 or 40 persons. In the convalescent wagons the floor area is occupied with seats that can be easily shifted, and as already stated, stowed away in the space between the double walls of the vehicle. As we have already stated, the wagons, instead of being provided with fixed berths, can be fitted with stretcher beds suspended to ropes depending from the roof.

Each complete train of twenty-four carriages includes only two special vehicles, the doctors' and the kitchen carriages, the others may be employed as common freight wagons in time of peace. The doctors' carriage, however, may be employed for special purposes in ordinary traffic.—*Engineering.*

We learn from the *Polytechnisches Centralblatt* that a Government official in Paris, M. Rathelot, has succeeded in deciphering a number of valuable documents which were burnt during the outbreak of the Commune in that city. These had lain so long in the fire that the leaves of the separate volumes formed a homogeneous mass, resembling a carbonised block of wood. However carefully it was attempted to separate the leaves, they fell asunder in fine powder. Rathelot first of all cut off the back of the book, then immersed the whole in water then exposed it at the orifice of a calorifer, to a pretty strong heat. Through rapid evaporation of the water the individual leaves became loosened, and could, with care, be separated The successive pages were then read off. In this way about 70,000 such documents have been saved. The writing looked dull, the paper itself a bright black, the former could be read with ease.

THE STEVENS BATTERY.

This celebrated American ironclad was, by the will of the late Edwin A. Stevens, of Hoboken, New Jersey, to have been presented, in a complete condition, to the State of New Jersey. It was further directed that the machinery and tools used in construction and not exceeding 1,000,000 dols. in money, should be appropriated for the purpose of carrying out this provision of the will. It was still further provided that, should the State of New Jersey not receive the said vessel, the executors were to sell the ship and to retain the proceeds of such sale as part of the estate of the testator. A special Act of Congress having been obtained, authorising the State to accept the gift under the provisions of the will, the Legislature, by an Act approved April 1st, 1869, accepted the vessel on the terms above stated. It was the intention of the executors and their engineers to put afloat a vessel that should be the most formidable iron-clad on the ocean. The amount of money appropriated proved insufficient to complete the vessel, and after the hull and the machinery had been nearly finished, the work was necessarily stopped, leaving the ship in the condition hereafter described. A question having been raised as to the real ownership of the vessel, suits in Chancery were commenced, and, pending these suits, the State Legislature, by an Act, to which reference has already been made, directed a positive sale and the payment of the proceeds into court. The vessel was accordingly sold and the Federal Government, being the highest bidder, secured it, subject to the approval of Congress. The following description of the vessel is from *The Engineer*.

Length over all of the vessel is 401ft ; length between perpendiculars, 390ft.; breadth, 45ft ; armour, 54ft.; depth to main deck, 24½ft.; draught, maximum, fore and aft, 22ft., displacement at 22ft. draught, 6006·02 tons; area of immersed midship section to circumscribing parallelogram, 0 867, ratio of displacement to circumscribing parallelopiped, 0 544. The general appearance of the vessel, if completed as here proposed, will be that of a "monitor" iron-clad, such as is illustrated in the annexed cut. The proportion of length to breadth —8 666 to 1—is that now usually observed in sea-going high powered steamers, and is somewhat less than in those which represent the extreme limit yet attained The lines are fair and fine, giving a sharp bow and the fine run which is essential to the efficient working of screw propellers The proportions of the midship section, which has a breadth equal, very nearly, to double the intended draught, are such as are best calculated to make the vessel easy in a sea-way. The displacement per foot of draught at the intended load line is 424 19 tons, or 35·35 tons per inch. The hull of the ship is double, the inner and outer skins being separated by a space varying from 22½in. at the bottom to 6½in. at the top of the inner portion. Seven transverse bulkheads are built, dividing the ship into distinct water-tight compartments. Two additional bulkheads are carried across the ship below the berth deck. Coal bunker bulkheads, forward and aft, and the several smaller bulkheads in the extreme ends of the vessel, still further strengthen the structure, and assist in securing immunity from liability to founder in consequence of injury to the hull. The hull is further strengthened by the bulkheads of the "turret chamber," which stiffen the whole structure by tying the decks, the coal bunkers, and the lower longitudinal bulkheads firmly together. The double bottom is not only made water-tight as a whole, but is divided into spaces of 32ft. in length each, separated by water-tight partitions, formed by caulking frames and cross-floors These spaces were to be fitted each with its own pipe leading to the bilge pumps, thus enabling them to be pumped out separately. The stem of the vessel rises vertically, and is of a section 10in. by 3in. The cell-like construction of the vessel behind it, and the immense strength of this portion of the hull, will enable it to receive very heavy shocks without serious injury. The whole of this part may be torn away to a distance of 35ft. from the stem, by intentional or accidental collision, without endangering the safety of the vessel Three of the partitions in the bow being horizontal, formed by the extension of breast hooks back to the transverse bulkheads, a projectile may penetrate, or a seam may start, at any one point without doing other injury than to fill one of these small compartments with water. The stern "overhang" is carried well out over the rudder, which it fully protects. It is prepared to receive armour-plating like other portions of the vessel. The outer skin is composed of selected boiler plate, which is stated to have been tested as received, under the inspection of an officer of the Government, and received only when found to have a tensile strength of 60,000 lb per square inch of cross section. Its tenacity is at least 20 per cent greater than that of iron customarily used in the construction of iron vessels by foreign builders. The thickness of keel strake is 1in ; the garboard strakes are ⅝in. thick; the intermediate strakes are of ½in. iron; and the wale strakes are ¾in. in thickness. The keel strake is double riveted, as are also the garboard and two wale strakes The riveting has all been done by hand, with both care and skill. The inner skin is also of selected charcoal iron, of "C No. 1" quality, such as is generally used only for boiler-plate. Its joints were all planed and fitted under the inspection and the direction of the engineer in charge, and the workmanship is unexceptionable. Its thickness is 1in. for a distance of 193ft amidships, ½in for a distance of 30ft. at the ends, and ¾in at the intermediate portions. It is double riveted fore and aft. with treble riveted butt-straps for 240ft. amidships. The inner skin is carried up to the 14ft line, and is made water-tight throughout, as already stated, permitting the rupture of the outer skin without endangering the safety of the vessel. This, with the division of the whole into short water-tight spaces by caulking the frames, is an insurance against even loss of trim by the penetration of the water throughout the space between the two hulls. The four bulkheads nearest the middle of the vessel are of plating ¾in. thick. All joints are planed and fitted, and all lines of junction with the hull are carefully strengthened and made water-tight. Water-tight doors with packing are fitted to the passages leading fore and aft to these bulkheads The bulkheads are stiffened by angle iron frames. The four bulkheads immediately beneath the intended location of the turret are strengthened by angle iron frames, spaced 20in apart, extending from top to bottom. The coal bunker bulkheads are of ½in. iron, are water-tight and are strengthened by angle iron frames 4in. × 4in. × ½in. riveted back to back The main deck is supported by heavy yellow pine deck beams, of scantling 14in. × 14in. and 16in × 4in. spaced usually 36in. between centres. They rest at each end upon a heavy and very strong iron shelf, which serves also to strengthen the ship as a stringer The beams are also secured to the skin of the vessel by strong iron knees. They are intended to be supported in the middle by a line of iron stanchions not yet in place This deck is planked with selected Southern yellow pine, free from sap, shakes, or other defects, and thoroughly seasoned Its thickness is 8½in. throughout. It is not fastened down. The berth deck extends from the foremost bulkhead to the boiler compartment, and from the stern to the engine-room bulkhead. It is supported by angle iron beams measuring 4in. × 3in. × ½in. and spaced 24in. apart. The planking is laid with splined joints, and is 3in. in thickness, except under the anchor hoister, where it is 4in. thick. This deck is laid down, and permanently secured in place. The plans of store-rooms, officers quarters, and all joiner work remain to be prepared, and may be given any shape that may be desired by the purchaser, or such as may be determined by the form ultimately given the vessel.

The machinery consists of two main engines, number of steam cylinders, 4; diameter of ditto, 72in ; stroke of piston, 45in., refrigerating surface of surface condensers 12,650 square feet; number of screw propellers, 2; diameter of ditto, 18ft., pitch of ditto, 27ft.; number of boilers, 10; area of heating surface, 28,000 square feet; area of grate surface, 866 square feet.

The main engines are arranged in pairs, each of the two pairs driving a screw independently. Each pair has its own surface condenser and its own set of pumps, including a centrifugal circulating pump, driven by a small independent engine, taking steam from the main steam pipe The main engines are of the vertical return connecting-rod type, formerly known as the Maudslay and Field engine They are shown in the engraving in side elevation and section, and in end elevation. This general design was decided upon as being at once compact, readily accessible, and convenient in operation, and as stowing well in a ship of which the form was too fine to admit of twin engines of other types

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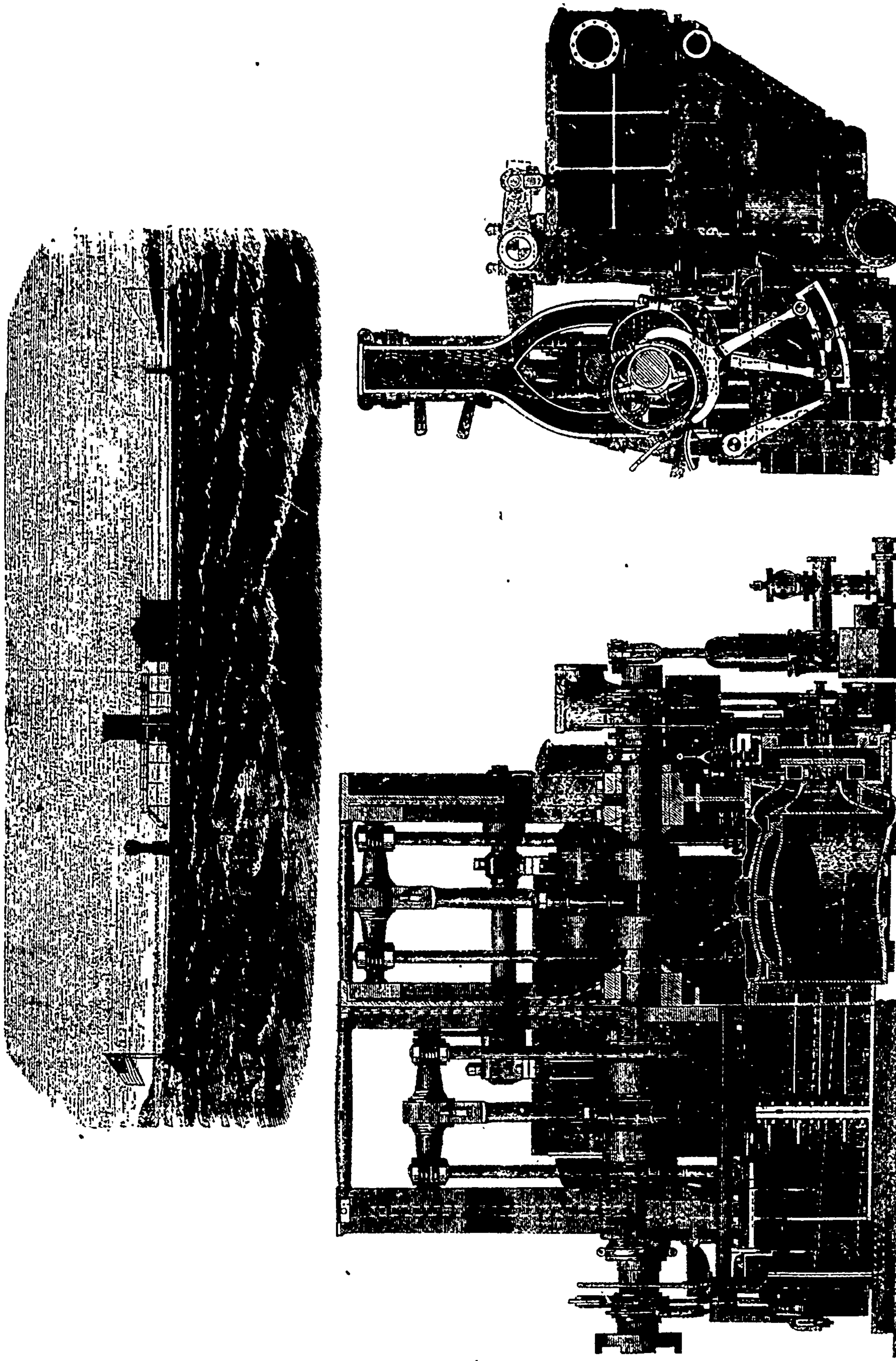
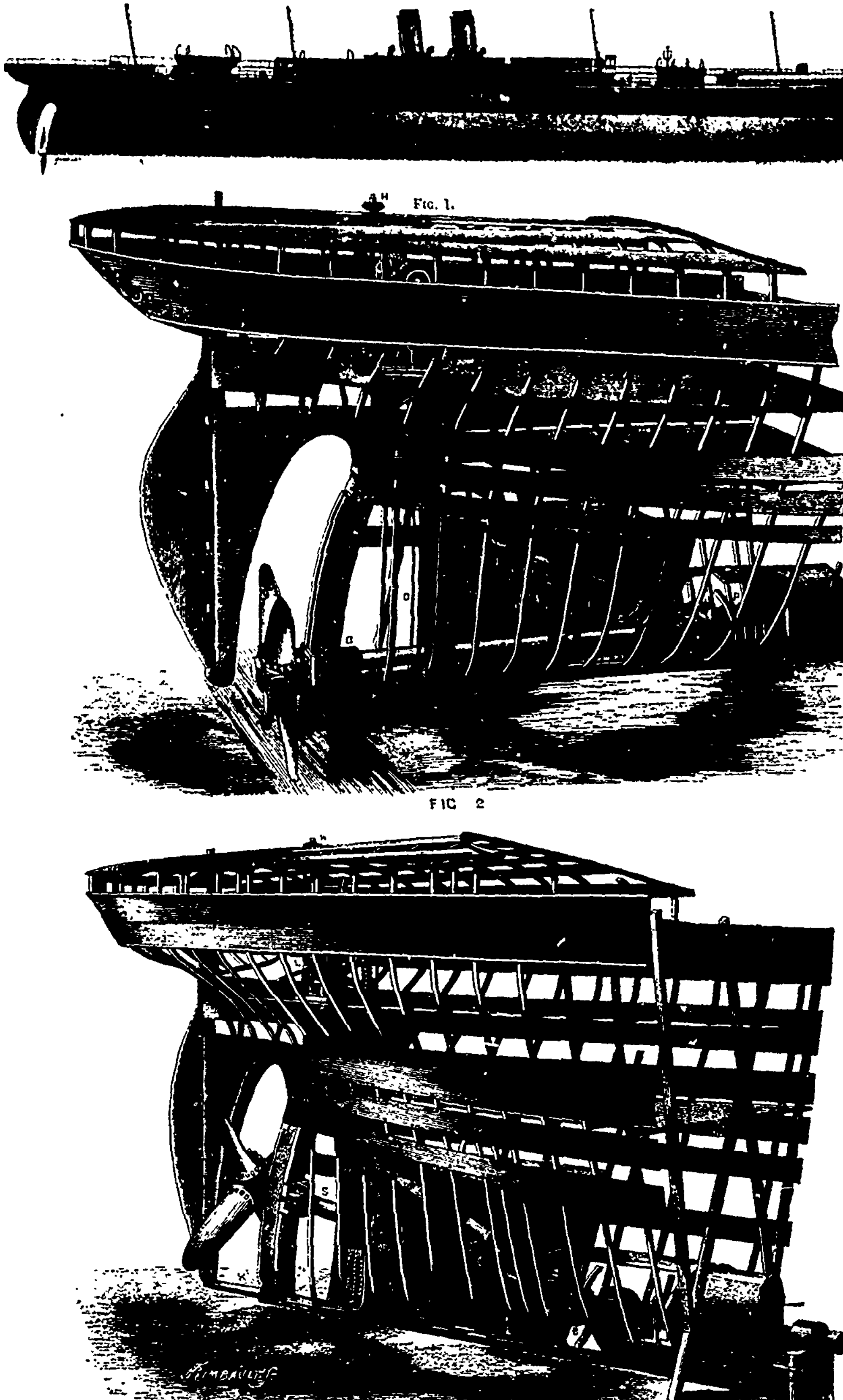
The Sarnia and Point Edward Street Railway Company expected that the rails would be laid and the road in running order by Christmas.



THE STEVENS BATTERY AND ENGINES.



LOWERING SCREW OF THE S. S. BRITANNIC.

LOWERING SCREW OF THE S. S. BRITANNIC.

The views on page 277 show an arrangement for lowering the propeller of steamships as fitted on board the S. S. Britannic, a vessel constructed by Messrs. Harland and Wolff, of Belfast, a firm of which Mr. Harland is the senior partner.

We may refer, in the first place, to the reasons for introducing this lowering propeller. In long ships the pitching in a heavy seaway, and the vertical motion of the waves, tend to expose the upper portion of the screw when fitted in the usual way, and the evil effects arising from this are the "racing" of the engines and its attendant dangers, together with a diminished speed of the vessel.

With the lowering propeller these defects are guarded against and some important features secured. Several writers have pointed out the loss of power due to the screw working in water disturbed by the passage of the ship; this also is partially remedied, as one-half of the propeller works below the vessel's bottom, and the additional head of water presents a denser medium for the propeller to work against.

The S. S. Camel, 170 ft. in length, built some three years ago by Messrs. Harland and Wolff, Belfast, for their own use, was the first vessel fitted with this arrangement, and its successful working ever since, in voyages round the coast and to distant ports of the Continent, led to its adoption in the S. S. Britannic, belonging to the White Star line, the company being anxious to retain the supremacy for high speed and good average results which their steamers have gained in the rough Atlantic passages between Liverpool and New York.

The fig. at top of page 277 shows the propeller in its normal position at sea, the shaft S being in a straight line with the rest of the shafting. On arriving in shallow water, or nearing a port, the screw is raised, so that the bottom of it is above the level of the keel, as shown in Fig. 2, and when the blades require examining or replacing, the shaft can be raised still higher, thus exposing the boss and allowing ready access when the ship is in light trim. This latter is an additional advantage, as there is very inferior dry-dock accommodation in New York, and the docks in the Mersey are often engaged for some time in advance.

The last two lengths of shafting are coupled with a universal joint, shown at U, Figs. 2 and 3, P being a fixed plummer block, and B a sliding bush lined with strips of lignum-vitæ in the manner usually adopted for stern tube bearings. The bush is guided by the two checks of the stern post, and raised, by means of the rods R with gearing on the middle deck at L, by a steam engine, or by a hand winch placed on the upper deck, additional manual power being also at command at the capstan head H placed on the top of the turtle back. The shaft works through a slot in the bulkhead A, the water being excluded by the radial gland G working on the two centres B and C. The universal joint works in a chamber in the after end of the tunnel T, and is at all times accessible to the engineers.

The lifting rods R and gearing L are enclosed in iron casings extending to the upper deck, excluding any water that might rise. To prevent warps or nets from fouling the screw when raised in shallow water, a sliding keel K is run out, by means of the rods D worked by hand on the upper deck, or by the rod E in the universal joint space.

The want of the customary keel piece joining the inner and outer stern posts conveys an appearance of weakness, but this is amply compensated by the increased width and additional thickness at the head of the screw aperture, and the centre of effort of the rudder being raised above the ordinary height. A false foot is fitted to the bottom of the rudder post, and this foot can be readily removed, allowing the screw boss to be changed without disturbing the shaft, which is another very important feature.

The Britannic has made three voyages to America, and the whole arrangement has worked most satisfactorily, the screw being raised or lowered by steam in two minutes.—*Engineering.*

THE *Citizen's* lumber report calculates the amount of lumber made at Ottawa for 1874, at 371, 500, 000 feet, the amount held at 120, 500, 000, and the amount sold at 251, 000, 000. There are logs enough on hand for the spring to make a hundred million feet of lumber. It is calculated there will be as much stock on the market next year as this.

MANUFACTURE OF SMALL-ARMS.

Birmingham has long been famous for the manufacture of arms. At the time of the great Rebellion her swords were in high repute, and it was for supplying the Parliamentary forces, and for refusing to supply the king's, that the fiery Prince Rupert displayed such severe hostility to the people when he seized and burned the town. In the reign of William III, the making of guns was added to the then increasing industries of the place, and it has since developed to such an extraordinary extent, and the skill of the workmen has been so great, that the trade is now, and has long been, one of the most important staple trades of the many-traded town. It is divided into two principal classes of work—military and sporting. Military arms are chiefly made by machinery, and sporting by hand, with the exception of the action, which is partially machined; and in both cases the processes of manufacture are full of interesting examples of the skill and ingenuity of man in conquering difficulties, and in displaying his power over the apparently most difficult of materials.

The following very interesting account of the various processes involved in this manufacture is from the columns of *Iron.*

For the purpose of the present paper we selected the well-known works of Messrs. P. Webley and Son, of Weaman Street, at which we could witness at one time the largest amount of work in the trade.

To begin at the beginning. The iron used for guns is of a peculiar make, and consists of several layers of iron and steel piled together—both the iron and steel varying in quality according to the quality of the barrel it is desired to make. The whole is then put into a furnace, and when sufficiently heated rolled out into square rods, differing in size according to the quality and dimensions of barrel required. "The better the barrel the smaller the size of iron it is made of." In this condition it comes to the welder. Welding is most important in making a gun-barrel. The workman takes a strip of iron, heats it red-hot, places it in a machine, and by turning a wheel twists it to the shape of a screw. Any defect in the iron is soon seen in this process, as in the case of a "fault," the screw is to that extent imperfect and useless. In every gun-barrel of medium quality there are two, and in the best three of these bars, each being twisted in alternate directions, one to the right, the second to the left, and when there is a third, that to the right again. By this means is obtained that varied twist which we see in gun-barrels. The various ways of twisting are known as "plain twist," "Damascus," and so on.

The two or three rods are then welded together the entire length, and go back to the mill to be what is called over-rolled, that is, rolled out edge-wise to the required size. The metal is then twisted on a mandril and welded together on the anvil. When it leaves the mandril it is a hollow piece of twisted iron, with spaces between each winding. Welding is the process by which it is made into a barrel, and is a very delicate operation, requiring great skill in the workmen, of whom three are engaged at each anvil. The hollow twisted metal is heated red-hot; as soon as it is taken out of the fire the workman strikes the end sharply on a metal plate on the floor, which forces the heated iron to close, he then places it on the anvil, and all three beat the heated portion with their various hammers. Two of them then take a long piece of steel, called a "float," and whilst the third turns it round and moves it to and fro on the anvil, work the float backwards and forwards, thereby clearing the surface of "scales," and all other impurities. This process is repeated until the whole barrel is made. Only about four inches can be welded at each passing through the fire, an uniform heat of that part of the metal worked on being absolutely necessary for the production of a perfect barrel.

In illustration of the great changes produced in the process of barrel making, we may mention here, that 17lb. of iron are used in making the two barrels of a best double-barrelled gun, which, when finished, only weigh 3½lb. The iron used in the best barrel costs 7d. a pound; and that in cheap ones 3d.

The barrel has next to be bored—another important process. First it is "rough-bored." In this operation a four-sided "bit" which cuts at each edge, is placed in the barrel, barrel and borer are placed in a machine, and by the use of great power the bit works its way through the barrel, smoothing and levelling the surface of the bore. It is then "fine bored." In this operation a square bit, "with a wooden spill on one side," is used, which only cuts on one edge, and its cuttings are left on the bit in the form of the very finest powder. A slip of thin paper is put between the spill and the bit to increase the size, and such is the delicacy of this operation, that this simple addition is sufficient to produce the result required. The tubes are then turned at breech, muzzle, and several intermediate parts, to gauges specially made not only to suit the various bores, but to suit the varied requirements for light, medium, or heavy guns, in each bore.

In the manufacture of a specially light pair of barrels the reader can readily understand the necessity for a judicious distribution of metal.

The next operation is grinding, which is a laborious—probably the most laborious part of barrel making. It also requires great skill, and much practical experience, but there is nothing specially to describe in the work. The stones used in grinding are from Derbyshire. The barrel is now ready for provisional proving, and on its return from this first test it is carefully examined to see if there are any grey specks—every such speck being considered a defect—or any other imperfection which may detract from its value. It is then re-set, and finally (as a separate tube) struck up into shape.

For a double-barrel gun, two (an exact pair) are now jointed together, and the locking-lump fitted in. That part of the tubes which lies under the rib is then tinned, and the forward parts of the two tubes are soldered together on a parallel, the lump is then bound into its place by iron wire bands. A composition of brass dust and borax is placed round it, and then the breech end of the united barrels is subjected to an intense heat, and the brazing is effectually secured. Instead of the ordinarily bungling mode of brazing by the usual hearth and bellows—in which it is almost impossible to entirely exclude dirt, and obtain a uniform heat—the Messrs. Webley have constructed a muffle, which is heated by coke, and the ends of the barrels are placed in the intense heat thus generated, and are never in contact with the coke itself By this process the brazing is effected in about two minutes; in the common way it takes about ten minutes. This method, however, can only be used when there are a number of barrels to be brazed, as it would not pay to heat the muffle for one or two. The breech end having been thus secured, the barrels are ready for the ribs to be fitted and soldered on, they are then struck up from end to end, with various-shaped strikers, and are then taken to the action-filer, who provides for putting the "action" on the barrels. Then follow in order the furniture forger and filer, who provide the guard, the trigger, &c., the lock forger and filer. Of lock making, Mr. J. D Goodman truly says:—"Till within the last few years locks were entirely the production of hand labour, the several parts were forged on the anvil by men whose wonderful skill became proverbial. They were afterwards put together by filers, to be finished by the polisher and hardener. At the present time the steam hammer and stamp are superseding the forge, and milling machinery is doing much of the filer's work, but in no case, even when machinery is carried to the highest perfection, can the filer be dispensed with; the locks cannot be put together until all the limbs have passed through his hands to receive the final adjustment." The parts are again taken to the action-filer, who fits on the breech action, to which he attaches the lock, trigger, and guard. It then goes for final or definitive proof, with action attached, and is afterwards finally smoothed, and when viewed and found perfect is passed to the stocker.

One of the most interesting operations in gun-making is that of making the top lever action for breech-loading guns. Messrs. Webley make a specialty of this action, "which is made either single or double bite; when the latter, Mr. Purdey's patent double bolt is used, for the right of using which they have a licence from Mr. Purdey." They have put down some special and ingenious machines for the purpose of machining it in the most perfect manner. You first see a rough looking piece of iron, which has been stamped roughly into the form required. This forms the body of the action, and it is first passed between two cutters, which cut it into the exact width. It is then cut to fit on the joint of the barrel. It is now ready for drilling. In this operation the body is placed in a "jig," which is, in fact, the pattern in which are the holes through which the drill works, and makes the body ready for the bolt. This done, it is placed in another jig, and drilled for the joint holes and slots. It is then passed to another machine, by which the slot is sawn out for the lump of the barrel.

It is now ready to be worked on the barrels of the gun. And first a plug, the exact size of the cartridge is fixed into each barrel, and the lump is cut horizontally, and then the ends of the barrels are squared. The next operation is to cut the lump the proper shape, which is done crosswise. It then goes to a machine by which it is cut out for the extractor, and with the extractor which has been properly turned and fitted, it is given to the jointer, who joints the parts together Then the lock-holes are cut out, then the grip in the lock into which the bolt passes. The gun is now ready for proof. After it has stood this test it is percussioned by hand labour. The workman now puts in the locks, fits in the bolts, puts in the perpendicular spindle, and the lever on the spindle at the top The whole action is then filed into shape, smoothed, and is at last ready for the stocker, whose work is hereafter described

We have not paused in this progressive account of making a top-lever action to describe any of the machines by which the various operations are performed. They are all self-acting, and one man can superintend several at the same time, for when once set they work automatically. In all the cutting operations the body is fixed into a jig or mould on a movable table. All the cutters are of the same shape as the pattern to be cut, and some of them are composed of as many as seven pieces. Some of them have a double action, and as the cutter is guided by a pattern fixed on the table opposite to the piece to be cut, the utmost exactitude is secured in all the operations, whether of cutting or drilling. In all cases the best lard oil is used for the purpose of lubrication. It is quite an intellectual treat to see these machines at work.

The stocks are of walnut. Mr. Webley, senior, pays the greatest attention to this part of the gun. He is always in search of good—especially of good English—walnut, which is the best. By constant watchfulness he is able to secure a large quantity of the finest wood for this purpose, and we saw some splendid specimens of walnut on the occasion of our visit. The difference in the value of wood for gun-stocking is great; one stock-piece may not be worth more than a shilling, while another is worth twenty-five. After the tree has been sawn into planks, great care has to be taken in marking out the stocks so as to secure the right way of the grain; and, after cutting out, the pieces have to be kept from two to three years in order that they may be thoroughly seasoned.

The rough wood is taken by the stocker, who cuts it into the proper shape; he then lets in the stock the action, then the lock-plates without the inside work, afterwards putting on the inside work and letting that in also, he fits on the fore-end, and rounds all the wood into shape, and passes it on to the screwer, who lets in the trigger-plate, trigger-guard, &c, and fits the pins and screws to bind the whole together, and passes it to the man who fits the hammers (called in muzzle-loading guns percussioning). Barrels are then bored for shooting, and the gun is carefully shot at forty yards for penetration and pattern. Should it not shoot up to the required standard of excellence it is altered until it does. It is then passed to the finisher, who finally makes off the stock chequers, and smooths all the work level. The whole is then taken asunder, the barrels are finally smoothed, engraved, and named, at which stage it goes to the barrel-browner.

Browning is a very interesting process. The browner takes the barrel and paints on a coat of acid, after which it looks as if covered with rust. This is rubbed off with a wire brush, and it is then boiled in water, and another coat of acid put on, and so on till the work is done, and the figure is completely developed. This operation takes from three to four days for the best guns. For military guns it is much simpler, and more easily done.

The action, locks, and other parts are next polished, then engraved and named, and afterwards case-hardened. The whole is then ready for the hands of an experienced action filer, who frees the action, which in hardening usually swells a little. The gun is then put together by the man who finishes it, and it is then ready for final examination and regulating, and we have a gun fully and completely made.

We were very much struck with the great variety of systems of guns and rifles manufactured by Messrs. Webley, as well as by the many grades of quality, commencing at the lowest, consistent with soundness, and progressing step by step to the very finest work that skill and taste can produce. Amongst the various systems shown to us, we noted, as still being in

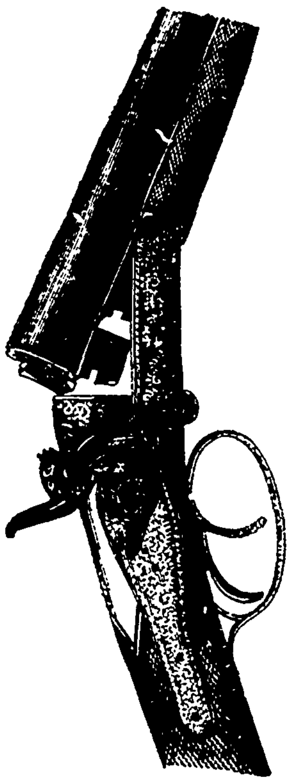


Fig. 4. No. 2 System. Back-work Lock Central Fire, Side-lever Snap Action, with Purdey's Double Bolt.

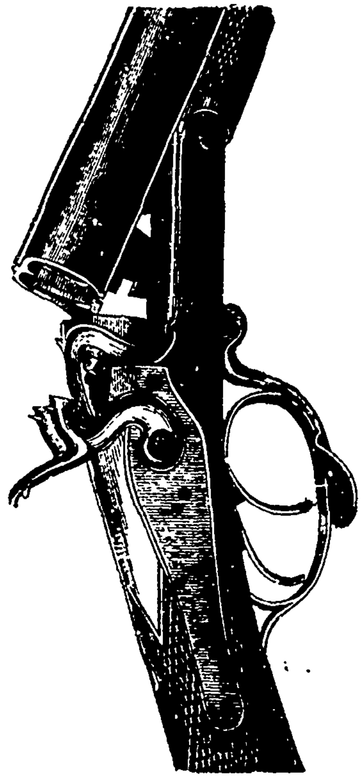


Fig. 6. No. 3 System. Top Lever, Purdey Bolt.

Fig. 1. Swinburn Sporting Carbine.

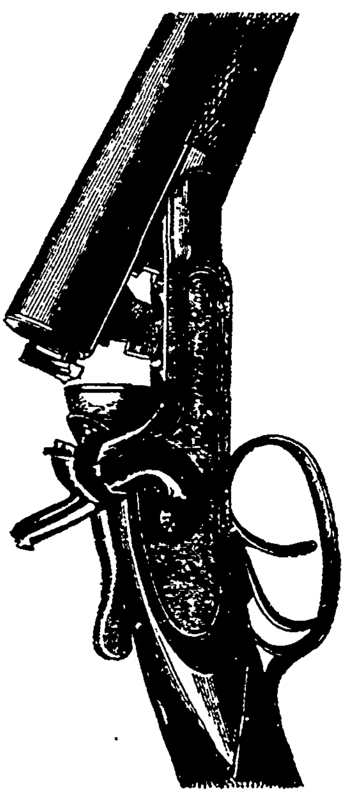


Fig. 2. Central Fire Breech-loading Gun.

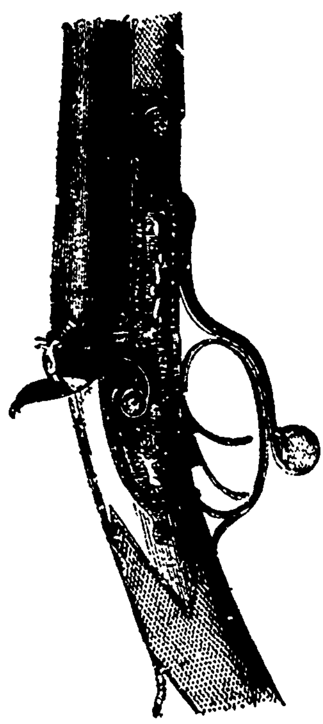


Fig. 3 No. 0 System. Bar Lock Central Fire, Lefaucheux Action.

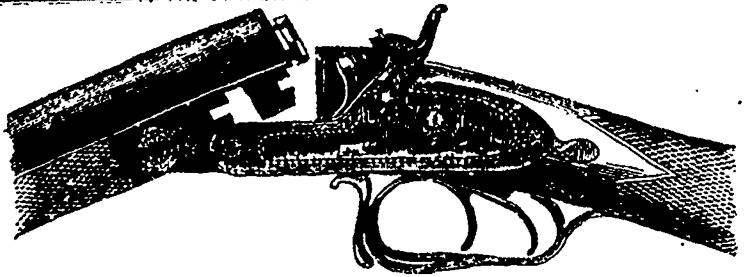
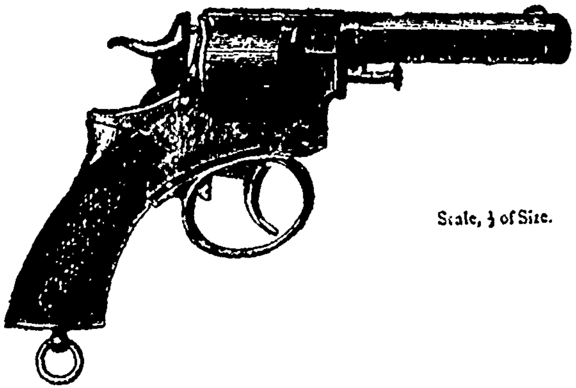
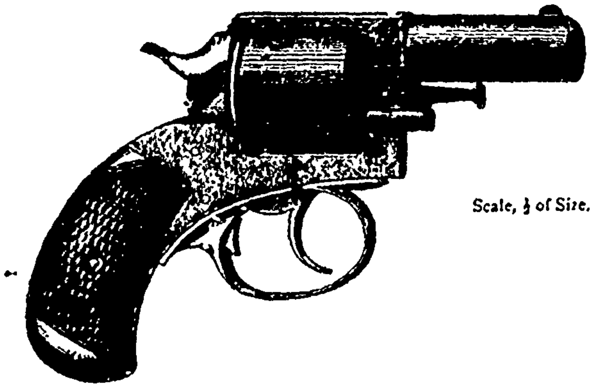


FIG. 7. No. 5 SYSTEM. PURDEY LEVER, FRONT OF BOW.



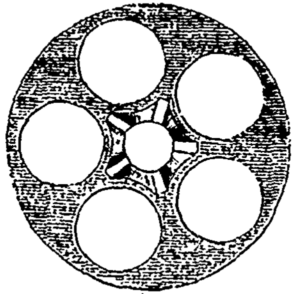
Scale, ½ of Size.

FIG. 8. ROYAL IRISH CONSTABULARY REVOLVER, DOUBLE-ACTION, WITH EXTRACTING-ROD IN SPINDLE.



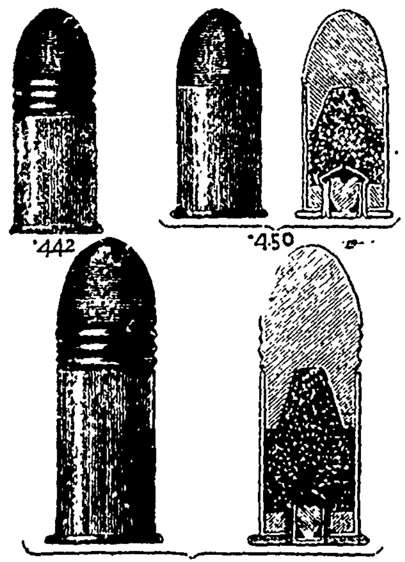
Scale, ½ of Size.

FIG. 9. BRITISH BULL-DOG REVOLVER, DOUBLE-ACTION, WITH EXTRACTING-ROD IN SPINDLE.



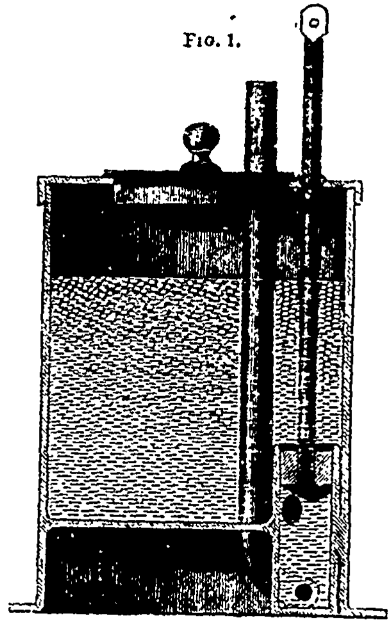
THE BRITISH BULL-DOG CYLINDER.

FULL SIZE.



CARTRIDGES—FULL SIZE.

FIG. 1.



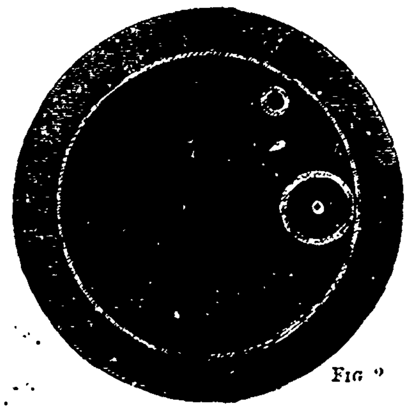


FIG. 2

THE UNIVERSAL DISINFECTOR.

large demand, the old original double-grip Lefaucheux action with lever over guard; then the same action made self-locking by a very simple addition, patented by Mr. T. W. Webley in 1866, which has been still further improved upon by making it treble-grip, by the addition of a compensating bolt. This is a great advantage, more especially for rifles, and was patented by Mr. James Lang of London. Snap-action guns both with single and Purdey's double bolt are made with the levers placed in every conceivable position; on the top, between the hammers; on the side, either right or left, under guard; side of guard or in front of it, and with the bow made open to receive the thumb, known as Purdey's lever. These again, are all made with or without rebounding (self half-cocking locks, and with lever fore-part fastening, entirely doing away with the old fashioned bolt. The best of these by far, is a very neat arrangement of lever, strong and certain in its action, which we did not consider the spring fore-parts to be.

Great attention is paid by Messrs. Webley to the making of double and single sporting, "Express," and long-range rifles. The favourite action for double "Express" rifle, being the treble grip, the joint patent of Mr. T. W. Webley and Mr. James Lang. To turn out a perfect double rifle, with both barrels shooting accurately, is the height of gun-making art. In single rifle, "Express" and otherwise, they use the "Swinburn" breech action, of which they hold a very high opinion, alleging that it has all the advantages of the "Martini" breech action, without its many defects. We annex an engraving of the Swinburn sporting carbine.

For the information of our readers, we furnish illustrations of various systems and forms of lever of breech-loading guns manufactured by Messrs. Webley.

The Messrs. Webley and Son have a world-wide reputation as manufacturers of certain well-known kinds of revolving pistols Among these are pre-eminently noted the Royal Irish Constabulary pattern made by them for this force in 1868, and selected by the Inspector-General of the Forces, after a keen competition. This arm has since been adopted, and largely used by the Queensland Goverment, the Victoria Government, and the Cape Mounted Police. A large number of these revolvers were also used by Her Majesty's officers engaged in the Ashantee war.

Another pattern worthy of especial notice is a revolver constructed about two years ago, which, in comparison with the size of cartridge used therewith, is the smallest yet manufactured. This revolver has been most appropriately named "The British Bulldog," which is stamped on the top strap of each pistol. This weapon has found a great demand in all export markets.

We will now initiate our readers into the mysteries of revolver-making. You first see the pistol body, which is a rough-looking bit of malleable iron of the form and shape required. In the centre of each of these pieces of iron is a square hole, which is, after several processes, to receive the cylinder containing the chambers of the revolver. The first process is to force a long piece of cutting steel, called a "drift," through this hole, and thereby cut it into shape. Two "drifts, the second of a finer cutting power than the first are used, and the force required to effect this sometimes amounts to a pressure of ten tons. This forms a "standard, to which all the other parts of the work have to be done, and it must be absolutely true. The next operation is a very beautiful bit of machine work. The piece of iron is put in a block the size of the drift-hole, and by moving it backwards and forwards the sides are planed or milled quite true. This machine also cuts out the recess by which the cartridge passes into the chambers. When one side has been milled it is reversed, in order to mill the other side. This beautiful machine is capable of the most delicate working; in proof of which we saw, on a piece of iron, the name of the workman, which he had cut out as an illustration of its power.

The milled body is next placed in a jig, in which all the action-holes are drilled; then the strap is made for the handle of the pistol, and it is next cut along the top of the strap and round the body, and the slot for the shield-spring is cut in.

In making the cylinder, a round bar of steel is cut into the required length, and a hole then drilled through the centre. This centre is the standard from which the rest of the work is done. The cylinder is next turned quite smooth, and to its exact gauge. It is then placed in a chuck, and the chambers are drilled. In the chuck are the divisions giving the number of chambers to be drilled in each cylinder, and as each chamber is made, the chuck and cylinder are turned to the next division, and is again drilled, and so on, until all are completed. The ease with which this drilling machine works is manifest from the fact that a six-chambered cylinder can be drilled in from five to seven minutes. The bolt holes are then cut, and then the ratchets, there being as many bolt-holes and ratchets as there are chambers in the cylinder.

This done, we go to barrel-making. A square bar of solid steel of the length of the barrel is placed in a chuck in a lathe, and is slowly drilled through. After drilling about three-eighths of an inch, the drill is drawn out, bringing with it the dirt and the refuse. A barrel of four inches and a half in length can be bored in ten minutes. Soapsuds are used in this operation, which are in a bucket suspended over the lathe, and flowing down through a hose, continually runs on the boring tool, thus preventing it from getting too hot. When bored, the barrel is cut down for screwing, and the screw cut for jointing to the body. It is then cut into shape. Two nuts are fastened on the screw end, and it is laid in a pair of cutters, and by a succession of cuts up the barrel, it is finally shaped.

By similar processes the hammer, sear, and trigger are made Each being put in a jig, having the necessary holes drilled, the sides flattened or machined, and all work needful to make each part fit and work accurately is done. The rounding and pointing the nose of the cock is a very interesting operation.

All the parts being thus prepared, they are put together by the action-maker, and afterwards sent for proof. On returning, the pistol is taken to pieces, smoothed up and sighted. These operations have to be very carefully done, as the utmost accuracy is required in making a good sight. This done, the revolver goes to the stocker, then to the polisher; after it is polished, it has to be cleaned and put together, and at last, after all these operations have been skilfully and carefully executed, the revolver is ready for use.

THE UNIVERSAL DISINFECTOR.

It is the opinion of those who have most studied the matter that the presence of typhoid fevers and much other ill-health is due in a very large measure to the presence in the house of losely constructed "modern conveniences." These diseases are just now almost epidemic in some parts of Canada, and of an unusually fatal type. We illustrate, from *Engineering*, on page 281 a new invention intended to be used in public buildings, private houses, hospitals, clubs, &c., for entirely removing all smell from water-closets, drains, and other places whence offensive or dangerous emanations may arise,and which is now being introduced by a company entitled the Universal Disinfector Company (Limited). For closet use the disinfecting liquid is contained in a vessel called the "disinfector,' which is placed under the seat of the closet, and is entirely out of sight. When so fixed, it is called into operation by the ordinary movement of the handle, which causes the usual flushing of the pan, and supplies a definite, although small quantity of the disinfecting fluid at the moment of the closing of the pan, and while the water is in rapid motion within it. This period is chosen so as to prevent all waste of the disinfecting fluid, and to insure the full beneficial results from it at the moment of application. The water remaining in the pan receives a blue tinge, and at once deodorises any gas that may arise, or any fœcal matter that has escaped the water-flushing. The disinfector holds enough liquid for 950 uses of the closet, and the cost of each operation does not exceed the sixteenth part of a penny.

As shown by the engraving, the apparatus is of simple construction. It consists of a vessel of gutta-percha, at the bottom of which is formed a short barrel in which a piston works. Just above the bottom of the vessel are holes which allow the disinfecting fluid to flow into the barrel, while from the bottom of the barrel itself a gutta-percha tube is led off to the pan of the closet. When the piston is in the position shown in the engraving, the barrel evidently becomes charged with the disinfecting fluid, while as the piston descends a portion of this fluid is forced out again through the charging holes until the piston passes them, when the remainder is by the continual descent of the pistonf orced out through the gutta-percha tube already mentioned into the pan of the closet. The rod from the piston is, as we have said, connected to the ordinary lever which causes the flushing of the pan. It will be seen that by the arrangement we have described, a pump action is obtained without the employment of any valves. The apparatus can be very easily fixed, and insures the economical use of the disinfectant.

ON REMOVING STAINS.

Many articles of clothing, carpeting, &c., otherwise in good condition, are thrown aside in consequence of having contracted an unsightly spot by contact with grease, wine, or other soiling substances In very few instances is the texture of the material injured; and a ready means of removing the stain, or of restoring the colour, if it has been discharged, would often be gladly employed, were it not that the owner of the damaged article is fearful lest the means employed should tend to aggravate the evil, either by enlarging the stain, changing the colour of the ground, or rotting the texture of the fabric. With a little care, however, and attention to the nature of the material, the dye, and the stain, these bad results may be avoided, and the soiled material restored to its pristine integrity.

In order to proceed with any degree of certainty in our endeavours to remove stains, we must divide them into three classes, as each variety will require a peculiar treatment. The first class comprehends those stains which do not in any way affect the nature of the material or colour, but simply alter its appearance, and which can be removed by the application of one agent alone. These we may designate Simple Stains.

The second division includes such as are produced by two or more substances conjointly, and which consequently require the employment of several cleansing agents These are known as Mixed Stains.

In the third category we may place such stains as are produced by bodies which alter or destroy the colour.

In the first class we may place water, oily matters, vegetable juices, blood, and iron or ink stains. If water be allowed to fall on some kinds of silks, satins, or woollen fabrics, it dissolves away part of the dressing, and the consequence is that a dull spot appears on the glossy ground. To remove a stain of this nature, it is necessary to steam the spotted material until it is all equally moistened. It may then be hot pressed, or if small, ironed with a hot but perfectly clean iron.

Grease spots may generally be removed from the most delicate material by the employment of benzine, or oil of turpentine, care being taken that sufficient be employed to remove all line of demarcation. Ox-gall is particularly useful in extracting grease stains from woollen goods If the stain be very thickly crusted and old, it may be sometimes advantageous to soften the grease (previous to the application of benzine) by means of a warm iron laid on a piece of thick blotting-paper which has been placed over the spot

Tar and pitch produce stains easily removed by successive applications of spirits of turpentine, coal-tar naphtha, and benzine. If they are very old and hard, it is as well to soften them by lightly rubbing with a pledget of wool dipped in good olive-oil. The softened mass will then easily yield to the action of the other solvents. Resins, varnishes, and sealing-wax may be removed by warming and applying strong methylated spirits. Care must always be taken that, in rubbing the material to remove the stains, the friction should always be applied the way of the stuff, and not indifferently backwards and forwards.

Most fruits yield juices which, owing to the acid they contain, permanently injure the tone of the dye; but the greater part may be removed without leaving a stain, if the spot be rinsed in cold water in which a few drops of liquor ammonia have been placed *before the spot has dried.* Wine also leaves an ugly stain on white materials; from these it may be removed by rinsing with cold water, applying locally a weak solution of chloride of lime, and again rinsing in an abundance of water. The dressing must again be imparted by steaming, starching, and hot-pressing.

Fresh ink and the soluble salts of iron—such as are used by photographers in their developing solutions &c —produce stains which, if allowed to dry, and especially if afterwards the material has been washed, are difficult to extract without injury to the ground. When fresh, such stains yield rapidly to a treatment with moistened cream of tartar, aided by a little friction, if the material or colour is delicate. If the ground be white, oxalic acid employed in the form of a concentrated aqueous solution, will effectually remove fresh iron stains. Acids produce red stains, or blacks, blues, and violets, made from the vegetable colours (except indigo.) If the acid has not been strong enough to destroy the material, and the stains are fresh, the colour may generally be restored by repeated soakings in dilute liquor ammonia, applied as locally as possible. Photographers frequently stain their clothes and cloths with nitrate of silver. The immediate and repeated application of a very weak solution of cyanide of potassium (accompanied by through rinsings in clean water) will generally remove these without injury to the colours.—*English Mechanic*

NEW RECIPES.

COMPOSITION FOR PICTURE FRAMES.

1. To make composition ornaments for picture frames Boil 7 lbs. of the best glue in 7 half pints of water, melt 3 lbs. of white resin in 3 pints of raw linseed oil; when the ingredients are well boiled, put them into a large vessel and simmer them for half an hour, stirring the mixture and taking care that it does not boil over. When this is done, pour the mixture into a large quantity of whiting, previously rolled and sifted very fine, mix it to the consistence of dough, and it is ready for use.

2 Dissolve 1 lb. of glue in 1 gallon of water; in another kettle boil together 2 lbs. of resin, 1 gill of Venice turpentine, and 1 pint of linseed oil: mix together in one kettle, and continue to boil and stir them together till the water has evaporated from the other ingredients; then add finely pulverized whiting till the mass is brought to the consistence of soft putty. This composition will be hard when cold: but being warmed, it may be molded to any shape by carved stamps or prints, and the molded figures will soon become dry and hard, and will retain their shape and form permanently. Frames of either material are well suited for gilding.

INVISIBLE INK.

If we write with a very dilute solution of chloride of copper, which has scarcely more color than pure water, the characters are invisible; but if gently heated, they become distinctly yellow, and are easily read Let the paper cool, and they vanish, and they may be made to appear and disappear an indefinite number of times. If heated too strongly, the compound is decomposed, and the writing becomes permanently brown from the deposition of the copper. The chloride of copper may be conveniently made by mixing solutions of ammonic chloride (sal ammoniac) and of cupric sulphate (blue vitriol.)

The change of color in this and kindred cases is due to the removal of the water of crystalization by the heat. In chemical combination with the water, the salt is transparent, without the water, it is opaque The salt, being very deliquescent, rapidly absorbs moisture from the air when cool

Iron as a Wood Preserver.—According to Hubert, the best means of protecting wood which is exposed to moisture, especially railroad ties, is to drive into them long, fine iron nails with broad and flat heads. When wood thus protected is placed in the ground the nails rust, and the rust spreads equally throughout the wood protecting it. The ties may also be wound with iron wire. Hubert states that wood treated this way has been buried in moist earth and remained sound for nearly fifteen years.

A Strong White Paste.—Dissolve 2½ oz. of gum arabic in 2 quarts of water, and stir it into 1 pound of wheat flour until the whole becomes of a pasty consistency. It is then to be heated, and 1½oz each of sugar of lead and alum dissolved in a little water, added thereto, and the composition well stirred until it shows signs of boiling when it must be removed from the fire. Add while hot six drops of carbolic acid. This is a very tenacious and durable paste and may be used on almost any substance.

MAKING PACKETS OF TOBACCO.

MAKING CIGARETTES.

RULES FOR HANDLING NITRO-GLYCERINE.

As Mr. Mowbray, the chemist at the Hoosac Tunnel, has probably had a larger and more thorough experience with nitro-glycerine than any man in America, we are glad to have the opportunity of appending the rules made by him for handling and transporting this famous explosive. The following rules and instructions are substantially those which have insured the unusual safety maintained at Hoosac Tunnel:—

1. Handle with the greatest care, avoiding every possible jar or concussion, and be very careful, if any is spilled outside the can, to avoid striking it with or against any hard substance.

2. When in a solid state, thaw out by placing the cans in a vessel of warm water, never warmer than the wrist can bear, first pouring some of the warm water from the vessel into the can, and always removing the can or cans before adding more warm water to that in the vessel in which the cans are placed.

3. When filling cartridges hold them carefully over a tray about two feet by three, the bottom of which must be thoroughly covered with plaster of Paris, which latter must be replaced as rapidly as lightly saturated with the nitro-glycerine. Memorandum; plaster of Paris saturated with nitro-glycerine does not readily explode.

4. If necessary to store nitro-glycerine in a liquid state for any length of time, insert the cork loosely, and pour a pint of cold water in each can, which water must be frequently and carefully poured off and replaced with fresh cold water in warm weather, always taking care to retain the bladder under the cork. If ice can be procured, however, it its both safer and more desirable to congeal the nitro-glycerine and keep it in a solid state.

5. Use gutta percha funnels for filling water holes. Never tamp the drill holes, it is totally unnecessary and is pretty sure to kill the individual who does it.

6. Never use hot irons to warm the water, or for soldering the cans, both are sure to cause explosions.

7. Never sledge or drill in a hole or seam where nitro-glycerine has been spilled, without first firing an exploder to clean the place out.

8. Never pour nitro-glycerine into a hole, unless perfectly sure that the hole is sound and will hold water; if otherwise, always use a cartridge.

9. To obtain the best results, use drill holes always 6 feet in depth, or over, fire with powerful exploders and well insulated wire, by electric battery and with simultaneous explosion.

10. After a blast, look carefully for any unexploded cartridges that may be laying around loose.

11. Allow none but the most careful, competent, and sober persons to handle or have charge of nitro-glycerine, and enforce ridgid obedience to orders and compel the adoption of every precaution to prevent accidents or explosions.

12. Never use empty cans for other purposes, transport them to a safe place, and destroy them by fire, or with a fuse and exploder.

13. Carefully examine the cans from time to time, and notice if any pin holes have been eaten through at the level of the nitro-glycerine therein. Should the presence of such holes be detected, procure new cans or stone jars, and place the contents of the unsound can therein, never loosing your hold of the upper portion of the unsound cans, lest it break loose and trouble ensue.

14. When congealed, nitro-glycerine is absolutely safe; if, possible, therefore, it should always be stored surrounded with ice, since explosion is impossible when a solid state.

ODORS.

Among mineral substances, few solids, but quite a number of liquid and gases, are endowed with more or less powerful scents, in most cases not very pleasant ones, and usually characteristic. Those odors belong to simple substances, such as chlorine, bromine, and iodine; to acids, as hydrochloric and hydrocyanic acid; to carburets of hydrogen, as those of petroleum; to alkaline substances, ammonia, for instance, etc. The odors observable among minerals may almost all be referred either to hydrocarbonic or hydrosulphuric gases, or to various solid and liquid acids produced by the decomposition of fats or to peculiar principles secreted by glands, such as musk, ambergris, civet, and the like.

The odor of plants is due to principles very unequally distributed throughout their different organs; some solid, as resins and balsams, others which are liquid, and known by the name of essences or essential oils. In most cases the essence is concentrated in the flower, as occurs with the rose and the violet In other plants as in bent grass and Florence iris, only the root is fragrant. In cedar and sandal wood, it is the wood that is so; in mint and patchouli, the leaves; in the Tonquin bean, the seed, in cinnamon, it is the bark which is the seat of the odorous principle. Thus the orange has three: that of the leaves and fruit, which gives the essence known by the name of *peti' grand*; that of the flowers, which furnaces neroli; and again the rind of the fruit, from which essence of Portugal is extracted.

What, now, is the chemical nature of the odorous principles in plants? The chemistry of today reduces almost all of them to three catagories of well ascertained substances: hydrocarburets, aldehydes, and ethers. We will endeavour to give a clear account of the constitution of these three kinds of substances, and to mark their place in the register of Science. The hydrocarburets are simple combinations of carbon and hydrogen, as, for instance, the petroleum oils. They represent the simple compounds of organic chemistry. As to aldehydes and ethers, their composition is rather more complex; besides carbon and hydrogen they contain oxygen. Every one knows what chemists mean by an alcohol; it is a definite combination of hydrogen, carbon, and oxygen, neither acid nor alkaline, which may be regarded as the result of the union of a hydrocarburet with the elements of water. Common alcohol, or spirits of wine, is the type of the most important series of alcohols, that of the mono atomic alcohols. Chemists represent it by the formula C^2H^6O, to indicate that a molecule of it arises from the union of two atoms of carbon with six atoms of hydrogen ond one of oxygen. Independently of the alcohols, which are of great number and varying complexity, organic chemistry recognizes another class of bodies, of which vinegar is the type, and which receive the name of organic acids, to mark the resemblance to mineral acids, such as oil of vitriol or aquafortis. Now, every alcohol, on losing a certain amount of hydrogen, gives rise to a new body, which is called an aldehyde; and every alcohol, on combining with an acid, produces what is called an ether. These rapid details allow us to understand precisely the chemical character of the essences or essential oils which plants elaborate within their delicate tissues. Except a small number among them which contain sulphur, as the essences of the family of crucifers, they all present the same qualitative composition—carbon and hydrogen, with or without oxygen. Between one and another of them merely the proportion of these three composing elements varies, by regular gradations, but so as always to correspond either to a hydrocarburet, or to an aldehyde, or to an ether. In this case, as in almost the whole of organic chemistry, everything is in the quantity of the composing elements. The quality is of so little importance to Nature that, while following always the same laws and constantly using the same materials, she can, by merely changing the ponderable relations of the latter, produce, by myriads of various combinations, myriads of substances which have no resemblance to each other. The strange powers of the elements and the mysterious forces concealed in matter make themselves known to us in a still more remarkable phenomenon, to which the name of *isomery* is given. Two bodies, throughly unlike as regards their properties, may present absolutely the same chemical composition with respect to quality and quantity of elements. "But in what do they differ?" it may be asked. They differ in the arrangement of their molecules. Coal and the diamond are identical in substance. Common phosphorus and amorphus phosphorus are one and the same in substance. Now, the odorous principles of plants offer some exceedingly curious cases of isomery. Thus the essence of turpentine, the essence of lemon, that of bergamot, of neroli, of juniper, of salvin, of lavender, of cubebs, of pepper, and of gillyflower are isomeric bodies, that is, they all have the same chemical composition Subjected to analysis, all these products yield identical substances in identical proportions, that is, for each molecule of essence, ten atoms of carbon and sixteen atoms of oxygen, as denoted by their common formula $C^{10}O^{16}$. We see now these facts as to isomery prove that the qualities of bodies depend far more on the arrangement and the inner movements of their minute particles, never to be reached by our search, than on the nature of their matter itself, and they show, too, how far we still are from having penetrated to the first conditions of the action and forces of substances.

But chemistry has not stopped short with ascertaining the inmost composition of these substances, it has succeeded in reproducing quite a number of them artificially, and the compounds thus manufactured, wholly from elements, in laboratories, are absolutely identical with the products extracted from plants. The speculations of theory on the arrangements of atoms, sometimes condemned as useless, do not merely aid in giving us a clearer comprehension of natural laws, which is something of itself, but they do more, as real instances prove, they often give us the key to brilliant and valuable inventions. An Italian chemist, who was then employed in Paris, Piria, in 1838, was the first who imitated by art a natural aromatic principle. By means of reactions suggested by theory, he prepared a salicilic aldehyde, which turned out to be the essence of meadowsweet, so delicate and subtile in its odor. A few years later, in 1843, Cahours discovered methyl-salicilic ether, and showed that it is identical with the essence of wintergreen. A year after, Wertheim composed essence of mustard, while believing himself to be making only allyl-sulphocyanic ether. These discoveries produced a sensation Nowadays the chemist possesses the means of creating many other natural essences. Common camphor, essence of bitter almonds, that of cummin and of cinnamon, which are aldehydes, as we have seen, may be prepared without camphor leaves or almonds, without cummin or cinnamon. Besides these ethers and aldehydes, whose identity with essences of vegetable origin has been proved, there exist, among the new bodies known to chemistry, a certain number of products formed by the union of common alcohol or amylic alcohol with different acids, that is to say, of ethers, which have aromatic odors more or less resembling those of some fruits, but as to which it cannot yet be affirmed that the odors are due to the same principles in both cases. However this may be, perfumers and confectioners, more industrious and wide-awake than chemists, have immediately made good use of many of these properties.

Artificial aromatic oils made their first appearance at the World's Fair of London in 1851 There was there exhibited a pear oil, diffusing a pleasant smell like that of a jargonel, and employed to give an aroma to *bonbons*. This product is nothing else than a solution of amylacetic ether in alcohol. Apple oil was exhibited beside the pear oil, having the fragrance of the best rennets, and produced by dissolving amylvaleric ether in alcohol. The commonest essence was that of pineapple, which is nothing else than ordinary butyric ether. There was observed, too, an essence of cognac, or grape oil, used to impart to poor brandies the highly prized aroma of cognac The product which was then, and still is, the most important article of manufacture, is the essence of mirbane, which very closely resembles in its odor that of bitter almonds, and which commerce very often substitutes for the latter. Essence of mirbane is nothing else than nitrobenzine, which results from the action of nitric acid on benzine. Benzine, in turn, is met with among the products of distillation of tar, which also yield the substances used in preparing those beautiful colors called aniline —*F. Papillon, in Revue Scientifique.*

We understand that the Grand Trunk Railway are about to put ticket clerks on their trains to perform the duties in connection with the collection and issue of tickets and fares on the trains. This course has probably been brought about by the declaration of the conductors that they could not perform the whole of the duties required by the Company in connection with this portion of their work.

SCIENTIFIC NEWS.

Cockroaches in the Carboniferous of Cape Breton.— In the *Canadian Naturalist* (Vol. VII., No. 5) Mr. Scudder describes two new species, having two wings, described by R Brown. He has given them the names of *Blattina Bretonensis* and *B. Heeri*. They are in a duskish shale, and are associated with leaves of Sphenophyllum and fern.

Marine Champlain Deposits on Lands north of Lake Superior.—Dr. Dawson, in his annual address before the Natural History Society of Montreal, says that Professor Bell, in the "Report of the Canadian Geological Survey for 1870-71," states the occurrence of marine shells, similar to those of the Champlain deposits in the vicinity of Montreal, at a height of 547 feet above the sea. Dr. Dawson also remarks that in the hills behind Murray Bay and Les Eboulements, he has observed these shells at a height of at least 600 feet; and also that Mr. Kennedy has recently found marine shell deposits of the same era on Montreal Mountain, at a height of 534 feet above the sea.

Painting on Zinc without Paint.—M. Puscher, of Nuremberg, has lately invented a simple process for colouring sheet zinc, based on the employment of acetate of lead. On applying this substance, mixed with a minimum preparation, a reddish brown tinge is obtained. The cupola of the synagogue at Nuremberg was thus coloured as an experiment over a year ago, and, to all appearance, is yet unaffected by the weather. By adding other bases, lighter or darker tints of grey and yellow may be obtained, giving the zinc work the appearance of carved stone. With a solution of chlorate of copper the preparation turns the sheets of zinc black.

Another tunnel under the Alps is proposed: it will pass under the St. Bernard and be 20,000 ft. in length. The novel feature of this undertaking is that under the summit, the tunnel will be widened out to make a station, and a shaft will be cut, up which passengers will be taken to a hotel on the top of the mountain.

A Correspondent of the Albany *Argus*, who evidently knows whereof he writes is imparting valuable information on transportation. He says:—" A few years ago a Canadian ship builder remarked that 'a rule of thumb law ' was that to obtain the cheapest transportation, the vessel should have as many tons carrying capacity as her destined voyage had miles. The distance between Chicago and Buffalo is a thousand miles, and by this rule the cheapest transportation, would be in vessels of a thousand tons. In arranging the size of the new enlarged Welland Canal it was adapted for vessels of twelve or fifteen hundred tons, which would be the number of miles to Oswego or Kingston, showing that the Dominion engineers have followed that rule : " The ocean ships, he says, are constructed on that rule.

A new compass has been invented in France by M. Duchemin, the magnetic force of which resides, not in a bar or needle, as in the ordinary instrument, but in a flat steel ring, magnetised, with its poles at two opposite extremities of the same diameter. This ring, supported upon an aluminium traverse, pivoted on agate at its centre, has attached to it the ordinary compass card, and acts promptly and efficiently. The author claims for it the following advantages:—(1) A magnetic power, double that of a needle whose length is that of the diameter of the ring; (2) two neutral points instead of one, as in the needle; whence it happens that none of the magnetism escapes, and that strong sparks like those from the Holtz machine do not derange the poles; (3) a better and more prompt performance of the compass, the card seeming to float, as it were, in a liquid; (4) a large increase in the sensitiveness of the instrument; (5) the ability to regulate the magnetic intensity of the ring, and thus to compensate for local causes. This is effected by means of a second magnetised steel ring, smaller than, and inside of, the first, the position of which—and therefore its neutralising action-may be easily adjusted. Under the direction of the Minister of the Marine, a trial trip of the new compass was made on the steamboat Faon with very satisfactory results. M. Duchemin now proposes, as an improvement, the use of a set of such rings, forming a spherical or spheroidal system of still greater magnetic power.

RAILWAY MATTERS.

An old copy of the English *Quarterly Review* of the year 1819 contains an account of a scheme for a railroad, on which it is proposed to make carriages run twice as fast as stage coaches. The editor evidently failed to appreciate the idea, or to believe in its possibility, for he comments upon it thus wise:—" We are not partisans of the fantastic projects relative to established institutions, and we cannot but laugh at an idea so impracticable as that of a road of iron upon which travel may be conducted by steam. Can anything be more utterly absurd or more laughable than a steam-propelled wagon movving twice as fast as our mail coaches? It is much more possible to travel from Woolwich to the arsenal by the aid of a Congreve rocket."

Paper Car-wheels.—An American paper says that the Connecticut River Railroad Company is about introducing, for trial, a set of paper car-wheels under the forward truck of one of its engines. These wheels are manufactured by bringing a pressure of 350 tons upon sheets of common straw-paper, which forces them into a compact mass, which is then turned perfectly round and the axle forced into a hole in the centre, this requiring a pressure of 25 tons weight. The tire is of steel, and has a one-quarter inch bevel upon its inner edge, thus allowing the paper filling to be forced in, 250 tons pressure being required in the process. Two iron plates, one upon each side of the paper, are bolted together, which prevents the possibility of the fillings coming out. The tire rests upon the paper only, and partakes of its elasticity in consequence.

A Safety Car Shoe.—A car shoe has been invented by Mr. Stillson, of Minneapolis, Minnesota, which is designed to prevent cars from leaving the track. It consists of a clamp-like arrangement, which is affixed between the wheels of each truck. This runs about two inches above the rail, and if anything happens to throw the wheels from the track the clamp at once grasps the rail, holds the car on the track and brings the train to a halt very quickly. During one of the experiments, in a curve of the road, on a down grade, a rail was removed from the track. The car having the shoe on was started down the grade, its speed being not less than thirty miles an hour. On reaching the gap the wheels jumped the track, the car settled down upon the shoe, which at once grasped the rail that had not been removed, held the car in an upright position on the track, and finally brought it to a standstill in a distance of 250 feet. At a second trial, with a speed of fifteen miles an hour, the same result was accomplished, the car being brought to a halt in 30 feet.

DE NEGRI AND HERRMANN'S ENGINE.

We illustrate on page 288 from Engineering a new style of horizontal Engine, which was recently exhibited in England. It is of 8 horse power nominal, and, beside being well designed is well made, and works very smoothly. The leading feature of novelty in the engine is undoubtedly the very ingenious automatically variable expansion gear, which is the invention of Mr. C. De Negri. With this gear, as the governor balls are extended or contracted, the steam is cut off at any earlier or later stage in the stroke, so that the engine is controlled without the use of a throttle valve, although the load may vary considerably.

It will be seen from the engraving, which shows at Fig. 1 an elevation, and at Fig. 2 a plan of the engine, that there is only one eccentric, eccentric rod and valve rod. These actuate the principal valve in the ordinary way, the back valve being entirely worked from the principal one, in which the two steam ports are carried through, so that in the two extreme positions of the back valve on the principal one, when one induction port is open the other is shut; the exhaust being controlled entirely by the principal valve.

The manner in which the back valve is worked by the principal valve is as follows: There is a flat disc piece with a recess cut out of its circumference, so that it somewhat resembles a cam. The bottom of the recess is struck from the centre of the disc piece, with a radius as much less than the radius of the disc piece itself, as the required play of the back valve on the front one. Rollers are fixed in the back valve, so that the disc piece, when revolving, works against, and fits between them, at any point in its revolution. The disc piece revolves as many times to

Fig. 1.

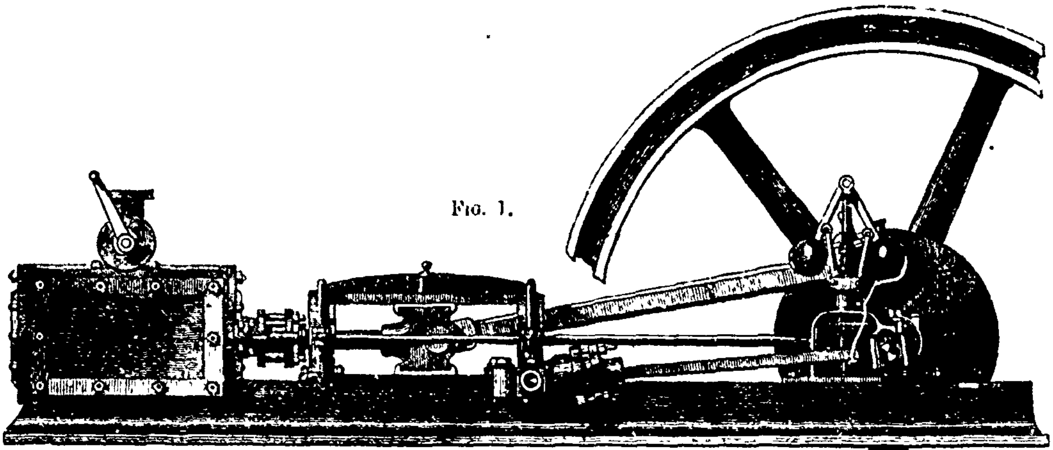
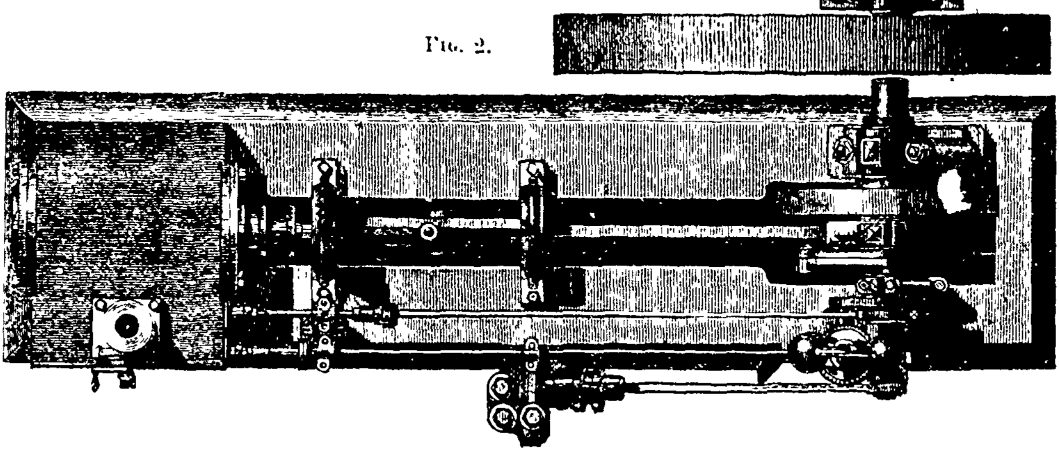


Fig. 2.



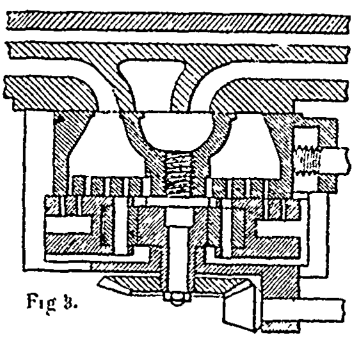
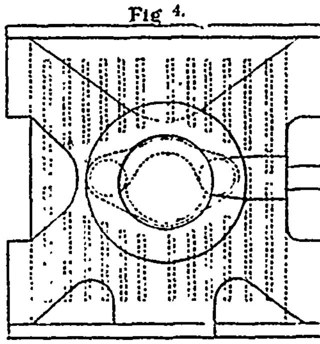


Fig 3.

Fig 4.



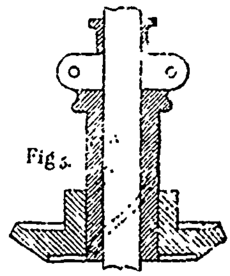


Fig 5.

DE NEGRI AND HERMANN'S ENGINE.

one revolution of the engine as it has recesses on its periphery, in the present case only once, the governor being so arranged as to cause, when up, a lead to the revolutions of the disc piece.

In Figs. 1 and 2 are shown the eccentric rod from which both the main and back valves are worked. The extension of the rod has both a revolving and a reciprocating motion as it is geared into a wheel which revolves the disc piece, and which also travels with it. The rod is square at the rear end, which works in a square collar, which allows of it following the travel of the valve. Fig. 5 shows a section through the governor stand, which has a screwed bush *e*, and as the governor balls are extended they lift this bush, causing a twist or lead between the wheel which gives motion to the side rod *c* and the wheel which takes the motion for the governor The indicator diagrams, show the great range of cut-off given by the gear we have described, which gear, we may add, acts very promptly

Apart from the novelties we have described, there are several, special features in this engine which are deserving of notice. One peculiarity is that the guide bars are cast in one, and bored out, the crosshead carrying slippers at top and bottom, which are turned to fit the guide. The wear can readily be taken up by means of keys between the crosshead and slippers. The engine has a disc crank and a small countershaft to carry the valve and pump eccentrics as well as driving the governors, thus allowing that part of the gear to be kept as small as possible. This countershaft is drivenf rom the crank pin by a drag link. It will also be seen that in this engine the centres are kept very low, by which arrangement the strain usually thrown on the bedplate and on the bolts, by which the various parts are attached to the bedplate, is reduced.