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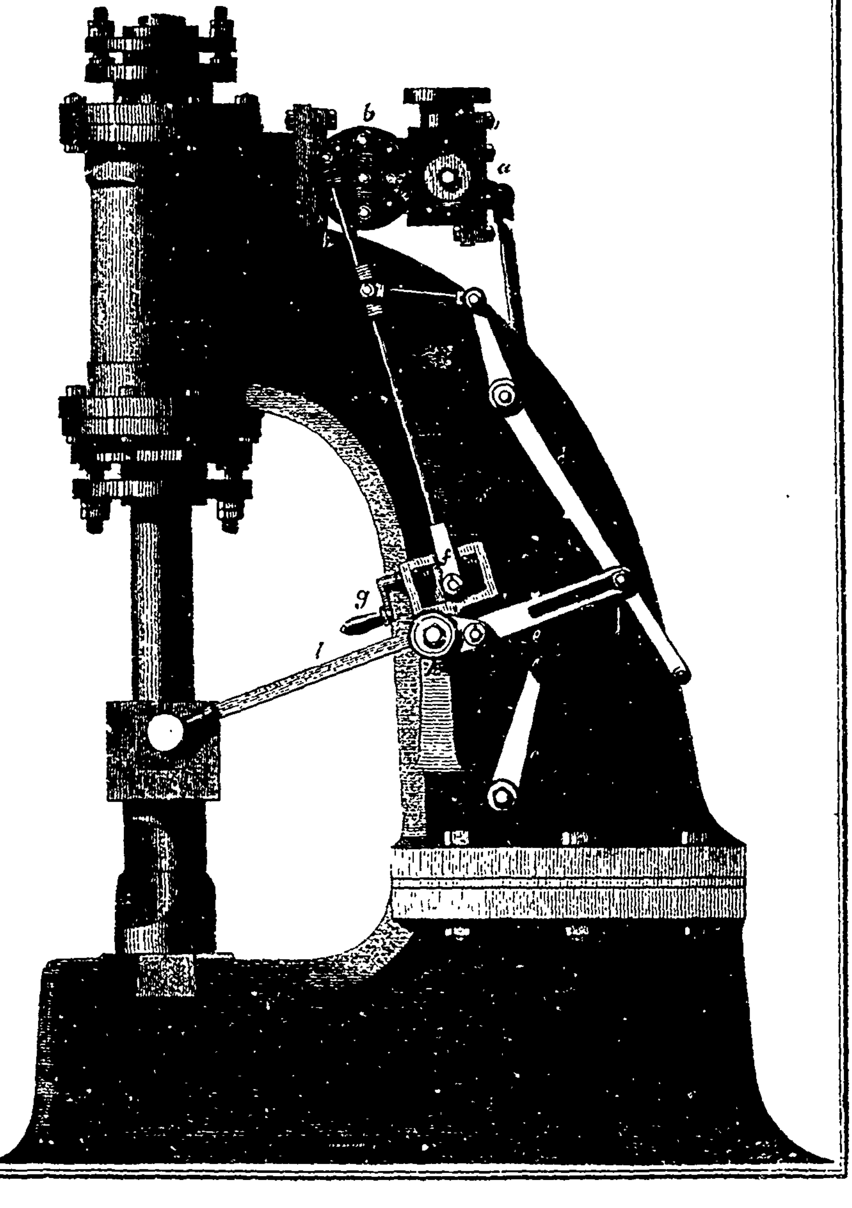
DOUBLE ACTING STEAM HAMMER AT VIENNA.

We present, on this page, an engraving of a small double-acting hammer, exhibited at Vienna by the Chemnitzer Werkzeugmaschinen Fabrik (formerly J. Zimmerman), Chemnitz. It is a very neat and handy little tool, and is arranged to be either hand-worked or self-acting, its maximum speed in the latter case being about 200 strokes a minute. The general shape of the hammer is clearly shown in the engraving; and we may remark that the casting is remarkably clean and good, which is by no means always the case in the tools of even the best German makers. The piston rod is of cast steel, the tup and piston being in one piece with it, and the lower cylinder cover and gland being on this account made in halves. The upper end of the piston rod is flattened to prevent it turning round. There are two valves only, an admission valve, *a*, and a distribution valve, *b*. The former is controlled by the lever, *c*, the rest of the gear being all in connexion with the distributing valve. When it is desired to make the hammer self-acting, the hand lever, *d*, is made fast by a screw in the position it at present occupies in the link, *e*. This link is merely a slotted lever free to vibrate a little when the lever, *d*, is moved, but not otherwise in connexion with the valve gear. The handle, *g*, is then turned until the sliding block in the end of the connecting rod, *f*, has been moved by the screw to the end of the link furthest away from the spindle, *k*. The slotted link in which the block works is on the same spindle, *k*, with the rod, *l*, and is compelled to vibrate along with the latter. The distribution valve is then worked automatically from the tup by the lever, *l*, the distance, *k*, *f*, (in the new position of *f*,) being the length of the lever which works the valve through the connecting rods, *f*, and *h*, and the lever



of the end of the valve spindle. When it is desired to work the hammer by hand, the screw securing *d* to *e*, is loosed, so that the former can be moved at will, and *f* is screwed down by the handle, *g*, to the lower end of the slotted link. As *f* is then immediately between *k*, and the valve, its motion (which is just as great angularly as before, being still derived from the tup), has no appreciable effect on the valve, which is now entirely under the control of the hand lever, *d*.

The maximum stroke of this hammer is 280 mm. (11.02 in.,) and the weight of its piston and rod, &c., 70 kilogrammes (114 lb.) It is worked at a pressure of 75 lb. per square inch, and, as has been already mentioned, it is double acting, the steam being admitted above the piston to intensify the blow. The gear for working the distribution valve is of steel. The weight of the whole machine is 2200 kilos, or very nearly 44 cwt.—*Engineering.*

THE CANADIAN RIFLE.

The Canadian rifle, known as the Duval-Macnaughten, has been tried at Wimbledon, and has elicited marked expressions of praise from the metropolitan press. The London *Post* thus refers to it, and we select this opinion from a number of others:—

"During the afternoon a trial was made at the 900 yards range with a new Canadian rifle, named the Duval-Macnaughten. This weapon is constructed on the hinge-block principle, and somewhat resembles the Henry and Martini-Henry in appearance. Its action, however, differs considerably from both these, and externally the principal difference is that there is no long lever below, the only lever visible being one which rises from the side of the lock, in much the same position as that occupied by the hammer of the Snider rifle The springs of the lock are all upon the old principles, and if any were out of order they could readily be repaired by a common blacksmith; they are, moreover, of considerable strength, and the objectionable spiral spring, one of the principal faults of the Martini-Henry, does not find a place in the lock. The extractor is of the most simple and ingenious character, being worked by a sort of double action by which a pressure outwards is slowly given during the act of cocking the rifle against the cartridge case, followed by rapid stroke against the angle of the extractor, which throws out the case at once. The facility of this action was well demonstrated by means of a tight cartridge case which, when a rapid pressure was applied to the hammer, was thrown out with a jerk that sent it a good two yards behind the manipulator. The manipulation of the gun is extremely simple, and a man lying down can load, fire, throw out the case and load again without altering the position of the rifle, a great advantage when compared with the Martini-Henry, from which the cartridge cannot be extracted without using the lever below the stock, thus rendering it necessary to lift up the gun or turn it to one side By taking out a single screw a plate on the side of the breech-shoe can be taken off, exposing the whole mechanism of the lock, which can thus be examined, and, if needful, cleaned, while if during such an operation it became necessary to use the weapon, the plate might be dropped into the pouch, and the rifle loaded and fired without it. The hinge lock of the breech is so grooved out that the barrel can be inspected or cleaned out from the breech, so that the soldier or sportsman can clean out his rifle, both breech and barrel, without for one moment losing its value as an effective weapon. The rifle is entirely worked by the hammer and trigger, and 30 shots a minute can be readily got off from it by skilful hands. It can be half-cocked when necessary, and the barrel is constructed so as to use the ammunition supplied for the Martini-Henry. The barrel is also said to be of an improved construction, and to possess a considerably lower trajectory than the Henry barrel. It is rifled with seven shallow segmental grooves, and the recoil of the weapon is very slight compared to that of the Martini-Henry. It is said that the Canadian Government are about to supply the forces of the Dominion with this rifle, and if so they will have men armed with probably the most serviceable weapon yet provided for troops."

STREET LIGHTING IN PARIS.

M. Maxime du Camp, in an able article in the *Revue des Deux Mondes*, gives some interesting particulars of the street-lighting of Paris. In olden times all good citizens were commanded in moments of trouble — "which, adds the author, rather quaintly, were of more frequent occurrence [illegible]en than in our day" — to put a light in their windows and a pail of water on the threshold of their doors. These precautions were intended to prevent fires and nocturnal attacks. The first attempt at street-lighting was made in 1558, when by an ordinance of the Parliament of Paris, a *falot* was placed at the corner of every street, and in the case of very long streets, an additional one in the middle. This instrument resembled a gibbet, having suspended from it by a chain a heavy iron bowl filled with resin and tow. The *falots* did not illuminate the city very brilliantly, but they at any rate displayed a ruddy flame, which served to "guide the wanderer's steps aright;" but the Wars of the League soon put an end to them, and for the space of a century Paris was left in utter darkness. Louis the Fourteenth, who, by the way, took for his device a rising sun, ordered Nicolas de Reynie, the founder of the city police, to put an end to this state of things, and gave him as a word of command three substantives—cleanliness, light, safety. Very little time was lost, and in 1667 the edict was published prescribing the establishment of lanterns These were simply candles, enclosed in a glass frame, and suspended by cords at the height of the first storey of the houses. Lanterns were, in 1745, succeeded by the oil lamps called *réverbères*, which remained in use till within the memory of many living persons.

Philippe Le Bon—the inventor of gas—met with a tragical fate. On the day of the coronation of the first Napoleon the unfortunate inventor was assassinated, it is said, in mistake for the emperor. Three years before this, in 1801, he had exhibited this wonderful discovery in public, but what is most remarkable—although he had shown the quality of light that he could produce either from coal or wood—the chief point which struck the minister of the First Consul was, that the distillation of wood produced cheap tar. To Philippe Le Bon was therefore granted the concession of part of the forest of Rouvray for the purpose of making tar.

The widow of Le Bon endeavoured to carry out the plans of her deceased husband, but on her death the patent was suffered to lapse by her family, and was taken up by a German naturalised in England named Winsor. It was one more instance of the *sic vos non vobis*, with which the history of inventions is filled. Curiously enough the French were slow to appreciate the advantages of gas. It was not till the year 1830 that the first street in Paris, the Rue de la Paix, was lighted by gas in the teeth of a violent opposition. Every misfortune was attributed to the unpopular light. The nature of the calamity did not matter much—the death of a tree or the arrival of the cholera—it was all put down to the gas.

For some time the lighting of Paris was in the hands of several companies, but by degrees these have been fused into one great corporation, possessing ten great factories in and around the city. The Parisians, who found it so difficult to accustom themselves to the new light, are now great and increasing consumers of gas In 1855 they consumed 53 millions, in 1865 they used 155 millions, and in 1872 no less than 196 millions of cubic yards of gas This vast monopoly is charged heavily by the municipality of Paris, in various ingenious ways To begin with, the company pays the city 200,000 francs per annum for the rent of the ground occupied by its pipes, and, in addition, reimburses all costs of paving, &c. In 1869 these expenses reached 179,667 francs, and are estimated at 100,000 francs in the municipal budget for 1873. It is true that the company pays no *octroi* duty on coal, but, on the other hand, pays a fixed duty of 2 centimes on every cubic metre (39⅜ inches) of gas manufactured On this account alone the company paid 2,508,953 francs in 1872, and was also obliged to pay to the city a proportion of its profits, amounting to 5 millions of francs. The good city of Paris thus received from the gas company in 1872 no less than 7,708,95[illegible] francs, or £308,358 2s. 6d. sterling This is truly a tremendous tax upon light.

It is always curious to investigate the meaning of the word progress as used by a distinguished foreigner. M. du Camp observes that "gas enters every day more and more into our domestic habits—before *a hundred years* are over, the smallest hut will be supplied with gas and water. This will be great progress."

Moderation is a virtue—unhappily so rare among Frenchmen, that we cannot help congratulating M. du Camp on possessing such an ample supply. The hope that every Frenchman may have gas and water laid in his house within *a hundred years* does not reveal a very sanguine nature. Let us hope better things of France.

THE SOUDAN RAILWAY EXPEDITION.

(*Continued from page* 115.)

At Kohé, the site of the proposed bridge for carrying the Soudan Railway across the Nile, that river takes a sharp bend towards the east, and between Kohé and Fakir Bender, a distance of about 35 miles, a camel track makes a chord line to the irregular arc formed here by the Nile.

After the necessary soundings of the river at Kohé had been completed, and the party was ready to continue its southward journey, it was determined to abandon the Noggurs, and strike across the chord-line just mentioned, upon camels, as far as Fakir Bender. This resolution was taken because the duration of the north wind was uncertain, and the obstacles to navigation at the Third Cataract were great.

Leaving the Noggurs, therefore, to proceed as they could up the Nile to Ambukol, where probably their services would be again required, preparations were made for the short desert ride. The caravan formed was quite an imposing spectacle, comprising 60 camels, a few horses, besides a number of more humble quadrupeds carrying a military escort of mounted infantry, who, to their credit be it said, assisted their animals frequently by propelling them, the donkeys being short, their riders tall of stature, and the feet of the latter touching the ground with ease. When not assisting locomotion, the troops curled their legs around their donkey's necks and sought repose. The supreme charge of the caravan was entrusted to an officer of irregular cavalry in the Khedive's army, and who, from the jealous care he bestowed upon the water-skins, received the title of " Turncock Pasha," a dignity in which he much delighted.

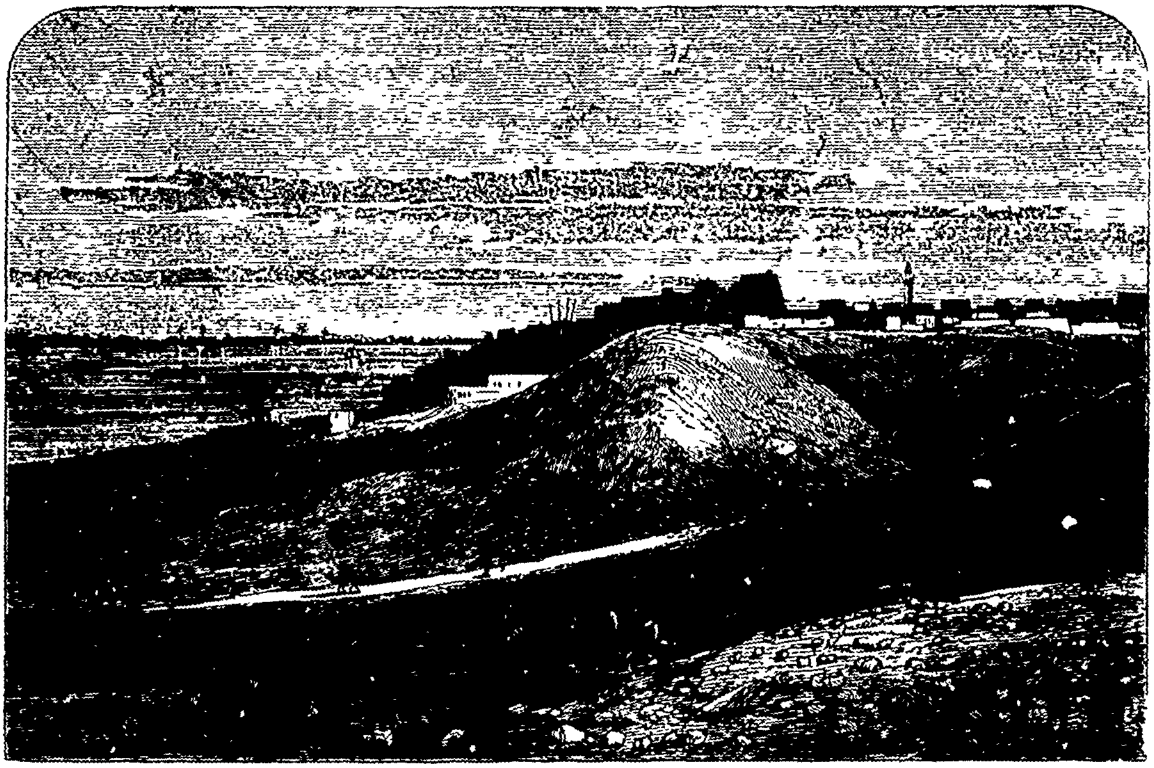
There being no wells or other means of obtaining water, except by conveying it, in the desert between Kohé and Fakir Bender, the caravan started half an hour before midnight, and rapidly crossing the track, which is well defined throughout by the bones of camels, it arrived at its destination at four o'clock the following morning. From Fakir Bender the caravan continued its route to Oordeh, or New Dongola, about 60 miles further on. New Dongola is situated on the west bank of the Nile about 955 miles south of Cairo. The district contains a population of about 3000, and is a place of considerable importance. The houses are built principally of sun-burnt bricks, and many of them are comparatively important structures, some with gardens wherein are grown nearly all the fruits common to Lower Egypt. The population consists of many nationalities; the principal foreigners, however, are Greeks, who like Jews in other countries, are for the most part devoted to money-changing and store-keeping in the Bazaars. Until quite recently New Dongola, or El Oordeh, was the principal seat of Government for a considerable district, extending almost to Khartoom. Latterly, however, it has given place to Berber, where laws are now administered by the Bey, who transmits instructions to the Vokeel, or sub-governor, at New Dongola, where a large Government establishment still exists. The amount of trade is considerable, and after Berber it is the most important town upon the Nile in Upper Egypt, north of Khartoom. During high Nile it can be easily approached from the river, which is then about one mile wide at this point. At low Nile, however, the inner or western channel is unnavigable and direct access by water is cut off. As the trade is large a great number of native merchant vessels are generally lying alongside the river bank, increasing the appearance of activity and importance to which New Dongola can, in reality, lay some claim. The bazaar contains many stores in which almost all local requirements can be supplied, and the scene there, as well as in the streets, is striking, enlivened as it is by the strange blending of nationalities, by Nile sailors, Greek merchants, native Dongalese, Nubian soldiers, and most picturesque of all by the desert Arab, scantily attired with long heavily greased and plaited hair, carrying on his left shoulder the leathern shield, and in his right hand a spear.

The mud huts and scattered villages which are seen at intervals along the banks of the Nile, point out like the mimosas and palm-trees, and patches of cultivated ground, those places where the desert sand has spared the soil, and a fair estimate of the extent of profitable land may be obtained from a glance at the different villages. Where, however, a few towns and some larger villages are situated upon the camel routes, trade has, of course assisted in raising their condition. Handak, two sketches of which are shewn on page 134, may be taken as a fair example of a town thus benefited by the desert trade. It is situated on the west bank of the Nile, 45 miles south of New Dongola, and about 1000 miles south of Cairo, and contains a population of some 1500 persons. The most striking feature it possesses are the ruins of some ancient forts, which are situated on an elevated ground and command a wide-spread view of the surrounding country. Handak is, so to speak, a considerable shipping port, as large quantities of the products of the far south, such as gum, ivory, &c. conveyed on camels by way of Khordofan and Khartoom, are unloaded here and placed on Noggurs to be transported down the river to Cairo and Alexandria. The town boasts of several Nubian merchants, whose establishments are based upon a Turkish model, sure sign in Upper Egypt of wealth. It is worth noting that Handak, being on a sandstone formation, and having but little ground in the vicinity that can be cultivated, owes what importance and prosperity it does possess entirely to commerce.

As a rule the route taken is within sight of the Nile and often passes through plots of cultivated ground beside the bank. Short rests were always made by the caravans at midday under the shade of palm-trees, and whenever possible near villages the chiefs of which were always eager to do honour to the staff, and the representatives of their sovereign, the Khedive, by presents of water, dates, and the loan of easy chairs. At night the tents were pitched near the river, and thus progressing the party arrived at New Dongola. At this place, however, the authorities found it impossible to provide the necessary means for carrying the party forward, and all the inhabitants available were despatched to bring up the Noggurs which were lying becalmed some distance down the river. As soon as they arrived the New Dongola party and stores were got on board, and after six days of sailing and towing, Ambukol, the farthest point at which navigation could be made available for the expedition, was reached. Here the second division of the party was left behind to work their way back to Kohé, where their survey would join with that of the first division, who had charge of the section from Wady Halfa to the river crossing.

At Ambukol, then, the whole of the stores, &c., were taken out of the Noggurs, and that part belonging to divisions three and four, were transferred to camels, and transported to their respective destination at Abou Halfa and El Metemmeh, a distance by camel route of 180 miles from Ambukol, and where the river is again met. The view seen from Mount Fog, a granite rock some distance north of Ambukol, gives an excellent idea of the serpentine course taken by the Nile through the desert. In the flat unbroken expanse of sand, of course the river is invisible almost until it is reached, and the groups of palm trees which grow upon the river banks, serve as beacons to the Arab, guiding him in his course across the desert.

The caravan comprised about 70 camels, horses being now useless, as the wells in the desert about to be traversed were several days journey apart, a circumstance which of course necessitated the employment of a large number of camels as water carriers. The march through was conducted in the usual manner. The baggage camels and those laden with the water skins continued their march steadily without a halt until the night's resting place was reached; on the other hand the riding camels were urged forward with variable speeds, before and after the mid-day rest, thus enabling the travellers to enjoy as long as possible the grateful shade of the desert trees during the hottest part of the day. In order to facilitate the subsequent studies which were to be undertaken in their return journey by the third division of the expedition, several of the party were occupied during the desert crossing in making sketch surveys of the country, the distances being estimated by the rate at which the camels travelled, and the



VIEW OF HANDAK ON THE NILE.

VIEW OF HANDAK ON THE NILE.

directions by compass bearings. The trouble thus taken was amply repaid when the more complete survey was made, as it afforded great facilities in recognizing the different features of the country.

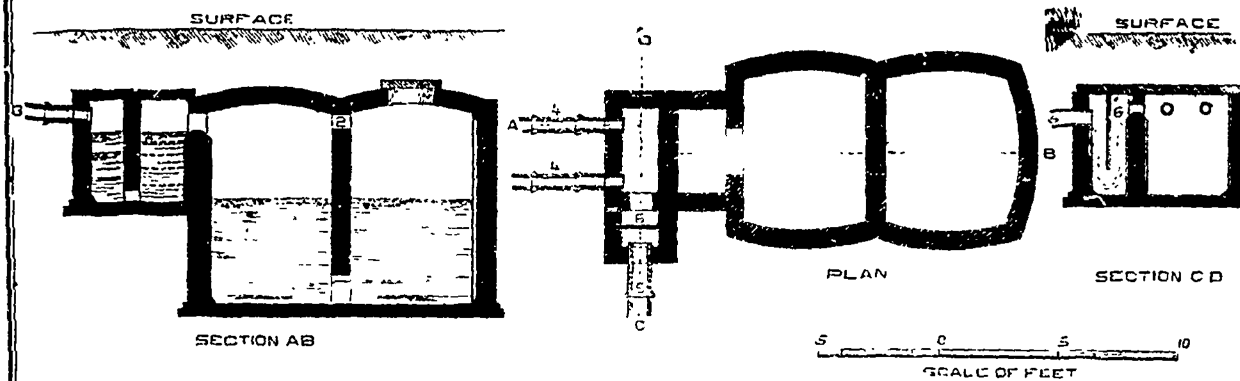
At the oasis of Abou-Halfa, in mid-desert the third division was left behind, whilst the fourth and last division proceeded onwards towards the extreme end of the line at Metemmeh on the river Nile.

We may now indicate briefly the proposed direction of the route to be taken by the Soudan Railway after it has crossed the Nile at Kohé. The river at the place as we have seen, takes a very remarkable bend and as there are no obstacles in the way the line quits the river after crossing it, and goes direct across the desert to Fakir Bender, saving a length of at least 25 miles as compared with the alternative of following the river bank. After crossing at Kohé the line passes over an alluvial plain about five-eighths of a mile in breadth, and then for a distance of three miles and three quarters, follows the course of a Wady. This differs from the camel track, which by reason of its rough and frequent ascents and descents over the broken ground between the Nile valley and the desert plateau, is rendered unsuited for railway purposes. After arriving at the level of the plains, about 147 feet above the river bank at Kohé, a series of flat sandy plains are crossed until the 284th mile from Wady Halfa is reached. After this point the ground becomes more difficult, and broken up with basaltic rocks, and occasional detours are advisable to avoid costly cutting before the line reaches Fakir Bender, where there will be a small station. The line then skirts the river bank as far as the village of Sarr, 193 miles from Wady Halfa, the works being easy with the exception of three large Wadys which have to be crossed.

Shortly after the railway leaves the river bank, and crosses the desert direct to Hameby a village on the Nile, where the series of rapids extending up the river from Wady Halfa, and the granite rocks on the western bank terminate. The railway will then proceed at an average distance of about five-eighths of a mile from the bank in order to avoid the cultivated ground, of which there is a considerable extent, passing twelve villages whose aggregate population is about 3000. For the accommodation of these villages a station is to be erected. At about the 350th mile from Wady Halfa, New Dongola is reached, but in order to avoid interference with the bank of the river the line is carried to the west side of the town where a flat plain offers a favourable site for a station. Seventeen miles further the village of Satali is reached; a market is held at this place, and its ruins indicate that at some previous time it must have been a town of considerable importance. At present, however, it has only a population of 300. For another 30 miles the line follows the river bank, leaving it only to avoid the strips of alluvial soil which overlie the lower Nubian sandstone; it then leaves the Nile, passing through an open desert, and near two villages containing about 750 inhabitants. A station will be provided at the important town of Handak, of which sketches are given on page 134. And about 35 miles further there will be a station at Old Dongola, at one time the capital of the district of Dongola, and now containing 1000 inhabitants. Between Handak and Old Dongola there are thirteen villages with a total population of 2700. For the next 7 or 8 miles the soil is alluvial and thickly covered with desert vegetation, through which the line passes, then crossing to the town of Aboo Goosi (1000 inhabitants), it strikes into the desert. At Dubbe a station will be provided, Dubbe being a place of some little importance, as it is one of the chief points of departure for caravans going to Khartoom, Khordofan, and other districts. The navigation between Halfa and Dubbe is practicable throughout the year.

Through a distance of 40 miles beyond Dubbe the line passes over an alluvial tract covered in many places with desert shrubs and coarse grass, and goes forward to Ambukol, an intermediate station being provided for the accommodation of five villages, having a population of 3500. At Ambukol the second section of the line terminates. This length is one-third longer than that between Wady Halfa and Kohe but the works are much less extensive, the embankment containing little more than one half, and the cuttings less than one-third of those on the preceding section. Of the cuttings 79 per cent are in light material, 10 per cent in soft rock, 2 per cent in hard rock and 9 per cent in rock of a medium quality. The culverts, too, are insignificant in number and extent. The curves and gradients are favourable throughout, for although the ruling gradient is occasionally necessary, it occurs only in short lengths.

(To be continued.)



1. Filtering beds.
2. Air-vent.
3. Rain-water inlet.
4. Rain-water pipe.
5. Overflow.
6. Trap.

RAIN-WATER TANKS.

RAIN-WATER TANKS.

The above sketch of rain-water tanks, which explains itself is by a correspondent of *The Builder*. We reproduce it, thinking it may be of service to some of our readers.

Fire Detectors.—An experimental display of some of Professor Grechi's instruments for signalling the commencement of fires in any room, or in interspaces difficult of access, has been made in one of the corridors adjoining the Machinery Court at the International Exhibition at South Kensington. Small straw fires, inflamed with petroleum, were ignited, when the instruments caused the alarm-bells to ring, and notified the particular locality by the fall of a numbered disc. A lantern was also lighted in one compartment by the falling of a small weight upon glass globules of sulphuric acid. The principle of the apparatus is this: a double spiral of zinc and platinum is soldered to a disc carrying an index and a small wire contact-maker. When the spiral expands by the heat the contact-maker is turned by the motion of the spiral, thus putting in action a current from an electrical battery, by which the alarum-bells and signal apparatus are put in action. The instruments are very roughly made, and cost about 2s a piece.

QUALITATIVE ANALYSIS FOR AMATEURS.—III.

REACTION OF METALS OF GROUP SECOND, SECOND DIVISION.

It will be remembered that we said (p. 118), that the second group embraced those metals which are precipitated by hydrosulphuric acid from acid solutions. The sulphides of arsenic, antimony tin, gold, and platinum are soluble in ammonic sulphide, and constitute the second division of this group.

Ammonic sulphide $(NH_4)_2S$, is prepared, according to Fresenius, by saturating a given volume of ammonia solution (sp. gr. 0 96) with hydrosulphuric acid gas, and adding to it an equal volume of the ammonia. The solution, which is at first colourless, soon becomes yellow by keeping, or may be at once converted into the yellow sulphide by the addition of sulphur. It should yield no precipitate with magnesic sulphate. This reagent is also decomposed by acid, sulphur being precipitated.

Arsenic is the most important member of this group, and owing to its very poisonous character great caution must be observed in making the tests with it. A small piece of bright green wall paper usually contains enough of this metal to give several characteristic tests. Apply a single drop of nitric acid to the paper, a moment after neutralise with ammonia and observe the colour—a deep blue always indicating copper. When the white fumes have nearly disappeared, apply to the same spot a drop of argentic nitrate solution (Ag. NO). If arsenic is present, a yellow ring of arsenite of silver is formed, which becomes more distinct after drying. A neutral solution of any soluble arsenite gives with argentic nitrate a yellow precipitate. Arsenates produce a reddish-brown precipitate ; both are soluble in ammonia and in nitric acid. With hydrochloric acid, it will be remembered, silver solutions give a white precipitate, insoluble in nitric acid With sulphate of copper, or cupric sulphate, neutral arsenic salts give a green precipitate. Hydrosulphuric acid gives a beautiful yellow precipitate, soluble in ammonic sulphide, and in ammonic carbonate, from either of which solutions they are again precipitated by hydrochloric acid. To hasten the precipitation of arsenic acid and arsenates, sulphurous acid or sodic sulphite is introduced before precipitation with H_2S. The most delicate and characteristic test for arsenic is that known as the Marsh test. A small bottle is arranged with funnel and delivery-tube, the delivery-tube being horizontal, and drawn out almost to a point. Some pieces of zinc are put into the bottle and covered with water, and the cork is put in perfectly tight, a luting of paraffine or a linseed poultice being employed if necessary. A little sulphuric acid is now poured in by the funnel tube, and hydrogen gas is immediately evolved. Aft r the air has all been expelled from the bottle, the gas may be ignited at the end of the delivery tube, taking care to wrap a towel around the apparatus to prevent accident in case of an explosion. If the zinc and acid are pure, the gas will burn with a colouress flame, which produces no stain on a piece of cold porcelain held in it. A few drops of a dilute arsenious solution are then introduced by the funnel tube, and the arsenic at once unites with the hydrogen to form arseniuretted hydrogen. AsH_3. This gas burns with a violet or peach-blow flame, and deposits a black stain of metallic arsenic upon cold porcelain. Several of these stains upon pieces of broken china should be preserved for future use. A few drops of a solution of bleaching powders, or of Javelle water, dissolve the stain with ease. While the arseniuretted hydrogen is burning, a gas or alcohol flame is applied to the delivery-tube a few inches from the end. The heat decomposes the gas and a mirror of crystalline metallic arsenic is deposited on the cold portions of the tube beyond. If arseniuretted hydrogen gas be passed into a solution of argentic nitrate, metallic silver will be precipitated, and enough nitric acid set free to prevent the precipitation of the yellow arsenite of silver. After filtering out the metallic silver, the solution may be neutralised with sodic acetate, when the yellow arsenite of silver will be precipitated.

Reinsch's test consists in placing a clean piece of copper in a hydrochloric acid solution containing arsenic, and heating ; a gray film of Cu^5As^2 is formed on the copper. If a few grains of arsenious acid be heated with sodic carbonate on charcoal, an odour resembling garlic is perceived. Compounds of arsenic heated with sodic carbonate and potassic cyanide, in a tube of hard glass, yield a sublimate of metallic arsenic in the form of a mirror. The sulphide precipitated by H^2S may be used for this test. In testing for arsenical poisoning, all of the above tests should be made.

Antimony very closely resembles arsenic in many of its reactions, and the separation of the two metals, when both are in the same solution, is not a very easy matter, considerable practice being required to accomplish the separation with certainty. If a current of hydrosulphuric acid be passed into a solution of tartar emetic, or other soluble salt of antimony, an orange-coloured precipitate of sulphide of antimony is thrown down. This sulphide is soluble in ammonic sulphide, from which it is again precipitated by hydrochloric acid. It differs from the sulphide of arsenic in being much less soluble in a dilute solution of ammonic carbonate than the latter, so that the two sulphides may be separated, to some extent, by this reagent. A concentrated solution of chloride of antimony (called also butter of antimony) gives a white precipitate when poured into water, and in this respect resembles bismuth, excepting that this precipitate with antimony is soluble in tartaric acid, that of bismuth is not. If a compound of antimony be introduced into a hydrogen bottle, it will combine with that gas to form antimonetted hydrogen, SbH_3, and the burning gas deposits a black stain on cold porcelain ; but, unlike the arsenic stain, it is insoluble in Javelle water, solution of bleaching-powder, or other hypochlorites. This enables us to detect antimony with great certainty, but fails to detect traces of arsenic in the presence of antimony If antimonetted hydrogen be passed through a solution of argentic nitrate, the antimony combines with the silver and is precipitated as antimon-silver, $SbAg_3$, soluble in tartaric acid. It will be noted that this reaction differs entirely from that of arsenic and affords the best means of separating two metals.

SEPARATING ARSENIC AND ANTIMONY.

A Marsh apparatus is constructed, consisting of a generating flask, in wash-bottle containing plumbic nitrate, and a delivery-tube reaching to the bottom of a test-tube containing argentic nitrate in solution. The solution to be tested is introduced gradually into the generating bottle through the funnel tube, the mixture of arseniuretted and antimonetted hydrogen is passed through the silver solution for a considerable time ; the contents of the test-tube are then filtered, and the filtrate boiled with sodic acetate until a yellow precipitate of arsenite of silver is produced. The residue on the filter contains both metallic silver and antimon-silver, and must be boiled for 15 minutes with tartaric acid to dissolve the latter, the silver is then filtered out, and the antimony precipitated from the solution by means of hydrosulphuric acid. In making these tests in cases of suspected poisoning, all the apparatus employed must be new, and the zinc, acid, and water must be carefully tested to see that they are perfectly pure.

The reactions for tin, gold, and platinum will be given next, together with the manner of separating them from each other and from the above. Suffice it for the present to say, that none of these metals interfere with the detection of arsenic and antimony in the Marsh apparatus.

According to M. Offret, in batswing burners it is found that, though the size of the flame diminishes with the amount of gas consumed, it is not in equal ratio. The cost of a large flame for each candle power per hour may be, for instance, 0 42 centimes, while with a small one, it will be 0 897 centimes. Or, again, the light of a large flame may be equivalent to fifteen candles, while that of two small ones together will be 7 4 candles. The cause of this is attributed to the complete combustion of the gas in the blue zone in the gas flame, which gives little or no light in either case, and has more favourable circumstances for its occurrence relatively to the size of the flame in the small than in the large flame. Another more inexplicable phenomenon is that with a flat flame the intensity of the light is the same, whether the edge or the flat of the flame is tested. This points to the absolute transparency of the flame. The use of cylindrical glass chimnies with round jets (argand, &c) is concluded to be, on the whole, somewhat more economical than with flattened chimnies, after a series of experiments to settle this point.

FACTS AND FIGURES CONNECTED WITH BELTING.

By Mr. J. H. Cooper, in *Journal of Franklin Institute.*

FRICTIONAL GEARING

Frictional gearing is a term applied by Webster to wheels that transmit motion by surface contact without teeth. This style of gearing is much used in the lumbering regions of the North-West and is fast gaining favour wherever applied. It has some advantages, not possessed by other modes of communicating motion, which do not appear to be counteracted by any peculiar disadvantages. In large mills where this gearing is used to transmit power to drive five or six gangs, one or two large circular saws, a muley, gang edgers, trimmers, slashers, lath mills, shingle mills and other machinery, where 20,000 feet of boards may be sawn in an hour, the faces of the wheels are made as smooth and straight as possible; one wheel is made of iron and the other of wood or of iron covered with wood. Where it is practicable this gearing is so arranged that the wood drives the iron, to prevent the "slip" at starting from wearing the wood-faced wheel unevenly. Although this tendency is much less than might be supposed, as in most cases the "bull-wheel" used for drawing logs into the mill, is a large wooden wheel driven by a small one of iron, and these wheels started and stopped while the driver is in full motion a hundred times a day, work well and last for several years. But for machinery in constant use, the wooden wheel should always drive the iron wheel. For driving heavy machinery, the wooden drivers are put upon the engine shaft, and each machine is driven by a separate counter-shaft. Two or more of these counter-shafts are usually driven by contact with the same wheel, and each is arranged so as to be thrown out from the driver and stopped whenever required, and again started at any moment, by a slight movement without interference with other machinery. To drive small machinery these friction drivers are put upon a line shaft so as to drive a small counter-shaft from which the machine is driven by a belt, which may be shifted in the usual way. In many mills from 100 to 300 horse-power are transmitted by this kind of gearing.

For driving light machinery, running at high speed, as in sash, door and blind factories, bass-wood, the linden of the Southern and Middle States, has been found to possess good qualities, having considerable durability, and being unsurpassed in the smoothness and softness of its movement.

Cotton-wood has been tried for small machinery, with results somewhat similar to those of bass-wood, but is found to be more affected by atmospheric changes; even white pine makes a driving surface which is, considering the softness of the wood, of astonishing efficiency and durability. But for all heavy work, where from 20 to 60 horse-power is transmitted by a single contact, soft maple has, at present no rival. Driving-pulleys of this wood, if correctly proportioned and well built will run for years with no perceptible wear. For very small pulleys, leather is an excellent driver and very durable. Recently, paper has been introduced as a driver for small machinery, and has been applied in some situations where the test was most severe; and the remarkable manner in which it has thus far withstood the severity of these tests, appears to point to it as the most efficient material yet [illegible]. The proportioning of friction pulleys to the work required, and their substantial and accurate construction, are matters of perhaps more importance than the selection of material. The mechanic who thinks he can put up frictional gearing temporarily and cheaply will make it a failure. Leather belts may be made to submit to all manner of abuse, but it is not so with friction pulleys. They must be accurately and substantially made and put up and kept in perfect line. All large drivers, say from 4 ft. to 10 ft. diameter and from 12 in. to 30 in. face should have rims of soft maple 6 in. or 7 in. deep. These should be made up of plank $1\frac{1}{2}$ in. or 2 in. thick, cut into "cants" 1-6th, 1-8th or 1-10th of a circle, so as to place the grain of the wood as nearly as practicable in the direction of the circumference. The cants should be closely fitted, and be put together with white-lead or glue, strongly nailed and bolted. The wooden rim thus made up to within about 3 in. of the width required for the finished pulley, is mounted upon one or two heavy iron "spiders" with 6 or 3 radial arms. If the pulley is above 6 ft. in diameter there should be 8 arms, and 2 spiders when the width of the face is more than 18 in.

Upon the ends of the arms are flat "pads," which should be of just sufficient width to extend across the inner face of the wooden rim, as described, that is three inches less than the width of the finished pulley. These pads are gained into the inner side of the rim, the gains being cut large enough to admit keys under and beside the pads. When the keys are well driven strong "lag" screws are put through the ends of the arm into the rim. This done an additional "round" is put upon each side of the rim to cover bolt-heads and to secure the keys from ever working out. The pulley is now put to its place on the shaft and keyed, the edges trued up, and the face turned off with the utmost exactness.

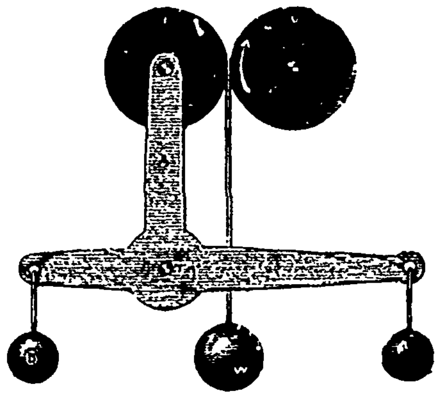
For small drivers the best construction is to make an iron pulley of about 8 inches less diameter and 3 inches less face than the pulley required. Have 4 lugs about one inch square cast across the face of this pulley. Make a wooden rim, 4 inches deep with face equal to that of the iron pulley, and the inside diameter equal to the outer diameter of the iron. Drive this rim snugly on over the rim of the iron pulley, having cut gains to receive the lugs, together with a hard wood key beside each. Now add a round of cants upon each side, with their diameter less than the first so as to cover the iron rim. If the pulley is designed for heavy work, the wood should be maple, and should be well fastened by lag screws put through the iron rim. But for light work it may be of bass wood, or pine and the lag screws omitted. But in all cases the wood should be thoroughly seasoned.

In the early use of friction gearing, when it was used only as backing gear in saw-mills, and for hoisting in grist-mills, the pulleys were made so as to present the end of the wood to the surface; and we occasionally yet meet with an instance when they are so made. But such pulleys never run so smoothly nor drive so well as those made with the fibre more nearly in line with the work. Besides it is much more difficult to make up a pulley with the grain placed radially, and to secure it so that the blocks will not split when put to heavy work, than it is to make it up as above described.

As to the width of face required in frictional gearing, when the drivers are of maple, a width of face equal to that required for a good single leather belt to do the same work is sufficient. Or, to speak more definitely, when the travel of the surface is equal to 1,200 ft. per minute, the width of face should be at least 1 in. for each horse power to be transmitted, and for drivers of bass-wood or pine, $1\frac{1}{2}$ to 2 in. The driven pulleys are wholly of iron, and similar to belt pulleys, but much heavier, having more arms and stronger rim. The arms should be straight rather than curved and there should be two sets of arms when the face of the pulley is above 16 in. A very good rule is to make the thickness of the rim $2\frac{1}{2}$ per cent. of the diameter of the pulley. To secure perfect accuracy these pulleys must be fitted and turned upon the shaft; and when large, the shaft should run in journal boxes, while the face is being turned, after which they should be balanced; neglect of which has been the means of destroying friction pulleys that were otherwise well made. The conditions and results of a few experiments made to test the tractive power of smooth face friction pulleys are here given, these experiments, when made, were not meant for publication or for the benefit of science, but to establish rules for private practice. They should be repeated by others before being taken as conclusive. For the experiments, two pulleys were made in the usual way, one being of wood—soft maple—and the other of iron. Both were accurately and smoothly finished. These pulleys were each 17 in. in diameter, and of 6 in. face, and were put up as shown in the diagram (Fig. 1.)

A is a double bell crank frame, with arms 2 ft. long. The ends of the upright arms receive the bearings for the iron pulley, I. The journals of this pulley are $1\frac{1}{2}$ in. diameter and 3 in. long, and run in Babbitt boxes. The frame is hung upon journals, T, and is balanced by the weight B. The face of the pulley I, is extended beyond the six inches to receive the cord C, for which purpose a shallow groove is cut in the pulley, so as to bring the centre of the cord to the periphery. The driving pulley V, is put upon a shaft where it may be made to revolve slowly in the direction of the arrow. It will be seen that P, will bring the pulleys together with a pressure just equal to its weight. The wooden pulley being in motion, the pressure, when sufficient, will roll the other pulley and raise the weight W. The manner of experimenting was to put a given weight upon the cord C, and while the driving pulley was moving, to increase the weight P, until W, was lifted. The machinery was then stopped, when the weight would descend, slipping the iron pulley upon the wood. The weight of P, was now noted; the weight

FIG. I.



was again raised, and the pressure increased sufficiently to hold the weight from slipping down, and the pressure again noted. After these experiments were made and twice repeated with the pulleys, the frame A, was reversed, so that the weight P, would tend to separate the pulleys. They were then connected by a 6-inch leather belt, and the experiments repeated, giving the results in the fourth and fifth columns.

FRICTION PULLEYS.			BELTED PULLEYS.	
Weight raised.	Pressure required to just raise the weight.	Pressure required to raise the weight without slip.	Pressure required to raise the weight.	Pressure required to raise the weight without slip.
10	29	53	30	34
20	58	65	60	69
30	87	96	91	120
40	115	125	121	159
50	143	154	153	199
60	171	185	183	242
70	199	214	213	247
80	225	244	239	332
90	264	289	278	375
100	295	312	310	419
120	354	387	372	487
140	416	438	442	563
160	477	499	524	652
180	538	561	592	731

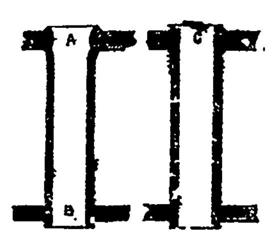
It will be seen that, in this test, the traction of the friction wheels was greater than that of the belted pulleys, and considerably more than is usually supposed to be obtained from belts upon pulleys of either wood or iron; and that while there is a marked falling off in the adhesion of the belt as the work increased, that of the friction increases as the labour becomes greater. Also that the difference in the pressure required to just do the work, and that necessary to do it without loss or slip, advances in an increasing ratio with the work of the belt; but in the friction it is almost constant throughout the whole range of experiments. The figures applied to the friction wheels are the mean results of repeated experiments; those applied to the belted pulleys are each of a single test. It is not thought that these experiments were sufficient to fully establish all that the figures show; but they were enough to prove that smooth faced wheels possess a much higher tractive power than has been generally supposed.

And now a word as to some of the advantages of friction gearing. Being always arranged with a movable shaft, so that the wheels may be thrown together or apart with the greatest ease, the machine driven by it is started and stopped at any moment, while the driving wheel remains in motion. And when stopped, the separation is complete, and may so remain for any number of minutes or months without attention, and may be again started at any moment without the least inconvenience or injury. So slight is the separation required, that it is done almost without an effort. And by it we entirely dispense with the nuisance of loose pulleys, belt shifters and idle running belts, and with the risk of throwing off and putting on belts. It obviates the delay and labour of shipping and unshipping pinions, and the rattle and bang and frequent breaking of clutches. It is durable and requires no repairs; it is compact and economises room. It does not increase the pressure on journals when the speed is quickened, as in the case with belts running with great velocity, but remains constant at all speeds. And it will transmit any amount of power, even up to 100 horse-power, with no greater percentage of loss, and with less pressure on journals than can be done by belts.

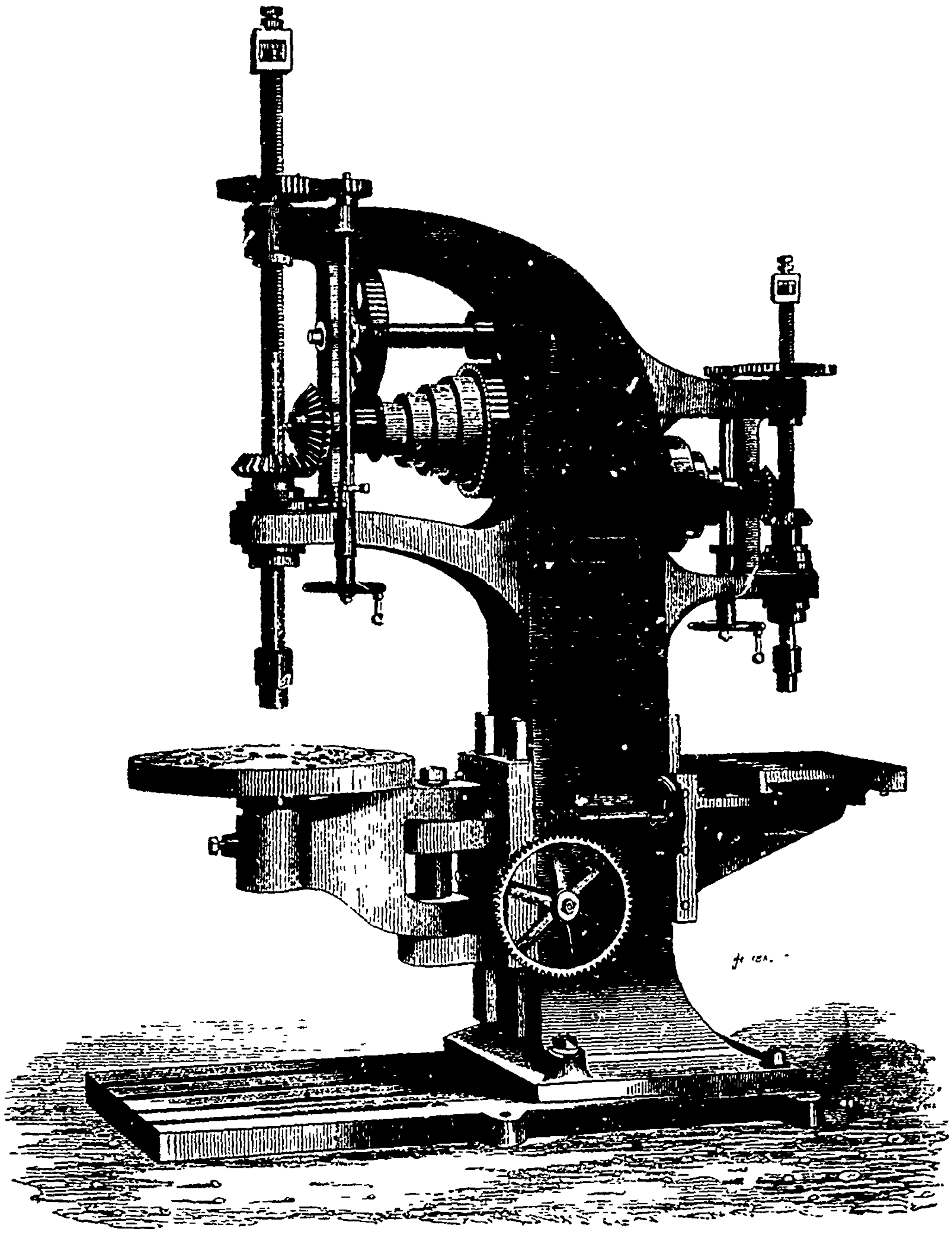
A METHOD OF FIXING TUBES IN VERTICAL BOILERS.

The following paper, descriptive of a method of fixing vertical boiler-tubes, was read before the Royal Scottish Society of Arts by Mr. R. W. Thomson, C.E., F.R.S.E., and was awarded the silver medal of the Society:—

Manufacturers and others who, on account of limited space and other reasons, use vertical boilers, have found that one of the greatest objections to them is the difficulty of keeping the tubes tight; all multitubular boilers are liable to have leaky tubes, for reasons which I will hereafter explain; but horizontal boilers do not give much trouble, as both ends of the tubes being under water, any small leaks "take up," as the deposit is forced into them. In vertical boilers, however, whenever a leak occurs at the upper end of a tube, it gets worse and worse, as no deposit can reach it, and causes great waste of fuel, and necessitates the stopping of the engine, in order to tighten the tube with a drift, or expander, or otherwise. The principal reason why tubes leak is the unequal expansion and contraction. Stays maintain the temperature of the water; but the tubes, through which alternately flame or heated air only is passing, are ever varying their temperature, and consequently their length. And this expansion follows no rule; a tongue of flame may shoot up one tube, which instantly lengthens to a much greater length than the tubes on all sides of it. This expansion and contraction being admitted, it follows that we must humour it, and still find out some means of keeping the tubes tight; and, as I have shown above, it is necessary that the upper ends, in vertical boilers, should be kept perfectly tight, it follows that the upper ends must be perfectly and firmly fixed in the top plate, whilst a certain amount of play is allowed through the lower tube-plate. This is accomplished in the most perfect way as follows:—After the boiler has been put together, the holes in the top plate and lower tube-plate, but most particularly the latter, are carefully rimled out parallel by a rimer which passes through both plates; each tube has its lower end turned in the lathe to a good tight fit in its hole in the tube-plate; the tubes are then inserted in their places, and the upper ends firmly fastened by being ex-



panded within and without the top plate, as shown in the diagram at A. The lower end is left as it is; care should be taken that it is not turned over the tube-plate in any way, but be kept perfectly cylindrical, as at B. It then acts in the same way as the piston-rod of a steam-engine working through a gland, the deposit acting as packing, which, although it may



DOUBLE DRILLING MACHINE AT VIENNA

be constantly passing through, is always renewing itself. Some boilers so fitted by Roby and Co. have stood a water pressure of 300 lb. on the square inch without leaking. Another way is to screw the upper ends of the tubes into the top plate, as at C. A simple way of fitting the lower ends of the tubes, is to expand them slightly with a Dudgeon's parallel tube expander, instead of turning them to a perfect fit.

In the form of vertical boiler known as the "pot," the pot and lower ends of the tubes act so effectually in abstracting the heat from the ascending gases, that the tubes last for a very long time, as witness the specimen shown, which has been drawn out of a boiler after having been in constant use for eight months. From the way in which it stands bending and hammering, and from the fracture, it can be seen that the fibrous character of the iron is unaffected, although only one-half of it was covered with water.

The pinciple on which my method of fixing tubes rests, may be shortly stated thus :—It is impossible to fix tubes at both ends; any tendency to leak under water constantly cures itself, while a tendency to leak above water does not cure itself. It therefore follows that if the tubes are more firmly fixed at the top than they are at the bottom, the expansion and contraction will cause a slight movement of the tube in the lower tube-plate only, in which case no leak will take place.

The illustration on the preceeding page shows a double drilling machine exhibited at Vienna by Messrs. Pfaff, Fernau, and Co. It is a form of tool which is not common in England, but which possesses several advantages, and of which there are a number of specimens in the Exhibition. The larger drill is double geared and is driven by a cone with four speeds. The tool receives its revolving motion by bevel gear in the usual way. The downward feed is arranged both to be self-acting and to be worked by hand. In the latter case it is given by means of the small handwheel, while in the former case a small eccentric rod worked by a steel eccentric on the drill spindle immediately underneath the bevel pinion, is made to work a spring ratchet which communicates motion to a ratchet wheel on the same vertical spindle with the handwheel. This drill has, as will be seen from the engraving, two tables, the upper one is circular, and is supported by a radius arm capable of being pushed aside out of the way when necessary. The pin in which this arm works is made very large in diameter in order to prevent as far as possible the wear to which such an arrangement is necessarily subject. The whole upper table with its bracket can be moved up and down by hand by means of a worm and worm wheel, pinion, and rack. The lower table is fixed and forms a kind of base plate for the whole machine.

The second or smaller drill has only single driving gear, with a three-speeded cone, the feed of the tool is arranged in the same way as described above, either to be self-acting or to work by hand. It has only a single table, which has a raising gear similar to that of the opposite table, and it has in addition a hand cross traverse. The framework of the machine is everywhere in section a hollow rectangle, which gives solidity in appearance as well as in reality.

The principal dimensions are as follows: diameter that can be taken in by large drill 1.300 metres (4 ft. 3 in.), maximum distance between drill stock and face of top table 600 mm. (23½ in.), maximum distance between drill stock and face of lower table 1.300 metres (4 ft 3 in). Diameter that can be taken in by small drill 800 mm. (2 ft. 7½ in.), maximum height between drill stock and face of plate 350 mm. (13¾ in.)—*Engineering*.

BEET-ROOT BOILERS.

In view of the fact that attempts are now being made to establish in Canada the production of beet-root sugar the apparatus we illustrate on pages 142 and 143, will be of interest to our readers. The illustrations are from *Engineering* and represent a very complete and interesting set of evaporating apparatus for beet-root sugar making. The apparatus is exhibited at Vienna by Herr F. Hallstrom, of Nienburgh-on-the-Saale:

Before proceeding to a detailed description of the construction and working of these boilers, it will be well just in a few words to describe their general arrangement. The beet-root juice is introduced first into the boiler on the left-hand side of the engraving—the "thin-juice pan." Here it undergoes its first concentration by being heated with low pressure steam drawn from the engines and a certain amount of direct steam from the boilers. The vapour from the boiling juice passes up through the dome and through the hinder safety vessel into a steam chamber at the back of the second boiler or "thick-juice pan." This boiler receives the partially concentrated juice from the first, and the concentration is here completed by the heat from the steam of the first boiler, which is compelled to pass through the tubes. The steam from the boiling juice in this second boiler is passed through a safety vessel and then condensed in the usual way.

The thin-juice pan is a plain cylindrical wrought-iron boiler 1.75 metres (5 ft. 9 in.) diameter, and 3.180 metres (10 ft. 5 in.) long. A rectangular steam chamber or box, also of wrought iron, and about 12 in. deep, crosses its front, and the steam is admitted to this box by either one of two valves placed at its ends. From this chamber there lead into the boiler 15 copper pipes, which are so arranged that each one (except the two s[illegible] ones, which are somewhat shorter) [illegible]verses the whole length of the boiler six times, and then [illegible] again connected with the front tube plate—but at a much lower level than the steam chamber—and has a small valve attached to it to let off the water. The valves, however, are not allowed to communicate directly with the atmosphere, but are so connected with a long wrought iron cylinder in front of the boiler that no uncondensed steam is permitted to pass away along with the water. The steam that is used in these tubes is the exhaust steam from the engines about the factory, and will consequently possess a pressure of about 3 or 4 lb. per square inch above the pressure of the atmosphere. In the lower part of the boiler, below these tubes, are two sets of smaller pipes (each arranged to traverse the length of the boiler six times) which are supplied with steam direct from the steam boilers through separate valves, placed near the back of the pan.

The second boiler, or thick-juice pan, is entirely different in its construction from the first. It is also 5 ft 9 in. diameter but is only 2.89 metres (9 ft. 6 in.) in length. It has a tube plate at each end, and contains 140 brass tubes 56 mm diameter (2.20 in.) running from end to end and communicating at each end with a separate chamber. The chamber at the hinder end receives the steam from the boiling juice in the thin-juice pan, but a valve is provided by which low pressure steam can be introduced to it directly (as to the thin-juice pan), if it should be desirable or necessary to do so. The chamber at the front end of the boiler is much smaller than the other, and is provided only with cocks for drawing off the condensed water. The tubes are kept tight by means very similar to those often used in surface condensers, viz., as follows: each end of the boiler (up to the level of the top tubes) consists of two thicknesses of plate, rivetted together, making up a total thickness of 40mm, (1.57 in.) The holes in the inner plate are made as nearly as possible the same diameter as the tubes, which passing through them are left perfectly free to expand. The outside plate has holes concentric with the others, but considerably larger in diameter, so as to form a kind of stuffing box round each tube. Into this an india-rubber ring is slipped, then a thin brass washer, and then the whole is made tight by a brass gland, screwed into the outer tube plate. This system of packing is expensive, but it ought to be thoroughly effective.

The domes of both boilers are alike, and are each fitted with internal chambers, as shown in dotted lines, for intercepting the sugar carried up by the steam. The top of each is connected by a copper pipe with the middle safety vessel, but under ordinary circumstances only the second boiler actually communicates with this vessel, the communication with the first boiler being closed by a blank flange. The construction of the safety vessel is clearly shown in the drawing. The steam from the boiler obtains access near the upper part of the vessel to the annular space left between its inner and outer cylinders. It is then compelled to pass down a spiral passage by an intercepting diaphragm, and the sugar which has been carried over by it, intercepted by this diaphragm, falls to the bottom of the vessel, while the steam ascends through the inner cylinder or pipe, and is led away by it to the condenser. A glass gauge on the lower part of the vessel shows the level of the sugar juice in it, and a small valve is fixed to its bottom with pipes to convey the juice back to either of the two boilers. In the usual mode of working this apparatus, as before explained, the steam from the juice in the first boiler, prevented from communicating with the middle safety vessel, passes through a pipe to a somewhat similar vessel placed on the top of the steam chamber at the back of the second boiler. Having been by this vessel freed from sugar, it passes through the tubes of the second boiler, and is itself condensed by imparting its heat to the contents of that boiler.

The total heating surface of the copper tubes in the first boiler amounts to 52 square metres, or 559 square feet, and the total heating surface of the brass tubes in the second boiler amounts to 70 square metres, 753 square feet. The boilers are mounted with a complete set of fittings, which are clearly shown in our engravings. They include the following: main steam valves, 6 in. diameter; juice induction valves 65 mm. (2.55 in.) diameter, juice eduction valves, 75 mm (2.95 in.) diameter, a complete set of water escape cocks for tubes of first boiler, with valves for preventing loss of steam, admission and egress valves for direct steam to the lower pipes in the first boiler, vacuum gauges, thermometers, butter cocks, glass gauges, testers, peepers, etc. The larger fittings are of cast iron with brass valves, the smaller ones entirely of brass, the domes and safety vessels, as well as the boilers, are of wrought iron, and the steam pipes of copper.

HOW TO IMPROVE THE APPEARANCE OF FURNITURE.

Mr. G. J. Henkels, of Philadelphia, Pa., suggests that when the polish on new furniture becomes dull it can be renewed by the following process: Take a soft sponge, wet with clean cold water, and wash over the article. Then take a soft chamois skin and wipe it clean. Dry the skin as well as you can by wringing it in the hands, and wipe the water off the furniture, being careful to wipe only one way. Never use a dry chamois on varnished work. If the varnish is defaced and shows white marks, take linseed oil and turpentine in equal parts; shake them well in a phial and apply a very small quantity on a soft rag until the color is restored; then with a clean soft rag wipe the mixture entirely off. In deeply carved work, the dust cannot be removed with a sponge. Use a stiff haired paint brush intead of a sponge. The cause of varnished furniture becoming dull, and the reason why oil and turpentine restore its former polish, it will be appropriate to explain. The humidity of the atmosphere and the action of gas cause a bluish white coating to collect on all furniture, and show conspicuously on bright polished surfaces, such as mirrors, pianos, cabinet ware and polished metal. It is easily removed as previously directed. The white scratches on furniture are caused by bruising the gum of which varnish is made. Copal varnish is composed of gum copal, linseed oil, and turpentine or benzine. Copal is not soluble in alcohol as other gums are, but is dissolved by heat. It is the foundation of varnish, as the oil is used only to make the gum tough, and the turpentine is required only to hold the other parts in liquid state, and it evaporates immediately after its application to furniture. The gum then becomes hard and admits of a fine polish. Thus, when the varnish is bruised, it is the gum that turns white, and the color is restored by applying the oil and turpentine. If the mixture is left on the furniture, it will amalgamate with the varnish and become tough, therefore the necessity of wiping it entirely off at once. To varnish old furniture, it should be rubbed with pulverized pumice stone and water to take off the old surface, and then varnished with varnish reduced, by adding turpentine, to the consistency of cream. Apply with a stiff haired brush. If it does not look well, repeat the rubbing with pumice stone, and when dry, varnish it again.

MOTHS IN FUNITURE.

The same author says: There are two species of moths which infest furniture. One is a large fly of silvery white color; the worm of the same is shaped like a chestnut worm, and is familiarly known. It rarely infests furniture. The other is a small fly of a dark drab color; the worm is about one fourth of an inch long, and tapering from the head to the tail. It was first observed by upholsterers about thirteen years ago. This fly penetrates a sofa or chair, generally between the back and seats of sofas, or under the seats, where the vacancy among the springs affords a safe retreat. It may make a lodgment in one week after the furniture is placed in the house. If such should be the case, in two months the worm will appear; and the continual process of procreation in a few months increases the number to thousands. This moth has no season. It destroys in winter and summer alike, and it is kept in active life by the constant heat of the house. We find at the same time, in the same piece of furniture, the fly, the worm, and the eggs; thus showing that they are breeding and destroying all the time. It does not eat pure curled hair, but fastens its cocoon to it, the elasticity of which prevents its being disturbed. The inside of furniture is used by it only for the purposes of propagation. The worm when ready for food crawls out and destroys the covering, if of woollen or plush material; and falling to the carpet, destroys it. It rarely cuts through plush from the inside, as it is of cotton back, but there are instances where the worms have cut up muslin on the outside back of sofas. There is no protection against them but continual care. New furniture should be removed from the walls at least twice a week at this season of the year, and should be well whisked all round, and particularly under the seats, to prevent the fly from lodging. This is an effectual preventive, and the only one known. Cayenne pepper, Scotch snuff, camphor, turpentine and all other remedies for protection from the large moth are of little or no avail against the furniture moths. Saturation with alcohol will not destroy them when in a piece of furniture. If the furniture is infested, they may be removed by taking off the muslin from under the seats and off the outside ends and backs, where they congregate most, and exposing to the air as much as possible. Beat well with a whisk or the open hand, and kill all the flies and worms which show themselves. This done often will disturb them, and may make them leave the furniture, in their desire to be left in quiet. When the furniture is free from moths and is to be left during the summer months without attention, it may be protected by camphor in small bags or highly concentrated patchouli. The safest way is to have the furniture well whisked twice a week. If the moths attack the carpet, which they will first do under the sofas and chairs, spread a wet sheet on the carpet and pass a hot flat iron over it quickly; the steam will effectually destroy both worms and eggs. If furniture is delivered in a dwelling free from moths, the upholsterer's responsibility ends there and all rests with the housekeeper, as no tradesman can tell whether the moth will attack it or not. There are cases where the furniture has been in use ten or twelve years before being attacked. It would be as fair to hold the tailor responsible for the safety of clothing from moths as to hold the upholsterer responsible for the safety of furniture.

STRENGTH OF CEMENT.

Professor Bauschinger, of the Polytechnic School of Munchen, has lately made experiments (in the technical laboratory of that institution) with mortar of Perlmosen Portland cement and water-lime; and he publishes his results in the *Zeitschrift des Bayer. Ingen.-und Arch.-Vereins.*

Cubes of pure cement, as well as of mixtures of one part cement with sand or rubble up to five parts, were submitted to pressure. The resistance of pure cement was found to be greater than that of the mixture of the proportion of 1 : 5; it diminishes very slowly, even if as much as three parts sand (even coarse rubble) are added. Cubes of water-lime and coarse rubble were found to resist pressure best, mixed in the proportions of 1 : 2 or 1 : 3; pure water lime offering the least resistance. The resistance to pressure in a mixture of the proportion of 1 : 4 is nearly as great as in that of 1 : 1.

Cubes of brickwork, made of common bricks and mortar of one part water-lime and three parts fine sand, after hardening for ninety days, were next tried, when it happened that the mortar remained firm, whilst the bricks were crushed.

Slabs of one part cement and two parts fine sand, about 1½ in. thick, also, after setting for ninety days, were likewise experimented upon, and the results showed that the strength per square unit increases with the dimensions of the cross section, but it is also determined by its form, and diminishes somewhat with the thickness of the slab.

Similar experiments with cement prisms likewise showed that the strength of rupture of cement increases if it is mixed with sand in the proportion of 1 : 3, and even that of mortar mixed in the proportion of 1 : 4 is greater than that of pure cement.

In the trial with slabs made of one part cement and two parts fine sand it was found that they possess equal strength whether they rest on all four corners or only on two edges, and that the resistance was nearly proportional to the square of thickness of the slabs. The slabs were tried after hardening for 105 days; the prisms after 90 days.

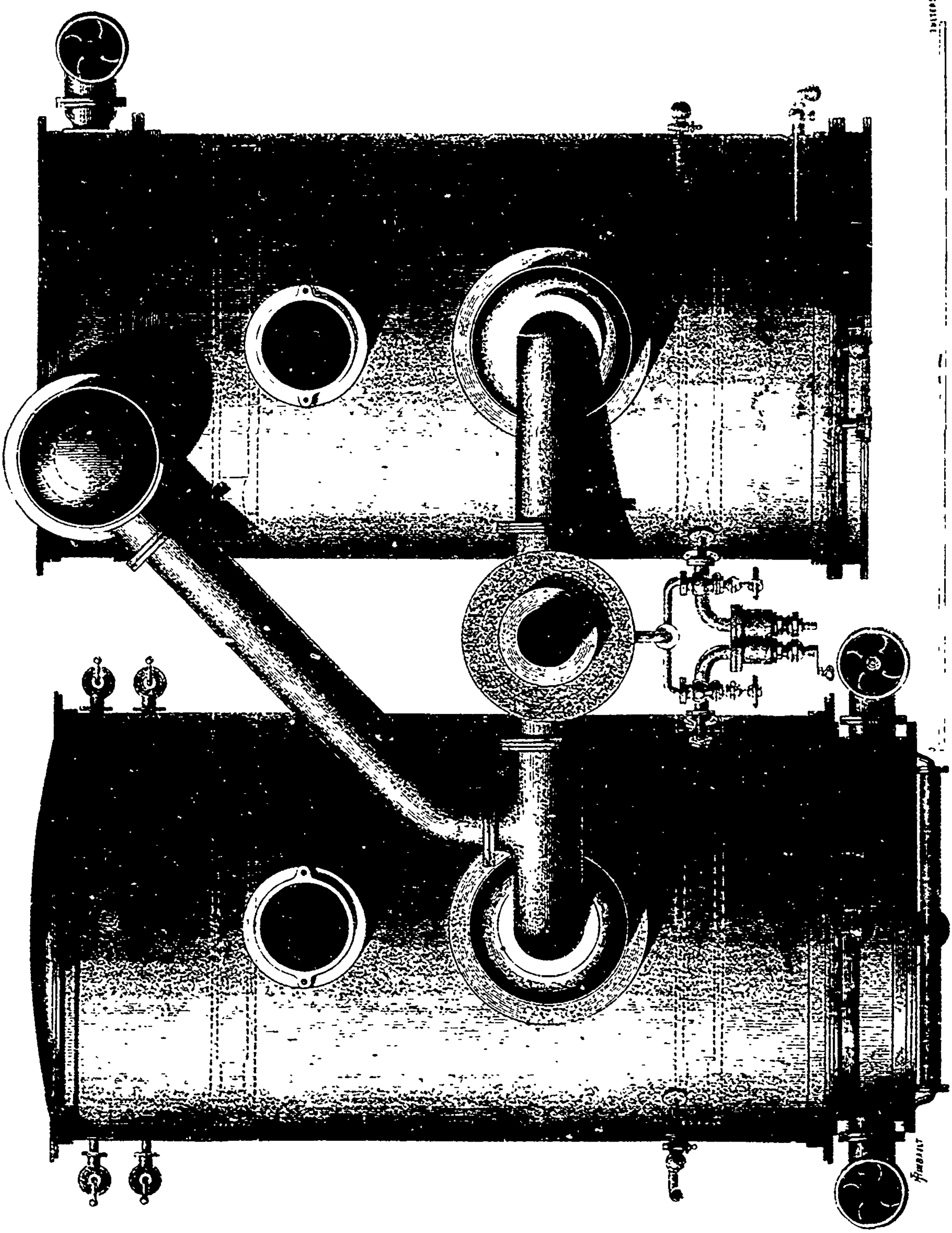
Professor Bauschinger intends publishing an empirical formula as soon as a sufficient number of experiments are available for the purpose.

For the week ending September 4th there were shipped from Petrolia station 3,070 barrels of crude, 116 refined, and 1,120 of distilled oil.

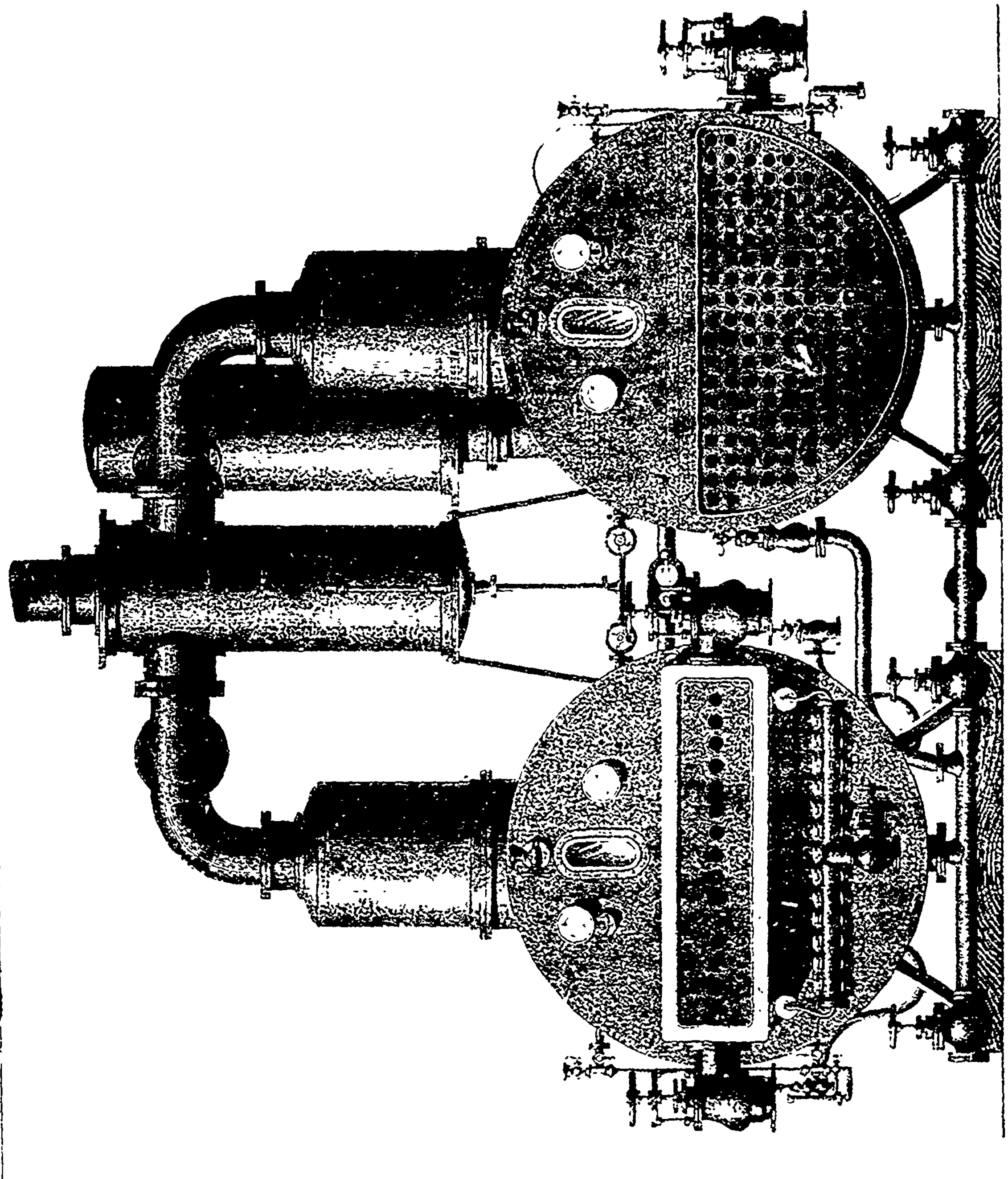
The great pumping operation on the Lower Fraser has proved a failure. The pump will suck up water and sand like a ad, but when it comes to gravel and boulders, it is not on it. The enterprise has been abandoned.

Ebony weighs 83 lb. to the cubic foot; *lignum vitæ* the same; hickory, 52 lb.; birch, 55 lb.; beech, 40 lb; yellow pine, 38 lb; white pine, 25 lb., cork, 15 lb.

There are saws made so small and minute as not to exceed one-fiftieth of an inch in width and less than that in thickness.



BEET-SUGAR BOILERS (See page 140.)



BEET-SUGAR BOILERS (See page 140.)

WRIGHT'S PATENT AIR GAS.—The new air gas manufactured under the patent of Mr. William Wright, Carver Street, is being brought into practical use in Sheffield. The patentee has erected a complete apparatus at the London Music Hall, and the gas is said to be 20 per cent. better than that ordinarily extracted from coal, whilst it is 5ᴗ per cent. cheaper. Mr. Wright's system is most peculiar. First he employs two airometers, and as one of them discharges, it lifts up the lid of the empty one. These work continuously, one helping the other, and no pumping of air is necessary. At the "London," however, the air is forced into the airometer, the second airometer not having yet been completed. From the airometer the air passes in a state of compression into a large iron cylinder, in the interior of which are arranged composition pistons, and these latter are impregnated with some particular description of spirit. Appliances are affixed to the cylinder which impregnate the pistons with the spirit. Directly the air has passed through the cylinder, it becomes gas of great brilliance In the interiors of the pipes which lead to and from the cylinder, self-acting valves are placed, which cut off the supply of gas the instant that the gas is turned off at the jets, thus preventing any evaporization of spirit. When a jet of air is turned on with the air gas, and the two are brought into contact at the burner, the heat given out is so intense that a bar of iron is readily melted by it. We understand that Mr. Wright has other inventions in hand which are of a most extraordinary character, and which will shortly be brought before the public.

MECHANICS' MAGAZINE.

MONTREAL, AUGUST, 1873.

ILLUSTRATIONS:

CONTENTS:

THE VIENNA PATENT CONGRESS.

In a former number of this journal, we drew attention to the present unsatisfactory state of patent law in certain parts of Europe, especially in Austria.

The Congress at Vienna of persons interested in such matters to visit the International Exhibition, afforded an opportunity of discussing the whole question of patent right, and of laying down fixed principles which might serve as guides to Legislation with reference to an international patent law reform.

The Congress met for the first time on the 4th August, and after five days of animated deliberation brought their labours to a satisfactory conclusion. The resolutions adopted are not as a whole so liberal as perhaps they might have been ; but it was conclusively shown that the party opposing Patent Laws, in toto, was a very small minority.

On the other hand the work of the Congress is not concluded, since at the closing of the present meeting, the committee was constituted as a permanent executive committee with power to publish the resolutions adopted, and to submit them to the various Governments. It is also authorised to choose members, and to make arrangements for a second congress at some future time. The following are the resolutions adopted by the Congress.

"*Resolution I.*—The protection of inventions is to be guaranteed by the laws of all civilised nations under the condition of a complete publication of the same ; because :

"*a.* The sense of right of civilised nations demands the legal protection of intellectual work.

"*b.* This protection affords the only practical and effective means of introducing new technical ideas, without loss of time, and in a reliable manner to the general knowledge of the public.

"*c.* The protection of invention renders the labour of the inventor remunerative, and induces thereby competent men to devote time and means to the introduction and practical application of new and useful technical methods and improvements, or to attract capital from abroad, which, in the absence of patent protection, will find means of secure investment elsewhere.

"*d.* By the obligatory complete publication of the patented invention, the great sacrifices in time and of money, which the technical application would otherwise impose upon the industry of all countries, will be considerably lessened.

"*e.* By the protection of invention the secrecy of manufacture, which is one of the greatest enemies of industrial progress, will lose its chief support.

"*f.* Great injury will be inflicted upon the countries which have no rational patent laws by the native inventive talent emigrating to more congenial countries, where their labour is legally protected.

"*g.* Experience shows that the holder of a patent will himself make the most effectual exertions for a speedy introduction of his invention."

"*Resolution II.*—An effective and useful patent must have the following principles

"*a.* The inventor or his legal heir only can obtain a patent. A patent cannot be refused to a foreigner.

"*b.* In order to carry out the principle stated above (*a*), the introduction of the system of a preliminary examination is recommended.

"*c.* A patent for an invention should be granted for fifteen years, or the option should be to extend it to that period.

"*d.* The granting of a patent must be accompanied by a detailed and complete publication, which renders the practical application of the invention possible.

"*e.* The cost for the granting of a patent should be moderate, but in the interest of the inventor an increasing scale of fees should be fixed, so as to cancel an useless patent as soon as possible.

"*f.* It should be easy for any one to obtain, through a well-organised patent office, the specifications of any patent, as well as to ascertain which patents are still in force.

"*g.* Laws should be passed by means of which a patentee may be compelled, in cases of public interest, to allow the use of his invention for a suitable remuneration to all *bonâ fide* applicants."

For the rest, and especially with respect to the proceedings in the granting of patents, the Congress refers to the English, American, and Belgian patent laws, and to the proposition made by the union of German engineers for a patent law of the German empire.

"*Resolution III.*—In consideration of the great difference between the existing patent laws, and in consideration of the altered state of international communication, the necessity of reform becomes evident, and it is to be strongly recommended that the different Governments should endeavour to arrange, as soon as possible, an international understanding on the patent laws.

"The not executing of a patent in a country is no reason for its becoming void in that country, as long as the invention has been carried out once, and the possibility is there that the right of using the invention can be obtained by any inhabitant of this country."

CORRESPONDENCE.

[*We do not hold ourselves accountable for the opinions of our Correspondents.*]

PATENT LAW.

To the Editor of the MECHANICS' MAGAZINE,

SIR,—Having in my last letter pointed out what appeared to be the defects of the 28th section of the Act, I will now proceed to discuss the 39th section, passing over the intervening clauses as calling for no important remarks:

"39. An intending applicant for a patent who has not yet "perfected his invention, and is in fear of being despoiled of "his idea, may file in the Patent Office a description of his "invention so far, with or without plans at his own will; "and the Commissioner, on reception of the fee hereinbefore "prescribed, shall cause the said document to be preserved "in secrecy, with the exception of delivering copies of the "same whenever required by the said party, or by any judicial "tribunal, the secrecy of the document to cease when he obtains a patent for his invention; and such document shall "be called a *caveat*: provided always that if application shall "be made by any other person for a patent for any invention "with which such *caveat* may in any respect interfere it shall "be the duty of the Commissioner forthwith to give notice by "mail to the person who has filed such *caveat*, and such person shall within three months after the date of mailing the "notice, if he would avail himself of the *caveat*, file his petition "and take the other steps necessary on an application for "patent, and if, in the opinion of the Commissioner the applications are interfering, like proceedings may be had in all "respects as are by this Act provided in the case of interfering applications: Provided further, that unless the person "filing any *caveat* shall within one year from the filing thereof, have made application for a patent, the Commissioner of "Patents shall be relieved from the obligation of giving "notice, the *caveat* then remaining as a simple matter of "proof as to novelty or priority of invention if needed."

The only objection I have to make to this is that there is no provision by which the *caveat* may be renewed, and as many very valuable inventions require a much longer period than one year to bring them to the proper perfection to submit to the public, I think all will agree with me that by a yearly fee, the *caveat* should be renewed as long as the inventor may require. This privilege is allowed to to inventors by the United States Government. See Patent Office Rules, July, 1870, section 93, as follows:

"93. The caveator will not be entitled to notice of any ap-"plication pending at the time of filing his *caveat*, nor of any "application filed after the expiration of one year from the "date of filing the *caveat*; but he may renew his *caveat* at the "end of one year by paying a second *caveat* fee of ten dollars, "which will continue it in force for one year longer, and so on "from year to year as long as he may desire."

The pertinence of this remark I will only illustrate by one example, that of Mr Bessemer, in his improvements in the manufacture of steel, which took him about twenty years to bring to perfection, during which time his workmen were not only employed under oath of secrecy, but while engaged at labour, were strictly kept under lock and key Had Mr. Bessemer not had the command of a very large amount of money, his invention might at this day be unknown, and I am convinced that I am within limits if I say that his invention is worth £5,000,000 sterling to the human race for the present year.

I will now pass over the following clauses till I come to the 48th which is the last one worthy of notice, and with it I shall conclude the subject for the present.

This reads as follows:

"48. Every person, who before the issuing of a patent has "purchased, constructed, or acquired any invention for which "a patent has been obtained under this Act, shall have the "right of using and vending to others, the specific article, "machine, manufacture, or composition of matter patented, "so purchased, constructed or acquired before the issue of "the patent therefor, without being liable to the patentee or "his representatives for so doing; but the patent shall not be "held invalid as regards other persons by reason of such purchase, construction or acquisition, or use of the invention "by the person first aforesaid, or by those to whom he may "have sold the same, unless the same was purchased, constructed or acquired or used for a longer period than one year "before the application for a patent therefor, which circumstance would then have the effect of making the invention "one having become public and in public use."

The provision of the clause should be extended from one to two years, during which the invention may have been in use, before the inventor loses his rights, my reasons for such an opinion are already given in my remarks on the 6th section of the Act, and it is therefore unnecessary to repeat them here. But there is also another important deficiency in the Act, and that is that no provision is made for the inventor being protected from a breach of confidence in the parties to whom he may have exhibited his invention during the time that may elapse between the invention and obtaining of Letters Patent therefor, and for this purpose the following words might be added to the present clause.

"But the above shall not apply to any article manufactured "by or for any person to whom the inventor may in confidence "have communicated his invention previous to the obtaining "of Letters Patent therefor, without the consent of the inventor in writing."

In concluding this series of comments on the existing Patent Law, I may advert to one or two points, the force and truth of which will, I think be readily admitted by all.

It cannot be denied that we of this present generation are indebted for the material comforts and pleasures we enjoy, and which have almost become necessaries of life to us, to the efforts of inventors, especially during the last hundred years. To appreciate these comforts, we must try and realize a state of affairs with the steam engine and electric telegraph unknown, but little of our present abundant supply of manufactured articles, and not even a properly macadamized road to travel upon, and I think that then all would agree that we cannot be too grateful to those who, under God, have been the means of so improving our condition, and neither be niggardly in rewarding, nor slow in giving every possible facility to those who may, and will doubtless raise us still higher in the scale of civilization, and do as much for their fellow men within the coming hundred years, as they have done in the century past.

I am Sir,

Your obedient servt.

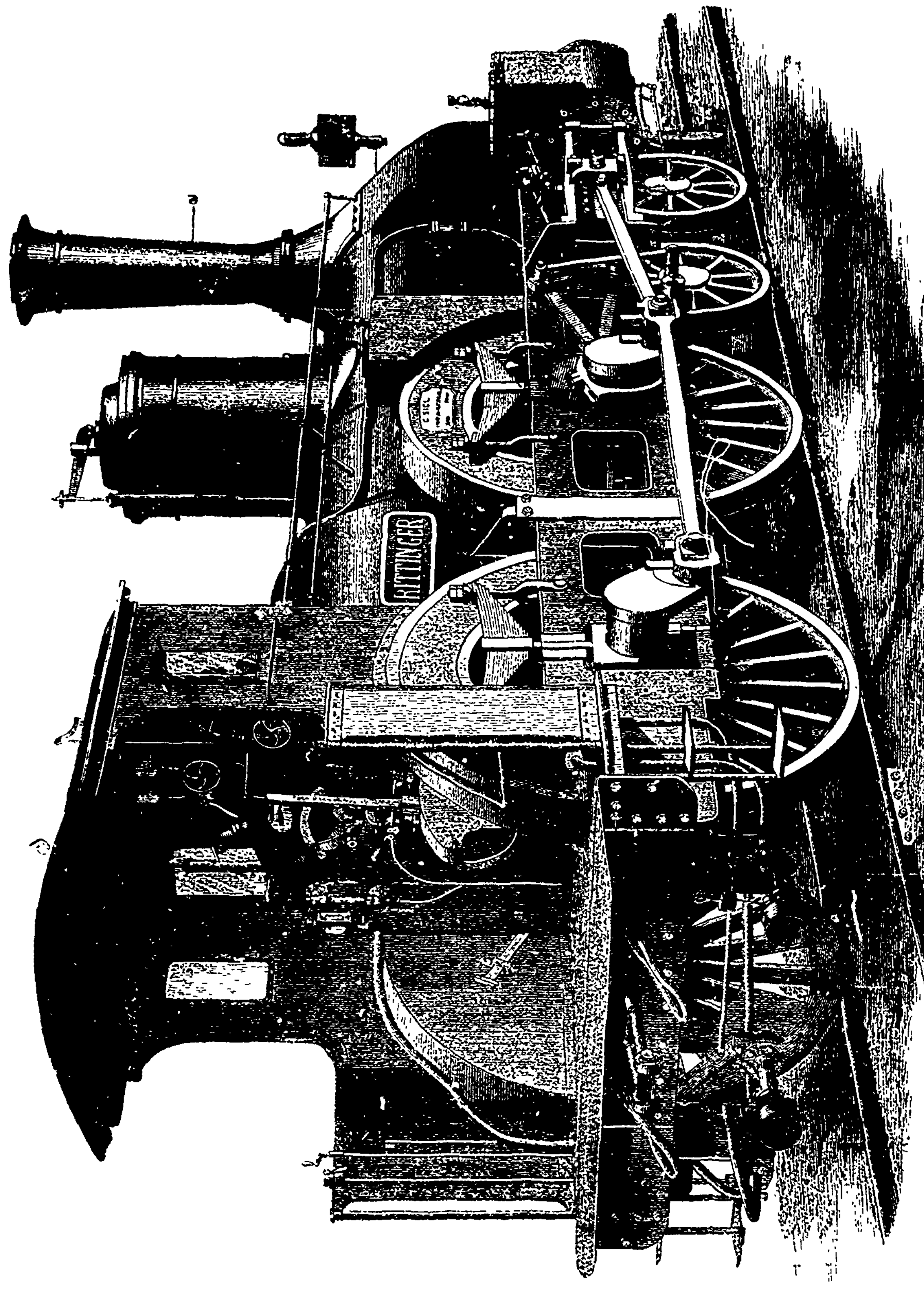
C. G. C. SIMPSON.

A WONDERFUL AGRICULTURAL MACHINE.—Our enterprising American cousins are not content with machines designed to perform ordinary operations in agriculture, but they devise extraordinary operations, and then proceed to invent machines to carry them out In this country we are satisfied to wait a while after reaping before we begin to plough for another crop. At St. Louis, Illinois, a machine is being built which is designed to cut and take up grain, and at the same time to plough and seed the ground. Surely the ingenuity of agricultural machinists cannot transcend this. —*Iron.*

WINDSOR has a fire alarm telegraph in working order.

A bridge is to be built across the St. Lawrence at Coteau Landing.

NUT works are being established in the town of Paris and will soon be in active operation.

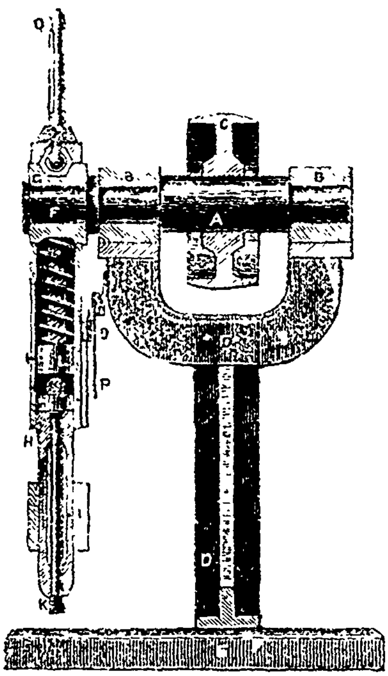


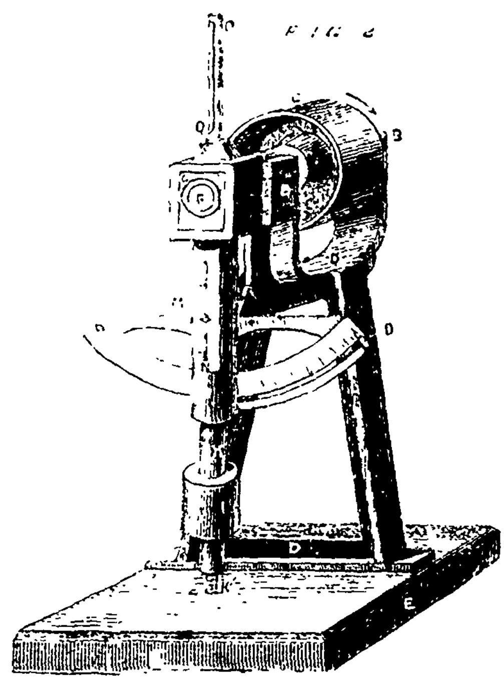
EXPRESS LOCOMOTIVE FOR THE SOUTHERN RAILWAY OF AUSTRIA.

CONSTRUCTED BY MR G. SIGL, ENGINEER, WIENER NEUSTADT (See page 150.)

MACHINE FOR TESTING LUBRICATING MATERIALS.

The following is a description of a machine for testing the value of lubricating oils invented by Professor R. H. Thurston, of the Stevens Institute of Technology, Hoboken, New Jersey, which we extract from the Chicago *Railroad Gazette*. The form shown in the illustration was designed by Mr J. A. Henderson, a student of the above-mentioned Institute. The machine is intended to give the co-efficient of friction, pressure on bearings, and temperature of journal boxes at any time, and the readings are proposed to be taken at short intervals throughout the test. Fig 1, page 147, is a sectional side elevation, and Fig 2 a perspective elevation The machine consists of a shaft A, running in two bearings B B, and driven by a pulley C The shaft is supported by a standard D D, carried on the base E E At the outer end of the shaft is a journal, F, of either steel or selected iron; suspended from this journal and clamping it by means of boxes G, is an arm H, carrying an adjustable weight I, which may be changed for one of different size, or adjusted on the arm, as is found requisite. The pressure under which the oil is to be tested is obtained by setting up the boxes, G, by means of the screw K acting on the nut L, on which nut the spring rests. The pressure per square inch is read off from the scale N which is traversed by an index M, attached to the spring. The friction causes the arm H to swing out from the vertical position, the moment of friction being indicated by the index on the arm O, which traverses the graduated arc P The co-efficient of friction is obtained by dividing the reading on the scale cut on the arc P by a second set of empirical divisors laid off on the scale N. The temperature is indicated at all times by a thermometer Q, set in the upper brass.





In using the machine, a small and determinate quantity of the oil to be tested is placed on the journal F, and the pressure being adjusted by the screw K to that at which the oil is desired to run under test, the machine is started at a speed which will give the desired relative velocity of rubbing surfaces. Observations are made at short intervals, and recorded, until the test is closed by rapid heating, as shown by the thermometer, and excessive increase of friction, as indicated by the arm H swinging up against its checks. Competing oils are similarly tried, and the records afford a perfect means of comparison.

Thus, sewing-machine builders desire oil of long endurance and small frictional resistance and viscosity; on locomotives an oil that will bear high pressure for the greatest length of time without heating is the most desirable, even although not as limpid and of a slight frictional resistance. The relative power of resisting high temperatures without decomposition is another important point which may be tested. Any lubricant may be tested, whether mineral, vegetable, or animal oil, or tallow or mixture like axle-grease. The only precautions necessary are not to allow the temperature to run so high as to injure the thermometer or the journal surface, and to measure accurately the quantity of oil used

The form shown in the cut is that proposed for general use, but for extremely heavy pressures another form has been designed in which the pressure on the journal is obtained by a clamp composed of a fixed arm and a spring, the spring being set up by a hand wheel turning a nut in the end of the fixed arm. In this form of the machine, the moment of friction is measured by the compression of the spring. The essential feature of both forms is the combination in one machine or apparatus for making simultaneous dynamometrical and thermometrical tests of the lubricant. The machine is patented by Professor Thurston, but the patentee announces that master mechanics can obtain permission to construct and use it on application to him. He will also furnish applicants with the necessary dimentions for the machines and with the numbers to be attached to them.

News of a rather extraordinary feat in photography comes from San Francisco. It appears that a gentleman desired a photographic portrait of a celebrated trotting horse taken while the animal was going at full speed. The photographer set to work by arranging all the sheets in the stable as a sort of reflecting background. In front of these the horse was trained to trot, moving at the rate of 38 ft. a second. After two unsuccessful attempts, the photographer hit upon a method which gave a result as excellent, we are told, as could be desired. The operator closed his camera by two boards, so arranged that on touching a spring they slipped past each other, leaving an opening of one-eighth of an inch for the 500th part of a second. Using double lenses, crossed, a perfect likeness of the horse was obtained, and so instantaneous was the impression of the sensitive film that the spokes of the wheels of the vehicle to which the animal was harnessed were shown as if at rest This method may probably be turned to account in other directions.

FOOD AND ITS PREPARATION.

The following notes are taken from an interesting essay by Dr. George Derby, secretary of the State Board of Health of Massachusetts, treating upon the forms of food in common use throughout that State, how they are prepared and how they are eaten, together with the considerations whether this food, as generally used, promotes public health, power, and usefulness. The question :

IS SUCH AN ARTICLE WHOLESOME OR NOT ?

cannot be truly answered in a general sense. Very few articles ranked as good are absolutely unfit, but a man laying a stone wall may digest and thrive on diet which would be very unwhole some to him if employed in shoemaking or other sedentary occupation. Of the many causes of consumption, want of proper food is surely one, and there is good reason to believe that the many forms of dyspepsia so commonly met with are but too often the danger-signal that Nature gives us to show that the food, either in its quality, its preparation, or its variety, is unsuited to maintain the vital process. It is but a modified form of starvation, with the mockery of a display of abundance.

Bread.

Leavened or fermented bread is as old as the time of Moses and its value has been fairly tested. Whatever be the precise action of the leaven, it transforms grain by partial decomposition of its original elements, and leaves as its resultant what men in all ages have approved. Modern substitutes impair the flavour, diminish the nutritive property, and break the staff of life Bakers' bread is almost universally composed of flour with extraneous substances, alum and carbonate of ammonia being most employed. Bread hastily made in families is mixed in a variety of ways with carbonates of soda or potash, combined with phosphate of lime, with cream of tartar or with sour milk, and is generally imperfectly cooked. Very often the elements of wheat and fat which the body demands are furnished in underdone pastry made of flour and hogs' lard ; the first legitimate effect of such food as this with people of average condition is indigestion or dyspepsia ; the second is all that train of ailments caused by imperfect nutrition.

Good bread should be made from a mixture of flour such as is generally used in our markets, water, salt and yeast, and nothing else. The yeast is composed of malt, potatoes, and hops, and the dough, kneaded for from one and a half to two hours, is then thoroughly baked In this connection, regarding the quality of bread retailed in large cities, we should judge from Dr Derby's report that Boston bread was inferior to that sold in New York. Some time since one of our great dailies, desiring to gather a column or two of sensational matter, made arrangements with a young ph   ian of this city to procure one hundred samples of bread from various localities, analyse the same, and astonish the country with revelations of gross adulteration, swindling the poor, &c. After gathering a few specimens from corner groceries and other unpromising spots, the investigator was obliged to discontinue his labours, for the simple reason that the bread contained no impurities worth mentioning, and such as there were did not exist in any deleterious quantity. It is needless to add that the enterprising journal did not publish the results obtained.

Variety of Food.

Experience has proved that, for some reason unknown to science, variety is essential to health after reaching the age when we are free to choose our food. The perpetual recurrence of the same edibles, even though their number be considerable, becomes in all periods of life except infancy not only wearisome, but positively injurious. The lack of variety in many cases is due to the poverty of poorer classes and the difficulty of buying fresh provisions in places remote from markets. Salt-pork, salt-fish, and potatoes, with pies, poor bread, and Japan tea, are the staples of food of thousands of families during our long winters. It should be understood how needful a change of diet is from time to time. Fresh vegetables, particularly in the country, are readily obtained and preserved, and should be unsparingly used The edible roots, as turnips, carrots, onions, and beets, and cabbage, are as well worth preservation as the omnipresent potato All these vegetables need thorough boiling, and more than they generally get.

Frying Meat.

A common habit in American cookery, is most unprofitable to the eater. It robs the meat of its juices and hardens its texture. The extreme heat of the fat not only burns the outer layers of the meat, so as to injure their value for nutritive purposes, but also changes the chemical condition of the fatty acids, giving rise to products which obstruct the breathing and cause tingling of the nose and eyes of the cook, and which are more or less harmful to the eater. The peculiar flavour of the meat is in a great measure lost by frying, and for it is substituted the flavour of the fat in which it is cooked. This fat permeates the fibres of the meat in such a way as to render them less soluble in the watery fluids of the mouth and stomach, and thus causes difficult digestion. Broiling on a gridiron over a quick fire costs a little more time and trouble. and very likely fuel also, but by this process the juices of the meat are sealed up (to a certain extent) instead of being evaporated, and the nutritive value is thereby much increased

DOMINION.

A large potash factory is in course of erection in Seaforth.

The business of the new railroad—the South Eastern Railway—exceeds the expectations of all. Every passenger train is well loaded, and the first freight through comprised eleven cars. This road has upwards of 300 cars of freight promised and ready along the line to come through. The road when fully known is sure to become one of the most important in the country for travel and freight as well.

Amethysts on the Gatineau.—We were shown to-day by Mr Sutherland, jeweller, some splendid specimens of amethysts which were found up the Gatineau. The specimens are of fine color, and run down deeply into a quartz surface. Surely there must be some valuable minerals in the neighborhood which would be worth looking after.—*Ottawa Free Press.*

Cobourg, July 26.—There has been a Company formed here for the purpose of manufacturing sugar from the sugar beet. Mr. John Purser, President; Mr. A. F. Burnet, Managing Director. Shares $25 each, which are payable either in cash or be . s. The best quality of seed has been imported from France, and is supplied to the share-holders by the Managing Director on application. The best and most approved machinery has been purchased for the factory. The experiments made thus far prove highly satisfactory, and there is no doubt but that the enterprise will be a success.

Mr Marwood Gilbert, who formerly resided in St Thomas and lately removed to Tilsonburgh, and Prichard Bros , of Bayham and Fort William, have been on a visit to the Lake Superior mining region, and while there discovered a rich mine of silver, lead, and copper, mixed with gold, about 150 miles from Fort William. They purchased 320 acres of land upon which the mine is situated. They had the ore tested, and were offered $50,000 for their claim by those who tested the ore. They brought some specimens of the metal home with them, and also some of the ore.

The Great Western Railway Company have just completed a steam passenger car, to be placed on the branch of their line running from Wyoming to Petrolia. In one end of a passenger car a powerful upright steam engine and boiler has been placed, having direct connection with the axles of the wheel truck below. The car will accommodate about thirty or thirty-five persons comfortably, and it is expected will do the work of conveying passengers between Petrolia and Wyoming at a satisfactory speed at a much less cost to the Company than by the use of a locomotive. A refitted pony car will accompany the passenger car, and do duty as a baggage van.

THE AIR WE BREATHE

Much attention is now being paid to the characteristics of the atmosphere in various localities, and under diverse circumstances. Analyses show that air in open and exposed localities varies in the amount of oxygen which it contains from 20·4 to 21·0 per cent. The most favorable localities, as on the heaths of Scotland, show the latter; while it is necessary to go underground into a mine to find the former. Well ventilated mines show about 20·4; while our illy ventilated mines, where it is possible to labor, rarely go below 20. These results are derived from thousands of careful analyses. Cavendish made 500 in the course of his enquiries.

The cursory reader may think that the difference between 21, and 20 in the per cent. of oxygen in the atmosphere can have but little importance, and is hardly worth enquiring. It is true that the deficiency named is small when considered in figuring, but when we reflect that while 21 represents the largest amount of oxygen ever found in the best natural atmosphere, a candle goes out at 18·50, and life can barely be sustained for a short time at 17·20, the importance of a small per cent. of difference becomes apparent. Even so small a difference as that between 21, and 20·981 is equal to 190 in a million; and if we place impurity in water at that rate it will amount to 13 grains in a gallon. This amount would be considered enormous, if it consisted of putrifying matter or any organic matter usually found in water.

But we drink but a small quantity of water, and with such a percentage we might be several days in swallowing the whole 13 grains; whereas we take into our lungs from 1,500 to 2,000 gallons of air each day. Moreover the blood receives such impurities almost entire, very little being filtered out in its passage to the lungs, while the stomach has powers of disinjection and destruction which render harmless very much of the organic impurities contained in water. But if we take the air found in the pit of the theatre, generally about 20·740 we find the minute analysis becomes a matter of the highest importance.

The senses are bad and inefficient guides to the wholesomeness of air as regards the amount of oxygen and carbonic acid, save when the former is reduced and the latter increased to such an extent that the lungs seem to refuse to expand and the whole vital action is threatened with paralysis. Rooms badly ventilated, which contain less than 20·7 per cent of oxygen are very unwholesome, and the necessity of taking into consideration the proportion of oxygen and carbonic acid in the sanitary inspection of factories and workshops is abundantly evident from the result obtained by Dr. Smith.

Mr. Clemson, a French chemist, made public, in 1856, a theory with regard to the presence of living organisms in the atmosphere, so minute as to be almost or quite unobservable by the best microscope, and which organisms exerted a marked influence on health—in fact were the origin of most diseases to which men are subjected. He also argued that there is phosphoric acid in the air, derived from the successive generations after generations of myriads of these organisms, produced, living and dying in the atmosphere; that such organisms exist and are at work, assimilating from one to the other, preparing food for more perfect organisms, from the microscopic points of life to the most perfect animal existence. He also entertained the idea that the increased fertility of the earth by being broken up and exposed to the atmosphere, was due to the presence of such animalculæ.—*Rural Home.*

If there is a thing which is utterly detestable to look upon by a strict observer and one who has a general knowledge of what is right, it is to see the heads of bolts driven down below the surface of the wood. The bolt has a certain duty to perform, and where that duty is the securing of a piece of iron to wood, or wood to iron, if the head of the bolt sets firmly upon the wood, and the nut is firm upon the iron, it is all that is required; but when we commence to draw upon the bolt until the head sets below the surface of the wood, that moment we commence destroying the fibre of the wood, and aid the premature rotting at that one point; for, no matter how nicely painted, or how neatly puttied up, there will soon be a cavity for the retention of a few drops of water. This alone would be enough to condemn the practice, to say nothing of the other results it produces.

MISCELLANEA

It seems that the old story of "bread with gin in it" is not without foundation according to Mr. Thomas Bolas, who writes in the *Chemical News* stating that forty 2lb loaves contain about the same amount of alcohol as a bottle of port.

Gardeners have long affirmed that the moon's rays give great activity to the growth of mushrooms. M. Charbonnier, of Paris, states that he has observed in his aquaria a very remarkable growth of cryptogamus vegetation under the influence of the light of the full mooon.

The cultivation of science spreads steadily. A scientific society has recently been established at Buenos Ayres. Mr. A. Luis Huergo for its first president. According to their programme, the members have arranged for carrying out several branches of original research.

It is reported that hemp, when the blossoms are just opened is an infallible preservative of textile fabrics against the attacks of moths. The stalk, with leaves and flowers, is cut when blooming (about July), and dried in the shade. It is said to preserve its properties for several years.

It is worthy of note that Mr. E. H. Hoskins, of Lowell, Massachusetts, U. S. has showed by experiment, that collodion may be usefully employed for the preservation of charred paper. Many papers charred in the great fire of Chicago—bank-notes, &c.—were treated with collodion, which forms a thin transparent film, and dries in a few minutes. The printing or writing can be read through this film.

Perpetual Paste.—The *Journal of Applied Chemistry* says: Dissolve a tea-spoonful of alum in a quart of warm water. When cold, stir in as much flour as will give it the consistency of thick cream, being particular to break up all the lumps; stir in as much powdered rosin as will lie on a dime, and throw in half a dozen cloves to give a pleasant odor. Have on the fire a tea cup of boiling water, pour the flour mixture into it, stirring well at the time. In a very few minutes it will be of the consistency of mush. Pour it into an earthern or china vessel; let it cool; lay a cover on, and put it in a cool place. When needed for use, take out a portion and soften it with warm water. Paste thus made will last twelve months.

To Clean Paint.—A correspondent of the *Country Gentleman* says: Use but little water at once; keep it warm and clean by changing it often. A flannel cloth takes off fly specks better than cotton. Soap will remove the paint; so use but little of it. Cold tea is the best liquid for cleaning varnished paint, window panes and mirrors. A sharp piece of soft wood is indispensable for cleaning out corners. A saucer of sifted ashes should always be at hand to clean unvarnished paint that has become badly smoked; it is better than soap. Never put soap upon glass, unless it can be thoroughly rinsed off, which can never be done to window glass. Wash off the specks with warm tea, and rub the panes dry; then make a paste of whiting and water, and put a little in the center of each pane. Take a dry cloth and rub it all over the glass, and then rub it off with a chamois skin or flannel, and your windows will shine like crystal.

An Anatomical Hint.—Dr. Herman Meyer of Zurich asserts that a shoemaker ought not only to produce a shoe that does not pinch, but a shoe so constructed that it will give to a foot distorted by the pinching it has borne already, a fair chance of a return to its right shape, and full possession of its power as a means of carrying the body onward. He says that in measuring a foot for a shoe or boot, the first thing to be considered is the place of the great toe. Upon this toe, in walking, the weight of the whole body turns at every step; in a natural foot, therefore, it is in a straight line with the heel. A central straight line drawn from the point of the great toe to the middle of its root, if continued, would pass very exactly to the middle of the heel. But, by the misfitting boot usually worn, the point of the toe is pressed inwards, the root outwards. No last, or model of a foot already injured by wearing ill-fitting boots or shoes should ever be made of the exact size of such a foot.

EXPRESS LOCOMOTIVE AT THE VIENNA EXHIBITION.

We give on page 146, a perspective view of the express locomotive "Rittinger," constructed by Mr. G. Sigl, of Wiener Neustadt, for the Southern Railway of Austria. The illustration will give a good idea of its general arrangement.

The engine has four coupled wheels, and a four-wheeled bogie at the leading end, the diameter of the coupled wheels being 6 ft. 2¼ in., and the total wheel base 17 ft. 7 in. The cylinders are 16½ in. diameter and 24¾ in. stroke, and they are as will be seen, placed outside, the coupled axles having outside cranks. The arrangement of the valve gear will be readily understood from our illustration. The eccentrics, we may mention, are forged solid on the boss of the driving cranks, this making a very neat job. The boiler contains 179 tubes, 1 13/16 in. diameter outside, and 11 ft. 7¾ in. long between tube plates, these tubes giving an outside surface of 1073.8 square feet. The firebox surface is 85 square feet, the total heating surface being thus 1158.8 square feet. The firegrate area is 17.22 square feet, and the boiler pressure 147 lb. per square inch.

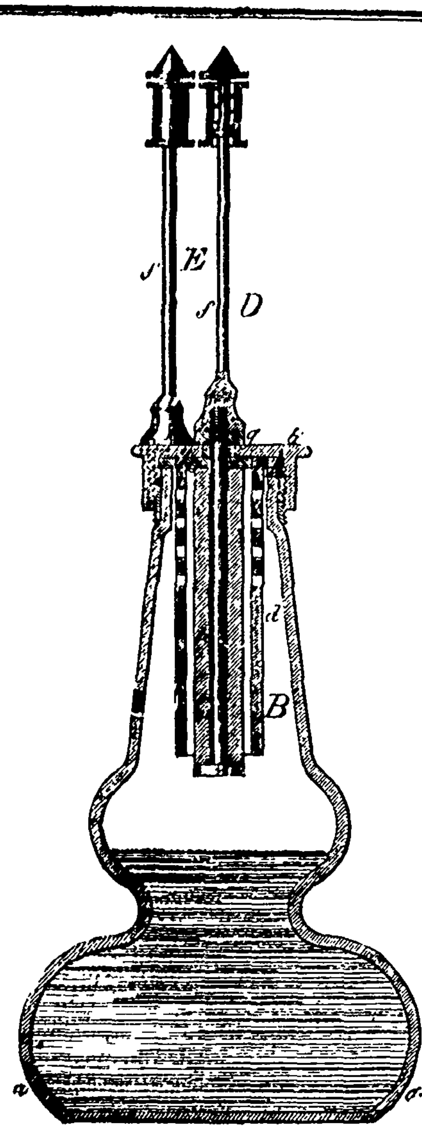
The weight of the engine is 33½ tons empty, and 37½ tons in working order, of which latter weight 23 tons rest on the coupled wheels, namely, 11 tons on the trailing and 12 tons on the driving. The engine is very neatly finished, and the workmanship is altogether very creditable to the manufacturer, Mr. Sigl.—*Engineering*.

New Method of Hardening the Surface of Steel.—A method of hardening the surface of steel by subjecting it, while in motion, to the action of a surface in contact moving at a high velocity, has been patented in the United States. If, for example, it is desired to harden the surface of a cylinder made of steel, the cylinder is mounted in a lathe turning at the slow motion usually given for turning such an article. To this is applied an emery wheel rotating at a velocity of about 1,800 revolutions per minute. The periphery of the emery wheel is kept in contact with the surface of the cylinder, which in addition to its slow rotary motion has a traversing motion of a little less than an inch to each revolution. At the end of this operation the entire surface of the cylinder will, it is said, be hardened to a depth of about one thirty-second of an inch, so hard, in fact, that it will resist the action of the best tools. Better results, it is stated, can be obtained when the emery wheel can be run at a higher velocity than that above given, and cast-iron wheels with smooth faces, or hard substances, may be employed in lieu of emery wheels. For hardening flat surfaces, the piece of steel should be mounted in a carriage so that it can be moved forward, in order to present in succession every part of the surface to contact with the periphery of the wheel; or the same result can be produced by mounting the wheel in a carriage having the required traversing motions. Or if the surface to be hardened be of greater width than the face of the wheel, the block steel may be mounted on a carriage having one motion, and the wheel also mounted in a carriage having a motion at right angles to the motion of the block-carriage. If the surface to be hardened be of any other form than in a cylindrical or flat surface, the form of the periphery of the wheel or the motions to be given, other than the rotary hardening motion, must be such as to present in succession every part of the surface to the action of the wheel.

ELECTRIC GAS LIGHTER.

This is a very neat and ingenious apparatus, the invention of Dr. Klinkerfues. Our illustration on this page is from the Belgian *Bulletin de Musée*. The principle of the arrangement consists in the heating of a coil of fine platinum wire, by a weak current of electricity, to a sufficient temperature to ignite the gas.

The invention is composed of a glass vase of suitable shape, closed by a cover screwed on, and packed so as to exclude the air by a rubber plate, A. The two elements, B and C, are zinc and graphite, the former is in the shape of a tube, is pierced with several holes, and is attached to the cover. The graphite is in the form of a cylinder and is secured as described further on. Upon the cover are the two electrodes, D and E, consisting,



ELECTRIC GAS LIGHTER.

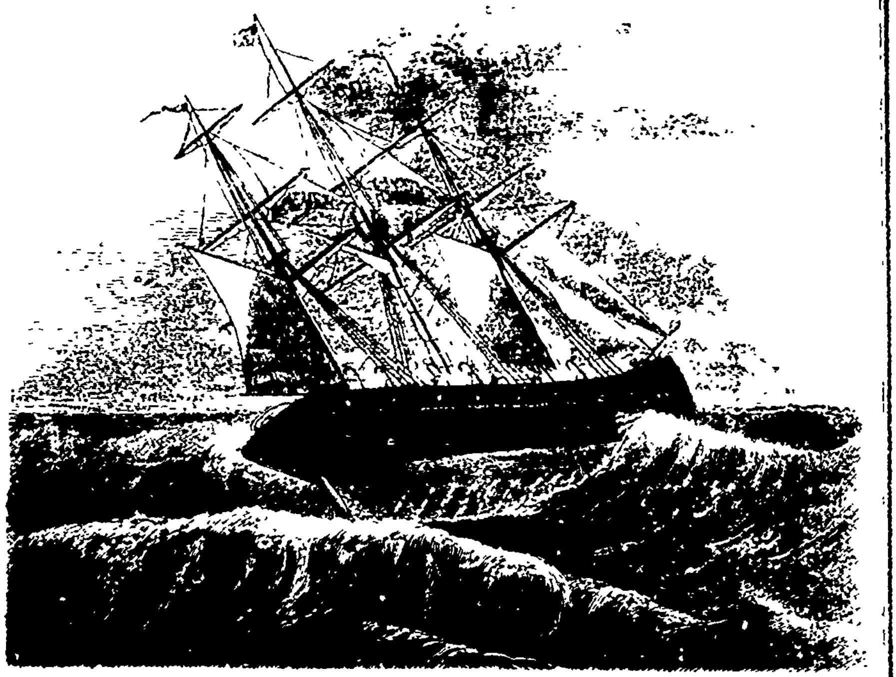
of rods of brass at the upper extremities of which are spring clamps which hold the spiral of platinum wire. One electrode, D, is attached directly to the cover, the other, E, carries the graphite cylinder, and is isolated at its point of contact with the cover by a rubber envelope.

The liquid contained in the vase is composed of three parts chromate of potash, four of sulphuric acid, and eighteen of distilled water. To use the apparatus it is only necessary to slightly incline the vase so that the liquid is brought in contact with the elements. A current is established which heats the platinum by which the gas is lit. On returning the device to its vertical position, the fluid rests at the bottom and the current is interrupted.

The Midland Engineering Company of Alexandria have, it is said, contracted with the Khedive to supply a quantity of cotton machinery for erection in the Soudan, the districts just visited by Baker Pasha, and opened to foreign enterprise. The machinery, consisting of engines, ginning, carding, and bale pressing apparatus, is to be so constructed as to admit of its being transported on the Nile to the highest possible point on the river, and to be carried on the backs of camels across the desert to its destination. Lathes, drilling machines, and other tools for the repair of the machines, will be sent out with each set, and these several factories will be set up at various parts of the

HYDRAULIC PROPELLER.

Mr. Henry B. A. Boys, of Barrie, Ontario, has recently perfected a very novel plan for the propulsion of vessels at sea. The propelling force is to be the reaction of water ejected from the hull, the ejection to be accomplished, without the aid of any machinery whatever, by the rolling of the ship and the dash of the waves. Our illustrations are from the *Scientific American*, Fig. 1. shewing the general application of the device to a vessel and Fig. 2, a section of the ship with the arrangements represented in detail. The inventor explains his idea more fully in his own words, as follows



BOYS' HYDRAULIC PROPELLER.

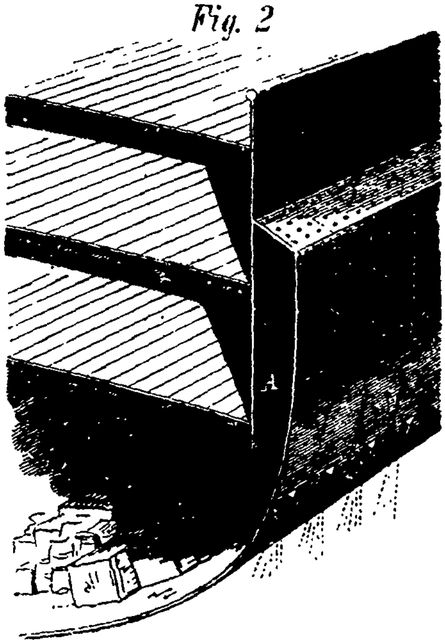
"For a vessel of 36 ft. beam, 30 ft. depth of hold, and 400 ft long," says the inventor, "I make tanks or penstocks (A, Fig. 2) on each side, for the whole length of the ship, these tanks to be 16 feet high, 8 feet above and 8 feet below the water line when loaded, to be 5 feet wide fore and aft, and 3 feet wide from the vessel outwards or across beam. In the top of these tanks are holes 6 inches in diameter, and as close as they can be conveniently made, to admit water (whenever, through rolling, or pitching, or high seas, the outside water may be over the tanks) Valves B, one foot square, are arranged near the water line, opening inwards, for the purpose of admitting water whenever the outside water is above that inside; and there is an opening C, at the bottom of each tank, shaped so as to discharge aft, and 6 by 12 inches in the opening.

"A ship so fitted will, from the rolling or pitching, or from the dash of the waves, receive water into the tanks when submerged, or whenever (from any of the causes previously mentioned) the water within the tanks is lower than the water outside And whenever the hollow of the waves is being passed, or the roll or pitch is upward, and the water in the tanks is above the water outside, then the re-action, consequent upon the discharge from the outlets at the bottom of the tanks, will propel the vessel forward.

"The discharge outlet may be made to close by pressure from without, or it may be drawn up by rods attached and leading to the deck, or made to reverse the action, the valves also may be manipulated by rods, if necessary; but it is thought that fixed outlets and plain valves will answer best."

The inventor also suggests a plan for similarly utilizing the pitching of a ship, by arranging two tanks, one at either end: "Valves in the bottom admit water in either tank when down; and when the tank is up, valves will let it discharge into a tube on the bottom of the vessel; said tube discharges both tanks at the stern or each at its own extremity of the ship, or, for the sake of the greater head of water, each at its opposite end."

Fig. 2



Prof. Tyndall argues against the commonly taught notion that man requires absolutely pure air and water. Chemically pure air—air that is without a trace of ammonia, carbonic acid, or water—is, he says, not to be found, and the one thing certain about it is, that if it were, no one could live in it. Neither is pure water ever found in nature; and observation of the whole animal creation, including man himself, tends to show that pure water is not necessary, nor even demonstrably desirable. Every sunbeam which enters a darkened room shows how thick with solid impurities is the air which man breathes—yet no one on that account fears to breathe it; the same thing holds true in regard to water, but this need not necessarily make any one afraid to drink it. Neither all foreign matters, nor even all foreign organic matters, are of necessity unwholesome, and the votaries of strict science too often represent man as a being who must submit the world to a series of severe chemical operations before it is fit for him to live in.

In removing ink spots from delicate colours, when oxalic acid or chloride of lime cannot be used without injury to the colour, a concentrated solution of sodium pyrophosphate is reccommended.

FRUIT WITHOUT FLOWERS.

At a meeting of the Academy of Natural Sciences, Philadelphia, February 11th, Dr. Ruschenberger, the president, in the chair, Mr. Thomas Meehan presented an apple, which was borne by a tree at Kittaning, in Pennsylvania, and which tree never produced any flowers in the popular acceptation of the term; but always yielded an abundance of fruit. This specimen furnished a practical illustration of some morphological truth which could not often be demonstrated in the way this afforded the opportunity of doing. It was admitted that a fruit was a branch with its accessory leaves transformed. The apple fruit was made up of a series of whorls of leaves comprising five each. Cutting an apple through we found a series of five formed the carpels containing the seeds. Several series of whorls, very much retarded in development, probably formed the stamens, but this could not be so well seen in the apple fruit, as they seemed to be almost absorbed in the corolla series. This was the next in order that appeared in the divided apple—the green curved fibrous line which we find in all apples midway between the "core" and the "rind" is the dividing line between the series which forms the corolla and the outer series forms the calyx.

In this tree there are no pistils, the series which usually goes to make up this part of the fruit structure being either very rudimentary or entirely wanting. Hence there was no core to the fruit. The result of this want of development was that the usual calyx basin of the apple was in this case occupied by a cavity three-quarters of an inch across. There were no petals; but in place five gland or rather bud-scale-like processes, at regular distances, on the edge of the green fibrous outline before referred to. The outer whorl, which usually forms the calyx, was almost asepalous, as a mere scarious membrane marked the place where the calyx segments or sepals should have appeared. It was so easy in this specimen to trace the dividing line between the outer or calycine whorl and the inner or corolline whorl, which uniting and becoming succulent, formed the popular apple fruit, that it was worthy of note in this connection. But the most interesting feature in this specimen was what were probably, from their similarity in appearance, cork cells, formed abundantly on the outside of the apple. It would seem that, with the lack of development in the inner series of whorls necessary to the perfect fruit, those which remained were liable to take on somewhat the character of bark structure.

The walls of aquaria, exposed to light, become covered with a growth of cryptogamous vegetation. M. Charbonnier has observed that sometimes two or three days are sufficient for the full growth of this green moss, while at other times it hardly appeared in eight or ten days. He has noticed that every month, at the time of full moon, the vegetation has its maximum of intensity, and it is almost *nil* at new moon. At full moon a daily cleaning is needed; whereas, this period over, cleaning twice a week will be sufficient. M. Charbonnier has also made observations on the germs of microscopic confervæ in water coming to his reservoirs from the Ourq, in Paris. This water passes a considerable distance in the open air. Now, the quantity of these germs is found to be very variable, and it is greatest at the time of the full moon. The explanation he suggests for such a curious phenomenon is as follows: Vegetable germs lying at the bottom of a stream are raised in sunlight by the gas bubbles they then give off in respiration, and which continue some time attached to them. When night comes on the bubbles disappear, and the plants sink again; but if there is strong moonlight the production of gas continues, and they are kept floating; hence the superabundance met with at full moon.

The copper operations of the ancients in the Lake Superior regions still remain a mystery, though there seems every reason to believe that they were conducted by the Aztecs, who left their haunts in Mexico and the Ohio Valley, and made summer pilgrimages to the copper region. There have not been found either bones or implements or any means of identification whatever, except the tools which are occasionally picked up in the ancient pits. And some of these pits and workings are so completely covered with drift and formation that it is impossible to form any estimate in regard to the time when they were worked. The presence of bismuth, lead, mercury, and arsenic in this copper enabled these ancient miners to mould it into cutting tools, which possess a finer and tougher edge than pure metal, and answered to some extent the place of iron and steel —though the tools found, after being cleaned of their oxidation, do not appear materially harder than the copper itself. Along the courses of some of the veins old shafts or surface gougings have been found, which, when freed of *debris*, show plainly the methods pursued by their former workers in extracting the ore. So far as can be judged the rocks were softened and cracked by means of fire built against it, and kept going for days, then the loosened masses were forced out by poles. Remains are found of huge stone hammers, and copper chisels and other cutting tools, and in several cases large masses of metal have been found that have been dug around on all sides and partly underneath, and then left, as if the miners had given up all hopes of detaching and raising them to the surface. The only reason for inferring that this was the work of the Aztecs is the fact that specimens of this copper, with native silver adhering, have been found in the mounds of the Ohio Valley, having evidently been used as ornaments by the mound builders, and buried with them. Similar specimens have been handed down for many generations in Mexico, as having been possessed by the Aztecs, who were said to be cognizant of valuable mineral lands far to the north.

HOME MADE HORSE-POWERS.

The cheapest and best way to make a horse-power for dairy and other light use, is to put a light drum on a centre post, high enough to have the belt clear the horse's head. Attach a sweep ten or twelve feet long to the centre post, so that the track in which the horse walks will be from twenty to twenty-four feet in diameter if possible. Let the track be soft ground. The whole arrangement may be made of white pine except the sweep, which should be hard wood. Let the drum be about ten feet in diameter, and six inches face. Use a two-inch rubber belt. Make a small pulley from four inches to a foot in diameter, according as you want fast or slow motion. If you want the motion still faster, gear up with a second belt and set of pulleys. The direction of the motion may be changed by a quarter twist in the second belt, or by passing the first belt over idler pulleys.

This arrangement will be almost noiseless, while the clatter and jar of a circular platform would be enough to drive a sensitive or nervous person almost crazy. Besides, it is much easier and safer to teach a horse to follow a circular path than to keep his balance on a revolving platform.—*Cor Country Gentleman.*

Wasp Trap.—It sometimes becomes desirable to rid one's premises of the unpleasant presence of numerous wasps, and here is a way to do it as suggested by a cotemporary: Mount four panes of glass of equal dimensions in tin framing (like a lantern), leave the top and bottom open, cover the latter end with thick white paper well attached with strong water-proof glue, and the paper well oiled, and protected from damp or fire. In this make a hole about six inches in diameter, and then place this hole over a plate, on which three pieces of bricks are put; in this plate you will have put a mixture of beer, sugar, and a little rum. On the top end you will have fitted in a glass pane, removable at pleasure, to clean the trap. Now prepare some long matches of stout paper dipped in brimstone; when your trap is "all alive" with captives, ignite a match and put it under the hole, they will soon be suffocated. Each day empty out the contents for your pet toad's dinner. I once saw a most ingenious insect-catcher in Africa, invented by some English artisan. There was a wire-work dome like a meat cover; just below it a roller covered with cloth, saturated in syrup, slowly revolved when the clock-work adjustment had been wound up. Into this "Sirens' cave" every flying thing tempted to settle on the sweet stuff was unconsciously drawn, and the cage was soon a museum of Diptera and Hymenoptera! There was a trap-door at which the suffocating operation was carried out (as in the first mentioned trap.) It was altogether a great success.

THE BRANCH INSANE ASYLUM, NAPA, CALIFORNIA.

An asylum for 500 insane patients being required for Napa, designs were invited in competition, and from those submitted the *projet* we now illustrate was selected, and will be carried out. The architects are Messrs. Wright & Sanders. The architects say they have worked on the principles laid down for the construction of hospitals, at the convention of medical superintendents of American institutions for the insane, in 1871.

The new asylum is intended to face the west, and consists of a centre building with wings extending on each side, and exactly alike—the divisions for the sexes being equal; twelve wards on each side, exclusive of the infirmaries, and one ward on the forth floor of the centre building, and has accommodations for 500 patients. The style of architecture is Domestic Gothic. The building will accommodate:—

Females.

First floor, four wards	74	
Second floor, four wards	74	
Third floor, three wards	60	
Fourth floor, one ward	20	
		228

Males.

First floor, four wards	74	
Second floor, four wards	74	
Third floor, three wards	60	
Fourth floor, one ward	20	
Fourth floor, centre building, one ward	44	
		272
		500

The outside walls of the basement story were designed to be built of stone from the quarries adjoining the asylum property; but it has been determined to use pressed brick facings and stone dressings. The walls will be 16 in. thick, laid hollow, with an air space of 4 in.; the interior walls on the corridors will be 16 in., to leave room for the ventilating and heating flues, the division walls between the single rooms will be 9 in. thick. The roof will be framed in wood and prepared for slate or medallion metal. The plastering will be done directly upon the brick walls, and the floors will be deafened with spent ashes and mortar, with view of rendering the building as nearly fireproof as possible, without going to the expense of iron joists and brick arches. The circular towers at the intersection of the wards are to be built upon a system of fireproof construction with stone staircases and well-holes built up solid. The floors will be on the Dennett arch principle, and paved with artificial stone. The doorways connecting with the wards on the different stories, are all to have stone sills with iron doors, in addition to the ordinary wooden ones. The upper stories of the towers are intended for water-tanks.

The basement, about 5 ft. above the ground, contains the hot-water boilers for supplying the wards, the tramway, which extends through the basement of every ward—and also to the basement of the laundry,—dumb-waiters from the kitchen and laundry, with the other dumb-waiters for supplying the dining-rooms on the different floors, the clothes and dust-shafts, also the hot-air chambers for heating the building, and a number of storerooms under the kitchen wing.

On the ground floor, the main centre building is divided by the centre hall into two equal parts, that to the left contains the apothecary's shop, superintendent and secretary's offices, with private staircase communicating with the superintendent's apartments above, and in the rear the steward's office and men's reception-room; while that to the right contains the public parlour, library, and officers' dining-room, and immediately behind these the matron's room and ladies' reception room

The second floor is reached by the main centre staircase, and is appropriated exclusively to the use of the medical superintendent's family It contains a parlour, sitting-room, library, dining-room, and three bedrooms, water-closet, bath-room, dumb waiter, and three clothes-closets, and in the rear four large spare rooms, and also a private entrance and staircase from the ground floor.

Each ward has connected with it a day-room, a corridor, single lodging-rooms for patients, an associated dormitory communicating with a chamber for two attendants, a clothes-room, a bath-room, a water-closet, a lavatory, soiled-clothes shaft, closet for brushes and buckets, a drying-closet, a dust-flue and two fire-proof staircases to each, so that the patients will be able to reach the enclosed yards in the rear, or the pleasure-grounds in front, without communicating with the other wards. Every room in the building has a flue communicating with the fresh-air duct for warm or cold air, with ventilating-flues terminating in the various ventilators in the roof of the building. The water-closet, lavatory, and bath-room open from a small passage, and not from the main corridor; and the bath-room and the lavatory have communicating door, in order that the latter may serve on bathing-days as dressing-room to the former.

The wards for excited patients are to have on one side of the corridor a conservatory for flowering plants, birds, &c., and a water fountain in the centre of each.

Laundry, bakery, and engine-house are placed in a detached structure 100 ft. to the rear of the hospital buildings, and containing on the first-floor the engine-room, workshop, bakery, bread room, store-room, foul linen-room, mending-room, laundry, with staircase to the drying and ironing room on the second-floor.

In detached buildings in the rear of the last wings, but connected by means of covered corridors, infirmaries are provided for each sex.

It is proposed to light the building with gas, to be manufactured from gasoline, without the use of fire, the works to be placed in a brick building adjoining the dead-house.

Hydrants are to be placed on the landings of each staircase throughout the building, and supplied direct from the main, with hose constantly attached, to be used in case of fire.

The boilers for heating the building are placed in the detached building in the rear of the hospital, and are also used for driving the machinery, cooking, washing, and heating the hot-water boilers in the basement for supplying the baths in the different wards.

It is also proposed to have in the basement story hot-air chambers, built in brick, to receive the steam-chests, which are supplied with steam from the boilers, with direct flues leading from them to the wards above.

With a view thorough ventilation, it is proposed to place above the collar-ties a horizontal galvanised iron tube, to receive the vitiated air through separated vertical flues from the different wards below, terminating in the towers and ventilation turrets.

Downward currents of air, for the ventilation of the water-closets urinals, bath-tubs, and sinks, are to be secured through an arrangement of pipes terminating in the fire-boxes of the boilers.

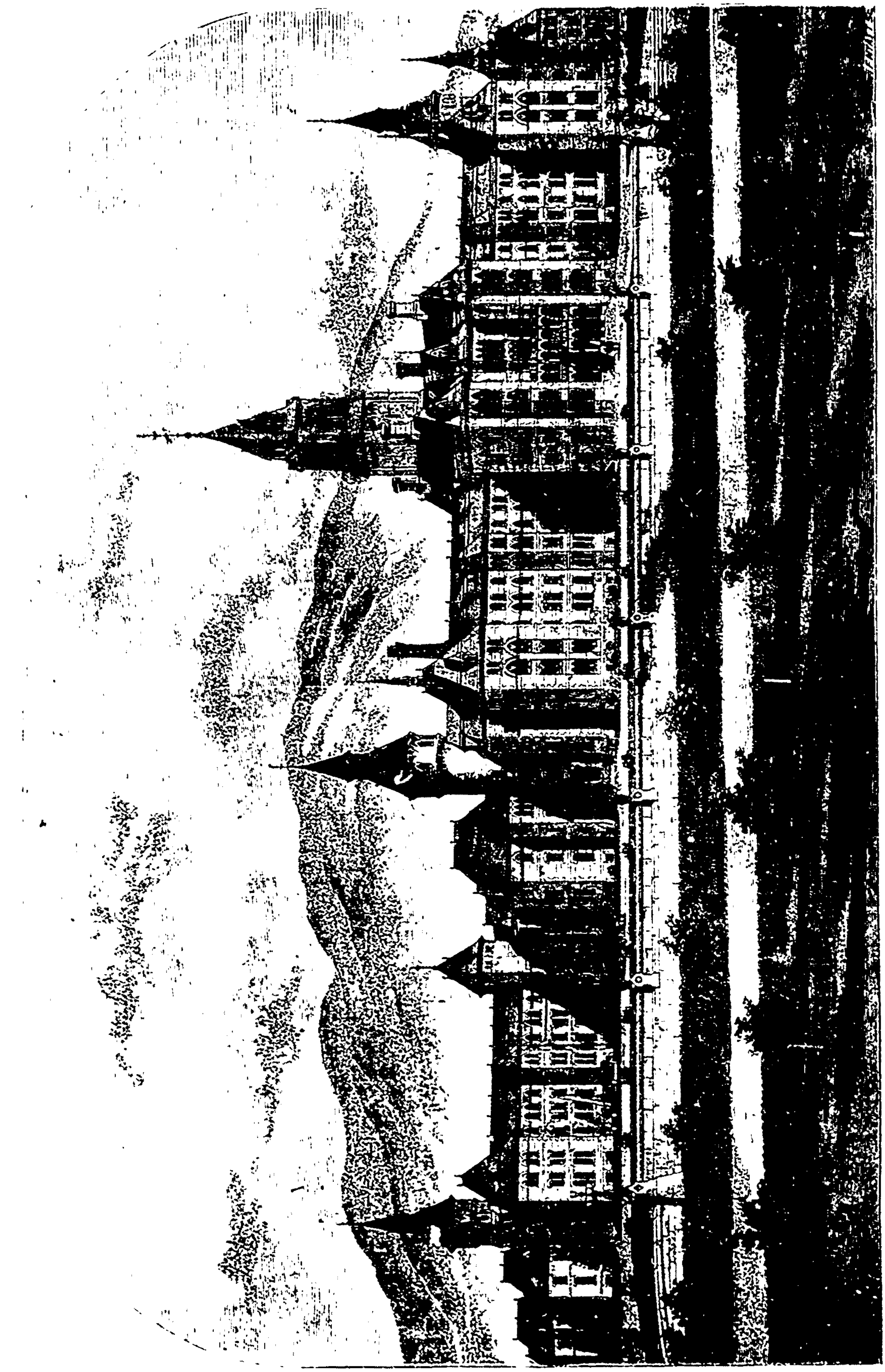
In the rear of the building there are three private yards on each side connected directly with the adjacent wards, for the use of the patients, with large airing sheds, and water fountain in the centre of each.

The stipulated cost is 600,000 dollars.

THE smallest circular saws in use are those employed in the manufacture of gold pens, and are a-half inch in diameter. It is said that some of the sarcophagi of ancient Egypt bear the marks of having been hollowed out with tools of the crown or cylinder saw order.

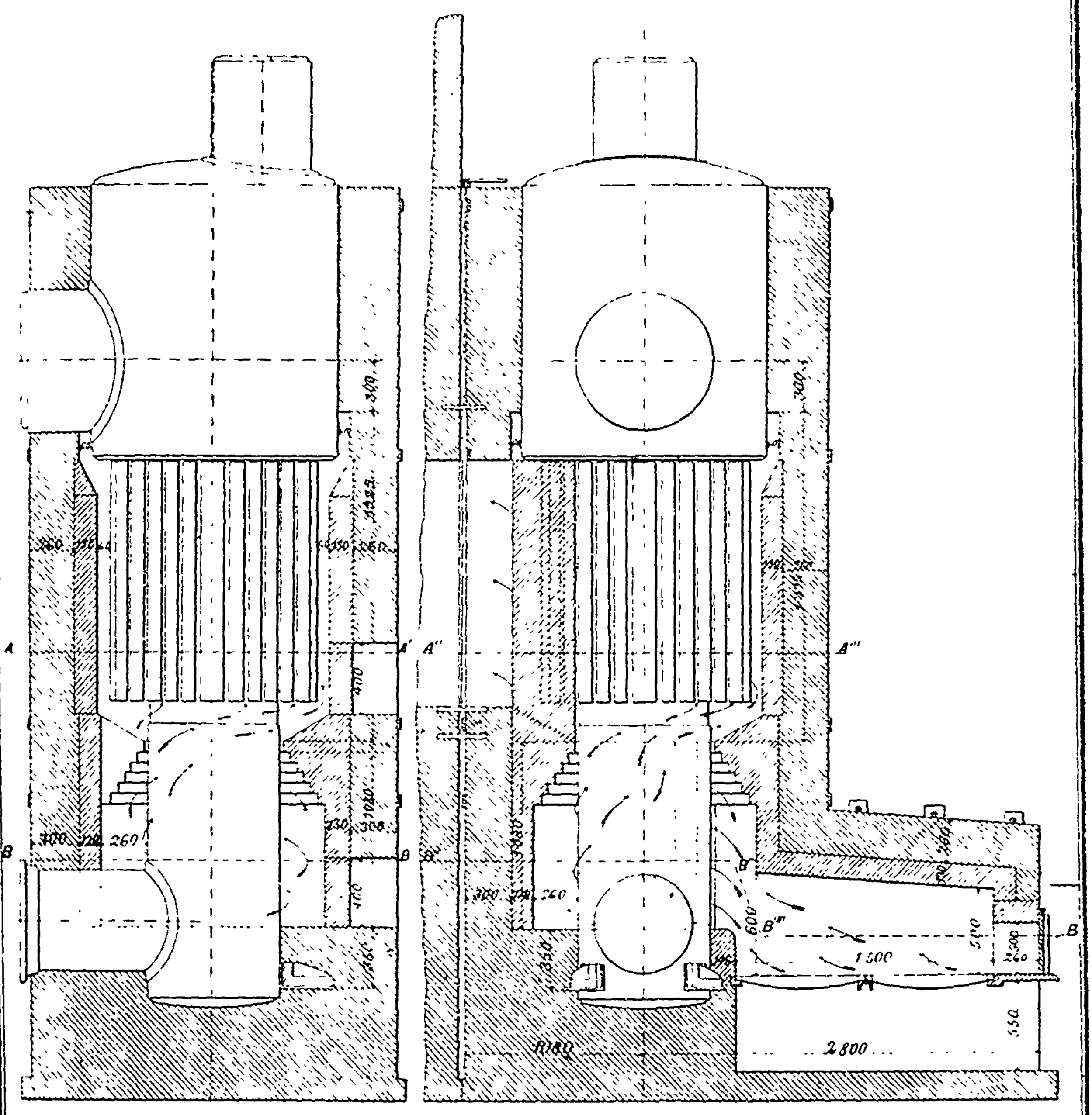
HANDSAWS in America and England have the teeth pointed from the handle, while in Asiatic countries and in Greece they are made with teeth pointed the other way. The latter must be operated by pulling them, the former by pushing. In delicate work, and where very fine small saws are used, the Eastern saw is the best. The Orientals differ from us in setting the teeth of the saw also. They turn a group of a dozen one way, and the next group the other, while we alternate one on one side, the next on the other.

THE ancient Egyptians made saws of bronze, and applied them to cutting out planks from logs. These were single-handed like those now used by carpenters, and the log was placed on one end, and fixed firmly in the ground. The sawyer then began operations, sawing downwards, and dividing the log into planks, but the process was very slow. The Greek saws were fixed in a frame, very much as the contrivance used in modern times.



THE BRANCH INSANE ASYLUM, NAPA, CALIFORNIA. Messrs Wright & Sanders, Architects

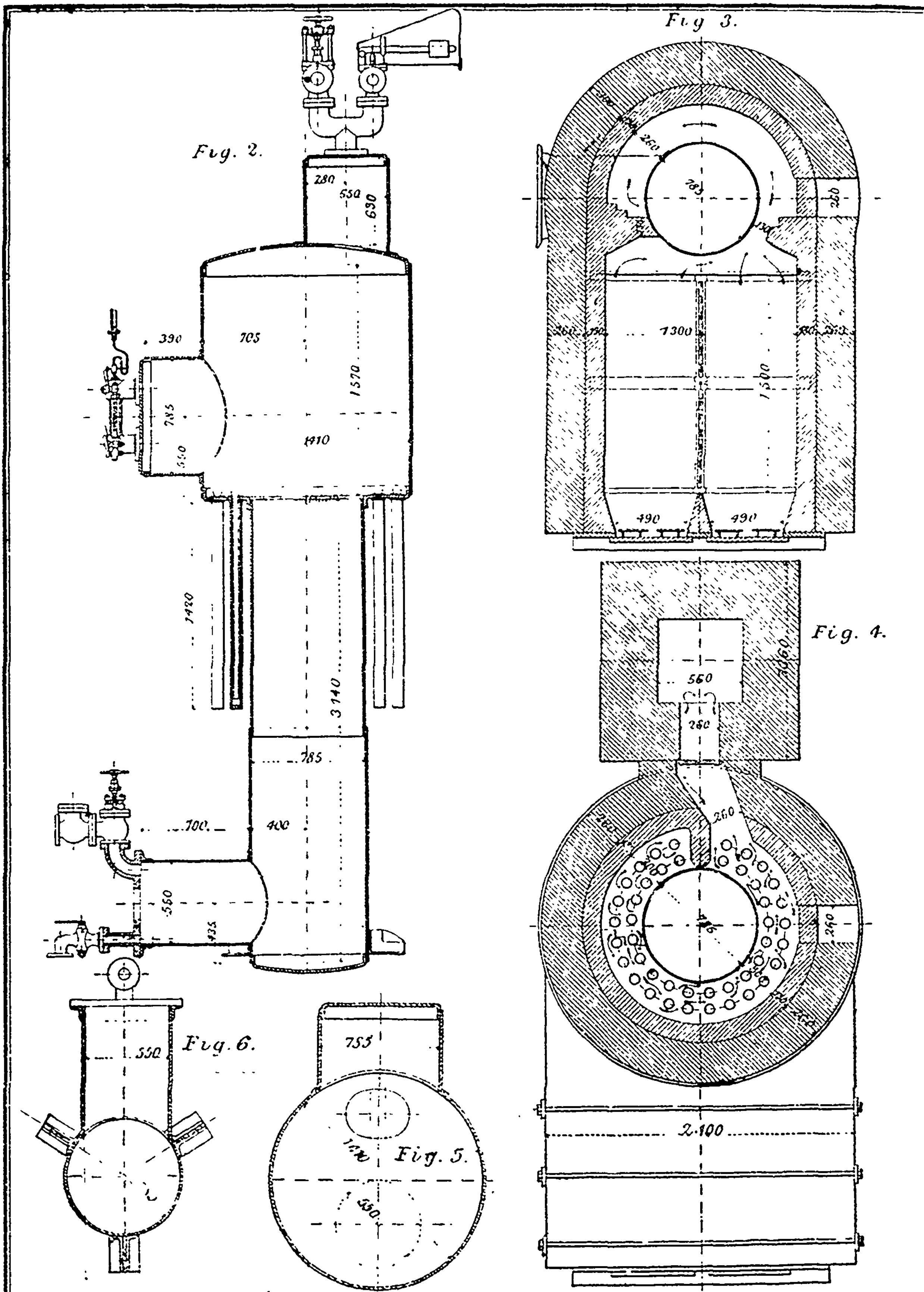
Fig. 1.



BERGMANN'S HIGH-PRESSURE BOILER AT THE VIENNA EXHIBITION.

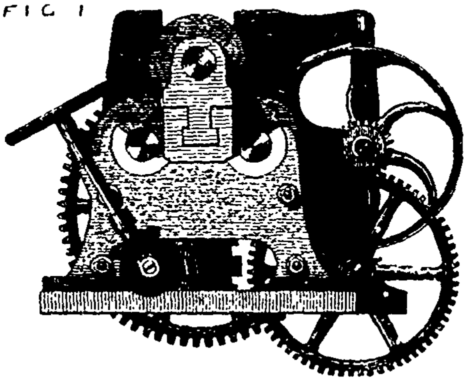
On this and following pages we illustrate some of the principal exhibits at the Vienna Exhibition. Our first illustration is from *Engineering* and represents one of the two large boilers on Bergmann's patent. They are not exhibited at work but are lying outside the German boiler house in a position where every part of them can be freely inspected. Their construction is somewhat novel and the boilers themselves have excited a good deal of attention in Germany

In our engravings Fig. 1 shows a front and a side elevation of the boiler, with corresponding cross sections of its furnace and brick setting. Fig. 2 is a longitudinal section, of the boiler only. Fig. 3 shows a cross section of the boiler and furnace along the line B, B'''''' in Fig. 1, and Fig. 4, above, a similar section along the line A, A'''. Figs. 5 and 6 are sections through the upper and lower horizontal branches respectively. The boiler consists essentially of two cylinders, of which the upper one is larger in diameter and shorter than the lower one. The lower cylinder is 10 ft. 3¾ in. long by 2 ft. 7 in. in diameter, its bottom end is entirely embedded in brickwork for a depth of about 14 in. A wrought-iron sediment tube, which also is mostly imbedded in brickwork, and which is 1 ft 9½ in in diameter, is rivetted to the shell as near the bottom as possible. In the cover of this tube are the feed valve and the blow-off valve, but the latter is thus necessarily several inches above the lowest part of the boiler. The upper part of the boiler is 4 ft. 7½ in. in diameter by 5 ft. 6 in. high. From its lower plate hang suspended 44 tubes of the kind well known in England as Field tubes, that is, water tubes closed at the lower end, and having an internal circulating tube of small diameter. These tubes, as will be seen from the engravings, are placed so as to hang vertically in a double ring round the lower part of the boiler. They are 3 in external diameter, and 4 ft. 8 in. long. On the upper end of each a conical ring is welded and the holes in the tube plate are bored of the same taper as the ring, the tubes being kept tight by the pressure of the steam. In order that the steam and water



BERGMANN'S HIGH-PRESSURE BOILER AT THE VIENNA EXHIBITION.

FIG 1



gauges may be placed directly on the boiler and not connected to it only by tubes through the setting, a cylindrical box is rivetted on the upper shell of sufficient length to extend through the brickwork, and on the front of this are attached the gauges. On the top of the boiler is a small steam dome, on which stand the stop and safety valves, the latter being enclosed in a lock-up case.

The furnace, it will be seen is entirely external to the boiler itself, and is constructed of brickwork lined with firebricks. The grate is 4 ft 11 in. long (the firebars being in two lengths) by 4 ft. 3 in. wide. The surface is all in one; but there are two fire-doors, so as more easily to distribute the fuel. The flues are arranged so as to compel the products of combustion to pass spirally round the lower shell and among the tubes in the way indicated by the arrows. After leaving the tubes they go direct to the chimney, scarcely playing at all on the upper part of the shell, which is almost entirely embedded in brickwork.

PLATE BENDING ROLLS AT THE VIENNA EXHIBITION.

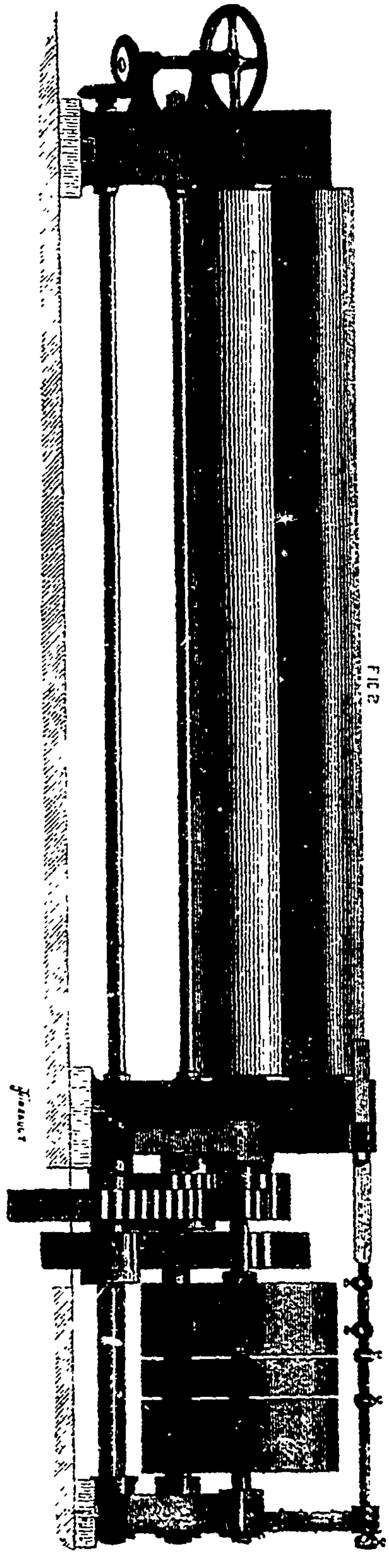
The accompanying illustration represents a plate-bending machine exhibited at Vienna by the Chemnitzer Werkzeugmaschinen Fabrik (formerly J Zimmermann), Chemnitz. The rolls are 2.25 metres (88.58 in.) in length, and 250mm. (9.84 in.) in diameter. The pulleys are arranged so as to drive, through double gear, both backwards and forwards. There is a very neat arrangement for raising and lowering the top roller. A handwheel at one end of the machine communicates motion through a pair of bevel wheels to a horizontal spindle traversing the whole length of the rolls. This spindle has two worms on it which give motion to worm wheels (one of which is seen in the end view) on the outside of two columns lying right underneath the end gudgeons of the roller. The rotation of these worm wheels raises the roller (which is shown in the engraving in its lowest possible position) by means of internal screws. The machine is simply and strongly constructed, and its workmanship is first-class; it is intended to bend plates up to ¾ in. in thickness.

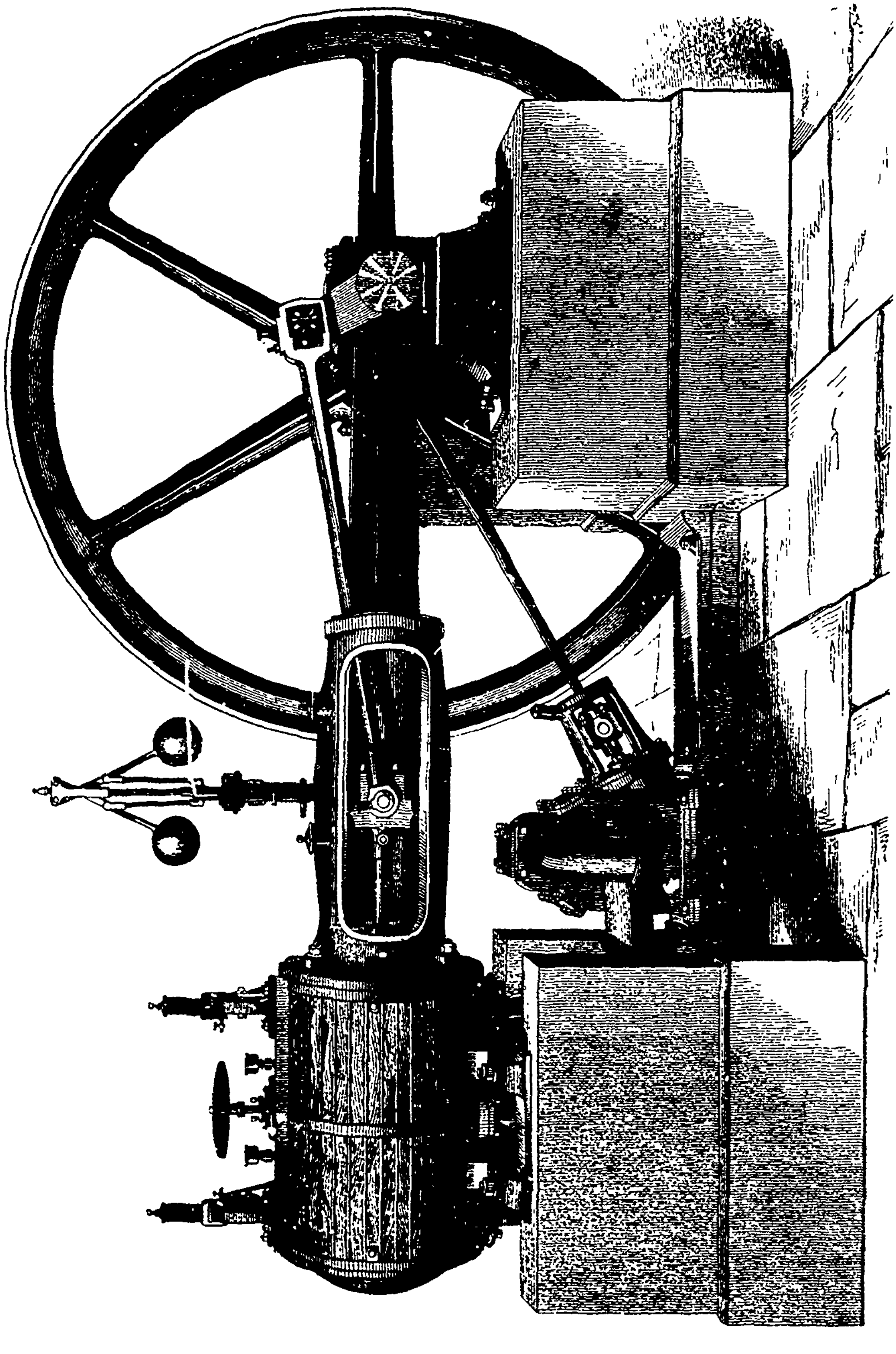
—*Engineering.*

HORIZONTAL ENGINE WITH SULZER VALVE GEAR AT THE VIENNA EXHIBITION.

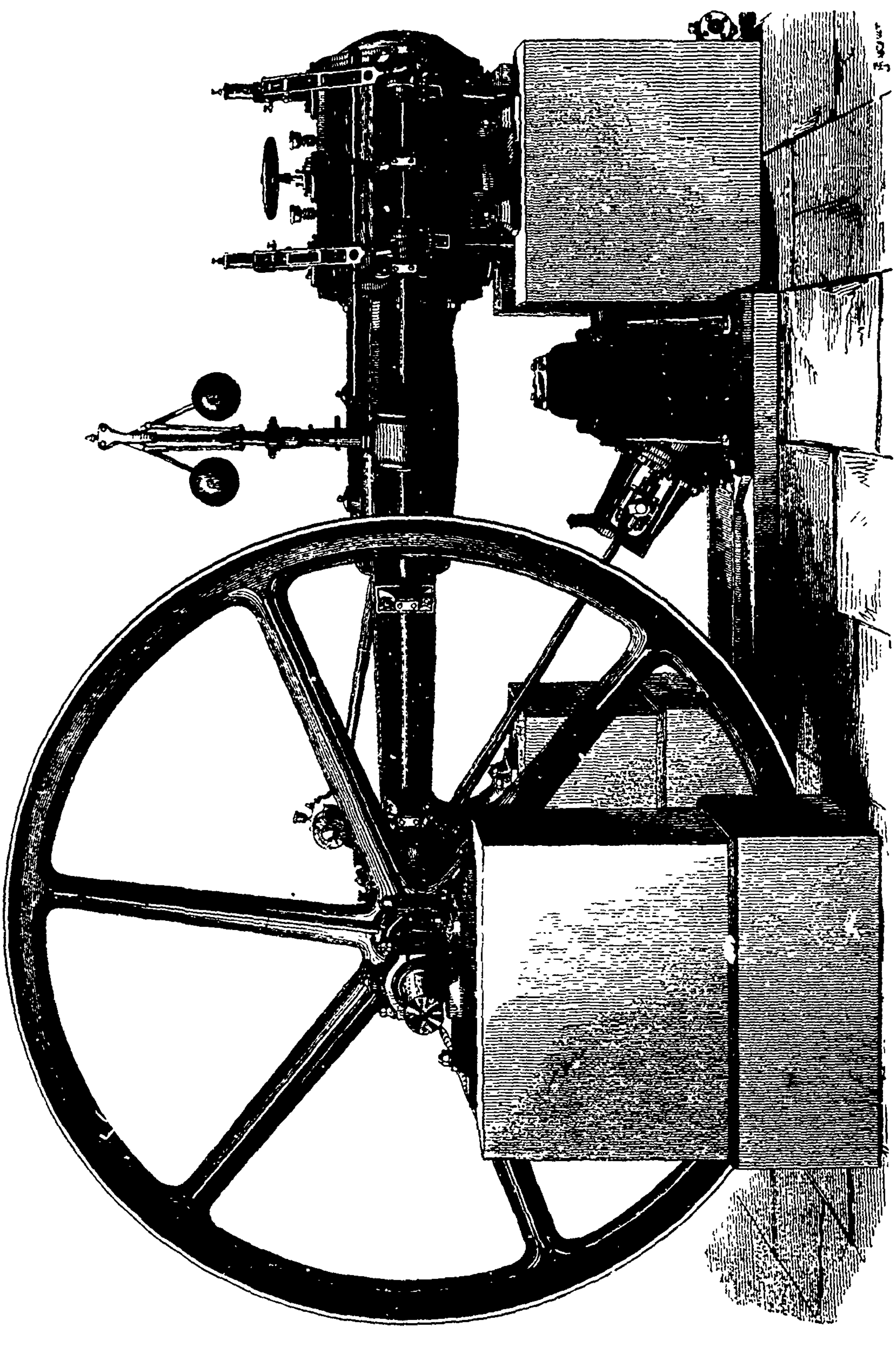
The valves in this engine are four in number—two induction, and two eduction—and are of the ordinary double-beat equilibrium type. The steam valves are placed on the top of the cylinder, and the exhaust valves below it. A spindle running along the back of the bedplate is driven off the crankshaft by bevel gearing; it drives the governor in the same way, and also, by means of two eccentrics, opens the steam valves. Cams on the same spindle, close to the eccentrics, open the exhaust valves, which are closed by spiral springs,

PLATE BENDING ROLLS AT THE VIENNA EXHIBITION.

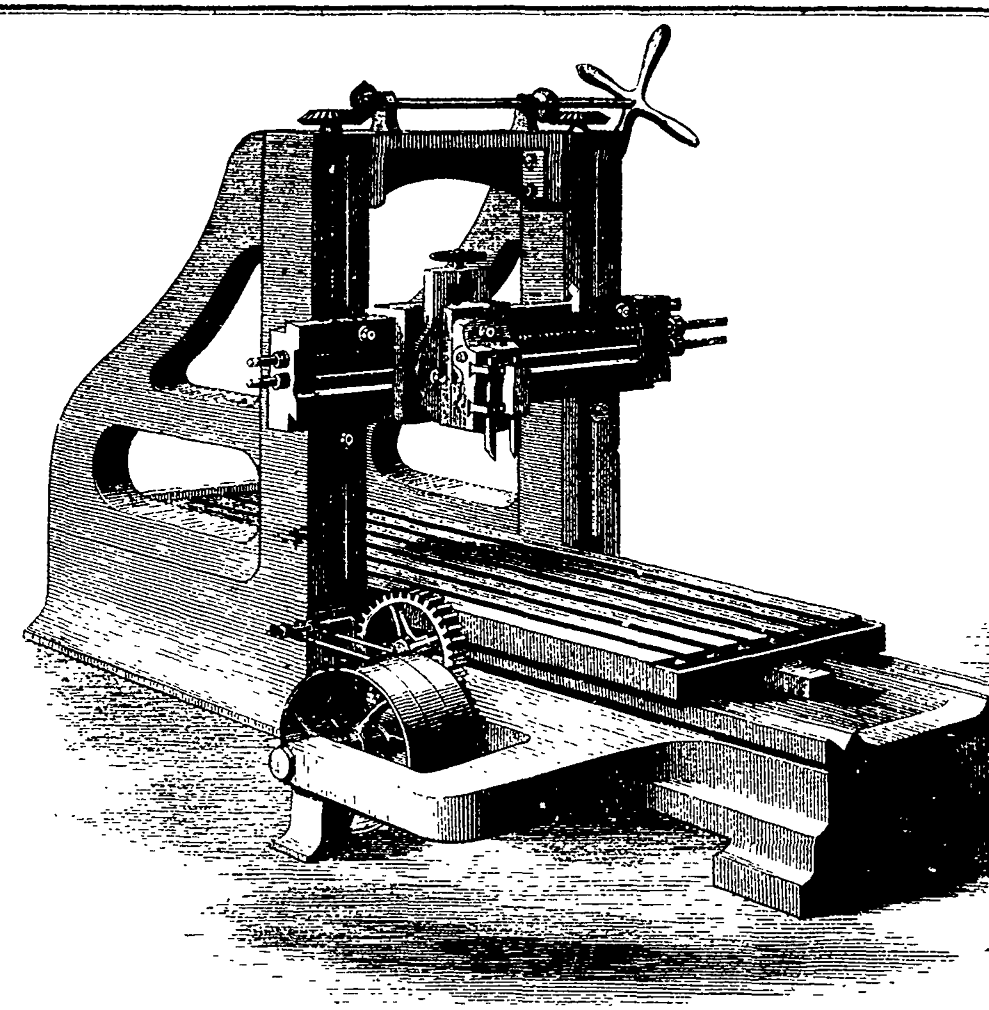




HORIZONTAL ENGINE WITH SULZER VALVE GEAR AT THE VIENNA EXHIBITION. (See page 131.)



HORIZONTAL ENGINE WITH SULZER VALVE GEAR AT THE VIENNA EXHIBITION. (See page 131.



PLANING MACHINE, AT THE VIENNA EXHIBITION.

CONSTRUCTED BY MESSRS. SCHONE AND SON, LEIPZIG.

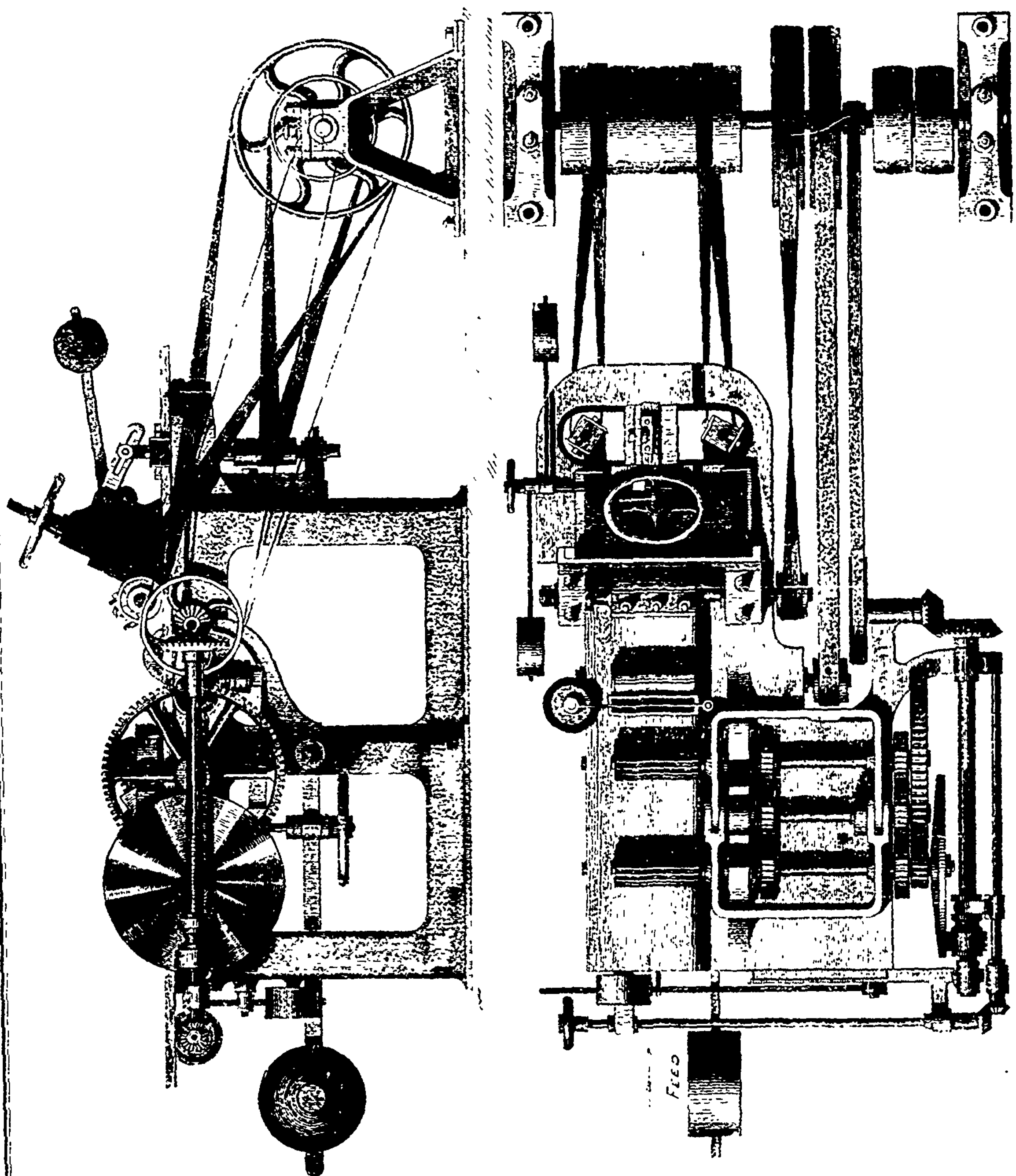
and kept closed also by the pressure of the steam. The arrangement for closing the steam valves is under the control of the governor as follows. The connection between the rods of the eccentrics above mentioned, and the levers which directly operate upon the valve spindles is not rigid, but is effected by the contact of steel edges in the former with steel sliding blocks connected with the latter. These blocks are entirely under the control of the governor, which it will be seen is of the approximately parabolic description, and the length of the contact which it permits between them and the edges before mentioned, determines the cut off. The actual closing of the valves is effected by means of spiral springs, the boxes of which are each furnished with a small air cylinder as a buffer. The steam is admitted to the jacket near its underside, and passes through it on its way to the valves, to which it is admitted by the stop valve shown on the top of the cylinder.

The bedplate is of the usual Corliss type, and well designed, the piston rod guides are bored out, and the head, which is, as usual, made separate from the rod, has its brasses adjustable by two bolts. The connecting rod is of somewhat unusual design, being flattened on each side from the head downwards for a considerable portion of its length, and the air pump rod is made in the same way. The crank itself, like many others at Vienna, has a considerable amount of unnecessary width at the small end. The air pump is made in a casting entirely separate from the engine, it is placed at an angle, and worked by an eccentric on the crankshaft. The exhaust pipe from the cylinder is connected with a larger pipe lying horizontally, and leading to the air pump, this pipe serves as the condenser, a jet of water being introduced into it at the back end.

We illustrate above, a planing machine exhibited at Vienna, along with other tools, by Messrs. Schone & Son, of Leipzig. The machine embodies nothing specially new in its construction, but is very strongly and simply made, and ought to be an excellent working tool. It is intended for planing both horizontal, vertical, and bevelled surfaces. It will be seen that it is provided with two tool boxes; of these the one to the right is a fixed box of the ordinary construction, while the one to the left consists of a couple of clamps, either of which can be moved sideways at pleasure. The object of the latter is to allow the tool to be placed in the rest at an angle, which is often more convenient for, for instance, undercut surfaces. The machine is made self-acting throughout, and the slide rest, as usual, can be set at any angle. The width between the standards is 850 mm (33.46 in.) and the maximum height available for work is the same distance. The length of the moving bed is 1700 mm. or 5 ft. 7 in.

MOULDING AND PLANING MACHINE AT THE VIENNA EXHIBITION.

This machine planes or moulds up to nine inches wide, and is fully shown by the elevation and plan. The specialities consist in the cutters being all ranged on one side of the main framing and the feed-driving gear on the other. The object of this is to give easy access to the cutters for sharpening and setting without the inconvenience of having to get on or lean over the gearing, as in other machines of this class. A further advantage is obtained in having the feed-rollers to overhang

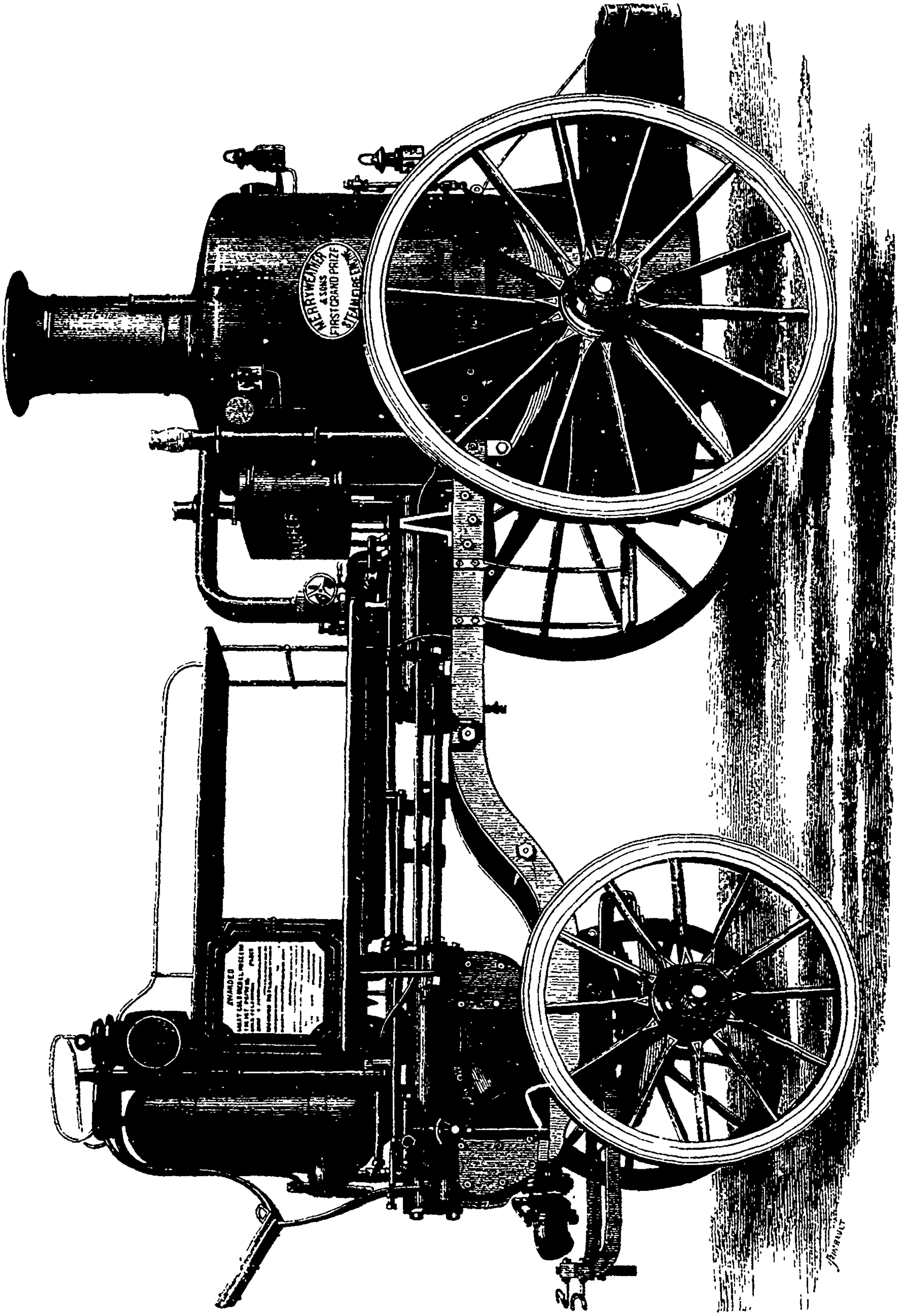


MOULDING AND PLANING MACHINE AT THE VIENNA EXHIBITION.

the bearings so that they may be readily changed according to the kind of moulding and planing to be done, for instance, when planing skirting-boards, parallel rollers are used, but when w rking, say, inlay mouldings, these are replaced by conical rollers. An economy is effected by first champering the wood at the saw-bench, and if this is done the bearing surface is decreased to such an extent that if parallel rollers were used great weight must be applied to make the wood feed This is here entirely obviated by the facility with which fluted conical rollers can be substituted, and the larger portion of cone being placed to propel the wood in the part ordinarily termed the "quirk," has a tendency to break the grain, and also allows the deep or quirk part of the iron to work more easily The rate of feed can be changed without having to stop the machine, by means of an adaptation of frictional contact, the side cutters can be angled so that cylinder lagging or any undercut moulding can be worked at one operation.

MERRYWEATHER'S STEAM FIRE ENGINE.

We give, on the next page, a very good illustration of one of Messrs. Merryweather's large-class double-cylinder engines of the Admiralty pattern It is worthy of notice as possessing several new features of construction, and as exemplifying the leading principles observed by the firm. The engine weighs barely 57 cwt., and has a pair of pumps $6\frac{3}{4}$ in. in diameter, and 24 in stroke, and steam cylinders $8\frac{3}{4}$ in. in diameter, and the same stroke as the pumps. The pumps, as well as their fittings, are made of phosphor-bronze, this metal having been selected on account of its superiority over gun metal, in point of lighter weight with equal strength being obtainable with it. The boiler fittings are of the same metal. The boiler plates, engine frame, springs, &c, are of steel, the boiler tubes being of weldless drawn steel No. 18 gauge.



STEAM FIRE ENGINE, AT THE VIENNA EXHIBITION. (See page 135.)

CONSTRUCTED BY MESSRS. MERRYWEATHER AND SONS, ENGINEERS, LONDON.