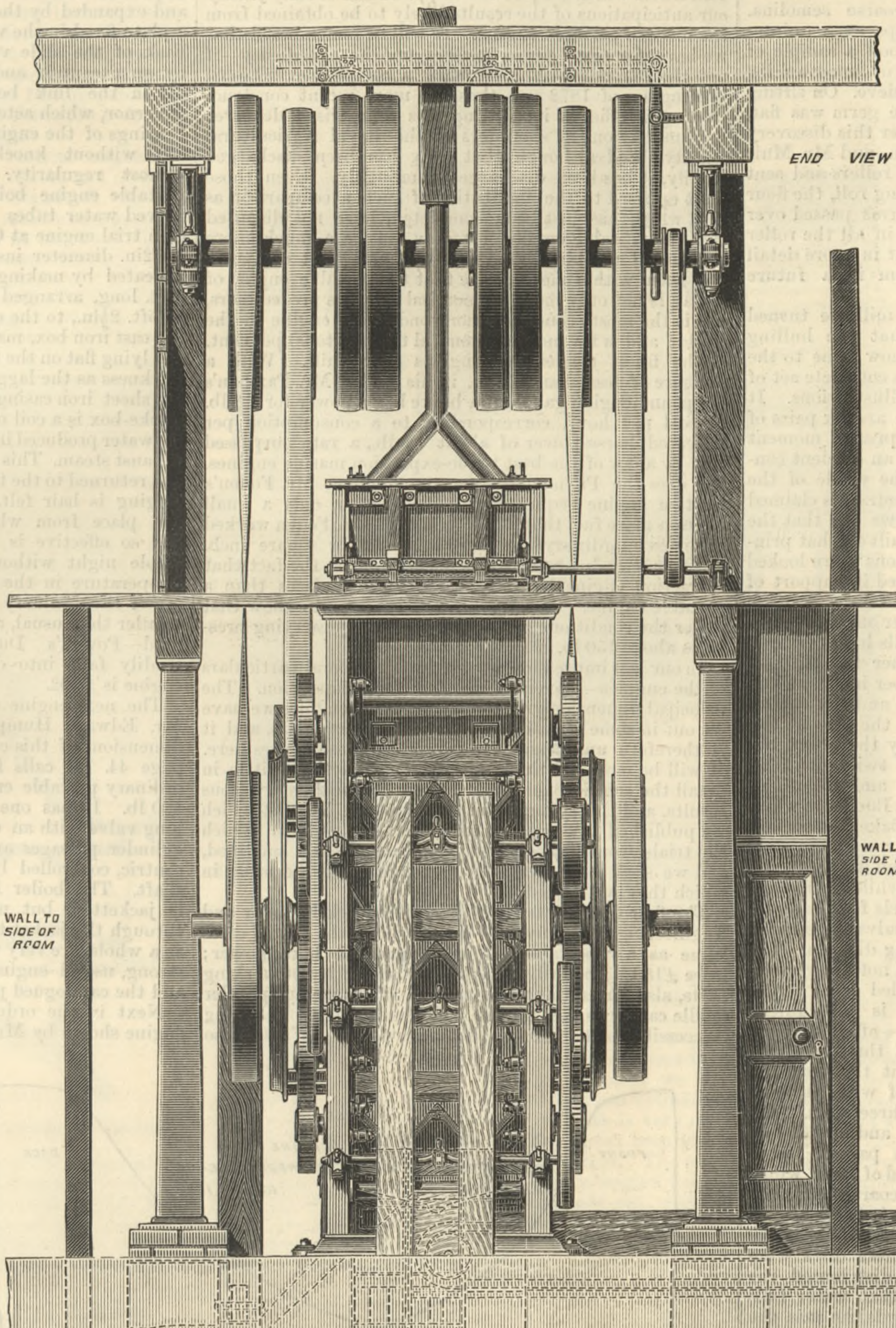
MODERN MILLING.—ITS BIRTH AND DEVELOPMENT.

By GILBERT LITTLE.

I.—THE BIRTH.

MACAULAY, in his review of Hallam's history, refers to the custom, universally followed by writers of the last century, of amalgamating the history and science of their subject. In our day these two ingredients have to a large extent been separated with the best results, and our readers will understand the reasons that have induced us to refrain from mixing the ancient history with the modern philosophy of milling. In this series of articles we shall deal with "Modern Milling: Its Birth and Development," and the time where our record begins is the still recent date, 1869, when Messrs. W. Baker and Sons, of Bristol; Mr. Stannard, of Nayland, Suffolk; Mr. Allen, of Middleton, Cork; Messrs. Radford, of Liverpool; Messrs. Hays and Messrs. Muir, of Glasgow; and Mr. James Wood, of the North Shore Mills, Liverpool, attempted the Hungarian or "semolina system."

It will serve no good purpose to refer to the early failures in detail, or to rake up the ashes of the dead-and-gone objections that were urged against the new system, as the subsequent revolution has only confirmed the great lesson which the history of all changes in the arts and sciences teach, viz., that the agitation in favour of any new departure in an industry lives, and is formidable only by virtue of what is reasonable in its demands. This has been very clearly exemplified in the development of gradual reduction milling, as it was the few who advocated that there was no middle course between "sudden-death" milling, and the six or seven break method, the men who rushed to the complete change with scant consideration for the majesty of custom, who have reaped the fortunes made during the great "boom" in milling. It was not necessary that our modern milling engineers should possess that proud patience which the gods are said to love, by reason of which many great inventors have lived down misappreciation, as the change was so sudden that there was not the slightest chance of any display of that hard, uphill, unrewarded struggle against deeply-rooted beliefs in the efficiency of methods that have so long obtained. The only delay arose from the tardiness of the British milling engineers to give fitting embodiment to the ideas of the progressive millers, and it is known that many improvements were birth-strangled through the crude machinery, and nearly all the early machines were imported from Germany and America. As stated in the "Jubilee" article in THE ENGINEER of June 24th, engineers have made very few discoveries. The carrying out of original research is not their duty. The milling engineers also left that to the philosophic millers, and the McDougalls, the Bakers, the Muirs, and other scientific millers having discovered here a fact and there a fact, the milling engineers combined them, and produced results of the most far-reaching nature; and think of it as we may, the highest form of engineering genius is that power of combining facts or forces that fit each other and give birth to something greater. It may be as well to describe here the different phases peculiar to the inception of the gradual reduction system in this country and in America. In this country the reducing or break rolls led to the introduction of purifiers, in America the purifiers were the forerunners of the rolls. In order that this point may be made perfectly clear to engineers not versed in the details of milling, we shall give a succinct description of the great underlying points of the old and the new systems. Prior to 1869, that is, before the introduction of any of the modern machinery, the ingenuity and skill of all millers were devoted to attempts to reduce the entire kernel of the wheat berry into flour, without the production of any semolina or middlings. Every improvement tried on the millstones—their speed, their dress, and their general handling—had this one object only in view. Middlings, of which it is now the aim of all millers to make the largest portion possible, were regarded as a product that might make an inferior flour; and the best milling was believed to be the system that made the least quantity of middlings and the greatest amount of flour at one operation. In the modern system the central idea is to produce the largest quantity of middlings and the smallest portion of "break" flour. In the old system about 93 per cent. of the kernel was instantly ground into flour, and about 7 per cent. of middlings; in the new system this is just reversed, and it is considered a highly organised mill which makes 90 per cent. of semolina and middlings and only 10 per cent. of flour in the reductions. In America the purifier was invented to deal with the 10 per cent. of middlings which the miller could not but produce, however close he might grind with his millstones, and the handling of this despised product on purifiers developed an entirely new principle in milling. The American sieve and air purifier not only made this product more valuable, as the miller expected, as a cattle food, but more valuable than the highest grade of flour he formerly made. As this idea was forced home on the miller, the necessity of producing a larger portion of middlings was apparent, and high-grinding with millstones was tried. Before the development of the purifier the millstones were grinding about twenty bushels an hour, after, they were fed to turn out only seven or eight bushels, and all with a view to make more middlings. The best form of millstone, however, could only make a very small percentage of middlings, and as the grinding became higher and higher, a kind of gradual reduction was tried on millstones; and mills which formerly contained only millstones for reducing the wheat in one operation, had bran cleaners, middlings stones, and two or three pairs for treating the tailings. Following each pair were dressing reels, and at this stage the limit of the production of middlings by millstones was reached. The rigid spindle millstone, with its grinding surfaces, at a fixed and controllable distance apart, was the last step previous to the roller system; the rolls were the necessary outcome of this idea, and thus we see how the purifier in America was the prelude to the gradual "break" system by corrugated rolls. In England, on the other hand, the attempt was made to make middlings by means of rolls, before the purifier had been invented to make the necessary separations. Scattered throughout the kernel of the wheat berry are impure particles which it is essential to remove, and practice has shown that it is only the purifier that can remove those impurities. While there is a very general impression that improved milling was brought from America to this country, there is no doubt rolls and semolina milling were practised here prior to their adoption in America; but it was not until the introduction of the American purifier that the new system became a *commercial* success.



MULTIPLE ROLLER BREAK MILL, MADE BY MR. J. A. BUCHOLZ IN 1871.

To make the early efforts at semolina milling clear to the readers of THE ENGINEER, we shall proceed to describe the mill of Mr. J. Stannard, of Nayland, Suffolk, erected in 1869 and 1871. Between 1869 and 1871, Messrs. Baker and Sons, of Bristol, Mr. Allen, of Middleton, and Messrs. Radford, of Liverpool, had all attempted the semolina system, under the superintendence of the father of British milling, Mr. J. A. Buchholz, but none of the above-mentioned firms had as complete systems as Mr. Stannard—hence our desire to explain his alterations. Writing to the author on December 14th, 1886, Mr. Stannard says:—"I replaced nearly all the machinery in my mill at a heavy outlay of money and time, but owing to various causes I substantially returned to the old system. In the first place, while we had rolls there were no purifiers, and the other machines that now render the gradual reduction system a success, and not an English operative miller, who understood what was required, and too many of them did not desire to be informed, as no doubt the new system appeared only a means of bringing on them more trouble."

Another drawback which seriously interfered with the success of the early attempts at gradual reduction milling was the failing to observe that smooth roller mills were indispensable to the successful treatment of semolina after it had been made by the fluted rolls. In some of the best English and American mills a pair or two of millstones are still retained to treat the pure semolina, but they are only suited for this part of the process, and certainly do not make a better flour than can be done by smooth chilled iron rolls, while in the treatment of the second and inferior quality of middlings the rolls are infinitely to be preferred. This part will be fully dealt with in a later article; meantime, we continue our description of the points in Mr. Stannard's mill as erected by Mr. Bucholz.

In 1869 one of the Buchholz hullers was constructed by Messrs. Murgatroyd, of Stockport, and is still to be seen in the mill at Nayland; this huller contained 10,850 steel blades with a special kind of cardboard between them. The blades on the outer segments were set to face those on the inside revolving drum. After some experience Mr. Stannard removed the segments and replaced them with wire, which enabled him to pass double the quantity of wheat through it with less than half the power, and a much better class of work was done so far as making a larger proportion of the best description of middlings, but it failed to liberate and remove the germ so efficiently, while the bran was not so clean. For a time it was thought that the future of improved milling lay in the direction of hulling and decorticating machines, but experience demonstrated that while a certain portion of the excellent semolina could be made, the severe action of these devices in comminuting the bran and triturating the remaining portion of the berry into "dead" flour led to their rejection. The next machines were the disc mills and dismembrators, which were a cross-breed between rolls and millstones, but they also failed from defects similar to those developed in the hulling machines. It is well-known that the dismembrators produced a large proportion of the very highest quality of large semolina, which when ground by smooth roller mills made a grade of patent flour that has never been excelled; but the remaining portion of the berry was almost pulped, and the resultant flour was so dead that it could not be sold, and dismembrators had also to be abandoned.

Any reference to the birth of modern milling would be incomplete without some notice of the graduated system erected by Messrs. Muir and Sons, at the Tradeston Mills, Glasgow. The experimenting with this system led to the patent—No. 2560, July 17th, 1875—taken out by Mr. Thomas Muir, for the extraction of the germ. This patent was the subject of a recent interesting patent suit, to which special attention was drawn in THE ENGINEER of November 26th, 1886. This mill was worked on the "combination" system, that is, a mixture of rolls and millstones, and the *modus operandi* was as follows. There were seventeen pairs of millstones for the graduated breaking of the wheat, the speed of which varied from 100 to 150. Over sixty sets of steel roller mills were used to reduce the semolina into flour, and the mills were altogether the best equipped in Great Britain at that time. The system would not be able to hold its own against the complete roller systems of the present day, although 74 per cent. of flour was made from American wheats, and the entire mill was completely automatic. As the germ defence case excited a great deal of attention, it may be of some interest if we describe Mr. Muir's system. Writing to the author on 17th February last, Mr. Muir states that his alterations were made at a very large expenditure of time and money, and his patents were rendered valueless through what The Engineer described at the time as a "little snake-in-the-grass point of law," and Mr. Muir lost his rights, not through the demerits of his invention, but through want of knowledge of every point in the Patent Law. After a long series of experiments Mr. Muir discovered that when wheat grains are cracked and broken up, the germs are for the most part mixed with the large semolina. Under the old millstone system the germ was ground up with the other parts of the kernel, and its oily nature had the effect of discolouring the flour and the bread baked from it. The problem was, how to eliminate the germ; and Mr. Muir discovered a method almost by accident. In the process of reducing the fine semolina and coarse semolina Mr. Muir had observed that the flour from the latter was a much darker colour than that made from the former, and after a minute examination he found that the germs largely predominated in the coarse semolina. Without expecting any result, or perhaps even uninterested in what he was doing, Mr. Muir took a sample of this product and passed it through a set of smooth rolls, catching the crushed material in a hand-sieve. On sifting the crushed semolina Mr. Muir found the germ was flat, and was retained in the sieve. It was after this discovery an easy matter to extract the entire germ, and Mr. Muir passed all his semolina through smooth rollers and sent the crushed product to an ordinary dressing roll, the flour being dressed out while the flattened germs passed over the tail. This method is still followed in all the roller systems, and we shall describe the point in more detail and illustrate the process by a diagram in a future article.

In our progress with Mr. Stannard's mill we turned aside at the point where he found that the hulling machinery would not answer, and we now come to the time—1871—when he decided to put in a complete set of Buchholz break rolls, of which we give illustrations. It will be seen from our views that there are six pairs of rollers in one frame. In America at the present moment there are efforts being made to produce an efficient concentrated break roller mill, in which the whole of the rolls are fitted into one frame; this, of course, is claimed as a purely novel American idea, while we see that the first set of rolls made in England were built on that principle, and the more American "inventions" are looked into the stronger evidence can be adduced in support of the fact that many of them are old and discarded English methods. In the first English-made roller mill—as illustrated on pp. 41, 47—the upper pair of rolls had V-shaped flutes, about 9 per inch, while all the other five pairs of rolls had straight flutes, from 12 to 20 per inch; and all the top rolls were run at 360 per minute and the bottom ones at 120 per minute. In the rolls of the present day the number of flutes per inch are exactly the same, but V-shaped flutes are used at an angle of twist on a 30in. long by 10in diameter, of about 10 deg.; and the differential speed is also the same as tried by Mr. Buchholz, which shows how near he was, as Mr. Procter Baker remarked, "to hitting a big thing." Under each pair of rolls a sieve was fitted, all covered with No. 16 wire, and it is only fair to Mr. Buchholz to put it on record that, while the milling engineers who succeed him all adopted reels for the scalping process, they have gone back with advantage to his original system of using sieves or rotating dickeys. The rolls were made of steel, which was found not a very suitable material for grooved rolls, and chilled iron is now universally used. The "chop"—which is the miller's term for the liberated kernel of the berry—after it passed through the scalping sieves was dressed through a long rell with a head sheet of silk to dust out the flour and three tail sheets of different meshes of wire, through which the semolina was divided into three sizes. The first division of semolina was very fine and almost free from germ, and was spouted direct to a pair of stones which reduced it to a really excellent brand of flour, which sold on Mark-lane at a high price. The coarser semolina was treated on three centrifugal machines, in the centre of which were discs 10in. diameter which revolved inside the centrifugal rell at a very high speed. These discs were formed of small steel blades, which distributed the semolina very much after the manner that water falls from a fountain, only more inclined towards the axis, the light fluffy portion dropping by the law of gravity at the centre—on the same principle as the "eclectic" disintegrator—the next heavier falling into a second division, and the coarsest of all being thrown by the centrifugal force into the outer chamber at the circumference. This principle has been widely adopted in modern purifiers (and is now being largely adopted for separating cement, basic slag, ores, chemicals, &c., the author himself having recently taken out a couple of patents for apparatus pneumatically to sift these materials) and in every part of the first attempt by Mr. Buchholz can be seen the germ idea of nearly every good feature in the perfected system of gradual reduction milling. Witness his break system on six pair of rolls, his scalping of each break on a separate sieve, the dusting and sizing of the "chop" on a long circular reel, and there is no room left for a doubt that he introduced into this country a complete system of break rolls and a no less complete system of dusting and separating the breaks. The weak part of roller milling at this early stage was the treating of the semolina on the "sudden-death" principle and the lack of good middlings purifiers. Mr. Bucholz evidently clearly grasped the principle of gradual reduction of middlings and semolina, as well as the graduated breaking of the wheat, as he tried to deal with the former on four different pairs of millstones, the speed of which he reduced to seventy-five per minute. The semolina, however, after the first reduction on the stones was not suited for further treatment by the same severe rubbing system, and the result was that without the intermediate purifications between the reductions and the want of smooth rolls, the product, germ, specs, and all the internal impurities, were pulverised into flour by the millstones, and a very dark grade of baker's and household flour was made. In a future description of one of the best and most recent mills we shall show how the separation of all the impurities is effected, according to difference of structure; meantime we wish our non-milling readers to grasp the idea that modern milling is a process of gradual reduction and gradual purification; and the best "break" system is that which makes the largest portion of middlings and semolina, the least "break" flour, and the cleanest and broadest bran; and the best system of gradual reduction of the middlings and semolina is that which reduces these products, and at the same time comminutes the smallest portion of their inherent impurities.

THE ENGINE TRIALS AT NEWCASTLE-ON-TYNE.

The tables which we publish on pp. 44 and 45 fully justify our anticipations of the results likely to be obtained from the modern portable engine. It will be remembered that we have, for many years, insisted on the expediency—if not the necessity—of instituting a comparison between the engines of 1872 and those of more recent construction. The office of instituting this comparison, devolves legitimately on the shoulders of the Royal Agricultural Society; and although that duty has been discharged tardily, it has been discharged thoroughly. Even those most opposed to the institution of such a comparison as that which has just been completed, have not disputed that the portable engine of to-day can be a much more economical machine than that of 1872. But engineers will learn with some surprise that the portable engine of to-day is not only more economical than its predecessors, but is the most economical non-condensing engine in the world; and is far more economical than quite 90 per cent. of the finest condensing engines ever built. With a pressure of less than 150 lb. in his boiler Mr. Paxman's compound engine gave out a brake horse-power for 1·8 lb. of coal per hour, corresponding to a consumption per indicated horse-power of about 1·6 lb., a rate surpassed only by a few of the best triple-expansion marine engines. Nor does the Paxman engine stand alone; Mr. Foden's traction engine required, it will be seen, only a small fraction more fuel than Mr. Paxman's. Mr. Foden worked at the extraordinary pressure of 250 lb. per square inch. The economy due to this may be set against the fact that a traction engine has larger radiating surfaces than a portable engine. The figures, however, go to show that under the conditions nothing is gained by carrying pressures above 150 lb.

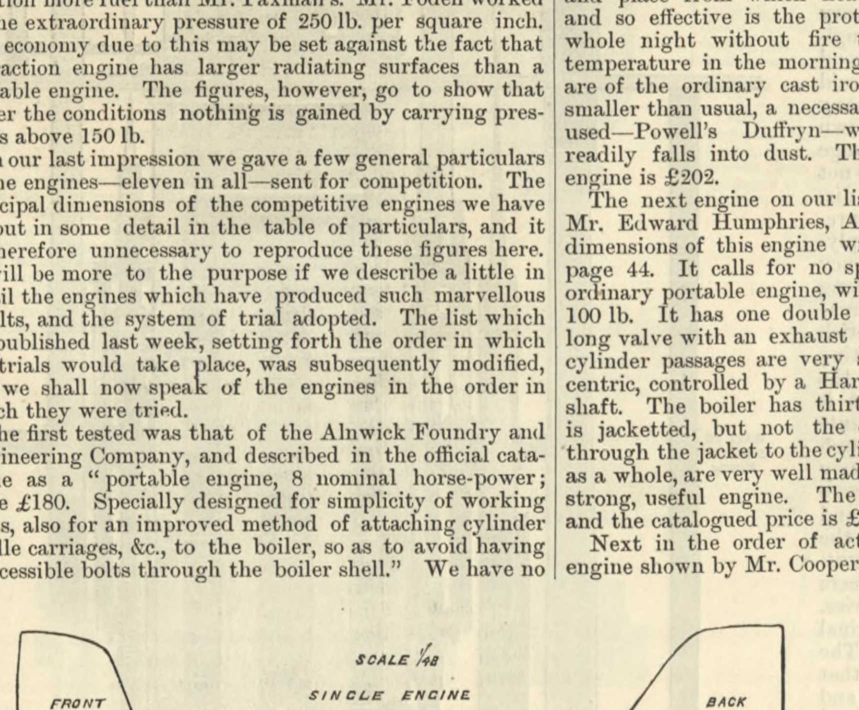
In our last impression we gave a few general particulars of the engines—eleven in all—sent for competition. The principal dimensions of the competitive engines we have set out in some detail in the table of particulars, and it is therefore unnecessary to reproduce these figures here. It will be more to the purpose if we describe a little in detail the engines which have produced such marvellous results, and the system of trial adopted. The list which we published last week, setting forth the order in which the trials would take place, was subsequently modified, and we shall now speak of the engines in the order in which they were tried.

The first tested was that of the Alnwick Foundry and Engineering Company, and described in the official catalogue as a "portable engine, 8 nominal horse-power; price £180. Specially designed for simplicity of working parts, also for an improved method of attaching cylinder saddle carriages, &c., to the boiler, so as to avoid having inaccessible bolts through the boiler shell." We have no desire to say hard things of any exhibit or exhibitor, but we must speak the truth, and the truth of this engine is that the firm has still everything to learn concerning the construction of a portable engine sent to compete for a prize. This particular engine is the first built by the firm, and no doubt the experience obtained in the trial shed will bear good fruit in succeeding engines. We may perhaps do some service to a section of our readers, if we make it clear to them that the day is gone past when "anything would do" for a portable engine. The English trade in portable engines is nearly dead, and the competition for the foreign trade is so keen, and agents are so independent, that nothing whatever is to be done, save in a very small and precarious way, with second or third-rate engines. If engineers wish to go into the portable engine trade, they must be prepared to supply something very good indeed. If they are not, then let them keep away from portable engines. That shown by the Alnwick Company closely resembles what used to be common enough twenty-five years ago in country farmyards. It has a single cylinder, 8⅝in. diameter by 12in. stroke, and the crank shaft is certainly not too strong for the work professed to be done. It has a simple slide valve and one excentric. We need not go into any details. Even twenty-five years ago the engine would not have been regarded as economical. The Alnwick Foundry Company, if it wishes to go into the portable engine trade, must produce something entirely different from this its first venture. We know that the price is small, and it is quite possible that the machine is good value for the money; but this will not do in the present day. The foreign purchaser not only expects a good deal for his money, but is willing to pay a good deal of money for what suits him, and this must not be forgotten.

The "simple" engine sent for competition by Messrs. Davey, Paxman, and Co., of Colchester, is in nearly all respects an ordinary portable engine. The cylinder is carried in the usual way on the fire-box; the boiler is of the locomotive type, with raised fire-box, and of Siemens' steel, machine rivetted; the cylinder is jacketted all over, including covers, the jacket being formed by putting a hard cast iron liner into the outer casting; the jacket is carefully drained back into the boiler. The crank-shaft is carried in a cast iron saddle in the usual way. Steam is distributed by a single Trick slide-valve, and expanded by the aid of a gridiron valve working on a plate fixed in the valve chest, as close as possible to the back of the slide valve. The gridiron valve is worked by an excentric and link motion, the position of the die in the link being determined by the high-speed governor, which acted to perfection during the trial. The bearings of the engine were not too slack, and the engine ran without knock, maintaining its speed with the utmost regularity. The boiler differs from ordinary portable engine boilers, in that it has eight Paxman curved water tubes fitted in the fire-box—as in the Paxman trial engine at Cardiff—and that the steel flue tubes are 2in. diameter instead of 2¼in. or 3in. The feed-water is heated by making it traverse a 1in. copper pipe about 42ft. long, arranged in four "coils," each of two lengths of 5ft. 2½in., to the centre of the bend. The coils lie in a flat cast iron box, making an extension of the exhaust pipe and lying flat on the top of the boiler. The box is the same thickness as the lagging into which it is let, so that when the sheet iron casing is put on it cannot be seen. In the smoke-box is a coil of copper tube, through which passes the water produced in the heater by the condensation of the exhaust steam. This water is heated up in the smoke-box, and returned to the tub, from which the pump sucks. The lagging is hair felt, wood, and sheet iron. Every thing and place from which heat might escape is covered, and so effective is the protection that after standing a whole night without fire the boiler still retained a temperature in the morning of 190 deg. The fire bars are of the ordinary cast iron type, the air spaces being smaller than usual, a necessary precaution with the coal used—Powell's Duffryn—which is very friable, and readily falls into dust. The catalogued price of this engine is £202.

The next engine on our list is a "simple" engine by Mr. Edward Humphries, Atlas Works, Pershore. The dimensions of this engine will be found in the table on page 44. It calls for no special description, being an ordinary portable engine, with a boiler made to work at 100 lb. It has one double slide valve, that is to say, a long valve with an exhaust port at each end, so that the cylinder passages are very short, driven by a single excentric, controlled by a Hartnell governor on the crank shaft. The boiler has thirty 2⅜in. tubes. The cylinder is jacketted, but not the covers. The steam passes through the jacket to the cylinder. The engine and boiler as a whole, are very well made and of good proportions—a strong, useful engine. The working pressure is 100 lb., and the catalogued price is £190.

Next in the order of actual competition comes the engine shown by Mr. Cooper, of Ryburgh, Norfolk. This engine was built for Mr. Cooper by Messrs. Richard Garrett and Sons, of Leiston, but wholly from the designs and under the direction of Mr. Cooper, who has departed widely from the dimensions invariably adopted by the firm for compound cylinders. It goes without saying that the engine is thoroughly well made. It ran very well and without hitch of any kind, but the governors required adjustment, and did not maintain regularity of speed. It will be seen from our table that it did a very fair duty on the brake. As the machine is of very peculiar construction, we may here describe it at some length. This engine has been specially designed for the general work of a farm, and the aim has been to produce an engine that will move itself and a moderate load, and yet is nearly as simple and easy to drive and more convenient to get about than a common portable engine. Care has been taken to dispense with all superfluous weight, and the introduction of some novel features has contributed to the result obtained. It is an 8 horse-power compound engine, weighing only 5 tons 18 cwt. empty, and is only 6ft. wide over the hind road wheels, the latter being 4ft. 8in. by 16in. The front wheels are made to turn under the boiler, so that the engine will turn round in its own length. One of the novel features is the driving gear for the road motion. Instead of the train of spur gear and counter shafts now generally used, the power is communicated direct from the crank shaft to the axle of the hind road wheels by means of a steel chain, which is composed of a large number of thin links, of the form of the early Green's lawn mower; it is almost noiseless in working, and although so light it will stand a strain of 7 tons; but when the engine is giving off 18 brake horse-

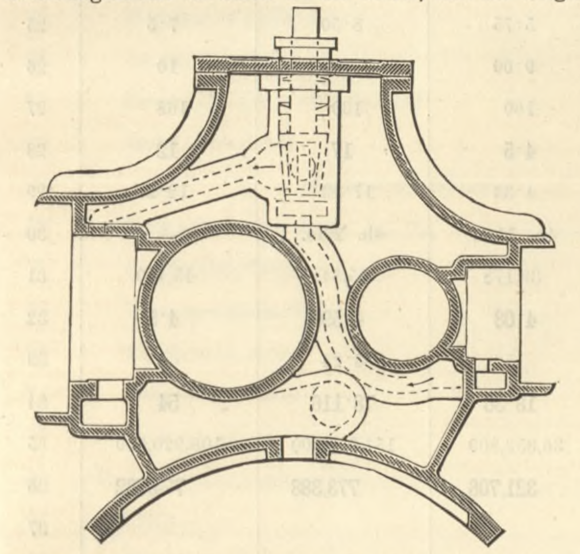


DIAGRAMS FROM DAVEY, PAXMAN, AND CO.'S SIMPLE ENGINE.

power there is a pull of only $24\frac{1}{2}$ cwt. on it, and as it is protected from dust and well lubricated, it will last a long time. Special provision has been made of automatic apparatus for taking up any slack, and that in such a manner that the pulling side of the chain is always straight, whether the engine is running backwards or forwards. Two deflecting rollers are used on the outsides of the chain. They are carried by light bars, which are pivotted underneath the crank shaft, and these bars are coupled near to the rollers by an adjusting screw, to put the requisite amount of pressure on to take up the slack; and as they can swing on the pivot, they accommodate themselves to the chain, the pulling side of which is always straight. In the width of the chain there are twenty-six links. The gearing is proportioned for the crank to run about 270 revolutions per minute when the road wheels are travelling four miles an hour. There is no "slow" speed as generally understood, but its equivalent is provided in a very simple manner by admitting steam direct from the boiler to the low-pressure cylinder. This is done by the starting valve, which is arranged in such a manner that when the lever is in central position the valve is closed; if lever is pushed forward engine works compound, but if lever is pulled backward both cylinders work high pressure, and give off sufficient power to lift the entire weight of the engine. The reversing gear is of a very simple nature; but as we understand this and some other points are subject to some foreign patent not yet completed, we defer a detailed description for the present. The catalogued price is £325.

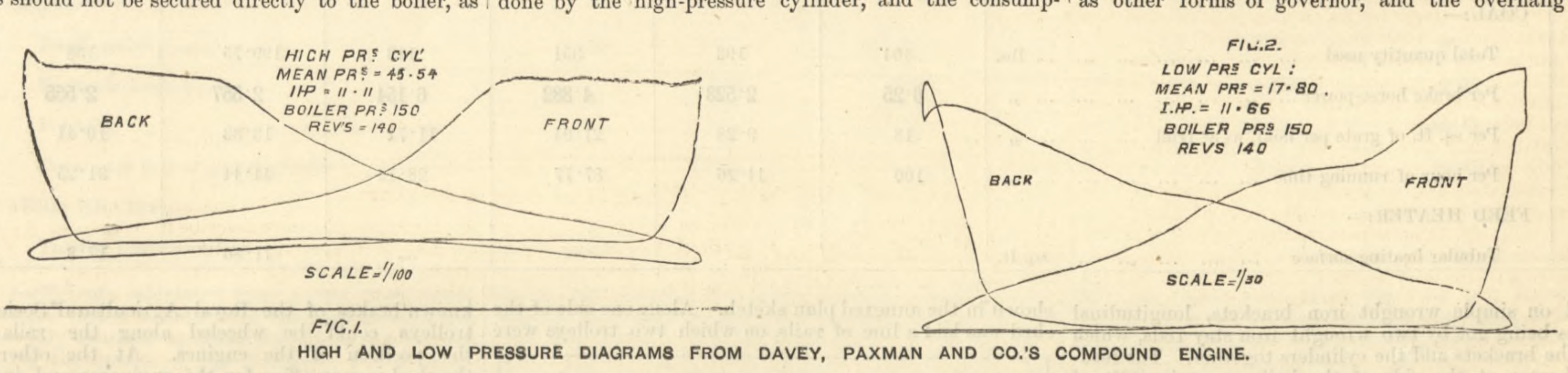
The fifth competitor is a small vertical engine and boiler, mounted on high, light, iron wheels, and made by Messrs. Jeffery and Blackstone, of Stamford. It is intended for working small thrashing machines, corn mills, &c. The vertical cylinder is fixed at the back of the boiler, and the crank shaft above, near the top. The whole is carried on a well designed wrought iron frame bolted to the boiler. The machine is very rigid, and the bearings are large. There is a good governor, of the ordinary centrifugal type. The boiler has vertical tubes. The finish of the whole machine is good, and during the run on the brake it worked very steadily and well. By the addition of a second or cut-off slide and lagging the boiler, the economy of this engine might be greatly augmented. Of its class it is a very praiseworthy little engine. The catalogued price is £100.

The sixth engine is the compound by Messrs. Davey, Paxman, and Co. This engine is of a type very similar to that adopted some years ago by the firm for use in the African diamond fields. The engine is secured to a wrought iron frame made of I plates, fixed to the boiler by brackets. In this way, by slacking a few bolts, the whole engine can be taken off the boiler, and the weight



SECTION OF FODEN'S COMPOUND ENGINE CYLINDERS.

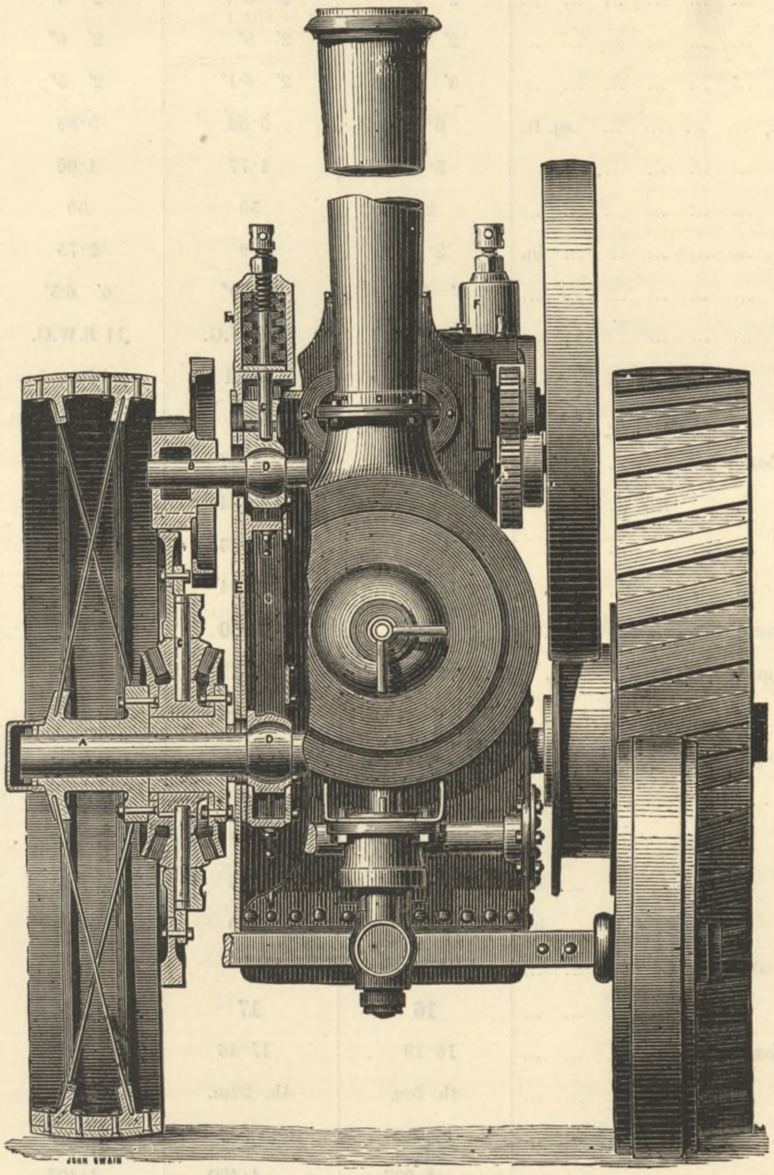
reduced for transit across a difficult country. As coal was extremely dear, and, what was much worse, very scarce in Africa, economy in its use was of the utmost importance, and these engines were made to work at high pressures. Mr. Paxman holds that when high pressures are used the cylinders should not be secured directly to the boiler, as



HIGH AND LOW PRESSURE DIAGRAMS FROM DAVEY, PAXMAN AND CO.'S COMPOUND ENGINE.

the stresses are likely in time to injure it. The cylinders are jacketted, and so are the covers; the drainage of the jackets being carefully provided for by four wrought iron tubes, two taking steam into the tops of the jackets and two drawing off water from the lowest point. The boiler is very similar to that of the simple engine by the same firm, only there are no Paxman tubes in the fire-box. To the low-pressure cylinder there is one Trick valve for the distribution of the steam; the high-pressure cylinder is fitted with the Paxman cut-off gear, identical with that on the simple engine. It controlled the engine perfectly throughout the run; indeed, none of the other engines tested were as well governed as the Paxman engines. The feed-water heater is the same as for the simple engine, only there is no coil in the smoke-box. The working pressure is 140 lb. The catalogued price is £290.

The seventh engine on the list is a compound, by Mr. E. Humphries, of Pershore. In our table will be found dimensions. The cranks are placed at an angle of 180 deg., that is to say, they are opposite each other. The arrangement of the valves is very peculiar. On the outside of the high-pressure cylinder is a valve-box of great length, rendered necessary by the circumstance that the steam ports are in the covers of the cylinders, not in the cylinders themselves. There are here two plain slides for admission and cut off, one at each end of the cylinder. These are driven by an excentric actuated by a Hartnell governor, which, of course, determines the point of cut-off. Between the two cylinders is another valve chest in which work four plain slide valves, two being exhaust valves from the



FODEN'S COMPOUND TRACTION ENGINE.

low-pressure cylinder, and two being at once admission valves to the low-pressure cylinder and exhaust valves from the high-pressure cylinder. There are four separate rods for the four valves carried in a species of frame embracing the valve chest, so that two rods go into the chest at the back and two at the front end, this arrangement being rendered necessary by the fact that although we have spoken of it as one chest between the two cylinders, a thick partition renders it actually two. It is very much to be regretted that the indicator had never been put on this engine before it came into the showyard. The consequence was that it was not known till the engine went on the brake that the valves were improperly set, with the result that enormous back pressure was set up in the low-pressure cylinder. All the work was thus virtually done by the high-pressure cylinder, and the consumption of fuel was so high that with the consent, indeed at the suggestion of the maker, the run was stopped after a couple of hours; it is therefore impossible to say of what the engine is capable. For this reason we have not included its performance in the table; we may say, however, that the engine is well made, and of good proportions. It is much to be regretted that the experiment could not be carried out, because the engine constitutes a radical departure from normal practice. The catalogued price is £215.

The eighth engine with which we have to deal is a compound traction engine built by Messrs. Edwin Foden and Sons, of Sandbach, Cheshire. This engine we illustrate above and on page 43. It is in many respects identical with the spring mounted traction engines built for some years by the firm with great success. The wheels are about 6ft. high, and the springs, of the helical type, are in boxes on the side frames near the crank shaft bearings. The interest in this engine does not, however, turn at present on its performance as a traction engine, but its powers on the brake. During the trial it was run at 250 lb. boiler pressure. The steam is cut off by a special gear, which we shall explain in a moment, when the piston has made a stroke of half an inch. This corresponds—with the proportions of the cylinder—to an eighty-fold expansion, if we neglect clearance, &c. As a matter of fact the terminal pressure is about 5 lb. above the atmosphere, and we have therefore $\frac{265 \text{ lb.}}{20 \text{ lb.}} = 13\frac{1}{4}$ expansions as occurring in practice. The cut-off gear is suitable for running either way, and is a modification of Farcot's. On the back of the main slide is another. The main slide has the admission ports through it, and the riding-valve will when in mid position leave these ports open. The riding valve is carried by the main valve, the friction between the two being sufficient for this purpose. Each valve has its own rod; that of the main valve is driven by a link motion in the usual way; that of the riding-valve is prolonged through a stuffing-box carried by an arm on the main valve spindle. This stuffing-box is only used to supply friction, should there not be enough to secure the action of the riding-valve and appears to be entirely unnecessary. The end of the riding-valve spindle enters a brass box, in which slides vertically a spindle caused to rise and fall by the governor. The spindle has a V piece on it, which passes through a slot in the valve spindle. The action of the gear will be readily understood. As the governor rises and falls so does the V piece, and on its position depends the point in its stroke at which the motion of the riding-valve shall cease, by the valve spindle being stopped by coming against the V when the steam is cut-off. The working of the whole will be readily understood from the drawing, page 46

This apparatus worked fairly well during the trial, but the governor hunted almost incessantly. The action would be improved by a dash-pot. The equivalent of a dash-pot now used by Mr. Foden—namely, a small stud pressed by a spring into a notch in the governor spindle—failed from some cause to do its duty. We believe that Messrs. Foden's works cannot compare in dimensions with those of the great Lincolnshire houses; it is the more creditable to him that the workmanship of boiler and engine is excellent. Notwithstanding the enormous pressure of 300 lb.—the pressure at which the safety valves blow off—the boiler and all its fittings were perfectly tight, not a breath of steam or drop of water being apparent. The crank shaft is of steel, with discs instead of cheeks. The crank pins are not set quite at right angles. By a simple arrangement the engine can be made to work non-compound, in starting. The catalogued price of this engine is £460.

The simple engine sent in for competition by the same maker is so similar in other respects to that just described, that it requires no special description. It works at 120 lb. pressure, and all the traction arrangements are practically identical. The price is £400.

The last two engines on our list are a simple and a compound portable, by Messrs. J. and H. McLaren, of Leeds. These engines seem to leave little to be desired in the matter of design, save that the Hartnell governors with which they are both fitted do not perhaps look as well as other forms of governor, and the overhang of the Hartnell governor, and two excentrics beyond the crank shaft bearing in the compound engine is not commendable. The engines have identical boilers, the dimensions of which will be found in the table. The boilers are very long, and, as will be seen, is the stroke. The cylinders are jacketted all over in the most elaborate way, even the ports being surrounded with steam. We need not say that the casting, especially for the compound engine, was extremely difficult and complicated. Yet it was made by Messrs. Hill Bros., of Leeds, in just one week after the patterns had been delivered to them. This firm is celebrated in the North for its admirable castings, and those in Messrs. McLaren's engines are so hard that they had to be planed with chilled cast iron tools. The cylinder bodies are very little softer than the valve seats. The cast iron saddles are suppressed, the crank shaft brasses being carried

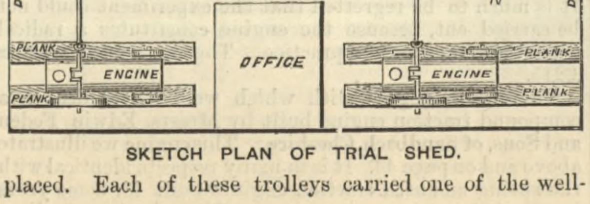
TRIALS OF ENGINES AT NEWCASTLE.—SIMPLE ENGINES.

Particulars of Boilers, Engines, and Results of Trials.

No.	Names of exhibitors / PARTICULARS.		Alnwick Company.	Paxman and Co.	Humphries.	Jeffry and Blackstone.	McLaren.	Foden.	No.
1	BOILER:— Type...		Locomotive	Locomotive	Locomotive	Vertical	Locomotive	Locomotive	1
2	Length of barrel		6′ 0·5″	7′ 0″	6′ 3″	5′ 6″	6′ 8·5″	—	2
3	Diameter of barrel inside		2′ 6″	2′ 7·625″	2′ 8″	2′ 3″	2′ 7·5″	2′ 6″	3
4	Length of fire-box, mean		2′ 9″	2′ 0″	2′ 4″	—	3′ 0·75″	1′ 9″	4
5	Width of fire-box, mean		2′ 6″	2′ 8″	2′ 6″	—	2′ 2·25″	2′ 0″	5
6	Height of fire-box over grate		3′ 1″	2′ 8·4″	2′ 5″	1′ 9″ dia.	2′ 5·25″	2′ 2″	6
7	Area of grate, normal	sq. ft.	6·875	5·33	5·88	2·4	6·70	3·58	7
8	Area of grate at trial	„	5·62	4·77	4·00	2·4	3·34	3·00	8
9	Tubes, number		24	53	30	27	52	76	9
10	„ diameter outside	in.	2·75	2	2·75	1·75	2	1·625	10
11	„ length between plates		6′ 0·5″	7′ 0″	6′ 6·5″	2′ 10·75″	6′ 8·5″	6′ 0″	11
12	„ thickness		0′ 0·125″	14 B.W.G.	11 B.W.G.	12 B.W.G.	12 B.W.G.	18 B.W.G.	12
13	„ material		Iron	Steel	Iron	Iron	Steel	Steel	13
14	Heating surface, fire-box	sq. ft.	35·5	30·4	27·50	14·75	31·30	19	14
15	„ tubes in fire-box	„	—	8·37	—	—	—	—	15
16	„ tubes	„	105·0	194·24	141·26	37·00	182·70	177·6	16
17	„ smoke-box	„	—	2·23	—	—	—	—	17
18	„ total	„	140·5	235·24	168·76	51·75	214·00	196·6	18
19	„ per brake horse-power	„	**8·75**	**13·80**	**10·55**	**11·25**	**12·60**	**16·75**	19
20	„ per sq. ft. of grate	„	20·45	44·11	28·70	21·56	32·0	56·15	20
21	Area through tubes	„	0·81	0·90	1·041	0·33	1·126	0·93	21
22	Ratio of area through tubes to grate area	„	0·118	0·168	0·177	0·14	0·168	0·26	22
23	Pressure, lbs. per sq. in.		80	95	85	60	130	120	23
24	ENGINE:—								24
25	Diameter of cylinder	in.	8·75	9·5	10·5	5·75	8·50	7·5	25
26	Length of stroke	in.	12·0	12·0	14·0	9·00	15·00	10	26
27	Revolutions per minute declared		150	132	130	160	130	168	27
28	Brake horse-power		**16**	**17**	**16**	**4·5**	**17**	**12**	28
29	„ „ at actual revolutions		16·19	17·46	17·99	4·33	17·83	12·27	29
30	Time of running, total		4h. 5m.	4h. 22m.	4h. 0m.	4h. 11m.	4h. 29m.	—	30
31	Revolutions, total		37,342	35,558	35,050	39,178	35,842	45,400	31
32	Time, mechanical hours		**4·037**	**4·489**	**4·493**	**4·08**	**4·595**	**4·5**	32
33	Revolutions, actual		152·4	135·7	146	156	133·24	—	33
34	Horse-power hours		**64·59**	**76·32**	**71·89**	**18·36**	**78·116**	**54**	34
35	Foot-pounds, total		127,888,200	151,137,600	142,342,200	36,352,800	154,677,600	106,920,000	35
36	Foot-pounds per lb. coal		**316,554**	**783,091**	**402,687**	**321,706**	**773,388**	**774,782**	36
37	WATER:—								37
38	Total quantity used	lbs.	3060	1687	2864	657·5	1868	1394	38
39	Per brake horse-power per hour	„	**47·35**	**23·58**	**39·82**	**35·26**	**23·91**	**25·63**	39
40	Evaporated per lb. of coal	„	7·60	8·74	8·16	5·73	9·34	10·10	40
41	Temperature of feed		160, about	—	170 about	—	—	—	41
42	COAL:—								42
43	Total quantity used	lbs.	404	193	351	113	199·75	138	43
44	Per brake horse-power	„	**6·25**	**2·528**	**4·882**	**6·154**	**2·557**	**2·555**	44
45	Per sq. ft. of grate per hour, as at trial	„	18	9·28	21·94	11·72	13·33	10·41	45
46	Per hour of running time	„	100	44·26	87·77	28·12	44·44	31·25	46
47	FEED HEATER:—								47
48	Tubular heating surface	sq. ft.	—	—	—	—	11·80	17·8	48

instead on simple wrought iron brackets, longitudinal stiffness being got by two wrought iron stay rods, which brace the brackets and the cylinders together. The feed-water heater at the side of the boiler contains 42ft. of 1in. copper tube, placed in a pipe through which the exhaust steam passes. The tube is cut up into equal lengths, and secured at each end into a head, so that each length can be readily removed. The tubes have each one complete turn in their length, to give elasticity and provide for expansion. The steam passes outside. The temperature of the feed was raised to 212 deg. during the trial. The cut-off gear consists of a gridiron valve, which works direct on the back of the main high-pressure slide, and is controlled by a Hartnell governor on the crank shaft. The low-pressure slide is set to cut off steam at about $\frac{5}{8}$th of the stroke. The prices are, simple £175; compound £200.

The system of testing was very nearly that employed at Cardiff in 1872. The testing shed was arranged as shown in the annexed plan sketch. Along one side of the shed was laid a line of rails, on which two trolleys were placed. Each of these trolleys carried one of the well-known brakes of the Royal Agricultural Society. The trolleys could be wheeled along the rails to suit the position of the engines. At the other side of the shed was an office for the engineers and judges, and two sets of planks laid level in ballast, on which the engines stood. At each end of the shed were large double doors to admit the engines. The chimneys of these last stood out through the canvas roof, removed for the purpose where needed. A water service was laid on, and weighing machines were provided. The water was all supplied to the engines from 30-gallon standard measures. Each engine pumped from a barrel set on end beside it. This was filled to the top at starting, and again at the finish, all the feed-water passing through the 30-gallon vessels and being properly noted. The brake weights were calculated by the engineers, and, for the first time in the annals of the Society, an allowance was made for what we may term the internal resistance of the brake



SKETCH PLAN OF TRIAL SHED.

TRIALS OF ENGINES AT NEWCASTLE.—COMPOUND ENGINES.

Particulars of Boilers, Engines, and Results of Trials.

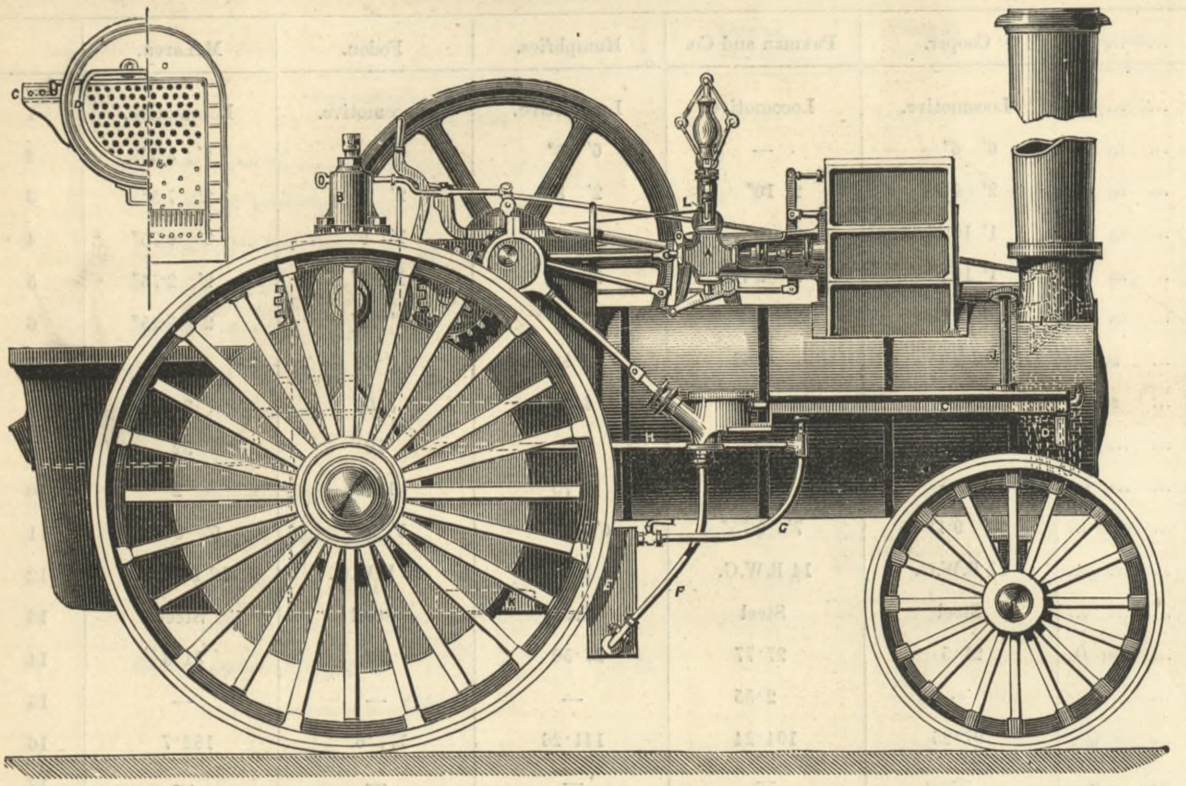
No.	Names of exhibitors ... PARTICULARS.	Cooper.	Paxman and Co.	Humphries.	Foden.	McLaren.	No.
1	BOILER:— Type...	Locomotive.	Locomotive.	Locomotive.	Locomotive.	Locomotive.	1
2	Length of barrel ...	6′ 6″	—	6′ 3″	—	6′ 8·5″	2
3	Diameter of barrel inside ...	2′ 5·25″	2′ 10″	2′ 8″	2′ 6″	2′ 7·5″	3
4	Length of fire-box ...	1′ 10·4″	2′ 0″	2′ 4″	1′ 9″	3′ 0·75″	4
5	Width of fire-box ...	1′ 10·5″	2′ 3·75″	2′ 6″	2′ 0″	2′ 2·75″	5
6	Height of fire-box over grate ...	2′ 7″	2′ 7·4″	2′ 5″	2′ 2″	2′ 5·25″	6
7	Area of grate, normal... sq. ft.	3·49	4·62	5·88	3·58	6·7	7
8	Area of grate at trial... sq. ft.	—	4·21	4·00	3·00	3·35	8
9	Tubes, number ...	22	53	30	76	52	9
10	„ diameter outside ... in.	2·5	2	2·75	1·625	2	10
11	„ length ...	6′ 9·4″	7′ 0·75″	6′ 6·5″	5′ 6″	6′ 8·5″	11
12	„ thickness ...	11 B.W.G.	14 B.W.G.	11 B.W.G.	18 B.W.G.	12 B.W.G.	12
13	„ material ...	Steel	Steel	Iron	Steel	Steel	13
14	Heating surface, fire-box ... sq. ft.	21·5	27·77	27·50	19	31·3	14
15	„ smoke-box ... „	—	2·55	—	—	—	15
16	„ tubes ... „	97·25	194·24	141·26	177·6	182·7	16
17	„ tubes in fire-box ... „	—	—	—	—	—	17
18	„ total... „	118·75	224·56	168·76	201·0	214·00	18
19	„ per brake horse-power ... „	**7·0**	**11·22**	**10·55**	**11·15**	**10·7**	19
20	„ per square foot of grate ... „	34·0	48·80	28·7	56·15	32·0	20
21	Area through tubes ... „	0·611	0·90	1·041	0·93	1·126	21
22	Ratio of area through tubes to grate area ... „	0·172	0·195	0·177	0·26	0·168	22
23	Pressure, lbs. per square inch ...	125	150	—	250	150	23
24	ENGINE:—						24
25	Diameter of cylinders ... in.	6 and 9	5·75 and 9·25	7 and 12	4·75 and 9·5	5·75 and 9·0	25
26	Length of stroke... in.	11·0	14·0	14	10	15	26
27	Revolutions per minute declared ...	170	134	185	156	135	27
28	Brake horse-power ...	**17**	**20**	**20**	**18**	**20**	28
29	„ „ at actual revolutions ...	18·3	20·89	19·54	18·85	22·02	29
30	Time of running, total ...	4h. 6m.	4h. 28m.	2h. 26m.	4h. 21m.	4h. 23m.	30
31	Revolutions, total ...	42,348	37,496	26,549	41,730	39,343	31
32	Time, mechanical hours ...	**4·15**	**4·66**	—	**4·583**	**4·85**	32
33	Revolutions, actual ...	172	139·9	181·8	159·8	149·5	33
34	Horse-power hours ...	**70·55**	**93·24**	—	**80·25**	**97·38**	34
35	Foot-pounds of work done, total ...	139,689,000	184,536,000	—	158,895,000	192,812,400	35
36	Foot-pounds of work per lb. of coal ...	**539,340**	**1,096,796**	—	**782,241**	**1,071,608**	36
37	WATER:—						37
38	Total quantity used ... lbs.	2414	1658	Trial	1394	1904	38
39	Per brake horse-power per hour ... „	**34·21**	**17·78**	not	**17·37**	**19·75**	39
40	Evaporated per lb. of coal... „	9·32	9·88	completed.	9·06	9·38	40
41	Temperature of feed ...	—	—	—	—	211	41
42	COAL:—						42
43	Total quantity used ... lbs.	259	168·25	—	148·5	203	43
44	Per brake horse-power ... „	**3·685**	**1·804**	—	**1·858**	**2·08**	44
45	Per hour ... „	63·17	37·66	—	34·3	46·31	45
46	Per square foot of grate per hour ... „	18·08	9·0	—	10·85	13·82	46
47	FEED HEATER:—						47
48	Tubular heating surface ... sq. ft.	—	—	—	—	—	48

based on coefficients calculated from actual experiment. The allowance varied a little with the load carried, but may be roughly assumed as about 0·75-horse power; and in comparing the results of the Newcastle with those of the Cardiff trials, it must be borne in mind that in the latter case the true brake work done was a little in excess of that set forth in the Royal Agricultural Society's report. The method of working we have already described. A preliminary run was first made, and when it was seen that everything was in good order, and the steam pressure that at which the exhibitor declared to work, the fire-box was swept out, and 14 lb. of wood was served out to him, and weighed coal. As soon as the steam was up to the point at which he resolved to work—generally a few pounds over the declared pressure—the experiment began, and the run was then made for four hours. At the end of that time any coal the competitor had left from the last lot served out to him was taken away, and he was credited with its weight. The engine was then allowed to run as long as it could until its speed fell below the entered or nominal speed, when it was stopped and the counter number taken. During the run Mr. Stead, of Middlesbrough, acting as chemist to the Society, took samples of the furnace gas in a way which we shall describe presently; and after the run was over Sir Frederick Bramwell made various experiments to ascertain the quantity of air admitted to the furnace.

There are many ways in which the fuel consumptions can be worked out from the data. The simplest is that which we have used. It consists in dividing the whole number of revolutions on the counter by the nominal speed—that is to say, the speed at which the engine would have given out the power for which the brake weight was calculated. The quotient is the mechanical time in minutes, and this divided by sixty gives the mechanical time in hours and decimals of an hour. This being multiplied by the declared horse-power, gives the power for one hour, suppose the whole work done by the coal had been done in one hour, and this divided into the total coal, gives the coal per horse-power. Minute decimal fractions we have neglected, as it is useless to overload data with a multiplicity of figures possessing no real significance. As an example of the process of calculation, we may take the figures for Mr. Foden's compound engine. He "declared" to run at 156 revolutions per minute, and to exert 18 brake horse-power at this speed. His brake was loaded, therefore, to 202·75 lb., its circumference being to the point of suspension of the load 17·24 ft., and its internal resistance 0·8-horse power. The total number of revolutions made was 41,730, and this divided by 156 gives 4·455 hours. The mechanical time was greater than four hours, partly because the speed of the engine was about 158 during the run, and partly because the fire in the fire-box and the steam due to the surplus pressure was sufficient to keep it going for some minutes after the serving out of coal had ceased at the end of the four hours. The total coal burned was 148 lb., and 4·455 hours multiplied by 18-horse power, gives 80-horse

COMPOUND TRACTION ENGINE[1]

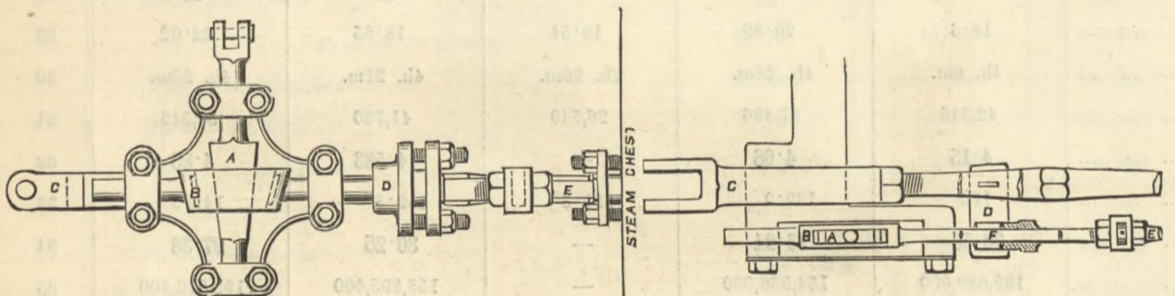
MR. E. FODEN SANDBACH, ENGINEER.



power for one hour, which divided into 148 lb. of coal, gives an hourly consumption at the rate of 1·85 lb. per hour.[1] The other figures in our table are easily deduced, and many others will suggest themselves to our readers which they can calculate for themselves almost *ad libitum* without our aid. It must not be forgotten that the water supplied is no measure of the water actually evaporated, because all the water resulting from steam condensed in the jackets returned to the boiler at once and re-evaporated, and there is no means of ascertaining with any approach to accuracy what this weighed. Much the same statement applies to water resulting from steam condensed in the feed-heaters and returned to the pump-tub unmeasured.

The whole of Monday, the 4th inst., was spent in getting things put right in the testing shed. On Tuesday the trials began with the engine of the Alnwick Company. The trial calls for no particular comment. We need only say that the governor wanted adjustment and acted very badly. The brakes are fitted with a new and engine was almost perfectly uniform, the tachometer denoting the passing of the crank over the dead points twice in every revolution by a slight movement.

When the four hours' run was concluded the engine was hauled out of the shed and steam again got up, which was allowed to blow away from the safety valve; the engine, working without a load, was run at just such a speed as would enable it to pump in feed enough. In this way an attempt was made to test the boiler for evaporation without the jacket influence making itself felt in the result. The performance of this engine was wonderful in itself, but more wonderful when it is borne in mind that the fire lighted in the trial shed was the second fire lighted in it, as its completion was so hurried that it was only run for half-an-hour in Colchester before being sent away by rail. While on the subject of limited time, we may add that the drawings for Messrs. McLaren's engines were only completed on June 6th. Not two months were spent in getting out the drawings, making the



FODEN'S AUTOMATIC CUT-OFF GEAR FOR REVERSING ENGINES.

very ingenious tachometer, the invention of Dr. T. Horn, and made by Mr. Thorne, of Gracechurch-street. A magnetised bar of steel hangs on five pivots in front of and close to a disc of copper, which rotates rapidly as the brake revolves, and by the action of the Faradic currents, set up the plate, tends to drag the magnet round with it, and thus moves the hand on the dial. It will be understood that this brief description is intended only to explain the principle, not details. The tachometers are not calibrated, and so give no positive indication of speed in numerical terms, but they served admirably to show whether the engines ran steadily or not. After the run on the brake was over, the engine had a board fitted to the mouth of the ash-pan. In this board were two rectangular holes controlled by slides, and an anemometer applied to these holes gave an indication of the quantity of air passing into the furnace. The experiment in the case of the Alnwick engine was brought to a conclusion by most of the fire-bars tumbling into the ash-pan. They got bright red-hot when the supply of air was stopped, and no means existed of removing the hot ashes below them.

On Wednesday, the 6th inst., two engines were tested, namely, Mr. Paxman's simple engine on the north brake, or that marked N in the sketch, while the simple engine of Mr. Humphries went to the other brake. Mr. Paxman fired his own engine with consummate skill, in spite of an injured hand, on the system of "little and often." His pressure never varied more than a pound during the run, and the engine was over twenty minutes in "running down"—that is, after the end of the four hours—during which period he burned his ashes. The speed of the patterns, and building Mr. Paxman's compound engine. In the face of such facts as these—and we find it necessary to state that we have taken pains to satisfy ourselves that they are facts—it seems strange that the firms signing a now memorable circular letter, should insist that twelve months are required in which to design, build, and test an engine which would give satisfactory results. Such a statement argues incompetence—it argues that those who make it do not know how to build a good engine, and require a year or two of experiment and instruction before they can produce a satisfactory result. We know that this is not the case; we are certain it is not the impression they intended to convey. That it does convey it is an additional proof, if any were wanting, of the injudicious character of a document which we have reason to know more than one firm already regrets signing.

On Wednesday the Paxman engine was replaced with Messrs. Jeffery and Blackstone's vertical engine, which made its preliminary run in the evening and its four-hours' run on Thursday morning. Also Humphries' engine on the south brake was replaced by Cooper's self-propelling compound, which made a preliminary run, and went on at 12.40 p.m. with its four-hours' run. The vertical engine was replaced at 3.30 p.m. on the same day with the Paxman compound engine, which underwent its trial on Friday. Mr. Cooper's engine was replaced on Thursday evening by Mr. Humphries' compound, which began its four-hours' run on Friday at 1.38 p.m., the experiment coming—as already explained—to an abrupt conclusion at 4.7 p.m. The Paxman compound engine ran for 4h. 28m., and during that time its speed was perfectly uniform; there was no knock or vibration; in all respects the engine ran in a way that left nothing to be desired, and gave the highest economical result ever obtained from a non-condensing engine. We give some diagrams.

On Saturday only two engines were tested; the compound of Mr. Foden on the north brake, and the simple engine of Messrs. McLaren on the south brake. We have already spoken of the running of the former engine; it was fired by Mr. Foden's son, a youth of sixteen, who bids fair to be the best fireman in England. It is much to be regretted that the Hartnell governor on Mr. McLaren's engine worked loose during the run. In consequence he had to stop to secure it, losing thus eight minutes; of course this was allowed for by the judges but we need not say that a stoppage of this kind seriously affects the result in trials such as these were, so much depending on small matters of detail in the management of a fire.

It was seen early in last week that the trial of strength really lay between three firms only—namely, Messrs. Davey, Paxman, and Co., J. and H. McLaren, and E. Foden and Sons. The engines of the Alnwick Co., and of Messrs. Jeffery and Blackstone, were quite out-classed. That of Mr. Cooper included too many novel features to render it probable that it would give a very high result. The simple engine of Messrs. Humphreys did not claim to be exceptionally economical, and the unfortunate mistake or accident with the slide-valve of the compound engine, brought to an untimely end what promised to be an interesting experiment. This engine is, as we have explained, constructed with the cranks opposite each other a system which has not hitherto been applied to portable engines, and the merits of this mode of compounding as compared with that usually adopted, would have been, at all events to some extent, elucidated could the engine have made a run under legitimate conditions. The end of the week fully confirmed what had been prognosticated. The Paxman compound engine and the Foden compound engine had beaten all previous records to an enormous extent, and much the same might be said of the performance of the Paxman simple engine and the McLaren simple engine. A reference to our table will show how closely these engines competed in the matter of fuel. There remained to be tested the McLaren compound engine and the Foden simple engine, and of the former great things were expected. On Monday the test of these engines began. The first to run was the McLaren compound, which started on its four hours' trial at 10.42 a.m., and finished at 3.5 p.m.—a total run of 4 h. 23 m., the last 23 minutes being run with the coal in the fire-box at the end of the four hours' run and the ashes. The engine was entered to make 20-horse power at 135 revolutions, and overran a good deal. The engine ran beautifully, the speed being kept very steady. Mr. H. McLaren acted as fireman, and his skill and coolness left nothing to chance. Unfortunately, after the run had lasted about an hour, the stuffing-box of the high-pressure piston-rod, which is fitted with metallic packing, began to blow a little, and could not bear tightening up without heating the rod, and this told no doubt against the result, which was, however, admirable, the consumption being at the rate of only 2·08 lb. per brake horse-power. This is really a wonderful performance.

Shortly after the McLaren engine started, the Foden engine began to run. Some trouble was caused at first by the expansion gear, but this was easily put right by the adjustment of a couple of nuts, and the engine began its four hours' run on the north brake at 12.32 p.m., and finished at 4.55 p.m., thus making 4 h. 23 m., the 23 m. being running-down time. The engine ran very well, but the governor, which is similar in all respects to that of the Foden compound engine, hunted persistently. The cut-off gear is, in fact, too quick and delicate in its action, and would be greatly improved by the addition of a dash-pot to steady it. This engine made an excellent run, the consumption of fuel coming out at 2·55 lb. per brake horse-power per hour. Thus it will be seen that the performance of the three simple engines differed only by fractions of a pound expressed by hundredths. The performances of the compound engines was not quite so close, but still the differences are very small. It seems evident that nothing was gained by the use of the excessive pressure carried in the Foden engine, and this is satisfactory, for while we see no reason why 250 lb. should not be adopted if the adoption was attended by an adequate saving in fuel, we must add that, other things being equal, the lower the pressure carried in any engine—and above all in an agricultural engine—the better. If Mr. Paxman secured a better result than Mr. Foden, with 100 lb. less pressure, the fact goes to prove that the additional 100 lb. is not wanted with these types of engines. In so close a competition it became a difficult task for the judges to award a prize, and much time was spent on Tuesday morning in examining the workmanship and the design of the engines. In the afternoon the awards were made known in the show-yard, both prizes, £200 for the compound, and £100 for the simple engine being awarded to Messrs. Davey, Paxman, and Co. Where three firms had done so well, it is to be regretted that all could not take prizes, but according to the rules laid down by the Council for the guidance of the judges, there was no room for hesitation. The most economical engines were those of the Colchester firm, and the firm won accordingly, and fully deserved what it has obtained. Mr. Foden and Messrs. McLaren may find ample consolation in the fact that they have beaten all other makers of non-condensing engines save one, and have turned out machines which cannot fail to raise their reputation to the highest point.

Although time and space press, we cannot conclude this notice of the performance of the competing engines without drawing attention to the remarkable character of the results obtained. The best triple-expansion marine engines scarcely get below $1\frac{1}{2}$ lb. of coal per indicated horse-power. Yet here we have little non-condensing engines, running at about the same pressure, working with about the same quantity of coal. A most interesting experiment remains to be carried out. A condenser ought to be fitted to one of the competing engines, and a test made for economy of fuel. We are disposed to believe that the result would be very little altered, the cooling action of the condenser on the low-pressure cylinder neutralising the advantage gained by a vacuum. It is at all events difficult to believe that anything much

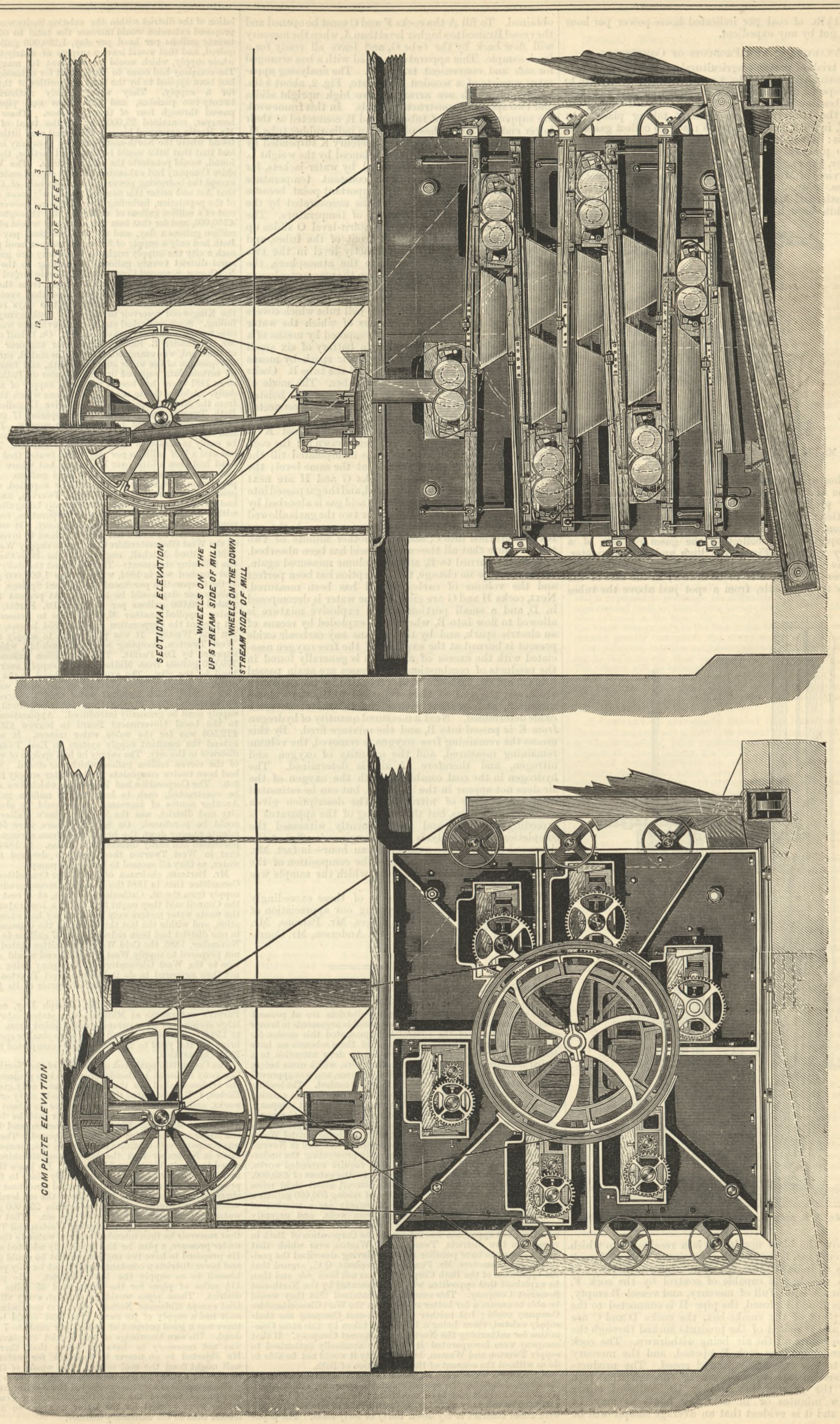
[1] It will be seen that there are certain small discrepancies in the table, which are due to the circumstance that the fractions used are in some cases nearer approximations than they are in others. Thus, for example, the official consumption of the Foden compound is given as 1·848 lb., instead of 1·85 lb. as given by us above. The difference is obviously quite insignificant. The quantities referred to brake horse-power are obtained with those given in line 28.

MULTIPLE ROLLER BREAK MILL AND SIEVES.

MR. J. A. BUCHOLZ, LONDON, ENGINEER.

(For description see page 41.)

(For description see page 41.)



below 1½ lb. of coal per indicated horse-power per hour can be got by any expedient.

ANALYSIS OF THE PRODUCTS OF COMBUSTION.

THE trials of portable agricultural engines at Newcastle have been characterised by a novelty to which we wish to draw especial attention. For the first time the products of combustion have been completely analysed during the times the trial runs were actually taking place. At Cardiff, in 1873, an attempt was made to collect gases for analysis: but so imperfect were the means then available that no practical results were obtained. At Newcastle, however, the engineers were fortunate enough to secure the services of Messrs. Pattinson and Stead to conduct the analyses. Mr. J. Pattinson is the Public Analyst of Newcastle, and Mr. J. E. Stead occupies the same position at Middlesbrough. To the latter gentleman is due the invention of an apparatus, which we shall proceed to describe and illustrate, by means of which the analysis of the products of combustion is rendered easy and expeditious. The process consists of two parts—first, the collection of the products, and secondly their analysis. The apparatus for collecting the gases consists of a mercury vessel A, Fig. 1, 7in. high and 1⅜in. diameter, which is connected by the tube H and cock D to the place wherever the sample is to be drawn; in the case of the engines at Newcastle, from a spot just above the tubes and below the blast nozzle. B is a receiver into which the mercury can flow through the pointed pipe and cock E. G is an india-rubber pipe connecting the bottoms of the two vessels, and capable of control by the cock F. The vessel A being full of mercury, and vessel B empty, the cocks E and F closed, the pipe H is connected to the desired point of the smoke-box, the cocks D and C are opened, and sufficient of the products sucked through the tube I to ensure all the air being withdrawn. The cock C is then closed, the cock E opened, and the mercury allowed to flow out at any desired speed. The products of combustion are thus drawn in through the pipe H, and the sample in A may be collected either in a few minutes or in as many hours as may be desired, and it is evident that an average sample will be obtained. To fill A the cocks F and C must be opened and the vessel B raised to a higher level than A, when the mercury will flow back by the tube G, and leave all ready for a fresh sample. This apparatus is fitted with a box arranged for safe and convenient transport. The analysing apparatus consists of a wooden base-plate, Fig. 2, about 14in. by 9in., on which are arranged two high upright slides and two specially-constructed stands. In this framework are supported a pair of tubes, A and B, connected at their lower ends by a breeches-piece to an india-rubber tube M, which unites them to a vessel of mercury K suspended by a cord passing over a pulley and balanced by the weight L. The tubes A and B are surrounded by water-jackets, for the purpose of maintaining a constant temperature throughout the analysis—a very important point, because it eliminates the tedious calculations necessitated by the changes of volume due to changes of temperature. The tube B is graduated, and a small spirit-level O slides up and down on a pair of wires in front of the tubes, and enables the mercury to be set exactly level in the two tubes, and as tube A is open to the atmosphere, the pressure in B must be the same when the mercury columns are level. C is an inverted bell tube dipping into a beaker of caustic potash. E is an inverted bell tube containing hydrogen. D is a similar inverted bell tube which covers a pair of platinum poles, by means of which the water contained in the beaker can be decomposed by means of a current of electricity produced by a battery of six small cells, which also serve to send an electric spark by means of a Rumkorf coil through the top of the tube B. Cocks F, G, H, I, J, govern the various tubes. The mode of operating is as follows:—The mercury vessel K is hoisted till the tube B is full, the gas to be analysed is connected to the tube N—corresponding to tube I, Fig. 1; the cock F is opened, the cock G being shut, the vessel K is depressed until sufficient gas has been drawn in; the cock F is then closed, and the vessel K is manipulated till the mercury in tubes A and B stands at the same level; the volume in B is then read off. Cocks G and H are next opened, the mercury vessel K hoisted, and the gas passed into the bell tube C, where the carbonic acid gas is absorbed by the caustic potash. After a minute or two the gas is allowed to flow back into tube B, the volume measured; the gas is then returned into C, and left another minute or two to make sure that all the carbonic acid has been absorbed. It is then returned to B, and the volume measured again, and if there be no change, the absorption has been perfect and the volume of carbonic acid has been measured. Next, cocks H and G are closed, some water is decomposed in D, and a small portion of the explosive mixture is allowed to flow into B, when it is exploded by means of an electric spark, and by that means any carbonic oxide present is burned at the expense of the free oxygen associated with the excess of air which is generally found in the products of combustion. The gases are again passed into C, and the carbonic acid generated by the explosion absorbed; the gas is then returned to B, the volume measured, and by that means the volume of carbonic oxide determined. Next a measured quantity of hydrogen from E is passed into B, and the mixture fired. By this means the remaining free oxygen is removed, the volume remaining measured, and the quantity of oxygen and nitrogen, and therefore of air, is determined. The hydrogen in the coal combining with the oxygen of the air does not appear in the products, but can be estimated from the volume of nitrogen. The description given above seems tedious, but the working of the apparatus is exceedingly simple, and we frequently witnessed the completion of an analysis in the engineer's office at the showyard in about one-quarter of an hour—in fact, Mr. Stead was often able to announce the composition of the waste gases before the run during which the sample was taken was complete.

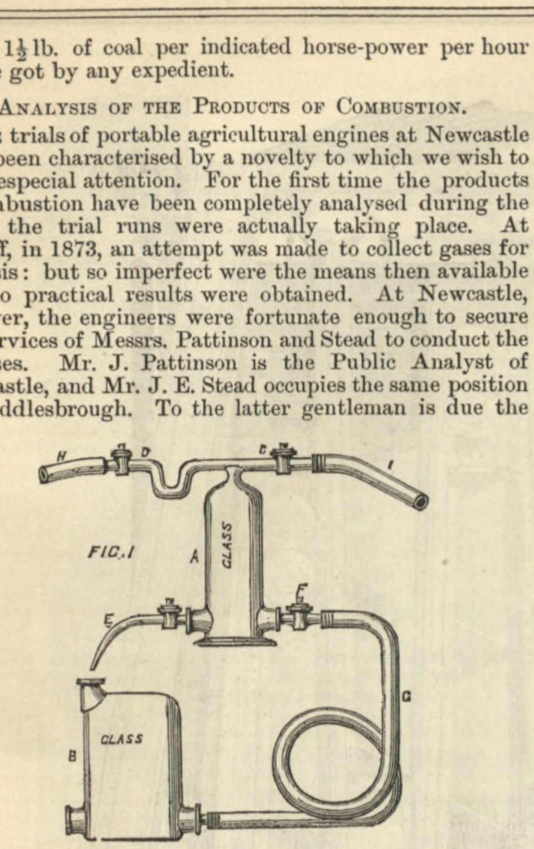


FIG. 1.—MR. J. E. STEAD'S APPARATUS FOR TAKING SAMPLES OF THE PRODUCTS OF COMBUSTION—SCALE ⅛.

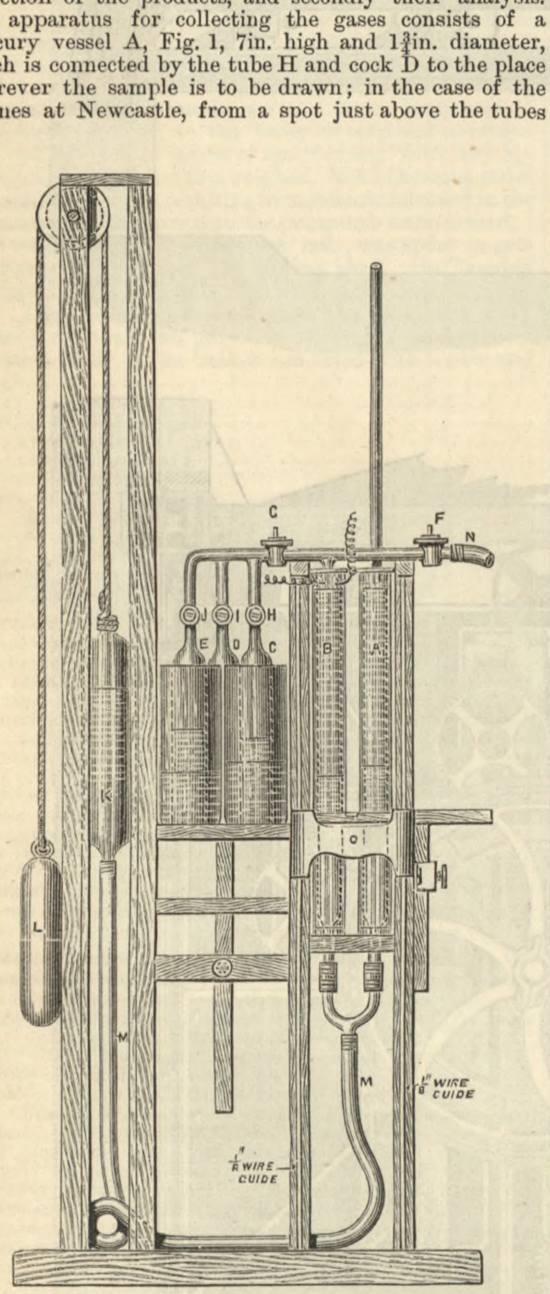


FIG. 2.—MR. J. E. STEAD'S APPARATUS FOR ANALYSES OF PRODUCTS OF COMBUSTION—SCALE ⅛.

We cannot conclude our notice of these exceedingly interesting trials without expressing our appreciation of the courtesy shown us by the judges, Mr. Parsons, Mr. Pidgeon, and Mr. Yates, and by Mr. Anderson, Mr. Courtney, and the engineering staff.

THE WATER SUPPLY OF WEST GLOUCESTERSHIRE.

THE severe drought from which many districts are at present suffering furnishes one of the strongest possible arguments in favour and in justification of the several bills promoted this session for increasing water supplies. With some of these schemes we have dealt in former issues; we now propose to draw attention to a similar measure affecting West Gloucestershire, which came before a House of Lords Committee in the first instance, and was approved of after a lengthy examination and a vigorous contest. The leading purpose of the Bill was to extend the limits of supply of an existing water company, and to confer further powers on that company. This company, called the West Gloucestershire Water Company, was authorised in 1884, after an unusually severe struggle in each House, caused by the opposition of the then existing Bristol Water Company. The first pipe of the new company was laid in November, 1885, and the company is vigorously prosecuting the undertaking; but they find already that they require extended works, and for that purpose additional capital to the extent of £60,000. Their pumping station is at Frampton Cotterell, about eight miles from Bristol, and the engine is capable of raising 500,000 gallons a day. Adjoining the present limits of supply are a number of districts at present mainly supplied from wells, and urgently needing a better source. All these districts were in favour of the new Bill; but opposition was set up by the Corporation of Bath in respect to two districts, Twerton and Weston, over which that body claimed to have peculiar rights. Having described the position of the promoters, Mr. Pembroke Stephens, Q.C., argued that the opposition of the Bath Corporation was not *bona fide*, and then he explained that opposition was also presented by the North-east Somerset Company. This company maintained that they would be able to ensure a far better supply than the West Gloucestershire Company could; but neither the North-east Company nor their supply existed, there being a Bill to be taken by this same Committee for authorising the North-east Somerset Company. If that company were incorporated it would be nominally authorised to supply Twerton and Weston, but in reality it would not be able to do so without the consent of the Corporation of Bath.

Mr. Henry John Martin, engineer to the West Gloucestershire Company, describing the operations of the company, said the supply of water so far had been ascertained to be 3,000,000 gallons a day. The company were laying down a mile of service pipe, and were under contract to lay down thirty or forty miles. The population of the district within the existing limits was 35,000, but the proposed extension would increase the total to 60,000. Allowing twenty gallons per head per day, 1,200,000 gallons would be required, and that would leave a surplus of nearly two-thirds of the whole supply, which would be sufficient for many years to come. The company had come to Parliament for extensions because they had been applied to by the local authorities of three new districts for a supply. They were already authorised to supply twenty-two parishes, and the mains and pipes already laid passed through four of these parishes. These four parishes, however, contained 25,000 out of the total of 35,000 people. Mr. Martin expressed his conviction that very little water would be found where the North-east Somerset Company intended to bore, and that that little would be bad; and further, that such water, if found, would penetrate the coal workings. The West Gloucestershire Company had exhausted all their capital under their first Act, except the borrowing powers; and the whole of the capital under that Act and under this new Bill would only mean £2 10s. per head of the population, including the borrowing powers. The average cost of a million gallons of water per day throughout England was £150,000, and for that sum the company would obtain their three million gallons a day, and at the same time pay for their works. Bath had only a supply of fifteen gallons per head per day, but for such a city the supply ought to be twenty-five gallons; and for a rural district twenty gallons. Reverting to the scheme of the North-east Somerset Company, Mr. Martin urged that as nobody would have a right to demand a supply from the company that scheme was incomplete, and he added that even at present the West Gloucestershire Company had a two days' reserve supply at the Kingswood reservoir to meet the contingency of the engine failing. Some geological and general evidence was given, and the case for the promoters was concluded. On behalf of the opponents, Mr. Alexander R. Binney, C.E., water engineer to the borough of Bradford, was examined. Having, he stated, carefully gone into the question of the water supply of Bath, and founding his figures on certain data supplied by the engineer of Bath, he found that since 1881 there had been a minimum supply of a million gallons daily. Adding this to the 170,030 gallons which they could obtain from the Midford springs, it would give 17 gallons per head to Bath, Twerton, and Weston. In his opinion 17 gallons per head per day was sufficient for a domestic supply. The Corporation had storage power to the extent of eleven millions, which could be easily increased to thirty millions of gallons. This would give one and a-half millions per day. He found that the average per head had been a little over 17 gallons, but where the waste water meters were used the average was 14 gallons. At that rate a population of 70,000 or 80,000 could be supplied, which was much greater than the population of Bath, Twerton, and Weston. He had never known an instance of a company being allowed to compete within the limits of a supply of a Corporation, nor a Corporation competing within the limits of a company. It would be a waste of money, and he would not advise a client to invest in the scheme of the West Gloucestershire Company to supply West Twerton.

Mr. Alfred Mitchell, engineer to the Bath Corporation, made the following statement:—The point that the daily supply of water had reached was in 1884, when it was 1,008,000 gallons per day. If the Corporation purchased the Midford Springs, another 170,000 gallons per day would be secured. At present the Corporation rented 30,000 gallons per day, and Dr. Parfitt, who owned the water, supplied another 30,000 gallons to houses in the district. At present the Corporation supplied 9854 houses, including Twerton and Weston. It was practicable to supply all the houses in West Twerton, excepting some on Rush-hill, which were already supplied by Dr. Parfitt. The one million gallons added to the 170,000 gallons from Midford would supply over 20 gallons per head to the city. The average per head in the districts on the constant supply system, checked by the waste water meters, was 13·9 gallons, which included water used for street watering and all purposes. The change frcm an intermittent to a constant supply must be gradually introduced. Application had been made to the Local Government Board to borrow £20,000, of which £12,500 was for the waste water meters. It was intended to extend the constant supply system to East Twerton and all the districts in the city. The supply he had spoken of was independent of the eleven million gallons which was stored. Since 1883 there had been twelve complaints of the water supply from East Twerton. The Corporation had land upon which two reservoirs could be constructed, each to hold twelve million gallons of water. Another source of increase, which would be abundant for the city and district, was the St. Catherine's Valley, where water could be purchased. On Saturday there were 5000 gallons per minute passing down the brook there from springs which could be purchased and easily directed into mains. In 1884 he ascertained that in West Twerton there was no demand for Corporation water, as they all seemed to have good pumps.

Mr. Bartram, chairman of the Water Committee, informed the Committee that in 1886 the Committe recommended an increased supply from the St. Catherine's springs, at a cost of £32,000, but the Council said they ought first to try a less expensive plan, and the waste water meters were tried. They had exceeded all expectation, and within the last three months the consumption per head in one district had been reduced from 37 gallons to 12 gallons. In November, 1886, the Cold Water Committee stated that they were not prepared to supply West Twerton, and would offer no opposition to the West Gloucestershire Company doing so. They were not then prepared to do it because West Twerton was in a very different position as regarded the character of its population from East Twerton.

The brief examination of Mr. Joseph Day, engineer to Dr. Parfitt's waterworks at Midford—who stated *inter alia* that the large spring they were pumping now yielded from 140,000 gallons to 150,000 gallons a day, and there were smaller springs that would bring up the yield to 200,000 gallons—completed the case for the Bath Corporation.

The Committee next took up the Bill of the North-east Somerset Company in order to decide upon the two projects together. Of the evidence called for this Bill, we need only give that of Mr. Easton, C.E., who stated that he had made sixty or seventy waterworks, and was now consulting engineer to about twenty Corporations and companies. In November last he looked into the question of supplying Weston and Twerton, and he then advised the larger scheme which was now proposed. The whole district was comparatively destitute of water in the summer. He did not know in November that the West Gloucestershire Company proposed to supply Weston and Twerton. He knew the district well, and selected Keynsham as a most likely place to find water. He proposed to sink a well into the new red sandstone series at Keynsham, at a surface level of 155ft. above the sea level; to pump the water into a covered reservoir to contain 250,000 gallons at a top water level of about 175ft. above the sea. That would supply a population of 11,000 people, including Weston and Twerton. From that reservoir he then intended to force water to the upper district under pressure, a plan he had frequently adopted at other places. He proposed to have two engines, so that he could give both upper and lower districts a constant supply; but he only proposed to bind himself to so supply the lower district. He proposed to lay 11½ miles of pipes for the lower, and 45 miles for the upper district. These pipes would go through every village in the district except Midsomer Norton, which was not included in the Bill, as it had a supply of its own. The cost would be £38,000, and there was a good prospect of from 5 per cent. to 7 per cent. dividend. His own knowledge of the district convinced him that it was not necessary to have to prove that there was water. He objected to go nearer to Radstock for water, because the well might flood the coal mines. The whole of the works could be done in a year; he had done much larger works in that time.

The Committee eventually rejected the North-east Somerset Bill, and passed that of the West Gloucestershire Company, without calling upon counsel for the latter measure to address them a second time in the customary manner.

RAILWAY MATTERS.

IT is stated that the construction of the Delagoa Bay Railway is progressing rapidly.

THE Birmingham railway carriage and wagon builders are busy. The demand on South American, Indian, and other export account is considerably better than it has been for some years past. Some of the firms report themselves very busy indeed.

In spite of the circumstance that the cantons of Geneva and Neuchatel have refused to grant any money towards the construction of the tunnel through the Simplon, the prospect of the scheme being carried out is good, the cantons of Vaud, Valais, and Freiberg having, the *Railway News* says, decided to contribute respectively £160,000, £40,000, and £80,000 towards the undertaking, or a total of £280,000. It is, however, doubtful whether the Italian Government will subsidise the work.

THE construction of the Trunk Railway of New Zealand is being steadily proceeded with. At present it is passing through the valley of the Waipa, which is an exceedingly fertile country, but the land is almost entirely in the hands of the natives. Further down the line, about the centre of the island, the Government have recently completed the purchase of a block of land called Waimarino, which contains a considerable proportion of good land, and which will shortly be made available for settlement.

A WELL-KNOWN railway chief engineer writes:—"I am very busy with the line this hot weather; in 25 miles 42 rails have had to be cut off 4in., that is 14ft., and afterwards as equally divided as possible." "One of my best inspectors declares the steel rails grow, and he is in a quiet way quite nervous. Some of the rails crack longways before they are put in the line. When I go to cut a few feet off with a cold chisel, the steel rail breaks, and yet under the falling weight test the same rail seems to be tough, as three blows in one spot fail to break it."

THE Russian railway system increased in 1886 to the extent of 1268 versts, the following additions having been opened for public traffic:—From Kisil-Arwat to Amu-Darja, 788 versts; from Luniwez to Homel, 283 versts; and from Baranowitschi to Bjelostok, 197 versts. The traffic also of the Objan line, which had been suspended January 20th, was resumed again on June 13th. On the other hand, traffic has been stopped on the Ssestrorjezk line, six versts, and on the Kaluga-Oka branch of the Rjashsk-Wjasma Railway, seven versts.

OUR Birmingham correspondent notes that "the rapid development of railways in South America, India, and other distant countries continues to afford to local engineers very acceptable enquiries for wheels and axles, bridges, and similar work. The Patent Shaft and Axletree Company keep very busy on work of this description, and prospects are declared to be good. Steel is increasingly superseding iron for every department of railway engineering; yet some of the East India railways, after giving steel wheels and axles a trial of some ten or fifteen years, are reverting to iron axles. Their consulting engineers in this country advise that their experience is that after a trial of the duration intimated steel is found to lose its tenacity, and that destruction then quickly sets in."

IN view of the many shocking accidents on American lines, the New York Legislature has passed a Bill excluding coal stoves from passenger cars on the railroads of the State. After May 1st, 1888, it will be unlawful for a company "to heat its passenger cars on other than mixed trains by any stove or furnace kept inside the cars or suspended therefrom," except in case of accident or other emergency. In a car already supplied with apparatus for using heat drawn from the locomotive, the old stove may be used when the car is standing still. Stoves of a pattern approved by the Railroad Commissioners may be used for cooking purposes in dining-room cars. The law does not apply to roads that are less than fifty miles long. The penalty is 1000 dols. Provisions requiring floor systems and guard rails on bridges, evidently suggested by the accidents of last winter and spring, are also found in the Act.

SPEAKING of the bridge which failed so disastrously in the States a short time since, the American *Engineering News* says:—"There is to be no mistake this time about the new 'tin bridge,' work on which we are informed has begun. Instead of having one of the greatest skews on record, the new bridge is to have none, and instead of being a wretched iron one, it is to be a solid stone one, and the massive and imperishable abutments which have stood uninjured for nearly fifty years, and are good enough to stand for 100 years more, are to suffer vicariously for the sins of the bridge they carried.

'For poor human nature a pendulum seems
That must constantly vibrate between two extremes.'

There will be no great harm done, and yet it seems almost a pity, for half the money that the new stone arch will cost would build a solid plate girder with a buckle-plate floor and stone ballast on top of it, which would be to all intents and purposes as solid and as safe as an earth embankment, while it would leave the beautiful road which now passes under the bridge undisfigured. There have been a number of instances in which bad iron bridges have been replaced by stone in this way, and while a fine stone arch is a beautiful thing to look at, we regret to see them built at such times and for such reasons, for it amounts to a confession of what is not the truth, that for real, true solidity we must revert to stone. As a matter of fact, an iron structure with anything like the same surplus of strength as a stone one is, if anything, a more durable structure, quite as safe, and much cheaper. But the engineer who should attempt to figure the strains in a stone structure down to a pound, and then work to them, would be laughed at, while the man who figures iron bridge strains in that way, unfortunately, is not. Hence the delusive apparent contrast in stability."

THE Iowa Railroad Commissioners' report for 1886 contains a classified summary of car-coupling accidents for the past nine years, showing that during that time in the State of Iowa 131 employés have been killed and 965 severely injured. In the *Railroad Gazette* for September 25, 1885, elaborate computations were made from the best attainable data, and the following conclusions were arrived at as being the probable annual slaughter of employés in the United States:—

	Killed.	Severely injured.	Total.	Ratio of killed to injured
In coupling cars..	459 ..	4073 ..	4532 ..	1 to 8·9

'The indications are, as we have already seen, that the slighter injuries would bring up the ratio of injured to killed to something like that in the Baltimore and Ohio and Lake Shore experience. Doing this, and distributing the various injuries, as respects their nature and severity, about in the proportion of the Baltimore and Ohio experience, we obtain as the appalling totals of the apparent annual injuries to servants from coupling cars in the United States, 459 killed, 4073 severely injured, and 13,770 not seriously injured, or 18,302 in all—one-half more than the casualties to the United States army in the great battle of the Wilderness, though the number killed is not one-fourth as great." "This terrible and unnecessary loss of life must be lessened. The executive committee of the Master Car Builders' Association have accomplished much in reducing the number of competing couplers, but it is reserved for the railroad companies to take the matter in hand, to select from them some single coupler, or a combination of them into a single device. A man of national reputation among railroad men asked to predict the solution said, 'The matter will be solved very quickly when the railroad companies are willing to combine in forming a pool or corporation.' Done in a proper way, this is a rational, and perhaps the only possible, immediate solution."

NOTES AND MEMORANDA.

THE deaths registered in twenty-eight great towns of England and Wales correspond to an annual rate of 18·1 per 1000 of their aggregate population. The six healthiest places were Derby, Halifax, Portsmouth, Sunderland, Brighton, and Leicester.

ADULTERATION of flour by means of the flour of inferior grains may be ascertained by pouring upon a spoonful of flour a little pure ammonia. If the flour be wholly of wheat, the ammonia will render it of a yellow colour, but if it be adulterated with maize, the ammonia will turn it to a pale brown, and if it be adulterated with pease or bean flour, it will become a darker brown.

IN London during the week ending the 2nd inst., 2735 births and 1,338 deaths were registered. Allowance made for increase of population, the births exceeded by 49, whereas the deaths were 157 below, the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had declined in the five preceding weeks from 19 to 15·9, rose to 16·6.

THE number of hours of bright sunshine recorded by Campbell's sunshine instrument at the Greenwich Observatory during 1886 was 1228, which is about twenty hours above the average of the preceding nine years. The aggregate number of hours during which the sun was above the horizon was 4454, so that the mean proportion of sunshine for the year was 0·276, constant sunshine being represented by 1.

THE mean temperature of the year 1886 at Greenwich was 48·7 deg., being 0·6 deg. below the average of the preceding forty-five years. The highest air temperature in the shade was 89·8 deg. on July 6th, and the lowest 16·5, on January 7th. The mean monthly temperature in 1886 was below the average in January, February—6·0 deg.—March, June, and December, and above the average in September, October, and November. In the period of 156 days from 1886 December 16th, to 1887 May 20th, the mean temperature was 3·1 deg. below the average of twenty years, the daily temperature being below the average on 115 days.

SUPERFICIAL tension in liquids being, like the magnetic state, an essentially molecular phenomenon, we might expect that it and phenomena depending on it would be modified by action of an intense magnetic field. *Nature* says Professor Dufour lately proved such an effect by making mercury flow through a horizontal capillary tube placed between the poles of a strong electro-magnet. The liquid describes a parabola, the vein being continuous to a certain distance from the orifice, when it separates into drops. While the magnet acts the parabola is stretched, and the continuous part of the vein lengthens, indicating more rapid flow.

A PAPER was read at a recent meeting of the Physical Society on "Comparing Capacities," by Mr. E. C. Rimington. It is an investigation of the conditions under which the integral current through a galvanometer in a balanced Wheatstone's bridge is zero, when the battery circuit is broken, two adjacent arms A and D of the bridge being shunted by condensers of capacities K_1 and K_2. It is shown that $\frac{K_1}{K_2} = \frac{C}{B}$, where C and B are the resistances of the arms opposite to A and D respectively. If A and D be made infinite, the necessity of balancing for steady currents is obviated; but if either of the condensers has an appreciable leakage, corrections are required. The best resistance to give to the galvanometer is shown to be $G = \frac{B(C+D)}{B+C}$, and the conditions under which a telephone may replace the galvanometer are $\frac{K_1}{K_2} = \frac{C}{B}$. The case where all the arms have self-induction is investigated.

EXPERIMENTS have been recently made by S. Leone—*Gazetta Chimica Italiana*—as to how organic substances in water are affected by development of bacteria. He used distilled water, to which a little gelatine was added. The organic nitrogen and carbon are changed by the organisms into inorganic compounds, chiefly carbonic acid, ammonia, nitrites, and nitrates. It appears that up to the fifteenth or sixteenth day the ammonia steadily increased, then it decreased till it was quite gone. Meanwhile, nitrous acid appeared; it increased as the ammonia disappeared, and when this was gone, a formation of nitric acid began, at the cost of the nitrous acid, so that in thirty-five days the latter too was quite gone, and only nitric acid present. If a little gelatine was put in the water which had turned ammonia into nitrates, the reverse process began; ammonia was formed again, and even directly-added nitrate was changed into this. If no fresh gelatine was added, however, nitrites and nitrates were, *Nature* says, again produced. The author ascertained that the same organisms that in presence of organic substances formed ammonia, in absence of such effected nitrification.

AT a recent meeting of the Berlin Physical Society, the president gave an account of a communication which had been made by Siemens at the last meeting of the Akademie der Wissenschaft, describing a method of making steel tubes or cylinders. The following is from *Nature* on the subject, but it does not appear to be very lucid. A steel tube 10 cm. long, with perfectly smooth external and internal surfaces and extremely uniform bore, and whose walls are apparently of perfectly equal thickness at all points, was prepared by the following method, patented by Männermann in Bemscheid. Two rollers, slightly conical towards their lower ends, are made to rotate in the same direction near each other; a red-hot cylinder of steel is then brought between these cylinders and is at once seized by the rotating cones and is driven upwards. But the mass of steel does not emerge at the top as a solid, but in the form of the hollow steel tube which Siemens laid before the meeting. Professor Neesen gave the following explanation of this striking result: owing to the properties of the glowing steel, the rotating rollers seize upon only the outer layer of the steel cylinder and force this upwards, while at the same time the central parts of the cylinder remain behind. The result is thus exactly the same as is observed in the process of making glass tubes out of glass rods.

HERR A. LEDEBUR has been making experiments on the behaviour of pig iron when heated in wood charcoal, which are described in *Stahl u. Eisen*. In earlier experiments the samples of pig iron employed contained but little manganese and phosphorus, and were comparatively rich in silicon; he has, therefore, made experiments with low silicon metals, with varying amounts of the other elements. Nine test pieces of various kinds were packed separately, amidst small fragments of charcoal, in a pot such as is used for making malleable castings. They were then heated to about 1000 deg. C. for 108 hours. On examining the samples, it was found that in all malleable irons the percentage of carbon had increased; thus in—

Fibrous wrought iron	from	0·10 to 0·58 per cent.
Thomas steel	,,	0·11 to 0·26 ,,
Cast steel	,,	0·40 to 0·65 ,,

Similarly in a manganiferous (2·75 per cent. Mn) cast iron for the Thomas process the carbon had increased from 2·63 to 3·27 per cent., whilst in a refined Lowmoor iron, with but a trace of manganese, it was constant at 3·5 per cent.; in all the other specimens there was actually a diminution in the amount of carbon. Thus although confirmatory of previous experiments, no further light is thrown on the cause of the decrease noted with so many samples of cast iron. The silicon and phosphorus percentages alike remain unchanged. With the alteration in composition was a corresponding change in the appearance and in the physical properties; all specimens with less than 1 per cent. of manganese having become granular, soft, and comparatively tough, whilst the manganese Thomas cast iron, above alluded to, remained unaltered in fracture and in brittleness.

MISCELLANEA.

MESSRS. WHEATLEY, PRICE, KIRK, AND GOULTY announce a sale of engineers' and contractors' plant on the 21st inst., at Bankside.

THE Carron Company has secured the contract for supplying the cast iron cylinders for the first of the artesian wells which are to be sunk for the London Corporation.

THE Association of Sanitary and Municipal Engineers are meeting to-day and to-morrow at Leicester. To-morrow after assembling in the Town Hall at nine a.m., several excursions will be made to quarries and elsewhere.

MESSRS. HOLDEN AND BROOKE, of Salford, have dissolved partnership, and the business has been converted into a Limited Liability Company, under the title of Holden and Brooke, Limited. Mr. Brooke and Mr. Hooper will act as managing directors.

AN even half of a trestle, a mile and a-half long, over the Columbia slough at Portland, Oregon, fell over like a row of bricks, on May 22nd, but fortunately did no damage, except, says the American *Engineering News*, to the reputation of the man who built it. Cause: complete absence of longitudinal bracing and a bad foundation to start the fall.

ON the 5th inst. a law was published at St. Petersburg decreeing the payment of the following import duties on metallic and mineral ores, excepting copper ores or zinc ores, graphite in lumps or powder, as also on iron, 7 gold copecs; on iron and steel manufactures which have not been tooled, as anchors, nails, hooks, bells, mortars, and railway appliances, 120 gold copecs per pud.

A FINANCIAL contemporary has sent a reporter to see a water battery, and forthwith announces to the world that the light of the future is to be seen at a certain place in London, and that the wonderful battery will yield as much electric light for £1 3s. 8d. as gas at 2s. 9d. will yield for £2 2s. Reporters not troubled with electrical knowledge are always easily assured on matters electrical.

ATTENTION is again being drawn to the growth of the sandbank across the Dee below Port Connahs Quay which is making navigation more than ever dangerous. The schooner Aeron Queen, of Carnarvon, got aground in coming up and in going out; and the vessel John and Ann, of Riga, while being towed up took bank and had to be lightened before getting into port. The river threatens to become unnavigable unless the sandbank is removed.

THE Birmingham, Tame, and Rea District Drainage Board have, upon the recommendation of their works committee, resolved to ask the sanction of the Local Government Board for their borrowing of an additional loan of £20,000. This sum it has been decided to expend as here:—Drainage, £3984; levelling, £3825; roads, £1282; main carriers, £2640; fencing, £200; buildings, £3247; intermediate drains, £1776; professional charges, £700; works executed in excess of estimates, £1646; contingencies, £700; total, £20,000.

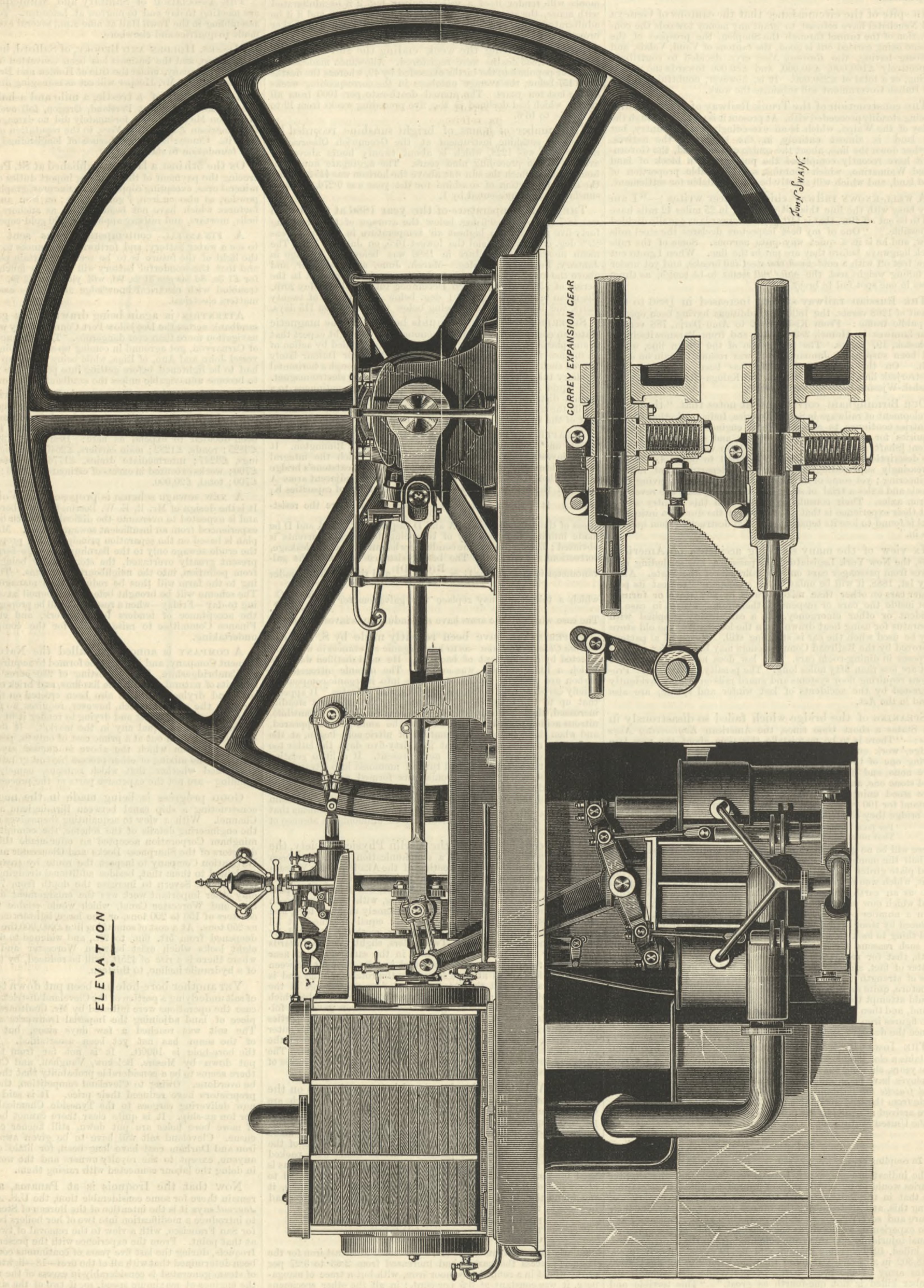
A NEW sewage scheme is proposed for Wolverhampton. It is the design of Mr. R. E. W. Berrington, the borough engineer, and is expected to overcome the difficulties which have long been experienced from an insufficient sewage service. Mr. Berrington's plan is based on the separation principle. He proposes to convey the crude sewage only to the Barnhurst sewage farm, which is at present greatly overtaxed, the storm water being drained, free from pollution, into the neighbouring streams. The volume flowing to the farm will thus be reduced to a manageable quantity. The scheme will be brought before the Council at a special meeting to-day—Friday—when a resolution will be proposed, authorising the acceptance of tenders for the work, and empowering the Finance Committee to raise £8000 for the completion of the undertaking.

A COMPANY is announced called the Natural Portland Cement Company, and is said to be formed to acquire and develope, in Cambridgeshire, land consisting of 230 acres of "extensive deposits of natural cement, fine lias lime, and brick earth. Grinding mills and drying kilns have also been erected on the property for treating the cement, which, however, requires no mixing or other process beyond grinding and drying to render it fit for use, and its quality is said to equal any in the market. It follows that this company can turn out at a prime cost of only 9s. per ton." Though the paper from which the above is quoted says the material "requires no mixing or other process beyond grinding," it must be questioned whether that which remains—namely, burning and grinding—are not the expensive parts of the process.

GOOD progress is being made in the negotiations for constructing a ship canal between Birmingham and the Bristol Channel. With a view to acquainting themselves more fully with the engineering details of the scheme, the committee of the Birmingham Corporation accepted an offer made this week by the directors of the Sharpness Docks and Gloucester and Birmingham Navigation Company to inspect the route by steamboat. It was explained to them that, besides additional dredging operations on parts of the Severn to increase the depth from 7ft. to 8½ft., the only other important work was the enlargement of the Birmingham and Worcester Canal, which would enable the passage of coasters of 150 to 200 tons, or the large lighters carrying as much as 250 tons. At a cost of something like £600,000 the canal would be deepened from 5ft. 6in. to 9ft., and widened to 66ft. The fifty-eight locks which exist between Worcester and Birmingham, where there is a rise of 425ft., will be reduced, by the substitution of a hydraulic incline, to thirteen.

YET another bore-hole has been put down to the stratum of salt underlying a portion of the Cleveland district. In the present case the operations were initiated by Mr. Coulthard, who owns the piece of land adjoining the Imperial Ironworks at South Bank. The salt was reached a few days since, but the thickness of the seam has not yet been ascertained. The depth of the bore-hole is 1600ft. It is not far from the second one put down by Messrs. Bolckow, Vaughan, and Co. Meanwhile there seems to be a considerable probability that the salt trade will be overdone. Owing to Cleveland competition, the Cheshire salt proprietors have reduced their price. It is said that they are now delivering cargoes to the Tyneside Chemical Works at 7s. per ton ex-ship. It is quite clear there cannot be profit in this. If more bore holes are put down, still keener competition will ensue. Cleveland salt will have to be given away, as Cleveland iron and Durham coal have long been, for little or no benefit to anyone, except to the royalty owners and the workmen engaged in doing the labour connected with raising them.

NOW that the Iroquois is at Panama, and likely to remain there for some considerable time, the U.S. *Army and Navy Journal* says it is the intention of the Bureau of Steam Engineering to introduce a modification into two of her boilers before departure for San Francisco, with a view to the removal of two on her arrival at that point. From the experience with the present boilers of the Iroquois, during the last five years of continuous commission, it has been determined that with all of the fires—18—lighted, the quantity of steam generated is considerably in excess of the requirements of the engines at maximum speed, so, if two of the six boilers can be removed, the coal capacity of the vessel will be materially increased without affecting the speed or efficiency of the ship in any way unfavourably. Late reports from the Iroquois indicate that her engines are in good repair and efficient, and the boilers are good for several years of active service yet. The material of these boilers is the highly and justly vaunted "Otis steel," more properly a mild steel, or manganese alloy. They were built in the Mare Island Navy-yard from Bureau plans, and have proved good boilers. The hull of this vessel is said to be in pretty fair condition, but the decks are nearly used up.



COMPOUND ENGINE—LAUBARDEMONT FLOUR MILL

MESSRS. T. POWELL AND CO., ROUEN, ENGINEERS

(For description see page 55.)

PUBLISHER'S NOTICE.

*** *Next week a Double Number of* THE ENGINEER *will be published, containing the Index to the Sixty-third Volume, and also a Supplementary Engraving showing the large Compound Condensing Engines, Pumps, and Engine-house erected at Hampton, for the Southwark and Vauxhall Water Company, from the designs of Mr. J. W. Restler, M.I.C.E., by Messrs. Richard Moreland and Son, of London. Price of the Double Number,* 1s.

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THE ENGINEER, July 15th, 1887.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1d. *postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

UNIT.—*Get the little book on engine-driving in Weale's Series, published by Lockwood and Co. and written by Reynolds. Concerning the rock drill, if you are going out to a country where they are in use or likely to be used, no doubt some of the makers in London would explain to you the working of their machines. For names of makers, consult our advertising columns.*

OLD SUBSCRIBER.—*The usual formula in connection with fans will not apply without modification, as the grain materially affects the quantity and velocity. The velocity of the air must be considerably increased, but probably not in the usual proportion to increase in height. The pressure with your present arrangement is probably about* – 0·75 *lb. per square inch, and this must be increased; but no definite information can be given upon it under the conditions, as no deductions from exp riments with over 30ft. are available. Probably another form of elevator would be found more economical in power, if you want to elevate to the height you mention.*

ARTIFICIAL IVORY.

(To the Editor of The Engineer.)

SIR,—I should be greatly obliged if you or any of your readers would inform me who are the manufacturers of the artificial ivory referred to recently in "Notes and Memoranda," or where I could obtain information about it. E. A. G.

Croydon, July 11th.

TOWN REFUSE CREMATORIES.

(To the Editor of The Engineer.)

SIR,—I shall be glad if any of the readers of THE ENGINEER can, through your columns, inform me what towns in England are using crematoriums for the consumption of their town's refuse, where the night soil is conveyed away in sewers, and also what towns have the pan system in use. I enclose my card. SUBSCRIBER.

July 11th.

THE ENGINEER.

JULY 15, 1887.

THE MALIGAKANDA RESERVOIR.

SINCE we last noticed the regrettable failure of this important work, which was designed for the water supply to the City of Colombo, Ceylon, further important details have come to hand as to the character of the cracks through which the water escaped from the reservoir. We had expected that ere this we should have learned the nature of the report of the Commission locally appointed to inquire into the matter; but, as we are informed, that report has been withheld from publication pending its reference to those with whom the responsibility for the design and execution of the work rests. But the report made by the resident engineer we know to assign as the cause of failure the sudden cooling of the great mass of concrete, heated as it was by the intense sun, owing to the introduction of the comparatively cold water flowing into the reservoir from the hilly ranges. Before dealing with this hypothesis—which, by the way, we understand to be accepted with certain reservations by the engineer who designed the work—it will be as well just to revert to the theory we ourselves put forward when intelligence of the second failure first reached us.

As we then stated, the walling of the Maligakanda reservoir was founded on a species of laterite known in Ceylon as "cabook." This is a material the clay base of which becomes exceedingly slippery when exposed to wet. Our argument was that there was extreme probability that, all adhesion between the concrete walling and its foundation having been destroyed by the latter becoming saturated owing to percolation through cracks which had appeared in the floor of the reservoir, the weight of the great head of water admitted overcame the resistance due to the mere statical weight of the face wall, and slid this outwards until, at the apex of the curve formed under the pressure, the main wall burst, as it did with a loud report like that of a cannon when fired. Since we so wrote, however, it has been notified to us that although the crack in the centre of the face wall did occur, the main injury manifested itself in the side walls very close to their junction with the face wall. In both these positions there are cracks extending from the top to the bottom of the concrete work, and we are told they seem to extend in some degree even into the cabook foundation itself, actually creating fissures in it. We are, therefore, forced primarily into the endeavour to reconcile our first proposed theory with the existence of these previously unknown cracks in the side walls. We cannot see that there is any difficulty in doing this. If the front wall was, as we have suggested, forced outwards, it must to an extent have assumed the form of a bow before yielding at the apex of the resulting curve. If we take the familiar illustration of an archer's bow, it is demonstrable that in the act of drawing such a bow the points to which the cord is attached must be drawn both inwards and downwards. Such would be the nature of the strain at the points where the cracks in the side walls are now observable. So long as the concrete work held together the maximum of strain would be felt at those points. It appears that whereas after the accident the crack in the centre of the face wall was but slightly visible only, those at the junction of that wall with the side walls remained open and very apparent. We hold this fact to strongly support our own theory as to the cause of failure. When the tension on the face wall became relieved by the parting of the concrete in three places, that wall would lose its bow-like form, and, the pressure behind it being relieved by the withdrawal of the water, there would result a tendency for the wall to resume its normal form, and this would of course close the crack due to its curved extension. But there would be no such tendency as regards the side walls. The failures in these therefore remain, as we have said, very apparent, and the length of the walls in which they occurred must have been increased abnormally by the width of those cracks. To allow of this increased length, however slight it may be, being both established and maintained, the face wall to which the side walls were united must have moved correspondingly forward. If this be admitted, it must also, we think, be granted that the forward movement can only have been permitted by the sliding action of the wall upon its base to which we have ourselves assigned the accident.

Passing from our own theory upon the subject to that stated by the resident engineer, we confess that at the time of our first dealing with this subject we should have been disposed to have regarded it as utterly untenable, in spite of the high authority which, as we have stated, has given it a certain amount of support. It has certainly never been known to ourselves—and we should be curious to learn if it be within the experience of any other one of our professional brethren—that Portland cement concrete has ever shown the capacity for expansion and contraction to the degree requisite to cause disruption in a mass of it such as formed the walls of the Maligakanda reservoir. But our confidence in this material we must admit to have been rudely shaken of late. Accepted dogma as to its durability under nearly every possible condition of use has been overset by the discovery of the serious extent to which marine works constructed with it have been chemically acted upon. It is not impossible, we should say—having in view the facts recently ascertained—that extremely foul fresh water may prove as deleterious to Portland cement as sea water has been proved to be. Now we may remark that the *Ceylon Observer* notices many complaints as to the very foul nature of the water supplied by the works. It is reported to be full of decaying vegetable matter, and no filtering bed having been provided, the water, when admitted on the first occasion of filling to the reservoir which has burst, would have been heavily charged with chemical components which may have proved to be as deleterious to the cement as have those of sea water. As to this, we can only of course indulge in conjecture; but with all our previously formed notions as to Portland cement disturbed by late experience, we can but admit that such an hypothesis does not admit of absolute denial. We must decline therefore to consent now to dismiss the theory of failures from contraction and expansion as being an impossible one; for we do not know under what changed chemical conditions the Portland cement may have been acted upon by the heat of the fierce sun of the tropics and the coldness of the supply of water from the mountains.

It remains, of course, to be seen whether the officers of the local Commission may have been able to advance some third theory altogether distinct in character from the two broached by ourselves and by the resident engineer respectively. It seems to us that it would be extremely difficult to discover one, though it would be premature to decide that it may not have been possible to do so, as the result of close professional inspection of the damaged work. Months have, however, now passed since failure for the second time occurred at this reservoir, and we have read with attention all that has during that interval appeared, written by engineers and others, who have unofficially reported their impressions and conclusions after visiting it. In no such instance have we been able to find a suggestion of a third alternative. Indeed, all that has been published supports in a greater or less degree our own first-written theory; and it would be strange if, after the lapse of time we have named, any officially appointed experts could have discovered signs or appearances which have been concealed from the searching investigations made by non-official persons. Unless such have been forthcoming, we must anticipate that in a greater or less degree the official report, when made public, must give support either to the theory of ourselves or to that of the resident engineer. So far as we have been able to learn, no steps are at present contemplated towards the restoration of the work, and we hold that they would be useless until the cause which unhappily necessitates them is satisfactorily determined. But we cannot help expressing the hope that the concrete of the walling of this reservoir may be submitted to the same chemical analysis which has recently led to such disquieting apprehensions at the Aberdeen Docks.

EXPERIMENTAL MACHINERY.

IN producing mechanical inventions the importance of conducting experiments with rapidity and economy cannot be over-estimated. It is impossible to say how many inventions have collapsed, at least as far as the original inventor has been concerned, simply through the immense cost of the experiments. The ways of some inventors are rather mysterious—they seem to have a peculiar veneration for good workmanship, or to think that because a machine is well made and highly finished it must necessarily answer, when perhaps the principles on which it is constructed are radically wrong. Some inventors will construct elaborate machines without any previous trials or experiments worth speaking of. They then discover that the machine requires extensive alterations; but having been made in the first place as if it were perfect, it does not admit of that easy or rapid alteration that a machine of this class should, so it often has to be thrown aside and another one made. Perhaps the next machine is nearer the mark, the inventor having profited somewhat by his first failure; but still it may not attain the desired result, and so it goes on, and it is in this manner that some inventors conduct their experiments, if indeed they can be called such, for these machines are not, strictly speaking, experimental machines at all. They are made in the hope that they will answer the inventor's purpose, and are often entirely destitute of the characteristics which a machine constructed for the purpose of testing the value of an inventor's ideas should possess.

It should be remembered that the expense of making a final machine after the experiments have been brought to a successful issue is often but a small item in the cost of producing an invention. Even if an inventor possess the requisite knowledge, it is not always that the circumstances of the case will admit of his designing a machine so that it can retain its original form when it is perfected. There is but little affinity between a perfect machine and an experimental one. Even in improving an existing machine, it will be found that this is often the case, for the very compactness of a machine will prevent alterations and additions. Of course, the reader must use discrimination as to what class of machine these remarks apply. In an invention of which types exist closely resembling it, a careful consideration of the matter should prevent the inventor designing anything very wide of the mark; but where he plays the part of a pioneer in a new field, the case is different—for instance, in a machine for working a hitherto unused material, where the results are sometimes so unlike the preconceived ideas of the inventor. Therefore, we would advise an inventor, if the machine which he is about to construct is at all complicated, or involving unusual combinations, to make it in a purely experimental form, and keep it in that state until it is felt that the experiments have come to an end. What we mean by an experimental machine is this: a machine for testing practically the value of the inventor's ideas, one that will allow the alterations, additions, or enlargements so often found to be necessary to be made with ease and rapidity, and which, when it has done its work, will serve as the foundation on which to model the final machine.

This idea is the outcome of considerable experience with inventors and inventions, and, in our opinion, possesses many advantages. For instance, in working on this system, when the final machine comes to be made it will often be found that a considerable quantity of work can be omitted which at an earlier stage was thought to be indispensable, and compactness, economy, and elegance of design can then be considered, when attempts to do so in the experimental machine would only add to the inventor's difficulties. If an inventor makes a machine with the full knowledge that it will be thrown aside when it is done with, it gives him a freedom of action and room for the display of boldness—one of the most useful qualities in an inventor—which can never be attained by working on any other system. One of the most fruitful sources of trouble in an experimental machine is the accumulation of moving parts through unforeseen circumstances, especially in the interior, causing them to get in the way of each other, and rendering some portions difficult of access or enlargement. This points to the importance of framing in this class of machine. In fact, in some cases it is simply impossible to say what shape the framing will eventually take. It has been found best in these circumstances to make the frame in separate portions, these portions being only what were actually required for the accommodation of the moving parts, which, when their dimensions and relative positions have been found, will then develope the frame. There is room for the display of a great deal of judgment in designing the framing of an experimental machine, particularly in making provision for the contingency of having to alter the positions of the moving parts, as with a little forethought this may often be done without entailing any extra work. For instance, in complicated cases it is often very difficult to determine the relative positions of the various important parts of a machine. Therefore it is sometimes advantageous to construct what may be termed the component parts independently, so that the best arrangement may be arrived at by actual trial. This applies to cases where a machine may be said to consist of several separate machines combined to form a whole, such as a driving gear, feeding arrangement, regulating apparatus, &c. In a case like this, these separate portions can at times be designed both as regards framing and moving parts, so as to admit of their being connected in the various relative positions they are likely to assume in the course of experiment.

We can give a very appropriate instance taken from our own experience of an error into which some constructors of experimental machinery fall as regards framing. A practical man, who should have known better, on carrying out an invention of his, made a machine the frame of which may be best described as a box turned upside down, and it was cast in one piece. Now, although this was a very good form for it to assume finally, it was ill-chosen for the purpose of experiment, as most of the moving parts being inside they were difficult of access; in fact, they could only be reached by raising the machine from the floor. It was then discovered that the frame was too small, not much, it is true, but in this case "a miss was as good as a mile," for the frame being cast in one piece it was impossible to enlarge it. The fact was that the inventor had been endeavouring to secure compactness at the wrong time, and instead of accepting the situation, and having another frame made either larger or else better suited to the purpose of experiment, he fell into another error and tried to crowd the working parts into a place really too small for them, and after rendering most of them useless through reducing them beyond their proper limits, and wasting an amount of time that would have sufficed to construct another machine, he became disheartened and abandoned the whole affair. Had we had the designing of this machine, we should have made a top-plate, supported by four uprights, or else by open side frames, so that had the machine extended itself unexpectedly in any direction, latitude would have been allowed, and the necessity of discarding the whole frame would have been avoided. But we should certainly not have ventured to construct a boxed-in frame, enclosing the working parts, until we were quite positive about their positions and dimensions.

It has been our experience in these matters that there is what may be called a secondary stage in an invention. For instance, a machine may work after a fashion, but it may not work well enough or fast enough. The general principles on which it is constructed may be sound, but it may fail to come up to a certain standard. The causes of the defects may be trifling, but the inventor shrinks from making the necessary alterations, because in a case like the one we have just quoted, he, being bound down by circumscribed limits, finds it almost impossible to make any alterations, and has to choose between two evils—namely, constructing another machine either entirely or partially, or else carrying his experiments into the secondary stage under a weight of superadded difficulties. An inventor should follow a policy at once bold and yet tentative—bold in design, but allowing the machine to possess tentative qualities—and he should remember the old adage, "Hope for the best, but prepare for the worst."

THE SANITARY REGISTRATION OF BUILDINGS BILL.

A SHORT time back we commented upon the Bill introduced into the House of Commons last session by Mr. Lacaita, the Member for Dundee, providing for the compulsory sanitary registration of public, or what may be called semi-public, buildings. Since last session the promoters of the Bill formed a sanitary legislation conference, and the result of four meetings of this conference is embodied in sections from 10 to 19, inclusive, of the amended bill, a copy of which, through the courtesy of Mr. Mark H. Judge, is now before us. In our last notice we took exception to certain clauses or sections of the Bill, and regret to observe that what we consider defects still remain. Thus, in section 10 certain provisions and modes of arrangement of drains, pipes, and flushing services are very minutely specified as essential to the obtaining of a certificate. We pointed out, and now again do so, that this section is too inelastic; it leaves no discretionary power whatever in the hands of the inspecting sanitary officer, by whom, or on whose report, a certificate is to be given or withheld. In this, as in other things where experts in technical and scientific administration are employed, a certain amount of latitude should always be allowed. Trained experts, such as must be employed to administer the provisions of this Bill, must also be placed on the footing of judges, and not have their functions narrowed down in the way this section operates. Another section is No. 14, dealing with the duration of certificates, and fixing the time at five years; we said that period was too long, and gave reasons for our opinion. We would suggest two instead of five, coupled also with a proviso to the effect that whenever pipes or drains, but especially the former, had undergone overhaul and repair, a notice to that effect should be sent to, or served on, the inspecting sanitary officer of the district. The water pipes in a house are the things at once most perishable, most often out of order—especially in winter—and most concerned in connection with the sanitation of dwellings. Section 17 runs as follows:—"The provisions of this Act, in so far as they apply to penalties, shall not be enforced against a lessee, sub-lessee, or occupier, whose lease or term of occupation shall have less than seven years to run at the passing of the Act." This clause is intended to protect the parties enumerated from sustaining loss on the basis of what might be called "unexhausted improvements;" but this brings into prominence a defect in the Bill, upon which we have already commented, namely, that the incidence of responsibility is not sufficiently defined. Nothing can certainly be known as to who will be the party held responsible for evasion of the Act. Who will be prosecuted for receiving customers into a hotel, for example, which has no sanitary certificate? This point most certainly needs amending, but we do not see any amendment in the draft now before us. In this section, 17, the onus is inferentially thrown on the landlord-in-chief, as soon as the lease granted by him is within seven years of expiration. Who will be responsible, say, a year previous to that? The Act, as it stands, will not, if it be enacted, become law till the 1st of January, 1890, or for, say, two years after passing. To what purpose is this delay? Surely the promoters do not want us to believe that the buildings affected by it are now so bad that a less period will not suffice to put them in a sanitary state? We suggested before, and now do so again, that a section or other suitable drawing should be supplied to each occupier of a dwelling, showing clearly the exact position of each pipe within, and each drain without it. The present neglect to do this often entails immense trouble and expense, and even danger to health. A meeting of the conference was to have been held on the 14th ult., to consider the second reading of the Bill, but we have not received any information or report of its proceedings. Then the concluding paragraph of requirement 5 runs as follows:—"Provided further, in addition to the foregoing, every certificate for a building used, or to be used, as a hospital shall specify the cubic contents of each ward, and set forth in detail the provision made for lighting, warming, and ventilating the ward." *Cui bono?* Either these provisions are sufficient, or they are not. If insufficient, we presume no certificate will be granted; then the possession of a certificate will logically imply that these provisions are satisfactory. We venture to think that the less a Bill of this sort is encumbered with words and clauses—the simpler its phraseology, in fact—the better.

The petition to the House of Commons in support of this Bill consists of eight short paragraphs, and deserves some notice from us. Paragraph 1 simply expresses the opinion of the petitioners that the Bill, if passed, will promote public health. No. 2 states that the petitioners are already aware that a law exists providing for enforcement of house drainage and abatement of nuisances. In No. 3, however, there is much pith. It is as follows:—"Your petitioners are, however, of opinion that to do nothing until a nuisance is created is not a policy which can approve itself to those who realise the fearful consequences that result from sanitary neglect." The four next clauses comprise an expression of the impression of the petitioners that "an examination and approval of the sanitary arrangements of every dwelling by some authority of recognised and efficient standing, before being considered fit for human habitation, is absolutely necessary." These remarks are conjoined to an admission of the difficulties and improprieties, as well as the great expense that would be entailed by any attempt to inspect every dwelling house, and disavowing any desire to see "a central authority with power to stereotype in detail even the best system of sanitation;" but they do desire "to see a law enacted which shall empower the local authorities to demand the certificate of some competent person or corporation that the sanitary arrangements of any building are satisfactory, before it shall be lawful for such building to be occupied, and your petitioners point to the law respecting vaccination as an instance of how a desired object may be secured without the interference of a public official." The concluding paragraph again acknowledges the difficulty of making so great a change in the law apply to all buildings, but likewise reiterates the impression of the promoters that "compulsory sanitary registration ought without delay to be insisted upon in all cases of buildings used for the purposes set forth in the Bill." We fully endorse the opinion of the petitioners, that to do nothing until a nuisance is created, is not a commendable policy; but the word "nuisance" is not quite applicable to the subject-matter of this Bill. It does not exactly convey its true meaning, or precisely define defects with which that Bill is intended to deal. As a rule, nuisances are external to buildings, and are sources of annoyance, and, at times, of disease, to neighbours; but they generally "speak for themselves." A dwelling, large or small, may, on the other hand, be—so far as external signs, or even easily observable internal indications go—apparently in a perfectly healthy state, yet be really not anything of the kind; and therein lies one of the strongest reasons for the introduction of a Bill such as this now under notice. The introduction of the expression nuisance "is also regrettable in another way. The wording of this clause—taken in conjunction with its immediate predecessor, which acknowledges that a law against nuisances already exists—by saying it is inadvisable to do nothing till a nuisance is created," is bad logic. A nuisance must have existence before it can be dealt with, and we repeat that all the points dealt with in the Bill are distinct from nuisances; it is a preventive enactment. Besides this also, the promoters of the Bill, by allowing so great a space of time to elapse between the issue of a certificate and its renewals, ignore nuisances altogether; a nuisance may be created in a week, and therefore the Bill leaves nuisances untouched, which it need not have done. The Bill could easily have been framed to bring nuisances created by the owners or occupiers of the buildings with which it deals, within its operation, by the addition of a clause providing that "where the local inspector of nuisances made an order for the abatement of one, at any building to which the Act applied, notice should be served on the person served with the order for abatement, to the effect that his sanitary certificate would be suspended after a certain date if the order of the inspector were not carried out." The principle of this Bill has met with approval, but we invite the attention of its promoters to the foregoing comments.

FOREIGN SHIPS AND BRITISH TRADE.

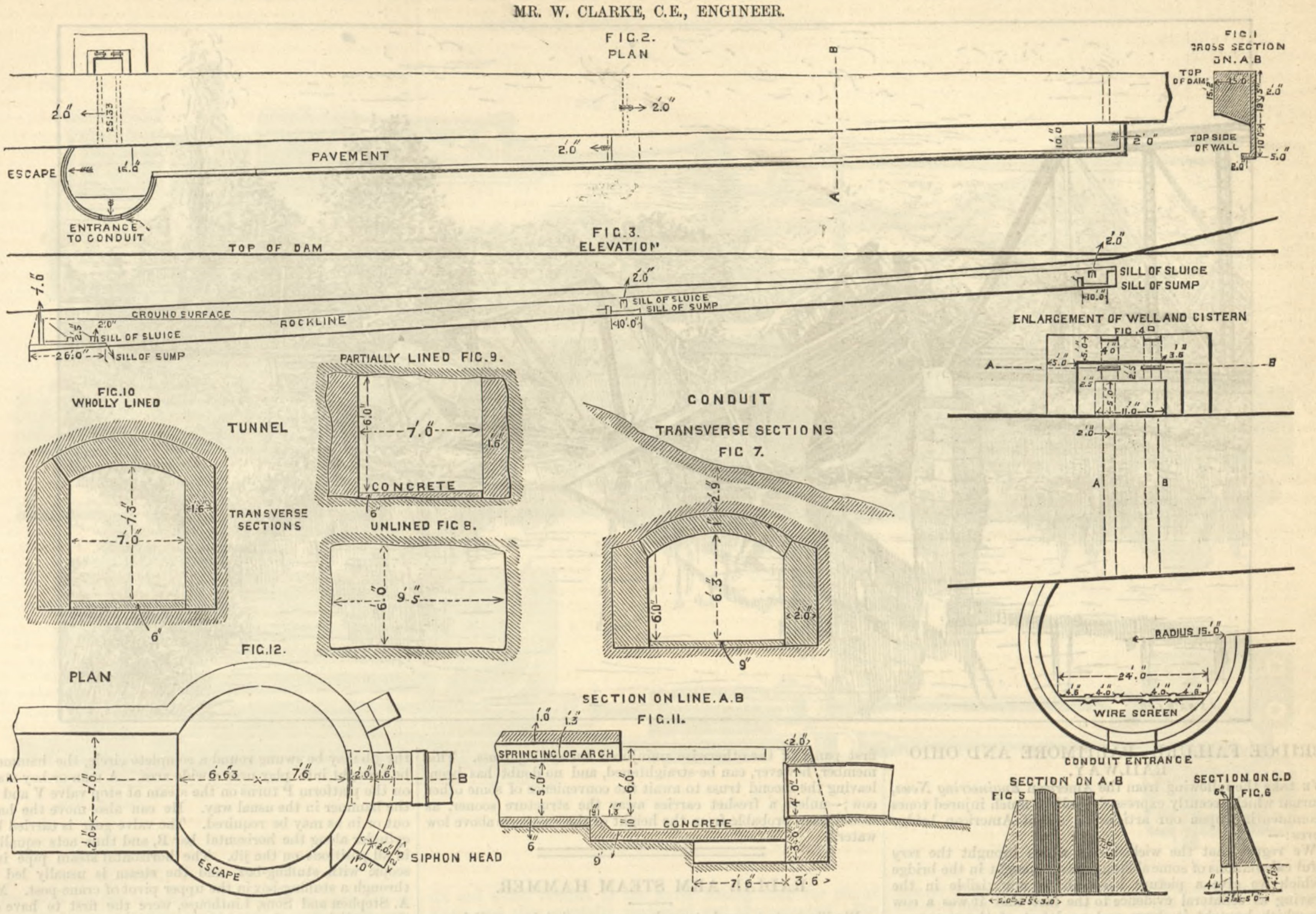
A FEATURE in the shipping trade to which we have previously alluded in THE ENGINEER is the large proportion of foreign vessels which carry coal from our ports. Last month there were 46 foreign vessels which took coal cargoes for export from Borrowstoness, and only 15 British vessels so loaded; from Blyth 63 foreign and 37 British vessels loaded coal; from Alloa 134 foreign and 15 British loaded coal; from Grimsby 66 foreign and 30 British; and from West Hartlepool 90 foreign and 24 British vessels were engaged in the export coal trade. These are, perhaps, exceptionally heavy instances; but at some of the larger ports we find that there were large numbers of foreign vessels engaged. At Hull, the numbers were 77 foreign and 114 British; at Cardiff, 114 foreign and 331 British; at Sunderland, 72 foreign and 86 British; at Newcastle, 223 foreign and 295 British; and so on through a large number of ports. When we command the sea-carrying trade of the world, it is a somewhat significant fact that so much of our coal is carried from our coal-shipping ports in foreign vessels; and as it is an employment which seems to be growing, it is a question whether there should not be some attempt to ascertain the reason. It has been suggested that one chief cause is the fact that the coal thus sent out is sent in small cargoes, and that the British vessels of small sizes are now fewer than they were, and are also decreasing in number. For instance, from Blyth, the average cargoes carried were only 600 tons each, and many of the individual cargoes were under 200 tons each. From Borrowstoness the average was less, and from Alloa at least eight cargoes were under 100 tons each. Wherever the number of foreign vessels is very large in proportion to that of the British, it is found that the quantity of coal carried on the average is small. The rule is so general that it can scarcely be a mere coincidence. At Cardiff and Newcastle, which are the two greatest shipping ports for coal, it is found that the proportion of British vessels is larger, and that the average tonnage is greater. As we have often shown, the number of small British vessels for oversea use is falling off, and is likely still to fall off, for the tendency is to build steamships in larger sizes, and wooden shipbuilding for over-sea carrying purposes may be said to be an industry almost extinct. As the cargoes needed by some of the ports of the Continent are small, because the nature of the navigation renders large cargoes impracticable, and because some of the customers prefer the small cargo for convenience, it follows that, unless we provide small vessels for carriage, those of other nations will be used. The difficulty might be met if we could devise a cheaply-working small steamship; and it may be that in this direction shipbuilders in the future will find work for some of the idle "berths." It is probable that in the cause named, and in the fact that our British vessels are subject to more stringent laws as to loading than are foreigners in our ports, we have to trace the large and increasing proportion of the latter which is employed in the coal carrying trade.

THE KHYBER RAILWAY.—The departure of General Annenkoff to supervise the construction of the railway from the Oxus to Samarcand and Tashkent, contrasts forcibly with the news from India that the Indian Government is only now beginning to think of surveying the country for twelve miles ahead of Peshawur, in the direction of Cabul. It is a well-known fact in military circles that the plans of the Indian Government for the defence of India against Russia provide, among other things, for the immediate construction of a railway to Cabul the moment Russia attempts the invasion of Afghanistan. On the first intimation of war, troops would at once march to Cabul to help the Ameer, and the Peshawur Railway would follow as swiftly as possible through the Khyber Pass to help them.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Alexander Kerr, engineer, to the Immortalité; John F. Price, engineer, to the Alecto; John W. Hayes, staff engineer, to the Euphrates; J. T. H. Denny, chief engineer, to the Orontes; Charles J. Hay, assistant engineer, to the Impérieuse; John A. Richards and Alfred T. H. Stone, acting assistant engineers, lent to the Agincourt; William S. Frowd, acting assistant engineer, lent to the Iron Duke; Thomas P. Jackson and Harold E. H. Ash, acting assistant engineers, lent to the Minotaur; Abraham R. Rolle and Herbert B. T. Cox, acting assistant engineers, lent to the Monarch; Henry St. C. Baldwin and Charles Broadbent, acting assistant engineers, lent to the Sultan; Frank D. Thompson and Thomas H. Pounds, acting assistant engineers, lent to the Hercules; James H. D. Barry and Victor E. Snook, acting assistant engineers, lent to the Shannon; William W. Pearce and William C. Morcom, acting assistant engineers, lent to the Ajax; Walter J. Kent and Henry J. Allen, acting assistant engineers, lent to the Rupert; Walter T. Stearn and Percy D. Mastell, acting assistant engineers, lent to the Devastation; William G. Glanville and Philip Hobbs, acting assistant engineers, lent to the Neptune; Herbert Cooper, acting assistant engineer, lent to the Arethusa; William C. Stevens, acting assistant engineer, lent to the Mersey; Cuthbert R. Roger and Charles Langton, acting assistant engineers, lent to the Collingwood; Edward Gaudier and Sidney J. Drake, acting assistant engineers, lent to the Edinburgh; Robert W. Simmonds, acting assistant engineer, lent to the Glatton; Wallace Wright and George Attwood, acting assistant engineers, lent to the Impérieuse; John H. A. Burgess and Robert A. Hunter, acting assistant engineers, lent to the Inflexible; Joseph H. H. Ireland, acting assistant engineer, lent to the Mercury; Charles W. J. Bearblock, acting assistant engineer, lent to the Amphion; Charles Bannister and W. R. Parsons, acting assistant engineers, lent to the Black Prince; Henry R. Reed, acting assistant engineer, lent to the Conqueror; and George H. Morris and James Roye, acting assistant engineers, lent to the Inconstant.

THE TANSA WORKS FOR THE WATER SUPPLY OF BOMBAY.

MR. W. CLARKE, C.E., ENGINEER.



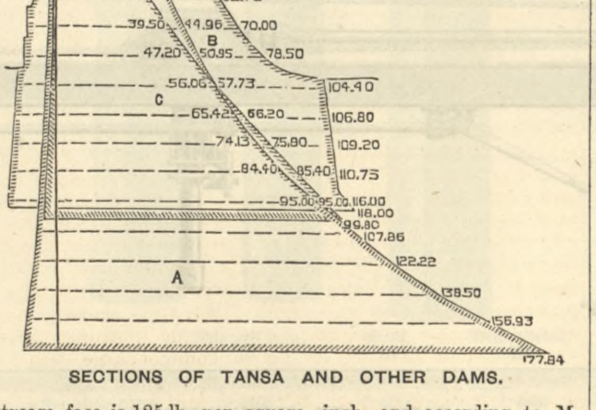
THE TANSA WATER SUPPLY OF BOMBAY.

By KILLINGWORTH HEDGES, M.I.C.E.

IN THE ENGINEER of May 20th I briefly referred to this important scheme, which it is calculated will afford a water supply for the city of Bombay amply abundant for all future requirements, and now propose to give some details of the work, which is in active progress under the superintendence of Mr. W. Clerke, C.E., whose designs are being carried out. From the site of the dam to the boundary of the island of Bombay the distance is 53½ miles; the water will be conducted by gravitation from one point to the other by tunnels 2½ miles long, conduits 26¼, and iron pipes for the remaining 24¾ miles. The capacity of the tunnel and conduits as designed is sufficient to deliver 33,000,000 million gallons daily, or about forty-five gallons per head—in addition to all the present sources of supply—according to the population of Bombay returned in the last census. It is not intended to utilise these large conduits and tunnels to their full capacity at present, and it has been decided to lay a single line of 48in. iron pipes and raise the dam to a height which will give a supply of 17,000,000 gallons of water daily, without exceeding a fall of 6in. per mile for the conduits and tunnels. The area of the artificial lake at Tansa, which is being formed by impounding the water of the river Tansa and building a dam in the first instance 118ft. high above the river bed, will be 8 square miles; the area from which the rainfall is collected is over 52 square miles, and all sources of impurity, such as villages and houses, are being removed from this district. The rainfall of the Tansa valley is on average about 100in., and Mr. Clerke estimates that the available run-off would be one-third of the rainfall, and states that after making allowances for evaporation and absorption, there will be sufficient storage to provide for a supply of 60,000,000 gallons per day for a whole year. In order to impound this vast quantity of water, a masonry dam of exceptional size has been designed, which will be 8500ft. long, 100ft. wide at base, and 12ft. at top; the greatest height, where it crosses the bed of the Tansa river, is 118ft. The drawing, Fig. 1, shows the section of Mr. Clerke's dam and also the relative cross-sections of the dam projected by the late Professor Rankine, who was consulted when the waterworks scheme was originally proposed, also the dam which is being erected for the Liverpool Waterworks. The sections of each dam can be identified by referring to the lettering A, B, and C.

It will be seen that Mr. Clerke's dam provides for considerable saving in material compared with that of Professor Rankine; special arrangements are also designed for carrying off the surplus water by means of a waste weir 1800ft. long, also for drawing off the supply from the lake. The outlet works are shown in plan and elevation in Figs. 2 and 3. Fig. 4 is an enlarged plan of the outlet, which consists of a pair of sluiceways A and B, each 2ft. 5in. by 2ft., which are cut through the solid rock itself, which rises to this level. These sluices are closed by cast iron gates worked by screw-gearing from top, and they are fixed on the inner side of the dam and discharge into a circular cistern, from which the duct will lead off. These two sluices, with only one foot of head, are sufficient to draw off the greatest quantity of water that will ever be required, and nothing further would be necessary were it not for the desirability of drawing off from different levels, according to the level of the water in the lake. For this purpose it is intended to use a single sluice of the same pattern at two other points where the rock foundations are at a convenient height from the top of the dam. Figs. 2 and 3 show the position of these sluices, which each discharge into a small square cistern connected with the above-mentioned circular cistern by a masonry channel built along the outer toe of the dam, as shown on Fig. 2. The upper sluice is to be used until the water falls to such a level that the sluice does not discharge sufficient quantity; it will then be supplemented by the middle sluice, and in a similar manner the lower sluice may be worked when the level of the lake falls below that of the middle one. The upper sluice would be exposed every year, and could be examined and kept in perfect order; probably the middle sluice would be also exposed or could be got at, but in order to obtain access to the lower sluices a well is built round them as shown in Fig. 4, which communicates with the lake by two openings, each 4ft. by 4ft. Should it be desired to examine the sluices these openings can be closed by needles or vertical bars of timber 4in. by 4in., let down through grooves left in the well for the purpose, as shown by Figs. 5 and 6, which are sections at A B and C D on Fig. 4. In calculating the strength of the dam Mr. Clerke has used M. Bouvier's methods; the maximum pressure on the down

Fig. 1



SECTIONS OF TANSA AND OTHER DAMS.

stream face is 125 lb. per square inch, and according to M. Bouvier's calculations, masonry built of good hydraulic mortar after it is ten years old may be safely subjected to a pressure of 187 lb. per square inch, which gives a good margin of stability even if the dam be raised to its final height of 12ft. above what will be the present elevation. The duct leads off from the circular cistern, which receives the water from the outlet sluices. This duct, for the greater part of the distance, has been laid out as a conduit so as to minimise the amount of tunnelling. The transverse section of the conduit is shown by Fig. 7, and will necessitate about 10ft. of cutting to the floor. The cross section is 7ft. wide with 5ft. depth of water; the fall is 6in. per mile, and its discharging capacity—using Busin's coefficient—is 48 cubic feet per second, which is equivalent to twenty-six million gallons per day. The conduits will be provided with manholes every 220 yards, and with means of washing out and scouring at convenient places about half a mile apart. Some tunnelling on the line of duct is unavoidable; that is, the length of conduit which would be required to avoid it would be so much in excess of the length of tunnelling as to be more costly. The tunnels when lined will have the same width as the conduit, but will be a foot higher. Where lining is unnecessary the cross section will be 9·5ft. wide by 6ft. high; the fall will be 6in. per mile, and the discharging capacity 33,000,000 gallons per day. Cross sections of the tunnel are shown by Figs. 7, 8, 9, and 10. Where the line of duct crosses valleys it will consist of cast iron pipes 48in. diameter, with a fall at the rate of 3·20ft. per mile. The discharging capacity of this pipe, according to Eytelwein's formula, is seventeen million gallons per day. In calculating the rate of discharge Mr. Clerke has used the method of Mr. Fanning, C.E., of Boston, U.S.A., who has studied the question of relative discharge of new and old mains. The amount when clean would, according to this method, be 21,500,000 gallons per day; slightly tuberculated, 20,500,000 gallons; foul, 19,500,000 gallons. So that the discharge from the ordinary formula of 17,000,000 gallons is quite on the safe side. The main is being laid entirely above ground; where an embankment has to be constructed, a width sufficient for two 48in. mains is provided for, allowing for a space between, as it is intended to lay down a tramway to facilitate carrying the pipes, and in the case of a pipe bursting, renewals from the nearest depôt of spare materials. At the commencement and head o each line of piping, where it joins the conduits, the junction will be formed by a masonry cistern or siphon head, 15ft. in diameter, as shown by Figs. 11 and 12, from which the pipe will take off at its head and discharge at its tail. A sluice valve has been designed to work inside the siphon head, by which the supply can be cut off in event of the pipe bursting, and each cistern is provided with an overflow or escape for passing off water to the nearest "nalla," or natural watercourse, in the event of the siphon valve being closed. For laying the lines of pipes up and down the steep sides of the hills which are found between the head works at Tansa and Bombay, special precautions are being taken. At short intervals the pipes are built into heavy pillars of masonry, founded on hard ground, so as to prevent sliding or creeping. Scouring valves and air escape valves are provided at the principal depressions and summits along the lines of pipes. The head of water in the different lines of pipes differ considerably, varying from 104ft. to 256ft. Where the maximum head exceeds 190ft., the thickness of the pipes is 1⅜in.; where less than 190ft., 1¼in. thickness is considered sufficient. Of the total length of waterway from the Tansa Lake to the reservoir to be constructed at a terminal point 48¼ miles off, 28¾ miles will consist of tunnel and conduit, and 19½ miles of siphon pipes. The only engineering work of importance on the line of main is the bridge which will carry the pipe across the Bassein Creek, and this is now being erected. The piers and abutments consist of cast iron cylinders 5ft. in diameter, filled with concrete, and sunk to a foundation in the river bed, which, for some of the cylinders, was not reached until 60ft. below the low-water level. These cylinders support lattice girders, with rolled joists placed across so as to carry one line of pipes now, with ample space for a second to be added. In all there are three bridges across the creek, of respective lengths of 400ft., 1500ft., and 400ft., the height being sufficient to allow of the barges, which use the navigation, passing under. It was originally intended to carry out the erection of the dam departmentally, instead of by contract, but the latter plan has been adopted, the work, however, being directly under the superintendence of the consulting engineer, who has a residential staff, who, besides directing the work, examine the materials employed, and daily test the mortar which is most carefully made to the engineers' specification.

BROKEN BRIDGE, BALTIMORE AND OHIO RAILWAY.

BRIDGE FAILURE—BALTIMORE AND OHIO RAILWAY.

WE take the following from the American *Engineering News*, a journal which recently expressed itself in much injured tones in commenting upon our articles on recent American bridge failures:—

"We regret that the wicked cow which brought the *very* careful calculations of some able engineer to naught in the bridge of which we give a picture herewith, is not visible in the engraving as collateral evidence to the fact that it was a cow alone which brought it down and no defect of the structure, which was 'amply strong for all legitimate requirements.' The peculiar locomotives will show that the 'accident' occurred on the Baltimore and Ohio Railroad. Its scene was Independence, O., and the time about a month since, on April 30th.

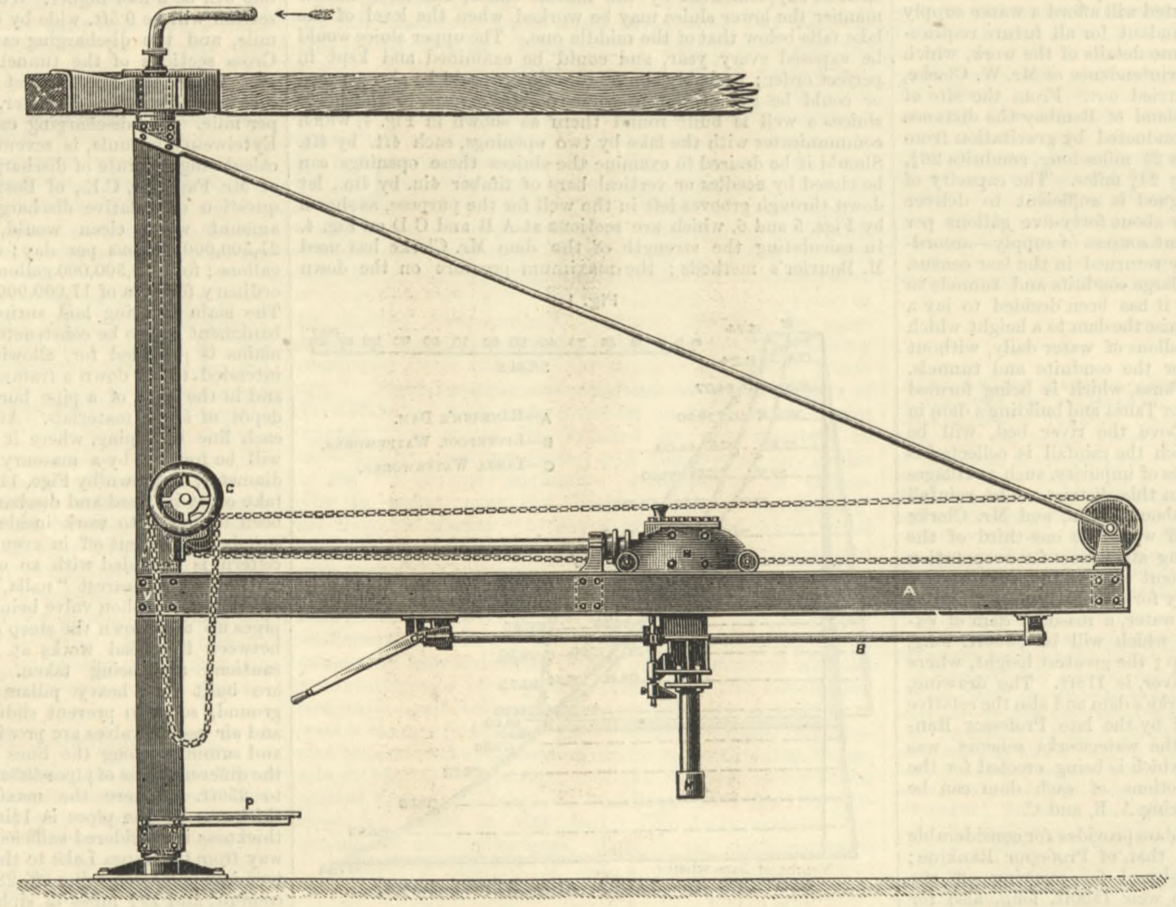
"Whether the cow was actually hit by the locomotive and so flung against one of the posts, as the officers of the road alleged, or whether the cow happened to swing its tail against one of the compression members just as it was taking strain from the locomotive, we cannot say, but the internal evidence rather favours the latter theory, for the span was so short that had the break occurred directly *under* the locomotive, that machine would have been likely to have escaped before it fell, as at the Bussey Bridge, and the cars only have been dropped into the stream beneath. At any rate, it was certainly the cow which did the mischief, for it will be seen that the locomotive did not leave the rail. The bridge itself was strong enough, as it had carried locomotives safely for several years, and its strain-sheet shows that the moments of every wheel were very accurately computed, and the precise sections required determined therefrom according to Wöhler's laws. The moment of the cow was the only thing left out of the calculation, and it had no business on the bridge. Moreover, we are not so sure, on second thoughts, but that the cow was a horse.

"The way in which the whole structure fell to pieces like a pack of cards under the effect of this slight additional impact, whatever it was, tells a story which it is needless to enlarge upon. The span was very small, the structure very high, and the last ounce of material had been saved in it. The day is near at hand, let us hope, when it will ruin a man's professional reputation to have either designed or accepted such a bridge. It cannot come too soon, but the surest and quickest way to bring it about, as respects this particular kind of atrocity, is to forbid by law the erection of pin-connected bridges of such short spans, and to require that all bridges below a certain considerable span shall be heavy enough to carry a buckle-plate floor and coating of ballast, and be provided with it, so that the dead load shall bear some reasonable and rational relation to the live.

"It will be observed that the floor held together pretty well, and its spring was enough to buckle the tension member of the first panel of the otherwise uninjured succeeding truss. This member, however, can be straightened, and no doubt has been, leaving the second truss to await the convenience of some other cow;—unless a freshet carries away the structure sooner, as would seem probable from the height of the structure above low water."

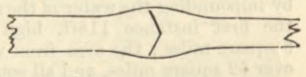
RADIAL ARM STEAM HAMMER.

WE illustrate a novel steam hammer, carried by a radial arm or jib similar to that of a foundry crane. This hammer is specially designed for welding up such forgings as stern-frames,



RADIAL ARM STEAM HAMMER

rudder-frames, and such work as cannot be brought under an ordinary fixed steam hammer. A stern frame is usually forged in several separate parts, and these parts when made are brought together into the required position and united at the ends by wedge-shaped pieces welded in between these ends. Hitherto, and to a great extent even now, this welding has been done entirely by hand hammers made as heavy as men can wield. But difficulty has always been experienced, especially in heavy forgings, to get a sound weld by hand hammers. The impact is too light, and too frequently it welds only the surface of the mass. Observation of this defective mode of uniting the component parts of a stern frame led Messrs. James Bennie and Co. to design a steam hammer that could be applied effectively to such work. The steam hammer H is mounted on a radial arm, preferably of wrought iron, and by the racking gear G it can be moved out or in on the jib over a considerable extent; and as the jib may be swung round a complete circle, the hammer can be brought into play over a wide area. A man or boy standing on the platform P turns on the steam at stop valve V and works the hammer in the usual way. He can also move the hammer out or in as may be required. The valve gear is carried by the cylinder along the horizontal bar B, and thus acts equally well in all positions on the jib. The horizontal steam pipe is telescopic with stuffing-box, and the steam is usually led down through a stuffing-box in the upper pivot of crane-post. Messrs. A. Stephen and Sons, Linthouse, were the first to have one of these radial steam hammers at work in the forge. It was found at once to be a decided improvement over the old system of welding, and there is a great saving effected in labour. The engraving shows it as made for the Parkhead Forge, Glasgow. These hammers can be mounted on a travelling bogie on rails with steam boiler attached, and in this way the hammer can be brought into action along a smithy of any length. The welding-up process as described is in accordance with the practice as it exists in Scotland generally; but there is another mode of welding which prevails in the North of England. It is by "scarf" joints. The meeting parts of these joints are sometimes planed before welding, so as to bring them



into close contact, and the joint is thus heated and welded, and kept together in proper relation by screws. This mode of welding renders a steam hammer all the more useful; and it is obvious that the hammer requires to be somewhat heavier than is needed for the Scotch method of welding.

COMPOUND ENGINES

THE compound engine which we illustrate on pages 50 and 55 was exhibited in the Rouen Exhibition of 1884, where it was bought by M. G. B. Prennez for the Laubardemont flour mill, in the Department of the Gironde, one of the largest roller mills in France, where 80 tons of wheat per twenty-four hours can be worked up. The engine works only when the tide partly drowns the turbines. The high-pressure cylinder is 400 mm. diameter; the low-pressure cylinder is 630 mm. diameter; stroke, 1 m.; speed, 65 revolutions per minute. The power is transmitted to the mill shafting by ropes, as indicated on the plan. Both cylinders are fitted with cut-off gear—Correy's patent—the late Mr. Correy having been manager at Messrs. Powell's works. Mr. Powell applied this year with perfect satisfaction to the different types of engines that he has made. There are separate steam valves and exhaust valves to each end of the cylinders—two steam and two exhaust valves to each cylinder. The steam valve spindles are of a diameter sufficiently large that the steam pressure acting on their ends closes the steam valve directly

COMPOUND ENGINE—LAUBARDEMONT FLOUR MILL

MESSRS. T. POWELL, ROUEN, ENGINEERS.

FIG 1

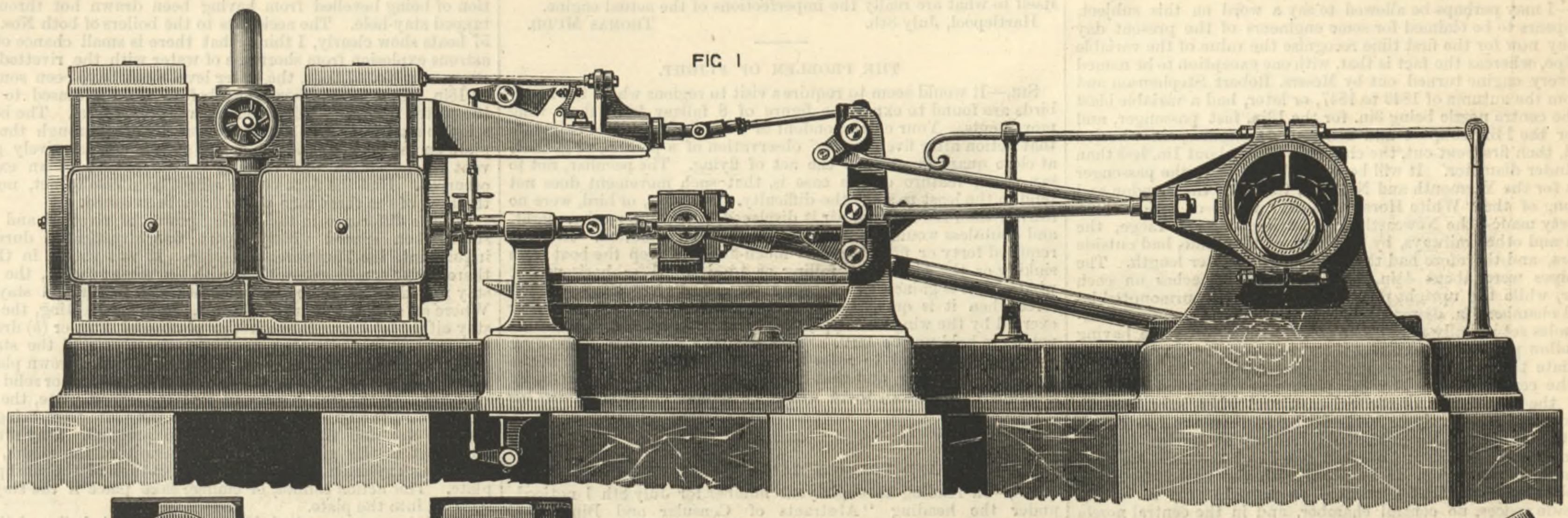
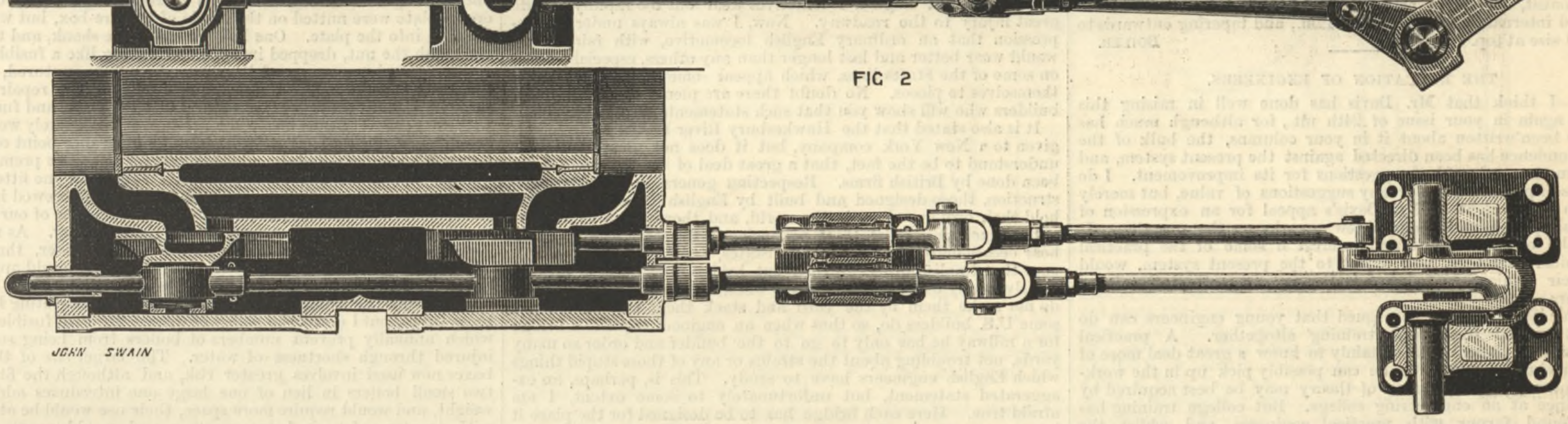


FIG 2



JOHN SWAIN

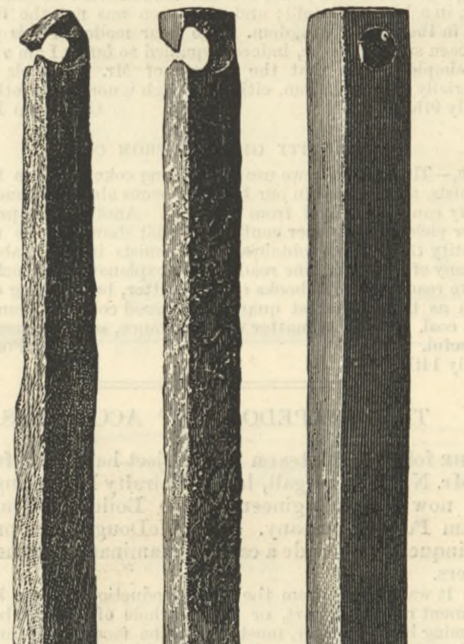
they are freed by the tripping gear; and an air dash-pot, as shown on the elevation, regulates the speed of closing and prevents any shock. The catch piece of the tripping gear is kept in gear with the shoulder of valve spindle by a coil spring; but when the trigger encounters, as it moves forward with the valve spindle, the triangular cam, the catch is pressed out of gear, and the valve spindle being free, is driven outwards by the steam pressure, and closes the valve. The governor has simply to shift the triangular cams, and as they are balanced, and the shaft carrying the cams works in roller bearings, the governor has little to do, and consequently, with a sensitive governor, the engine becomes a very steady one. The resistance of the tripping gear is taken by the shaft carrying the cams, and not thrown on the governor.

The governor acts on the high-pressure cylinder only. Mr. Powell informs us that he has only made two compound engines with cut-off tripping gear on the low-pressure cylinder, for he does not consider the gain equal to the extra cost. He places a Meyer cut-off on the low-pressure cylinders. He has adopted the plan of driving the governor by a double strap, as being the simplest and best way of preventing an accident from the engine running away from the governor not acting through a strap or its driving gear becoming deranged. Both cylinders are steam jacketted, the liners being of hard, close-grained cast iron, and fitted in. The crank shaft bearings are of phosphor bronze—long bearings—and made to adjust horizontally and vertically. The exhaust valves are driven by one excentric for each engine, and rod through a double lever and separate valve spindles, which, it will be clearly seen, gives a very rapid opening and closing to the valves with a small horizontal motion. It is a movement similar to that of the Corliss engine applied to a flat valve. The exhaust valves commence to open 3 mm. before the end of the stroke, are 30 mm. open at the commencement of the back stroke, and fully open—65 mm.—when the piston has reached 50 mm. out of its stroke of 1000 mm. The exhaust valves are self-balancing; steam is admitted to the back of them until the pressure is reached necessary, and only necessary, to keep them to their faces, and should the pressure fall a leakage takes place past the valve until the necessary pressure is reached, which itself then stops the leakage. They act perfectly. The steam passes from one cylinder to the other through a superheater made of wrought iron, and from the low-pressure cylinder to the condenser fitted with a double air-pump. The double air-pump has the advantage over the single air-pump of keeping a steadier vacuum; the needle of the gauge hardly moves. The injection cock—an arrangement of Mr. Powell's—is of a simple and very efficient form. It is an ordinary cock, but by a second handle, under the turning handle, you lift the plug before turning it round, and lower it when in position, and so it is easily moved. This insures a tight joint by a slight jam, and there is no wear and tear due to the opening and closing movement.

The steam for these engines is furnished by a Belleville boiler, working at about 150 lb. per square inch. The steam passes direct at this pressure to the jackets, but through a reducing valve to the engine at about 100 lb. pressure. We shall publish a plan next week. No regular test has been made of the engine's consumption of steam per indicated horse-power, but the coal consumption indicates a very economical engine.

CORROSION OF METALS IN MINE WATERS.

THE Bonifacius Coal Mining Company in Westphalia having much trouble from the acid waters quickly corroding the iron and steel of their underground machinery, made a series of experiments with a view to finding the relative corrosion of metals of suitable strength. Brass and gun-metal are not strong enough, and trials were made of steel, iron, and Delta metal Rolled bars of each of these were immersed during a period of six and a-half months in the water issuing from the pits at Kray, and then carefully reweighed and photographed. The bars were of 7·5in. long, and had a sectional area of 0·62 square inch. The foregoing were the weights of the three kinds of bars before and after the trial. The condition after the tests is shown by the accompanying engravings. In consequence of the rapid corrosion of iron and steel, Delta metal is now used instead for underground machinery in this and other mines.



	Wrought iron. lb.	Steel. lb.	Delta metal. lb.
Weight of bars when put in	1·1805	1·2125	1·2787
After 6½ months ..	0·6393	0·6614	1·2633
Loss	46·3°/₀	45·45°/₀	1·2°/₀

WATER POWER FOR MILLS.

THE following is a description, with results of a test, of the water-wheel erected by Messrs. Bodley Brothers, Exeter, for Mr. W. R. Mallet, Exwick Mills, Exeter. The plant is on Simon's system:—The wheel is 11ft. 8in. diameter by 16ft. broad; built of steel, hereinafter described in detail; the maximum fall of water is 4ft. 8in.; the minimum fall of water is 4ft.; the mean fall may be taken to vary from 4ft. 2in. to 4ft. 6in., depending greatly upon tail water; in this paper 4ft. 6in. is assumed throughout. The wheel when first started, March 26th, 1887, had the fender raised 1in. by gauge, the quantity of water then flowing in a vein, through the orifice under the fender, of about 22·50 cubic feet per second. The theoretical horse-power of this water equals 11·50; the gross effective horse-power, taken as ·666, equals 7·66. The wheel, with this quantity of water, was impelled at the proper number of revolutions and had the first motion gear, pulley, and the belts upon the three shafts of the mill at work. By calculation made in September last it was found that the water-wheel would consume in friction, revolving upon its bearings at 14·50 revolutions per minute, equals 3·57-horse power; the first motion shaft, gear, and pulley at 52 revolutions per minute, equals 1·84-horse power; total, 5·41-horse power. The power absorbed by friction of the three shafts within the mill for driving the rollers and other machinery may be fairly assumed as the balance of 7·66 — 5·41, equals 2·25-horse power. Therefore the power absorbed by friction of the water-wheel, first motion gear, and shafting in the mill may be properly taken as 7·66-horse power as "friction of motion."

In the middle of May last the mill had fairly got to work. The fender was raised 5in. to impel the water-wheel and machinery. The quantity of water (maximum) was 113· cubic feet per second. The theoretical horse-power of the water equals 57·60; the gross effective horse-power of the water-wheel, ·666, equals 38·40; the net effective horse-power, minus friction of motion, equals 30·74. The output of the mill was then about fifty sacks of 280 lb. each in twelve working hours, equal 4·166 sacks per hour, with 30·74 net effective horse-power, or equal 7·3776 net effective horse-power per sack of flour per hour.

The water wheel, from the manner in which it receives the water, may be designated "undershot;" but it more nearly resembles an inward-flow turbine, set vertically upon a horizontal shaft. The curves of the floats are novel and peculiar, unlike any previously made, as far as the writer knows, being so delineated that the water is received upon the external periphery of the wheel, and absorbs the greater portion of the impulse of the vein of water issuing under the fender with the velocity due to the vertical head; the shaft is octagonal, and of mild steel, 8½in. diameter; five cast iron bosses, each fitted with six wrought iron arms; five rings, 11ft. 8in. diameter, of mild steel, 0·20in. thick, fitted together in six segments; to the segments and rings are rivetted 336 angle steel starts; to the starts are bolted 168 mild sheet steel floats, curved to form. The fender is of ½in. wrought iron plate, stiffened with 4in. by 4in. by ½in. L and T iron, hung upon pins, and guided by radius bars. The wheel is calculated to pass at the maximum 200 cubic feet of water per second, and will then give out in theoretical horse-power equal to 102·00; gross effective horse-power equal to 68·00; net effective horse-power equal to 60·333.

This water-wheel has the great advantage over a turbine as ordinarily made that it will give out approximately the same ratio of effective power to the theoretical power, with varying quantities of water, the friction of motion remaining nearly constant. The *Millers' Gazette* says no opportunity has yet arisen to test the effective horse-power of this wheel by a dynamometer.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending July 9th, 1887:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m.: Museum, 6892; mercantile marine, Indian section, and other collections, 4396. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m.: Museum, 1012; mercantile marine, Indian section, and other collections, 2660. Total, 14,960. Average of corresponding week in former years, 16,006. Total from the opening of the Museum, 25,721,914.

COLLISIONS AT SEA.—At a recent meeting of the Paris Academy of Sciences, a paper was read on this subject by M. Jurien de la Gravière. In connection with the increasing number of disasters caused by preventable collisions, attention is directed to the practical measures recently proposed at various conferences by M. Riondel. Of these the most important are (1) that all steamers be required to follow one outward and another homeward route, in order to divide the present single stream of traffic into two parallel streams; (2) that a maximum velocity be determined for vessels navigating narrow straits in foggy weather; (3) that the lighting of the high seas be rendered more powerful, and brought more into harmony with present rates of speed; (4) that international maritime tribunals be established in order to adjudicate between vessels of different nationalities. The latter proposition has already been approved by the United States, and several Governments have consented to take part in the future International Conference to which the whole question must be referred.

LETTERS TO THE EDITOR.

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

LOCOMOTIVE BLAST PIPES.

SIR,—I may perhaps be allowed to say a word on this subject, as it appears to be claimed for some engineers of the present day that they now for the first time recognise the value of the variable blast pipe, whereas the fact is that, with one exception to be named later, every engine turned out by Messrs. Robert Stephenson and Co., from the autumn of 1843 to 1847, or later, had a variable blast pipe, the centre nozzle being 3in. for the 13in. fast passenger, and 3½in. for the 14in. coupled and 15in. goods engines, six wheeled coupled, then first sent out, the chimneys being about 1in. less than the cylinder diameter. It will be remembered that the passenger engines for the Yarmouth and Norwich, those for the London and Brighton, of the "White Horse of Kent" type—of which there were forty made—the Newcastle and Darlington, the Liège, the Silesian and other railways, by that firm, at that time, had outside cylinders, and therefore had the funnels of greater length. The blast pipes were about 4½in. by 4in. at the breeches on each cylinder, while the upright pipe was 4in. to 4½in., surmounted by a belled chamber 7in. diameter, in the cover of which were a number of holes set radially round, the nozzle with a port piece having short hollow projections to direct the steam, capable of adjustment to regulate the area available, fitted exactly upon the ports and round the central pipe. This flat plate was considered an objection to the free escape of the exhaust, and when submitted to Mr. Thomas Kirtley early in 1844—he being then the locomotive superintendent of the North Midland Railway at Derby—he suggested an improvement, and ordered No. 74 of the N.M.R., then in course of construction, to be fitted with the new blast pipe, which differed from that illustrated on page 14 only in having larger side spaces, no central chamber, and in the central nozzle being above that conducting the side escapes, the sizes being about the same as given above. The chimney was also new to meet this exhaust, being 18in. at bottom and 17in. at top, lined with a rounded internal flue from 18in. to 12in., and tapering outwards to the full size at top. BOILER.

THE EDUCATION OF ENGINEERS.

SIR,—I think that Mr. Davis has done well in raising this subject again in your issue of 24th ult., for although much has already been written about it in your columns, the bulk of the correspondence has been directed against the present system, and has been almost devoid of suggestions for its improvement. I do not myself pretend to offer any suggestions of value, but merely wish to add weight to Mr. Davis's appeal for an expression of practical opinion, and to offer a few remarks on the question. It would be of great value and interest if some of the practical mechanical engineers, who object to the present system, would give their opinions as to what is the proper method of training engineers.

I think it will scarcely be argued that young engineers can do without special theoretical training altogether. A practical mechanical engineer ought certainly to know a great deal more of theoretical engineering than he can possibly pick up in the workshop, and a good knowledge of theory may be best acquired by attendance at an engineering college. But college training has never found favour with practical engineers, and whilst the methods of some colleges are not what they might be, I think that practical engineers are themselves largely to blame for this, since they take little or no interest in college work, and offer no more encouragement to young men with college and workshop training than to those who have been trained in the workshop only. It is very disheartening to a young man who has spent a few years in studying theoretical engineering, in the hope that by adding this to his practical knowledge the value of his services may be enhanced, to find that his theoretical knowledge is regarded as a very doubtful acquisition, and that he can get no more remuneration in his profession on that account. Surely the young engineer who is able to calculate intelligently and accurately anything his employer may require is of much greater value in a drawing office than one who has no theoretical knowledge, and who, if he attempts any calculation at all, works blindly with formulæ from Molesworth, the principles of which he does not understand.

I think, however, that colleges are to blame for introducing into the course of study for engineers subjects which are extraneous to engineering. Engineering is a profession in which a knowledge of many branches of science would undoubtedly be advantageous, but it should not be expected that young men can possibly acquire all this knowledge in the few years which they may be willing to devote to the theoretical study of their profession. What is wanted is more concentration of energy on subjects with which the engineer has to deal practically. College professors, in framing an engineering class for young men who intend to be practical engineers, should endeavour to get rid of the idea that mechanical engineers require to be thoroughly acquainted with all the details of physics, chemistry, mineralogy, &c.; and if they would do so I think that good results, to the students at least, would follow. Unfortunately, engineers in general always appear to be sceptical of the practical knowledge of anyone who has attended college.

I cannot but regret the vague and enigmatical nature of "Slow-Coach's" letter in your issue of last week, and I trust that we shall yet have some further and more unequivocal communication from him, as the ideas of college professors on this subject would be of some interest. VIA MEDIA.

Glasgow, July 5th.

GUNPOWDER AS A BOILER CLEANER.

SIR,—I should be glad if you can find space for the following, and also if some of your readers will offer an opinion of the case which has come under my notice within the last fortnight. A vertical multitubular boiler has been at work here about two years. It was new when started. The boiler is 5-horse power, the engine 4-horse power. The chimney, of sheet iron, about 20ft. high, has given trouble by fouling, so the foreman has occasionally treated it to 5 oz. or 6 oz. of gunpowder placed in the fire-box while under steam, the ash-pan door, and fire-hole door being made fast. A few weeks back the crown of boiler failed, and was repaired by having a circular piece containing all the tube holes cut out, and a plate of larger diameter fastened on with set screws. The exhaust was removed from chimney and led into the open air. Since that, another charge of powder was applied, and two or three days after the crown of the fire-box failed, suddenly putting out the fire in a few seconds, the water running all across the building. The engine driver has been discharged for "burning the box;" while he declares the gauge was in working order and the water at the proper level not three minutes before the failure took place. A man who was in the place when the powder exploded ran out, and says he did not know if the boiler was coming after him or not. I shall look with interest for comments on the above.

Wing-road, Linslade, Leighton, Beds, July 6th. J. W. SMITH.

THEORETIC DIAGRAMS.

SIR,—Mr. Campbell has in two recent issues of your journal amply and satisfactorily acknowledged his misrepresentation of my views on this subject, and it gives me much pleasure as frankly to acknowledge his apology.

I consider the simplest, best, and most accurate method of framing the standard area diagram is to take the working volume of the low-pressure cylinder and imagine you are dealing with a single cylinder perfect engine of that capacity, and supplied with steam of a volume equal to the new steam taken from the boiler into the high-pressure cylinder. The diagram will then be that of a single cylinder without either clearance or compression, and will be such as I represented typically in enunciating the principle involved in this method at the meeting of Mechanical Engineers previously referred to.

If the method suggested by Mr. Campbell were followed, the standard diagram could vary for the same size of engine and same steam supply, which means that it would be made to accommodate itself to what are really the imperfections of the actual engine.

Hartlepool, July 8th. THOMAS MUDD.

THE PROBLEM OF FLIGHT.

SIR,—It would seem to require a visit to regions where the heavy birds are found to expel the figure of 8 fallacy from their wing movements. Your correspondent of June 3rd could not entertain that fiction after five minutes' observation of a pelican, or gannet, at close quarters while in the act of flying. The peculiar, not to say queer, feature of the case is, that such movement does not tend in the least to solve the difficulty. If a boat, or bird, were no heavier than the water or air it displaced, figure of 8 motion might, and doubtless would, be sufficient to give lateral motion. But if it required forty or fifty times as much force to keep the boat from sinking or the bird from falling as to drive them horizontally, what object is gained by changing the direction of the propelling force when it is quantity that is wanting? Take the total power exerted by the wing and apply it against gravity and it is incompetent to hold up the bird. Suppose a man were able by standing squarely on his feet to raise 500 lb. by his utmost exertion in the most direct manner, and that he then attempted to lift 5000 lb. by standing on his head, there would be danger of extinguishing his "vital spark." I. LANCASTER.

Chicago, June 17th.

ENGLISH AND FOREIGN LOCOMOTIVES AND BRIDGES.

SIR,—In reading through your number for July 8th I noticed, under the heading "Abstracts of Consular and Diplomatic Reports," New South Wales, that it is stated that English locomotives are too clumsy and heavy, and must give way to the American; that English locomotives wear out too rapidly and do great injury to the roadway. Now, I was always under the impression that an ordinary English locomotive, with fair usage, would wear better and last longer than any others, especially those on some of the States lines, which appear sometimes to be rattling themselves to pieces. No doubt there are plenty of English loco. builders who will show you that such statements are not correct.

It is also stated that the Hawkesbury River bridge contract was given to a New York company, but it does not mention, what I understand to be the fact, that a great deal of the work has really been done by British firms. Respecting general iron bridge construction, those designed and built by English firms will, I think, hold their own anywhere in the world, and there is this to be said, not so much danger of their collapsing in the same manner as we hear occasionally some do in the States, and I know from experience that English firms can turn out bridge work quite as expeditiously as any other manufacturers when required. They certainly do not make them by the yard and stack them, as I understand some U.S. builders do, so that when an engineer requires a bridge for a railway he has only to go to the builder and order so many yards, not troubling about the strains or any of those stupid things which English engineers have to study. This is, perhaps, an exaggerated statement, but unfortunately to some extent, I am afraid true. Here each bridge has to be designed for the place it has to cross, the load it has to carry, and the various strains it may be liable to. ENGLAND.

London, S.W., July 13th.

ROLLER MILLING MACHINERY.

SIR,—My attention has been drawn to the correspondence in your columns on roller milling. I know nothing of the relative merits as to who started the first automatic roller-mill plant in or about the year 1878, but can state one fact, at all events.

Ten years earlier—*i.e.*, 1868—Mr. G. A. Buchholz erected a large automatic roller-mill plant, for the manufacture of semolina and flour, in a Liverpool mill; and this even was not the first of its kind in the United Kingdom. The flour made on this plant has not been surpassed—or, indeed, equalled so far as I am aware—for the simple reason that the system of Mr. Buchholz has been materially departed from, either through ignorance or other cause.

July 9th. ONE WHO KNOWS.

QUANTITY OF COKE FROM COAL.

SIR,—The coal that we use for making coke has been tested by chemists, and we find in our bee-hive ovens almost as much as they certify can be obtained from the coal. Another has produced a larger yield by a few per cents. than that shown as the maximum quantity that can be obtained by chemists in their laboratories. Can any of your scientific readers give explanations of such results? I have read some text-books on the matter, but nothing definite is given as to the largest quantity of good coke that can be made from coal. As it is a matter of importance, some discussion might be useful. FOREMAN.

July 14th.

THE TORPEDO BOAT ACCIDENTS.

THE following notes on this subject have been furnished by Mr. Niel McDougall, late Admiralty Inspecting Officer, and now Chief-Engineer of the Boiler Insurance and Steam Power Company. Mr. McDougall was present at the inquest, and made a careful examination of the injured boilers.

(1) It was evident from the first introduction of these boats that imminent risk of a part, or of the whole of the fire-box crown becoming bare of water, must always be faced while running in a rough sea, or even in any weather at high speed. The boiler of the Lightning, which, together with a number of the boilers of the first torpedo-boats built for the Admiralty, were constructed under my supervision, was stayed in the same way as Nos. 47 and 57 boats. The general design of the Lightning's boiler is also similar to these, with the important exceptions, however, that the Lightning's boiler had brass tubes, was fitted with fusible plugs in the fire-box crown, and being a much smaller boiler, has a correspondingly smaller fire-box. No serious accident has ever happened to the Lightning's boiler, although she certainly must have been subjected to a considerable amount of rough usage during her time.

(2) As the boilers are specially subject to overheating, the importance of providing in the design against accidents from this source is evident, and I think the best way to arrive at a just conclusion as to the relative advantages in this respect of various modes of staying is by observing the behaviour of different stays when accidents take place. Among the 22,000 boilers of all types in use on land and at sea under the supervision of the company I represent, two accidents per week, coming under the head of "collapse of furnace" occur on an average. These accidents are almost invariably due to overheating of the furnaces from shortness of water, or from greasy or other deposit, being allowed to accumulate on the furnace plates. No accident has occurred from the giving way of the crown stays of any boiler fitted with stays attached to the roof, and rivetted over like those used by Messrs. Thorneycroft, but we had some time ago a narrow escape of a bad explosion in the case of a large boiler of the locomotive type with rivetted crown stays. It was the stays to the front of the fire-box which, however, gave way in this case. The crown stays were undisturbed, although their rivetting could scarcely have been as sound a job as in the torpedo boat boilers. The centre stays were 1ft. 8in. long, and as the upper ends were screwed into sockets attached by pin joints to a tee-iron rivetted to the fire-box shell, there was no possibility of solid holding up against the rivetting. The threads of both the top and bottom ends therefore no doubt suffered in rivetting the lower ends.

(3) The threads of the stays drawn through the crown plate of No. 47 boat boiler, which I examined very carefully, had evidently not suffered in the rivetting. They were perfect, with the exception of being bevelled from having been drawn hot through the tapped stay-hole. The accidents to the boilers of both Nos. 47 and 57 boats show clearly, I think, that there is small chance of a disastrous explosion from shortness of water with the rivetted crown stays. In No. 47 boat, the water level must have been some 15in. or 18in. below the fire-box crown before the fire ceased to act on the plates, and the result, after all, was purely local. The boat had a list to starboard, and the stays were drawn through the crown plate on the port side of the boiler, giving comparatively gradual vent to the steam, and nothing in the nature of an explosion occurred. Had the flaps of the ashpit been free to act, no doubt the lives of the three men would have been saved.

(4) The difference in the holding power of rivetted and nutted stays when spaced widely apart was investigated during the inquiry into the Thunderer explosion. It was shown in the case there under consideration that, with the same spacing, the nutted stay was decidedly the superior with the plates and stays cold. Where an accident occurs, however, from overheating, the nutted stay either (*a*) draws through the plate and nut, or (*b*) draws the nut through the plate, or, finally (*c*), the shank of the stay may part either in the hole or on the water side of the crown plate. It is in the last case (*c*) where the danger of the nutted or solid headed stay lies. If the stay is screwed into the crown plate, the thread will prevent the bit of stay attached to the plate from being blown into the fire, and the hole will remain plugged. Stay after stay may part in this way without giving vent to the steam, and a disastrous explosion may result from rupture of the unsupported plate. This action cannot, of course, take place if the stay is not screwed into the plate.

(5) A recent case we had illustrates this. A boiler of the locomotive type, stayed with girder stays on the fire-box crown, was allowed to get short of water. The bolts through the girder and crown-plate were nutted on the inside of the fire-box, but were not screwed into the plate. One bolt parted in the shank, and the bolt end, with the nut, dropped into the fire, acting like a fusible plug. Neither the plate nor any of the other stays were ruptured, no one was hurt, and the accident cost us only £35 for the repair of the fire-box. Had the stays been screwed into the plate, and furnished with nuts or solid heads inside the fire-box, it is not likely we should have got off so easily. Putting it from an insurance point of view, I should be inclined to take a higher risk for the same premium on a boiler with rivetted crown stays than I should on one fitted with nutted or solid headed stays, if these latter were screwed into the plate, calculating that there would be the least chance of our having to pay the full amount insured with the rivetted stay. As may be gathered from the particulars given above, however, there are other modes of attachment of stays in use which would appear to be preferable to either of the systems under consideration.

(6) I think the Admiralty have been wise in substituting iron for brass tubes, but I doubt the policy of dispensing with fusible plugs, which annually prevent numbers of boilers from being seriously injured through shortness of water. The larger size of the fire-boxes now used involves greater risk, and although the fitting of two small boilers in lieu of one large one introduces additional weight, and would require more space, their use would be attended with greater safety in heavy weather, and would possess other evident advantages for a fighting vessel of this kind.

(7) The result of the inquest, from an engineering point of view, is, of course, extremely disappointing. No serious attempt was made to show how the boiler became so empty of water. No evidence whatever was given in support of the theory advanced by the Admiralty engineering representative—who was bound in good faith to tell the court all he knew—that the loss of water from the boiler was due to heavy leakage round the tubes. The tube-plates showed no sign of such leakage, and it is past belief that so large a quantity of water could have been poured into the fire without someone becoming aware of what was going on. Among other disagreeable experiences I had in the earlier days of these boats, I was on deck when the end of a brass boiler-tube broke off, and I helped the stoker up before he fully realised that anything serious had occurred. The dense volumes of steam, however, coming out of the funnel told us at once on deck that heavy leakage of some kind had taken place. Fortunately for the stoker in this case the ashpit arrangement—Yarrow's—for guarding against the effects of mishaps of this kind answered admirably.

(8) Had the engine and boiler in No. 47 boat, with all the fittings implicated, been subjected to a careful and exhaustive examination immediately after the accident, and before anything was disturbed, the cause of the loss of water might have been discovered, and there would then at least have been some compensation in the experience thus gained for the lamentable loss of life which has occurred. Looking at the work for which a torpedo boat is intended, the use of fusible plugs, or of stays which will act in a similar manner, are, after all, minor matters. The blowing out of a plug, or the giving way of a stay, or tube, which would prevent a violent explosion of the boiler, would certainly cripple the vessel, and probably place her quite as much at the mercy of an enemy as if an explosion occurred. The questions of real importance requiring the grave attention of the Admiralty are with regard (1) to the employment of men of sufficient training and intelligence in the working of machinery essentially delicate, with whatever skill it may be designed; and (2) to the simplification to the greatest possible extent of engines and boilers which have to be used in the excitement of an action. With regard to the latter point, some of the arrangements—notably that provided for shutting off the water gauge cocks from the engine-room in the event of a glass breaking, although introduced with the best possible intentions, are, in my judgment, directly conducive to accident. It is more than possible that the water was locked in one of the gauges in No. 47 boat by this very arrangement. Again, the Admiralty instruction to use the blow-off, so as to run with the smallest possible quantity of water, is liable to lead to accident from failure to close the cock properly after blowing out. How much of the large quantity of water which disappeared found its way into the sea in this way, or through other complicated connections insisted upon by the Admiralty, as I understand, will never now be discovered. One thing, I think, is at all events certain, that had much of it escaped either into the fire or elsewhere in board, it would have made its presence felt in some way.

CONCRETE WORK UNDER WATER.—The *Bulletin de la Céramique* has called attention to the process employed by M. Houde in concrete work under water. It was desired to make the concrete penetrate between stones driven into the bottom at irregular intervals, it being impossible under these circumstances to use ordinary caissons. A square tube of 16in. sides of ordinary planks was so arranged that it touched the bottom, while its upper extremity rose about 60in. above the surface of the water, being transportable along the length of the work. This tube served to convey the concrete to the desired spots. When the tube is being raised care must be taken that the upper surface of the concrete does not descend below the level of the water. Layers of about 16in. thickness can be laid without the slightest difficulty by this appliance. The entrance of water and consequent saturation of the concrete at the commencement of the operation can be prevented by the lower orifice of the tube being closed with a board kept in position by cords, the tube being let down in such a manner while being filled, that the surface of the concrete is always above the water-level. When the lower orifice is near the bottom the cords are removed. This system was used with marked success in the construction of the bridge over the Loire on the line from Blois to Romorantin, when each appliance laid about 2000 cubic feet of concrete per day.

LOCOMOTIVE BOILER FITTINGS, MANCHESTER EXHIBITION.

MESSRS. GRESHAM AND CRAVEN, MANCHESTER, ENGINEERS.

Fig. 1

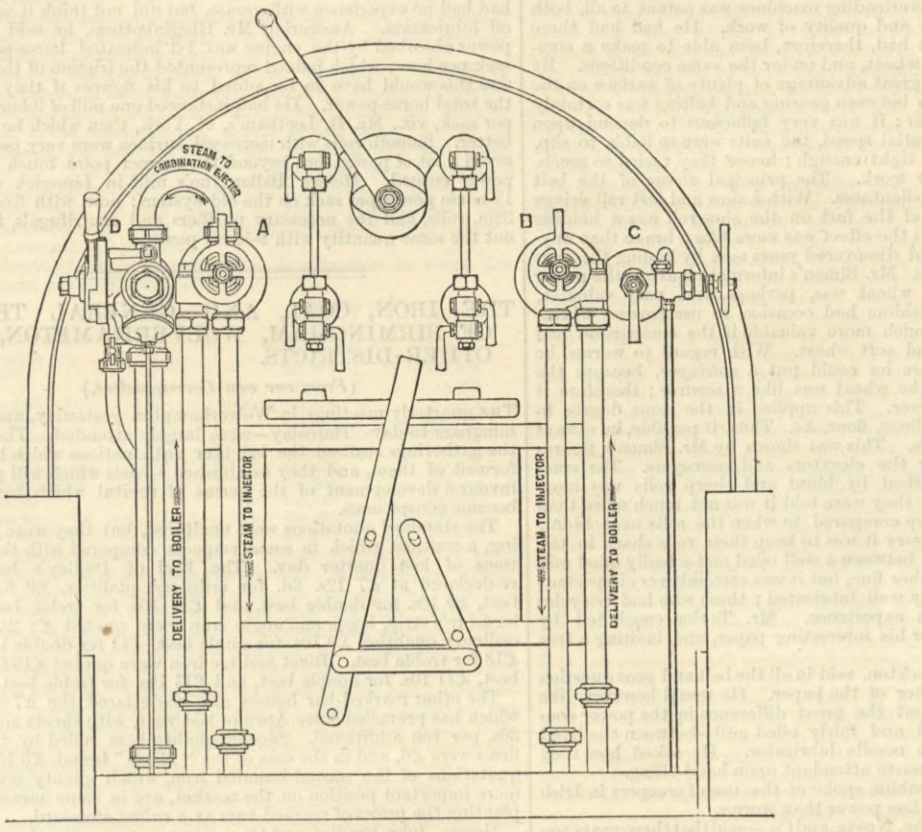
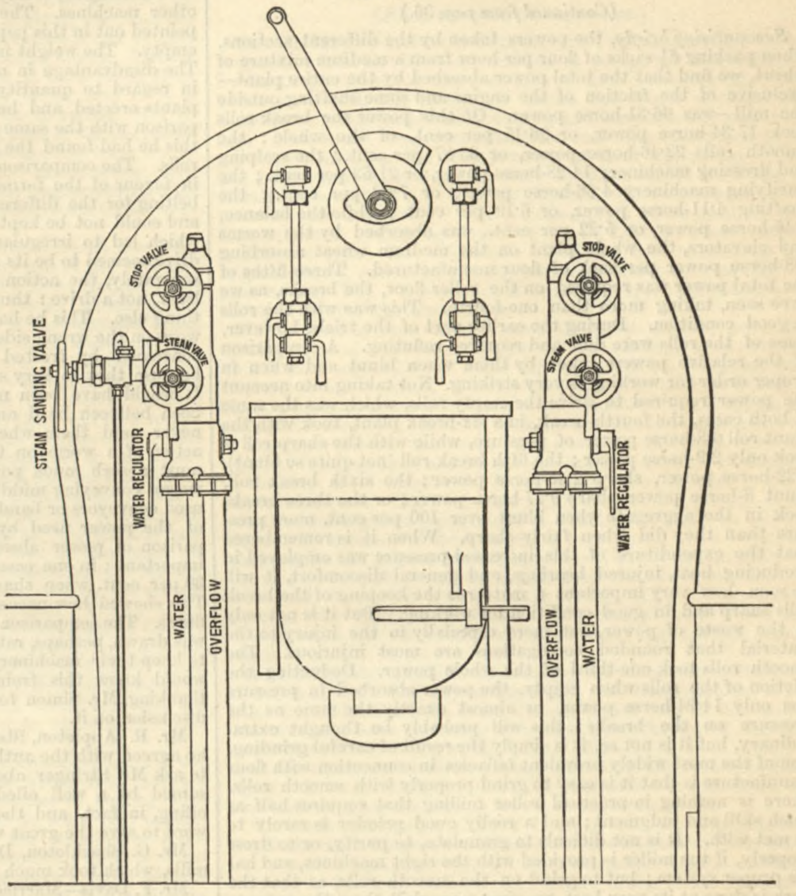


Fig. 2



LOCOMOTIVE BOILER FITTINGS.

AT the Manchester Exhibition, Messrs. Gresham and Craven, of that city, show the back of two locomotive fire-boxes, with their improved fittings attached. The object of these is to reduce the number of valves, &c., required to a minimum, and at the same time to bring all within easy reach and under the eye of the driver. Another object gained is a reduction of the number of holes necessary to be drilled into the boiler plates.

Fig. 1 shows one of these fire-boxes which is fitted with Gresham's patent "combination valves." The valve A consists of a double steam valve combined with a back-pressure valve or clack box. The purpose of this valve is to supply steam for working the injector, which in this case is placed below the foot plate in the usual manner; the steam passes through the pipe on the right of the valve, the delivery from the injector to the boiler being conveyed to the back-pressure valve by passing through the pipe on the left. Besides admitting steam to the injector, this valve is arranged to supply steam also to the combination ejector for working the vacuum automatic brake, so that in this case three valves are brought together into one fixing, requiring only two internal pipes. The steam supply to the ejector may be used for other purposes if desired—for instance, the working of steam brakes or compressed air pumps. To admit steam to the ejector, the driver simply turns the spindle full back, and when he desires to put on the injector this is done by moving the wheel back again for one turn. Valve B is placed on the right-hand side of the fire-box, and is similar in construction to valve A, but is only arranged for working the injector, the steam valve consequently does not require to be double seated. Valve C is another combination, the object of which is to supply and regulate the steam for blowing, and also for sanding the rails with Holt and Gresham's patent sanding apparatus. These fittings can be seen on the engines exhibited by the Lancashire and Yorkshire Railway at stand No. 640, and the Manchester, Sheffield, and Lincolnshire Railway at stand No. 641.

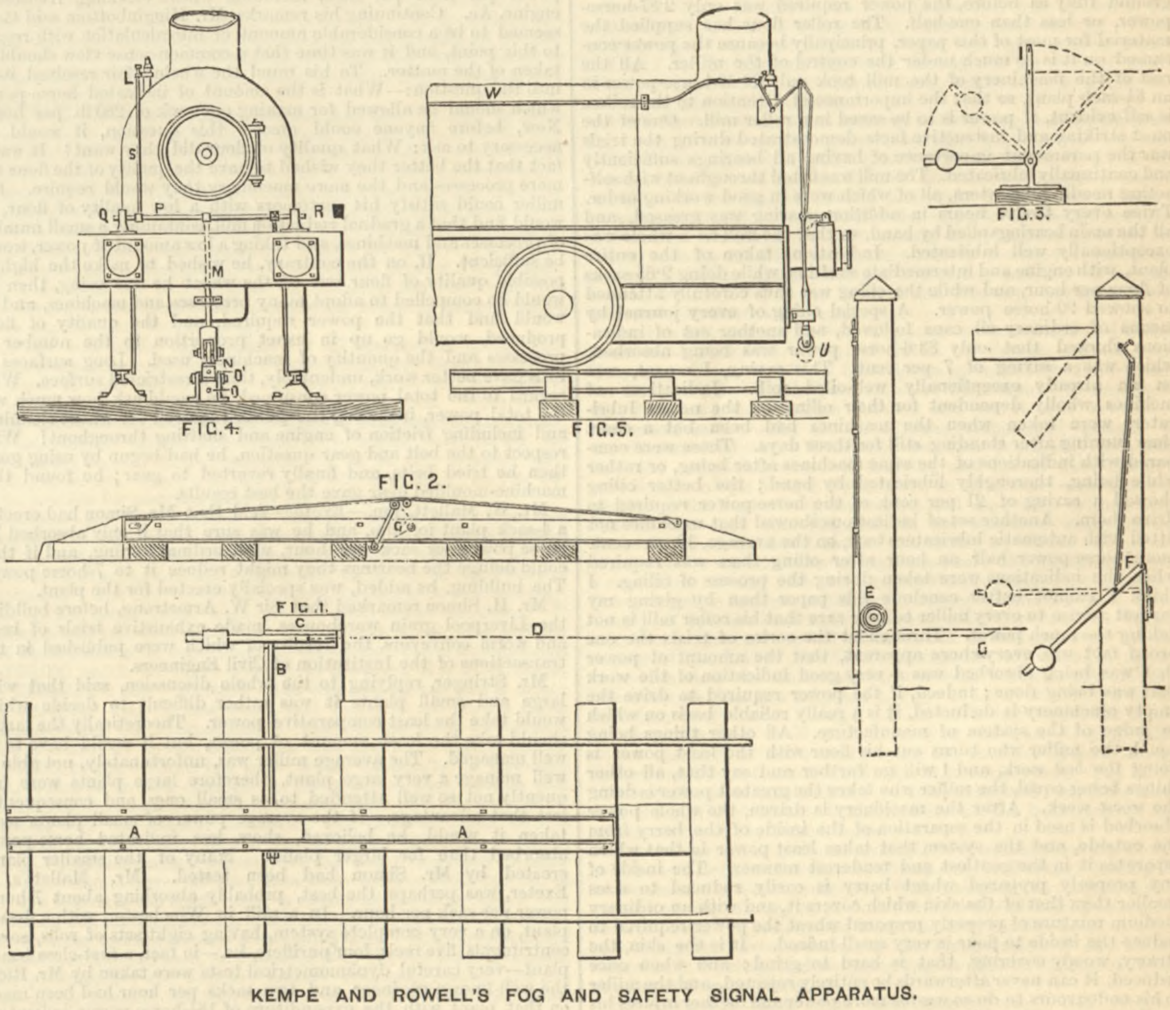
Fig. 2 shows a novel and very neat arrangement of injectors. This is a further development of the valve arrangement already described, advantage having been taken of the self-acting re-starting injector made by the same firm—which may be fixed either above or below the water supply—to combine in one fixing the injector and all the cocks and valves necessary for feeding the boiler, viz., steam valve, feed or back-pressure valve, stop valve, and water-regulating cock. The great advantages claimed for this arrangement of injector are:—(1) There are no pipes outside the boiler exposed to pressure, and therefore there is no danger from burst steam or feed pipes; (2) only one connection with the boiler is required; (3) the cones of the injector can be removed without breaking any pipe joints for cleaning, &c., whilst under pressure.

Messrs. Gresham and Craven also exhibit the vacuum automatic continuous brake and passenger communication for railway trains, the self-acting re-starting injectors, combination vacuum ejectors, water sifters and ejectors, &c., Holt's patent feed-pipe for locomotives, and numerous other specialities.

KEMPE AND ROWELL'S FOG AND SAFETY SIGNAL APPARATUS FOR RAILWAY PURPOSES.

THE invention illustrated may be briefly described. Fig. 1 represents parts of an ordinary railway, A is a box, B is a cylindrical shaft on which is fixed a crank B outside the line of railway, D is the wire attached to the crank, and passes to the signal posts E and F, and is connected to the wire of the ordinary signal at point G. Fig. 2 represents the box with the lid or cover raised, G^1 is a crank under the hinge of the lid or cover. Fig. 3 is the crank with an adjustable weight with the wire attached at point I. When the signalman puts the signal at "danger" the roller crank G^1 is forced up under the lid or cover and raises the same, as shown on Fig. 2. When the signalman puts the signal at "line clear" the crank is pulled over, as shown by dotted lines on Fig. 3, and the lid or cover falls to the level of the rails. Fig. 4 is the front elevation of an engine with a rod, roller wheel and cranks, affixed; M is the vertical iron rod, N is the roller wheel, O is the box, O^1 is the lid or cover as raised, P is a horizontal bar revolving in two bearings Q and R, S is a vertical crank rod, and L is a whistle. Fig. 5 is the side elevation of an engine, showing the roller wheel and cranks attached, U is the roller wheel, and W is the horizontal rod passing into the engine driver's cab.

An engine with the vertical rod and roller wheel affixed in passing over the box when the signal is at "line clear" and the lid or cover lying level with the rails produces no sound, but if the signal is at "danger," and the lid or cover raised, the roller wheel strikes the lid or cover and opens the whistle, and forces the horizontal rod towards the engine driver and continues to sound until the driver presses the rod back. The indicator and ground apparatus are so constructed that whether the engine or tender be running first they are equally met and come into operation as described. The apparatus has stood the test of the last two winters, and can be seen in work at the Wimbledon station of the London and South-Western Railway.



KEMPE AND ROWELL'S FOG AND SAFETY SIGNAL APPARATUS.

THE IRON INDUSTRY OF LUXEMBURG.—At the summer general meeting at Treves, on the 26th ult., of the German Ironmasters' Union, M. Léon Metz, of Esch, gave, in a paper read, some interesting information concerning the mining and iron industry of Luxemburg, which, as many readers of THE ENGINEER are aware, is the German equivalent for the Cleveland district in England. It appears from this paper that the iron ore beds extend over an area of 4062 hectares, and at almost every point where the ore crops out along the lines of railway it is gotten by means of open work or levels, deep mining being nowhere necessary in Luxemburg. The two beds of the East basin give combined an output of 100,000 to 120,000 t. per hectare. In the immediate vicinity of the blast furnace works of Esch there are, however, as an exception, three beds of ore one above another, which produce collectively 160,000 to 180,000 t. per hectare. The upper bed, consisting of the so-called red minette, has a thickness of 3 to 3½ m.; the middle or grey bed one of 3½ to 4 m.; and the lower or black bed one of 2 to 2½ m. The whole output of average sorts of the ores in 1886 was 2,361,372 t. of which quantity 1,198,000 were exported to Belgium, 212,000 to Germany, and 38,000 t. to France. The residue of 913,372 added to 350,000 t., which was imported from Lorraine, were smelted in the works of the Luxemburg district. The price of the ores varies from 1s. 6d. up to a few shillings a ton. There were 3025 miners engaged in getting the ores. Out of 21 blast furnaces 20 were in operation during the same year, which produced 400,644 t. of pig iron, consisting of 148,089 t. of forge, 176,599 of basic, and 75,956 of foundry pig. In seven foundries there were 178 moulders employed, who turned out 448 t. of hollow ware and 2142 t. of machinery castings, columns, &c. The steel works of Dudlingen produced 40,000 t. of basic steel ingots with 250 workmen. Two rolling mills employing 401 workmen produced 40,000 t. of wrought iron of various sections. Of German cokes 300,000 and of Belgian 140,000 t. were consumed. After the reading of this paper M. Sack of Duisburg, read one upon, and exhibited a model of his newly invented universal rolling mill, with which he rolled various sections in lead, to the satisfaction of the assembled industrials.

RECORDS OF TESTS AS TO THE POWER CONSUMED BY VARIOUS MACHINES USED IN ROLLER MILLS.[1]

By HENRY SIMON, C.E.

(*Continued from page* 36.)

Summarising briefly, the powers taken by the different sections, when packing $8\frac{1}{2}$ sacks of flour per hour from a medium mixture of wheat, we find that the total power absorbed by the entire plant—exclusive of the friction of the engine and some shafting outside the mill—was 66·31-horse power. Of this power the break rolls took 17·34-horse power, or 26·15 per cent. of the whole; the smooth rolls 22·46-horse power, or 33·87 per cent.; the scalping and dressing machinery 14·28-horse power, or 21·53 per cent.; the purifying machinery 4·66-horse power, or 7·02 per cent.; the shafting 4·11-horse power, or 6·19 per cent.; while the balance, 3·46-horse power, or 5·22 per cent., was absorbed by the worms and elevators, the whole plant on the medium wheat absorbing 7·8-horse power per sack of flour manufactured. Three-fifths of the total power was required on the roller floor, the breaks, as we have seen, taking more than one-fourth. This was with the rolls in good condition. During the earlier part of the trials, however, some of the rolls were dull and required refluting. A comparison of the relative powers taken by them when blunt and when in proper order for working is very striking. Not taking into account the power required to drive the empty rolls, which was the same in both cases, the fourth break, in a six-break plant, took with the blunt roll 6·8-horse power of pressure, while with the sharp roll it took only 2·9-horse power; the fifth break roll (not quite so blunt), 3·22-horse power, sharp 2·45-horse power; the sixth break roll, blunt 3-horse power, sharp 0·77-horse power; or the three breaks took in the aggregate when blunt over 100 per cent. more pressure than they did when fairly sharp. When it is remembered that the expenditure of this increased pressure was employed in producing heat, injured bearings, and general discomfort, it will be seen how very important a matter is the keeping of the break rolls sharp and in good condition for working. But it is not only in the waste of power, but more especially in the injury to the material that rounded corrugations are most injurious. The smooth rolls took one-third of the whole power. Deducting the friction of the rolls when empty, the power absorbed in pressure was only 14·94-horse power, or almost exactly the same as the pressure on the breaks; this will probably be thought extraordinary, but it is not so, it is simply the result of careful grinding. One of the most widely prevalent fallacies in connection with flour manufacture is that it is easy to grind properly with smooth rolls. There is nothing in practical roller milling that requires half as much skill and judgment; and a really good grinder is rarely to be met with. It is not difficult to granulate, to purify, or to dress properly, if the miller is provided with the right machines, and has the proper system; but to grind on the smooth rolls, so that the work is done at its very best, requires more skill than the average practical miller possesses, and as a consequence rolls sweat, journals wear out, gear make a noise, and power is wasted. Properly constructed smooth roller mills, properly set, will grind the middlings from any wheat, hard or soft, without sweating; and an exhaust to a smooth roller mill is never necessary, except to take away the troublesome effects of bad work. Too much pressure, badly fitted or too light scrapers, or uneven setting, are the most usual causes of wasted power. To give an instance of over-pressure:—A roller mill with a certain feeder was set too closely, that is, after the material was properly ground, more pressure was put upon it. After a few minutes the machine began to sweat, and gradually, through some of the material sticking to the roll, the work became higher; another increase of pressure followed, and eventually the roll was indicated, showing 6·19-horse-power was being absorbed. The pressure was then reduced, the roll cleaned itself, the sweating gradually disappeared, and the material was ground fully as before, the power required was only 2·87-horse-power, or less than one-half. The roller flour has supplied the material for most of this paper, principally because the power consumed on it is so much under the control of the miller. All the rest of the machinery of the mill took only 26·49-horse-power in an $8\frac{1}{2}$-sack plant, so that the importance of attention to the rollers is self-evident, if power is to be saved in a roller mill. One of the most striking and instructive facts demonstrated during the trials was the paramount importance of having all bearings sufficiently and continually lubricated. The mill was fitted throughout with self-acting needle lubricators, all of which were in good working order. Twice every twelve hours in addition gearing was greased, and all the main bearings oiled by hand, so that the mill as a whole was exceptionally well lubricated. Indications taken of the entire plant, with engine and intermediate shafting, while doing 9·65 sacks of flour per hour, and while the oiling was thus carefully attended to showed 90-horse power. A special oiling of every journal by means of ordinary oil cans followed, and another set of indications showed that only 83·6-horse power was being absorbed, which was a saving of 7 per cent. This saving, I repeat, was on an already exceptionally well-oiled mill. Indications of mchines wholly dependent for their oiling on the needle lubricators were taken when the machines had been but a short time running after standing still for three days. These were compared with indications of the same machines after being, or rather while being, thoroughly lubricated by hand; the better oiling showed a saving of 21 per cent. of the horse-power required to drive them. Another set of indications showed that machines not fitted with automatic lubricators took, on the average, 10 per cent. more horse-power half an hour after oiling than was required when the indications were taken during the process of oiling. I think I cannot better conclude this paper than by giving my earnest advice to every miller to take care that his roller mill is not taking too much power. Throughout the series of trials the one broad fact was everywhere apparent, that the amount of power that was being absorbed was a very good indication of the work that was being done; indeed, if the power required to drive the empty machinery is deducted, it is a really reliable basis on which to judge of the system of manufacture. All other things being equal, the miller who turns out his flour with the least power is doing the *best* work, and I will go further and say that, all other things being equal, the miller who takes the greatest power is doing the *worst* work. After the machinery is driven, the whole power absorbed is used in the separation of the inside of the berry from the outside, and the system that takes least power is that which separates it in the gentlest and tenderest manner. The inside of any properly prepared wheat berry is easily reduced to sizes smaller than that of the skin which covers it, and with an ordinary medium mixture of properly prepared wheat the power required to reduce the inside to flour is very small indeed. It is the skin, the strawy, woody covering, that is hard to grind; and when once reduced, it can never afterwards be entirely rejected, and the miller in his endeavours to do so wastes more power and further injures his quality by re-rolling his granular flour in order to try and get it smaller than the branny particles that he had cut up and mixed with it. Let him remember that "prevention is better than cure," and that the using of excessive power not only increases the cost of production, but injures also the quality of the flour he manufactures.

Mr. Seth Taylor remarked that Mr. Simon in his paper had said that an $8\frac{1}{2}$-sack plant took a gross total power of $7\frac{1}{2}$ to 8-horse-power per sack per hour. This seemed very low, and would probably depend on the conditions under which the wheat was ground, whether it was native or foreign, hard or soft wheat. Even in stone mills 50 per cent. difference in power could be found sometimes. It was also possible in comparing large and small plants that there would be some difference in favour of small plants, where so many connections are not necessary. The power absorbed by the breaks was very interesting, and although, as he had already remarked, all statistics should be taken with a grain of salt, these figures might be approximately true. The difference in the power consumed by empty and full machines was put by Mr. Simon at about one-half, which seemed too large except in the case of centrifugals, which required more power when empty than other machines. The difference between reels and centrifugals, pointed out in this paper, could hardly be so great loaded as when empty. The weight in the centrifugal when loaded was the point. The disadvantage in overloading machines was patent to all, both in regard to quantity and quality of work. He had had three plants erected, and he had, therefore, been able to make a comparison with the same wheat, and under the same conditions. By this he had found the great advantage of plenty of surface on the rolls. The comparison between gearing and belting was certainly in favour of the former; it was very fallacious to depend upon belting for the differential speed, the belts were so liable to slip, and could not be kept tight enough; hence they varied so much, which led to irregular work. The principal virtue of the belt drive seemed to be its silentness. With a slow and fast roll driven separately, the action of the fast on the slow roll was a holding back, not a drive: thus the effect was more like a brake than anything else. This he had discovered years ago, by finding the cogs worn on the wrong side. Mr. Simon's information about the power consumed by frosted wheat was, perhaps, not very valuable, because they so very seldom had occasion to use frosted wheat. It would have been much more valuable if the comparison had been between hard and soft wheat. With regard to worms, he never used them where he could put a conveyor, because the action of a worm on the wheat was like a scourer; therefore it must absorb much power. This applied in the same degree to worms conveying middlings, flour, &c. Thus, if possible, he always used conveyors or bands. This was shown by Mr. Simon's figures of the power used by the elevators and conveyors. The comparison of power absorbed by blunt and sharp rolls was most important; in one case they were told it was not much more than 30 per cent. when sharp compared to when the rolls were blunt. This showed how necessary it was to keep their rolls sharp in the flutes. The comparison between a well oiled and a badly oiled mill was drawn, perhaps, rather fine, but it was certainly very important to keep their machinery well lubricated; those who had tricycles would know this from experience. Mr. Taylor concluded by thanking Mr. Simon for his interesting paper, and inviting a free discussion on it.

Mr. R. Appleton, Stockton, said in all the belt and gear question he agreed with the author of the paper. He would however, like to ask Mr. Stringer about the great difference in the power consumed by a well oiled and fairly oiled mill—between the hand oiling, in fact, and the needle lubricator. He asked how they were to save the great waste attendant upon hand oiling.

Mr. G. Shackleton, Dublin, spoke of the use of creepers in Irish mills, which took much less power than worms.

Mr. F. Davis—Marriage, Neave, and Co.—said that three years ago in Liverpool experiments were carried out with conveyors and screws, and bands were found to be much the best in point of power absorbed. He also confirmed Mr. Taylor in the advantage of gear over belts. Mr. Stringer himself had persuaded the speaker to try the gear-driven roll, and he had found by comparison in his own mill that the belt-driven mill gave trouble, but the gear none; nor was there any noise in the latter mill because there was no vibration, the machine being so well built.

Mr. Higginbottom, Liverpool, said that continuous lubrication took half the power of intermittent lubrication; the trouble, however, was to get continuous lubrication. The needle, he thought, was the best so far known in the market. Mr. Simon's paper he considered good, but not conclusive. It was very difficult indeed to get at the exact amount of power absorbed in a mill. His opinion was that no really first-class all roller plant, working on the gradual reduction system, could be worked at 10 indicated horse-power per hour per sack, including wheat cleaning, friction of engine, &c. Continuing his remarks, Mr. Higginbottom said there seemed to be a considerable amount of miscalculation with regard to this point, and it was time that a common-sense view should be taken of the matter. To his mind the whole affair resolved itself into the question:—What is the amount of indicated horse-power which should be allowed for making one sack of 280 lb. per hour? Now, before anyone could answer this question, it would be necessary to ask: What quality of flour did they want? It was a fact that the better they wished to have the quality of the flour the more processes and the more machinery they would require. If a miller could satisfy his customers with a low quality of flour, he would find that a gradual reduction mill, containing a small number of processes and machines, and taking a low amount of power, would be sufficient. If, on the contrary, he wished to make the highest possible quality of flour out of the wheat he was using, then he would be compelled to adopt many processes and machines, and he would find that the power required, and the quality of flour produced, would go up in exact proportion to the number of processes and the quantity of machinery used. Long surfaces in rolls gave better work, undeniably, than a restricted surface. With regard to the total power consumed, he would ask how much was the total power, including the power required for wheat cleaning, and including friction of engine and shafting throughout? With respect to the belt and gear question, he had begun by using gear, then he tried belts, and finally reverted to gear; he found that machine-moulded gear gave the best results.

Mr. W. Mallett, jun.—Exeter—said that Mr. Simon had erected a 4-sack plant for him, and he was sure that it only absorbed $7\frac{1}{2}$-horse power per sack per hour, with ordinary oiling, and if they could deluge the bearings they might reduce it to 7-horse power. The building, he added, was specially erected for the plant.

Mr. H. Simon remarked that Sir W. Armstrong, before building the Liverpool grain warehouses, made exhaustive trials of band and worm conveyors, the results of which were published in the transactions of the Institution of Civil Engineers.

Mr. Stringer, replying to the whole discussion, said that with large and small plants it was rather difficult to decide which would take the least comparative power. Theoretically the larger should take the least amount of power, but it would have to be well managed. The average miller was, unfortunately, not able to well manage a very large plant, therefore large plants were frequently not so well attended to as small ones, and consequently lost that advantage. If the average power of small plants were taken it would, he believed, show less indicated horse-power absorbed than for larger plants. Many of the smaller plants erected by Mr. Simon had been tested. Mr. Mallett's, of Exeter, was perhaps the best, probably absorbing about 7-horse power per sack per hour. In a mill in Winchester, with a 4-sack plant, on a very complete system, having eight sets of rolls, seven centrifugals five reels, four purifiers, &c.—in fact, a first-class 4-sack plant—very careful dynamometrical tests were taken by Mr. Rich, the well-known engineer, and two sacks per hour had been made on that plant with the expenditure of $18\frac{1}{3}$-horse power indicated, and $4\frac{1}{2}$ sacks with $27\frac{1}{2}$ indicated horse-power. Perhaps the smallest amount of power used in a large plant reliably tested which he knew was that of Mr. Leetham's, of York, where $26\frac{1}{2}$ sacks of flour per hour was made with 239 indicated horse-power, including wheat cleaning and all necessary tackle. This showed an average of 9 indicated horse-power per sack per hour, thus averaging the same as in some smaller mills. On the question of hard and soft wheat, if hard instead of frosty wheat had been tested, it would not have differed much, especially in the reductions of middlings; therefore they might assume hard wheat instead of frosted in the trials referred to. Coming to the question of worms *v.* creepers, he said that there was no doubt that a conveyor took much less power than a worm. It was, indeed a very surprising thing that it was cheaper in power to elevate the grain and let it fall by gravity than to worm it. In fact, 100 sacks of wheat could be elevated 400ft. at one-third less power than if it were wormed. Elevators, indeed, took wonderfully little power, as was very conclusively proved by the trials at the Kirkdale Mill. He also quite endorsed Mr. Davis in his opinion about the band, horizontally driven, taking so little power. In answer to Mr. Appleton, he said it was difficult to solve the question how, with hand oiling, the waste could be prevented, but it might be made practical by-and-bye to run bearings always in oil. On the subject of discs *versus* rolls he could not say anything at that meeting, because it would be unfair to take advantage of other engineers by his position there. He had had no experience with grease, but did not think it as good as oil lubrication. Answering Mr. Higginbottom, he said that the power absorbed by the engine was 1·3 indicated horse-power per sack per hour, which indeed represented the friction of the engine, and this would have to be added to his figures if they required the total horse-power. He had instanced one mill of 9-horse power per sack, viz., Mr. H. Leetham's, of York, than which he knew no better. Smooth rolls with increased surface were very useful, and saved a lot of power, but beyond the correct point much waste of power ensued. Messrs. Ballantyne's mill in Limerick absorbed 12-horse power per sack on the old system; now, with five sets of 32in. rolls, and the necessary purifiers and centrifugals, it turned out the same quantity with 9-horse power.

[1] Paper read at the Millers' Convention

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE quarterly meetings in Wolverhampton yesterday, and in Birmingham to-day—Thursday—were largely attended. The tone of the gatherings realised the brighter anticipations which had been formed of them, and they established a basis which will probably favour a development of the germs of revival which have lately become conspicuous.

The standard quotations were unaltered, but they were unyielding, a contrast which in some respects compared with the quotations of last quarter day. The Earl of Dudley's bars were re-declared at £7 12s. 6d. for ordinary qualities, £9 for single best, £9 10s. for double best, and £12 10s. for treble best. His lordship's strip, hoop, and angle iron were quoted £8 2s. 6d. for ordinary qualities, £9 10s. for single best, £11 for double best, and £13 for treble best. Rivet and tee iron were quoted £10 for single best, £11 10s. for double best, and £13 10s. for treble best.

The other marked-bar houses also re-declared the £7 standard which has prevailed since April of last year, with sheets and plates 30s. per ton additional. Second quality bars rolled by the same firms were £6, and in the case of the "Mitre" brand, £5 15s. The quotations of the second-branded iron, which quality occupies a more important position on the market, are in some measure supplanting the prices of marked bars as a ruling standard.

Messrs. John Bradley and Co. occupy an exceptional position that they still price all bars above $\frac{5}{8}$in. at £9 10s.; hoops they quote £8 10s., which is 20s. above the standard of the market; and sheets and plates, £10, which is 30s. advance upon other best makers. Rounds and squares up to $\frac{5}{8}$in. are quoted £8, a rise upon other firms of 20s. per ton. The New British Iron Company quotes:—Slit rods, £6 5s. for Corngreaves; £7 C.G.C. brand; £7 10s. Lion; £9 best Lion; and £11 10s. best charcoal. Steel rods are £8 and iron horseshoe rods, £6 10s., £7 10s., and £9, according to quality. Hoops the company quotes £7, £8, and £9 10s. Steel hoops are £8 10s., and best charcoal, £8.

The list of John Bagnall and Sons is:—Bar 1in. to 6in., £7; $6\frac{1}{2}$in. to 9in. flat bars, and $4\frac{1}{2}$in., £8 10s.; $4\frac{5}{8}$in. to $4\frac{3}{4}$in., £9; $4\frac{7}{8}$in. and 5in., £9 10s. As to rounds, only the large sizes are:—$5\frac{1}{8}$in. and $5\frac{1}{4}$in., £10; $5\frac{3}{8}$in. to $5\frac{1}{2}$in., £10 10s.; $5\frac{5}{8}$in. to $5\frac{3}{4}$in., £11; $5\frac{7}{8}$in. and 6in., £11 10s.; $6\frac{1}{4}$in. to $6\frac{1}{2}$in., £12 10s. Hoops and angles are quoted at £7 10s., and rivet iron at £8 10s. to £9 10s., according to quality. Sheet quotations are:—20 gauge, £8 10s.; 24 gauge, £10; and 27 gauge, £11 10s.; but these quotations are hardly more than nominal. Boiler plates are £8 10s., £9 10s., £10 10s. and £11 10s., according to quality.

Marked bars are in slow request, and only a few firms show much activity. Messrs. Noah Hingley and Sons, whose principal occupies the position of chairman to the trade, are particularly active. In addition to good Australian orders they are receiving larger lines from South America and the Cape. Staffordshire is now experiencing the benefit of the improved position of these markets through the higher prices which are now being realised for wool. The home demand for marked bars is exceptionally quiet. Messrs. Hingley's works are running about three-fourths time, which i about all that the present hot weather will permit of the men working.

There is a quiet demand for medium and common qualities of bars and hoops, but those establishments who have a good colonial connection are in a fair position. Prices of such iron are influenced by the rise in pigs, and are proof against any demand for a concession. Medium quality bars remain at £5 10s., with common at £5, and hurdle sorts ranging down occasionally to £4 17s. 6d. Hoops are about £5 for common sorts, and bedstead strip £5 to £7. Gas tube and nail strips are in fair call, more especially the latter, for local consumption. The price of gas strip is £4 17s. 6d. to £5 for narrow sizes.

The demand for black sheets has largely improved during the past few weeks, so much so that some makers at the quarterly meetings declared that their order books present a better appearance than at any time for two years past. A good feature of the improvement is that inquiries are running with more freedom upon large lots. Prices have strengthened, and makers generally are demanding 2s. 6d. to 5s. per ton advance. This is possibly because of the limited supply upon the market, consequent upon the late closing of some of the sheet mills. Doubles are quoted by firms who are well placed, at £6 5s., and lattens, £7. Other firms, however, will still accept £6 to £6 2s. 6d. for doubles, and £6 17s. 6d. for lattens. Merchant singles are sometimes to be had at £5 17s. 6d. per ton

More disposition is being shown to negotiate in pigs by these consumers who have not previously covered themselves, particularly as many of the Derbyshire and Northampton makers being fully sold forward, the supply upon the market is limited. Some purchasers are this week desiring to place lots of from 500 to 1000 tons in a line in addition to their earlier purchases, but in order to do this they have to pay advanced rates. Prices were to-day—Thursday—very strong. Derbyshire pigs vary in quotation from 37s. to 37s. 6d. and on to 38s., and Northamptons from 36s. to 37s., both delivered to consumers' works. Lincolnshires are in some few cases procurable at 40s. at stations, but the general quotation is 41s. to 41s. 6d. The No. 3. brand of hematites of the Tredegar Company was priced to-day at 52s. 6d., and 43s. 6d. for second qualities; 55s. was demanded for the Ulverston—West Cumberland—brand. Some West Coast brands were as high as 57s. 6d. delivered.

A better tone was likewise observable in local pigs. Some makers have their books well filled. The brands of the Spring Vale Company were quoted at the following figures:—Common iron, 30s.; B.F.M., 37s. 6d.; and hydrates, 45s. But little business is being done in best local pigs. Cold blast all-mines sustain the quotation of 75s., and hot blast qualities 50s. to 52s. 6d. Some Staffordshire cinder pigs are in actual business 28s. 6d. upwards per ton

The Galvanisers' Association met in Birmingham to-day and advanced prices 10s. because of the increased price of sheet iron and spelter, and the enlarged demand. Prices now become £10 5s. for twenty-four gauge, delivered Liverpool. Local steel makers reported an increased sale, and many of them declined orders.

Inquiries for steel are still being expressed with much freedom The demand on Birmingham 'Change was most encouraging. Th local works are fully employed, and production is being further increased by the starting to-day of the new open-hearth basic con verter which has been building at the works of the Staffordshire Steel and Ingot Iron Company, Bilston. Quotations for basic steel of local make are this week: Blooms and billets, £5; bars and angles, £5 5s.; channel sections, £6 5s. to £6 7s. 6d.; girder and tank plates, £6 15s. to £7.; and best boiler plates, £7 5s. Welsh and other imported steel competes very severely with Staffordshire steel. Ingots from Wales are procurable at £4, blooms at £4 10s., billets at £4 10s. to £4 12s. 6d., and tin bars and plating bars at £5, all delivered.

The cable and anchor engineers report that trade at present is only quiet. With the shipping business in its present inactive state, nothing more could be expected.

According to the Government returns the class of exports in which this district is more materially interested—iron and steel—were larger in June by 40,052 tons in quantity, and 5 per cent. in value, than in the corresponding month of last year. In the six months' trading the excess was 393,056 tons in quantity, and 10 per cent. in value. The largest ratio of increase has been in railroad iron. There is an increase of about 17 per cent. in the value of the month's exports of bar and angle iron, and in wire 20 per cent. Old iron has advanced 4 per cent., steel unwrought 50 per cent., and tin unwrought 12 per cent.

The following table succinctly shows the direction in which the improvement has appeared:—

	Month of June. 1886.	1887.
Pig and puddled	£254,090	£264,101
Bar, angle, &c.	109,949	130,052
Railroad	361,274	463,902
Wire	43,774	54,250
Telegraphic ditto	193,024	18,870
Cast and wrought	315,396	326,546
Hoops, sheets, &c.	295,622	289,222
Old iron	49,159	56,242
Steel, unwrought	116,210	216,868
Tin, unwrought	47,235	53,182
Tin-plates	533,950	416,820
Machinery	694,704	685,821
Steam engines	317,055	247,757

In the heavy hardware trades of Birmingham there are some considerable orders under execution for India, Australia, and South America, which will keep the manufacturers concerned steadily going for some weeks to come. The Cape trade has shown considerable animation of late, and the improvement continues, more particularly as regards railway material and machinery. For India, Burmah, and China, also, railway material and machinery are in good request. Continental requirements for some time past have been much under the average for general hardware, but machinery is still going in considerable quantities to all the principal European markets, and the United States orders for machinery have increased very considerably of late.

Two colliery accidents occurred on Tuesday night, one at the Glasshouse Pit, Chesterton, North Staffordshire, and the other at the Hamstead Colliery, West Bromwich. At Chesterton, the brickwork of a downcast shaft fell and stopped the ventilation of the mine, thus placing the lives of about 400 men in peril. They were, however, got safely to bank. Two miners at the Hamstead Colliery were overwhelmed by a fall of coal, and on being extricated one of them succumbed to his injuries.

The gas question at Wolverhampton has assumed a peculiar phase. The town is supplied by a private company, but as their price of 2s. 6d. per 1000 cubic feet, which they are resolute in refusing to abate, compares unfavourably with the 1s. per 1000 charged by Birmingham to Wednesbury, the Wolverhampton Corporation are making preliminary negotiations with a view to being supplied with gas by Birmingham under the same terms with which Wednesbury is now being treated.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—With the exception that an occasional little outburst of buying helps to relieve the monotony of the persistent depression which has been the prevailing characteristic of the iron trade of this district for so long past, it can scarcely be said that there is any really material change to report. Last week there was a moderate amount of buying going on in pig iron, with also more business stirring in finished iron, but the limited wants of consumers are very speedily satisfied, and the market quickly relapses again into its normally stagnant condition. The only satisfactory feature is that prices seem to have got on to a fairly steady basis, and if they do not show any appreciable advance they do not get any lower. Both in common pig iron and hematites makers appear to be firm at current rates, and in some instances do not seem disposed to take quite such low figures as they have been doing recently. The same may be said with regard to finished iron, which is now being held more closely to what in some measure have only been nominally quoted rates. If this position can be maintained, it may, of course, be made the starting point for some upward movement directly that any real improvement manifests itself, but the necessary improvement in trade is still wanting.

There was only a moderately attended and very dull iron market at Manchester on Tuesday. The little extra buying which took place last week was not followed up, and there was only a very small inquiry generally. Any actual business there was doing was for the most part confined to small odd lots, which are generally to be picked up in the market, but which have really little or no connection with what may be termed the staple requirements for ordinary consumption. Although there is some underselling in pig iron, prices, so far as makers are concerned were generally steady. Lancashire makers still hold to about 38s. 6d. for forge and 39s. 6d. for foundry, less 2½, as their list rates for delivery equal to Manchester, and although in the face of the much lower prices at which some of the district brands can be got, they are quite out of the market, they show no disposition to give way to any material extent. They would probably be prepared to entertain offers at about 6d. per ton under their quoted rates, but this does not meet the views of buyers, and the result is that in the open market local makers are at present selling little or nothing. For Lincolnshire iron the average figures are about 36s. 6d. for forge, and 37s. to 37s. 6d. for foundry, less 2½, delivered equal to Manchester; but even at these low prices business is difficult. In outside brands offering here, there is some underquoting by merchants, but not to any great extent, and makers' prices remain firm, 43s. 4d., net cash, being still the minimum quoted price for good named foundry brands of Middlesbrough delivered equal to Manchester.

The leading hematite makers are also very firm at the full prices which have recently been quoted, and except that merchants here and there might be disposed to book an order at a lower figure, 53s. to 53s. 6d., less 2½, represents the current market price for good No. 3 foundry qualities, delivered into the Manchester district.

In the manufactured iron trade, although there is no really very appreciable actual improvement, a steadier tone is being maintained in prices, partly as the result of some increased buying recently, and partly owing to a restricted output consequent upon regular operations at the forges having been interfered with recently by the hot weather. For delivery into the Manchester district, £4 17s. 6d. per ton is now the minimum quoted price for bar, with makers in some instances holding for £5 per ton; hoops, £5; and sheets £6 5s. for local, to £6 10s. per ton for good South Staffordshire qualities.

In the condition of the engineering trades there is still no very material change to report; although, as I have previously stated, there seems to be more inquiry stirring, this does not develope into any really appreciable improvement in the general condition of trade, and the excessively low prices at which any work that is to be got continues to be sought after, are only too plainly an evidence of the keen struggle which many engineering concerns are carrying on simply to keep their shops going. Boilermakers are being kept busy with work in hand, whilst machine tool makers are also, in most cases, being fairly employed; but, outside these branches, slackness in trade is the general complaint.

The Bolton strike, which has now entered upon the tenth week, seems to be as far off as ever from any prospect of settlement; on neither side is there any sign of compromise or giving way, and the men are continuing their policy of organised intimidation to prevent the employers obtaining workmen from other towns. But for this the employers would have no difficulty in at once filling their shops with men willing to work on their terms, and as it is scarcely to be expected they will submit to be terrorised over in this fashion, but will be resolute in obtaining men to fill the places of those who have gone out on strike, the authorities have wisely and very properly retained the services of the extra police force and the military to prevent a repetition of the disgraceful riots by which a fortnight ago it was sought to intimidate workmen from coming into the town.

A meeting of the local reception committee, which has been appointed in connection with the forthcoming visit of the Iron and Steel Institute to Manchester, was held in the Town Hall on Tuesday, Mr. John Craven presiding, and Mr. Daniel Adamson, the president, and Mr. J. S. Jeans, the secretary of the Institute, being present. The chief business was the drawing up of a draught programme for the autumn meeting in Manchester on the 14th, 15th, and 16th September, and the following provisional arrangements were made:—The meetings are to be held in Owen's College, and on the first day, Wednesday, the 14th, there will be a reception by the Mayor of Manchester and the Chancellor of the University, to be followed by the ordinary business; in the afternoon the members will pay a visit to the Royal Jubilee Exhibition, and in the evening the Mayor will receive the members at a *conversazione* in the Town Hall. Thursday, 15th: The meeting will be resumed in the morning at Owen's College for the reading and discussion of papers; in the afternoon there will be excursions to Messrs. Robinson's engineering works at Rochdale, and to Messrs. Platt Brothers' works at Oldham, and in the evening the annual dinner will be held at the Manchester Town Hall. Friday, 16th: The reading and discussion of papers will be resumed at Owen's College; in the afternoon the members will be invited by the president to a garden party at the Towers, Didsbury, and in the evening there will be a reception at the Royal Jubilee Exhibition by the executive committee of the Exhibition. On Saturday, the 17th, an excursion will probably be arranged to Haddon Hall and Chatsworth.

What seems to have been a want of due consideration for the legitimate requirements and comforts of the attendants, coupled with perhaps a little too high-handed officialism in dealing with any complaints that might be made, has led to some very unpleasant friction between the managing staff of the Manchester Exhibition and the exhibitors in the machinery section, which for a time assumed so serious an aspect that for several days a large proportion of the attendants were actually on strike, and the machinery in motion section practically at a standstill. One of the main grievances has been that, while the attendants have been denied the privilege, which has been accorded to the working staff of the Exhibition, of obtaining food and refreshments in the building at a reduced tariff, no accommodation has been provided so as to enable them to get the meals they may bring with them in comfort, and in addition they have been compelled to pay the full charges for the use of the lavatories. These grievances have been submitted to the executive committee, and I understand they have under consideration the provision of a special building for the use of the attendants, whilst one or two other concessions have been made which, it is hoped, will restore harmony. Following closely upon these proceedings, the general manager has issued a circular to the exhibitors, in which he states that he is instructed by the executive committee to call their attention to the conditions with regard to sales contained in the letters of allotment, and to notify that they must be complied with. He is also further instructed to take immediate steps to close any exhibit when the conditions imposed by the committee and accepted by the exhibitors are not observed, and he trusts that exhibitors will cordially meet the views of the executive committee, and thus prevent any unpleasantness which might otherwise arise.

The Manchester Ship Canal scheme may now be said to have surmounted the main difficulty which has hitherto stood in the way of its successful accomplishment. The practicability of the scheme from an engineering point of view has never been seriously questioned, but the financial portion of the project has been regarded with considerable doubt. The raising of the requisite capital seems now, however, to be practically assured; this week the requisite deposit on £3,000,000 ordinary share capital, to enable the issue of £4,000,000 preference shares, sanctioned by the special Act of Parliament, which received the Royal Assent on Tuesday, has been paid into the company's bank, and every confidence is felt in the preference share capital being forthcoming.

In the coal trade the demand for all descriptions of fuel continues extremely dull, and pits are not working more than an average of three to four days a week, with heavy stocks accumulating in some instances out of even this restricted output. With stocks being forced for immediate sale, prices are weak and very irregular, and can only be quoted approximately at about 8s. to 8s. 6d. for best coals; 6s. 6d. to 7s., seconds; 5s. to 5s. 6d., common coal; 4s. 3d. to 4s. 9d., burgy; 3s. 6d. to 3s. 9d., best slack; and 2s. 6d. to 3s. per ton for common sorts at the pit mouth.

Barrow.—All the attention of business people and others has been centred this week in the celebration of the Queen's Jubilee and the opening of the new town hall on the 4th inst. by the Marquis of Hartington, who is chairman of the three large Barrow companies. The new town hall is a fine, imposing Gothic building, with central tower 170ft. high, and is built in red sandstone. It embraces the official or municipal department in one wing and the free library and civic department in the other. It has cost upwards of £50,000, and is the finest building in the town. Mr. W. H. Lynn, of Belfast, is the architect. The demand for pig iron is firmer and stronger than it has been, and there is not only a fuller business doing, but a disposition to increase the trade on the part both of home and foreign consumers who are more readily paying quotation prices. There is a good trade, especially in Bessemer iron, which is in full demand on the part of steel makers and others, and it is noticeable that hematite iron of ordinary quality is selling well for general purposes. The price at which iron is changing hands is steady at 45s. 6d. per ton for Bessemer of No. 1, 2, and 3 qualities mixed, and 44s. 6d. for No. 3 forge and foundry iron net. Sales in special cases have been made at from 44s. 3d. to 45s. per ton, and the trade doing is chiefly at the latter figure and upwards. The foreign demand, save that from America, is very steady, and on home account there is a very good tone. The business doing in steel is on the increase, and especially in the rail trade is there a good prospect, for not only are makers well sold forward, and are busy at the moment, but they are in receipt of inquiries which show that the trade is growing in bulk, and the requirements of customers, both home and foreign, will, during the present year, and a considerable part of next year, be very great. Rails are quoted still at £4 3s. per ton net, f.o.b., for heavy sections, but it is probable before the month is out that this price will increase to £4 5s. per ton. Other descriptions of steel are also in considerable request. There is a good business doing in bars and billets, and makers hold large orders for these classes of goods. There is also a fair business doing in shipbuilding qualities of steel, but not so much on local as on general account, although the hope and belief has been expressed that good orders were on the point of acceptance by local shipbuilding firms which would have revived that industry in Barrow, while at the same time affording employment to an important branch in the steel trade. There is not much doing in blooms in the steel trade. This district is not well adapted for this trade, as it is more profitable to produce the finished article. Iron ore finds a good market at from 8s. 6d. to 11s. per ton net at mines. Coal and coke remain steady, and there is a good demand. There is also a good trade doing in shipping, particularly in metal exports.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Sheffield Waterworks Company, at a special meeting of the proprietors held last Monday, decided to accept the terms offered by the Corparation for the purchase of their undertaking. The Bill, it is hoped, will now come before the House of Commons Committee as an unopposed measure, and may speedily pass into law. Millowners, large manufacturers, and others have had to be negotiated with for the abandonment of their opposition. This has been successfully done in every instance except the Duke of Norfolk, whose hostility, it is anticipated, will be arranged satisfactorily after interview. The purchase price to be paid by the Corporation is something equivalent to £2,220,000; others reckon it £100,000 less. The immediate effect has been to send up the original shares, which have long been at a discount, from £60 to close on par—99½. A good deal of successful speculation has been indulged in over the transaction.

Public sewers, even on the most approved system, have the disadvantage of noxious discharges at the gratings or manholes. This is more especially felt in the higher parts of the town, and particularly in hot weather. Dr. Sinclair White, the Medical Officer of Health, with the approval of the Health Committee, is making an experimental trial of a plan for flushing and deodorising the sewers in the upper parts of the town. The system is one which has been tried on the Continent and in several English towns. It consists in flushing short lengths of sewer with water mingled with a deodorising fluid. The deodoriser adopted is soluble phenyl, about two-thirds of a gallon being added to a cart-load (or 250 gallons) of water. By means of a short length of hose-piping and a lever, the whole of the 250 gallons is discharged down one of the manholes in a second or two, thus creating a rush down the sewer sufficient, it is thought, to remove accumulations of soil, while the deodoriser destroys the offensive effluvium. The limited trial which has already taken place has been sufficient to encourage further experiments.

A very singular incident occurred on the Manchester, Sheffield, and Lincolnshire Railway on Thursday. At Oughtibridge, a few miles from Sheffield, the down distant signal east of the station was observed to be swarming with bees near the top of the post round the outside casing of the lamp. The officials were unable to light the signal, and had, in consequence, to do their work by hand signal. It was midnight before they succeeded in dislodging the bees and bringing the signals into their accustomed use.

Mr. James Mansergh, C.E., of London, who was appointed by the Rotherham Corporation to report on the leakage of their baths, has reported that he found two separate failures in the building, viz., one in the cross walls at right angles to the river, and one in the floor of the baths themselves. The cross-wall at the north end of the first-class bath had developed two very fine cracks running diagonally upwards from the bath platform level at the west, and towards the east. The direction of the cracks seemed to indicate that there had been a slight settlement of the east wall, and they would probably not have occurred if the west wall had been built upon a similar foundation to the east, and at the same level. It was because the cross wall was tied into the unyielding west wall at one end, and into the slightly settling wall at the east, that the cracks had been produced. The north wall of the low building, containing the second-class bath, also showed a very slight crack on its outside. The second and more important failure was in the baths themselves, and particularly in the first-class baths. It had arisen from the settlement of the floor, especially on the west or river side. The cost of making the first-class baths water-tight would be about £350, and the second-class £120.

Messrs. Davy Brothers, the Park Ironworks, well known in the engineering world, have just held their annual meeting. Their trading shows a profit equal to 4 per cent. per annum, and a dividend to the amount has been confirmed, the sum of £1299 being carried forward. Mr. David Davy, the retiring director, was re-elected managing director.

South Yorkshire collieries continue to do a large trade with Hull. The weight sent to the great Yorkshire port last month was 156,840 tons, against 122,096 tons for June, 1886; for the six months 854,312 tons, against 612,488 for the corresponding period of 1886. At the head of the list is Denaby Main Colliery, with a tonnage of 18,456 During June the exports to foreign markets represented a tonnage of 87,232, against 58,870 for June, 1886; for the six months 403,758 tons, against 236,195 for the corresponding period of 1886. The principal increasing markets are again Russia, France, Germany, Sweden and Norway, Belgium, Italy, Denmark, Holland, and Egypt.

The Council of the Sheffield Chamber of Commerce had before them on Monday the Customs' duties of France, Canada, and Uruguay. A memorial had been drawn up by the Sheffield Chamber and presented by the Association of Chambers of Commerce to the Secretary for Foreign Affairs, and in it was set out a memorandum by Mr. J. A. Crowe, commercial attaché to the French Embassy. This memorandum practically admitted that the complaints were well-founded, and stated that the present temper of the French Parliament, in all matters of commerce, precluded the hope of any concession, and especially called attention to the fact that England, in her relations with France, has only most-favoured nation treatment by virtue of a law which can be repealed at a moment's notice. The Chamber passed a resolution viewing with great regret the proposal of the Canadian Government to impose prohibitory duties upon iron and steel, being clearly of opinion that such a course must inevitably be highly injurious to the trade of both Canada and of this country. At the request of the British Iron Trade Association, the Chamber agreed to memorialise the Canadian Government, through the Colonial Secretary, against the proposed duties. A letter was read from the Secretary of State for Foreign Affairs, enclosing a detailed report by the authorities of Monte Video, with reference to the unfair duties charged in that country upon the goods of Messrs. Joseph Rodgers and Sons, the well-known Sheffield cutlery firm. The Monte Video authorities justified the position they took, on the ground that the goods of Messrs. Rodgers were of the best quality, and consequently of the largest value.

A communication has been received in Sheffield from the newly-established British Chamber of Commerce in Turkey, having its headquarters at Constantinople. This Chamber has communicated with Sheffield, offering to protect the interests of British traders in that country. A motion has been passed by the Sheffield Chamber welcoming the announcement of the inauguration of the British Chamber in Turkey, and reciprocating its offer of assistance in any manner within its power.

An important letter has been received from Col. Nepean, Director of Army Contracts, requesting the Sheffield Chamber of Commerce to inform the Foreign Secretary whether a desire is prevalent among manufacturers in the Sheffield district for the publication of the prices quoted in the accepted tenders for Government contracts. The matter was fully considered, and the Chamber has decided that it is not desirable to publish such prices.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE is nothing special to notice in connection with the quarterly meeting of the Cleveland iron market, which was held at Middlesbrough on Tuesday last. The attendance was poor and the tone less cheerful than might have been expected. Buyers continue to watch the Glasgow market closely, and do not fail to take notice of the continued weakness thereof. They are confident that prices will have to be further reduced here, and meanwhile hold back their orders, consequently business is almost stagnant. As regards merchants' quotations, No. 3 g.m.b., for prompt delivery, remains at the same price as during the last three weeks, namely, 34s. 6d., but one or two small lots are said to have been sold at 1½d. less. Makers will not accept less than 35s., which is also merchants' price for delivery over the next three months. Forge iron is somewhat more plentiful than it was, the demand from finished iron makers being less owing to the hot weather. The value is now 33s. per ton, or 6d. less than a week ago.

There is at present but little inquiry for warrants. They were offered at Glasgow on Tuesday at 33s. 6d. per ton.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough store was on Monday last 335,959 tons, which represents a decrease of 894 tons during the week.

Exports of pig iron from Middlesbrough show some improvement this month. The quantity sent away up to Monday evening was 28,530 tons, as against 25,386 tons in June.

Inquiries for finished iron are few and far between. The competition for orders is very keen, but notwithstanding this, prices remain as last quoted. The men are working very irregularly owing to the hot weather.

The certificate of the accountant to the pig iron trade, which has just been issued, shows that the invoice price of No. 3 Cleveland pig iron during the past three months was 33s. 2·68d. per ton. Blast furnacemen's wages will remain unaltered, but miners will receive an advance of 1½ per cent.

The smelters in the south of France must surely be in a bad way, when the owners of the minerals with which they have hitherto been supplied, have to come to England to try and find a market for them. This is surely a very similar proceeding to carrying coal to Newcastle. Nevertheless it is a fact that it is being done at the present moment. A firm of merchants at Marseilles, to whom is entrusted the sale of a quantity of iron ore produced within eighty miles of that town, has been writing letters to English consumers with a somewhat pitiful story. They say that French blast furnace proprietors have hitherto taken all that they could supply; but lately most of them have been compelled to suspend operations. That consequently they are able now to export a considerable quantity of their native iron ore, which is of a very high quality, and about equal in metallic iron to that produced at Bilbao. They desire to find fresh markets for this ore; but, unfortunately, the prices they expect, f.o.b., at Mediterranean ports, are considerably in excess of what Spanish ore can be bought at, delivered ex ship at English ports. It is sad to find our French neighbours, in the iron trade, as badly off as we are in England, notwithstanding the difference in our respective commercial policies. Many people think that the depression which has lasted so many years in the British iron trade is due to our one-sided free trade notions, as they are called. Whether that be so or not, it seems tolerably clear that the French iron trade, which is conducted on exactly opposite principles, is in no better position. The French not only prevent as far as possible the importation of British iron goods of all kinds, but they give bounties to encourage shipbuilding and shipowning in France, to an extent which makes those industries more or less artificial ones. Yet the result they anticipated does not seem to have taken place. Shipowning and shipbuilding in France are, if possible, more depressed than in England, and Frenchmen seem to object to build or to own more ships, notwithstanding the encouragement which the State gives them. But it could scarcely have been anticipated that our protectionist neighbours would have been forced to come to us to sell their minerals, because their home consumers were everywhere stopping their works. Such a confession of weakness was scarcely to have been foreseen, and perhaps would not have been made if it had occurred to them how we should regard it. But necessity knows no law. At any rate, it is certain that French ores have no chance to find a market in England as against those of the North of Spain.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has lacked animation in the past week. There is to some extent a continuance of the reports as to the receipt of orders from America and Canada, but on account of the very unsatisfactory shipments these rumours have scarcely any effect on the market. It is a fact, however, that makers are obtaining American and Canadian orders, but they are generally small, and not such as to indicate any marked improvement in the demand. The amount of the output has been slightly increased since last report by the putting in of three furnaces—one at Gartsherrie, one at Eglinton, and one at Summerlee. A furnace has been extinguished at Carnbroe, but the total blowing is eighty-three as against eighty-one in the preceding week. Considerable additions continue to be made to the stock of pig iron in Messrs. Connal and Co.'s Glasgow warrant stores.

The market value of makers' pigs are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 49s. 6d.; No. 3, 44s. 6d.; Coltness, 54s. 6d. and 45s.; Langloan, 50s. 6d. and 46s.; Summerlee, 52s. 6d. and 43s. 6d.; Calder, 49s. 6d. and 42s. 6d.; Carnbroe, 44s. and 40s. 6d.; Clyde, 46s. 6d. and 41s. 6d.; Monkland, 43s. 6d. and 39s.; Govan at Broomielaw, 43s. 6d. and 39s.; Shotts at Leith, 49s. 6d. and 45s. 6d.; Carron at Grangemouth, 52s. and 44s. 6d.; Glengarnock at Ardrossan, 48s. 6d. and 41s. 6d.; Eglinton, 43s. 3d. and 39s. 3d.; Dalmellington, 44s. and 40s. 6d.

In the malleable iron trade, business has been comparatively quiet, but there is steady and increasing activity in steel. Messrs. Merry and Cuninghame have obtained several fresh orders both for home and American consumers, and have advanced the prices of basic steel blooms 2s. 6d. per ton.

The shipments of iron and steel manufactured goods from Glasgow in the past two weeks were £11,240 worth of locomotive engines and tenders for Huelva, £6500 ditto to Rangoon, £9500 marine engines to Bremen, £3800 ditto to Rangoon, a barge worth £3750 to Calcutta, a steamer and engines £7300 to Egypt, machinery to the value of £8160, sewing machines, £3112, steel goods £17,382, and general iron manufactures £43,100.

The Eglinton Iron Company have abandoned their clay-land ironstone mines in the lands of Todhills, Kerslands, and Brownhill, and are now removing their machinery from these pits; and Messrs. Merry and Cuninghame, who a year ago gave up Ryesholm pit, are about to close that at Highfield. These stoppages will cause not a little inconvenience and possibly distress to the mining communities of the parishes of Kilbirrie and Dalry.

The miners employed at the shale pits of the Scottish mineral oil companies have been working irregularly, and some of them have been on strike during the week in consequence of a reduction that has been made in their wages. This reduction has been rendered necessary by the unprofitable nature of the oil trade, in which great losses have been sustained by the companies in the past year. In the case of the Bloxham Oil Company, the miners have resolved to resume work and renew the strike two months hence, when they think they will have a better chance of success.

There has been a fair business in the shipping department of the coal trade in the past week, but the inland inquiry is very poor, in consequence of the stoppage of factories for the holidays.

With reference to the general reduction in the colliers' wages, the Central Board of the Lanarkshire Miners' Association have resolved—"That, looking to the reduction of wages and depressed rates of coal values, we strongly urge that all districts of the county resort to the old policy of restricted darg, eight hours a day and five days per week."

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

ANOTHER good week has been enjoyed in the steam coal trade, Cardiff totalling over 170,000 tons. At this rate the Bute Dock extension will become an urgent necessity, and the sooner the opening takes place the better. It is likely that the event will occur about the end of the month, and is expected to be accompanied with considerable demonstration. The extension will give 30 per cent. increase in dock capacity. This, singularly enough, exactly amounts to the percentage increase which has taken place under the new management, as a glance at statistics will show. Swansea showed a total slightly above 25,000 tons, Newport about an average, but the coasting a little less. This is not to be surprised at, as the house coal trade is dull, and has nothing of the vitality shown by the steam coal. Even the small steam is in much better favour than it has been, and an advance of 3d. to 6d. per ton is being generally exacted. The ruling price for best samples is 5s. 3d. per ton. This is quite a bound from late quotations, for at one time prices seemed to be gravitating down to 4s. Best steam coal prices are well maintained; current quotations, 9s. 6d.

Next year promises to change the course of trade somewhat from the Rhondda. The progression of the Barry is steady, and continuous, and though little has been said of late, a good deal has been done towards the Rhondda and Swansea Railway. The great undertaking of the line is the tunnel, which I am assured is almost half completed.

Sinking operations have been commenced at Tynygraig, between Ystrad Mynach and Caerphilly, under the direction of Mr. Galloway, of Cardiff, the engineer to the company—the Llanbradach. This is a new coalfield, on the side of the Rhymney and Great Western lines. The contract for sinking has been given to Mr. Coulson, of Cumberland.

House coal is being quoted at 8s. Coke is quoted at 14s. and 16s., according to quality. Pitwood is weaker, and 15s. is a common quotation; best, 3d. more.

The question of pitwood is one likely to come more prominently to the front in a little time. It is stated that Canada has only a supply for a few years, and there seems to be scarcely any cultivation of pitwood in this country, though there are millions of acres of waste land where it might well be grown. Some have suggested hollow steel tubes with wooden caps, but the cost would be a drawback.

Steel rail quotations now are about £4 7s. 6d.

I am sorry to report badly of the rail trade, from one cause or another. Two good cargoes appear to be the principal features last week; one of 1000 tons rails to New York from Newport, Mon., and another of 1100 tons to Colombo.

Ironmasters regard the signs of trade as moderately good, but the drought has done a good deal of mischief, and very few works have remained unaffected. The principal part of Dowlais works is stopped, and prospects are as gloomy as ever. The slight rain that has fallen has done nothing towards filling the ponds. In the Swansea District, where water has been in great need, the action of the authorities may be taken as a practical sarcasm against engineers in general. They have gone back to the primitive system of getting water, and re-opened about thirty wells which formerly supplied the town. Merthyr ran to within a fortnight of exhaustion from its reservoir, a leak having existed for a very long time, which has defied correcting, except in part, and that only lately. The cause of the leak is a lesson to engineers. The compensatory reservoir is sunk, in part, into the carboniferous limestone, and, as shown by the strata at the side, there is a fault or slip which is evidently continued through the bed. Sinking a few hundred yards higher up the valley, as any geologist would have advised, would have prevented this. The drought will have done good service if it awakens prudential measures for securing a good supply in future in all large towns.

The "Swansea Exchange" is now an accomplished fact. It is held every Tuesday, and judging from the number of tin-plate manufacturers and others attending, the weekly meeting will be just the thing needed. It may be of interest to give a few of the ruling quotations. Bessemer pig iron was 47s. to 47s. 6d.; Middlesbrough No. 4 forge, 33s.; No. 6 foundry, 34s.; Scotch, 42s. 1½d.; steel bars, £4 15s.; blooms, £4 5s.; steel rails, £4 7s. 6d.

The tin-plate trade is firm. Makers are well sold, and do not accept any but current quotations, and in some cases are even indifferent about working for forward delivery. Some degree of quietness has in consequence characterised sales, buyers hanging back a little, but it is not likely that any reduction will take place. Birmingham meeting will certainly follow in the track of that of Middlesbrough, which was firm. Tendency is clearly upward.

Present prices of tin-plates are: Cokes, 13s. 6d. to 14s.; Bessemer, up to 14s. 3d.; Siemens, as much as 14s. 6d. The stocks are clearing rapidly, and only 89,750 boxes remain in Swansea. Large shipments have been made of late, and this week will witness a "big" total. Last week 1000 tons went to New York, and 1800 to Philadelphia and Baltimore.

Imports were large of iron and steel in the Monmouthshire district. The tin-plate trade is satisfactory.

A meeting of tin-plate workers this week at Pontypool decided to subscribe 6d. per week each member towards a fund for trade combination and assistance.

There is an issue of £300,000 Cardiff Corporation stock going on by the London and Westminster Bank. The issue is to provide against the expenses of the new waterworks, &c., and will bear 3½ per cent. interest redeemable.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

IT is difficult to give a general opinion on the state of the Rhenish-Westphalian iron market just at present, for whilst in rolling mill products the tone is better than it was, the condition of the pig iron business has remained almost unchanged. In addition to this, the air is still so full of conventions, either definitely settled or just on the point of being so, that until the buyers know what is ultimately to be the upshot of all this unrest it is not likely that a steady, pronounced trade will be established. The middle German group of wrought ironworks on the 5th inst. formed a convention at Hanover; so now there are three actually established, and there is a serious talk of the south-west or Saar group also forming one; so when this takes place the whole of this branch of the trade will be under syndicates, all of which will then probably join hands, which must in one way or another materially change the condition of the market for wrought bar iron, including also that of wire rods, a convention of rollers of them having also been established within the last few days to regulate import and export prices. Dortmund has now been fixed upon for the chief office for the western group, and not Düsseldorf, which would have been more central and a better place.

Silesian rolling mills are also very satisfactorily engaged on every kind and section of iron, but the forge pig market is nevertheless very dull, on account of not knowing yet where to place the surplus make; but all the better qualities of pig iron find a ready sale. The former is noted M. 43 to 44; the latter, 48 to 50 p.t.; whilst bars cost M. 127·50; superior sorts, 130 to 140; and plates, 150 to 160 p.t., base price.

In the western districts ores, which for some time past have been neglected, are improving in price now old stocks are decreased, and have gained 3d. to 4d. a ton. They now stand at from M. 8 to 10·60, according to sort and quality, on trucks at station. The pig iron convention at their meeting on the 2nd inst., resolved to make no change in the minimum prices ruling last quarter, which indicates a little more confidence in the situation; and in the Siegerland a rise of M. 1½ to 2 has been demanded for forge pig. There is a moderate sale of high-percentaged spiegel, with a demand for very speedy delivery, but in other sorts little is doing. M. 50 to 50½ is noted for that containing 10 to 12 p.c. Mn., with 2 to 3 extra for higher qualities; best forge fetches 40 to 43·50; foundry, 49 to 55 the 3 Nos.; Bessemer, 50 to 51; basic, 41 to 42; Luxemburg forge, 32 to 33 p.t. at works. The raising of the price of bar iron has given an impulse to buyers, whose stock had run very low, the consequence being that the rolling mills have lately received orders enough to keep them nearly all actively going for some length of time to come, and they insist on six weeks' terms of delivery in most cases. Girders have gone up a few marks per ton, and the convention has raised the base price of plates from M. 145 to 150, otherwise there is no alteration to note in the condition of either the plate or sheet trade. Wire rods continue exceptionally dull, and it is only in steel rods that there is any demand worth speaking of. The steel works are sufficiently engaged, but they are being exercised by news from Belgium that a meeting had lately been held at Brussels wherein a fresh plan had been resolved upon for making commercial war upon them on their own ground with regard to rail tenders. The constant dread of this competition naturally keeps prices down here, but it seems strange that there should be no profit on rails at, say, M. 110 average price, when they can be sold in England at £4 2s., or M. 83 to 84 p.t., the raw materials being, if anything, cheaper here than there, to say nothing about the rate of wages in the two countries. The present base price quotations are—merchant bars, M. 112; angles, 111 to 115; hoops, 115; Bessemer billets, 110 to 112; plates, 5½ m.m., and above 150; sheets, 125 to 127; iron wire rods, 110; steel ditto, 108 to 110; drawn wire in either metal, 125 to 128; light rails, 110; heavy sorts at tenderings, ranging 109 to 112 p.t., all at works. The foundries and machine shops are a little better off for orders, but at the accustomed depressed prices. The metal founders were mostly fully employed during June, and if copper continues to rise, the prices of the finished goods, it is hoped and expected, will take a rise too, and not before it was needed. Castings in bronze cost M. 1·50; phosphor bronze, 1·60; and in red copper, also 1·60 p. ko.

The vice, steel spade and shovel, and manufacturers of other such-like hardware, have come to a common understanding to arrest the downward tendency of prices, caused by insane competition, which had got down below par.

No very large sales of ores were effected at Bilbao last week, yet prices are firm—Campanil 6s. 10d. and 7s. 2d.; first quality red ore, 6s. 6d. to 6s. 9d. a ton. The shipments amounted the week before last to 92,537 t. and would have been larger had there been more vessels to hand, and last week to 49,000 t. Shipments this year till 2nd July, 2,255,209 t.

The French iron market remains in a very dull and unsatisfactory condition. The Paris houses depress the prices, and this affects them all throughout the country, and they can nowhere be brought to make a rise either by works or dealers. Girders are being sold at 120f. to 125f., merchant iron at 130 to 135 p.t. The foundries and constructive shops are also only poorly supplied with work and the small hardware industries loudly complain.

The Belgian market continues quite firm, and for some branches orders come in abundance, only the constructive shops are just now ill supplied with work. Very large orders for girders and bar iron come to hand, a great part of the former for England and South America, all of which tends to encourage a rise in prices, those fixed at the last convention meeting remaining unchanged and being now paid. Forge pig is noted firm at 42f.; best sorts at Charleroi 50, down to 40 for mottled. The coal market is unchanged; coke firm at 11·50f. p.t.

LAUNCHES AND TRIAL TRIPS.

H.M.S. UNDAUNTED (12) belted cruiser, steamed out of Plymouth Sound into the Channel recently for a final contractor's four hours' trial of her machinery with forced draught. The vessel was in charge of Captain H. H. Rawson, C.B., the navigation was conducted by Lieutenant E. Leak, and the officials from the Admiralty present were Mr. Thos. Soper, engineer from the steam branch of the Admiralty; the builders were represented by Mr. J. P. Hall, engineering manager; Mr. H. Williams, chief inspector of machinery; and Mr. C. Rudd, second assistant to the chief engineer of the dockyard on behalf of their respective departments; on behalf of the ship, the trial was watched by her chief engineer, Mr. E. Norrington, and Mr. C. G. Nicholls, constructor, was present to represent the constructive department of the dockyard. The vessel was ballasted with heavy weights in order to bring her down to her deep load line draught, the same as if she had all her stores, guns, ammunition, coals, and crew on board ready for sea. Her draught of water forward was 20ft., and aft 22ft. The result of the trial was as follows:—Starboard engine horse-power, 4204; port engine horse-power, 4398; for both engines 8602, or 102 over the power contracted for, which was 8500. The highest power obtained was 9020, or 520 above what was contracted for. The speed of the ship on the measured mile was 19·4 knots per hour, which is the highest speed attained by any of her Majesty's heavily-armed ships of war. The wave line was measured, and the curve proved that the protective belt was above and below the water line in the position as originally intended in the design. The stability of the ship was most satisfactory, and the machinery worked admirably throughout. The ventilation of the ship was also exceedingly satisfactory. The Undaunted is the second of five vessels of the same class ordered about two years ago by the Admiralty. Messrs. Palmer and Co. have done important work in completing the two vessels entrusted to them to build, and which are the first two of the five. They have thus completely demonstrated how rapidity of construction and excellence of workmanship can be easily combined. This vessel previously had a natural draught trial on the 5th inst., when she attained a speed of over 17 knots, and indicated 5640 horse-power during the four hours' run, the maximum horse-power being 5890, or 390 horse-power above the contract, which was 5500.

Messrs. Raylton, Dixon, and Co. have launched a steel steamer, named the Tartar, which has been built for Messrs. Gellatly, Hankey, Sewell, and Co., London, for their China trade. Her leading dimensions are 332ft. over all, breadth 38ft., 27ft. depth moulded. She is built on fine lines, and will have a carrying capacity of over 4100 tons of tea. She has long bridge, top gallant forecastle, poop aft for accommodation of passengers, her officers and engineers being arranged under the bridge. Water ballast in double bottom in after hold and under engines, teak decks especially strong, and ample cargo discharging gear, makes her a ship especially adapted for this particular trade. She will be fitted with engines by Messrs. Thos. Richardson and Sons, of Hartlepool, built on the triple expansion principle, having cylinders 26in., 42in., and 69in., and 42in. stroke, capable of developing 1700 indicated horse-power.

The steamship Benholm, which was launched by Messrs. Craig, Taylor, and Co., shipbuilders Stockton-on-Tees, for order of Mr. Joseph Hoult, of Liverpool, had a most successful trial trip at sea last week, a speed of over 10 knots having been attained. She is built for the Demerara sugar trade or American cotton trade. She is fitted with triple-expansion engines, with cylinders 18in., 29in., and 48in. by 36in. stroke, pressure 150 lb., by Messrs. Carr and Co., Sunderland. Both ship and engines performed the work very satisfactorily.

On the 6th inst., Messrs. Edward Withy and Co., West Hartlepool, launched the steel screw steamer Picton, built for Messrs. R. Ropner and Co., West Hartlepool. She is a vessel of 300ft. in length, with a large deadweight carrying capacity and built to 100 A1 class at Lloyd's. The vessel has a long raised quarter-deck, short poop, long bridge house and a top-gallant forecastle, and is built on the web frame system. The main, bridge, and quarter-decks are of iron and steel, the charthouse, cabin skylight, engine room skylight, bulwarks, rails, galley, grain divisions, and four watertight bulkheads of iron. The steamer is fitted with Withy and Sivewright's patent improved cellular double-bottom for water ballast all fore and aft; four steam winches, patent windlass, and two donkey boilers, by Clarke, Chapman, and Co., stockless anchors, hauling up into hawse pipes; hand and steam gear amidships, by Davis and Co., and Hastie's right and left-hand screw gear aft. The vessel is rigged as a two-masted fore-and-aft schooner, with iron lower masts, and she will be fitted with triple expansion engines by Messrs. Blair and Co., Stockton-on-Tees.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, June 30th.

RAIL-BROKERS received instruction to-day from railway builders in the South-western States to make cable inquiries for prices for September and October deliveries of rails at New Orleans, Galveston, and San Francisco. Pennsylvania buyers have made inquiries for Bessemer, Spiegel, and rail blooms. It is rumoured to-day that a speculative movement is to be attempted in copper, but the best authorities in copper ridicule the suggestion. Railroad earnings are increasing in the States west of the Hudson River. Traffic is unexpectedly large. Rolling stock is scarce and large contracts have been placed for coal, lumber, and general freight cars. The consumptive capacity of the country is increasing, and prices are firm in most channels. Railroad builders have 8000 miles of road under contract for the next six months. Only 1700 miles of main track have been laid so far. The abundance of money is helping promoters of a multitude of new enterprises. Business in building material, such as lumber, stone, &c., is very active, and the excess in value of operations undertaken in thirty cities is found to be 30 per cent. greater than for the first half of last year. Shipbuilding is increasing, but is confined to the construction of small craft for coastwise service. The wheat, corn, and cotton crops are large. Lumber is in active demand for export. The blast furnace output will be 10,000 tons per week greater in six months. Six steel mills are under construction, to be completed next winter. Labour agitations are in progress in the iron trade for a 10 per cent. advance, and at this hour a strike is threatened, but the market is too bare and consumption too heavy for a prolonged suspension.

NEW COMPANIES.

THE following companies have just been registered:—

Coryo Gold and Antimony Mines, Limited.

This company proposes to carry on the business of a mining company, but the registered documents do not afford any information as to the locality in which it is proposed to carry on operations. It was registered on the 4th inst., with a capital of £100,000, in £1 shares, with the following as first subscribers:—

	Shares.
W. Powter, 72, Durley-road, Amhurst Park, N., secretary	1
G. E. D. Durnford, Old Charlton, accountant	1
G. H. Newman, 47, Walterton-road, W., secretary	1
J. Owen, 127, Packington-street, N., accountant	1
A. Evans, 89, Brook-street, Commercial-road, stenographer	1
C. J. Bosdet, 14, Bayley-street, W.C.	1
C. E. Green, 6, Wells-street, Gray's-inn, clerk	1

The number of directors is not to be less than three nor more than nine; the subscribers are to appoint the first; qualification, 100 shares. The remuneration of the board is to be 5 per cent. of the net profits, but is not to exceed a sum equal to £500 per annum to each director; but no director is to receive less than £150 per annum, and in the event of the percentage of the profits being insufficient for the payment of that amount, the same will be made up out of the assets of the company irrespective of profit.

Eureka Refrigerating Company, Limited.

This company was registered on the 2nd inst., with a capital of £100,000, in £1 shares, to purchase the patent rights of Frank Albert Smith, for improvements in refrigeration, and in apparatus for the manufacture of ice. The subscribers are:—

	Shares.
W. H. Reynolds, 19, George-street, Hanover-square, merchant	1
Clarina Shaw, Fire Brigade, Southwark	1
W. B. Chapin, George yard, Lombard-street	1
T. Doublet, Manor Park, Essex	1
J. Higson, C.E., 18, Booth-street, Manchester	1
W. R. Blogg, 23, Old Broad-street, law stationer	1
E. T. Booth, 49, Arlingford-road, Tulse Hill	1

The number of directors is not to be less than three, nor more than seven; qualification, 250 shares; the subscribers are to nominate the first; remuneration, £1500 per annum, with power to the directors to increase the same by any sum not exceeding £3000 in any year in which 10 per cent. dividend is paid.

Higginbottom and Stuart, Limited.

This is the conversion to a company of the business of flour mill and general engineers and iron and brassfounders carried on in Sell-street and Fleet-street, Liverpool, by the above-named firm. It was registered on the 2nd inst., with a capital of £30,000, in £10 shares. The subscribers are:

	Shares.
*J. Higginbottom, C.E., 51, Sell-street, Liverpool	1
*O. Stuart, 117, Bedford-street, South Liverpool, engineer	1
*B. Stuart, Seaforth, general manager	1
*T. W. Stephens, 39, Lime-street, shipowner	1
C. J. Higginbottom, 70, Aspen-grove, Liverpool, mechanical engineer	1
T. H. Brookes, 16, Blantyre-road, Liverpool, clerk	1
D. Chadwick, 36, Coleman-street, chartered accountant	1

The number of directors is not to be less than three, nor more than seven, the first being the subscribers denoted by an asterisk; qualification, 10 shares; remuneration, £200 per annum.

Junction Reefs Gold Mine Company, Limited.

This company was registered on the 1st inst., with a capital of £250,000, in £1 shares, to carry on mining operations in New South Wales. The subscribers are:—

	Shares.
G. E. Borradaile, 1, Edinburgh-terrace, Kensington Palace, barrister	1
B. F. Cramer, 13, Elsham-road, Kensington	1
H. C. Raikes, Suffolk House, Laurence Pountney-hill	1
J. Wallace, 81, Gracechurch-street, merchant	1
J. G. Laidley, 62, Queen's-road, Bayswater	1
R. M. Albery, West Hill, Epsom	1
T. Wright, 7, St. Paul's-place, Canonbury	1

The number of directors is not to be less than three, nor more than seven; qualification, 200 shares; the subscribers are to appoint the first; remuneration, £1200 per annum. The chairman of the local committee at Sydney will be entitled to £300 per annum, and each ordinary member of such committee to £200 per annum.

Kimberley United Diamond Mining Company, Limited.

On the 6th inst. this company was registered, with a capital of £250,000, in £10 shares, to acquire the diamond mines known as Octahedron Mine, Hall's Claims, the North-West Company's Claims and the South-West Company's Claims at Kimberley, Cape Colony. The subscribers are:—

	Shares.
J. F. Gordon, 34, Clement's-lane, merchant	1
F. J. Mirrilees, 31, Hertford-street, Mayfair, shipowner	1
John Napier, 6, Audley Mansions, Grosvenor-square, shipowner	1
C. W. Stronge, C.B., 9, Osnaburgh-terrace, Regent's Park	1
*C. Howard, 17, Philpot-lane, shipowner	1
W. Borders, 3, Fenchurch-street, secretary	1
J. Smith, 3, Fenchurch-street, secretary	1

The number of directors is not to be less than two, nor more than seven, in addition to the managing director or directors; qualification, £1000 in shares or stock. The first directors are: Sir Donald Currie, K.C.M.G, M.P., Messrs. C. Howard and Campbell Wyllie. The company in general meeting will determine the remuneration of the board.

Midland Uruguay Railway Company, Limited.

On the 2nd inst. this company was registered, with a capital of £600,000, in £10 shares, to acquire and carry into effect a concession granted by the Government of Uruguay for the construction, equipment, and working of a railway between Paso de los Toros, on the Rio Negro, and the city of Salto, passing through the city of Paysandu. The subscribers are:—

	Shares.
D. J. Lanley, 124, King Henry's-road, Primrose-hill, N.W.	1
H. Cave-Brown, 9, Cowley-street, Westminster	1
J. C. Hayne, 17, Cornwall-gardens, South Kensington	1
J. W. Curtis, Bromley, Kent	1
R. Anderson, Welwyn, Herts	1
T. O. Chapman, 50, Old Broad-street, solicitor	1
C. Chabot, Talbot-villa, Buckhurst-hill	1
A. J. Kent, 10, Cross-road, South Wimbledon	1

The number of directors is not to be less than four, nor more than seven; qualification, 100 shares; the subscribers are to nominate the first.

Natural Portland Cement Company, Limited.

Upon terms of an agreement of the 9th ult., this company proposes to acquire the business of Messrs. Edward Prime, Miller Prime, and Albert Prime, of Barrington, Cambridge, cement merchants, brick-makers, and lime burners. It was registered on the 2nd inst., with a capital of £100,000 in £5 shares, and 250 4 per cent. debentures of £100 each. The subscribers are:—

	Shares.
E. J. Suckling, 4, Worship-street, printer's manager	1
E. B. Howard, 9, Lebanon-street, Walworth, clerk	1
F. Burr, 43, Porson-street, Lewisham, clerk	1
R. H. Gould, 33, Theobald's-road, clerk	1
C. Dunlop, 4, Motley-avenue, Finsbury, printer	1
E. Lea, 12, Nicholas-lane, clerk	1
J. Jackson, Northwich	1

The number of directors is not to be less than three, nor more than nine, the subscribers are to appoint the first; qualification for subsequent directors, 100 shares; remuneration—chairman, £150 per annum; each director, £100 per annum. The board will also be entitled to a bonus of 5 per cent. upon all profits after the shareholders have received 10 per cent.

BUTE DOCKS EXTENSION. — Owing to some delay, the opening of the extension of the Bute Docks is postponed for a week or two. The undertaking is a large one, but there is plenty of energy in active exercise to bring about a completion. Cardiff then will be worthy of its position as the first coal port of the world. The Queen's reign is, singularly enough, the measure of its progress, from a very insignificant place to its present position. The historian of the coal trade of Wales tells of a widow woman sending a barge load of steam coal to Cardiff, which proved the starting-point. An Aberdare coalowner followed suit, first with a parcel of coal, and then with a truck load; and this literally put a match to the huge bonfire. What shall be said for the men whom no Smiles has yet honoured, who have brought about all this, and been the means first of supporting an enormous population, and then of getting it into shape, civilising and rationalising them for their own good and that of the country?

THE LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.—The usual monthly meeting of this Association was held in the Cannon-street Hotel on Saturday, the 2nd inst., at 7.30 p.m., when the half-yearly report and balance-sheet was submitted and approved. Mr. Ronald, of Woolwich Arsenal, the senior auditor, stated that the accounts were in a most satisfactory condition, and showed that they had made steady financial progress during the last twelve years, but more especially during the last five years of that time. A paper was read by Mr. Haggis on "The Native Army in India." This was a continuation of or the second part of a similar one read at the January meeting, and dealt principally with the system of reorganisation adopted after the meeting, and the present condition of our Indian Army. The author stated that British India was now much better governed than at any previous period, and the Army better equipped and organised and more loyal to us than ever before, and that if we continued to treat the natives with kindness and consideration we might rely on their loyal and effective support in any time of trouble or difficulty we might have before us.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

4th July, 1887.

9464. EXPANSIBLE SOCKETS, E. Porte and A. Josseron, London.
9465. PUMPS, G Blackwell, London.
9466. LIFTS, W. P. Gibson, London.
9467. STRAW HATS, W. Vero, jun., and W. Bussey, London.
9468. RED AZO-COLOUR, T. R. Shillito.—(*J. R. Geigy, Switzerland.*)
9469. WASHING and RINSING PLATES, &c., G. W. B. Crees, London.
9470. CONNECTING BARS, &c., C. Bennett, Northamptonshire.

5th July, 1887.

9471. CASTING METALLIC INGOTS, J. B. D'A. Boulton, London.
9472. SKATES, J. Sant, Newcastle-under-Lyme.
9473. GAS ENGINES, A. W. Earnshaw and A. A. Dorrington, Manchester.
9474. TREATMENT of ORES, J. Parkinson, London.
9475. PORTABLE TOWER, J. Whitehead and W. Hayhurst, Burnley.
9476. DRIVING the BOBBIN RAIL of ROVING FRAMES, J. Holt, Manchester.
9477. BRAKE-HOLDER for CYCLES, J. G. Booth, T. Thornton, and F. Booth, Bury.
9478. CLOSING BOTTLES, F. Ashton, Spilsby.
9479. PLANING WOOD, M. Sherry, Glasgow.
9480. DRIVING GEAR of BICYCLES, J. L. Garsed, Halifax.
9481. STRETCHING TROUSERS, J. Glendening, London.
9482. WASHING CLOTHES, J. B. Moorhouse and W. W. Barraclough, Keighley.
9483. RAILWAY CHAIR, F. A. Durnford, London.
9484. BALL for SHOOTING, W. Currie, jun., Edinburgh.
9485. TELEPHONIC TRANSMITTERS, J. L. Corbett, Glasgow.
9486. CATTLE TRUCKS, J. Hood, Glasgow.
9487. COMBINED RULER and CALENDAR, A. S. Goodrich and J. J. Moore, London.
9488. RAILROAD TIE, R. Morrell and E. F. C. Young, London.
9489. CIRCULAR SAW SPINDLES, W. Lee, London.
9490. FACILITATING the STARTING of TRAM-CARS, A. C. Bluett, London.
9491. DRIVING MECHANISM for SEWING MACHINES, J. K. Macdonald.—(*The Singer Manufacturing Company, United States.*)
9492. PREPARING SEAWEEDS, M. Smout and C. L. Smout, London.
9493. SOFTENING LEATHER, H. H. Lake.—(*A. M. Bowers, United States.*)
9494. CAR WHEELS, E. Peckham, London.
9495. CAR WHEELS, E. Peckham, London.
2496. CAR WHEELS, E. Peckham, London.
9497. ELECTRIC CIRCUITS, H. H. Lake.—(*J. F. McElroy, United States.*)
9498. NAIL-MAKING MACHINES, H. H. Lake.—(*E. B. Parkhurst, United States.*)
9499. DRILLS, A. J. Boult.—(*W. H. Larimer, United States.*)
9500. PAPER-ROLL HOLDERS, W. P. Thompson —(*The American Roll Paper Company, United States.*)
9501. FURNACES, W. P. Thompson.—(*The Aërated Fuel Company, United States.*)
9502. PERCUSSION FUZES, H. C. Seddon, London.
9503. WIRE CLOTH and CARPET LOOMS, A Knox, Glasgow.
9504. WINDOW FASTENERS, C. D. Norton, London.
9505. ALCOHOLIC LIQUORS, J. Wetter.—(*E. T. Gautier, Belgium.*)
9506. HOT-AIR PUMPING ENGINE, P. A. Kühne, London.
9507. TABLE FOUNTAINS, A. J. Needham, H. C. Needham, and W. C. Needham, London.
9508. FASTENINGS for STUDS, &c., G. Coop, London.
9509. PIN or MATCH-BOXES, J. W. Hunter and J. A. Mackay, London
9510. VELOCIPEDES, J. J. Statham, London.
9511. MATCHES, W. B. Fitch, London.
9512. PENS for RECORDING INSTRUMENTS, J. Gordon, jun., London.
9513. NAIL-ROLLING MACHINE, H. E. Fuller, London.
9514. PORTABLE RAILWAY, A. M. Leinwather and H. Glaser, London.
9515. TANNING, E. Worms and J. Babé, London.
9516. OIL-CANS, A. Moyes, London.
9517. ARC ELECTRIC LAMPS, F. de Wolffers, London.
9518. PENHOLDERS, J. Y. Johnson.—(*The Eagle Pencil Company, United States.*)
9519. PENHOLDERS, J. Y. Johnson.—(*The Eagle Pencil Company, United States.*)
9520. AGE CALENDAR, B. Wecksler and M. I. Becker, London.
9521. FILTER PRESSES, S. H. Johnson and C. C. Hutchinson, London.
9522. MEASURING, P. H. B. Bedingfeld and E. Jones, London.
9523. ARRESTING the WORKING of KNITTING MACHINES, H. J. M. Mellor, N. Lowater, and A. Baker, London.
9524. ELLIPTIC SPRINGS, S. Pitt.—(*T. B. Chase, United States.*)
9525. PRINTING MACHINES, J. C. Mewburn.—(*J. Derriey, France.*)
9526. RULING MACHINES, R. Haddan.—(*J. Dale, United States.*)
9527. DISCHARGING METERS, A. Springer and W. Kent, London.
9528. LINK-MOTION in STEAM and other ENGINES, R. Haddan.—(*J. Rademacher and F. Voss, Germany.*)
9529. PRODUCING ART and other ORNAMENTATIONS on GLASS, &c., C. G. Picking and E. Bussy, London.

6th July, 1887.

9530. HOLDERS for SEWING and TRAVELLING OUTFITS, &c., S. Hahn, Germany.
9531. APPARATUS for PRINTING FLOOR-CLOTHS, &c., E. Webb, Manchester.
9532. PROPULSION, &c., of SHIPS, W. R. Bigsby-Chamberlain, Eastbourne.
9533. EXPANDER for BREAKING COAL, &c., R. Thompson, Wigan
9534. OIL-CAN and LAMP FILLER, E. G. Eaton.—(*J. Lancaster, United States.*)
9535. EXCAVATING APPARATUS, T. Smith, Rodley, near Leeds.
9536. DAMPING, GUMMING, &c., PAPER, J. Allen and the Allen Machine Company, Halifax.
9537. PROMOTING COMBUSTION in BOILER and other FURNACES, R. Hamilton and T. McKillop, Glasgow.
9538. CALICO PRINTING MACHINES, R. Hamilton and T. McKillop, Glasgow.
9539. FEEDING FUEL into FURNACES, W. Davidson, Glasgow.
9540. CENTRE PORTIONS of the COVERINGS of DOWN QUILTS, T. Nicol, Glasgow.
9541. MOTIVE-POWER from CHEMICALS by HEAT, J. Robson and W. J. Cowan, Newcastle.
9542. DUST-PAN IMPROVEMENTS, J. Kemp, London.
9543. SULPHATE of AMMONIA, H. C. Bull and Co. and W. E. Sendey, London.
9544. VENT-PEGS, S. Smith, Sheffield.
9545. TREATMENT of RHINOCEROS HIDE, R. Ward, London.
9546. BLAST PIPE and EXHAUST ARRANGEMENT for STEAM ENGINES, J. Atkinson, London.
9547. ELASTIC COUPLINGS, E. Mossberg, London.
9548. CHIMNEYS and VENTILATING SHAFTS, E. J. Hurley, London.
9549. BOTTLE STOPPER, T. Judge, London.
9550. FASTENER for ATTACHING ARTICLES to WATCH GUARDS, &c., F. Price, London.
9551. TACK or NAIL-STRIP MAKING MACHINES, H. H. Lake.—(*G. W. Copeland, United States.*)
9552. SHAFT and other COUPLINGS, L. Wetzell, London.
9553. WEIGHING MACHINES, W. Defries, O. Eckenstein, and V. I. Feeny, London.
9554 TRACTION and SELF-MOVING ENGINES, T. Cooper, London.
9555. ORDNANCE, G. Quick, London.
9556. APPLIANCE for CARRYING ANGLERS' NETS, A. J. Adams, London.
9557. LASTING MACHINES for BOOTS and SHOES, H. H. Lake.—(*G. W. Copeland, United States.*)
9558. BALL AXLE ARM and BOX for the WHEELS of VEHICLES, C. E. Jackaman, London.
9559. SECURING in POSITION ARTICLES EXHIBITED for SALE in SHOP WINDOWS, J. Bruce, Birmingham.
9560. FASTENINGS for CUFFS, &c., W. West, London.
9561. ORDNANCE, M. Gledhill, London.
9562. ORGAN, &c , KEYBOARDS, R. Smith, Glasgow.
9563. DETACHING HORSES from VEHICLES, J. Hirschfeld, London.
9564. ORDNANCE, M. Gledhill, London.

7th July, 1887.

9565. ASCERTAINING CONDITION of PIPES, &c., W. H. Beck.—(*A. Kaiser, France.*)
9566. LOCOMOTION, D. Cockshaw, Glass Houghton.
9567. WEDGES, A. B. Baylis and E. Walker, Rotherham.
9568. FURNACES, N. C. F. Jochumsen.—(*J. Hansen, Denmark*)
9569. RAISING the PILE of SEALSKIN, &c., H. Lister, Halifax.
9570. COMPENSATING APPARATUS, H. Williams, Glasgow.
9571. MINERS' PICKS, J. A. Redfearn, Chesterfield.
9572. UTILISATION of "FLUX SKIMMINGS," A. E. Tucker Smethwick.
9573. LOCK STOPPERS for BOTTLES, S and W. Ramsey, Hull.
9574. CONSUMING SMOKE, J. Hull, Liverpool.
9575. DOCUMENT CASES, W. P. Thompson.—(*L. Field, United States.*)
9576. LOCKING SAFES, W. S. Masters and E. G. Wood, Liverpool.
9577. TELESCOPIC SIGHTS, W. J. Jeffery, London.
9578. UNIQUE BOTTLE SOAKER and CASE FILLER, C. B. Inman, Hunslet.
9579. VARNISH for LAMP REFLECTORS, F. W. Hayward, Norwich.
9580. RULING MACHINE, M. J. D. Carter, London.
9581. NAILS, E. S. Clark, London.
9582. COUPLING, E. Murgatroyd, London
9583. WOOD PAVING, D. Goddard, Farnham.
9584. STARTING VEHICLES, J. J. Hooker, H. Lescher, R. G. Schwarz, London.
9585. OPENING GREENHOUSE VENTILATORS, R. and C. G. Kidd, London.
9586. OBTAINING ALUMINIUM and ALLOYS, A. Mann, London.
9587. STAND, D. Freeman, W. H. Foster, and H. Bentley, Lozells.
9588. VELOCIPEDES, C. P. Byrne, London.
9589. VELOCIPEDES, C. P. Byrne, London.
9590. KNIFE SHARPENING MACHINE, B. S. J. Mackay, London.
9591. CANS, J. E. A. Gwynne, London.
9592. SPORTING CARTRIDGES, M. Tweedie and F. L. Muirhead, London.
9593. FIREPLACES, H. J. Hansom, London.
9594. CUTTING and PARING LEATHER, C. H. Raeb, London.
9595. EGGS, W. Robinson, London.
9596. RACQUET BATS, J. Salter, London.
9597. ROLLING MILL, S. Duff, London.
9598. ELECTRICAL BREAKING CONTACTS, I. A. Timmis, London.
9599. TRICYCLES, J. Wharton and C. W. Hoskyns-Abrahall, London.
9600. DIRECTING LIGHT, W. Hucks, London.
9601. BOILERS, J. de Fontaine, London.
9602. MAGNETIC CURATIVE APPLIANCES, H. W. Call, London.
9603. FRICTION CLUTCHES, O. Reynolds, Manchester.
9604. YIELDING COUPLINGS for SHAFTS, O. Reynolds, Manchester.
9605. MANUFACTURING PORTLAND CEMENT, G. H. Innes, London.
9606. FILTERS, P. Everitt, London.
9607. COMBS, J. H. Edmunds, London.
9608. TWIN CRANK BICYCLE, J. Lavery, London.
9609. COMPOUND ENGINES, D. Greig and F. J. Anson, Leeds.
9610. SELF-FOLDING BAGS, W. G. Wallis and J. Kirk, London.
9611. The PURSE NOSE-BAG, W. G. Wallis and J. Kirk, London.

12,825A. STEAM ENGINES, T. Mudd, Liverpool, 8th October, 1886.—[Received 8th July, 1887. This application having been originally included in No. 12,825, A.D. 1886, takes under patents Rule 23, that date.]

8th July, 1887.

9612. PLASTERING MACHINES, W. E. Baker, London.
9613. CLOSING of AIR-TIGHT DOORS in SHIPS, C. Skidmore, Hockley.
9614. METALLIC SEATS, W. H., S., and C. Sproston, Birmingham.
9615. TEMPLES in LOOMS for WEAVING, W. E. Johnys, Bradford.
9616. MEASURING HEIGHT, W. P. Ingham, Middlesbrough-on Tees.
9617. METALLIC GRIT, J. Harrison, Stockton-on-Tees.
9618. VARNISH, S. Washington, Oaklands.
9619. STOPPING LEAKS, J. Reid, Bolton.
9620. MUSTARD, A. Carter, London.
9621. BATS, G. S. Grimston, London.
9622. CONCRETE FLOORS, J. A. Jones, London.
9623. ANGLE CLAMPS, W. H. Welshman, Birmingham.
9624. POWDERED ANILINE WRITING-INKS, R. J. Waters, Manchester.
9625. ADVERTISING APPARATUS, T. and J. H. Carter, Sheffield.
9626. METALLIC HANDLES, W. Tyzack and S. S. Balme, Sheffield.
9627. GIRDERS, F. Pilkington, London.
9628. KETTLES, G. Clark, London.
9629. STOVES, G. Clark, London.
9630. VELOCIPEDES, W. Clegg, London.
9631. VELOCIPEDES, W. Clegg, London.
9632. PULP, T. B. Holmes and S. H. Holmes, Liverpool.
9633. TUBES, W. P. Thompson.—(*M. C. Stone, United States.*)
9634. TRIVETS, R. Rowbotham, London.
9635. DOOR LATCHES, J. Lindley, London.
9636. LOOMS, S. Blamires, London.
9637. CONTROLLING DEVICES, B. Drake, J. M. Gorham, E. Manville, and W. L. Magden, London.
9638. STEAM BOILERS, W. and J. Beesley, London.
9639. EXTRACT of SUGAR and TEA, A. McDougall, London.
9640. CRICKET PAD, R. J. Shepherd, London.
9641. RAISING SUNKEN BOATS, &c., P. Berthelot, London.
9942. BUCKLES, J. S. Boyd, London.
9643. ROUNDABOUTS, F. Savage, London.
9644. PROVIDING ESCAPE for ANIMALS from FIRE, O. A. Ericsson, London.
9645. BOILERS, F. Martinot, London.
9646. HOSE, G. Meacom, London.
9647. ROTARY MOTIVE-POWER ENGINES, A. Glembowieski, London.
9648. CIGARETTES, A. B. Biggs, London.
9649. STERN BEARINGS of SCREW PROPELLER SHAFTS, S. Menzies.—(*J. Menzies, United States.*)
9650. LABELS for CIGARETTES, J. A. Bonsack, London.
9651. CAR COUPLINGS, P. Jensen.—(*D. J. Harding, J. S. Cain, R. McDonald, and P. Cain, United States.*)
9652. SEALING PACKAGES, A. J. Phelps, London.

9653. Clasp for Elastic Straps, C. Voorhis and A. Shenfield, London.
9654. Galvanic Batteries, J. J. Shedlock, London.
9655. Measuring Force, A. J. L. R. Goddyn, London.
9656. Fire-bar, W. E. Gedge.—(*Wiedenbrück and Wilms, Prussia.*)

9th July, 1887.

9657. Cleaning Fibrous Waste, J. Allmann.—(*H. Isitt, United States.*)
9658. Weft Forks for Looms, T. Ratcliffe, Manchester.
9659. Cotton Cloth, J. Hothersall, Manchester.
9660. Driving Gear, J. Wilks, Stockton-on-Tees.
9661. Applying Lubricating Matter to Journals and Bearings, A. Ness, Stockton-on-Tees.
9662. India-rubber Valves, C. Moseley and B. Blundstone, Manchester.
9663. Air Guns, A. Arbenz.—(*Messrs. Flurscheim and Bergmann, Germany.*)
9664. Drying Sand, J. J. Pearson.—(*J. McDonald, Japan.*)
9665. Self-generating Gas Burners, J. J. Norman, London.
9666. Flooring Cramp, W. B. and N. N. Haigh, Manchester.
9667. Automatically Extracting Honey, J. Dixon, Yorkshire.
9668. Excavators, H. O. Baldry and J. T. Pullon, Leeds.
9669. Vents for Casks, H. Harrison, Leeds.
9670. Automatic Coupling of Carriages, G. W. Moon, London.
9671. Pneumatic Brakes for Railways, E. H. Trelease, London.
9672. Fustian Cutters' Knives, R. Collinge, Manchester.
9673. Iron Fences, G. H. Boulton.—(*C. W. Howarth, Toronto.*)
9674. Punching Presses, T. Dixon and J. Bowers, London.
9675. Packing for Stuffing-boxes, A. J. Boult.—(*P. Aunay, Russia.*)
9676. Seats of Tram-cars, &c., W. Bilsborrow, Liverpool.
9677. Knitting Machines, J. R. A. Peter, London.
9678. Storage of Fish, A. Mitchell, London.
9679. Expanding Reamers, J. Whiteley, London.
9680. Kettle, C. Wayte, London.
9681. Extraction of Platinum, A. N. Contarini, D. Forbes, and R. Matthews, London.
9682. Advertising in or on Match-boxes, &c., L. de Liendendorff, London.
9683. Detachable Hame Couplings, A. H. Fryer.—(*J. E. Hyde, United States.*)
9684. Mechanical Devices, C. J. Whellams and C. R. Bestwetherick, London.
9685. Boxes for Galvanic Batteries, D. A. Davis, London.
9686. Gun Carriages, R. C. Christie, M. Gledhill, and H. H. S. Carington.—(*J. B. G. A. Canet, France.*)
9687. Gun Carriages, R. C. Christie, M. Gledhill, and H. H. S. Carington.—(*J. B. G. A. Canet, France.*)
9688. Hydraulic Brake Apparatus, R. C. Christie, M. Gledhill, and H. H. S. Carington.—(*J. C. G. A. Canet, France.*)
9689. Automatic Machine Gun, T. Nordenfelt, London.
9690. Purifying Molasses, C. Leuchtenberger and B. Moiske, London.

11th July, 1887.

9691. Charging Steam Boilers with Anti-corrosive Liquids, J. Batson, H. S. Batson, and W. G. Causer, Birmingham.
9692. Treatment of Textile Fabrics, J. Hebblewaite, Manchester.
9693. Photograph Frame or Holder, W. D. Wilkinson and F. Fowler, Birmingham.
9694. Burning of Cement, F. W. S. Stokes, London.
9695. Windows, W. H. Wise, West Hartlepool.
9696. Eyelets for Boots, J. Butterworth, Rochdale.
9697. Bolts for Doors, T. Hartley, Bradford.
9698. Crank Shafts, R. Stephenson and W. Stafford, Newcastle-on-Tyne.
9699. Travelling Hoisting Gear, W. G. Scott, Manchester.
9700. Telescope and Walking Stick, T. Hayward, Smethcott.
9701. Travelling Bags, T. Poore, London.
9702. High-pressure Steam Engines, W. Chilton, London.
9703. Boots and Shoes, J., P., A., F., and A. Cave, London.
9704. Shield for Opening Mineral Water Bottles, J. T. Humphrey, Plaistow.
9705. Refrigerators for Cooling Meat, &c., S. W. Candy, London.
9706. Condensing and Separating Lead Fume, J. B. Clark and the Panther Lead Company, London.
9707. Bearings and Bushes, &c., J. and C. A. Baker, London.
9708. Mould for Measuring and Partially Shaping Cigar Fillers, F. A. Ford, London.
9709. Trough Closets, W. Bartholomew, London.
9710. Gas Pressure Gauge, C. M. Walker, London.
9711. Lamps or Lanterns, C. Craston, London.
9712. Shafts for Carriages, &c., P. Adolph, London.
9713. Pads for the Hoofs of Horses, H. Deceulener, London.
9714. Toilet Ewers or Jugs, &c., W. Starley, London.
9715. Revolving and Tilting Mould for Casting Tubes, G. Adams, London.
9716. Fastenings for Doors, J. Hirschfeld, London.
9717. Filtering and Purifying Oil, E. Ducretet, London.
9718. Reflector-indicator Device for the Water-gauge Glasses of Steam Generators, J. Stevenson.—(*A. Poudloue, France.*)

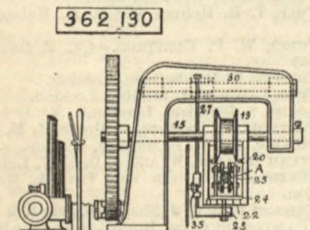
SELECTED AMERICAN PATENTS.

(From the United States' Patent Office Official Gazette.)

362,130. Machine for Pulling Coke from Ovens, *F. C. Weir, Cincinnati, Ohio.—Filed June 28th, 1886.*

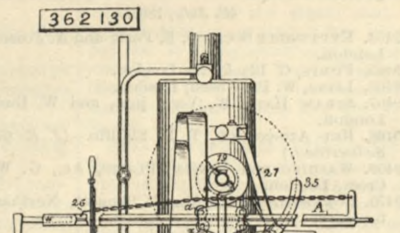
Claim.—(1) In a coke-pulling device, the combination of a windlass and roller supporting frame, guiding the reciprocating arm and oscillating upon a windlass shaft, with the arm 27 and segment 35 detachably connected, whereby the parts are locked in any desired

362 130



fixed position, substantially as specified. (2) In a coke-pulling device, in combination with a main frame, the coke-pulling arm mounted upon a vertically-adjusting frame supported by shafts 15 and 30 and laterally adjustable thereon, substantially as specified. (3) The combination of an oscillating and horizontally swivelling frame, rollers journalled in said frame, a four-winged claw arm supported between said rollers, and a windlass and chain for reciprocating said claw arm, substantially as described. (4) The combination of the shaft 15, the windlass 19, hanger arms 20, bridge tree 22, spindle 23, base plate 24, studs 25, grooved rollers *a a*, four-winged claw arm A, and chain 26, substantially as described. (5) The combination of the shaft 15, the rod 30, the windlass 19, and oscillating hanger arms 20, supported on the shaft 15, a laterally swivelled frame supported by the hanger arms, rollers *a a*, journalled in said frame, the claw arm A, chain 26,

362 130

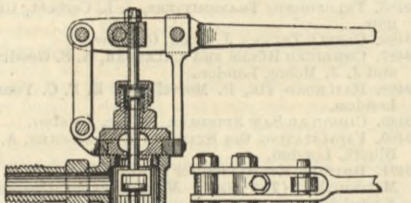


setting arm 27, having grooved segment 28, the sliding head 29, and bolts 33, connecting the grooved segment and rod 30, the arm 35, having a swivelled connection with the roller-carrying frame, and means for adjustably connecting the arms 27 and 35, substantially as described.

362,166. Check Valve, *C. Lieb, Wilmington, Del.—Filed October 1st, 1886.*

Claim.—The combination, with a valve casing, of a ring encircling said casing and adapted to be turned on the same, supports attached to said ring, a valve

362,166

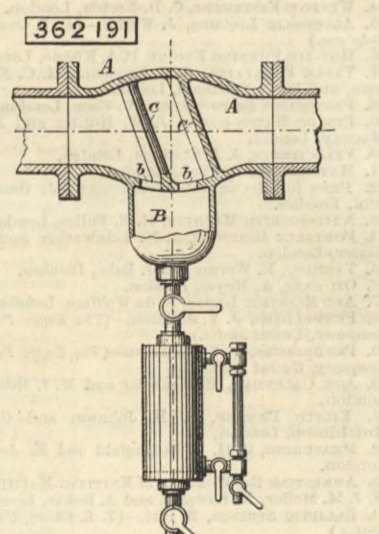


rod mounted to move on said supports, a square box at the lower end of the rod and within the casing, said box having a recess in its bottom part, a puppet valve having a square head located in said box, and a stem guided in the bottom recess of the box, substantially as set forth.

362,191. Apparatus for Separating Oil and Grease from Steam, *S. Stuart, Plainfield, N.J.—Filed October 13th, 1886.*

Claim.—(1) The combination, with the shell or casing A to be inserted in a line of pipe, of a well B communicating therewith by openings *b*, and catch plates or separating abutments C, springing from the interior of the shell and extending transversely to the length

362 191

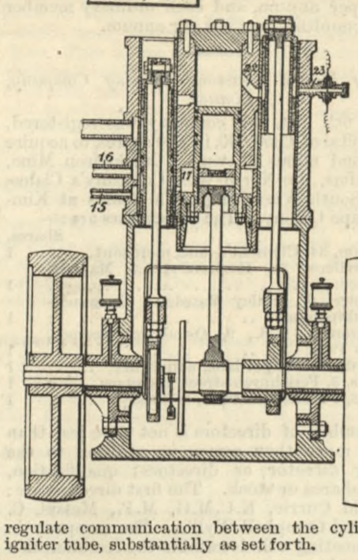


of the passage through the shell, whereby oil, grease, and water will be separated from the steam and delivered through the openings *b* into the well, substantially as herein described. (2) The combination, with the shell or casing A to be inserted in a line of pipe, of the well B at the bottom thereof and communicating therewith by openings *b*, and the catch plates or separating abutments C, extending transversely across the shell from side to side thereof and formed integral with the shell, substantially as herein described. (3) The combination, with the shell or casing containing the catch plates or separating abutments C and the well B connected therewith, of the chemical receiver *s*, communicating with the said shell or casing, substantially as and for the purpose herein set forth.

362,187. Gas Engine, *A. Schmid and J. C. Beckfield, Allegheny County, Pa.—Filed November 15th, 1886.*

Claim.—(1) In a gas engine, the combination of the power and compressing cylinders, a valve chamber connected to said cylinders by suitable ports, and a piston-valve located within said chamber and constructed substantially as set forth, to co-operate with the piston in regulating the flow of gas and air into the compressing cylinder and the flow of dead gases from the power cylinder, substantially as set forth. (2) In a gas engine, the combination of the power and compressing cylinders, a valve-chamber connected to said cylinders by suitable ports, a piston-valve located within said chamber and constructed to regulate the flow of gas and air to the compressing cylinder and escape of dead gases from the power cylinder, and an adjustable excentric on the power shaft of the engine for regulating the movements of said piston-valve in accordance with the speed of said engine, substantially as set forth. (3) In a gas engine, the combination of the compressing-cylinder, a valve chamber connected thereto by a suitable port, 17, and provided with gas and air inlet ports 15 and 16, the gas port being in line with the port connecting the valve chamber and cylinder, and a piston-valve constructed to open and close the ports 15 and 17 simultaneously, substantially as set forth. (4) In a gas engine the combination of the power cylinder, a valve chamber connected thereto by a suitable port 22, an igniter consisting of a tube connected by a port 23, to the valve chamber, said ports 22 and 23 being in line with each other, or approximately so, a constant igniting flame or body located in the tube, and a piston-valve constructed to

362,187

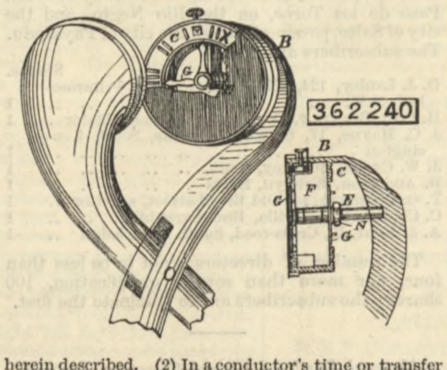


regulate communication between the cylinder and igniter tube, substantially as set forth.

362,240. Conductor's Time or Transfer Punch, *S. Adler, San Francisco, Cal.—Filed August 19th, 1886.*

Claim.—(1) In a conductor's time or transfer punch, the cylinder B, connected with one of the jaws, having corresponding time dials C at each end, in combination with the central spindle E, the wings F, pivotted upon said spindle, and the hands G upon the spindle and connected with the wings, whereby the movement of the hands at the back effects a corresponding movement of the hands at the front, substantially as

362 240

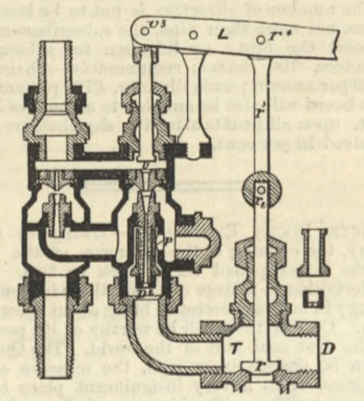


herein described. (2) In a conductor's time or transfer punch, the cylinder B, connected with one of the jaws of the punch, having corresponding time dials C on each end, in combination with the central spindle E, the wings F pivotted thereon, the hands G pivotted on the spindle and connected with the wings, and the nut N on the back end of the spindle, for fixing the hands, substantially as herein described.

362,300. Injector, *W. McShane, St. John, New Brunswick, Canada.—Filed March 19th, 1886.*

Claim.—(1) The combination of the lever L with the steam valve *v* in the injector and the T or corresponding overflow valve *r* in the delivery pipe D, in a fitting distinct and separate from the body or casing of the injector, so that *v* opens before *r* closes, as and for the purpose described. (2) The combination of the lever L with the spindle of valve *v*, connected by loose coupling v^3, and with the standard E attached to the casing of the injector, and with the spindle of the

362,300

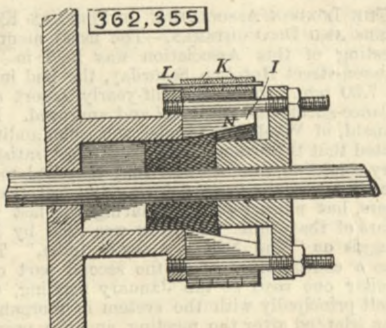


valve *r* by the coupling r^4, and the swinging link r^3 and movable coupling r^2, or corresponding device, as and for the purpose described. (3) The combination of the steam valve *v* in an injector and the overflow valve *r* in the delivery pipe, in a fitting distinct and separate from the body or casing of the injector, and the lever L, with the puppet *p* in the delivery chamber D^2, all as and for the purpose described.

362,355. Rod Packing, *A. Bradford, Fall River, Mass.—Filed February 8th, 1887.*

Claim.—(1) In a rod packing, a collar to direct the packing ring into a stuffing-box, the said collar having

362,355



a conical opening, the inner end of which is of the same diameter as the opening in the stuffing-box, substantially as described. (2) In a rod packing, the guiding collar to direct the packing ring into the stuffing-box, the said guiding collar having the hinged sections I and the conical opening N, made between the said sections, for the purpose set forth, substantially as described. (3) In a rod packing, the guiding collar to direct a packing ring into a stuffing-box, the said collar comprising the sections I, hinged together and provided with the conical opening N, formed between them, the said sections having the lugs or ears K projecting from their free sides and adapted to align with each other, and the pin L, adapted to extend through aligned openings made in the said lugs or ears to lock the free sides of the hinged sections together, substantially as described. (4) In a rod packing, a collar to direct the packing into a stuffing-box, and having the funnel-shaped passage to receive the packing, as set forth.

362,446. Car Truck, *H. C. Hodges, Detroit, Mich.—Filed March 23rd, 1887.*

Claim.—(1) The combination, with a car truck having an equalising bar pivotted thereto, of springs beneath the extremities of an equalising bar, said springs provided with universal bearings at their upper and lower

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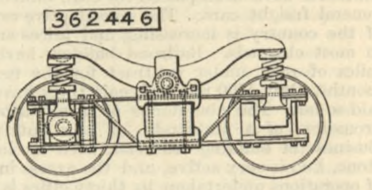
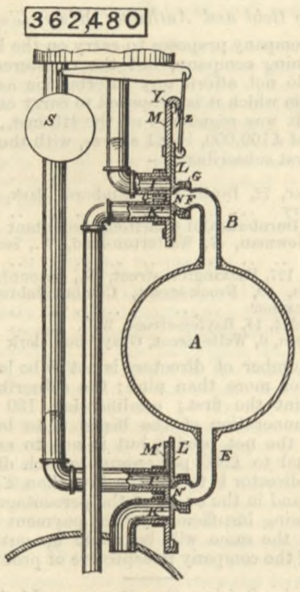


extremities, substantially as and for the purpose described. (2) In a car truck provided with a pivotted equalising bar, springs located above the axle bearings and beneath the extremities of the equalising bar, said springs seated at their upper and lower ends upon universal bearings, substantially as and for the purpose described. (3) In a car truck provided with an equalising bar, springs located beneath its extremities above the axle bearings, said springs having universal bearings at one of its ends, substantially as and for the purpose described.

362,480. Boiler Feeder, *J. Austin, East Liberty, Ohio.—Filed November 11th, 1886.*

Claim.—(1) In a boiler feeder, the combination, with stationary plates M M', having water and steam ports therein, of the sliding plates L L', having ports N N' therein, chamber A, and connecting pipes B E, as and for the purpose set forth. (2) In a boiler feeder, the combination, with the automatically filling and emptying chamber A, of the balancing weight S and

362480

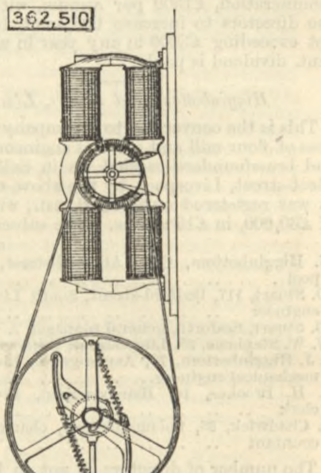


retaining springs Z, as and for the purpose set forth. (3) The combination of chamber A and pipe B with plate L and ball unions F G, as and for the purpose set forth. (4) The combination, with the balanced chamber A and sliding plates L, of the rubber Y and spring Z, as and for the purpose set forth. (5) The combination, with the frame Q, having the plates M M', with ports I I' K K' therein, of the balanced sliding plate L L', having ports N N', as and for the purpose set forth.

362,510. Regulator for Dynamo-electric Machines, *E. T. and E. Higham, Philadelphia, Pa.—Filed June 29th, 1886.*

Claim.—(1) The combination of the dynamo shaft and engine shaft and a spring connection between the two, and devices controlling the supply of motive fluid to the engine, with a compensator for the springs, substantially as and for the purpose set forth. (2) The combination of a dynamo-electric machine and driving shaft with a lever fast to the shaft, a wheel loose from

362,510



the shaft, and springs connected at one end to the wheel and having at the other end a connection with the lever, varying the leverage of the latter in proportion to the varying tension of the springs, substantially as set forth. (3) The combination of a dynamo-electric machine and driving shaft with a lever fast to the shaft, a wheel loose from the shaft, and excentric controlled by the wheel and lever to operate the valve of the motive-power engine, and springs connected at one end to the wheel and having at the other end a connection with the lever, varying the leverage of the latter in proportion to the varying tension of the springs, substantially as set forth. (4) The combination of a dynamo-electric machine and driving shaft with the wheel loose on the shaft, a lever fast thereto and having inclined bearing faces, with an excentric operated by the wheel to control the engine-valve, and springs connected to the wheel and having a strap connection with the inclined faces of the lever, all substantially as specified