MACHINERY AND MECHANICAL APPLIANCES AT THE INTERNATIONAL HEALTH EXHIBITION.

No. II.

Messrs. Crossley Bros., of Manchester, exhibit, for the first time in this country, one of their newly patented twin cylinder gas engines, of 12 nominal horse-power, which is shown at work driving a dynamo machine and pumping water. This engine is illustrated on page 358, and, as will be seen from the engraving, it consists of a pair of cylinders contained in a single jacket casing, which is bolted to the end of the frame, the connecting-rods working on to a single crank, and the charges of gas being so arranged as to permit of an impulse at every revolution when the engine is working at its full power. A single governor and a single slide with one set of gear controls the admission of gas and air to both cylinders. The space occupied by this engine is practically no greater than when a single cylinder is used, while the horse-power exerted is double, which is a matter of very great importance where room is limited. For starting, self-acting gear is applied, according to a patent taken out by Messrs. Holt and Crossley in 1881. With this apparatus, instead of the fly-wheel having to be rotated by hand in order to compress an initial charge of gas and air, the same effect is accomplished without manual labour, in the following manner:—During the working of the engine a portion of the burnt expanded gases is exhausted into a suitable reservoir until it becomes charged to a pressure of from 70 lb. to 90 lb. per square inch, and so forms a store of energy which can be drawn upon as desired. The reservoir being charged when the engine is stopped, it is obvious that by having a suitable valve arrangement the store of compressed gas can be utilised for propelling the engine for a few revolutions, until the fly-wheel has acquired enough momentum to carry on the working in the usual way. A single clack valve serves both for charging the reservoir and for controlling the admission to the cylinder, but in the latter case it receives its motion from a cam on the valve shaft, which, by means of a bell crank, raises and lowers it as required, while in the former case it works automatically like an ordinary check valve, the cam being thrown out of gear. For large engines this apparatus will no doubt be found extremely useful, especially as it adds but little to the first outlay, and occupies no additional space. Among other improvements we may mention that the air suction arrangement has been modified in a manner which very greatly reduces the noise, and a new form of bed much neater than the older one has been adopted. The engine is worked with Dowson's economic gas, by the use of which an indicated horse-power is obtained, we are told, with a consumption of 1·3 lb. of anthracite coal per hour, a performance which, it is almost needless to state, has never been realised with a steam engine of equal size.

In addition to the twin engine, Messrs. Crossley Brothers have thirteen of their ordinary type engines in various parts of the Exhibition, several of them being erected in connection with mechanical bakeries. It has long been a matter for wonder among those who thought upon such subjects, why the art of bread-making—one of the most important of all industries—has remained stationary for so many years, while other manufactures have been so much improved by the application of modern inventions; and in connection with the present Exhibition it may not be out of place to point out what seems to be at least one of the principal causes by which this undesirable state of affairs has been kept up. The explanation appears to be that, on account of the short time bread will keep sound, capital has been prevented from being attracted to its manufacture, and the trade has therefore remained in the hands of small people, who carried on their business from hand to mouth, in the old style, without considering in what way improvements could be effected. Steam power could not, as a rule, be applied in such bakeries on account of the space occupied and the trouble and difficulty in its management, and in the disposal of the products of combustion; and of course, so long as the only available power was manual labour, the stimulus to adopt improved mechanical appliances did not exist. It would, however, appear that if bakers could only be induced to incur the expense of putting down suitable gas engines—which are not open to the same objections that could be urged against steam engines—the trade would undergo a complete revolution, and that hand-labour might almost entirely give place to machinery, and so lead not only to improvement in the quality of the bread, but to a reduction in the cost of its manufacture. We propose to treat further of this matter at a future time, when we shall deal fully with the various appliances exhibited in the department specially devoted to the steam bakeries.

On page 358 we now illustrate the small dry air refrigerator which we noticed last week as having been erected by the Bell-Coleman Mechanical Refrigeration Company, for cooling chocolate, at Messrs. Allen's stand in the Western Gallery. In this apparatus the air-compressing and expansion cylinders are combined with an Otto gas engine on one massive bed-plate, a single piston-rod serving for the gas-motor and compressor, which are arranged tandem fashion; while the expansion cylinder is placed vertically at one side, and acts on an overhung crank keyed to the end of the shaft. The compressed air is cooled partly by injection of cold water into the compressor, and partly by subjecting it to the action of the waste cold air from the cooling rooms, by means of tubes placed in the bed-plate; but in cases where the temperature of the return air is too high, cold water or water spray is substituted for it. We understand that though the expansion cylinder is only 6in. diameter and 6in. stroke, there is no difficulty in delivering the air at 40 deg. below zero Fah. This class of machine has been specially designed for the use of butchers and others requiring small cooling power, who usually have too little space to spare to admit of a separate engine being employed; but at the Exhibition the gas cylinder is removed, the driving power being obtained by a belt from the overhead shafting.

Messrs. Siebe, Gorman, and Co., 187, Westminster Bridge-road, S.E., exhibit one of their patent ice-making machines capable of producing about 15 cwt. of pure transparent block ice per day in this country, or about 10 cwt. per day in the tropics. Figs. 1 and 2 show this machine, which consists of a vertical standard carrying at its upper end a double-acting water jacketted ether pump and a double-acting steam cylinder, separate connecting rods coupling the two pistons to the crank shaft. A cast iron bed-plate bolted to a foundation of stone or wood receives the standard, and has blocks cast on it for the crank shaft bearings. The cold producing agent is sulphuric ether, a liquid having a specific gravity of 720, a latent heat of vaporisation of 162, and which boils at 90 deg. Fah. under ordinary atmospheric pressure. The action of the apparatus is as follows:—Air being exhausted by the ether pump A, a charge of liquid ether is introduced into the refrigerator C, which is a cylindrical vessel of copper, carefully lagged on the outside, containing a series of tinned gun-metal tubes, through which brine is circulated by the pump E, worked from the crank shaft, the stroke being capable of easy alteration, so as to vary the quantity of brine passed through in a given time. After the machine is fully charged, the cocks H and I being open, the ether pump is set to work, and the vapour, which completely fills the refrigerator above the surface of the liquid, is rapidly removed. This causes a reduction in pressure, and the boiling point being in this way lowered, rapid ebullition takes place; and as the supply of heat for vaporisation can only be drawn from the brine which passes through in a limited quantity, the temperature is reduced considerably below the freezing point, and the cooled brine may therefore be conveyed in suitably protected pipes and utilised for ice-making or other purposes of refrigeration. To render the process a continuous one, it is obvious that the supply of liquid ether in the refrigerator must be maintained; and in order to accomplish this the condenser D is provided. In this apparatus there is a series of copper cooling pipes, into which the ether is delivered from the pump in a slightly compressed state, the pressure varying with the temperature of the cooling water, the arrangement being such that the ether is caused to flow from above downwards. These pipes are surrounded with cold water contained in a wood tank, the water being admitted at the bottom and discharged at the top, so that the coldest water meets the coldest ether. In this way the ether is condensed at a pressure of about 5 lb. to 10 lb. per square inch, and is returned to the refrigerator by the pipe K to be re-evaporated. The flow of ether is indicated in the engraving by arrows. The quantity of heat abstracted in the refrigerator depends on the weight of ether evaporated, each pound absorbing 162 thermal units, part of which, however, comes by conduction from the outside, no matter how carefully the vessel is lagged. The method of utilising the cold is, as we have stated, subject to modification. At the Exhibition the machine is making clear block ice, and for this purpose an ice tank F, containing twenty tinned copper moulds, each 27in. by 24in. by $2\frac{1}{2}$in. thick, is provided. These moulds are filled with filtered water, and are surrounded by the cold brine, which is pumped in at one end of the tank and withdrawn from the other. When it is only required to produce opaque ice, no further apparatus is wanted; but for transparent ice, it is necessary to fit each mould with an agitator to keep the water in a continual state of motion while being frozen so as to permit the air to escape. This agitating gear is shown in the illustration, driven by a belt from the main shaft, the crank wheels L on the supplementary shaft G causing the slide blocks M to work up and down in guides by means of suitable levers and rods. There are two slides, one at each end of the tank, and they are connected together by a light beam, to which patent agitating bars are attached, the bars reaching down into the ice moulds and partaking of the up-and-down motion of the slides. As the ice forms, these bars are withdrawn automatically, until finally the whole of the water is frozen and the moulds are filled with pure, transparent blocks which may then be removed. The whole of this plant seems well designed and compact, the vertical type of pump enabling a very convenient disposal of parts to be obtained.

At the adjoining stand, which is not yet quite complete, Messrs. Siebe, Gorman, and Co. also show one of Lightfoot's patent dry air refrigerators of the "Universal" type, in connection with a cold room in which will be stored frozen New Zealand and Australian mutton by Mr. J. S.

Fig. 1

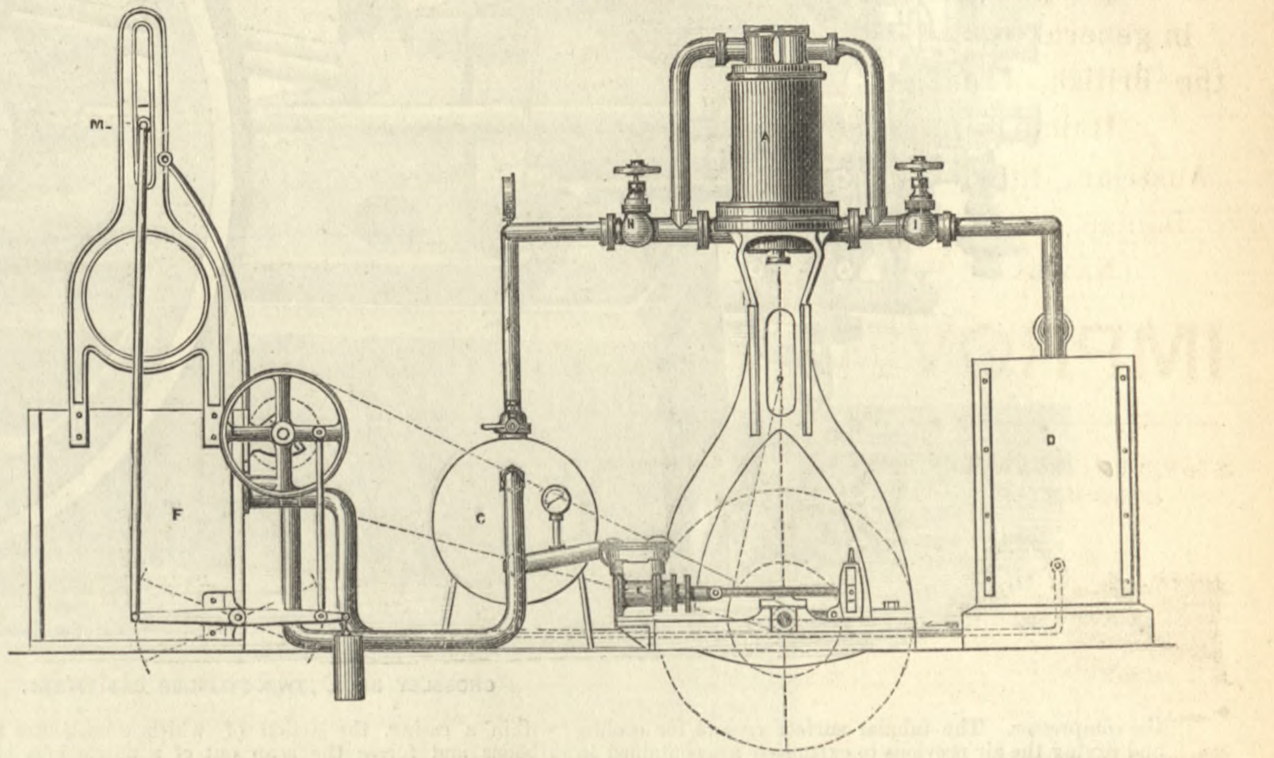
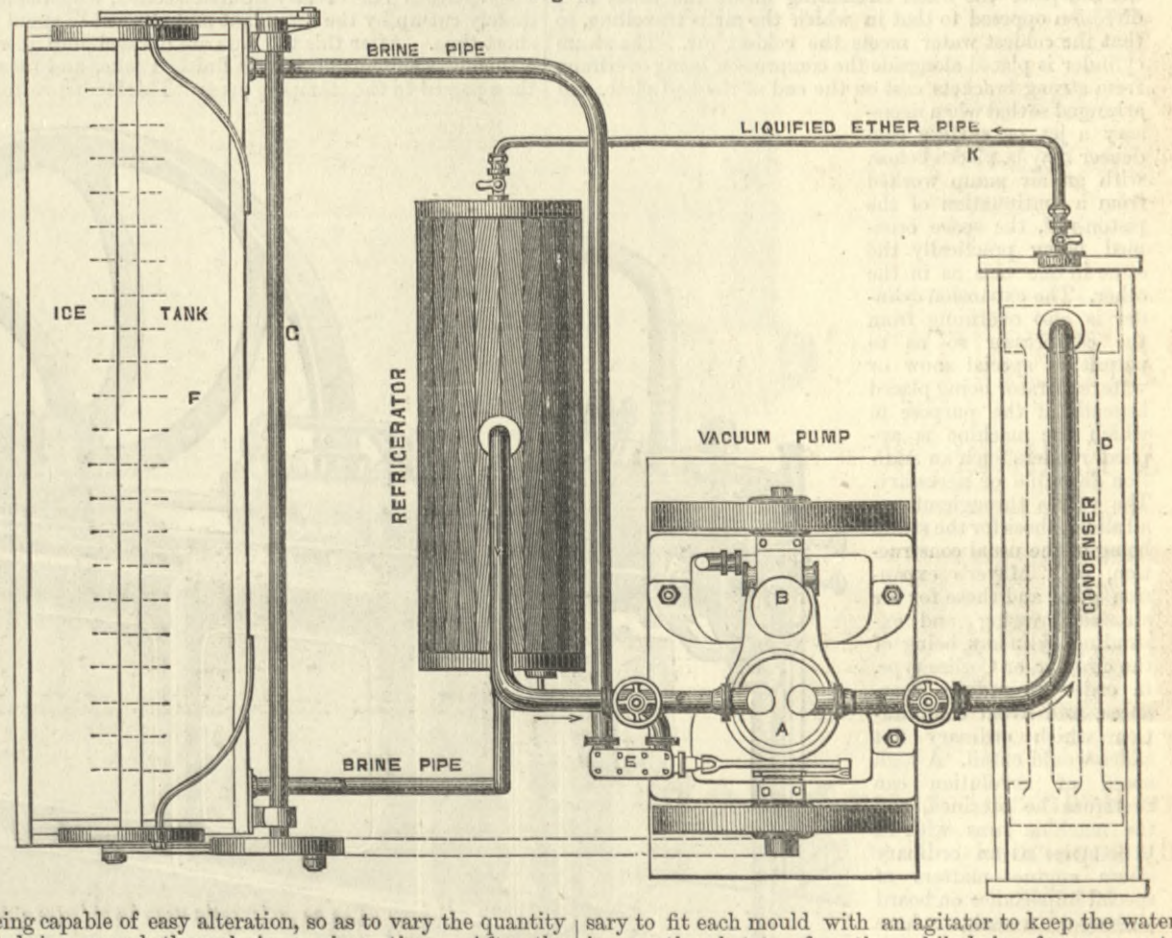
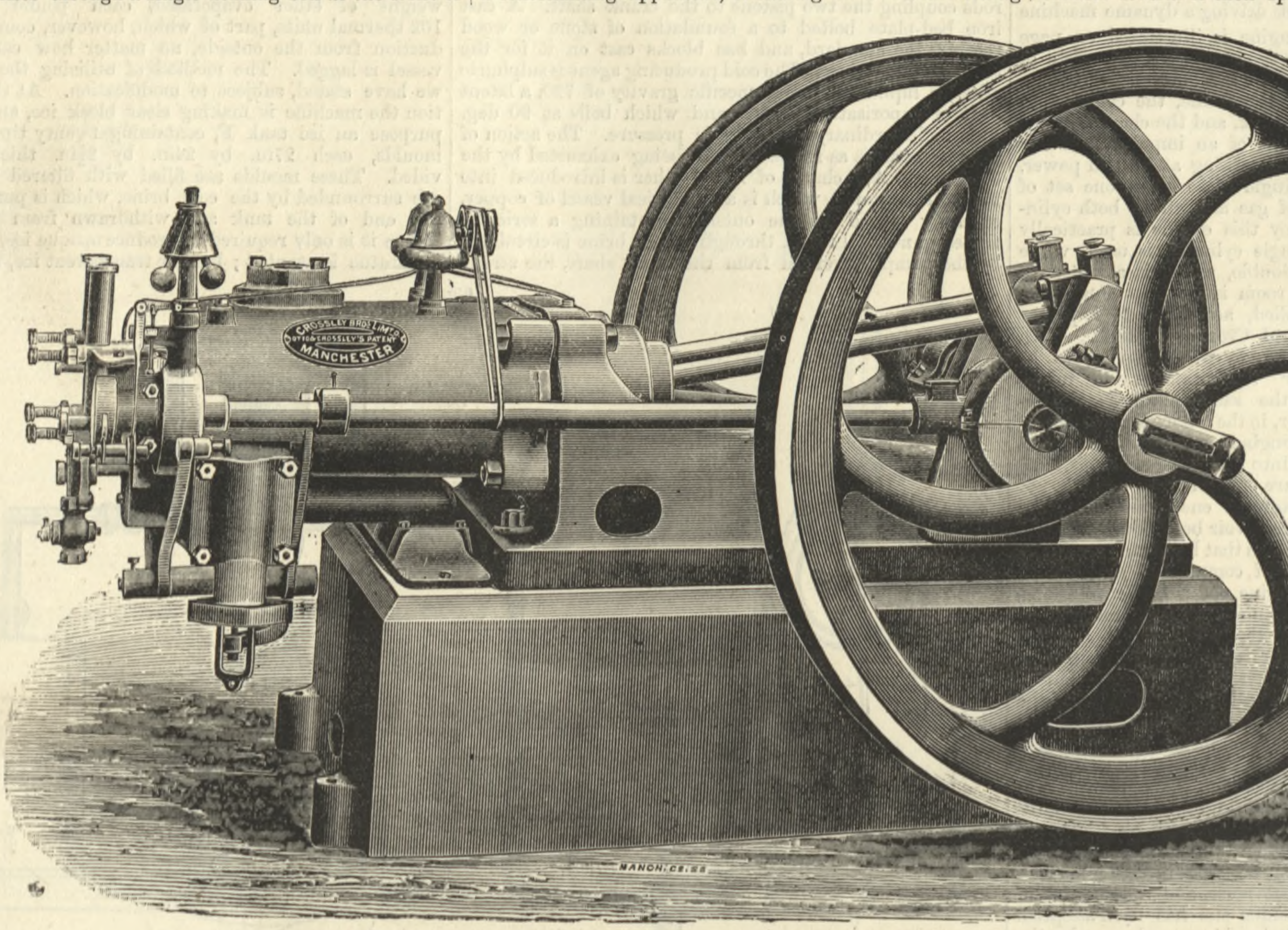


Fig. 2



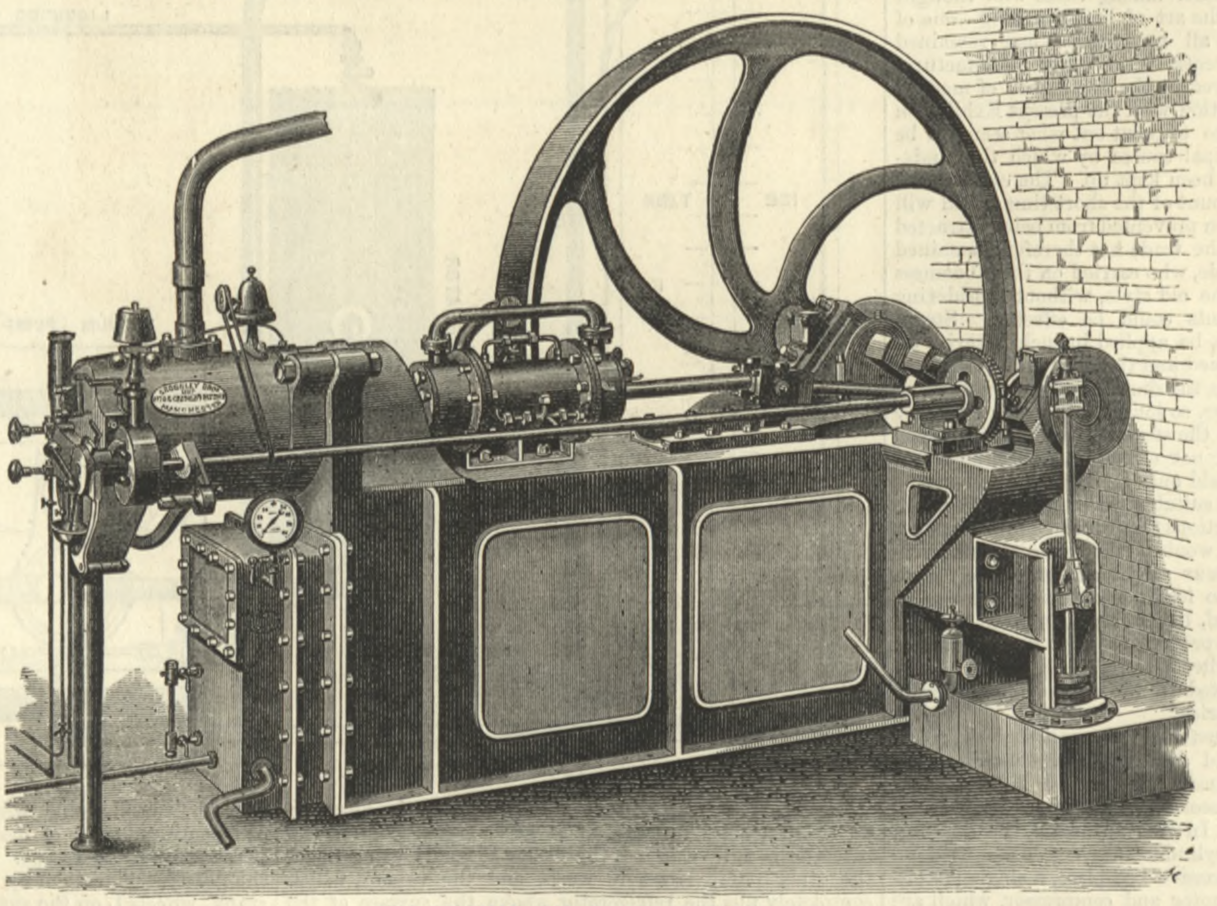
Fitter, of Leadenhall Market, who has specially laid himself out for supplying frozen and other kinds of imported fresh meat. As will be seen from the illustrations on page 359 this is a very simple form of refrigerator, occupying but little room, and affording great facility for getting at all the working parts while the machine is in operation. The compression and expansion cylinders are placed close together, end to end, the pistons being secured to one rod which passes through a single stuffing-box at the front of the compressor. The tubular surface coolers for cooling and drying the air previous to expansion are contained in the bed-plate the water circulating inside the tubes in a direction opposed to that in which the air is travelling, so that the coldest water meets the coldest air. The steam cylinder is placed alongside the compressor, being overhung from strong brackets cast on the end of the bed plate, and arranged so that when necessary a jet or surface condenser may be placed below, with an air pump worked from a continuation of the piston-rod, the space occupied being practically the same in one case as in the other. The expansion cylinder is also overhung from the compressor so as to permit a special snow or water separator being placed beneath, if the purpose to which the machine is applied renders such an addition desirable or necessary. The valves throughout are all slides, those for the steam being of the usual construction, with Meyer's expansion gear, and those for the air compressing and expanding cylinders being of the circular or Corliss type, in order to reduce clearances, and avoid complication which ordinary flat slides would entail. A high speed of revolution can therefore be attained, and the machine runs with as little noise as an ordinary steam engine—matters of special importance on board passenger vessels, where space is generally very limited, and where absence of noise is so very desirable. The same type of refrigerator is made with a gas engine combined in place of the steam engine, or with a pulley, for being driven with a belt. All the thermometers at Messrs. Siebe, Gorman, and Co.'s stand, many of which are of special construction, have been supplied by Messrs. Hudson and Co., Hatton-garden, E.C.

The manufacture of indurated toilet soap is shown by Messrs. F. S. Cleaver and Sons, Red Lion-street, W.C. Ordinary soap is made from tallow and caustic potash, and contains in its original state some 29 per cent. of water. Unless this superfluous moisture was extracted, the soap tablet would not retain either its form or weight, but would crack and dry up to a large extent when exposed to any desiccating action. To avoid this Messrs. Cleaver have introduced a special process which may be briefly described as follows:—The tallow and caustic soda are first of all boiled together and moulded into rough bars. The bars are then cut into shavings and exposed to a blast of hot air, which causes the moisture to evaporate. After this drying process is complete the shavings are passed several times through a horizontal rolling machine with three granite rollers, the perfume and colouring matter being added here and thoroughly worked in, the soap finally leaving this machine in fine ribbons. It is then put into a consolidating apparatus, consisting of a worm working within a casing, the action of which consolidates the ribbons and forces the soap out of a nozzle in a long homogeneous bar of any desired section, which is immediately cut up by the attendant and allowed to stand for a short time. After this the bars are divided into pieces of a thickness suited to form the finished cake, and these are then passed to the stamping press. This is a powerful and ingeniously designed machine, invented and patented by Mr. F. Cleaver, in which the soap tablets are finished and delivered to the packer without any handwork except the placing of the rough block into position. A circular revolving table contains the bottom half of four moulds, into which the rough piece of soap is placed, each mould being successively brought below a stamp having at its extremity the top half of the mould, and is subjected to a couple of sharp, heavy blows, which give it the required shape. The pressed tablet is then moved round by the revolving table, in the act of which it is pushed out from below, and while another piece of soap is being stamped the finished tablet is seized hold of by a pair of nippers which carry it off and deposit it automatically on a travelling band for delivering it to the attendant, who places it in a tray ready for trimming and packing. About thirty-five tablets are pressed and delivered each minute. Messrs. Cleaver state that soap prepared in this manner never loses its shape and weight, and, what is perhaps of more importance to the consumer, goes half as far again as ordinary soap containing the original proportion of moisture.



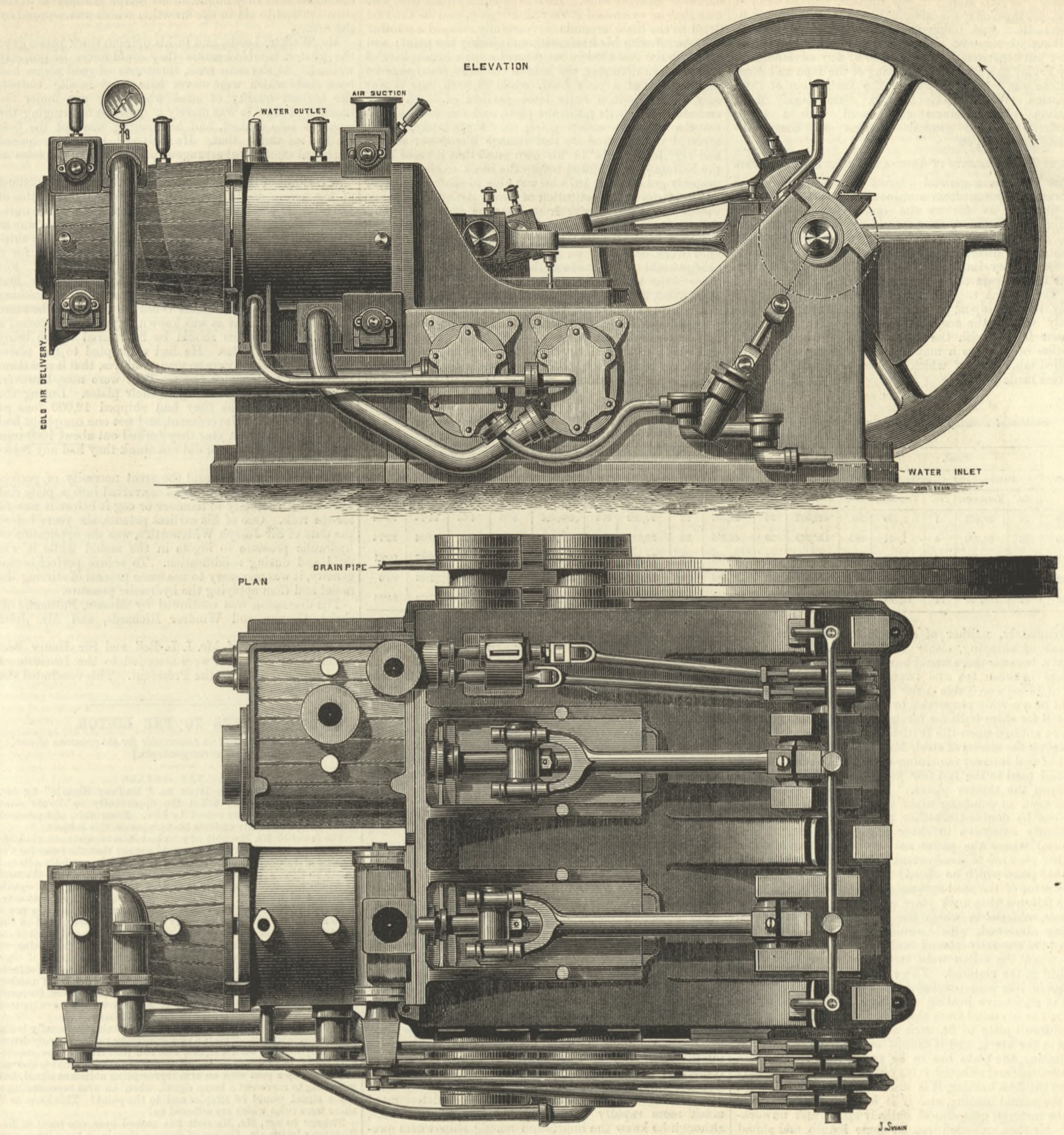
CROSSLEY BROS.' TWIN-CYLINDER GAS ENGINE.

Messrs. Waygood and Co., Great Dover-street, S.E., exhibit several of their specialities in hydraulic and other lifts of various kinds, mostly on a reduced scale, so as to permit of the apparatus being shown at work in the confined space of the Exhibition building. Among them we would specially mention a working model of a patent hydraulic balanced passenger lift, in which overhead gearing is dispensed with, the cage resting entirely on the ram, which is therefore always in compression. The absence of chains and ropes also removes a cause of noise and vibration, and permits the cage to travel at a higher rate of speed without interfering with the comfort of the passengers. Another most important feature is that by the introduction of an arrangement of supplementary cylinders, which we will term the economiser, a considerable saving of water will be effected. This economiser consists of a couple of hydraulic cylinders and rams placed vertically, and so connected to each other that the upper ram and lower cylinder are free to slide up and down while the upper cylinder and lower ram are fixed. The upper cylinder is always in connection with the main lifting cylinder, and its ram, which works upwards, is so loaded by the lower cylinder—assisted by cast iron weights—that the pressure induced by the weight of the cage and main lifting ram is just sufficient to cause it to ascend, so that in lowering the water, instead of being wasted, is passed into the economiser under considerable pressure. For lifting, the lower cylinder, which is connected to the upper ram in such a manner that any pressure exerted within it intensifies the pressure of water in the upper cylinder, is brought into requisition, either by pumping direct or by putting it in communication with some other source of supply. In this way, by properly proportioning the area, such additional pressure is imparted to the water in the upper cylinder, and consequently to that in the main lifting cylinder, as to cause the ram and cage to ascend with its load. The only water used at each stroke, therefore, is what is admitted to the lower cylinder of the economiser, and this, putting aside friction, is just the amount necessary to lift the full load, and nothing more. Messrs. Waygood and Co. also show one of their worm-gear power hoists, suitable for goods or passengers, with automatic stop gear at top and bottom, as well as safety gear to hold the cage



BELL-COLEMAN GAS DRIVEN REFRIGERATOR.

LIGHTFOOT'S DRY AIR REFRIGERATOR.



in the event of the rope or driving strap breaking. There are also several examples of hand-power lifts for both warehouse and domestic purposes, these being fitted with an ingenious self-sustaining brake to prevent the loaded cage running down when the lifting rope is released.

Machinery for jam-making is shown by Messrs. Edward Pink and Sons, London; and from the commencement of the fruit season the actual manufacture of jam will be carried on at the Exhibition. Two principal apparatus are used, one a fruit stalking machine, and the other a steam boiling pan, with patent stirring arrangement. The moving part of the fruit stalking machine consists of a revolving fan or paddle wheel, which is mounted on the underside of a strong frame. Below this is bolted a semicircular wire sieve, underneath which is an inclined trough leading into an oak vat. The upper part of the frame is boxed in, leaving a space above the fan, a feeding hopper being placed in front and a door or flap at the back. The fruit is fed into the hopper, and falls upon the rapidly revolving paddles, which alternately draw it across the surface of the sieve, and throw or toss it back into the upper part of the machine. By this treatment the fruit is almost instantaneously separated from the stalks, and passed through the sieve ready for boiling up with sugar, while every now and then the attendant moves a lever which opens the flap at the back, and allows the stalks to be thrown out by centrifugal force. The machine is arranged so that it can be most readily taken to pieces and thoroughly cleansed, while spare sieves are kept, with finer or coarser wires, so that the sieve can be changed to suit different kinds of fruit. The steam-boiling pan, which is made to tilt over for pouring out the contents when boiled, has an outside body or jacket of cast iron, while the inside is formed of copper, a space being left between the copper bottom and the jacket, which is filled with steam at a pressure of 70 lb. to the inch. The patent revolving steam stirrer consists of a vertical rod which slides telescope fashion in a fixed tube, and can be raised or lowered, the lower end of the rod being fitted with perforated screw blades, the under edges of which are curved to suit the hollow bottom of the pan. The action of this machine keeps the jam thoroughly stirred while boiling, and prevents its burning. Messrs. Pink's process of manufacture of jam is as follows:—The fruit is brought direct from the gardens and orchards of Kent early each morning during the season. After being carefully inspected, it is passed to the patent stalking machine. It is then placed in the steam boiling pan with the proper proportion of crystallised refined sugar, and when boiled to the right degree the jam is filled into pots or glasses, ready to be labelled up and sent out.

THE IRON AND STEEL INSTITUTE.

We stated last week, on page 381, that Mr. Head opened the discussion on Mr. Sutherland's paper on gaseous fuel, and Mr. Casson's paper on gas puddling, but we did not, for lack of room, report what he said. We now give an abstract of his speech. Mr. Head, as manager for the representatives of the late Sir Wm. Siemens, said there were two papers before them, one of which had reference to gas furnaces, and the other dealt with the production of gas. With regard to the latter, the feature which had been most prominently brought before them was the recovery of tar and ammonia from producer or blast furnace gases. Upon that subject Sir William Siemens and he had had several discussions. Sir William Siemens took the view that tar and ammonia formed part of the volatile constituents of coal, the other gases made from the destructive decomposition of coal being only a combination of air and steam with carbon. A few weeks ago, however, Mr. Foster read a paper before the Institution of Civil Engineers, in which it was shown by chemical analysis that some nitrogen was resident in coke, and it was suggested that under certain conditions it would be possible to recover that nitrogen in the form of ammonia. He believed that this had only been done experimentally, so far; but if that scientific deduction could be realised in practice, the ideas he was about to express would have to be modified to some extent. Sir Wm. Siemens considered that if the recovery of tar and ammonia from coal gases to be used for furnaces was to be effected, the best way to do this would be to distil the coal in retorts, and to convert the hot coke as it leaves the retorts by means of gas-producers, thus making two separate operations of the decomposition of coal. By adopting that course, only about 10,000 cubic feet of gas per ton of coal would have to be treated for the recovery of tar and ammonia, whereas the same weight of coal would yield from 160,000 to 180,000 cubic feet of gas if entirely converted in the producers, and the gas from the coke could be enriched by the addition of those hydrocarbon gases obtained from the retorts, which were not required for other purposes. Dealing with 10,000 cubic feet of gas instead of from 160,000 to 180,000 cubic feet, of course meant a considerable saving in plant, as the enormous condensers, exhausters, &c., that would be required for treating the larger quantity were somewhat frightening in their aspect.

With regard to Mr. Smith-Casson's furnace, that gentleman justly pointed out that it was not a regenerative gas furnace. It was simply a gas furnace, and as such it might, perhaps, offer the advantage of a little better combustion than was obtained in the ordinary furnace, involving absence of smoke, coupled with purity of flame; but otherwise it would not be of any advantage.

On Friday the concluding meeting of the Iron and Steel Institute was held at the hall of the Institution of Civil Engineers, Westminster, Mr. B. Samuelson, M.P., presiding. The business commenced with a paper by Mr. John, the general manager of Barrow-in-Furness Company, on

Recent Improvements in Iron and Steel Shipbuilding.

This paper is a general *résumé* of the subject, and its present aspects, from a shipbuilder's point of view. The question, so far as the material used in shipbuilding is concerned, is not entirely set at rest, and probably never will be; and the author, in this paper, indicated the directions in which he thought we have to look for further improvements. The principal improvements in progress at the present moment are connected with the marine engines and boilers, and these also he briefly touched upon, although they do not perhaps come strictly within the scope of his paper. Mr. John dealt at some length with the history of the introduction and adoption of steel as a material for building ships, and supplied tables, one of which is given below, showing the progress made:—

Table B.

Statement showing the Number and Tonnage of Steel and Iron Vessels Built in the United Kingdom and Registered therein during the Years 1879 *to* 1883 *inclusive.*

Year.	Steel.				Iron.				Total.				Percentage.			
	Steam.		Sailing.		Steam.		Sailing.		Steel.		Iron.		Steel.		Iron.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Ton'age	No.	Ton'age
1879	22	19,522	1	1,700	337	428,082	33	35,332	23	21,222	370	463,414	5·85	4·38	94·15	95·62
1880	26	36,493	4	1,671	362	447,389	39	40,015	30	38,164	401	487,404	6·96	7·26	93·04	92·74
1881	34	68,366	3	3,167	411	590,503	50	68,650	37	71,533	461	659,153	7·43	9·79	92·57	90·21
1882	65	115,449	8	12,478	446	672,740	83	112,852	73	127,927	529	785,592	12·14	14·0	87·86	86·0
1883	92	141,552	11	14,193	548	742,292	72	114,698	103	155,745	620	856,990	14·24	15·37	85·76	84·63

Unfortunately, neither of these tables show the actual amount of shipping, either steel or iron, built in this country, because there would have to be a small percentage, perhaps between ten and twenty, to be added to those class of Lloyd's on Table A for unclassed ships, and there would be a certain proportion to be added to the figures on Table B for ships built for foreign owners in this country, and not entered upon the British Register. After further discussing the merits of steel, Mr. John said that the only point of real interest remaining to him in connection with the steel used in the last few years is the effect of punching upon the thicker plates. He had seen plates lose 30 per cent. in punching when they got above ½in. thickness, but he doubted whether the experiments had been sufficiently extensive to show clearly whether this is universal where the plates are of the finest quality, or whether they are to some extent exceptional experiments. Another point which he should much like to see cleared up by some of the steel makers present was the real cause of the failures that took place some time ago, when, for instance, material in which the chemical analysis showed nothing abnormal, which would bend double when the edges were carefully planed and prepared, broke off like glass when the edges were rough, or when holes were punched in the material. There was another point which he should like some explanation upon. It is as to the effect of successive heating upon steel; and the point has occurred to his mind from this fact, that where we have a very difficult plate to fit, such as in some cases the oxter plates at the stern, and it cannot be got to the shape in one heating, the plate has to be put in the furnace again and reheated; and although it may have worked exceedingly well in the first heating, it is much more difficult to work it in the second heating, and if it has to get a third heating, the material gets almost entirely spoilt and unworkable. He then criticised iron at some length, and stated that the Barrow Company had to condemn last year, out of 7500 tons of iron, no less than 33 tons. As to the influence of price, speaking roughly, the difference between the price of iron and that of steel has fluctuated in the last five years from about £2 10s. in 1879, to £4 5s. in 1880, £3 in 1881, £2 10s. in 1882 to £2 18s. in 1883, and £2 4s. now. These figures, it will be seen, are highest about 1880 and 1881, when an apparent check took place in the progress of steel shipbuilding, due to the excessive prices charged for steel. They would see that, taking the vessels classed in Lloyd's in 1878, ·85 per cent. were of steel; in 1879, 3·28; in 1880, 7·14; and then in 1881 it falls back to 5·74, to rise again in 1882 to 12·9, and in 1883 to 15·12. This period of 1881 was evidently one when the price of steel was excessively high; but the steel works then in existence could not cope with the work, there were great complaints with regard to delivery, and there is no doubt that at that time the demand far exceeded the supply. As to the question of strength, he thought experience would tell in the long run decidedly in favour of steel ships, even at the present reduction of scantlings sanctioned by Lloyd's. Next in importance came the question of corrosion, and this no doubt holds very nearly the first, if not the first, place in the minds of shipowners at the present time. He did not know, indeed, that the question had yet reached nearly a settlement, and he mentioned a curious instance he saw not many months ago. It was the case of a steel ship which had been launched just six weeks to receive her engines and boiler and was then docked, and although she had been carefully painted before launching with a good composition specially chosen by the owners, many of the plates presented a most curious appearance of pitting. They were scattered about without any apparent connection in some parts, and in others the little mole-hills of rust—if the term may be used—seemed to have an order of their own, either in curves or straight lines. He was so much struck with this case that he examined it very thoroughly, and as the rust dried in the little mounds he carefully scraped a number of them off with his knife without injuring the paint; and although the rust thrown out formed a little hemisphere of about ⅛in. in diameter, the hole in the paint was not more than the size of a pin's head, while in each case it was easy to pick out a little loose particle of black oxide embedded in a little pit in the plate, and one could almost see the galvanic action going on. Fortunately, it was arrested in time, and no real damage was done; and he had very little doubt in his own mind that it arose from the bottom being painted before the black oxide had been properly got off. In 1874 he was able to show, in a paper he read before the Institution of Naval Architects, that as vessels increased in size from 100 tons up to 3000 tons, they grew weaker in almost regular progression to the extent of between four and five times, and that the larger ones were bordering on unsafety; but such a sweeping charge could not be made at the present time against the ships of the mercantile marine, even when we get up to 6000, 7000, or 8000 tons. He mentioned in the early part of the paper that one of the most marked features is the progress now being made with the marine engine, arising from the rapid adoption of very high pressure and extended expansion beyond the ordinary compound engines, where there are only two expansions. His company is at the present moment building two sets of engines, one on the triple expansion principle with 150 lb. pressure, and the other with quadruple expansions, or four cylinders expanding into each other, and 160 lb. pressure; and it is scarcely too much to say that they had a right to expect at least 20 per cent. saving in fuel over the ordinary compound engine. Triple expansion has been adopted by several firms for some time past. He did not know whether any besides themselves have started quadruple expansion. To deal with these pressures at all, the introduction of steel in the construction of boilers was an absolute necessity, and he did not think they had come to the end of their improvements in that direction. There was only one other point he wished to dwell upon, viz., the large introduction of steel castings into shipbuilding and engine works. Their ordinary and standard practice is to make reversing links, excentric rod-ends, reversing levers, and link blocks of cast steel, and the bulk of these have been supplied to them by the Steel Company of Scotland. They have proved of excellent quality, sound and tough, and have, whenever so required, been capable of being machined about all over with an almost entire freedom from air-holes. Recently they had constructed a set of engines which were provided with Joy's valve gear, and for this the working parts were made entirely of cast steel, thus avoiding most difficult and expensive forgings.

Mr. Martell, of Lloyd's, agreed with Mr. John that steel for shipbuilding purposes had passed out of the experimental stage, and he looked forward to the time when it would entirely supersede iron for shipbuilding purposes. Steel could be made of a perfectly reliable character infinitely superior to iron. He was also persuaded in respect of strength and ductility steel was superior, and would compare favourably as regarded durability with iron. There was an impression that steel deteriorated much more rapidly than iron, but it was a mistake, although he knew the impression among shipowners prevented them adopting it. On the Continent he heard some complaints of the quality of steel made by the basic process; but on inquiry in Germany he found that steel of a perfectly reliable character could be made by the basic process, and if there were any defects in the quality it was owing to the want of knowledge on the part of the manufacturer. From the experiments made in England, the Committee of Lloyd's Register could not do otherwise than place steel made on the basic process on the same footing as steel made by any other process. Since then he had had evidence to convince him that it was owing to the process by which the basic steel had been made, for want of knowledge, which caused the failure to which he had alluded on the Continent. He heard whispers that steel could be made much cheaper now than formerly, and that there was a probability of its competing with iron so far as the price was concerned. He hoped it would be so. If steel such as they had tested could be made, he hoped to see the day when steel would entirely supersede iron for shipbuilding purposes.

Mr. Jeremiah Head was afraid he might be considered a biased witness, as he was himself an iron manufacturer. There was no question that steel for shipbuilding purposes was making progress, but he did not think it had yet superseded iron, for during the last year there was more manufactured iron made and used for shipbuilding than in any former year. Whatever progress therefore steel had made, it was entirely on the top of iron. But iron manufacturers would be extremely foolish if they were to shut their eyes to the probability that steel might be the material of the future, and failed to arrange accordingly; and if the world said it wanted steel and did not want iron, then iron manufacturers ought to be able to supply it. He held the opinion strongly that to make good steel plates it was necessary that they should be hammered. It was of the greatest possible interest to them all to see how steel had developed, and they ought all to adapt themselves to the situation and to aid in the direction which was required by the future.

Mr. Walker, Leeds, said in his opinion thick plates gave the greatest trouble because they could never be properly worked. At the same time, thousands of good plates had been made which were never hammered at all. Indeed, the highest quality of steel was never put under the hammer at all. It was merely a question of bringing the particles into contact, and hammering was not the best method of doing that. He believed it only required improved mechanical arrangements to make steel plates as cheaply as steel rails.

Mr. Riley, of the Steel Company of Scotland, complained of the severe strain put upon steel by the Committee of Lloyd's. It was only common justice that the more unreliable material—iron—should be tested in the same way as steel. Six months ago he was informed by a Clyde shipbuilder that he was prepared to accept contracts for a steel vessel of 4000 tons at the same price as iron. For smaller vessels there was still a difference, in the first instance, in favour of iron; but we appeared to be reaching the period when steel vessels could be built for the same cost as iron. So far as was known at present, it seemed a necessity that ingots should be hammered before being rolled into steel plates. He had attempted to roll plates like rails, but there were so many failures, that it cost them more than to hammer them. They were now, however, making arrangements to cog all their plates. During the last eighteen months they had shipped 12,000 tons of plates to a foreign Government, and not one complaint had reached them. Last year they turned out about 1000 tons of iron per week, and he did not think they had any rejections.

Sir Henry Bessemer said the great necessity of perfect homogeneity in the ingot to be converted into a plate had rendered it necessary to hammer or cog it before it was fit for the rolls. One of his earliest patents, six years before the date of Sir Joseph Whitworth's, was the application of hydraulic pressure to ingots in the mould while it was fluid and during solidification. To secure perfect homogeneity, it was necessary to use some process of stirring the metal and then applying the hydraulic pressure.

The discussion was continued by Messrs. Putnam, Gilchrist, Cooper, and Windsor Richards, and Mr. John replied.

On the motion of Mr. I. L. Bell and Sir Henry Bessemer, votes of thanks were accorded to the Institute of Civil Engineers and to the President. This concluded the proceedings.

LETTERS TO THE EDITOR.

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

RAILWAY SIGNALS.

Sir,—Having seen the letter on "Railway Signals" by Mr. Stretton, I have lately taken the opportunity to devote some attention to the points raised by him. From this, and previous experience, I can fully endorse his opinion on this subject.

The letter of Mr. Marriott in your last issue requires some modification. In its present form it would appear that the rules for the placing of railway signals—if there are any—are strictly adhered to. The signals should be placed on the left-hand side of the road to which they refer, the only exception to this being such signals as cannot of necessity be so placed. This rule, Mr. Marriott says, is followed wherever practicable. My observations on this point have shown me that a great many of the signals are placed on the right-hand side of the road, and not on the left; and in all these cases there has not been the least necessity for their being so placed, as the signals could have been seen quite as far off if they had been placed on the left side. In fact, to my eye, the signals seem to have been placed anyhow and anywhere, in a great number of cases; and I can assure Mr. Marriott that there are frequent and just complaints on the part of the drivers. I have noticed this on many lines, and especially on the Midland.

Mr. Marriott mentions cases of distant signals occasionally being used as home signals. This is a very dangerous practice. Any driver can easily mistake such a signal, and run past it under the impression that it is a distant signal, as it ought to be. What is the use of putting up a post with an arm representing a distant signal, but intending to represent a home signal, when an arm representing a home signal would be simpler and to the point? This looks as if there were rules which are adhered to!

Strange to say, Mr. Marriott has passed over one point in Mr. Stretton's letter, viz., the use of dummy signals—a most dangerous practice. Perhaps he will enlighten us as to the rules for their use later on; but I am afraid that even Mr. Marriott cannot justify this use.

E. L. Ahrons.

Bradford, May 5th.

Sir,—Your correspondent, Mr. William Marriott, page 325, appears to have entered into this important discussion without having given sufficient consideration to the subject, and most certainly some of the opinions he expresses are at variance with the views of the engine-drivers and railway servants of this country. Mr. Marriott, in the concluding line of his letter, thinks, perhaps, I look at the subject from "a different point of view." Of course I am unable to know which side he takes, but can say for myself that I have no interest of any kind in the matter, and look at it from the railway passenger's and engine-driver's point of view. The letter of "A Midland Engine-driver" last week, p. 343, together with the frequent reports and complaints, prove more clearly than any words of mine, that on many railways signalling is carried out in a very defective manner, and reports by the inspectors of the Board of Trade, on various accidents, fully confirm this fact.

In conclusion, it may be mentioned that my former letter was an epitome of a paper read by me before large and important meetings of railway servants. In each case full and fair consideration and discussion followed, and the unanimous opinion of these practical men has been in favour of the efficient system of signailing which I have so long and so persistently advocated.

Clement E. Stretton.

40, Saxe-Coburg-street, Leicester, May 10th.

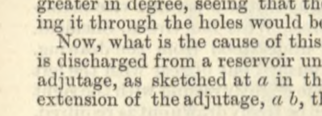
THE EFFICIENCY OF FANS.

Sir,—I may now briefly explain why there was measured within the entrance adjutages of the Capell exhausting fans which I tested, a degree of energy and horse-power greater than what was delivered to the fan shaft.

When a current of air is discharged into the atmosphere from a reservoir under pressure, through an aperture in the side of the vessel, fitted with a conical converging mouthpiece or adjutage, the velocity of outflow at the extremity of the adjutage is from 90 to 99 per cent. of the velocity due to the pressure. It does not exceed 100 per cent. The outflowing current advances through the air, and expands laterally, as it advances, in the form of a cone, until it is lost in the surrounding medium. The velocity of flow of the current is gradually retarded as it advances, accompanied by a vacuous state of minus pressure within the mass of the current, and in consequence, by a rush of air from the surrounding atmosphere into the current, tending to restore equilibrium. The phenomena are easily observed by permitting the escape of a jet of dry steam from a boiler into a still atmosphere. The jet expands uniformly at the rate of 1 in 2½—that is, for 2½in. of advance it expands 1in. in diameter. The smoke of an extinguished taper held near the current, at any part, is seen to stream towards, and plunge into, the current at right angles to its surface, obviously to complement the minus pressure within it. If the inrush of the surrounding air resulted simply from adhesion or drag between the current and the surrounding air, as is commonly supposed, the inflowing streams would be seen to take an oblique course, and would trend outwards. But, on the contrary, as I have said, the inflowing streams plunge at right angles into the current, and disappear.

Mr. Charles W. Williams illustrated this phenomenon by means of a cone of tin-plate perforated with minute holes, into the smaller end of which he introduced the nozzle of a pair of bellows. The air being blown smartly through the cone, streams of air rushed into it through the small holes—by induction, as it is called; in reality, by the surrounding pressure of the atmosphere, to supply the vacuum within. In this case it is clear, that supposed adhesion or drag between the body of the current and the surrounding air had no part in the action, since the substance of the cone intervened; and, of course, if the holes were entirely closed, and a solid-surface cone employed, the vacuum would be still greater in degree, seeing that the means of even partially supplying it through the holes would be cut off.

Now, what is the cause of this vacuum? When a current of air is discharged from a reservoir under pressure, through a cylindrical adjutage, as sketched at *a* in the annexed figure, into a coniform extension of the adjutage, *a b*, the velocity is retarded as the current advances in the cone-frustrum, in the inverse ratio of the sectional area. Supposing, for instance, that the diameter, *b* at the end of the conical adjutage, is twice the diameter *a* at the beginning of it, the sectional area at *b* being four times that at *a*, the velocity of outflow is only one-fourth of that at *a*. The current, at each point of its course through the cone, tends to move forward with undiminished velocity, but in doing so, to however limited an extent, it becomes rarefied proportionately, since it could not advance anywhere at a uniform velocity with an expanding front, without being augmented in volume. Such augmentation does take place to some extent, and, correspondingly, a rarefaction and a reduction of elastic pressure ensue, giving rise to an unbalanced fraction of atmospheric pressure from the front. It is by this unbalanced pressure that the velocity of the current is gradually retarded.



The fact of the retardation of outward velocity proves the presence of a retarding force at the front, and this force is simply brought into action by the formation of a partial vacuum within the cone, due to the tendency of the current to move at a uniform velocity, so enlarging its volume. This it succeeds in doing to just such an extent, that the degree of vacuum—otherwise the excess of opposing atmospheric pressure—is just sufficient to excite a resistance to outflow and a retardation in consequence, adapted to the angularity of the conical frustrum. The vacuous action is accumulated at the origin of the conical frustrum *a*, and it has a reflex influence on the primary current from *c*. Inasmuch as a minus pressure is set up at *a*, initiated by the conical delivery, there is by so much an addition to the net head of pressure at *c*; and, in virtue of that augmentation of working pressure, there is an addition also to the velocity of flow through the tube at *a*. The absolute head, of course, is not increased, but the net head of pressure is increased, as above explained. We arrive, therefore, at a condition of things in which the velocity of flow of the current through the tube at *a* is greater than that due to the net head of pressure in the reservoir at *c*.

The conditions under which the Capell exhausting fans were tested, are similar to those above explained, except that the motive power is applied, not at the entrance to the suction tube, corresponding to the tube *a* in the figure, but at the expanding outlets through the fan, corresponding to the outer portion of the coniform outlet *a b*, in the figure. The fan generates a partial vacuum at the inner end of the suction tube; hence a head under excess atmospheric pressure is generated at the entrance to the suction tube. The air currents rush at maximum velocity through the portholes into the radially expanding interspaces between the vanes. As the currents advance towards the periphery they are forcibly retarded in outward velocity, since they move in enlarging passages; and, precisely on the principle of the conical enlargement in the figure, the retardation is accompanied by an augmentation of vacuum at the centre, and a corresponding augmentation of net head of pressure at the entrance to the suction tube, the absolute atmospheric head pressure, of course, remaining unaltered. Hence it follows that the air flows through the suction tube with a velocity greater than that which is simply deducible from the engine-power delivered to the fan.

It is not contended that, by such means, power can be created. The phenomenon of excess energy in the suction tube can only be manifested in combination with the vacuousness or minus pressure in the outlet, and the consequent countervailing or compensatory retarded velocity and re-absorption of energy in the outlet. Abandon the expanding frustrum, whatever form it takes, and the augmentation of energy in the suction tube vanishes. Suppose, for instance, that the fan is simply a cylindrical extension of the suction tube, having the same diameter, that a cylindrical screw propeller is employed within the cylinder, and that the air is discharged from the square end of the cylinder into the atmosphere, there would not be any augmentation of vacuum within the tube, and there would not be any more energy produced within the tube than that which would be due to the power delivered to the screw shaft. D. K. CLARK.

8, Buckingham-street, Adelphi, London, May 6th.

SIR,—Whatever Mr. Clark may say as to what his business with the Capell fan was, your readers who are interested in the subject have assumed that he is the competent engineer who was to test the performance of the fan, and settle the question of its merits, and they expected that the tests to which he subjected it would have been both practical and searching. Now Mr. Clark, by his report, and by the figures he tabulated, left it to be inferred that the performance of the fan was excellent, and apparently lent the weight of his high authority in corroboration of previous vague statements of its wonderful performance which from time to time have been made.

Mr. Clark now tells us that the experiments were not made under working conditions, inasmuch as the exhaust fans were not drawing from a space of diminished pressure, and the blast fans were not discharging into a space of excess pressure, as fans when at work have to do, and as I in my calculations purposely assumed was the case. The water gauge heights, which, in experiments as ordinarily conducted, are indications of differences of pressure, and the insertion of which in the results gave a semblance of practical value to the experiments, represent, if anything, something else, and are, we are now told, not to be considered as trustworthy. Whether the fan is capable or not of circulating a large quantity of air which does not, in its flow, meet with resistance, is of small importance.

My reason for entering into this correspondence was purely in the interest of scientific truth, to protest against its being accepted as established by Mr. Clark's experiments that the constricting cylinder of the Capell fan is capable of producing any valuable effect. If it is, other and more practical experiments must be made to prove it. T. A. HEARSON.

Royal Naval College, Greenwich, S.E.,
May 7th.

SIR,—The Rev. G. M. Capell refers in a very indiscriminate way to the text of a former misleading letter, without at the same time referring to the context. Anyone reading his letter of the 3rd of May would never dream—if they had not read his previous letter, which appeared in your impression of February 8th—that it was he who conjured up the "castle in the air," and who, with no other data than the 2ft. outlet and his conjecture of 11in. w.g., to suit the exigences of the *reductio ad absurdam* with which he wound up that document, and your readers will, by referring to the above letters in question, have an opportunity of judging in what a disingenuous manner the reverend gentleman has treated them.

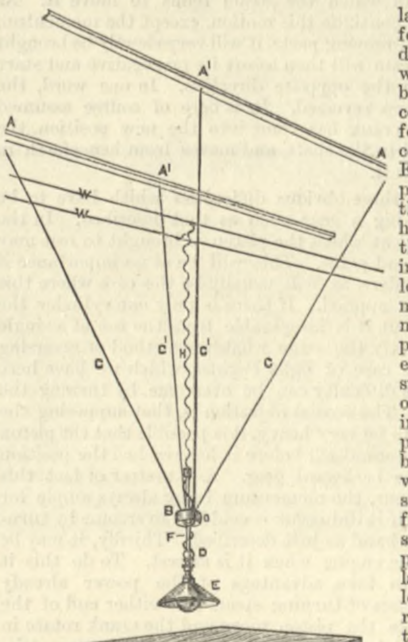
He tells you in his letter dated 29th April, to work out the results of the two 3ft. fans, but I was satisfied to get 38,240 cubic feet of air at any pressure out of a 3ft. fan 12in. wide at 699 revolutions per minute, and was not seeking for 3½ w.g., so that it would be just as reasonable for me to ask Mr. Capell to pass through his 20in. tube the same quantity of cubic feet per minute at any pressure; but should I require 3½ w.g., I can get 13,377 cubic feet through a 20in. tube at 580 revolutions per minute with my 3ft. fan. When my w.g.'s are recorded, I promise him they shall not have added to them from 30 to 115 per cent. Mr. Capell has admitted that Test 8 is 3½in. w.g., instead of 8in., as published, thereby proving my version of his test in column 5 correct. He tells you of the outside atmosphere getting into my discharge, but there is too much air forced out to allow the smallest portion to return. He gives you the pressure for its reduced volume, and sets it at 1·90; he is mistaken. He is also mistaken in its being a broad Waddle type fan, and no doubt when writing his last letter to you Mr. Capell overlooked the fact that his fans are much wider than mine. He asks you to allow him a future letter on what has nothing to do with the question; he also invents three water-gauges, but it has nothing whatever to to do with volume or given area on his tables. I send you herewith his test table recorded at Dudley, and, according to Hutton's tables, Test 1 has 25 per cent. added, Test 6 has 45 per cent. added, and Test 9, 35 per cent. added. Test 3 is the great controversial test, and is tested correctly by the members of the South Staffordshire Institution of Mining Engineers. The power of those tests to drive are still disputed, and who can believe in the power to drive, especially when 25 per cent. is taken off from a machine driven direct from the engine and 4½ w.g. added to test.

His explanation about a fan of any type of modern construction to a cupola is a complete farce. It would be impossible for a reduction to take place in a foundry cupola from 12in. to 4in. w.g., each having the volume from the centre inlet under the same circumstances to the fire, unless the same want of care was displayed on his rival fan as he displayed on his test tables. To be reduced in such a manner he describes, his rival fan must pass its air into the atmosphere, and every person connected with w.g. on a cupola fan knows it. HENRY ALAND.

46, Commercial-road, Lambeth, May 12th.

ELECTRIC LIGHT IN THE DRAWING OFFICE.

SIR,—In the lighting of a drawing office it is of great importance to place the lamps in such positions that they will not cast shadows from the working edges of T-squares, set-squares, and other tools. If the light is localised over every drawing board—as, of course, it ought to be—this condition can be satisfied only by supporting each lamp so that it may be moved over all parts of the board. A pedestal support is seriously in the way, and the right plan evidently is to hang the lamp from above, but in a manner which will leave it two degrees of freedom to move horizontally. This has been very successfully done in the drawing class-room of this college on a plan suggested by my assistant, Mr. Thomas Reid, and shown in the sketch.



An incandescent lamp is carried at the foot of a rod F, which depends from a small wooden block B. The block is hung by two cords *c c*, *c*¹ *c*¹ from four points in the ceiling A A A¹ A¹. Each of the two cords passes down and up through two vertical holes in the block, the two cords crossing each other on its lower face. This permits the block to be moved easily to any part of a surface as extensive as the spread of the points of support in the ceiling, the cords slipping through the block as it is moved, while their friction serves to keep it from returning of itself after being displaced. Further, the lamp can be raised or lowered by sliding the rod F up or down in the block B, in which it is secured by a pinching screw. A small weight at D keeps the rod vertical. A stout paper cone over the lamp reflects the light downwards and screens the eyes of the draughtsman. The current reaches the lamp by a double flexible conductor H from a pair of main leads *w w*, which are thick, bare copper wires tightly stretched across the room from wall to wall above a row of drawing tables, at a height which keeps them clear of the suspension cords when a lamp is displaced. Each man has his own table and lamp, and is independent of his neighbours. The lamps are Swan's 100 volt of twenty candles, but a smaller power would suffice, as no light is wasted in illuminating spaces where it is not wanted. Over other tables ranged along the walls the lamps are carried by double-jointed brackets ending in collars through which rods similar to F slide. The system has been in use for some months. Its introduction brought about a very striking improvement in the air of the room, which the burning of much gas had formerly made almost intolerable. We now have pure air and a far better light.

University College, Dundee, J. A. EWING.
May 3rd.

MARINE BOILERS.

SIR,—Some time ago I called attention to the above subject through the columns of THE ENGINEER, which seems to have awakened considerable interest amongst boiler makers. It is evident that improvements in marine boilers are considered very difficult, as nothing new appears. Attention seems to be directed chiefly to closed stokeholes and forced air, in order to obtain a higher rate of duty from the old pattern boilers. Many so treated have not taken very kindly to the new conditions, and have manifested certain displeasure by priming and saturating the steam to dangerous degree, not to mention leakage caused by excessive heat on the plates and tube-ends exposed to the fire; from this cause a whole set of boilers has had to be removed from H.M.S. Polyphemus, and a new set substituted of another kind, and it may be with no better results. It seems strange that such mistakes should be made in these days of boiler making; it has the appearance of a game of chance; for boilers are made and put into ships without the slightest knowledge of how they will answer before they are put on trial. If closed stokeholes and forced air are to be adopted in large ships for long voyages, some attention should be given to the formation of boilers suitable for the purpose. The locomotive seems to offer the highest example we have for rapid steaming, due to the discharge steam acting as a powerful blast in the funnel. Take the same boiler, and reverse the process in closed stokeholes with forced air, and you have an inveterate primer at once. The blowing principle localises the heat like a forge, so that the water is driven off the surfaces in the vicinity of the fire, and the plates burned. I have attended a number of experiments, but have not seen any means employed to register the temperatures or rate of evaporation. It is the engines that command the most attention. The forced air system may do for torpedo boats, where the funnel is suppressed, and short spurts of steaming only are required; but for long runs the service is too precarious and unreliable; even the stokers seem to work under the greatest fear, with one eye on the shovel and the other on the escape door, expecting something to happen every moment. It creates an unpleasant feeling to be shut up with the boilers where all is uncertainty; you cannot keep your eye off the gauge glass, the water dancing about as if mad; the fires have to be eased occasionally to ascertain its level. In no case has it been found possible to keep the boilers tight very long.

In experiments with marine boilers at Portsmouth with natural draught, the rate of evaporation indicated was 9·25 lb. of water per pound of coal at the common temperature. It is a question whether two-thirds of this could be effected on the forced air system. Economy must be sacrificed for speed. Small boilers and large coal bunkers go together. This cannot be otherwise, for half the gas evolved from the fuel is forced through the tubes, unconsumed, into the funnel, where the temperature gets dangerously high. A great deal of information might be obtained if the results of full speed trials were allowed to be reported. The contractors for the engines raise strong objection to anyone but their own staff being present. This at least indicates a weakness or a want of confidence in the results. Something must be done to prevent so much waste heat escaping up the funnel before forced air can become general for the merchant service. Naval ships do most of their steaming on half boiler power, for the reason that few are capable of running full speed for many hours together. It is evident that the system has not received due consideration, but now that it is about to be introduced into large ships there will be a necessity for giving the subject proper attention. W. A. MARTIN.

Pocock-street, Blackfriars-road, London, S.E., May 7th.

AN ELECTRO MECHANICAL PROBLEM.

SIR,—I noticed your inquiry in THE ENGINEER of May 2, and beg to submit some devices for attaining the object you have in view. Although rather crude, they are sometimes sufficient, and, in fact, did prove so in some experiments I undertook some time ago. I hope that they will equally serve your purpose.

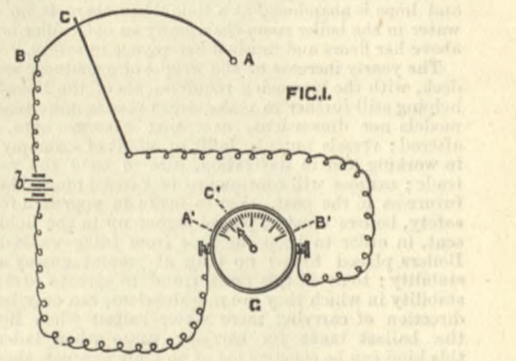


FIG. I.

Suppose A B be a platinum wire, or, better still, a thin carbon or graphite rod of great resistance compared to that of the rest of the circuit, and C be a pointer moving on it, so as always to establish a contact at the point C, *b* being a battery, and G an ordinary dial galvanometer of some sensitiveness. Then, if the rest of the circuit—including line wire, galvanometer, and battery—be of small resistance, a slight increase in the length of the part A C will produce a noticeable change in the total resistance, and the

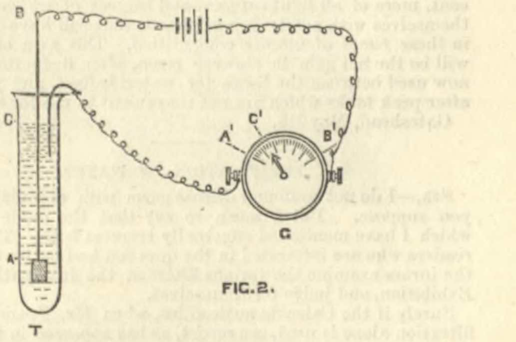


FIG. 2.

pointer of the galvanometer G will move according to the varying current passing in the circuit. It is easy so to graduate the galvanometer as to establish a definite relation between its indications and the various positions of C along A B.

The accompanying sketches show another method of getting at the same result. T is a tube filled with mercury, into which dips a very thin wire of platinum, or a carbon rod weighted with platinum; then as the wire or rod is lowered into the mercury or taken out from it, the galvanometer needle will be so affected. Here again the comparative resistance of the part A B should be as high as possible, in order to make the indications on the galvanometer more apparent. L. H. DESPEISSIS.

18, Rue Lafayette, Paris,
May 8th.

STABILITY OF CARGO CARRYING STEAMERS.

SIR,—The question of the stability of steam vessels, or rather the want of it, that has been discussed in your columns is connected in another direction not noticed with the safety of navigation, that is, the placing of the boilers in the vessel. So that this most weighty piece of engineering may contribute to its fullest extent to the stability of the vessel, it is placed as low down in the hold as possible. The consequence of this nearness of the boiler to the bottom of the vessel is seen, without much variation, in the oft-repeated reports of the foundering of steam vessels when survivors have been left to tell their tale. A sudden leak, they say, was reported in the boiler room, the sweep of water from side to side carried all the loose cinders, coals, waste, and articles that are always to be found under and above the stokehole plates of a steamer that has been a few days at sea, to the strainers of the pipes leading to the circulating and bilge pumps; while the engineers were freeing them, the water in the meantime rose high

BOUTARD'S REVERSING GEAR.

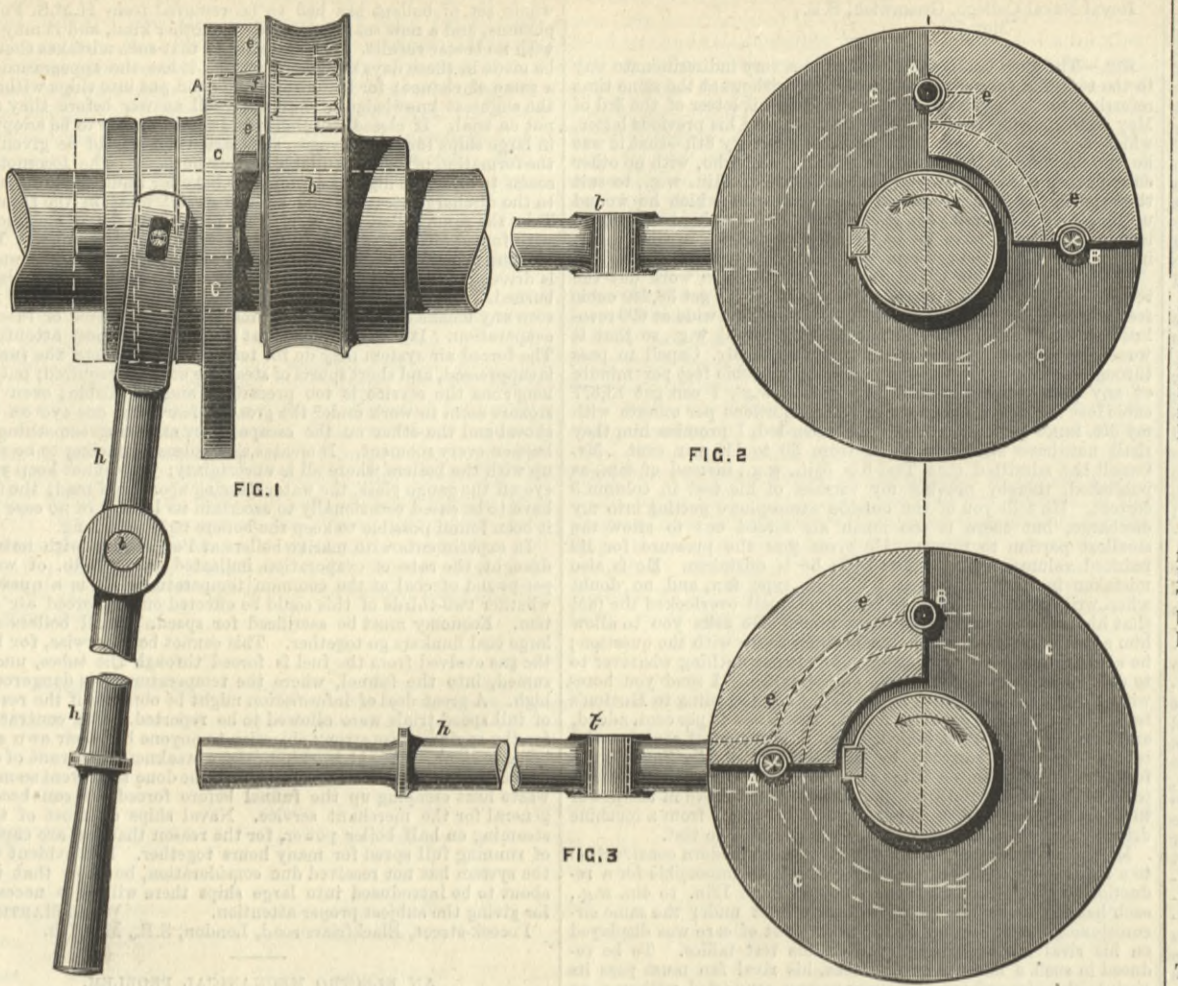


FIG. 1 FIG. 2 FIG. 3

enough to splash out the fires. Thus, with about a couple of feet of water above the stokehole plates, the whole of the powerful and costly pumping arrangements of the steamer are rendered useless at the moment of danger for which they were specially designed to be a means of safety. The vessel is left at the mercy of the waves, and hope is abandoned at a time when there is no more depth of water in the boiler room than many an old collier brig has carried above her floors and finished her voyage in safety.

The yearly increase of the weight of machinery and erections on deck, with the increasing requirements of the Board of Trade, are helping still further to make steam vessels more tender. Neither models nor dimensions, excepting extreme ones, can be much altered; vessels must be built to admit of economy in first cost, in working and in navigation, also to meet the requirements of trade; cargoes will continue to be carried much the same in the future as in the past. Yet to make an approach from danger to safety, boilers must be placed higher up in the hold than at present, in order to keep the fires from being washed out so soon. Boilers placed higher up than at present means a lessening of stability; to avoid this danger, and to give to steam vessels the stability in which they are now deficient, can only be found in the direction of carrying more water ballast when light, and using the ballast tanks for carrying cargo when laden. Tanks of this kind can be constructed at no more expense than the present ones. They can be made high enough to work in, and can be thoroughly dried out by a special process when wanted for carrying perishable merchandise.

Steamers carrying cargo as low down as sailing vessels will be nearly as stiff as them; with more stability more sail can be carried to diminish rolling, and so lessen the danger of shifting cargo and straining.

In addition to the advantage of increased stability gained by the adoption of cargo carrying tanks, there is also the powerful argument that steamers so fitted will be able to carry at least 5 per cent. more of all light cargoes, and cargoes of which they can fill themselves with safety—an argument that will have great weight in these times of intense competition. This gain of 5 per cent. will be the net gain in stowage room, after deducting the spaces now used between the floors for water ballast, and the fore and after peak tanks which are not convenient to use for cargo.

Gateshead, May 5th. LOG CHIP.

PURIFICATION OF WATER.

SIR,—I do not confound disease germ with organic impurity, as you suppose. But I mean to say that the mode of filtration which I have mentioned effectually removes both. Those of your readers who are interested in the question had better attend when the jurors examine the various filters at the International Health Exhibition, and judge for themselves.

Surely if the Calcutta authorities, when Mr. Spencer's mode of filtration alone is used, can report, as has appeared in the *Times* on three occasions during the last month or two, that the Hoogly water pumped into the filter beds contains on its emission no disease germs whatever, the matter is worth notice. I shall be glad to answer any further questions. CHARLES FRANCIS.

London, May 6th.

[Can Mr. Francis say what happens to the disease germs when they come in contact with the filter? His statements have a far wider bearing than he supposes, and affect some of the most keenly debated physiological problems. Any information he can supply will be interesting.—ED. E.]

BOUTARD'S REVERSING GEAR.

IN our notice of the show at the Agricultural Hall last Christmas, we called attention to a new reversing gear, applied to a compound portable engine by Messrs. Garrett, of Leiston. We are now able to supply a further description of this gear, and details of its practical arrangements. We may add that a compound portable engine, indicated up to 100-horse power, and fitted with this gear, will be on view at the Bath and West of England Show at Maidstone, on June 2nd, and the four following days.

The principle on which the gear acts will be most readily understood from the following description. Suppose that the excentric is so set as to be 135 deg.—or a right angle and a-half—in advance of the crank, which is assumed to be about the best position. In ordinary working the excentric of course moves with the crank, and the axis of the former always keeps at the same angle—135 deg.—in front of the axis of the latter. But suppose that it is possible to arrest the motion of the excentric, keeping it stationary while the crank still continues to revolve, and to let the crank so revolve until it has described three right angles, or 270 deg. Then there is again an angle of 135 deg. between the axis of the excentric and the crank, but it is now measured in the opposite direction from the stationary position of the excentric. Consequently the excentric is now once more in the right position, provided that the crank were moving in the opposite direction, for in that case the excentric would again be 135 deg. in advance of the crank, which we have assumed as its proper position. As a matter of fact, however, the crank is still moving in the original direction. What will happen? Clearly the state of things is simply the same as if the engine were being reversed under steam by any other system, or was in fact being carried round in the opposite direction to that in which the steam tends to move it. As there is nothing to continue this motion, except the momentum of the fly-wheel and moving parts, it will very shortly be brought to an end. The steam will then assert its prerogative and start the engine again in the opposite direction. In one word, the engine will have been reversed. It is here of course assumed that as soon as the crank has come into the new position, the excentric is coupled to the shaft, and moves from henceforth in correspondence with it.

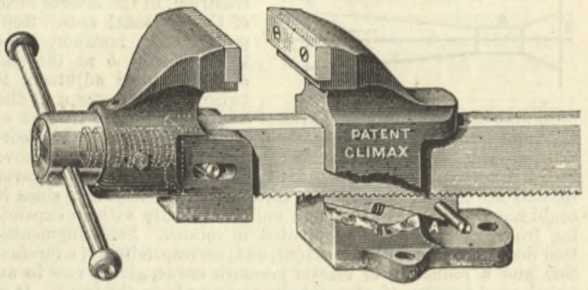
There are two or three obvious difficulties which have to be considered in working a gear such as that described. In the first place, the point at which the piston is brought to rest may be exactly on the dead point. This will be of no importance if there are two cylinders, as will usually be the case where this gear is likely to be applied. If there is only one cylinder the difficulty remains, but it is inseparable from the use of a single cylinder, and is exactly the same whatever method of reversing is adopted. In the case of light engines, which we have here mainly in view, this difficulty can be overcome by turning the fly-wheel by hand. The second objection is, that supposing the load on the engine to be very heavy, it is possible that the piston may be brought to a standstill before it has reached the position corresponding to the backward gear. As a matter of fact this is never found to occur, the momentum being always ample for a single stroke, but if it did occur it could be overcome by turning the fly-wheel by hand as just described. Thirdly, it may be desired to reverse the engine when it is at rest. To do this it is only necessary to take advantage of the power already possessed in most cases of turning steam into either end of the cylinder, and so make the piston move and the crank rotate in the direction required, having previously uncoupled the excentric. So far, then, as land engines of any kind are concerned, no difficulty is experienced. In marine engines one additional point would have to be provided for. There must be means of throwing the slide to mid-gear, so as to prevent leakage of steam when the engines are standing. For this it is necessary either to be able to move the pistons in either direction, independently of the position of the slide valves—*e.g.*, by letting steam into the cylinders through special valves worked by hand—or else to be able to work the slide valves by hand, so as to set them in any required position without turning the engine. There is no difficulty with the present gear in providing mechanism for effecting either of these objects, by very simple arrangements which we need not enter into at length. It will be seen, therefore, that we have here a simply theoretical method of reversing an engine, which, in order to be practically carried out, only requires that we should be able to connect or disconnect the excentric with the shaft at any given point of the crank's revolution, and with complete accuracy.

The mechanical means of doing this are shown in Figs. 1, 2, and 3, and are of a very simple character. Close to the excentric *b* in Fig. 1 there is mounted on the shaft a disc C, sliding on a feather, so as always to rotate with the shaft itself. It can be made to slide backward and forward on the shaft, as required, by an ordinary fork and lever *h*, pivotted on a pin at *t*. In this disc there are two holes A and B, Fig. 2, and the segment *c c* between these holes is raised from the face of the disc, so as to form a projection as indicated by the shading in Fig. 2. Upon the side of the excentric *b* there is mounted a taper pin *f*, which is bolted to it, and which will fit fairly into either of the taper holes A and B. Suppose that the pin *f* is fitted into the hole A, and that the shaft is running in the direction shown by the arrow. Now withdraw the disc by moving the handle *h* sufficiently to let the pin slip out of the hole. The excentric is now no longer coupled to the shaft, and will not turn with it any further. The disc, however, goes on turning until it has made three-fourths of a revolution, by which time the forward face B of the projection *e e* will have come round to the position formerly represented by A. This face of the projection will then strike the pin *f*, and carry the excentric forward with it. The end of the pin will thus be opposite to the hole B, and by pushing the disc to the right hand the hole will fit over the pin and will be coupled as before. Meanwhile the shaft, crank, and piston have made three-fourths of a revolution, which is needed in order to put the excentric in the correct relative position for backward gear.

In the above description we have assumed that there is only one cylinder. If there are two cylinders, two discs—one for each excentric—would be required; but it is not necessary to have two levers, as a horizontal sliding bar carrying two forks, and actuated by the lever *h*, answers the purpose. By giving a sufficient taper to the pins there is no difficulty in ensuring that they should fit into the holes correctly. The operation of reversing is so easy that it can be done correctly the first time of trying, even by one who has not seen the gear previously.

THE CLIMAX VICE.

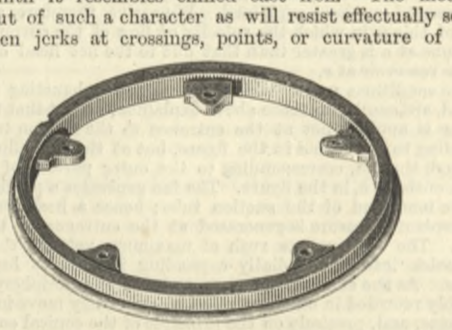
THE accompanying engraving illustrates a parallel vice manufactured by Messrs. Crampton Bros., West Bar Green, Sheffield. Its construction will be readily understood from the drawing. To open the vice the wedge A is pushed out of gear with the left hand, the workman at the same time slightly raising with the right hand the front jaw, which can then be freely drawn out as required.



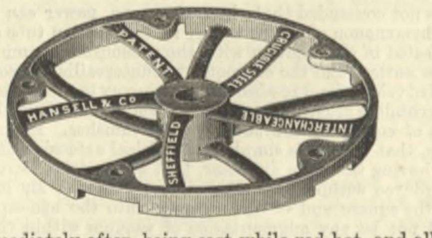
To grasp the work the front or sliding jaw is pushed until it presses against the work, then the handle is used to secure the grip, as in the ordinary vice. It will be seen that the serrations on the sliding bar catch in those on the wedge A and hold it fast until the strain is taken off, when the wedge may be pushed back by hand so that the serrations clear each other.

HANSELL'S TRAMWAY WHEELS.

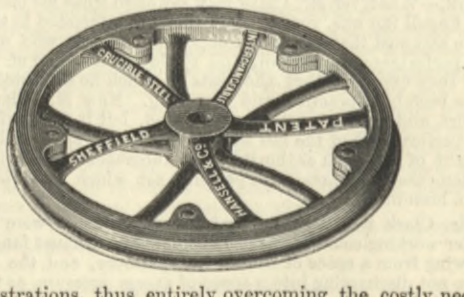
THE accompanying engravings illustrate a steel tramway wheel, manufactured by Messrs. Hansell and Co., Canal Steel Works, Sheffield. These wheels are made in two parts, namely, the centres and the tires. Both are of crucible steel, but the centre is comparatively tough and soft, while the tire is strong and hard, being hardened on the tread, indeed, by a special process until it resembles chilled cast iron. The metal is throughout of such a character as will resist effectually severe and sudden jerks at crossings, points, or curvature of lines



without fracture. We are informed that the Hansell wheels possess the important feature of not being affected in wear during frosty weather, the contractive influence is exerted equally, and there are no parts to be weakened by tension. As a proof of this, although Hansell's special crucible steel contracts ¼in. per foot, these patent wheels are taken from the



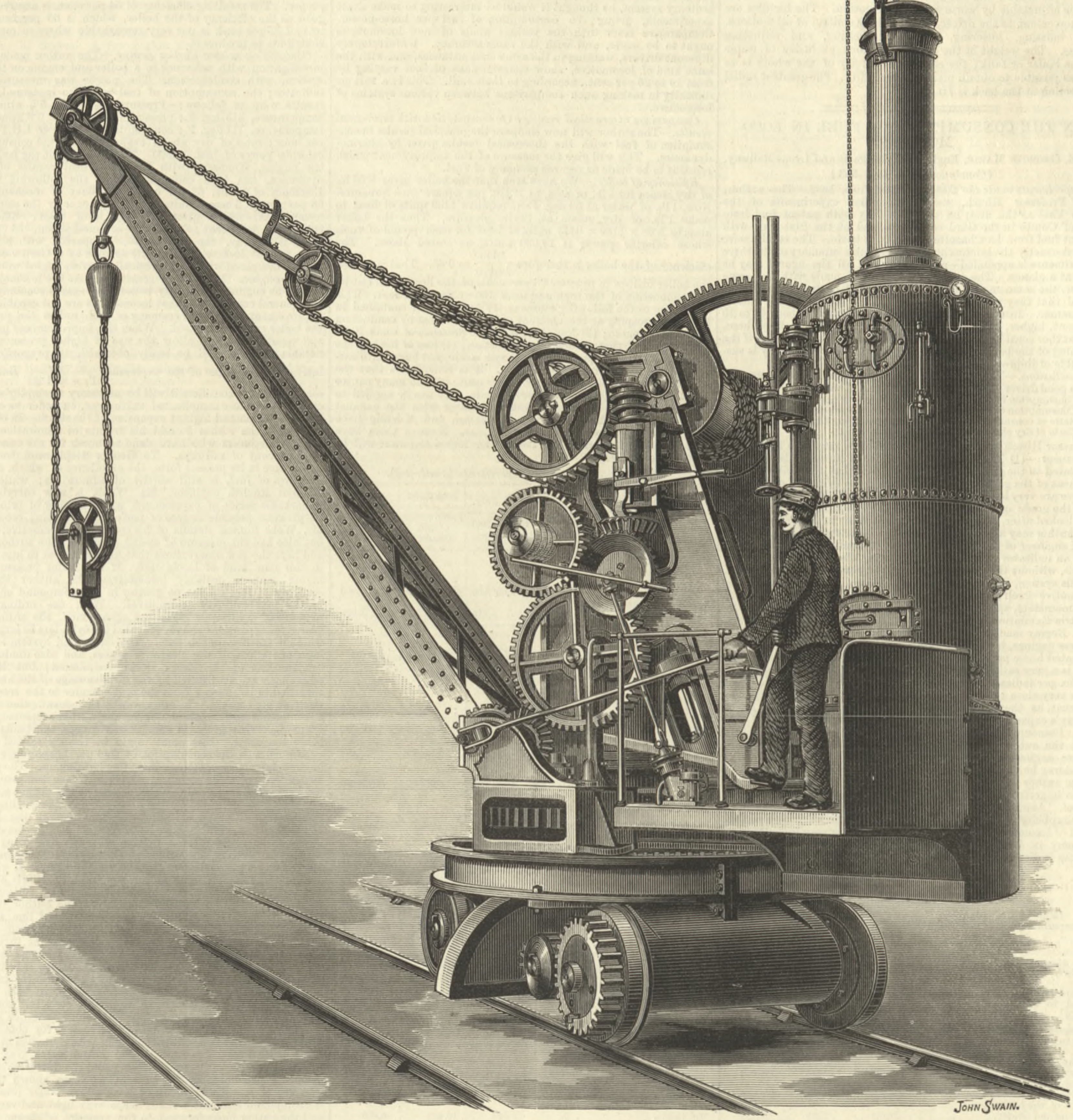
moulds immediately after being cast while red-hot, and allowed to cool down in the open air, and in that condition will stand severe blows from a sledge-hammer without fear of cracking. After the tires become worn out or otherwise unfit for use, these old tires may be removed and readily replaced with new tires, which fit in the recesses cast on the wheel centres, shown



in our illustrations, thus entirely overcoming the costly necessity of removing the whole wheel, without any machine or lathe work whatever, requiring no experienced workmen or the need of taking off the wheel from the axle. When the tires are thus replaced, the wheels are again as good as new. These wheels do not rely upon bolts or rivets only, although used and hidden from view. There are five recesses and snugs on each wheel, and these are made from accurately finished iron patterns, so that the tire and centre fit firmly together, and do not require any costly machine work.

FOURTEEN-TON PORTABLE STEAM CRANE, PARKHEAD STEEL WORKS, GLASGOW.

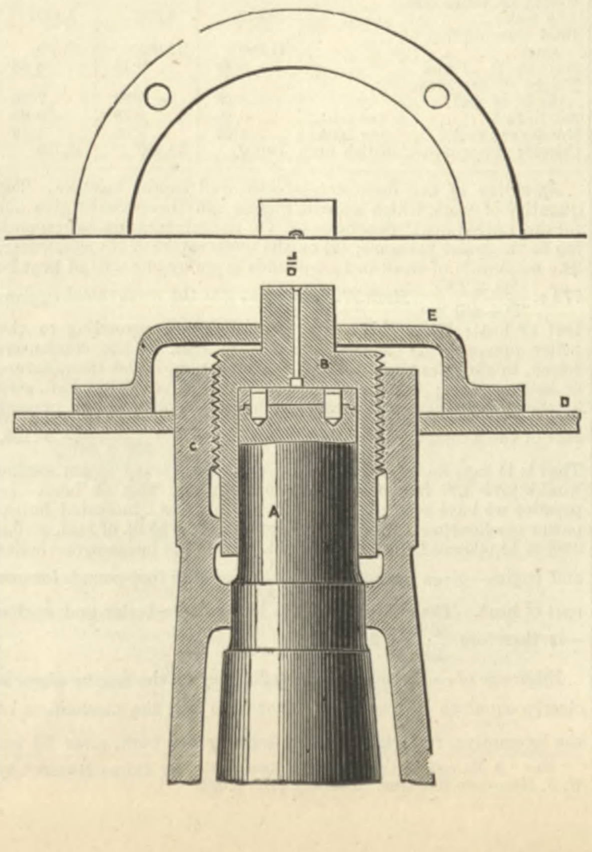
MESSRS. GEORGE RUSSELL AND CO., MOTHERWELL, GLASGOW, ENGINEERS.



THE crane illustrated above is representative of a class of portable steam cranes specially designed and constructed in various sizes for use in steel works. The work to be performed is constant and heavy, night and day, such as ordinary cranes could not cope with. Every part is extra strong, and easily accessible for inspection, while compactness is a prominent feature. In order to be universally available through the works, they travel on the standard railway gauge, and have sufficient stability to lift, slew, and travel with their full load suspended in any position. The engraving is from a photograph of the makers' No. 6 standard size, which lifts 14 tons at 12ft. radius, or 12 tons at 14ft. radius. It is the fifth crane supplied to Messrs. Beardmore, of Parkhead Steel Works, Glasgow, but it the largest yet made capable of slewing and travelling with its full load on ordinary gauge. These cranes are now in use in the principal steel works in this country, and several have gone also to America and the Continent.

The carriage is a massive casting of 10 tons, with a fore and aft wheel base of 8ft. centre to centre. The wheels with steel tires are for a gauge of 4ft. 8½in. The axles are of steel, 6in. diameter, in brass bearings. The travelling gear, wheels, and pinions are of cast steel, and all outside. On each side of the carriage is a strong wing bracket, giving a width over all of about 7ft., so that a guide rail or bar could be laid parallel to the rails on which the crane travels on each side, in special positions, when the maximum weights may require to be lifted. This is an extra precaution to provide for any jerk or abnormal strain tending to overcome the stability of the machine. These side rails or bars being half an inch under the brackets, would only come in contact when too great strain was put on the crane, and in case of a jerk the crane would immediately settle back on the travelling rails.

One of the special features of this crane is the construction o the central post and its connections. The post with its bearings is the most important detail in such cranes. For some years Messrs. Russell have abandoned the use of the roller path so universally adopted in cranes by other makers, holding that when such cranes are exposed to dust and grit the wear is excessive. If the crane is used so that only a part of a revolution in slewing is performed, that portion of the path wears the remaining portion below the level, so that through time the crane ceases to be able to make a complete revolution. If the roller path and sole-plate are cast together, the casting requires occasional returning and even renewal, which is inconvenient. For many years Messrs. Russell cast the roller path separately, of hard metal, in halves, so arranged that it could be moved round occasionally, so as to wear equally, and when requiring turning it could be removed and replaced without taking down the crane. It was not bolted to the sole-plate, but was simply held by two bolts clasping the halves together against a turned projection on the sole-plate, the friction being sufficient to keep it from moving.



The accompanying detail engraving shows the improved arrangement of post and bearings, which has been recently designed and patented by Mr. Russell. The post is a wrought iron forging A, fixed in the carriage, with a bearing at top and bottom, on which the crane revolves. The weight is carried on a steel plate fixed on top and the steel bush B. This bush is screwed into a jacket or case C, which is continued down to the bottom bearing. The post is thus entirely enclosed, and no dust or grit can find access to the bearings. There is a square head on the bush, to which is fitted a large cap E, fixed by four bolts to the cross girder D, which is a wrought iron plate. The bush can be adjusted by screwing it in the case to maintain the crane at a constant level above the carriage, taking up any wear. It can also be removed and replaced for inspection or cleaning in a few minutes. On unscrewing the bush the crane settles down about a quarter of an inch lower than the working level, and rests on the carriage till the bush is replaced. The side frames are of massive proportions, with brass bushes and covers for the various bearings of the shafts. There is a large balance weight of 8 tons under the boiler, with ash space and self-discharging arrangement, as illustrated in THE ENGINEER for the 8th of September, 1882. The boiler has two cross tubes in the fire-box, and is double rivetted in the vertical landings. A capacious tank is carried on the opposite side to the platform. The engines have a pair of 8in. cylinders, with link reversing motion of steel. The crank shaft is balanced by weights to prevent vibration. The disengaging clutch for hoisting is in the view of the driver on the platform, and there is a powerful foot brake for lowering.

The jib is 22ft. 6in. long, of wrought iron, with lattice stays, and is adjustable by worm and wheel motion. The handles are all convenient to the driver, who has easy control of all motions, viz., hoisting, lowering, slewing, travelling, and adjusting radius. The weight of the crane is 41 tons, exclusive of water in the boiler or tank; the centre of gravity of the whole is as low as possible to obtain maximum stability. The greatest radial projection at the back is 7ft. 9in.

ON THE CONSUMPTION OF FUEL IN LOCOMOTIVES.*

By M. GEORGES MARIE, Engineer of the Paris and Lyons Railway.

(*Concluded from page* 353.)

Experiments made the 20th and 21st July, 1882.—The author, with Professor Hirsch, made two other experiments of the same kind as the first; on the 20th July with patent fuel from Grand' Combe in the Gard coal basin, and on the 21st July with patent fuel from La Chazotte in the Loire basin. The results were almost exactly the same as before. A tabular summary of the three experiments is appended—p. 12—in which all the figures may be seen at a glance. The experiments were all made with the same driver, the same engine, and the same kind of train. It will be noted that they were made in July, that is to say, in the middle of summer. In winter the consumption of fuel is about 10 to 15 per cent. higher, on account of the loss of heat to the atmosphere. The author considers that this loss of heat might be diminished if the clothing of the boiler were better—a point which assuredly is susceptible of improvement, especially for cold countries.

Conclusions.—The author has proved that with a good locomotive and a good driver the consumption of fuel and water is as follows:—

Consumption of fuel per effective horse-power per hour. 3·27 lb.
Consumption of fuel per indicated horse-power per hour 2·88 lb.
Ratio of consumption of water to consumption of fuel .. 8·88
Ratio of dry steam produced to fuel consumed .. .. 8·08

Professor Hirsch attributes these satisfactory results to the following causes:—(1) The total heating surface of the boiler is very large compared to the grate surface—96 to 1—so that the boiler absorbs the heat of the gases very completely; (2) the cylinders of the locomotive are very large—according to the late M. Marié's system—so that the grade of expansion is high; (3) the locomotive was very well looked after, which is an important point in economy of fuel. The author may also refer to some experiments made by M. Regray, chief engineer of the Eastern Railway of France; they were made with an indicator on a new system, giving diagrams at the highest speeds, without the errors of the ordinary indicator. M. Regray, on this system, takes the diagrams at some distance away from the locomotive itself; the indicator is in a special van, with several dynamometers, speed indicators, &c. This van was shown at the Electric Exhibition in Paris, and obtained one of the highest prizes.

M. Regray made a few experiments on consumption of fuel in express engines, hauling express trains; the result was 3·01 lb. per indicated horse-power as an average, and 2·48 lb. as the minimum. This is a very satisfactory verification of the author's result, viz., 2·88 lb. per indicated horse-power. It is important to notice that these very close results have been arrived at by two methods as different as they could possibly be. The fuel employed in M. Regray's experiments was not patent fuel, but ordinary small coal from Bascoup, in Belgium. These satisfactory results confirm what the author's father always maintained, namely, that locomotive engineers ought to use large heating surfaces and large cylinders; he always built his own locomotives by that rule.

The author has thus endeavoured to prove that locomotives are not so imperfect as engineers generally believe, as regards ecomony of fuel. Assuredly the locomotive is a very simple form of engine; but simplicity is of great importance with the very high piston-speed of locomotives. That speed, however, is very favourable to economy in fuel—contrary to the opinion of some engineers—because it diminishes the leakage of steam and the condensation of steam during admission. A locomotive working with a very slow piston-speed is not so economical as with a high speed. Express engines give better results than mountain engines, as is seen by M. Regray's experiments, where the consumption attained the very low figure of 2·48 lb. per indicated horse-power under the best circumstances.

Tabular Summary of Experiments.

Items of experiments.	Units.	18th July. Patent fuel: Anzin.	20th July. Patent fuel: Grand' Combe.	21st July. Patent fuel: La Chazotte.
Total distance run by train	foot	91,536	91,540	91,540
Ratio of resistance on level to weight of train	ratio	$\frac{1}{232·5}$	$\frac{1}{232·5}$	$\frac{1}{232·5}$
Difference of level of the two stations ..	foot	1,7(9	1,709	1,709
Weight of engine and tender (not loaded).	lb.	125,076	125,076	125,076
Weight of carriages and vans (not loaded)	,,	204,800	225,285	176,212
Weight of the load on engine and tender..	,,	24,614	24,738	26,422
Weight of passengers and men	,,	7,409	5,711	4,785
Weight of goods.. ..	,,	4,575	4,264	3,149
Total weight of train.	,,	366,474	385,074	335,614
Before firing the boiler at Saint Jean-de-Maurienne.				
Patent fuel and fagots loaded on tender ..	lb.	2,249	2,251	2,249
Pressure in boiler (above atmospheric pressure) ..	lb. per sq. in.	46·28	21·36	18·23
Height of water in boiler (above water-line)..	inch	+5·16	+5·24	5·08
After arrival at Modane.				
Fuel remaining on tender	lb.	1,133	966	1,158
Pressure in boiler (above atmospheric pressure)	lb. per sq. in.	19·65	21·36	7·83
Height in water in boiler (above or under water-line)	inch	−4·49	+0·82	−4·73
Depth of water withdrawn from tanks during the experiment ..	inch	19·38	27·30	17·38
Weight of metal in boiler..	lb.	44,100	44,100	44,100
Capacity of boiler, water being at water-line	cubic foot	217·4	217·4	217·4
Diameter of cylindrical shell	foot	4·92	4·92	4·92
Total length of boiler.	foot	22·31	22·31	22·31
Distance from water-line to top of boiler.	foot	0·984	0·984	0·984
Horizontal surface of tanks in tender ..	square foot	73·59	73·59	73·59

* Institution of Mechanical Engineers.

The author has no intention of implying that locomotives will not be improved—in fact, he proposes to indicate further on the probable directions of improvement; but, before abandoning the ordinary system, he thought it would be interesting to make exact experiments, giving the consumption of fuel per horse-power. Comparative tests with the various kinds of new locomotives ought to be made, and with the same accuracy. Unfortunately different drivers, working in the same circumstances, and with the same kind of locomotive, show consumptions of fuel varying by from 10 to 20 per cent., according to their skill. This is a serious difficulty in making such comparisons between various systems of locomotive.

Comparison of practical results as to consumption with theoretical results.—The author will now compare the practical results in consumption of fuel with the theoretical results given by thermo-dynamics. This will give the measure of the improvement which remains to be made as regards economy of fuel.

Efficiency of boiler.—We have seen that the boiler gives 8·08 lb. of dry steam for 1 lb. of coal, at 128 lb. per square inch pressure. Now, 1 lb. of water at 59 deg. Fah. requires 1169 units of heat to make 1 lb. of dry steam at 128 lb. pressure. Thus the boiler absorbs 8·08 × 1169 = 9445 units of heat for each pound of fuel, whose calorific power is 14,600 units, as stated above. The efficiency of the boiler is therefore $\frac{9445}{14,600} = 0·65$. That is to say, the boiler utilises in practice 65 per cent. of the heat given out by the combustion of the fuel, and loses 100 − 65 = 35 per cent. This loss is due to the following causes:—(1) Loss of heat contained in the gases escaping at the chimney; (2) loss of heat by conduction to the atmosphere; (3) loss of heat by the presence of some little air in excess of that needed for combustion; (4) loss of heat by the escape of a small proportion of carbonic oxide, not burnt into carbonic acid; (5) several minor causes. It is remarkable that the total loss of heat should be only 35 per cent. with so many causes of waste. One of the best improvements that can be applied to locomotives is the heating of the feed-water with the exhaust steam. MM. Kirchweger, Mazza, Chiazzari, and Körting have designed several apparatus for that purpose. None of them have been a practical success, but the author hopes the want will be supplied before long.

Tabular Summary of Experiments (continued).

Items of results.	Units.	18th July. Patent fuel: Anzin.	20th July. Patent fuel: Grand' Combe.	21st July. Patent fuel: La Chazotte.
Work of locomotive measured at circumference of driving wheels	foot-lb.	770,600,000	810,100,000	705,900,(00
Apparent consumption of fuel	lb.	1,116	1,286	1,094
Before firing the boiler at Saint Jean-de-Maurienne.				
Volume of water in boiler	cubic foot	251·34	252·04	250·98
Temperature of water in boiler	deg. Fah.	293°	261°	255°
Weight of water in boiler ..	lb.	14,509	14,663	14,652
Units of heat in water	British unit	3,436,000	2,985,000	2,901,000
Units of heat in metal	British unit	1,175,000	1,012,000	988,000
Units of heat in boiler, total	British unit	4,611,000	3,997,000	3,889,000
After arrival at Modane.				
Volume of water in boiler	cubic foot	182·40	223·41	180·64
Temperature of water in boiler	Fah. deg.	257°	261°	232°
Weight of water in boiler ..	lb.	10,637	13,031	10,703
Units of heat in water	British unit	2,135,000	2,652,000	1,885,000
Units of heat in metal	British unit	1,008,000	1,024,000	885,000
Units of heat in boiler, total	British unit	3,143,000	3,676,000	2,770,000
Loss in units of heat.	British unit	1,468,000	321,000	1,119,000
Corresponding weight of fuel	lb.	155	33	123
True consumption of fuel	,,	1,271	1,319	1,217
Consumption of fuel per effective H.P. per hour	,,	3·27	3·22	3·40
Consumption of fuel per indicated H.P. per hour	,,	2·88	2·84	2·99
Weight of water lost by tender..	lb.	7,420	10,449	6,650
Weight of water lost by boiler	,,	3,872	1,632	3,949
Total consumption of water..	,,	11,290	12,081	10,599
Ditto per lb. of fuel ..	,,	8·88	9·15	8·68
Weight of dry steam per lb. of fuel.. ..	,,	8·08	8·32	7·90
Ash in fuel	per cent.	6·90	9·70	9·60
Moisture in fuel.. ..	per cent.	1·00	1·30	1·10
Calorific power of fuel.	British unit	14,600	14,400	13,700

Efficiency of the locomotive—boiler and engine together.—The quantity of work which a steam engine can theoretically give out for one unit of heat* depends—(1) On the temperature corresponding to the boiler pressure; (2) on the temperature of the condenser. The maximum of work in foot-pounds given by one unit of heat is: $772 \times \frac{T^1 - T^2}{T^1 + 461·2}$. Here 772 foot-pounds is the mechanical equivalent of heat; T^1 is the temperature Fah. corresponding to the boiler pressure; T^2 is the temperature Fah. of the condenser, which, in steam engines without condensation, is the temperature of boiling water; 461·2 is the number of degrees below Fah. zero of the absolute zero of thermo-dynamics. Applied to the present case of the locomotive, the formula gives:—$772 \times \frac{356 - 212}{356 + 461·2} = 136$. That is to say, under such conditions, a theoretical steam engine would give 136 foot-pounds of work for one unit of heat. In practice we have seen that the locomotive gives 1 indicated horse-power per hour, or 1,980,000 foot-pounds, for 2·88 lb. of fuel, giving 2·88 × 14,600 = 42,450 units of heat. Thus the locomotive—boiler and engine—gives practically $\frac{1,980,000}{42,450} = 46·6$ foot-pounds for one unit of heat. The efficiency of the locomotive—boiler and engine—is therefore $\frac{46·6}{136} = 0·35$.

Efficiency of engine alone.—The efficiency of the engine alone is clearly equal to $\frac{0·35}{0·65} = 0·54$. That is to say, the mechanism of the locomotive, receiving steam and giving out work, gives 54 per cent. of the work which a theoretically perfect engine should give in the same circumstances. The loss of work is 100 − 54 = 46 per cent. This is due to the following causes:—(1) Loss of work from the expansion of steam in the cylinders not being quite complete. (2) Throttling of the steam, on entering or leaving the cylinders. (3) Back pressure of the steam during the return stroke. (4) Imperfection of the valve motion. (5) Condensation of steam during admission. (6) Leakages of steam, and several minor causes. Such are the many causes of loss of work in the engine proper. The resulting efficiency of 54 per cent. is assuredly not so good as the efficiency of the boiler, which is 65 per cent.; still a loss of 46 per cent. is not very remarkable where so many causes contribute to produce it.

* See "A Manual of the Steam Engine and other Prime Movers," by W. J. Macquorn Rankine. London, 1876, p. 343.

Comparison with a Corliss engine.—The author made a similar investigation with reference to a boiler and engine on the Corliss system, with condensation. The power was measured by an indicator; the consumption of fuel was also measured, and the results were as follows:—Pressure in boiler, 5·5 atmospheres; temperature, 313 deg. F.; pressure in condenser, 0·9 atmospheres; temperature, 111 deg. F.; consumption of fuel per I.H.P., 2·01 lb. per hour; ratio of dry steam evaporated to fuel consumed, 8·5; calorific power of fuel, 14,500. The efficiency of the boiler and of the engine, compared with the theoretical results of thermo-dynamics, has been calculated, with the following results:—Efficiency of boiler, 64 per cent.; efficiency of mechanism done, 53 per cent. These results are almost exactly the same as with locomotives, which gives, as we have seen:—Efficiency of boiler, 65 per cent.; efficiency of mechanism, 54 per cent. That is to say, the locomotive, compared with a theoretically perfect locomotive, is quite as good as a Corliss condensing engine compared with a theoretically perfect engine working as a Corliss engine. The author concludes that the locomotive is not so bad as engineers generally believe as regards economy of fuel. The general conclusion is that locomotives are not capable of much improvement as regards economy of fuel, unless the pressure in the boiler can be increased. When the improvements in material and construction will allow the use of higher pressures, then a notable economy will be easily obtained, in proportion to the increase in the value of the expression $\frac{T_1 - T_2}{T_1 + 461·2}$. But in that case the author considers it will be necessary to employ compound cylinders or more complicated valve gear, in order to obtain the best utilisation and highest expansion of the steam. In concluding this paper, he wishes to add his tribute of admiration to those English engineers who have done so much for the existence and improvement of railways. To George Stephenson we owe the locomotive in its present form, the excellence of which, as regards economy of fuel, is still worthy of admiration; while another eminent English engineer, Mr. Webb, is now carrying out a remarkable series of experiments with the view of bringing it to its greatest possible degree of perfection. Having received from Mr. Webb himself details of his compound locomotive, which he has also had the pleasure of seeing at Crewe, the author is led to add here the few observations that have occurred to him in regard to this new kind of locomotive. If the boiler pressure be not higher than in ordinary locomotives, the author thinks the economy of fuel cannot be greater in the compound engine than in the best ordinary locomotives. With the ordinary boiler pressure of 9 atm., or 135 lb. per square inch, the ordinary valve gear gives expansion enough, provided the cylinders be large enough, which is not always the case. The compound system lessens the injurious effect of the clearance spaces, and also diminishes the condensation of the steam during admission; but these two advantages are neutralised by the disadvantage of the steam being throttled in its passage from the first cylinder to the second, especially at high speeds. In other words, the consumption of fuel in a compound engine could not, in the author's opinion, be much lower than that given in the present paper, the boiler pressure being the same. This point would be readily settled by a few experiments on the consumption of fuel per horse-power per hour in the compound locomotive, including lighting up. The particular locomotives of ordinary class, with which the compound engine has been compared by Mr. Webb, appear to the author to be somewhat too heavily loaded for the best economy, their cylinders being smaller than those of the express locomotives on the Paris and Lyons Railway, which have cylinders of 19·7in. diameter and 24·4in. stroke, with 6ft. 6in. driving wheels. Fuel being very expensive on this line, the author's father always made his engines heavy but very economical; and these express engines, which were designed by him and built at the works of the Paris and Lyons Railway and of Messrs. Sharp, Stewart, and Co., are some of the most economical locomotives there are. The author has indeed made experiments, in which—on the same kind of line, and at the same speed, and with the same total weight of train—the consumption of fuel was almost exactly the same as in the latest experiments with the compound locomotive; but he cannot look upon such a comparison as of great value, because it is impossible to estimate precisely the difference of circumstances in the two cases. The further experiments he has suggested with the compound engine seem therefore to be needed for a fair comparison. In his own experiments the author has found 9 atm. or 135 lb. per square inch to be the maximum boiler pressure for obtaining good expansion with ordinary valve gear and with cylinders of ordinary size. With higher pressures, either better valve gear must be employed, or the compound system; and the latter is considered decidedly preferable by the author, who has shown that great economy of fuel can be obtained with a high boiler pressure. In the compound locomotive the boiler is very light and very strong; and the author looks forward to the pressure of steam being yet further increased during the next few years, without making the engine too heavy for the rails. It will then be a necessity to adopt the compound system for obtaining good expansion; and the compound locomotive, without being too heavy, will then unquestionably be much more economical than ordinary engines could be, and will be well adapted for high speeds. Goods engines of the ordinary kind are not so economical in consumption per horse-power per hour as express engines; and the author anticipates, therefore, even better results from the compound system in goods engines than have been obtained with express locomotives. The compound system, with yet higher boiler pressure, will thus, in his opinion, turn out to be the greatest impovement in locomotives since the time of Stephenson.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Edward L. Carte, engineer, to the Asia, for the Rupert; William T. Searle, engineer, to the Asia, for the Dwarf; Thomas H. Hyde, engineer, to the Asia, for the Dreadnought; Richard G. Wilby, engineer, to the Pembroke; William Nicklin, chief engineer, to the Turquoise; Harry Taylor, engineer, to the Turquoise; Arthur G. J. Faulds, assistant engineer, to the Turquoise; and Richard Phillips, assistant engineer, to the Himalaya.

RANSOMES, SIMS, AND JEFFERIES, LTD.—We are requested to state that on account of the continuous extension of their business, and the desirability of fixing the capital employed in it, Messrs. Ransomes, Head, and Jefferies have converted their partnership into a private limited company, constituted under the Companies' Acts, 1862 to 1883, which has been registered, and will be henceforward carried on under the name of Ransomes, Sims, and Jefferies, Limited. The new company has acquired all the assets, and will discharge all the liabilities of their partnership. The management of the business of the company will be continued by the partners of the late firm, viz., Robert Charles Ransome, James Edward Ransome, John Robert Jefferies, who, together with Mr. William Dillwyn Sims, and members of their respective families, are the shareholders in the new company. They bespeak for the company a continuance of the support and confidence which for nearly 100 years has been continuously given to it and to its predecessors as a private firm.

RAILWAY MATTERS.

THE Caledonian, North British, and Glasgow and South-Western Railways are so rapidly fitting their carriages with the Pintsch gas that travelling in Scotland will, so far as light is concerned, soon be much better than in England.

A TRAIN is as susceptible of direction from its proper path by soft things as some other moving bodies. An express from Manchester to Normanton was thrown off the rails a few days ago, at Milner Royd Junction, near Halifax, by a bale of goods falling from a wagon.

BROKEN rails are yet amongst the most fruitful cause of accident in the States. A few nights since a passenger train was wrecked on the Wabash Railway, near Decatur, Illinois, two sleeping coaches being overturned, thirty persons injured, and three killed. There were ten accidents caused by broken rails in last March alone.

THE proposed Parks Railway, which may be looked upon as a short extension of the Metropolitan, is estimated to cost about £1,245,000. No less than about 40 per cent. of this sum will go towards new streets, damages, land, &c., and yet a line will pay with the usual fares. It may be imagined from this at what a low rate passengers might be carried by a line not saddled with these enormous burdens—the London Central Electric Railway, for instance.

"INSTRUCTIONS with reference to Sanders-Bolitho automatic vacuum brake" on the Midland Railway have been issued, which show that it is not an automatic brake. One paragraph says:—"In the event of a train becoming divided when going up a rising gradient, the guard must, in addition to turning the tap to the 'remain-on' position, also apply his hand brake tightly, and take such other measures as may be necessary to prevent the vehicles from moving."

THE gauge in India controversy is opening up a burning topic, and the battle of the gauges will have to be fought again. There are no less than five railway gauges in India—the 5ft. 6in., or broad gauge, the 3ft. 3in. or metre gauge, the 4ft. used on the Azimganj Railway, the 2ft. 6in. gauge of the Gaekwar of Baroda's line, and the 2ft. or military gauge of the Himalayan Railway. Practically the contest now lies between the broad and metre gauges; the most important lines have been laid on the former, and the broad gauge is the proper one to survive. What is now desired is uniformity, as the present breaks of gauge, and consequent shifting of goods add considerably to the cost of transport, though Indian railways now pay.

IN a report on an accident, which occurred on the 28th February, at Fenchurch-street station on the Great Eastern Railway, when as a passenger train was entering Fenchurch-street station, the engine left the rails with all its wheels at the sharp curve leading from the right-hand up line to No. 5 platform line, and was stopped after running about forty-nine yards, Major-General Hutchinson says:—"The train consisted of an eight-wheeled tank engine, with a four-wheeled trailing bogie, and a train of twelve vehicles, fitted throughout with the Westinghouse brake. This accident, which is almost a repetition of those which occurred at the same spot last October, must, I think, be attributed to the speed having been too high round the sharp curve of five chains radius, and to the gauge at the points being unnecessarily tight, the result being that the left leading wheel of the engine left the rails at the outside of the curve, having crossed the left switch 15in. from its tip."

A GENERAL classification of the accidents in the United States during March are as follows:—

	Collisions.	Derailments.	Other.	Total.
Defects of road	—	24	—	24
Defects of equipment	2	13	3	18
Negligence in operating	36	5	—	41
Unforeseen obstructions	1	16	1	18
Maliciously caused	—	1	—	1
Unexplained	—	13	—	13
Total	39	72	4	115

This division presents accidents of management as constituting 36 per cent. of the entire number. Some of those resulting from unforeseen obstructions might possibly be charged to defective management, in so far as they may have resulted from failure to keep up strict watch over the line when breaks in the road may be expected.

THE annual report of the Dominion Minister of Railways, as presented to the Canadian Dominion Parliament, shows that during the year under consideration as many as 1275 miles of railway were added to the length of road in operation in the Dominion, making a total of 8805$\frac{1}{2}$ miles under traffic. The railway system of Canada will within the next two years, when all the uncompleted lines are finished, comprise something over 11,400 miles. The paid-up capital has increased during the year from 415$\frac{1}{2}$ million dollars to 494$\frac{1}{4}$ million dollars, or 19 per cent., an increase in the capital per mile completed and under construction of 17·03 per cent. The business done by all the lines in operation has grown in large proportions. The gross amount of freight carried during the year was 13,266,255 tons; and the gross receipts 21$\frac{1}{3}$ million dollars. The number of passengers carried was 9,579,948, and the gross receipts showed an increase over those of the preceding year of 4$\frac{1}{4}$ million dollars. The net earnings were sufficient to pay approximately a dividend of 2$\frac{1}{2}$ per cent. on the share and bonded liability of the roads in operation.

THE *Railroad Gazette* record of railway accidents during March mentions 39 collisions, in which 11 persons were killed and 48 injured; 72 derailments, in which 15 were killed and 63 hurt; and 4 other accidents, in which one person was injured—a total of 115 accidents, in which 26 persons were killed and 112 hurt. As compared with March, 1883, there was a decrease of 27 accidents, an increase of 13 killed, and a decrease of 25 injured. These accidents are classed as to their nature and causes as follows:—Collisions: Rear, 23; butting, 15; crossing, 1—39. Derailments: Broken rail, 10; broken frog, 1; broken switch-rod, 1; broken bridge, 4; spreading of rails, 8; broken wheel, 8; broken axle, 2; broken truck, 1; accidental obstruction, 3; wash-out, 5; landslide, 5; snow, 2; wind, 1; runaway cars, 2; misplaced switch, 5; bridge purposely burned, 1; unexplained, 13—72. Other accidents: Boiler explosion, 1; dynamite explosion, 1; broken coupling-rod, 1; broken wheel not causing derailment, 1—4. Total, 115. Derailments continue to be one of the chief causes of accident, and of these a large proportion are, as usual, unexplained.

THE rapid tramway extension in Birmingham should be regarded with much satisfaction by makers of engines, rolling stock, and permanent way material. The Birmingham Central Tramways Company has now completed its line connecting the centre of the town with the suburb of Moseley; while the Western Districts Company will shortly begin the laying down of an extensive system on the western side of the borough. On the Moseley route steam power will be employed to haul the cars as far as the end of Bradford-street. The Villa Cross line will also utilise steam power. There are now in course of construction three depôts for the accommodation of the engines, cars, and horses which are to work the lines of the Birmingham Central Company. The first and largest is being erected in Kyott's Lake road, and will be capable of holding at one time no fewer than forty engines and sixty cars. The Perry Bar Station will accommodate about half of this number, and at Butlin-street, Nechells, sixty or seventy horses will be stabled. The company has already ordered twenty engines from Messrs. Kitson, of Leeds. These will be exactly the same as those which are used upon the Aston route—condensing engines with outside cylinders. A number of the cars are being made at the Falcon Carriage and Engine Works, Loughborough. It has not yet been decided when the lines will be opened; at present they await the inspection of an officer of the Board of Trade.

NOTES AND MEMORANDA.

THERE were 2811 births and 1586 deaths registered in London last week. The annual death-rate from all causes, which had increased in the four preceding weeks from 19·1 to 22 per 1000, declined to 20·6.

THE transition resistance supposed by Poggendorff to exist in electrolytic cells between the surface of the electrode and that of the electrolyte in contact with it has lately been investigated with great care by Professor J. Gordon Macgregor in solutions of very pure zinc sulphate, using electrodes of amalgamated zinc. The conclusion arrived at was that such a transition resistance, if it exists at all, is less than 0·0125 of an ohm.

AT a recent meeting of the Royal Society of Edinburgh, Sir W. Thomson communicated a paper on the efficiency of clothing for maintaining temperature. He showed that if a body be below a certain size, the effect of clothing will be to cool it. In a globular body the temperature will only be kept up if the radius be greater than $\frac{k}{2e}$, where k is the conductivity of the substance, and e its emissivity.

AT the Royal Observatory, Greenwich, the mean reading of the barometer last week was 29·73 in. The mean temperature was 51·3 deg., and 1·1 deg. above the average in the corresponding week of twenty years. The mean was below the average on the first four, and showed an excess on the last three days of the week. The lowest night temperature was 36·2 deg. on Wednesday, and the highest day temperature in the shade 75 deg. on Saturday; the extreme range in the week was therefore 38·8 deg.

THE American Iron and Steel Association reports that the production of pig iron in 1883 amounted to 5,146,972 tons, showing a decrease of 31,150 tons in comparison with the previous year's figures. The production of Bessemer steel rails amounted to 1,286,554 tons, the decrease being 152,601 tons; 7,762,737 tons of nails and spikes were made, and 1,615,640 tons of kegs, both items showing an increase. The prices of pig iron decreased by about 16 per cent. during the year. At the close of the year 307 furnaces were working, and 376 were idle.

FOR the week ending April 12th, 1884, in thirty-two cities of the United States, having an aggregate population of 7,347,900, there died 2982 persons, which is equivalent to an annual death-rate of 21·1 per 1000, an increase of 0·2 over that of the preceding week. For the North Atlantic cities the rate was 17·1; for the Eastern cities, 22·6; for the Lake cities, 18·6; for the River cities, 18·9; and in the Southern cities, for the whites, 19·8; and for the coloured, 39·6 per 1000. Of all the deaths 37·2 per cent. were under five years of age, the proportion of this class being 48·7 in the Lake cities; the highest rate of this class was 64·7 in Minneapolis.

A FACT of much interest to students of natural history is vouched for by Cavalier Moerath, a civil engineer, formerly of Rome, and now visiting this country. This gentleman has devoted much labour and attention to the improvement of water supplies in Italy. In prospecting for water with one of Norton's "Abyssinian" tube wells, he tapped a spring from which was pumped a living fish. This fish had passed into the tube well through the ordinary perforations of about $\frac{1}{8}$in. Examination proved it to have no eyes—clearly indicating that it belonged to an order intended to inhabit subterranean waters. The occurrence was certified to by two other gentlemen who were present when the fish was pumped up.

A PAPER "On a New Form of Pyrometer," by T. Carnelly and T. Burton, was read on the 1st inst. before the Chemical Society. The pyrometer, which the authors have used since 1881, consists essentially of a copper coil which is placed in the muffle, kiln, &c., whose temperature is to be determined. Through this coil flows a constant current of water. The temperature of the water is taken as it enters the coil and as it flows out. From the difference of these two temperatures and a table, the temperature to which the coil has been exposed can be ascertained. A similar instrument has been devised by Boulier—Bull. Soc. Chim. 40, 108. By means of the above instrument temperatures up to 650 deg. C. have been determined to within 25 deg.

No part of England or of the British Isles is so rich in remarkable mineral springs as Yorkshire. The Harrogate waters have been known and esteemed for more than three centuries, since the discovery of the Tewitt Well by Captain Slingsby in 1570. The old sulphur well is still without a rival among hepatic waters. So far as is known, no water in the world is so strongly chalybeate as the chloride of iron spa of Harrogate; indeed, there are only two other springs in Europe which are believed to contain this particular salt of iron; they are the Selkenbrunnen at Alexisbad, and the water of Bahowina in Silesia. Very remarkable, too, is the existence of relatively large quantities of barium chloride in many of these springs; the presence of this compound in several of the Harrogate waters was first pointed out by Mr. R. Hayton Davis. Perhaps no locality in England can show such an extraordinary sight as that of the bog field in Harrogate, where, in a space of some half-dozen acres, springs of the most widely different character—magnesian, sulphuretted, chalybeate, &c.—are found to rise within a few yards of one another.

AT a recent meeting of the Chemical Society, Dr. Percy Frankland read a paper "On the Composition of Coal and Cannel Gas in Relation to their Illuminating Power." In this paper the author gives the results of his examination, somewhat in detail, of the gas supplied to some of the more important towns of the United Kingdom. The constituents which have been individually determined are the hydrocarbons absorbed by fuming sulphuric acid, carbonic anhydride, oxygen, nitrogen, hydrogen, carbonic oxide, and marsh gas. In all cases the carbon density of the hydrocarbons has been determined, and in many cases also the hydrogen density, the carbon and hydrogen densities together representing the average molecular formula of the hydrocarbons present. Details of the determination of these densities are given. The reputed illuminating power and the ratio of the illuminating power to the proportion of ethylene to which the heavy hydrocarbons are equivalent are also recorded. The predominant hydrocarbon seems to be ethylene, but the quantity of this gas present is quite insufficient to account for the illuminating power of the gas, so that the denser hydrocarbons, though present in comparatively insignificant proportions, have much to do with the actual illuminating power. In comparing these analyses with similar results obtained in 1851 and 1876, it is seen that the carbon density has diminished, whilst the quantity of nitrogen has increased.

SOUTH of the Sulphur Bank on the northern side of Clear Lake, in California, at a distance of less than a mile, is a spot which indicates an immense outpouring of boracic acid, though the emission has been only in times long past, and the acid has all entered into combination with soda, as the name above given indicates. "Borax Lake is very insignificant in its appearance, but fifteen years ago it completely revolutionised the borax trade of the United States. It seems absurd to give the title of lake to it, for it is only a large pool of shallow water, with muddy shores and bottom, and without either inlet or outlet. The length of this oval 'mud hole' varies with the season. At the close of the dry season the water has sometimes, though not commonly, entirely evaporated, leaving only a space of mud incrusted with salts, while after an extremely wet season the water is 5ft. or 6ft. deep in the middle, with a length of a mile and a-half. This water, even in its most diluted condition, is intensely alkaline, its strength, of course, increasing with the progress of the summer's evaporation. "When the depth of the water is 4ft.," the *Scientific American* says, "which may be reckoned a fair average, and which gives a length of about three-quarters of a mile, it holds in solution 18·75 grains of salts to the fluid ounce. These are salts of soda, in the following proportions: Sod. carbon., 0·618; sod. chlorid., 0·204; sod. bibor., 0·178. Each gallon of the water, therefore, holds about a quarter of a pound of borax."

MISCELLANEA.

THE steamer Faraday has laid the shore end of the new Mackay Bennett cable at Dover Bay, Nova Scotia, and has started across the ocean paying out the deep-sea cable.

A STEAMER arrived a few days since at Sebastopol from Marseilles with a cargo for Moscow. This is the first instance of direct communication between the Mediterranean and Moscow *viâ* Sebastopol and Kharkoff.

MESSRS. WORTH, MACKENZIE, AND COMPANY, of Stockton, are at present busily employed with serveral large contracts, one being for plant for the Simon-Carvé process of utilising the bye-products in the manufacture of coke.

THE Tankerville Great Consuls Mining Company has stopped work at its large lead mines in Shropshire. Great distress is resulting. The mines returned 120 tons per month, but the expenses have been, it is said, for some time greater than the receipts.

THERE are now provided for entrances to the Health Exhibition no less than twenty turnstiles. They are made under Norton's patent by Messrs. Le Grand and Sutcliff, and are seven more in number than last year, with a view to the large numbers expected to visit the Exhibition.

THE Antwerp Universal Exhibition of 1885 will be divided into five sections—public instruction, industry, marine, electricity, and agriculture. The rent will be 70f. per square metre for ordinary stalls, and for separate stalls 150f. In the principal galleries 25 per cent. more will be charged. For the machinery show-rooms the rents will be lower, and special agreements may be made.

A POCKET card, containing a table of the relative weights and sizes of insulated copper conductors for conveying electrical currents of from 1 to 2741 ampères, showing the electro-motive force absorbed by the conductors, and the nearest corresponding b.w.g. size of solid copper wire or strand for the purpose, has been compiled by Mr. E. J. Cowling Welsh and published by Messrs. E. and F. N. Spon.

AN unreasoning exultation over any disaster with a traction engine characterises the reports of mishaps by one of the Sheffield papers. One can understand this sort of thing with people who live in country districts full of narrow roads and lanes, but the objection in Sheffield seems to partake of straining at a gnat, for a traction engine cannot be out of place there, or in any way destroy the appearance of the general fitness of things.

ON Saturday last a Midland district meeting of the Association of Municipal and Sanitary Engineers and Surveyors was held in Leicester, and was attended by a larger number than has been known at a district meeting for some years past. The principal business of the day was an inspection of the flood works now being carried out, on which a paper was subsequently read by Mr. J. Gordon, C.E., the borough surveyor, and a discussion followed.

THE death is announced of M. Wurtz, the eminent chemist and Republican life Senator. He was born at Strasburg in 1817, and after being educated there came up to Paris in 1845. After holding some subordinate posts, he became professor at the Faculty of Medicine, and in 1866 won the Emperor's biennial prize of 20,000f. In the following year he succeeded Pelouze in the Academy of Sciences. His chemical work led to the transformation in France of the study of organic chemistry. In 1881 he was elected to the Senate.

A COPY of "Gasworks Statistics for 1884," compiled from special returns from engineers and secretaries throughout the United Kingdom, and edited by Mr. C. W. Hastings, has been sent us by the Scientific Publishing Company. The information is given under the heads:—Name of town, date up to which returns are made, tons of coal carbonised, annual make of gas in thousands, annual sale in thousands, illuminating power, price per 1000 cubic feet, number of consumers, price paid for public lamps, number of public lamps, average price realised for coke, tons of sulphate made, and dividend. The same information is given as relating to the supplies of a large number of towns abroad, chiefly in America.

ON the 7th inst. a council meeting was held in Glasgow for the purpose of receiving evidence on the following points:—(1) The necessity that exists for cross-river communication below the Broomielaw; (2) the most suitable point on the river at which to provide for it; and (3) the most practicable scheme for carrying out the purposes intended. The chairman said the inquiry was held in compliance with a memorial, and also with a resolution of the town council appointing a sub-committee to consider the whole subject. Evidence was given by Mr. W. Simons, of Renfrew, in favour of a four-screw elevating steam ferry conveying carriages, wagons, goods, and passengers. Mr. Deas gave evidence in favour of a high-level bridge near Finnieston-street, which he had found could be made without too severe gradients. Mr. A. G. Thomson and Mr. Jas. Waddell gave evidence in favour of a tunnel.

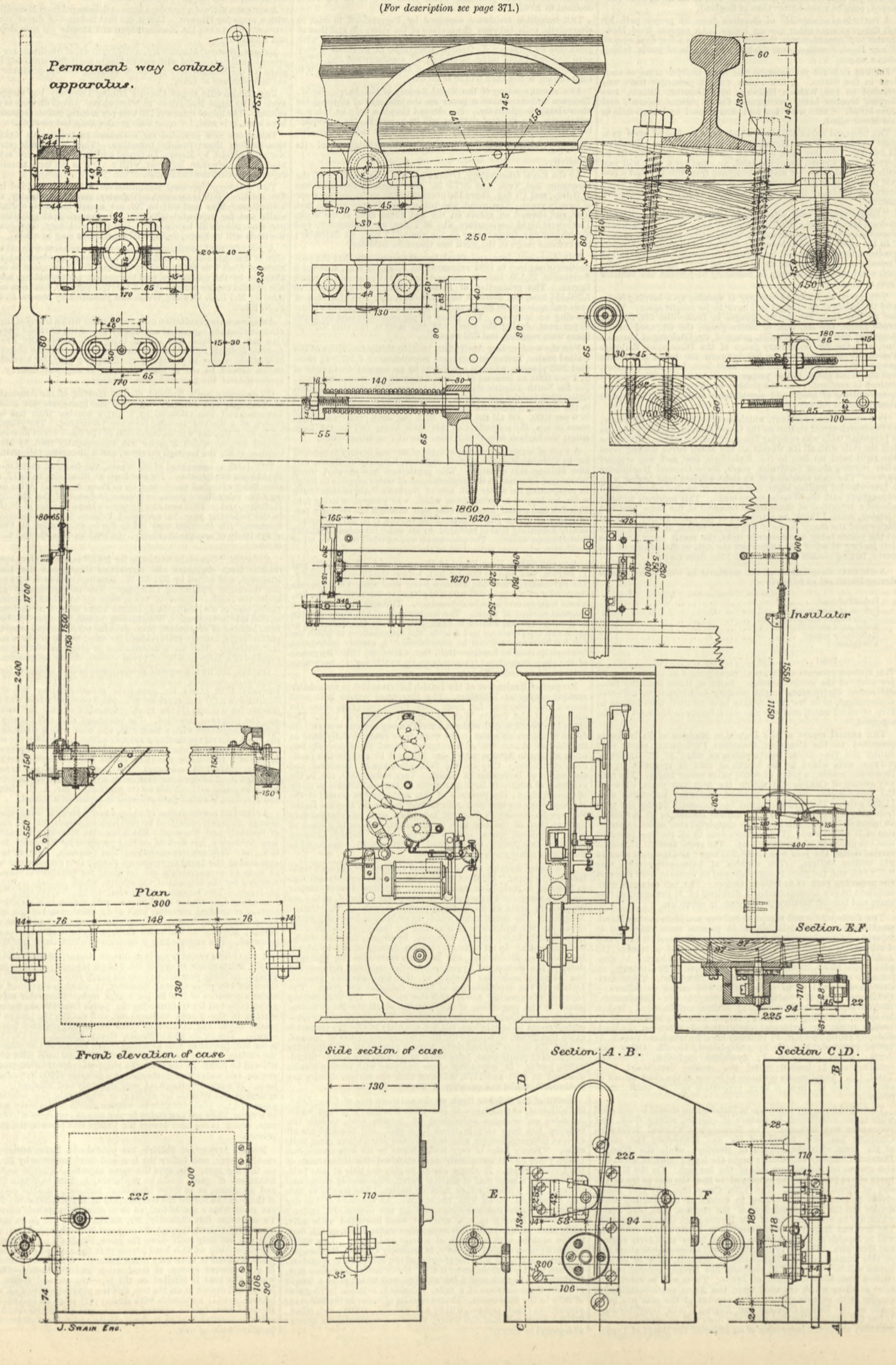
AFTER full consideration of about twenty plans of sewerage and sewage disposal, submitted by different engineers, for the district of Southall and Norwood—Middlesex—the Uxbridge Rural Sanitary Authority, has decided on that prepared by Mr. John Anstie, C.E., of Westminster-chambers, and proposes, subject to the approval of the Local Government Board, to commence the works as soon as arrangements can be made for purchase of the land required for the disposal of the sewage, which belongs to the Earl of Jersey. The scheme provides for the main sewerage of a district about four square miles in area, with a view to a considerable portion of it being hereafter built upon, the disposal of the sewage being effected by means of precipitating tanks, and subsequent natural filtering of the water through an area of land specially prepared. The undertaking is estimated to cost about £10,000.

A TRIAL was recently made at Messrs. Grant, Ritchie, and Co.'s works, Kilmarnock, of one of Mr. Joseph Moore's patent hydraulic pumps. In these pumps there are no pump rods, and in their place there are two pipes of small diameter, in which is contained water under a pressure of 1000 lb. per square inch. This water serves as a hydraulic rod for transmitting the power from the engine on the surface to the pumps underground, and enables the pumps to be placed round any number of turns and at any distance from the engine. The pump which Messrs. Grant, Ritchie, and Co. tested is for the Broxburn Oil Company. The engine will be placed on the surface and the pump down a drift 300 yards long. The vertical lift will be 720ft. In the trials the pump was placed 120ft. from the engine, and water was discharged at a pressure of 200 lb. per square inch. It worked throughout very smoothly and efficiently. The system is also suitable for sinking, in which case the columns of pipes and the plungers slide in wooden guides in the same manner as a cage. They are suspended by two sets of rods from a hydraulic ram, which raises and lowers the pumps and pipes in the sinking process.

MR. H. AITKEN, of Falkirk, has published a letter commenting on the paper read before the Iron and Steel Institute by Mr. Bell on the 1st inst. He says the same objection is made as to the treatment of gases made in producers, in order to obtain the tar and ammonia, as to those from blast furnaces, viz., the costliness of the plant to reduce the temperature of the 150,000 cubic feet of gas made from a ton of coal, so as to obtain the tar and ammonia. To overcome this difficulty, Mr. Aitken passes the gases made in one producer down through the cold coal in another producer; and in this way not only cools down the gases, but heats up the raw coal. His experience on this head proves that the amount of condensing plant required is thus very much reduced. The great advantages of a downward system of combustion and distillation—that is, where the coal is kindled on the top—the air and steam being forced and drawn in on the top, and the products carried off at the bottom, are (1) no trouble with clinker; (2) more oil and ammonia obtained than by the upward method; and (3) the oil much more valuable, containing, as it does, spirits and a large proportion of paraffine scale or wax.

ELECTRICAL APPARATUS, ST. GOTHARD RAILWAY.

(*For description see page 371.*)



TO CORRESPONDENTS.

*** *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 will be taken of communications which do not comply with these instructions.*

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

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

J. D.—*A letter awaits the application of this correspondent.*

C. F. (Nicolaieff).—*Your idea has already been put into practice.*

T. B.—*Many schemes for automatically placing fog signals on rails have been patented and tried. The railway companies have not adopted any of them, nor is it likely that they will. Why, we do not pretend to explain.*

M. Z. (Rotterdam).—*There is nothing very new about the scheme for working by ebb and flow of the tide, save in the arrangements for storing power, which would be very expensive. On the whole, the first cost of the plant would be much greater than that of steam power, and nothing would be saved but coal, the cost of which is a very small item in producing the electric light.*

J. A. (Spiral Springs).—*Let* E = *compression or extension of one coil in inches, then* $E = \frac{d^3 \times w}{D^4 \times C}$, d *being diameter of spring centre to centre of steel,* w = *weight applied in pounds,* D = *diameter or side of round or square steel in sixteenths of an inch,* C = 22 *for round steel and* 30 *for square steel.* $D = \sqrt[3]{\frac{w \times d}{3}}$ *for round steel, and* $D = \sqrt[3]{\frac{w \times d}{4{\cdot}29}}$ *for square steel. See Rankine's "Machinery and Millwork," and Clark's "Rules, Tables, &c.," and Unwin's "Elements of Machine Design."*

J. W. (Forest-gate).—*The reversing gear you sketch will do very well. You need not have a loose excentric because the lead is of no consequence in going astern; so long as the engine turns round it will do. The best vertical boiler you can have for your purpose is one with a large number of small diameter brass vertical tubes. They ought not to be more than 1in. diameter, and might be about 15in. long, of which 8in. or 10in. may be in the water. The great difficulty you will have to contend against is priming, but this can be combatted by taking a coil of steam pipe close up to the crown of the boiler and perforating the upper side of the coil with small holes. If at any time the tubes become choked, they can be cleaned by putting a small spoonful of gunpowder into a roll of paper, thrusting it into the fire, and shutting the door.*

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 20th, at 8 p.m.: Paper to be read with a view to discussion, "On the Progress of Upland Water through a Tidal Estuary," by Mr. R. W. Peregrine Birch, M. Inst. C.E.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, May 22nd, at 8 p.m., the following paper will be read:—"The Electrical Congresses of Paris," by Mr. W. H. Preece, F.R.S., Past President.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, May 21st, at 7 p.m., the following papers will be read:—"Note on the Proceedings of the International Polar Conference, held at Vienna, April, 1884," by Mr. Robert H. Scott, M.A., F.R.S., President. "Meteorological Observations on the Maloja Plateau, Upper Engadine, 6000ft. above the Sea," by Mr. A. Tucker Wise, M.D., F.R. Met. Soc. "On Some Results of an Examination of the Barometric Variations in Western India," by Mr. A. Naylor Pearson, F.R. Met. Soc. "Illustrations of the Mode of Taking Meteorological Averages by the Method of Weighing Paper Diagrams," by Mr. Richard Inwards, F.R. Met. Soc., F.R.A.S. "Ten Years' Weather in the Midlands," by Mr. Rupert T. Smith, F.R. Met. Soc.

SOCIETY OF ARTS.—Monday, May 19th, at 8 p.m.: Cantor Lectures.—Lecture II., "Fermentation and Distillation," by Professor W. Noel Hartley, F.C.S. Wednesday, May 21st, at 8 p.m.: Twenty-second ordinary meeting.—"Telegraph Tariffs," by Lieut.-Colonel C. E. Webber, R.E., C.B. Dr. Cameron, M.P., will preside. Thursday, May 22nd, at 8 p.m.: Applied Chemistry and Physics Section.—"Economic Applications of Seaweed," by Mr. Edward C. Stanford, F.C.S. Mr. W. H. Perkin, F.R.S., will preside.

DEATH.

On the 24th ult., JOHN GEORGE LIDDIARD, C.E., of Swindon, Wilts, aged 37 years.

THE ENGINEER.

MAY 16, 1884.

THE WEAKNESS OF OUR FLEET.

WE print elsewhere tables by Sir Thomas Symonds, G.C.B., Admiral of the Fleet, showing the comparison between the work performed on the English and French fleets. These tables were referred to in the House of Commons in the course of the discussion on the Naval Estimates, by Mr. Campbell Bannerman, as very fallacious. We believe, nevertheless, that in their present form they are accurate, a few minor corrections having been made by Sir Thomas himself, which at no time affected their general bearing. The matter is so serious as to deserve earnest attention. It is clearly shown that the French fleet is rapidly gaining on our own year by year. In 1875, we felt the weight that the power of our fleet gave to our words in the council of European Powers. At that time France had given her attention to other more pressing needs. She was still suffering severely from the shock of her war with Germany, and had scarcely eyes and ears for anything that did not bear very directly on the powers of attack and defence in the direction of her German frontier. Italy's first grand ships were then only in an early stage of construction. Russia had allowed her fleet to drop far below its old strength compared with that of other Powers. Hence, without any sensible effort, England found herself, rather to the surprise of all European Powers, as well as many of her own people, paramount on the seas, a situation which Lord Beaconsfield knew how to turn to the best account. The purchase of some armour-clad ships which were ordered for Turkey was effected at a time when the need of a strong fleet was apparent, and in this way England continued by hook or by crook to hold her own, so that King, in his "War ships and Navies of the World," was able to write even in 1880, "The maritime preponderance of England is no new theme." . . "A powerful navy is a necessity, as well for the preservation of the realm as for promoting the trading enterprise which forms the basis of her wealth and greatness, and in this way it has become an element of the national existence, closely identifying itself with all the domestic and foreign relations of the people." . . "No censure is ever passed upon the large expenditures for maintenance and additions to the fleet." . . "Never since the application of steam propulsion to ships of war has the British navy been relatively so strong as at the present time."

If this could be said up to 1880, it shows how rapidly circumstances may change. The French navy has been growing by leaps and bounds; breech-loading guns are introduced throughout; heavier guns are brought in, and thicker steel and compound armour are adopted, while Italy has pushed on her large ships so rapidly that in a table published by Krupp we find our own Inflexible and 80-ton guns left at the lowest end of the scale, and not, as some Englishmen would fondly expect, at the highest. That a nation's fleet should drop behind is easily to be understood in some cases at a time of peace. Nothing is more natural than that this should happen in the case of the United States of America. She has nothing to fear, if she leaves other nations alone. At the present moment it is true her neighbours possess ships that might crush any of hers easily, but they might expect eventually to suffer so severely from the consequences of such a victory that it is improbable in the highest degree that they would attempt to snatch it. The United States as a Power may very probably be wise, up to a point, in her policy. We are inclined to think that even in her case she is finding out she has gone too far. Still her position is a peculiar one, and she may do safely what few Powers could venture to imitate. The case of England is also a peculiar one, but it is so as being the opposite to that of America in most essential points. America is far removed from contact with dangerous and powerful nations. England, although an island, has possessions and interests bringing her into constant contact with some of the most ambitious and powerful nations that exist. America has an abundant supply of the necessaries of life. England absolutely depends on her ships to bring them to her shores from remote parts of the world. Is there any one, it may be asked, who is jealous of America? On the other hand, is there any one who has not in some way reason to be jealous of England? If we were wholly passive our possessions would excite envy, so would the existence of our trade; but their existence in truth renders it impossible to be wholly passive.

Some years ago circumstances arose which enabled England to speak with weight in Europe, and Englishmen who remember it are slow to believe that our condition is changing as rapidly as is the case, and that it only needs political events, which might arise at any time, to show us very painfully that our prosperity is no more safe than was that of France in 1870. We commend the tables and notes we publish to the attention of our readers. We do not concur in the view taken of all the features in detail by Sir Thomas Symonds; for example, if machine guns will prove so destructive to men at our muzzle-loaders, as it is urged will be the case, would they not prove still more destructive to the detachments of French guns firing *en barbette*? We cannot endorse the condemnation of the construction of our ships as to armoured decks, want of cellular system, and weak rams. We do not admit the existence of such gross faults for a moment. At the same time we do not wish to weaken the force of the general statement of Sir Thomas Symonds as to the serious danger of allowing our fleet to drop so fast as it is now doing in the scale of European navies. We look upon this as fraught with danger to the position of England as the great trading power of the world—a position which it is surely worth while to maintain; and this being so, it is madness not to make the comparatively small sacrifice necessary to render our position reasonably secure.

HIGH-SPEED LOCOMOTIVES.

IN our impressions for March 14th and 21st, the problem of high-speed locomotion was considered at some length, and it was shown that if the tractive resistance of a train should reach 40 lb. per ton, it would be nearly impossible for that train to make a trip of 200 miles at an average speed of sixty miles an hour, if there was one stop. It was shown further that the obstacle standing in the way was want of grate surface; in other words, of boiler power, and this grate surface could not be got while high driving wheels were retained. Although the conclusions arrived at by the writer of the two papers referred to appear to be sound enough, it by no means follows that the last word has been said on the subject. Whether our express trains will ever average sixty miles an hour or not is more, in our opinion, a question to be solved on financial grounds by the directors of railway companies than by anyone else. That there are mechanical difficulties in the way we do not doubt, but mechanical difficulties are the joy of the competent engineer. Honours can scarcely be won without battles.

There are three different ways in which sufficient boiler power—say 1500 horses—can be obtained on a narrow gauge —4ft. 8½in—road. The first consists in so constructing the engine that the fire-box shall be nearly the full width of the machine. The second consists in altering the construction of the grate. The third in adopting mineral oil as a fuel, either in conjunction with coal or by itself. We put the wide fire-box scheme first, because experience acquired in the United States seems to indicate that the plan is perfectly feasible. Mr. Wooton has run his engines successfully at seventy-five miles an hour. Their driving wheels are only 5ft. 8in. in diameter, and their grates are 9ft. long by 8ft. wide. The fire-box spreads far over the trailing wheels on each side, and the centre of gravity of the machine is very high; but for reasons which we have fully explained, and the validity of which are all but universally recognised, this elevation of the centre of gravity promotes steadiness, and gets rid of the bumping, jerking motion of engines with low boilers and wheels. The true difficulty about the Wooton engine appears to be the excessive speed at which the reciprocating parts must move. A 5ft. 8in. wheel running at seventy-five miles an hour makes nearly 366 revolutions per minute. With a piston stroke of 2ft. this means 1464ft. of piston speed per minute. There is no objection to this high velocity; but there is a great deal to the fact that the piston, with all its appendages as the crosshead, connecting-rod, &c., should have to be stopped and started 732 times in a minute. Even higher velocities of rotation are obtained by screw engines in torpedo boats, but difficulties are got over with them by making all the moving parts very light. Unfortunately the same thing cannot be done with a locomotive. At a piston speed of 1464ft. per minute, a pressure of 23 lb. nearly, will give a horse-power. As we have two pistons, a pressure of 11½ lb. on each will give a horse-power for the pair. Thus to get 1500 lb. horse power, we should require a gross effective pressure on each piston of about 17,250 lb., and dividing this by 255, the area of an 18in. piston, in round numbers, we have 67·5 lb. as the average pressure, and the greatest strain due to pressure ever put on the mechanism will be 17,250 lb. But when the engine is starting with a train this stress may be doubled and must be provided for. We ignore the fact that the initial pressure in the cylinder, even when the engine is running at full speed, may reach as much as 130 lb. per square inch. There will be no corresponding strain on the piston-rod or connecting rod, because the inertia of the mass to be moved will absorb it. In other words, much of it will not get beyond the piston. Mr. Wooton, however, manages to get his engines over the road at 75 miles an hour without accidents, and if he does this there is no reason why we should not be able to do the same with small wheels.

Whether or not the required end may be obtained by altering the construction of the grate is a point well worth discussion. It may be taken as proved that more than 100 lb. of coal cannot be burned per hour on a square foot of grate bar. The rate of combustion is almost entirely dependent on the volume of air that can be admitted to the fire; but this will in turn be settled by the area of the grate and the velocity at which the air passes through it. When the grate is small the fire must be thick, and the velocity of the air is so great that large quantities of fuel are carried away unconsumed. If, now, the grate area be extended, then the velocity of the air may be reduced. Thus, in Mr. Wooton's grates, with an area of 72 square feet, very small anthracite slack can be burned. If the draught through the grate bars was not very moderate, this stuff would be carried away like the dust of a highway in a March breeze. One Wooton grate is, indeed, almost as big as four ordinary locomotive grates, and the very moderate rate of combustion of 30 lb. per square foot per hour on it, represents the immoderate rate of 120 lb. per foot on an ordinary grate. The velocity of the air through the tubes will be the same, however, no matter what the size of the grate; but this point we need not discuss at present. Now, is it essential that the grate in a locomotive should be a plane? Let us suppose that it is not essential, and that the ordinary fire-box of a locomotive is fitted with a species of basket grate, to be kept constantly filled with coal. This basket might be, in round numbers, 2·5ft. by 5ft.; thus the area of the bottom of the basket would be 12·5 square feet. The two sides, if each 1ft. deep and 5ft. long, would give 10ft., and the two ends would give 5ft.; thus the total grate area available for the admission of air would be 12·5 + 10 + 5 = 27·5 square feet. Here, then, we would have at once, and almost without any change whatever in the engine, an increase of over 50 per cent. It is not necessary to go into details. We believe that there would be no great difficulty in making such a grate durable. The sides might, indeed, be made of water-tubes, in which there would be nothing new, such water-tube bars being freely used in the United States, although for a different purpose. But in any case, the experimental use of a cage grate presents no difficulty whatever, and would involve an outlay of less than £10, as it might be fitted to any engine without involving the smallest structural change in the existing fire-box. It will be readily seen that there are many forms which a grate may assume as soon as we abandon the notion that it must be flat.

The third and last proposition which we have to consider is the use of petroleum for fuel. That it can be used for making steam is indisputable. Many engines fired with petroleum are running on Russian railways. Nothing, indeed, seems to stand in the way of its adoption but its cost. In the case of express trains, however, the value of the fuel consumed is insignificant. An engine indicating 1500-horse power would burn, say, 2 tons of coal per hour, costing at most £2 on the engine. Now, 1 ton of petroleum will do as much as 2 tons of coal. We do not know at what price per ton crude petroleum might be delivered in this country, but the raw material is abroad, as at Baku, practically of no value whatever. If it could be delivered on our railways at £2 per ton, or even £3, its use would not be prohibited by considerations of expense, and speeds of seventy-five miles an hour might be readily attained. Anyone who has had practice in designing locomotives will see how much his work would be simplified if the necessity for providing a huge grate could be avoided. As we have said already it is not necessary that we should go into details; our present purpose will have been served if we have succeeded in showing that there is no insuperable mechanical difficulty, as far as providing power enough is concerned, standing in the way and preventing the attainment of those high velocities which will sooner or later be reached on English railways.

STEAM ENGINE CONSTRUCTION.

THERE are many problems in the design and construction of steam engines which will probably remain for a long time matters of opinion, because they are not demonstrable by any rigid methods. There are others which remain to some men matters of opinion long after they have passed from that stage with their professional brethren, and it is sometimes almost amusing to hear the confidence with which the engineer of the type that objects to be taught by the advancing experience and enquiry of a younger generation of men declaims against improvements which are of as unequivocal a kind as any ever made. At a recent meeting of the Institution of Civil Engineers, for instance, Mr. Rich, in a paper on the comparative merits of engines for pumping, directed special attention to what seemed an old and settled problem as to the adjustment of the brasses of prime mover journals, and one on which there could be no difference of opinion, whatever might be the difference of practice. The discussion, however, showed that this was not the case. The example given was of the crank shaft bearings as made by a well-known firm for the best kind of portable engines. The brasses of these are cut in three places, and are adjustable in two directions, namely, horizontally and vertically, so that the wear due to the thrust and pull on the crank and to the weight on the crank may be respectively taken up. Now all those who have had any experience with ordinary class, medium size engines running at what would now be called slow speeds, know that the wear on crank shaft brasses can be taken up even when these brasses are adjustable in only one direction, that is when the brasses are only cut in one plane, whether that plane is horizontal or placed at an angle, and that for all ordinary purposes engines so fitted run tolerably well, and do not make noise enough to attract more than the usual amount of attention bestowed upon them. But it is almost equally well known that with a horizontal engine running at a speed of anything over 150 revolutions per minute, and with a load pretty well up to its capacity, really satisfactory smooth running cannot be maintained for any great length of time with main bearings so made. The difference between the form and actual dimension of the bearings and journal gradually increase, the bearings become somewhat oval, and the crank shaft journal makes the tour from one centre of curvature of this oval to the other at every revolution. The looseness cannot be avoided except by easing the brasses in the direction in which they are not worn, and it is communicated to and multiplied by the connected rod. Mr. Rich therefore advocated the use of bearings adjustable in two directions, but a well-known maker of engines used in rolling mills and for similar purposes gave it as his opinion that such things were unnecessary refinements, and from his point of view there is something to be said, namely, that bearings would not want adjustment if they did not wear, and the wear would be inappreciable if bearings were large enough. In vertical marine engines, for example, no means of lateral adjustment is ever provided. It is, however, so very uncertain what proportions this policy of "large enough" would require, that there can be no doubt that in horizontal, if not in vertical engines, it will continue to be wise to adopt proper adjustments for the bearings of crank shafts of engines for high speeds. The American practice is against this. Even for the fast running engines which have recently been sent to this country for electric lighting installations, crank bearings of Babbit metal are used. They are of great length, but it may be found that the "let them run as long as they will" policy will not do for them. Renewal is not so easy as adjustment, and nothing but the best design and work can answer for driving dynamo-electric machines for any length of time.

The custom of providing means of adjustment for some parts of steam engines no doubt arose from the habit of giving too small wearing surfaces. It is, for instance, noteworthy that, while twenty years ago every maker provided packing slips of thin brass or cartridge paper under the ends of crosshead guide bars, or made the ends with but a fitting rib, so that they could be easily eased, to-day no one does anything of the kind. Guide bars and crosshead blocks when of good proportions wear so very slightly that, after years of work, hardly any slackness is perceptible. It would therefore be folly to continue to provide loose elements, in the way of slipper adjusting pieces, to the crosshead for this purpose, when a little extra area of wearing surface will avoid the necessity. The fact that guide bars wear so very slowly is some proof that the friction between them and the crosshead is but small. This would seem to be an answer to Mr. Rich's argument in favour of parallel motion instead of guides, the lesser friction of which he gave as one point of superiority in the beam over the horizontal form of engine. It is, however, within the experience of many that parallel motion bars are not always properly adjusted as to length; and in this way may cause far more loss of power by friction of the piston-rod in the gland and the want of freedom in the motion bars than is ever lost by the sliding of a crosshead of sufficient area over guide bars.

In discussing the relative merits of engines for pumping, Mr. Rich leaned very strongly towards the beam engine form, and seemed to feel some surprise that the horizontal type had gained so much ground in a comparatively short time, and that for purposes other than pumping it was almost exclusively used here, and in Germany and Belgium. He seemed to be of opinion that this was a mistaken policy. Friction of the piston rubbing along the bottom of the cylinder he looked upon as a fruitful source of loss, while the use of an upwardly curved piston-rod carried at both ends did not much improve matters. In vertical engines the pistons pressed equally all round the cylinders, and they did not wear oval. In horizontal engines it is more often than not the top of the cylinder that is worn, because it is not as well lubricated as the bottom; and in any case the difficulty can be entirely got over by fitting slippers to the bottom of the lower edge of the piston, as done by Mr. Stroudley in the marine engines of the Newhaven and Dieppe boats. In reply to Mr. Rich it was argued, as in the case with the bearings, that if the piston was wide enough, the wear of the cylinder would be small, if of hard iron, as cylinders should be. This is, of course, a point which only affects economy of working. The want of perfect cylindrical form in a cylinder after a few years' running will not affect the trustworthiness of the engine, but as a question of economy it is of some importance, as the results of trials with beam engines were brought forward as showing the great economy of this form of engine, a consumption of as low as 1·7 lb. of steam being mentioned by Mr. Rich. Horizontal engines have, however, reached as low a consumption of steam per indicated horse-power as this, and the consumption per actual horse-power probably differs little from that of the beam or vertical engine, although a heavy piston is not rubbed over a cylinder surface for nothing. Some compound rotative beam engines, working at the Surbiton and Hammersmith pumping stations of the Lambeth and Middlesex Water Companies, are, however, credited with having consumed on a twenty-four and forty-eight hours' trials respectively only 13·397 and 14·67 lb. of steam per indicated horse-power. The water consumed was in these cases measured in tanks, and a separate boiler supplying high-pressure steam to the jackets was employed. No horizontal engine, as far as we know, ever reached this economy; though careful tests of high-class engines of even greater power than the beam engines above referred to have been made, none have brought the total consumption down much below 16 lb. What the relative consumptions would be per actual horse-power it is difficult to say, but it is fair to assume that the relations would remain much the same in the absence of information as to the duty of large horizontal pumping engines. Though there are few of these engines employed in waterworks, there are many used in mine pumping, and some of the engineers concerned might conveniently carry out experiments of great value as far as this subject is concerned. The duty of the Surbiton pumping-station engines reached, it is said, 124·27 millions of foot-pounds per cwt. of coal. Mr. Rich put the question, "Are the modern continental engineers right in adopting horizontal engines for nearly all land purposes?" or is the author—Mr. Rich—right in advocating a much larger use than hitherto of vertical engines for land purposes and using them almost invariably where large pumping power is required? This is a question well worth discussing, for very many horizontal engines of large power are employed where neither the lower cost or the extra head room required enter into consideration when their selection is made. They are adopted because they are thought best, most accessible, easily kept in order and repaired, well under view in work, and supposed to be economical. If the slightly greater cost of vertical engines can invariably secure higher economy, it should be known; but the results of isolated trials at present available for comparison are not, perhaps, sufficient to permit a complete answer to the question. To get figures of any value, engines of the two kinds, of similar power, performing similar work, must be compared. Actual horse-power must be obtained; and the efficiency of the steam must be found, not simply as used in a vertical or a horizontal cylinder, but as effecting a certain amount of work in either of those cylinders. One form of engine—a beam, for instance—would have to drive a line of shafting through the medium of gearing of some sort. The horizontal engine, of the same power, might drive the shafting direct. The efficiency of the steam as the mover of that shafting is required, not simply as the mover of a vertical or horizontal piston. Taken in this way, it is open to question whether the horizontal engine would not come out considerably better than the beam engine; but this cannot be said when the vertical takes the place of the beam engine. This may be a return to an old question, but modern developments of high-class engines make it necessary to return to it. A good many makers of heavy and strong horizontal engines used in the northern part of England for rolling mill and other heavy work, will maintain that, for strength, freedom from wear, economy, and lasting powers, the horizontal engine is equal to any. We will not say it may not be so; but although many of these engines are made with large proportions, very large wearing surfaces everywhere, and run a long time without stoppage, we may venture to think that not one of them, with all their freedom from ailments, purchased at the cost of weight, can approach the efficiency of the vertical engines used in our fast Atlantic liners.

RAILWAY SIGNALS.

THE correspondence now appearing in our pages on railway signals calls attention to a subject of much importance. No good purpose, however, can be served by exaggeration of any kind, and we venture to think that it is going rather too far to assert that placing a signal on the right-hand, or wrong side of the road, entails risk. The theory is, of course, that the driver may conclude that the semaphore arm, really at danger for him, is at danger for a train moving in the opposite direction. Now, when double posts are used—and they are used largely—it is clear that if they are the right side of the road for one line, they must be at the wrong side for the other. It may be urged that double posts are only used for home signals, and that all that is being urged on the matter refers to distant signals. If this be granted, then it appears that Mr. Stretton and those on his side have hardly any case. A single distant signal can only refer to trains approaching the station covered by the signal, and cannot refer at all to one leaving it; consequently a driver approaching the station has no ground whatever for assuming that it applies to any train except his own, and nothing but gross carelessness can cause him to neglect its indications. To home signals the same truth applies; they have nothing to do with the man leaving a station—they concern deeply the man approaching it. Home signals must not be mixed up in this connection with yard signals, to which nothing that our correspondents have said will apply. No attempt can be made to arrange them at both sides of the road, and they are usually at important stations grouped on a bridge over the road. That their indications are often extremely puzzling to those who have not the key to them is true enough; but drivers and guards are expected to be able to read these indications before they are permitted to work trains controlled in this way. It is possible that Mr. Stretton refers specially to signals in which the arms are placed at the wrong side of the post, although the post itself is at the right side; but we do not so understand him, and we cannot ourselves call to mind a single instance of such a wanton inversion of the proper order of things. However, we give drivers credit for more intelligence than our correspondent does, and hold it to be unlikely that any man fit to have charge of an engine could make a mistake even then. At night he would clearly have no excuse; a red light would stare him in the face; and in the daytime he could hardly pass the semaphore without seeing that the side of the arm facing him was red, which he could not fail to recognise, as there would be a quite useless waste of paint as far as he was concerned, for sufficiently obvious reasons.

It is not to be supposed, however, that railway signals are absolutely perfect, or, to speak more precisely, that signalling arrangements are quite what they ought to be. There are frequent sources of danger about them, and our correspondents might, we think, have used their energies to better advantage in discussing, than in disputing whether it is or is not right to put a distant signal at the wrong side of the road. We have not heard of a single accident due to the latter cause. Every one who reads the reports of the Railway Department of the Board of Trade must be aware that some of the worst accidents on record have occurred from a totally different class of defects. We may cite, for example, those cases, all too numerous, in which a signalman, having permitted a train or a light engine to pass his signal cabin, forgets all about it, and gives line clear for an express, which comes thundering into the obstruction. These accidents are peculiarly liable to occur at night, and it does not appear that human vigilance alone can guard against them. It ought not to be beyond the power of engineers to devise means by which the signalman would be reminded that there was an engine or train blocking the road, and waiting to be sent on its way or into a siding. Of course the simplest plan is for the driver to whistle now and then, but whistling is a thing to be discouraged; and even whistling will not always suffice to recall a signalman to a sense of his duties. The range over which engines and trains can be left standing about is not large; and it would not be in any way impossible to devise means by which so long as a vehicle stood on a given length of rails, electrical signals would be sounded at, say, every quarter of a minute in the signal cabin. It would suffice to insulate pretty fairly one length of rail, which would be coupled electrically with the other rail when a vehicle stood on or ran over this portion of the road. The current would then pass, and start a little clockwork of a very simple kind, which would ring a bell, as we have suggested. Another defective feature in railway signalling is the want of sufficient means of protecting a train which from any cause has been stopped or broken down. It is supposed that the block system does this, but disastrous accidents have occurred because of the failure of the block system, and it is an instruction to a guard that he should run back when his train stops and put down fog signals or otherwise protect his train. This he not infrequently fails to do, because he cannot get back far enough to warn an approaching train in time. In the daytime there is less danger than at night, and to protect a stopped train in the dark no better expedient can be devised than flare lights or port fires to be stuck in the ground behind the train and ignited. They would make themselves visible a long way off, and the glare from them would attract immediate attention even in curved cuttings.

On one point we are entirely agreed with our correspondents. Nothing can be worse than the employment of "dummy signals," with the semaphore arms always at danger. They are intended to act as reminders to drivers; but they very soon lose their significance, and it is most unfair for a railway company to attempt to avoid responsibility by the use of such effete devices. Above and beyond all things a signal should be honest. If it tells lies, no confidence is placed in it. The number of such signals is, however, we believe, very limited. Another defective feature in railway signalling is the system of hand signalling, adopted, in some cases to save trouble. There is, however, some justification for this practice, which ought to be eliminated. The working of signals and points in crowded stations involves very severe labour, and for this reason we look with much favour on all attempts to supersede manual labour by power of some kind. Mr. Westinghouse has laboured with much success to attain this end in one way. Hydraulic power has been tried on the Metropolitan Railway; and we recently described very fully Timmis' electrical system, by which the large hand levers now in use are replaced by a set of miniature handles, which can be worked by a child. While engineers continue to go in this direction, there is hope that signals may be at last made perfect. The great difficulty lies, indeed, not in designing improvements, but in inducing railway companies to adopt them.

THE RIVER OUSE AND FEN DRAINAGE.

THE history of engineering in England may be said to open with narratives of the work of the Dutch hydraulic engineers, who busied themselves with the work that turned up in the Fens districts. From the middle of the seventeenth century until the present time the Fens have provided an unending—though irregularly periodical—source of employment for the profession, and important work yet remains to be done, some of which will, it is thought probable, soon be undertaken by Mr. H. Wheeler, M.I.C.E., under whom a good deal of drainage engineering has been carried out during the past few years. We have recently received a copy of a report on the best means of preventing the floods on the lands drained by the Ouse by the improvement of that river between Denver Sluice and Eau Brink Cut, names familiar to every one who has read Smiles's books. The report is very fully illustrated with general and dètail maps, and discusses various means for leading the waters which now trouble the Fen districts by a better course to the sea. Instructions were given to him in June last by the Denver Sluice Commissioners, after a public meeting on the subject, to prepare this report, with estimates of the probable cost of such works which might be proposed, and since then an entirely new survey has been made, as well as a series of hourly observations on the rise and fall of the tide at different stations along the river, embracing a complete set of tides, for the purposes of the report. The report commences with a description of the Ouse, and of the circumstances which led to the formation of the trusts which now have control of the different sections of the river and its banks. This is not only of interest, but based as it is upon the new surveys, it is of value, as showing the changes which have taken place naturally; the artificial changes; the quantities of water to be dealt with, and the proposals which have been made on the subject by many engineers of eminence from the time of the great John Rennie in 1809. Mr. Wheeler then gives a full description of the works which he proposes for effecting the desired object by improvement of the channel and course of the river and its banks between Denver Sluice and St. Germains, and cutting off Magdalen Bend, or by means of a low level drain which would require pumping power. The former is recommended as the better plan, the effect of which would be to depress the low water during floods at Denver Sluice 4ft. 6in., and put the river banks in a state of safety. The works include a straight cut across Magdalen Bend, easing off the sharpest turns in the course of the channel, and bringing it into conformity in width and depth with the Eau Brink Cut, the total estimated cost being £330,000, the payment of which would be met by a tax of 1s. 7d. per year per acre drained on a total of 187,214 acres. In the appendices is much statistical information relating to the rainfall, river sections, floods, and costs of draining. On Friday last a public meeting was held at Downham Market for the purpose of considering the Fens drainage, and Mr. Wheeler's report was then dealt with, the report having been previously placed in the hands of those concerned. The difficulties in dealing with the Ouse are much increased by the fact that it is under the control, or want of control, of twelve different bodies, and in some places the bank on one side is under one body, and the other bank under another, while the bed is under a third. One result of this is that the total cost of the improvement and maintenance work which has been carried out has cost much more than it need; and it was remarked at the above-mentioned meeting that the cost to which the different Fen bodies had gone to obtain their numerous separate Acts of Parliament would make them a new river. The Rivers Conservancy Bill has not been passed, and while waiting for it the Ouse and the Thames are suffering under the muddling of a multitude of councillors, and authorities are uncertain as to what course to take with respect to necessary improvements. At a meeting held at Ely on the same subject, several resolutions were passed, one being the adoption, as far as expressing an opinion is concerned, of Mr. Wheeler's proposal above briefly referred to. At the first-mentioned meeting a similar resolution was passed, although there were interested dissentients. The matter thus rests at present for rumination by the various bodies concerned, as an amendment proposing that the Denver Sluice Commissioners should take the necessary steps to carry out the works was lost.

EXIT THE CHANNEL TUNNEL.

WE have, it is to be hoped, heard the last of Sir Edward Watkin's Channel Tunnel scheme. It will be remembered that his Bill was read once, as a matter of form, some time ago. On Wednesday night he moved its second reading, and was taught that there are certain things which a railway company may not do to earn a profit for its shareholders. Of course, Sir Edward said nothing about profits in the House of Commons. With a happy appreciation of what would be most likely to enlist the sympathies of that very common-sense body of men, he asked them generally, and the Government particularly, if they wished to promote peace between nations and a cordial alliance with France, or if they would pursue a policy of isolation, which might lead to war. The Government, however, failed to see the connection between the South-Eastern Railway Company, Sir Edward Watkin, the Channel Tunnel, and peace. They refused to believe that the best way to be safe is to leave a door open for the entrance of those not so fond of peace as Sir Edward. Mr. Chamberlain said the report of the Scientific Committee was the death warrant of the project, for it stated that the measures which would be necessary for the security of the tunnel would be so complicated and costly that the tunnel could not be successful. A Joint Committee of both Houses had reported against the scheme, and the Government accepted its decision. He moved the rejection of the Bill. Sir M. Lopes, as a member of the Joint Committee, said the advantages of the tunnel were purely speculative, while the admitted disadvantages were new risks, new fortifications, increased military expenses, and jealousy in our relations with the Continent. Sir H. Vivian said, once the tunnel was made England would become a Continental Power, and would require to maintain a large standing army. Sir R. Peel said the question was one of confidence or no confidence in Sir E. Watkin, and Mr. Chamberlain had shown that the hon. baronet was a man in whom they could place no confidence whatever. Mr. Labouchere said he was in favour of a tunnel, but he had no confidence in Sir E. Watkin, and therefore he opposed the Bill. After considerable debate the Bill was rejected by 222 votes to 84. When Sir Edward will resume his endeavours to get the Channel Tunnel forward is uncertain. Possibly he may find some new field for the display of his energies. A tunnel between Scotland and Ireland would probably be as easily made as one across the Channel. It is true that the South-Eastern Company would not at present be directly interested, but it might be made, by suitable extensions, to include Port Patrick in its system.

THE DISTRIBUTION OF CHEAP DRIVING POWER.

Now that the Bill of the Birmingham Compressed Air Power Company has passed its third reading in the House of Commons it may be well to notice, more closely than we did three months ago, its provisions for the distribution of cheap driving power. The machinery and plant, which is shortly to be laid down upon a site already selected, will cost, with the necessary buildings and service construction, some £140,500. It will be capable of delivering 5000 indicated horse-power in compressed air. At the outset there will be put down four air-compressing engines driven by compound condensing steam engines, and heated by six sets of elephant boilers, four in each set. Now in the three wards forming the experimental area, we find from the latest total returns that scarcely 3000 indicated horse-power can be needed for engines up to 30-horse power; it may fairly be assumed that for no engines above that power is the new motor likely to supplant steam, since the pressure obtained by the user even after reheating will not exceed 40 lb. to the square inch. The whole of the surplus 2000 indicated horse-power is scarcely likely to be used up by tradesmen other than those engaged upon industrial processes, by builders and contractors for working winches and cranes, and by tramcar companies. In any case the user will have to look to the ice difficulty by having the service pipe passed through the nearest flue, or making special arrangements. The air will be supplied at a pressure of four atmospheres, and heating to at least 321 deg. Fah. will be necessary to obtain the best results. However, should the estimates of the engineers be anything like correct, the scheme should be a success. They see their way, it is said, to furnish the compressed air at £8 per annum per indicated horse-power. An addition of 20 per cent.—assuming say £10 for small steam power—is suggested. This movement, contemporaneously with the starting of refrigerating plant in the same town, is of much industrial significance for Birmingham, and of interest to all our engineering centres.

ENGINEERING TRADES' UNIONS.

THE reports of the district branches of the engineering trades' union societies just issued bear out what has been previously stated with regard to the general condition of trade. The tenour of the reports indicates that trade is getting gradually into a less satisfactory condition, and the number of men out of work is increasing. The chief cause of the falling off in the demand for labour is the depressed condition of the shipbuilding trade. Apart from the centres affected by this branch of industry, trade may be said to be fairly steady; but the shipbuilding trade affects so wide a range of engineering work, that its collapse is felt far away from the purely shipbuilding centres. The returns of the Amalgamated Society of Engineers show an increase as compared with the previous month, of about one per cent. in the number of men in receipt of out-of-work donation, the average being now about 3½ in some and 4 per cent. in other districts. In the Manchester district the increase has not been quite so great, and throughout Lancashire generally, trade would seem to be in a rather better position than in most other parts of the country. Locomotive builders and tool makers are kept busy, and cotton machinists, especially in the Oldham district, are well supplied with orders. With regard to wages, the only movement in Lancashire is in the Barrow district, where the employers are attempting to enforce a reduction of 10 per cent. on piece work and 1s. per week on the wages of the day men. The Secretary of the Steam Engine Makers' Society states that he cannot report any more favourable news this month, the branch returns, with very few exceptions, being of a despondent nature. From the centres where stationary engine and millwright work is the chief industry, the reports were of a less encouraging nature, and men were being suspended or discharged. The number of out-of-work members in receipt of support was, however, not much higher as compared with April, being still slightly under 2 per cent., but it was greater than they cared to see.

IDLE STEAMSHIPS.

THE proposal to lay up for four months one-fourth of the steamships by a combination of the owners for the purpose of forcing up freights has received much attention; but it seems to have escaped notice that it has been to some extent forestalled as the result of private decision. There are now, it is officially reported, eighty-one vessels laid idle in the river Tyne, the total tonnage being 69,119 tons. It is evident that the largeness of the tonnage thus laid idle must in time affect the freight market; and as there is no bounty for the laying idle, a fair conclusion is that the vessels have been unprofitable, or that at the present rates of freight they would be so. It may be concluded also that the large tonnage of idle vessels on the Tyne and at other northern ports would have an early effect on the freight market, were it not that the market is still being weakened by the tonnage still being placed on the sea as the result of the old orders. On the Tyne alone in the first four months of the year fifty-one vessels were launched. The vast amount of tonnage that is unprofitable will check the orders for the future, and as this acts upon the total of shipping—a total diminishing always by the inevitable loss at sea—there will be a better condition of the freight market. This is the natural operation of the laws of demand and supply, inexorable in their action.

TERMINAL CHARGES.

THE proposition of Mr. Chamberlain to introduce a Bill to give the railway companies additional powers to make further terminal charges is not beheld with equanimity by the South Staffordshire Railway and Canal Freighters' Association. Indeed, so injurious to trade in the Midlands would the scheme be, that they have determined to strenuously oppose any such measure. The Association base their opposition upon the fact that already the excessive rates have had the effect of driving trade to more favoured parts of the country or to America, and to give the companies increased powers to charge would therefore only aggravate the present evil. The Association moreover are resolved not to stand idly by, but to impress upon Mr. Chamberlain their objections, and with this view have appointed a deputation to confer with the right hon. gentleman.

PRIVATE BILLS IN PARLIAMENT.

THE Hybrid Committee on the Parks Railway Bill has proceeded further with the consideration of the evidence in support of the scheme. Sir John Hawkshaw, C.E., the engineer of the Inner Circle, the East London, the Charing Cross and Cannon-street and the Whitechapel-road Railways, as well as the proposed line from Edgware-road to Westminster, was called, and explained to the Committee the railway from an engineering point of view. Taking the line in sections, Sir John stated that Railway No. 1 commenced by a junction with the Metropolitan Railway, between Edgware-road and Praed-street. With a southward curve—6 chains radius—the line entered Edgware-road, and passing thence by Connaught-place and Uxbridge-road to Hyde Park, which it enters at a point 140 yards west of the Marble Arch. From this place the railway passes *viâ* Hyde Park, Knightsbridge-road, and Hyde Park Corner to the Green Park, traversing which, it crosses the Mall and enters St. James' Park, through which it passes, and finally reaches its termination in a proposed new street near King-street and Parliament-street. Railway No. 2 commences by a junction with the Metropolitan at the eastern end of the Edgware-road Station, and curving round towards Railway No. 1, joins it in the Edgware-road at the point where that road is crossed by the Marylebone and Grand Junction Roads. Touching the nature of the works to be undertaken, Sir John said that the gradients would be good throughout, the steepest being 1 in 80, which was under Hyde Park. The sharpest curve was 1 in 6. The railway is to be constructed partly in tunnel and partly in covered way. Three stations are to be constructed: one at the Marble Arch, one at Albert Gate, and a third at Parliament-street. For purposes of ventilation the line was to be divided into two sections, viz., from the junction with the Metropolitan Railway—that is, those two junctions to the Marble Arch station; that is one section. Then from the Marble Arch station to the Albert Gate station is another section; and from the Albert Gate station to Parliament-street is a third section. For the ventilation of the first section an engine with a fan was to be erected at a point about midway between the two ends of that section. That portion of the railway was to be made with a tunnel wide enough for two lines of way, and was similar to the Cannon-street Railway. The engine would only require to be about 5-horse power. For the purpose of the ventilation of that portion of the line which was under the parks, he intended, as they were not to be allowed to have openings, to make single tunnels in both cases—that was a tunnel for the up line and a tunnel for the down line. For the ventilation of the line between Albert Gate and Westminster they would have a 15-horse power engine erected for the down line at Westminster, and for the up line at the Albert Gate; and for the other section one engine would be erected at the end of the Edgware-road for the up line, and at the Albert Gate for the down line. He had no doubt that by this means they would be able to satisfactorily ventilate this railway. From the building holding the engine fan he proposed to build a shaft, which would be in the nature of a tower, and he had assumed it to have a height of 80ft. Similar gas engines were now at work. Close to the Mansion House station there are a number of them working in the shop window, and there are others on the opposite side of the way. The reason for using them was that they got rid of the smoke. In answer to Mr. Bidder, for the Metropolitan District, Sir John Hawkshaw said that he did not think this railway would interfere in any way with the working of the traffic on the Inner Circle. The question of the value of the land to be taken for the purposes of the railway was covered by Mr. John Clifton, land agent and surveyor. This gentleman stated that he had set apart a sum of £787,900 as the total cost of Westminster improvements, £342,800 for railway No. 1, and £152,600 for railway No. 2. Witness was cross-examined in the interests of various petitioners, but very properly declined to go into particulars respecting the amount set apart for specific properties, as evidence of that kind might prejudice the company hereafter before an arbitrator. Mr. Clifton stated, however, that he had not included in his estimates any compensation for cases of vibration, as he did not believe that the motion of the trains would result in damage of adjoining property. The next witness was Mr. Algernon Mitford, permanent secretary of the Office of Works, and the evidence of this gentleman was directed to the precautions taken by his department to protect the public interest. He expressed perfect confidence that the railway would not inflict any serious injury on the public, although there must necessarily be some interference with roads during construction. Mr. John Bell and Mr. Myles Fenton, respectively the managers of the Metropolitan and South-Eastern Railways Bills, gave evidence as to the practicability of working the Inner Circle system should this railway be authorised. The case against the Bill was then gone into, and a large number of witnesses were called for the opposing interests. Besides the general objection, that the line is unnecessary and ill-designed, it was alleged that the interference with the traffic in the Edgware-road would be such as to seriously affect the tradesmen in the conduct of their business, and to inflict upon them irreparable loss. All the petitioners constituted themselves defenders of the parks, but this matter was more particularly dealt with in connection with the petition of the Parks' Defence Association, and evidence was given to show the damaging effect on vegetation resulting from this scheme. On Tuesday the Committee arrived at the opposition of the District Company, who put into the box Mr. J. Wolfe Barry as their first witness. Mr. Barry did not think that the plans of this railway could have been prepared under the direct superintendence of Sir John Hawkshaw, for the engineering was bad; and he called particular attention to the nature of the junctions at the northern termination of the line, expressing his very great objection to this portion of the scheme, as, in his opinion, it could not but very seriously interfere with the working of the Inner Circle. With regard to the tunnel, which it was represented would be water-tight, he did not believe that that desirable end could be secured without the use of iron, as to which nothing was said by the promoters. Speaking of the works at Westminster, Mr. Barry characterised the proposed station as too large for the necessities of a local traffic, and too small for a Great Western terminus. If the Great Western were to be brought down to Westminster—and this he believed to be the object of the scheme—they should come in their own name, and with a line far different to the one proposed. In answer to the chairman, who put several questions relative to the instruction to the Committee as to a Westminster junction with the District, Mr. Barry said it was not the intention of that company to widen their line to the Mansion-house. Such a proceeding would be very expensive.

Group A.—The Select Committee on this group had before them an important scheme for constructing a subway and cable tramway from the Elephant and Castle to King William-street, in order to relieve the heavy traffic now passing over London Bridge. It is proposed to commence this subway by a station at Newington Butts, about 200ft. in length, and at a depth of 47ft. 2in. below the surface of the roads. The subway is then to be continued along Newington Causeway and Blackman-street to Great Dover-street, where a second station is to be formed, thence along Borough High-street to a point under the South-Eastern Railway Bridge. From this point, the scheme is to be carried on by upper and lower subways. One of these will then pass under the Thames in a diagonal direction from the south-west abutment of London Bridge to Swan-lane, thence along Arthur-street to Miles-lane, where a third station is proposed to be formed, about 200ft. in length. The subway will terminate at the proposed Inner Circle station at King William-street, between Arthur-street and Eastcheap. The lower subway will commence at the South-Eastern London Bridge station at the same level as the upper subway, and will descend at a gradient of 1 in 30 to the south-west abutment of London Bridge, being carried horizontally to the middle of the Thames. At this point this subway, being 14ft. below the upper tunnel, will rise at inclinations of 1 in 30 and 1 in 15 to the proposed station in Arthur-street, where the two subways will be on a level. The scheme is a revival of one brought forward in 1870, which was not carried out. The proposed subway is not to be used for pedestrian traffic, but the promoters intend to lay a tramway, along which passengers will be carried at moderate fares. The cars are to be worked by the cable system of traction, similar to that in operation on Highgate-hill and Chicago, U.S. According to the evidence of Mr. Greathead, the engineer to the scheme, the cars will run every two minutes, and can be worked up to a maximum speed of ten miles an hour. In answer to a sceptical member of the Committee, who wished to know what would happen if the cable in any case were to break or become detached from the car, Mr. Greathead said that the car would be brought to a standstill, and the following cars, seeing that the way was blocked, would stop also. Brakes would be attached which would bring up cars in a few yards. Should the demands of traffic require it, the service could be increased by coupling together two cars, or even attaching three or four. The object of this scheme is to relieve the pressure of traffic on London Bridge, which at certain hours of the day is very severe. For various reasons it had been thought well not to allow the tramways of the south of London to approach London Bridge nearer than St. George's Church. Accordingly a large traffic seeking the City is discharged at this point, and proceeds by foot across the bridge; and it is this traffic which it is sought to accommodate. The amount of share capital to be raised for the purposes of the scheme is £300,000, and powers are taken to borrow a sum equal to one-third of that sum. Judging from the nature of their undertakings, the company are not likely to have any very large sum in hand after the completion of their works. The Corporation of London object to the scheme, on the ground that the proposed works will interfere with the widening of London Bridge whenever that becomes necessary. The Vestry of St. Saviour's, Southwark object to the proposal on general grounds, and in their petition call attention to a provision which seems to be gaining favour with promoters, viz., the company may take only so much as they may require of any "warehouse, cellar, building, wharf, or other property," in respect of which they have acquired powers, notwithstanding section 92 of the Lands Clauses Consolidation Act. A preliminary objection of an unusual character was taken on behalf of the petitioners, and after hearing the evidence on both sides, the Committee held that the amount of the deposit was insufficient; that there was no clause in the Bill prohibiting the use of steam on this tramway or declaring what power it was proposed to use. An undertaking was given on behalf of the promoters that these matters should be rectified, and the case proceeded on this understanding.

Group 1.—The Committee on this group passed the East London Bill, which is the outcome of proceedings last year, giving the Metropolitan and Metropolitan District Companies a joint interest in the Whitechapel Junction. The Metropolitan District Railway Bill then came before the Committee. This Bill is unimportant in character, the principal feature being a subway from the South Kensington station to the Royal Horticultural-gardens. The Committee were next occupied in the consideration of the rival schemes of the Metropolitan and Metropolitan District Companies for providing subways at South Kensington. To take the scheme of the latter company first, Mr. Wolf Barry proposes to commence his subway at the South Kensington station, and taking it along Exhibition-road, to bring it to a termination at the entrance to the Royal Horticultural-gardens, the total length being about a quarter of a mile. The Bill of the Metropolitan Company provides for a subway of a more elaborate character. Commencing at the South Kensington station, the subway is to take the same line as that of the District Company, but will be continued as far as the Royal Albert Hall, its total length being somewhat over half-a-mile. The object of both schemes is to provide accommodation to persons visiting the various places of instruction and entertainment to be found at South Kensington. In his evidence in support of the District Bill, Mr. Barry stated that the extensive subway proposed by the Metropolitan Company was quite unnecessary, as persons wishing to go to the Albert Hall might, if they chose, use the covered way in the Horticultural-gardens. The Metropolitan proposal, too, partook rather of the nature of an extension railway, as it was proposed to run tram-cars in it, and the works were on a scale sufficient to admit of the use of locomotive power. After hearing evidence as to the merits of both schemes, the Committee accepted that of the District Company, giving to the Metropolitan a joint interest in the subway.

Group No. 2.—On Tuesday a large group of Bills relating to the Metropolitan District was before a Select Committee of the House of Commons, Mr. Vivian in the chair. The first Bill which came under the notice of the Committee was a scheme for a line from Hampstead to Hendon. Commencing by a junction with the Metropolitan and St. John's Wood Railway at West Hampstead station, the line proceeds by the side of the Kingsbury Extension road, crossing the North-Western line by a bridge 25ft. span and 14ft. 6in. high. The railway is then to be continued in a northerly direction on a viaduct 693 yards in length, and is to be carried over Iverson, Loveridge, and Maygrove-roads by bridges each of 40ft. span and 18ft. headway, and over the Midland Railway by a bridge of 60ft. span and 14ft. high. The line then goes by open cutting to its terminus at Hendon. The cost of constructing the 3 miles 37 chains of railway authorised under the Bill, including the works in connection therewith, is estimated at £164,500. The Bill was opposed by certain owners of property affected by the line. The Committee passed the Bill, inserting a clause protective of the interests of Mrs. Price, one of the petitioners against the scheme. The Committee then proceeded to inquire into the merits of the East of London, Crystal Palace, and South-Eastern Junction Railway Bill. This Bill authorises the construction of a railway from the Crystal Palace to Ladywell, where a junction is to be formed with the South-Eastern, and thus passengers from the Crystal Palace district will have access to the Metropolitan termini of the South-Eastern. By connection with the East London line, persons from Whitechapel and Shoreditch will be enabled to get to the Crystal Palace by a shorter and more convenient route than is at present open to them. The Bill is strongly opposed by the London, Brighton, and South Coast Company, as it will lead to a diversion of traffic from their line.

Group 3.—A week's adjournment in the case of this group had got rid of all the Bills save one—the Croydon Direct Railway Bill. This scheme covers the same ground as did the London, Reigate, and Brighton, and the Croydon, Norwood, and Dulwich Bills, but circumstances have now left it without a competitor. Shortly stated, the Bill sanctions a line from Croydon to Dulwich, where it is proposed to form a junction with the London, Chatham, and Dover Railway, and running powers are sought over the lines of this company to its City and West End termini. The Bill also gives running powers over the London, Brighton, and South Coast Railway to Victoria and London Bridge. At present access to Croydon from London is obtained by the South-Eastern and London, Brighton, and South Coast Railways, and, as a matter of course, these companies vehemently oppose a scheme, the effect of which will be to admit a competitor to a share in that traffic which they have hitherto divided between themselves. The case for the Bill is that as furnishing a new and independent route connecting Croydon with the Chatham Company's system, it will confer a great benefit on Croydon and on the district lying between that place and London. The estimated cost of the construction of the 6½ miles to be laid down for the purposes of the Bill is £805,610. The opposition of the London, Brighton, and South Eastern Companies amounted substantially to a defence of their treatment of the district, and to a contention that additional railway communication was not required.

Group No. 6.—The Select Committee on this Group, after a hearing extending over several days, gave their assent to the Blackpool Railway Bill, a scheme for the extension, by a private company, of the lines of the West Lancashire Company from Preston, their present terminus, to Blackpool. The Bill was promoted to meet the increasing requirements of the population constantly seeking Blackpool as a place of recreation. On behalf of the London and North-Western and Lancashire and Yorkshire Railway Companies, the owners of the present railway at Blackpool, it was urged that there was no such traffic to this place as would justify the admission of an additional line, the construction of which would be so costly. It was represented that the two companies had done, and were prepared in the future to do, all that was required for the accommodation of the traffic. The opposition to the Lancashire and Yorkshire Railway Bill was confined to a question of depreciation of property at Halifax, as to which the owner claimed a right to the insertion of a clause in the Bill providing for compensation. With this condition the Committee passed the Bill. The last Bill in this Group was one for authorising the North Western and Lancashire and Yorkshire companies to undertake the improvement of their Preston and Wyre Railway. The only petition was that of certain landowners, and the questions in dispute were speedily settled. The Committee then passed the Bill.

Group 8.—The Omnibus Bill of the London and North-Western Railway Company was before the Committee on this group, and the first question raised was as to the proposals of the Company in respect to the enlargement of their Euston Station. The great increase in the North-Western business both in passenger and goods traffic, and the consequent increase of the number of trains, has made it apparent to the officials of the Company that something must be done in the way of providing additional sidings, &c., in order that the conduct of this business may be satisfactorily carried out. It is therefore proposed by this Bill to take Ampthill-square, which is to be utilised for the purposes of the extension. The Vestry of St. Pancras, within whose jurisdiction the property lies, claim that they are entitled to compensation for the loss of revenue which will attend the demolition of houses at present rateable. Such a claim, although it has occasionally been allowed by Parliament, is not usually sustained in Committee Rooms.

THE MANCHESTER SHIP CANAL.

The inquiry of the Select Committee of the House of Lords into the Manchester Ship Canal scheme still drags its slow length along, and it would even now be rash to predict the date of its termination. The case for the Bill having been concluded at the last sitting before the Easter recess, the opponents opened their attack when the Committee reassembled after the vacation.

The attack was led by the Mersey Docks and Harbour Board, on behalf of whom Mr. Aspinal, Q.C., occupied a whole sitting. The learned Recorder of Liverpool, as a rule, adopts a plain and matter-of-fact method of dealing with schemes in Parliament, and he adhered very closely to this style on this occasion, resting his contention more upon a bare statement of facts—from his point of view—than on skilful argument or telling retorts. Taking up the high ground that the body he represented were acting not at all as personally interested, but as the guardians of a great public trust, he pointed out that the Board had a debt of £16,000,000, the interest upon which they could only meet by means of the dues and rates they now levied, and which they could not levy if the projected canal was made. The present charges he admitted were high, but for this he largely blamed Manchester, which, he said, had imposed heavy charges on the Board when it was constituted, and which had given no assistance when Liverpool had striven to reduce the transit rates between the two cities. As to those rates, if Manchester was dissatisfied with those charges, they could appeal to the Railway Commissioners, and afterwards, if necessary, to Parliament. Disposing of that element of the case thus summarily, he next dealt with the construction of the necessary low-water channel in the estuary of the Mersey, and the canal. Ridiculing the notion that the mere making of a canal would create a great port, and that once the canal was made all the bright visions indulged in by the promoters would be realised, he asserted that the formation of an artificial channel by means of training walls would so damage the river that the bar would be endangered, and so the great port of Liverpool, and, indeed, the whole kingdom, which was in a large degree dependent on the safety of that port, at least in regard to foreign trade, would be seriously jeopardised. In that event the Docks Board would probably be put to enormous expenditure—perhaps of millions—in order to preserve the bar. He further threw strong doubts upon the people of Lancashire being such lunatics as to subscribe the ten millions of capital required for a scheme which in twenty years could not pay 1 per cent. on the outlay, and promised to produce engineering evidence which would effectually crush the project.

The first really technical evidence presented was that of Captain Graham Hills, R.N., marine surveyor to the Dock Board, who gave a vast number of details as to the formation, bed, currents, depths, and other characteristics of the Mersey. His main contention was that if the training walls of this channel were made, the inevitable result would be an alteration in the flow of the channel and the restriction of it in one fixed course, and enormous silting up not only of the estuary itself, but of a considerable portion of the river beyond. Amongst other things he incidentally mentioned that when somewhat similar works were carried out on the Seine, the engineer calculated that it would take 21,000 years to silt up that river, and yet within 25 years one-third of the silting up he had estimated upon had taken place; although there was no bar as there was at Liverpool. As an old sailor he condemned the idea of telescope masts to be lowered when passing under Runcorn Bridge, and he predicted that vessels going up the channel to get to the canal would be in serious danger of being swung across the walls and so wrecked, or at least very badly damaged.

Mr. Thomas Stevenson, C.E., who is joint engineer with his brother, Mr. David Stevenson, to the Northern Lighthouse Board and Fisheries Board of Scotland, and who has had a wide and varied experience in river improvement works, described the conditions under which such schemes as this were not safe. The principal conditions were:—(1) If there was a large rise in the river; (2) if there were rapid tide currents; (3) if there was a bore or a breaking tide rushing up the river with great velocity, and breaking up the bottom; (4) if there was a bar, particularly if it was exposed to heavy seas; (5) if, in consequence of the silt which the conditions produced, there was much matter held in suspension, and if the river had a wide estuary, and a sufficient area for holding a large quantity of deposit. Some of these conditions existed in the Mersey, and that river had some other peculiarities, but for which he should be prepared to admit that training walls would improve the estuary of the Mersey. In a wide river such walls would always cause a large amount of accretion; and he was satisfied that if these works were carried out, the estuary would in time silt up, and be covered with grass, even although the walls were not flush with the sand, and the Mersey bar was one peculiarly likely to cause accretion, and it would, he declared, be simple madness to do anything at all that would interfere with it. He further said the Mersey was the worst river he had ever known for accretion, and when once these walls were made, a process of silting up would set in which no power could stop.

Mr. R. N. Dale, an underwriter, discouraged the scheme by declaring that higher rates of insurance would have to be paid on ships going up the canal than simply to Liverpool, looking to the difficulties and dangers which he was satisfied would arise in navigating the proposed channel and canal.

Mr. Vernon Harcourt, C.E., Mr. J. W. Barry, C.E., Mr. Robert Manning, C.E., and Mr. J. E. Williams, C.E., concurred in declaring that these works would not attain their object, and would seriously injure the river.

Mr. G. T. Lister, engineer to the Mersey Docks Board, followed these emphatic witnesses with equally positive condemnation of the scheme. He said he had had charge of the works of the docks estate for twenty-three years, and he had been concerned in an expenditure of no less than 2½ millions in the construction of docks and other works. The Board had done everything they could to meet the requirements of the trade of the port, and had spent between 20 and 30 millions upon their estate. He declared that he had no objection to the scheme on commercial grounds, but he was satisfied that it would go far to damage the river and destroy the proper working of the dock estate. He had no doubt in time through these works the whole of the estuary would be obliterated, and the promoters would not be able to remedy the injury they would do.

Colonel Frederick Beaumont, of the Royal Engineers, having had experience of the strata of the Mersey through being concerned in the construction of the tunnel between Liverpool and Birkenhead, assured the Committee that those parts of the bed of the river where there was rock could not be dredged until the rock had been first blasted, and that he believed would be a costly process.

Mr. Henry Law, C.E., also condemned the scheme as dangerous to the river, even if practicable, and some commercial and nautical evidence completed the opposition of the Dock Board. The case of the Shropshire Union Railway and Canal, which undertaking, it is said, will be interfered with by the scheme, is now engaging the attention of the Committee, whose inquiry has now extended over thirty sittings.

Up to Wednesday last something like 24,000 questions had been asked during this inquiry, which had then lasted thirty-four days; and the proceedings will probably last yet another week. Among the witnesses examined subsequently to those mentioned above was Mr. John Laird, of the famous firm of Messrs. Laird Bros., Birkenhead, who, in opposing the scheme, stated that the corporation of that town had originally paid £100,000 for the Liverpool and Woodside Ferry, and in the last twenty years had spent £50,000 on improvements, and £80,000 on new boats. The net profits of the ferry last year were £19,600, the gross revenue having been £56,000. In the interests of the Ferry and the town generally he condemned the canal scheme, because he believed it would ultimately destroy the Ferry through its ill effects on the river, and so tend to ruin the commercial welfare of Birkenhead. As a practical shipbuilder, he asserted that there was no likelihood of a shipbuilding trade being established on the banks of the proposed canal for several reasons, and mentioned that that trade had to a large extent even now left the Mersey, owing to the price in that neighbourhood of the particular kind of labour required. Mr. Royden, of Liverpool and Birkenhead, shipbuilder, and an ex-mayor of the former borough, and other witnesses, gave evidence as to the impracticability of the canal with regard to the question of masts, freights, insurance, and so on. Further commercial evidence was produced against the scheme; and a day and a-half were occupied by the examiners and cross-examination of Sir W. B. Forwood, one of the most prominent commercial men in Liverpool. Speaking in that capacity, and as a member of the Liverpool Cotton Brokers' Association, and of the Liverpool Chamber of Commerce, he entered into elaborate particulars to show that the canal would be dangerous and unprofitable from every point of view; that the Lancashire cotton trade depression, which was one of the grounds advanced for the construction of the canal, was not only not depressed, but was one of the most prosperous industries in the country at the present time; that owners and merchants would not send their ships up the canal if they could possibly avoid it, and that if they did so, both freights and insurance must be increased materially. On another of the allegations of the promoters, he admitted that the railway charges between Liverpool and Manchester were, and had been for the last twenty years, excessive; but he argued that a far less costly method of enforcing a reduction could be found than this scheme. And upon this point he stated that the merchants of Liverpool had for many years been striving to force the railway companies to lower their charges; but that Manchester had never given them the slightest help, and had never uttered a word of complaint upon that subject until certain able, but ambitious, lawyers and engineers had devised this scheme, and then set to work to organise what he should call a spurious agitation in the neighbourhood of Manchester for the purpose of supporting it. This description of the original designers of the scheme roused Mr. Pember, the leading counsel for the promoters, to some anger; but Sir W Forwood stuck to his contention, and was not shaken in the least during a sharp cross-examination. In support of the opposition of the London and North-Western Railway Company Mr. Stevenson, chief engineer to the company; Mr. Findlay general manager. and some other expert witnesses wer examined.

TELEGRAPHIC SIGNALLING ON THE ST. GOTHARD RAILWAY.

MOUNTAIN railways being exposed to more danger than those in the plains, require to be guarded with a more elaborate system of signalling, and more especially is this the case with the St. Gothard Railway, which reaches an altitude at which the snow is usually from one to two yards deep during the winter, and has to be cleared away by snow ploughs in front of the locomotives. Telegraphic lines in such localities are also more difficult to maintain; they have sometimes to be carried underground to avoid torrents and avalanches, and are more liable to breakdowns caused by lightning and by weight of snow.

The more essential portions of the telegraphic system of the St. Gothard Railway were complete when the line was opened in June, 1882, and the minor portions were finished in November, the same year. There are eight line wires on the posts alongside the two mountain sections of the St. Gothard Railway—four in the use of the Swiss Government, and four in use by the railway company. One of the State wires is an international one, giving direct communication between Berlin and Rome. This wire is 5 millimetres in diameter, and has a breaking strain of 780 kilogrammes; in Switzerland an instrument is in circuit on this wire at Bâle. The other seven wires are 4 millimetres in diameter, and have a breaking strain of 500 kilogrammes. The posts for the overground wires are but 60 metres apart, being placed thus near to each other to enable the wires to bear an exceptional weight of snow. The posts on the north side of the tunnel are of pine, and are impregnated with sulphate of copper by the process of Dr. Boucherie; one kilogramme of sulphate of copper is dissolved in 80 litres of water, and forced into the wood by pressure immediately after the cutting down of the tree; by the contract each cubic metre of the wood must contain from 6 to 12 kilogrammes of sulphate of copper. The posts on the line to the south of the tunnel consist of the stems of the edible chestnut tree, and are bought in Canton Ticino; they give more satisfaction than the other posts, and cost about 9f. each, when 8 or 9 metres long.

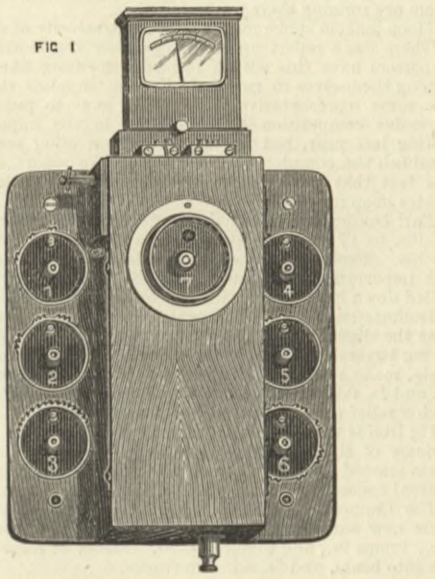
Of the four railway wires, two are for the train signals, and two for communication between the stations by means of the Morse printing instrument with ink markers. One of the two lines for railway messages has but three stations on it, namely Lucerne, Bellinzona, and Chiasso, and is used for through work. The other wire is usually worked in separate lengths, with an average of ten stations on each, but is joined up every day for a few minutes, that the time may be sent at twelve o'clock, direct from the observatory at Berne to every station on the St. Gothard Railway.

The circumstance that the St. Gothard Railway is worked at present by but one line of rails renders careful signalling all the more necessary. Two automatic systems of signalling are in use over the mountain portions of the railway, namely, the 90 kilometres between Erstfeld and Biasca, including the St. Gothard Tunnel, and the 30 kilometres between Bellinzona and Lugano, near Italy, the Italian frontier being 75 miles further south than the southern end of the tunnel. By one of the systems large bells fixed on the top of iron pillars, one of which pillars is fixed at the end of each kilometre along the mountain portions of the railway, are sounded by automatic apparatus placed in the nearest stations on either side. One line wire is required for this purpose. By the other system the flanges of the wheels of each train run over pieces of mechanism fixed alongside the rail at distances from each other of one kilometre, and the train is thereby made to record both its position and its speed on a constantly moving length of endless paper passing through the registering apparatus at the nearest station. Should an accident happen on the line, the guards of the trains have great facilities for giving information by wire to that station. The two systems are quite separated from each other, so that should one break down anywhere the other is not likely to break down at the same point; and even in the event of an accident to both, there is a third alternative in the use of the ordinary railway telegraph.

Among the engravings on p. 366 accompanying this article three of these pillars are represented, two of them in immediate connection with the sending apparatus at one of the stations, and the third one at a distance along the line. These pillars are of iron, and about twice the size of ordinary English pillar letter-boxes. The bells on the tops of them are large, and can be heard for a considerable distance; and as one of them is placed at the end of each kilometre along the line, they serve not only to inform workmen on the railway of the position of approaching trains, but to a certain extent are understood also by residents in the locality. The pillar bells, in fact, discharge three functions—(1) They advise the nearest stations of the movements of the trains; (2) they advise persons along the line of the march of the trains; (3) they enable persons on the line to send signals to the two nearest stations.

Battery power to work this system is not provided at every station, but at each alternate station. On reference to the diagrams it will be seen that some of the pillars have two bells, whilst others have but one. The double-belled pillars, giving a double chime, are always in connection with the next station to the north, and the single-belled pillars with the next station to the south; thus the great difference between the up and down chimes clearly indicates the direction from which the train is coming. A very feeble constant current is always flowing along the up and down line wires from two batteries, which have their copper poles connected with the earth. This current is too feeble to move the armature of the electro-magnet which we shall call A at the distant station, that magnet being wound with wire having but slight resistance, but it constantly holds down the armature of an electro-magnet R at its own station, the electrical resistance of that magnet being high. When a signal has to be sent along the line, the depression of the key, whether it be done by hand, as on the line, or by automatic apparatus, as at the stations, breaks the feeble line current, thereby releasing the armature of the magnet R, which in its turn draws back a detent, and the clockwork of station bell B begins to revolve, driven by a weight of 25 kilogrammes. This clockwork carries a rotating contact maker, which is in connection with a more powerful line battery, which when thus called into temporary use gives the signal at the distant station or stations, because it has power enough to cause the magnet A, or a series of such magnets in a series of line pillars to act. It will be noticed that the works inside the line pillars are very simple. When the distant signalman desires to give information about the trains, he depresses a key, thereby he breaks the feeble constant line current, and the clockwork of the station bell B is set in motion as before; but he has to give his signals by hand by means of the ordinary key instead of by the automatic apparatus used for this purpose at the stations, as hereinafter described. It is intended, in course of time, to use none but the automatic method on the St. Gothard Railway, because it gives great freedom from error, and each signal is sent with measured deliberation, such as might not always be done by hand by a man who wants to give hurried information about a railway accident. At each kilometre inside the St. Gothard and the other tunnels the automatic apparatus in each pillar-bell is made in specially compact form, and is so enclosed as to be protected as much as possible from the action of damp air.

FIG 1



The accompanying cut, Fig. 1, represents the automatic apparatus used at each of the mountain railway stations to send pillar-bell signals. These signals are seven in number, and are sent by means of brass discs. Six of these discs are represented resting on their several pegs; but disc No. 7 is upon the signalling peg. When the signal has to be sent, a little weight inside the box is raised by pulling down a short cord, the handle of which is represented at the bottom of the cut. The weight then slowly falls, turning the clockwork carrying the disc with measured velocity. Each tooth on the disc breaks the weak line current in turn by acting upon a contact breaker; thus the bells are rung by the method already described. The galvanometer needle, represented in the cut at the top of the apparatus, is in circuit with the feeble line current, and when that current is all right the needle has an inclination of 20 deg.

Seven different systems are used in connection with this bell system. In the following explanation of the signals, each dot means a stroke of the bell:—

(1) A train is starting southwards:—

• •   • •   • •

(2) A train is starting northwards:—

• • •   • • •   • • •

(3) Time signal given daily at twelve o'clock. The moment of midday is indicated by the first of the following twelve strokes of the bell:—

• • • • • • • • • • • •

(4) A man on the line between stations, but not at a station, asks for a locomotive to be sent, because of an accident:—

• • • • •   • • • • •   • • • • •

(5) Demand for a locomotive, with a man also, to assist:—

• • • • • •   • • • • • •   • • • • • •

(6) Stop all trains:—

• • • • •   • • • • •   • • • • •

(7) A runaway wagon on the line:—

• • • •   • • • •   • • • •

The two ends of the St. Gothard Tunnel are higher above the sea level than the top of Snowdon, so a runaway wagon has a long journey before it to Biasca in Italian-speaking Switzerland, or to Erstfeld in German-speaking Switzerland, if not stopped *en route*. Last year no less than three runaway wagons were stopped by the aid of signal No. 7; they were but workmen's small trucks. One of these pillar bells is placed in a niche at the end of each kilometre in the St. Gothard tunnel, and are most useful in informing the workmen therein as to the locality of approaching trains.

The apparatus for registering at the nearest stations the position and speed of trains next demands attention. At the station the positive pole of a battery is permanently connected with the earth, and the other pole with the line wire, on which the self-recording instrument is placed in circuit. Under normal conditions, no current passes, because the line wire has then no contact with the earth. For example, let A, B, Fig. 2, represent the line wire, D the self-recording instrument, K the battery, E the earth, and H H the line of rails, connected at each kilometre with mechanical apparatus acted upon by the flanges of the wheels of passing trains, which apparatus then places the previously disconnected line wire in electrical connection with the earth; it follows that each wheel of the train will send a single pulsation of electricity along the line, and these pulsations are registered at the station. The permanent way apparatus which does this is fully explained by the engravings, page 366. The box in which the contact is made is 1·5 metre above the ground, and has a closely fitting door to keep out rain. An insulator is attached to each side of it, the one carrying the line wire and the other the earth wire. The contact inside, when made, is a rubbing one, to keep the metallic surfaces at that point clean and bright.

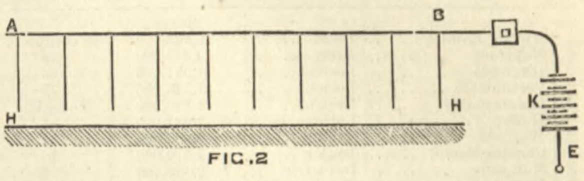


FIG.2

The registering apparatus at the railway station is driven by a good and strong clock, which runs for thirty-six hours, but is wound up daily at the same hour. This clock, by means of friction rollers, draws an endless slip of paper off a reel at the rate of 3 centimetres length of paper per minute, and this action goes on continuously day and night. There is a little inking roller, which does not normally touch the tape, and which is supplied with ink from a store which lasts for three or four weeks, in the larger wheel above it. A lever is connected with the armature of an electro-magnet, which is excited every time the wheel of a carriage passes over one of the contact makers on the permanent way. The point of this lever therefore presses the paper momentarily against the inking roller at the passage of each wheel, the wheels therefore giving with a lively rattle a series of dots with the passage of each train, which dots are so close together as to record a short straight line on the paper. The number of wagons on the train being known, also the speed of the tape, it follows that by measuring these recorded lines and the spaces between them, the railway managers can tell at what speed the train runs at each kilometre of its path, and as running fast down hill on a mountain railway might have dangerous consequences, any driver who makes too short a record on the paper is called to account. When a train is climbing the mountains either to the north or the south of the St. Gothard Tunnel, it always makes its record at the station above it; if the station below wants to know its position, it has to inquire of the station above by means of the ordinary Morse telegraph instrument.

The slips printed by the passing trains are carefully examined daily in the office of the inspector of telegraphs at Lucerne, Herr A. Bœchtold, and the work of examination of the speed of all the trains of the day before occupies an assistant for but two hours. There are permanent scales in the office with which the printing slips should agree, and upon placing the slip recorded by the passing of a train between any two stations alongside the permanent scale for the distance between those particular stations, it is at once seen whether the run has been performed in proper time. If not, the slip is more minutely examined to discover at what part of the length the speed was faster or slower than the regulation time. For instance, let us take the record of an actual run of a goods train between Bodia and Biasca on the southern side of the St. Gothard Tunnel. As the clock draws out the tape at the rate of three centimetres per minute, and this record of the train is 27 centimetres in length, it follows that the train was nine minutes on the journey instead of fifteen minutes, the regulation time. When a train goes down hill too fast the driver is fined 4f.—3s. 2d. To ascertain the actual speed of the train, the number of centimetres—1800—per hour traversed by the tape is multiplied by x, the distance between the marks, and divided by v, the authorised velocity in kilometres per hour, and the product should equal y, the distance on the tape between two marks if the driver goes at an even speed, thus: $\frac{1800 \times x}{v\ 50} = y$.

To save time in calculation, a transparent scale has been cut, which, when laid upon the tape, shows at a glance the speed at which the train was travelling. The whole apparatus serves another purpose—that of being very useful to the station master, as by it he knows exactly where the trains are, and how fast they are running.

The cable in the great tunnel is 15 kilometres long, and what with heat, moisture, and the operations of workmen, is more difficult to keep in order than tunnel cables always are. It consists of seven conducting strands; each strand is 1·84 millimetre in diameter, and is composed of seven fine copper wires, each 0·7 millimetre in diameter. Each strand is insulated by two coatings of Chatterton's compound, and two coatings of gutta-percha, in alternate layers; the diameter of each insulated strand is 5·2 millimetres. Each insulated strand has a serving of plaited hemp. The seven strands are twisted together, and the combined have an outer coating of plaited hemp. The protecting coating of the cable consists of 18 iron wires, each 4·4 millimetres in diameter, and the whole cable has a strong outer covering of plaited hemp, bringing its total diameter up to 33 millimetres. It was made by Messrs. Felten and Guillaume, of Cologne, and its total cost was 120,000 francs, including the placing of it in position in the tunnel. The Meidinger batteries used for the permanent currents in the apparatus already described consist of zinc and copper elements, the latter below, the former above, in each cell. Solid crystals of sulphate of copper are at the bottom of each cell. In the batteries used intermittently Leclanché cells are employed.

Auxiliary disc signals, worked by electrical and mechanical means, are used at some few places along the line to give warnings to the engine drivers.

ENGLISH AND FRENCH FLEETS.

ADMIRAL SYMONDS has prepared a statement of the relative strength of the English and French Navies, to which we have referred elsewhere, and from which we extract the following tables :—

The following are the Names of Armoured Ships Building in 1885, *with Vote from French Marine Budget, Exercise (Estimates), for Hull, Engines, &c.—See p.* 1700—1636 :—

	Names—French.	Where building.	Amount to be spent in 1885.	To advance to in 100ths.
			francs.	
Cuirassées d'escadre.	Amiral Baudin	Brest	2,903,000	98 complete*
	Neptune	Brest	2,573,000	49
	Bremnus	Lorient.. ..	1,511,000	23
	Formidable	Lorient.. ..	1,540,000	75
	Indomptable	Lorient.. ..	1,020,000	complete
	Hoche	Lorient.. ..	1,924,000	53
	Magenta	Toulon	3,000,000	34
	Charles Martel	Toulon	1,470,000	18
	Marçeau	Industrie ..	2,480,000	32
	Furieux..	Cherbourg ..	312,000	complete
	Caïman	Toulon	284,000	complete
	Requin	Industrie ..	826,000	complete
	N.B.—2 by contract "Industrie."		19,843,000	
Cuirassées stations.	Duquesclin	Rochefort ..	319,000	complete
	N.	Cherbourg ..	690,000	11
	N.	Brest	275,000	5
	15 Total		1,284,000	
Canonnieres Cuirassées.	Achéron	Cherbourg ..	541,000	complete
	Cocyte	Cherbourg ..	927,000	90
	Phlégeton..	Cherbourg ..	587,500	51
	Styx	Cherbourg ..	589,500	44
	Flamme	Cherbourg ..	233,000	90
	Fusée	Lorient.. ..	388,500	complete
	Grenade	Lorient.. ..	388,500	64
	Mitraille	Rochefort ..	852,000	complete
			4,507,000	
		Total	fr. 25,634,000 A. £1,025,360	

FRENCH CONTRACT, p. 1636.—Constructions par l'industrie privée (appareils à vapeur, chaudières, cuirassées).
francs, 12,250,000 = £490,000
Achats de bâtiments construits par l'industrie.
francs, 7,600,000 = £304,000

Total Contract Bill	794,000
Total ships A	1,025,360
B grand total	£1,819,360

P. 1521, Exercise 1885.—Division Cuirassée—"Tous les Ministres qui ont dirigé le service de la Marine dans ces dernières années, ont été d'accord pour reconnaitre l'utilité de la reconstitution d'une force navale stationnant comme autrefois sur les côtes Nord et Ouest de la France et composée de batiments cuirassées."

The French effective Naval Budget was in 1883, p. 1322, increased from £6,296,106; 1882, to £7,900,000 (Artillery vote omitted); and in 1884—1885 reduced to £7,400,000; p. 1524 Exercise, 1885, contains long explanations why the vote is not greater, owing to the failure of the National Budget.

English Armoured Ships Building Estimates, 1884-85, *pp.* 193, 7, 201, 4, 6, 11.

	Where building.	Amount to be spent in 1884-85. Hull.	Amount to be spent in 1884-85. Engines. Contract.	To advance to in 100ths.
		£.	£.	
Warspite (cruiser)	Chatham ..	33,400	50,000	90
(b) Rodney	Chatham ..	42,300	51,000	66
Hero	Chatham ..	30,670	15,000	25
(b) Camperdown ..	Portsmouth..	37,250	50,940	38
(b) Howe	Pembroke ..	54,420	34,910	56
(b) Anson	Pembroke ..	48,540	25,000	34
(y) Benbow	—	—	27,100	?
6 armour-clads—1 cruiser ..	—	(A) 246,580	(A') 253,950	—
1 new vessel proposed	—	0	0	387 tons

Armoured Ships Launched, Fitting.—See Estimates, 1884-85, *p. as above.*

		£.	£.	
(c) Collingwood ..	Portsmouth..	13,800	1,760	83
(f) Colossus	Portsmouth..	18,709	—	to complete
Imperieuse (cruiser)	Portsmouth..	41,620	15,940	to complete
(f) Edinburgh.. ..	Portsmouth..	10,346	—	73
		84,475	17,700	
8 building and 4 fitting 12		(A) 246,580	(A') 253,950	
Total English 12		(b) 331,055	(a) 271,650	
Total French. 15 8 gunboats. —		(b) 331,055 labour.		
French excess.. 3 and 8 gunboats —		460,407 { materials (p. 193, 7).		

N.B.—The amount (b) £331,055 being for labour only, the amount for material (pp 193, 7, and 201) must be added to form a basis for comparison between the French and English estimates. Both accounts seem to me as correct, as, for instance, apparent time, &c.

791,462	labour and materials.
(a) 271,650	engine amount (p. 211).
1,063,112	engines, labour, & materials.
160,000	Benbow; official statement in Parliament.
1,223,112	
1,819,360	(B) French amount.
596,248	excess of French amount.

1885.—The French thus vote £596,248 more per annum than we do in building 15 new armoured ships, to our 12 above.

(b) are imitations of the French barbettes; (c) also imitation with lighter guns and armour; (f) citadel ships, old style, 43-ton guns B.L. Comment is waste of time.

1884-85.—English engine amount is £271,650; building labour, £331,055.

N.B.—French Navy Estimates commence January 1st. The English April 1st; thence 2 dates to this paper.

(y). I can find no charge in our estimates for building Benbow by contract. It was stated officially in Parliament that Benbow is to cost £160,000 this year. Also new English ships are to be armoured one-third their length only. The French are armoured their whole length.

Two English and 6 French ships will be completed this year.

The French employ in their dockyards 22,852.—See p. 1658, Exercise 1885:—Contremaitres et ouvriers des constructions navales, 22,852.

Our (p. 205, Navy Estimates 1884-85) total men, 18,441.

P. 213.—We build by contract 1 ironclad, 2 despatch vessels, 2 torpedo vessels, 1 gunboat, 4 torpedo boats.

P. 1700.—The French, 2 ironclads, 8 torpedo vessels, 3 despatch vessels.

* Attached to a Fleet, p. 1686. N.B.—The above amount includes materials.

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

(*From our own Correspondent.*)

THE thin sheet and tin-plate makers of South Staffordshire and East Worcestershire report themselves busy. They are running their works full time, yet they are behindhand in deliveries. During the week good additional orders have been booked from the United States and Australia, while Germany and some other parts of the Continent are also buying freely. The sheets are used mainly for working up and stamping purposes. Makers would be glad to see an advance in prices, and should the present activity be maintained a rise will probably be secured by-and-bye. Current quotations are:—£9 to £9 10s. for working-up singles, £10 10s. to £11 for doubles, and £12 to £12 10s. for lattens. Stamping sheets, up to 24 g., are quoted £12 10s. to £13, and lattens, £13 10s. to £14.

Charcoal sheets, in which a select trade is doing, are quoted by such firms as Messrs. John Knight and Co. as—singles, £19 10s.; doubles, £21; and lattens, £22 10s. Tin-plates are reported firm at the rise of 1s. per box recently announced by Messrs. E. P. and W. Baldwin.

Makers of ordinary merchant and galvanising sheets reported themselves to-day—Thursday—in Birmingham, to be, here and there, in receipt of more specifications. Consequently certain of them are running their works full time.

Hoop makers spoke rather more satisfactorily of their position.

There was a report upon 'Change that the United States hoop importers have this season formed something like a combination among themselves to get their English supplies through one and the same representative in England, so as to put an end to the excessive competition which existed in the importing business during last year, but my inquiries from other sources failed to establish the complete authenticity of the report, or, at any rate, the fact that the combination includes the whole of the United States hoop importers.

Earl Dudley's bars remain at £8 2s. 6d. Other best bars are £7 10s. to £7; second qualities are £6 10s.; and common, £6 to £5 15s. Steel sheets, bars, and billets are in increased sale, and the importation of blooms from the steel making centres to be rolled down in our iron mills is growing.

Ironmasters this week repeat their contention of a week ago, that the slight drop in ironworkers' wages will not permit of their giving buyers any more favourable terms. The reduction will, they state, make a difference in the cost of manufacture of only between 1s. and 1s. 9d. per ton, according to the class of iron produced, and such a relief they badly need, even at the prices now prevailing.

Pig iron is without improvement.

Some of the wire-drawing mills in Shropshire have this week again started to work, the strike of the operatives being now over. Mutual concessions, I am given to understand, have been made.

The Cannock Chase Associated Colliery Owners have issued their new summer list. Deep house coal now becomes officially 10s., lumps 9s., and nibbles 8s. 6d. Steam or forge coal is 5s. per ton into boats, and 5s. 6d. into trucks.

Various of the millmen around Wolverhampton, Willenhall, Wednesbury, Darlaston, and Tipton have determined that a Millmen's Union, separate from the Iron Trade Wages Board, is needed, and have formed a committee to consider how such a Union can be established. When this society has been formed, it will take into consideration the question of extras on long lengths and 28 w.g., the restriction of the output, the employment of boys before the rolls, the question of supporting the Wages Board, and the protection of the existing card-list of prices.

Ten of the firms engaged in the South Staffordshire and East Worcestershire chain trade have, it is stated, consented to concede the advance of 10 per cent. demanded by the operatives. The other manufacturers, however, still resist, on the ground that the state of trade does not warrant a rise. The strike has lasted five weeks.

The local authorities in the Midlands who have undertaken the manufacture of gas on their own account are making very fair profits. Last week the Walsall Corporation notified that they had saved £8000 on the preceding year, and now the Tipton Local Board announces that up to March, 1884, the profits on the gas-works have amounted to £4763.

Satisfaction is expressed at the favourable reception of the Dudley, Sedgley, and Wolverhampton Tramways Provisional Order, the object of which is to allow the company to use steam or any mechanical power on their authorised tramways.

A notable exhibit at the Building Trades and Gas Exhibition at Bingley Hall, Birmingham, is the generator shown by the Dowson Economic Gas Company, of Great Queen-street, Westminster. The makers claim that it will supply gas at a saving of nearly 50 per cent. over the ordinary coal gas supplied from local authorities.

The industrial section of the Wolverhampton Fine Arts and Industrial Exhibition, which is to be opened on the 30th inst. by Lord Wrottesley, will embrace representations of the chief manufactures of the district.

Every effort is being made to make the visit of the Royal Agricultural Society to Shrewsbury in July next a complete success. The local railway companies have determined to provide temporary passenger stations as near as possible to the show ground, the result being that a large proportion of the traffic will be taken off the streets in the centre of the town. Some difficulty has, however, arisen as to the condition of the English Bridge. The Society have informed the Town Council that it is far from being commodious enough for the occasion. A committee of the Corporation are now considering the erection of an additional bridge or pontoon.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The iron trade of this district continues in a lifeless condition so far as the weight of new business coming forward is concerned. Prices are not actually quoted any lower, and makers who have deliveries against contracts to keep them going, hold on pretty firmly to late rates, but there is no real strength in the market, and where business has to be sought concessions are made upon current rates rather than allow orders to pass. There are a few buyers in the market at low prices, but generally there is an indifference about giving out orders, as there is nothing in the present prospects of trade to warrant the expectation that prices are at all likely to take any upward movement for some time to come.

There was only a very small business doing at the Manchester iron market on Tuesday, with a tendency towards weakness rather than firmness in prices. For pig iron there was but little inquiry. Lancashire makers who are fairly off for deliveries, and are putting very little iron into stock, are from 43s. 6d. to 44s., less 2½ as their minimum quotations for forge and foundry qualities delivered equal to Manchester. Only a very small weight of iron is being sold on the basis of these prices, but there have been moderately large offers at about 6d. to 1s. per ton less, which local makers have declined to entertain. District brands, such as Lincolnshire, average about 43s. 4d. to 44s. 4d. less 2½ for forge and foundry delivered here, but only a few occasional sales are being made. In some of the outside brands very low prices have recently been taken to effect sales, and notwithstanding the stronger tone reported during the past week from Glasgow, Scotch iron is being offered here at 6d. to 1s. per ton under makers' prices.

The hematite trade continues in a very depressed condition. There are very few orders going out, and 55s. 6d. to 56s. less 2½ remains about the average price which would be taken for good foundry brands delivered into this district.

The shipping season has brought forward a little more activity in the finished iron trade, but there is no great weight of orders giving out, and with a continued very dull tone in the home trade, prices are weak. For good Lancashire and North Staffordshire bars delivered into this district £5 15s. remains the minimum quoted price, but rather than allow orders to pass, makers in many cases are prepared to offer some concession to buyers, and some common local makes and North-country brands can be bought readily at about £5 12s. 6d. per ton delivered here. For local made sheets £7 7s. 6d. to £7 10s., and for hoops £6 5s., are about the average prices for delivery into the Manchester district.

A pair of powerful pumping engines, specially designed to supply an unusually large quantity of water for the space occupied by the pumps, have just been completed by Messrs. Goodbrand and Holland, of Manchester, for a sugar works at Calcutta. In addition there are one or two features rather out of the way in connection with these engines, which it will be interesting to notice. They have been arranged not only to act as supply pumps, but they are also designed to perform the duties of a fire-engine in case of need, and the engines are adapted to drive special machinery in connection with other portions of the works. The pumps are quadruple acting, drawing their supplies from two separate reservoirs, and are constructed to be stopped or started alternately or to work separately or in combination without stopping the engines. The steam cylinders are each 14in. diameter, and the cranks are set at right angles to enable the engine to be started at any portion of the stroke, and the maximum duty of the pumps is to discharge 224 tons of water per hour with a steam pressure of 90 lb. The whole arrangement of the pumping engines is very compact, the air vessels being utilised as supporting pillars for the working parts, whilst the bed-plate contains the passages of the suction water cast together, and is constructed with separate doors for clearing out the inside; it is also arranged to act as an air cushion to prevent any possibility of sudden shocks caused by the influx water on the suction side, and it is provided with a large chamber projecting downwards, the main object of which is to prevent any oscillation of the water from one pump to the other. Amongst other details of the pump, special attention has been devoted to construct the water passages of such form and proportion as to reduce the friction of the water to a minimum and to prevent the possibility of air accumulating. The valves are of the rubber pot lid type and the seatings are of gun-metal, having perforations cast obliquely with the object of causing the water in passing through them to gradually turn the lids at each stroke of the pump, and thus ensure durability. This arrangement of the valves gives a steady centrifugal motion to the water, and, it is claimed, creates a greater discharge than is secured by ordinary valves of the same dimensions. The faces of the seatings are turned concave, and this is a new feature introduced to ensure a perfect adjustment of the lids to the rim of the seatings.

A fairly steady tone is still being maintained in the coal trade of this district, and although the recent burst of warm weather has caused rather a falling off in the demand for house-fire coals, it has not been to such an extent as to make itself materially felt in the market. Other classes of fuel are without change, common round coals moving off only slowly for iron making and steam purposes, with engine fuel still in fairly good demand, but supplies generally quite equal to requirements. In the Manchester district collieries are kept running pretty near full time, with comparatively very little of the output going into stock, but in other districts four days a week will represent about the average all through. As regards prices, quoted rates are without material change; but the tone of the market is weak, and generally there is a little giving way where concessions are absolutely necessary to secure orders. The average prices at the pit mouth are about 9s. for best coals, 7s. for seconds, 5s. 6d. to 5s. 9d. for common house-fire coals, 5s. 3d. to 5s. 6d. for steam forge coals, 4s. 6d. to 4s. 9d. for burgy, 3s. 9d. to 4s. for best slack, and 3s. to 3s. 6d. for good ordinary qualities.

There is a moderate amount of activity in the shipping trade, but the quantity of coal, especially of the commoner qualities, offering in the market is so large that very low prices are taken to secure orders. Lancashire steam coal delivered at the high level, Liverpool, or the Garston Docks, can be got readily at 7s. per ton, with some of the better sorts fetching about 7s. 3d. per ton.

Barrow.—The attendance at the iron markets of the district was very thin, and business is almost at a standstill. Consumers are very backward in placing out orders, and although prices are remarkably low, no speculation is noticeable in transactions. Makers are anxious to do business, but expecting that merchants will have shortly to come in and buy, any attempt to force down prices is firmly met. I can hear of no order of any extent coming to hand on either home or foreign account. Prices are unchanged, last week's quotations ruling; business in mixed Bessemer samples is doing at 47s. 6d. per ton net at works prompt delivery. Inferior samples are in demand at from 46s. per ton and upwards. The weight of metal on hand has been slightly reduced, as makers have been bringing down the production nearer to the present transactions. Steel makers are but indifferently employed, and the trade generally is in a very depressed condition. Indeed, there is such a slight demand that some makers in the district have been forced to partially, and in some cases to entirely, suspend operations. It is impossible to say when an improvement will take place, but it is impossible for the trade to continue in its present state very much longer. Rails change hands slowly at from 90s. and upwards per ton net at works. Shipbuilders' are remarkably dull and few inquiries are being made; indeed no new orders have been booked for some time, and few contracts are on the books. Iron ore is in demand at from 8s. 6d. to 9s. per ton net at mines. Stocks are heavy.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

COALOWNERS generally combine in the statement that trade is very quiet, but from the official return of the weight sent by the various Yorkshire collieries to Hull by rail and water, over 8000 tons more were sent during April last than during March, and over 11,000 tons more in the four months than for the corresponding period of 1883. The total tonnage last month was 109,768 against 101,576 tons in April last year, or 390,520 tons from January to April as compared with 379,180 tons last year. Still the exports have fallen off considerably, only 33,825 tons having been sent, as compared with 51,643 in April, 1883. Denaby Main heads the list with 12,904 tons, which is a decline of 1272 tons in April, 1883. South Kirby Colliery, close to the New Hull and Barnsley line, has sent 3736 tons during the year, this being an entirely new name on the list. Wharncliffe Carlton, where the explosion took place, sent last month 1072 tons, as compared with 748 tons last year. The West Riding and Silkstone pits have only sent 7352 tons since January against 12,508 tons last year.

The Miners' National Union are not satisfied with the report of Mr. Arnold Morley on the explosion at Wharncliffe Carlton Colliery, in October last. They have issued a circular in which they urge that a theory put forward on behalf of the men, that the explosion was caused by shot-firing, is much more probable than that endorsed by Mr. Morley, viz., that the gas ignited at a Stephenson lamp, and state that there was found at one spot a full set of drilling gear, cartridges, the shot-firing lamp, and a hole drilled. Mr. Morley's statement that it had been "conclusively proved that there are no grounds for believing that the catastrophe was in any way due to the bad management," is controverted by the miners, who say that the chief manager, Mr. Mitchell, admitted that there was not more than 158 cubic feet of air per man per minute going down the mine, and that, too, in a Barnsley bed 9ft. thick. The circular, which is signed by John Forman, William Wight, and William Crawford, concludes with the strong statement:—"We regard Mr. Morley's report as most unsatisfactory. The statements made are not quite accurate, and the inferences drawn from them are groundless and absurd. He may not be to blame for having to take up such a ridiculous position, nevertheless throughout the entire inquiry he seemed more anxious to palliate the shortcomings of the management than to ascertain whether or not inefficient management or gross negligence had not been the cause of the sad catastrophe."

The Board of Trade returns for April are again most disappointing, so far as Sheffield goods are concerned. In hardware and cutlery the totals for April of 1882, 1883, and 1884 are £329,835, £294,863, and £264,889. France, Spain, and Canaries, the United States, foreign West Indies, Brazil, Argentine Republic, British North America, British possessions in South Africa, and Australasia are all decreasing markets, the most serious decrease, as usual, being in the United States, to which the value last month was only £25,692, as compared with £35,453 for the corresponding month of 1883. In pig iron there is also a fall from £346,121 to £274,894, the United States, France, Germany, and Holland showing a decrease, while Russia, Belgium, Italy, and British North America are improving. Steel rails are rapidly ceasing to be a Sheffield trade; still, it is interesting to note that here, too, the business has fallen off very seriously. Italy took a value of £39,984 in April, 1882; of £26,845 in April, 1883; and only £136 last month; the United States for the similar period show values of £93,982, £28,416, and £10,640; British North America, £23,469, £31,800, and £10,858; British possessions in South Africa, £19,814, £9630, and £7931; British East Indies, £46,953, £81,677, and £44,576; and Australasia, £29,034, £49,125, and £66,280—the latter a large increase. Sweden and Norway have increased from £6952 in April, 1882, to £18,571 in April, 1883, and £39,826 last month; while the values sent to Spain and Canaries in the same period have been £3781, £1066, and £5615.

There is still a serious downward tendency in steel. The value for April, 1882, was £184,096; in April, 1883, it dropped to £118,822; and last month it dropped again to £101,225. The United States is again the chief cause of the decline. In April, 1882, the United States markets took steel to the value of £113,739; the following April there was a "pull back" to £47,955; and last month the entire value sent to America was £33,908.

The miners, some 1500 in number, employed by Messrs. Crompton and Co., at the Butcher Wood, Stanton Hill, and Pleasley collieries, in the Erewash Valley, struck work against what they regard as a 2s. per week reduction, made up by the owners of the collieries, who also own the cottage houses occupied by the men, wanting to raise the rent 3d. per week, to put an extra 1d. per week on the colliery field club, and to take off the allowance of coal.

Messrs. William Coope and Co., of Tinsley Steel, Wire, and Iron Works, have recently booked orders for 1000 tons of steel wire rods for different firms in this country. It is satisfactory to be able to state that the German competition in the home market is now being fairly met.

Letters received from Sheffield workmen who have recently emigrated to Sydney, Australia, give a deplorable account of the labour market in those parts. Thousands of people are out of employment, hundreds of families living on one meal a day and sleeping in the open, and many capable artisans only too glad to be permitted the privilege of working their passages home.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland pig iron trade shows no sign of improvement, and the outlook is still most discouraging. At the market held at Middlesbrough on Tuesday last there was but a scanty attendance, and the prevailing tone was even less hopeful than on the previous Tuesday. Local consumers are holding off in the expectation of buying at lower rates, and inquiries from abroad are almost entirely absent. It was difficult to fix any market value for pig iron, as few sales were made. No. 3 g.m.b. may be considered to be worth 36s. 9d. per ton for prompt delivery, though it is not improbable that merchants would take 3d. per ton less. It is thought that some buying must shortly take place in order to cover sales previously made; consequently producers hold tenaciously to their nominal quotations, which are 37s. to 37s. 3d. for No. 3. These prices are, however, only paid where special brands are insisted on. The usual quotation for forge iron is 35s. 3d. per ton, but in some cases 3d. per ton less has been accepted.

Warrants have scarcely ever even been mentioned lately. The stocks in Messrs. Connal's Middlesbrough store has remained unaltered for several weeks. It stands at 60,427 tons.

Shipments from the Tees have been exceedingly slack this month. The pig iron exported up to Monday last amounted to 30,829 tons, as against 32,379 tons sent away last month.

In the finished iron trade bars command at present better prices than plates, and there are orders sufficient to keep all the bar mills regularly in operation. Orders for plates are still scarce, and it is with the greatest difficulty that the mills are kept going at all. Prices are unaltered, the lowest limit having evidently been reached. For ordinary specifications ship plates are £5 to £5 2s. 6d. per ton; angles, £4 12s. 6d. to £4 15s.; and common bars, £5 2s. 6d. to £5 5s.—all free on trucks at makers' works, cash 10th, less 2½ per cent.

The price of steel rails is maintained at £4 12s. 6d. per ton, and most of the works are at present working nearly full time. Messrs. Bolckow, Vaughan, and Co. are making at their Eston Steel Works rails which will not be required for several months. It is feared that these works will have to be closed at Whitsuntide unless further orders come to hand meanwhile.

The boring operations which are being conducted on behalf of Messrs. the Weardale Iron and Coal Company, in Weardale, have resulted in the discovery of a rich vein of ore about 100ft. thick.

Messrs. Tannett, Walker, and Co., engineers, of Leeds, have received orders for a portion of the machinery required for a new steel works at Bilbao. Amongst other things they have to supply some engines, the total weight of which, it is said, will amount to 400 tons. The engines are for rolling bars, rails, and beams. They are to be compound, with two high-pressure cylinders, 42in. diameter and two low-pressure cylinders 60in. diameter, with a stroke of 5ft.

Those engaged in the shipbuilding trades on the north-east coast have been somewhat perplexed by some recent remarks made by Sir J. Brown, of Sheffield, who ought to know something of the iron and steel trades. He is reported to have said that he was satisfied that the exact quantity of steel ship-plates sent from Germany to our shipbuilding yards would amount to half the consumption last year. He adds: "That is an item with which I am specially familiar, because Sheffield first made the Siemens-Martin plates, and because I have seen what vast quantities of German plates are being imported by the shipbuilding concerns on the east coast—Sir W. G. Armstrong's and our own Earle's Company among them. Yet this competition is successfully prosecuted by Germany in the face of enormous difficulties. She has to buy coal from us. A large portion of her pig iron is obtained from Cumberland, and she has many miles of land carriage to pay before the goods reach the port of shipment; and then there is the freight across the German Ocean. And after all these tolls Germany places her plates upon our soil at £1 a ton less than Sheffield—Sheffield, which began the manufacture of them—and at least 10s. per ton less than the prices of the Middlesbrough and Scotch rolling mills recently opened." Now the difficulties attending acceptance of Sir John Brown's statements are these—firstly, there were only twelve steel vessels built upon the Tyne and four upon the Wear last year, and if the steel required for them was one half of it imported from Germany—which it almost certainly was not—it still could not be properly described as coming in "vast quantities." The twelve Tyne-built steel ships include those made by Sir W. G. Armstrong, Mitchell, and Co. The total number of ships—iron and steel—built at all the yards in Hull was only twenty-one, and the majority of these were certainly of iron. This does not leave room for "vast quantities" of German steel having been used up by Earle's Company.

Then, again, the "Middlesbrough Rolling Mills," quoted as recently opened and making Siemens' steel plates, simply do not exist. There are none such; Middlesbrough steel plates, as at present made and in the market, are produced by the Bessemer acid, or the Bessemer basic processes, and by none other. Surely Sir John Brown has been "preaching a big sermon from a little text." If not, let him give chapter and verse, and inform the public how many ships were built in this country last year of German steel plates, and where they were built, and what was their tonnage.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been some little movement in the pig iron market this week. Prices were down as low as 41s. 5d. a ton for warrants, when a slight upward movement took place, caused by rumours to the effect that production was about to be further reduced in the Cleveland district, and also that several additional furnaces were to be put out of blast in Scotland. These reports led to covering operations on the part of bears, and some buying on account of speculators followed. The past week's shipments of pig iron were disappointing, amounting, as they did, to 11,925 tons as compared with 16,296 tons in the corresponding week of 1883. Advices received by ironmasters and merchants from Canada and the United States are not at all encouraging; and there is small chance of a very marked improvement in the state of business at present. The decrease in the stocks in Messrs. Connal and Co.'s Glasgow stores continues, having been rather greater than usual in the past week. There are ninety-seven furnaces in blast, as compared with 115 at the corresponding date last year; but it is expected that the number will be reduced by two, probably in the course of the present week.

Business was done in the warrant market on Friday down to 41s. 6d. per ton. The tone was flat on Monday, with a further decline in the cash prices to 41s. 5d. On Tuesday morning business was done at 41s. 7½d. to 41s. 8½d., the quotations in the afternoon rising to 41s. 10d. cash. Business was done on Wednesday between 41s. 8d. and 41s. 10d. cash., and 42s. to 41s. 10d. one month. To-day—Thursday—quotations fell to 41s. 5½d.; but there was a slight recovery towards the close.

The market values of makers' iron show a further reduction since last report, and are now as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 52s.; No. 3, 50s. 6d.; Coltness, 56s. 6d. and 50s.; Langloan, 53s. and 51s.; Summerlee, 51s. 6d. and 47s. 6d.; Calder, 52s. 6d. and 47s.; Carnbroe, 51s. 6d. and 47s. 6d.; Clyde, 47s. 6d. and 45s. 6d.; Monkland, 44s. and 41s.; Quarter, 43s. and 41s.; Govan, at Broomielaw, 43s. 3d. and 41s.; Shotts, at Leith, 52s. 6d. and 51s. 6d.; Carron, at Grangemouth, 48s. (specially selected, 54s.) and 47s. 6d.; Kinneil, at Bo'ness, 45s. and 44s.; Glengarnock, at Ardrossan, 51s. 6d. and 45s.; Eglinton, 45s. 3d. and 42s.; Dalmellington, 48s. and 44s.

The demand for hematite is quiet, and the price for Nos. 1, 2, and 3, f.o.b. at Cumberland ports, is 46s. per ton.

There is no new feature in the malleable iron trade. The week's shipments from Glasgow of iron manufactures embraced £64,500 worth of machinery, including important exports of locomotives for India, and a considerable amount of marine engines and sugar-making plant. There were besides sewing machines to the value of £2430; steel goods, £9610; and general iron manufactures, £27,000.

The coal trade is in a fairly active state in most of its branches. Although the shipments are in arrear to the extent of 45,000 tons, compared with what they were at this time last year, they are still a pretty good average of years. From Glasgow the cargoes dispatched included 1850 tons to Montreal, 1650 to Bordeaux, 900 to Constantinople, 900 to Dantzic, 500 to Caen, and smaller quantities to other places. The efforts made by the coalmasters to obtain an increase of prices have hitherto been quite unsuccessful. At Troon, 7244 tons were dispatched; Ayr, 9061 tons; Grangemouth, 5162 tons; and fair quantities cleared from other ports. In Fife and Clackmannan an improvement has taken place in the demand, chiefly in connection with the briskness that now marks the continental trade. The shipping prices are, in consequence, about 6d. a ton higher; but as there was great depression in the district for a long time, the increase will hardly compensate the colliery owners for previous losses.

In the circumstances above stated, together with the remarkably dull condition of the pig iron trade, the coalmasters still refuse to advance the miners' wages, although they are solicited to do so almost daily. The adoption of short time by the colliers at many of the pits in Lanarkshire is not producing the effects intended, for the reason mainly that abundant supplies of coal can be drawn without trouble from the other mining districts of the country.

The slackness which now marks the Clyde shipbuilding trade has led to a further reduction of wages, which took place in the shipyards on Monday, and varies from ¼d. to ½d. per hour. Operative engineers and boilermakers, whose wages have never been so high as those of the shipyard workers, have as yet not been reduced. Several new contracts have been fixed within the past week or two for iron sailing vessels, but they are not at all sufficient to replace the vessels that have come off the stocks.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE return of the Swansea Harbour Trust shows a very satisfactory condition of things. The shipping rate for the month past is the highest known. The Tyne dredger has done very good work; it has already raised 340,000 tons. It is recommended that a reduction be made in the tolls charged on vessels going to the Channel Islands, which will have the effect of putting the port on a par with Cardiff. At all the ports business has been very brisk this week; Cardiff maintains its lead, though there was a falling off last week of some 20,000 tons of coal as compared with the previous week. Prices have been well maintained, though in the matter of No. 3 Rhondda a slightly easier tone has been notieed. Best coal is in full demand at best prices.

Progress with the new collieries in Monmouthshire and Glamorganshire is about to be made, but some little delay has taken place in getting the necessary sidings; that in the direction of Pontypridd especially, which almost takes the form of a short line of railway.

Great progress is being made on the Great Western and Rhymney extension to Merthyr. The foundations of the great viaduct are now secure, and the present summer will see the most important part of the undertaking finished.

An important meeting of the Monmouthshire and South Wales Miners' Permanent Provident Society was held on Saturday, when it was shown that a substantial increase in members and funds had taken place, and arrangements were made towards the annual meeting, when we shall have fuller report of the progress made by this society, which is one of the best institutions the colliers possess. If such a society had been in existence twenty years ago, instead of the so-called friendly societies, a great amount of suffering would have been avoided. But there is one institution which still remains in the background—the Colliers' Building Society—which one of the leading coalowners started with the object that each collier should have a house of his own. It is notorious that throughout the present prosperity of the coal trade of Wales no healthy effort of the kind has been made; and there is too much fear that the colliers' extra earnings have been squandered just as they used to be.

The inquiry into the Barry Dock Promotion Bill continues to excite the liveliest interest. Though no fresh revelation as to the extent of the coal wealth of Wales has been made, there is no question that a large area of unworked lower coals remains; but the difficulty will be to produce them at a price that will enable the Welsh coalowner to compete in the market.

The condition of the iron trade, is most unsatisfactory; half-time and little demand being the leading features. I am afraid that even a reduction of wages will not meet the present emergency. Labour is now very low, and there is not much margin to be obtained from further reduction. A gentleman thoroughly conversant with the Welsh trade, and financially interested, told me this week that we have no outlook for good for a length of time to come, and that in his opinion some of the weaker ones will have to go to the wall. Artificial capital may support for a time, but without an improvement in trade a short time only.

The tin-plate trade continues brisk and prices are very firm, especially for best brands. The enterprise of Rhymney works, which under Mr. D. Evans is in capital hands, has gone to the extent of making tin-plate, and work at present is satisfactory. At Dowlais parts of the old tin-plate works are being utilised for steel. Pitwood is quoted at 17s. to 17s. 3d., patent fuel is in good demand.

STEEL SHIPS.—A deputation waited on Wednesday on Sir T. Farrer, at the Board of Trade, to present a memorial asking for the appointment of a committee to establish uniformity of tests for steel for shipbuilding, by which the cost of steel would be reduced and manufacturers relieved from a vexatious burden. It was calculated by one of the speakers that the general substitution of steel for iron would probably reduce the loss of life at sea by nearly 50 per cent. Sir Thomas Farrer, in reply, said that hitherto the action of the Board of Trade had been rather favourable to steel. He promised full consideration for the memorial. The question of a committee to secure uniformity of tests for steel involved communication with Lloyd's and other bodies, who now have separate tests of their own, but the Board would carefully consider it.

DR. ANGUS SMITH.—The death is announced of Dr. Robert Angus Smith, F.R.S., F.C.S., Ph.D., of Manchester, which occurred at Glyn-wood, Colwyn Bay, where he had gone for the benefit of his health. Dr. Smith was born near Glasgow, February 15th, 1817, was educated at Glasgow, and studied chemistry at Geissen, under Liebig, from 1839 to 1841. A report which he presented to the British Association in 1848 on the air and water of towns gave a great impulse to the question at that time, and a paper on the air of towns in the *Chemical Society's Journal*, of 1858, first produced data establishing the difference of the town and country air wherever found. He was elected F.R.S. in 1857, and was some time president of the Literary and Philosophical Society of Manchester. His special inquiries into the quality of the air of towns when polluted by gases from manufactures led to his appointment by the Board of Trade, under the Alkali Act of 1873, as Inspector-General of alkali works for the United Kingdom. The honorary degree of LL.D. was conferred upon him by the University of Edinburgh in 1882.

THE ROYAL INSTITUTION.—On Thursday, last week, Professor Dewar, in the course of one of a series of lectures on "Flame and Oxidation," said that ozone was once supposed to have an infinite density, because it unites with mercury without alteration of volume. The explanation is that, while it oxidises the mercury, a portion of oxygen is set free, so that the volume is unaltered. The speaker chiefly gave attention to peroxide of hydrogen, which is denser than water, contains twice as much oxygen, is transparent, colourless, and, under certain circumstances, exceedingly explosive. In a large number of chemical reactions ozone and peroxide of hydrogen are formed and decomposed together. One of the best tests for the presence of peroxide of hydrogen is a few drops of chromic acid in a large proportion of water. Peroxide of hydrogen gives this a deep brown colour, and when ether is shaken up with the brown liquid, and then allowed to rise to the surface, the ether has a fine blue colour. The blue liquid is a very unstable oxidising agent. When water is decomposed by electricity, and the electrodes are small, highly ozonised oxygen and some peroxide of hydrogen are given off by one of them. Professor Dewar proved his various points by experiments. He proved that when ether vapour in damp air is oxidised by the presence of hot platinum, peroxide of hydrogen is formed. Platinum black, blood, and animal fibrine, when placed in peroxide of hydrogen, each caused a copious evolution of bubbles of oxygen. He said that it was curious that peroxide of hydrogen, though an oxidising agent, yet possessed antiseptic properties, and for a time would prevent the putrefaction of certain organic compounds. A pressure of ten atmospheres of oxygen will prevent the formation of micro-organisms, being adverse to their cellular life. Peroxide of hydrogen in water, though transparent and colourless, is opaque to most of the ultra violet rays of the spectrum.

THE PHOTOGRAPHIC SOCIETY OF LONDON.—Last Tuesday night, at the monthly meeting of the Photographic Society in Pall Mall, Mr. James Glaisher, F.R.S., presiding, Mr. John Spiller, F.C.S., read a paper on "The Fading of Paper Photographs." He ascribes much of the fading to the presence of traces of free hyposulphite of soda in the cards and papers ordinarily sold by manufacturers, and on which the photographs are mounted. The presence of hyposulphite of soda therein, he said, is almost universal, especially in the black and highly-coloured tablets. The salt is used by manufacturers to get rid of the chlorine used in bleaching the materials. Although thirty years have elapsed since photographers made an outcry against hyposulphite of soda in ordinary papers, it is only of late that much chance of the disuse of the salt has appeared, but sulphite of soda will answer the same purpose, and at present this and several other sulphites are in course of manufacture on a large scale at Stratford for paper manufacturers. He had soaked paper photographs in sulphite of soda for forty-eight hours without their being the worse for the treatment, which was not the case when hyposulphite was substituted. In the discussion which followed, Mr. Dunmore said that he admitted that solutions of hyposulphite of soda would cause a print to fade, but in a dry state it would keep all right; he and others had tried it by experiment. Captain Abney said that the yellowing of the white and not the fading of the dark parts of photographs was the greater trouble; the organic oxides of silver did the damage, he thought. He could corroborate Mr. Dunmore's statements. Mr. Werge stated that very thorough washing of the prints after fixing, such washing as they did not always receive, had much to do with their permanency. Another speaker said that twenty-three years ago, when he was abroad, he sent some photographs to the London International Exhibition, and was surprised to receive no award or notice; he went to Dr. Diamond about it, who asked him to go to look at his pictures; he did so, and found they had all faded. Those kept by himself had not faded, so the effect was due to something in the mounts used by the London operator to whom he sent them to be mounted for the Exhibition. Mr. W. England stated that he remembered the photographs mentioned by the last speaker; they had been suspended in a damp place at the Exhibition. Mr. Spiller, in the course of his reply, said that sodium sulphite has little power in dissolving chloride of silver, but it absorbs free chlorine. He denied that prints with or without hyposulphite of soda in them can be kept dry, because paper is hygroscopic; a sheet of paper will, therefore, gain several grains in weight in wet weather. He was only dealing with one portion of the subject that evening, and not the one mentioned by Captain Abney. Mr. W. E. Debenham then read a paper on the "Illumination of the Developing Room," and the proceedings closed.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office Officials, by giving the number of the page of* The Engineer *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* The Engineer *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

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

6th May, 1884.

7258. Chlorine, E. Solvay, Brussels.
7259. Chlorine and Chloride of Lime, E. Solvay, Brussels.
7260. Hydrochloric Acid, E. Solvay, Brussels.
7261. Fire-lighter, J. F. Wiles, Old Charlton.
7262. Measuring Apparatus for Looms, R. Tasker, Prestwich, and L. Schwabe, Urmston.
7263. Damping Biscuits, T. Vicars, sen., J. Vicars, sen., T. Vicars, jun., and J. Vicars, Liverpool.
7264. Bedsteads for Invalids, G. L. Scott and I. Chorlton, Manchester.
7265. Chairs, &c., I. Chorlton, Manchester.
7266. Rollers, T. Grimshaw, Witton.
7267. Twist Drills, A. Söderström, Stockholm.
7268. Ventilators, J. L. Thomasson, Worcester.
7269. Hafting Table Cutlery, A. Lindley, Sheffield.
7270. Stop-cocks, H. J. Allison.—(*J. H. Blessing, New York.*)
7271. Combined Check and Stop Valves, H. J. Allison. —(*J. H. Blessing, New York.*)
7272. Burglar Alarms, H. J. Allison.—(*R. G. Vassar, New York.*)
7273. Door Bolts, H. J. Allison.—(*R. G. Vassar, New York.*)
7274. Preventing Nuts from Working Loose, E. Cooper, Sheffield.
7275. Metal Pickers, E. Sykes, Huddersfield, and W. Hanson, Crosland Moor, near Huddersfield.
7276. Caps for Spinning, J. C. Rouse, Halifax.
7277. Trough, C. A. Atkinson, Liverpool.
7278. Binding Music Sheets, Dr. Rome Wood, Barrow-in-Furness.
7279. Application of Timepieces to Electro-plated Ware, H. H. Bolton, Birmingham.
7280. Door Letter-boxes, G. W. Potter, London.
7281. Distributing Paint, W. P. Thompson.—(*The Air Brush Manufacturing Company, Rockford, U.S.*)
7282. Chargers for Powder Flasks, W. P. Thompson. —(*H. T. Hazard and W. W. Dodge, Washington, U.S.*)
7283. Tagging Machinery, A. Booth, Manchester.
7284. Gas-motor Engines, C. W. King, Southport.
7285. Tap or Stop-cock, W. B. Smith, Glasgow, and Dr. R. C. Moffat, Newart Hill.
7286. Preparing and Tying Yarns of Worsted, &c., F. W. Gardner, Leicester.
7287. Packing Tea, J. Dick, Glasgow.
7288. Gas Motor Engines, C. W. King, Southport.
7289. Coupling and Uncoupling Wagons, T. F. Barlow and W. Schofield, near Haslingden.
7290. Supporting Trousers, W. A. Bartels, London.
7291. Propelling Vessels, A. M. Clark.—(*A. C. de los Rios, New Orleans, U.S.*)
7292. Artificial Surface Bait for Fishing, M. Carswell, Glasgow.
7293. Sheep Shears, R. Marsden, Attercliffe.
7294. Keys of Safes, &c., J. J. Gilgeous, Manchester.
7295. Tricycles, G. J. Hills, Twyford.
7296. Coupling, &c., Railway Wagons, T. Pares, Bromsgrove.
7297. Filling, &c., E. S. B. Tombs, London.
7298. Lawn-tennis Rackets, P. W. D'Alton, London.
7299. Detonating Signals for use on Railways, E. de Pass.—(*G. Lirand and E. Gaupillat, Paris.*)
7300. Sanitary Receptacles, J. Heys, Ashton-under-Lyne.
7301. Seat for Velocipedes, W. Barnwell, Coventry.
7302. Fancy Leather Goods, R. Wheatley, jun., Birmingham.
7303. Automatic Expansion of Cut-off Valves, T. R. H. Fisken, East Greenwich, and J. E. Weyman, Guildford.
7304. Asbestos Compound, D. H. Brandon.—(*D. A. Brown, Boston, and C. F. Brigham, Worcester, U.S.*)
7305. Fire and Waterproof Material for Roofing, &c., D. H. Brandon.—(*D. A. Brown, Boston, and C. F. Brigham, Worcester, U.S.*)
7306. Securing Buttons to Boots and Shoes, D. H. Brandon.—(*W. A. Boland and G. W. Prentice, U.S.*)
7307. Fittings for Feeding Bottles, L. A. V. Pellegrin, Wandsworth.
7308. Bearing, L. A. V. Pellegrin.—(*G. Carette, Paris.*) *31st March*, 1884.
7309. Brake, L. A. V. Pellegrin.—(*G. Carette, Paris.*)—*31st March*, 1884.
7310. Distributing and Controlling Electric Currents, L. A. V. Pellegrin.—(*G. Carette, Paris.*)—*3rd April*, 1884.
7311. Driving Dynamo-electric Machines, L. A. V. Pellegrin.—(*G. Carette, Paris.*)—*3rd April*, 1884.
7312. Microphone, K. S. Dembinski, Brussels.
7313. Sewing Machinery, E. S. B. Tombs, London.
7314. Galvanic Batteries, J. Enright, London.
7315. Conducting a Current of Electricity to or from a Train in Motion, J. Enright, London.
7316. Metallic Packings for Piston Rods, H. Parkin, London.
7317. Filters, F. B. Hill, London.
7318. Reeds for Musical Instruments, J. B. Hamilton, London.
7319. Combined Casement Stay and Fastener, W. B. Ollis, Yarmouth.
7320. Mixtures to be used for Beverages, C. Jennings, London.
7321. Increasing or Restoring the Elasticity of Watch-pendants, O. Peters, Germany.
7322. Varying the Gauge of Carrying Wheels, F. Mackinlay, London.
7323. Glass Labels for Bottles, &c., C. Woodhead, York.
7324. Fitting the Seats of Ships, E. S. Copeman, London.
7325. Expeditious Loading and Discharging of Vessels Afloat, G. W. Penn, Holndale, and J. G. Penn, Cardiff.
7326. Steam Boilers or Generators, D. Nicholson, Middlesbrough-on-Tees.
7327. Coupling and Uncoupling Railway Carriages, H. J. Macey, London.
7328. Manganese Treatment of Iron, J. Imray.—(*La Société des Aciéries de Longwy, France.*)
7329. Mounting Spindles in Spinning, &c., Machinery, J. Dixon, Keighley.
7330. Knitting Machinery, J. Smith, Bradford.
7331. Parcel, &c., Holder, T. F. D. Heap, London.
7332. Safety Lamps, J. Raymer, New Shariston.
7333. Surgical Instrument, W. S. Richmond, London.
7334. Bit for Horses, A. Thornton, London.
7335. Anti-induction for Telegraph Cables, R. N. Laurie.—(*H. V. D. Werde, Brooklyn, U.S.*)
7336. Propelling Ships, &c., A. J. Boult.—(*Z. Oram, Philadelphia, U.S.*)
7337. Ventilation, C. M. Tate, London.
7338. Extracting Cartridge Cases from Barrels, F. T. Baker, London.
7339. Controlling the Drawing Off of Liquids, W. C. Edwards, Forest Hill.
7340. Jewellery, S. Betts, London.
7341. Ornamenting Waterproof Fabrics, W. S. Mackie, Manchester.
7342. Fire-proof Blocks, &c., C. Toope, London.
7343. Chair for Invalids, J. Mayer, London.
7344. Handle for Files, &c., W. R. Lake.—(*J. Wasse, Settin, Germany.*)
7345. Adjustable Steps for Bicycles, W. R. Lake.—(*G. F. Harwood, Massachusetts, U.S.*)
7346. Axle-boxes, W. R. Lake.—(*G. W. Stewart, U.S.*)
7347. Telephone Transmitters, W. R. Lake.—(*H. Clay, Philadelphia, U.S.*)

7th May, 1884.

7348. Portable Hand-drilling Machine, J. Tyson, London.
7349. Macrame Lace, W. Anyon, Manchester.
7350. Securing Pipes in Position, G. and G. W. Potter, London.
7351. Extending Backs of Costume Stands, R. G. Richards, Birmingham.
7352. Expanding Tubes, D. Marshall, Glasgow.
7353. Cartridges, J. Andrews, London.
7354. Lubricating Cylinders, J. Dickman, Newcastle-upon-Tyne.
7355. Tricycles, W. J. Spurrier, Moseley, and C. N. Baker, Birmingham.
7356. Fireplaces, &c., E. Lofts, Cambridge.
7357. Brake Apparatus, C. A. Atkinson, Liverpool.
7358. Purifying Gas, O. Roberts, Liverpool.
7359. Pumping Apparatus, G. A. J. Schott, Bradford.
7360. Stirrup Iron, W. J. Miller, London.
7361. Combined Collar Stud and Necktie Fastener, C. M. P. H. Triscott, Blackheath.
7362. Dividing Dough, P. Pfleiderer.—(*L. Gelbert and W. Ludowici, Germany.*)
7363. Daisy Rake, S. Rowland, Cranleigh.
7364. Ground Anchor, C. G. Gill, London.
7365. Photographic Shutters, W. H. Marshall, Scarborough.
7366. Hay and Straw Elevators, E. and H. Roberts, Northamptonshire.
7367. Bottle Stoppers, H. Curwen, Norton Malton.
7368. Double-stitch Sewing Machines, E. Capitaine. —(*H. Bengstenberg and A. Nörholm, Germany.*)
7369. Lantern, H. J. Haddan.—(*F. Wlach and M. Pincoffs, Vienna.*)
7370. Surgical Truss, W. Wood, Manchester.
7371. Railway Couplings, C. A. Drake, London.
7372. Frames of Landing Nets, W. Woodfield, Redditch.
7373. Ruler and Paper-knife, O. Meyer, Prussia.
7374. Furnaces, T. Knott, London.
7375. Facilitating the Use of Electric Currents, R. K. Boyle, Liverpool.
7376. Electric Bell Indicators, H. Thorpe, London.
7377. Pen Support, F. Hunt, London.
7378. Operating Governing Valves, W. Murdoch, Glasgow.—*3rd April*, 1884.
7379. Bracelets, T. Spill, London.
7380. Electric Telephones, C. Lever, Bowdon.
7381. Ball Taps, G. Drake, Torquay.
7382. Construction of Tricycles, P. Gibier, Boulevard St. Marcel, France.
7383. Insulators, A. F. Link.—(*H. Müller, Germany.*)
7384. Brakes, P. W. Britton, London.
7385. Car Umbrella Holder, C. A. Floyd, Eastbourne.
7386. Treating Plants, E. Edwards.—(*A. B. Escourron, Moux, France.*)—*13th Febuary*, 1884.
7387. Drying Animal Matters, J. F. Johnstone and J. B. Alliott, London.
7388. Filtering Liquids, J. F. C. Farquhar, London.
7389. Stoppers for Bottles, H. Barrett, London.—*2nd April*, 1884.
7390. Compressed Air Motion Tricycle, J. Judge, Drayton Bassett.

8th May, 1884.

7391. Code of Signals, J. Wall, Bootle.
7392. Washing Machines, J. H. Lynde, Manchester.
7393. Tricycles, J. Johnson, Manchester.
7394. Bicycle Saddles, I. Whitehouse, Birmingham.
7395. Artificial Stone, J. A. Jones, Middlesbrough-on-Tees.
7396. Scarifying Weeds, T. Hunter, Maybole.
7397. Artificial Stone, J. A. Jones, Middlesbrough-on-Tees.
7398. Separating, &c., Grain, T. F. Stidolph, Woodbridge.
7399. Chimney-pot, S. and J. D. Belham, London.—*20th March*, 1884.
7400. Preventing Down Draughts in Chimneys, S. and J. D. Belham, London.—*20th March*, 1884.
7401. Hammerless Guns, &c., J. W. Smallman, Nuneaton.
7402. Lever Lifting Jacks, W. P. Thompson.—(*The Hercules Lever Jack Company, Irvington, New Jersey.*)
7403. Utilising Slag, W. P. Thompson.—(*R. Sohlina, Dortmund.*)
7404. Purifying Iron Ores, W. P. Thompson.—(*R. Sohlina, Dortmund.*)
7405. Glass Melting Tanks, G. Kemp, Swinton.
7406. Tea-pots, J. E. Bingham, Sheffield.
7407. Dish Covers, J. E. Bingham, Sheffield.
7408. Caps of Pepper Castors, J. E. Bingham, Sheffield.
7409. Compressing Ensilage, T. Pearson, Wolverhampton.
7410. Compressing Ensilage, T. Pearson, Wolverhampton.
7411. Metallic Fountain Pens, H. T. Bruceton, Birmingham.
7412. Cleaning Bristles, H. J. Allison.—(*C. J. Baptiste Herbillon, Charleville, France.*)
7413. Vitrous Cement, J. Rust, London.
7414. Lock-up Stands, A. Watson, Willesden.
7415. Improving the Tone of Violins, &c., F. Hudson, London.
7416. Washing Machines, M. H. Pearson, Leeds.
7417. Type-writer, E. Wright, London.
7418. Soluble Phosphates of Lime, G. H. Anderton and W. W. Mellon, Howden.
7419. Hinge, C. Mackintosh and W. M. Richards, Leicester.
7420. Rotary Tile Press, A. J. Boult.—(*L. Damaze, St. Julien, France.*)
7421. Wire Stretcher, H. J. Haddan.—(*L. Auriol, Albi, France.*)
7422. Packings for Pistons, &c., M. V. Schiltz, Cologne.
7423. Steering Tricycles, W. B. Downey, Hendon.
7424. Clutch for Bicycles, &c., W. B. Downey, Hendon.
7425. Washing Soap, J. H. Johnson.—(*E. Bar, Paris.*)
7426. Convertible School Desks, C. F. Wake, London.
7427. Smoke-consuming Apparatus, C. Martin, Paris.
7428. Applying Vulcanised India-rubber, &c., to the Manufacture of Lamp Reservoirs, G. Downing.—(*G. Fischer, Germany.*)
7429. Governing the Admission of Steam in Engines, J. Allan, Johnstone.
7430. Transparent Painting on Glass, J. T. Cullum, London.
7431. Sewing Machines, G. Grisel, California, U.S.
7432. Drilling the Handles of Brooms, F. Roquet and S. F. Cohin, France.
7433. Nitro-glycerine, A. Schröder, Dresden.
7434. Magnifying Glasses for Gas Lights, M. Heale, London.
7435. Closed Stove Furnace, A. B. Reck, Denmark.
7436. Regulating the Supply of Gas in Railway Trains, W. E. Langdon, Derby.
7437. Self-cocking Break-down Fire-arms, E. and E. Harrison, London.
7438. Disinfecting, &c., Sewage, J. Chabanel and A. V. Brabant, London.
7439. Portable Electric-lighting Apparatus, A. M. Clark.—(*G. Trouvé, Paris.*)
7440. Regulating the Feed of Electric Arc Lamps, W. R. Oswald and W. R. Foster, London.
7441. Toy, W. M. Campbell, London.
7442. Casting Metal Tubes, H. Stephens, Manidec.
7443. Forcing and Raising Fluids, J. C. Stevenson, J. Formby, Cheshire, and C. Keizer, Liverpool.
7444. Lighting Gas Lamps by Electricity, J. H. Johnson.—(*W. Deckert and E. Homolka, Vienna.*)
7445. Ships' Windlasses and Capstans, E. Walker, London.

9th May, 1884.

7446. Cooking Apparatus, E. C. Baker, Stoke Bishop.
7447. Bicycles, &c., J. Keeling, Aston.
7448. Black Pigment and Polishing Material, A. French, North Shields.
7449. Hats, J. W. Thompson, Prestwich.
7450. Twisting and Doubling Flax, &c., T. Unsworth, Manchester.
7451. Rope Pulley Blocks, A. J. Bell, Manchester.
7452. Blind Furniture, W. Sanderson and T. A. Moffitt, Gateshead.
7453. Spring Packing for Pistons, W. C. Lockwood, Sheffield.
7454. Cask Gauging without Allowances, E. O'Brien, Liverpool.
7455. Lanterns, H. Lucas, Birmingham.
7456. Gong Cyclometer, G. Stephens, Hollywood.
7457. Valves for Pumps, J. Weir, Glasgow.
7458. Packing Bleaching Powder, J. Clare, Penketh.
7459. Brake, C. Foster, Halifax.
7460. Steel, &c., Hoops, J. Guest, Smethwick.
7461. Grinding, &c., Glass, H. Besson and E. N. Kent, London.
7462. Rolling Seamless and Weldless Tubes, &c., F. Johnson, Walsall.
7463. Drain Tube, J. I. Eden, London.
7464. Automatic Flushing Wheel Apparatus, J. I. Eden, London.
7465. Jointing Pipes, W. B. Dodd, Carlisle.
7466. Billiard Rest, T. Watson, Inchalloch.
7467. Sheets and Strips of Horn, &c., A. Mickelthwaite, Sheffield.
7468. Screw-drivers, C. Haigh, Sheffield.
7469. Fasteners or Clips for Stays, &c., F. Ahrenfeld, Liverpool.
7470. Corsets, &c., F. Ahrenfeld, Liverpool.
7471. Distributing and Elevating Grain, &c., P. Evans, Liverpool.
7472. Stoppering Bottles, W. Proctor and J. Sargant, Birmingham.
7473. Bicycle, M. D. Rucker, London.
7474. Telescopic Pencil-case, J. Merzbach.—(*Helmreich and Co., Nurnberg.*)
7475. Electric Arc Lamps, &c., R. H. Courtenay, London.
7476. Brakes, J. Magee, Belfast, and R. McGhee, Walthamstow.
7477. Grinding Mill, M. Hedicke.—(*N. Jahn, Prag-Bubna, Austria.*)
7478. Beverages, M. Hedicke, London.
7479. Baking Oat Cake, R. Thornton, Cleckheaton.
7480. Packing Fire Materials, J. Partridge, London.
7481. Filtering, &c., Sewage, C. Waite, Reading.
7482. Automatic Safety Apparatus, S. Williams, London.
7483. Construction, &c., of Dredger Ladders, S. Williams, London.
7484. Heating, A. B. Reck, Denmark.
7485. Heating and Ventilating Stove, A. B. Reck, Denmark.
7486. Brick-lined Hot-air Furnace, A. B. Reck, Denmark.
7487. Iron Hot-air Furnace, A. B. Reck, Denmark.
7488. Kitchen Cabinets, J. Lorrimer.—(*H. Hanna, Ohio, U.S.*)
7489. Catch-bar Safety Locking Mechanism, W. and R. Wragg and G. Husbands, Long Eaton.
7490. Casting, &c., Ceilings, W. Clark, West Brighton.
7491. Chimney Pots, H. Stringer, Brighton.
7492. Paint, &c., Brushes, G. Swann and W. J. Mason, London.
7493. Sliding Window Sashes, J. B. Adams and J. Telford, Liverpool.
7494. Carriages for Roundabouts, W. Laing, Sunderland.
7495. Construction, &c., of Railway, &c., Vehicles, A. Yeadon, Idle.
7496. Preventing Clinkers in Furnaces, A. M. Clark. —(*The Coal Economising Company, Kansas, U.S.*)
7497. Skirts of Ladies' Riding Habits, T. Doughty, London.
7498. Motor Apparatus, O. G. Rombotis, New York, and G. H. Hillyer, Minnesota, U.S.
7499. Covers for Bricks, W. S. Codner, London.
7500. Producing Power to Induce Electricity, W. Hillyard, London, and G. Newnes, Putney Heath.
7501. Kilns, S. De La G. Williams, Birmingham.
7502. Condensing Acid Gas, &c., L. Bémelmans, H. Tilmans, and E. Marlier, Brussels.
7503. Preventing Overwinding of Mine Cages, &c., G. Oldham, J. Hodgson, and T. Curry, Durham.
7504. Condensing Exhaust Steam, &c., J. Wright, Tipton.
7505. Lubricators, A. Baur, Germany.
7506. Provision Carriage, H. Kötgen, Germany.
7507. Water-waste Preventer, H. Trott, Battersea.
7508. Hooks for Water, &c., Pipes, E. Edwards.—(*J. L. Badré-Gillet, France.*)
7509. Cutting Cloth, &c., S. Hirschberg, Berlin.
7510. Gas, A. Ponsard, Paris.
7511. Bleaching Paper Pulp, &c., J. H. Johnson.—(*J. B. Jessy, France.*)
7512. Establishing, &c., Electric Communication between Fixed and Movable Parts of Electric Circuits, W. R. Lake.—(*N. de Kabath, Paris.*)
7513. Steam Boiler, &c., Furnaces, A. C. Engert, London.
7514. Lawn Tennis Apparatus, A. Le Grand and R. Sutcliff, London.
7515. Counters for Recording the Electricity in Lamp Circuits, S. Pitt.—(*J. Cauderay, Switzerland.*)

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7516. Electric and Automatic Transcription of Stenographic Signs, &c., into Typographic Characters, W. H. Beck.—(*G. A. Cassagnes, Paris.*)
7517. Cigars, T. R. Withecomb, Manchester.
7518. Compound Driving Gear for Bicycles, &c., F. W. Bagshaw, Sheffield.
7519. Discharging Oil upon the Sea for the Purpose of Calming the Force thereof, J. Gordon, jun., Dundee.
7520. Measuring, &c., Fluids, A. Budenberg.—(*H. Friemann and C. Wolf, Germany.*)
7521. Securing Bottles in Inkstands, W. L. Smith, Birmingham.
7522. Steam Traps, R. Pye, Blackburn.
7523. Odometers, C. Fairbairn, Manchester.
7524. Roofing Tiles, S. Turner, Barrow Haven.
7525. Carbonate of Soda, C. Wigg, Liverpool.
7526. Sulphate of Ammonia, W. Meadows, Rainhill.
7527. Bearing Springs for Road Carriages, &c., H. F. Lloyd, Liverpool.
7528. Substitute for Tobacco, &c., T. C. Lovewell, Brighton.
7529. Boots for Bicycle Riders, &c., J. J. Gascoine, Leicester.
7530. Finishing Machine for Leather, G. A. Hardy, Old Lenton.
7531. Spring Actions for Bicycles, H. James and G. Robinson, Sheffield.
7532. India-rubber Tires for Bicycles, G. Hookham, Birmingham.
7533. Dynamo-electric Machines, &c., G. Hookham, Birmingham.
7534. Incandescent Electric Lamps, G. Hookham, Birmingham.
7535. Cardboard Boxes, P. Hookham, Birmingham.
7536. Differential Gearing, A. Beck, E. B. Gittins, and J. Sharp, Birmingham.
7537. Destructive Distillation of Wood, &c., J. F. Scott, Withington.
7538. Safety Bolt, T. Suckley, Worthenbury.
7539. Consumption of Smoke, J. T. Pearson, Burnley.
7540. Crushing Stones, G. Dalton, Leeds.
7541. Mortars and Pestles, F. Barry, London.
7542. Opening, &c., Bottles, J. H. Hamilton and C. F. and S. F. Cohen, London.
7543. Bee-hives, J. R. W. Hole, Ledbury.
7544. Shovels, &c., W. Bell, Sheffield.
7545. Saddles, W. Woolley, Birmingham.
7546. Open-fire Grates or Stoves, S. Pickersgill, Derby.
7547. Securing Handles to Brooms, S. Pickersgill, Derby.
7548. Anchoring of Telegraph Poles, R. H. Twigg, London, and J. C. Johnson, Wednesbury.
7549. Sofa Beds or Couches, T. McIlroy, London.
7550. Operating the Shuttles of Looms, H. J. Haddan. —(*N. Drucbért, France.*)
7551. Tightening the Gut in Tennis Bats, W. Spink, London.
7552. Reproducing Pictures, D. MacNaughtan, W. S. Simpson, and G. Smith, London.
7553. Rest for Billiard Cues, J. G. Hayman, Weston-super-Mare, and W. H. Keey, Bristol.
7554. Railway Signals, R. Hudson, Gildersome.
7555. Bicycle Gongs, T. E. Ware, Bristol.
7556. Bicycle Bells, T. E. Ware, Bristol.
7557. Joints for Canisters, P. Simon, Vienna.
7558. Bicycle Lamps, A. W. Patching, Birmingham.
7559. Swivelling Tables, T. Murphie, Glasgow.
7560. Expansion Valve Gear for Steam Engines, J. Gillies, Glasgow.
7561. Automatic Extinction of Fires, M. C. Ruthenburg, London.
7562. Phosphates, F. W. Harbord, Wolverhampton.
7563. Bending Wire into Loops, &c., A. J. Boult.—(*G. Delome, France.*)
7564. Type Writer, M. A. Weir, London.
7565. Hydraulic Cranes, C. J. Galloway and J. H. Beckwith, Manchester.
7566. Homogeneous Iron, A. Ponsard Paris.
7567. Steam Engines, R. F. E. Rumsey, London.
7568. Bent Cranks, G. Brown, Lincoln, and R. Brown, Morton.
7569. Treating Sulphates, E. F. Trachsel, London.
7570. Producing Oxides, E. F. Trachsel, London.
7571. Dog Kennels, A. E. Maudslay, Southampton.
7572. Filter Apparatus, A. Domeier, London, and B. Nickels, jun., Bushey.
7573. Separating Glycerine from Animal Substances, J. W. Freestone, Bromborough.
7574. Filtering Tap, W. Bartholomew, London.
7575. Pumps, W. Bartholomew, London.

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7576. Drinking Fountains for Birds, J. Singleton, Preston.
7577. Ship Ventilators, J. G. Carrick, Glasgow.
7578. Actuating Tricycles, F. G. Myers, Wellingborough.
7579. Box or Cover for Tooth, &c., Brush, J. C. Pierpoint and J. O. Turnbull, Birmingham.
7580. Counter to Indicate the Loss of Production or Revolutions of Machinery, D. and F. H. Orme and C. Butterworth, Oldham.
7581. Silos, T. Potter, Alresford.
7582. Coating Iron Plates with Tin, &c., J. Williams, Landore.
7583. Reversing Steam, &c., Engines, W. H. Booth. —(*A. Broad, Chicago, U.S.*)
7584. Stretching Textile Fabrics, J. Roberts, Hadfield.
7585. Tobacco Pipes, J. Baber, Liverpool.
7586. Scribbling and Carding Engines, D. Whiteley and S. Bamford, Golcar.
7587. Fabric for use in Cleansing, &c., Purposes, F. Hudson, Manchester.
7588. Furnaces for the Combustion of Animal, &c., Refuse, W. Whittaker, Burnley.
7589. Nuts, &c., which have a Female or Internal Screw Thread, W. Bayliss and R. Howarth, Wolverhampton.
7590. Removable Metallic Tubes, H. J. Allison.—(*E. Perrody, Geneva.*)
7591. Valves for Bucket Pumps, H. Haughton, Audley.
7592. Steam Engine Governors, H. Lindley, Salford.
7593. Rotary Blowers, F. Bosshardt.—(*C. Hoppe, Germany.*)
7594. Treatment of Fibre-yielding Plants, R. Collyer, London.
7595. Metal Spring Mattress or Seat, H. Mawbey, London.
7596. Furnaces, M. Schwab, Deansgate.
7597. Expediting the Heating of Water in ordinary Domestic Kettles, J. Bland, London.
7598. Instrument for Examining the Interior of the Barrels of Martini-Henry Rifles, W. Gregory, London.
7599. Tricycles, &c., W. Britain, jun., London.
7600. Raising Water, J. Yeagley, Indianapolis, U.S.
7601. Flushing Cisterns, T. G. Messenger, Loughborough.
7602. Globes for Gas, &c., Lamps, J. H. Johnson.—(*C. H. Knoop, Dresden.*)
7603. Seed-sowing Machines, T. R. H. Fisken, East Greenwich, and J. E. Weyman, Guildford.
7604. Steam Boilers for Land and Sea, J. Harbert, London.
7605. Musical Scale, E. Edwards.—(*L. Pigot, France.*)
7606. Producing Designs on Metal, &c., D. C. Dallas, London.
7607. Drying, &c., Coffee, J. Duran, New York, U.S.
7608. Pneumatic Pumps, H. H. Lake.—(*F. Windhausen, Berlin.*)
7609. Vats, B. A. Bateman, London.
7610. Door Locks, &c., G. H. and H. W. Chubb and H. S. Ball, London.
7611. Actuating the Minute Indicator in Chronographs, B. C. Reber, Switzerland.
7612. Making Nails, P. Meyer, Cologne.
7613. Fire-escape, J. L. Westland, New Brompton.
7614. Clocks, W. L. Wise.—(*L. Hetzel, Prussia.*)

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for The Engineer *at the office of Her Majesty's Commissioners of Patents.*

4292. Securing the Lids of Baskets, Skips, and Cases, *T. Humphreys, Salford.—6th September*, 1883. 6d.

A tube contains a rod formed with cranks opposite openings in the tube, through which pass bars secured to the skip or basket, such rods having projections between which the cranks enter when the rod is turned, so as to lock the bars in position.

4295. Signal Indicator Apparatus, *H. Botten, London.—6th September*, 1883. 8d.

This relates to signal apparatus, more especially applicable to steamship engine-room telegraphs and to railway trains. The signals are actuated by an axis, to which a step-by-step motion is imparted either by an electric or pneumatic driving train. The signals are marked in lines parallel with the axis upon a drum mounted behind a suitably slotted front plate.

4336. Apparatus to Reduce Inflammable Gas for Lighting and Heating Purposes, &c., *E. Duchamps, London.—(Not proceeded with.)* 4d.

An ordinary aspirator actuated by weights, forces air into the bottom of an evaporating chamber fitted with a series of iron sheets covered with cotton or blotting paper to which gazoline is supplied in regulated quantities.

4369. Production of Decoration by Enamel upon Metal Articles, *T. Reeves, Birmingham.—12th September*, 1883.—*(Not proceeded with.)* 2d.

The articles, formed of "Webster's patent metal," are coated with an electro deposit of gold or silver on that part of their surface which is to be enamelled.

4372. Apparatus for Effecting Continuous Feed or Delivery of Granular or Pulverulent Material, *C. H. Gill, London.—12th September*, 1883.—*(Not proceeded with.)* 2d.

The channel through which the material has to pass is formed with an elongated narrow mouth in the form of a slit, and vertically beneath the mouth a cylinder is caused to revolve and carry away the material.

4416. APPARATUS FOR USE IN CHARGING SECONDARY BATTERIES OR ACCUMULATORS, *T. J. Jones and E. C. Rimington, London.—14th September*, 1883.—(*Not proceeded with.*) 2d.
To prevent the batteries discharging their current back through the generator a balance beam, in combination with electro-magnets and mercury contacts, switches out the batteries from the circuits and inserts a suitable resistance until the generator has again recorded its normal electro-motive force.

4457. APPLICATION OF MOSS PEAT, *F. Wirth, Germany.—18th September*, 1883.—(*A communication from L. Starck, Germany.*)—(*Provisional protection not allowed.*) 4d.
This relates principally to the application of moss peat to the tanning process.

4459. MEASURING PIECE-STUFFS, RIBBONS, &c., *W. P. Thompson, Liverpool.—18th September*, 1883.—(*A communication from Messrs. Desbruères Frères, Paris.*) 4d.
This relates to means for enabling the length remaining and also the length cut off of piece-goods to be indicated, and it consists in combining with the goods two measures provided with suitable divisions.

4484. TOOLS FOR THE MANUFACTURE OF BOTTLES, *H. Barrett, London.—19th September*, 1883.—(*A communication from J. Lippmann, Germany.*)—(*Not proceeded with.*) 2d.
This relates to tools especially applicable for forming the necks of screw-necked bottles, and it consists in fitting the tongs with lips or additional jaws, to prevent the metal from spreading forward when the neck is being formed.

4505. PEN AND INK-HOLDERS, *J. F. Williams, Liverpool.—21st September*, 1883. 6d.
The pen is fitted to a hollow tube, which encloses a tongue or feed trough acted upon by a spring, so that it can be made to project from or enter into the tube. When the trough is caused to project beyond the pen, the latter is dipped into ink, and on allowing the trough to enter the tube a supply of ink is stored therein, which will last some time.

4506. CAPS FOR UNSTOPPERING AERATED WATER BOTTLES, *R. A. Benson, Lichfield.—21st September*, 1883.—(*Not proceeded with.*) 2d.
A cap for forcing down the internal stoppers of bottles is provided with an elastic washer to fit tightly over the neck, and has a passage passing through it, which is continued outside and bent downwards, so as to direct the contents of the bottle into any suitable vessel. A handle enables the cap to be readily inserted in the neck of the bottle.

4507. DAVITS FOR LOWERING SHIPS' BOATS, *R. Hudson, J. Grantham, and J. H. Broker, Blyth.—21st September*, 1883. 6d.
This relates to swinging davits, each of which consists of an upright, inclining "inboard," and hinged at bottom, its upper end having an arm curved "outboard," the outer end of which is hooked to receive a crosshead, from which the boat is suspended, the boat being raised clear of the chocks by a rope connected with a winch, and its weight then causing the davits to swing outwards and lower it into the water.

4516. MANUFACTURE OF A CRYSTALLISED PHOSPHATE OF LIME APPLICABLE AS A FERTILISER, *J. Imray, London.—21st September*, 1883.—(*A communication from F. Barbe, Paris.*)—(*Not proceeded with.*) 2d.
The process consists in adding slowly to a phosphate solution successive portions of lime or carbonate of lime, and testing from time to time to make sure that the liquid still contains excess of phosphoric acid.

4518. REMOVING SNOW FROM RAIL OR TRAMWAYS, *P. M. Justice, London.—21st September*, 1883.—(*A communication from N. Jacobs, Brussels.*)—(*Not proceeded with.*) 2d.
A large double snow plough is mounted upon a truck fitted with toothed wheels which break up the snow on the rails, a brush wheel then removing the broken material.

4520. SECURING THE BILLS IN MILL-BILL HOLDERS, EMPLOYED IN THE FACING OF MILL STONES, &c., *E. B. Pearse, Exeter.—21st September*, 1883.—(*Not proceeded with.*) 2d.
The bill protudes through an opening in a tube, and is secured by a key or stop and wedge.

4521. EFFECTING IGNITION OF ELECTRIC CANDLES, *W. D. Gooch, London.—21st September*, 1883.—(*Not proceeded with.*) 2d.
It is proposed to unite the points of "Jablochkoff candles" by a piece of carbonised fibre.

4522. ROADWAY, *L. Stiebel, London.—21st September*, 1883.—(*Not proceeded with.*) 2d.
A layer of asphalte is spread over a level surface and broken granite or other stone rammed into it, asphalte being then inserted in the interstice and the whole again beaten or rolled.

4532. PRESERVING BEERS, &c., *R. G. Bell, Oxford.—22nd September*, 1883.—(*Not proceeded with.*) 2d.
This consists in injecting carbonic acid gas under pressure into fermented liquors, and subsequently subjecting them to a temperature suitable for the particular liquor, so as to give it a sparkling bright appearance, and to preserve it in good condition.

4538. PUNCHING HOLES IN METAL PLATES, *J. Mayoh and C. M. Willson, Manchester.—22nd September*, 1883.—(*Not proceeded with.*) 2d.
This relates to the combination of an automatic table with a punching machine, so as to hold the plate to be punched and move it a certain distance after each action of the punch. The table is advanced by a screw driven by gearing from the principal spur wheel on the cam shaft of the machine.

4539. RELIEVING FALLING HORSES OF THE WEIGHT OF VEHICLES, &c., *M. J. Rowley and W. G. Hobill, London.—22nd September*, 1883.—(*Provisional protection not allowed.*) 2d.
This relates to the combination of lever rods and foot-plates or handles, so arranged that the axle can be used as a fulcrum when actuated by the driver, and the front of the vehicle be thereby lifted.

4540. BOUQUET HOLDER, *F. Wibberly, London.—22nd September*, 1883.—(*Not proceeded with.*) 2d.
The handle can be opened on hinge joints to receive the stems of the flowers, and pins are provided in the interior of the handle to secure the stems in position therein. The open end has a detachable socket, which can be used to support the flowers in water, and the handle is composed of jointed legs, which may be spread out to form a tripod.

4541. PLOUGH HEADS, *J. Searby and J. Howe, Rotherham.—22nd September*, 1883.—(*Not proceeded with.*) 2d.
The object is to strengthen the woodwork of ploughs, and it consists in extending the back part of the plough head, so as to form a support for the tail piece in combination with a stay for the beam.

4543. SOFTENING WATER, *W. Wyatt, Ellesmere.—22nd September*, 1883.—(*Not proceeded with.*) 2d.
This relates to apparatus in which the water to be acted upon and the lime water or other reacting liquid are each measured in suitable "chambers," which empty simultaneously into the same pipe.

4546. VENTILATION, *G. F. Harrington, Isle of Wight. 24th September*, 1883.—(*Not proceeded with.*) 2d.
This relates to the application of the cowl arrangements described in patent No. 387, A.D. 1883, for ventilating sewers, to the ventilation of ships, rooms of houses, public buildings, and other places.

4556. BRUSH-CLEANING AND CUTTING MACHINES, *W. Walther-Vogel, Switzerland.—24th September*, 1883. —(*Not proceeded with.*) 2d.
A rotating cylinder is provided with metal pins to clean the brushes, which are pushed along by guiding plates. A rotating roller is provided with two or more spokes carrying knives standing at a sharp angle to a counter knife, the whole of the knives being adjustable.

4551. APPARATUS FOR CHURNING MILK, *T. Morgan. London.—24th September*, 1883.—(*A communication from A. Lebert, France.*—(*Not proceeded with.*) 2d.
In an oval barrel two pistons are caused to work up and down beside each other, always in opposite directions, and between the pistons is a stone jar to receive water to maintain the proper temperature in the apparatus.

4557. APPARATUS FOR TOUCHING PHOTOGRAPHIC PICTURES, &c., *E. G. Brewer, London.—24th September*, 1883.—(*A communication from J. Geesbergen and La Société Geruzet, Brussels.*)—(*Not proceeded with.*) 2d.
The vibrations of the armature of an electro-magnet carried on "a pencil" are caused to produce a fine dotting on the surface to be "re-touched."

4558. FASTENING FOR NECKLACES, &c., *F. H. F. Engel, Germany.—24th September*, 1883.—(*A communication from E. Hamann, Germany.*) 6d.
A rod provided with a projection near one end is secured to one end of the necklace, and its free end is introduced into a tube attached to the other end of the necklace, and the end of which has a slot formed in it, and bent off, so that the projection on the rod entering the same, and being caused to enter the bent part by turning the rod, prevents the latter from being withdrawn by a pulling movement. A spring is inserted in the tube and exerts pressure on the end of the rod, so as to prevent it turning too freely.

4562. COUNTERACTING INCRUSTATION IN BOILERS, *G. E. R. Mills, Langley Burrell, Wilts.—25th September*, 1883.—(*Not proceeded with.*) 2d.
This consists in introducing cutch or gambir into steam boilers.

4563. ARMATURES FOR ELECTRIC CURRENT GENERATING MACHINES, *H. J. Haddan, London.—25th September*, 1883.—(*A communication from C. F. Brush, Cleveland, U.S.*) 6d.
The laterally projecting portions of the "Brush" armature are, according to this invention, built up of a series of comparatively thin and distinct metallic plates interposed between the folds of a metallic ribbon, which, with an inner or base ring, on which it is coiled, forms the annular portion of the armature.

4573. PORTABLE ELECTRIC LAMPS, &c., *R. Barlow, London.—25th September*; 1883. 6d.
In a self-contained electric lamp the base is so shaped that the upper portion is of much smaller size than the lower, and the upper and outer edges of the battery electrodes are adjusted to allow of their being drawn up out of the electrolytic liquid into the upper portion of the base. A cone-and-sleeve contact piece permits of the lamp's rotation in a horizontal plane, a hinged joint being used for revolving electroliers.

4583. COMPRESSING YARN, &c., *G. Duncan, Lochee, N.B.—26th September*, 1883. 6d.
This relates to the compression of yarns when wound in the form of cops or pirns, and it consists of a pair of fluted rollers, suitably rotated intermittently and enclosing the cops or pirns between them, plungers being then caused to enter the cylindrical cavity formed by the grooves which are opposite each other, and to act upon the cops therein, so as to compress them lengthwise.

4584 APPARATUS FOR EXTRACTING OR SEPARATING OIL FROM METAL TURNINGS, &c., *A. G. Brookes, London.—26th September*, 1883.—(*A communication from G. W. Gregory, Boston, U.S.*) 6d.
This relates to a centrifugal machine with a pan to receive metal turnings or articles covered with oil, and over which a cover fits tightly, the pan being then caused to revolve within a case which receives the oil thrown out of the pan. The spindle of the pan is supported in elastic or yielding bearings.

4592. BARYTA OR STRONTIA TREATMENT FOR MOLASSES, &c., *J. Imray, London.—26th September*, 1883.—(*A communication from H. Leplay, Paris.*) 6d.
This consists, First, in treating molasses and other saccharine juices with monohydrate of baryta or strontia; Secondly, converting the carbonate of baryta or strontia into monohydrate by the action of superheated steam under the influence of heat; Thirdly, in apparatus for converting carbonate of baryta or strontia into monohydrate.

4596. HAND STEERING GEAR FOR SHIPS, &c., *W. Adair, Liverpool.—27th September*, 1883.—(*Not proceeded with.*) 2d.
To the rudder head is fitted a bed-plate with toothed quadrants, and in the centre of this plate is pivotted a sole plate carrying pinions gearing with the quadrants, and with a right and left-handed screw to which a hand wheel is secured.

4600. FIRE-PROOF PLATES, *J. Imray, London.—27th September*, 1883.—(*A communication from J. Nagel, Vienna.*)—(*Not proceeded with.*) 2d.
This relates to improvements in patent No. 1468, A.D. 1882, in which a mixture of asbestos and oxide of zinc was pressed on metallic wire and treated with chloride of zinc and other substances to produce fire-proof and water-proof plates, and it consists in substituting for or adding to the oxide of zinc magnesia, gypsum, or lime, and the liquid, instead of being a solution of chloride of zinc, may be a solution of other metallic chlorides.

4601. EXTRACTION OF FAT FROM CACAO, &c., *F. C. Glaser, Berlin.—27th September*, 1883.—(*A communication from Dr. H. Michaelis, Germany.*)—(*Not proceeded with.*) 4d.
The cacao beans are roasted, shelled, and crushed, and mixed with some comminuted substance, which is not affected by ether, and the mixture subjected to the ordinary extraction process.

4603. PROTECTIVE SIGNALLING APPARATUS FOR MARKING BUTTS OF SHOOTING RANGES, *W. Begg, Glasgow.—27th September*, 1883.—(*Not proceeded with.*) 2d.
The object is to ensure a danger signal being automatically displayed whenever the marker leaves his butt, and for this purpose the door of the butt when opened causes the signal to be displayed.

4604. APPARATUS FOR ROLLING WIRE AND BARS OF CHANNEL STAR AND SIMILAR SECTIONS, *G. W. von Nawrocki, Germany.—27th September*, 1883.—(*A communication from Schmidt Brothers, Germany.*) 6d.
A number of rolls are provided with a suitable profile, and work in combination, so as to produce the desired section of wire or bar.

4608 PERFORATING PAPER, &c., TO BE USED AS MUSIC SHEETS IN MECHANICAL MUSICAL INSTRUMENTS, *J. Maxfield, London.—27th September*, 1883. —(*Not proceeded with.*) 2d.
The object is to enable the perforations in such sheets to be so formed as to produce variations of tone in the instrument in which it is used; and it consists essentially in the use of a perforated metal plate, and means for burning parts of the paper away.

4609 ELECTRIC CLOCKS, *W. P. Thompson, Liverpool.—27th September*, 1883.—(*A communication from A. Winbauer, Baden.*)—(*Not proceeded with.*) 2d.
This relates to a clock, in which a very weak current suffices to effect the winding, and in which the regular speed of the hour train is independent of the variable strength of the current.

4610. MANUFACTURE OF STEEL DISC WHEELS, *E. Edwards, London.—27th September*, 1883.—(*A communication from La Compagnie Anonyme des Forges de Châtillon et Commentry, France.*)—(*Not proceeded with.*) 2d.
This consists essentially of a novel method of compressing the metal forming the centre of such wheels, and then tempering it in oil and annealing it.

4611. APPARATUS FOR STRETCHING TROUSERS, &c., *R. V. Ash, London.—27th September*, 1883.—(*Not proceeded with.*) 2d.
This relates to a rod fitted with adjustable clamps to grasp the trousers, and are acted upon by springs tending to separate them.

4612. ELECTRIC ACCUMULATORS, *G. F. Redfern, London.—27th September*, 1883.—(*A communication from D. Lontin, Paris.*)—(*Not proceeded with.*) 2d.
The invention is based on the decomposition of alkaline salts by the current. The accumulator is formed of sheets of amalgamated zinc opposed to sheets of lead.

4613. FENCES, *W. G. de F. Garland, East Molesey.—28th September*, 1883.—(*Not proceeded with.*) 2d.
This consists in fitting the end posts with a strut or spur to support them against the strain on them. The rails simply butt against the posts, and are kept in position by wires running along in grooves in the rails, and through holes in the posts, and which are stretched so as to bind the whole firmly together.

4615. FOLDING BASKETS, &c., *F. H. White, Liverpool.—28th September*, 1883. 6d.
The basket or hamper is formed with a metal frame, and the sides, top and bottom, are hinged so as to fold up into a small space when not in use.

4616. PROPELLERS FOR SHIPS, &c., *J. W. Boulton, Ashton-under-Lyne.—28th September*, 1883. —(*Not proceeded with.*) 2d.
One, two, or more thin sheets or blades of elastic, steel, or other suitable material is or are secured to a cross arm or boss on a shaft, which is caused to rotate, the blades bending to a curve and pressing against the water to propel the vessel to which they are applied.

4618. VENTILATING, &c., *H. C. Paterson, Glasgow.—28th September*, 1883.—(*Not proceeded with.*) 2d.
Under a chamber whose sides are made with louvres is arranged a hollow spherical body, with one side of which a steam or air jet is connected. A hollow bell-mouthed piece is connected to the under side of the sphere.

4619. APPARATUS FOR SUPPORTING ELECTRICAL CONDUCTORS, &c., *J. Sitzenstatter, London.—28th September*, 1883.—(*Not proceeded with.*) 2d.
Relates to an apparatus to be fixed to the roofs of houses, and to means for preparing the roof for the reception of the same.

4622. APPARATUS FOR LUBRICATING BEARINGS, *H. Reisert, Germany.—28th September*, 1883.—(*Not proceeded with.*) 2d.
This relates to apparatus for enabling a supply of lubricant to pass to the desired part each time a lid or cover is turned back, which action operates a piston in a cylinder containing the lubricant, in such a manner as to produce the desired effect.

4625. SIGNALLING BETWEEN VESSELS, *H. Gardner, London.—28th September*, 1883.—(*A communication from G. M. Mowbray, North Adams, U.S.*) 6d.
The apparatus consists of three lights of different colours and a vane of three different colours, said vane having a front, rear, and side wings, with the lights arranged respectively, one at the forward end of the front wing, and one on each side of the rear wing upon a platform or base pivotted so as to be turned to present the two desired coloured signals by night or day.

4626. "DRESS" OF MILLSTONES, *A. J. Boult, London.—28th September*, 1883.—(*A communication from G. Bernard, Montport, France.*)—(*Not proceeded with.*) 2d.
Relates to the arrangement of the furrows and lands.

4627. APPARATUS FOR TRANSMITTING MOTIVE POWER, *J. Robertson, Govan.—28th September*, 1883. 1s.
Relates to the transmission of motive power by the agency of wheels, pulleys, discs and cones by frictional contact, and chiefly for high speeds, and it consists mainly in modes and means of placing, shaping, fixing, and tightening on ropes on their peripheries, rims, or acting faces, so as to form an elastic, adhesive, durable, and noiselessly rolling or contiguous driving surfaces to roll or act by contact, and transmit motive force or power to corresponding metallic or hard surface wheels, pulleys, discs, or cones, or similarly covered wheels, pulleys, discs or cones; and in suitable dispositions, bearings, and means of connecting and disconnecting same.

4630. COLOUR PRINTING ON PORCELAIN, &c., *R. Beyermann and A. Kürth, Germany.—28th September*, 1883.—(*Not proceeded with.*) 2d.
Consists essentially in making of the design to be printed as many impressions as there are colours in it, by the lithographic or typographic press, and from each impression printing one colour only. If fresh from the press the impressions are transferred one after the other, in a succession corresponding to the shades of the china, by means of a brush, but in such manner that every colour as put on is burned in separately; but two or more homogeneous colours can be printed one after the other and burned in together, provided they possess equal shrinkage capacity and the harmony of the colours requires it.

4631. SHOW CASES FOR SHOPS, *H. J. Haddan, London.—28th September*, 1883.—(*A communication from J. A. Houston, U.S.*)—(*Provisional protection not allowed.*) 2d.
The show cases or shelves are combined with bridges, or galleries, or overhead passage ways for the assistants to pass to and fro.

4634. APPARATUS FOR ASCERTAINING SHIPS' COURSES, *G. C. Lilley, London.—28th September*, 1883. 6d.
Consists in an apparatus for laying off or ascertaining ships' courses, of the combination with a movable compass card (disc or plate) of a straight edge to be applied to the proposed course, and means (such as lines or pointers) for indicating upon the compass card (disc or plate) the true course for steering.

4636. SPINNING AND DOUBLING FRAMES, *J. Elce, Manchester, and W. Hammond, Todmorden.—28th September*, 1883.—(*Not proceeded with.*) 2d.
Relates to what is known as the "long collar" used in spinning and doubling frames, and the object is to improve the means of holding the shell on to the bolster.

4637. AERIAL TARGETS FOR SHOOTING, &c., *C. J. Barrett, London.—28th September*, 1883.—(*A communication from J. E. Bloom, Cincinnati.*) 10d.
Relates to the general construction of flying targets and to the traps for throwing the same.

4638. ELECTRO-MOTORS, *O. March and F. Cheeswright, London.—25th September*, 1883. 6d.
Two or more sets of multipolar electro-magnets, mutually attracting each other, are coupled up entirely in parallel arc, or partially in series and parallel arc. The armature and field magnets may be annular and arranged radially upon discs. Commutators and brushes are used to effect the alternate diversions of current through alternate sets of electro-magnets.

4640. FASTENING OF FISH-PLATES TO RAILWAY RAILS AND TRAMWAY RAILS, *J. Glover, Birkdale, and C. Walson, London.—29th September*, 1883.—(*Not proceeded with.*) 2d.
Screw bolts are used instead of bolts and nuts.

4642. ECONOMISING FUEL, &c., *T. J. Barnard, London.—29th September*, 1883.—(*Not proceeded with.*) 4d.
Relates to the general construction of the fireplace, furnace, or boiler.

4643. CRANES, *W. L. Williams and H. Adams, London.—29th September*, 1883.—(*Not proceeded with.*) 4d.
Consists in the construction and combination of parts, whereby the radius of the crane can be extended at will, and the cranes can be so constructed as to set down or take up a load at any reasonable distance from the centre, with or without altering the inclination of the jib.

4644. TREATING CARBONACEOUS SUBSTANCES, &c., *H. Aitken, Falkirk.—29th September*, 1883. 8d.
This relates to drying coal, shale, and lignite to be used in retort ovens or furnaces by causing it to drop from shelf to shelf in a tower, through which heated air is caused to ascend. Also in treating coal, &c., in specially constructed ovens so as to produce coke, gas, oil, tar, bitumen, resin, spirit, sulphur, and ammoniacal or cyanogen compounds, the non-condensed gases being utilised to coke the coal and heat the air for burning the gases. Other improvements are also described.

4645. SHIPS, *A. E. Fairman, Glasgow.—29th September*, 1883. 6d.
This relates, First, to carrying out the raised quarter-deck of ships in a continuous line so as to give a greater freeboard on a comparatively small increase of registered tonnage, and obtaining maximum safety at a minimum cost; and, Secondly, to the construction of double bottoms or water ballast tanks, and to the saving of the cutting of the reverse frame in such double bottoms, thereby increasing the strength greatly.

4646. APPARATUS FOR SORTING TEA, *A. Carson and S. R. Baildon, Glasgow.—29th September*, 1883. 6d.
This consists essentially of a vibrating sieve or sieves, formed in sections, and having elongated meshes of graduated size, such sieve being corrugated longitudinally or transversely.

4647. APPARATUS FOR PACKING TEA, &c., INTO BOXES, *A. Carson and S. R. Baildon, Glasgow.—29th September*, 1883. 6d.
The boxes are supported on a table, to which a jigging or vibratory motion is imparted, and over the boxes are arranged stampers, to which a vertical reciprocating movement is imparted.

4648. CRACKING AND GRINDING GRAIN, *J. Y. Johnson, London.—29th September*, 1883.—(*A communication from A. Decamp, France.*)—(*Not proceeded with.*) 2d.
This relates to the combination with grindstones of apparatus operated thereby, and serving to crack the grain before it passes to the stones, such apparatus consisting of a conical case with internal teeth, and within which a cone with teeth on its circumference is caused to revolve.

4649. PRODUCTION OF GAS, &c., *H. C. Bull, Liverpool.—29th September*, 1883. 6d.
The essential features of the invention are an improved furnace for producing gas; improved means for heating air to be applied to such furnace and cooling the gas produced; improved means of generating and superheating steam to be applied to such furnace, and for the production of the gas; and improved means of collecting and separating in a hydraulic main the tar and ammoniacal liquor from the gas produced.

4650. MACHINERY FOR WINDING AND REELING YARN, *B. A. Dobson, J. Hill, and J. A. White, Bolton.—29th September*, 1883. 10d.
The object is to automatically stop machinery for winding and reeling yarn when an end of yarn breaks, and as applied to a winding machine an intermediate roller is provided between the driving drum and the bobbin. The yarn to be wound passes through a needle connected with a stop motion to a traversing rod, on to the bobbin which is carried by the brake lever. The bobbin rests upon the intermediate roller, which lies in contact with the driving drum until the yarn breaks, when the needle it passes through falls, and projections on a revolving shaft below the stop motion, come into contact with the needle and actuate the stop motion which releases the brake lever, bringing the brake against the intermediate roller, and so stopping the roller and bobbin. Modifications are shown, and also the application of suitable stop mechanism to winding frames and reeling machines.

4651. VALVES FOR REGULATING THE FLOW AND PRESSURE OF LIQUIDS AND FLUIDS, *W. H. Bailey and W. Lawson, Salford.—29th September*, 1883. 6d.
Consists of an improved valve having an inlet valve and piston connected by a stem provided with a passage through which water or other fluid flows and closes by its pressure on the piston valve, in combination with a push spindle provided with a valve and plug, which plug is pushed into a recess in the piston to close the passage and remove the pressure of the water or other fluid—which escapes through another passage—from the piston and allows the valve to open

4652. WILLOWS, TEAZERS, AND SHAKERS. *J. Haigh, Huddersfield.—29th September*, 1883.—(*Not proceeded with.*) 2d.
The object is to secure a greatly increased grate surface, thereby to facilitate the removal of dust and dirt from the fibre, to adjust and determine at will the time or period of delivery of fibre from the machine, to secure delivery direct from machine into sheets or other receptacle, and to free the machine absolutely from element of danger to the attendant.

4653. APPARATUS FOR FACILITATING SUBMARINE EXPLORATION, *H. H. Lake, London.—29th September*, 1883.—(*A communication from A. Toselli, Paris.*) 6d.
This relates to a diving bell arrangement, in which the oxygen required for breathing purposes is produced by the electrolytic decomposition of sea water. Mechanism for disconnecting the "explorer" from the boat employed for carrying it is also described and illustrated. The ascent and descent is controlled by the admission of water, which is ejected as required by compressed air.

4656. RAILWAY COUPLINGS, *H. A. Barns, London.—29th September*, 1883. 6d.
Relates to a railway coupling constructed of members jointed together, and to the draw-bar or other point of attachment, so as to be flexible only in the vertical plane, the flexibility of the joint connecting the looped end member to the adjacent member or members being limited to one direction, for use in connection with a suitable means of supporting and raising the coupling in the act of coupling and uncoupling.

4658. CHILDREN'S COTS, &c., *G. W. Moon, London.—1st October*, 1883. 6d.
Relates to the construction of folding up cots.

4659. SLIPPING APPARATUS FOR HARNESS, &c., *C. F. C. Morris, London.—1st October*, 1883.—(*Not proceeded with.*) 2d.
Relates to the construction of a slip hook.

4660. MACHINERY FOR CUTTING FILES, &c., *A. Shardlow, Sheffield.—1st October*, 1883. 6d.
Relates partly to the construction of the tool holder and ram, and also to the arrangement of the brake and feed motion.

4661. FORKS, *H. Vaughan and J. Ball, Sheffield.—1st October*, 1883.—(*Not proceeded with.*) 2d.
The blank of the fork is stamped from a sheet of metal, and then the prongs cut by suitable tools. The curves are given to the fork by top and bottom bossing tools.

4665. REPEATING FIRE-ARMS, *E. G. Brewer, London.—1st October*, 1883.—(*A communication from W. Werner and A. Beer, Paris.*) 6d.
The two essential features of the invention are a magazine tube and a magazine distributing box. The magazine tube is intended to contain the required number of cartridges. The distributing magazine box receives the cartridges from the magazine tube, and conveys them to the arm as required.

4668. VELOCIPEDES, *H. Thresher, London.—2nd October*, 1883.—(*Not proceeded with.*) 2d.
The object is to provide a pawl and ratchet apparatus which shall work without the usual clicking noise; and to operate velocipedes by means of a lever and spring, instead of the usual rotary treadle apparatus.

4670. APPARATUS TO BE EMPLOYED IN THE VAPORISATION OF ANTISEPTIC AND OTHER SUBSTANCES FOR INHALATION, DISINFECTION, AND FOR OTHER MEDICAL PURPOSES, *A. H. Hassall, London.—2nd October*, 1883.—(*Not proceeded with.*) 2d.
Relates to the construction of a chamber inhaler and disinfector.

4672. GOVERNING APPARATUS FOR SCREW-PROPELLER ENGINES, *D. J. Dunlop, Port Glasgow.—2nd October*, 1883. 6d.
Consists in the combination in governing apparatus

for screw-propeller engines of a diaphragm acted on by the varying pressure of air communicating from an air vessel at the stern of a ship through a pipe, with the valve of a relay cylinder, and with parts connecting the piston of such cylinder to the valve.

4673. Frames for Holding Bottles, &c., *J. Mallol, Birmingham.—2nd October*, 1883.—(*Not proceeded with.*) 2d.

Relates to improvements in lock-up liquor frames.

4674. Gas Cooking Ovens, *S. Leoni, London.—2nd October*, 1883. 6d.

Consists in the construction of a gas cooking oven, with a tube or inlet for fresh external air, arranged so that the air admitted therein near the bottom thereof may become heated, and be supplied in a heated state to the interior of the oven near the gas jets.

4675. Latches and Locks, *F. J. Biggs, London.—2nd October*, 1883. 6d.

Relates to constructing latch locks in such manner that when the latch is locked it is thrown out of gear or connection with the handle, which is thus free to be moved or turned without acting upon the latch.

4677. Grinding Caustic Soda, *S. Pitt, Sutton.—2nd October*, 1883.—(*A communication from F. P. Harned, Camden, U.S.*) 4d.

Consists in adding to the broken mass of caustic soda carbonate of soda or soda ash, and grinding and bolting the mixture.

4679. Protecting Submerged Structures of Iron or Steel from Corrosion and Fouling and in Compositions therefor, *F. M. Lyte, Putney.—2nd October*, 1883.—(*Not proceeded with.*) 2d.

Relates to an anti-corrosive paint and to the manner of applying same.

4680. Ring Spinning and Doubling Frames, *J. M. Hetherington, Manchester.—2nd October*, 1883. 6d.

Consists in means for assisting the rotation of the ring travellers and for carrying and adjusting the rings.

4683. Electro-motors, *S. J. Coxeter and H. Nehmer, London.—2nd October*, 1883. 6d.

To obtain better centrifugal force the armatures are made in the shape of a short cylinder of large diameter. The coils are arranged so that the longer direction of the coil is at right angles to the axis of the armature, and the shorter direction parallel to the axis.

4684. Ventilating Apparatus, *A. J. Boult, London.—2nd October*, 1883.—(*A communication from L. J. Wing, New York.*) 6d.

This relates to a novel construction of a fan wheel and its blades and connections so as to enable the adjustment of the various parts to different positions.

4686. Apparatus for Making Wooden Boxes, *W. P. Thompson, Liverpool.—2nd October*, 1883.—(*A communication from the United States Box Machine Company, H. E. Fanshawe, Treasurer, New York.*)—(*Complete.*) 6d.

This relates to a machine for nailing wooden boxes by mitreing the ends of the boards, and cutting simultaneously the mitred ends, to form in and upon the same, in a line across the ends, a corresponding dovetail tongue and groove, by which to secure one to the other.

4687. Packing Cases for Bottles, &c., *M. Stuart, Liverpool.—2nd October*, 1883. 4d.

The cases have slits in the sides, so as to enable the bottles to be inspected to see if they are full, and slits in the top showing a part of the cork, to see that it has not been tampered with.

4688. Boxes for Postal Purposes, &c., *T. P. Bethell, Liverpool.—2nd October*, 1883. 6d.

The box is preferably made of cardboard, and is capable of being folded flat when not in use, but when in use the corners are supported and held together by flaps or tabs, secured by wire rivets.

4690. Ironing Boards, *G. W. von Nawrocki, Germany.—2nd October*, 1883.—(*A communication from J. Hess, Germany.*) 6d.

The ironing board is perforated, so that the steam produced in ironing the garment can readily pass away.

4691. Pianoforte Actions, *C. Collard, London.—2nd October*, 1883. 4d.

The object is to minimise the friction of the parts of the actions of upright pianofortes, and it consists in pivotting the check lever to an adjustable link pendent from the hammer rail. The check lever passes through a slot in the sticker, and is secured therein by a pin. This lever has a hinged extension piece attached by a pin to a fork secured by a clamping screw to a fixed rail in front of the action, so that the lever can be adjusted at its opposite ends to accord with the adjustment of the hammer on its rail. The button which serves to trip the stick lever is mounted upon the hinged extension of the check lever, its wire passing down through a bushed hole in the tail end of the sticker lever.

4692. Appliances for Carrying School Books, &c., *G. W. von Nawrocki, Germany.—2nd October*, 1883.—(*A communication from J. Wolff, Germany.*) 6d.

Two strong covers are connected by straps passing through eyes outside, and each cover has four flaps, so as to entirely enclose the books placed between the covers, the straps securing the whole together.

4693. Breech-loading Fire-arms, *G. H. Needham, London.—2nd October*, 1883. 8d.

This consists, First, in constructing the grip of drop-down fire-arms with teeth in combination with teeth on a slotted bolt; Secondly, in a self-locking action having a safety lever acting on the main spring and operated by the hand or shoulder of the operator; Thirdly, in a special cartridge extractor combined with the grip-locking action; Fourthly, in the employment of a locking bolt operated by a detachable key for locking the grip or tumblers, or both, when the fire-arm is not required for use.

4694. Transmitting and Receiving Audible Messages or Signals by Electricity, *A. F. St. George, London.—2nd October*, 1883.—(*Not proceeded with.*) 2d.

The vibrating plate of wood has arranged near its centre a number of insulated iron wires placed parallel to each other and of different lengths, so as to approximate a circle. The plate is arranged in the usual way opposite the pole of an electro-magnet.

4695. Steam Boilers, &c., *J. Tordoff, Leeds.—2nd October*, 1883. 6d.

This relates to the manholes, unions, or connecting parts of boilers and their separate steam chambers, mountings for the reception of safety, stop, or other valves, covers for openings in boilers, connecting pipes between tanks or cisterns, and it consists in forming such parts by means of a series of dies.

4696. Steam Pumps, *M. W. and A. E. Hall, Plainfield, U.S.—2nd October*, 1883.—(*Not proceeded with.*) 4d.

This relates to a duplex pump with two steam cylinders and two pump cylinders arranged side by side, and the axes of the pump cylinders incline with those of the steam cylinders, and the piston rods each having a piston at one end and a pump plunger at the other. The valve in each steam chest consists of two pistons on one stem, which is connected by an arm to the piston rod beneath, so that each piston moves the valve which controls the opposite cylinder. The steam engines are of special construction.

4700. Sewing Machines, *J. McDevitt, Belfast.—3rd October*, 1883. 4d.

This relates to hem-stitching machines, and it consists in the use of a cam in addition, and fixed to the ordinary stitch cam. The additional cam has a second screw in conjunction with it, and working independently, and by adjusting this screw the machine can be adapted to different classes of work.

4701. Making Bread, *A. McDonald, Glasgow.—3rd October*, 1883. 4d.

This consists in using bi-sulphates of potash and soda as a substitute for cream of tartar or tartaric acid in making bread, cakes, biscuits, puddings, and the like.

4702. Appliances for Raising Trouser-ends to Prevent their Soiling, *H. F. Richardson, Teddington.—3rd October*, 1883.—(*A communication from R. Sieke, Germany.*)—(*Not proceeded with.*) 2d.

This relates to a hook, which can be secured to the hind tag of a boot, so as to support the end of the trousers when the lower edge is inserted therein.

4703. Buttons, *G. W. von Nawrocki, Germany.—3rd October*, 1883.—(*A communication from F. Seidel, Germany.*—*Not proceeded with.*) 2d.

Moist china, ironstone, majolica, or clay is pressed in moulds and turned on both sides. The holes are then drilled or stamped and the buttons finished by painting, varnishing, or glazing.

4704. Washing Machines, *J. Childs, near Leeds.—3rd October*, 1883. 6d.

This relates to improvements on patent No. 4975, A.D. 1880, and it consists in the use of a revolving cylinder, the periphery of which is made up of a number of plates with angular formations, and one plate being hinged to allow the articles to be washed to be inserted. The cylinder rotates in a second cylinder containing the washing liquor and provided with a lid.

4705. Obtaining by Photography Definite Photographs to be used in the Production of Typographic Blocks and in the Art of Photo-lithography and like Arts, *R. Brown, R. W. Barnes, and J. Bell, Liverpool.—3rd October*, 1883. 4d.

The object is to produce photographs broken up into dots, lines, or grains, and one method consists in placing a photographic transparency upon a lined or hatched background, and taking from it a definite photograph on paper or other material, which can then be used for the production of typographic blocks by the art of photo-etching. Another method consists in covering the sensitive plate in the camera with a material, such as network; and by a third method a photograph is obtained in dots or lines by the use of a photographic transparency of the object and also of dots or line, and the two used to produce a photograph on a plate of sensitised zinc.

4706. Chaff-cutters, *S. Edwards, Salford.—3rd October*, 1883. 6d.

A safety roller is attached to the back of the top pressure plate or rising cover, which is also extended back to cover the top feed roll; and an auxiliary lever is employed to operate the clutch motion by which the feed is stopped and reversed.

4707. Inner Bands of Hats, *J. W. Thompson, Prestwich.—3rd October*, 1883. 2d.

A spring top cord made of wire covered with silk thread is secured to the inner band.

4708. Cuffs, *M. Wilson, London.—3rd October*, 1883. 4d.

The cuff is made with an inner smaller cuff, so as to conceal and shield the wristband of the shirt between it and the outer cuff.

4709. Railway Switch, *E. Bivort, Belgium.—3rd October*, 1883. 8d.

This relates principally to a system of shunting, crossing, or change of line without the use of tapered switches, by a combination of an adjustable part of the line with bed-plates, together with a mechanical arrangement for the switching or change of line, operated by an arrangement of levers, and a pedal mechanism for the automatic closing up or connection of the line.

4710. Telephonic and Telegraphic Apparatus, *A. R. Shaw, London.—3rd October*, 1883. 8d.

The usual diaphragm is replaced by a pivotted magnet provided with contact pieces and capable of mass movements under magnetic action. One or more adjustable magnets regulate the motion of the vibrating magnet, and the vibrations are transmitted in the usual manner. The circuit is made through earth as a return, the earth contacts being made through mercury. An "inductorium" is arranged in such a manner that the primary and secondary are included in one circuit.

4711. Sewing Machines, *H. Gamwell, Liverpool.—3rd October*, 1883. 8d.

The object is to enable the machine to be run in either direction, and it consists in taking the motion for the several parts direct from the main shaft, and adjusting the stitch cam, needle-bar cam, cotton control cam, and other parts, so that each will follow the other in the same order, and at equal increments of time, whether the machine be turned in one direction or the other.

4712. Sewing Machines with Rotary Hook, *C. Pieper, Germany.—4th October*, 1883.—(*A communication from R. Gritzner, Germany.*) 6d.

This consists in the employment, in sewing machines with rotary hook, of a spool case, maintained stationary in a holder, and having a dish-like shape, to adapt it to contain a large underthread spool, and which is supported at one point only, in combination with means for lifting and depressing the case to facilitate the passage of the loop of the upper thread round it. The case has a projection serving as thread guide, and lying in a recess of the case holder, to prevent the case turning. The projection and bearing point are arranged in a vertical line passing through the centre of gravity of the case and spool, and a portion of one side of the case is removed to facilitate the drawing up of the loop of the upper thread. The spool case and spool are provided with means for regulating the tension of the under thread, that when drawn up the tension will be in excess of the weight of the case and spool. A cone is made adjustable on a shaft, so as to regulate the stitch. A special arrangement of take-up lever is described.

4714. Joints of Water Pipes, *J. Robbins, London.—4th October*, 1883. 6d.

Consists, First, in a socket near one end of the pipe, beyond which end such socket projects, and a collar is arranged inside such socket so as to overlap the ends of two pipes when connected together; Secondly, in casting the parts to form the joints either upon the ends of plain pipes or separate therefrom, and then applying them thereto, or partly on the plain pipes and partly off the same, either in one piece or in two or more sections or parts; Thirdly, the method of rendering pipes made of porous material impervious by forcing any suitable impervious material into the pores of the pipes, or by coating the pipes with such material while casting on the parts to form the joints of such pipes.

4716. Air Compressors, *F. W. Scott, London.—4th October*, 1883. 6d.

The inventor claims an apparatus for the compression of air in stages, and consisting of a plunger having a small air chamber surrounded by water and working on a fixed tube or guide, through which the air is forced into the reservoir or chamber (or other suitable reservoir), such tube being cooled by its exposure on the down stroke of the plunger, and the stuffing-boxes and glands being arranged so as to be readily accessible.

4719. Branding Machines, *F. W. Blood, Liverpool.—4th October*, 1883.—(*Not proceeded with.*) 2d.

Relates to the construction of a machine to brand by motive power.

4721. Appliances for Holding or Containing Toilet and Wrapping Paper, *S. Wheeler, London.—4th October*, 1883. 6d.

Relates to the arrangement for holding and containing webs or rolls of paper.

4725. Apparatus for Aerial Transit by Wire Rope, &c., *F. Byrnes, Liverpool.—4th October*, 1883. 6d.

Consists in arranging the cable so as to span from the place of departure to the place of arrival at an incline, the cable being so arranged that the departure end can be lifted with the body to be forwarded, and also can be lifted at the arrival end for the return of the body, or empty conveyance.

4726. Cables for Transmitting Electric Currents, &c., *F. C. Guilleaume, Cologne.—4th October*, 1883. 6d.

This cable is designed for telephonic purposes, and consists of five insulated copper wires twisted round a non-insulated steel wire, which serves for earth connection and straining wire. The insulated wires are taped with tinfoil before stranding. Five of these strands are then twisted round a core of seven steel wires taped with tinfoil, and likewise serving both for earth connection and straining wires.

4730. Wheels for Bicycles, &c., *E. Hutchinson, London.—4th October*, 1883.—(*Not proceeded with.*) 2d.

Relates to means for attaching the rubber tire.

4742. Steam Generator, *J. Imray, London.—5th October*, 1883.—(*A communication from Albert Comte de Dion, G. B. Bouton, and C. Trépardoux, Paris.*) 6d.

Relates to the construction of a steam generator having in the lower part of its cylindrical body a fire-box in which inclined tubes radiate from a central tube, and from which vertical smoke tubes communicate with a space surrounding a steam dome or receptacle above the body.

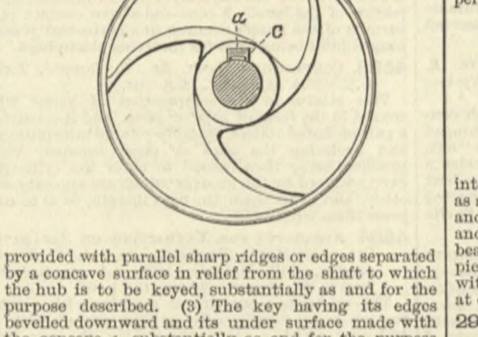
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

296,317. Means of Keying Wheels, Pulleys, &c., to Shafting, *Godfrey Dawe, Eau Claire, Wis.—Filed February 28th*, 1884.

Claim.—(1) A key for fastening a pulley, wheel, cam, eccentric, or other analogous part of machinery to shafting, consisting of a tapered bar having parallel sharp ridges or edges separated by a concave surface in relief from the shaft, substantially as and for the purpose described. (2) The combination, with a hub provided with a tapered key-seat *a*, of a tapered key

296 317



provided with parallel sharp ridges or edges separated by a concave surface in relief from the shaft to which the hub is to be keyed, substantially as and for the purpose described. (3) The key having its edges bevelled downward and its under surface made with the concave *c*, substantially as and for the purpose described.

296,335. Colter, *Robert Kloss, Shabonier, Ill.—Filed May 8th*, 1883.

Claim.—In a plough colter, the combination of the blade B, provided with flanges *a a*, the plate E, provided with peripheral flange *e* and central opening *e'*,

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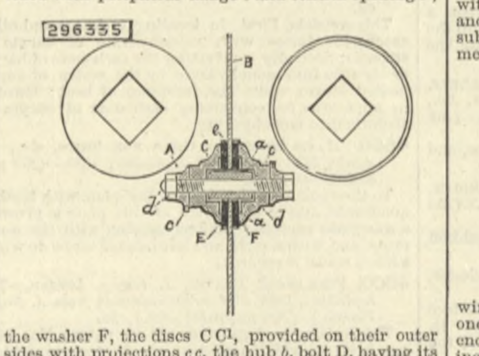
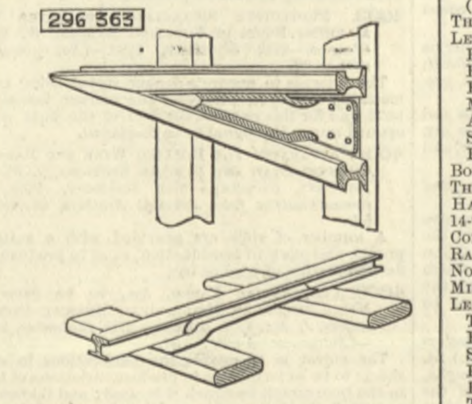


the washer F, the discs C C', provided on their outer sides with projections *c c*, the hub *b*, bolt D, having its centre plate and ends screw-threaded, the lock nut *d*, and yoke A, substantially as described and shown.

296,363. Foot-guard for Railways, *Hervey Sullings, Kalamazoo, Mich.—Filed August 23rd*, 1883.

Brief.—A foot-guard consisting of a rigid level plate secured at one end to the tie, and having upward and outward extending flanges to fit against the rail. *Claim.*—(1) In a foot-guard for railroad tracks, a rigid level plate having upward and outward extending flanges fitting up against the under edge of the upper part of the rail, substantially as set forth and described. (2) In a foot-guard for railway tracks, a rigid plate with the point turned to fit into the groove and resting on the base of the rail, with opposite end depressed

296 363



suitable for resting on and spiking to the tie, substantially as specified and described. (3) In a foot-guard for railroad track, a rigid plate provided with upward and outward extending flanges to fit against the under edge of the upper part of the rail, with the point turned downward and outward, fitting into the groove, and resting on the base of the rail, with opposite end depressed for resting on and spiking to the tie, holding it firmly in position, substantially as set forth and described.

296,364. Chain Hoist, *Chas. A. Teal, Philadelphia, Pa.—Filed February 15th*, 1884.

Claim.—(1) The combination, substantially as herein described, with a framework, of a shaft carrying a hand chain wheel and a pinion, and two gear wheels engaging with said pinion and operating the chain pulleys. (2) The combination, substantially as herein described, with the frame, of a pinion shaft carrying the hand chain wheel, a shaft on each side thereof having gears meshing with said pinion, and chain pulleys upon said shafts, the arrangement being such that one chain pulley will move faster than the other. (3) A chain hoist consisting of a frame A, shaft B, carrying a pinion and hand chain wheel, shafts F G, carrying gears F^1 G^1 and chain pulleys F^2 G^2, chain H, passing over said pulleys, and a pulley block, the

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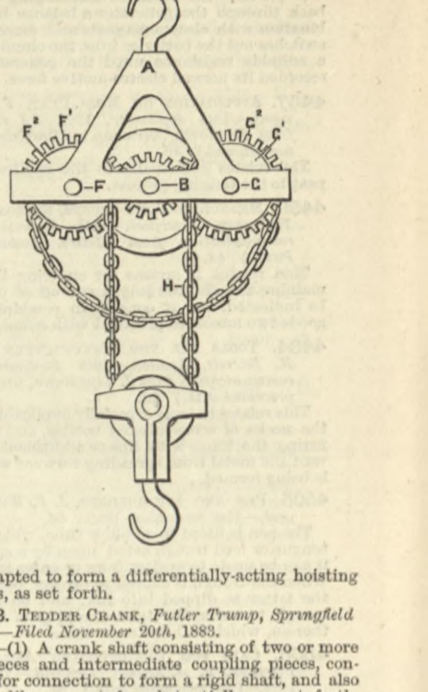
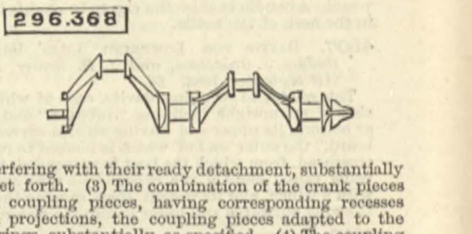


whole adapted to form a differentially-acting hoisting apparatus, as set forth.

296,368. Tedder Crank, *Fuller Trump, Springfield Ohio.—Filed November 20th*, 1883.

Claim.—(1) A crank shaft consisting of two or more crank pieces and intermediate coupling pieces, constructed for connection to form a rigid shaft, and also to be readily separated, substantially as set forth. (2) The combination, in a crank shaft, of crank pieces and coupling pieces, with corresponding recesses and projections upon the crank arm or coupling pieces, to permit the continuous connection of the parts without

296.368

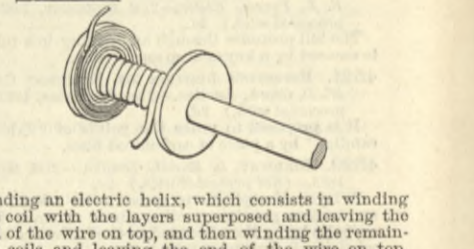


interfering with their ready detachment, substantially as set forth. (3) The combination of the crank pieces and coupling pieces, having corresponding recesses and projections, the coupling pieces adapted to the bearings, substantially as specified. (4) The coupling pieces adapted to unite adjacent crank pieces, and with projections or recesses at opposite ends arranged at different angles, for the purpose set forth.

296,380. Electric Helix and Method of Winding the Same, *Force Bain, Minneapolis, Minn.—Filed December 30th*, 1882.

Claim.—(1) The method herein described of winding an electric helix, consisting in winding a small portion of the helix from the core outward until said portion is completed and the end of the wire lies at the top, and then winding the remaining portion of the helix with the other end of the wire from the core outward, and leaving said final or second end also on top, substantially as and for the purpose set forth. (2) The method, substantially as hereinbefore described, of

296 380



winding an electric helix, which consists in winding one coil with the layers superposed and leaving the end of the wire on top, and then winding the remaining coils and leaving the end of the wire on top. (3) An electric helix composed of a continuous wire one coil of which has the consecutive layers of wire superposed and the end left on top, and the remainder of the wire wound in the usual way with the end left outside the coils, substantially as described.

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