OUR COMPETITORS IN IRON SHIPBUILDING.

By CAPTAIN GAMBIER, R.N.

No. I.

THE serious depression which has now extended for several years over the iron shipbuilding industries of England and Scotland demands anxious thought by the nation at large; and though the effect of this diminution has only as yet been practically felt by the classes immediately concerned, still the day is rapidly drawing near when our inability, not only to beat the foreign shipbuilder, but even to keep pace with him, may assume the proportions of a national disaster. It is useless to cry "Peace, peace!" when there is no peace, and nothing can be more fatal than to continue to bolster ourselves up with the idea that good times will return—by which expression we intend to convey the impression that, in the whirligig of time, and through causes which no one can explain, England is once more to be in that position in which her vast means and resources, and all her superiority of mechanism and appliances, placed her some twelve or fifteen years ago, not alone in iron shipbuilding, but in many other industries which are now feeling the pinch of foreign competition. The most casual observer must be struck by such simple facts as the falling off in the tonnage built from one decade to another in any of our great shipbuilding centres. If a retail grocer finds his business diminish to less than one-third of what he was wont to do, he and his friends predict bankruptcy for him. If all the other grocers in the same town are in the same plight, it means that the grocery business, as conducted by these particular individuals, is a losing concern, and that there is something morally and radically wrong, which is driving their customers away to buy their stores elsewhere. But to our large industries we shrink from applying this obvious reasoning. We endeavour to satisfy ourselves with fine phrases, and talk of over-production and similar expressions. We dare not face our own dishonesty and recklessness of living, but prefer to patch up our wounds with any *doctrinaire* plaister we find to hand. The shipbuilding trade is in no way different to the case of the grocers, and it is nothing but blindness and infatuation that fails to grasp this self-evident proposition. However, it is not within the scope or the intention of this article to discuss the folly of strikes, the prime, but by no means only cause of our failure. The intelligent working man can look back over a painful retrospect of ten years, and can gauge for himself how much he has benefitted by endeavouring to force the natural laws of supply and demand. As he stands shivering and half-starved in the windy streets, "looking for a job," he has ample time to reflect on the blessings that have been showered on him by agitators and *soi-disant* benefactors sprung from his own class; and so bitter must be the reflection that one would shrink from rendering it any harder by that bitterest of all remarks—"I told you so." Nor could one presume to give advice, but, as probably the best and surest remedy, to set forth the tale in simple and unvarnished language, as to how one great industry, that of shipbuilding, has been taken from him, and how it is that he has fallen from a position of comfort to one of positive want. It is clearly not from over-production that England finds her shipbuilding yards now practically idle. The wants of the world continue, and if it had not been so, this industry could not have risen in foreign lands and have become a competitor. Unless we were building badly or too dear—that is, dearer than we had a right to demand—it is incontrovertible that those requiring vessels would have continued to deal with us. But a time arrived when the buying public saw no object in contributing any longer to the inflated prosperity of a few; or in other words, those who required an iron vessel, or the Government that required an ironclad, did not consider it one of the immutable laws of nature that the owners of British shipbuilding yards should every one of them build himself a palace, and that every boiler maker and rivetter should habitually live in a style exceeding in luxury, say, a doctor, a lawyer, or a responsible clerk in a bank, through whose hands thousands of pounds pass daily. So these purchasers, both home and foreign, began to look about them, and it is the object of this article to show what the result of this looking about was, and how it transplanted an enormous amount of work direct from our yards to the shores of a foreign sea, and also to demonstrate how irretrievably lost is, at all events, that portion of this industry to England, through economic and far reaching laws which will work their ends to the end of the world, in spite of all strikes, in spite of all Socialistic legislation; laws which have, within the memory of man, shifted centres of trade and commerce from one end of the earth to another, leaving populations who disregard them to starve and sink into insignificance, but showering blessings on those who still obey them.

The example which it is desired to take in this article as illustrative of the above remarks is the iron shipbuilding trade of Italy. Ten years ago it would have seemed ludicrous to the builders on the Clyde had they been told that a country which had no coal worth speaking of, and where iron, though abundant, was difficult to get at, and where, moreover, not half a dozen men knew how to do the simplest iron shipbuilding job, would, in the course of those years, not only beat them in quality, but in price, and would be turning out the largest, the most powerful, and the best built vessels in the world. Such, however, is the case. The rise of iron shipbuilding in Italy is almost a romance. It owes its origin to the far-seeing efforts of Italy's greatest statesman, Cavour, and it is remarkable that this wonderful man based his reasons for wishing to develope shipbuilding in Italy on two facts which have since been amply borne out, and demonstrate how extraordinary was his insight into matters that one would imagine to have lain beyond the scope of a man occupied as he was in the vast scheme of creating a kingdom. These facts were, first, that Italy must imperatively become a maritime Power, and secondly, that wages and the cost of living in England were so high and extravagant that the actual price of ships built could bear no just proportion to their value, and that consequently other nations should look about for themselves and begin to build on their own account. He further held the view that the drunkenness of England and Scotland, and their tendency to repair the evils of these bad habits by sophistical legislation, brought about through trade combinations, would result in the loss of some, if not of all, of England's chief industries, especially as he foresaw the time when growing Radicalism would bring still more political pressure on these great economic questions from a socialistic point of view. These opinions Cavour expressed not long before his death. It was in the year 1860, one of the most stirring in Italy's history, that Cavour, the only man whose hand was powerful enough to guide the destinies of his country, formed the resolve that she should become a naval Power. Irritated by the meddlesome interference of France, whose fleet, by its presence, prevented his attacking Gaeta by sea, he is said to have resolved that such an intolerable state of affairs should not remain for ever possible. But it was uphill work—for his country was too poor to buy, and not in a position to build ships. However, he knew there must be a beginning in all things, and not daunted by the difficulties before him, he thought him of two Italians, by name Orlando, who at that time had put up a small workshop at Pila, near Genoa, and were endeavouring to persuade their countrymen that they were as well able as the English to make locomotive engines, and at a better price, and had already succeeded in carrying out one or two contracts with satisfaction to all parties. Cavour sent for these men, and with that promptitude which marked everything he did, instructed them to build an iron vessel. "Italy now only builds wooden ships," said Cavour to the brothers Orlando, "is there any reason why she should not build iron ones?" "None, your Excellency," replied the Orlandi. "Then will you undertake to build a vessel, say, of 1000 tons, suitable for Italian trade, and with the least possible consumption of coal, as we have no coal in Italy." "But as to price?" asked the brothers, "for we cannot compete with England at present; we have neither the necessary plant nor the raw material." "Send in your estimates and your plans," replied Cavour, "this is a national matter, and I shall take care that my colleagues of the Ministry accept your tender. But be honest—remember you are working for your country—be honest above all, and more work will come to you than you dream of." So the plans were drawn, and were accepted, and one of the brothers repaired to the Clyde to study the most economical kind of marine engine and boiler, whilst the other remained in Italy and got the material together. But unfortunately for Italy and the Orlandi, the great statesman died before these arrangements were finally completed, and was followed by Ricasoli and Ratazzi, under whom a period of acute political and ministerial jobbery set in, which ended in the cancelling of Cavour's order to the Orlandi, and the attempt to build the iron ship by the Government itself. The vessel was finally built, but cost so preposterous a sum that even these patriots did not venture to begin another, and iron shipbuilding in Italy was proclaimed a failure. But the Orlandi were not to be disheartened, and having collected much material, and not knowing what to do with it, set to work and built an iron dredger, and then tendered to dredge the harbour of Genoa for the sum of 1·25f. per cubic metre, the rate at that time being paid by the harbour authorities—probably to some of their friends—being actually 18f. per cubic metre. It is instructive that at even this surprisingly reduced rate the Orlandi had great difficulty in securing the dredging contract. This dredger was the first iron vessel of any kind built in Italy. The last is the Lepanto, one of the largest and most heavily armed vessels in the world—larger than anything in England's Navy, and actually built and completed by these same brothers. By indefatigable energy and perseverance, the brothers Orlando went on from smaller to greater things. At first they undertook trifling repairs to iron vessels, which was a great advantage to vessels trading in those parts, as before that time the only available places in the Mediterranean for work of that kind were Malta or Marseilles, the latter never popular through the bad quality of the work. By the year 1866 the firm of Orlando had made good progress, with the general improvement of affairs in Italy. The French had finally withdrawn from Italy, and the Italians began to breathe more freely. The Bank of Italy had been established, and credit became available for large commercial enterprises. But in the midst of this the Austrian war broke out, and with the defeat of the Italian Navy at Lissa, Ricasoli, who was again Prime Minister, bethought him of Cavour's idea of creating an Italian built navy. The Government, therefore, under certain stipulations, ceded a part of the port of Leghorn, called San Rocco, to the firm of Orlando Brothers. The site when taken over by the Orlandi was 53,000 square yards, and had not a single covered workshop or storehouse. It now measures 87,000 square yards, with an enclosed basin of deep draft of over 50,000 square yards. The covered buildings and workshops cover 25,000 square yards, and in the place of the small slip originally there, and only capable of carrying a vessel of 250ft. long, there are now seven—five for building and two for repairing. On one of these five slips was built the Lepanto, above named, measuring over 500ft. long. But in addition to these slips there is at San Rocco ample space to construct seven or eight first-class slips, and all within easy reach of the workshops, so that without the least strain on the resources of the yard, or cramping for want of space, no fewer than thirteen or fourteen of the largest vessels might be built at the same time. Nor is this expansion confined to mere space alone. In every detail, in the erecting of furnaces, in the machinery for plate rolling or planing, in the space for berths in the basin and the storage of material, in the mast-house and timber-yards, down to the joiners' and plumbers' shops, provision has been made for taking in hand this vast amount of work at one and the same time, whilst the aptitude and intelligence of the local workmen would render it easy to quadruple the number of hands employed in a very short time. The workmen are exclusively Italians, and for the most part natives of Leghorn. The population of Leghorn is quite unique—unlike their brethren of any other part of Italy—and are more intelligent and of finer *physique*. Taken man for man they would compare favourably with any race of men in Europe, and are capable of doing a hard day's work as well as the best British navvy. They are a mixed race, largely crossed with Northern and Austrian blood, and, above all, they have the immeasurable advantage of being sober and industrious. When later on their rates of pay are discussed, it will be seen that our shipbuilders are thus heavily handicapped; whilst at the same time it is unhesitatingly asserted that the Leghorn workman is himself better off in every respect than his British mate, and that his home is in every way happier. The result is that they turn out better and cheaper work than we do in England. It is no use mincing matters, and it is no use trying to smooth things over, and make it pleasant for the British working man. Facts are stubborn things, and statements are either capable of proof or disproof. Take, for example, the building of the Birmania, a vessel of 5000 tons, built by the Orlandi for the Rubattino Company, for which public tenders were invited. The rates of wages for the hands employed were as follows—reduced into English money—and show so far lower a proportionate scale to rates obtaining in England that the cost of construction must be obviously greatly diminished:—

For working day of ten hours.

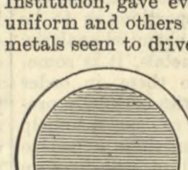
Nature of work.	1st Class.	2nd Class.	3rd Class.
	s. d.	s. d.	s. d.
Modellers	4 2	3 5	1 10
Fitters	3 2	2 5	1 10
Puddlers	3 6	3 2	1 6
Turners	3 2	2 4	1 6
Boiler-makers	6 0	3 5	2 6
Moulders	3 10	2 0	1 3
Carpenters...	4 2	2 6	—
Tinsmiths	3 0	2 0	—
Engineers and firemen ...	3 10	2 0	—
Labourers	2 10	—	—
Apprentices and boys ...	1 6	—	—

In addition probably one-half or two-thirds of the work was piece-work. These men earned considerably higher wages. The same scale of payment was also calculated upon in the Government contracts for building several torpedo boats after the models of White of Cowes, which were also publicly tendered for. But the instructive part of this matter is yet to come. Whereas our shipbuilders would have had the raw material, as it were, lying at their doors, every particle of metal employed in the construction of these vessels in Italy had to be imported from England, Germany, or Spain, and had to pay an *ad valorem* duty of 13 per cent., and yet we are beaten in Italy. Whence comes the difference? Is it in better workmanship or better machinery? And here, *par parenthèse*, it may be remarked that the Italian firm were unable to place the contract for a considerable portion of the manufactured iron and steel required for this work in England, though most anxious to do so by reason of the cheaper sea freight than to bring it by rail from Germany over the St. Gothard. Not only was the German iron and steel cheaper than the English in spite of the extra cost of transit, but was of better quality. A further fact bearing on this subject is also not one for pleasant reflection. The Orlandi have been recently building a torpedo ram for the Italian Government, and the strictest surveillance is exercised by Government officials as to the material employed. A very large quantity of a certain standard of bar steel was required for making rivets, &c., and again the contract has been carried off by the Germans, and the bars of the necessary tensile standard may be seen lying at San Rocco. The quality at the price was too high for any English firm. It did not pay them to make it so good.

THE ROYAL INSTITUTION.

IMPURITIES IN METALS.

On Thursday, February 11th, Professor W. C. Roberts-Austen, F.R.S., delivered his third lecture upon "Impurities in Metals." He said that he would first consider how molten masses of metals deal with the impurities they may contain. Lead in gold seems to be uniformly distributed, and the same is the case with alloys of lead and arsenic; but such is not the case with all alloys; some metals tend to throw out impurities, just as the ice in freezing water tends to do the same with certain aqueous impurities. Matthieson years ago, in the theatre of the Royal Institution, gave evidence in relation to some alloys which are uniform and others which are not so. In the latter case the metals seem to drive the impurities towards the centre of the mass. In this way what the alchemists called "the regulus of Venus," which is an alloy of copper and antimony, tends to reject lead by driving it to the centre. Professor Roberts-Austen illustrated this by placing a disc composed of the said three metals in the focus of the objective of the electric lamp; and when he pushed the centre of the disc, as represented in the accompanying cut, it fell out, leaving the representation upon the screen of the exterior ring of alloy, which had thus rejected the lead. Iron in the Bessemer ingot, he said, behaves somewhat in the same way—the sulphur and phosphorus are driven to the centre of the mass, and for good iron the exterior portion only should be utilised. Iron containing carbon in solution allows it to separate in graphitic form, unless the cooling be rapid; in the latter case white iron is the result. Cast iron and steel have mechanical and physical differences. He illustrated this by calling attention to a section of a hollow propeller shaft, made of compressed steel, and said that if a shaft of the same strength were to be made of wrought iron it would have to be 28 per cent. heavier, and solid. He said that there is no very hard-and-fast line between the different kinds of iron and steel—wrought iron contains $\frac{2}{10}$ per cent. or



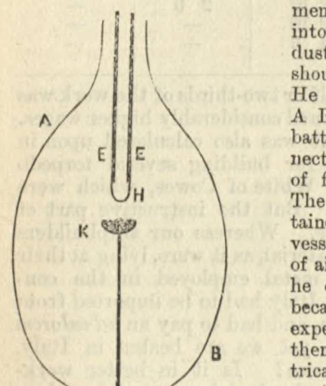
a little over, of carbon; watch-springs contains about $\frac{5}{10}$ per cent., and the dies used at the Mint $\frac{8}{10}$. The accompanying table, he said, gives some idea of the relative proportions:—

	Iron.	Steel.	Cast iron.
	Per cent.	Per cent.	Per cent.
Bergmann, 1781..	0 12	0·5	2 2
Modern view	0 to 0·15	0·15 to 1·5	1·5 to 3·8

Cast Iron.

	Grey.	Mottled.	White.
	Per cent.	Per cent.	Per cent.
Combined	0·08	1·43	3·17
Carbon, graphitic or free..	3·40	2·02	0·12
Total	3·48	3·45	3·29
Combined	0·18	1·14	1·93
Carbon, graphitic or free..	2·45	1·50	0·55
Total	2·63	2·64	2·48

The speaker next stated that Reaumur, in 1722, first noticed the black spot produced upon iron by nitric acid, and Bergmann, in 1781, made known that carbonic acid would give up carbon to iron. Clouet, in 1796, made steel by heating a diamond in an iron crucible. But the results of such experiments varied greatly in different hands, and left the question open whether furnace gases might not have had a share in the results. In 1815 Mr. W. H. Pepys, a working cutler and a member of the Cutlers' Society of London, was the first to exclude furnace gases from the experimental solution of the problem. He heated an iron wire with an electrical battery, keeping the wire from contact with air, and by bringing the hot wire in contact with a diamond, made steel, thus setting the problem to rest for ever. Margueritte showed, in 1865, that contact with carbon is sufficient to produce the carbonisation of iron. He placed three diamonds on a thin film of iron, displaced by hydrogen the air in the containing-tube, and when the arrangement was heated the diamonds fused their way through the iron. He (Professor Roberts-Austen) had repeated Margueritte's experiment at the Mint, the furnaces at the Royal Institution not being suitable for the work, and he would show them the result in the piece of iron through which the diamonds had passed, turning some of it into steel. He added that he would, however, perform the experiment of turning malleable iron into steel by means of diamond dust, in such a way that it should be visible to all present. He then took the glass vessel A B, in which descended the battery terminal wires E E, connected at the ends by the loop of fine malleable iron wire H. The little vessel K below contained diamond dust. The glass vessel could have been exhausted of air if desired, but he said that he did not exhaust it simply because it would complicate the experiment. The loop H was then made white hot by an electrical current, and brought into contact with the diamond dust K, when it at once fused into globules, where the contact was established. The speaker said that he could heat the globules, cool them under mercury, and then show that they would scratch glass, consequently that they consisted of true steel; but he thought that the time allotted for the lecture could be better utilised. He then said that he would exhibit a method of separating carbon in the sooty form from iron in a way not perhaps generally known. He took a little square plate of compressed fused chloride of silver, as transparent as glass, and on it placed a fragment of steel; then upon both he dropped a little hydrochloric acid; the piece of iron was then slowly dissolved into chloride of iron, and the carbon, he said, was left in the sooty deposit remaining. As to the probable relations between carbon and iron, conflicting evidence was given by chemists, but Sir Frederick Abel had satisfied himself that under certain conditions a carbide was formed. In hard steel, however, appearances seemed to indicate that the carbon was in actual solution.



The lecturer added that a few years ago the Institute of Mechanical Engineers appointed a committee to investigate the properties of steel, and that some of the experiments of the committee had been anticipated by Reaumur in 1722. Reaumur proved that steel gave out no gases when heated in a Torricellian vacuum. At present, he said, it is not absolutely necessary to resort to chemical analysis to determine the constituents of different varieties of steel, for Professor Hughes has devised a plan of classifying steel by measuring its magnetic capacity, a quality which depends mainly upon the amount of carbon it contains.

On Thursday, February 18th, Professor Roberts-Austen, F.R.S., delivered his fourth and last lecture on the above subject at the Royal Institution. He said that the subjecting of metal wires to incessant vibratory strains until breakage is effected, and registering the number of vibrations given until that point is reached, will sometimes indicate the presence of impurities in such minute proportions as to be altogether beyond the range of discovery by chemical analysis. In order to remove certain impurities from metals, it is sometimes necessary to add other impurities to them, in order to give an inducement to quit to the impurities originally present; thus arsenic has sometimes to be added to copper, to help to get rid of nickel or cobalt. Zinc is sometimes added to molten lead, and the zinc, rising through the lead, will carry up with it any silver present in the latter metal, leaving the "mother lead," if so it may be called, sensibly purer; the silver is afterwards separated from the zinc.

The ancients believed that nature is the great purifier of metals, and that by the long agency of time and heat, she gradually transforms the baser metals into gold; they also believed that man arrests this beneficent process by digging the latter metals prematurely out of the ground. Chlorination, or "trial by cement," was known to the alchemists. If gold contains just enough silver to destroy its colour, they found that the colour is restored by heating it for seven or eight days in contact with clay, earth, salt, and vinegar. The chlorine formed attacks the silver and carries it off as chloride, leaving the gold unacted upon, because chloride of gold cannot exist at a red heat. When an alloy of silver and gold is heated in a current of dry chlorine, chloride of silver is separated, and the gold remains. He then took some gold made brittle by an admixture of lead, melted the alloy, and sent a current of chlorine through it under pressure. The volatile chloride of lead separated, and the remaining gold was rendered malleable. In the year 1869, he said, he purified £40,000 worth of gold at the Mint by this process. He next took a solution of chloride of gold in water, containing also salts of other metals; he added a little oxalic acid to the liquid, it separated the gold and threw it down in a very pure state. He closed his lecture by describing the Bessemer process of making steel, and illustrating various points by experiment.

PHOTOGRAHY AS AN AID TO ASTRONOMY.

On Friday evening, February 26th, Mr. A. A. Common, F.R.S., Treasurer to the Royal Astronomical Society, lectured on the above subject, under the presidency of Dr. William Huggins, F.R.S. The lecturer said that the first record of the application of photography to astronomy was published in New York, in March, 1840, describing how Dr. J. W. Draper photographed the moon upon a Daguerreotype plate, with an exposure of twenty minutes. The record may be read to possibly imply that other and more imperfect photographs of the moon were then in existence. Mr. Common then reviewed the work, in the same field of research, by De la Rue, Crookes, Rutherford, Janssen, Huggins, and others, concluding with the recent remarkable results obtained by himself and by the Brothers Paul and Prosper Henry, of Paris. These included some recent star maps, and a wonderfully perfect photograph of Saturn, and of the great nebula in Orion. The Brothers Henry had found the following to be the necessary times of exposure for photographing stars upon gelatino-bromide plates, under conditions requiring 0·01 second exposure for stars of the first magnitude:—

Star Exposures.

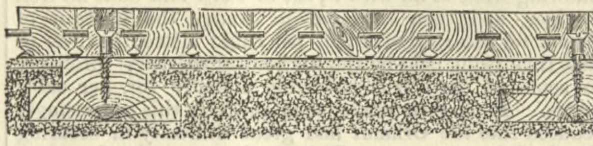
1 Mag.	0·01 seconds.	
4 „	0·08	
6 „	0·5	
8 „	3·0	
10 „	20·0	
12 „	120·0 =	2 minutes.
14 „	600·0 =	10 „
15 „	1800·0 =	30 „
16 „	5400·0 =	90 „

THE ANCIENT GEOGRAPHY OF BRITAIN.

Professor W. Boyd Dawkins, M.A., has delivered a course of four Thursday afternoon lectures on the above subject. He began with the time when the area of the British Islands formed part of the bed of a shallow sea, with the Archaian land to the north stretching away to what is now the interior of North America. He described how at different geological periods some portions of these islands were sometimes above and sometimes below water, illustrating his remarks by maps giving approximate ideas of the geography of each era. The mountains of Wales and Scotland were frequently above water, when much of the remainder of the British Isles was below. He described the islands and swamps of the carboniferous period, stretching away from the present area of Ireland to the banks of the Rhine, and he told how palms, opossums, and eucalyptus gum trees once flourished in these islands; also how turtles paddled about the present area of London, when there were no aldermen to eat them.

WOOD-BLOCK FLOORING.

A NEW system of wood-block flooring for stations, halls, and other buildings is being introduced by Messrs Duffy and Sons, of Storks-road, S.E. The blocks, which may be laid in any variety of herring-bone or interlacing pattern, are laid on a cement-covered base, into which is laid or built dovetailed or



rebated timbers or blocks, to which the floor blocks are here and there fixed. The floor blocks are dowelled together as laid, and are dipped into a preservative compound, which cements them to the base and to each other, and also acts as a key by filling grooves formed in every block. The floor of the new station at Stratford has been laid on this system. The above illustration shows a section of a floor so laid, the section being through the block built into the concrete, as well as through the floor blocks.

SUMMERS' SELF-ADJUSTING PUMP-PLUNGER JOINT.

THIS is a recent invention of Mr. T. Summers, of Gloucester, and it will be observed from the engraving that it refers to an improved mode of attachment between the trunk or plunger of a pump and its rod, and that the attachment forms a self-adjusting joint, so that as the joint wears it cannot become slack, by reason of the spiral spring C constantly pressing upon the gun-metal cap B, and so taking up all the wear of the joint. The hollow gun-metal nut D is screwed into the plunger, and by this means the necessary pressure is put upon the spring. The nut being continued beyond the plunger enables the joint to be adjusted with facility. The flange of the nut at E is made of the same diameter as the outside of the plunger, so that it may pass within the gland of the pump if desired, and has "tommy" holes drilled in it for convenience of screwing. A ball-and-socket joint introduced with this arrangement has the advantage over the ordinary arrangement of a jaw and pin that, within the confined interior space of a given plunger, a ball-and-socket joint can be placed of four times the wearing surface of a jaw and pin. The ball-and-socket joint will also adjust itself to any slight irregularity that might occur through a careless workman not fitting the pump exactly in a line with its rod. The centre hole in the cap B need only be sufficiently large to admit the screwed end of the rod passing through it. There is, then, a wearing surface left on the cap at least 50 per cent. greater than can be obtained with the jaw and pin; and since the pull upon this cap and spring is only against the atmospheric pressure plus the friction of the pump-gland packing, both the cap and the spring may be made comparatively very light. For instance, it is found in practice that a feed-pump plunger 3in. diameter and 4in. stroke, working at 100 strokes per minute, works well with a spiral spring made of ⅜in. steel, with, say, six coils. A very small compression of the spring is sufficient for adjustment; and when once the nut D is screwed up to its proper position the plunger and its rod may be left for many months without further attention, except, of course, for the ordinary lubrication. The spring by its pressure adjusts the wear of the joint, and at the same time locks the nut so that it does not slack back.

Several high-speed pump plungers upon this principle have been made, and in every case with the utmost success, the smallest being only 1½in. diameter, and running at 300 strokes per minute without the slightest click or noise. The turning engine pump plunger at the maker's works is fitted in this way, and has been constantly at work during the daytime for over seven months at 140 strokes per minute. It has required no attention whatever, other than the ordinary oiling, during the whole time. The joint shows no appreciable wear, and is in as good condition as when fitted seven months since.

Compared with the jaw and pin arrangement—see Fig. 2—it is found that this improved method—Fig. 1—does not require any greater length or diameter of plunger, so that, if thought desirable, old plungers and rods can be fitted with these self-adjusting joints. This joint is cheaper to make than the jaw

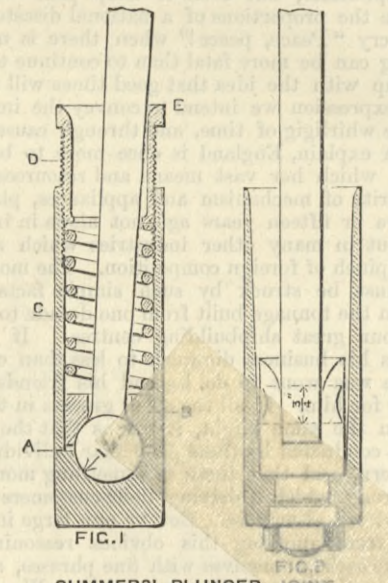


FIG. 1 FIG. 2

SUMMERS' PLUNGER JOINT.

and pin joint, because all the work is done by the lathe, and is more simple. No slotting or fitting is required. The steel springs are very cheap, and for, say, a 3in. plunger, can be purchased at the best makers for about 1s. 6d. each. The joint is adapted to the trunks or plungers of all sorts of force pumps, air and circulating pumps, &c., and also between the pistons and connecting-rods of single-acting engines. It is not, of course, necessary that a form of rod should be used with screwed end into the excentric strap and a ball joint as represented, for in some cases it may be advisable to use a T end, when only a slight modification in the adjustable arrangement is needed.

H.M.S. FEARLESS.

ON Saturday, March 20th, the Barrow Shipbuilding Company, launched from its shipbuilding yard, at Barrow-in-Furness, the twin screw torpedo cruiser Fearless, of the Scout class, built by it for the British Admiralty. The launch of this vessel has been somewhat delayed, through the fire which burnt the engine works of the firm, last September, having kept back the vessel's engines. The engine-works are now quite restored, replete with the most modern machinery, and the completion of the work for the Fearless is being rapidly accomplished. The vessel is in length 220ft. between perpendiculars, 34ft. extreme breadth, and 19ft. 9in. in depth of hold. Her displacement is 1430 tons, on a mean draught of 13ft. 6in. when completely equipped with armament, coals, and all stores on board. She is propelled by twin screws, each screw being driven by an independent pair of engines of the collective power of 1600 horses, giving an aggregate indicated horse-power of 3200 horses for both pairs of engines. The diameter of the high-pressure cylinder is 26in., and that of the low-pressure 46in., the length of the stroke being 30in. The number of revolutions required is 150 per minute on the forced-draught speed trials, which will be made in Stokes Bay soon after the completion of the vessel. Steam is supplied by four boilers of the Navy type, at a pressure of 120 lb. per square inch. Each boiler has three furnaces, with the tubes at the end of the furnaces; and the combustion will be accelerated by forced draught, the latter being secured by two high-speed fan engines, fitted in each stokehole. The slide-valves, Thom's patent, are worked by Joy's valve-gear, an arrangement that is expected to effect a material economy of fuel. The shafting and working parts of the high and low pressure cylinders are made of Whitworth's fluid compressed steel. The maximum weight of engines and boilers, including the water contained in them and all spare gear, is specified by the Admiralty in most cases now. In the present case, by the utilisation of cast steel in the manufacture of framings, and care in the combination of materials, lightness with strength has been secured, and a considerable reduction in the weight specified under the contract effected.

The speed expected by the Admiralty when this vessel was designed was about 16½ knots, but the Barrow Shipbuilding Company is confident from the result of more recent experience that a higher rate of speed will be attained on the forthcoming trials. The gun armament of the Fearless consists of four 5in. B.L.R. guns, mounted on Vavasseur's central pivoted carriages, eight Nordenfelt and two Gardner machine guns. The torpedo armament consists of eleven torpedo-tubes, or air guns, one fitted in the bow under water and the others ranged along the upper deck. The gunners, when working the guns, are protected by shields revolving with the carriages, and those working the torpedo tubes are protected by steel plating in wake of each torpedo port. Four air-compressing engines are fitted in the vessel for supplying motive power to the torpedoes, and for ejecting them. Two electric search lights of 20,000-candle power, supplied by a dynamo, are also to be fitted. The Fearless being unarmoured, her safety as a war cruiser is secured by the engines and boilers, steering arrangements, magazines, and other vital parts being placed below the load water-line in water-tight compartments, with a protective steel deck fitted over them.

The extensive system of subdivision into water-tight compartments, the coal bunkers fore and aft protecting engines and boilers above and below, and the water-tight coffer dams round all hatches from the machinery compartments reduce the risk of damage by sinking to a minimum if penetrated by the enemy's projectiles when in action.

The Fearless has two complete decks—the upper and lower—with a poop and a forecastle each about 70ft. long. High bulwarks, forming the hammock netting, between the poop and forecastle, give the vessel a continuous sheer line from stem to stern. A conning tower of 3in. steel is fitted on the forecastle deck, and a steel chart house on the poop; from these communication by an elaborate system of voice pipes and telegraphs is established to the main engines, steering engines, torpedo tubes and magazines, by which all operations of the vessel are under control of the commander. The complement of officers and crew is 130 men, the officers being berthed in comfortable cabins fitted aft on the lower deck, and the crew in hammocks slung in the forecastle and fore part of lower deck. Careful arrangements for ventilation have been made to insure the comfort of officers and crew. Strong steam and hand-steering engines placed below the waterline, acting on a wide rudder, give effective control of the vessel when manœuvring. A capstan windlass—Baxter's patent—to be driven by steam power is fitted forward for working the anchors and cables. The vessel is built of steel throughout, and great care has been taken to combine strength with lightness. The parts of the hull subject to corrosion have been galvanised, the inside of the bottom been coated with Portland cement, and the outside with Sims' protective and anti-fouling compositions. The construction of the Fearless and her machinery has been superintended, on behalf of the Admiralty, by Mr. H. R. Champness, the Admiralty overseer, and by Mr. W. B. Rock, chief engineer, R.N., respectively.

The usual service of prayer for those who will man the vessel was conducted by the Rev. G. T. Dunne, vicar of the parish, after which the launching ceremony of christening the ship was performed by Lady Ramsden, and a most successful launch followed. Among the objects of interest which attracted the attention of those who visited the launch of this most recent addition to her Majesty's torpedo fleet, was a Nordenfeldt submarine torpedo-boat, in hand, as we understand, for the Turkish Government, which was being built in the same yard close by; and speculation was indulged in as to what the result would be in the case of their engaging one another, the one diving and shooting its torpedoes out below water, the other, with a greater number of torpedoes and machine guns, trying to catch her when she rises to the surface.

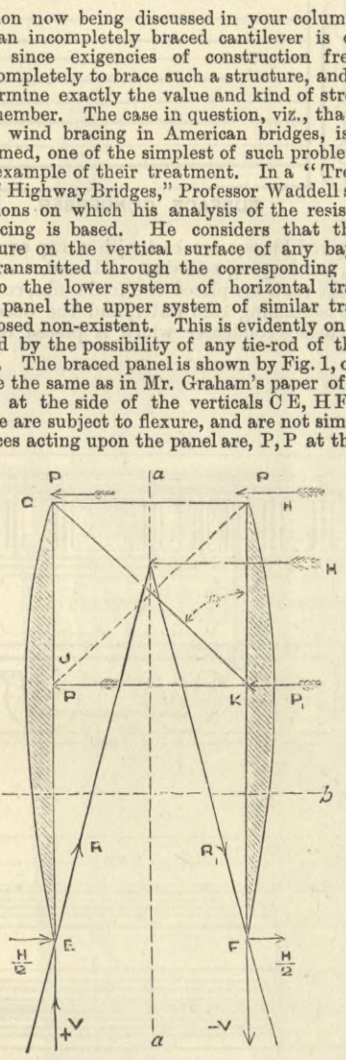
LETTERS TO THE EDITOR.

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

AMERICAN IRON BRIDGES.

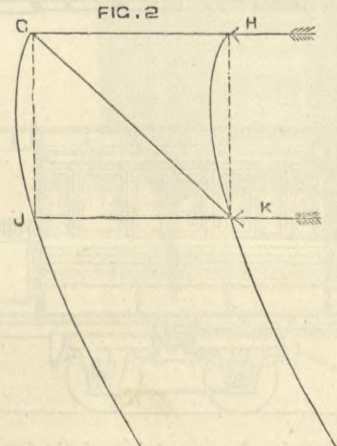
Sir,—The question now being discussed in your columns as to the resistance of an incompletely braced cantilever is of much practical interest, since exigencies of construction frequently render it difficult completely to brace such a structure, and it is of importance to determine exactly the value and kind of stress then occurring in each member. The case in question, viz., that of the vertical transverse wind bracing in American bridges, is, under the conditions assumed, one of the simplest of such problems, and furnishes a useful example of their treatment. In a "Treatise on the Construction of Highway Bridges," Professor Waddell states in detail the assumptions on which his analysis of the resistance of vertical wind bracing is based. He considers that the horizontal wind pressure on the vertical surface of any bay of the bridge is entirely transmitted through the corresponding panel of vertical bracing to the lower system of horizontal transverse bracing, for such panel the upper system of similar transverse bracing being supposed non-existent. This is evidently on the safe side, but is justified by the possibility of any tie-rod of the upper system being slack. The braced panel is shown by Fig. 1, on which the letters used are the same as in Mr. Graham's paper of the 5th inst.; the shading at the side of the verticals C E, H F merely indicates that these are subject to flexure, and are not simple bars. The horizontal forces acting upon the panel are, P, P at the points

FIG 1



C H, at each side of the bridge, and P_1, P_1 at each end of the strut J K. Their resultant is $H = 2(P + P_1)$, indicated in position on Fig. 1. The resultant H is assumed to be equally resisted by the

FIG. 2



points E, F at the feet of the posts C E, H F, and this will be the case if the posts have the same cross section, and if the alteration in length of the braces C H, C K, J K under stress is small enough to be neglected. The form which the panel tends to assume under the given forces is shown in an exaggerated degree by Fig. 2, the points C, H remaining vertically over the points J, K, so that C K is unaltered in length; the posts C J E, H K F, suffer flexure to exactly the same extent, the bending moment and curvature being greatest at J, K and *nil* at C, E, H, F. The resultant H of the external forces, and the two equal resisting forces $\frac{1}{2}$ H at E, F, form a couple whose moment is

$$M = 2\,P\,d + 2\,P_1\,(d-f) = H\,d - 2\,P_1\,f;$$

the opposing couple is supplied by two equal and opposite vertical forces V, which are respectively the upward reaction at E and the downward reaction at F of the main bridge trusses, and its moment is

$$M_1 = V\,b.$$

Hence from the equality of M and M_1,

$$V = \frac{1}{b}\left\{H\,d - 2\,P_1 f\right\}.$$

The vertical reactions V and the horizontal reactions $\frac{1}{2}$ H at E, F form the pair of inclined resultant reactions R, R_1, whose lines of action intersect on the vertical centre line of the panel at the same point with H.

The direct compression on the post C E is + V, and the direct tension on K F is − V.

Let S_1, S_2, S_3 represent the stresses on C H, C K, J K respectively, and take a vertical section line *a a*, dividing the panel into two parts. From the equilibrium of all vertical components of force acting upon the right-hand segment

$$S_2 \cos.\theta = -V,$$

or

$$S_2 = -V \sec.\theta = -\frac{1}{b}\left\{H\,d - 2\,P_1\,f\right\}, \textit{ tension.}$$

Take moments round the point K of the forces acting upon the piece H K F; then

$$\frac{1}{2}H\,(d-f) + P\,f = S_1\,f,$$

or

$$S_1 = \frac{1}{2f}\left\{H\,(d-f) + 2\,P\,f\right\} = +\frac{1}{2f}\left\{H\,d - 2\,P_1\,f\right\}, \textit{ compression.}$$

Similarly, taking moments round the point C of the forces acting upon the piece C J E,

$$\frac{1}{2}H\,d - P_1\,f = S_3\,f,$$

or

$$S_3 = +\frac{1}{2f}\left\{H\,d - 2\,P_1\,f\right\}, \textit{ compression;}$$

equal in value to and same in sign as S_1. The horizontal component of S_2 is

$$S_2 \sin.\theta = -V \tan.\theta = -V\frac{b}{f} = -\frac{1}{f}\left\{H\,d - 2\,P_1\,f\right\},$$

and it is at once seen to be equal and opposite to the sum of S_1, S_3, S_3, so that the sum of the components normal to the section *a a* of the stresses on the three bars cut by it becomes zero, and the conditions of equilibrium at that section are satisfied. The posts are subject to uniformly varying bending moment, the value of which at any section of each below J K, and at height x above E F, is

$$m = \frac{1}{2}H\,x;$$

and at any section of each above J K, at depth x_1, below C H, is

$$m_1 = \frac{1}{2}H\,.\,\frac{d-f}{f}x_1.$$

Take any section *b b* across the cantilever, parallel to E F, and at height x above same. The moment at that section of the external forces acting on the upper segment is

$$M = 2\,P\,(d-x) + 2\,P_1\,(d-f-x) = H\,(d-x) - 2\,P_1\,f;$$

also, the moment of resistance at the same section due to the direct stresses V and the bending moments in the two posts is

$$M' = -V\,b + 2\,m = -(H\,d - 2\,P_1\,f) + H\,x = -H\,(d-x) + 2\,P_1\,f;$$

which is equal in value and opposite in sign to M, and fulfils the condition of equilibrium of moments at the section. At every such section *b b*, the horizontal shearing force is H, so that between the points J, E and K, F there is a constant shearing force equal to $\frac{H}{2}$ on the cross section of each post.

The maximum stresses on the posts are found by combining the stress due to bending moment m with the direct tension or compression V.

Precisely similar results are obtained if the tie C K is omitted, and the strut H J inserted; the stress on H J is S_2 *compression*, and on C H and C, K is $S_1 = S_3$, *tension*, the values being as before given.

The artifice employed by Professor Smith for converting the panel into a completely braced structure, by the addition of an imaginary triangular truss to each post, is a legitimate one, and enables a stress diagram to be drawn which gives graphically the stress in each member. The accuracy of the diagram does not depend upon the shape of the triangles, which need not even be similar, but must have their vertices on the prolongation of J K. In Professor Smith's diagram the direct stress V upon the posts is obviously given in value by the line O 4, and not by A O.

The above results are precisely those given by Professor Waddell, and there seems to be no ground whatever for disputing the accuracy of his treatment of this problem, the same remark applying also to his solution of the case of the gusseted frame shown by Fig. 4 in your issue of the 5th inst.

Professor Burr has been mentioned as having suggested the method of treatment of wind bracing now in question; his interesting and original analysis of many points occurring in scientific bridge design will be found very useful by those engaged in that occupation.

H. Reilly.

March 22nd.

Sir,—In his letter in your issue of yesterday, which is quite as amusing as the article complained of, Mr. R. H. Graham does not quote me correctly. He puts the singular where I used the plural, and the plural where I used the singular. This makes a great difference. Paraphrasing my own words in order that Mr. Graham may more clearly understand them, I said that Professor Waddell assumed that on the section at the base of each of the two columns there was zero bending moment. In other words again, the assumption is that the foundation at each of these bases acts on the column in the same way as it might act if the joint were a pin-point. Mr. Graham in his article made the same assumption, so that we all start from the same data. This does not mean, however, that, taking the forces on *two* bases together, these do not give a moment on the whole section at the base of the structure, that whole section being composed of the two sections of the two columns. If Mr. Graham thought I meant this latter, he misread me; my words did not bear that interpretation. Of course, taking the two forces together at the two bases, they give a moment on the double section taken as one section. The terms "fancy" and "ideal," as applied to the pin-joint trusses substituted for the beams, are also misquotations. They are imaginary additions to the structure introduced to get rid of the difficulty of dealing with the beams in the stress-diagram—just as one has often in an algebraic investigation to introduce imaginary quantities which are afterwards eliminated when they have served their purpose. Mr. Graham is wildly wrong in his interpretation of my stress-diagram. My letter stated that the lines in it that represented actual forces in the actual structure were made heavy; the stresses along the bars of the imaginary trusses were drawn in thin lines. But Mr. Graham says that when the triangles of the imaginary trusses become indefinitely small, the points "O A B C E and F pass to infinity." Let him draw out the diagram several times over, making these triangles smaller and smaller, and observe whether the result bears out his assertion. O and C do not do so. The others, E F A B, do so, as was intimated in my letter; but they are points on imaginary stress lines. None of the actual stresses are measured to these points. By the above process of trial Mr. Graham may find out that the positions of the points D C in the stress diagram are not altered by changing the sizes of the frame triangles A B E F. These triangles may be taken of any size, the vertices, however, being chosen on the lines of the wind forces 23 and 56. Even this last restriction of choice is not necessary, but without it the construction becomes needlessly complicated in a way I need not explain here. Mr. Graham's mysterious assumption, that line C D bisects O 4 in this stress diagram, is incomprehensible. The application of a pair of dividers might have saved him from this blunder. He also seems displeased that I should show the "reactions at the bases of the columns inclined instead of vertical." This is very funny. He chooses to draw in the vertical and horizontal components of these reactions separately, and then suddenly forgetting the latter, asserts that the reactions are vertical. I chose to draw the reactions in as single resultant forces, but my reactions are really precisely the same as those appearing in Mr. Graham's drawing.

Regarding the + and − moments, Mr. Graham defends himself by saying he was "handling Professor Waddell's tools," and "in his fashion." But Professor Waddell certainly does not handle them in this extraordinary fashion, and his assailant must not be allowed to get out of his mistake by trying to throw it on the shoulders of a man who is not here to defend himself. To put it plainly, this is what Mr. R. H. Graham did. Professor Waddell calculated a moment, which for shortness sake we will call + M. Mr. Graham wished to prove this incorrect. He calculated the moment of the forces on the other side of the section. It so happened that he made the calculation correctly, and therefore got the value − M. "But," says he, "if Professor Waddell's reckoning was right, we would then have − M = + M. This is an absurd result, and therefore Professor Waddell's reckoning is wrong." That is a plain statement of the value of Mr. R. H. Graham's criticism of Professor Waddell.

Mason Science College, Birmingham, March 20th.

Robert H. Smith.

THE LOSS OF THE OREGON.

Sir,—Allow an old shipbuilder to express his hearty concurrence with your remarks on the loss of the Oregon, and in your wish that the discussions likely to arise out of this unfortunate event will result in suggesting improvements in vessels building and to be built.

It may seem to those who have not studied the subject unlikely that a 7000 ton iron steamer with ten compartments could be sunk by a blow from a small schooner; but the schooner was deeply laden, and 400 or 500 tons of weight multiplied by the resultants of the speed of the two vessels is sufficient to account for a large hole, especially striking where it did. The schooner being laden, and doubtless without a single bulkhead, also accounts for her sudden disappearance.

What you and all who are alive to the importance of this subject wish is that owners, builders, and the public should unite in requiring that all passenger vessels should be more collision-proof than they are. A well-built and carefully-navigated large steamer should be proof against any stress of weather. Her chief danger lies in being run into. I maintain that a passenger steamer should be so constructed that both ends should float even if cut in two, and one compartment being filled should make little difference in the trim. The extra expense need not be greatly increased, but it is the chief bar to its adoption. Owners say it won't pay, and you say if a few thousands extra in the cost, or a few shillings extra in the passage money, are of more consequence than the lives of perhaps a thousand people, no more needs to be said; but the public won't think so. Your surmises as to the possibility of doors or sluices not being shut may be correct, for though the managers of the Cunard steamers are proverbial for being careful that all doors, sluices, scuttles, and hatches be kept closed, yet sailors, and especially firemen and coal-trimmers, are equally proverbial for their carelessness; and I should like to see the adoption of means for registering the shutting, and thus insuring that they are not kept open when they should be closed, which can be done without much expense.

One or both of the engine space bulkheads probably gave way, for though the plating is ample, these are, as you say, seldom sufficiently supported. Moreover, one may have been injured by the collision. Neither the builders of the Oregon nor Messrs. Burns' inspectors were likely to pass bad workmanship, but so far as regards bulkheads, it was a common rejoinder from foremen when defects in bulkheads were pointed out that "bulkheads were of no manner of use, and were only put in to fulfil Lloyd's requirements," and they might be excused the remark, as there is actually no law requiring them at all, and, in fact, it is to the culpable folly of the Board of Trade itself that some thirty years ago the regulations regarding bulkheads were completely done away with. To show the difference between work as it should be done and that done only to fulfil the rules, I mention three cases, two of large steamers, which had their after compartments filled by water from the stern tube. The one filled both hold and engine space, and sank immediately, with great loss of life. The other filled the after compartment only. The passengers on the lower deck had to rush quickly up, but the steamer never made a drop of water into engine space or tunnel, and steamed some hundreds of miles to land with so little loss of speed, and otherwise so thoroughly safe, that the chief engineer actually proposed to cross the Atlantic in that state. The third case was one of injury by fire. The whole after compartment was burnt out, and part of the stern blown away by explosion of powder in the magazine; and yet that steamer got in that state to the Mauritius, many hundreds of miles off, without the loss of a single life.

I could write at greater length, but will not at present occupy your space, which I trust will be required for other profitable discussion, and will conclude with the grave charge that though the construction of passenger steamers is still defective, they have elements of safety which are completely wanting in sailing passenger ships. Had any one of such got the same treatment as the Oregon got, instead of floating for hours, she would have sunk with 300 or 400 emigrants in three or four minutes. So much for the fatherly care of our Board of Trade.

L. Hill.

5, Doune-gardens, Kelvinside, Glasgow, March 22nd.

Sir,—Here in Liverpool we do not believe that the Oregon was run down by a schooner. The big ship was travelling at twenty miles an hour, and was, it is said, struck right on the broadside and amidships. The Oregon was an enormously strong vessel, and the schooner must have been sailing at a great speed to drive a large hole in her; but there is no evidence of anything of the kind. The wind was not very high, and a heavy-laden schooner would not make more than 7 knots. The masts of a big schooner would stand high over the top rail of the Oregon. How is it that not a single spar or scrap of the top hamper of the schooner came on board the Oregon? How is it that not a vestige of a craft going down under full sail has not been found? It is very probable that the mate of the Oregon did see a schooner, and that she passed all right, and is still afloat.

A canister of dynamite hung quietly over the ship's side and ignited would do the work much better than any schooner.

It is strongly suspected by many people here that the ship encountered a lost torpedo. It would be worth while to learn if any loaded torpedoes were missing after the Bantry Bay manœuvres.

Seacombe, March 23rd.

Nauticus.

[*For continuation of Letters see page 251.*]

ROWAN'S STEAM CARRIAGE AT THE ANTWERP TRIALS.

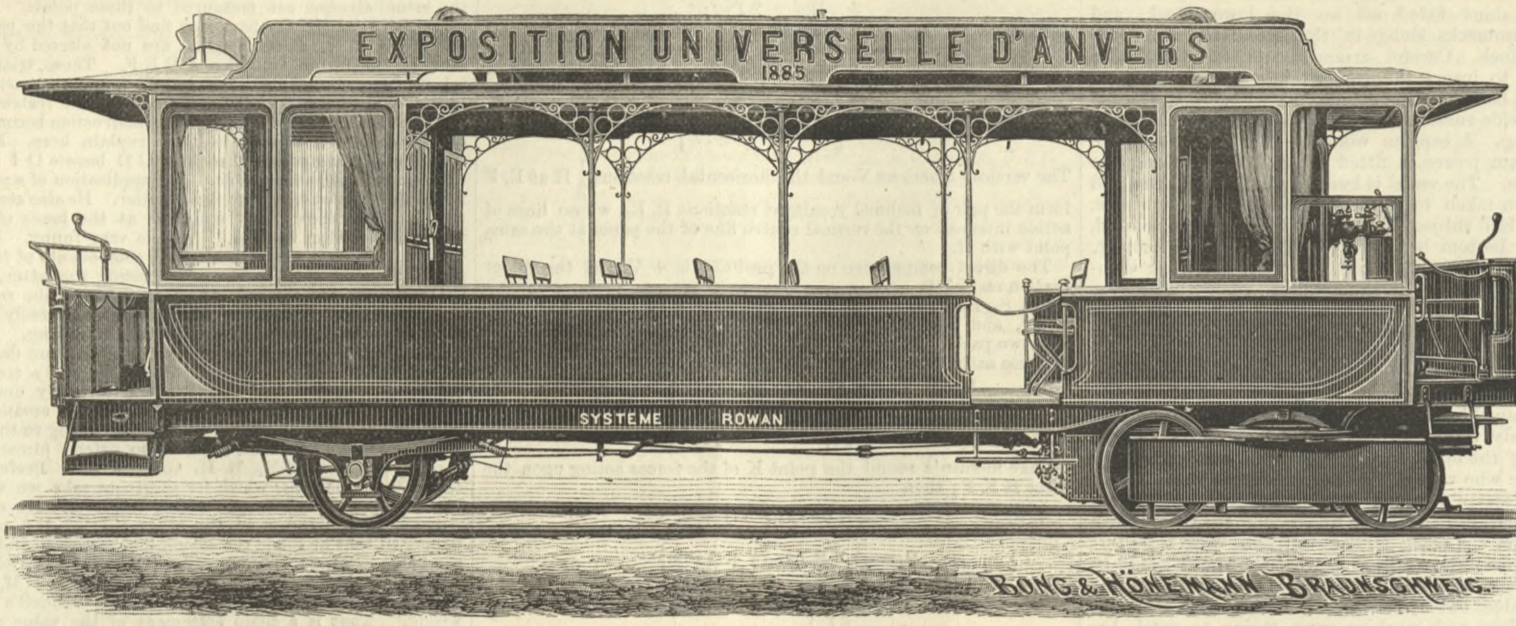


Fig. 2

ROWAN'S STEAM CARRIAGE.

As stated in our article on the Antwerp* tramway trials, the Rowan steam carriage was awarded the gold medal in the first competition of Group I.—locomotives or automotive vehicles for towns and cities. In seeking a method of working tramways and light railways economically, Mr. Rowan adopted the principle of reducing the dead weight by the use of an engine whose power considerably exceeds its adhesion, while utilising the weight of the passengers for the balance of adhesion; and this he accomplishes by supporting the vehicle on two bogies, one of which is the motor. Fig. 1 of the accompanying illustrations shows the manner in which this principle is carried out. The body of the carriage may be raised by a pair of screw jacks, and the front bogie carrying the engine and boiler run out, thus rendering it perfectly accessible for cleaning, inspection, and repairs. This operation, which is common to all three types of these carriages, viz., for town tramways, light or secondary lines, and railways, is accomplished most easily and rapidly, eleven minutes being sufficient to run the engine out and in again.

Fig. 2 shows the steam carriage which took part in the Antwerp competition, and Fig. 3 a plan thereof one-fiftieth actual size.

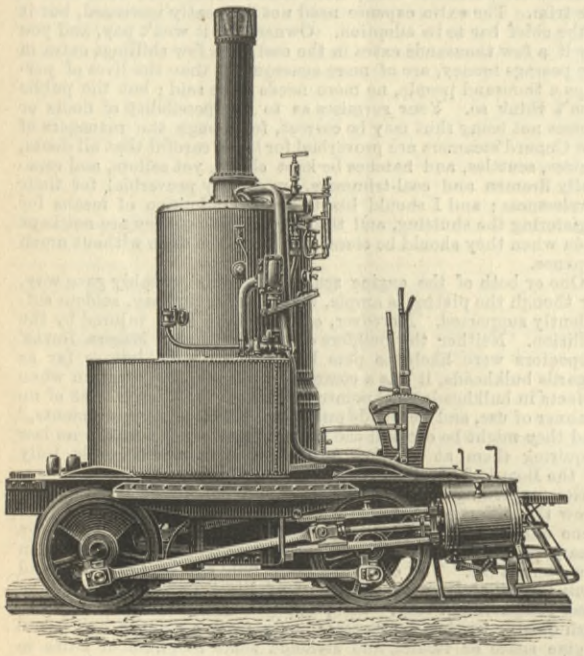
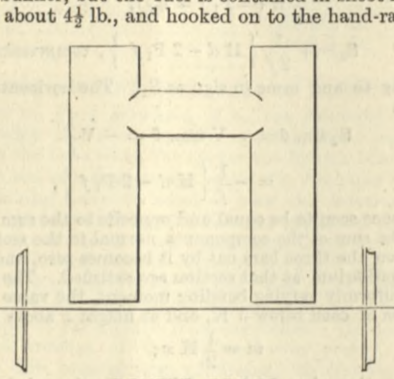


Fig. 4

Although the middle is shown open for summer traffic, it may be completely closed for the winter, and also warmed by the exhaust steam without extra expense. The total length is 9½ metres, or 31ft., and that of the body 8·15 metres, or 26ft. 9in., while the width of latter is 2·2 metres, or 7ft. 2in. The wheel base is 22ft. 6in.; and the car, of normal gauge, is capable of running round curves of 15 metres, or 16½ yards' radius. The total weight in running order is 7¼ tons; and the maximum weight of the wheels on the rails with full load 1·7 ton, the weight available for adhesion in this state being 6·2 tons. The steam carriage as shown will carry 50 passengers, and 110 when drawing a supplementary car after it. One man is sufficient to stoke, drive, and brake, so that, with the conductor for tickets, only two men are required for working. The tractive power is 500 kilogrammes, or 25-horse power, sufficient to mount gradients of 1 in 20; and on the level a speed of 20 kilometres, or about 12½ miles an hour, is attainable. When running at half that speed, with dry rails, the carriage may be pulled up in 10 metres. The car was made by Herbrandt, of Ehrenfeldt, near Cologne; and the engine by Borsig, of Berlin.

The engine shown run out in Fig. 1 is of an early type, with inverted cylinders; Fig. 4 illustrates the engine of a larger form of steam carriage for light railways; and Figs. 5, 6, and 7 give details with metrical dimensions. But, as shown at Fig. 3, the boiler for the town steam carriage is made double, in accordance with the sketch above, with two internal fireboxes and two chimneys with natural draught, the horizontal member considerably strengthening the vertical shells of 0·54 m. = 21¼in. diameter, containing cross water tubes. This arrangement provides a large steam space, and affords plenty of dry steam, which can be raised in thirty-five minutes, 400 kilogrammes, or 881 lb., of water being evaporated per hour under a pressure of thirteen atmospheres, or 195 lb. per square inch. The boiler is so constructed that, by unbolting a flange and lifting off a plate, the tubes with turned flanges are freely exposed, so that the inside may readily be cleaned; but, thanks to the active circulation, no scale has yet been formed. There is no coke bunker, but the fuel is contained in sheet iron boxes, containing about 4½ lb., and hooked on to the hand-rail, so that



DOUBLE BOILER.

the fire is fed without shovel and with the greatest ease and cleanliness. At Antwerp 100 kilogrammes, or 2 cwt., of gas coke were burnt every day for the run of 80 kilometres, or

Fig. 9

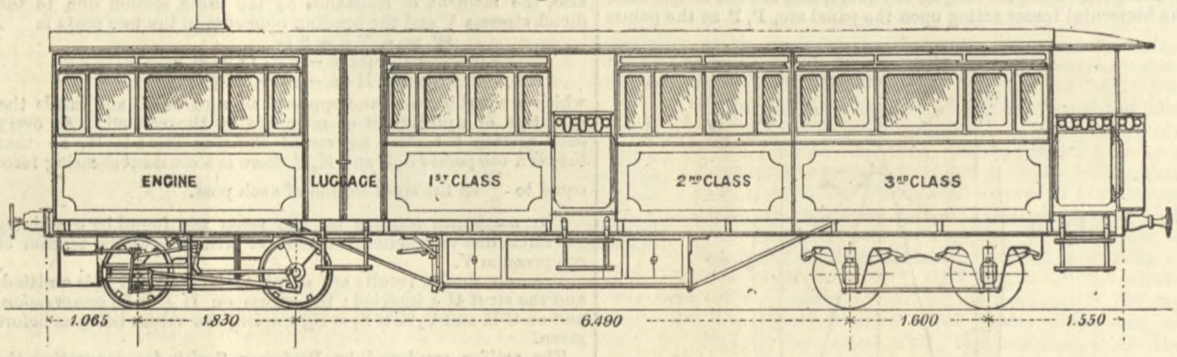


Fig. 10

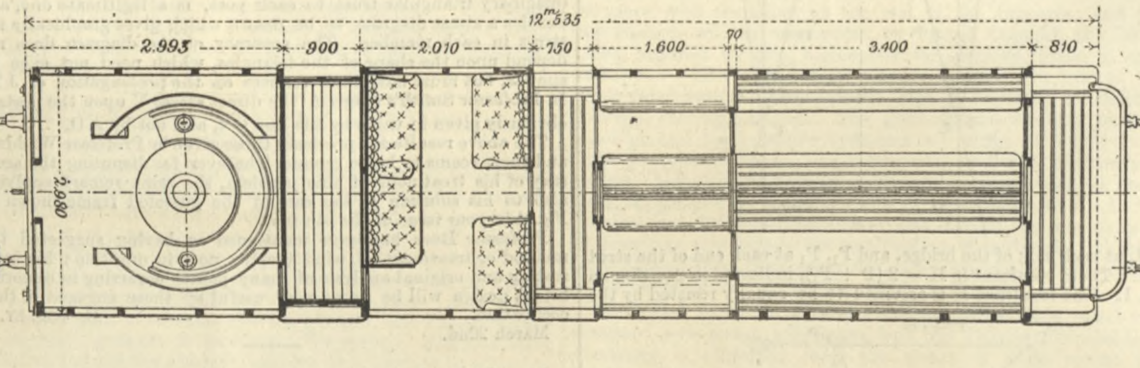
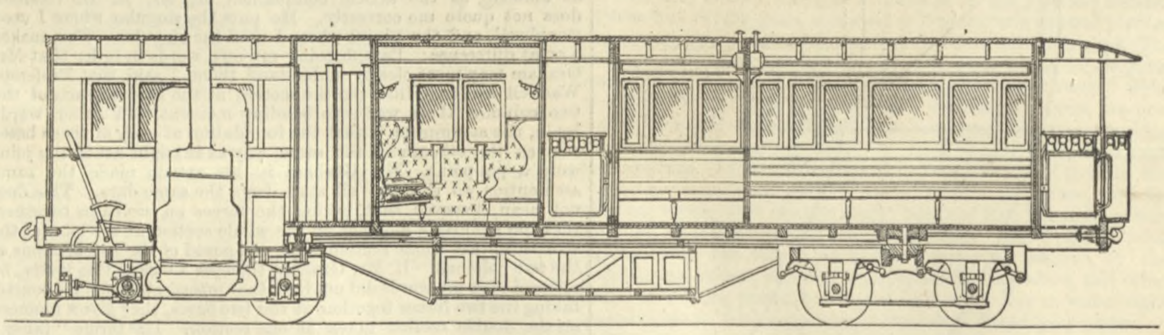
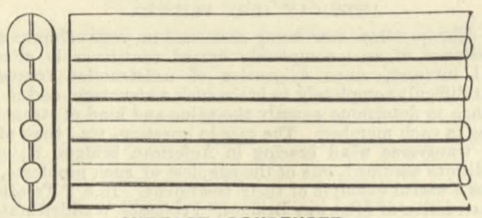


Fig. 11



nearly 50 miles, which amounts to 1¼ kilogramme per kilometre, or about 4½ lb. per mile. The consumption of oil is only 1 litre, or less than a quart, a day.

The cylinders, 0·13 metre, or 5·1in., in diameter, and of 0·25 metre, or 9·8in., stroke, are bolted to the feet of the boiler, this arrangement bringing the whole weight between the two axles, and distributing it uniformly over the four wheels. The weight of the front portion of the body carried by the engine bogy also bears evenly between the two axles, which circumstance, in addition to the horizontal position of the cylinders, causes a remarkably regular and noiseless motion of the engine. This is a point of the greatest importance, because, combined with the slight weight and low centre of gravity, it has great influence in preserving the way. The axles are not coupled because, with the slight gradients usually encountered in towns, the adhesion of two driving wheels generally permits of drawing a supplementary car. The other pair of wheels can, however, be coupled with a chain, or with side rods in the ordinary manner. The



SURFACE CONDENSER.

connecting rod brasses are cast with a cap over the end of the crank-pin, for keeping out dust and mud.

Under the seats are placed two feed tanks, composed of copper tubes, one containing cold water, and the other the hot water from the surface condenser which is placed on the roof. The latter consists of a series of copper tubes, of the form shown in the sketch above, presenting about 80 square metres, or 860 square feet, of condensing surface. The parts are hung freely so as to allow for expansion and contraction, and the surface exposed to the air is sufficiently large to dispense with the necessity of water for cooling. The feed pump is constantly at work circulating the water, which is thus used over and over again, so that a steam carriage can run for forty or fifty kilometres without renewing its water supply. The passengers feel no heat from the condenser or hot-water tank; and the motion of the engine is completely deadened by springs introduced between the engine and the carriage. The thrust of the bearing-springs is

* The Engineer, 29th January, 1886.

ROWAN'S STEAM CARRIAGE AT THE ANTWERP EXHIBITION TRIALS.

(For description see page 242.)

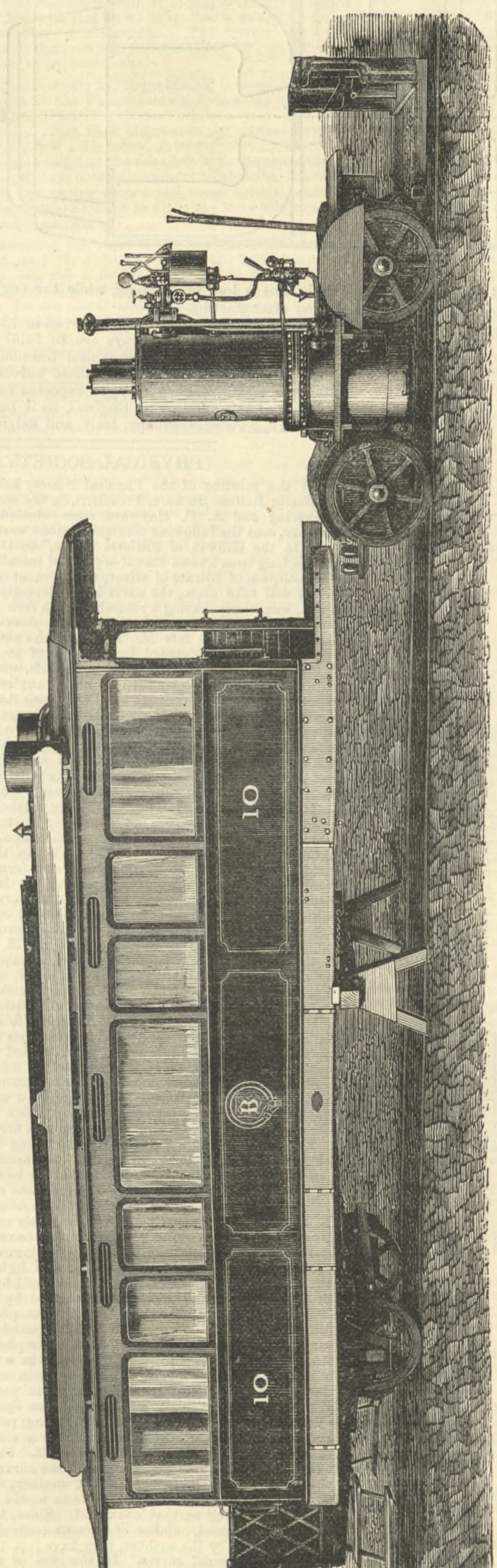


Fig. 1

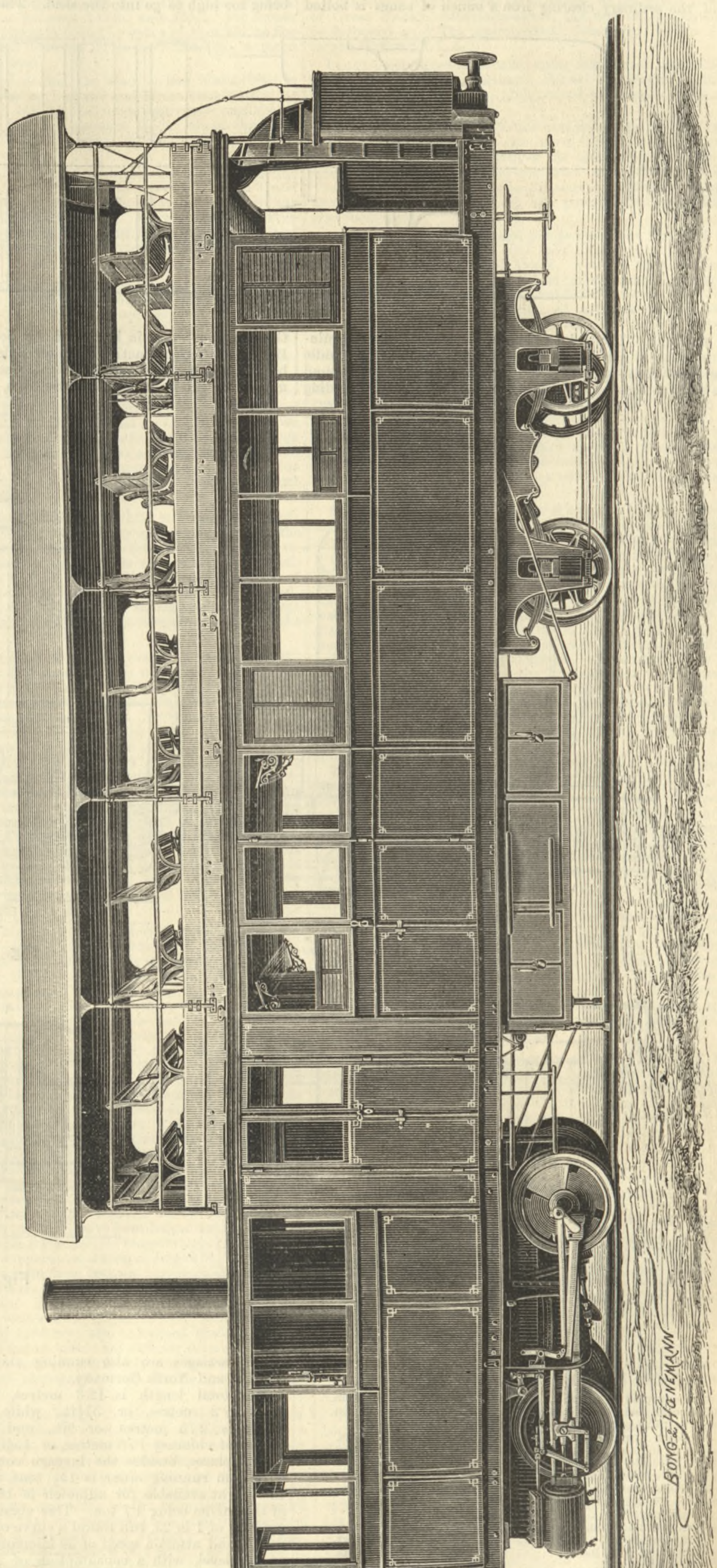
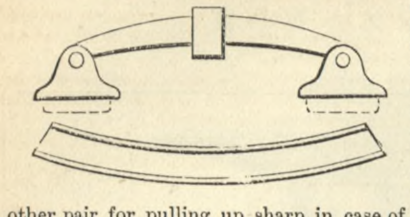


Fig 3

received by shoes which slide in segmental guides, shown by the annexed sketch, thus producing the effect of a radial axle-box.



There are two sets of brake blocks, four, worked by pedal, on one pair of wheels for ordinary use, and four, worked by screw, on the other pair for pulling up sharp in case of an emergency. In place of the ordinary clearing iron a bunch of canes is bolted on to the tank. The body of the supplementary car—Cleminson's patent—is carried by three bogies, that in the middle sliding, and those at the ends swivelling, so as to run round curves of 20 metres, or 65½ feet. The following are the leading dimensions, including for convenience some given above, and also the relations determined by the jury during the trials:—

Length occupied by motor	3 m. = 9ft. 10in.
Length occupied by passengers	6 5 m. = 21ft. 4in.
Weight of fifty passengers, at 70 kilog., or 1cwt. 1 qr. 14 lb.	3500 kilog. = 3½ tons.
Weight of vehicle	2500 kilog. = 2½ tons.
Weight of condenser and reservoirs ..	600 kilog. = 11¾ cwt.
Weight of vehicle, condenser, and reservoirs, empty p	3100 kilog. = 3 tons.
Relation p weight empty to n weight of passengers	0·886
Load on motor in running order without passengers	1400 kilog. = 27⅓ cwt.
Load on motor fully loaded	2900 kilog = 2⅘ tons.
t Boiler pressure	13 atmosp. = 195 lb. pr. sq. in.
d Diameter of cylinders	0·13 m. = 5·1in.
l Piston stroke	0·25 m. = 9·8in.
D Diameter of wheels	0·75 m. = 2ft. 5½in.
E Tractive effort = $\frac{0·5\ td^2l}{D}$	366 kilog. = 7 cwt.
S Heating surface	5·96 sq. m. = 64 sq. ft.
G Grate surface	0·29 sq. m. = 3 sq. ft.
C Condenser surface	80 sq. m. = 860 sq. ft.
P′ Weight in running order (motor only)	4100 kilog. = 4 tons.
P″ Weight, fully loaded	7000 kilog. = 6·8 tons.
Content of water tanks	120 litres = 26½ gals
Content of coke boxes	100 litres = 3½ cub. ft.
Wheel base of motor	1·54 m. = 5ft.

$$\frac{P'}{E} = 11·2;\ \frac{P''}{E} = 19·12;\ \frac{P'}{S} = 688;\ \frac{P'}{G} = 14{,}138;\ \frac{C}{S} = 13·42;\ \frac{E}{C} = 4·57.$$

By adopting this system of steam carriage, the fundamental principle of the tramway, in opposition to the railway, is maintained by running small trains at frequent intervals. As regards brake power, the combined engine and carriage is far more under control than a locomotive drawing a separate carriage, besides occupying less space in the street. An objection has been made that the steam carriage requires turning at each end of the line; but, with a triangle like that laid down at Antwerp, this operation takes up less time than detaching a locomotive, running it by a siding from one end of the train to the other, and again hooking it on. Besides, with the steam carriage there is no door in front, giving rise to draughts, which are much complained of in tramcars.

Fig. 8 shows a larger steam carriage, intended for light railways in the country, and therefore non-condensing, which ran regularly at Antwerp, but was disqualified from competing because no suitable car was found for it to draw in addition to that which forms an inherent part of itself. The seats and awning on the roof were, however, removed, on account of their being too high to go into the shed. This carriage was made at the Rhaismes works in France of the Société Anonyme Franco-Belge pour la Construction de Matériel de Chemin de Fer, and has been bought by the Société Générale des Chemins de Fer Economiques to run between Turin, Settimo, and Rivarolo. Similar steam carriages are also running successfully in Denmark, Sweden, and North Germany.

The total length is 12·3 metres, or 40½ft., and of the body 10·2 metres, or 31½ft., while the greatest outside width is 2·75 metres, or 9ft., and the height from rails to top of chimney 4·76 metres, or 15½ft. There are altogether eighty places, besides the luggage compartments. The total weight in running order is 15½ tons, and, when fully loaded, the weight available for adhesion is 15 tons, the tractive force of the engine being 1·7 ton. This steam carriage will mount a gradient of 1 in 25, run round a curve of 30 metres, or 33 yards, radius, and attain a speed of 30 kilometres, or 20 miles, an hour on the level, with a consumption of 2½ kilogrammes of coke per kilometre, or about 9 lb. a mile. All four wheels are coupled; and the brake acts upon two axles only, or all four in case of emergency. With dry rails, and going at a speed of 20 kilometres, or 12½ miles, an hour, the carriage may be pulled up in a distance of 20 metres, or 22 yards. Steam can be got up in the tubular boiler in half an hour. The cylinder is 0·23 metre in diameter, and the stroke 0·33 metre, or 9in. by 13in.

Figs. 9, 10, 11, and 12 show a similar carriage, made at the La Croyère works of the Franco-Belgian Construction Company above mentioned, which runs regularly on the Brussels Ceinture line of the Belgian State Railway, between the Luxemburg Station and Schaerbeck Junction. This, too, has no impériale, or seats on the roof, but compartments for all three classes, besides one for luggage. The total length outside buffers is 13·45 metres, or 44ft., affording space for the engine, a luggage compartment, a first-class compartment of eight places, a passage for entrance, a second-class compartment of twelve places, a third-class ditto of twenty-eight places, and a platform giving access and also standing room for twelve passengers—sixty altogether—while below is a large space where parcels may be stowed. The steam carriage, which weighs empty about 16 tons, including the 7-ton engine, makes 30 kilometres, or 20 miles, an hour, but can attain a speed of 40 kilometres, the coke and water space being sufficient for 20 kilometres, or 12½ miles, while curves of 120 metres, or 131 yards, radius are easily turned. The following are the principal dimensions:—

Grate surface	0·258 sq. metres	= 3 sq. ft.
Total heating surface	17· ,,	= 183 ,,
Number of tubes		190
Diameter of cylinders	0·205 metre	= 8in.
Stroke	0·33 ,,	= 13in.
Diameter of four-coupled wheels ..	0·82 ,,	= 2ft. 8¼in.
Between axles of engine truck ..	1·83 ,,	= 6ft.

The motion is very easy, even on a badly-laid line; and but little time is lost in stopping, while the engine soon gets into speed after starting.

As Captain Douglas Galton observed in his paper before the Society of Arts, "If tramways are to fulfil their object satisfactorily, it must be by mechanical traction;" and, when once the "interference from a centralised burocracy" is removed, Rowan's steam carriage may be expected to afford a practical solution of this question in England, as it has already done in Denmark, Sweden, Germany, Italy, and Belgium.

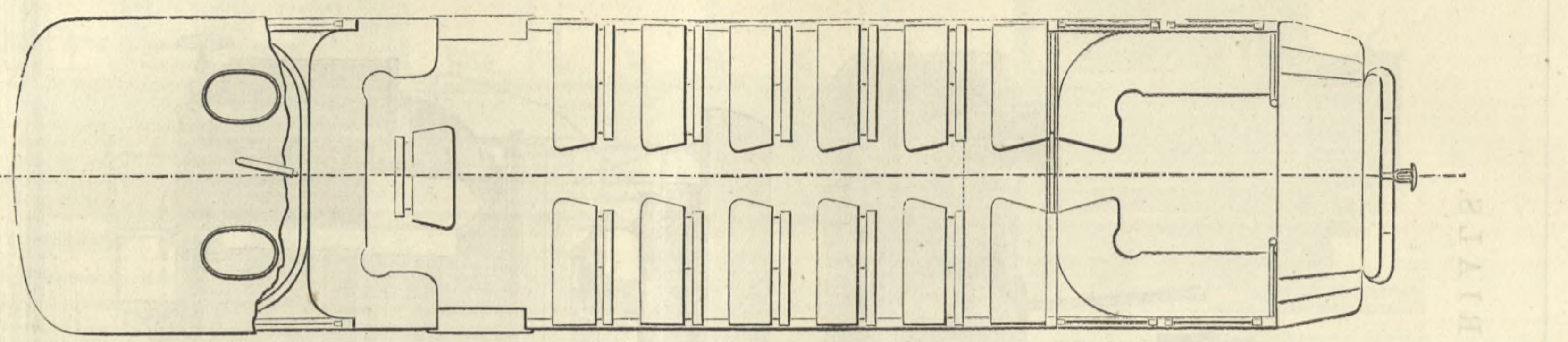


Fig. 3.

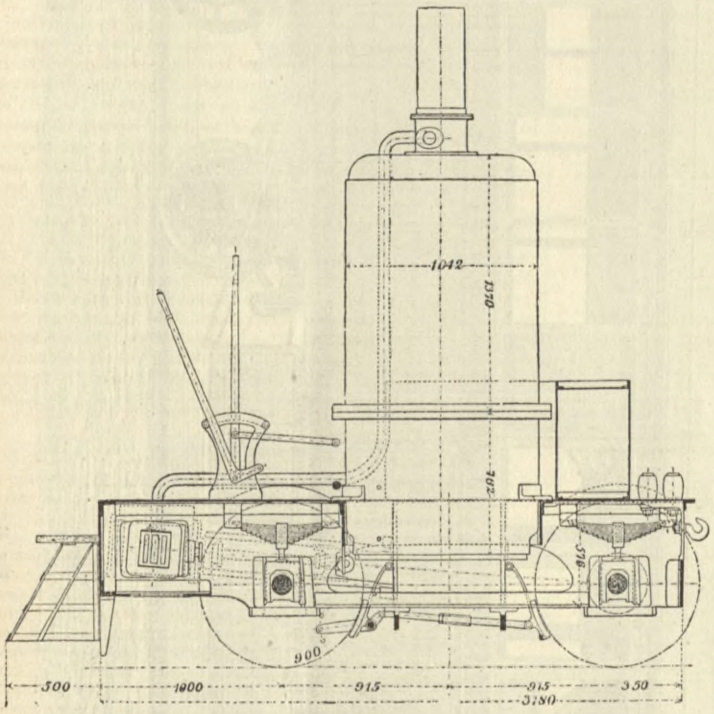


Fig. 5

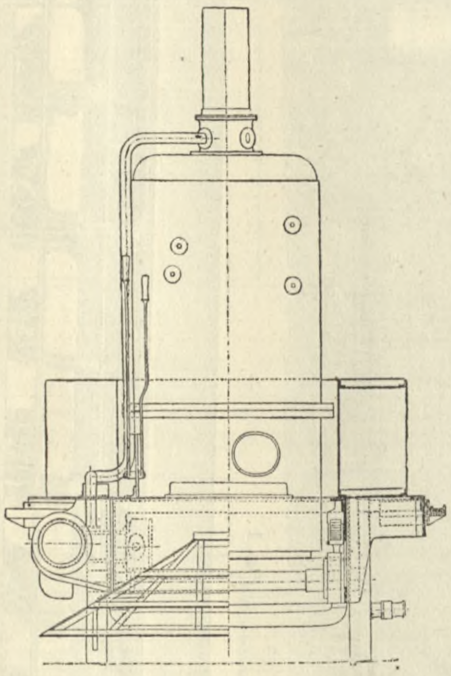


Fig. 6

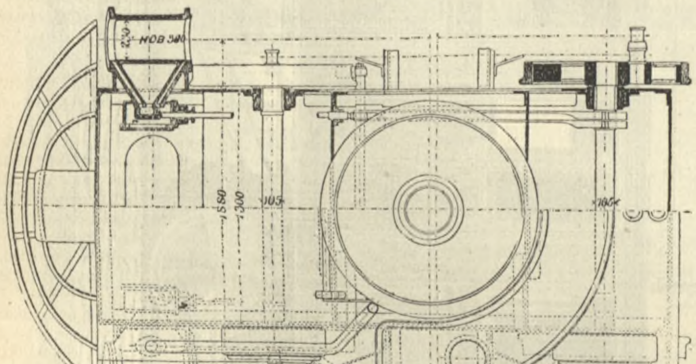


Fig. 7

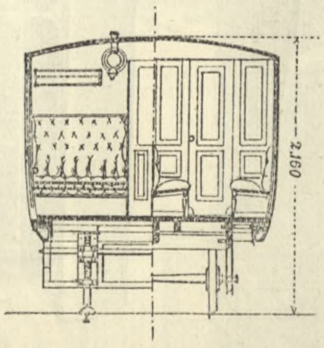


Fig. 12

PHYSICAL SOCIETY.

At the meeting of the Physical Society held on March 13th, Professor Balfour Stewart, President, in the chair, Professor U. S. Pickering and A. C. Hayward were elected members of the Society, and the following communications were read:—

"On the Growth of Filiform Silver," by Dr. J. H. Gladstone. It has long been known that if a piece of metallic copper be placed in a solution of nitrate of silver, replacement of one metal by the other will take place, the silver being deposited in the crystalline form, sometimes having a resemblance to fern leaves or as superposed hexagonal plates or knobs. It was observed, however, as far back as 1872 by the late Mr. Tribe and the author that if nitrate of silver were decomposed by suboxide of copper instead of the metal, the silver presented itself in threads, which rarely, if ever, bifurcate, but frequently turn at sharp angles or twist in every direction. This was described in the British Association report for 1872, and it was observed that the same forms occurred in native silver. More recent observations have shown that the particular character and rapidity of formation of these threads depends very much upon the strength of the solution and the condition of the suboxide. Hydrated suboxide will scarcely decompose a 2 per cent. solution even after standing. The threads, which bend at a sharp angle, usually do so at 60 deg. or 120 deg.; other threads, however, are symmetrically curved, but, especially in strong solutions, they are given to twisting about in every direction, and generally terminate in irregular knobs of silver. When the solution is very nearly exhausted of silver, fine arborescent forms appear, but with the suboxide there are never produced the fern-leaved forms or hexagonal plates, or the other distinctly crystalline structures which characterise the growth from metallic copper. During the reaction the suboxide is changed into black protoxide and metallic copper, which dissolves, and the change will take place as well with the acetate and sulphate as the nitrate. If a mixture of suboxide and metallic copper be employed, not only do the distinctly crystalline and the filiform forms make their appearance, but strange intermediate forms come into existence.

"Apparatus for Measuring the Electrical Resistance of Liquids," by Professor Reinold. The apparatus consists of two bottles, connected by a horizontal tube. The whole is filled with the liquid to be examined and immersed in water, by which means, and by thermometers inserted in each bottle, the temperature may be regulated and accurately ascertained. The electrodes are platinum plates, one dipping into each bottle. Two fine tubes terminate near the ends of the connecting tube, and electrodes are fitted into them at some distance from the ends. By connecting these to a quadrant electrometer or a condenser and galvanometer, the difference of potential between the ends of the tube can be compared with that at the ends of a known resistance in the same circuit.

"On Chromatic Photometry," by Capt. Abney and Lieut.-Col. R. Festing. (This paper had been previously communicated to the Royal Society.) A series of experiments have been made by the authors to determine the comparative luminous effect of different parts of the spectrum. A monochromatic light from any part of the spectrum of the electric arc was obtained by a method devised by Capt. Abney, and previously described by him to the Society (Physical Society, June 27th, 1885). The photometric effect at different parts of the spectrum was compared with that due to a candle at different distances by Rumford's photometer. In using this it was found best to place the candle in a given position, and obtain a balance by moving the slides upon which the spectrum was formed, and through a slit in which part of the light was allowed to pass rapidly to-and-fro. For each position of the candle there are thus two corresponding positions of the slit. From the results of these observations a curve may be drawn showing the luminosity at different points. From the method by which it is obtained it is evident that the curve of one observer is not directly comparable with that of another, since a deficiency of perception in any part of the spectrum would affect the light of the candle as well as that examined. Since, however, the curves obtained by a great number of persons coincide very closely with those obtained by the authors, they have felt justified in adopting them as the normal curves. In the case of the electric arc the normal curve attains a maximum rather nearer the red end of the spectrum than the blue. Assuming the normal curve, any other curve may be compared with it by increasing or decreasing its ordinates, so that no part of it shall lie without the normal curve. In curves thus obtained, several of which were shown, deficiency in colour perception is often very clearly marked. By the use of two or more slits in the movable slide, experiments were made upon mixtures of colours, and it was found in all cases that the luminous effect of a mixture of colours was the sum of the luminous effects of its components. It was also found that the colour of the comparison and the quantity of light admitted to form the spectrum were without effect upon the form of the curve. Light from the sun and from an incandescent lamp were similarly examined, though it should be observed that the result for sunlight differs notably from that given by Maxwell. An examination has also been made of light after passing through a turbid medium and an expression of Lord Rayleigh's

$$I^1 = I\,e^{-x\lambda^{-4}}$$

where I is the original radiation, I^1 that after passing through the medium, λ the wave length of the light, and x a constant depending upon the medium, has been closely verified.

RAILWAY MATTERS.

IT is stated in Belgrade that the railway line between Leskovatz and Vranya will be formally opened for traffic on the 28th inst.

THE tender of Messrs. Lewis, Roberts, and Glover, for £27,273, has been accepted for the section of the direct line of rail to Ballarat between Gordons and Ballan, Victoria.

THE oft-made proposal to make a tunnel to connect the railways of England and Scotland with those of Ireland, from Portpatrick to Donaghadee, has again come forward for discussion. The distance is twenty-one miles, and the cost of making the tunnel is now estimated at six or seven millions. Of the advantages to Ireland of railway communication with England there can be no doubt—but?

DURING a recent discussion of the estimates for the railways of Alsace and Lorraine, which are owned and worked by the State, it was mentioned that the daily work of locomotive drivers varied from four to five hours on fast trains to ten hours on freight trains with switching service for a long time. The drivers had every fourth or fifth, or at the least every seventh, day for rest. Pointsmen have a day off every two weeks.

ON the morning of January 24, about 60ft. of the road-bed of the Shenandoah Branch of the Philadelphia and Reading road, near Shenandoah, Pa., sank about two feet while a coal train was passing over it, and a short time afterwards the surface dropped into the working of a coal mine below, leaving a hole 75ft. in length. An attempt was made to fill up the cave, but as the track continued to sink at various points it became necessary to abandon the work and to wait until the caving ceased and some bottom could be found. Subsequently the attempt to fill in the cave was renewed with some prospect of success.

AS another instance of the value of the new Canadian route to the Pacific, *India and the Colonies* recounts the following:—"It appears that not long ago a British vessel bound from China to Victoria, British Columbia, was injured when near the harbour of Esquimault, the British naval station on the Pacific. It was thought that the vessel would have to be towed for repairs to Liverpool, *viâ* Cape Horn. The Canadian Pacific Railway Company, however, telegraphed to Victoria that the machinery could be cabled for to Liverpool, and be shipped over the Canadian Pacific road, and repairs made at Victoria. The owners of the ship consented, and within fifteen days the machinery was delivered at Victoria. The time from Quebec was less than seven days, the quickest time ever made across the Continent to Vancouver Island on which Victoria stands."

THE following, headed "Ruined by the Patent Register," is given by the *Arkansas Traveller*:—"Moseby, who has been away from town for some time, returned the other day. Shortly afterwards a friend met him, and noticing his low-spirited appearance, asked: 'Moseby, what's the matter, old fellow?' 'Ruined.' 'What?' 'A financial wreck.' 'How did it occur?' 'Well, you see, I had charge of a bridge not far from here. The owners are very particular about receiving every cent that is due them, so they put in one of those registers. It is a sort of fool arrangement sunk in the foot passageway of the bridge, and makes a mark with a clicking punch every time anybody steps on it. Well, everything was all right until the other day. A big Newfoundland dog got on the blamed thing and began to scratch himself, and, sir, before I noticed him he had charged me up 275 dols. Yes, I am a ruined man.'"

THE report by Major Marindin to the Board of Trade on the collision which occurred on the 10th ult. at Finsbury Park station, on the Great Northern Railway, when a number of people were slightly injured, concludes as follows:—"Such an accident as this could hardly have occurred if the system of interlocking the block instruments with the starting-signal levers had been in use, for in that case the signalman in No. 4 box would have been prevented from giving the 'line clear' signal to No. 6 box. It might also have been prevented if there had been clearance bars on the platform line to prevent the home-signal from being lowered when there was a train standing on the line, and I am glad to be able to report that the company is about to have such bars fixed at once. It should, however, be remarked that these additional safety appliances are of somewhat recent introduction, and do not as yet form part of the absolute requirements of the Board of Trade."

THE accidents on the American railways in December last are classed as to their nature and causes by the *Railroad Gazette* as follows:—Collisions: Rear, 27; butting, 8; crossing, 2; total, 37. Derailments: Broken rail, 5; broken frog, 1; broken bridge, 1; spreading of rails, 5; broken axle, 2; broken truck, 1; accidental obstruction, 1; land-slide, 1; snow, 1; misplaced switch, 5; unexplained, 9; total, 32. Other accidents: Boiler explosion, 1; broken parallel rod, 2; cars burned while running, 1; falling rock, 1—5; total number of accidents, 74. No less than eleven collisions were caused by trains breaking in two. Three resulted from the absence of signals or failure to use them properly; two from mistakes in orders; two from cars blown out of sidings on the main track; one each from a misplaced switch, a runaway train, and a conductor's slow watch. The thirty-seven collisions caused twenty-three deaths and fifty-four injuries; the thirty-two derailments killed seven persons and injured ninety-eight, while in the five other accidents one person was killed and one hurt.

IN the House on Thursday, the 18th inst., Mr. F. Pease asked whether it was the intention of the Government within the present year to encourage and expedite the construction, whether by the State or by public companies, of railways and other works in India which had been recommended in the interests of that Empire, and would be securities against famine, while in this country they might have the effect of encouraging the iron, steel, and other industries. Sir U. Kay-Shuttleworth replied that the annual report on railways in India for the year 1885-6, which will be presented as usual this session, will give the desired information; but if the member for North Leeds desires any part of the information immediately, he would as far as possible meet his wishes. In the opinion of the Secretary of State in Council the numerous railways and other public works now in course of construction, which include the frontier lines, should be further advanced towards completion before fresh obligations are incurred. He added for the information of the House that the Budget estimate for the current year included a capital expenditure of about £8,250,000 on Indian railways. The Indian Midland Railway Company, with a capital of £3,000,000, has also been formed, and the Southern Mahratta Company has raised £600,000 for a new railway. These two sums were not included in the estimate.

THE proposed Western Australia Railway, to connect Perth, the capital, and its harbour, Fremantle, with the rising town of Geraldton, thus opening up for traffic the fertile lands abounding in mineral and vegetable wealth lying between these localities, will be about 270 miles in length. The basis of the proposal of Mr. J. Waddington to construct this line includes a provision for the introduction into the colony of 5000 immigrants during the next seven years. On the part of the Crown, the Colonial Government are asked to grant lands to be selected within a reserve eighty miles in width, equal to a belt nineteen miles in depth along the whole length of the line; also the right to declare town sites and villages on such lands. The proposals were favourably received, and Mr. Waddington has since formed a strong syndicate under the title of "The Midland of Western Australia Land and Railway Syndicate," for the purpose of taking over the concession. In November last the syndicate sent out Mr. Richard Price-Williams, M. Inst. C.E., to report on the scheme and complete the negotiations with the Government. The contract has been signed, and the caution money—£10,000—required by the Government paid. The governor of the colony—Sir F. Napier Browne—turned the first sod of the new line on the 2nd inst., amidst great rejoicings. Besides the actual construction of the line, the works connected with the development of the lands will afford ready employment to many.

NOTES AND MEMORANDA.

ONE-THIRD of the whole of the deaths in London during the week ending 20th March were referred to diseases of the respiratory organs.

IN Greater London 3593 births and 2938 deaths were registered last week, corresponding to annual rates of 35·3 and 28·9 per 1000 of the population.

IN London 2750 births and 2413 deaths were registered during last week. Allowance made for increase of population, the births were 145 below, while the deaths were 595 above, the average numbers in the corresponding weeks of the last ten years.

HERR FRUHLING, of Königsberg, has given the tensile strength of ice at 23 deg. Fah. as between 142 lb. and 233 lb. per square inch. Its compressive strength found by cubes of over 2in. at the same temperature varied between 61 lb. and 204·8 lb., a mean being 148 lb. per square inch.

THE deaths registered during the week ending March 20th in twenty-eight great towns of England and Wales corresponded to an annual rate of 29·3 per 1000 of their aggregate population, which is estimated at 9,093,817 persons in the middle of this year. The six healthiest places were Norwich, Leeds, Bristol, Leicester, Birkenhead, and Sunderland.

THE annual death rate of London during the week ending the 20th inst. per 1000 from all causes, which had been 25·0, 26·9, and 28·7 in the three preceding weeks, rose to 30·3, and exceeded the rate in any week since February, 1882. During the first eleven weeks of the current quarter the death rate averaged 24·9, and exceeded by 1·0 the mean rate in the corresponding periods of the ten years 1876-85.

SOME of the soldering fluids used are injurious to tools and also to parts that have been laid on the bench. The following fluid, an American paper says, will do the work as well, and will not rust and tarnish any more than water would. Take two ounces of alcohol and put into a bottle, and add about a teaspoonful of chloride of zinc and shake until dissolved. Use it in the same manner as muriate of zinc, commonly used. It has no bad smell.

CONCERNING cement for leather belting, the *American Engineer* states: "One who has tried everything says that in an experience of fifteen years he has found nothing to equal the following: Common glue and isinglass, equal parts soaked for ten hours in just enough water to cover them. Bring gradually to a boiling heat, and add pure tannin until the whole becomes ropy, or appears like the white of eggs. Buff off the surfaces to be joined, apply the cement warm, and clamp tightly."

TO remedy the hardness of castings which will sometimes occur from putting very hot metal in very loamy sand moulds, or from the moulds being too much wetted, the *Bulletin de la Céramique* recommends the subjection of the objects to a process of annealing, which softens the surface. When the objects treated are of grey pig iron, they are put in cases surrounded with coarse sand, and heated for twenty-four hours with sal-ammoniac and forge scales in the proportion of one part of the former to twelve of the latter.

PROFESSOR FUCHS' record of seismic events of 1884, gives 123 shocks of earthquakes, distributed in time as follows:—Winter, 57 (December, 19; January, 28; February, 10); spring, 24 (March, 13; April, 7; May, 4); summer, 21 (June, 5; July, 9; August, 7); autumn, 21 (September, 8; October, 1; November, 12). Those deserving individual mention are, March 24th, in Upper and Central Slavonia, where in Diakovar and other places numerous buildings suffered injury; April 22nd, in England; May 13th, in Crevassa, where a church and other buildings were destroyed; May 19th, on the Persian Gulf, in which 200 persons fell victims by the overthrow of their houses; August 10th, in the eastern United States; and the Spanish earthquakes in December. In regard to the last, Dr. Fuchs believes the centrum was not a point, but a line parallel to the Sierras Tejeda and Almijara; nor does he think they were of greater importance than those of Belluno in 1873, of Agram in 1880, and of Chios in 1881. There was very little volcanic activity throughout the year, and that only in Ætna, Vesuvius, and St. Augustin, in Alaska.

AT a meeting of the Meteorological Society on the 17th inst., the President—Mr. Ellis—gave a historical sketch of the barometer. After remarking on the accidental nature of the discovery of the instrument in the year 1643 in its best form, in ignorance for some time of its value for purposes of meteorological inquiry, he gave a brief account of many early kinds of barometers, the first endeavour being, in consequence of difficulties experienced with the ordinary mercurial form, to enlarge the scale of variation; attempts which, in general, introduced other errors and inconveniences. The desire to experiment on elevated positions induced the construction of an early form of portable barometer; one such, with cistern completely closed leaving the air to communicate through the pores of the wood, having been made above 200 years ago. The President further described various points in the arrangement of the Ramsden, Gay Lussac, and other barometers, including also mention of some modern patterns of long range barometers, standard barometers, and such barometers as are more commonly used. The practice of driving out air from the mercury by heating or boiling appears to have been in use early in the last century. Engraved plates, indicating the weather to be expected with different heights of the mercury, have been longer used, at least as early as 1688. As regards correction for temperature, De Luc in the last century adopted a temperature corresponding to 54·5 deg. Fah. as that to which to make reduction, because corresponding nearly to the average of observations, such reduction being now made to the natural zero 32 deg. Fah. Reference was made to the employment of water—as in the well-known Royal Society barometer—and other liquids instead of mercury; also to various kinds of floating and other barometers not at all or not entirely mercurial, and to metallic barometers, history of recording barometers or barographs, and the application of photography and electricity to recording purposes.

AT a recent meeting of the Berlin Physical Society, Dr. Schulze-Berge spoke on the condition of electricity in dielectric media, a subject which had hitherto been examined in most cases only from a technical standpoint, in order to determine the insulating power of gutta-percha sheathings for telegraph wires and cables. If it were assumed that the resistance of the dielectrics differed with the thickness of the layer, according to the same law as prevailed in metals, then—seeing that the resistance of a cubic centimetre of gutta-percha was, in accordance with Jenkin's determinations, equal to 25×10^{12} ohm—the thickness of a layer, the resistance of which amounted to about 100 ohms, and ought to be measurable, must be so small as to be incapable of being produced. It might possibly be the case, however, that in dielectrics the resistance varied in another relation to the thickness; and, in point of fact, he had found that a gutta-percha layer of $\frac{1}{13}$ millimetre thickness, and a superficies of 175 square centimetres inserted between two metal plates into the circuit of a Daniell's element connected to earth, produced a very rapid discharge. Measurements executed by the speaker by means of a quadrant electrometer on thin layers of gutta-percha, sulphur, paraffine, and sealing-wax between two metal plates, yielded resistances very well capable of being measured, and which in the case of gutta-percha amounted on an average to about 200 ohms. In the case of sulphur the values varied between 20 and 2000 ohms, and just as varied and irregular were the resistances in the case of the two other substances. The layer offering resistance was produced by placing rubber tissue or purest flowers of sulphur on a heated plate of zinc, and thereupon pressing the second heated metal plate, after which the whole was allowed to cool. In the course of time the resistance changed. In the case of sulphur it increased; in the case of paraffine and sealing-wax, however, the resistance abated; in the case of gutta-percha the resistance continued pretty equal.

MISCELLANEA.

THE full-power trial of the engines of the composite corvette Emerald, a few days ago, gave a total of 1795-horse power, and a mean speed of 12·142 knots an hour.

IT is announced that on and from the 1st of April parcels not exceeding 7 lb. in weight will be received at any post-office in the United Kingdom for transmission to Switzerland.

AN exhibition on saving life at and extinguishing fires will be held at the Royal Aquarium, Westminster, commencing May 1st to 15th next. Lectures, demonstrations, and competitions will take place.

TO-MORROW afternoon, at three o'clock, at the Royal Institution of Great Britain, Albemarle-street, the first of two lectures will be delivered on "The Astronomical Telescope," by Mr. Howard Grubb, F.R.S., F.R.A.S.

LLOYD'S sub-agent at Ismalia, under date March 23rd, 9.50 a.m., telegraphed that the Carthage, lighted by electricity, left Port Said on the 22nd at 8 p.m. and arrived at Ismalia at 5 a.m., the trip being very successful.

BELGIAN competition will not many years be so very excessive if strikes like the present one are to become common and check the Belgian progress, especially if the men get notions as to the inferiority of their wages as compared with what England pays. The men on strike are wandering about the different villages and the outskirts of Liége begging, and promising to spare those who give them alms.

SOME very large centrifugal pumps have been made by Messrs. John and Henry Gwynne, who have recently fixed them for the Mersey Docks and Harbour Board. Four of these pumps, with suction pipes 36in. diameter, driven by engines 21·5in. cylinders, 2ft. stroke, and 160 revolutions, lift 685·6 tons per minute. They are to fill up the Sandon Dock, 10 acres in extent, so as to increase the depth 5ft. This the pumps have done in 90 minutes, lifting 60,000 tons of water in that time.

THE *Twickenham and Thames Valley Times* of March 13th reports as follows respecting the new sewage pumping engine erected by Messrs. Hayward Tyler and Co., of London:—"The contract pumping power of the pumping engines at the outfall works having been tested in the presence of Messrs. Little, Donpart, Withers, Beard, Begent, and the surveyor, the committee had much pleasure in reporting their approval of the machinery, and that the conditions of the contract and quantity to be lifted of 1,000,000 gallons per ten hours were fulfilled in a satisfactory manner."

"A MAN of Mark-lane," in the *Mark-lane Express*, repeats the untruths concerning the London water which an interested few circulated some years ago, and which will probably be repeated for ever by those who find it more pleasant to grumble than find out the truth. He says that, "if Mr. Chamberlain—[why Mr. Chamberlain does not appear]—could organise a scheme for supplying London with pure drinking water in the place of the sewage and water at present barbarously consumed by the people of the greatest city in the world, he would be the means of setting to work thousands of labourers in the most useful way possible. No public work could be more desirable." There is not one word of truth in this deprecation of the London water, and thousands of labourers would not be a bit of use even if it were true, and the scheme could be organised. London water is equal to that supplied to any large city in the world, and no one can disprove this as a broad statement. London house water cisterns are bad, but before it enters these the water is excellent.

THE lighting of railway carriages by electricity is, the *Electrician* says, making great strides in France, and recently the Compagnie des Wagons-Lile have been carrying out a course of experiments under the direction of their engineer, Mr. Street, with the system recently invented by M. Lucien Desruelles, the results of which are said to have been of a satisfactory nature. The experiments have been principally carried out on the restaurant cars; each car is lighted by twenty-one incandescent lamps, of which nineteen are of 6-candle power and two of 3-candle power. These lamps, with the exception of the two last, which are grouped in series, are placed in multiple arc upon the terminals of the source of electricity, which, in this case, is a primary battery invented by M. Desruelles. Each of the elements weighs 14 kilogrammes and has an E.M.F. of 2·19 volts, giving on short circuit about 35 amperès. Its capacity is about 200 ampère hours. The twenty-one lamps in each car are supplied by a battery of 45 elements, 15 of which are connected in series and 3 in multiple arc; in average working the difference of potential at the terminals is 17 volts, and the current about 17 ampères.

AN elaborate report has been issued by the Board of Trade on the explosion of a feed-water heater in the Midland Railway Company's Carriage Works at Derby on the 1st November last. The heater was formed by giving the lower part of a wrought iron chimney, which carried off gases from two Siemens regenerative gas furnaces, an annular form, one tube being rivetted inside another, and the space between filled with water. This chimney feed-water heater was connected to a 7in. water main, but it had not been quite finished, an escape pipe for preventing the accumulation of pressure not having been fixed, and a temporary test cock used instead for the few days it had been at work. If the escape pipe had been fixed the heater would have been an open annular tank, but not being finished the heater was a closed vessel, and when the water supply cock was closed pressure could accumulate. Both things happened, and the inner tube, 19ft. long, 31in. diameter, and 0·3125in. thick, collapsed. The report by Mr. Peter Samson gives the pressure that would collapse the tube, assuming it to be covered with water and as much out of the circular form as long tubes generally are, approximately from the following formula:— $\frac{375{,}023 \times T^2}{L \times D} = P$, where D = the diameter in inches, L = the length in feet, P = the collapsing pressure in pounds, T = the thickness in inches; or as about 64 lb.

IT has long been known that petroleum existed in the neighbourhood of Suez, but previous explorations had produced no result. In September, 1884, a Belgian mining engineer, M. Debay, was sent to report on the possibilities of the practical working of the oil beds. He reported favourably, and considered the experiment was worth a preliminary expenditure. Accordingly he was entrusted with £3000, and was charged to engage workmen for the purpose of ascertaining the value of the discovery. M. Debay, with thirty Belgian workmen, was dispatched from Suez towards the end of November, 1885, the Government agreeing to defray all expenditure until the 1st of March. After carefully selecting a spot on the peninsula of Jemsah, on the west coast of the Red Sea, about 170 miles south of Suez, at the foot of the mountain known as Djebel Zeit, or Oil Mountain, he commenced boring at a distance of thirty yards from the sea on the 15th of January. After penetrating successively through gypsum, containing veins and nests of sulphur, shale, green and blue clay, limestone, and sandstone, the drill on February 28th, the day before the expiration of the period limited, fell suddenly 40 centimetres, and petroleum rose, it is reported, to a point two metres above the sea level. On receipt of the news, Nubar Pasha, with characteristic energy, arranged an expedition, which a *Times* correspondent was permitted to accompany. He says:—"The examination by the party of above-mentioned experts has resulted in the establishment of the following facts:—That petroleum undoubtedly exists; that the geological formation of the country is favourable to the existence of larger quantities at lower depths; that the store of oil is generally distributed over a large area in the neighbourhood; that under existing unfavourable conditions a single source yields about two tons daily; that the specific gravity is ·88; and that the spot is easily accessible from the coast, where there is exceedingly good anchorage."

THE KÖRTING-LIECKFELD GAS ENGINE.

MESSRS. KÖRTING BROTHERS, LONDON, ENGINEERS.

(*For description see page 249.*)

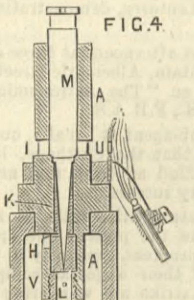


FIG.4

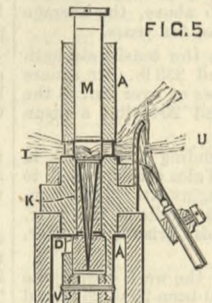


FIG.5

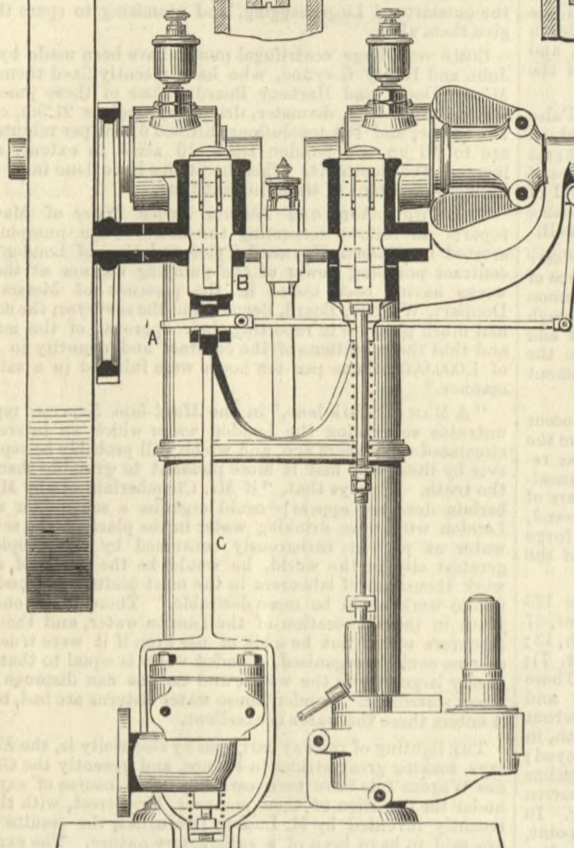


FIG.1.

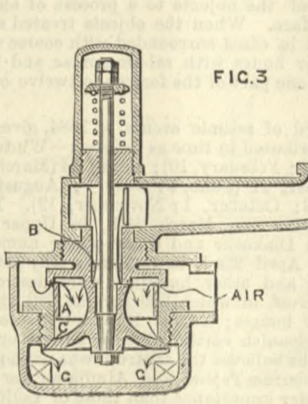


FIG.3

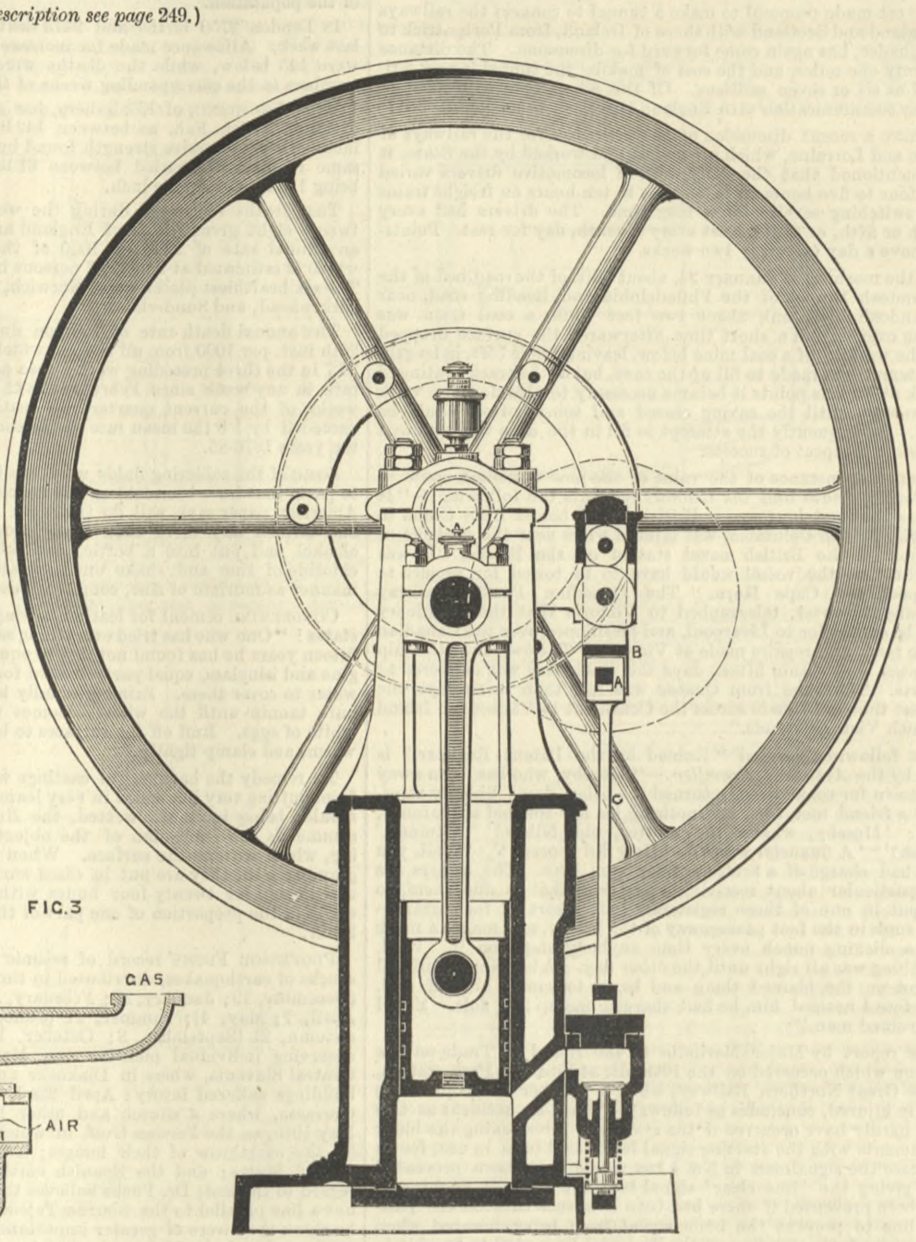


FIG.2.

Fig 6

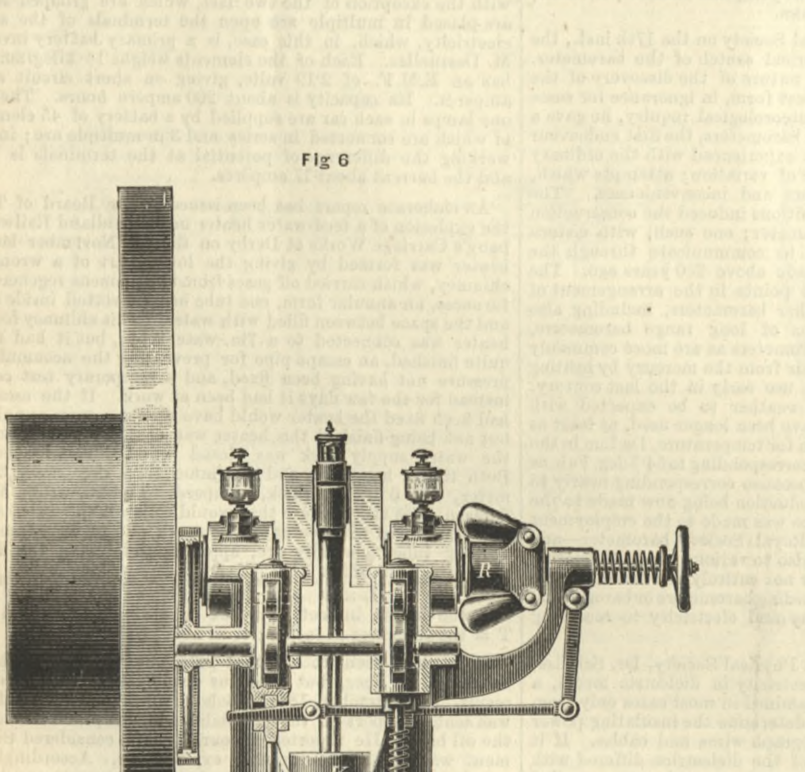
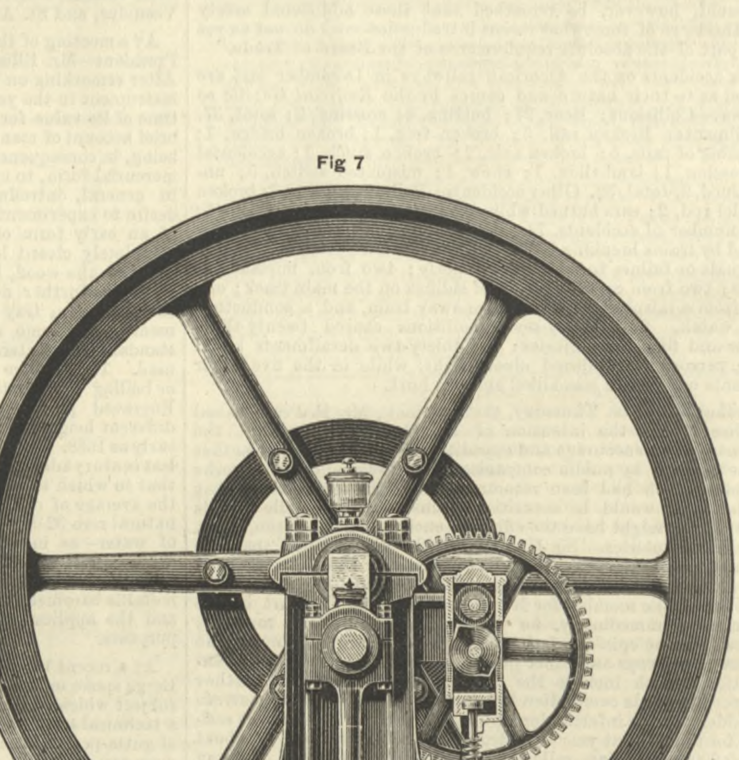


Fig 7



CONTENTS.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

*** *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.*

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

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

H. C. (Barnsley).—*Apply to Messrs. Macmillan, Bedford-street, Strand.*

F. M. R —*We cannot insert, for reasons which we have already very fully explained, any letters raising questions of priority of invention.*

J. P —*Both may be considered good, but under all ordinary applications the bar with the greater deflection will be the better one. You should say with what load the bars break.*

J. B. H.—(1) *You can get a patent for the mixture.* (2) *You can get a patent for the use of the mixture.* (3) *What the patent would cover depends on how it is worded. Comprehensive specifications of the kind you suggest require to be drawn with great skill by a highly competent patent agent.*

LEAD MILLS.

(*To the Editor of The Engineer.*)

SIR,—Will any reader kindly give me the address of firms making machinery for rolling tea chest lead? CONGOU.
London, March 24th.

TRAPPING GREASE.

(*To the Editor of The Engineer.*)

SIR,—Would some of your numerous correspondents of THE ENGINEER kindly give a description of the best way of trapping oil from a surface condenser so as to prevent its going into the boilers, and when the plates and tubes have become greasy, what is the best way to clean them?
Greenwich, S.E., March 24th. ANTI-FAT.

SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

Half-yearly (*including double numbers*).. .. .. £0 14s. 6d.
Yearly (*including two double numbers*) .. .. .. £1 9s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made. THE ENGINEER *is registered for transmission abroad.*

Cloth cases for binding THE ENGINEER *Volume, price* 2s. 6d. *each.*

A complete set of THE ENGINEER *can be had on application.*

Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the rates given below:—Foreign Subscribers paying in advance at the published rates will receive THE ENGINEER *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

Remittance by Post-office order. — Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Egypt, France. Germany, Gibraltar, Italy, Malta, Natal, Netherlands, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, Cyprus, £1 16s. China, Japan, India, £2 0s. 6d.

Remittance by Bill in London.—Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Mauritius, Sandwich Isles, £2 5s

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Friday, March 26th, at 7.30 p.m.: Students' meeting. Paper to be read, "The Construction of the Hirnant Tunnel on the Line of Aqueduct of the Vyrnwy Waterworks for the Supply of Liverpool," by Mr. William Andrew Legg, Stud. Inst. C.E. Mr. James Mansergh, Member of Council, in the chair. Tuesday, March 30th, at 8 p.m.: Ordinary meeting. Papers to be further discussed, "The Economical Construction and Operation of Railways in Newly-developed Countries, or where Small Returns are Expected," by Messrs. R. Gordon, J. R. Mosse, and G. C. Cuningham, MM. Inst. C.E. Paper to be read, time permitting, "Water Purification: its Biological and Chemical Basis," by Mr. Percy F. Frankland, Ph.D., B.Sc., F.C.S.

KING'S COLLEGE ENGINEERING SOCIETY.—A general meeting will be held on Tuesday, March 30th, at 4 p.m., when Mr. H. C. Paxon will read a paper "On Sanitary Towns."

PARKES MUSEUM OF HYGIENE, 74A, Margaret-street, Regent-street, W.—Thursday, April 1st, at 8 p.m.: Lecture by Dr. Louis Parkes "On London Vestries, and the Administration of Sanitary Laws in the Metropolis."

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, March 29th, at 8 p.m.: Cantor Lectures. "Petroleum and its Products," by Mr. Boverton Redwood, F.I.C., F.C.S. Lecture IV.—The uses of petroleum and its products Illumination: paraffine candles, mineral oil and spirit lamps, air gas, natural gas. Heating: crude petroleum and petroleum residuum as fuel, mineral oil stoves. Natural gas as fuel. Lubrication. Pharmaceutical. Wednesday, March 31st, at 8 p.m.: Seventeenth ordinary meeting. "Methods for Rendering the Blind Self-Supporting," by Mr. T. R. Armitage, M.D. The Right Hon. Sir Henry J. Selwin-Ibbetson, Bart., M.P., will preside. Friday, April 2nd, at 8 p.m.: Indian Section. "The History of Archæology in India," by Mr. James Gibbs, C.S.I., C.I.E., late Member of the Viceroy's Council. Sir George Birdwood, M.D., C S.I., Member of Council, will preside. Saturday, April 3rd, at 3 p.m.: Special lecture. "Electricity," by Professor George Forbes, M.A., F.R.S.E.. Lecture I.—Electro-motive force and potential.

THE ENGINEER.

MARCH 26, 1886.

THE EDUCATION OF ENGINEERS.

THERE are two theories extant concerning the way in which young men should be taught the science of engineering. According to one, a college training is all-sufficient; according to the other, nothing will make a competent engineer but practice. Both are right; but both are wrong in the sense that they are too narrow and exclusive. There is more to be said in favour of the latter than of the former view; because it is quite possible for a man who has never been taught the refinements of the theory of his profession to be a competent and successful engineer, while it is quite impossible for a man who has had nothing but a college training to be either or both. We dealt briefly with one aspect of the question in our last impression, but more can be said on the subject with advantage.

Let us consider what it is that is taught in an engineering college. On examination it will be found that the whole course of study is intended to teach the pupil the science of quantity, dimension, and proportion, and nothing else. For example, he learns the law of gravitation, how to calculate the speed which a body attains in falling from a given height. The rule $v = 8 \sqrt{H}$ gives nothing but a quantity. Trigonometry teaches how quantity of distance, if we may use the phrase, is to be measured. The rules by which the strength of a girder or a boiler is calculated all deal with quantities or dimensions. Marriotte's law gives quantities of volume and dimensions of pressures. The barometer, thermometer, sextant, theodolite, are all instruments for measuring quantities or dimensions of some kind. Statics and dynamics deal with dimensions, proportions, ratios, quantities, and nothing else. Euclid, algebra, all deal with the same things, and with nothing further. No one can dispute that such knowledge of the art of measuring—for that is what it all comes to in the end—as can be imparted by a college training, must be of enormous use to the engineer; but engineering means a great deal more than the art of measuring and calculating, and just in so far as it means more must a training which teaches nothing but the art of measuring and calculating fail to make an engineer. The mistake made too often by professors and college men is that engineering is nothing more or less than measuring and calculating. It is a natural mistake, for those who hold this view most strongly are just those who have never done any engineering work themselves. Let us see what engineering really means.

It may be divided under two heads—civil and mechanical; or, more accurately speaking, statical and dynamical. The civil engineer has to deal almost entirely with matter at rest; the mechanical engineer almost entirely with matter in motion. Now, the first object which a young man's parents, at all events, have in making an engineer of him is that he shall earn his livelihood. It is a noteworthy fact that the civil engineer almost always uses other people's money, while the mechanical engineer uses his own. Take, for example, a civil engineer employed to make a railway; none of his own money is invested in the line. The sum to be spent is so large that nothing short of the united purses of many capitalists can supply it. A mechanical engineer, on the other hand, will be a partner or proprietor in a concern, small or large, and will use his own money and his partner's. This fact largely modifies the training required by each. Thus, for example, a man may be a very fair civil engineer, and successful withal, and yet entirely lack commercial skill and experience; while a mechanical engineer equally ignorant on these points must fail in life. So far, it is possible for a civil engineer to be turned out of college a competent man; but no college can turn out a competent mechanical engineer, in the sense of ability to make money. We do not for a moment assert that the civil engineer should not know how to do things cheaply; but it is certain that he has less opportunity for doing mischief than his professional brother, because he is usually well looked after by those who hold the purse-strings. But there is more to be considered. A man taught exclusively at a college is called on to design and erect a bridge. The first portion of the work he will probably do well; nothing is demanded of him but the practice of the art of measuring. He has to calculate—that is measure—the strains to which every part of the structure will be submitted, and to proportion the dimensions of the different parts to the different strains put on them. This is all plain sailing. Place him in the bridge-builder's yard and he is all at sea. Of the actual details of the method of construction he knows nothing. He can know nothing, because bridges are not built in colleges. At last the bridge is completed, and delivered on the site where it is to be erected. As to the way in which it is to be put in place, how the scaffolding is to be got up, how the great weights are to be moved, he is entirely ignorant. The information he lacks cannot be gathered from books. At the very outset he finds himself left at the mercy of a foreman, to whom he is unable to give a single useful order. If he attempted to carry out the work himself he would spend twice the time and money needed, and probably fail in the end. We once knew a young man, and a clever one too, who was sent down the country to superintend the erection of a large steam engine. He wrote back to his employers that nothing could be done until they sent him down a steam crane, and some rails and sleepers on which to work it, as the castings were too heavy to move. His employers sent instead a steady old foreman of labourers. With a "three legs," two crab winches, a couple of jacks, and some heavy balks of timber—all hired on the spot from a contractor's yard—the engine was put in place in three days. The comment made by the young engineer was instructive. "I never knew," he said, "that so much could be done with so little." The difference between the theoretical man and the practical man is that the first knows what a thing ought to be like when it is made, and that the latter knows how to make it.

There is, however, a yet more important point, perhaps, on which we have said nothing. It may be possible to learn in a college how to engineer matter; it is impossible to learn how to engineer men, and this is by far the more difficult of the two. If our younger readers will turn to our advertisement columns, they will find over and over again that one of the first qualifications asked for in a works manager is that he shall be "accustomed to the management of men." What do they suppose this means? A civil engineer may have to control a complete army, to look after their housing, their feeding, their accommodation. He may find himself in the position of a general on the march. Even in our country this has constantly happened on railway works; abroad yet more frequently. Take the case of the Severn Tunnel. How much downright generalship, tact, and energy were needed to carry that work to a successful termination? How much courage, and what is more important, power of giving courage to others, was needed? On one occasion some twenty or thirty men were caught in the tunnel by the inrush of water due to abnormally high tide. A boat had actually to be lowered down the shaft to men standing on a ladder below, and in this boat they had to go to the rescue of their fellow-workers. The engineer in charge worked for thirty-six hours almost without food, certainly with no rest. Those who think that engineers can be made by books do not understand the importance or the glory of the profession.

Many instances can be named in which young men trained in colleges have been thoroughly successful engineers. There is no reason why this should not be the case. We are not arguing against a college training for engineers. All that we maintain is that by itself it is inadequate to the required end. Such an education is the best possible groundwork on which to build up a structure of practice. There is only one drawback to it. It is very slow. A young man leaving college at any age must spend at least two years subsequently in learning the practice of his profession before he can expect to be able to earn enough to support himself, unless his notions on the subject of money are very small. On the whole, however, the system of college training, properly and judiciously carried out, is better than that which it tends to supplant. The old system was to article a lad say sixteen to a mechanical engineer for five years. In this time he learned to become a very indifferent fitter and a worse draughtsman; concerning the theory of his profession he was taught next to nothing. Now a gentleman does not want to be a fitter, although he should possess some skill with tools, for various reasons; and he ought to be a very good draughtsman. By far the better plan is to send a lad of sixteen to some of our colleges—such, for example, as University, Owen's, Mason's, &c.—for three years; and then, when he is well grounded in theory, let him go into the shops for two years. In like manner, if he is to be a civil engineer, then three years at college and two on works will be found the best training; only the young man must bear in mind that in neither case is he at the end of five years entitled to call himself a competent engineer, with nothing more to learn.

THE PREVENTION OF BOILER EXPLOSIONS.

THAT the history of the steam engine will ever come to be absolutely free from records of boiler explosions is scarcely to be hoped for. That such records are happily reduced in number as compared with past times, allowing for the much greater number of boilers now in use, few will dispute. Much has been done, but we venture to think still more may be effected. In the early days of steam boilers, explosions took place sometimes from causes not then controllable as they are now that the art of boilermaking and the science of boiler working are better understood, and tools and appliances are available such as could not be obtained, say thirty years ago. We may be told that if boilers are better made, pressures are increased. Quite so; but a well-made boiler can be, and generally is, safe at its intended pressure, while a badly constructed boiler is never safe at any but insignificant pressures. The boiler user has even more to do in preserving it than the maker; and most, if not all, the refined scientific theories at one time propounded to account for explosions have given place to more intelligible and common sense views, the soundness of which have been demonstrated in a great measure by the various boiler insurance companies, and in a different way by independent research. Since the inception of the first boiler insurance association, by Sir W. Fairbairn, in Manchester, and which at first was strictly private, others have sprung into existence, and, praised by some, blamed by others, those now in existence do good work, and if it were not for difficulties inseparable from all attempts to discipline mankind, could do much more. One obstacle in particular attends the operation of these associations since they came to deal with the public—this is, that their clients or customers seem apt to regard them in a twofold aspect, to consider that all responsibility is taken off their own shoulders, and also that the insurance company has not always a direct interest in preventing explosions; or, put in another way, that although the sum for which this or that boiler is insured will have to be paid if the boiler explodes, it is not directly to their interest to do all in their power invariably to prevent them. There is also a great difference between life insurance and boiler insurance, telling against the latter. In the former case, the insurer seeks to benefit or to provide for others in the event of his death, and except sentimentally, he reaps no personal gain. Boiler insuring is quite another matter; and in the interest of all concerned it may be well if we attempt to make clear the exact relation between a boiler insurer and an insurance company. At the outset, it must be observed that there is one fundamental point of difference between life insurance and boiler insurance. Death is inevitable, explosion is not. When a man insures his life he must inform the office of the state of his constitution, of his age, &c. Long experience has enabled offices to estimate with tolerable accuracy how long the proposed policy will run; the life is accepted subject to certain stipulations as to residence abroad or engaging in hazardous pursuits. There the matter ends. The person insured has not to present himself periodically for medical examination, or to be told he must alter his habits or mode of life. The insurance he effects does not interfere with his comfort in any way, save so far as paying the premium goes.

With a boiler all this is absent. There is no sentimental element about its insurance, and both the effecting of this and its subsequent maintenance entails periodical inconveniences, and even an expenditure of money over and above the premiums, which has a deterrent effect on steam users. Boiler insurance companies do so much useful work, both directly and indirectly, that anything in the least tending to shake confidence in them cannot be too strongly guarded against. It is to be feared that some boiler owners are apt to imagine that an occasional explosion, though at the time causing loss to a company, more than compensates for it by frightening more steam users to insure; and if by some cause for which the company is in no sense responsible, a boiler insured by it explodes, the owner thinks that the company is at all events "not sorry." There cannot be a greater mistake. The one thing that is the backbone of the principle is to demonstrate that explosions are preventible; and though insurance does not prove a perfectly clean bill of health, that does not show that the rare mishaps that do befall insured boilers are due to inability or neglect of the insurers. The relations between a steam user and a company are very delicate. Companies of this kind are, in a sense, traders, like any other commercial body; they work for money, not for love. Their gains are not extraordinary, and they, like any others, must canvass and seek to some extent for customers. Probably some can and do live without the necessity for this; still we all like to extend our business. But even putting this aside, and simply considering voluntary insurers, we find that the inspector has to work under considerable difficulties. When he calls to examine a proposed boiler, unless he does so at holiday time, and by pre-arranged appointment, his visit is simply perfunctory; he can do no examining of a boiler under steam, save and except inspect the mountings, and see if the safety valves are in tolerable order. Such a visit is time wasted, save and except that it may enable an inspector of tact and good sense to win over a waverer to effect an insurance. The greatest care, however, ought to be taken to make it clear to the owner of the boiler that the object of the company—the principle on which it works—is to prevent an explosion, not to treat the transaction as a life policy, and simply agree to make good all loss caused by an explosion. No company working on that principle, we venture to say, could live long. Once the boiler was thoroughly inspected and accepted, the owner would have but one form of interest to give him much further trouble—namely, the delay caused to business if an explosion took place. Was he not insured? Would not everything be made good? So his purse was safe, and also his moral responsibility. Why should he put himself out of his way particularly to carry out the recommendations of the company's engineer, or give special facilities for thorough inspection? In point of fact, boiler insurance, to be of use, must be preventive, not merely compensatory; and such a principle, if it is to be effectually applied, must be recognised both by insurer and insured.

No one who has read any annual report of the chief engineer of any leading insurance company can doubt that such bodies do much to reduce the number of explosions and to prevent the consequent loss of life and property, besides, it is to be hoped, educating young steam users as to the nature of the splendid servant and merciless master with whom they have to do. Judging from the reports of chief engineers the marvel is, not that boilers explode, but that such catastrophes are not of daily occurrence. Here are a few selections:—A Lancashire boiler, 30ft. long, 7ft. diameter, proposed, brickwork removed, inspector pushes, not strikes, but pushes his hammer through some of the plates. Egg-ended boiler, safety valves loaded with fire bars laid on levers conveniently parallel and distant from each other. A steam crane boiler in the West India Docks blown to pieces; evidence to show safety valve lever could be and was at times fouled by cordage and so bent as to jam. This boiler was insured, and this brings us to observe that unless the owner of a boiler is careful to carry out the instruction of the company's engineer it should not be held answerable; in fact, the insurer must himself really desire to prevent explosions, and companies cannot too forcibly impress on their clients the fact that though they have their boilers insured, that fact by no means relieves them of personal responsibility; on the contrary it increases it, for it deprives them of the excuse of ignorance. A company can and will be held responsible, at least by public opinion, if it continue a policy on a badly worn or corroded boiler an hour longer than that occupied in reporting its condition to the owner with an urgent and peremptory caution. It should not be held responsible for shortness of water or jammed or over-loaded safety valves, and the mutual relations between insurers and insured cannot be too clearly understood by insurers.

As an example of the work done by insurance companies take the following extract from a chief engineer's report: "During the year 80,457 examinations were made, of which 10,278 were thorough, 1915 fractured angle irons were found, 508 fractured plates and angle irons, and 1653 safety valves useless." Such facts speak for themselves. We wish these companies or associations all possible success so long as they continue to preserve their good name and do not act in an inquisitorial or vexatious manner; and we would point out to steam users that unless the tale of explosions is kept very low, public opinion may insist on Government interference of a very unpleasant kind.

SHIPBUILDING IN 1885.

THE annual report of the British Iron Trade Association, as regards iron and steel shipbuilding in 1885, has just been issued. It has been prepared, under the direction of the council, by Mr. J. S. Jeans, the secretary, who is one of those rare but useful individuals who have a natural taste for statistics. According to returns received from the several shipbuilding ports, the gross tonnage of new ships launched in the United Kingdom during 1885 was 540,371 tons, which is less than in any year since 1868, and 46 per cent. less than the average of the last five years. The total output was 182,645 tons less than was launched the previous year, the greater part of the decrease having taken place in the Clyde and the Wear yards. Mr. Jeans estimates that this falling-off represents the dismissal of no less than 13,120 workmen who were employed in 1884, and of 50,000 who were employed in 1883. A considerable portion of the report is taken up with an investigation into the question of how far steel has continued to supersede iron as a material for shipbuilding. There is some difficulty in ascertaining this proportion, owing to the fact that Lloyd's Underwriters' Association registers ships not built in this country, as well as those which are. This much, however, appears to be certain—namely, that whereas 151,339 tons of steel shipping were launched in the United Kingdom in 1884, no less than 223,288 tons were launched in 1885, or nearly half as much more. Excluding the returns from those ports where no steel ships were built at all, and taking into account only those coming from ports where both iron and steel were built, it appears that 43 per cent. of these were steel. As regards the Clyde, which has been hitherto the chief seat of steel shipbuilding, and which has special facilities for obtaining the dearer material cheaply, we find that 48 per cent. of all launched were of steel. Other ports were not behindhand. The Tyne-built ships were to a greater extent of steel than they were of iron, and the same may be said of those built at Belfast, Dundee, Hull, Grangemouth, and West Hartlepool. On the other hand, on the Wear, the Tees, Leith, Aberdeen, the Mersey, and Barrow, iron predominated, as it did also at Southampton, Whitehaven, and all other shipbuilding centres not hitherto mentioned. Turning from the statistics of vessels launched, and directing the attention to those of vessels classed at Lloyd's, it appears that 470,240 tons of new shipping was added to the register in 1885, as against 807,708 tons during the previous year. This decrease, amounting as it does to 42 per cent., was entirely in iron vessels and in steamers. There were 56 per cent. less steamers classed in 1885 than there were in 1884, and 57 per cent. less iron vessels. On the other hand, there was an increase of 12½ per cent. in the steel ships registered. Of the new shipping classed at Lloyd's, 95 per cent. was built in the United Kingdom. Of the remainder, amounting in all to only 5966 tons, Germany, the Colonies, Italy, and America each contributed a little. This fact seems to dispose entirely of the idea that foreigners are able to build ships for British owners in competition with British builders, for all British owners would certainly enter their ships in Lloyd's registry. The 5 per cent. of foreign or colonial-built ships registered were, therefore, no doubt for foreign or colonial owners, and the 95 per cent. were mainly for British, but to some extent also on foreign or colonial account. Looking more closely into this proportion, it appears that at the ten ports where vessels were built on foreign and colonial account in 1885, about 16 per cent. were for registers other than British. The increased favour with which sailing ships have latterly been regarded by owners is remarkable, especially when the low cost of fuel is remembered. Taking the production of the Clyde, Tyne, and Wear together as a general indication, it will be found that 272 of the vessels built there were steamers, and 120, or 40 per cent. of the total, were sailing ships. This circumstance tends towards the relief of two of our present great difficulties, viz., the glut of the shipping and the glut of the labour market. For the replacement of steam by sailing tonnage means, firstly, less frequent voyages—that is, less carrying power—and, secondly, the employment of more men. If, instead of the three shipbuilding rivers last named, the total tonnage registered in the United Kingdom be taken, it will be found that the proportion of sailing to steam tonnage built in 1884 was one to two, whereas in the year 1880 it was about one to six. It appears that in France, Italy, and the United States shipbuilding has been for some years declining, and that those nations do not meet their own requirements, far less do they compete seriously with us in our own or in neutral markets. In all Germany the net tonnage launched in 1884 was only 50,277, which is 12,587, or 20 per cent. less than in 1883. But during the five years ending with 1884 an average of 90,000 tons was annually added to the German register. So that Germany appears to buy nearly as much tonnage from foreigners as is built in her own ports. The orders for these are, no doubt, mainly given to English builders. The only vessels of any moment which were built in Germany during 1883 and 1884 on foreign account were two war vessels for China. These transactions were, no doubt, nursed or influenced by the Berlin Government for political reasons, and were not made on their own merits in fair competition with English builders. There were twenty yards where iron ships were built in Germany in 1884, but only five of these were able to turn out more than 4000 tons in the year.

HAND GRENADES FOR EXTINGUISHING FIRES.

A NUMBER of German savants have been recently engaged in investigations into the manufacture of these new weapons against fire. One of the first grenades put on the market was found to contain some free carbonic acid gas—under feeble pressure—a considerable sediment of carbonate or bicarbonate of soda, and a liquid containing in solution common salt and chloride of ammonium, also some sulphate of ammonium. Since this was made, however, the composition has been simplified, and Dr. Geissler has made the following three analyses. In Hayward's hand grenade the bottle was found to contain a yellowish, slightly turbid aqueous liquid, containing in solution 15·7 per cent. of chloride of calcium, and 5·6 per cent. of chloride of magnesium, with the usual impurities of crude salt. The contents weighed 760 grammes—450 grammes = 1 lb. In Harden's hand grenade the contents weighed 555 grammes. This was a yellowish, somewhat turbid aqueous liquid, containing in solution 19·46 per cent. of common salt, and 8·88 per cent. of chloride of ammonium. In Schoenberg's "Feuertod" the contents weighed 440 grammes, and was a slightly turbid, almost colourless liquid, containing 1·66 per cent. of carbonate of soda and 6·43 per cent. of common salt. In connection with this subject two formulas are given in the *Pharmac. Centralhalle* by Dr. Eng. Dietrich. Both are intended to extinguish fire, one by withdrawing or consuming the oxygen, the other by coating the combustible objects with a protecting crust. The former, or "dry fire extinguisher," is made as follows:—Nitrate of potassium—powdered—59 parts; sulphur—powdered—36 parts; charcoal—powdered—4 parts; and colcothar, 1 part. These are dried thoroughly, and then mixed, and fitted into pasteboard boxes, each holding about 5 lb. Through an orifice in the side a fuse or quick match is fixed, which extends some 4in. inwards and 6in. outwards, and fastened on the outside. These extinguishers are intended for closed rooms, and are said to act automatically. Dr. Dietrich says that he has tried them, and has found their effect excellent. The liquid fire extinguisher is made of chloride of calcium—crude—20 parts; common salt, 5 parts; and water, 75 parts. This solution can be thrown into the fire by a hand pump, or in ordinary bottles. The burning portions become incrusted and cease to be combustible. With these receipts persons could very well make their own solutions and keep them in convenient places, together with hand pumps for projecting the liquid.

FAST TORPEDO BOATS.

ADVICE has just been received of the safe arrival at Pola of the two Austrian torpedo boats of the Falke type, lately constructed by Messrs. Yarrow and Co. During the voyage they proved themselves to be thoroughly seaworthy, and made the run from Portland to Oporto in two days. This class of torpedo boat is of especial interest, on account of its exceptional speed, which led to the remarks made by Lord Charles Beresford in the House last week, when he strongly advocated adding to the Navy a number of this type, with a speed of from 22 to 23 knots an hour, the torpedo boats now being constructed for the British Admiralty having only a 19 to 20-knot speed.

LITERATURE.

Modern Armour, a Question for the Day. By Lieutenant W. H. JACQUES, U.S. Navy. 1885. New York: "G. B. Putnam's Sons."

THE question mainly discussed in this pamphlet is whether iron or steel will be employed generally in the future. The writer has visited Europe repeatedly, being well known as the author of the work embodying the results of the labours of the Gun Foundry Board. He has collected valuable information which we have not met with elsewhere, and his opinions are such as must win consideration and respect, and are ably and clearly expressed. On the tests of plates Lieutenant Jacques gives much information, and some beautiful cuts of results obtained at Gâvre, of which very little is ever known in this country. On steel Lieutenant Jacques is especially strong. He considers it undoubtedly the armour of the future; and it is not surprising, consequently, that he has given us more data in connection with it than with wrought iron. The book is the more valuable in England on that account, where we have the facts on the other side more within our reach.

On the future of armour he says: "In regard to future development, I am not alone in the belief that the progress is limited to steel. Whether the best steel plate will be compounded mechanically — and there are those who believe that they have devised the means—or whether the Schneider hard front and soft back will reach the highest development by the means he now employs, the future must decide; but the great cost of compound armour, and of sandwiching and accurately fitting wrought iron, added to the inferior resisting power and greater weight and space occupied, clearly demonstrates that, for economic as well as military reasons, *steel* is the best material for the armour of ships and fortifications."

In a great deal that is said by Lieut. Jacques we concur. On a large scale steel plates have shown wonderful powers during the last few years, and he reviews the experiments fairly enough. Nevertheless there are points that should be borne in mind. Our author admits that steel has failed at times from brittleness. It remains to be shown whether this fault can be altogether obviated by improvement in manufacture. He contemplates a hard face and tough back, such as we should all like to have. We are inclined to think, however, that the difficulty in guarding against occasional brittleness has been found such that steel has become softer, and the hard face almost given up. Certainly in the later experiments steel has been perforated in a manner unknown in former trials. In Spezia, in 1884, a clean hole was made through the steel, through which the projectile passed bodily, though breaking up into a few pieces. We have not ourselves given up the hope of seeing the compound principle applied to steel of different qualities, but we have not yet seen the combination of hard face and tough back on Schneider's system. Lieut. Jacques gives a sketch of a very remarkable proof plate at Gâvre, but the projectiles fired were chilled iron. In the main we agree with the conclusions of the pamphlet, and commend it to English readers. In certain details we differ from the writer. For example, we cannot admit that the union of iron and steel in compound plates has not been successfully achieved. He implies this when he says that "there is no compound plate in existence where the weld is perfect." We have been much struck by seeing plates under strains separate at the junction surfaces of layers of wrought iron in preference to that of the steel and iron, and we consider this part of the manufacture has been conspicuously successful generally.

Lastly, with regard to wrought iron, the recent Bucharest trials illustrate the fact that it has a peculiar power—such indeed as has long been attributed to it in this country—to bear long-continued fire from any guns that are not capable of perforating it. For this reason soft wrought iron will probably long maintain its value for inland defences, while for coasts the manner in which the plate-upon-plate system lends itself to alterations or further development of resisting power, is a great recommendation. Steel-faced armour has peculiar powers of resisting oblique blows. This again was seen at Bucharest. The fact is that while solid steel has certainly resisted full-front attack on a large scale as nothing else has done, it has to develope a good deal in three particular directions—hardness of face, toughness and softness of body, and certainty as to its qualities—before it replaces wrought iron in all its forms.

Almanach für die K. K. Kriegs-Marine. 1886. 12mo. pp. 338. Pola-Vienna: Gerold and Co.

ALTHOUGH this handy little volume is intended primarily for the use of the officers of the Austro-Hungarian navy, it appeals to a much more extended circle of readers, as in addition to the seniority lists and service regulations of the Imperial and Royal Marine it gives summaries, which are at the same time both elaborate and complete, of the naval forces of other nations and their armaments. The first part contains a very good series of tables of the weights and measures of different countries, as well as others for the conversion of English nautical units and combined quantities—foot-pounds, pounds per I.H.P., &c.—into the corresponding metrical quantities and *vice versâ*. The second part deals with naval artillery, giving dimensions and ballistic data for the different systems, and diagrams of the armour-piercing power of the larger guns now in use, while the third is devoted to the fleet lists of the different Powers, which are taken in alphabetical order. By the use of a well considered system of abbreviations the leading dimensions of each ship and her armament are condensed into a single line, so that the navy lists of the whole world are brought into a very small compass, and in addition the year of launching, draught of water, and realised speed, data which are not usually contained in the official lists are given. The list is followed by a supplement in which descriptions of the structure and appearance of the principal armour-plated and protected ships are given in some detail, together with data concerning their coal stowage, and manœuvring capacity. The dimensions throughout are given in metrical measure. This part of the book contains descriptions of many strange marine monsters now under construction, among which the French torpedo ram cruiser, Tage, seems to take the first place. She is described as being 390ft. long, 52ft. broad, and 7045 tons displacement, at a mean draught of 23ft., and intended to steam 19 knots with engines of 10,330-horse power. Protection is afforded by an armour-plated deck and battery bulkheads, and a cellular belt filled with *cellulose*. This seems to be the largest imitation of the Polyphemus yet undertaken, as other European naval Powers adopt ships of the Esmeralda class or even smaller as torpedo cruisers. The fourth and final part contains the navy list proper, and the circulars and orders for its government, which latter as regards complexity and minuteness, bear a strong family likeness to those issued by "My lords" from Whitehall.

BOOKS RECEIVED.

Report on the East Anglian Earthquake of April 22nd, 1884. By Raphael Meldola, F.C.S., W. White. London: Macmillan and Co. 1885.

The Design and Construction of Harbours: a Treatise on Marine Engineering. By Thomas Stevenson, *P.*R.S.E., F.G.S. Third edition. Edinburgh: A. and C. Black. 1886.

The Practice of the Improvement of the Non-tidal Rivers of the United States, with an Examination of the Results thereof. By Captain E. H. Ruffner. New York: John Wiley and Sons. London: Trübner and Co. 1886.

Dynamo-electric Machines: a Manual for Students of Electrotechnics. By Sylvanus P. Thompson, D.Sc., B.A. Second edition. London: E. and F. N. Spon. 1885.

Notes on the Chemistry of Iron. By Magnus Troilus, E.M. London: Trübner and Co. New York: J. Wiley and Son. 1886.

The Modernised Templeton: the Practical Mechanic's Workshop Companion. By W. Templeton. An entirely new edition. Revised, modernised, and enlarged, by W. S. Hutton, C.E. London: Crosby Lockwood and Co. 1886.

Land and Marine Surveying in Reference to Preparation of Plans for Roads, Railways, Canals, Rivers, Towns, &c. By W. Dans Haskoll, C.E. Second edition. London: Crosby Lockwood and Co. 1886.

Frictional Electricity. By T. P. Tregloham. London: Longmans, Green, and Co. 1886.

Berly's Universal Electrical Directory, Advertiser, and Electrician's "Vade Mecum." London: Dawson and Son. 1886.

Annual Report of the Comptroller of the Currency to the First Session of the 49th Congress of the United States. Washington Government Printing-office. 1885.

Some Particulars of the Municipal and Sanitary Works of Blackburn. By J. B. McCallum, borough engineer. Blackburn: J. Janson. 1885.

Statistics of Hydraulic Works and Hydrology of England, Canada, Egypt, and India. Collected and reduced by Lowis D'A. Jackson. London: W. Thacker and Co. 1885.

Mineral Resources of the United States—United States Geological Survey. By A. Williams. Washington Government Printing-office. 1885.

Laxton's Builders' Price Book for 1886. Sixty-ninth edition. London: Kelly and Co. 1886.

Electro Deposition of Gold, Silver, Copper, Nickel, and other Metals and Alloys. By Alexander Watt. London: Crosby Lockwood and Co. 1886.

The Ocean: a Treatise on Ocean Currents and Tides, and their Causes, demonstrating the System of the World. By W. Leighton Jordan, F.R.G.S. Second edition. London: Longmans and Co. 1885.

AUTOMATIC BRAKES IN THE UNITED STATES. — A Pittsburg despatch, dated March 9th, says: "The employés of the Westinghouse Air Brake Company are greatly elated over the large order which, it is said, that company is about to secure. The order is to equip the entire Baltimore and Ohio Railroad with the Westinghouse automatic air brake, placing it on passenger and freight cars. The railroad has about 35,000 cars, and it would take the machine shops, running at their fullest capacity, one year at least to complete the contract. The Westinghouse machine shops are just completing an order for 9000 sets of the brakes for the Atchison, Topeka, and Santa Fé road, and when this is finished every car in the Far West will be equipped. The Pennsylvania Railroad is also contemplating the use of air brakes on its freight cars." According to the *Railroad Gazette*, the number of Westinghouse automatic brakes already in use exceeds 15,000 sets for engines, and 125,000 sets for vehicles, in all parts of the world, and of these 45,000 are for freight cars. There seems to be a fair prospect of these figures being doubled before very long.

GAS ENGINES.

No. VI.*

WE illustrate on page 246 the Körting-Lieckfeld gas engine, of new design, made by Messrs. Körting Brothers, of London, which possesses several features of interest to engineers. The general principle on which it works is that described by Beau de Rochas in 1862,† and which is now so well known as the four-cycle movement, so that any explanation of this may be considered unnecessary. It is to the details that we wish particularly to call the attention of our readers. The most striking departure from the old rules has been made in the method of regulating the speed, which hitherto has always been effected either by diminishing the gas supply, or by reducing the number of explosions. Both of these plans are objectionable, the fault of the former being that the engine is not economical when running much below its full power, on account of the charge being made too weak to get the full effect out of the gas; and although this objection is done away with by adopting the latter plan—where the charge is of uniform strength, and the number of explosions reduced—yet this necessitates a great irregularity in the speed of the engine, which renders it inapplicable for many purposes, such, for instance, as driving electric light machines, where steadiness in running is indispensable. Messrs. Körting Brothers have devised a method of obtaining regularity in the speed without in any way interfering with the economical working of the engine—a result which has never before been attained.

This is effected by varying the quantity of explosive mixture taken in at every second revolution. The proportions of gas and air remain the same, but the quantity admitted is altered, so as to give an explosion of the requisite strength to overcome the resistance of the work. This may be easily explained by referring to the illustration. The governor, Figs. 1 and 2, is connected by levers with a wedge-shaped cotter A, which connects the slide B and the rod C with the exhaust valve. This cotter is free to move horizontally under control of the governor, and according to its position it causes the exhaust valve to be opened to a greater or less extent. Thus, supposing the engine to be working at its maximum power, the governor forces in the cotter as far as it will go, forming a rigid connection between the rod C, Figs. 1, 2, and the slide B, which receives a vertical motion from a cam. The exhaust valve will then have the same amount of movement as the slide B, and will be kept open during the whole of the down-stroke, so that nearly all the waste products are expelled, and on the next up-stroke of the piston a full charge of explosive mixture will be drawn in. Let us now suppose that part of the work is taken off the engine. The cotter will at once be drawn out by the governor, and allow the slide B to move independently of the rod C for a certain portion of its stroke. By this means the exhaust valve will be kept closed during part of the down-stroke, and only a portion of the waste gases will be expelled, the remainder being compressed by the piston, and afterwards allowed to expand again. It follows from this that the quantity of explosive mixture next drawn in will be limited, and will correspond exactly to the amount of waste gases expelled. In this manner the strength of the explosion will be reduced, being exactly adapted to the amount of work put upon the engine, and allowing the latter to receive an impulse once in every two revolutions, which ensures perfect steadiness in running. Reference may be made to Figs. 6, 7, and 8, but not to the letters.

The gas and air are drawn in through a self-acting mixing valve, which is shown in Fig. 3, together with the inlets for both, and the manner in which they combine before passing to the cylinder. The gas passes into the mixing valve through the slots B, which are made in the movable stem of the valve; this is opened by the partial vacuum made when the piston makes its up-stroke, and uncovers the small gas ports. The air ports, marked *a* in the engraving, are necessarily opened at the same moment. Whatever be the extent of the opening of this valve, the quantities of gas and air drawn in are always in the same relative proportion, so that the strength of the mixture in the cylinder never varies. The mixed charge is now drawn along the passage, into which the end of the igniter protrudes—see Figs. 1, 4, and 5—and from there the greater part passes into the cylinder, mingling with the waste gases which remain from the last explosion, while a small proportion is retained in the passage; a back-pressure valve, placed immediately under the igniter, intervenes between the two, and closes as soon as the piston has finished the first up-stroke. The down-stroke is now commenced, and the charge is compressed to from two to three atmospheres. The ignition then takes place, the arrangement by which this is effected being a peculiar feature of the engine. This has been described as follows by the inventors. In Figs. 4 and 5, A is the body of the casting, having in its lower end a movable hollow ram, bored with holes immediately above a conical valve seat D, and in its upper part a solid ram or plunger M, to which motion is imparted from a cam on the auxiliary shaft. While the compression is going on the upper ram M is pressed down on the valve seat I, and closes the communication between the outside flame and the inside of the cylinder, as shown in Fig. 4. As soon as the charge is sufficiently compressed, the upper ram is suddenly lifted, and the pressure on the lower end of the loose ram K forces it up against its seat D—Fig. 5—again preventing any escape of the charge except through the extremely fine hole at the bottom of the hollow cone, which allows only a very small quantity to pass. It is shown at H, and is 2·5 mm. in diameter. The explosive mixture coming through this finds its way to the outside flame, as shown in Fig. 5, where it ignites, and the flame retires at once into the cone. The ignition cannot be communicated to the charge through the small hole, owing to the great velocity of the gases issuing therefrom, but the flame continues to burn at that part of the cone where the gradually decreased velocity allows the combustion to take place. When the piston has reached the dead-point, and it is desired to effect the explosion, the upper ram M is forced down upon its seat, and the lower ram K falls about one-tenth of an inch—see Fig. 5—allowing the flame contained in the hollow cone to ignite the charge, the communication between the two being made by the small holes at D already referred to, through which the flame passes along the channel V into the cylinder.

Another improvement consists in arranging the gear wheels so that the motion shaft has only one-fourth the velocity of the crank shaft, and by placing the carrying rollers above the cams, they are kept in contact with the latter by their own weight, and prevent that objectionable knocking which would otherwise take place.

A feature of great convenience also is the ease with which the speed can be adjusted while the engine is in motion by simply turning the small hand wheel shown on Fig. 1. By screwing this in or out the resistance to the movement of the governor is increased, and the number of revolutions per minute may be increased or decreased correspondingly. Messrs. Körting Brothers have now been several years making gas engines, and in designing the present one the results of years of experience have been embodied in a good engine. The general construction and details are so simple that anyone can take the engine to pieces for cleaning purposes, and the liability to get out of order is very slight indeed. The amount of space which it occupies, which is very small, itself is a strong recommendation. The gas engine is now so well understood that any reader will be able to gather that the principle on which the Körting engine is constructed is that upon which the greatest economy can be secured, namely, the use of a highly compressed combustible charge. Fig. 9 is a *fac-simile* of a diagram from this engine, which to those acquainted with the subject is evidence of very satisfactory performance. Its scale is 4 mm. to the atmosphere. The combustion is not too explosive, it evidently continues some time, the pressure is well sustained, and the diagram is very satisfactory except perhaps in the slight delay in the exhaust.

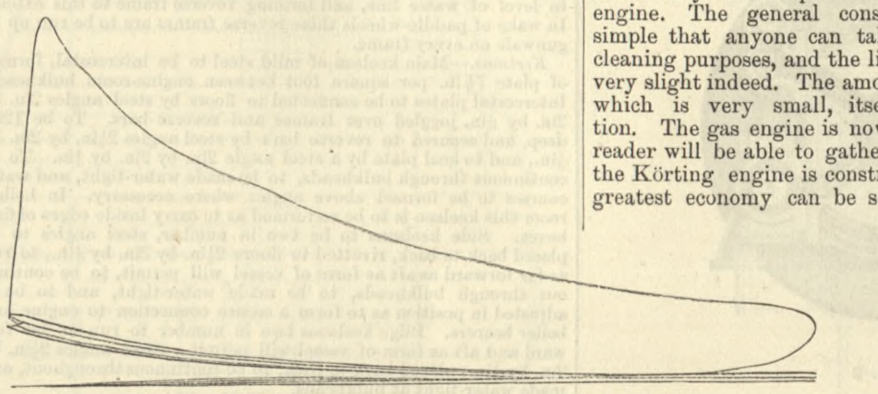


Fig. 9—DIAGRAM FOR KORTING LIECKFELD GAS ENGINE.

Messrs. Körting, like many others, have felt the oppressiveness of those patents which are supposed to cover the whole ground of application of a principle, and they have been in litigation in Germany on the subject. The judgment in the case of Körting Brothers, of Hanover and London *v.* the Deutz Gas Engine Works was published in Leipzig, on the 30th of January last, and is certain to have the greatest influence on the development of the German gas engine industry. A digest of the case has been given as follows:—"The Deutz Gas Engine Works were the owners of three patents—Dr. Otto's—which gave them the entire monopoly of the gas engine trade in Germany. By their interpretation of the first claim in patent No. 532 they asserted that they alone had the right to use an explosive charge consisting of a heterogeneous mixture of gas, atmospheric air, and different gases or products of combustion, so that every gas motor which employed such a charge was considered by them to be an infringement of their patent rights, and builders of such engines were accordingly proceeded against. This claim was especially brought to bear against all engines using a heterogeneous mixture, in which the charge was ignited at that point where there was most gas, namely, at the port where the charge was admitted to the cylinder. The second and third claims of patent No. 532 extended the general principle described in the first claim to engines which worked without compression as well as those which compressed the charge previous to ignition. The fourth claim gave the Deutzer Gas Engine Works the sole right to make engines working on the so-called "viertact" or four cycle principle, in which the same cylinder is employed as the pump and as the working cylinder. If the first, second, and third claims gave them the sole right to employ a rational theoretical principle in the making of gas engines, the fourth claim gave them the monopoly of the only rational mechanical method on which gas engines can be built, and it is, therefore, not to be wondered at that these four claims were always considered by the Deutz Gas Engine Works to be the most valuable part of their patent. In addition to these, there is in patent No. 532—English 1876 patent—a fifth claim, which is merely expressed by the words, "the construction as described." This claim, which is found in many patents, was intended in this case, as it is in all others, to give the patentee a protective right against infringement of the general arrangement and construction of his invention as described in his specification, and signifies the erection or putting together of the separate parts so as to form a complete machine; therefore, any single detail, as such, is not protected by this claim. This has already been decided in former actions in which the Deutz Gas Engine Works have been engaged. It is to be noticed with regard to patent No. 2735—English patent of 1877—that this only refers to the constructive arrangements, the special feature being Claim 2, concerning the slide, which is used in the

* For Art. V., see THE ENGINEER, vol. lx., p. 480. † Vol. lx., p. 441

present engines built at the Deutzer Works, and the novelty of which remains unquestioned by Messrs. Körting. In the first claim of this patent there is specified the arrangement of a port axial to the cylinder, through which the ignition flame is intended to pass, and by entering rapidly, or, as it were, shooting into the midst of the explosive gases in the cylinder, to bring the whole charge at once to the point of ignition, and so produce an instantaneous explosion. This method of igniting the charge is, according to the specification, only intended to allow of the ignition of a homogeneous mixture in contradistinction to patent No. 532—1876—in which the mixture is to be ignited at that part which contains most gas. This claim, therefore, it appears, only refers to a detail in the construction to provide means whereby a homogeneous mixture may be ignited. Further, the Deutz Gas Engine Works possessed by their specification No. 14,254 a patent for the "special construction of a gas engine with compression pump, and the method of working such an engine." [So far as we know, the Deutzer firm have never made an engine according to this specification—probably for the reason that their engine working with a compression pump cannot successfully compete with those which have only one cylinder. The decision of the Reichgericht with reference to the axial port is, it appears, that Dr. Otto only retains his patent for a port constructed in certain proportion to the cylinder and speed of the piston, and also that it must be filled with a richer mixture than that drawn into the cylinder at the earlier part of the stroke.]

'In the recently-concluded case, Messrs. Körting had attacked the whole of patent No. 532—1876—and the first claim of patent No. 2735—1877—the latter on account of the Deutz Gas Engine Works having attempted to give a general interpretation to this claim also. Besides Messrs.

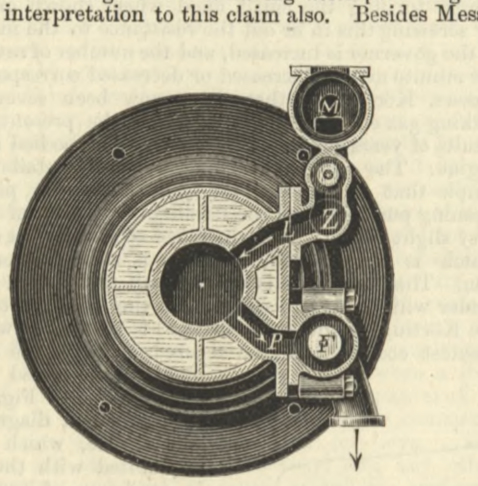


Fig. 8

Körting, the firm of Buss, Sombart, and Co., Magdeburgh, had also attacked patent 532 and patent 14,254. By the decision now published of the 'Reichsgericht'—the highest Court of Justice in Germany—the claims 1, 2, 3, and 4 of patent No. 532 have been definitely invalidated and done away with. Of this patent there therefore only remains the fifth claim, which refers to the arrangement of the whole engine, as such, but which does not secure a patent for any separate detail or method of construction. This claim has in any case no practical signification whatever, as, up to the present time, no engine has been constructed according to this specification. The first claim of patent No. 2735 has also been allowed to remain; and also, of course, the second claim, the validity of which was not questioned. The Deutz firm, therefore, still retain their patent for the slide, and also for the long ignition port intended to produce an instantaneous combustion of the charge; and, further, the special constructive arrangement of the engine described in patent No. 14,254, which, however, is of no great importance, as it would never occur to anyone to make such an engine. On the other hand, the important principles of the Deutzer patent, which for a long time have prevented free competition in the gas engine trade in Germany, have now fallen to the ground. The Reichsgericht has decided that the four-cycle movement mentioned in the fourth claim of patent No. 532 is not an invention of Dr. Otto, but, on the ground of being known to former inventors, shall be for the 'common good of all.' Therefore, every engineer is now free to build an engine on the four-cycle principle if he so wishes. Furthermore, the claims 1, 2, and 3 of this patent, embodying the principle of the formation of the charge for engines with and without compression, have been annulled; and in this case also it has been decided that this principle is no invention of Dr. Otto, but, in consequence of its having been known to older inventors, shall be public property, for "the common good of all." Every engineer is therefore at liberty to employ a heterogeneous mixture for the charge, and to leave a space at the end of the cylinder to contain that charge, which the compression necessitates in the 'viertact, or four-cycle engine. The invalidation of these claims has reduced the value of the Otto patents simply to the discovery of the before-mentioned details of construction, chief of which is the admission slide; this and the long axial ignition port must not be infringed. The Körting gas engine has neither an axial ignition port, since the port enters at the side of the cylinder, nor has it any slide whatever. The gas and air are drawn in through valves, and the arrangement for igniting is one which has been patented and used for some years. The firm of Körting Brothers, therefore, is now in a position to proceed with the manufacture and sale of these engines without interference in Germany."

NAVAL ENGINEER APPOINTMENT.—Stephen B. Williams, chief engineer, to the Hecate.

DENISON'S TESTING MACHINE.—This machine, illustrated in our impression of the 12th inst., is manufactured by Messrs. Samuel Denison and Son, North-street, Leeds.

CONTRACTS OPEN.

EAST INDIAN RAILWAY.—STEEL PADDLE FERRY STEAMER.

THE Indian Railway Company wants tenders for a steel steamer to replace the Kasheejee, at Salubgunge. The work required under the specification consists of one paddle steamer, without woodwork, fitted with diagonal compound engines, surface condenser, feathering paddle-wheels, and tubular boilers, of the following dimensions:—Length over all, 170ft.; breadth moulded, 24ft. 6in.; ditto extreme, 40ft. 6in.; depth moulded, 8ft. 3in.; draught of water on an even keel, with 20 tons of coal on board, all stores, and steam up, with cargo, 3ft. The general appearance and arrangements of vessel to be in conformity with the engraving on page 251. The midship section to have a rise of floor about 3in. The intended speed of the boat is twelve statute miles per hour.

Outside plating.—Of mild steel, Siemens-Martin. Keel plate, 3ft. wide, 10·5 lb. per square foot; from keel plate to upper turn of bilge in engine and boiler rooms, 8 lb. per square foot; remainder of plating, 6½ lb. per square foot. The plates are to be of as long lengths as possible, the longitudinal seams lap-jointed and single-rivetted, the vertical seams butt-jointed. The butt straps are to be $\frac{1}{16}$in. thicker than the plates they connect, and treble-rivetted in engine and boiler rooms; forward and aft to be double-rivetted. The strakes of the plates to be worked alternately in and out, the spaces between the outer strakes and the frames to be fitted in with solid liners 2½in. wide and the thickness of the adjoining plate. All butt straps and vertical edges of plates to be planed.

Stem post.—Of mild steel 5in. by 1in., lower part to be forged to suitable forms to scarph to keel plate, the scarph to be not less than three frame spaces long.

Stern post.—Of mild steel 5in. by 1in., with step on lower end and braces for rudder forged on, to be bushed with lignum vitæ. To scarph into keel plate, the scarph to be at least three frame spaces long.

Mild steel angles.—In engine and boiler rooms 2½in. by 2½in. by $\frac{5}{16}$in. forward, and aft 2¼in. by 2in. by ¼in., in one piece from keel plate to gunwale; to be spaced 24in. apart.

Floors.—Of mild steel 7½ lb. per square foot and 9in. deep. One to each frame, to be carried up frames high enough to make a secure attachment, and as shown in drawing. Limber holes are to be formed through floor plates as low as practicable. Limber chains to be provided.

Floor angles and reverse frames.—To have a steel angle 2in. by 2in. by ¼in. rivetted to the upper edge of each floor plate extending to level of water line, and forming reverse frame to this extent. In wake of paddle-wheels these reverse frames are to be run up to gunwale on every frame.

Keelsons.—Main keelson of mild steel to be intercostal, formed of plate 7½ lb. per square foot between engine-room bulkheads. Intercostal plates to be connected to floors by steel angles 2in. by 2in. by ¼in. joggled over frames and reverse bars. To be 12in. deep, and secured to reverse bars by steel angles 2½in. by 2in. by ¼in., and to keel plate by a steel angle 2in. by 2in. by ¼in. To be continuous through bulkheads, to be made water-tight, and water courses to be formed above angles where necessary. In boiler-room this keelson is to be so formed as to carry inside edges of fire-boxes. Side keelsons to be two in number, steel angles to be placed back to back, rivetted to floors 2½in. by 2in. by ¼in., to run as far forward as aft as form of vessel will permit, to be continuous through bulkheads, to be made water-tight, and to be so adjusted in position as to form a secure connection to engine and boiler bearers. Bilge keelsons two in number to run as far forward and aft as form of vessel will permit. Steel angles 2½in. by 2in. by ¼in., placed back to back, to be continuous throughout, and made water-tight at bulkheads.

Engine and boiler bearers.—To be in mild steel, plate and angles of the box form where possible, and to suit the requirements of the engineers in form and strength. These keelsons are to be secured to reverse bars by small gusset plates, having at least seven rivets at each joint, and to be secured to bulkheads by steel angles.

Bulkheads.—To be five in number, and arranged in accordance with the drawings; to be water-tight throughout. The lower plates to be 7½ lb. per square foot, to have stiffening steel angle bars 2in., 2in. by ¼in., placed vertically about 2ft. 6in. apart. Each bulkhead to be fitted with brass valve capable of being worked from deck, and fitted with brass socket and cover for deck. A bulkhead or transom plate to be fitted on fore side of stern post, and secured by short angles on each side.

Rudder.—Truck of steel plates to be flange rivetted to skin and deck plating and stern post; of sufficient size to withdraw rudder bolt and to be made water-tight.

Tests for Steel and Wrought Iron.

	Tensional strain per square inch.	Reduction of area at fracture per cent.	Extension on whole length of 8in. per cent.
Steel plates either with or across grain, angle or flat bar, not less than	Tons. 27	30	20
Or more than	31		
Iron with grain	20	10	
Iron across grain	18	5	

The engine cylinders.—To be two in number, to be of hard, close-grained iron, a mixture of Scotch No. 1, Blaenavon and good clean scrap, the high-pressure cylinder to be 27in. in diameter and the low-pressure cylinder 48in. in diameter, both cylinders arranged for a stroke of 3ft. The cylinders to be fitted with escape valves at either end, having guards to prevent accidents. Drain cocks to be fitted at ends of cylinders, and slide casings with copper pipes to bilge; to be worked from the starting platform. A supplementary valve to be fitted on to reservoir with a 2in. pipe, for the purpose of admitting steam to low-pressure slide casing to assist in starting the engines. The gear for working the same to be led to starting platform. The reservoir between cylinders to have a relief valve fitted capable of adjustment whilst engines are at work. Indicator pipes with the necessary cocks and gear are to be fitted to either end of both cylinders for the purpose of taking off indicator cards. The cylinders to be felted in all parts, neatly covered with polished teak wood, tongued and grooved and secured by polished brass bands. The piston-rod and slide-rod glands to be fitted with gun-metal bushes, and the stuffing-boxes lined with gun-metal. The high-pressure cylinder to be fitted with a false face for slide valve, of hard close-grained cast iron, secured with brass pins having countersunk cheese heads.

Cylinder covers.—The cylinder covers to be in cast steel of single plate form, ribbed, fitted with polished loose covers in steel plate secured to cover; the space between to be filled with felt.

Slide valves.—To be of the same mixture of iron as the cylinders. The high-pressure valve to be single ported and fitted with expansion valve on back, and the low-pressure valve double ported, with an approved arrangement for relieving pressure on back of both slide valves. Valves to be arranged to cut off at two-thirds of stroke. The doors of slide valve castings to be in cast steel.

Expansion valve.—To be in cast iron working on back of high-pressure valve, of the gridiron form, to be so arranged as to cut off steam at any portion of the stroke from two-twelfths to two-thirds. The hand gear for working the same to be led to starting platform.

Pistons.—To be in cast steel of the single plate form. Edge of junk ring to be flanged. The metallic rings to be in cast iron fitted with the usual steel springs, having solid blocks to carry weight of piston. Junk ring bolts to screw into brass nuts, and the heads of bolts to have secure stops.

Piston rods.—To be in steel. The nuts to secure rods to be on outside of piston as shown, to suit ordinary spanner. The upper end of piston rod to be forged solid and cut out to take gun-metal bearings secured by steel cap, bolts, and nuts. The lower edge to be formed so as to receive guide block; gun-metal bearings to be lined with Parsons' white brass, No. 2.

Connecting rods.—To be of forged steel of the same quality as piston rods, of not less length than 7ft. 6in. centre to centre, to have T-end, with steel caps, bolts, and nuts. Brasses to be lined with Parsons' white brass, No. 2. To have a solid key cast on under side of brasses and let into T-end of connecting rod. The connecting rods, brasses, straps, and bolts to be interchangeable. The lower end to be forked long enough to allow of connecting rod being turned up clear of piston rod cap nuts.

Guide bars.—To be in forged steel, securely bolted to cylinder bottom and cross stay on main diagonal supports. Oil ways to be cut on upper surface, and care to be taken to prevent them being run to outer edge.

Slipper for guide bar.—To be in two parts, joggled and bolted together, lined with Parsons' white brass, No. 2; to be in cast steel.

Slide valve rods.—To be in steel, secured to valves by double nuts and stop pin at bottom end, and with cone and collar at top ends. The rods to be guided at both ends, at lower ends by brass bush secured by pins to slide valve casing, and independent of the cover over end of rod. The upper ends to have an eye forged solid, fitted with steel bolts and nuts for adjusting rocking brasses carrying sweeps. The rod below this eye to be forged square, for the purpose of guiding the upper end; to have cast iron guides fitted to casings in the usual manner.

Excentrics.—To be in cast iron, in halves to be bolted together with steel bolts and nuts carefully stopped. The straps to be of gun-metal, fitted with steel bolts and nuts brought as close to side of excentric as possible, to have provision cast on for taking T ends of excentric rods, with through steel bolts and nuts. Lubricators to be cast on strap.

Excentric rods.—To be in steel of flat section, to have forked ends fitted with adjustable brasses, steel bolts and nuts for attachment to sweeps. If found necessary, these rods are to be trussed.

Links.—To be in steel, not less in length than 15in. between centres. To be made of two bars, with pins forged on the solid. The suspension bar for shifting sweeps to be double, to be attached to go-ahead excentric pins, and to be fitted T-ended with adjustable brasses, steel bolts and nuts stopped. The starting shaft and levers to be in forged steel, the pins to be stopped in end of levers. Blocks for carrying starting shaft to be in cast iron, with steel bolts and nuts.

Expansion gear.—Lever links and rods to be in steel, the links to be double.

Starting gear.—To be a combined arrangement, as shown in drawing, of hand and steam, with water-controlling cylinder, so that by placing the starting handle in any position the links may stand at the same proportionate part of stroke, to be so arranged that the steam or hand gear can be used independently, the steam cylinder to be not less in diameter than 8in. All packing glands to be lined with gun-metal, and all rods and pins to be in forged steel. The starting gear to be efficiently supported below starting platform in general conformity with the drawing, the supports in steel.

Crank shaft.—Crank shafts to be in forged steel, and shrunk on to shafts.

Main stay.—The main stay running from the plummer blocks to cylinders to be in forged steel. The main plummer block bolts to go through upper end, and the lower end fitted against faced provision cast on cylinders, secured by four screwed pins having nuts at either end, turned and fitted into rimered holes; to have boss forged on for taking support, with double nuts.

Support for guide bar.—To be in steel, each guide bar to have separate supports, consisting of two steel stays extending from bottom frame to main stay, having nuts to carry cross beams supporting guides bar. The cross beams to be I-section cast in steel.

Air pump gear.—The levers to be double, and all pins and side rods to be in steel. The main links to be T-ended, fitted with brass bearings and steel caps, bolts, and nuts. The air pump rod through plunger and top nut to be in steel, with gun-metal box nut at bottom, the crosshead to be in steel and turned. The side links to have brass blocks, and through steel bolts and nuts; the bolts to have solid collars, to be worked from crosshead gudgeon of high-pressure engine.

Paddle shafts.—To be in forged steel, the crank to be shrunk and keyed on to paddle shaft. The crank eye to be fitted with gun-metal side pieces dovetailed into crank for taking flattened sides of crank pin. The shaft to be not less than 9¼in. diameter and 15in. long in entablature.

Condensers.—To be in cast iron, generally of the form shown in drawing. The tube plate to be in rolled Muntz's metal, drilled and tapped for ⅝in. outside diameter tubes, 18 B.W.G. thick, fitted with brass screwed ferrules, the ends of which next packing to be smoothly rounded in lathe. Tube plate to be 1⅛in. thick. Tubes to contain not less than 70 per cent. of copper. The cooling surface to be not less than 1000 square feet. The steam to be condensed externally and the circulating water to run twice through the tubes, entering top rows of tubes first from centrifugal pump. A brass cock to be fitted on to exhaust pipe for injecting soda solution. The condenser, with tubes packed in place, to be tested with cold water pressure to 5 lb. per square inch before putting on doors. A supplementary supply pipe with regulating cock into condenser, for making good any loss of feed-water. The gear for opening and shutting same to be led to starting platform. Provisions to be cast on sides of condenser to form continuation of main frame, which is to be bolted to faced flanges on top of condenser, the bolts and nuts to be in steel and holes rimered out.

Air pump.—The barrel, plunger, and bucket with guard to be in gun-metal, the top and bottom chambers in cast iron, and so arranged that foot and delivery valves can be removed without disturbing other than the two doors. The cover guides and blocks for crosshead to be in cast iron. The cover to have gun-metal glands, the stuffing-box to be lined with gun-metal. The air pump to be not less in capacity than 2·6 cubic feet. To be fitted with air valve and adjusting screw. The guides to be made in two pieces bolted together top and bottom, secured to faced provision on air pump cover. Cover to be ribbed below guides.

Foot and delivery valves.—The seats and guards to be in gun-metal, the valves in india-rubber, and so arranged that the valves can be removed without lifting the seats.

Hot well.—To be in wrought iron, arranged with closed top and manhole-door and air pipe.

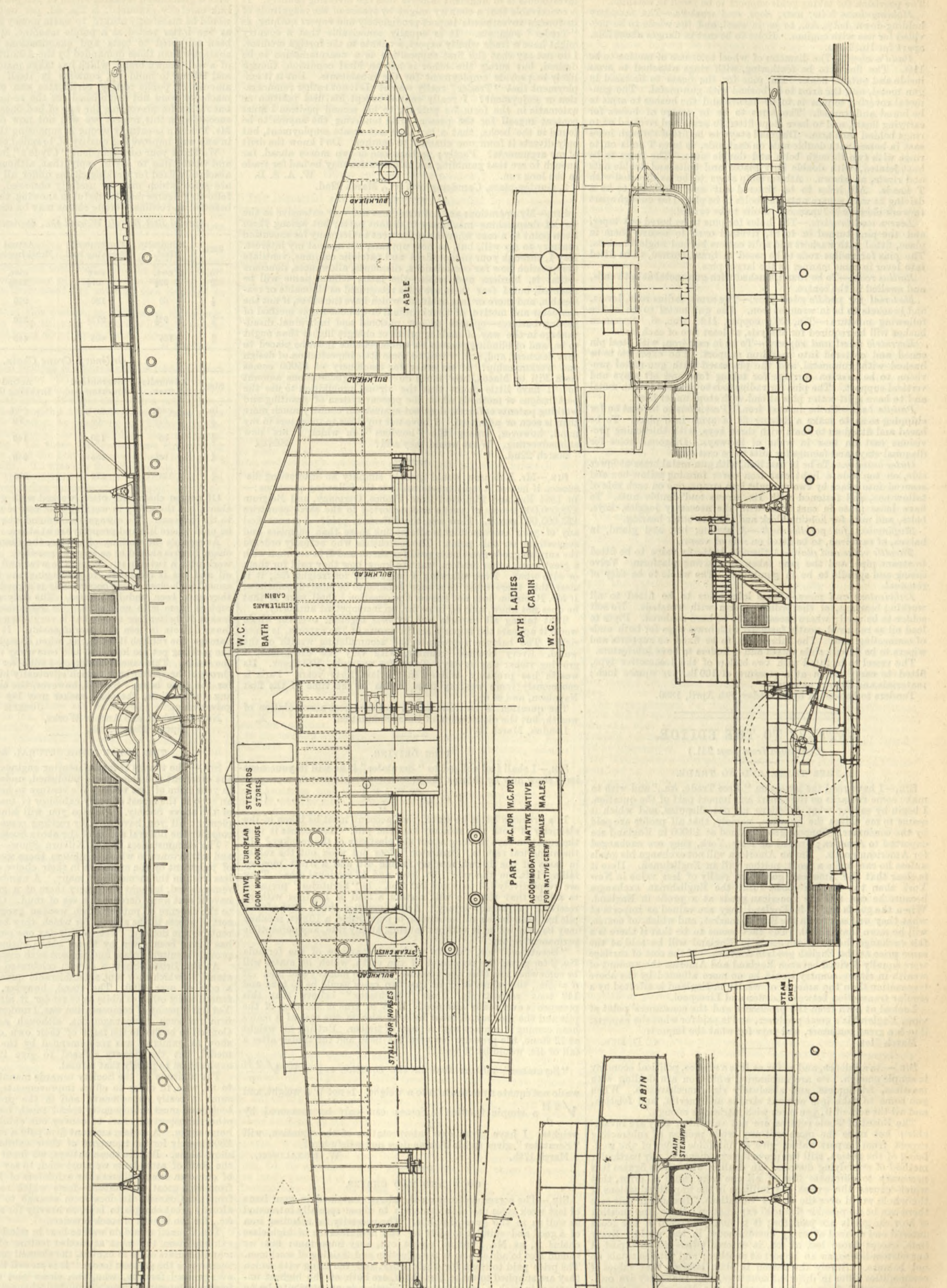
Feed and bilge pumps.—To be one in number of each, the barrels in cast iron; plungers, glands, and bushes in gun-metal; the stuffing-boxes to be lined with gun-metal; each pump to be of not less capacity than 275 cube inches stroke. The feed pumps to be fitted with suction cock and shifting valve on pump, and escape valve on delivery pipe. The valves and seats to be in gun-metal, with adjusting screws for regulating lift ef delivery valves for feed, the feed pump to draw direct from hot well. The bilge pump fitted off same pattern as feed pumps to deliver overboard, fitted with suction pipes in lead, and delivery pipe overboard in copper.

Entablature.—To be in cast iron of the box section, and generally of the form shown in drawing, to be bolted to top of condenser with turned steel bolts, and nuts, and rimered holes. To be fitted with gun-metal bearings for main shaft lined with Parson's white brass, the bolts to have solid collar, with nuts and caps to be in steel; the distance through stay with nuts to be in steel and the thimbles in cast iron. The forward end of entablature to be secured to box beams by at least six steel bolts and nuts, with cast iron washer plates on fore side of beam; bolts, nuts, and washer plates to be provided.

Bottom connecting frame.—To be in cast iron of the box form, the ends to be planed and securely bolted to condenser and cylinders

CONTRACTS OPEN.—FERRY STEAMER, EAST INDIA RAILWAY.

(For description see page 250.)



with turned steel bolts and nuts, the holes to be rimered out. The provision for taking guide support to be faced in machine.

Holding-down bolts, nuts, dogs, and washers.—The necessary holding-down bolts, &c., to be in steel, and the whole to be provided for use with engines. Holes to be cast in flanges about 15in. apart for 1in. bolts.

Paddle-wheel.—The diameter of wheel to centre of motion to be 11ft. The floats to be feathering, with rings attached to arms inside and outside floats. The pins for the floats to be cased in gun-metal, and the arms to be bushed with gun-metal. The gun-metal covering to pins is to be turned and the bushes to arms to be bored and turned. The arms to be in centre of bosses for carrying floats, and to have stops fitted to arms and rivetted on to rings behind each arm. Diagonal stays to be fitted through holes cast in bosses with double nuts on each side, to have T ends on to rings with two through bolts and double nuts. The rings to be butt-jointed, with double butt plates and bolts and double nuts and rivets, as shown. Athwartship stays to be as directed with T heads. All holes to be rimered out and the bolts to be a driving fit with square nuts, the bolts to be placed far enough apart to work close-ended spanner. Bolts to be turned.

Levers and brackets.—The holes for pins to be bored out taper, and the pins turned in to fit, rivetted over to secure them in place, fitted with washers and split cotters beyond angle brackets. The pins for radius rods to be cased in brass, turned, to be fitted into lever in same manner as the larger pins.

Radius rods.—To be round, bushed with gun-metal at both ends, and swelled in the centre.

Material for paddle wheel gear.—The arms, radius rods, levers, and brackets to be in wrought iron. The gun-metal to be of the following mixture:—Tin, 20; copper, 112; zinc, 6. Specimen bushes will be required for analysis, at least two of each size.

Excentric wheel and support.—To be in cast iron, with steel pin coned and cottered into cast iron support. The excentric to be bushed with gun-metal, and the pin cased with gun-metal provision to be cast on carriage for taking fore and aft stays and vertical support. The pins for radius rods to be cased in gun-metal and to have split cotter pins at end with stops under head.

Paddle boss.—To be in cast iron. Provisions to be cast on for chipping so as to make a driving fit of arms into place. To be bored and fitted on to shaft with three keys, with thickening provisions cast on boss in wake of keyways. Diagonal holes for diagonal stays and facings for nuts to be cast on.

Outer bearing.—To be in cast iron, with gun-metal brass at lower side, on top side a light cast iron cover forming tallow-box and secured into place by two wrought iron straps, one on each side of tallow-box, and fastened with 1in. screws and double nuts. To have loose plate in cast iron, with the necessary joggles, keys, bolts, and nuts for holding block and plate to outer bearing.

Stuffing-box for paddle shaft.—A stuffing box and gland, in halves, of cast iron, to be fitted on side of vessel.

Throttle valve and gear.—A throttle butterfly valve to be fitted to steam pipe, and the gear taken to starting platform. Valve casing and spindle to be in gun-metal. The whole to be easy of removal.

Lubricators and pipes.—Brass lubricators to be fitted to all working bearings, of the ordinary form with worsteds. No soft solder to be used; where necessary, to be hard soldered. Pipes to lead oil as required, neatly fastened with brass clips for both ends of connecting rod. The lubricators to be fixed on supports and wipers to be fitted; slide valves and cylinders to have lubricators.

The vessel to be fitted with two boilers of the locomotive type, fitted to carry steam at a pressure of 100 lb. per square inch; materials and fittings as usual.

Tenders to be sent in by Thursday, 8th April, 1886.

LETTERS TO THE EDITOR.

(*Continued from page* 241.)

FREE TRADE AND NO TRADE.

SIR,—I have read the letters on "Free Trade, &c.," and wish to make some remarks on the export and import part of the question. I begin by saying what I believe no one disputes, and which it seems to me solves the question, namely, that all profits are paid by the consumer. Suppose goods valued at £1000 in England are exported to America; arrived in New York, they are exchanged for American goods. But an American will not exchange his goods unless he can make a profit, neither will an Englishman. Here it is clear that the American goods are really of less value in New York than the English goods. But the Englishman exchanges because he can sell the American goods at a profit in England. When the goods arrive in England they are valued as imports at what they will sell for in the English market, and which, of course, will be more than £1000. The fact seems to be that if there is a fair exchange the American goods in England will be sold at the same price as the English goods in America. If the cost of carriage were equally divided between England and America the amount of wealth in either country would be no more affected by the above transaction than the amount of wealth in England is affected by a similar transaction between London and Liverpool.

Looked at both from the producers' and the consumers' point of view, England is a great producer, and is paid for what she exports. She is a great consumer, and pays for what she imports.

March 21st. C. D. DUB.

SIR,—As a science, and so far as it is a science, political economy is simple enough. So are mechanics, while you are dealing with massless, frictionless, and absolutely rigid mechanisms. When you come to take into account strains and inertia, and friction, and all the rest of it, you meet with intricacies enough.

The Board of Trade returns are not valueless; they are invaluable; but none the more will any crude process of subtracting export from import values give an infallible index of the well-being of the nation, still less prove the expediency of any particular method of remedying distress. In dealing with these figures it is necessary to eliminate first of all one large cause of error, that which causes the excess 115 millions in the import valuations of the whole world over the export valuations. Because in this case there can be no possible financial explanation; there is no question of how the goods are paid for; it is simply a record of the goods entered and cleared at every custom-house in the world. Every item, except those lost at sea, is entered twice—as an export at our custom-house, as an import at another; and yet the totals do not balance. Surely the reason is plain enough, that values of commodities differ in different countries, and that they are ordinarily exported from a cheap market to a dear one. Newcastle sends coal to Odessa, and Odessa wheat to Newcastle. I have heard of a shipload being bartered weight for weight, so that an export item of £1000 balanced an import item of £10,000, valuing the coals at 10s. a ton, and the wheat at £10! Of course such bargains were not common even in good times, and I merely quote it as an extreme case of a universal process.

Next we must observe that this total excess of import values is a balance of excesses and deficiencies in the cases of the separate countries, Britain, France, Belgium, and Holland, having a large import excess; Russia and the United States the reverse. Mr. Muir states very fairly the process that has been going on lately between England and the United States, and I agree with him in thinking that what we did with this tribute of corn, or, in other words, how the bondholders who were paid off re-invested their money, is an interesting and important question. But the fact remains that every sound investment of British capital abroad swells imports in the future. We may send rails and locomotives to China and Burmah, and so increase our exports for the next few years, but what then? Can the process go on indefinitely? Unless we invest in affairs that do not pay, inevitably there comes a point when the dividend or interest is larger than the normal annual addition to the capital; in short, the tendency of foreign investments is to augment imports into the investing country. It is conceivable that a country might by reason of the magnitude of its foreign investments import prodigiously and export nothing, as "Trader" suggests. It is equally conceivable that a country might have a trade wholly export, a tribute to the foreign creditor. I do not say that the first supposition is a consummation to be desired, but surely the other is not an ideal condition, though likely to provide employment for the inhabitants. But is it employment that "Trader" really wants? Is it not rather remuneration or enjoyment? I really cannot accept his first position as axiomatic in the form he puts it; to his second position I must content myself for the present with tendering the answer to be found in the books, that a tax does not create employment, but only diverts it from one channel to another. Do I know the drift of my arguments? Partly; perhaps one or two moves ahead, far enough to see that gambling and adulteration may be bad for trade in the long run. W. A. S. B.

2, Gordon-place, Camden-grove, W., March 22nd.

SIR,—My operations are not numerous nor very extensive in the way of despatching machinery to distant parts; but among them I can point to a case where an order went to Germany for execution contrary to my will, but, as now appears, not against my interest. May I, through your independent and patriotic columns, ventilate the question how far commissions, discounts, allowances, douceurs—that is, burdens and bribes—the latter odious name will be resented, but I fear there are gifts recognised as claimable or reasonable, and more or less habitual, which have the effect, if not the character and motive, of that criminal or dishonourable method of getting business—operate to our national and individual disadvantage in the way of making prices or charges higher than ought to be, and of blinding persons on whom reliance must be placed to that dearness, and, still worse, to some little imperfection of design and workmanship? If an order for machinery of £5000 comes from Fiji or Macoa, how much do these augmentations amount to? I have little doubt that the virtual prohibition to use the best designs or methods which the present system of granting and working patents enforces, does act against our country much more than is seen or admitted. I have not royalties to inventors in my mind, however, among the "burdens" on which I am now animadverting. What would they add? SENEX

March 22nd.

SIR,—Mr. Robinson would greatly simplify an interesting discussion if he would reply categorically to the following questions:—In 1884 England imported from France, Germany, and Belgium £78,000,000 worth of goods and exported to the same countries £33,000,000 worth. How was the difference paid? I cannot find any of your correspondents attempting more than surmises and suggestions on this point. The merchants who actually ordered the surplus goods must have paid for them, and I, in common with a great many other readers, want to know how they paid for them or with what. Even allowing a large sum for freight, &c., it is clear that there must be a huge balance to be cleared somehow. If Mr. Robinson does not answer the question I shall take it that he does not know, and is, in so far, an incompetent authority.

That taking all imports and exports together over the whole world it appears the imports are in excess of the exports, is quite right. The balance represents the accumulating wealth of the world. Every civilised country, with very few exceptions, is growing richer day by day. Take, for example, Middlesex. Its wealth has probably doubled in the last forty years. Paris is enormously more wealthy than it was in the time of the first Napoleon, and so on.

The question to be discussed is not the gross accumulation of wealth, but the distribution of the accumulation. X.

London, March 23rd.

PILE DRIVING.

SIR,—I shall feel obliged to "Scrutator" if he will in your next issue show how he obtains the equation

$$P = \sqrt{\frac{2\,W\,h\,E\,A}{L}} \quad \ldots\ldots (1)$$

In a previous letter he stated that account must be taken of the elasticity of both the monkey and the pile. How comes it that the equation says nothing about the elasticity of the monkey? In the numerical results "Scrutator" does not work out the values in cases of the 10 cwt. monkey falling 4ft. and a 5 cwt. monkey falling 16ft. on the pile 16ft. long and 12 sectional area. They are respectively 134 tons and 190 tons. Is "Scrutator" prepared to affirm that the pile will sustain a load of 134 tons without receiving permanent injury? Actual practice shows that after a pile has been driven till no motion is perceptible, a 10 cwt. monkey may be dropped on it without causing, at any rate, any perceptible permanent injury.

"Scrutator," too, fails to work any examples of the formula No. 2 for giving the resistance of the earth, which he states will be somewhat less than the pressure between monkey and pile. If $d = \frac{1}{8}$in., the values of F in the two cases would be 95 tons and 149 tons respectively. Does "Scrutator" believe that this pressure is ever really attained? If it be true in the case of the pile and the monkey, it must be true also in the case of a man's head coming in contact with a piece of timber. Putting his weight at 12 stone, the pressure between his head and the timber after a fall of 4ft. would be 56 tons!!

"Scrutator" affirms that in the equation $m\,v = W\sqrt{\frac{2\,H}{g}}$ we do not equate a momentum to a weight. Is not W a weight, and $\sqrt{\frac{2\,H}{g}}$ a simple fraction? Forces can only be measured by weights. I have given one interpretation of the equation, will "Scrutator" gives us his if mine does not satisfy him?

March 17th. W. DONALDSON.

GOOD AND BAD CHAINS.

SIR,—The correspondence on the above contained in your issue of last week gives useful information to those specially interested as well as to the general public. The necessity for selecting iron of a good and suitable quality for the manufacture of high-class chains is, as Mr. Penman points out, very important; but we should like to add so also is the selection and training of workmen. The price paid to them for their work, and the firing with which they are supplied to make the chain, are both of the highest importance in such a manufacture. Testing is an attribute by no means so important to good chains as it is to bad ones, and it is to this latter class, we presume, Mr. Penman's remarks chiefly apply when he recommends chains to be tested at the public testing establishments licensed by the Board of Trade. We are not of the number who think the certificate of the establishments any guarantee that a really good chain has been adequately tested, but rather that a bad one has passed muster; and we venture to think our own Government itself does not altogether disagree with our view, as neither the Admiralty, the India Office, nor the Colonial Department allows its chains to be tested at a public machine. But it would appear from what your correspondent, Mr. Barnes, says, that even the authority of the Admiralty is on the wane, as it seems to be indifferent about using high-class chains so long as the price is low, and a breaking strain of 100 per cent. above Admiralty test is secured. This test may seem a high one to the outside public, but to those connected with the trade it is regarded as only under third class. For example, our No. 3 best best crane chain, proved to 10 per cent. above Admiralty test all through the chain, with a breaking strain of 100 per cent. over, and carefully examined, is 17s. per cwt. for $\frac{1}{2}$in.; while our "A1 Special Best Best J. W. and Co. (registered brand) crane chain, proved to 25 per cent. above Admiralty test all through, with a guaranteed breaking-strain of 200 per cent. over, and every link carefully examined, is 23s. 6d. per cwt. for $\frac{1}{2}$in." Now, it would be manifestly absurd to waste money in having such chains as the latter tested at a public machine, after they had already been subjected to tests and examinations of a much severer character than those demanded by the Admiralty. The reputation of a well-known brand, which has taken many years of experience and labour to build up, contains in itself a security which no amount of public testing certificates can give. Public testing machines were not established for the re-testing of good chains, but rather for preventing the sale of bad ones. How far they have succeeded in this respect we will not now discuss; but we think Mr. Penman is entirely wrong in supposing that public testing can in any way improve the quality of branded chains.

We think your correspondent "Clyde's" letter worthy of note, and would like to say in reply that, although there are no rules absolutely fixed for working chains under all circumstances, there are some which may be usefully observed. For example, the following figures may be useful in showing the safe load at which branded and ordinary crane chains may be employed:—

Special Best Best J. W. and Co., Registered A 1 Brand.

Size.	Admiralty Test.	Guaranteed Breaking load.	Actual Breaking load.	Safe Working load.
in.	cwt.	cwt	cwt.	cwt.
$\frac{3}{8}$	32½	97½	118½	20
$\frac{1}{2}$	60	180	220	36
$\frac{5}{8}$	92½	277½	320	55
$\frac{3}{4}$	135	405	440	81

Ordinary Crane Chain.

Size.	Admiralty Test.	Guaranteed Breaking load.	Actual Breaking load.	Safe Working load.
in.	cwt.	cwt.	cwt.	cwt.
$\frac{3}{8}$	32½	65	76	13
$\frac{1}{2}$	60	120	140	24
$\frac{5}{8}$	92½	185	210	37
$\frac{3}{4}$	135	270	305	54

Of course chains are often worked with greater loads than the above, but the safety in working is of course reduced in proportion to the increase. We always recommend the very best quality to be used where life and property are at stake.

As regards the working of chains, the diameter of pulleys and chain barrels should be as large as possible. No chain should ever work with a twist in it. When the wear and tear is great, a little oil and tar is conducive to prolonging the life of a chain. To anneal high-class chains occasionally is a good thing, but not after they have been unduly strained. The only safe plan then is to replace them with new ones. To galvanise good chain neither makes it better nor worse, but is very often the winding-sheet of many defects in iron and workmanship. It is sometimes said to damage the rubbish it hides, as, when cheaply-made chains are in the pickling pot too long, the acid eats away the flimsy scarphs of the welds. This cannot be detected till after the chain has passed through the spelter bath, which effectually hides all imperfections for the time being. Should, however, the chain come to grief at any future time, the chain-maker may lay the blame upon the galvanising. JOSEPH WRIGHT AND CO.

Neptune Chain and Anchor Works,
Tipton, March 24th.

THE ROYAL AGRICULTURAL SOCIETY.

SIR,—The thanks of manufacturing engineers are due to you for the excellent and able article published, under the above heading, in your issue of last week. We venture to believe that it will find an echo in the breast of every exhibitor of machinery at the shows of the above Society. Perhaps you will kindly allow me to supplement all you have said, by reciting some instances of what I consider the illiberal action of the above Society.

The circumstances of the Kilburn Show—the losses, expenses, and misfortunes to which exhibitors there were put through want of judgment by the executive in their choice of ground—is doubtless fresh in the memories of many. A number of firms, it will be remembered, brought machinery there at a great expense, only to have it cast away derelict in a sea of mud. Other firms had to go to the expense of putting down wooden gangways to afford some sort of access to the stands, for which they had to pay such heavy rents to the Society. Yet to this day one penny of compensation has never been given by those whose business it clearly was to provide a suitable place and prevent such disasters.

At the Bristol Show a certain celebrated firm were allotted a stand, to which they sent a considerable quantity of machinery at a cost of over £100. The stand, however, was so completely fenced in by other exhibits as to render it altogether inaccessible. Yet not a penny of compensation was, I understand, ever given the firm for such mismanagement, although acknowledged by the Council to be due to the fault of their own officials. At another show an exhibitor was recommended by the judges for a silver medal, but the Society refused to give it, yet advancing no explanation to justify that refusal.

The attitude of the Society towards manufacturers is an injury to us, who, in order to effect improvements, must lay out heavy sums in costly experiments, and in the provision of expensive tools, and must subsequently spend much money in railway and other transport expenses to convey our exhibits out to shows and home again. A certain eminent firm paid a railway bill of nearly £800 merely for the transport of their exhibits to and from one show alone. Besides these outlays, we incur heavy expenses for the staff of attendants we must send, to say nothing of the value of our own time; whereas the exhibitors of live stock are exempt from such great expenditure—facts which receive no recognition from the Council. It does seem strange to tax those who have already great charges to bear, so heavily for stands, entrance fees, &c., for the benefit of stock breeders.

The Council would do well to bear in mind that the engineering exhibits form the most attractive feature of their shows, and if manufacturers cease to exhibit, the Council may find that they are themselves the greatest losers. It is an evil likewise to the already over-pressed farmers, who, run closer and closer each year by foreign competition, have diminished chances of cheapening their productive expenses by obtaining improved machinery such as the agricultural engineers of this country are ready and willing to devise if we can only get a little encouragement. Is it not also a fact that Messrs. Easton and Anderson—who, as engineers to the Society, did so much to elevate the influence of that body—now hold but honorary appointments? We submit that this also is a proof of the indifference of the Royal Agricultural Society to the interests of engineering exhibitors. I am strongly of opinion that unless the Royal Agricultural Society take speedy steps to amend things, the engineering firms ought to unite against them—first, by convening a meeting at which to pass appropriate resolutions, of which copies would be forwarded to the secretary, and if this failed, then to decline unanimously to exhibit at any of the Society's shows till reforms were made. MANUFACTURER.

March 23rd.

SIR,—I read the leading article under the above heading in your last week's issue with a great deal of pleasure, and feel that the entire community of manufacturing engineers who exhibit at the shows of the above Society owe you thanks for the able manner in which you review grievances under which exhibitors have suffered and still are subject to. As things stand at present the Royal is the only testing tribunal enjoying the confidence either of home or foreign buyers. In this capacity it has great power of doing good alike to the farmer and steam user and also to manufacturers if it so chooses. Its functions in this respect are superior to those performed by it as regards live stock. The sphere of usefulness, I venture to submit, of the stock breeder is smaller than is that of the engineer. Stock breeding is but a single branch of agricultural interest, the successful cultivation of the soil involves many interests, and can only be effected by the aid of the engineer, whose attempts at effecting improvements always entail heavy experimental expenses to begin with, which, when a good thing is produced, is followed up by further large outlay in the shape of the almost prohibitive rentals for stands and entrance fees charged us by the Society, who seem to take no account of our heavy railway and other transport expenses to and from the shows, the expenses of our staff in charge, our own time and hindrance to our regular business, to none of which are stock exhibitors exposed at all in the same degree. All this would be hard enough even if a respectable sum were set aside by the Council as prize money for engineer exhibitors, but on this point Mr. McLaren's figures speak for themselves.

Furthermore, many cases might be cited of injury and loss sustained by exhibitors, altogether due to want of care and judgment on the part of the Council and their staff—*vide* the Kilburn Show—but for which not one penny of compensation was ever paid to exhibitors; not even their stand and entrance fees returned to them.

I venture to hope that this matter, so ably taken up by you, will not be suffered to drop till such pressure is brought to bear upon the R.A.S. as will bring about much-desired reform.

March 25th. A VICTIM.

SIR,—I have read with feelings of amusement the leader in your issue of the 19th inst., entitled "The Royal Agricultural Society." There were thirty-two firms who entered portable engines for Exhibition at Preston in 1885. If there had been a prize offered for portable engines it is possible that thirty-one of these firms would have shown their wisdom by preparing a "Racer" for the competition. One firm would have exhibited its traditional stupidity by abstaining. Of these thirty-one more enterprising firms, we may assume that the first prize would have been given to one. It was at Cardiff. To that one firm the trouble, expense, worry and anxiety of the competition might possibly have been compensated by a corresponding measure of commercial notoriety, but not by any means by a money prize or medal. But what about the thirty unsuccessful aspirants for the prize, who would probably have expended at least £1000 a piece in the preparation of a commercially useless racing engine? The stupid one which held aloof from the competition would almost have the best of it. The irony of the whole argument, however, consists in the patent fact that the racing engines of any firm of standing would possess not the slightest identity with their engines of commerce, and the results would be therefore valueless to the public.

To explain the difference between breeding pigs and making portable engines would occupy too much space for a single letter.

Leiston Works, March 25th. FRANK GARRETT.

CURTIN'S BOILERS.

SIR,—In reply to Mr. Buckland's letter in your last impression, I beg to state that my tubes can be renewed in vertical boilers without removing the furnaces if required. Vertical boilers, as at present made, invariably fail in the flanges of the cross tubes first, and as by my patents these are done away with and all rivets removed from the fire, there can be no doubt but that the tubes will last considerably longer, and perhaps not require renewing at all. As to Lancashire and oval flue boilers, if Mr. Buckland will kindly give me an order for one or more I will undertake to renew the tubes—if ever necessary—at a less cost than can be done at present with flanged tubes, and also without removing the flues. Mr. Buckland also states that he has made several vertical boilers with the furnaces flanged to take the uptake. This is a very usual plan, and I am not aware of having made any claim for it. I sincerely trust that Mr. Buckland will live to make several hundred boilers more in the same way, and if in these he would fix the cross tubes in accordance with either of the plans mentioned in my patents, I feel assured he will have a better boiler than ever he has made before.

Clifton Wood, Bristol, March 24th. EDWARD J. CURTIN.

SIR,—Mr. Curtin's method of fixing tubes in boiler flues is not a very patent one, nor is it, so far as I can see, practical. It has been applied to the chimneys of vertical boilers years ago. But suppose a Galloway-flued boiler, containing sixty tubes' strakes to to made in one plate, and tubes on Curtin's system, how would Mr. Curtin flange the holes, keep the plate the right set, and punch the rivet-holes to template, make the job to defy inspection, and, above all, compare the expense against the method of the ordinary flanged tubes?

Again, suppose a Cornish boiler-flue 2ft. 6in. diameter, three tubes in the course, diameter at large end 10in. outside diameter, at small end 5in. outside, breadth of flange on the flat 2½in., how would he flange the small end? and, when flanged, what would be the thickness on the outside edge? Putting the difficulties of rivetting and retubing to one side, I should think the flanging alone one great hindrance to the method ever becoming popular.

East Hartlepool, March 23rd. JAMES MCDONALD.

THE LAW OF COPYRIGHT.

SIR,—English authors have long been obliged to submit to having their work reproduced in America without any benefit to themselves. Hitherto the plagiarists have usually had the grace to append the name of the author, but latterly some of the American "authors" have begun the fashion of lifting large pieces of English books and passing them off as their own work. I take it this practice should be exposed wherever possible; I therefore write to you. In looking over a "paste-pot-and-scissors-book" issued by an English firm recently—we will call it the "Amateur Engineer's Daily Remembrancer and Encyclopædia of Useful Knowledge"—I found considerable extracts from my book on saw mills, &c., attributed to one Hodgson. On making further inquiries, and placing the matter in my solicitor's hands, it was found the English firm had copied from an American book, "Hodgson on Hand Saws," who had coolly palmed off parts of my work as his own. I am taking steps to prevent this book being sent into this country, and have obtained damages from the English publishers. I would also recommend all authors who wish to reap any benefit from the sale of their books in America to get someone in that country to write a few lines of additional matter, and secure the American copyright in their joint names. This is the only way at present of stopping these gentlemen. M. POWIS BALE.

Appold-street, March 22nd.

TESTING THE COMMERCIAL EFFICIENCY OF DYNAMO MACHINES.

SIR,—I have only just now noticed Professor Jamieson's letter in your issue of 12th March. As all the resistances in connection with the potentiometer and current readings were taken in B. A. units, it was necessary to take the E. M. F. of the Clark cell as 1·453 as stated in my article. This does not affect the accuracy of the determination of the current. The resistances of machines were, however, given in legal ohms, and their electromotive forces in legal volts. GISBERT KAPP.

Wimbledon, March 22nd.

CLOSE TENDERS.

SIR,—As I have no doubt it may be interesting for you to know how closely work is at present gone into in Liverpool, I hand you particulars of three quotations sent in to Messrs. Kitchen and Co.—for the supplying and erecting with all pipes, tank fittings, meter, antifluctuator, &c.—at their new warehouses Walter-street:—Higginbotham and Stuart, £436; Crossley Brothers, £414; Ransome and Marshall, accepted, £414 5s. We, however, agreed to allow £4 5s. off our estimate as we received £300 with order, but the small difference between ourselves and Crossley's seems to me to show more conclusively than anything else could the care that has now to be taken in estimating. We have run very close on many jobs lately, but none so close as this.

Liverpool, March 23rd. RANSOME AND MARSHALL.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, March 13th.

THE industrial situation is seriously unsettled by the unprecedented epidemic of strikes, extending from the Atlantic to the Pacific. After matters quiet down, all will be well. Labour is agitated, and has been stimulated to action by an almost uniform success in securing the wages demanded. The advance will range from 10 to 15 per cent. throughout the United States for both skilled and unskilled labour. To-day ugly rumours are rife on the streets from the South-West as to threatened violence upon the part of the railroad employés because of the stubborn refusal of the management to arbitrate or confer. The concessions made by employers were necessary, by reason of the urgent demand for material of all kinds. During the past few weeks demand has fallen off until the labour question is settled. The Western nail-makers met last week, and decided to continue the fight all summer. The building trades are extremely active all over the city, and the nine-hour day has been accepted by employers. Lumber is advancing slowly, and there is a growing belief that the prices will be slightly higher this year than last for white and yellow pine, cherry, and oak. The steel rail-makers have not booked any large orders for the week, and are rather quiet at 34.50 dols. Large sales have been made of rails on the water, but no more orders will be sent abroad, as supplies will be sufficient in thirty days. Bridge-builders are withholding orders. The demand for plate and sheet iron is active. Crude iron of all kinds is very firm, and to-day's quotations on Bessemer pig show prices to be 19 dols. to 20 dols.

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

(*From our own Correspondent.*)

THE spring quarterly meetings of the iron trade are fixed to come off on the 7th and 8th of next month in Wolverhampton and Birmingham respectively. It is not anticipated that there will be any declared alteration in the crucial prices of marked bars and all-mine pigs. These are likely to be re-declared at, for the former, £7 10s. to £8 2s. 6d., and for the latter, 55s. to 57s. 6d. for hot-blast sorts, and 80s. nominal for cold-blast. What were formerly regarded as crucial prices have now, however, got to be of little account in regulating the great bulk of the trade.

This week a few of the sheet makers report rather better orders, but the accession is not of any large account. Still sheets will most likely show the earliest revival. Prices continue at £6 to £6 5s. for 24 gauge, and £7 to £7 5s. for 27 gauge. Thin sheet makers' quotations are £10 to £11 for working-up sorts, and £11 to £12 for stamping qualities.

In the bar and angle and tee trade the severe competition from the North of England, South Wales, and other districts, remains an important factor of trade, which has a considerable influence upon common iron prices. Orders for hoops and some other descriptions of merchant iron are coming forward moderately well from Australia and the Cape, Eastern Europe, and some other markets, but the mills could do very much more work if it were to hand. Common bars have got down in some cases to £4 15s. per ton. Gas tube strip is £4 17s. 6d. to £5, and common hoops £5 to £5 5s.

The demand for steel rolled in this district is not extensive just now, but a considerable Government contract for Siemens-Martin steel strips has just been booked at the Earl of Dudley's works, which will provide employment in one department for some little time ahead. Mr. E. Fisher Smith, who has been connected as the principal agent with the Earl of Dudley's ironworks and collieries for a great number of years, is about to retire from the management. The present earl being a minor, his trustees, the Earl of Warncliffe and Mr. Stuart Wortley, have appointed Mr. C. J. Wright, of Worksop, to succeed Mr. Smith, who has proved himself a man of great business shrewdness and sound judgment, and whose opinion upon the question of best iron prices has practically ruled the trade for many years. The Ettingshall Ironworks, formerly carried on by Messrs. Morewood and Co., and the acquisition of which under a lease by the Birchills Hall Company I announced a little time ago, are likely to be re-started this week upon sheets.

In the pig iron trade competition from other districts with native makers keeps severe. Smelters' stocks are increasing, and it is reported that three furnaces have lately been blown out in the Tipton district. Sellers of Derbyshire and Northampton pigs reiterated this—Thursday—afternoon that the present prices were wholly unprofitable. Northampton pigs were abundant at 36s. 6d. to 37s., and Derbyshires at 9d. to 1s. more, though some Derbyshires were not to be bought under 38s. 3d. delivered to railway stations, or 39s. delivered at works.

Hematites of the Ebbw Vale brand were this afternoon 50s., but other Welsh and west coast brands were 52s. 6d. to 53s. 6d. delivered. Native pigs were 40s. to 45s. for part-mines and 30s. to 32s. 6d. for common sorts. It is reported that three furnaces have lately gone out of blast in the Tipton district.

Ironmasters have this week received from the London and North-Western, Great Western, and Midland Railway Companies intimation that, from the 1st of April, the rates for the conveyance of iron to London and Liverpool, for export, are to be reduced. The new rates to Liverpool will be: Upon pig iron, 9s. per ton; upon undamageable iron, such as bars above ⅝in., plates, and strong sheets, 10s.; and upon damageable iron, such as the general run of sheets, hoops, rods, and small bars, 12s. 6d. per ton. This is a reduction of about 1s. per ton to Liverpool from Birmingham and towns in the East Worcestershire district, but no alteration from Wolverhampton. The new rates to London are announced as 12s. 6d. upon undamageable and 15s. per ton upon damageable and finished iron. Much disappointment is, however, expressed that the lower rates to the metropolis are to apply only to lots of 10 tons and upwards. Hitherto the prevailing rates have been for 2-ton lots and upwards. The home trade derives no benefit at all from the changes. Even for large lots for shipment, the reduced rates offer no advantage, except in the matter of rapidity of despatch, over the rates at which, for many weeks past, senders have been able to forward their iron by canal.

The Severn Commissioners have considered the influential traders' memorials which have been presented to them asking for further improvements of the Severn from Gloucester to Worcester and Stourbridge, to facilitate improved communication between Birmingham and South Staffordshire and the sea. Their reply is that whenever the traders are in a position to improve the canals communicating with the Severn, the Commissioners will do their part.

The Ironmasters' Association have just issued a circular warning buyers against the unscrupulous trading customs which have sprung up in some circles of the chain cable industry, and among certain export merchants. It is pointed out that the method pursued has been first to buy a small quantity of the genuine branded iron, taking care to see that every rod or bar is branded, but for the great part of the cable to use a cheaper make.

Merchants have also been found shipping bar iron in such as to allow buyers to suppose that they were being supplied with best quality iron. I am informed that some merchants have also been sending out circulars offering to supply iron of the brands of such firms as the Earl of Dudley, Messrs. William Barrows and Sons, and the New British Iron Company, at common bar prices. As to the spurious certificates of cable tests, the safest course is to require that all certificates are from public proving houses—establishments of an efficient character which exist in Staffordshire no less than in other parts of the kingdom.

The ironworkers have now given their formal notice for a reconsideration of the rate of wages, the notice to expire in the middle of April. A question has, however, arisen as to its validity. On behalf of the employers it is urged that Alderman Avery did not intend that either side should have power to hand in a notice until the actual expiration of the present arrangement. The question of the correct interpretion of the award is now before the arbitrator.

The strike in the Shropshire iron trade continues, and an attempt by the committee of the South Staffordshire Wages Board to bring about a settlement has failed. The committee offered their services as arbitrators.

The strike at the engineering departments at Oakengates, of the Lilleshall Iron and Steel Company, terminated, I am happy to say, on Tuesday. A deputation met the managers on that day, and a compromise was effected by which the men consented to a reduction of 1s. per week all round, and work has now been resumed.

Messrs. Shirlaw and Co., engineers, Birmingham, have just begun the manufacture of Spiel's patent petroleum engines, for the making of which they are the English and colonial licensees. This engine, which is a German invention, has the advantage of being in no way dependent upon the local supply of gas. It can, therefore, be erected in any locality, and can also be used for tramcars, small yachts, &c. It is worked by the explosion in the cylinder of small quantities of benzoline, which trickle from a reservoir, and which is converted by an ingenious mechanical arrangement into liquid spray. The reservoir is attached to a storage tank, from which supplies of benzoline can be pumped up without handling or exposure of the spirit. The cost of working is 1¼d. per horse-power per hour, or equal to about 35 cubic feet of gas at 3s., but the manufacturers hope to further reduce it. The firm have just now a 2-horse power nominal stationary engine erected at the works driving shafting for several machines.

The annual meeting of the Wolverhampton Chamber of Commerce at the end of last week developed a further reference to the question of Continental competition, especially in the Colonies. Mr. W. W. Walker, of the merchant firm of T. W. and J. Walker, London and Wolverhampton, stated that he found that many English manufacturers and workpeople were still quite sceptical upon the question, yet if they did not arouse themselves they would possibly find that they were now only upon the fringe of the depression; and he adduced fresh examples of competition. The discussion which followed was closed by the president-elect announcing that, with a view to assist manufacturers to compete, he had determined to form something like a commercial museum of those European metal goods in which the competition abroad was most severe.

The longer hours and lower wages which the Continental workmen receive are exciting increased attention from manufacturers here.

The arrangements for the Exhibition of Local Manufactures, which will be opened next August in Birmingham in connection with the visit of the British Association, are proceeding satisfactorily. A large number of the trades of the town and district will be represented.

On Wednesday a deputation of Staffordshire members of Parliament had an interview with Mr. Mundella at the Board of Trade, and urged the objections entertained by traders in Staffordshire and East Worcestershire to certain details of the Railway Bill. Mr. Mundella promised to consider the points which had been laid before him, and said the object of the Government was to make the Bill as satisfactory as possible to all parties whom it affected.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—To say that the iron trade of this district continues without improvement is simply to repeat what I have had to record week after week since the year commenced, the only movement which the market has shown being persistently in a direction adverse to the interests of producers; and there is still nothing coming forward or even in prospect to break the depressing monotony of my reports. Stagnation of demand continues throughout all branches, with the condition of trade in some respects even worse. For the small weight of business offering in the market competition grows constantly keener, until makers, who do not care to seek after orders at prices so ruinously low that only the absolute necessity of keeping works going can at all justify their acceptance, have practically to stand aside. Buyers, on the other hand, seeing that, even with prices already cut down in most cases below the actual cost of production, the market is so unvaryingly in their favour whenever they have orders to give out, find it to their advantage to purchase only as they have immediate wants to cover. Business consequently drags on from hand to mouth, the day-by-day driblets of small orders resulting certainly in some weight of iron changing hands, but only at prices which are unremunerative and with nothing to look forward to in the future.

Only a very restricted inquiry for either pig or finished iron was reported on the Manchester iron market on Tuesday. For pig iron prices are being excessively cut up by one or two of the Lincolnshire brands, which are openly quoted at about 36s. for No. 4 forge and 37s. for No. 3 foundry, less 2½ per cent., delivered equal to Manchester, figures which are quite 1s. per ton under the lowest quoted rates for Lancashire iron, and 1s. 6d. per ton below what is being asked for one or two of the better class Lincolnshire brands. In outside brands prices for both Scotch and Middlesbrough continue extremely low, with comparatively little or no business doing.

Hematites still meet with but a very limited inquiry, with 51s. 6d. per ton, less 2½ per cent., about the average quoted figure for No. 3 foundry delivered into this district.

Extreme depression continues all through the finished iron trade, and the weight of new work giving out is so small that one large works in the district had to be closed entirely for the whole of last week, whilst where forges have been kept going they have only been working on a very restricted output. There is so much eagerness on the part of makers to secure orders, that where buyers have actual specifications to give out it is almost a question of taking any price that can be got. For bars delivered into the Manchester district, £5 per ton is the lowest acknowledged price, but there are makers who are not firm even at this figure; hoops can be got at £5 7s. 6d., and sheets at £6 10s. per ton.

As to the condition of the engineering trades generally, there are still very few inquiries being put upon the market, with, if anything, a still more rapid decline in prices, owing to the fierce competition for orders simply to keep works going. Tool makers seem to be fairly well engaged on orders taken at low prices, and some of the boiler-makers have also recently secured a moderate weight of orders, for which, however, they have had to cut very low. Locomotive builders in some instances are being kept on full work finishing orders; but there are absolutely no new inquiries of any moment coming forward, and this applies not only to the district here, but to locomotive builders all through the country. In all classes of stationary engineering work trade is extremely quiet.

The information given in the articles published last month by THE ENGINEER with reference to the wages, rates, and hours worked in the several branches of the iron and engineering trades throughout Europe, are considered of so much importance to the employers in the engineering trades of Great Britain that they have been reprinted in pamphlet form by the Iron Trades Employers' Association, and circulated throughout the country.

A drop hammer on an improved design has just been constructed by Messrs. Wm. Collier and Co., of Manchester, for forging rings for ring throstles, and as it is the first that has been made for this special purpose, a short description will be of interest. The chief feature in the hammer is that the friction board, which is usually employed for manipulating the falling weight in this class of tool used for die sinking and metal stamping, is replaced by a loose strap passing over a constantly running flanged pulley; when the attendant wishes to raise the hammer the strap is simply pulled down by hand to give it a grip on the pulley, which at once draws up the weight, and this can be immediately dropped from any height according to the blow required by simply releasing the strap and again allowing it to hang loosely over the pulley. The hammer consists of a cast iron base or anvil, with set screws for fixing the bottom die accurately under the falling weight carrying the top die. The base plate carries two vertical standards with V-slides which fit into the falling weight, and which can be adjusted to take up any wear on the slides by set screws at the top and bottom. To give additional stability to the hammer the standards carry two brackets at the top, which are attached to an overhead beam. The falling weight of the hammer is 3½ cwt., and it can be readily manipulated by one man. There is a distance of 7ft. 9in. from top to bottom in the slides for the falling weight, and the overall dimensions from floor to ceiling are 14ft.; the width inside the V-slides is 16in., and the outside measurement 2ft. 4½in. The pulley for raising the weight, which is carried immediately over the standards, can be attached to any ordinary running shaft in a shop.

I have had brought under my notice an invention of Mr. James Howarth, of Manchester, by which he proposes to utilise the power of falling streams by transferring their force to the compression of air to be afterwards used as a motive power. The apparatus he has designed, briefly described, consists of an upper and two lower chambers, of any required size. The water is conducted through pipes first into the upper chamber, where it forces the air within into a small pressure-dome fixed above the chamber. The stream at the same time runs through slide-valves into one of the lower chambers and then into the other, and so on continually, as inlet and outlet water and air valves are alternately opened and closed by suitable mechanism for the entrance and escape of the fluids, when the full force of the stream is applied to condense volumes of air in quick succession, and force it through valves and pipes into a suitable receiver, or direct from the compressing chamber for use. The advantages which the inventor claims for this apparatus are that it combines the gravity and velocity of the stream, in one force, to compress air into the smallest compass and the highest pressure to which it is possible to force it by any certain stream of water, whilst other hydraulic motors, such as the water wheel, cannot utilise pressure, and momentum cannot operate upon the turbine. Other advantages which the inventor sets forth are, that the chambers, or cylinders, would require no piston plates, consequently packing would be unnecessary and friction from them avoided, whilst the cylinders, requiring no boring, could be made of rough cast or plate iron, and up to sizes exceeding the largest engine boilers. On high mountains the exhaust water could be utilised by less elevated machines using successive descents of the same stream, by which means it might serve one employer after another so long as the water retained sufficiently high to exert the required pressure. It is claimed that the pressure produced by this appliance would exceed 95 per cent. of the power applied, and that the compressed air could be conducted on to the highest tractable mountains or to the deepest mines for quarrying and blasting purposes, or along the most rugged dales to the driving engines of works or road conveyances, situate where wheels, chains, ropes, &c., could not be used for transferring power. The inventor has before him the prospect that the waterfalls of Europe and America could be utilised more efficiently by his apparatus than by the means at present in use for producing work by day and electric light by night; so far, however, the invention has not got beyond the construction of a model, and consequently has not yet been put to practical test; but the method by which Mr. Howarth proposes to utilise present waste water power may probably interest some readers of THE ENGINEER.

The Manchester Association of Engineers, at a special meeting held on Saturday, paid a very deserved recognition of the long and valuable services rendered to the society by Mr. Thos. Ashbury, C.E. For some time past there has been a widespread feeling amongst the members that the services rendered by Mr. Ashbury since his election in 1866, and more especially during the last five or six years, should be fittingly acknowledged; a spontaneous movement was set on foot, which met with a most hearty response on all sides, and on Saturday an elaborately illuminated address "as a testimony of their grateful recognition of the valuable and devoted services rendered by Mr. Ashbury to the Association as an ordinary member, a member of the Council, and as vice-president in 1881 and 1882, and president in the years 1883 and 1884," and "as a desire to record their high esteem for him and their best wishes for his happiness and future welfare," and that he might "long be able to contribute by his counsel and presence to the stability and useful work of the Manchester Association of Engineers, was presented to Mr. Ashbury before a crowded meeting of subscribers, at the Grand Hotel, Manchester. The presentation was made on behalf of the subscribers by Mr. W. H. Bailey, the president, and the eulogistic terms in which he referred to Mr. Ashbury's connection with the association were afterwards endorsed by Mr. John Craven, Mr. John Thompson, Mr. Rawlinson, and Mr. Councillor Asquith. Mr. Ashbury, in acknowledging the presentation, said he received it with all the more pleasure, because it was not a parting gift to commemorate a severance from old associations, but would only tend to bind him still further to the service of that society.

In the coal trade the break up of the severe weather has naturally had a tendency to slacken off the demand for house fire coals, but otherwise there is no material change to report. The pits are still mostly kept on about full time, with deliveries on account of orders in hand, whilst prices are maintained at late rates, but with the continued extremely poor demand for all classes of fuel for iron making and steam purposes, which are a general drug in the market, a giving way in prices is looked forward to, and buyers are giving out orders only very sparingly in anticipation of some possible reduction next month.

The shipping demand is only dull, and steam coal is offered both at Garston and Liverpool at very low figures.

Barrow.—No change can be noted in the condition of the hematite pig iron trade. The demand is practically for the moment dead, and there are no indications of any improvement until the fate of the Steel Railmakers' Association is known. Practically speaking this association is dead, and it is generally accepted by all who are connected with it that at the next meeting on the 6th of April means for winding up its affairs will be adopted. The fact is that for some time past the association has succeeded in keeping up prices all round, but now buyers are banding themselves together and refusing to give out orders until makers are free to treat with them outside the influences of the association Makers have pulled down the prices of rails by 10s. per ton, making heavy sections £4 5s. per ton net at makers' works; but even this reduction has not resulted in any accession of orders. On the contrary, it has confirmed the determination of buyers to hold over many orders which they are ready and anxious to place, as they in many cases require early attention, but they are waiting for the lower prices which are expected to be aimed at so soon as the market is again thrown open. Some buyers are confident of being able to buy at 10s. per ton even less than the reduced price lately adopted. The quietness in the steel trade also affects the iron trade, and until this question is solved trade will be prostrated. Iron is quoted at 6d. per ton lower this week, the quotations being 42s. 6d. for mixed Bessemer parcels net at works, prompt delivery. If lower quotations were given at present, it is questionable whether any accession of orders would result. The output of iron only represents one-half of the production of which the district is capable. The shipbuilding trade is indifferently employed, and no new orders are offering. Engineers have not much work in hand, except in the marine department, where they are temporarily busy. The demand for iron ore remains restricted, and the greatest difficulty is experienced in making sales. Coal and coke are in comparatively small sale. Shipping has been rather better employed lately on metal exports.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

LAST week Sheffield was visited by representatives of the Royal Laboratory and the Ordnance Committee, who were conducted over the River Don Works—Messrs. Vickers, Sons, and Co.—and the Cyclops Steel and Iron Works—Messrs. Charles Cammell and Co. The visitors were Lieutenant-Colonel W. R. Barlow, Superintendent of the Royal Laboratory, Woolwich, and Mr. Anderson; General Sir Michael Biddulph, Major Bainbridge, and Captain Jenkins, of the Ordnance Committee. At the Cyclops Works, the visitors, who were conducted over the premises by Mr. Alexander Wilson, managing director, witnessed the rolling and casting of a compound plate, and a gun forging for a 66-ton gun for the Arsenal, Woolwich, as well as a number of large forgings for Sir William Armstrong, Mitchell, and Co., at Elswick, Vavasour carriage castings for the Royal Carriage Department, Woolwich, and several large castings for the 110-ton gun carriages.

The Trades Council convened a meeting of the working men on the 18th inst., at which resolutions were passed condemning false marking of cutlery, steel, and other goods, and requesting the Government to appoint a Royal Commission of inquiry. The speeches up to a certain point were temperate and sensible, but, unfortunately, several of the later speakers—trade union secretaries and political agitators—marred the effect of the meeting by introducing the political element and declaring that Broadhead's atrocities were not so bad as certain practices which they alleged against Sheffield manufacturers. One declared, in reference to the Royal Commission on trade outrages, that the manufacturers had their turn then; "it is our turn now," he cried out, and the meeting cheered his utterance most heartily. It was unpleasant to notice that several allusions making light of the rattening, blowing-up, and shooting of twenty years ago were favourably received. It is to be feared that there is a good deal of the old embers of "Mary Ann"—*i.e.*, Broadheadism—still smouldering, which, as on Thursday, can be easily fanned into a flame. The Town Council, at a special meeting on the 24th inst., discussed the subject, eight members having requisitioned the Mayor for the purpose. By a considerable majority they decided to appoint a committee to consider the charges made against Sheffield manufacturers.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market held at Middlesbrough on Tuesday last was well attended. There was not much actual business done, but the tone was less despondent than it has been for some time past. Inquiries for iron for both prompt and forward delivery were more numerous, but neither merchants nor makers would take the prices which they accepted last week. Sales of No. 3 g.m.b. were made by merchants at 30s. per ton for prompt delivery, but no makers would accept less than 30s. 3d., and the leading firms asked 3d. per ton more. Nothing further has transpired with respect to the proposal to restrict. It is believed that makers will quietly wait until the shipping season commences, in the expectation that the increased demand will then help them. If relief does not come, then some firms will probably have to damp down their furnaces.

Warrants continue in poor request, the price being 30s. per ton.

The increase in the stock of pig iron at Messrs. Connal and Co.'s Middlesbrough store last week was 7663 tons. At Glasgow it was about 4500 tons. The total quantity now held by them at Middlesbrough is 207,193 tons, and at Glasgow 706,189 tons.

Shipments of pig iron show an improvement now that the weather is more favourable. Up to Monday last 40,891 tons had been sent away since March 1st, being about the same quantity as in the corresponding portion of February.

There is no change in the finished iron trade, either as to volume or price.

It is stated that the members of the Cleveland Ironmasters' Association contemplate enforcing a further reduction in the wages of their operatives, and that notices to terminate all contracts will shortly be given.

Only by quite the end of last week was the line passing over Stain-moor freed from snow. Large bodies of men had been engaged for days in clearing the line, but until Friday afternoon no train was able to get through from Darlington to Kirkby-Stephen. The snow wreaths on the Midland Railway, where it passes through Westmoreland, were unprecedentedly great. On the 18th inst. an enormous mass fell like an avalanche and completely overwhelmed a locomotive. Since then the thaw which set in has caused the rivers to swell, and has therefore become a new source of anxiety because of the floods which are likely to take place.

Various shipbuilders in the North have, it appears, been invited to send in designs and estimates for a typical tank vessel to carry sewage sludge from the Thames out to sea. Such a cargo would evidently be not a little awkward to deal with especially in rough weather, and careful consideration is necessary in determining the best way to attain the desired end. Of course the vessel must be divided into sections, not only transversely, but also longitudinally, so that each portion of the cargo may be kept to its own place. As to loading and unloading, the most likely method of doing this safely and effectively would seem to be by centrifugal pumps of large capacity. As the lift would not be great in any case, a comparatively small power would suffice to drive the pumps. And as the propelling engines would be standing still whilst loading and emptying were in progress, the same boilers would be available for supplying steam for either kind of work. One advantage of this method will be that the more offensive portion of the sewage will be got rid of completely, and without any chance of its return with the flood tide. At first sight it might appear to be waste of a substance which if spread over the land would have a fertilising effect. In the immediate neighbourhood of London, however, and of other very large cities, manure of all kinds is plentiful, and the cost of conveyance, if it be desired to utilise it at any considerable distance from its origin, is so great that its small intrinsic value will not cover it. The idea of tank vessels for getting rid of it seems to be a good one, and orders for any such will be very acceptable just now at East Coast shipyards.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE being much less difficulty in obtaining warrants this week than last, the market has been flat, and prices have been on the decline. The volume of business in the pig iron trade is still disappointing, and neither ironmasters nor merchants are able to report any material improvement in the demand. The shipments in the past week, both coastwise and foreign, amounted to 7142 tons, as compared with 6009 in the preceding week and 7299 in the corresponding week of 1885. The demand being still limited, the increase in stocks continues, and 4880 tons were added during the week to the stock in Messrs. Connal and Co.'s Glasgow stores. There are ninety-five furnaces in blast, against ninety-two at the same date last year.

The current values of makers' iron are somewhat lower, as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 43s.; No. 3, 40s. 6d.; Coltness, 47s. and 43s.; Langloan, 44s. 6d. and 42s.; Summerlee, 46s. 6d. and 42s.; Calder, 46s. 6d. and 41s.; Carnbroe, 43s. and 40s. 6d.; Clyde, 43s. and 40s.; Monkland, 39s. and 36s.; Quarter, 39s. and 35s. 6d.; Govan, at Broomielaw, 39s. and 36s.; Shotts, at Leith, 45s. and 44s. 6d.; Carron, at Grangemouth, 48s. 6d. and 45s. 6d.; Kinneil, at Bo'ness, 43s. and 42s.; Glengarnock, at Ardrossan, 42s. 6d. and 40s. 6d.; Eglinton, 38s. 9d. and 35s. 9d.; Dalmellington, 41s. 6d. and 38s. 6d.

On Wednesday warrants sold at 38s. 2½d. up to 38s. 5½d. cash. To-day—Thursday—warrants were done up to 39s. 0½d.

The malleable iron trade is very slack, and at one of the Glasgow works it has been necessary to place the men on short notice.

At a meeting a few days ago the Scotch—Siemens—steel makers who are connected with the Association resolved to reduce the prices of angles by 5s. a ton.

Several orders of moderate size have lately been placed with Scotch founders for cast iron pipes, and there are others in the market, this department of trade being, on the whole, fairly active. General founders are in many cases but moderately employed. Some of the tube makers are busy, while others have much less to do than they could desire.

The iron and steel manufactured goods shipped from Glasgow in the past week comprised machinery to the value of £2210; sewing machines in parts, £3221; steel goods, £6200; and general iron manufacture, £17,600.

In the shipbuilding trade of the Clyde the most considerable order lately received is that which the Spanish Government have placed with Messrs. J. and G. Thomson, of Clyde Bank. This vessel is of 4300 tons displacement, is to carry twenty-one guns, and is to have a speed of 20½ knots. She will be 300ft. in length, 50ft. in breadth, and 31½ft. in depth. The type of the vessel is what is known as "raft-bodied." She will have no side armour but a complete deck from end to end, and from side to side, just underneath the water, formed of steel varying in thickness from about 5in. to 2in. This deck protects the whole of the motive power and powder magazines. The part between this deck and the deck above the water will be filled with coal and stores, stowed in spaces divided into the largest possible number of water-tight compartments. These compartments are also made to contribute to the stability and buoyancy of the ship by being surrounded by a series of coffer-dams, which can be filled with substance of such a nature that if a shot passes through it, and the water enters the compartment, the rush of the water will be stopped by the squeezing of the substance into the hole made by the shot. The ship has this principle carried through the whole of her length, and in consequence has totally discarded side armour.

There has been a fair business in the shipping department of the coal trade, the week's shipments having been 15,122 tons at Glasgow, 543 at Greenock, 10,075 at Ayr, 2629 at Irvine, 6846 at Troon, 1123 at Leith, 3119 at Grangemouth, and 3660 at Bo'ness. It is expected that the shipping department will now assume greater activity. But the demand for coals for domestic and manufacturing purposes at home is quiet. All qualities are nominally unchanged in price.

Boring operations are now being carried out on the estate of Major Frazer, of Kilmuir, in the Island of Skye, the expectation being that minerals of different kinds will be discovered.

There is a considerable revival in the demand for sulphate of ammonia, the prices of which have advanced in the course of the last few weeks from £11 10s. to £14 a ton. It is believed that the movement is to some extent speculative, but the supply is short, and for immediate delivery the advanced rates are paid.

Macfarlane, Strang, and Co., Glasgow, have received the order to supply 50,000 tons of pipes for Bombay Waterworks. The contract price is about £300,000.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE fight of the Bills—Bute Dock, Taff Vale, Rhymney, and Barry—is engrossing all attention, and, fortunately, takes the mind away from the very serious condition of trade at home. Both in coal and iron there are no signs of encouragement. Dowlais iron-workers are only employed half-time; and now, to add to the distress of that neighbourhood, the coal trade has begun to slacken. Hitherto Dowlais has been exceptionally favoured, but prospects are now gloomy. The same may be said of Nixon's Collieries, Mountain Ash, which has enjoyed a fair run; now little is being done, two days a week is about the rule, and at Merthyr Vale half-time is the ordinary course of things. One would not be surprised at second-class coal falling in demand, but when the best collieries in the country are showing signs of stagnation matters begin to wear a serious outlook. Prices are firm, small steam especially, output being so limited. A slight improvement was shown at Swansea Port last week, but Cardiff and Newport totals were low. The Cardiff total was only a little over 100,000 tons, and the shipment of iron was confined to 500 tons.

A little while ago I noted the fact that Cyfarthfa turned out from one Bessemer converter 1500 tons of steel in one week. This has been commented upon as showing a satisfactory and an unsatisfactory state of things. The fact redounds to the excellence of scientific arrangements and skill of management, but it also shows that make can be increased out of all ratio to demand. In the coal trade, again, a similar fact has come to light. Last year the Great Western Colliery at Pontypridd turned out 400,000 tons, one of the largest totals known, showing an excess over 1000 tons a day output. The fact is a sinister one. A dozen collieries might be named of the first standing, Coedcae, say, Ocean, Ferndale, and the like. These might be so worked as to put the mass of small ones out of court, and this is what we are coming to. The small colliery is going the way of the sailing vessel, and it is the large colliery with its powerful engines, and its double shaft and treble shift which are taking its place, and this in combination with the largest steamers.

Cardiff is going in for new industries. The Bute Shipbuilding, Engineering, and Dry Dock Company—manager, Mr. H. W. Lewis, Treherbert—turned out last week a magnificent steel steamship. She has a carrying capacity of 2000 tons. The steel plates were from Landore; Messrs. Palmer, of Jarrow, are supplying the engines. In all respects the steamer is voted as admirable, reflecting the greatest credit on the firm, and ensuring certain business in the future in the same line.

I am told that the prevailing figures for steel vessels are now lower than they have ever been. They have been as low as £8 per ton; now the figure is £7.

The tin-plate trade is moderately firm. Prices vary 3d. or 6d., acccording to brand, but for ordinary cokes 13s. 6d. for good brands is easily obtainable.

Good orders are in hand for Baltimore, Philadelphia, and New York. Last week over 52,000 boxes were sent from Swansea alone to America and France, and as this reduced stocks by 10,000 boxes, prospects of a firmer tone to quotations are regarded as certain. Cokes are quoted from 13s. 6d. to 14s. Bessemers, good, at 14s., and Siemens the same. It is a singular fact that prices are approaching a dead level for best brands of each kind. Ternes are being freely booked.

A South Wales brattice cloth company has been floated, principally by residents of Newport and Cardiff.

A striking illustration of the slackness of the coal trade in Cardiff was given this week by an attempt to sell the coal cargo of a French steamer which collided with a Cardiff vessel last week. After a vigorous attempt to sell, the auctioneer was obliged to give up in despair, and no one even ventured near the low existing market rate.

NEW COMPANIES.

THE following companies have just been registered:—

Box and Beadle's Patent Durable Horseshoe Company, Limited.

This company proposes to acquire and work the letters patent No. 3647, dated 8th September, 1880, and No. 7234, dated 5th May, 1884, for improvements in horseshoes and appliances for setting them, and also foreign letters patents for the same inventions. It was registered on the 13th inst. with a capital of £50,000, in £10 shares. The subscribers are:—

	Shares.
*C. Beadle, Erith, wharfinger	1
*C. N. Kidd, Dartford, brewer	1
*J. B. Martin, M.R.C.V.S., Rochester	1
*J. M. Gray, Maidstone, Kent	1
*W. Philpott Cosier, Dartford, farmer	1
*F. J. Beadle, Erith, coal merchant	1
A. W. Blunt, 14, Queen Victoria-street, accountant	1

The number of directors is not to be less than three nor more than seven; qualification, 25 shares; the first are the subscribers denoted by an asterisk, and Mr. G. A. Cape, of Abbey Wood, Kent; the company in general meeting will determine remuneration.

Hillman, Herbert, and Cooper, Limited.

This is the conversion to a company of the business of manufacturers of velocipedes, light carriages, machinery, and other articles, carried on at the Premier Works, Coventry, by the firm of Hillman, Herbert, and Cooper. It was registered on the 17th inst. with a capital of £75,000, in £25 shares. The subscribers are:—

	Shares.
*G. B. Cooper, 5, Gray's-inn-square, cycle manufacturer	1
*W. H. Herbert, Coventry, cycle manufacturer	1
Mrs. F. M. Herbert, Coventry	1
*G. F. Twist, Coventry, solicitor	1
*A. Rotherham, Coventry, silk dyer	1
*W. Hillman, Coventry, cycle manufacturer	1
Mrs. Hillman, Coventry	1
*R. A. Dalton, Coventry, manufacturer	1

The number of directors is not to be less than five nor more than ten; the first are the subscribers denoted by an asterisk. Messrs. W. Hillmann, W. H. Herbert, and G. B. Cooper are appointed managing directors for five years at salaries of £600 per annum, £600 per annum, and £400 per annum respectively. The directors may appoint an additional managing director at a salary not exceeding £100 per annum. The remuneration of the ordinary directors will be determined by the company in general meeting; qualification, 10 shares.

Lancashire Alkali and Sulphur Company, Limited.

This company was registered on the 13th inst. with a capital of £100,000, divided into 3000 £7 per cent. preference and 7000 ordinary shares of £10 each, to trade as manufacturers of alkali, sulphur, and other chemicals for such purposes, will take over the business and assets of the Desoto Alkali Company, Limited, and will also acquire the patents and inventions of Messrs. Edward Wm. Parnell and James Simpson for improvements in the manufacture of alkali, sulphur, &c. The subscribers are:—

	Shares.
*R. Rayner, Exchange-buildings, Liverpool, general broker	1
*R. J. Glasgow, 4, India-buildings, Liverpool, merchant	1
G. Ashcroft, 4, Paul-street, Liverpool, chemical broker	1
*J. Simpson, 8A, Rumford-place, Liverpool, merchant	1
G. A. Mather, Birchfield-road, Liverpool, chemical broker	1
*E. W. Parnell, Queen's Park, Chester, analytical chemist	1

The number of directors is not to be less than three nor more than seven; qualification, 50 shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Peruvian Mining Company, Limited.

This company was registered on the 17th inst. with a capital of £100,000, in £1 shares, to acquire, work, and develope the whole of the property of the three mines named respectively La Sociedad, La Esperanza, and La Inglesa, situate in the district of Tarma, Peru. It also proposes to colonise and cultivate lands in Peru. The subscribers are:—

	Shares.
A. E. Gush, 3, Buckingham-road, Wood-green, stockbroker	1
J. Pope, 232, High-street, Lewisham, Custom House agent	1
W. H. Peers Williams, M.A., 83, George-street, Portman-square, barrister	1
J. W. Richardson, 17, Gordon House-road, N.W., stockbroker	1
C. E. Rose, 94, Camberwell-grove, stockbroker	1
F. Cherry, 42, Old Broad-street, stockbroker	1
F. C. Hill, 1, Park Villas, Venner-road, Sydenham, accountant	1

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first and act *ad interim*; qualification, 200 shares; remuneration, £100 per annum each, and 10 per cent. of the profits after payment of 10 per cent. dividend.

Salford and Irwell Rubber Company, Limited.

This company proposes to take over the business carried on by the Irwell India-rubber and Gutta-percha Works, Limited, at Salford, Lancaster. It was registered on the 17th inst. with a capital of £50,000, in £5 shares. The subscribers are:—

	Shares.
D. B. Myers, 15, King-street, St. James's	1
H. W. Price, 17, Mincing-lane, broker	1
S. S. Harper, Lloyd's, underwriter	1
R. H. Harper, Weybridge, merchant	1
C. J. Price, West Molesey	1
J. T. Horley, Harrow, banker	1
P. Harper, Upper Tooting, agent for the sale of rubber	1

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first and act *ad interim*; qualification, 50 shares; each ordinary director will be entitled to £50 as remuneration for the first year; in subsequent years the company in general meeting will determine remuneration. Messrs. R. H. Harper and D. B. Myers are appoined managing directors, the former at a salary of £400 per annum, and the latter at £300 per annum, together with a percentage upon the profits.

South African Mercantile Company, Limited.

In England, South Africa, and elsewhere, this company proposes to carry on the business of engineers, iron and brass founders and metal manufacturers, hardware dealers, commission agents and general dealers, and will take over the assets and liabilities of John Vernon Hope and Co., Limited. It was registered on the 17th inst. with a capital of £30,000, in £1 shares. The subscribers are:—

	Shares.
*G.F. Wear Hope, Greenhithe, Kent, merchant	1
*J. Wilson, 63, Leadenhall-street, manufacturer	1
*W. J. Berry, 72, Mark-lane, shipping agent	1
W. H. Wollverton, 4, Wynell road, Forest-hill, clerk	1
H. Wilks, 198, Tuffnell Park-road, secretary to a company	1
G. L. Lanning, 6, Russell road, Bowes Park, N., clerk	1
G. Edmonds, 185, Victoria Park-road, shorthand writer	1

The number of directors is not to exceed five nor to be less than three; qualification, £500 invested in the company; the first are the subscribers denoted by an asterisk, Mr. Charles Rice, of Southend, and Mr. John Shaw, of Sohohill, Sheffield; the company in general meeting will determine the remuneration of the board.

Iran Steamship Company, Limited.

This company was registered on the 12th inst. with a capital of £25,100, divided into 25 shares of £1000 each, and 10 shares of £10 each, to acquire and work a steamship to be called the Iran, or such other name as the directors may think fit. The subscribers are:—

	£10 Shares.
Sir E. Bates, Bart., Liverpool	1
G. T. Bates, Liverpool, merchant	1
E. P. Bates, Liverpool, merchant	1
S. E. Bates, 27, Clement-lane, E.C.	1
C. W. Kelloch, Liverpool, shipowner	1
H. G. Kelloch, Liverpool, broker for the sale of ships	1
W. W. Kelloch, Liverpool, broker for the sale of ships	1
J. M. Dickens, Liverpool	1

Messrs. Edward Bates and Sons, of Liverpool, appointed managers.

Kingston Company, Limited.

This company proposes to carry on and develope a large blue, blacklead, soap, railway grease, and ultramarine manufacturing business, and for such purposes will acquire the businesses of the Hull and East Riding Drysalter's Company and of Gibbons, Brady, and Co. It was registered on the 11th inst. with a capital of £50,000, in £1 shares. The subscribers are:—

	Shares.
*F. P. Koe, Montpelier House, Blackheath, merchant	100
A. Gibbons Brady, 44, Windsor-street, Hull, blue and black lead manufacturer	10
C. J. Bethell, 38, King William-street, E.C., merchant	50
*John Clarke, Anlaby-road, Hull, agent	100
*F. C. Ramshaw, Grimsby, agent	100
G. Spinks, 2, Wright-street, Hull, agent	10
F. S. Wooler, Batley, solicitor	10

The number of directors is not to be less than two nor more than five; the first are the subscribers denoted by an asterisk. The managing director will be entitled to £500 per annum, and each ordinary director to £100 per annum. Mr. Gibbons Brady is appointed secretary at a salary of £250 per annum, increasing £50 per annum until £500 per annum be attained.

BRIDGE BUILDING IN AMERICA.—The material for nine of the largest bridges in the United States is being tested in Pittsburgh, says the *American Manufacturer*, of that city, by the Pittsburgh Testing Laboratory. The cost of the bridges will range from 5,000,000 dols. down to 450,000 dols. Captain Hunt has returned from New York, where he was consulting with United States Engineer-General Q. A. Gilmore, of the St. Paul bridge across the Mississippi river. It will be a suspension bridge, much larger than the St. Louis bridge, and will be made strong enough to carry a battalion of artillery at a trot. It is to be constructed jointly by the Government and the city of St. Paul. One end of it will be at the fort in Rob-street, St. Paul, and the structure will extend over the top of the three bridges now at that point. The material is being made by the Morse Bridge Company, of Youngstown, and the Union Rolling Mills and Wilson, Walker and Co., of Pittsburgh. The second bridge is to be built by the Union Pacific Railroad Company, across the Missouri river at Omaha to Council Bluffs. The present two-track structure will be replaced by one having four tracks. The iron for it is being made by the Union Bridge Company, of Buffalo, and by the Union Rolling Mills, Wilson, Walker and Co., and Graff, Bennett and Co., of Pittsburgh. The next two are being thrown across the river at Grand Rapids, by that thriving city, to be known respectively as the Sixth-street and Pearl-street bridges. They are being made in Pittsburgh. The fifth, by contract, is held in Pittsburgh, by the Keystone Bridge works, for all of the iron bridges on the Virginia Midland Railroad. The next two are being constructed by the Union Bridge Company, of Athens, N.Y., for the Atchison, Topeka and Santa Fe Railroad Company. This bridge company also has the structural iron work for the Harlem river stone bridge of New York, and over which so much of a row was made in the New York Legislature because the contract was let privately and not by publicly being advertised for bidders. The last on the list is the Dauphin county bridge across the Susquehanna river, near Harrisburg. All this iron work is now being tested by this Pittsburgh firm. The Harlem bridge will be the largest stone bridge in the world. It is to have a span of 250ft. All the others are "go-as-you-please" suspension bridges.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

15th March, 1886.

3634. SLIDE RULE for CALCULATING TIME, E. L. Walford, London.
3635. TENT POLES and VENTILATORS, S. S. C. Hill.—(*P. Lewis, Canada.*)
3636. PAINT for PREVENTING ATTACHMENT of BARNACLES to the BOTTOMS of SHIPS, A. C. Ireland and J. R. Bowbeer, London.
3637. STEAM TRAPS, J. Kirkman, London.
3638. TEMPLES for LOOMS, J. Winter and T. Ivers, London.
3639. ROTARY WEB PRINTING MACHINES, J. M. Black, London.
3640. POWER LOOMS, A. J. Boult.—(*A. Hohlbaum, Austria.*)
3641. COCKS for GAS and LIQUIDS, G. K. Cooke, London.
3642. ROTARY ENGINES, E. A. Muskett, Enfield.
3643. ERASURE of WRITTEN MATTER, W. F. Bower and G. F. Down, London.
3644. EXTRACTING OILS by VOLATILE SOLVENTS, A. W. MacIlwaine, London.
3645. DECORATION of WOOD, &c., SURFACES, O. Lindner, London.
3646. ADJUSTABLE BIB APRON, R. M. Moody and F. W. Mugford, London.
3647. PIANOFORTE TUNING KEYS, W. Taylor, London.
3648. HYDRAULIC FILTER PRESS, J. Critchlow, London.
3649. ATTACHMENTS for REGENERATIVE GAS LAMPS, D. Macfie, Glasgow.
3650. HAND BORING MACHINES, A. Baird and J. Allison, Glasgow.
3651. TREADLE MECHANISM, P. A. Mackintosh, Woking.
3652. LADIES' MUFFS, S. Walton London.
3653. HOOKS for use in HARNESS, &c., R. Matthews, London.
3654. ELASTIC PENS and PEN-HOLDERS, E. Mögel, London.
3655. WATCHMAN'S INDICATOR, W. H. Beck.—(*L. S. and P. F. Naudin, France.*)
3656. HANGING CURTAINS, E. Edwards.—(*J. B. Coq, France.*)
3657. ELECTRIC INCANDESCENT LAMPS, E. Edwards.—(*F. Herrmann, Germany*)
3658. LOCKING, &c., a SERIES of DOORS, F. B. Aspinall, London.
3659. COMMUNICATING PRESSURE to ENSILAGE, C. G. Johnson, London.
3660. HOSE, F. Johnson, London.
3661. ROTARY ENGINE, W. H. Cross, London.
3662. VELVET and other PILE FABRICS, G. Chwalla, London.
3663. PRESERVATION of INFLAMMABLE MATTERS, S. Pitt.—(*C. Haret, France.*)

16th March, 1886.

3664. AUTOMATIC GOVERNORS for MARINE STEAM ENGINES, C. Dickenson, London.
3665. FLOOR and WALL COVERING, H. J. Allison.—(*R. F. Nenninger, United States.*)
3666. FLEXIBLE CLIP, J. Porritt and J. S. Garland, Warrington.
3667. PAPER FOLDING MACHINES, R. Cundall, Halifax.
3668. LOCKS, J. R. Walker, Manchester.
3669. VEGETABLE DISH, G. Wilkinson, Birmingham.
3670. ELECTRIC INCUBATOR, H. Neumann, London.
3671. BOOT HOOK, F. R. Baker, Birmingham.
3672. TAKING STEREOS, E. Bush and W. Pickersgill, Leeds.
3673. ARRANGING PINS for SALE, J. M. Edelsten, Manchester.
3674. ELECTRO-PLATING APPARATUS, A. F. Harris, Birmingham.
3675. TRANSMITTING MOTIVE-POWER from MOTORS, J. Gibson, Paisley.
3676. BOTTLES and STOPPERS, F. Keeling and R. Rigley, Bulwell.
3677. METALLIC TAGS for LACES, J. Halliwell, Manchester.
3678. SECURING METAL TAGS to LACES, J. Halliwell, Manchester.
3679. COUPLING APPARATUS, F. Attock and W. Mosley, London.
3680. HIGH-PRESSURE STEAM ALARM APPARATUS, J. H. Dewhurst, Sheffield.
3681. ENGAGING and DISENGAGING FRICTION GEAR, &c., E. Wood, Hunslet.
3682. PLANING TRUNK, F. H. Butter, London.
3683. PORTABLE COULTER BLADE FASTENING, T. C. Sargeant, Northampton.
3684. PRODUCING a "COLOURED GOLD" SURFACE on ARTICLES of GOLD, &c., C. Clarke, Birmingham.
3685. CUTTING LIFTS and SOLES, W. Freeman, Leicester.
3686. UMBRELLAS, &c., J. D. Kirkham, Tunstall.
3687. REPEATING FIRE-ARMS, F. Rees, London.
3688. CONVERTIBLE STAND, E. J. Hurley, London.
3689. SAWING, &c., WOOD, D. A. Greene, London.
3690. SEAMING TIN CAN BODIES, W. P. Thompson.—(*C. M. Symonds, United States.*)
3691. BAKER'S TRAVELLER'S COMPANION, M. Baker, London.
3692. READING and WRITING REFLECTOR CANDLE LAMP, J. Braham, London.
3693. ROTARY ENGINE, T. Hollings, London.
3694. WINDOW FASTENING, H. C. Pennell, London.
3695. DIRECT-ACTING STEAM ENGINES, W. Boby, London.
3696. STOPPERS of BOTTLES, W. Hemsley and E. Burton, London.
3697. GAS, F. Windham, London.
3698. CONVERTIBLE SCHOOL DESKS, R. J. Porteus, London.
3699. METALLIC SLEEPER, L. A. Groth.—(*P. Kolgraf, Belgium.*)
3700. LADIES' SADDLES, J. B. Höhne, London.
3701. EXPLOSIVES, F. B. W. Roberts, R. Gausden, and A. Luck, London.
3702. TREATING ARGENTIFEROUS MATERIAL, E. B. Parnell, London.
3703. MEDICAL PREPARATION, S. Watkins.—(*F. R. Harris, Cape of Good Hope.*)
3704. SELF-LIGHTING BURNER, T. A. Brass, London.
3705. ROCKERS for COTS, &c., G. H. Needham, R. Stapley, and W. Smith, London.
3706. LASTING the UPPERS of BOOTS and SHOES, J. Y. Johnson.—(*F. Chase and O. E. Lewis, United States.*)
3707. PRODUCING ENGRAVED ROLLERS for CALICO PRINTING, J. Kerr and W. Willian, London.
3708. METER for MEASURING LIQUIDS, H. B. Payne, London.
3709. STEAM BOILER, &c., FURNACES, W. L. Wise.—(*F. C. Marshall, Italy.*)
3710. PORTABLE COOKING APPARATUS, A. von Neufville and G. Warnecke, London.
3711. STANDARDS for CONTINUOUS BAR FENCING, W. P. C. Bain, Glasgow.
3712. BAKERS' OVENS, D. S. Sutherland and J. McIntosh, Glasgow.
3713. STOCKING SUPPORTERS, R. Haddan.—(*R. Hicks, United States.*)
3714. HORSESHOES, G. T. Mackley, London.
3715. DRYING APPARATUS for CLAY, P. Freygang, London.
3716. WATCHMAN'S CLOCKS, E. J. Colby, London.
3717. TWO-WHEELED VEHICLES, T. Slinger, London.
3718. ELECTRIC RAILWAYS, E. M. Bentley and W. H. Knight, London.
3719. STEAM BOILERS, B. J. B. Mills.—(*J. P. Serve, France.*)
3720. ATTACHING BUTTONS to WEARING APPAREL, J. Lakeman, London.
3721. FIXING SPRINGS of GLOVE FASTENERS, W. J. Walden, London.
3722. CARRIAGE SEATS, C. Morgan, London.
3723. ROTARY HAIR BRUSHES, J. Appleton, London.
3724. VERTICAL DRILLING MACHINE, C. D. Abel.—(*B. Fischer, Germany*)
3725. SEWING MACHINES, J. B. Robertson, London.
3726. GALVANIC BATTERIES, H. H. Lake.—(*J. Serson, United States.*)
3727. REFINING SUGAR, H. H. Lake.—(*Société Nouvelle des Raffineries de Sucre de St. Louis, France.*)
3728. UNITING METAL and GLASS, H. H. Lake.—(*B. B. Schneider, United States.*)
3729. FUEL, &c., A. von Neufville and G. Warnecke London.
3730. PURIFYING WATER, C. W. Burton and F. T Moison, London.
3731. PURIFYING WATER, C. W. Burton and F. T. Moison, London.

17th March, 1886.

3732. DYEING TEXTILE MATERIALS, H. Kershaw, Manchester.
3733. ELEVATING GRAIN, J. Edwards, Wednesbury
3734. SLICING POTATOES, &c., R. H. Pethebridge, Somerset.
3735. HORIZONTAL SLIDING TARGET, S. Whaley and J. Tennyson, Chester.
3736. SLIDE VALVES for LOCOMOTIVE ENGINES, J. Dewrance, London.
3737. KNITTING MACHINES, W. G. Jones, Leicester.
3738. UTILISATION of WASTE HYDROCARBONS, G. T. Beilby and J. B. McArthur, Slateford.
3739. AUXILIARY STEERING APPARATUS, A. Taylor, Liverpool.
3740. WIRE DRAWING APPARATUS, C. Campbell, Birmingham.
3741. FEEDING APPARATUS for THRASHING MACHINES, R. G. Hammond, Suffolk.
3742. PORTABLE BANJO, J. E. Dallas and J. E. Brewster, London.
3743. BOXES, L. W. Stone, Banbury.
3744. DYEING WOOL, T. Holliday, London.
3745. SEED DISTRIBUTING MACHINES, J. Miles, Somersetshire.
3746. ARMOUR-PLATES, J. F. Hall, Sheffield.
3747. FORGE and TILT HAMMER HELVES, J. F. Hall, Sheffield.
3748. METALLIC SPRING WORK for CUSHIONS, W. S. Laycock, Sheffield.
3749. SEPARATING OIL from SUBSTANCES of SPECIFIC GRAVITIES, A. F. Craig, A. Neilson, and J. Snodgrass, Glasgow.
3750. MACHINE, &c., GUNS, J. W. Petty, London.
3751. AUTOMATICALLY EXTINGUISHING CANDLES, A. B. O'Conner and J. H. Wilson, London.
3752. VELOCIPEDES, H. Newbold, London.
3753. BALL BEARING CASTORS, R. H. Hughes, London.
3754. METALLIC MANOMETERS, W. P. Thompson.—(*H. Mignot, France*)
3755. SOFTENING of LINEN, &c., W. S. Johnstone, Liverpool.
3756. REGULATING APPARATUS for ELECTRIC ARC LAMPS, A. W. Richardson, Liverpool.
3757. BENDING EBONY, L. Baum, London.
3758. PRODUCING DESIGNS on TEXTILE GOODS, W. Cockcroft Leeds.
3759. WINDOW TICKET HOLDER, L. Courlander, Croydon.
3760. WARMING and VENTILATING ROOMS, J. A. Wheeler, London.
3761. TWO-WHEELED VEHICLES, W. Rudd, London.
3762. MAKING SCREWS, C. Peach.—(*A. Johnstone United States.*)
3763. VENETIAN BLIND, R. Shardlow, Lenton.
3764. COUPLING RAILWAY CARRIAGES, S. A. Sarel, Yarmouth.
3765. INSTRUMENTS for TAKING SOUNDINGS, E. E. Wigzell, London.
3766. HOLDERS for TICKETS, E. Mögel, London.
3767. BURNING HYDROCARBON OILS, J. H. W. Stringfellow, London.
3768. PADDLE-WHEELS and VESSELS, J. M. Hale, London.
3769. CLIPPING HAIR, &c., W. Bown and H. Mitchell, London.
3770. OBTAINING ALUMINIUM from SALTS of ALUMINA, J. B. Spence, London.
3771. MAKING GAS from HYDROCARBONS, W. Edwards, London.
3772. LOCK-STITCH SEWING MACHINES, D. Jones, London.
3773. APPARATUS for SAVING LIFE, E. Bruce, London.
3774. FILLING BOTTLES with AERATED LIQUID, H. W. Stevens, London.
3775. FILTERS, R. Gough, London.
3776. REGULATOR for ELECTRIC LAMPS, J. D. Andrews, London.
3777. FITTING FASTENERS to PURSES, F. Weintraud.—(*Messrs. Weintraud and Co., Germany.*)
3778. ADDITIONS to TIRES of VELOCIPEDES, G. Hookham, London.
3779. FURNACE BARS and ATTACHMENTS, J. Love London.
3780. WASHING DISHES, &c., H. H. Lake.—(*H. B. Scoville, United States.*)
3781. COFFEE HULLERS, J. R. Merrihew, New York.
3782. FOLDING SAFES, E. B. Pearse, London.
3783. PIPE JOINT, J. Ellam and E. T. J. Adams, London.
3784. SEPARATING GRAIN, &c., from SEED, &c., Towl, jun., London.
3785. DRESSING GOWN, L. Ososki, London.
3786. TURBINE or WATER MOTOR, Sir W. Vavasour London.
3787. SECURING RAILS to METAL SLEEPERS, J. Whitestone and W. C. Somerville.

18th March, 1886.

3788. INVALID COUCHES or PALLETS, T. Andrews Birmingham.
3789. TRIPLE TANDEM SAFETY BICYCLE, J. and G. N Howes, London.
3790. SHIFTING BOTTOM FIRE-GRATES, G. G. Brodie J. D. Prior, Birmingham.
3791. HORSE-RAKES and HAY-MAKERS, T. H. Ramsden Bramhope.
3792. LOWERING LIFE-BOATS from SHIPS, P. Anderson Bridlington Quay.
3793. RECOIL BRAKES for GUN CARRIAGES, A. C. Koerner, Paris.
3794. APPLICATION to SPORTING GUNS of REGISTERING, &c., INDICATORS, T. Kay, Stockport.
3795. LETTING-OFF MOTION for LOOMS for WEAVING G. and G. H. Hartley, Bradford.
3796. PRODUCING HEAT, &c., for COOKING, &c., G. Parkes.—(*A. Parkes, U.S.*)
3797. GLASS FRAMES or SASHES of RAILWAY, &c., ARRIAGES, J. H. Fletcher, Manchester.
3798. PRESSER-FLYERS, G. F. Cooke, Manchester.
3799. SIGHT-FEED LUBRICATORS, J. Holland and J. Lever, Manchester.
3800. BOILERS for HOT WATER, &c., R. Robson, Leeds.
3801. PRODUCING CURRENTS of AIR, &c., J. Anderson and R. McKinnell, Glasgow.
3802. GAS ENGINES, L. Cooper, Manchester.
3803. COMPOUND DRILL for BORE RODS for COLLIERIES, &c., R. Wilson, Bishop Auckland.
3804. PEAT FIRELIGHTERS, A. Johnson, Manchester.
3805. OPTICAL LANTERNS, H. M. Whitefield and S. Washington, Manchester.
3806. GRINDING and TRUEING SPINDLES, E. and W. Crossley, Manchester.
3807. CONSTRUCTION of METALLIC FIREPROOF ELEVATOR CASINGS, D. Dempster, Manchester.
3808. COUPLING and UNCOUPLING RAILWAY VEHICLES, J. W. Hadwen, Manchester.
3809. BAGS, &c., I. D. E. L. Lloyd-Jones, London.
3810. TRAVELLING FLAT CARDING ENGINES, G. and E. Ashworth, Manchester.
3811. METAL RING or WEDGE, W. Arnold, Halifax.
3812. SHARPENING PENCILS, L. E. Emmett, Sheffield.
3813. COKE, &c., FORKS, A. E. Stayner and W. Roberts Millhouses, near Sheffield.
3814. FOODS for the use of ANIMALS, L. C. Tipper, Birmingham.
3815. VENTILATORS, J. Meek, Liverpool.

3816. Fishing Reels, D. Slater, London.
3817. Constructing Trout Fishing Reels, W. H. Hudson, London.
3818. Equalised Drill and Wood-bit Shanks, &c., S. P. Graham, Canada.
3819. Tug Strap Holders, T. Kendray and G. N. Mathieson, Canada.
3820. Preventing Leakage in Bottles, S. C. Goodhart, London.
3821. Propelling Ships, F. Fenton and H. A. Whitaker, London.
3822. Blind Roller, J. Lang, London.
3823. Grinding or Grating Salt, &c., T. E. Morris, East Twthill.
3824. Safety Lamp for Use in Mines, &c., J. E. Williams, London.
3825. Spring Razor Strop, H. Hescote (Escott), London.
3826. Formation of Organic Oxides, &c., J. G. Lorrain, London.
3827. Vent-plug for Vessels containing Liquids, G. H. White, Dunstable.
3828. Actuating Couplings of Wagons, J. Day, Bradford.
3829. Bicycles, C. R. E. Bell, London.
3830. Food for Animals and Poultry, G. H. Bonnor, London.
3831. Cartridges for Revolvers, &c., E. Mote, London.
3832. Artificial Asphalte, W. E. Constable, London.
3833. Gear for Cycles, &c., J. Roots, London.
3834. Air Heating Grate Backs, A. Salmon, London.
3835. Composite Iron and Cement Pipes, &c., J. Monier, London.
3836. Casting Ingots of Steel or Metal, A. Kurzwernhart and E. Bertrand, London.
3837. Watches and Timepieces, J. and F. Durrstein, London.
3838. Rotary Pumps, W. Hucks, London.
3839. Portable Presses, F. S. Reisenberger and M. C. Keith, London.
3840. Half-stuff for Paper-making, F. S. Reisenberger and M. C. Keith, London.
3841. Shot, G. Lampen, London.
3842. Compound Engines, A. Boyd, London.
3843. Nut Lock, A. M. Clark.—(*A. C. Vaughan and J. H. Sternbergh, United States.*)
3844. Screw Propellers, J. Pinches.—(*W. Pinches, New Zealand.*)
3845. Scutching and Hackling Machines, J. C. Mewburn.—(*S. G. Brookes, France.*)
3846. Carrying Knapsacks, J. C. Mewburn.—(*A. Mendel, Germany.*)
3847. Shovels, I. Nash and J. L. Dubois, London.
3848. Opening and Closing the Lids of Tea-pots, &c., A. Evans, London.
3849. Field Magnets, P. B. Elwell, London.
3850. Dumbells, H. Holcroft and A. H. Mould, London.
3851. Splashers for Dogcarts, &c., A. R. Holmes, London.
3852. Car Couplings, A. J. Boult.—(*T. L. McKeen, United States.*)
3853. Jury Rudders for Steering Ships, J. A. Hill, Liverpool.
3854. Monocycles, Z. J. and C. Francis, and F. D. Barritt, London.
3855. Marking, &c., Lawn Tennis and other Games, G. Bedford, London.
3856. Looper for Circular Hosiery Web Machines, C. A. Roscher and F. Knorr, London.
3857. Triturating Apparatus, J. R. Alsing, London.
3858. Valves, T. H. White, Manchester.
3859. Hot-air Furnaces, H. E. Newton.—(*R. A. Chesebrough, United States.*)
3860. Combined Portable Engines and Pumps, D. Greig, Leeds.
3861. Balance Ploughs, D. Greig and T. Benstead, Leeds.
3862. Machine Drills, F. Greenaway, London.
3863. Propellers for Ships or Vessels, J. Higham, London.
3864. Destroying Insects on Animals, R. V. Tuson, London.
3865. Operating the Wheel Brakes of Vehicles, T. Burney, London.
3866. School Desks, J. Blazek, London.
3867. Basic Lining for Metallurgical Apparatus, A. M. Clark.—(*H. Harmet, France.*)
3868. Converting the Martini Rifle into a Repeating Arm, Baron de Overbeck.—(*A. Schratzenthaller, Austria.*)

19th March, 1886.

3869. Fasteners for Bangle Bracelets, W. H. Wilkes, Birmingham.
3870. Conveyance, &c., of Petroleum, E. Phillips, London.
3871. Safety Lamps, J. Rayner, New Sharlston.
3872. Fire Snow Plough, J. H. Bell and W. Rockliffe, Sunderland.
3873. Chairs, W. Brierley.—(*Messrs. Ruscheweyh and Schmidt, Germany.*)
3874. Hydraulic Differential Power Lift, T. P. Ford, London.
3875. Roller Blind Fittings, N. Voice, Crawley.
3876. Blind Rack Pulleys, J. Walker, Birmingham.
3877. Solitaires, &c., J. Walker, Birmingham.
3878. Open Hearth Furnaces, R. Hanson and J. Fernee, Sheffield.
3879. Adjustable Diaphragm for Photographic Purposes, W. J. Lancaster, Birmingham.
3880. Fabric for Dress Goods, &c., H. Rouse, Bradford.
3881. Alarms for Windows, &c., W. J. R. Hill, Birmingham.
3882. Hatching Eggs by Artificial Heat, A. Fiddes, Bristol.
3883. Electrostatic Induction Machines, W. Grierson, Glasgow.
3884. Stoppering Jars, &c., J. Gray and S. Jones, Birkenhead.
3885. Envelopes, A. Thomson, London.
3886. Speedy Lighting of Fires, E. Greenfield, Hastings.
3887. Vapour Burners, M. Plumb.—(*H. Wellington, United States.*)
3888. Fishing Lines, H. Cholmondeley-Pennell, London.
3889. Hinged Waist Stay or Corset, E. J. Jones, Kingston-on-Thames.
3890. Preparing Para-amidodiphenyl Sulphonic Acid, T. Carnelley, Dundee.
3891. Punching Tickets, W. H. Bailey and J. Duncan, Manchester.
3892. Motor, A. Tomkinson, Stratford.
3893. Producing Electric Light, H. de Clairmont and C. L. Field, London.
3894. Fasteners for Gloves, &c., G. T. Mackley, London.
3895. Imitation Ivory, G. Murphy, London.
3896. Gas Stoves, J. Stapler, London.
3897. Heating Water for Feeding Steam Boilers, W. Sellar, London.
3898. Loom Attachments, J. and J. Nightingale, London.
3899. Quilling Machines, J. and J. Nightingale, London.
3900. Flower Vase Holder, E. V. Good and W. Egerton, Erith.
3901. Measuring Fluids, D. Pope, London.
3902. Coal-cutting in Mines, R. Thomson, Liverpool.
3903. Step Ladders, G. W. G. Knight, London.
3904. Fuses, W. Wells and C. F. Thompson, London.
3905. Supplying Air to Fireplaces, R. J. Charleton, London.
3906. Buffer, &c., Springs, A. G. Spencer, London.
3907. Tin-plates, W. F. Richards, London.
3908. Filling Cans, E. T. Worssam, London.
3909. Portland Cement, H. Peters, Rochester.—11th January, 1886.
3910. Iron or Metal Ships, J. Long, London.
3911. Loading Coal, W. L. Turner, London.
3912. Smoothing Irons, G. Pickup, London.
3913. Preventing Perspiration, J. V. Brandau, London.
3914. Filling Bottles, A. Saxlehner, London.
3915. Strings of Pianos, &c., F. Rahse, London.

20th March, 1886.

3916. Rotary Engines, J. and W. Moss, Nottingham.
3917. Coupling Wagons, H. J. Lever, Tisbury.
3918. Eyes for Stair Rods, F. French, Handsworth.
3919. Tobacco Pipes, J. and J. H. Walkden, Manchester.
3920. Circuses, &c., J. Oller, London
3921. Coupling Wagons, J. Day and B. Rhodes, Bradford.
3922. Shuttle Tongues, J. Williamson, Manchester.
3923. Safety Lifts, A. Heywood jun., and E. McGee, Manchester.
3924. Rearing Chickens, E. Ryder, Manchester.
3925. Adjusting the Brushes in Dynamo-electric Machines, R. Sugden and A. D. Shaw, Halifax.
3926. Preparing Fibres for the Combing and Drawing Operations, J. Crabtree, Halifax.
3927. Variable Expansive and Reversing Motion for Engines, J. W. Hartley, Longport.
3928. Syphon Flushing Cisterns, A. Huxley, P. Connor, and J. McIntyre, Liverpool.
3929. Opening and Shutting Water-tight Doors for Bulkheads of Ships, &c., W. Madge and J. T. Ford, Southsea.
3930. Wheel Motors, D. Rylands and B. Stoner, Barnsley.
3931. Combined Rest and Portable Stove or Lamp, T. Brookes, Birmingham.
3932. Steam Boilers, B. E. and G. F. Hipkins, Peckham.
3933. Gloves, G. Pye, London.
3934. Match-boxes, &c., J. R. M. Jacoby, Great Grimsby.
3935. Supply Valves for Gas Motors, F. Oehlmann, London.
3936. Cleaning and Grading Barley, &c., J. W. Clinch and L. Greening, London.
3937. Preparing Wild Silk Cocoons, H. Birkbeck.—(*T. F. Peppé, India.*)
3938. Fastenings for Surgical Appliances, &c., W. Macgill, Fraserburgh.
3939. Saddles and Drawing Rollers in Spinning Frames, W. Scott, Belfast.
3940. Preserving Fish, C. J. Henderson, Edinburgh.
3941. Attaching Knobs and Handles to their Spindles, W. G. Macvitie, Maney.
3942. Driving Bands, A. J. Gesking, Birmingham.
3943. Pinned Rings for Hanging Curtains, &c., E. Compton, Worthing.
3944. Screw, T. Humpage and E. Shaw, London.
3945. Electrical Switches, R. M. Baily, jun., and A. Grundy, London.
3946. Transforming the Conditions of Electric Currents, L. Bollmann, E. Bidermann, and D. Monnier, London.
3947. Arc Lamp, E. A. Ashcroft, London.
3948. Water Meters, H. C. Ahrbecker and N. Grew, London.
3949. Forming Sockets on Lead Pipes, F. Humpherson, London.
3950. Grinding Twist Drills, E. D. Barker, London.
3951. Costume Stand, H. J. Turner, J. Boldero, and P. Pike, London.
3952. Safety Pins, W. G. Packer, London.
3953. Portable Book-case, C. J. Jones and F. N. Haseldine, London.
3954. Cleansing Steam Boilers, W. F. Bower and G. F. Down, South Norwood.
3955. Lamps, J. C. Mewburn.—(*H. A. K. Jennings, India.*)
3956. Producing Ozone, J. H. Johnson.—(*E. Hermite, France.*)
3957. Chlorine Compounds, J. H. Johnson.—(*E. Hermite, France.*)
3958. Umbrellas, W. C. Phillips, London.
3959. Umbrellas, G. Kirkman, London.
3960. Operating Sashes, C. H. Metcalfe, London.
3961. Cement, S. Frankenburg, London.
3962. Steering Ships, J. Léveillé, London.
3963. Stone Breaker, G. F. Redfern.—(*C. Klammt and — Brierck, and — Hubner, Germany.*)
3964. Separating Machine, G. F. Redfern.—(*C. A. Johansson, Sweden.*)
3965. Measuring Moisture, G. F. Redfern. —(*A. Bonino, Italy.*)
3966. Ladies' Boas, B. Groner, London.
3967. Deep Sea Sounding, J. G. Jones, London.
3968. Seat and Milk Receptacle, M. Braun, London.
3969. Switch, &c., Regulator, A. M. Clark.—(*Messrs. Schafer and Montanus, through Wirth and Co., Germany.*)
3970. Seizing, &c., Light Objects, A. M. Clark.—(*A. Dubois, France.*)
3971. Crushing Ores, J. M. Macdonald.—(*T. D. Williams, South Africa.*)
3972. Sheets of Rippled Glass, W. E. Chance, London.
3973. Treatment of Sewage, &c., J. W. Slater, S. K. Page, W. Stevens, and the Native Guano Company, London.

22nd March, 1886.

3974. Couplings for Metal Pipes, D. and F. H. Orme, Manchester.
3975. Warp Machines, R. Thornton, Nottingham.
3976. Extinguishing Fires, R. Walsh and R. Entwistle, Bolton.
3977. Testing the Force of Guns, &c., T. Birkett, Birmingham.
3978. Clog Irons, W. Carter and W. Chaloner, Preston.
3979. Metallic Bedsteads, &c., W. H., S., and C. Sproston, Birmingham.
3980. Plush and other Pile Fabrics, F. Robinson, Leeds.
3981. Jointing, &c., Leather Driving Belts, W. White, Bradford.
3982. Lamps and Lanterns, T. G. Normanton and S. E. Major, Barrow-in-Furness.
3983. Drilling and Planing Machine, G. Sant and S. Farnsworth, Derby.
3984. Railway Station and Street Indicator, S. Mason, Leicester.
3985. Plating Metals and Metallic Alloys, C. E. Steinweg, London.
3986. Furnaces, J. M. While, Darlington.
3987. Soaps, J. Townsend, Glasgow.
3988. Runner and Notch for Umbrellas, G. R. Adams and R. S. Barrie, Dundee.
3989. Mooring Bitts for Pier Heads, &c., G. Adamson and J. T. Fenwick, Gateshead.
3990. Heat Conductors, W. F. Stanley, South Norwood.
3991. Steak Tenderer, W. F. Stanley, South Norwood.
3992. Increasing Steam-producing, &c., Power of Steam Engine Boilers, &c., W. A. Drummond, Dundee.
3993. Coupling for Connecting-rods, &c., T. H. P. Dennis, Chelmsford.
3994. Altering the Pitch of the Pianoforte, G. King, Truro.
3995. Portmanteaus, &c., G. Morgan, London.
3996. Driving Gear of Velocipedes, G. D. Ingall.—(*C. H. Bingham and D. W. van Rennes, Holland.*)
3997. Displaying Advertisements, C. S. Nelson and W. N. Colam, London.
3998. Wheels, T. Turner, Birmingham.
3999. Stamping Machines, J. R. Crapper and S. Boaz, Birmingham.
4000. Pipe Joints and Connections, J. M. Lamb, London.
4001. Urinals, R. A. Hall, London.
4002. Hassocks, &c., A. Ollerenshaw, London.
4003. Fastening Buttons without Sewing, G. H. Jones, London.
4004. Embroidering, E. Cornely, London.
4005. Guards for Circular Saws C. E. Mumford, London.
4006. Gas-burners, H. C. Van-de-P. Ahrbecker, London.
4007. Propulsion of Vessels, H. J. F. Russell.—(*M. Marzan, Cuba.*)
4008. Automatic Machine Guns, B. Burton, London.
4009. Grain-cleaning Machines, L. Gathmann, Chicago, U.S.
4010. Washing Machines, E. H. White, London.
4011. Pneumatic Brake Apparatus, M. Schleifer, London.
4012. Agricultural Forks, W. Hassel, Liverpool.
4013. Lubricating Bearings, &c., H. L. Hansen, Liverpool.
4014. Devices for Protecting Trees from Injury, H. C. Frettingham, London.
4015. Pumps and Air Compressors, C. Little, Chesterfield.
4016. Pianoforte Actions, J. Delerue, London.

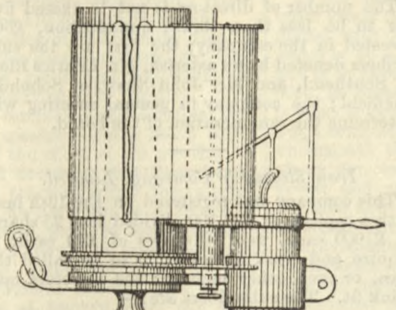
SELECTED AMERICAN PATENTS.

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

334,779. Steam Engine Recorder, *Joseph J. Illingworth and Harry R. Illingworth, Utica, N. Y.—Filed October 19th, 1885.*

Claim.—The combination, with the cylinder of a steam engine indicator and the devices usually employed for producing diagrams of pressure, of a spool

334,779

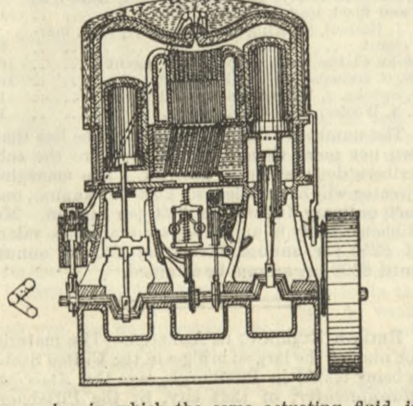


constructed and mounted outside of the drum, holding a continuous strip of paper, which is wrapped and held on the drum for receiving the diagram, substantially as described.

334,154. Method of Operating Air or Gas Engines, *George H. Babcock, Plainfield, N.J.—Filed June 29th, 1885.*

Claim.—(1) In an air or gas engine in which the same actuating fluid is repeatedly heated and cooled, the method of securing and maintaining combustion within said fluid by introducing a combustible gas within the engine, together with a proportionate quantity of oxygen, and burning the gaseous fuel within the actuating fluid in the main chamber of the engine and behind the working piston, substantially as set forth. (2) The method of operating an air or

334,154

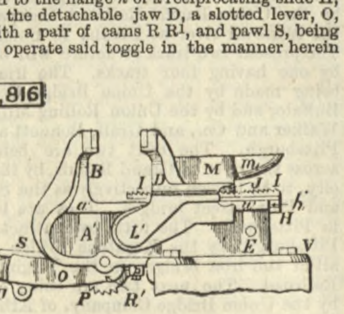


gas engine in which the same actuating fluid is repeatedly heated and cooled, and of securing and maintaining combustion within a fluid which of itself is incapable of supporting combustion by introducing a measured quantity of combustible gas or vapour within said engine, together with a proportionate quantity of oxygen, mixing these gases together and burning the same within the actuating fluid in the main chamber and directly behind the working piston before they are mingled with the fluid of the engine, substantially as set forth.

334,816. Vice, *John J. Spilker, Cincinnati, Ohio.—Filed October 2nd, 1885.*

Claim.—(1) The combination in a vice, of the stationary jaw B at the junction of the outer ends of the side plates, A A¹, the latter being separated by a longitudinal passage C, having near its rear end a transverse pin E, to which is coupled the link F, of a toggle lever, F G G¹ *g*, the links G G¹ of said toggle being united to the flange *h* of a reciprocating slide H, that carries the detachable jaw D, a slotted lever, O, provided with a pair of cams R R¹, and pawl S, being arranged to operate said toggle in the manner herein

334,816

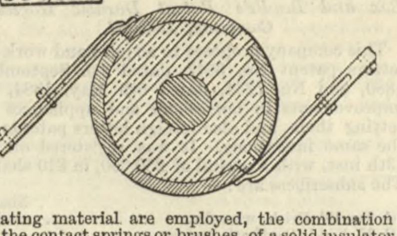


described, and a ratchet wheel, P, being fitted in the slotted end of said lever for the purpose of holding said toggle to any specific adjustment, as set forth. (2) In combination with a vice having a reciprocating slide or carriage H, and a shiftable jaw D, coupled thereto in the manner described, the cheeks L L¹, provide, respectively, with bosses *l l*¹, that bear against the under side of the flanges a¹ a¹ of the frame or bed for the purpose specified.

334,823. Commutator for Dynamo-electric Machines, *Nikola Tesla, Austria-Hungary. — Filed May 6th, 1885.*

Claim.—(1) The combination, with the commutator bars and intervening insulating material and brushes in a dynamo-electric machine of a solid insulator or bad conductor of electricity arranged to bear upon the surface of the commutator adjacent to the end of the brush, for the purpose set forth. (2) In an electric apparatus in which sliding contacts with intervening

334,823

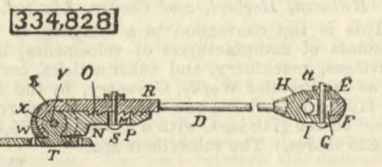


insulating material are employed, the combination with the contact springs or brushes, of a solid insulator or bad conductor of electricity, as and for the purposes set forth.

334,828. Sickle Driver Attachment for Mowing Machines, *James Walker and Henry T, Caulk, Iantha, Mo.—Filed October 17th, 1885.*

Claim.—(1) The combination of the eye, the pitman having the downturned end and the ratchet teeth, the gib N, having the ratchet teeth engaging with the teeth of the pitman, said gib bearing against the eye to secure the latter between it and the downturned end of the pitman, the bolt or key S, to secure the gib N to the pitman, and the gib F, in the other end of the pitman, the gibs N and F, being movable in the same direction, substantially as described. (2) The

334,828

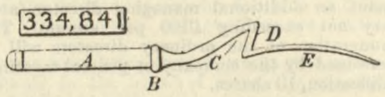


combination of the eye, the pitman having the downturned end and the ratchet teeth, and the gib having the ratchet teeth engaging with the teeth of the pitman, said gib bearing against the eye to secure the latter between it and the downturned end of the pitman, and the bolt or key to secure the gib to the pitman substantially as described.

334,841. Carving fork, *Lionel B. Bethell, Chelsea Lodge, London.—Filed May 15th, 1885.*

Claim.—(1) As a new article of manufacture, a carving fork the shank of which is first curved, turned, bent, or angled outwardly and upward from the plane of the axis of the handle, and then turned, curved bent, or angled downward and toward said plane to form a flange or guard, at or near the lower portion of

334,841

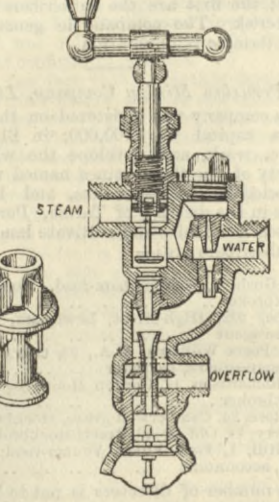


which flange or guard, the tines are connected and from which they project, substantially as and for the purposes set forth. (2) The combination, to form an inherently guarded carving fork, of the handle A, curved shank C, flange D, and tines E E, substantially as and for the purposes specified.

334,852. Injector, *Albert S. Eberman, Cleveland, Ohio.—Filed March 6th, 1885.*

Claim.—(1) In an injector, the combination, with the main casing and main water passage, of an injector discharge nozzle and a valve for automatically closing the initial and secondary overflows independently of the check valve, substantially as set forth. (2) In an injector, the combination, with the main casing, the main water passage, and injector tube adapted to operate as a combining and delivery tube, of a valve for automatically closing the initial and secondary overflows, substantially as set forth. (3) In an injector the combination with the main casing and main water passage, of an injector combining tube adapted to slide within the casing, and thereby automatically close the initial and secondary overflows substantially as set forth. (4) In an injector, the combination, with the main casing and water supply pipe, of an injector combining tube, adapted to admit water to the overflow both from the supply pipe and from the

334,852



pipe leading directly to the boiler and further adapted to automatically close the said overflow passages, substantially as set forth. (5) In an injector, the combination with the main casing and main water-passage, of a movable injector tube adapted to act automatically as a valve for shutting off the initial and secondary overflows, substantially as set forth. (6) In an injector the combination, with the main casing and main water passage, of a movable injector tube provided with enlarged portions, which serve as valves to close the initial and secondary overflows, said tube being automatically operated by the pressure of steam forced water, substantially as set forth. (7) The combination with the main casing main water passage an injector tube, and a valve for automatically closing the overflows, of a loose valve for throwing the whole force of the steam on to the water lift in starting the injector substantially as set forth. (8) In an injector provided with a water lift and means for automatically closing the initial and secondary overflows, a loose valve operated by the valve which admits steam, and adapted to remain on its seat while the steam inlet valve is slightly raised, for the purpose substantially as set forth. (9) The combination with the main casing and main water passage of a water lift, an injector tube, and a valve for automatically closing the initial and secondary overflows independently of the check valve substantially as set forth.