EXPERIENCE WITH SUCTION GAS PRODUCERS.

No. III.*

Depth of fuel.—This should not be less than 1ft. 9in. in the smaller sizes, increasing to 2ft. 9in. or 3ft. in generators of about 150 to 200 brake horse-power when using anthracite "beans" of about ¾in. to 1in. cube, though for smaller fuel, which lies closer together and tends to check the free passage of the gas, the depth may be reduced 2in. or 3in. with advantage.

A plant of 200 brake horse-power size was tried on depths of 2ft. 6in. and 2ft. 9in. when using anthracite "beans," all other conditions remaining the same, but no difference could be discovered in the working. The deeper fire should be of advantage in warming the "green" fuel before it reaches the combustion zone, provided the vacuum necessary to draw the gases through the hot fuel does not become too high, causing dust to be carried to the scrubber and connecting pipes.

Although the depth should usually be kept at the figures given above in every-day work, gas can be obtained to work the engine when the fire is from 12in. to 18in. deep, but it should not be allowed to get so low as this if fresh fuel is to be added later, as the fire will be deadened, and probably give such poor gas as to stop the engine. If, however, it is decided to clean out the plant, the stoker may gradually reduce the level of the fuel in the generator until the fire is only 15in. deep when the time to stop the engine arrives, and thus reduce the amount of half-burnt fuel to be removed from the generator. If time admits when cleaning out, this hot fuel should not be immediately removed as this permits cold air to impinge on the hot fire-brick lining, and may cause cracks and air leaks to form in it; but the whole generator should be left for some hours to cool gradually before the fuel is taken out.

Fire-brick lining.—This should not be less than 6in. thick in the small sizes, and run up to 9in. thick in plants of 120 brake horse-power and upwards. The blocks should be specially made to suit the plants, of good hard material, and in as large pieces as can be conveniently handled, to reduce the number of joints to a minimum. The jointing should be made with fire-clay, and care should be taken in placing the blocks to ensure their fitting very closely, and with a minimum thickness of jointing material. The space between the fire blocks and casing should be packed with dry sand or other non-conducting material. If the lining shows signs of wear a spare set of fire-clay blocks should be ordered at once, to avoid having to make up a lining of ordinary fire-bricks, which has too many joints, and would only last a very short time owing to air leakages into the furnace.

A generator badly built up in this way has been known to admit so much air into the furnace as almost to fill the generator with hard clinker in a day's working; when suitable fire-clay blocks were properly built in the generator the plant worked quite successfully, the small amount of clinker could be taken out through the door, and it was only necessary to draw the fire for cleaning purposes every two or three weeks.

Air leaks.—In addition to the leakage through the lining, considerable trouble has sometimes arisen with plants owing to the joints between the various parts not being made air-tight; this applies especially to the joints connecting the hopper body to the top cover and the latter to the body of the generator. With suction plant all leakages when at work are into the generator, and the extra supply of oxygen causes partial or entire combustion of the gas above the fuel. If the leakage is small the gas supplied to the engine may be enough to enable it to run, but, as more of this poor gas is required for a given power, the suction on the plant becomes heavier, causing excessive generation of heat; this, and the extra heat caused by the combustion in the top of the generator, is liable to crack the casing or vaporiser if of cast iron, or to burn them away very quickly if made of thin steel sheets.

Excessive heating of generator or scrubber can generally be traced to air leaks into the generator, and the cause removed before much damage is done. This leakage is not likely to happen when plant is first erected by the makers, as their workmen know the places requiring air-tight joints; it usually occurs after one or two of the joints have been broken for greater facility of examination and general cleaning, as the attendant does not generally realise the necessity for preventing any leakage, and fails to ensure the joints being air-tight when re-making them.

In no case should the slightest leak into the top of the generator be tolerated or be allowed to continue, as it will quickly increase in size, and probably spoil the generator; in such a case it is well to take to heart the old proverb, "A stitch in time saves nine."

The use of steel or wrought iron plates should be avoided—unless they are of exceptional thickness—wherever they are exposed to hot gases on one side and vapour on the other, owing to their liability to rust quickly. Several generators with steel casting having air and vapour on one side, and hot gas on the other, were soon rendered useless owing to small pin holes developing, which permitted air to pass to the gas and quickly opened out into large holes.

Leakage is often found to take place through the cleaning doors of the generator, which, though not so serious as into the top of the generator, will cause the formation of clinker on the side of generator above the door; it is always well to ensure these doors being kept absolutely tight when at work by using an asbestos joint let into the door or casing; to prevent them being opened too often a small sight-hole with suitable cover should be provided, so that the fire may be examined at intervals without letting in too much cold air and thus upsetting the good working of the plant. These sight-holes are also useful for poking the fire just above the fire-bars and breaking up pieces of clinker whilst the plant is at work.

The piping between the generator and the scrubber should be of ample size to pass the volume of hot gas, which at 600 deg. Fah. will occupy about double the space it would take when cold, and thus prevent too much dust being drawn out of the generator and deposited in the scrubber and water seal pots. This feature should receive special attention in generators of small area per brake horse-power, which require pipes to pass the gas quite as large as those used by generators of larger proportionate area.

Cleaning doors, easily removed, should be provided at all bends and other places in piping where dust and tar may be deposited, so that the cleaning may be done without much trouble to the attendant; joints and elbows that cannot be easily examined are often neglected until they call attention to themselves by causing stoppages, which usually happen at most inconvenient times.

The connecting pipe between the generator and scrubber should have a water seal for use when plant is not working; this will prevent any escape of gas from the scrubber, and ensure good gas being ready for starting the engine again. Some makers arrange for a constant water seal of ¼in. to ½in., through which the gas is always drawn; this helps to clean and cool the gas coming from the generator, but in several cases has not proved satisfactory. The hot gases have been known to carry a small amount of hot carbon, which floats on the water and gradually

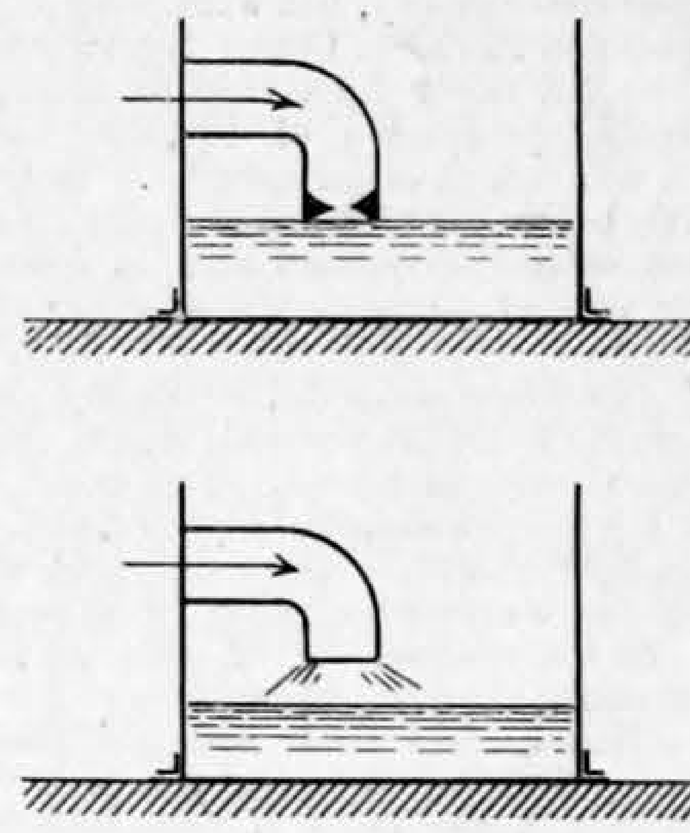


Fig. 4

forms a hard deposit on the extreme edge of the pipe, this action being assisted by the alternate cooling and heating effect due to slight fluctuations in water level. This deposit gradually stops up the pipe—see upper part of Fig. 4. The carbon will not set on a dry hot pipe, but only when the latter is moistened by the water and dried by the hot gases alternately, so that the pipe should be quite clear of the water when working—as also shown in Fig. If the scrubbers are of ample capacity the smaller amount of cleaning required will more than compensate for the slight difference in cooling efficiency.

A large plant with double scrubbers had this deposit form on the end of the inlet pipe, and it caused considerable inconvenience until the reason was discovered. Owing to the excessive suction to draw the gas through the small opening, the coke in the scrubber nearest the engine was found to be moving up and down in places with every pulsation from the engine. The position of the trouble was found by the application of vacuum gauges to each part of the plant. Temporary ones were first used, but permanent gauges have now been fixed, and periodic reading of these gives warning of any change taking place, in ample time to enable cleaning to be done at the next week-end.

Fan and chimney or waste pipe.—A fan should always be provided for blowing the fire and putting a small amount of pressure on the system when testing the gas before starting the engine. As the labour of working a fan for 15 or 20 minutes is heavy, care should be taken to have one both well made and efficient; the small extra cost that may be involved will be fully repaid in the time saved in blowing, and also in the satisfaction of the attendant. In the larger sizes it is customary to fix a power-driven fan for blowing, but if the waste pipe is really made into a chimney, not the small short pipe usually fitted, but of ample diameter and from 25ft. to 35ft. high, it acts almost as well as a fan, and the time of blowing may be much reduced.

In a 200 brake horse-power plant having a fire about 36in. diameter by 2ft. 9in. deep, a waste pipe, 4in. diameter, was originally provided, and a 4in. power-driven fan was fixed for blowing. Owing to the small area and long length of pipe, the fan was choked and of no use, so the waste pipe was altered to 6in. diameter by about 35ft. high to clear the roof. After this change the power fan would blow up the fire quickly, but was soon found to be unnecessary, as the chimney draught was ample in itself to force the fire to a heat suitable for gas making, and the power fan was removed at the attendant's request, the only fan used being a small hand fan, to put pressure on the plant for two or three minutes whilst the gas was being tested.

When the plant was not at work the chimney valve was kept almost closed, to avoid burning too much fuel, and keep down the standby losses. About thirty minutes before the time for starting the engine, the attendant opened the chimney valve to its full extent, and then did all necessary clinkering, stirring, and cleaning of plant. When this was done he tested the gas, using the hand fan to prevent back fires, and was always ready for starting with good gas in twenty to twenty-five minutes.

It is not suggested that such results can be obtained from all plants and engines; the conditions in this case were more favourable than usual, as the engine had high compression, enabling it to fire poor quality gas, and was fitted with a very heavy fly-wheel, to ensure steady turning of the direct-coupled dynamo; being started by compressed air, it would run light for several minutes, owing to the energy stored in the fly-wheel, and thus assisted in drawing up the fire in the plant. It does show, however, that a judicious arrangement of size and length of chimney can greatly reduce the labour entailed in using a fan, and modify what is often considered the most troublesome feature in using gas plants.

In moderate size plants the time taken for starting is usually 15 to 20 minutes; but under suitable conditions this can often be reduced. With one plant of 30 brake horse-power driving an electric light installation at a private house, the gamekeeper, who had never seen a plant previously, was able to start the engine in an average time, over three months, of 10 minutes, and in no case had he exceeded 20 minutes. In another case, with 20 brake horse-power plant and engine driving sewage pumping machinery, the attendant several times had the centrifugal pumps, which took from 1 to 2 minutes to charge, at work in 8 minutes from going in to the pump house; but, on one occasion when trying to do so, failed to get the engine to run for over 10 minutes, and was much chagrined when asked at the end of that time, "Why not try with the gas cock open?" an essential feature, which, in his haste, he had omitted, much to the amusement of the onlookers.

Scrubbers.—These are made of mild steel plates, having a grid in the base above the entrance for the hot gas to carry the coke. Doors of ample size must be provided at the top and bottom of the scrubber for convenience in emptying and refilling with the coke, which must be changed about every six months. When two scrubbers are used, that nearest the generator should be supplied with fresh coke about every three or four months, but the second one can usually be worked about twelve months before the coke becomes too dirty for good results. The coke should be clean and hard, from 3in. to 4in. cube in the bottom part of scrubber, gradually reduced to about 2in. cube in the upper portion.

The water for cleaning and cooling should run in the opposite direction to that in which the gas is moving, and about 1¼ to 1½ gallons per brake horse-power will be required. Any ordinary water supply will be suitable for the scrubber, provided it is fairly clean, but if possible the water fed to the generator should be soft to avoid deposition of lime, &c., in the vaporiser. In larger size of plants the scrubber should have the coke in two tiers

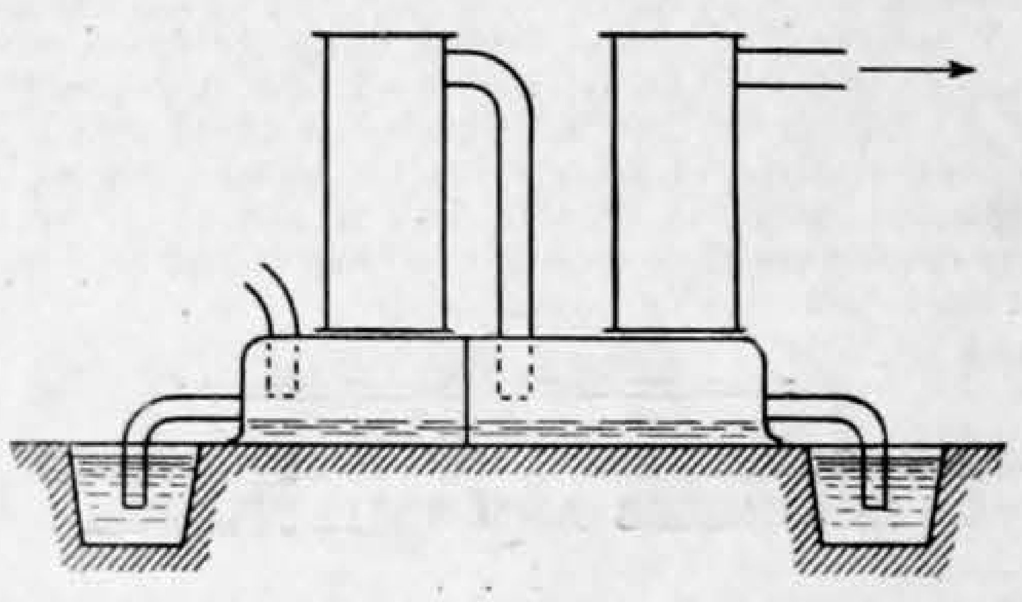


Fig 5

or two scrubbers of smaller size used in series, as Fig. 5. Though more expensive than a single scrubber, they are more convenient. If mounted on a cast iron base, as shown, with suitable cleaning doors, they will make a good substantial arrangement, and be less likely to corrode from the action of the water and hot gases in the base, which have in some cases quickly worn out the steel scrubbers. Even the smaller sizes would be improved by the use of such a base, and the extra cost would be fully repaid in the longer life and durability of the scrubber.

A capacity of about ⅞ to 1 cubic foot per brake horse-power of engine will be ample for ordinary Welsh anthracite, although even larger sizes have no disadvantage, and will work for a proportionately longer time without requiring renewal of coke, &c. The diameter of scrubber may vary to a considerable extent, but usual sizes are about 1ft. 9in. to 2ft. for 20 brake horse-power; plants up to 4ft. or 4ft. 6in. for 200 brake horse power; Two scrubbers, each 4ft. diameter by 6ft. 6in. high, mounted on a cast iron base—as shown in Fig. 5—are suitable for a 200 brake horse-power plant.

When gas coke or inferior anthracite is used in the generator, the ordinary coke scrubber may not be found to remove all the tar, &c., from the gas, and a sawdust scrubber or tar extractor should be added to prevent dirty gas passing to the engine and causing its valves and spindles to become clogged.

Expansion box.—Most makers now include an expansion box in their plants; this should be placed close to the engine and at a lower level than the rest of the gas main, so that the latter will drain into the box. A drain cock should be fitted to it for drawing off condensed water, and a blow-off pipe with a good cock to admit of poor gas being blown out of the mains and scrubbers before starting engine. The capacity of the expansion box is usually made from a-half to three-quarters that of the engine cylinder, but where not inconvenient a much larger size will be found advantageous; it will enable the engine to get an ample supply of gas without excessive suction pressure, and will cause the suction action on the whole plant to be slower and easier, thus drawing the air and vapour through the generator at a slower rate. This gives a longer time for the chemical reactions to take place, and assists in obtaining a better quality of gas.

Use of town's gas.—In the earliest examples of suction gas plants and engines, arrangements were usually made to enable town's gas to be used for starting purposes and as a stand-by, but it was soon proved to be unnecessary, and most plants are now fixed without any such arrangement. Numerous installations are at work miles distant

* No. II. appeared August 6th.

from any town's gas supply, and are quite as trustworthy as any steam plant.

In some cases, where the maximum power is only required for a short time, gas engines have been arranged with a town's gas supply for the short period of maximum load. This has proved a convenience, but as gas authorities naturally object to providing such intermittent supply, especially when it occurs at their period of maximum demand, and may at some future time obtain powers enabling them to refuse to give such service except at greatly increased rates for gas, it is much better when putting down a new plant to make it amply large for any work it may have to do.

Many authorities have now reduced the price of gas when used for power purposes. In order to meet the competition of suction gas plants, and before putting down a new installation, the relative costs should be carefully considered. It will be found that with town's gas at 1s. 3d. per 1000 cubic feet there will be no advantage in driving gas engines from suction gas plants in sizes below 40 brake horse-power, and even in larger sizes, say, 40 to 70 brake horse-power, the economy in fuel may be almost lost because of extra attention required, increased first cost of plant and engine, and the extra room required for the plant and larger engine. In sizes above 70 brake horse-power the fuel cost is more serious, and town's gas becomes too expensive to admit of its competition with the independent gas producing plant.

Fuel for plants.—This has been referred to incidentally, but the quality and kind used will depend to a considerable extent upon the position of the town in which the plant is being used. Welsh anthracite is generally agreed to give the best results, and can be obtained in most English and Welsh towns, of suitable size and quality for use with suction gas plants. The great demand has caused the price to increase about 40 per cent. during the last three years, and many firms have taken up the use of gas coke, either using it in the plant alone or mixed with anthracite "peas," which are much cheaper than anthracite of larger size, and will give good results, provided means are taken to prevent tar getting to the engine valves, &c.

In the North of England and Scotland Scotch anthracite is mostly used; it is a good fuel for suction plants, and can be bought at a low price, but has rather more volatile matter and ash than Welsh anthracite, so that tar extractors should be fitted to all plants where it is to be used.

Whatever kind of fuel is used, it will be found advantageous to keep it under cover, and with such conditions of flooring as will prevent dirt being mixed with it and delivered to the plant. The latter should also be fully protected from the weather, and it will be found that any care or small expense in this way will be fully repaid in the better working of the plant.

JOINT CONFERENCE OF INSTITUTIONS OF ENGINEERS AND SHIPBUILDERS.

No. I.

It was a happy inspiration to mark the first year of the Institution of Engineers and Shipbuilders in Scotland in its new home in Glasgow by a joint Conference with the North-East Coast Institution of Engineers and Shipbuilders, and it is gratifying to record that the suggestion to hold such a Conference was very warmly taken up by members of both Institutions. There was a large attendance when the Conference opened in the hall of the Scottish Institution on Wednesday morning the 4th inst.

Mr. C. P. Hogg, the President-elect of the Institution of Engineers and Shipbuilders in Scotland, occupied the chair in the absence through illness of Mr. John Ward, the President. In a written address, however, Mr. Ward offered a welcome to the members of the North-East Coast Institution. He said that conferences of this character reacted upon the general prosperity of the industries concerned. The shipowner was not satisfied to-day with the results obtained yesterday. In merchant shipwork owners used to be satisfied with a coal consumption of 1.5 lb. per indicated horse-power per hour, but to-day the figure had fallen to about 1.25 lb. per indicated horse-power per hour. From a maximum of 20 knots for cross-Channel steamer service, there had been an advance which made 23 knots the ordinary speed for such vessels. For intermediate steamers, 16 knots was formerly considered a satisfactory performance when the capacity required a block coefficient of .76, but owners under the same conditions now called for 18 and even 20 knots, which required a high propulsive efficiency. It was the same in other engineering work. The bridge engineer was expected to give a higher load capacity per unit of area for a less quantity of metal and at lower cost, and to overcome difficulties in foundations which a few years ago would have been regarded as practically insurmountable. It was largely owing to the exchange of experience through the medium of technical institutions and the technical Press that there had been relatively more rapid progress made during the past twenty years than in preceding generations.

Mr. Summers Hunter, President of the North-East Coast Institution, in acknowledging the address of welcome, said that the Scottish Institution, established fifty years ago, had played an important part in the development of steam shipping.

The reading and discussion of papers was then proceeded with.

Sir Andrew Noble, who was very warmly received, had the first place on the programme in a paper bearing the title "A Slight Sketch of the History of Propellants." Sir Andrew first of all dealt with the question of gunpowder, the origin of which was, he explained, lost in remote antiquity. In England gunpowder consisted of 75 per cent. of saltpetre, 15 per cent. of carbon, and 10 per cent. of sulphur. In other countries the amounts of carbon and sulphur were equal—12·5 per cent. Sir Andrew then gave an account of the experiments on gunpowder which had been carried out by various investigators. He mentioned such names as De la Hire, 1702; Robins, 1743; Hutton, 1778; Count Rumford, 1797; Bunsen, Shisschkoff, and Piobert. The results arrived at by various workers varied widely—thus Robins estimated that the maximum pressure arrived at by exploding gunpowder when completely filling the space in which it was enclosed, would be 1000 atmospheres, while Rumford concluded that the pressure would be 101,000 atmospheres. Discussing the work of these investigators, Sir Andrew said that they much under-rated the rapidity of combustion of gunpowder under pressure. They assumed that the combustion was comparatively slow, and that due to this slow combustion the possible maximum pressure was never even approximated to in the bores of guns. In some experiments he had carried out in conjunction with the late Sir F. Abel, he had succeeded in determining for the three powders of the English service—pebble, rifle large grain, and fine grain—the tension of the exploded gases at all densities up to unity, and in altogether retaining the whole of the products of combustion, even of charges of several pounds, which filled entirely, or nearly so, the chambers of the explosion vessels. The result of these experiments gave for a density of unity a pressure of about 6500 atmospheres. The temperatures of explosion of the different gunpowders varied considerably, but were generally between 2000 deg. Cent. and 2230 deg. Cent. Sir Andrew went on to say that he had never been able to understand why the considerable proportion of sulphur was so long retained as a component of gunpowder. In the English service, shortly before the adoption of modern propellants, it was almost entirely dispensed with in cocoa powder; and with the view of studying the question he, in 1883, had made four experimental powders. In two of these the sulphur was dispensed with, or nearly so. In the third the amount of sulphur was halved, and in the fourth the percentage was increased. The result obtained showed that the powder without sulphur had its potential energy increased by about 13 per cent., while that of the powder with the increased sulphur was decreased by 9 per cent. As the readiest way of showing the striking differences between the old gunpowders and some of the modern propellants, Sir Andrew had had prepared two tables exhibiting first the volume of gas generated by the explosion; secondly, the units of heat generated; and, thirdly, the product of the units of heat and volumes of gas which represents approximately the comparative potential energy of the explosives. It was explained that in these tables the transformation was taken approximately at the pressures at which the propellants are generally used in guns.

Older Propellants.

	Pebble.	R. L. G.	F. G.	Mining powder.	Spanish powder.
Volumes of gas ...	278	274	263	360	234
Units of heat... ...	721	726	738	517	767
Comparative energy	200,438	198,924	194,094	186,120	179,478

Modern Propellants.

	Cordite Mark 1.	Italian ballistite.	M.D. cordite.	Norwegian 167	Nitro-cellulose.	Norwegian 165
Volumes of gas	875·5	810·5	913·5	899·9	934	909·9
Units of heat...	1246·0	1305·0	1030·0	1005·5	924	935·5
Comparative energy	1,090,873	1,057,703	940,905	904,850	863,016	851,212

With cordite, the first modern propellant adopted in England, artillerists have been able, with the same maximum pressure, to more than double the energy of the projectile. Commenting on these tables, Sir Andrew said:—

It will be observed that the figures I give as representing the comparative energies of the old propellants vary from 200,438 to 179,478, while the similar figures for the modern explosives vary from 1,090 873 to 851,212, or more than four times as great, and the diagram—reproduced in Fig. 1—I also show exhibits the comparative pressures developed up to the density of ·5; thus, at the density of .5 the pressure of gunpowder is about 1700 atmospheres—amide powder 3500 atmospheres—while the modern explosives at the same density lie between pressures of 8600 and 7200 atmospheres. Turning now to the total volumes of gas generated and the units of heat developed by the explosion, I find in the various explosives I have examined the same general rules hold. With the increase of density the volumes of gas decrease, and the units of heat increase.

Thus, taking one or two illustrations, with an Italian ballistite at the density of .05 the total volume of gas per gramme was 824 c.c., while at the density of .5 it was 780 c.c.; with M.D. cordite the corresponding figures at these densities were 955 c.c. and 789 c.c., and with a Norwegian ballistite 959 c.c. and 780 c.c., showing reductions in volume respectively for the three explosives of 44, 166, and 179 c.c. per gramme. The corresponding units of heat at the same densities are:—For the Italian ballistite 1228 and 1264, for the M.D. cordite 965 and 1178, and for the Norwegian ballistite 860 and 1092, or increments respectively of 36, 213, and 232 units, and I draw attention to the remarkable difference in the increments of heat in these three explosives. The pressures developed by these same explosives were at the density of .05 respectively 457, 457, and 389 atmospheres, while at the density of .5 the pressures rose to 7956, 7545, and 8536 atmospheres, or from about seventeen to twenty-two times as great. It is hardly necessary to say that the last-named pressures are greatly above those which are permissible in guns, but they are interesting as showing how greatly the pressure and temperature of explosion increase with the increase of density of charge.

Thus, taking for the three explosives I have selected the density of .25 as representing approximately the maximum density permissible in guns, it is found that the pressure for the Italian ballistite is 3148, for the M.D. cordite 3193, and for the Norwegian ballistite 2896 atmospheres, while at the double density of .5 these pressures become respectively 7956, 7545, and 8536 atmosphere, the pressure last named being approximately three times as great as that at the density of .25. Now, I have pointed out that with the increase of density there is in all cases a decrease—in most cases a considerable decrease—in the volume of gas, and as the pressures developed, increase much more rapidly than the density, it is obvious that with increase of density there must be a very considerable increase of temperature. At a density of .5 I place the temperatures of the high explosives I have examined as varying between 4000 deg. and 5000 deg. Cent. I need not say that at less densities they are very much lower.

I have mentioned that the percentages of the several gases generated by the explosion vary greatly, dependent upon the pressure under which the explosion takes place, and I shall exhibit to you three diagrams—reproduced in Figs. 2, 3, and 4—in two of which there are, with increase of density, large increases in volume, and in the third a considerable decrease. I shall take first carbonic acid, and it will be observed that in all cases the differences in volume between the low and high densities are large. In M.D. cordite, for example, the percentage varies from 14 8 to 32.4, and it will be observed that as the densities increase, the differences in the percentage greatly diminish. Thus, at a density of .05, there is a difference between the several explosives of 13 per cent., while at .5 density this difference is reduced to 3 per cent. The next diagram exhibits the percentage of marsh gas (CH_4); at the density of .05 the percentage in all cases is very small, under a half per cent., but the percentage, as will be seen, increases rapidly, and in this case instead of the percentage approximating at the higher densities, there is very considerable divergence. The last diagram I shall refer to shows the percentage volume of hydrogen. Here it will be observed that at the lowest density there is a considerable difference, the percentages varying from 8 per cent. to over 20 per cent.; the whole of the percentages slightly rise with increase of density and then rapidly fall, finally closely approximating, the difference at .5 density being only about 1½ per cent.

But I must not fatigue you with these somewhat dry figures, and I will only draw attention to one other point. The whole of the new propellants develop on explosion a very much higher temperature than did the old gunpowders, and the introduction of armoured vessels has necessitated the employment of guns fifteen or sixteen times heavier than the guns in use fifty years ago, and capable of giving to their projectiles energies nearly fifty times as great.

Now, as regards the serious question of erosion, in the case of the very large guns it is important to remember that while the surface of the bore subject to the more violent erosion increases approximately as the calibre or a little more, the charge of the propellant required to give to similar projectiles the same maximum velocity, increases as the cube of the calibre; and, consequently, unless special arrangements as to the projectile are made, or other means adopted, the life of the largest guns before relining must be short when compared with that of smaller guns. It, therefore, becomes a matter of great importance that attention should be given to the best method of reducing erosion when very large charges are used, either by lowering the temperature of explosion of the propellant, or possibly by introducing with the charge some cooling agent. As regards the first of these points some very considerable advance has been made, as will be seen by some specimens of the erosive action of a few different propellants I have placed upon the table, but I venture to think that the question of erosion has, at least in this country, hardly received sufficient attention, and that, in some respects, mistaken notions as to the amount of erosion with reduced charges are entertained.

For instance, it has been stated that in a gun the erosion due to four three-quarter charges and sixteen half charges is in each case equivalent to that due to one full charge; and for several explosives I have tested, in the manner I have for many years adopted, the absolute capacity for erosion of several propellants, and as the temperature of explosion varies with the density I selected the density at which propellants are generally fired in guns. The propellants varied very considerably in their capacity for erosion, but all gave the same result, viz., that the erosion due to one three-quarter charge was less than that of a full charge, but that two three-quarter charges gave more erosion than one full charge, while two half charges gave less, but three half charges gave more erosion than one full charge; or, in other words, that the erosion was a little less than that due to the comparative weight of the charges.

Mr. H. A. Greer said that the paper explicitely stated the compositions of the older forms of gunpowder, and he would ask Sir Andrew to make a more detailed statement in his reply on the discussion as to the constituents of the modern explosives referred to in the paper.

Mr. Herbert B. Rowell said that considerable trouble had arisen in warships owing to the high temperatures experienced in the magazines. He would like to ask whether any steps had been taken in recently built warships to introduce any refrigerating arrangement.

Professor Archibald Barr, in moving a vote of thanks to Sir Andrew Noble, said there was a close connection between the branch of engineering discussed in the paper and ordinary departments of engineering. It was becoming increasingly difficult to make the requisite provision for ordnance in ship design, as the powers of guns became higher, and many of the advances in steel manufacture had grown out of the need of making proper provision for the requirements of the artillerist. It was interesting to note that while 1 lb. of gunpowder properly burned could raise 1 lb. about 200 miles against the action of gravity, the energy contained in 1 lb. of coal and the air it would consume would raise it 2000 miles against the action of gravity, so that the enormous power of gunpowder was small compared with the powers which had to be dealt with in ordinary steam engineering. Modern explosives gave about four to five times the energy obtained from gunpowder.

Sir James Williamson seconded the resolution of thanks, which was carried unanimously.

Sir Andrew Noble said that Italian ballistite contained 47.1 per cent. of nitroglycerine and 52.9 per cent. of nitrocellulose, M.D. cordite 30 per cent. of nitroglycerine, 65 per cent. of nitrocellulose, and 5 per cent. of mineral jelly, while Norwegian ballistite contained 36 per cent. of nitroglycerine, 52 per cent. of nitrocellulose, 6 per cent. of nitronapthalene, and 6 per cent. of a secret ingredient.

The second paper read was that by Engineer-Commander W. McK. Wisnom, R.N., "Notes on the Trials and Performances of the s.s. Otaki, Fitted with a Combination of Reciprocating and Turbine Machinery." The author explained that the Otaki was the first vessel fitted with a combination of reciprocating and turbine engines. She was built for the New Zealand Shipping Company, by Denny, of Dumbarton, was delivered in November, 1908, and has since made a voyage to New Zealand and back. She is virtually a sister ship to the twin screw vessels Orari and Opawa, which are fitted with reciprocating engines, the Otaki being about 4ft. 6in. longer. Her principal dimensions are:—

Length between perpendiculars ...	464ft. 6in.
Breadth, moulded	60ft. 0in.
Depth, ,, ...	34ft. 0in.

Her deadweight capacity is about 9900 tons on a draught of 27ft. 6in. The engines consist of two sets of ordinary triple-expansion reciprocating engines driving wing propellers, and a low-pressure turbine driving a centre propeller, as shown in outline in Fig. 5. In ordinary ahead working the reciprocating engines exhaust into the turbine, which can only revolve in one direction, but change valves are also fitted so that the reciprocating engines can exhaust direct to the condenser, as shown in Fig. 6. The turbine is automatically cut out when going astern, and can be also cut out when going ahead, and the vessel manœuvred as an ordinary twin-screw boat. Two condensers are fitted, and each reciprocating engine exhausts into its own condenser when the turbine is not running. When the turbine is running it exhausts into both condensers. A shut-off valve is fixed in the exhaust from the turbine to each condenser, so that if either of the latter fail the turbine exhaust can be turned into the remaining apparatus. This valve is shown in Fig. 7. The diameters of the cylinders of the reciprocating engines are 24½in., 39in., and 58in. respectively, and the stroke is 39in. The cylinders of the Orari and Opawa are 24½in., 41¼in., and 69in. in diameter, and the stroke is 4ft. The ratio of high to low-pressure cylinders is thus 1 to 5.6 in the Otaki and 1 to 7.93 in her sister ships. The Otaki's turbine is, generally speaking, of the ordinary Parsons low-pressure type. The diameter of the rotor drum is 7ft. 6in., and the length of the blades varies from 4¾in. in the first expansion to 12 11/16in. in the last expansion. The drum is closed at both ends, and any leakage past the dummy is led away by an external pipe to the condenser. The turbine spindles are packed with soft packing separated into two parts by a metallic lantern ring—see Fig. 8. This ring enables the shaft to be surrounded by water between the two divisions of the packing, thus forming a water seal. The water is supplied under a slight head. The condensers were made to the design of the Contraflo Condenser Company, and the total cooling surface of the two is 6000 square feet. There is a single-acting air pump of the ordinary bucket type, worked from each set of main engines, the diameter of the bucket being 26in. and the stroke 19½in. The circulating pumps have 16in. suctions and discharges, and the diameter of the impeller is 48in. The feed pumps are of the Woodeson's type. A surface feed heater is fitted in connection with the exhaust from the auxiliary engines. A general arrangement of the feed heater is shown in Fig. 9. The Otaki was designed for a continuous sea speed of 12 knots when fully loaded, but the contract provided for a trial speed of 14 knots with 5000 tons of dead-weight on board. Two lengthy tables are given in the paper, which set out the results obtained during a series of progressive runs on the measured mile at Skelmorlie, and particulars of various trials. These are too long to reproduce here, but they are full of interest. The Orari had obtained a mean of 14.6 knots on this measured mile. The Otaki, under the same conditions, and with apparently greater ease, obtained a mean speed of over 15 knots for a total water consumption of 6 per cent. less than that of the Orari. The total water consumption per hour in the Otaki at 14.6 knots was 17 per cent. less than that in the Orari at the same speed. In the Otaki the water was measured both by means of tanks and by counting the strokes of the feed pumps. The water consumption as calculated by strokes was in all cases greater than that obtained by tank measurements, the difference being about 3 per cent. at the higher speeds. In the case of the Orari tanks were not used, but the strokes alone counted. A correction was therefore made, and it was found that the total amount consumed at 14.6 knots was 88,300 lb. per hour, or 16.5 lb. per indicated horse-power per hour. The consumption of the Otaki on the Skelmorlie route was 82,000 lb. per indicated horse-power hour, with a speed of 15.02 knots. At 14.278 knots the consumption was 69,300 lb. The coal consumption during one of the trials at a speed of 11.7 knots worked out to 1.887 lb. per horse-power per hour, this amount including fuel for all purposes. The coal used was Scotch, and had a heating power in lbs. of water evaporated from and at 212 deg. Fah. per lb. of coal of about 14.0. A curve of water consumption of the Otaki is given in Fig. 10, and a curve of speeds and horse-powers of the Otaki, Orari, and Opawa is given in Fig. 11. The proportion of total power developed in the turbine of the Otaki was found to vary with the speed. At full power it was about one-third, while at very slow speeds the turbine was only doing a small proportion of the work. At 14.6 knots the indicated horse-power of the Orari was 5350, and the corresponding power of the Otaki was 5880. At this speed the E.H.P. was 3210 in the Orari, and 3350 in the Otaki, the propulsive coefficients being then 60 per cent., and 57 per cent. in the two vessels. The propulsive coefficient of the Otaki at full speed fell to 54 per cent. A table is given showing a comparison of trial results of the Otaki and Orari for a

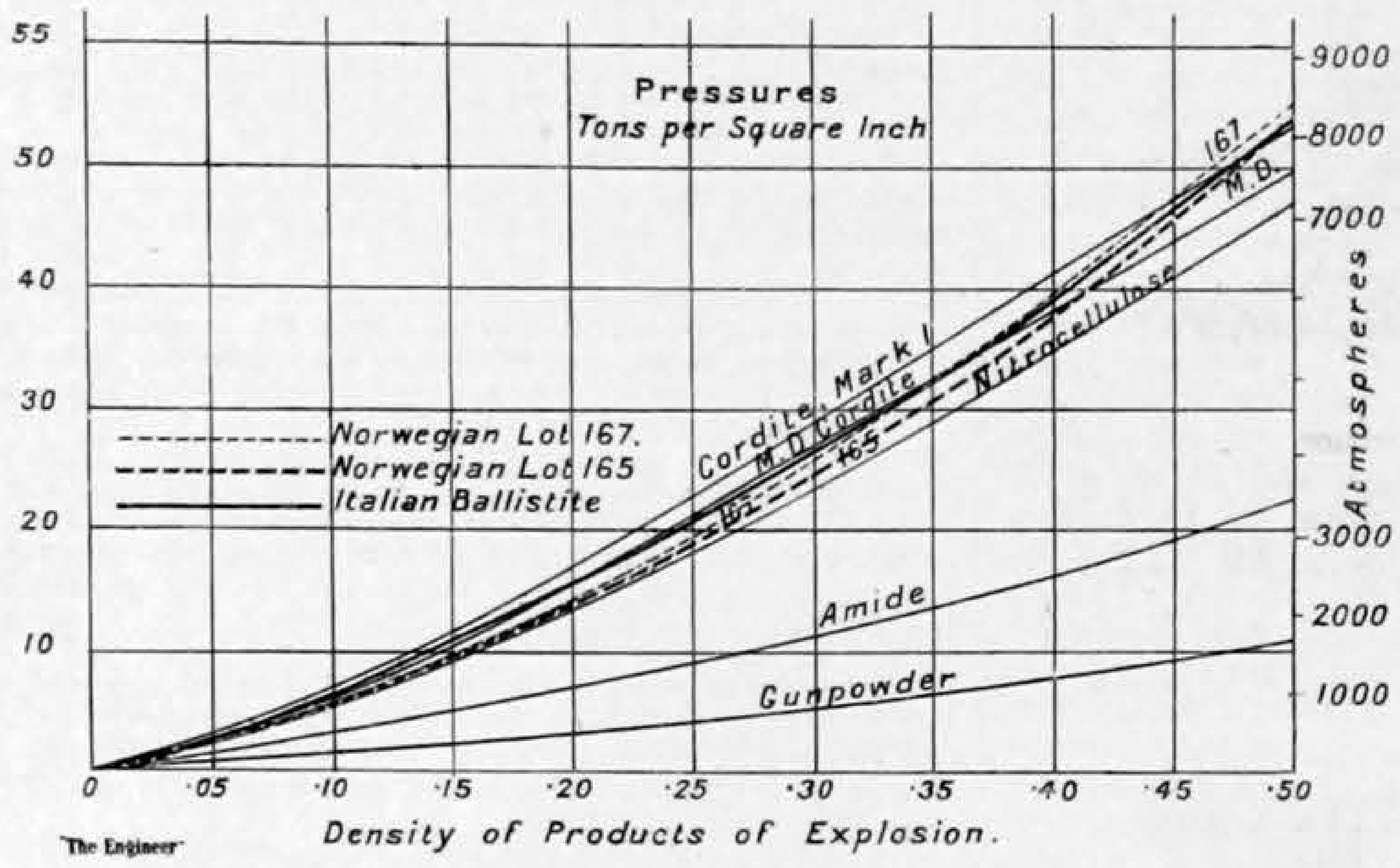
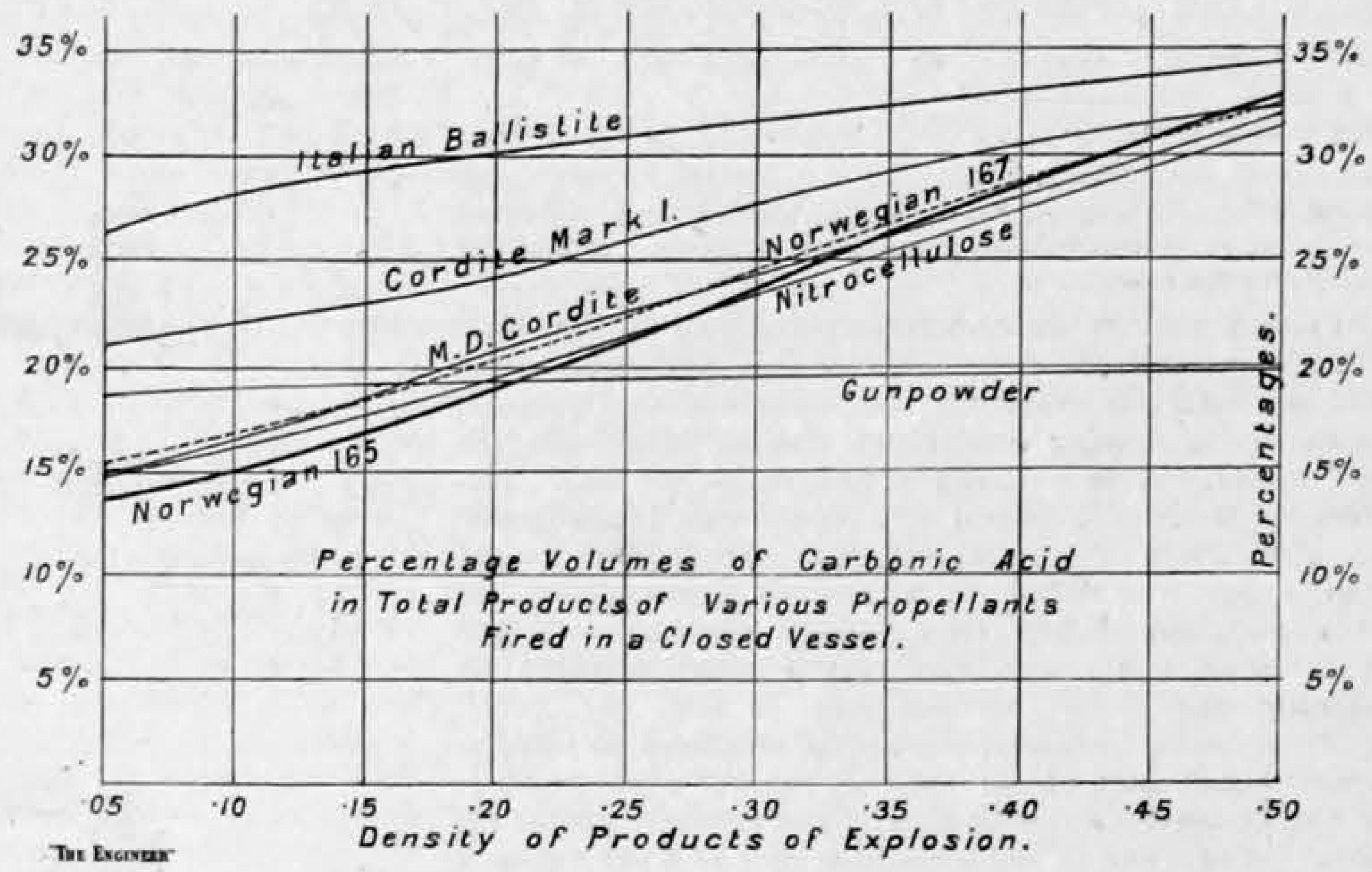


Fig. 1



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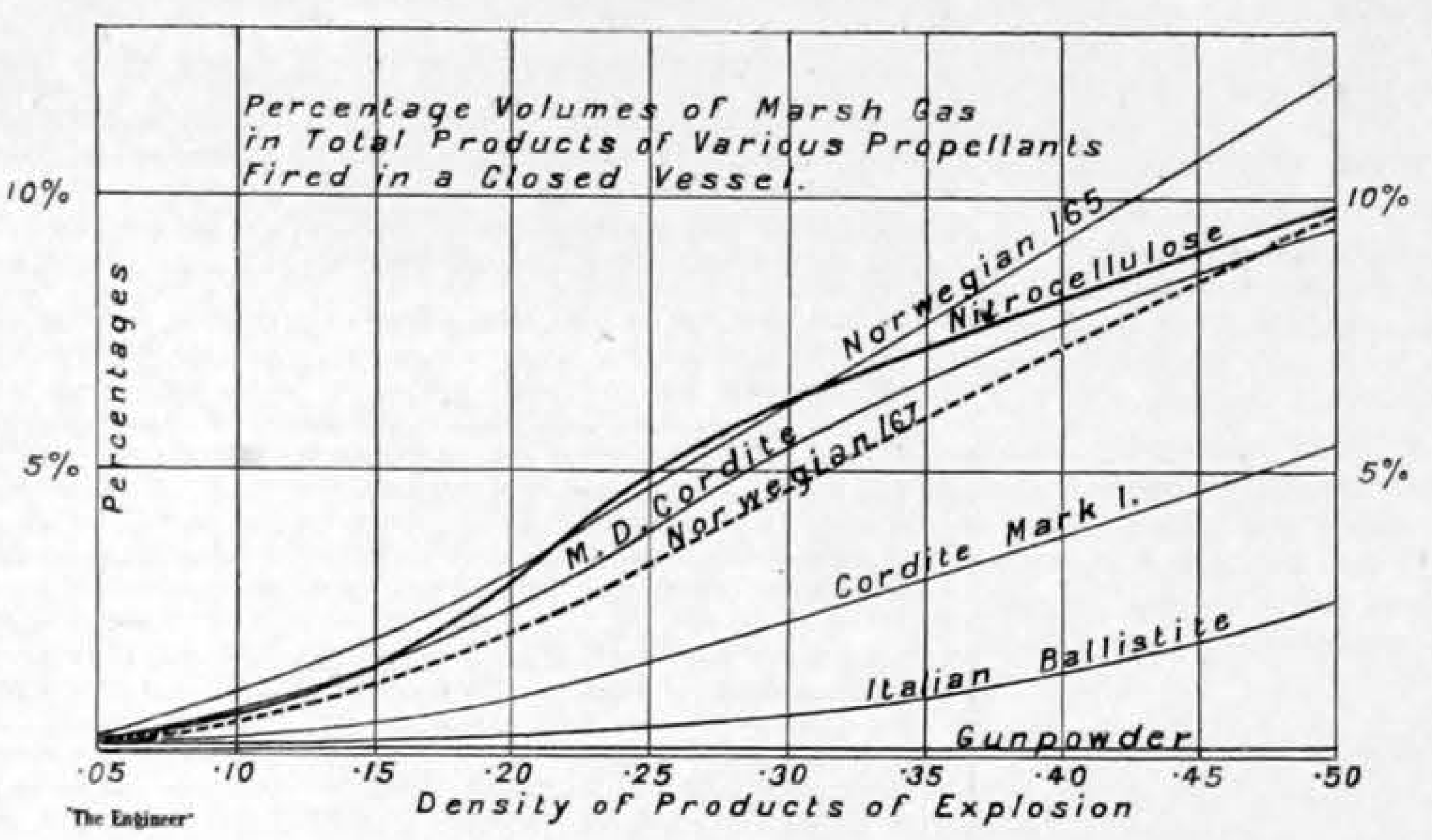


Fig. 3

Percentage Volumes of Hydrogen
in Total Products of Various Propellants Fired in a Closed Vessel

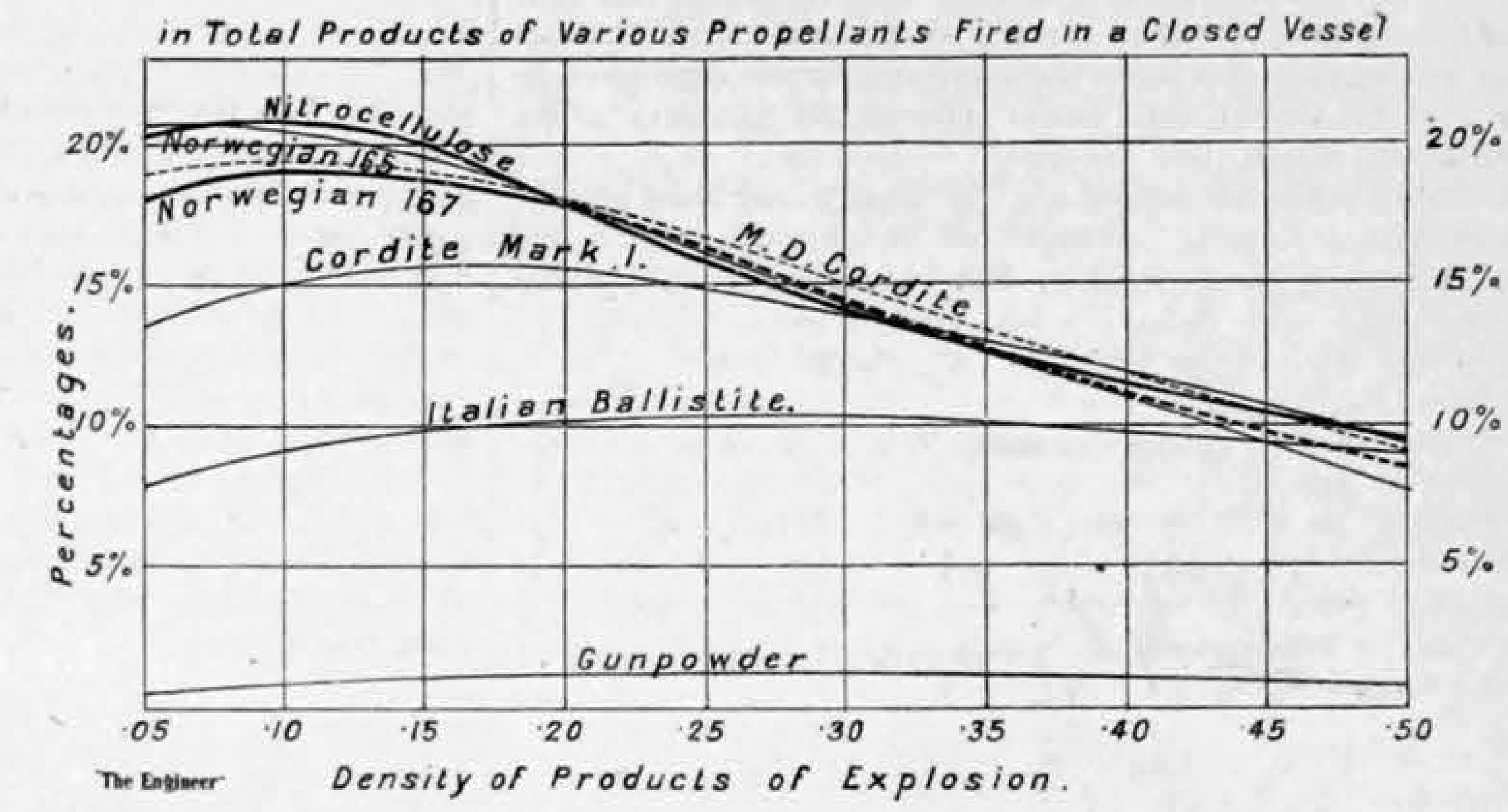


Fig. 4

Outline Arrangement of the Combined System of Piston and Turbine Engines on T.S.S. "Otaki," 1908.

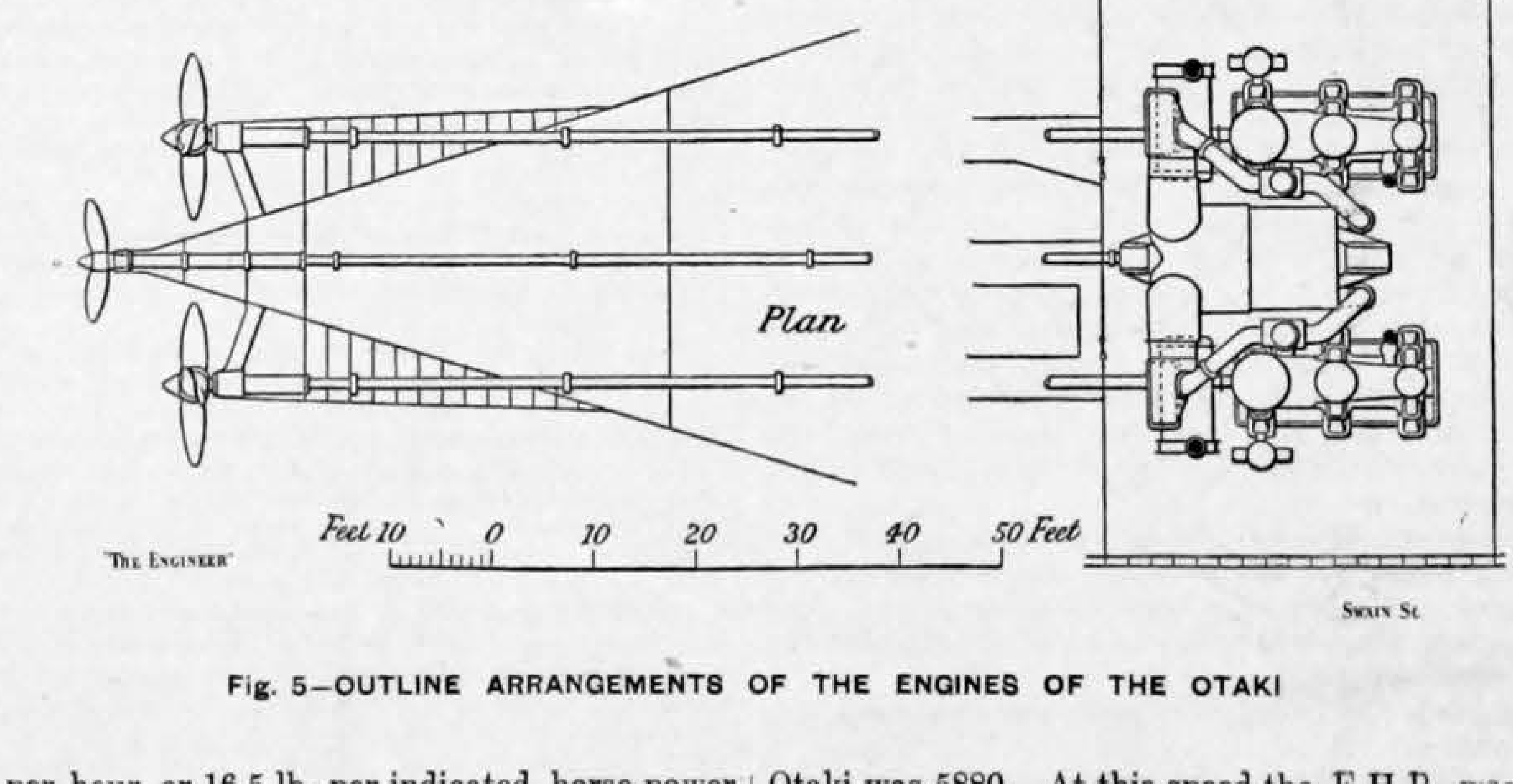


Fig. 5—OUTLINE ARRANGEMENTS OF THE ENGINES OF THE OTAKI

speed of 14.6 knots on the measured mile. This is reproduced as follows:—

	E.H.P.	I.H.P.	Propulsive co-efficient.	Water consumption.		
				Total per hour.*	Per E.H.P. per hour.	Per I.H.P. of Orari per hour.*
			Per cent.	lb.	lb.	lb.
Otaki ...	3350	5880	57	73,300	21·9	13 7
Orari ...	3210	5360	60	88,300	27·5	16·5
Gain per cent. in Otaki				17	20	17

Note.—Columns marked * do not take into account the difference of E.H.P. in the two ships; these two methods of comparison should show the same gain.

On actual service the consumption of coal on the Otaki on the voyage from Liverpool to Teneriffe was 11 per cent. less than the mean for the sister vessels Orari and Opawa under similar conditions and at practically the same speed. The average speed of the Otaki, from Liverpool to New Zealand and back, was 11.09 knots. This speed, it was pointed out, did not represent the sea speed which the vessel is capable of maintaining, the power required being only about one-half of that developed on trial; nor was it the most suitable for obtaining the lowest consumption of coal per horse-power. It was, however, the speed arranged to suit the owners' conditions of service. A careful comparison of her coal consumption with that of her sister ships for the round voyage shows an apparent gain of 8 per cent., or about 500 tons as a total. As enough coal is carried from Liverpool for the round trip, some 250 tons could be spared, and cargo carried out to this amount. The engines made a non-stop run from Teneriffe to New Zealand, a distance of 11,669 knots as logged. The total weight of the machinery of the Otaki is about 30 tons more than that of her sister ships—an increase of about 3.25 per cent. But allowing for the greater efficiency of the former vessel, the boiler power might have been decreased, when the weights would have been about the same. As an appendix to the paper the author made the following remarks at the meeting:—"Since the foregoing was written the Otaki has completed another voyage to New Zealand at a mean speed of 12.35 knots, and the anticipations as regards improved economy have been realised. As the speed was greater than that of her sister vessels under similar conditions, it is difficult to make comparisons, but the gain in coal consumption in the Otaki, as compared with similar vessels, was not less than 12 to 15 per cent."

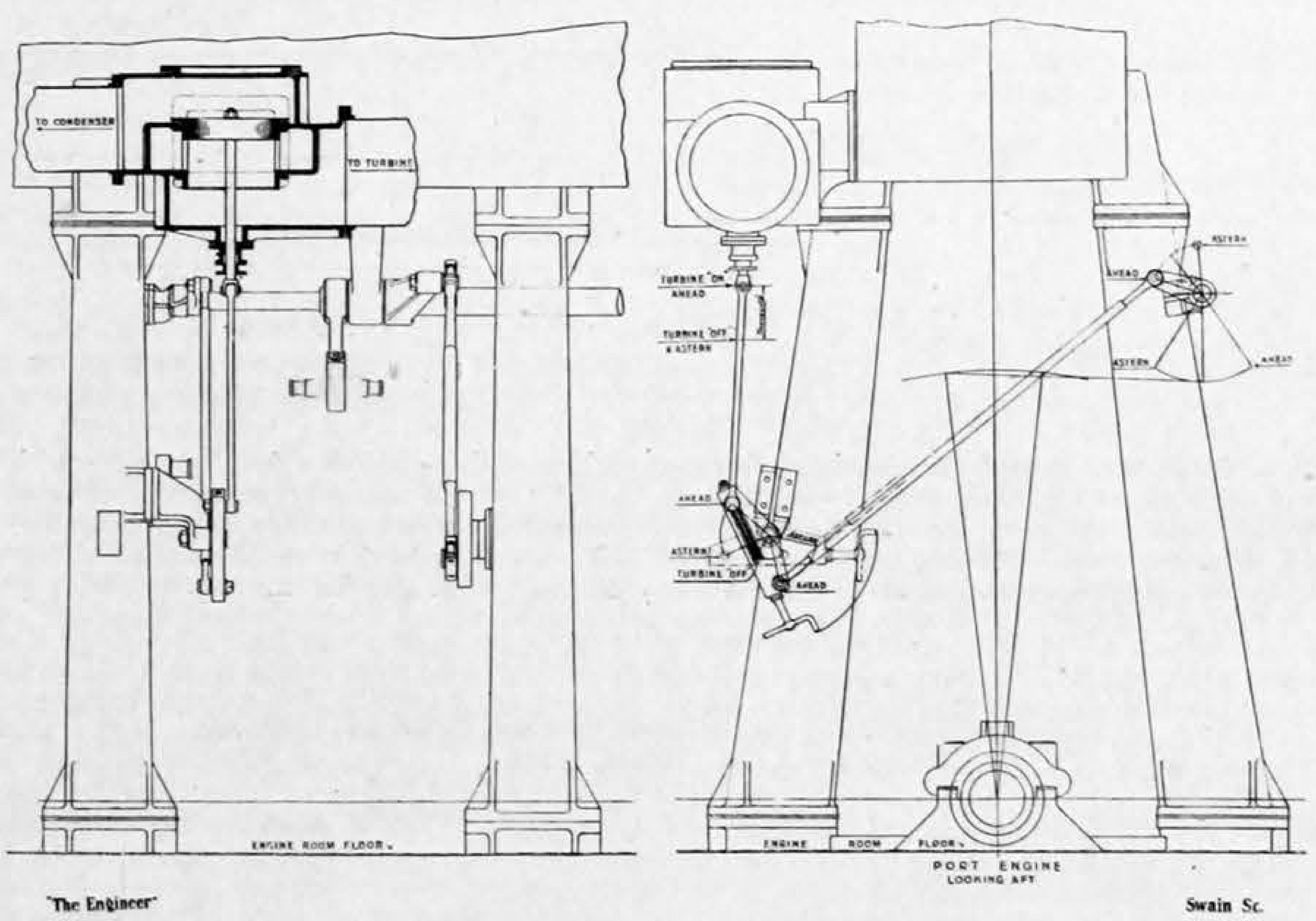


Fig. 6—ARRANGEMENT OF CHANGE VALVE ON THE OTAKI

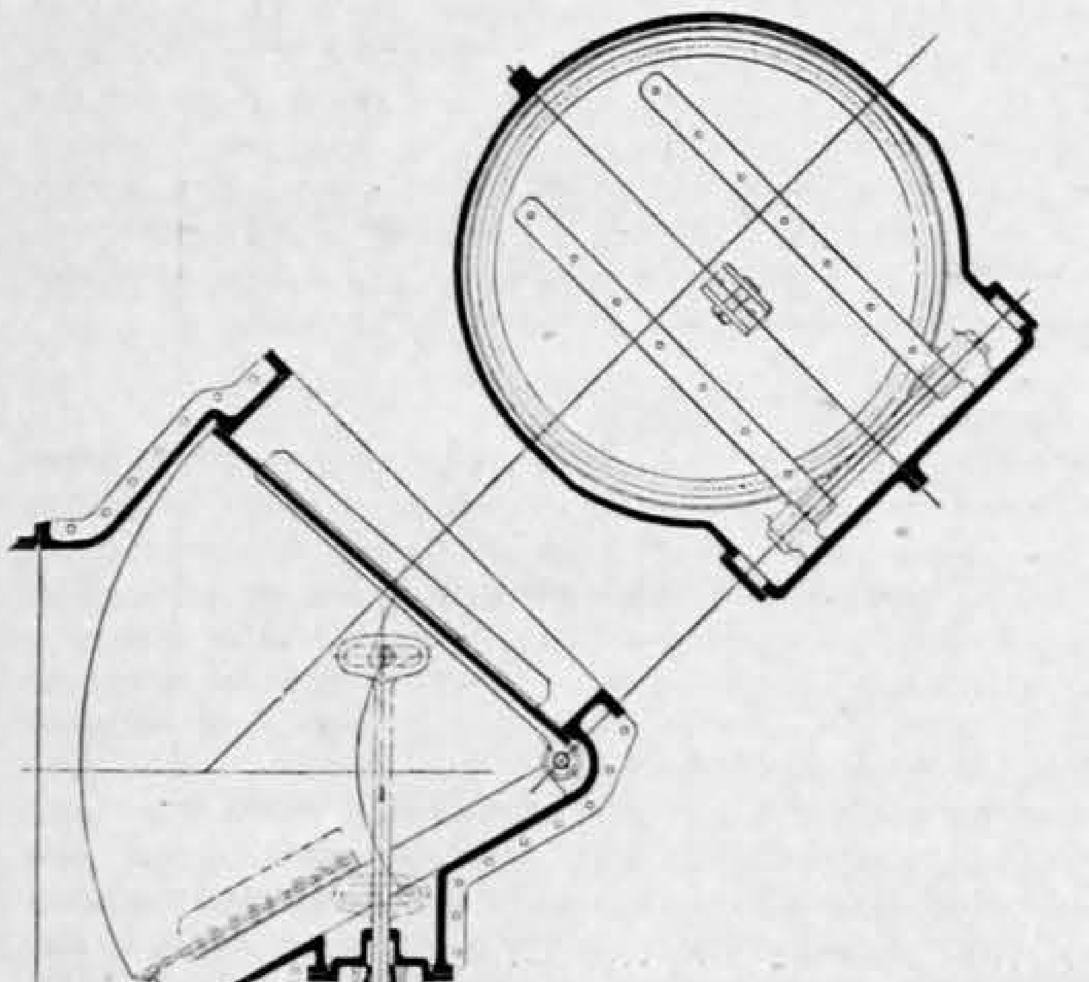


Fig. 7—SHUT-OFF VALVE

Mr. D. B. Morrison congratulated Messrs. Denny and the owners on their courage in making this distinct advance in marine engineering. It was extremely useful to have results so unreservedly published, and a study of them suggested that the economy which could be realised was about 10 to 12 per cent. That, he believed, had been the experience of the White Star Company with the Laurentic, and, at any rate, the White Star Company was so satisfied with the results achieved by the combination that it was its intention to install the system in its new Transatlantic liners. Whether any further gain in economy would be achieved was doubtful, so that the question for decision was whether an economy in coal of 10 to 12 per cent. was sufficient to justify the extra complication involved by the general adoption of the system on boats of moderate speed. He had been personally much interested with the problem in connection with cargo boats. Taking the case of a cargo boat of 1200 horse-power, there was available 200 horse-power, and the difficulty was to apply that 200 horse-power to the existing shaft, additional shafting being quite out of the question. Mr. Parsons proposed gearing, belt driving, and an electric drive. Belt driving was, in his opinion, quite out of the question. Engineers were not in sympathy with gearing on board ship, and the electric drive had its objectionable features, when it was remembered that the *personnel* of a cargo boat was not of a very high standard. He had seen a very interesting device for a magnetic drive of the worm-and-wheel type, but with no contact whatever between the worm and the wheel. When it worked it worked very well indeed, but when it stopped it stopped hopelessly. It got out of phase rather easily, and took time to get into step again, and he was afraid that the device was not adaptable to this particular problem. If, however, a method of applying the 200 horse-power to the main shaft in a simple and effective manner could be devised a decided forward step would have been made.

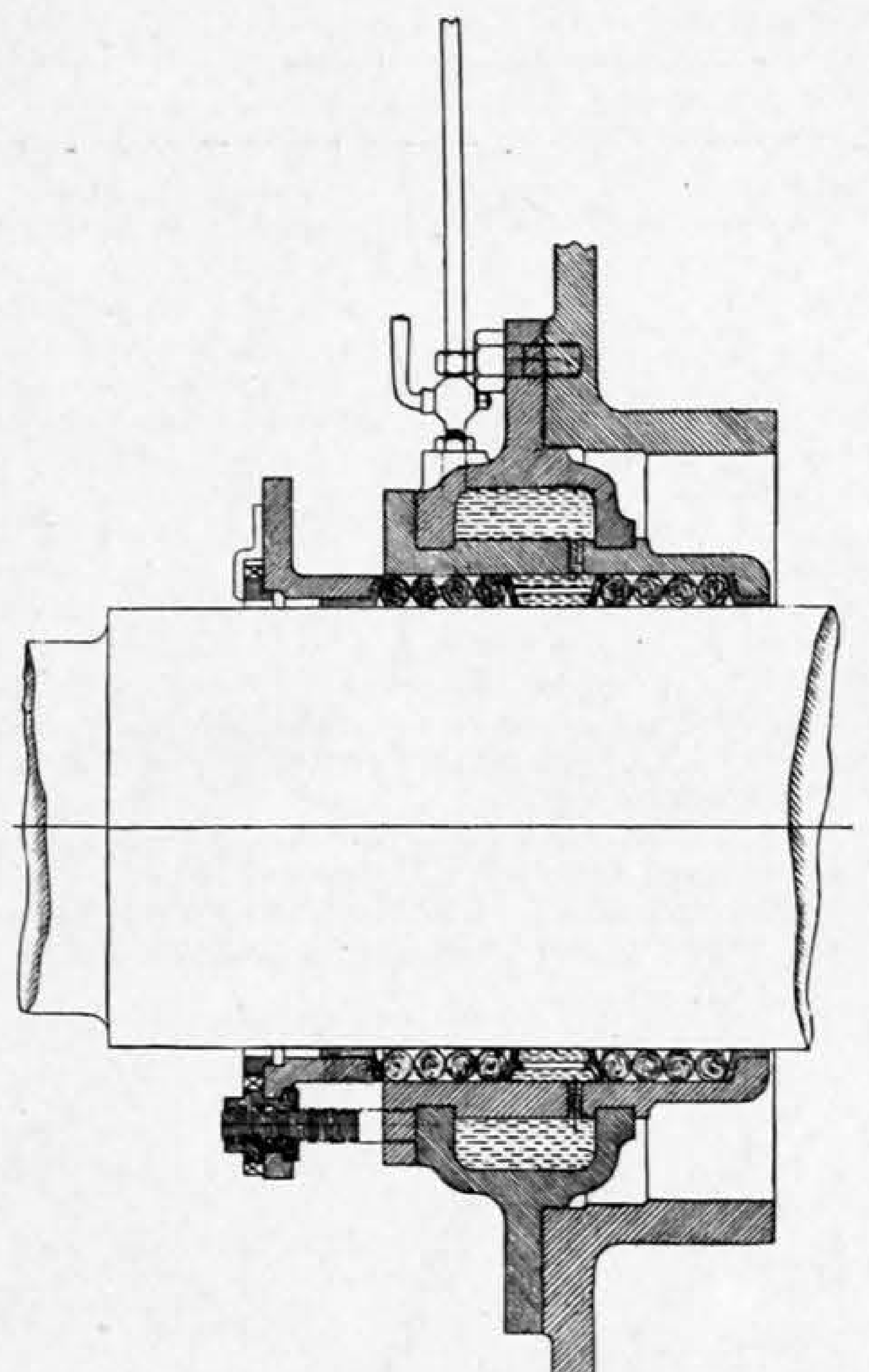


Fig. 8—PACKING OF TURBINE SPINDLES

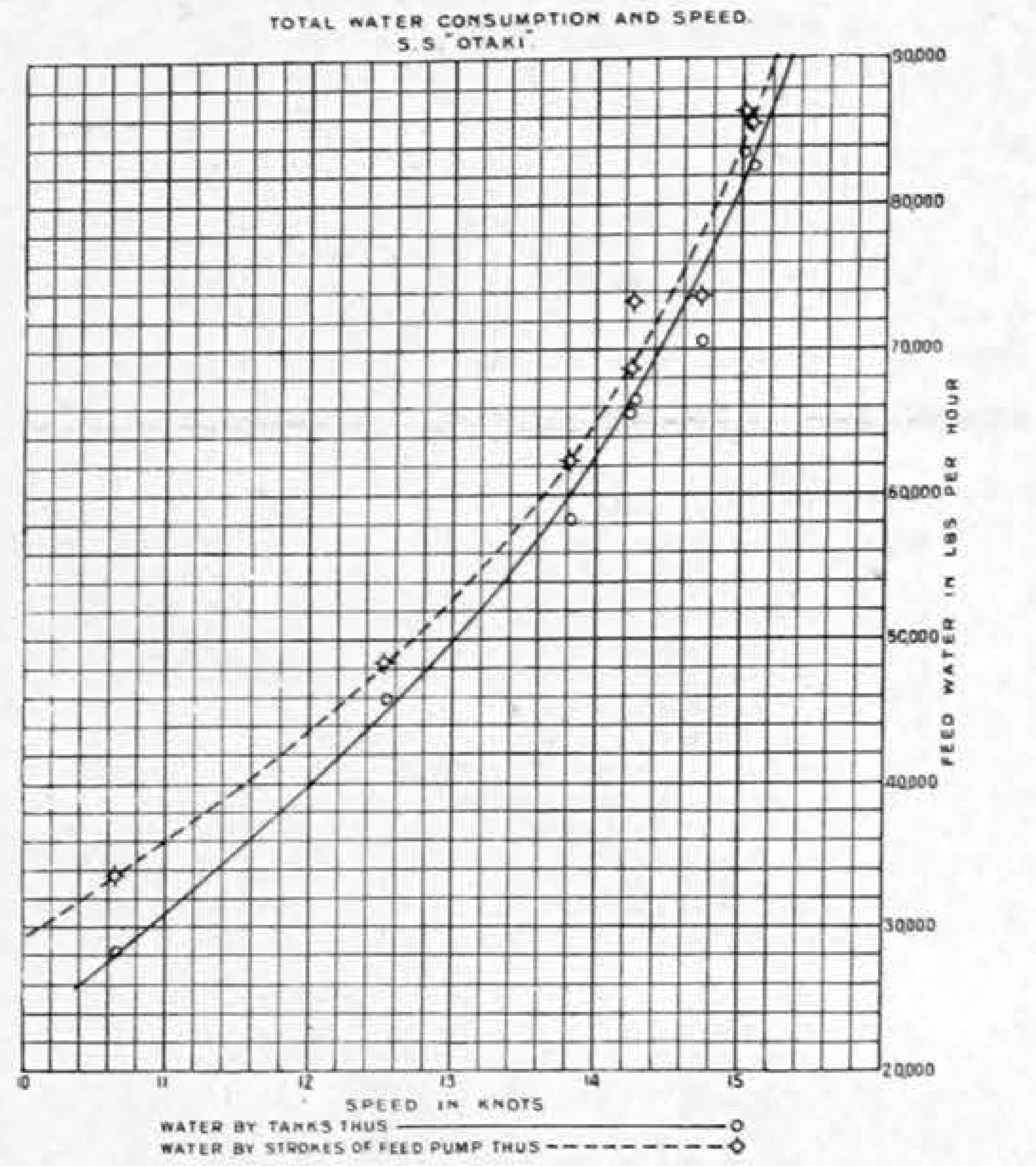


Fig. 10—CURVES OF WATER CONSUMPTION

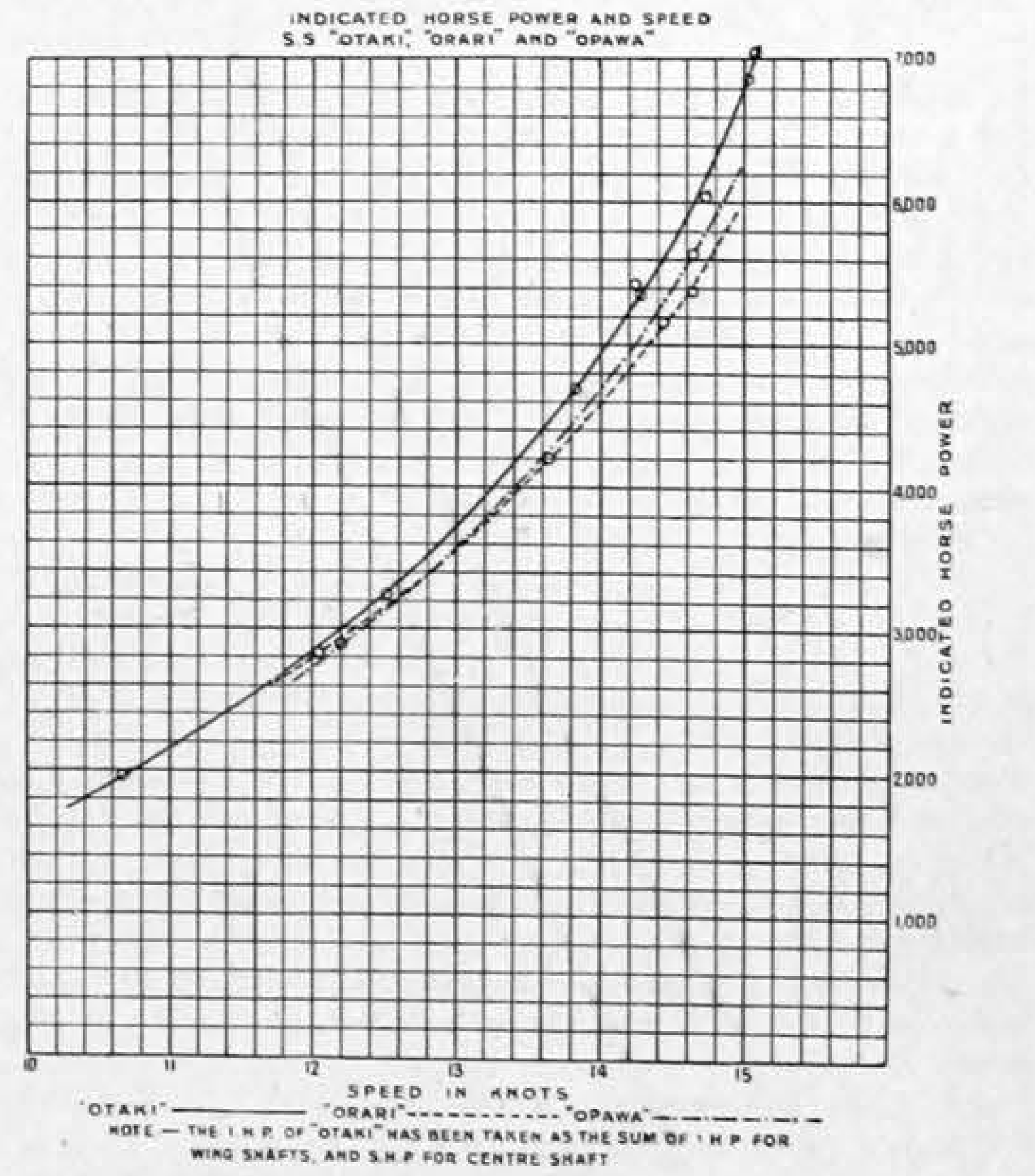


Fig. 11—SPEED AND POWER CURVES

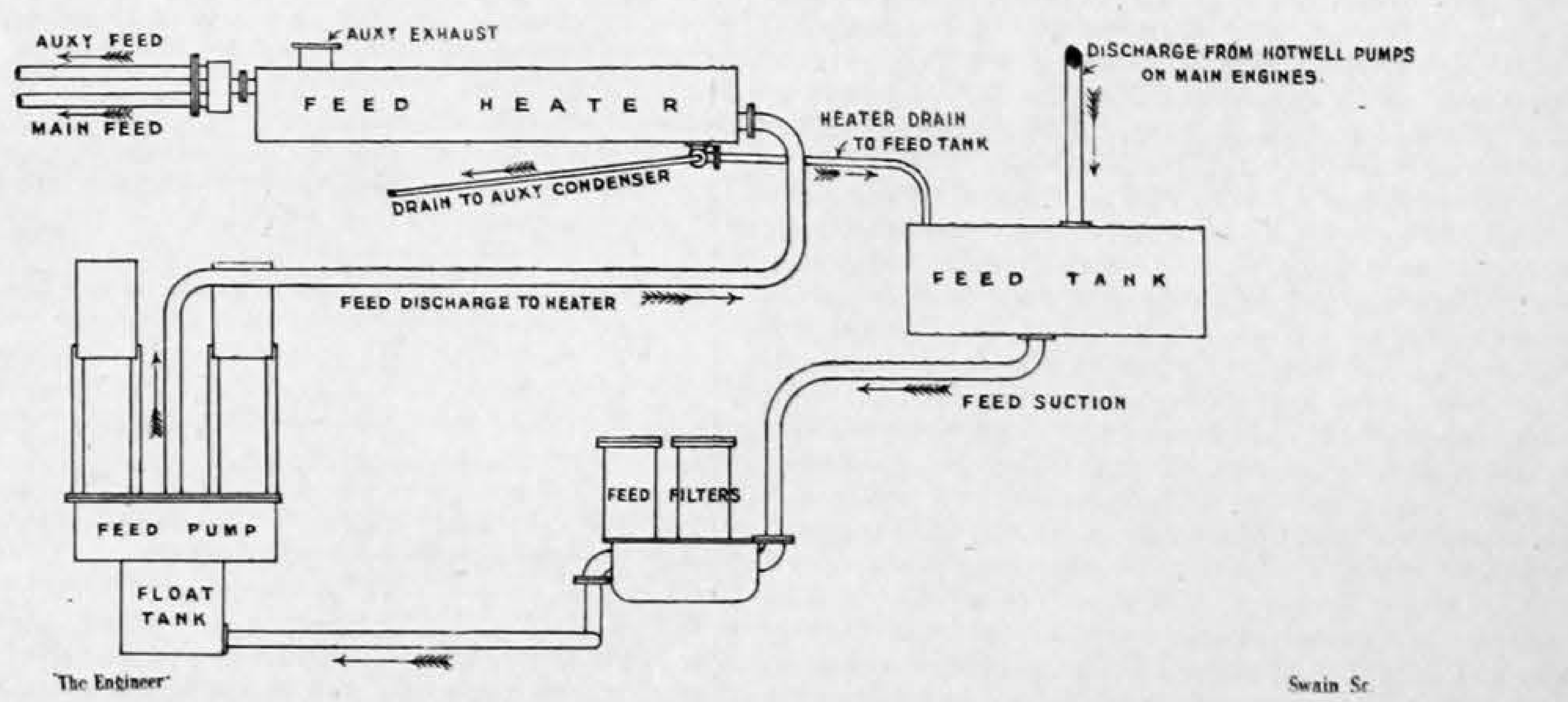


Fig. 9—FEED HEATING ARRANGEMENTS ON THE OTAKI

Mr. W. B. Sayers exhibited the diagram which is reproduced in Fig. 12. He pointed out that the curve showed the size of plant required for a given amount of power to be much greater at the vacuum than at the pressure end. He was inclined to regard the combination system as a transitional design, the recourse to it being a confession that the Parsons' form of turbine was not really satisfactory for the high pressure end unless for very large sizes and high speed. In other forms, such as the Curtis and the Rateau, the plant efficiency, or weight and bulk per horse-power, must be unnecessarily great, owing to large sections of the rotor and corresponding portions of casing being unproductive of power. The form which promised better results was that in which the steam at the high-pressure end was led through the same rotor discs and buckets a considerable number of times. In such a turbine the efficiency attainable was largely determined by the extent to which leakage between the rotor and stator could be minimised, which, again, depended largely upon the degree of truth to which the surface of the rotor could

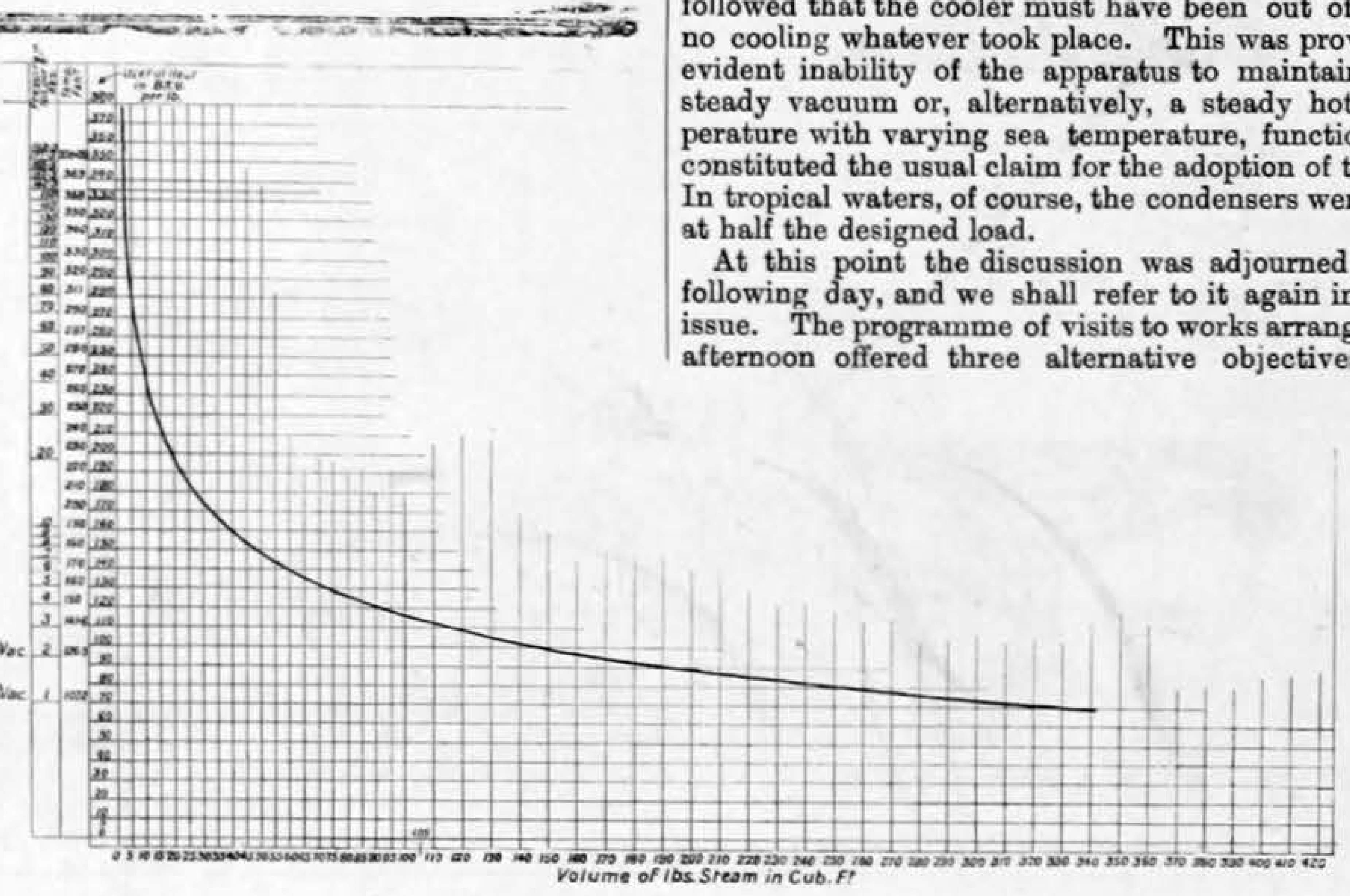


Fig. 12

be made to run. He had devised a form of rotor presenting a smooth cylindrical surface with that object, so that the working efficiency would be largely under the control of the operator. He believed he could design high-pressure turbines to take the place of the reciprocating engines in s.s. Otaki to weigh not more than 25 tons each, including special gear to reduce the speed from 600 to 100 or 125 revolutions per minute, rendering them suitable for equally efficient propellers to those used with reciprocating engines. The gearing problem should be practically attacked, and he believed it could be solved. He was himself prepared to design a suitable gear.

Mr. H. A. Mavor said that the electrical engineer could solve the problem of applying the 200 horse-power referred to by Mr. Morison. Something had been said as to the difficulty of dealing with electrical gear on shipboard, but all round Glasgow motors of the size required were in service and were being looked after by the type of men who were employed on cargo boats. The weight difficulty was the real trouble, and he believed the solution of the problem before them was to run the turbine at the high speed it was customary to run it for electrical work on land. If that were done a cargo vessel could be driven with an economy of 20 per cent. on the present arrangement. All that was needed was an absolutely simple apparatus which any electrical engineer would undertake to make.

Mr. Wm. Weir said that the marine engineering profession was once again indebted to Messrs. Denny for the publication of the first definite results of the working of a new system, and the paper ought to give the lead to many shipowners in the adoption of the combination principle. Quite apart from the information as to the performance of the main propelling machinery, the paper was of value as giving the first public declaration of results which he had seen of the performance of a type of condensing plant (Contraflo type) which had attracted considerable attention recently. In analysing the results it was his desire to establish the degree of progress in design which the figures represented. The trial trip figures were the only ones of real scientific value, as they comprised vacua recorded by mercurial columns. Further, the trial trip represented four days' running over a period of almost a month, allowing occasion for making good any considerable air leakages which developed. On page 8, column 2, of the paper he found data which enabled him to establish a transmission rate of about 450 B.Th.U.'s, the thermal loss being 24 deg. and the condensation rate 14 lb. of steam per square foot per hour. At the lower powers on the voyage to Liverpool the transmission rate was 200 B.Th.U.'s, thermal loss 30 deg., condensation rate 7.63 lb. Such figures did not represent any advance on results frequently achieved with ordinary cylindrical condensers making no pretensions to special design. Indeed, the figures did not reach results recorded elsewhere. He would quote first the results for a turbine-propelled vessel of about 4500 horse-power where on careful trial the condensing plant gave a transmission rate of 960 B.Th.U.'s, a thermal loss of 20 degrees, and a condensation rate of 28.5 lb. per square foot. A later performance was at Clydebank Shipyard, on Monday of that very week, when a carefully designed plant gave the following:—Transmission rate, 1140 B.Th.U's; condensation rate, 18.5 lb.; thermal loss 3 deg. In this latter plant the inlet temperature was 59 deg. and the vacuum at 30in. barometer 28.9in. In both plants the proportions of the air and circulating pumps were such as could be easily fitted to any marine installation. The air pump capacity in the first plant was one-fifth of that fitted to the Otaki, and in the other case less than half that of the Otaki. With reference to the figures given in the paper of the performance of the Otaki's condensers in tropical waters, he regretted to find inconsistencies which rendered acceptance of the figures open to some question. His main point was that in each case the vacua, even when subjected to the author's deductions, were in exact agreement with the hotwell temperature. Accepting those figures, it followed that no air pump whatever was required on the Otaki, and, granting the absence of air leakage, the conclusion was reached as to the absence of air in the steam. This conclusion was, however, quite inadmissible. The design shown in the paper included a cooler situated in the base of the condenser, apparently of the non-controllable type. It followed that the cooler must have been out of action or no cooling whatever took place. This was proved by the evident inability of the apparatus to maintain either a steady vacuum or, alternatively, a steady hotwell temperature with varying sea temperature, functions which constituted the usual claim for the adoption of the device. In tropical waters, of course, the condensers were working at half the designed load.

At this point the discussion was adjourned until the following day, and we shall refer to it again in our next issue. The programme of visits to works arranged for the afternoon offered three alternative objectives for the visitors, one concerned with Motherwell, one with Johnstone, and a third with Renfrew.

DAVID COLVILLE AND CO., LIMITED, MOTHERWELL.

The works of David Colville and Co., Limited, at Motherwell, which are situated on the main line of the Caledonian system, have sidings, &c., equivalent to over eleven miles of single track railway. They are able to produce over 6000 tons of finished material per week. The number of men employed is from 2000 to 2500, depending on the state of trade. The firm's products are mild steel boiler and ship plates, high tensile boiler and ship steel, nickel steel plates and sections for ship and bridge building purposes, rounds, flats, locking bars, single and double-reeled bars, forging blooms, ingots, also cast steel rolls.

The smelting department contains twenty-one furnaces, and is housed in three shops. The two older shops have Siemens open-hearth furnaces, ranging from 25 to 30 tons capacity each, whilst the newest shop has furnaces ranging from 60 to 100 tons capacity each, some of them laid down two years ago. This latter shop is provided with Wellman-Seaver open-hearth charging machines. The gas producers, which are of the cylindrical continuous type, are all provided with mechanical feed, and gasify about 600 tons of fuel per day of twenty-four hours. The ingots are cast in pits in front of the furnaces, and those intended for plate-making are conveyed, after stripping, to soaking pits and reheating furnaces, which are served by automatic overhead electric cranes. The slab-cogging mill is able to deal with ingots up to 20 tons in weight, and has a capacity of over 60 tons per hour. It is driven through gearing by a pair of non-condensing reversing engines, and is provided with hydraulic manipulators and live roller racks, &c. At the end of the cogging mill rack is a steam-driven slab shearing machine, able to cut 60in. by 14in. The slabs, which are intended for the light plate mill, are cut to lengths in a set of steam hydraulic shears. The slabs are conveyed on racks, after being cut to length, and charged by means of electric charging machines, of which there are four, into the reheating furnaces, which are of the gas-fired type.

The plate mills are three in number, the largest having rolls 12ft. 6in. long on the barrel. It is driven through gearing by a compound tandem reversing engine. The mill is also provided with steam-driven live roller racks. The intermediate mill has rolls 8ft. long, and is driven direct by a pair of non-condensing reversing engines. It is also provided with steam-driven racks. The light plate mill, which roll plates as thin as ⅛in. thick, has rolls 7ft. long, and is driven direct by a pair of tandem compound condensing reversing engines fitted with Joy valve gear. The racks and screw gear are electrically operated. The capacity of the three plate mills is about 4000 tons of sheared plates per week. The plates, after cooling, are sheared to sizes, five sets of shears being continually at work; the heavy shears being provided with casters to facilitate handling of the plates. Plate flattening machines, and also annealing furnaces, having electrical self-recording pyrometers, are provided for the further treatment of the material.

The ingots which are intended for rolling into sectional material are conveyed from the smelting department on a narrow-gauge railway to the reheating furnaces, and are then rolled down into billets in the blooming mill, from which they are skidded across to the finishing mill, which has two stands of housings. The blooming and finishing mills are each driven by geared non-condensing reversing engines, and the live roller racks are steam driven.

In the steel foundry department heavy castings are made up to 50 tons in weight, including housings, plate, and bar mill rolls, mill pinions, heavy ingots for forgings, &c. The ironworks department contains puddling and ball furnaces of the usual type, two steam hammers, and a steam-driven pull-over puddle train. It has a capacity of about 350 tons of puddled and scrap bars per week. In this department are also installed a merchant and a guide mill, both steam driven, and having a capacity of about 600 tons per week of finished material, which includes steel as well as iron. Special features here also are the reeling machines, where single and double-reeled bars are made up to 4½in. diameter.

Steam is raised for the mills, &c., throughout the whole works in 34 boilers of the water-tube type—24 Babcock and Wilcox and 10 Stirling—and 16 cylindrical boilers, which latter include the waste heat boilers used in connection with the puddling, ball, and reheating furnaces in the ironworks. There are also three separately fired superheaters.

The electric generating station contains two 400 kilowatts direct-current compound-wound dynamos, one direct coupled to a Bellis and Morcom triple-expansion condensing engine, the other direct connected to a three-cylinder Galloway engine. There has recently been installed a Rateau exhaust steam turbine which utilises the waste steam from the shearing machines, &c., and there is also here a Chloride electric storage battery having a capacity of 1200 ampère hours with an Entz automatic booster. The energy is taken from the station by overhead cables mostly bare, to the distribution boards in different parts of the works, where the circuits are subdivided for the several motors, &c. There is also in the station a small three-phase plant which drives the machinery in the engineering shops. The works are lighted by over 200 arc lamps and 1000 incandescent lamps. The roll turning department, in which steel rolls of all sizes and for any purpose are made, is housed in a building 375ft. long by 55ft. wide, served by an electric overhead crane. All the machines here are electrically driven by variable speed motors. The works, of course, have the usual mechanical testing department and chemical laboratory.

ALEXANDER FINDLAY AND CO., LIMITED, MOTHERWELL

At the Parkneuk Works at Motherwell of Alexander Findlay and Co., Limited, the manufacture of steel bridges, roofs, and all kinds of general structural iron and steel work has—since their establishment in 1888 by Mr. Alex. Findlay—been vigorously carried on. The works have been extended from time to time, and have now a capacity for an output of over 12,000 tons of manufactured work per annum. The main building for the department concerned with bridge construction is entirely roofed over, and is equipped with modern plant for the rapid handling and painting of work under cover from the weather. To deal with the manufacture of lighter work there is also a roof shop. The firm makes a speciality of the manufacture of steel trough flooring for railway and road bridges, and of fireproof floors for warehouses and other buildings, and for this purpose there is a special department. The hydraulic press for producing this flooring is specially heavy, and troughs up to 36ft. long by 18in. deep can be pressed from single plates up to ¾in. in thickness.

The covered-in shops of this company's works, and their equipment with modern tools, were inspected. Among the contracts being dealt with at the time of the visit the following may be mentioned:—The pier extension at Egremont on the Mersey, and bridgework for the Great Northern Railway (Ireland), the Highland and North-Eastern Railways, and the Great Indian Peninsular Railway. In addition, work was proceeding on contracts comprising locomotive erecting shops, running sheds, piers, water tanks and towers for various South American railway companies, as well as a number of road bridges for various Councils in Scotland and England.

BRANDON BRIDGE BUILDING COMPANY, LIMITED, MOTHERWELL.

The works of the Brandon Bridge Building Company, Limited, Motherwell, form one of the largest and most modern bridge building establishments in the country. They extend to over 10 acres in area, and comprise, besides bridge building, ironfounding and engineering departments. The more important work at present on hand includes bridges for the Argentine, Cape-to-Cairo Railway extension, swing bridge and dock gates for the new harbour at Kirkcaldy, as well as the steel work for the new naval base at Rosyth, the latter being a very extensive contract. In the engineering department work was seen in progress on a large number of pillar water cranes and turntables for foreign railways.

JOHN LANG AND SONS, JOHNSTONE.

The works of John Lang and Sons, at Johnstone, were laid out on the present site, which extends to about twenty acres, with workshops designed to embody as nearly as possible a model manufacturing system. For the production of lathes in quantities the firm enjoys a combination of advantages. The foundry is adjacent to the Glasgow and South-Western Railway, from which a siding supplies all raw material direct. Moulding machines are used whenever possible. When the castings, &c., are delivered into the machine shops, the various operations form a systematic progression with a minimum of transport, until the finished lathe is delivered into the show-room or dispatched to its destination. About 700 men are employed in manufacturing lathes by the most up-to-date methods with jigs and fixtures. In recent times, with the advent of high-speed steel, there came a general desire to improve the plant of workshops. To meet and encourage this, all the firm's lathes were re-designed and made from entirely new patterns throughout. A series of sliding, surfacing, and screw-cutting engine lathes is built, these ranging from

6in. to 16in. centres, and of surfacing and boring lathes with from 18in. to 48in. swing. Besides these, many special designs of lathes are made for different classes of work, where quantities are required to be machined economically. The question of correct speeds has also had very careful consideration.

THOMAS SHANKS AND CO., JOHNSTONE.

The Union Ironworks of Thomas Shanks and Co., which have in recent years undergone considerable extensions, have been in existence since 1824. The firm's reputation for heavy machine tools is world-wide, but it has made lathes as small as 10in. centres, while its largest—just lately completed—has a face-plate no less than 15ft. diameter, and could swing 15ft. clear over the saddles. This machine is, it is believed, the largest lathe without packing yet built. The firm make lathes of all kinds, single bed and double bed, for all purposes, such as machining crank shafts, propeller shafts, turbine rotors, &c. Their table planing machines range from 2½ft. square up to 14ft. square for armour plates, their horizontal and vertical planing machines from the smallest, 7½ft. by 6½ft., up to the largest, 32ft. by 23ft. In a similar way the various machines they make, such as those for turbine boring, horizontal drilling, tapping and studding, slotting, shaping, radial drilling, screwing, &c., extend over a great variety of sizes. The recent introduction of turbines has led to a very great demand for special machines, and to meet this demand Shanks and Co., some time since, extended their works by adding to the existing shop another bay 360ft. long by 70ft. wide, and equipping both with overhead electric cranes.

Among the machines brought under the notice of the visitors in passing through the works was a very large turbine casing boring machine to the order of the Admiralty for Portsmouth Dockyard; a large vertical and horizontal planing machine; a 28in. stroke slotting machine; a motor driven lathe, and a number of the firm's radial drilling machines. Machines of these types are shown on page 166, and in Figs. 13 and 14. Other machines upon which work was proceeding included boiler shell drills, plate edge planers, various sizes of horizontal and vertical planing machines, slotting machines, and shafting lathes. Included in the latter class was a very long double shafting lathe, having a bed 104ft. long, in two lengths, capable of finishing a shaft 80ft. long when one loose head is removed. Of vertical drilling machines there was one example of a new design, having a 3½in. diameter spindle, with all-gear drive, positive feeds, and a very rigid framing.

The third alternative visit on Wednesday afternoon to the works of Messrs. Babcock and Wilcox, Limited, Renfrew, which was taken advantage of by a fair number of the members, and yielded many points of decided interest, must be left over till next issue.

SOME FOUNDRY HINTS.

(By a Correspondent.)

THERE is much waste of time and material in many foundries owing to an excessive number of defects in many castings, whether machined or not. This article will endeavour to point out some of the leading causes and suggest aids to prevent many, and so reduce the costs and increase the foundry output. First, then, what are the principal causes of defects in the machine tool or general foundry?

Blow-holes.—There are two distinct kinds, and both are to be found on the back or top parts of castings. This proves one fact, that the air or gases did not freely escape from the moulds, owing, perhaps, to sleeked, tough, water-logged sand. The blow-holes, however, may have been caused by the sand being over-ground in the sand mill and not sufficiently open. This close-ground facing sand on the back parts of moulds causes thousands of machinery castings to be rejected. Open, clean sand is required for parts to be afterwards machined. Not freely using the vent wires will assist in producing blow-holes; these are found when the first cut is taken on the machine of planers or turners. The parts to be machined should be marked, so that the moulders can take more precaution. Another kind of blow-holes, not so common or numerous, is that caused by the iron being overcharged with sulphur. These can be detected by their silvery interior. Carelessness in filling up moulding boxes with black sand not properly screened, or too much water-logged, may also cause trouble. Do not mind a rough surface on parts to be machined; what you want is a sound surface, free from blow-holes after machine operations have been performed. As for gear blanks, pulleys, cones, capstan slides, turret blocks, saddles, or gear boxes, all these castings for machine tools require the greatest possible care all round, including the facing sand on the back parts. Heavy sleeking with the trowels is quite unnecessary, and prevents the free escape of the gases. If a little more clearance on the back parts of many patterns were allowed by many patternmakers, this would save many castings from the defective scrap heaps. I refer chiefly to the machined parts, where the risks are greatest. Moulders could then often claim more credit for their work, as things can be cut too fine in this direction. Extreme hardness of green sand moulds will often produce blow-holes in the top parts, as the gases are obstructed in their exit from the mould. Vent well and use open sand with as little moisture as possible. Put on plenty of runner, and, where necessary, riser. Cast with well-skimmed hot metal, and keep the runners full when pouring.

Facing sands.—Here is a great study. For undried or green sand moulds, the moisture of the sand, the coal-dust, and the close or open nature of the sand, largely determine the appearance of castings. Many castings are spoilt by using weak sand, and filling the mould with extra hot metal; this often causes nasty seams. Study the quantity of coal dust according to the size and weight of the casting; seams and rough surfaces are both preventable if the facing sand mixing is properly studied. For machined castings two kinds of facing sand are required, one for a clean face where not machined, and the other for solid, sound iron underneath where steel tools will take cuts, and so expose any defects, if any can be found, by milling, planing, or turning. Put every bit of facing sand carefully through the sieves and well cover the patterns. Using too little facing sand and then filling around the patterns with wet black sand spoils many castings. Many men are very careless with facing sand on machinery castings. As the surface of the mould has to stand up against the metal, and be free from any kind of movement, it is necessary to avoid scab by taking every care with facing sands, and keeping the runners full when pouring the metal. For light castings ram firmly, but vent freely, and pour quickly. Facing sand for good, smooth surfaces is best used the day after mixing. Employ plenty of plumbago to give good surfaces where no machining is required.

Cores.—Core making has now become a great art in the foundry. So many castings are now made chiefly with dried core parts, as, for instance, parts of modern lathes, feed boxes, aprons, gear cases, gear boxes, beds, auto bodies, and parts of other machinery, some delicate, some heavy. Many defective castings are due to defective cores, probably not properly dried or vented, or not properly fixed, or made up too full in the prints, so as to produce a crush. Place the runners so as to avoid an undue rush of iron in one particular part against the cores, and so that all the cores take a fairly equal share of the strain when pouring the iron. Paint well, dry well, vent well; but to get away the gases properly is all-important. Moulders on cored machinery castings have great responsibility. The machine shops are the real examiners of their work.

Gases and air.—These are the moulder's greatest enemies; defeat them by giving them every facility to escape from the moulds. Avoid conflict as much as possible between these gases and the iron by placing the runners in the best positions. The chief troubles with gases and air, apart from the cores, are the top parts of the castings; so vent freely and shave the joints to get away the gases quickly, and use open sand where possible.

Skimming the iron.—Many castings could be saved if this question was considered more. Machine shop costs are increased and work delayed by this great foundry fault. More care is wanted in the use of the water brush, as many machined castings are spoilt by the too free use of water. It chills the castings and runs up extra costs with steel cutting tools in the machine shops. Many defects can be traced to this cause.

Moulding plant.—For the want of good moulding boxes much work is spoilt, and many moulders work under difficulties in this respect. Many founders make this question a vital one, others seem to hang on to the make-shift principle. Good plant is of first importance. Twist and strain, bad lifts owing to faulty bars in top box parts, or other defects in boxes, lead up to a number of faulty castings being produced. Firms which pay attention to and secure good moulding plant and good brands of pig iron are on the road to increased output, fewer defective castings, and lower foundry and machine shop costs.

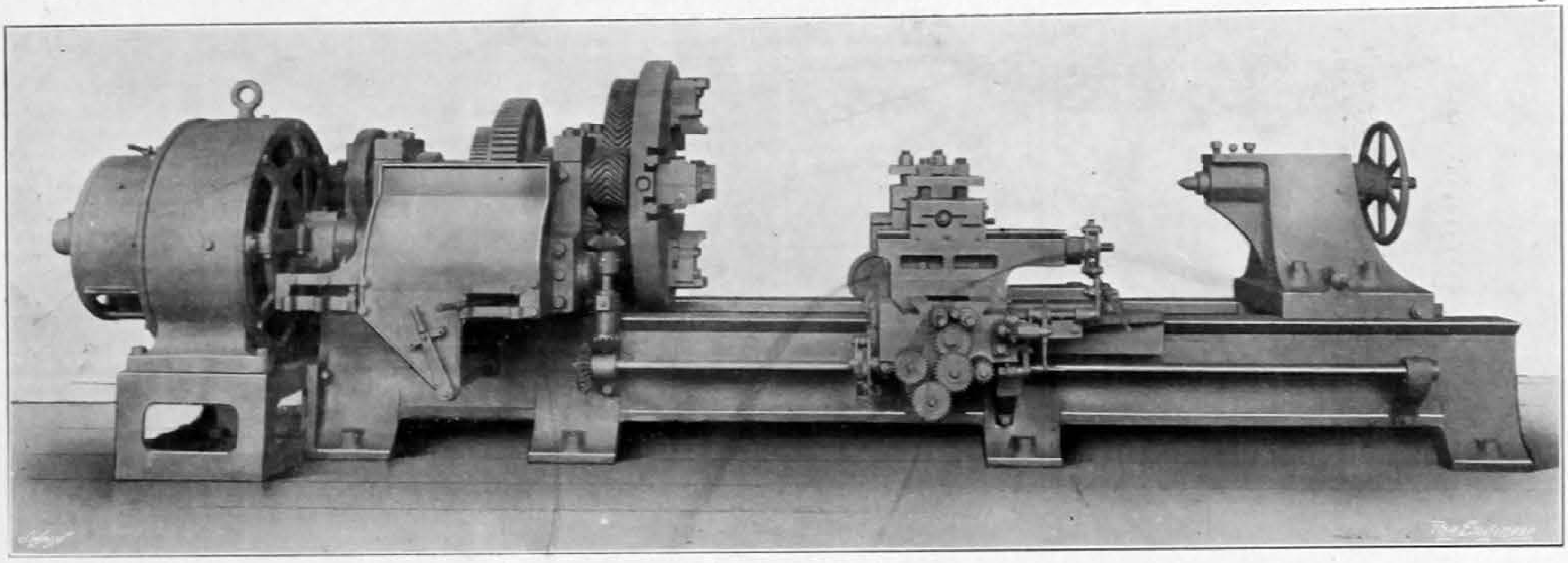


Fig. 13—MOTOR DRIVEN LATHE

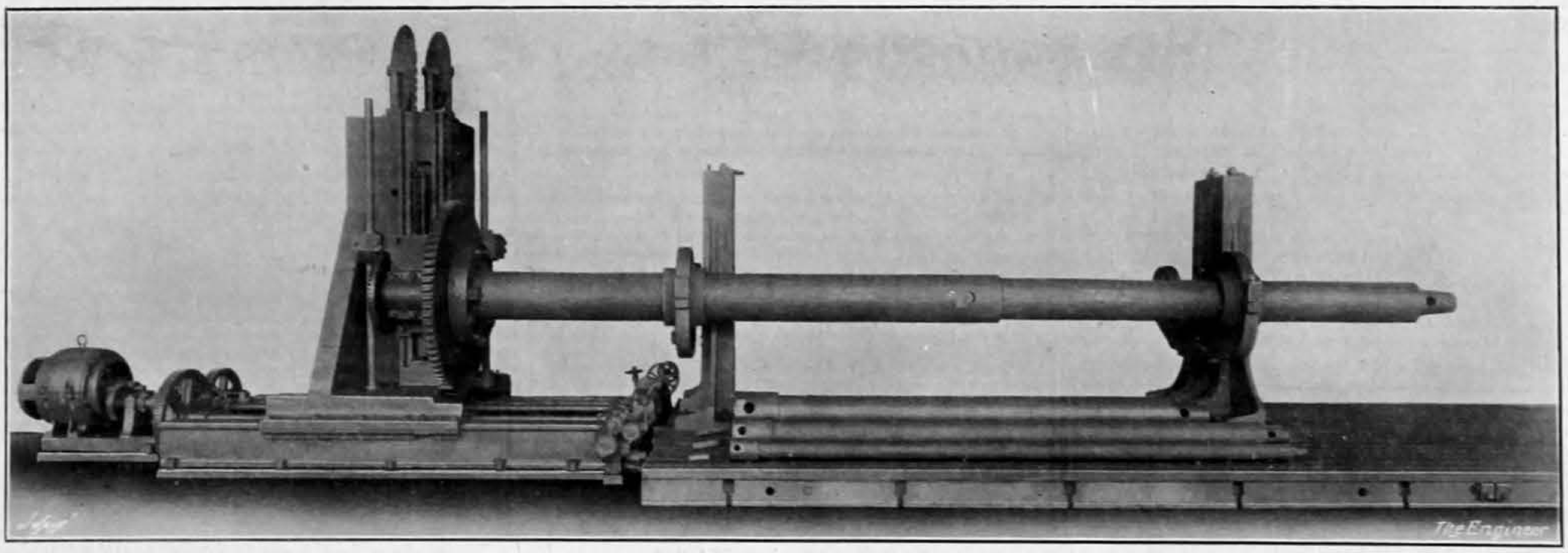


Fig. 14—TURBINE-CASING BORING MACHINE

Rapid and Easy Method of Obtaining Bevel Gear Figures.

Proportion of Wheels.	F. Large wheel.	F. Small wheel.	E.	D.	B. (Centre Angle) Large wheel.	B. (Centre Angle) Small wheel.
1 to 1	1·414 ÷ J	1·414 ÷ J	86° – 36′ ÷ K	93° – 20′ ÷ K	45°	45°
1 ,, 1·020	1·400 ,,	1·428 ,,	81° – 18′ ,,	94° – 14′ ,,	45° – 34′	44° – 26′
1 ,, 1·040	1·386 ,,	1·442 ,,	82° – 0′ ,,	95° – 9′ ,,	46° – 7′	43° – 53′
1 ,, 1·050	1·379 ,,	1·448 ,,	83° – 16′ ,,	95° – 35′ ,,	46° – 24′	43° – 36′
1 ,, 1·100	1·345 ,,	1·479 ,,	85° – 4′ ,,	97° – 39′ ,,	47° – 43′	42° – 17′
1 ,, 1·111	1·338 ,,	1·486 ,,	85° – 27′ ,,	98° – 5′ ,,	48° – 00′	42° – 00′
1 ,, 1·125	1·328 ,,	1·494 ,,	85° – 57′ ,,	98° – 39′ ,,	48° – 22′	41° – 38′
1 ,, 1·143	1·317 ,,	1·505 ,,	86° – 31′ ,,	99° – 19′ ,,	48° – 48′	41° – 12′
1 ,, 1·150	1·312 ,,	1·509 ,,	86° – 45′ ,,	99° – 35′ ,,	48° – 59′	41° – 1′
1 ,, 1·166	1·301 ,,	1·518 ,,	87° – 18′ ,,	100° – 13′ ,,	49° – 24′	40° – 36′
1 ,, 1·180	1·293 ,,	1·526 ,,	87° – 43′ ,,	100° – 41′ ,,	49° – 43′	40° – 17′
1 ,, 1·200	1·280 ,,	1·535 ,,	88° – 21′ ,,	101° – 24′ ,,	50° – 12′	39° – 48′
1 ,, 1·240	1·255 ,,	1·557 ,,	89° – 32′ ,,	102° – 46′ ,,	51° – 7′	38° – 53′
1 ,, 1·250	1·249 ,,	1·561 ,,	89° – 47′ ,,	103° – 4′ ,,	51° – 20′	38° – 40′
1 ,, 1·280	1·231 ,,	1·576 ,,	90° – 37′ ,,	104° – 1′ ,,	52° – 00′	38° – 00′
1 ,, 1·285	1·227 ,,	1·579 ,,	90° – 47′ ,,	104° – 12′ ,,	52° – 8′	37° – 52′
1 ,, 1·300	1·219 ,,	1·585 ,,	91° – 9′ ,,	104° – 38′ ,,	52° – 26′	37° – 34′
1 ,, 1·320	1·208 ,,	1·594 ,,	91° – 39′ ,,	105° – 12′ ,,	52° – 51′	37° – 9′
1 ,, 1·333	1·200 ,,	1·600 ,,	91° – 59′ ,,	105° – 35′ ,,	53° – 7′	36° – 53′
1 ,, 1·350	1·190 ,,	1·607 ,,	92° – 24′ ,,	106° – 4′ ,,	53° – 28′	36° – 32′
1 ,, 1·400	1·162 ,,	1·627 ,,	93° – 41′ ,,	107° – 25′ ,,	54° – 28′	35° – 32′
1 ,, 1·420	1·151 ,,	1·635 ,,	94° – 2′ ,,	107° – 56′ ,,	54° – 51′	35° – 9′
1 ,, 1·428	1·147 ,,	1·638 ,,	9.° – 12′ ,,	108° – 7′ ,,	55° – 00′	35° – 00′
1 ,, 1·440	1·141 ,,	1·642 ,,	94° – 27′ ,,	108° – 25′ ,,	55° – 13′	34° – 47′
1 ,, 1·470	1·135 ,,	1·646 ,,	94° – 39′ ,,	108° – 39′ ,,	55° – 24′	34° – 36′
1 ,, 1·480	1·120 ,,	1·657 ,,	95° – 16′ ,,	109° – 22′ ,,	55° – 57′	34° – 3′
1 ,, 1·500	1·109 ,,	1·664 ,,	95° – 41′ ,,	109° – 50′ ,,	56° – 19′	33° – 41′
1 ,, 1·520	1·099 ,,	1·670 ,,	96° – 5′ ,,	110° – 16′ ,,	56° – 40′	33° – 20′
1 ,, 1·550	1·084 ,,	1·680 ,,	96° – 37′ ,,	110° – 54′ ,,	57° – 10′	32° – 50′
1 ,, 1·560	1·079 ,,	1·684 ,,	96° – 48′ ,,	111° – 7′ ,,	57° – 20′	32° – 40′
1 ,, 1·600	1·060 ,,	1·696 ,,	97° – 31′ ,,	111° – 56′ ,,	58° – 00′	32° – 00′
1 ,, 1·640	1·041 ,,	1·706 ,,	98° – 11′ ,,	112° – 42′ ,,	58° – 38′	31° – 22′
1 ,, 1·650	1·036 ,,	1·710 ,,	98° – 21′ ,,	112° – 53′ ,,	58° – 47′	31° – 13′
1 ,, 1·666	1·029 ,,	1·715 ,,	98° – 36′ ,,	113° – 11′ ,,	59° – 2′	30° – 58′
1 ,, 1·680	1·023 ,,	1·718 ,,	98° – 49′ ,,	113° – 25′ ,,	59° – 14′	30° – 46′
1 ,, 1·700	1·014 ,,	1·724 ,,	99° – 7′ ,,	113° – 46′ ,,	59° – 32′	30° – 28′
1 ,, 1·720	1·005 ,,	1·730 ,,	99° – 25′ ,,	114° – 7′ ,,	59° – 50′	30° – 10′
1 ,, 1·750	·992 ,,	1·736 ,,	99° – 50′ ,,	114° – 36′ ,,	60° – 15′	29° – 45′
1 ,, 1·760	·988 ,,	1·739 ,,	100° – 0′ ,,	114° – 46′ ,,	60° – 24′	29° – 36′
1 ,, 1·800	·971 ,,	1·748 ,,	100° – 31′ ,,	115° – 23′ ,,	60° – 57′	29° – 3′
1 ,, 1·840	·955 ,,	1·757 ,,	101° – 3′ ,,	116° – 0′ ,,	61° – 29′	28° – 31′
1 ,, 1·850	·951 ,,	1·759 ,,	101° – 10′ ,,	116° – 8′ ,,	61° – 37′	28° – 23′
1 ,, 1·880	·940 ,,	1·765 ,,	101° – 30′ ,,	116° – 32′ ,,	61° – 59′	28° – 1′
1 ,, 1·900	·932 ,,	1·770 ,,	101° – 45′ ,,	116° – 47′ ,,	62° – 14′	27° – 46′
1 ,, 1·920	·924 ,,	1·774 ,,	102° – 0′ ,,	117° – 3′ ,,	62° – 29′	27° – 31′
1 ,, 1·950	·912 ,,	1·779 ,,	102° – 19′ ,,	117° – 27′ ,,	62° – 51′	27° – 9′
1 ,, 1·960	·908 ,,	1·781 ,,	102° – 26′ ,,	117° – 34′ ,,	62° – 58′	27° – 2′
1 ,, 2·000	·894 ,,	1·789 ,,	102° – 51′ ,,	118° – 3′ ,,	63° – 26′	26° – 34′
1 ,, 2·040	·880 ,,	1·796 ,,	103° – 15′ ,,	118° – 31′ ,,	63° – 53′	26° – 7′
1 ,, 2·080	·866 ,,	1·802 ,,	103° – 39′ ,,	118° – 58′ ,,	64° – 20′	25° – 40′
1 ,, 2·100	·859 ,,	1·805 ,,	103° – 49′ ,,	119° – 10′ ,,	64° – 32′	25° – 28′
1 ,, 2·120	·853 ,,	1·809 ,,	104° – 0′ ,,	119° – 23′ ,,	64° – 45′	25° – 15′
1 ,, 2·160	·840 ,,	1·815 ,,	104° – 21′ ,,	119° – 46′ ,,	65° – 9′	24° – 51′
1 ,, 2·200	·830 ,,	1·821 ,,	104° – 40′ ,,	120° – 9′ ,,	65° – 33′	24° – 27′
1 ,, 2·240	·815 ,,	1·826 ,,	105° – 0′ ,,	120° – 32′ ,,	65° – 57′	24° – 3′
,, 2·250	·812 ,,	1·827 ,,	105° – 5′ ,,	120° – 37′ ,,	66° – 2′	23° – 58′
1 ,, 2·280	·803 ,,	1·831 ,,	105° – 19′ ,,	120° – 53′ ,,	66° – 19′	23° – 41′
1 ,, 2·300	·797 ,,	1·834 ,,	105° – 27′ ,,	121° – 2′ ,,	66° – 30′	23° – 30′
1 ,, 2·333	·788 ,,	1·838 ,,	105° – 42′ ,,	121° – 19′ ,,	66° – 48′	23° – 12′
1 ,, 2·360	·780 ,,	1·841 ,,	105° – 52′ ,,	121° – 31′ ,,	67° – 2′	22° – 58′
1 ,, 2·400	·769 ,,	1·846 ,,	106° – 9′ ,,	121° – 50′ ,,	67° – 23′	22° – 37′
1 ,, 2·440	·758 ,,	1·850 ,,	106° – 24′ ,,	122° – 8′ ,,	67° – 43′	22° – 17′
1 ,, 2·480	·747 ,,	1·855 ,,	106° – 39′ ,,	122° – 26′ ,,	68° – 3′	21° – 57′
1 ,, 2·500	·743 ,,	1·857 ,,	106° – 46′ ,,	122° – 34′ ,,	68° – 12′	21° – 48′
1 ,, 2·520	·738 ,,	1·859 ,,	106° – 53′ ,,	122° – 40′ ,,	68° – 21′	21° – 39′
1 ,, 2·560	·727 ,,	1·863 ,,	107° – 7′ ,,	122° – 57′ ,,	68° – 40′	21° – 21′
1 ,, 2·600	·718 ,,	1·866 ,,	107° – 18′ ,,	123° – 11′ ,,	68° – 57′	21° – 3′
1 ,, 2·640	·708 ,,	1·870 ,,	107° – 32′ ,,	123° – 25′ ,,	69° – 15′	20° – 45′
1 ,, 2·666	·702 ,,	1·872 ,,	107° – 39′ ,,	123° – 34′ ,,	69° – 26′	20° – 34′
1 ,, 2·700	·694 ,,	1·875 ,,	107° – 50′ ,,	123° – 47′ ,,	69° – 41′	20° – 19′
1 ,, 2·720	·690 ,,	1·877 ,,	107° – 57′ ,,	123° – 53′ ,,	69° – 49′	20° – 11′
1 ,, 2·760	·681 ,,	1·880 ,,	108° – 7′ ,,	124° – 6′ ,,	70° – 5′	19° – 55′
1 ,, 2·800	·672 ,,	1·883 ,,	108° – 17′ ,,	124° – 18′ ,,	70° – 21′	19° – 39′
1 ,, 2·840	·664 ,,	1·886 ,,	108° – 28′ ,,	124° – 30′ ,,	70° – 36′	19° – 24′
1 ,, 2·880	·656 ,,	1·889 ,,	108° – 37′ ,,	124° – 41′ ,,	70° – 51′	19° – 9′
1 ,, 2·900	·651 ,,	1·891 ,,	108° – 43′ ,,	124° – 53′ ,,	70° – 59′	19° – 1′
1 ,, 3·000	·632 ,,	1·897 ,,	109° – 6′ ,,	125° – 14′ ,,	71° – 34′	18° – 26′
1 ,, 3·100	·614 ,,	1·903 ,,	109° – 26′ ,,	125° – 37′ ,,	72° – 7′	17° – 53′
1 ,, 3·200	·596 ,,	1·909 ,,	109° – 45′ ,,	126° – 0′ ,,	72° – 39′	17° – 21′
1 ,, 3·333	·575 ,,	1·915 ,,	110° – 8′ ,,	126° – 25′ ,,	73° – 18′	16° – 42′
1 ,, 3·400	·564 ,,	1·919 ,,	110° – 20′ ,,	126° – 38′ ,	73° – 37′	16° – 23′
1 ,, 3·450	·557 ,,	1·921 ,,	110° – 26′ ,,	126° – 46′ ,,	73° – 50′	16° – 10′
1 ,, 3·500	·549 ,,	1·923 ,,	110° – 34′ ,,	126° – 55′ ,,	74° – 3′	15° – 57′
1 ,, 3·550	·542 ,,	1·925 ,,	110° – 41′ ,,	127° – 3′ ,,	74° – 16′	15° – 44′
1 ,, 3·600	·535 ,,	1·927 ,,	110° – 48′ ,,	127° – 11′ ,,	74° – 29′	15° – 31′
1 ,, 3·631	·531 ,,	1·928 ,,	110° – 52′ ,,	127° – 15′ ,,	74° – 36′	15° – 24′
1 ,, 3·684	·524 ,,	1·930 ,,	110° – 59′ ,,	127° – 23′ ,,	74° – 49′	15° – 11′
1 ,, 3·736	·517 ,,	1·932 ,,	111° – 5′ ,,	127° – 30′ ,,	75° – 1′	14° – 59′
1 ,, 3·777	·512 ,,	1·934 ,,	111° – 10′ ,,	127° – 36′ ,,	75° – 10′	14° – 50′
1 ,, 3·789	·510 ,,	1·934 ,,	111° – 11′ ,,	127° – 37′ ,,	75° – 13′	14° – 47′
1 ,, 3·833	·505 ,,	1·935 ,,	111° – 16′ ,,	127° – 43′ ,,	75° – 23′	14° – 37′
1 ,, 3·888	·496 ,,	1·937 ,,	111° – 22′ ,,	127° – 48′ ,,	75° – 35′	14° – 25′
1 ,, 3·944	·492 ,,	1·938 ,,	111° – 27′ ,,	127° – 53′ ,,	75° – 46′	14° – 14′
1 ,, 4	·485 ,,	1·940 ,,	111° – 33′ ,,	128° – 3′ ,,	75° – 58′	14° – 2′
1 ,, 4·111	·472 ,,	1·943 ,,	111° – 45′ ,,	128° – 16′ ,,	76° – 21′	13° – 39′
1 ,, 4·176	·466 ,,	1·945 ,,	111° – 50′ ,,	128° – 22′ ,,	76° – 32′	13° – 28′
1 ,, 4·235	·459 ,,	1·946 ,,	111° – 54′ ,,	128° – 28′ ,,	76° – 43′	13° – 17′
1 ,, 4·312	·452 ,,	1·948 ,,	112° – 1′ ,,	128° – 35′ ,,	76° – 57′	13° – 3′
1 ,, 4·375	·446 ,,	1·949 ,,	112° – 6′ ,,	128° – 40′ ,,	77° – 7′	12° – 53′
1 ,, 4·428	·440 ,,	1·951 ,,	112° – 10′ ,,	128° – 45′ ,,	77° – 17′	12° – 43′
1 ,, 4·5	·434 ,,	1·952 ,,	112° – 15′ ,,	128° – 51′ ,,	77° – 28′	12° – 32′
1 ,, 4·571	·427 ,,	1·954 ,,	112° – 20′ ,,	128° – 57′ ,,	77° – 40′	12° – 20′
1 ,, 4·666	·419 ,,	1·955 ,,	112° – 26′ ,,	129° – 3′ ,,	77° – 54′	12° – 6′
1 ,, 4·8	·408 ,,	1·958 ,,	112° – 35′ ,,	129° – 13′ ,,	78° – 14′	11° – 46′
1 ,, 5	·392 ,,	1·961 ,,	112° – 45′ ,,	129° – 26′ ,,	78° – 41′	11° – 19′
1 ,, 5·142	·382 ,,	1·963 ,,	112° – 53′ ,,	129° – 34′ ,,	79° – 0′	11° – 0′
1 ,, 5·230	·375 ,,	1·964 ,,	112° – 57′ ,,	129° – 39′ ,,	79° – 11′	10° – 49′
1 ,, 5·385	·365 ,,	1·966 ,,	113° – 3′ ,,	129° – 46′ ,,	79° – 29′	10° – 31′
1 ,, 5·461	·360 ,,	1·967 ,,	113° – 6′ ,,	129° – 49′ ,,	79° – 37′	10° – 23′
1 ,, 5·538	·355 ,,	1·968 ,,	113° – 10′ ,,	129° – 53′ ,,	79° – 46′	10° – 14′
1 ,, 5·666	·348 ,,	1·969 ,,	113° – 16′ ,,	129° – 59′ ,,	79° – 59′	10° – 1′
1 ,, 5·75	·342 ,,	1·970 ,,	113° – 18′ ,,	129° – 2′ ,,	80° – 8′	9° – 52′
1 ,, 5·833	·338 ,,	1·971 ,,	113° – 20′ ,,	130° – 5′ ,,	80° – 16′	9° – 44′
1 ,, 5·916	·333 ,,	1·972 ,,	113° – 23′ ,,	130° – 9′ ,,	80° – 25′	9° – 35′
1 ,, 6·0	·328 ,,	1·972 ,,	113° – 26′ ,,	130° – 12′ ,,	80° – 33′	9° – 27′

EXAMPLE.

Wheels 60 teeth and 30 teeth; 8 diametral pitch

Proportion = 60 to 30 = 2 to 1

Outside diameter of large wheel = Pitch diameter + F = 7½″ + ·894 ÷ J = 7½″ + ·894 ÷ 8 = 7½″ + ·111 = 7·611

Centre angle wheel = 63° – 26′

Face angle = 63° – 26′ + E = 63° – 26′ + (102° – 51′ ÷ K) = 63° – 26′ + (102° – 51′ ÷ 60)
= 63° – 26′ + (1° – 43′) = 65° – 9′

Cutting angle = 63° – 26′ – D = 63° – 26′ – (118° – 3′) ÷ K 63° – 26′ – 1° – 58′ = 61° – 28′

BEVEL GEAR TABLES.

By CHAS. WATTS.

THE accompanying table has been arranged for the convenience of engineers and draughtsmen in calculating diameters, angles, &c., of all ordinary combinations of bevel gearing. Any proportion from 1 to 1 up to 1 to 6 may be obtained from the table. The table is only applicable to gears with their shafts at right angles, and 99 per cent. of bevel gear drives are so arranged. Where an exact proportion of wheels is not given, it is near enough in nearly every case to take the proportion between the one above and the next below.

This table is founded upon one originated by Mr. George B. Grant, of the Boston Gear Works. The author some time ago had a communication from Mr. Grant, who kindly suggested that any use considered desirable could be made of the original table. The accompanying table, while in the main following Mr. Grant's idea, has been very considerably enlarged and improved by the addition of many new proportions, and also of a new column "D."

The table is used in the following way:—

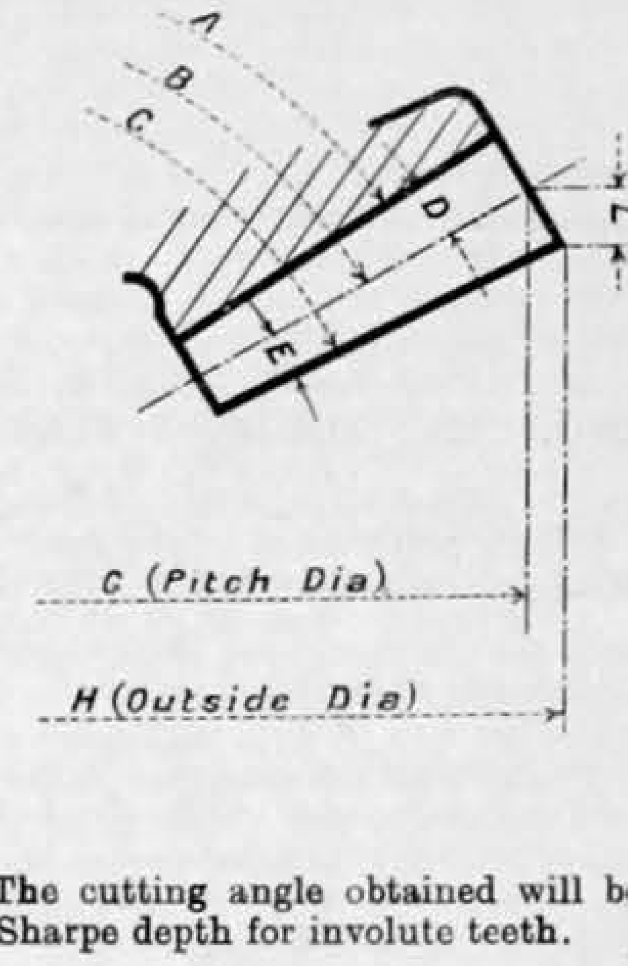
PROPORTION OF WHEELS.—To find proportion of wheels divide number of teeth of wheel by number of teeth of pinion.

CENTRE ANGLES.—Having found the proportion of wheels, the centre angles of wheel and pinion may then be read from columns "B."

OUTSIDE DIAMETERS.—Add to the pitch diameter the diameter increment, the total is the outside diameter. To find the increment divide amount in column "F" for large wheel by the diametral pitch. The result is the diameter increment. Treat the small wheel in the same way, using column "F" (small wheel).

FACE ANGLE.—The face angle is centre angle plus angle increment. To find angle increment, divide amount in column "E" by number of teeth in large wheel. The result will be angle increment in degrees and minutes. Add this increment to centre angle, and this will give the outside or face angle. The same amount added to small wheel centre angle will give outside or face angle of small wheel.

CUTTING ANGLE.—To find the cutting angle for the bevel gear-cutting machine, deduct the angle decrement from the centre angle. To find angle decrement, divide amount in column "D" by number of teeth in large wheel.



NOTE.—The cutting angle obtained will be the standard Brown and Sharpe depth for involute teeth.

A = Cutting angle = B – D
B = Centre angle
C = Face angle = B + E
D = Angle decrement
E = Angle increment
F = Diameter increment
G = Pitch diameter
H = Outside diameter = G + F
J = Diametral pitch
K = Number of teeth in large wheel
L = From pitch line to outside angle = ½ diameter increment of mating wheel

G + F = H
Angle B + angle E = angle C
Angle B – angle D = angle A
The values of F, E, D, B are shown in table

THE ALASKA, YUKON, AND PACIFIC EXHIBITION.

AN interesting exhibition is now being held at Seattle, which is one of the principal cities and ports of the North Pacific Coast. Its purpose is to give publicity to the modern commercial and industrial development of the great Pacific North-West region. The exhibition covers a site of 260 acres, with a natural scenic setting of lakes, forests, and mountains. Some of the large buildings are permanent structures, and will become the property of the University of Washington after the close of the exhibition. The site is about 20 minutes' ride from the centre of the city, by several lines of electric tramways and a branch line of the Northern Pacific Railway. The main buildings front on three sides of a rectangle, in the middle of which is a series of artificial waterfalls, down which the water flows into a large ornamental basin with a 6in. jet of water under 150 lb. pressure, as a "geyser" fountain. There are four miles of water mains for fire service, and four miles for a drinking-water system, besides four miles of sewers. The water is pumped by four-stage centrifugal pumps, each having a capacity of 60,000 gallons per hour and being driven by an electric motor of 200 horse-power. For the waterfalls there is a similar pump, having a capacity of 600,000 gallons per hour. For the illuminations there are 250,000 incandescent lamps, current being supplied at 13,000 volts, and transformed to 3000 volts for distribution. The city of Seattle has a population of about 300,000, and is peculiar in that its natural site has been artificially altered to make it more convenient by levelling hills, filling valleys, and reclaiming "mud flats," or tide flats, along the water front. With the recent completion of the Chicago, Milwaukee, and Puget Sound Railway, the city is served by six transcontinental railways, and it is the port of many lines of steamers to Alaska, the Orient, Australia, &c.

HORIZONTAL BORING, DRILLING, AND MILLING MACHINE

LOUDON BROTHERS, LIMITED, JOHNSTONE, ENGINEERS

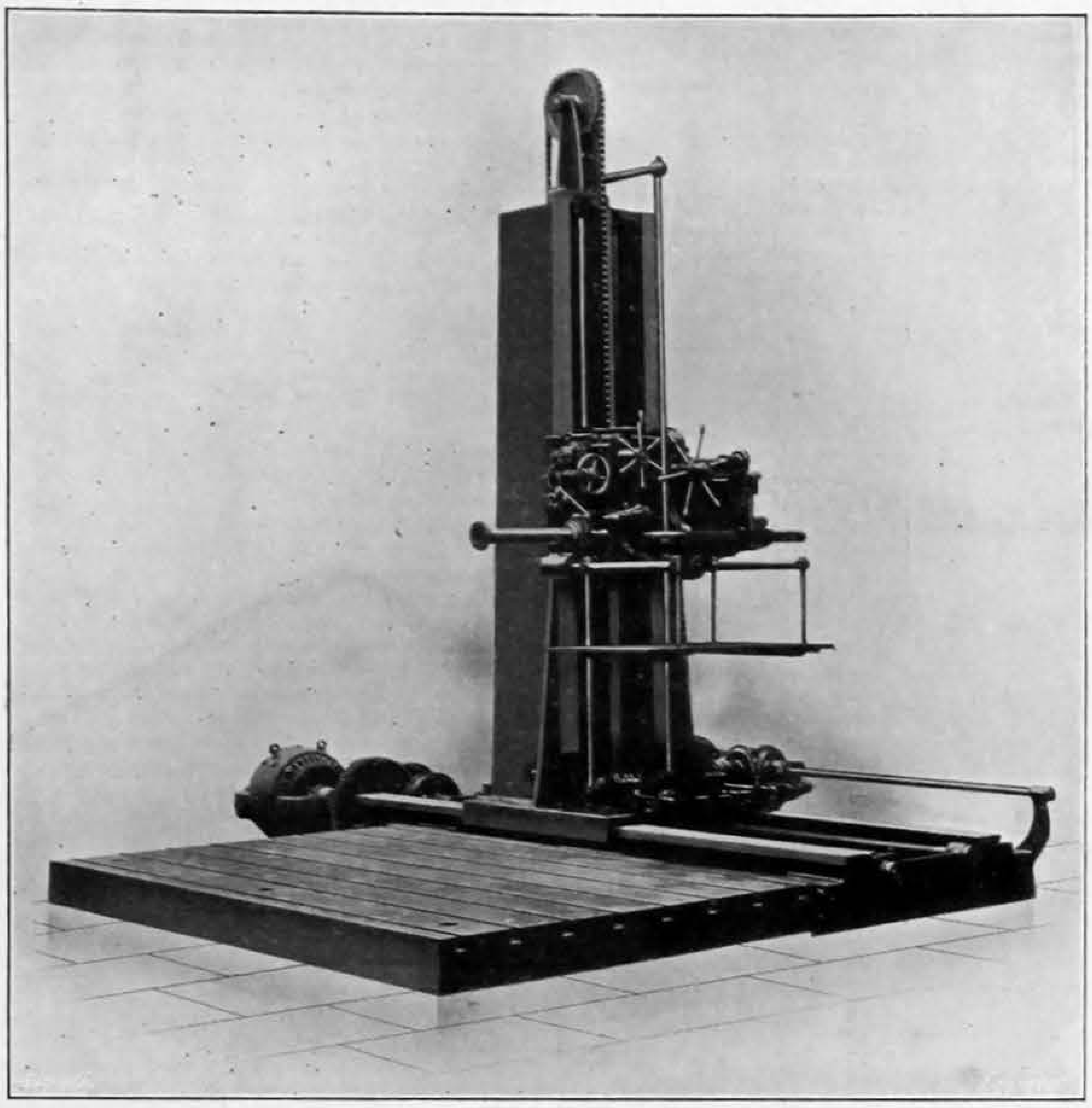


Fig. 1

HORIZONTAL BORING, DRILLING, TAPPING, STUDDING, AND MILLING MACHINE.

A HIGH-SPEED horizontal boring, drilling, tapping, studding, and milling machine has been made by Loudon Brothers, Limited, of Johnstone, to the order of one of the leading engineering firms in Glasgow. It is shown in the accompanying engravings and embodies several new features and details. All movements of the machine can be easily controlled from the saddle platform. The general construction of the machine may be regarded as consisting of a table to which the work is secured, a casting bolted to the table, as shown in the engraving, Fig. 1, having two horizontal sliding surfaces formed on it, an upright carrying the sliding tool saddle, and moving over the surfaces on the previously mentioned casting, and a bracket bolted to the table and carrying the electric motor and change-speed gear wheels.

It will be seen from a consideration of the purposes for which the machine has been designed that provision has to be made for the following movements of the tool spindle :—Rotation, common to all the operations; forward feeding for boring, drilling, tapping, and studding; vertical and horizontal feeding for milling. In addition, provision has to be made for bringing the spindle quickly into any desired position. Each of these movements has to be performed in either direction and at various speeds. Hence reversing and change-speed gears have also to be provided. Taking these operations in order, we purpose dealing with the details associated with each. To give rotational motion to the spindle, power is taken from the motor to drive a horizontal shaft A—Fig. 2—lying between the horizontal sliding surfaces and passing beneath the base of the upright. This shaft drives through spur wheels a vertical shaft B, which extends the whole height of the saddle column.

To permit of the movement of both the column and saddle, each of these shafts has a keyway cut along its whole length, thus allowing any connection to slide on it lengthwise. From Fig. 3, which shows the saddle details, it will be seen that the motion of the vertical shaft mentioned is transmitted through two horizontal toothed wheels C, D to a group of three mitre wheels E, of which the two side wheels revolve loosely on a common spindle, while the top wheel is keyed to the larger toothed wheel already mentioned. An ordinary clutch between the two side mitre wheels permits either to be utilised for driving the tool spindle, and thus allows for reversing the direction of rotation. Motion is transmitted from the upper spindle to the tool spindle through either of two series of toothed wheels F, G, the choice being controllable by a clutch on the main tool spindle itself. As shown on the engraving, the left-hand train of wheels would be employed for slow speeds, such as are required for heavy cutting, tapping, &c.; while for the quicker speeds required for drilling, withdrawing taps and other operations, the right-hand train would be used. The spindle itself, which is of 3¼in. diameter, works in a sleeve H, which revolves with it, and on which the clutch, toothed wheels, &c., are mounted, driving connection being made between the sleeve and spindle by means of a key J and a keyway cut in the latter. Wear on the spindle is thus considerably reduced. Means are provided for mechanically feeding the spindle forward or backward, for quickly adjusting its position by hand and for slow hand feed. The mechanical feed is driven from a three-step cone K, mounted on the sleeve of the tool spindle; from this a belt drives on to a similar cone Z on a spindle working in journals formed on the top of the saddle. Two sliding toothed wheels M, controlled by a lever N, are mounted on this shaft, and either, or neither, can be brought into mesh with two corresponding wheels P keyed to a parallel spindle lower down. The end of this last-named spindle passes outside the saddle casting, and has mounted on it a worm Q, which in turn meshes with a worm wheel R. This worm wheel revolves loosely on a small spindle on which is mounted a clutch, which can be meshed with the worm wheel and thus cause the shaft to revolve; a second worm S and a hand wheel T for slow hand feeding of the spindle are also provided. The second worm drives a worm wheel mounted on—but capable of being easily disconnected from—a shaft U passing through the saddle parallel with the tool spindle. This shaft can be turned by means of a star handle V and mitre wheels so arranged as to give a quick horizontal adjustment to the tool spindle. Connection between the tool spindle and the last-named shaft is made through mitre wheels and a short vertical shaft with a pinion W mounted on its lower end;

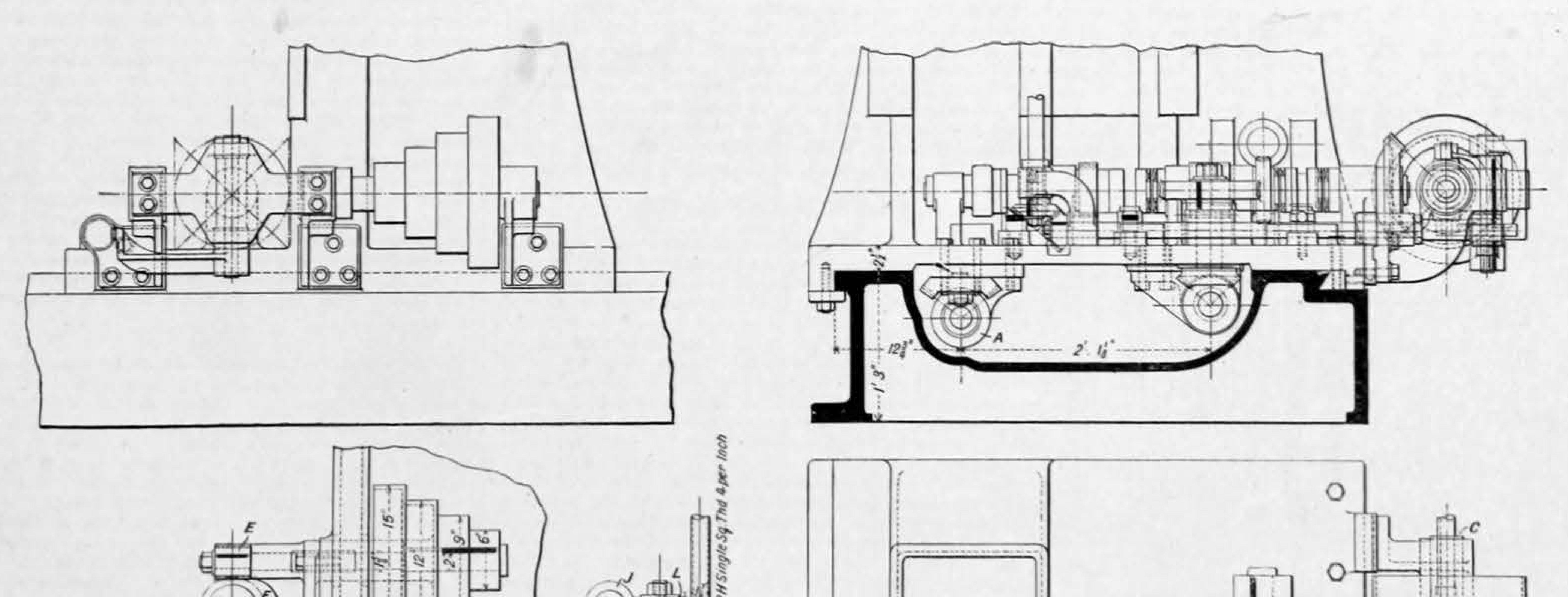
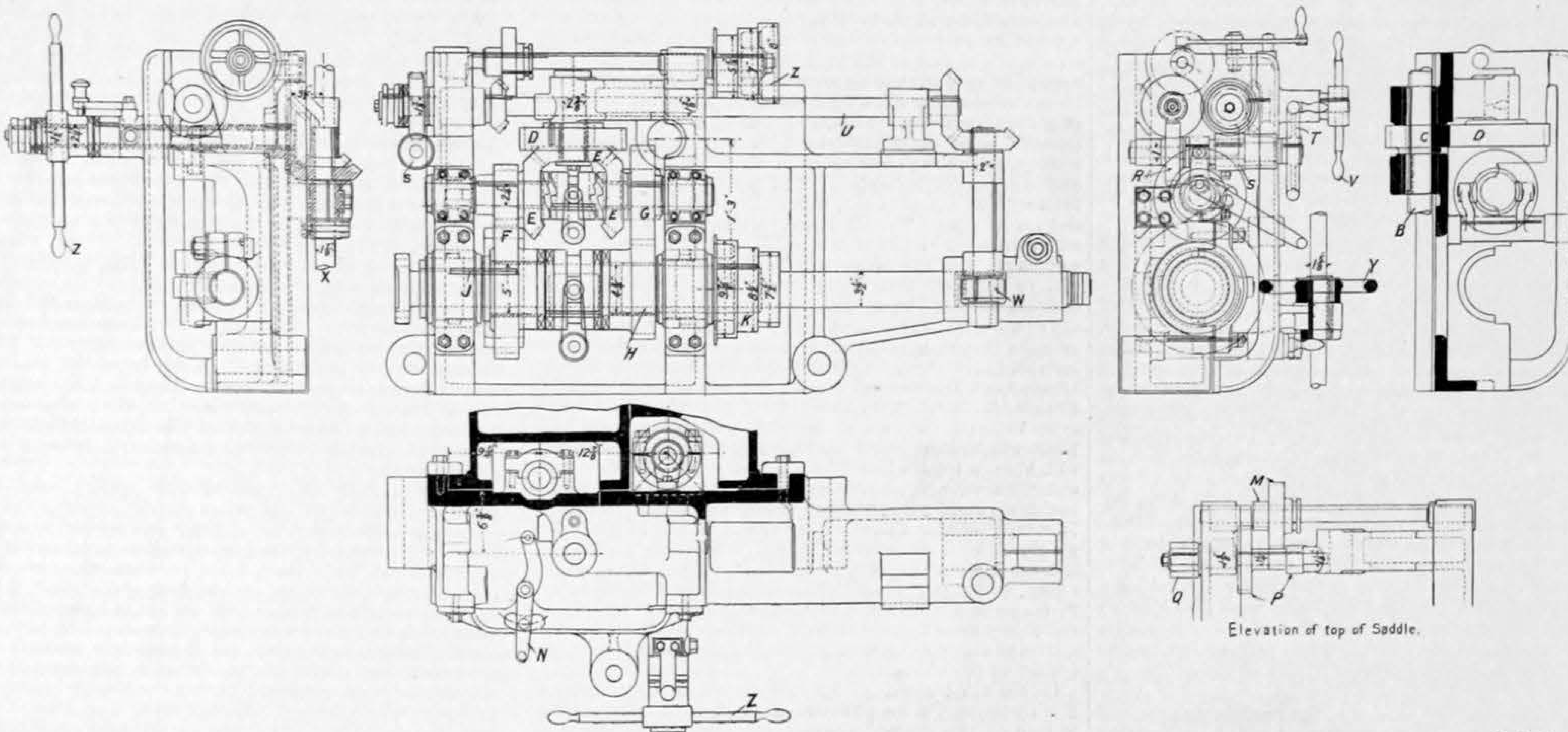


Fig. 2—GENERAL ARRANGEMENT OF THE FEED MECHANISM

HORIZONTAL BORING, DRILLING, AND MILLING MACHINE

LOUDON BROTHERS, LIMITED, JOHNSTONE, ENGINEERS



"The Engineer" Swain Sc.

Fig. 3—DETAILS OF THE SADDLE

this pinion works on a rack formed on the side of the tool spindle. It will be seen that by means of the three-step pulley K and the gear wheels M s x changes of speed of horizontal feed can be obtained. The total traverse is 42in.

Coming now to the feeds required for milling, the vertical motion is obtained by direct upward or downward movement of the whole saddle, while the horizontal motion involves the motion of the entire column. Both these motions can be given by hand or mechanical power, the devices adopted for these being, perhaps, the most interesting part of the whole machine.

The mechanical milling feeds derive their motion from a shaft mounted on brackets at the rear of the machine, and driven by belt from the motor. This shaft is provided with a keyway running its whole length, and it passes through a steel sleeve C—Fig. 2—on which are mounted a four-step cone and a mitre wheel. Brackets fixed to the rear of the base of the upright carry this sleeve, pulley, &c. To make connection between the driving shaft and the sleeve a friction clutch D is provided, and for reversing purposes this clutch can be thrown into gear with another mitre wheel, which drives the sleeve through the first-named mitre wheel and a third. Motion is taken from the four-step pulley to one corresponding, mounted on a short spindle at the base of the upright, and parallel with the feed driving shaft. This spindle drives through a worm E on to a worm wheel F running loose on a shaft journalled at the base of the upright, and

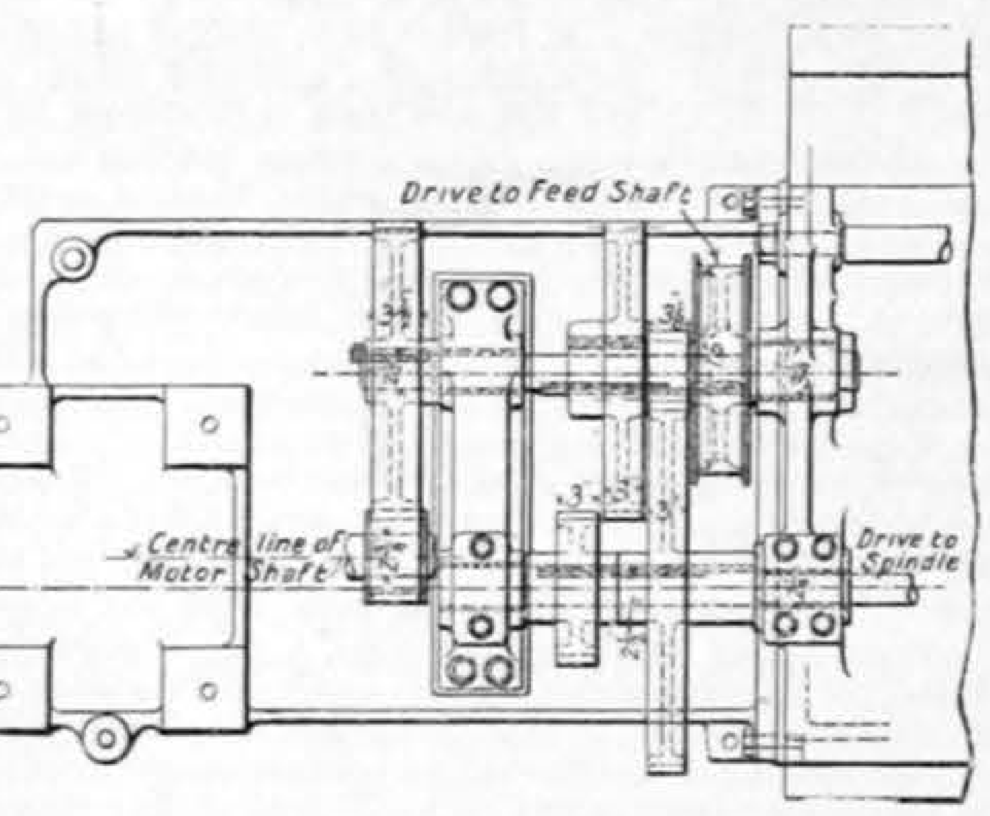


Fig. 4—DETAILS OF THE ELECTRIC DRIVE

lying at right angles to the former. A clutch G serves to connect in the usual way this worm wheel and shaft when desired. From this shaft motion both for traversing the column and saddle and for feeding the milling cutter is taken. For these purposes there are two worms H, J running loose on the shaft, and each working on to a worm wheel K, L. Clutches M, N again are provided for connecting these worms with the shaft. One worm and worm wheel H, K drive down on to two mitre wheels beneath the base of the upright and give horizontal motion to the column and feed to the cutter by means of a screwed shaft and nut, the nut being formed in the inside of one of the mitre wheels. The other worm wheel gears on to a vertical screwed shaft X—Fig. 3—which passes through a nut formed on the saddle, thus giving vertical feed and adjustment. It will be seen from the engraving of the clutch shaft details that, to set the vertical or horizontal milling feed—of which there are four speeds for each spindle speed, obtainable by means of the stepped cone—the operator first has to throw the right-hand clutch G on the clutch shaft into gear, thereby giving the shaft rotational motion, and then either of the other two clutches N, M, the one on the left if vertical motion of the saddle be desired, the middle one if the column is to be traversed. The friction clutch D controlling the starting, stopping and reversing of whichever milling feed is being used is worked through a sector arm P—Fig. 2—and horizontal and vertical shaft from a hand wheel Y—Fig. 3—attached to the saddle and movable with it. Thus these movements can be accomplished without necessitating the operator's leaving the platform. With the friction clutch open the feed movements, as already stated, can be controlled by a star hand wheel Z—Fig. 3—on the saddle, the one wheel serving for either motion, as will be seen from the figure. Thus either the inner or outer shaft, and in conjunction therewith the inner or outer set of bevel wheels respectively, can be given rotation according as the left-hand or right-hand clutch is used. In the figure the handle is shown out of gear for power feeding. The outer bevels, giving vertical motion to the saddle, work on to the screwed shaft X in a nut and bolt fashion, while the inner, giving traverse to the column, use the screwed shaft as a spindle and transmit through a key and keyway running the length of the shaft, motion to the clutch shaft at the base of the column and thence through the worm wheel, &c., H—Fig. 2—to the horizontal screw. When milling is being done it is necessary to lock the spindle securely against motion forwards or backwards, and for this purpose a suitable device is provided.

The motor driving the machine is one of 10 brake horse-power and drives through gearing with raw hide pinions—see Fig. 4—both the shaft giving rotation to the spindle and the feed shaft at the back of the machine. Taking advantage of the change of speed which can be obtained by regulation of the current supplied to the motor in addition to the change speed gear, there is a full range of speeds of rotation of the spindle of from 3 to 320 revolutions per minute.

SHIPBUILDING NOTES.

AT the time of writing, the Institution of Engineers and Shipbuilders in Scotland and the North-East Coast Institution of Engineers and Shipbuilders have just concluded their joint meetings at Glasgow, and the unanimous verdict of those fortunate enough to have been present is that the meetings, themselves largely in the nature of an experiment, have been a great success. For this success there are many reasons, the principal of which, perhaps, is that no better place for meetings of this kind could be imagined than this sombre northern city. The river is thickly dotted with shipyards, and within easy distances by train or tram are engineering and other works of a widely diversified character—steel works, roof and bridge-building works, and mechanical and electrical engineering establishments. Another reason is that the secretaries of the respective Institutions appear to have a most admirable conception of the lines on which a summer gathering should be run. The mathematician, with his painful flight into the regions of the speculative, has been conspicuous by his absence, and the papers read have been characterised by an appeal to popular interest and to the practical difficulties and problems of the audience.

ON Wednesday, 5th August, the meetings opened in the new premises of the Scottish Institution in Elmbank-street, and it was a matter of universal regret that Mr. Ward was prevented from taking the chair on that occasion by indisposition. Mr. C. P. Hogg, however, admirably filled his place, and read the address which had been prepared by Mr. Ward. The address, which was largely retrospective in character, emphasised the utility of meetings such as these by means of which interchange of ideas and experience could most effectively be achieved. After Mr. Summers Hunter had suitably replied, the members proceeded to the consideration of the two papers for the day. The first of these was by Sir Andrew Noble on the "History of Propellants," and the second by Engineer Commander Wisnom on "The Trials and Performances of the Otaki, Fitted with a Combination of Reciprocating and Turbine Machinery."

THIS latter paper had been very eagerly anticipated. In this column some time ago reference was made to the Otaki and to the Orari and Opawa, to which vessels she is a sister. Mr. Wisnom's paper set forth the comparative trial results of the Otaki, together with a statement of the vessel's performances on her first voyage to New Zealand and back. With regard to the measured mile trials it was stated that the Otaki, which was required to obtain a trial speed of 14 knots with 5000 tons deadweight on board, really attained a speed of 15 knots as compared with 14.6 knots by the Orari, and with a less water consumption. With regard to the service conditions, the coal consumption of the Otaki on the voyage from Liverpool to Teneriffe worked out at 11 per cent. less than that of the sister vessel at the same speed, the average speed for the round voyage being about 11 knots. For the round voyage it appeared the Otaki's coal consumption was about 8 per cent. better than that of the sister vessel, and the author explained this reduction by certain adverse circumstances not connected with the machinery, as, for instance, the state of the ship's bottom. The longest non-stop run made was 11,669 miles, during which the machinery worked satisfactorily. It will be seen from the above that the figures given are somewhat meagre in respect of all the information one might desire to have effectively to compare two types of machinery, and moreover leave a little to be desired in the matter of consistency. Neglecting, however, these elements, it would appear that, broadly speaking, as stated here previously, a gain of 10 per cent. is secured by the adoption of recipro-turbine machinery in vessels working under similar conditions to the Otaki, and that this gain will be subject to variation depending upon the actual conditions. Short runs, with much harbour work, for example, might cause it to disappear altogether. Assuming this increased economy of 10 per cent., it appeared that the most pertinent contribution to the discussion came from Mr. W. B. Morrison, of Hartlepool, who raised the very significant point as to whether, in ordinary cargo vessels of moderate speeds, this gain would be a satisfactory set-off against the increased complexity of the machinery, and the extra demand on the intelligence—not already too high—of the engine-room staff. This appears to us to be a question which cannot yet be answered in the affirmative. So far as the Otaki is concerned, however, the most effective comment on the general efficiency of the ship is, that the builders are to build a duplicate for the same owners.

ON the second day (Thursday) the papers were of a general interest. Dr. G. B. Hunter, associated with Mr. E. W. De Russett, read a paper on "Sixty Years of Merchant Shipbuilding on the North-East Coast," and Prof. J. H. Biles' paper (taken as read) was entitled "Fifty Years of Warship Building on the Clyde." Both of these were valuable and stimulating contributions—that of Dr. Hunter, concerned as it was with merchant shipbuilding, being especially so. His account of the working hours and pay of the old Sunderland shipwrights illustrates very vividly the change for the better which has taken place in the conditions of the shipbuilding industry. Prof. Biles' paper was an exhaustive *résumé* of the Clyde's contribution to his Majesty's Navy, and will be read with profit by those interested in the subject.

OUTSIDE the meetings in Elmbank-street there were the usual festivities of a public and private character. On Wednesday the members were entertained at a reception by the Lord Provost and Corporation of Glasgow, and on Thursday the British Corporation for the Survey and Registry of Shipping entertained the principal members at luncheon. There were also numerous expeditions to the engineering and shipbuilding establishments in the vicinity, of which advantage was fully taken. On the occasion of the visit to Parkhead Forge a prominent Scotch steel maker expressed surprise that the Admiralty authorities should experience difficulty in obtaining guns and armour when so much first-class plant was standing idle. Concurrently with this expression of opinion we notice with pleasure that Messrs. Wm. Beardmore and Co. have secured the contract for 1650 tons of armour plate for the new battleship Colossus, which is being built by Scott's of Greenock. We commence a detailed account of the meetings and visits in another column.

THE appointment soon to be made to the newly instituted Chair of Naval Architecture in Liverpool University will bring to completion a scheme long and carefully considered. With this appointment there will then be three fully endowed Chairs of Naval Architecture in the United Kingdom. It remains to be seen how far the Liverpool one will be successful in view of the relatively small amount of actual construction in the port.

OBITUARY.

THOMAS TURNER.

THE death is announced of Mr. Thomas Turner, managing director of the firm of Andrew Barclay, Sons, and Co., Limited. Mr. Turner had a wide and varied practical experience, and worked his way up from post to post, always steadily improving his position. He gained practical experience in engineering, not only at home but in India—an experience of foreign work which afterwards stood him in good stead. He also did good work for a time in journalism, being associated in the management of the *Mechanical World*, of which he acted as editor for about twelve months.

When he was appointed general manager of Barclays more than fourteen years ago, he threw himself into the work in the most whole-hearted way. The company's interests were ever foremost in his mind, and he handled the business as if it were absolutely his own property, and identified himself entirely with its interests. The purely technical matters which occupied a great deal of Mr. Turner's personal time and attention were the improvements of the design and manufacture of the Barclay standard locomotives; the modernising and bringing up-to-date of their old standard line in winding engines, so as to produce the best results in steam economy and speed, and safety in working. In the last connection Mr. Turner designed several special safety devices, which were patented in the name of the company, and have been fitted to large numbers of winding engines. The other special lines developed under his personal direction were the modern high-speed reciprocating pump known as the Oddie Barclay Patent and the Barclay drum-pattern fan, not to mention other smaller detail specialities of the company's manufacture.

Mr. Turner joined the service of the company as general manager on 1st April, 1895, afterwards becoming managing director, which position he occupied at the date of his death. He was a native of Tyneside, where he served his apprenticeship. He was a Whitworth scholar and a member of the Council of the Federated Mining Institute of Great Britain, and also of the West of Scotland Iron and Steel Institute. He was also a member of the Institute of Mining Engineers, of the Institution of Engineers and Shipbuilders in Scotland, and of the Institute of Mechanical Engineers. He was for some time back president of the Kilmarnock branch of the Engineering Employers' Federation. During his career he was successively steel works manager to Joseph Fenton and Sons, Sheffield; manager to Messrs. Nicholson and Wilson, Blaydon-on-Tyne; and works manager to the New British Iron Company, Corngreaves; and prior to his joining Barclays he was works manager of the Shelton Iron and Steel Company, Limited, Stoke-on-Trent.

NEWCASTLE QUAYSIDE IMPROVEMENTS.

THE Newcastle-upon-Tyne Corporation has for the past three years been actively engaged upon a comprehensive scheme of quay improvements and extensions, the amounts already sanctioned for which are £91,760 and £57,537 respectively. The first section of the improvement scheme includes the rebuilding of 22 yards of quay wall, opposite the Milk Market, and the building and equipping of sheds between the Milk Market and the Swirle, a distance of about 233 yards (£35,982); the provision of electric cranes, capstans, ducts, and cables (£6400); the paving of the quay between Broad Chare and the Ouseburn, a distance of 1116 yards, and the relaying of the old paving opposite the grain warehouse (£10,914); the remodelling of the railway between the swing bridge and the Ouseburn, a distance of 1473 yards (£27,123); and gas and water diversions, &c. (£8581). The rebuilding of the 22 lineal yards of quay wall aforementioned was completed in March, 1907, and progress has since been made with the other works. There will be shed accommodation over a length of 909ft. of quayside, comprising one 303ft. single-storey shed, varying in width from 20ft. to 66ft.; one 303ft. two-storey shed, with roof, 66ft. wide; and one 303ft. shed, 66ft. wide. These sheds are being fitted with a verandah 12ft. wide upon the land side, so that goods can be loaded under cover. The single-storey shed, the steelwork for which was supplied by John Abbot and Co., Limited, of Gateshead, has been completed, and the present equipment consists of one 5-ton portable electric crane, with a 40ft. radius, supplied by Cowans, Sheldon and Co., Limited, of Carlisle, and two 1-ton capstans, working at 100ft. per minute, supplied by C. and A. Musker, Limited, of Liverpool. The two-storey shed will be so arranged that the second storey will be connected to Sandgate by means of a bridge now being erected, so that by this means cart traffic will have direct access to the sheds, and the land adjoining Sandgate upon the north of the quayside will become of greater value for storage purposes. A contract has been let to Parkinsons', of Blackpool, for one of these sheds, as also for a steel girder bridge of 53ft. span, with approach works extending from the Milk Market to the first floor of the shed. On this portion of the quay the railways will consist of one line of rails between the shed and the river and two lines of rails on the land side of the sheds, and, in addition, the relaying of existing and the laying down of new sidings between the foot of Horatio-street and the Ouseburn has recently been completed. The points and crossings are of manganese steel, supplied by Edgar Allen and Co., Limited, of Tinsley. The section of the works now in hand is expected to be completed about the close of the year.

It is intended at an early date to take in hand the rebuilding, by monolith work, of the quay wall at the London wharf and various other sections, so as to give 25ft. below low water of spring tides, and also to provide up-to-date sheds and equipment between the grain warehouse and the Ouseburn. This involves the removal of the present sheds and the 80-ton hydraulic crane. With a view to coping with the congestion of traffic which will result when a commencement is made with this work, an extension to the quayside eastward of the Ouseburn was commenced in October, 1906. These works, estimated to cost £59,537, include provision of an additional berth 360ft. long, a new quay of 120ft. in length, and a heavy retaining wall at the northern boundary of the works, together with the construction of a new road connecting Burrell-road with St. Lawrence-road. The new quay is being constructed of a monolith wall 20ft. thick, carried down to a solid foundation so as to allow for 25ft. below low water of spring tides. The monoliths, 30ft. by 20ft., and spaced at distances of 2ft. 6in., were formed of concrete walls 5ft. thick, resting on a cast iron shoe in the form of a hollow rectangle. The monoliths were sunk to an average depth of 33ft. 6in. below low water of spring tides from temporary staging by means of grabs attached to cranes, and, owing to the clay passed through being exceedingly hard, it was necessary to blast continually, and use was made of as much as 600 tons of cast iron kentledge weights. The new quay walls are being built with an ashlar facing, concrete backing, granite coping, and fender piles. The 120ft. quay which faces the Ouseburn will be dredged to 12ft. low water of spring tides. When completed, the new quay will have a width of 145ft., and will be equipped with a double set of rails and warehouse accommodation. These new quays will be connected with the existing quayside railways by means of a low level bridge over the Ouseburn. This bridge, the contract for which has been let to the Cleveland Bridge and Engineering Company, Limited, of Darlington, will be carried on six monoliths, 22ft. by 15ft., sunk to about 31ft., and will have a single span 74ft. 6in. centres of bearings, and square span 55ft. There will be three heavy plate girders 7ft. deep. The bridge will have a total width of 62ft., and will carry two 30in. water mains, and smaller gas and water pipes, as also a double standard gauge railway track, and a 20ft. roadway. It is expected that this new quay extension will be completed within three months from date. The exact method of haulage upon the quayside has not yet been finally determined, and the Corporation have in the meantime instructed their engineer to visit several continental ports to investigate and report upon the advisability, or otherwise, of adopting a system of electric accumulator locomotives charged from the municipal power-house.

On the 4th December, 1907, the Newcastle City Corporation recommended the purchase of about 3274 square yards of land on the quayside beyond the area of the extension previously authorised, but within the limits of deviation of the plans of the 1904 Act, and this land has been acquired. The powers of the Corporation for the compulsory acquisition of land for the purpose of this Act expire on the 15th August, and the Trade and Commerce Committee of the Newcastle Corporation has had under consideration the desirability of acquiring certain portions of the remainder of the land authorised to be purchased by that Act for quay extension purposes, which will enable the Corporation to extend the quay for a length of 775ft. beyond the present extension when such extension is found to be necessary. At a special meeting of the Newcastle City Corporation held on Monday last, August 9th, it was decided to enter into negotiations for the purchase of this land, 8270 square yards, which, with a frontage of 223ft. to the river, is the property of Mr. T. G. Gibson, whilst another parcel of 5118 square yards, with a frontage of 136ft. to the river, belongs to T. and W. Smith, of the St. Lawrence Ropery. In addition to the foregoing, extensions have lately been carried out at the Newcastle Corporation pumping station on the quayside, and two 13in. turbine pumps, each driven by one of W. H. Allen, Son and Co.'s motors, capable of giving 135 brake horse-power, and two turbine pumps, each with branches 12in. diameter and developing 58 brake horse-power at 650 revolutions per minute have been installed. These are required for circulating water through the condensers in the municipal power station, which is situated a quarter of a mile away from the pumping station.

TESTS ON COMMUTATING POLES.

A METHOD of testing commutating poles of dynamos and motors so that they may be adjusted to give the correct strength at various loads in order to obtain sparkless commutation is described in a paper which was recently read before the American Institute of Electrical Engineers by Mr. John N. Dodd. It is stated that in the absence of facilities for making full load tests, it will be sufficient to adjust the auxiliary poles at the maximum current obtainable until the voltage between the two bars undergoing commutation is zero. Two metal points press on the commutator at one of the brushes. These contact points, which are a bar's thickness apart, are connected to a low reading voltmeter, and when this voltmeter registers zero the strength of the commutating poles is correct.

It is immaterial whether the machine is tested as a motor or as a generator, at full voltage or low voltage, or at full speed or low speed, provided that the results of calculation and of experiments with other similar machines make it certain that the cross section of the auxiliary poles is ample to carry the flux corresponding to the flux of the armature, self-induction at the extreme overloads to which the machine will be subjected. If in a generator under test the voltage of a bar under the trailing half of the positive brush is higher than the voltage of the preceding bar, the pole is too weak and more current is required in the auxiliary coil. If the voltage of this bar is lower than that of the preceding bar, it indicates that the pole is too strong. When the two bars have the same voltage—that is, when the volts per bar is zero, the pole is of the correct strength. Measurements can be made with a direct-current voltmeter with a maximum reading of 3 to 5 volts. It should be noted that this voltage should be measured under the centre of the brush, or between bars equi-distant from the centre.

As an example of the accuracy of this method of adjusting a high capacity machine at low currents, the author mentions a machine adjusted by him for no volts per bar under a load of 200 ampères. With the same adjustment the machine was able to carry 10,000 ampères very satisfactorily. If there is any danger of saturation under maximum conditions, a saturation curve of the auxiliary pole is desirable. With zero volts per bar under the brush, the auxiliary pole flux is exactly equal to the armature flux. The armature flux varies directly as the armature current. Therefore, if a series of readings are taken of armature current and the corresponding auxiliary pole current necessary for zero volts per bar, a curve plotted from these readings is the saturation curve of the auxiliary pole. Such a curve is of great value for checking the original calculations, and of particular value when it is necessary to supply new coils or poles, or both.

It shows the exact point at which even a slight degree of saturation is approached, and therefore the correct size of the new poles and the number of turns necessary on the coils at light loads, and hence on the new coils at all loads. A method of taking this saturation curve is illustrated where a low voltage separately excited booster is connected directly across the auxiliary pole coils of the machine. An ammeter is connected in this circuit, and also one in the main armature circuit.

NEW REGULATIONS FOR TINNING METAL.

IN accordance with the report made by the Commissioner, Mr. E. T. Lawes, after a public inquiry held in February and March of this year, the Factory Department of the Home-office has recently issued regulations relating to the operation of tinning various metal goods such as hollow-ware, iron drums, and harness furniture.

The coating of metal articles with a mixture of tin and lead or with tin alone has been certified as dangerous, and these regulations have been issued in pursuance of the Factory and Workshop Act of 1901. With one exception the regulations come into force on October 1st, 1909. This exception provides that all tinning shall be carried out under efficient draught, the latter term being defined to mean localised ventilation effected by heat or mechanical means for the removal of fumes or dust. The date from which the operation of this regulation will take effect is deferred until April 1st, 1910.

In addition to the above the duties of employers are prescribed to include the provision of lavatories with the necessary requisites, and of a room, separate from any in which the process of tinning is carried out, in which the workpeople may have their food—no such room need be provided if the works be closed during the meal hours. Persons under sixteen years of age are not to be employed in tinning, although the employment of women is now sanctioned. The skimmings from the dipping-bath and the dust and refuse collected from the floor must be removed from any room in which work is carried on.

Provision is also made for the periodical inspection of the persons employed by a duly qualified medical practitioner, who shall have the power of suspending them from engaging in tinning. The fees for these medical examinations and duties arising out of them are to be met by the employers as is prescribed in the Act of 1901.

The duties imposed by the new regulations on the workpeople include that of washing the hands before partaking of food or leaving the premises, and the preparation or consumption of any food or alcoholic drink in any room in which the process of tinning is carried out are prohibited.

It is not intended that these regulations should apply to any process of silver-plating or any in which a soldering iron is used. Further, the Chief Inspector of Factories is empowered to exempt from these regulations, by a written certificate, any process which he may adjudge as not requiring their enforcement on the ground of the infrequency or intermittency with which the operations are carried on.

HULL COAL TRAFFIC.

THE return of the Hull Chamber of Commerce and Shipping for July shows that the weight of coal received at the port during that month was 562,224 tons, as compared with 525,168 tons in July of 1908. The increase on the month is therefore 37,056 tons. For the seven months the weight forwarded to Hull was 3,268,288 tons, as compared with 3,461,632 tons for the corresponding period of last year. The difference, being a decrease of 193,344 tons, is accounted for by the smaller trade passing in the earlier months of the year. Denaby and Cadeby Main, as usual, head the list of contributing collieries with 120,488 tons, against 72,616 tons for July of last year; Hickleton comes next with 29,304 tons, against 19,680 tons; and Manvers Main is third with 28,456 tons, against 23,280 tons. Among other leading consignments during the month were:—Carlton Main, &c., 23,440 tons, against 35,896 tons; Brodsworth, 17,400 tons, against 8320 tons; Thorncliffe, 16,728 tons, against 8136 tons; Birley, 16,520 tons, against 11,896 tons; Dalton Main, 14,560 tons, against 11,864 tons; Staveley, 13,144 tons, against 7112 tons; Acton Hall, 10,856 tons, against 9800 tons; Elsecar, 10,424 tons, against 11,864 tons; Allerton Main, 10,304 tons, against 3648 tons. The export trade from Hull for the month amounted to 344,970 tons, compared with 300,558 tons for July of last year; for the seven months, 1,699,786 tons, compared with 1,550,801 tons for the corresponding period of last year. There is thus an increase on the month of 44,412 tons, and on the seven months of 148,985 tons. The principal foreign market was North Russia, which took a weight for the month of 114,934 tons, compared with 100,371 tons for July of last year; for the seven months, 349,456 tons, compared with 332,299 tons. Sweden is second with 43,701 tons, compared with 39,915 tons; for the seven months, 215,841 tons, compared with 211,551 tons. Germany is slightly under Sweden for the month—43,125 tons, compared with 32,572 tons—but for the seven months shows 260,617 tons, compared with 248,003 tons. Holland is close up on the month with 42,292 tons, compared with 32,314 tons, while for the seven months it is an easy second—281,433 tons, compared with 248,003 tons. Austria shows the most remarkable advance—6188 tons last month, compared with 931 tons for July of 1908; for the seven months, 61,286 tons, compared with 8859 tons. France on the month declined to 5707 tons from 25,053 tons, and for the seven months to 73,462 tons from 127,044 tons. Denmark advanced to 14,279 tons from 10,751 tons, but decreased on the seven months to 61,882 tons from 69,543 tons. Italy advanced to 12,567 tons from 4308 tons, for the seven months to 52,902 tons from 40,584 tons. Belgium decreased to 6548 tons from 6868 tons; for the seven months, to 44,305 tons from 50,591 tons. Norway increased to 5219 tons from 3100 tons; for the seven months, to 26,410 tons from 20,224 tons. Egypt increased to 18,800 tons from 16,660 tons; for the seven months to 96,666 tons from 55,722 tons. Another increasing market was South America, which took last month a weight of 22,455 tons, against 14,503 tons for July of 1908; for the seven months, 117,490 tons, against 98,561 tons. Turkey showed a decrease on the month to 2412 tons from 5157 tons, and on the seven months to 15,539 tons from 18,839 tons. Coastwise shipments amounted to 75,117 tons for July, and for the seven months to 485,949 tons.

RAILWAY MATTERS.

THE Sudan is said to be developing steadily and satisfactorily. New parts of the country are fast being opened up through the railways and telegraphs. The great bridge over the Blue Nile at Khartum is practically completed, and the railway has been continued 70 miles south, as far as Pass Kamber, in Ghezireh. Thence it will run south and west to the White Nile. At Hallat Abbas, on the Blue Nile, 180 miles south of Khartum, a big railway bridge is in course of construction. It should be completed by the end of next year, at which time the railway is expected to reach there also.

A SUM of about £240,000 was paid in 1908 by the Finnish Government to the Russian Treasury as the contribution of the Grand Duchy towards constructing a bridge over the Neva in St. Petersburg, with a view to establish a connection between the terminus of the Finnish railways and a Russian station, and thus to facilitate traffic between Russia and Finland. The Finnish railways are not able to carry the same weight as those of the Russian, and it has hitherto been necessary to have all goods unloaded and re-loaded in St. Petersburg. When the connection is made this will be avoided, probably to the great benefit of both parties.

THE total length of the State railways in Sweden amounts to 4345 kiloms. (2698 miles). Their value is given as representing a capital of 518,882,880 kr. (£23,826,826), with an increase during the year of 19,600,000 kr. (over £1,000,000). Materials and supplies are estimated as worth about 15,800,000 kr. (£877,777). During the year 1908 gross receipts amounted to 64,300,000 kr. (£3,572,222). Of this sum about 57,300,000 kr. (£3,183,333) were expended on running and maintenance costs, 3,100,000 kr. (£172,222) for increase of materials, 500,000 kr. (£27,777) for tools, &c., and 4,700,000 kr. (£261,111) were paid into the State Treasury.

IT is reported that the Swedish Riksdag has asked for renewed experiments to be undertaken in order to investigate the question of coal and peat used as fuel on railways, and new trials are now to be made. Between Elmhult and Alfvesta there will be run a special train, consisting of fifty wagons, loaded with coal and peat. This train will be running for a fortnight between the two places, using alternately as fuel English steam coal, peat and steam coal in different proportions, and peat only. There will also be used different types of locomotives. The results of the experiments are looked forward to with great interest, especially by those who are connected with the peat industry.

PRESIDING last Tuesday at the half-yearly meeting of the Great Northern Railway Company, Lord Allerton made reference to the continued loss on first-class traffic. The whole tendency, he said, was to show that more and more people were travelling third-class. That was due not only to the cheaper fares, but to the constantly increasing luxury which railway companies provided for third-class passengers. He did not know whether the time would ever come when they would only have one class, but he confessed that he hankered very much after trying some third-class trains for suburban traffic. First-class carriages were expensive to construct, expensive to haul, and were seldom occupied except at holiday times. He was sure something would have to be done, and the question was under consideration.

A CONSULAR report, in dealing with the Shanghai-Nanking Railway, states that the through service to Nanking was formally commenced on March 31st, 1909, and the line has been well patronised as far as passenger traffic is concerned. Trouble has been caused on various occasions by the stoppage of trains by villagers, in order to claim compensation for the death of or injury to some irresponsible Chinese who was trespassing on the permanent way, or who did not exercise due caution at a level crossing. The authorities have displayed regrettable lack of energy in preventing and punishing outrages of this kind. No freight worth mentioning was carried by the railway during 1908, as the arrangements had not yet been made with regard to the collection of likin or its substitutes.

AT a meeting of the London County Council on July 27th, the Highways Committee recommended that parliamentary sanction should be sought during the session of 1910 for the construction of several new lines of tramways. In addition to the seven new lines, which are as follows:—Marble Arch to Harrow-road, Harrow-road to Cricklewood, Chalk Farm to Child's Hill, Seven Sisters'-road to Hanley-road, Herne Hill Station to Brixton Hill, Putney Bridge to Wandsworth, and Wood-lane to Harrow-road, it is intended that powers should also be sought for the construction of several small connecting lines intended to improve the working of the existing system. Altogether, the proposals involve an expenditure of about £417,000, excluding the cost of cars, car sheds, sub-stations, &c., while the total length of the new lines will amount to about 24 miles.

IT is reported that the Western Railway of France has obtained authority from the Government to electrify its lines. A commencement is to be made with the lines which run from the St. Lazare Station in Paris to Argenteuil and Saint-Germain-en-Laye. Special tracks will be laid, so that the service can be effected without any interference with the steam-driven trains. Sub-stations will be erected which will supply continuous current at 600 volts. It is anticipated that from 12 to 20 trains, composed of a maximum of six double carriages 20 metres long, can be run per hour. It is estimated that the permanent way, equipment of line, &c., will cost £1,160,000; that the rolling stock and converter stations will cost £800,000; and that interest on capital and other expenditure will bring the total amount to £2,280,000 for the 33.5 kilometres of line to be constructed.

DIRECT communication with the centre of the city is to be made on another route of the Birmingham Corporation tramways system. Alterations are being carried out at Rea-street which will enable such of the Moseley cars as are put on the new service to turn off from Bradford-street and proceed *viâ* Deritend and Moor-street into High-street, as an alternative to the existing terminus in Hill-street. It is not at present contemplated to provide through communication between Moseley and Washwood Heath, in the same way as between Sparkbrook and Washwood Heath, and small Heath and Nechells, although the advantage of the new arrangement to those who wish to proceed from Moseley to the eastern side of the city will be obvious. It will also have the advantage of relieving the traffic in Station-street to some extent. The necessary junctions will be ready in about a month's time.

ON Tuesday of this week a very peculiar accident, believed to be due to the expansion of the rails by heat, occurred on the London and North-Western Company's line between Huddersfield and Stockport, near the wayside station of Friezland, on the Yorkshire and Lancashire border. The train, which left Huddersfield at 9 20, was not timed to stop until it arrived at Stockport. Shortly after it had passed through Friezland Station at a speed of 50 miles an hour the passengers noticed that something was wrong. All the three coaches of which the train was composed began to rock violently, and shortly afterwards the engine left the metals, swinging completely round as it did so, and finally lodging, after travelling about 200 yards, alongside the up main line. The first of the three coaches went forward with one end partially ripped off. The two rear coaches were thrown on the down line. Fortunately, all three remained on their wheels, for had they not done so the thirty occupants must have been injured much more seriously than they were. It is reported that the funnel of the engine was afterwards found thirty yards away from the engine itself, which was a complete wreck. The driver and fireman were both killed.

NOTES AND MEMORANDA.

IT is reported that Mr. Orville Wright has stated that he is completing the perfecting of his aëroplane. He considers the machine will soon be in daily use, and available to everyone, both as regards price and working.

A GOOD example of the economy often accomplished by chemical investigation and discovery is furnished in the case of ultramarine. Many years ago when this was made by powdering the mineral lapis lazuli, it sold for more than its weight in gold. Now that the chemist has discovered how to make the same material from such cheap substances as kaolin, sodium sulphate and carbonate, charcoal, sulphur and rosin, the price is only a few pence per pound.

THE *Engineering Record* states that bonding new and old concrete can be accomplished in the following manner:—Clean the surface of the old concrete with clear water and a stiff broom. Apply a mixture of one part of hydrochloric acid and three parts of water with a brush, making several applications one after the other. Then scrub the surface with clean water and a stiff brush until all the acid is washed away and the surface is perfectly clean and free from loose particles. While it is still wet apply the fresh concrete, and keep the new concrete damp for at least a week, being careful not to allow it to become dry at any time.

DURING the six months ending June 30th, Great Britain exported iron and steel and manufactures thereof to the value of eighteen and one-third millions; other metals, four millions; cutlery, hardware, &c., nearly two and a-half millions; machinery nearly fourteen millions; and ships, three and one-third millions. Our exports of iron and steel and manufactures thereof for June amounted to £3,073,091; of other metals to £632,876; of cutlery, hardware, &c., to £422,424; of machinery to £2,304,092; and of ships to £506,351. The total British exports for June amounted to £29,717,975. The total value of exports from the United Kingdom during the six months ending June 30th was £176,934,350.

THE June number of *Terrestrial Magnetism and Atmospheric Electricity* contains a frontispiece showing the magnetic survey yacht Carnegie under full sail, and an article describing her construction and the work she is intended to do. She has a displacement when fully equipped of 568 tons, and is built almost without iron, her bolts and metal fittings being of bronze, copper, or gun metal. The observation rooms are amidships. The yacht is to make a magnetic survey of the oceans during the next fifteen years, with the object of correcting the magnetic charts and compass data at present available. Her first voyage will be to Hudson Bay and the North Atlantic Ocean.

THE smelter production of lead in the United States in 1908, as given by C. E. Siebenthal, of the United States Geological Survey, under the date of May 24th, was 408,523 tons of 2000 lb., against 442,015 tons in 1907, and 418,699 tons in 1906. The production of refined primary lead, which embraced all desilvered lead produced in the country, and the pig lead recovered from Mississippi Valley lead ores, was 396,433 tons, against 414,189 tons in 1907, and 404,669 tons in 1906. The antimonial lead produced was 13,629 tons, and the recovered or secondary lead 18,283 tons. In 1908 the lead smelted from domestic ores was 310,762 tons, and from foreign ores and foreign base bullion—almost wholly Mexican—97,761 tons.

IN connection with the design of certain special towers in wireless telegraphy, in which numerous guys, together with the tower, act as an aërial capacity, the necessity arose of finding a quick method of determining the sags and tensions in the guys at different temperatures. The author of an article in the *Electrical World* obtains a simple cubic equation from which the sag can be readily determined. A numerical example is worked out completely to illustrate the method. It is shown how the wind pressure can be taken into account, and useful practical diagrams showing how the wind pressure varies with the velocity of the wind are given. The effect of a coating of ice on the wires is also discussed. This coating is usually elliptical in section.

VOLT scales for indicating the voltage to produce a desired candle-power have been used on photometers in many glow-lamp factories, as the public demand only a few candle-powers, but considerable latitude in the voltage. It would be extremely convenient to be able to ascertain the voltage required to produce the correct watts per candle by a direct reading, and if possible the corresponding watts or c.p. at the same time. A volt scale meter, described in the *Electrical World*, accomplishes this object. A watts-per-candle or "specific consumption" meter, designed by Hyde and Brooks, is part of the photometric equipment of the Bureau of Standards. Tables are calculated so as to reduce the labour required to find the "3.1-watt" voltage. The author of the article referred to diminishes this labour by using a volt scale on which the data given in the tables are indicated at once. It is shown how to combine a volt scale and a watts-per-candle meter so as to be able to read from one setting (1) the voltage to give a certain specific consumption, and (2) the c.p. or watts at that voltage.

LARGE-SCALE experiments on the underflow or subsurface flow of water through saturated sand or gravel are being made by the United States Reclamation Service in the Arkansas Valley, Western Kansas. After a search and tests to find a supposedly heavy underflow a row of wells was sunk across a valley near Deerfield, Kan., and pumps were erected there. A Press bulletin issued by the Service states that the wells and pumps lowered the water plane 19ft. or 20ft. below the river level; also that during the latter part of 1908 the wells began to weaken materially, the total amount of water removed being 10,000 acre feet; that is to say, enough to cover 1000 acres 10ft. in depth, or sufficient to irrigate, say, 4000 acres. By April, 1909, the gravels had become filled again on the north side of the river, but in the valley on the south side the "underflow" was not sufficient to restore the amount pumped during the preceding year. During 1909 the pumps lowered the underflow much more rapidly than in 1908. Part of the wells, or groups of wells, are allowed to stand idle in order to recuperate while the others are being pumped. It is hoped that by this system as much water can be obtained in 1909 as in 1908. The experience, however, shows that the so-called underflow, even where best developed, is not a very reliable source of supply on a large scale.

AN American has just patented in this country an invention for the manufacture of artificial nitrates. It is claimed that nitrate of lime can be produced at a cost of about £4 14s. a ton, the market price of Chili saltpetre being about £9 15s. a ton. Until now the principal attempts that have been made to fix atmospheric nitrogen may be classed as (1) processes in which atmospheric nitrogen is burnt to nitrous or nitric acid; and (2) processes in which atmospheric nitrogen is combined by means of carbides, obtained by fusing together in an electric furnace metals or metallic oxides and carbon. The cost of the nitrogen so obtained has been comparatively high, except where power can be obtained from waterfalls at a very low cost. The patent referred to above describes a process and apparatus by means of which sulphur may be burned on a commercial scale so as to remove all the oxygen from the stream of air supplied for its combustion. By this means, it is claimed, nitrogen of great purity can be obtained, and the inventor says that in practice he has rejected all nitrogen-gas which did not reach a purity of 99.6 to 99.8 per cent. Also by placing iron filings in the receiver for a few days the .2 of oxygen may be removed, leaving absolutely pure nitrogen. Cyanide of potassium can, it is claimed, also be produced at a cost of about 8½ cents a pound, the market price being about 22 cents per lb.

MISCELLANEA.

IN a printed reply to Mr. Ginnell, Mr. Winston Churchill says he understands that the Royal Commission on Canals propose to report first on British waterways, and expect to do so before the end of the year. They hope to report on Irish waterways in the early months of next year, and, until the report has been received and considered, no statement as to possible future legislation can be made.

ON the 9th July, the necessary material for the wireless station was landed at Kingston, Jamaica. The station will have a range of 300 miles by night and 200 miles by day. Great interest is being manifested in Jamaica in the new station, and some of the steamship companies trading in the Caribbean are having their steamers fitted, so as to be able to get into touch with the island as soon as possible. Most of the vessels in the West Indies are fitted with the De Forest system.

THE parallel operation of hydro-electric plants connected by about 500 miles of 44,000-volt three-phase circuits is carried on in Utah and Idaho by the Telluride Power Company. The five generating stations have capacities of 18,000, 3000, 3200, 6500, and 10,800 horse-power respectively, and connected with them are seven sub-stations. All stations are, or soon will be, connected by at least two separate lines, and are so designed that the development of power does not interfere with the use of the water for irrigation.

THE *Bulletin Commercial* (Brussels) of July 17th contains a long article on the electrical industry in Servia. The report draws attention to the good openings in that country for electric lighting and kindred appliances, and to the necessity not only for supplying articles of good quality at reasonable cost, but also for developing the market on the spot by means of personal visits. The establishment in Servia of a depôt where electrical material could be seen by persons interested would, according to this report, be the most efficient way of rapidly increasing business.

THE use of lignite as fuel in generating stations, states the *Electrical Review*, is increasing in Germany, where stations continue to be erected in the vicinity of lignite deposits, or the electricity companies purchase the mines or lease the production. Combinations of lignite mines with power stations already exist in the Weissenfels district, at Helmstedt and Schwandorf in the Upper Palatinate, and the Electricity Supply Company of Berlin has now arranged with the Hercules Brown Coal Company, of Zittau-Hirschfeld, for the supply of lignite for the overland central station to be erected in Oberlausitz.

ABOUT the end of March, 1909, the Imperial Don-Kuban-Terek Agricultural Society, Russia, circularised some fifty United States agricultural machinery firms, stating that they had decided to organise at Rostoff-on-Don an experimental farm for testing farm machinery and implements by scientifically arranged experiments. With this object the Nahitchevan town council had given the society 50 dessiatines (135 acres) of land, on which the society intends to erect the necessary buildings and appliances. For this invites subscriptions on the ground of the benefit which the manufacturer is likely to derive from these tests.

BOLIVIAN purchases of mining machinery depend on the development of the tin, silver, copper, and gold mines. The introduction of modern machinery is likely to be the result of the railway building which is now going on, since this will reduce the expenses of transportation, and render accessible regions in which heretofore the mines have been worked after the old methods and with limited means, on account of the very heavy charges incurred in carrying the products of the mines. According to the United States special agent in Bolivia, the tin mines are likely to furnish the best market. The Bolivian production in 1907 was approximately 16,000 tons of pure tin, slightly less than for the previous year.

A PARIS correspondent of the *Times* states that a law has just been promulgated in the *Journal Officiel* prohibiting the use of white lead. The terrible ravages caused by plumbism in the manufactories of this article and among painters and other workpeople who use it have for a long time excited public notice. The question has been debated at great length in Parliament for upwards of five years, owing to the defensive measures adopted by manufacturers engaged in the white lead industry. The present law enacts that, after the expiration of five years, the use of white lead, or of paint composed of linseed oil and white lead, and of all special compounds containing white lead in any form, shall be prohibited for every description of painting work.

THE coating of metal articles with a mixture of tin and lead, or lead alone, having been certified under the Factory and Workshop Act, 1901, to be dangerous, the Home Secretary has drafted a series of regulations which are to apply to all factories and workshops where tinning is carried on in the manufacture of metal hollow-ware, iron drums, and harness furniture. It is specifically laid down that no tinning shall be carried on except under efficient draught; that no person under sixteen years of age shall be employed in tinning; and that no person employed in tinning, mounting, denting, or scouring shall keep or prepare or partake of any food or alcoholic drink in any room in which work is carried on. Periodical medical examination is to be insisted upon.

BLACKFRIARS Bridge is now all but completed. Only the east half of the granite paving remains to be laid down, and the builders will be able to calculate the amount of bonus they will be entitled to from the City Corporation, estimated at the rate of £20 per day, for completing the work before the beginning of next year, the time specified in the contract. It is reported that Mr. Anderson, who is acting for the Corporation on behalf of the City Engineer, has stated that the work ought to be finished in the early part of next month, so that the bonus will amount to between £3000 and £3500. It will be the widest bridge in London, measuring 105ft. from parapet to parapet. The footways will be 16ft. wide, the remaining 73ft. being thrown into the roadway.

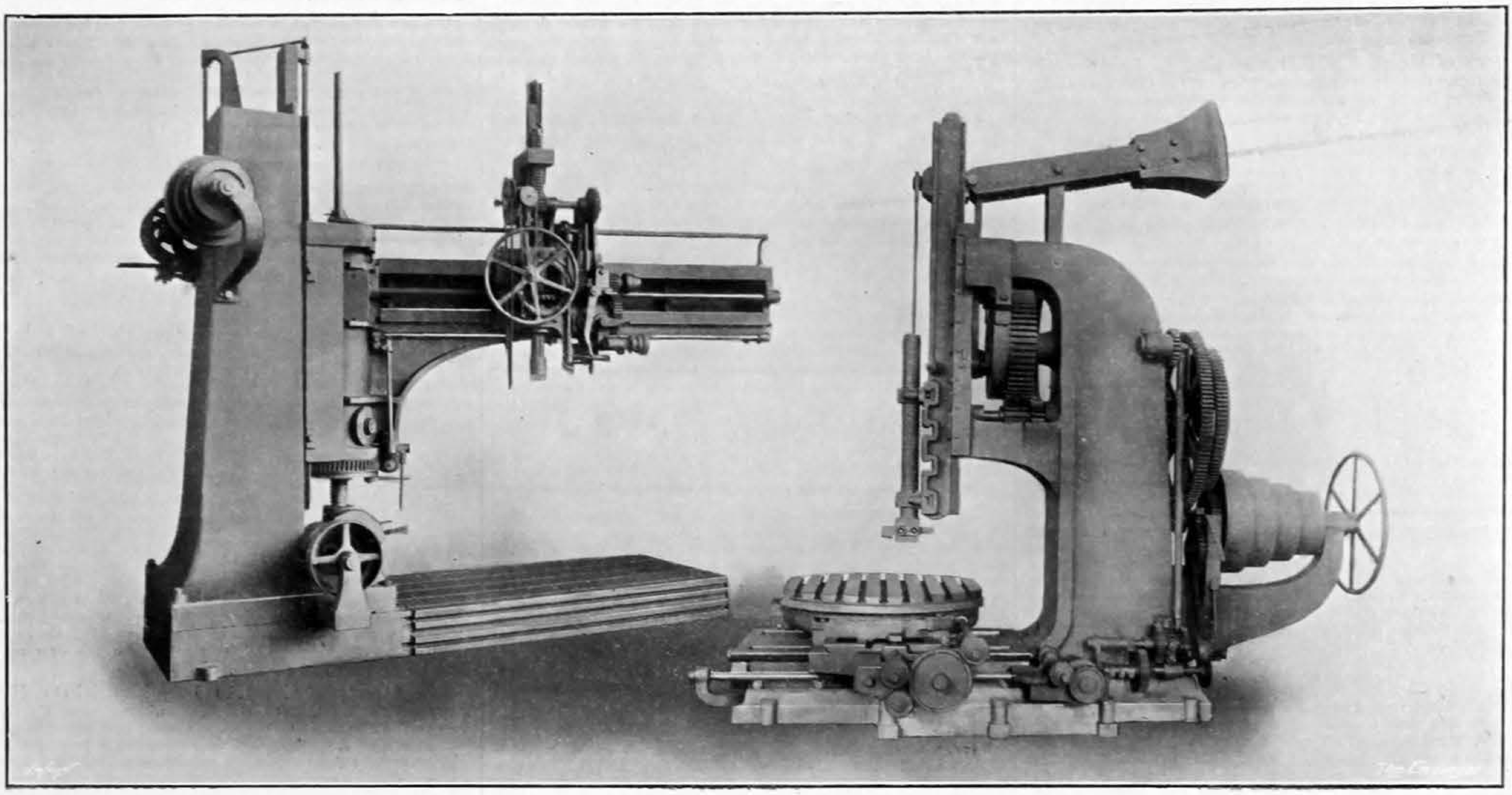
THE following information is from the report by H.M Minister in Uruguay on the trade of that Republic in 1908, which will shortly be issued:—"The construction of the great embankment at Monte Video, the 'Rambla del Sud,' has been entrusted to a British syndicate. This great engineering work will take five years to complete, and will cost £1,355,000. The embankment, which will be 4000 m. in length, will consist of a stout sea wall, 4 m. above sea-level, and an esplanade 70 m. wide. The proposed line of embankment takes a gentle outward curve, and, as it will run a considerable distance from the present irregular natural coast line, a large area of land will be reclaimed from the sea. The total area of land thus reclaimed is calculated at not less than 125 hectares—about 310 acres."

A CASE which affects the regulations of railway companies for governing the use of railway level crossings has been decided in the High Court. The railway company involved, relying upon a regulation approved by all leading railways, gave instructions that the gates at a certain level crossing should be closed to special forms of traffic, no heavy motor vehicle being allowed to cross the railway without one day's previous notice having been sent to the nearest station master. The legality of this proceeding was challenged, and an action was brought against the company. The view of the Motor Union, which interested itself in the case, that the company had no right to make rules against particular classes of traffic which might be using the highway has been upheld in the High Court, the judge deciding that the regulation referred to was not binding upon the public.

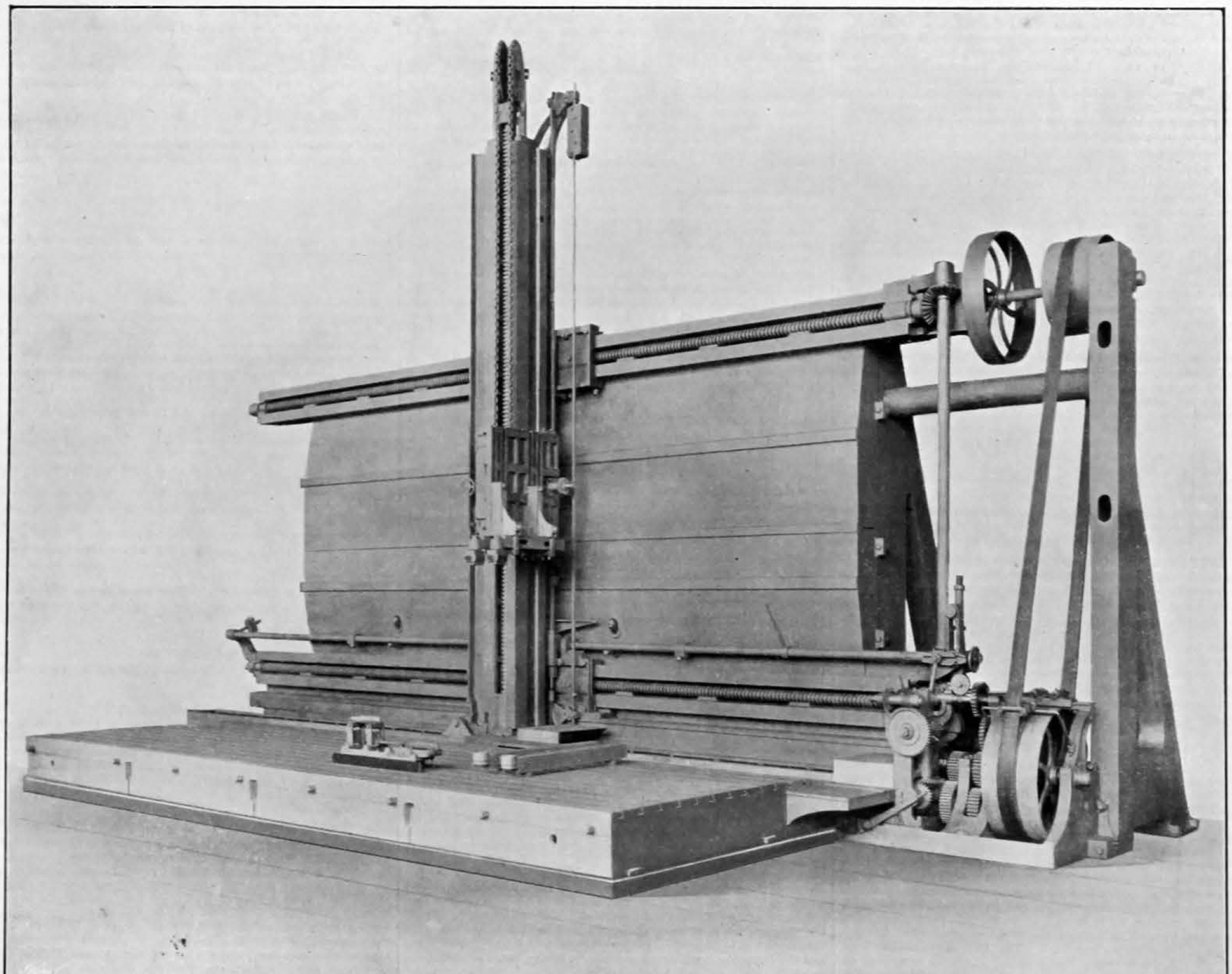
SOME NEW MACHINE TOOLS

THOMAS SHANKS AND CO., JOHNSTONE, ENGINEERS

(For description see page 160)



RADIAL DRILLING MACHINE SLOTTING MACHINE



VERTICAL AND HORIZONTAL PLANING MACHINE

CONTENTS.

TO CORRESPONDENTS.

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

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

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

INQUIRIES.

HAIR CLOTH MANUFACTURERS.

SIR,—I shall be obliged by the names and addresses of firms making hair cloth in large quantities. TEXTILE.
August 10th.

MACHINE FOR MAKING BOLTS FROM COLD IRON.

SIR,—I shall be obliged by the address of English makers of machines for making bolts and nuts from cold iron. N. L.
August 9th.

MACHINERY FOR MAKING GRAPHITE CRUCIBLES.

SIR,—Can any of your readers inform me where I could get a full outfit of machines for making graphite crucibles? V. M.
August 10th.

THE ENGINEER.

AUGUST 13, 1909.

Employers and Workmen's Compensation.

THE burdens placed upon employers directly and upon insurance companies indirectly by the Workmen's Compensation Acts continue to be reflected in the many cases which are transferred from the County-courts or County-court arbitrators to the Court of Appeal in the majority of instances, or the House of Lords in a comparatively small number of actions. During the past two months no fewer than fifteen cases have engaged the attention of the Court of Appeal, and the decisions seem to have enlarged the responsibilities of employers in various trades. In 1907, which is the latest year for which official figures are available until the Home-office return for 1908 has been published, seventy cases in England and Wales were carried to the Court of Appeal, although fifteen were either abandoned, withdrawn, or settled out of court before the time arrived for the hearing. This number compares with fifty-seven actions which were brought before the High Court in 1906, and it therefore shows a fairly large increase, notwithstanding the circumstance that the Workmen's Compensation Act, 1906, was only in operation during the second half of 1907. The upward tendency in the latter year will probably be found to have continued in 1908 when the official report is issued, while the cases already heard in the course of the present year indicate a maintenance of litigation both on the part of employers and workmen who have failed to be satisfied with the findings of County-court judges or arbitrators. The extension of the liabilities of employers under the Act of 1906 is naturally responsible for the growth of actions which reach the Court of Appeal. Yet these cases only form a very low percentage of those which are brought before the County-courts in some way or other; and the latter in their turn also constitute merely a small proportion of the thousands of claims made under the Compensation Acts that are never brought into court, but are settled by agreement between employers or insurance companies on the one hand, and the workmen, or their representatives, on the other. One important insurance company, which carries on business in Scotland, although its sphere of activity is probably not restricted to that country, received, approximately, 25,000 claims in 1908 under policies issued under the Compensation Acts. A second company, bearing an English title, reports the reception of nearly 35,000 claims under the Acts in 1908, and the chairman recently stated that workmen's compensation risk is virtually a burden, and probably a loss to those who undertake it.

It is scarcely surprising to learn on the authority of the same company that a revision of the rates of premium is being taken into consideration having regard to the large risks involved. A statement of this kind has, of course, to be read in the light of the fact that the Act of 1906 has only been in operation for two years down to the present time, and that the experience gained of its effects only applied to the first complete year when the many thousands of claims were recorded. Nevertheless, it is easy to conceive that if two insurance companies were confronted with 60,000 claims in one year, the total number of claims for other companies and for those employers who assume their own risks must have almost reached figures representing hundreds of thousands in 1908 for the whole of the United Kingdom. With such numerous applications before us it is probable that some of the recent decisions given by the Court of Appeal will tend to increase the financial charges imposed upon employers throughout the country. In the case of Gane *v.* the Norton Hill Colliery Company, the plaintiff was a carting boy employed in the pit, and on the day of the accident he was told to ascend the pit earlier than usual owing to a defect in the machinery. He did so, and was run over by some trucks on a line which he was accustomed to cross on the surface on the way home. The County-court Judge held that the employment did not continue up to the time of the accident, and he consequently gave his award in favour of the employers. On appeal, however, the Court of Appeal decided that the accident happened in the course of, as well as arose out of, the employment, and the case was remitted to the County-court judge to assess the amount of compensation. A second instance, which is of considerable importance, relates to a workman named Hughes, who was employed by the firm of Clover, Clayton and Co. The man was engaged in tightening a nut with a spanner, when he fell back and was found to be dead. An examination revealed the fact that a large aneurism of the aorta had existed, and death was attributed to this cause. The County-court judge at Lancaster decided that the exertion of tightening the nut caused the rupture, and that death was produced by a strain arising out of the ordinary work of the deceased operating upon a condition of body which was such as to render the strain fatal. In the circumstances the judge considered there was an accident within the meaning of the Act, and he decided in favour of the man's widow. The employer lodged an appeal, but the Court of Appeal has dismissed it on the ground that the workman sustained an injury in the reasonable and ordinary discharge of his duties, and that the rupture of the aorta was the result of the work upon which he was engaged.

The two cases referred to in the Court of Appeal place further emphasis upon the responsibilities of employers under the Workmen's Compensation Act, 1906. In the instance of the carting boy employed in the pit the plaintiff had actually left his work and was on his way homewards, although he had not quitted the colliery company's premises. As the Court of Appeal has decided that the accident happened in the course of as well as proceeding out of the employment, the question arises as to where employment begins and where it ends. It is certainly impossible to say in view of this decision, which seems to place liability on an employer so long as workmen are to be found in or about his works. The second case is even of greater importance to employers, inasmuch as pre-disposition to illness is held to be no reason why compensation should not be paid in the case of accident. The Master of the Rolls, in giving his decision, quoted a judgment given with regard to a man who, while in a weak and emaciated condition, died of heat stroke in the stokehold of a steamer. It was then held that the fact that a man who died from heat stroke was by physical debility more likely than others so to suffer could have nothing to do with the question whether what befell him was to be regarded as an accident or not, and it was decided that the stroke was an accident which happened in the course of his employment. If, then, successful claims for compensation can be made by dependents in the case of workmen who are pre-disposed to illness, or who are liable to sudden death, it will soon become a question as to whether employers will, or will not, have to consider the advisability of introducing medical examination as an essential condition preceding the engagement of workmen.

The Rhymney Railway Boiler Explosion.

ENGINE No. 97 had just returned to the running sheds at Cardiff Docks on the 21st of April when it exploded violently. Three men were killed on the spot, and three others were injured. It was an eight-wheeled saddle tank goods engine, six-coupled, of considerable power. The circumstances of the explosion were peculiar, but in no sense mysterious. Briefly, there were two Ramsbottom safety valves on a cast iron "column" or manhole cover. The joint leaked, and a fitter was sent to re-make the joint. To do this he had to dismount the safety valves. He re-made the joint, put back the valves, and reported to the foreman. The engine was taken out next day and employed for a short time shunting. Then the pressure gauge indicated 200 lb., the hand pressing hard against the maximum stop.

There was plenty of water in the gauge glasses. Neither of the injectors would work. Next both the gauge glasses broke. The driver then took his engine back to the shed. Two men began to drop the fire and then the explosion took place. The facts that although the valves were nominally loaded to begin lifting at 145 lb., and to blow hard at 155 lb., they would not move; that the pressure was too high for the injectors, and that it split both gauge glasses, is apparently conclusive evidence that the boiler burst from over pressure. And yet the report which lies before us contains no less than thirty large pages closely printed containing the evidence given before the coroner's jury, with Mr. Carlton of the Board of Trade sitting as assessor. The jury brought in a verdict as follows:—"The deceased men were killed by the explosion of the boiler of an engine belonging to the Rhymney Railway Company, and that the cause of the explosion was, that the man left on the engine after the driver had gone from it, got the injector to work, and that the flow of cold water on to the already overheated plates suddenly generated a large amount of steam causing the explosion. They considered it purely accidental, and no one culpably to blame."

In order that our readers may understand what really happened, we give on page 171 a section of the safety valves. All Ramsbottom valves are fitted with a safety link to prevent the valves and lever from being blown away if the spring breaks. Washers of various thickness are used to regulate the tension of the springs, care being taken that the slot in the safety link shall be given a clearance of about three-quarters of an inch. It seems to be beyond question that the fitter referred to above, who was called away two or three times from the job, got muddled about the washers, and put the thick washer above instead of below on the central pin, and thus locked the valves hard down on their seats. There is nothing about the evidence to justify the verdict of the jury. That was the result of a surmise—nothing more tangible. The evidence was in certain respects confusing, inasmuch as some of the witnesses thought that there was evidence of overheating. The fire-box crown sheet weighed about 400 lb. The specific heat of copper is one-tenth that of water. That is to say, 10 lb. of copper cooled one degree would raise the temperature of a pound of water one degree, or 400 lb. of copper falling one degree would raise 40 lb. of water one degree. If we suppose that the crown plate was so far heated that it could part with 500 deg., a very simple calculation shows that it could convert 24 lb. of water already at 390 deg. Fah. into steam. Taking two cubic feet to the pound, we have a maximum production of 48 cubic feet of steam. These conditions assume that the plate must be red hot. No one attempted to say that it was. Indeed, neither of the lead plugs was melted or softened. But inasmuch as the injectors would not work, it is impossible to assume that water could have been got into the boiler. Our figures are only intended to show the very worst that could be brought about by a careful establishment of the necessary conditions, which certainly were not available. Mr. Carlton is emphatic on the question of overheating. He says: "I carefully examined the fire-box for overheating, but was unable to find any such indication. The lead was not melted in either of the two fusible plugs in the crown, there was no local bulging whatever between the boltheads in the crown, except at one place where a sling stay had been driven against the plate, and there was no discoloration of the metal. The soot was still adhering to the fire side of the crown plate, and the stay heads in the crown plate had the original bloom upon them which they obtained in the process of forging. Where the copper plate was torn transversely, it had a bright metallic lustre, and it was suggested that this was produced by overheating; but in my opinion it was produced by the manner in which the plate was torn, and an overheated plate would, I think, show a dull oxidised fracture rather than a lustrous one."

In certain respects the explosion was very instructive. The fire-box roof was carried by eight steel girders, into which were screwed 96 square headed stay bolts. The feet of the girders were bedded in the usual way on the tube and back plate. They were further supplemented by ten strap sling stays from the outer roof plate. The failure consisted in the driving down on the grate of the entire roof plate with its girders intact. The plate was ripped away all round from the side, back, and tube-plates. The girders must have deflected before the slings broke. Mr. Carlton calculates that these last had a united strength sufficient to carry 300 tons. Without going into minute dimensions, it appears that 100 lb. on the square inch put 109 tons on the crown, 219 tons for 200 lb., 327 tons for 300 lb., and so on. It is not at all improbable that the pressure had risen to 400 lb. or more at the moment of explosion. Nothing is more easy than to be wise after an event. It is worth while, however, to consider whether it is or is not possible so to make valves that they cannot be locked in error. This will always be possible while the adjustment depends on the use of washers of variable thickness. We cannot call to mind, however, any other railway explosion which was due to the locking of Ramsbottom valves by mistake. The overloading of such valves by putting shot into the cups and letting it get under the toes of the lever was common several years ago on the London and North-Western. The practice was stopped by Mr. Webb fitting his valves with a casing, and offering a reward of £5 to any driver who could overload one of these cased valves.

The precise mode of fracture of the plates in the Rhymney case deserves very careful consideration. We have no doubt but that it will receive it from Mr. Hurry Riches. It seems to indicate that the feet of the roof girders did not receive adequate support. The boiler was only made last year by Messrs. Hudswell, Clarke, and Co., Leeds. The working pressure was 160 lb., and it was twice tested by water to 240 lb. without producing any permanent deflection, and once with steam to 180 lb. It seems to have been very well made and of excellent material. Colonel Druitt entirely agrees with Mr. Carlton that the cause of the explosion was the fact that the safety valves were inoperative. That is also our conviction. No direct blame can, we think, be laid on anyone. It is more obvious than ever that engines should not be let out of the shed until the safety valves are known to be clear and to agree with the pressure gauges.

Double-beat Engine Valves.

It is not only Professors Nicolson and Callendar who hold that the distributing valves of steam engines leak. Indeed, it may be taken as almost universally admitted that hundreds of leaking valves are in existence. The whole question turns on the assertion that valves can never be made tight, which is in no way affected by the admission that they sometimes leak. A subsidiary question is, granting that leakage takes place, what is its amount, or in other words, what percentage of loss does it represent? Distributing valves are classed under two heads—beating, drop or puppet valves; and sliding valves, under which latter head are included piston valves, and various modifications of the Corliss type, as well as the normal slide valve. We have never yet met a practical engineer who maintained that the double-beat valve was absolutely tight; but we have met many who believe that slide valves are.

The reason why double-beat valves are not tight constitutes an interesting subject for study. There is no difficulty in grinding such valves into place dead tight, while hot; but this does not prevent subsequent leakage. The metal for the valve is taken out of the same ladle as that from which the valve chest or even the entire cylinder is cast, in order that the coefficient of expansion may be the same. In effect we have two discs on a rod and two seats for the discs in a box. When the valves are ground in, the distance between the valve faces and the seats must be the same to a very minute fraction of an inch. If it is not, one valve will be seated and the other will not. Suppose that the valve spindle expands more than the valve chest; then the bottom valve will be seated and the top valve will leak. On the contrary, if the chest expands more than the rod, then the top valve will be seated and the bottom valve will leak. It is evident that the smaller the distance between the two valves the less will they be affected by expansion. In practice double-beat valves are always made as short as possible, the central rods being replaced by a ribbed spider or a tube, usually cast in one with the two valves. It is unfortunate that minute accuracy is essential to tightness, for though it is not difficult to secure in the first instance, it is very hard to maintain in the second. The *Revue de Mécanique* for July contains an interesting study of the question by M. Lefer, who begins by asserting that while all well-made sliding valves in good order are tight, no double-beat valve ever is; and he ventures to say that the compound engine enjoys favour in France largely because the use of a second cylinder does much to neutralise the defects of the double-beat valve. He also points out that while no one ever sees a single-cylinder drop valve engine, single-cylinder Corliss engines are quite common, and well able to compete in economy with the compound engine. He contends that the top valve being larger than the bottom one, the effect of the steam pressure is to crush or shorten the valve, while further deformation is produced by the pressure of the steam inside the ring, which tends to expand it. Furthermore, the temperature of the valve and its seat vary continuously, and are never identical throughout a revolution, and it is impossible to provide for these changes of temperature when the valves are being ground into their seats. He goes on to add that if we withdraw and examine a double-beat valve which has been at work for some time we shall find evidence that it has been seating itself all right; but this evidence M. Lefer holds to be deceptive, in that it represents only momentary contact. He says:—"We have proved, then, that under the influence of pressure during the time the valve is closed it is crushed and shortened on the one hand, while on the other hand the valve seating is lengthened; and so it follows that it is practically impossible that the lower edge of the valve ring should rest upon its seat. The result is a leak, which is important, because the steam goes directly into the air or the condenser, and does no useful work."

In criticising these arguments it must be carefully remembered that the distances with which we have to do are extremely small. M. Lefer supposes, for example, that the shrinkage of the valve and the expansion of the valve chest leave the lower valve 0.1 mm., or, say, $\frac{1}{250}$ of an inch off its seat. We have, then, a space not greater than that of a sheet of very thin paper. Taking a valve ring with a lower diameter of 3.15in. and an upper diameter of 4.72in., he calculates that the loss by leakage would amount, with steam at 120 lb. pressure, to not less than 156 kilos. per hour, or for an engine indicating 128 horse-power a loss of 1.3 kilos., or nearly 3 lb. of steam per indicated horse-power per hour. We have not the least hesitation in rejecting the argument that the pressure in the valve causes deformation by crushing or compressing the valve. The load is comparatively small. The worst that it can do is force down the ring on the upper seat. The effective pressure comes to bear on the valve chest, and tends to force it away from the lower edge of the ring; but in any properly designed engine the parts are far too stiff and strong to be deflected. For the like reason we do not believe that the pressure inside the ring can distort the ring by enlarging it. When, however, M. Lefer speaks of the effect of temperature he is on much more certain ground. No doubt there is a continual change of temperature going on in the valve chest, while that of the valve remains fairly uniform, and the contractions and expansions which result may well make the accurate seating of the valve rings throughout the whole time the valve is closed doubtful. But, beside this, we have the almost certainty of distortion to consider. The valve ring, as a whole, alters its shape. In this connection we may refer our readers to the first report of the Steam Engine Research Committee, by Professor Capper, read before the Institution of Mechanical Engineers in March, 1905, and the discussion which followed it. It is clear that if the valve ring and its seats are inclined or mitred, any departure in shape from a true circle must cause leakage. For this reason, in the best modern practice—as, for example, the Lentz engine—the seats are flat and very narrow. Nothing in the way of distortion which can cause leakage is likely to take place in such a valve save a change in the distance between the two seatings, either in the valve chest or the valve. It is further to be remarked, as Professor Burstall pointed out in the discussion named above, that when superheated steam is used cast iron is peculiarly liable to distortion. It ought not to be impossible to produce a really satisfactory engine with single-beat balanced drop valves. These, with flat seats, ought to be quite independent of any change of form resulting from changes in temperature. Seeing, however, how well the piston valve worked by trip gear answers, it may be hardly worth while to spend time or money in improving the double-beat valve. It is also certain that even if it does leak a little, it is so cheap, lends itself so comfortably to trip gear of all kinds, and is mechanically so satisfactory, that it will probably only be wholly supplanted with great difficulty.

LITERATURE.

Steam Tables and Diagrams. By L. S. Marks and H. N. Davis. London: Longmans, Green and Co.

The difficulty experienced in giving an exact definition to the term "saturated steam" is widely known, and within recent years perplexity in this direction has given rise to doubts as to the accuracy of Regnault's results on its properties.

Basing their calculations on the researches of Dieterici, Joly, Grindley, and others, as far as saturated steam is concerned, and on those of Knoblauch, Thomas, and Henning with regard to superheated steam, the authors of the present volume have compiled a series of tables dealing with the properties of steam. A true estimate of the value of this book could only be obtained from an actual inspection; some idea, however, will be conveyed by an enumeration of its contents.

Saturated steam is dealt with in the first two tables, where the temperature, pressure, specific volume, density, heat of liquid, latent heat, total heat, internal energy, and entropy, will be found exhibited.

In the first table the steam temperature is taken as the independent variable, and values of the above quantities stated at intervals of 1 deg. Fah. from 32 deg. Fah. to 689 deg. Fah.

In the second table the pressure becomes the independent variable, and the figures given at intervals of 1 lb. from a pressure of 1 lb. per square inch to a pressure of 600 lb. The third table, which extends to 44 pages, gives the temperature, specific volume, total heat and entropy of superheated steam at all pressures from 1 lb. to 600 lb., and at intervals of 10 deg. in the amount of superheat over a range commencing at 10 deg. and finishing at 600 deg. Fah. Table 4 carries briefly the figures for the total heat and entropy of superheated steam over the range from 600 deg. to 2000 deg. Fah., and is intended to supplement the previous table. For thermometer calibration work, Table 5 gives the boiling points of water in English and metric units for pressures near that of the standard atmosphere, while Table 6 shows the thermal properties, such as density, specific volume, &c., of water over a wide range of temperature. Conversion and logarithmic tables bring the first part of the book to a close. In a pocket at the end of the book two charts are supplied, showing the total heat of steam plotted against its entropy in one and against its pressure in the other. The method of using these diagrams is explained in Part II., and the illustrative examples given show their utility and the wide range of problems to which they are applicable. The third and last section of the book treats us to a discussion of the sources of the tables and the methods of calculating and reducing the results.

The subject of steam calorimetry is at present attracting attention in various directions, and the advances being made are rapid, but this book will be found to embody all the most recent data on the subject, and is in every way most complete. It is carefully printed, and great pains have been taken in the arrangement of the matter so as to enable the figures required to be extracted with a minimum amount of trouble and chance of error.

SHORT NOTICES.

A Manual of Locomotive Engineering. By W. F. Pettigrew. Third edition. London: Chas. Griffin and Co., Limited, Exeter-street, Strand. Price 21s.—The third edition of this book has several new features, and it has been revised and in many instances new illustrations have been substituted for the old. Many of the illustrations of the locomotives given in Chapter II. have been renewed, and additional notes are given with reference to rail motor cars. The illustrations and particulars relating to the Belpaire fire-box in Chapter XIII., and the vacuum automatic brake in Chapter XVII., have been improved upon and brought up to date. Chapters XX. and XXI. of the old edition have been entirely omitted on account of American and continental practice being fully dealt with in so many books. Appendices A, B, and C have also been revised.

Carburetters, Vaporisers and Distributing Valves. By Edward Butler. London: Charles Griffin and Co., Limited. Price 6s. net.—The carburetter has probably received more attention at the hands of motor engineers than any other part of the internal combustion engine; in this book we find fifty-two different types of carburetters and vaporisers described and illustrated, and these, it is stated, are only to be regarded as representing various stages in the development of this all-important element in the anatomy of an internal combustion engine. For purposes of classification the author has divided his subject into groups dealing separately with surface and spray carburetters, automatic carburetters and vaporisers suitable for heavy oils. Of equal importance with the carburetter are the admission and exhaust valves and actuating gear; these next receive the author's attention, and his remarks thereon will be found suggestive by those who may be engaged on the design of these details. The descriptive matter in the book is clear and concise, and worthy perhaps of increased care in the execution of the accompanying diagrams.

Canada—Department of Mines—Mines Branch. Bulletin No. I.: Investigation of the Peat Bogs and Peat Industry of Canada during the Season 1908-9. By Erik Nyström and S. A. Anrep. Ottawa: The Government Printing Bureau.—The importance of the peat fuel industry to the central portion of Canada, where coal fuel is non-existent and its importation comparatively costly, requires no demonstration. The Mines Branch of the Department of Mines, Ottawa, issued a year ago a report on "Peat and Lignite: Their Manufacture and Uses in Europe," with the object of giving to Canadians as complete a review as possible of this industry in those countries in which it has been most successfully carried on. This report is now followed by a bulletin entitled "The Investigation of the Peat Bogs and Peat Industry of Canada during the Season of 1908-9." This bulletin comprises twenty-five pages of text, and includes six large scale maps of the following peat bogs:—(1) Mer Bleue, near Ottawa; (2) the Alfred peat bog, about 40 miles from Ottawa; (3) the Welland peat bog, about six miles north of Welland; (4) the Newington bog, on the New York and Ottawa Railway, and about 40 miles from Ottawa; (5) the Perth bog, a mile and a-half from Perth; and (6) the Victoria-road bog, about a mile from Victoria-road station on the Midland Division of the Grand Trunk Railway. The bulletin contains a descriptive report of each bog, showing the position, area, and structure, and giving an estimate of the available supply of peat fuel, with records of analyses, calorific values, &c. A fuel testing plant is now being erected at Ottawa, in which the value of peat for the production of power gas will be demonstrated, and the Department proposes to carry on a very thorough investigation of this subject.

INSTITUTION OF MECHANICAL ENGINEERS.

No. III.*

IN our last issue we brought the account of the excursions arranged for the members of the Institution of Mechanical Engineers during their recent stay in Liverpool down to the afternoon of Wednesday, the 28th ult. The whole of Thursday and Friday were devoted to visits. On the Thursday there were alternative excursions to the Walker Engineering Laboratories at the University, the dredger Coronation, the Docks, the Southport electrified railway, the workshops of the Lancashire and Yorkshire Railway at Horwich, and to salt mines and factories at Northwich. On the Friday there were alternative excursions to Chester and Southport.

WALKER ENGINEERING AND OTHER LABORATORIES.

In the Walker Engineering Laboratory building there is a large, well lighted, and ventilated main laboratory, containing a splendid equipment of appliances, including a Stirling boiler, a triple-expansion marine engine of 150 brake horse-power; a 60 horse-power Rateau turbine, coupled to a direct-current generator, the field magnet casing of which is mounted on ball bearings, and is used as a brake for the measurement of horse-power; a 15 horse-power de Laval steam turbine driving a high lift centrifugal pump which delivers water to a Pelton wheel. This water is measured in three different ways, namely, by a Venturi meter, by a rectangular weir, and by a V notch. Other apparatus includes a refrigerating plant by L. Sterne and Co.; a 24 brake horse-power National gas engine, with tube and magneto ignition, and means of varying the compression pressures for experimental purposes; an 8 brake horse-power Premier gas engine, gas producers, a Gardner paraffin engine, and air compressors. The testing appliances include a 100-ton Wicksteed machine, with alternative centres, cement testing, cross breaking, and impact machines. For the heat engine course the smaller experiments are carried out in the experimental laboratory on the first floor. This is fitted up with a Sirocco fan testing set, by Davidson and Co., Belfast, model boilers, fuel calorimeters, gas analysis, and other small appliances. On the third floor is the well lighted drawing-office. The chief applied mechanics laboratory is housed in a building in the quadrangle.

The George Holt physics laboratory, which Lord Kelvin opened in 1904, covers an area of 9600 square feet. In the basement there is a large workshop fully equipped with machine tools, and there are store rooms, a liquid air plant, furnace room, accumulator room, and rooms for research work. On the ground floor, close to the entrance hall and cloak rooms, are the doors of the large lecture theatre, a smaller lecture room, and a large laboratory for elementary students. This floor also contains the preparation room, the apparatus room, and a sitting room, office, and private laboratory for the use of the professor. The first floor is devoted to the instruction of senior students, and contains two large students' laboratories, four smaller rooms, suitable for optical and acoustical experiments, a student's workshop, library, and private rooms for demonstrators. The second floor consists entirely of research rooms of various sizes. The several floors are served by an electric lift, and all the rooms are lighted by electricity, and heated by low-pressure hot water.

The applied electricity laboratories were opened in 1905 by Sir Joseph Swan, and contain a lecture theatre, class rooms, library, laboratories, and test rooms. The most important laboratory is that used for testing dynamos and motors. It contains among other machinery a small Westinghouse gas engine, coupled to a dynamo, and used for lighting the laboratory, and the under truck with complete equipment of an electric tramcar. A self-exciting alternator, said to be the first of its kind built in this country, is worthy of special mention. Adjoining the dynamo room there is a workshop for the repair of machinery and other incidental work. In addition there are photometric laboratories, a high tension test room, with a 20,000-volt transformer, and a high-tension static machine, a standards room, and a range of special laboratories for research students. The laboratory is well equipped with all the essential electric measuring appliances, and a large battery of storage cells.

THE SAND PUMP DREDGER CORONATION.

The sand pump dredger Coronation has a length of 345ft., and a beam of 53ft. She has a capacity of 3500 tons, and is capable of loading herself from a depth of 60ft. in 50 minutes. The vessel was built by Vickers, Sons and Maxim, Limited, in 1904, and is fitted with twin screws and propelling engines of the triple-expansion inverted type. The pumps are centrifugal, and are driven direct by tripleexpansion engines.

THE NORTH DOCKS, LIVERPOOL.

To do much more than enumerate the places of interest visited during the excursion to the North Docks at Liverpool would be impossible in the space at our disposal. They were the Brocklebank graving dock and pumping station, the coal hoist at No. 3 Canada branch dock, the Canada graving dock and pumping station, the Huskisson pumping station, and the Sandon dock entrances. The Brocklebank graving dock was opened in January, 1906. It has a length of 804ft., and a width of 96ft. The depth of water on the sill is never less than 30ft. On high spring tides the depth on the sill is 44ft. The coal hoist at Canada branch dock No. 3 has a capacity of 300 tons of coal per hour. It was designed to coal vessels up to 88ft. beam at a maximum height of 40ft. above coping level. It is movable, and is worked by hydraulic power at a pressure of about 750 lb. per square inch. It's maximum load is 30 tons gross. The Canada graving dock was opened in 1899. It is the largest graving dock in the port, being 925ft. 6in. long, 124ft. wide at the top, and 94ft. wide at the bottom of the chamber. It has a depth of water on the sill varying from 30ft. to 44ft. The pumps are three in number, each 51in. diameter. They are of the "Invincible" pattern, and were supplied by Gwynnes, Limited. They are capable of emptying the dock of 34ft. of water in 1¾ hours. To deal with heavy loads a 40-ton hydraulic crane is provided. This can travel the whole length of the dock. In the hydraulic pumping station at this place the machinery consists of three sets of triple-expansion engines of the marine type with cylinders 15in., 22in., and 36in. diameter, with a stroke of 2ft. driving ram pumps. Two accumulators weighted so as to give the requisite 750 lb. pressure per square inch are provided, the stroke of each being 16ft. and the rams 17in. diameter. The northern group of docks from Hornby to Sandon inclusive are worked on the impounded system, that is, the water is not allowed to fall lower than the level of high water of a low spring tide. The half-tide docks, which are run down to the level of the tide of the day, serve as locks for vessels to pass in and out at high water. The Huskisson pumping station attends to the level of the water in the docks first mentioned. There are four centrifugal "Invincible" Gwynne pumps, three of 51in. and one of 54in. diameter. All these pumps are driven by vertical compound steam engines. The Sandon dock entrances, together with the half-tide dock, were designed to afford a means of communication between the river and the docks south and north of them. They are 100ft., 80ft., and 40ft. wide respectively. Each is provided with two pairs of gates to form locks for the use of smaller craft between tides. The sills of the 100ft. and 80ft. entrances are 20ft. 6in., and of the 40ft. entrance 16ft. below Old Dock Sill datum. The two wider entrances have a depth varying from 30ft. at high water of low neap tides to 41ft. at high water of equinoctical spring tides. The gates are constructed of greenheart throughout, and are worked by cross chains attached to hydraulic rams.

THE LIVERPOOL-SOUTHPORT ELECTRIC RAILWAY.

The Liverpool-Southport electrified railway was so fully dealt with in our issues of 18th March to 15th April, 1904, inclusive, that it will not be necessary to make further reference to it here.

HORWICH LOCOMOTIVE WORKS.

This is the second occasion on which the members of the Institution of Mechanical Engineers have had an opportunity of visiting these fine works. The first was when the annual summer meeting was held in Manchester in 1894. Since that time certain extensions have taken place. These include a new heavy machine shop, a tinsmiths' shop, the boiler-house for Lancashire boilers, and the motor shop. The last named shop was formerly used for telegraph work, which is now carried on in the gallery of the stores. The building of the works was commenced in 1886, the land enclosed for the purpose measuring 116 acres, of which over 22 acres is covered by workshops. For the carriage of materials between the various departments there are 7½ miles of tramway lines, and the haulage is performed by small locomotives with cylinders 5in. by 6in., and wheels 16in. diameter. These work at a pressure of 200 lb., their tractive force is about 1400 lb., and their weight when full 3.57 tons. The boiler shop, which is one of the largest buildings in the works, is 439ft. long by 111ft. wide, and contains a splendid equipment of appliances. There are a pair of hydraulic pumps and an accumulator, two large fixed hydraulic riveters for boiler work, each having a hydraulic overhead crane for lifting boilers; three portable hydraulic riveters on swing cranes bolted to walls and columns, and overhead electric travelling cranes. The tools include a quadruple multiple stay tapping machine, right-angle plate edge planing machine, pneumatic caulking and riveting tools, and an electrically-driven multiple drill with twenty-eight spindles, which drills five thicknesses of plates simultaneously, thus enabling 140 holes to be drilled at one setting. Most of the rivet-heating furnaces are fired by liquid fuel, which is sprayed on the fire by compressed air. The boiler shop smithy is 120ft. long by 111ft. wide, and contains the usual smiths' fires and hydraulic presses. The forge measures 452ft. by 111ft., and contains Siemens regenerative furnaces for re-heating, the doors of which are raised by pneumatic means. In addition to the various mills this shop contains a 35-ton duplex hammer, and one 8 ton and two 5-ton hammers.

The steel foundry is 150ft. long by 135ft. wide, and is fitted with Siemens-Martin regenerative melting furnaces, heated by gas from Wilson's producers. The furnaces have a high level tramway for carrying the ladle, and a narrow gauge tramway beneath for the mould trolleys. The "Tropenas" process for making steel castings is also in use. The ironfoundry measures 212ft. by 111ft., and is served by both hydraulic and electric cranes. A separate building is devoted to the casting of chairs, and measures 124ft. by 128ft. In this shop a staging is provided for fettling the chairs, which are then placed on an endless chain to be conveyed to the railway wagons for dispatch. In the carriage and wagon wheel shop the members saw the lathes for turning and boring wheels, a hydraulic press for tires, and a second press for forcing the wheels on to the axles. A special multiple drill for making holes in the retaining rings, wood blocks, and steel wheels at one setting was also noticed.

After glancing through the smithies, signal and points and crossings shop, the next large shop traversed was that for the fitters, which is 508ft. long by 111ft. wide. This is provided with a large number of milling and other machines for dealing with locomotive work, including several automatic machines and turret lathes for turning copper fire-box stays, bolts, pins, &c., also drilling and slotting machines. These machines are driven by wall engines bolted at the end of the shop, and giving motion by means of bevel gearing to four ranges of shafting running longitudinally. Four 5-ton high-speed electrically-driven jib cranes are provided to serve the tools.

The boiler-house contains a battery of Lancashire

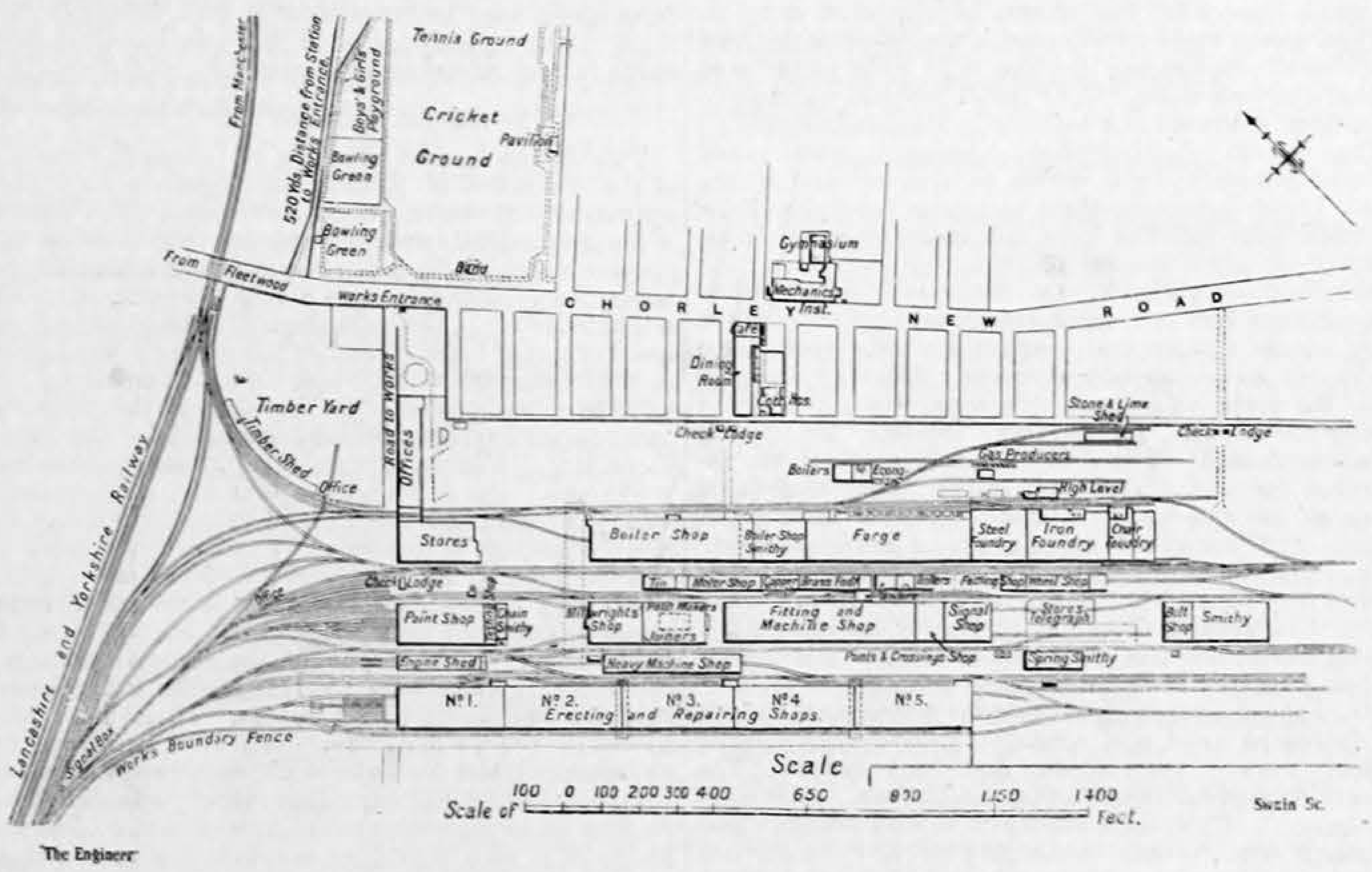
* No. II. appeared August 6th.

boilers with underfeed mechanical stokers and Green's economisers. The central power station is equipped with two 300-kilowatt Belliss and Morcom high-speed engines and dynamos, and four sets of 60-kilowatt capacity to generate current at 250 volts. A large portion of the works is supplied with power and light by this plant. In connection with the power station there is a barometric condenser by the Mirrlees Watson Company, which deals with the steam from several other engines of large capacity. Passing by several minor shops, we come now to the heavy machine shop, which is 360ft. long by 48ft. wide, and contains the necessary tools for dealing with frame plates, cranks, pins, &c. Many of these machines have been specially designed for particular work, and all are driven by separate 3-phase alternating-current motors. Two 10-ton three-motor electric overhead cranes serve the various tools.

The erecting shop is by far the largest in the works. It is 1520ft. long by 118ft. wide, and is served by twenty 30-ton electrically-driven overhead travelling cranes. There are portable hydraulic riveters, flexible shaft drilling machines, operated by motors, and other tools. Access for engines to the centre portion of the shop is obtained by two electrically-operated traversers. Wheel lathes, some electrically driven, are provided for dealing with wheels taken from engines under repair. Other shops, not hitherto mentioned, are the paint shop, the test shop, and the chain smithy. The latter shops are fitted with a 100-ton hydraulic testing machine, oil spring and chain testing machines, steam hammer, &c. The accompanying plan of the works will assist our readers in following the foregoing brief description.

In connection with the visit to Horwich, the members were entertained to luncheon by the directors of the Lancashire and Yorkshire Railway.

Sir George Armytage, in proposing the toast of "The Guests," said that he had always had the feeling in his mind that it was a good thing for a railroad company that its general manager should, like Mr. Aspinall, be an



PLAN OF THE HORWICH LOCOMOTIVE WORKS

engineer. That example, he noted, was being followed by other companies, and it was the right course to pursue. It was very important that every question coming before a general manager should be considered in all its aspects, both engineering and commercial. They had that day visited the electrified lines of the Lancashire and Yorkshire Company between Liverpool and Southport. That scheme was due to the initiative of Mr. Aspinall, and he was glad to say that the company had been able, by reason of the adoption of electric traction and the much better use of its terminal facilities which followed that, to carry an enormous number of passengers, and thereby to postpone for a considerable period large capital expenditure which would otherwise have been necessary.

The members were served with tea in the Mechanics' Institute, a large building which was built chiefly out of a grant of £5000 by the shareholders in the Lancashire and Yorkshire Railway Company. We have previously referred to the good work done in this Institute in the education of the apprentices of the company and the youths of Horwich.

THE SALT UNION WORKS, WINSFORD.

THE members who availed themselves of the invitation of the Salt Union, Limited, to visit the huge salt works at Winsford had an excellent opportunity of comparing the production of salt from the brine by the old and new methods, namely, by means of coal-fired open pans and by vacuum evaporators. The company's works in this district extend for a distance of about three miles along the river Weaver, and find employment for practically the whole of the adult male population of Winsford and many females. The Union embraces nearly all the salt works in this district, some of which bear traces of old age, and afford a remarkable contrast with the modern works and plant which have been erected within the last four years. Some idea of the output of the Winsford works can be gathered from the facts that the Salt Union owns some thirty-eight steam and some sixty ordinary barges, each capable of carrying from 200 to 250 tons of salt, and that all of these are kept in constant service along the river Weaver and the Manchester Ship Canal. The company has its own slips for building these vessels, and the engines and boilers are built in its own engineering works.

The brine is pumped up from a depth of about 150ft. by pumping engines, of which there are fifteen distributed about the Winsford works. A typical pumping plant, however, was viewed by the members and consisted of a pair of pumps operated by rocking beams driven by spur gearing from a compound vertical steam engine. This is capable of delivering 16,320 gallons per hour. The brine is stored in huge reservoirs, and from these it gravitates to the open pans or to the vacuum apparatus. It contains 26 per cent. of $NaCl$ (salt), and a certain amount of calcium sulphate ($CaSO_4$), and magnesium chloride ($MgCl_2$). In the old process of evaporation underfired open wrought iron pans, measuring 80ft. by 30ft. by 2ft., are employed, and the amount of fuel used is about ½ ton per ton of salt produced. The salt made is classified and sold according to the size of the crystals, which depends on the temperature of evaporation. The temperatures at which the different kinds of salt are produced are generally as follows :—

Butter and domestic (fine salt)	226 deg. Fah.
Common (medium salt)...	185 ,, ,,
Fishery (coarse salt)	145 ,, ,,

The salt is raked by hand to the sides of the pan periodically, and is either shovelled out to drain on "hurdles," or is deposited in boxes to form the rectangular blocks of commerce. These blocks are afterwards transferred to a drying chamber, which is usually on a level with the floor of the pans, and is heated by the waste heat from the pan furnaces.

In his paper—No. 3725—read before the Institution of Civil Engineers, Mr. P. M. Pritchard gives 226 deg. Fah. as the temperature at which saturated brine boils under atmospheric pressure. In a vacuum of 28in. the boiling temperature is, however, reduced to about 140 deg. Fah. Evaporation in vacuo, therefore, enables low pressure steam to be used, and gives a much greater temperature difference, with a correspondingly increased duty per unit of heating surface of the evaporator tubes than is possible with evaporation at atmospheric pressure. By multiple effect evaporation great economies can be made in the amount of steam necessary. The vacuum evaporators at Winsford work on the triple-effect principle. The chief point of difference between the evaporation of brine and that of other liquors is that in multiple-effect apparatus each unit is supplied with brine independently of the others, and graining takes place in the pans, whereas in concentrating liquors the latter are fed from the first effect to the second, and from the second to the third. Provision has also to be made in each effect for the removal of the salt as it is produced. The pans at Winsford are about 56ft. in height overall and 18ft. diameter, and the output is 15 tons per hour. The brine enters the apparatus at about 12in. above the upper tube plate, the steam being efficiently distributed among the tubes by a steam belt or annular passage. The tube plates are 18ft. diameter, and each "effect" contains some 2500 copper tubes 2⅜in. diameter and 4ft. 6in. long. The steam dome of the first effect is connected to the calandia of the second, the steam dome of which is in turn connected to the calandia of the third. The steam from the latter goes to the jet condenser, just as in any ordinary multiple-effect evaporator. The salt as it is formed gravitates into the elevator boot at the bottom of each effect, and is elevated by buckets of special design, so as to give a clean discharge when these reach the top of the elevator. The body of the latter is jointed to the down-take of the effect, thus providing a water seal to exclude air.

In the building containing the vacuum pans nothing but timber is employed for the staging and supports, owing to the injurious action which salt has upon metals. The building is provided with 10-ton overhead travelling cranes for repair work. On the top platform is arranged the driving gear for the elevators, which deliver the salt by means of chutes into a storage building. There are also a line of shafting for driving the circulating propellers for the pans, and a water tank for the condensing water. On the next floor below are the open tops of the deep wooden bins for receiving the salt. The floors of these bins are built of wood laths to allow the water to drain away, while doors are provided to enable the salt to be removed. On the third floor from the top is situated the engine which drives the elevators. Such an apparatus requires a number of pumps for the supply of brine and condensing water, air and vacuum pumps, and a considerable amount of steam is required. The boiler-house for the vacuum plant contains a battery of seven Lancashire boilers, fitted with Green's economisers ; some of these boilers are now being removed and are being replaced by Stirling water-tube boilers. The boiler-house has an equipment of recording pressure gauges, chimney draught gauges, pyrometric apparatus, and gauges for recording the temperatures of the chimney gases and a CO_2 recorder.

The salt which has to be dried for packing in bags is treated in a building adjoining the vacuum plant house. It is taken up from the stores by rubber conveying belts fitted with buckets to a floor above, and is delivered into a revolving inclined cylindrical vessel, in which it is dried by air passing over coils of steam piping. From the drier the salt is taken by a conveyor, which delivers the fine salt after separating the lumps. The visitors could not fail to be impressed by the mountains of snow-white salt stored in the admirably clean buildings. It may here be stated that improvements are constantly being carried out to bring the plant up to the highest pitch as regards production and quality of the output by the company's engineer, Mr. G. W. Malcolm, M.I. Mech. E., and an order has been placed with the Mirrlees Watson Co. for another complete triple-effect vacuum plant to make 25 tons of salt per hour, steam for which will be supplied by five Stirling boilers, each capable of evaporating 22,500 lb. of water from and at 212 deg. Fah. It is also intended to do away with fifty of the small steam power plants at present in use at saw-mills, brine pumps, fitting and wagon shops, &c., and to substitute one large electric power plant for the distribution of electrical energy, which will be generated by the steam at present used direct in the vacuum plant. Instead of passing from the boiler direct to the pans, it will be used in the power plant engines first, and then pass on at atmospheric pressure to the first effect of the vacuum plant.

Here every year some 15,000 tons of salt are packed in 1d. and ½d. packets. The works comprise grinding and packing rooms, paper bag and box-making machines. Scrupulous cleanliness is observed, and the salt finds its way to the consumer's table without having been once touched by human hand. A packet of Falk salt was handed to each visitor at the vacuum plant as a souvenir.

The Salt Union's mine at Northwich, which the visitors afterwards inspected, covers an area of 18 acres, and is situated 303ft. below the surface of the ground. It is of crescent shape, with no galleries, the roof being supported by pillars of salt 30ft. square and spaced 75ft. apart. All the salt is got by hand, with the exception of the work which is done by means of compressed air under-cutters. At Anderton, near Northwich, the members were enabled, through the courtesy of the River Weaver Navigation Authorities, to make an ascent in the boat lift which connects the river Weaver with the Trent and Mersey Canal. We must refer our readers to the issue of THE ENGINEER dated July 24th, 1908, for a full description of this lift, which was converted by Mr. Saner from hydraulic to electrical operation. It may, however, be stated that since conversion it has worked with the utmost satisfaction. The two caissons have made no fewer than 14,869 operations, and the tonnage of vessels dealt with is 211,071. The maximum number of strokes in twelve hours is 102, and the maximum number of boats in twelve hours 147.

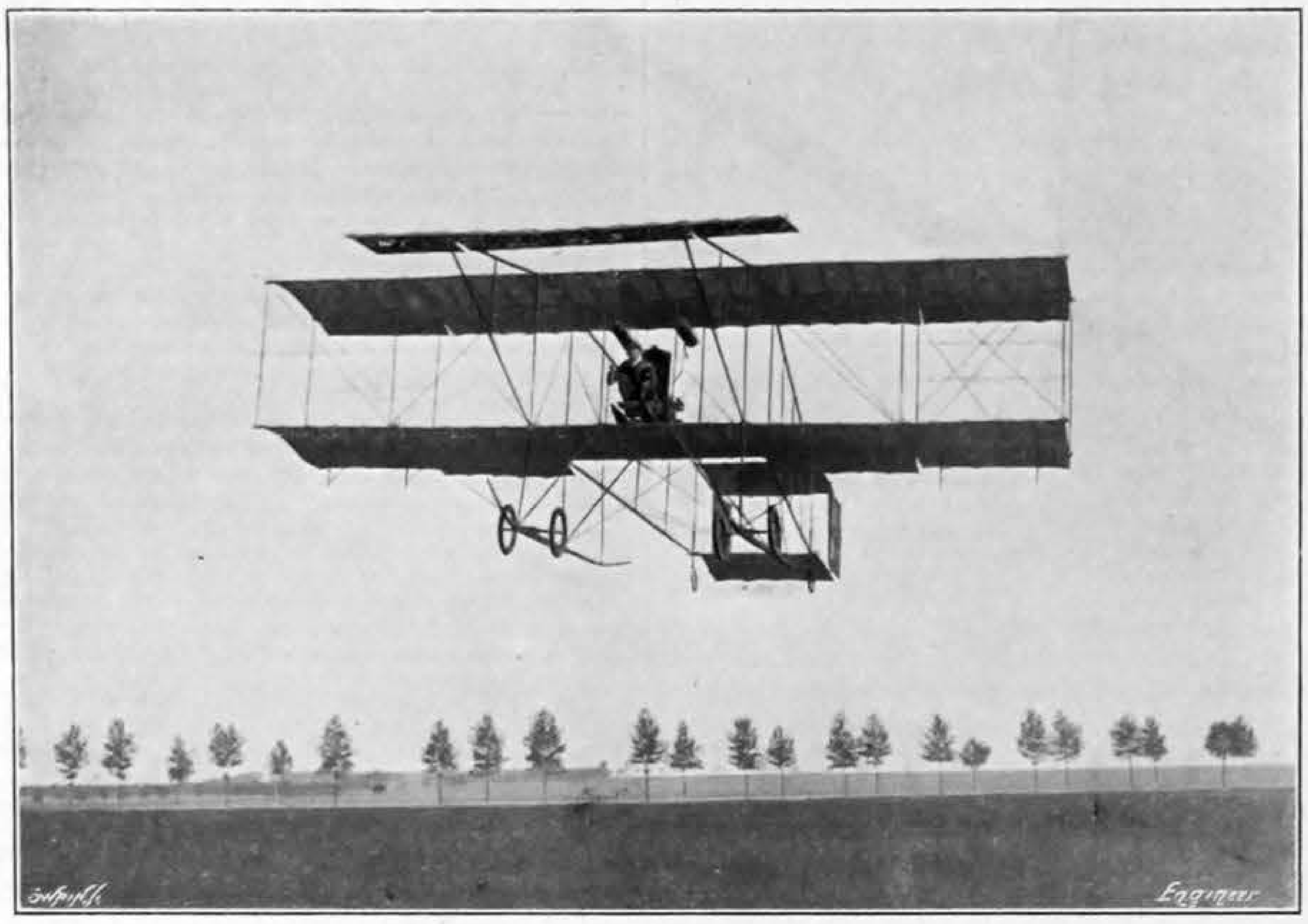
OTHER VISITS.

During the visit to Chester on the Friday, an opportunity was given for visiting the works of the Hydraulic Engineering Company, where amongst other things seen was the casting of a large accumulator cylinder, to take a ram 20in. diameter by 23ft. stroke. The city walls and the Cathedral also claimed attention, while in the afternoon a visit was paid to Iron Bridge. The objects of engineering interest in Southport are more or less limited, but as the Royal Lancashire Agricultural Society's Show happened to be held at the time, those members who made this excursion had an opportunity of visiting it.

During the continuance of the meeting, the members of the Institution had invitations to visit a large number of works, not only in Liverpool and Birkenhead and places already mentioned, but also in Garston, Prescot, and Preston.

OIL TRANSFORMER EXPLOSION.—Referring to the partial destruction by fire of the station of the Trinidad (Col.) Electric Light and Power Company, the *Electrical Review* states that the total loss was somewhat under £20,000, and that the fire was primarily due to the arcing over of a rotary converter, which short-circuited coils in three oil transformers installed on a wood floor in the same building. Probably owing to low oil, an explosion took place in the case of one of the transformers, which blew the top off, rent holes in the side and scattered burning oil over the wood floor. Within a few minutes the engine-room was untenable, and by the greatest effort only were the fires drawn under boilers and danger of explosion averted before the boiler-house roof fell in. The fire department was helpless when it did arrive, as oil had been by that time blown about from all the transformers in the station. The switchboard was dropped through to the basement. The new high-tension portion of the station was not cut off by a fire wall, and was completely destroyed. The only pieces of apparatus in the entire station not seriously injured were the boilers, two steam turbine units and the storage battery, which latter was only partially cut off, and suffered considerable damage from broken plates and jars. No insurance policies were in force, as upon the reorganisation of the company a few years ago the risk was re-rated with increases owing to a wood floor in bad condition, oil transformers on a wood floor, and large masses of combustible insulation beneath the wood floor, from generators to switchboard. As a consequence the company decided to do its own insuring.

MONSIEUR R. SOMMER ON HIS AEROPLANE



THE RECORD AEROPLANE FLIGHT.

Early last Saturday morning a world's record in the matter of time for an aëroplane flight was established at Chalons, in France, by M. Roger Sommer. The aëronaut, who is a pupil of M. Farman and who was flying in a machine of the biplane type constructed by the latter, commenced his flight at 3.14 a.m., and remained in the air until 5.41½ a.m. He thus flew for 2 h. 27 min. 15 sec., and has, therefore, broken the previous time record of 2 h. 20 min. 23 sec. held by Mr. W. Wright. It is reported that M. Sommer was compelled to descend to the ground after his flight on Saturday by his petrol supply giving out; other aëronauts have recently found their flights hindered by the same cause.

M. Sommer's flight is all the more remarkable when his previous occupations and training are taken into consideration. Originally a manufacturer of felt, he turned his attention to flying early this year, and until a month ago he had made no successful flights. The weather conditions on Saturday were very favourable for his purpose, an entire absence of wind greatly helping towards success. After running along the ground for about fifty yards, the aëroplane, which is provided with a six-wheeled landing chassis, rose to a height of about 50ft., and, circling over the military manœuvring ground, remained at this average height until the end.

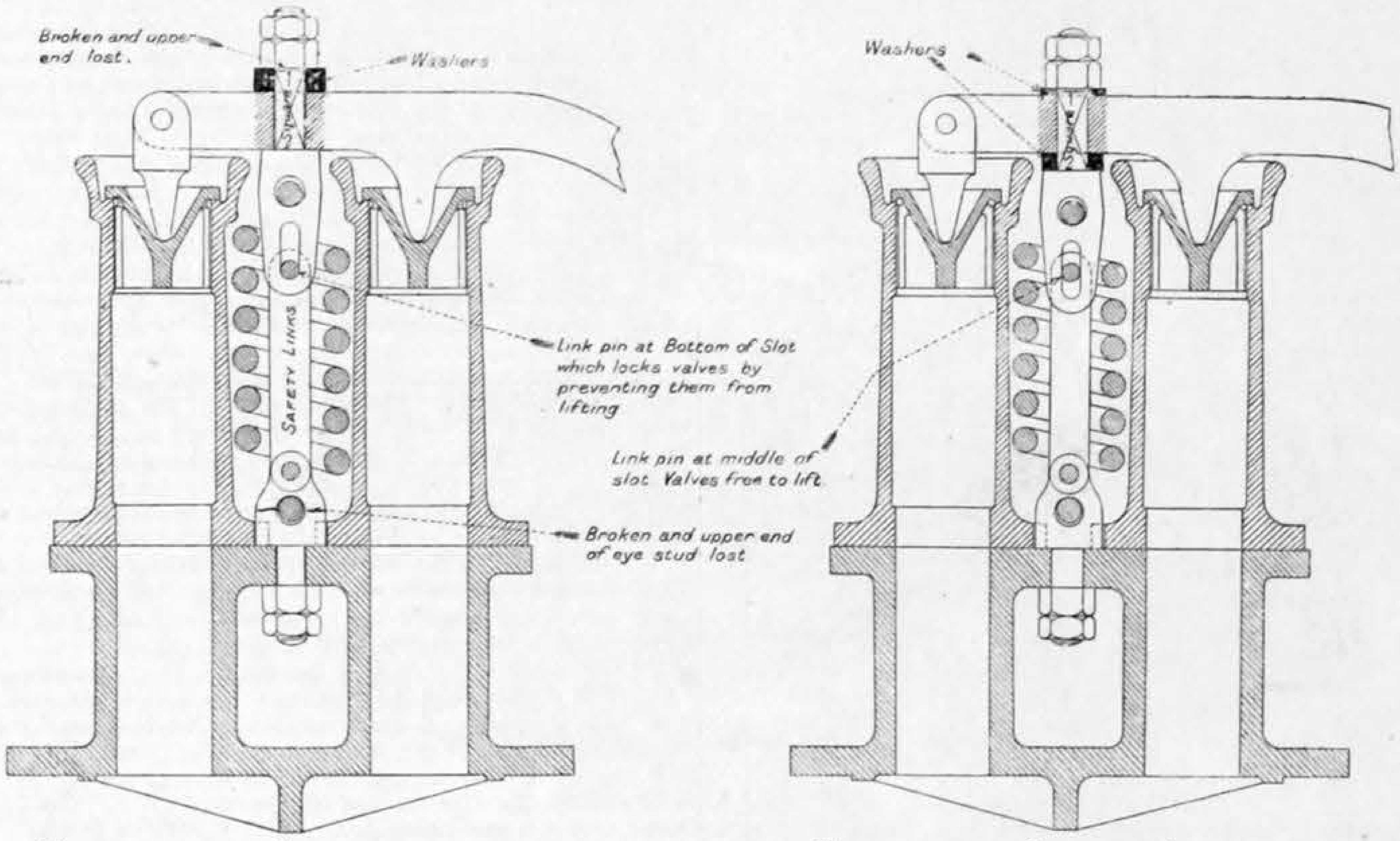
M. SOMMER IN HIS DRIVING SEAT

A minor accident is reported to have occurred shortly after the commencement of the flight. Some of the material forming the lower plane became loose and threatened to bring the machine to the ground, but the propeller blades catching on it removed it and permitted the aëroplane to rise again.

During the carrying out of a second flight on Sunday night the motor of the machine gave some trouble, and finally caused it to fall to the earth from a height of 25ft. Although the aëroplane itself was completely smashed, M. Sommer escaped uninjured. We are enabled to reproduce in the accompanying engravings two views connected with the latest aërial achievement. One shows the machine in the air during Saturday's flight; the other, from which some details of the construction of the machine may be gathered, shows M. Sommer seated in the chair ready to take flight.

THE RHYMNEY RAILWAY LOCOMOTIVE BOILER EXPLOSION.

We have commented fully in another page on the collapse of a fire-box on the 21st of April on the Rhymney Railway. The accompanying sections explain themselves. We reproduce them from the Board of Trade report. It will be seen that the putting of a thick washer above the lever instead of below it locked the valves down hard on their seats.



View showing Valves locked by Safety Links. — Position of Safety Links at usual working pressure.

The Engineer. Swain Sc.

SAFETY VALVE ON THE RHYMNEY RAILWAY LOCOMOTIVE

THE EUSTON TO WATFORD ELECTRIC RAILWAY.

The new line from Euston to Watford, under or alongside the present railway, is now well in hand. Power to make it was obtained by an Act of July 26th, 1907—the 7 Ed. VII., cap. 87. Whatever progress may have been made with the underground sections, at present the works begin to be visible, coming from London, just before the Midland Company's Acton Wells branch is reached. This point is nearly six miles from Euston. The new railway is on the north side of the main line; it is just behind the houses of Harley-road, Harlesden, and passes under the Midland embankment by a single arch, turned in blue brick. The arch is somewhat on the skew. A similar arch, but not skew, almost immediately follows, and is formed under the Acton-road. The line then keeps below the level of the sorting sidings, between them and the houses of Mordaunt-road and Milton-avenue. The shunting yard being made ground, considerably above the natural surface, a retaining wall of blue brick has been built for a considerable distance on its northern side. At the foot of the wall is the site of the new line. A temporary line of rails, with a passing loop at the Acton-road, is laid along it, by which the spoil from the tunnel is carried away. At the end of the shunting yard the line comes out behind the car sheds of the Metropolitan Electric Tramways, Limited, and will be upon an embankment of moderate height. This is partly tipped just here, and carries the temporary line across the Stonebridge to Alperton footpath. There is also a surface line just beyond, but it only leads up to the contractor's engine shed, on the level of the coal sidings. The embankment a little farther on is finished, and leads on to a two-arch bridge, the first arch spanning a new roadway and the other the river Brent. Both arches are of about 40ft. span. The whole work is in blue brick, and of rather neat elevation. At this point the new line is some 300 yards east of the old one, or, rather, from the last widening of it. A very little way beyond this short viaduct, as it may be termed, a cutting begins, and takes the line on to the point where it is carried under the whole of the old roads, so as to bring it to the down or western side. The passage is effected by a girder bridge, sharply on the skew, divided by a pier wall of blue brick. Curving round at as little distance as need be, the line comes to the present railway level at the south end of Sudbury and Wembley station. A long iron foot-bridge, leading over the fields from Wembley to Alperton, is being lengthened considerably to cover the new line close to where it emerges from beneath the fast roads, which at this point form the original railway of 1837.

So far as Sudbury station, the contractors for this work are Messrs. Monk and Newell, of Liverpool, but north of it Messrs. Naylor Brothers, of Huddersfield, are in charge. Additional platforms will be provided at Sudbury, and another opening made under the Harrow-road bridge. This work is in hand, as well as a widening of the bridge on the north side, long badly wanted in view of the growth of the district. The gardens of several houses will be abbreviated at the back of the station, and a few more to the north of it, whilst one or two houses have had to come down. There is enough room for the two extra roads under the Great Central Railway bridge. The contractors have their workshops and office just beyond this, abutting on the line, and an engine shed. From here the work is described in the Act as Widening No. 2 and continues on the down or west side, at about ground level, to East-lane bridge. Here there will be a new station, to be called East-lane, which will accommodate a rapidly rising neighbourhood. The widening will be carried under the bridge. Both the bridge itself and the approach to it on the station side will be broadened to 40ft.

Some nursery gardens come next to East-lane and will be invaded to some extent, as well as the back premises of a few houses beyond, but for about a mile after this not much is yet done. From the crossing of the Metropolitan Railway, where the cutting gets deeper, a large force of men, with two steam navvies, is at work down to Kenton-lane overbridge. There is already a vacant arch under the Metropolitan, so that only excavation is required there, but Kenton-lane bridge will require an extra span, and is being broadened to 40ft. Here also a new station will be erected, called Kenton, to serve the new villas on the Northwick estate. The cutting here is about 15ft. deep, but is considerably more nearer London, and the clay formation necessitates a very flat slope. An iron footbridge further on is being lengthened, the new flight of steps being of blue bricks outside. A bridge over a narrow lane leading to the Harrow Urban District Council's sewage farm has been widened with girder work, with blue brick wing walls, and a short bit of embankment tipped.

This brings the new line to Harrow station, still keeping on the down side. The over-bridge here—now a very busy thoroughfare—will be lengthened at the east end and widened as well. It is considerably on the skew. On the west side the foundations for the wing walls are already in. On the east a steam crane is at work fetching up the clay, which is carried out in hand trucks on a narrow-gauge line to widen the Stanmore branch or provide an extra siding alongside it. At Harrow, of course, new platforms and buildings will be required for the electric line, but nothing has been done yet, nor are any works in progress further on. They will be light enough—as far as Bushey, at any rate.

A large piece of ground is being got out at Kenton-lane, on the up side of the line, for a goods and coal yard. A similar piece is staked out for a like purpose at East-lane, north of the bridge, and opposite the nursery gardens. This is mostly at about rail level, though the far end begins in higher ground, near Wembley cutting signal-box.

A great improvement during 1908 in the Helsingfors tramway system can be reported, i.e., the extension of the single track to double lines throughout the town, with the exception of some short distances.

A NEW COUPLING FOR HOSE PIPES.

Some simple but effective couplings for flexible hose pipes have been brought to our notice by the firm of Livett, Frank and Son, Limited, of 22, Borough High-street, London. As will be gathered from the illustration—Fig. 1—and from the section—Fig. 2—they comprise parts forming male and female

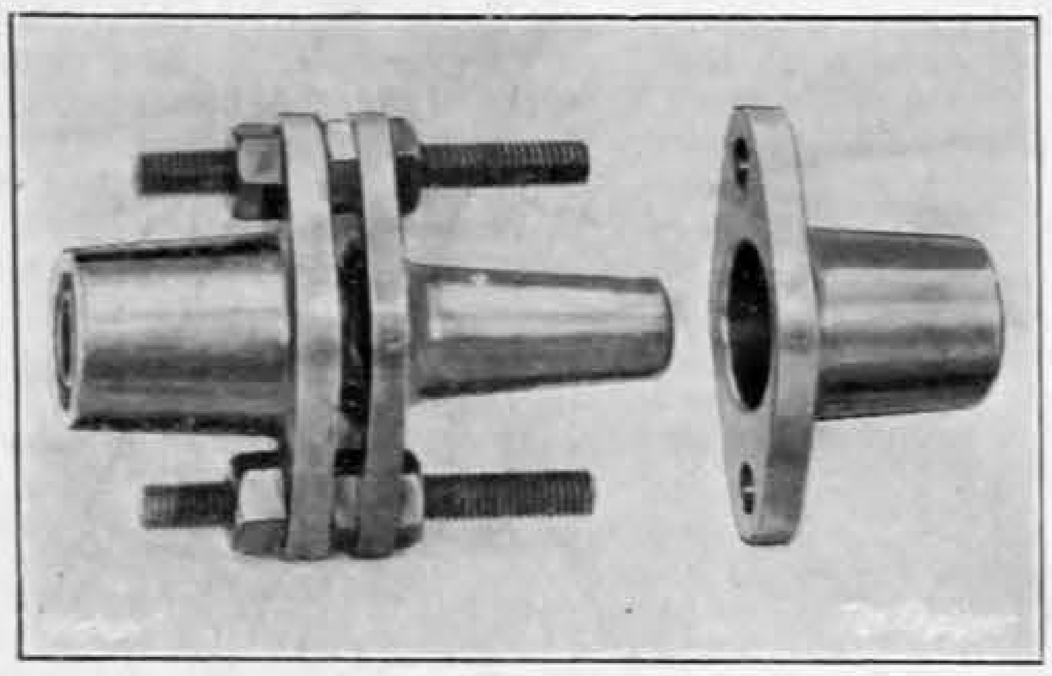


Fig. 1—THE LIVETT HOSE COUPLING

connections. The spigot forming the male connection has two tapered portions over which flanged sockets or glands fit, the bore of these sockets also being coned to correspond with the spigot. It will also be noticed that the double spigot is provided with a central flange, in which holes are bored to receive the bolts for drawing together the flanged sockets. In this way the parts are securely connected together, and any movement of the central spigot relative to the flanged sockets is prevented. In order to connect two lengths of hose pipe together, the sockets are first threaded over the pipes. Then the ends of the spigot are introduced into the

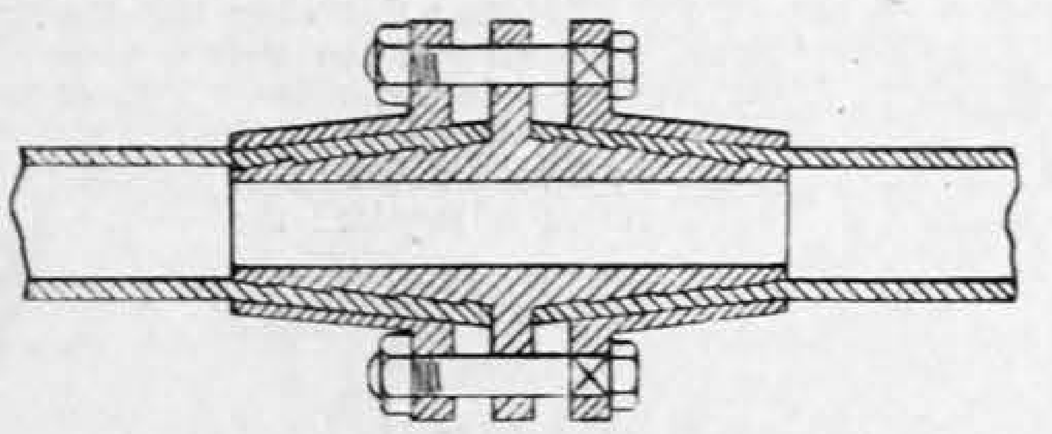


Fig. 2—SECTION OF HOSE COUPLING

pipes, and the sockets drawn towards the centre flange by means of the bolts. The spigot and sockets thus act as a clamp, and grip the ends of the pipes, thereby forming a tight joint. The coupling shown in Fig. 3 is suitable for connecting a hose to a service or other pipe, the spigot portion being screwed at one end. It is claimed that these

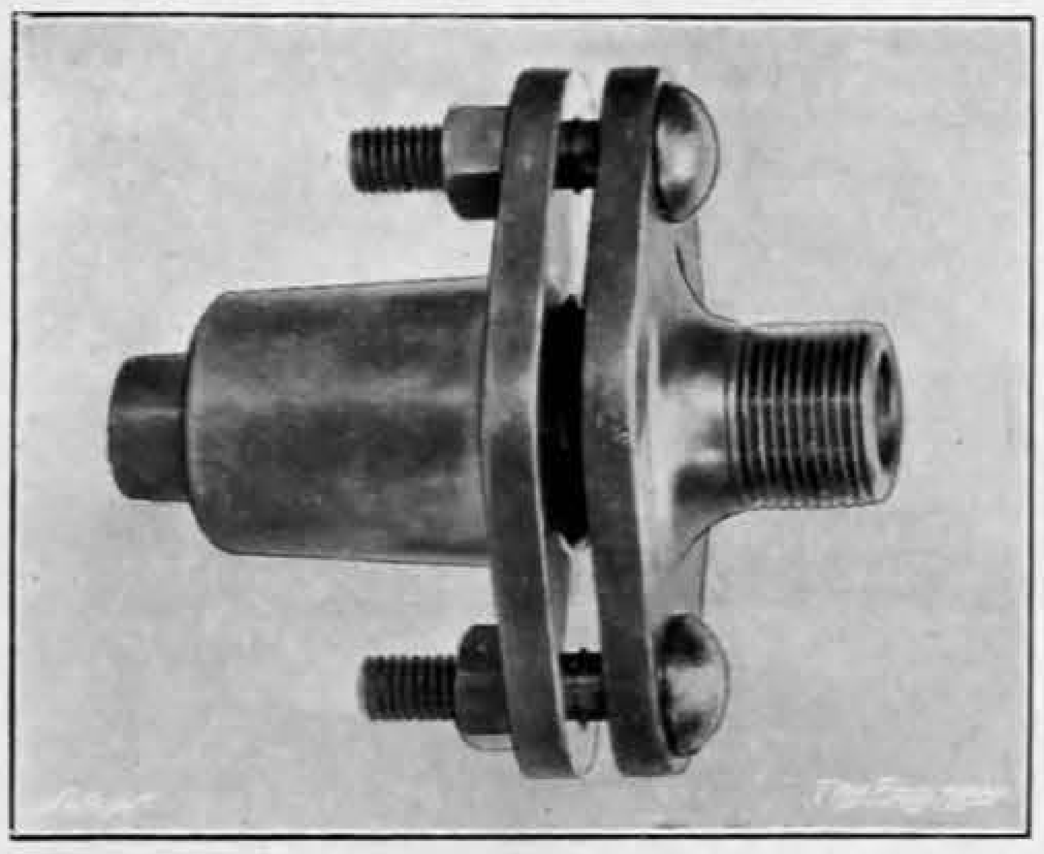
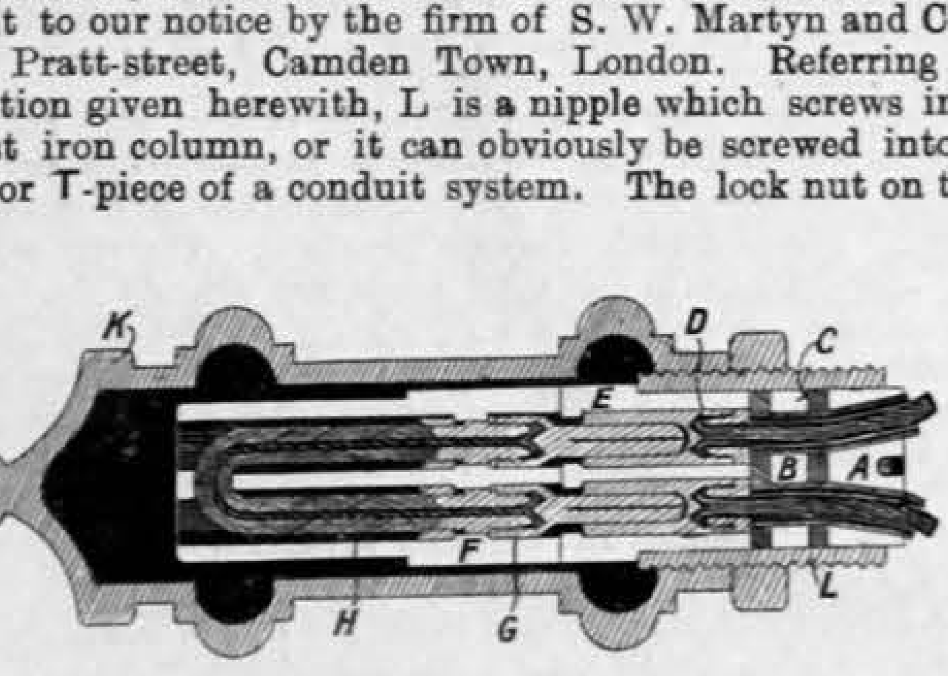


Fig. 3—HOSE COUPLING WITH SCREW ATTACHMENT

couplings ensure an absolutely tight joint, and that they are suitable for all pressures of gas, steam, air, and water.

AN IMPROVED FUSE.

A water-tight fuse for which several advantages are claimed, and which, among other things, is designed for use when gas lamp standards are wired for electric light, has been brought to our notice by the firm of S. W. Martyn and Co., of 11, Pratt-street, Camden Town, London. Referring to the section given herewith, L is a nipple which screws into the cast iron column, or it can obviously be screwed into a socket or T-piece of a conduit system. The lock nut on the



SECTION OF THE FUSE

nipple prevents the fuse from working loose. The wires are brought through the porcelain piece A, the rubber disc C, the porcelain disc B, and finally through another rubber disc to the left of B. The wires are then connected to the terminals D by means of cone joints in the manner shown. A brass wire clip with nuts embedded in the porcelain piece E presses these porcelain parts together, and expands the rubber discs against the inside of the nipple L and against the wire, thus making a water-tight joint. The fuse wire is enclosed in an asbestos tube H, which in turn is enclosed in a porcelain tube F. The ends of the fuse wire are joined by means of cone joints to split pin terminals G, which are fastened in the porcelain piece F as shown. Thus the fuse block can be withdrawn like a wall plug. A cast iron cover K fits over the various parts and screws on to the nipple L, a hexagon head being provided at the outside end to receive a spanner. Fuses of this type are made to take currents up to 15 ampères at 650 volts. Simplicity, reliability, safety, and complete protection against arcing are the makers' principal claims. For colliery work these fuses are said to be particularly well suited.

MECHANICAL STOKERS FOR LOCOMOTIVES.

The use of mechanical stokers for locomotives has been tried on several American railways, and a number of such devices has been used experimentally to a greater or less extent. A special incentive to their introduction is the great size of modern locomotives, requiring not only the shovelling of enormous quantities of coal, but making it difficult for a fireman properly to maintain the fire in a box of extreme length. The subject has been discussed at the annual meetings of the American Locomotive Superintendents' Association, and a report was presented at the recent meeting held at Atlantic City.

The report calls attention to the fact that mechanical stokers for locomotives are in their infancy, and that efficiency beyond that of hand firing can hardly be expected at this stage. But at the same time the results thus far obtained hold out great hopes for the future, especially as the matter has been taken up in earnest by a number of railways. With the introduction of stronger wagons and improved couplings and brake valves, it becomes practicable to increase the length of trains. It is reasonable to assume, therefore, that the average tractive power of locomotives will increase. This being the case, it is possible that the increased fuel consumption per mile will render it advisable to provide mechanical means of firing for two reasons :—First, to secure the development of a high sustained tractive effort ; and second, to render the service attractive to men who possess qualifications to become successful locomotive enginemen.

The report reviews some of the developments of the past year, and from it the following notes are taken :—

The Chicago and Alton Railway has equipped 22 of its engines with the Strouse mechanical stoker, which is of the steam-driven horizontal reciprocating plunger type. The coal is fed through a detachable hopper to the plunger distributor, which distributes it in the fire-box by the forward movement of the plunger. The fire-box door is replaced by a special door hinged at the top and opening inwardly, being operated automatically. In the event of resorting to hand firing, the suspension rods which support the stoker in position are disconnected, the stoker moved into the gangway and the original fire-door re-applied. The stoker successfully handles any grade of coal from slack up to what will pass through a 5in. screen. The coal is well distributed and raking is unnecessary.

The Pennsylvania Railroad is developing an underfeed stoker of its own design, which so far seems to give promising results. This uses coal up to sizes of 4in. or 5in. cubes, and requires no change of the locomotive other than the application of a special form of grate. The application of the mechanism is such that the fire-door is in no way obstructed, so that hand firing may be resorted to on the road without any change or removing of apparatus. At the present time the coal is shovelled from the tank to the hopper of the stoker, but it is intended to fit some kind of mechanical conveyor.

The Chicago, Burlington and Quincy Railway is using the Barnum underfeed stoker. This requires coal screenings of 1¼in. size. The application of this stoker is such that hand firing cannot be accomplished without changes which involve the work being done in the shop. The installation of the stoker necessitates the removal of the grates, extension of the back frames, and the remodelling of the ashpan and draught appliance in the front end. The distribution of coal in the fire-box is such as seldom to necessitate raking the fire. With this stoker also the coal is delivered to the hopper by hand, but it is the intention to make it automatic later.

The Erie Railroad is developing the Dodge stoker, which is of the overfeed type. The only change to the locomotive necessary for the application of this stoker is the replacing of the fire-box door by a specially designed box-shaped door, in the centre of which is a pivoted shelf, which can be tilted to any angle to the plane of the fire by means of a lever at the front of the door. Two four-blade gears revolving at about 250 revolutions per minute on the top of the shelf spray the coal over the fire as it falls on the shelf from the hopper, which is attached to the top of the door and forms a part thereof. The distribution of the coal is controlled by means of tilting the shelf, and thus directing the spray of coal to any desired part of the grate. The whole operation can be observed through peep-holes in the fire-door. The coal is conveyed to the hopper by a worm conveyor extending from the forward end of the coal space in the tank to the hopper, coal being delivered to this worm from the full length of the coal space by means of another worm. In order to fire by hand, the front worm conveyor is thrown back on its hinge and secured to the tank. The door requires no change, as being all in one piece and hinged on the original fire-door hangers ; and it can be operated like the ordinary door. The size of coal for which this stoker is adapted is everything that will pass through a 3in. or 4in. screen. The Hayden automatic stoker is in use on the Erie Railroad, and a number of tests have been made, which showed its possibilities to be such as to warrant the construction and placing in service of five more machines.

Model of High-tension Magneto Machine.—From the *Car Illustrated*, Limited, of 168, Piccadilly, W., we have received a model of a high-tension magneto machine. On the driving side of the model there are the magnets, the armature and the condenser, and also the two wheels for driving the distributor which is situated on the opposite side. On the front of the model there is the contact breaker, with lever attached for advancing and retarding the spark, the insulated platinum point, the rocker carrying a second platinum point, a double cam wheel operating the rocker, the high-tension distributor, and the four sparking plugs. By holding the model up to the light an imitation spark can be seen at four spark plugs. We have also received a similar model of a carburetter which embodies most of the essential features of the majority of carburetters at present in use.

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

BRITISH LOCOMOTIVE PRACTICE OF TO-DAY.

Sir,—From a footplate experience extending over twenty years with every notable system of engine employed in European countries during that time, I fail to find any objection to Mr. Riekie's proposal for very large cylinders, provided the boiler steam pressure is proportionately low, or the weight of the boiler increased so as to augment the adhesion weight. Mr. Riekie is merely suggesting what is now done regularly for low-pressure locomotives using superheated steam. In these it is usual to make the cylinders abnormally large to compensate for the low pressure, the mean effective pressure in such engines, as shown by cards, being little more than that attained in the low-pressure cylinders of compound locomotives of modern design ; but the very large size of such cylinders enables them even with a low M.E.P. to develop a considerable tractive force. The proposal to admit the use of abnormally large cylinders, where the existing boiler pressure is high, has been frequently rejected by engineers to whom abnormally large cylinders have been represented as necessary with superheated low-pressure steam, the objection to their use being the slipping difficulty. To overcome this objection the common practice is to reduce the pressure and provide enormous low-pressure boilers whose loaded weight furnishes the additional adhesion required. High-pressure boilers are compact and small for their power, and do not entail a great loaded weight. Mr. Riekie has referred to Serpollet boilers working at 1000 lb. pressure, and he is probably quite able to figure out the weight of a boiler which would replace them for working at, say, 50 lb. per square inch. In proper proportion, the same applies to locomotive boilers. The return to pressures of 150 lb. for superheated steam will account in one or two years hence for some locomotives of a weight wholly unparalleled with present high pressures. This heavy load will provide the requisite adhesion for cylinders of the extraordinary capacity to be adopted, and as suggested by Mr. Riekie. In one instance, the main lines of a railway will have to be reconstructed to carry a wheel load at least two tons heavier than at present in order to support these great low-pressure machines. In another case, some goliath low-pressure engines are already being built which will tax the heavily-railed existing lines for which they are intended.

Considering the success attained with modern British designed and built compounds in England, there appears no reason why this type should not be developed further, and with great advantage, if the most important condition, that of using low-pressure cylinders of about three times the capacity of the high-pressure cylinders, as recommended for many years by all eminent authorities, be respected. This ratio simplifies the engine. No intercepting valve is then needed. Two valves can be used in the place of four valves, and two-valve mechanisms can take the place of four-valve mechanisms, or their equivalents, as at present used for most British four-cylinder non-compounds. The saving in complication by such compound engines relatively to the simple expansion types is about 50 per cent. The range of steam expansion is also 50 per cent. greater—it is, just double. No more successful type than the Great Western Railway four-cylinder non-compounds is known in England, and with these engines, with full open regulator the cut-off averages 20 per cent. on a long run averaging 60 miles per hour with a train of 400 tons behind tender. The ratio of expansion is 5. Now, if the outside cylinders only were replaced with others of three times their capacity, the cut-off, under the same conditions of load and speed, would be 40 per cent. The ratio of expansion would then be 10 ; that is, steam of the same pressure would be expanded to twice the volume of that in the non-compound engines. Considering that the cut-off in the compound engine is double that of non-compound engines having H.P. cylinders of identical size, it might be thought that there was, in consequence, no saving of steam. The saving occurs not in earlier cut-off, but at the regulator, which is usually throttled down in compound engines. These facts are drawn from automatic records of compound engines closely resembling the non-compounds of the Great Western Railway, except that the outside cylinders have three times the capacity of the inside ones, the mechanical arrangements otherwise being the same. No such compound arrangement—the common one of most countries outside of France—is known in this country. Mr. Sisterson once showed readers how it could be effected for our small constructive gauge.

Mr. Holmes, on the North British, built his four-cylinder two-crank compound in 1886 with a ratio as low as 1 : 2.3. As British practice differs from continental, French excepted, in this most important particular, it is not impossible that improved results will be found to follow on the adoption of a greater ratio of volume H.P. : L.P. cylinders of about 1 : 2.95, according to the recommendations of Mallet and Goelsdorf, and now generally employed in Europe. I am led to believe that notable progress can be effected in this direction from the following instance of compound locomotive operation in England, and referring to an engine with two reversing gears and H.P. : L.P. cylinders having a ratio of 1 : 2.77. This ratio, it might be added, had been gradually increased, during years of practice, from 1 : 2.42 up to 1 : 2.77, obtaining better results with every increase. At full speed with a train of 300 tons, on the level, the running cut off of this engine, in England, is 30 + 60 per cent. With such exceptional relative admissions in the two groups the normal receiver pressure is only 25 lb., or less than one-ninth the boiler pressure. Admitting an initial pressure of 25 lb. on the L.P. pistons the mean effective pressure might perhaps be 16 lb. per square inch of piston area, and the total power developed in the L.P. cylinders under three-fourths of that developed in the H.P. cylinders. Whenever the driver decreased this ratio the receiver pressure augmented until, at 40 lb., the engine was liable to be disabled from a certain cause requiring too much space to mention in a letter, and certainly never experienced with the same system and type of engine worked under analogous conditions abroad. A previous driver had settled the matter in his own way : he started with both gears full forward and never touched the L.P. thenceforth. It has always been because of this possibility of what drivers may at any time do with their two independent distributions that every eminent engineer who has had great practice in compounding has most resolutely opposed the use of a separate reversing gear for the L.P. cylinders, which can be used as disastrously as were formerly intercepting valves for enabling such engines to work non-compound.

That compound engines operated in such manner that one side of the engine does little more than one-half of the work accomplished by the other should be found uneconomical surprises no one. But, now, examine the case of a compound engine having two high-pressure cylinders of precisely the same diameter as the one referred to, and only differing in the low-pressure cylinders, being 2.98 times larger than the H.P.

In this case there is no need for four sets of valve gears ; and two valves can be used to distribute steam to four cylinders. The reversing gear, being identical with that used upon all ordinary engines, the driver cannot interfere with the relative admissions of the two groups. The effect of this is at once apparent. With the same working boiler pressure as in the previous engine the receiver pressure averages as much as 72 lb. per square inch, or nearly one-third the boiler pressure. In the other case the pressure is only 25 lb., or one-ninth the boiler pressure, and acting on pistons only 23⅝in. diameter, whereas the 72 lb. per square inch relates to cylinders 24½in. diameter. The work done in the H.P. group is nearly equalled by that effected in the 24½in. L.P. cylinders, and the relative cut-off in both is invariable, this admission being from 40 to 45 per cent. with a gross load of 528 tons, run at an average rate of 60 miles per hour, with a maximum of 70 miles per hour on the level, as automatically recorded by the speed indicator, the engine weighing 66 tons, of which 32 tons are on the drivers. Using the same sized H.P. cylinders and the same boiler pressure, the engines now working in this country are limited to trains of 300 tons on easy sections of the line, whereas they should pull 530 tons gross load with ease at 60 miles per hour average.

The improvement which appears possible is, then, the increase of ratio H.P. : L.P. cylinders in the first place, followed by the abolition of duplex reversing gears, the suppression of all intercepting valves, and a general constructive simplification as, say, all cylinders in one line, suppression of heavy box casings between frames at level of outside cylinders, the use of one valve for each two cylinders, the adoption of one balanced axle instead of two driving axles, divided system, and thus to realise a total effective simplicity of the whole machine not attained in any non-compound engines having the same number of cylinders, and to increase the power of the engine all in reducing the weight of motions and frames, decreasing the first cost very considerably, and giving to the drivers engines which are not only simpler mechanically than the complicated ancient types usually adopted, but in no detail more trouble to manage than ordinary simple expansion engines.

Already Mr. Hughes has made a success of compounding in goods engines, his result of 25 per cent. coal saving at the same working pressures as his recent non-compounds being equal to the best average result of foreign compound locomotives. Mr. Deeley with express engines appears also to have been very successful—although his figures cannot yet be stated. Beyond these two cases of the Lancashire and Yorkshire and Midland Railways there are no railways using wholly British designs of compound locomotives to any large extent with experience sufficient to furnish conclusions against a system which abroad has long passed from the stage of experiment into an invariable practice fully justified by the average results which, whenever published, usually show an annual coal economy of 18 to 25 per cent. in slow moving trains, up to customary averages of 32 and 36 per cent. for fast express trains. This result is quite opposed to prevalent popular opinion, and to opinions that have been expressed by Mr. Hughes, who has no large experience of express compound engines, while Mr. Churchward, whose experience of very fast train services worked by compound engines is precisely similar to that of engineers throughout the whole of Europe, considers that the advantage of compounding is greatest at high piston speeds, and his reply to Mr. Hughes to that effect appears in your pages—see page 289, March 23rd, 1906. It is well known that a compound engine normally saving 30 per cent. of coal in ordinary passenger service will only save about 18 per cent. when it is put to working freight. Compounding goods engines has never taken anything but the second place as an economical system with continental railways.

Taking into account the low ratio of H.P. and L.P. cylinder volumes adopted so far, the success of the only two railways now employing the system to an appreciable extent in this country must be very encouraging to English designers in view, above all, of the considerable improvements that are within easy reach.

Hiterto the popular attitude has been to deprecate all that our engineers have accomplished by means of compounding, and to criticise their efforts. On this question I think most readers will concur with your correspondent, Mr. Dearberg, in his commendation of our engineers for knowing their own particular business better than outsiders, and agree with him heartily that "any course taken by these gentlemen must be taken as authoritative."

The personal experience of Mr. Riekie with compounding may have been the cause of his pessimistic statement that the "slight economy of fuel . . . . is not worth the extra complication;" but it has to be remembered that as there is no standard of economy for simple expansion locomotives, so there is none for compounds, results depending entirely upon excellence of design, and inferior results from mediocre designs cannot be more admitted as condemning single-expansion engines as a whole than they allow of the condemnation of the principle of double expansion in locomotives. I am sorry not to entertain the same views as expressed by Mr. Riekie regarding the absence of ameliorations in locomotive economy in the last forty years. The following published results of Austrian practice give quite another impression:—

Relative Coal Consumptions.

Three and four-cylinder compounds	79 and 66
Single-expansion engines...	100

The compounds, since fitted with Clench-King superheaters as modified in Austria, have now further lowered the compound-fuel consumption by 10 per cent., and without involving a penny for superheater repairs during two years. Still better fuel economy has been attained by applying Schmidt superheaters to such engines, both in France and in Austria, the result being in both cases a saving of about 14 to 15 per cent., the two means of economy combined in one engine effecting a total saving of about 50 per cent., and there is no reason to suppose that still further improvements for reducing the steam consumption per horse-power hour are impractical.

Charles R. King, M.I.C.E., France.

Sir,—I have read Mr. Dearberg's letter which appears in your issue of 6th August with great interest, but see no reason to alter the views I expressed regarding the necessity for enhancing the cylinder capacity of all locomotives. He has, no doubt, made out a good case in defence of British locomotive practice, but only in so far as it can be defended; at the same time he bears out my contention by quoting instances where locomotive engineers have enlarged the cylinders of their engines. That cylinders had to be lined up through breathlessness of certain engines due to a misconception on the part of the designer does not alter the fact that enhanced power was the objective aimed at.

I have no doubt Mr. Dearberg is aware that double engine trains are frequently run. If he will quote a case where a second engine was used, because the one engine lacked the required adhesive weight to allow of the train being started from a state of rest, I will admit the necessity for the use of a second engine if, on the other hand, the assisting engine was required to enable the train to be run to time. I hope he will admit that enhanced power of the locomotive is desirable to enable it to do the work single-handed.

The time may not have arrived to design a locomotive with 50 per cent. greater power than the Great Western Railway 4-6-2 engine. All the same, such a powerful engine could only be designed on the compound system, since a boiler could not be made large enough to give requisite steam for a simple engine of such great power.

Mr. Dearberg asks if I think engines would be better or more efficient by adopting the compound system. My reply is yes, decidedly so, but only if the engine were designed on lines which would make it impossible for him to repeat the astounding statement he makes, viz., that with four high-pressure cylinders as good expansions can be got as with a four-cylinder compound. Regarding his reference to the gentlemen who so ably control British locomotives, after having read the letter signed "L. A. F.," which appears in the same issue of your paper, I prefer to remain silent.

I was quite aware that a simple engine with two 19in. cylinders could do better work than the Worsdell compound, for the reason that it can, when necessary, pass twice the weight of boiler steam through its cylinders.

Mr. Dearberg states he does not wish to make odious comparisons, and then, to my way of thinking, proceeds to do so by explaining how a simple engine with a large cylinder capacity can do better work when pitted against a compound having, for the latter, a very small cylinder capacity. The De Glehn type of compound I had in view was the one with 24in. low-pressure cylinders.

I was pleased to find Mr. Dearberg had a kind reference to make about the late eminent engineer, Mr. Webb. I agree that the failure of this eminent engineer's type of compound was largely due to lack in cylinder power.

I will now deal with what I consider the most important statement made by Mr. Dearberg, and one made at the commencement of his letter, viz.: Unless the adhesion power exceeds the cylinder effort, the engine can never develop its maximum tractive effort. My quarrel with the modern locomotive is that it is designed with a tractive effort up to which it is impossible to work. For instance, the maximum tractive effort is based on a 75 per cent. cut-off in the cylinders—a condition under which we know it is impracticable to work the engine; consequently, it can never be worked to its earning capacity, although the boiler power and adhesion weight is ample to allow of this.

The most favoured cut-off used by all drivers, and one taught them from long experience in their endeavour to economise in fuel consumption, is at about 30 per cent. of the stroke of the piston. To bring about the last word in this discussion, it is only necessary, therefore, to design all locomotives, both simple and compound, taking this workable cut-off as a basis. As 30 per cent. would then be the maximum used by the driver when working a train, it follows that very much larger cylinders could be arranged for without in any way considering the engine as over-cylindered.

In conclusion, if a compound engine be fitted with two 19in. cylinders, so as to be on an equal footing with a simple engine having the same size of cylinders, as regards making use of an equal weight of boiler steam, and if the former be supplemented with two 28in. or the largest low-pressure cylinders admissible, thus enabling it to more than double the number of steam expansions of the simple engine under all conditions of work, it surely must be obvious that there can be no comparison as to which will be the better engine.

Argaith, Dumbreck, August 10th. John Riekie.

LATENT AND SENSIBLE HEAT.

Sir,—As no one has brought forward any evidence in support of Régnault, as asked for in my letter of July 2nd, are we to understand that the scientific world has accepted Régnault, Rankine, and Clausius entirely upon trust and without any corroboration of any sort or description, and this in spite of the fact that actual engines and independent evidence contradict their statements? I ask again for evidence corroborating Régnault, if it exists. I can find none, although I have honestly, conscientiously and to the best of my ability tried to do so.

The present position cannot be better summed up than by this quotation from your leading article on "The Tyranny of Scientific Dogma." "If Régnault is right, then steam in an engine ought to behave in one way. It insists on behaving in a different way." This is the fundamental fact which I feel sure has to be realised. Practice and theory are playing a terribly complicated game of cross purposes, owing to the fact that actual engines deal with actual steam, whilst the theorist and mathematician does not deal with actual steam, but what he believes is actual steam, and our text books do the same thing.

I have already shown that Carnot's fundamental basis can be arrived at by a totally different line of reasoning to Carnot's, and that Carnot's fundamental basis confirms Southern's Law, although neither Carnot nor Southern knew of the other's existence.

Again, I have shown that Despretz—one of the greatest experimental physicists who ever lived—and Southern, by carrying out in practice what Régnault declared essential instead of what Régnault actually did, made the total heat in saturated steam at atmospheric and above atmospheric pressure more than Régnault, whilst Willans, who wire-drew his steam—that is, measured the heat in superheated steam—like Régnault, a thing which Régnault says must not be done if the heat in saturated steam is to be measured, agrees closely with Régnault. I have also pointed out this obvious fact, if their methods are examined.

Despretz and Southern measured the heat in saturated steam. Régnault and Willans measured the heat in superheated steam. This means that the present steam tables are wrong, except for the temperatures equivalent to the pressures. Perhaps it will be thought that this is simply reiteration, but I have been asked to explain why the fact of Régnault having measured the heat in superheated steam instead of saturated steam, as he believed, owing to his not knowing that steam can superheat itself, makes such a difference in steam calculations.

If steam is superheated steam when the heat is measured, obviously to arrive at the latent heat the superheat must first be deducted, and then the sensible heat in steam at the pressure which the steam would be at if it was saturated steam instead of superheated steam. That is, two distinct quantities of heat must be deducted to arrive at the latent heat if the steam is superheated steam. It is also quite obvious that it is immaterial whether the superheated steam has been produced by its receiving external heat, or by saturated steam being wire-drawn. It is the actual condition of the steam when the heat is measured which counts, not its previous condition.

What Régnault did was this, he measured the heat in low-pressure superheated steam producing by wire-drawing steam, but instead of arriving at the latent heat as above, he deducted from the quantity of heat in the low-pressure superheated steam the sensible heat in the original steam, and called the balance of the heat the latent heat in the steam before it was wire-drawn. Obviously it is nothing of the kind. It is no definite kind of heat at all.

Not only does Régnault's own description of his experiments show that this is what he actually did, but the values he obtained show the same thing, as anybody can see in two minutes for himself if he looks at the steam tables, as all the total heats are for superheated steam at a low pressure, as they are less than the values for superheated steam at atmospheric pressure and at saturated steam temparature. The same thing is found if Willans' results are examined, viz., they are superheated steam values Here is a perfectly clear issue, and a definite statement of fact. Now what does this mean when steam is dealt with mathematically? It means: (1) That when latent heats are being dealt with, actual latent heats are not used. (2) That when dry saturated steam is being dealt with, actually the values for superheated steam at a totally different pressure are being used. (3) When superheated steam is being dealt with, actually the values for superheated steam at a totally different pressure, and containing a totally different amount of superheat are being used. (4) That when volumes are dealt with they are volumes which do not exist, except in theory, as they are calculated from these false latent heats.

Now I ask this perfectly plain question—how can theory and practice be expected to agree under these circumstances? The above only applies to steam at above atmospheric pressure, as Régnault made a different mistake at below atmospheric pressure which caused his error to reverse—that is, his values became too high instead of being too low for the total heat in saturated steam. Why I have such confidence in Southern cannot be better stated than by altering the quotation from your leading article. If Carnot, Despretz and Southern are right, then steam in an engine ought to behave in one way. It insists on behaving in this way.

Blackheath, August 3rd. Frank B. Aspinall.

EXPERIMENTS WITH A GLASS CARBURETTER.

Sir,—As a carburetter maker, anything relating to this subject is eagerly read by me. The article by Mr. Bickford in this week's issue is extremely disappointing, since it follows the usual course of ascribing the results obtained by the various carburetter makers to "pot luck" and "hit or miss" methods. Not only does the writer make such assertions, but proves them by experimenting with lamp glasses, tubs, tubes, pieces of metal plate, &c., under conditions utterly unlike those which occur in actual practice.

When an apparatus is constructed so that the actual volume weight of air may be measured, and then, in order to make the figures come right, the experimenter has recourse to calculation, something is very much out, especially in the light of recent remarks made in The Engineer, which stated that no reliable method of measuring the flow of fluids had ever been discovered.

In his extraordinary observations of the behaviour of petrol when passing along lamp tubes, does Mr. Bickford really believe that the same thing occurs in the induction pipe? If so, can he explain why an engine ceases firing instantly if petrol is cut off and air only admitted? Surely it should continue firing for a considerable time, until all the waves, &c., were used up.

He shows that if the petrol, after leaving the jet, passes with the air through a small opening the high velocity helps atomisation, and he instances one or two carburetters which follow this arrangement when throttle is nearly closed. Will he kindly tell us of any carburetters which do not present a small area when the throttle is nearly closed? Will he go into the temperature changes which take place when petrol is injected? I find in the Gillett-Lehmann carburetter there is a drop of about 50 deg. Fah. between the inlet and the outlet of the carburetter; what allowance did he make for this in his calculations for quantity? Does he really think that a constant proportion should exist in the mixture, or that some allowance should be made for varying amounts of compression in cylinders; and is it necessary to consider the proportions as affecting the length of time taken by inflammation in relation to piston speed?

When reading an article, apparently the same, in one of the motor papers, I passed it by as being suitable for the motoring public; but when I find it taking up valuable space in The Engineer, the paper accepted as the one technical organ, I must be excused for "kicking" at what, to me, as a carburetter maker, adds insult to injury.

August 10th. Walter Gillett.

Sir,—I have read Mr. J. S. P. Bickford's article on the above subject with great interest, and it has certainly deepened my convictions, that two characteristics are essential to get a reliable explosive mixture under all conditions, first, partly to atomise the petrol, and secondly, to vaporise the mixture.

Most carburetters will atomise sufficient to get an explosive charge under certain conditions, which vary with different types, and not till the combustion chamber is well warmed up can any reliance be placed on an explosion. The best results during my experiments were got by having a petrol-control valve. This admitted a small quantity of petrol into the suction pipe (this supply being regulated by the governors), which was partly atomised by the air, and the mixture being carried through a heated tube vaporised it. I found this plan very reliable and economical.

A very striking similarity is Patent 16,927 in this week's issue of The Engineer.

London. August 7th. Frank Ellenger.

EARLY BALANCED LOCOMOTIVES IN AMERICA.

Sir,—Replying to Mr. Brewer's inquiry in The Engineer of July 16th, it may be said that one of the earliest American designs of four-cylinder balanced locomotives was the Shaw locomotive with all outside cylinders, which was built and used experimentally about twenty-five years ago. Some years later the Ball locomotive was designed, but it does not appear that it was actually built. This also had the four cylinders outside, and those on each side were tandem, but offset laterally so that the long piston-rod of the forward low-pressure cylinder was alongside—and on the inner side—of the high-pressure cylinder. The two connecting-rods drove the same axle, that of the low-pressure cylinder being attached to the usual crank pin, while that of the high-pressure cylinder was attached to a return crank. The cranks on each side were placed at 180 deg. with each other, and at 90 deg. with those on the other side. The Strong engine, 1897, had two inside high-pressure cylinders and two outside low-pressure cylinders, all connected to the first driving axle of an engine of the 4-4-2 type. The first Baldwin four-cylinder balanced compound was built in 1902, and had all cylinders driving on the first driving axle of an engine of the 4-6-0 type. The high-pressure cylinders were inside.

Since then many balanced compounds have been built, but they are not now used to any great extent, the advantages being considered apparently as not warranting the increased cost. Three-cylinder simple locomotives were used many years ago to give a more equable turning moment, and avoid stalling trains on heavy gradients. A fast passenger engine of this type has been built recently for experimental work. Railways.

HOLLOW AXLES, CRANK PINS, AND STUD PINS.

Sir,—Concerning the practice of boring out the crank pins of locomotive wheels, of which you, in the recent article on "Flexible Crank Axles" are unaware of any instance, will you allow me to point out that the boring out of crank axle pins and outside wheel pins is the rule rather than the exception in modern locomotive practice of the Continent, and nearly all examples you have illustrated for some years past show this detail. Notable instances occur on page 94, July 27th, 1906; page 311, September 28th, 1906; page 570, December 7th, 1906, &c.

France. Charles R. King.

Wreck Statistics for 1908.—The statistical summary of vessels totally lost, condemned, &c., now published by Lloyd's Register, shows that, during 1908, the gross reduction in the effective mercantile marine of the world amounted to 800 vessels of 809,292 tons, excluding all vessels of less than 100 tons. Of this total, 382 vessels of 566,487 tons were steamers, and 418 of 242,805 tons were sailing vessels. The figures for various periods, which are given in the report in tabular form, show that steamers have a much greater immunity from disaster than have sailing vessels. The tables exhibit interesting data as to the relative frequency of the different kinds of casualty, &c., which conclude the existence of vessels. Strandings and kindred casualties, which are comprised under the term "wrecked," are much the most prolific cause of disaster. To such casualties are attributable 43.5 per cent. of the losses of steamers and 33.8 per cent. of the losses of sailing vessels. The next most common termination of a vessel's career is by condemnation, breaking up, &c., 20.4 per cent. of the steamers and 27.8 per cent. of the sailing vessels removed from the merchant fleets of the world being accounted for in this manner. Cases of abandoned, foundered, and missing vessels are no doubt frequently more or less similar in the circumstances of loss. If these be taken collectively, they comprehend 19.4 per cent. of the steamers, and 24.2 per cent. of the sailing vessels removed from the mercantile marine during 1908. The return has been compiled by Lloyd's Register in such a manner as to enable a comparison to be made between the percentages of loss suffered by each of the principal merchant navies in the world. Great as the absolute annual loss of vessels belonging to the United Kingdom appears to be, it is seen to form a very moderate percentage of the mercantile marine of the country, and to compare favourably with the average of the losses sustained by other leading maritime countries.

LOCOMOTIVES DESIGNED AND BUILT AT HORWICH, WITH SOME RESULTS.*

By Mr. GEORGE HUGHES, Member, Chief Mechanical Engineer, Lancashire and Yorkshire Railway, Horwich.

(*Concluded from page* 150.)

APPENDIX I.

Conditions of Service.

It is important that some of the conditions under which a given set of locomotives are designed and employed should be known; consequently the author gives in this Appendix an idea as to gradients, obstructions, junctions, rolling stock required, character of trains negotiated, and intensity of traffic, represented by miles of line and quantity of rolling stock required.

The total mileage maintained by the Lancashire and Yorkshire Railway Company is 585¼, divided as follows:—

	Miles.
Six or more lines	11¾
Five lines	7½
Four lines	64¼
Three lines	21¾
Double lines	440¼
Single line	35¼
Total	585¼

A map of the railway is shown in Fig. 2, and 337 miles of gradients in Figs. 3 to 10 [page 119, *ante*], and the following is a table of gradients up to 1 in 500 (Euxton Junction to Preston, Maudlands Junction, excepted):—

Gradients.	Mls.	chns.	yds.
Under 1 in 30	1	5	7
1 in 30 and under 1 in 50	12	1	19
1 in 50 „ 1 in 75	49	22	3
1 in 75 „ 1 in 100	61	17	10
1 in 100 „ 1 in 125	54	33	17
1 in 125 „ 1 in 150	36	52	14
1 in 150 „ 1 in 175	38	15	16
1 in 175 „ 1 in 200	21	16	4
1 in 200 „ 1 in 250	41	3	20
1 in 250 „ 1 in 300	28	55	20
1 in 300 „ 1 in 400	55	61	12
1 in 400 and including 1 in 500	29	21	6
Total	428	67	16

Euxton Junction to Preston, Maudlands Junction:—

Gradients.	Mls.	chns.	yds.
1 in 100 and under 1 in 125	1	6	20
1 in 125 „ 1 in 150	0	10	0
1 in 150 „ 1 in 175	0	9	0
1 in 200 „ 1 in 250	0	16	0
1 in 250 „ 1 in 300	0	72	0
1 in 300 „ 1 in 400	2	5	0
1 in 400 and including 1 in 500	0	67	21
Total	5	26	19

Total number of tunnels	90
Total number of under and over-bridges	2478
Total number of openings in same	5108
Signal-boxes (L. and Y.)	677
„ (Joint, maintained by L. and Y.)	61
Total	738
Ground frames (L. and Y.)	58
„ „ (Joint, maintained by L. and Y.)	2
Total	60
Number of block signal-boxes between:—	
Liverpool and Manchester	68
Manchester and Normanton	102
Manchester and Blackpool, *viâ* Bolton	107
Passenger stations (L. and Y.)	260
„ „ (Joint, maintained by L. and Y.)	31
Total	291
Halts (L. and Y.)	16
„ (Joint, maintained by L. and Y.)	2
Total	18

Junctions are frequent, and there are, from some of the stations, rising gradients as severe as 1 in 50.

The traffic moving in and out of large stations is considerable, as for instance at Victoria, Manchester, where 280 passenger trains arrive and 301 depart each day; in addition to which, 62 passenger trains and 80 goods trains pass through, but exclusive of specials and empty trains.

The number of engine workings per day is divided as follows:—

Express passenger workings	106
Slow „ „	273
Passenger shunt engines	21
Express goods workings	163
Slow „ „	341
All shunt workings	199
Total	1103

Total stock:—

Locomotives	1,517
Carriages	4,779
Wagons	32,793

The following trains are worthy of remark:—

Passenger:—2.10 *p.m. Liverpool to Hull* (Engine, Fig. 30, page 121 [*ante*]).—This train is run in connection with the company's steamers plying between Goole, Hull, and Zeebrugge, and the other continental ports. The train is formed of vestibule corridor stock, and frequently consists of equal to fifteen vehicles, or 375 tons behind the drawbar. The connection from Preston and East Lancashire district is attached at Brighouse, and a portion of the train is detached at Wakefield, to be worked forward to York. The train has five stops from Liverpool to Hull, and is run at an average speed on the total journey of 48.9 miles per hour. The return traffic from Hull is worked by the 9.5 a.m. train, which corresponds with the 2.10 p.m. from Liverpool. An engine that can haul equal to fifteen between Liverpool and Manchester, 36 miles 1653 yards, in 40 minutes, can do anything in this country.

10.55 *a.m. Liverpool to Newcastle* (Engine, Fig. 29 [*ante*]).—This train is worked by the Lancashire and Yorkshire Railway Company between Liverpool and York. It is formed of vestibule corridor and dining-car stock, and is made up to as much as equal to 11 vehicles, or 275 tons. The train has seven stops, and the average speed for the total journey is 46.1 miles per hour. The return train for this is the 12.42 p.m. from Newcastle, which leaves York for Liverpool at 2.36 p.m. This train has four stops, and the average speed for the journey is 48.9 miles per hour.

Leeds and Fleetwood Boat Trains (Engine, Fig. 29 [*ante*]).—The 8.5 p.m. from Leeds to Fleetwood is run in connection with the company's steamers between Fleetwood and Belfast. The train is formed of vestibule corridor and dining-car stock, and is made up to as much as equal to 14 vehicles, or 350 tons. The return traffic from Fleetwood is worked by a similar train leaving Fleetwood at 5.55 a.m.

Blackpool and Manchester Service (Engine, Fig. 29 [*ante*]).—The 8.10 a.m. from Blackpool to Manchester, with the return from Manchester at 5.10 p.m., is an important express train for business people residing in the Blackpool district. The train is formed of vestibule corridor stock, and two special club saloons, and is made up to as much as equal to 15 vehicles, or 375 tons. The first stop is at Lytham, and the speed between Manchester and Lytham is 45 miles per hour. The 7.13 a.m. from Blackpool Central and the 5.55 p.m. from Manchester are similar trains to the above, and are composed of vestibule corridor stock, and made up to as much as equal to 14½ vehicles, or 362 tons. The average speed between Manchester and Lytham is 44.1 miles per hour.

Southport and Manchester Service (Engine, Fig. 30 [*ante*]).—The 8.10 a.m. Southport to Manchester, and the 5.0 p.m. back, are important business trains for residents in Southport district. The trains are composed of vestibule corridor stock, and are made up to as much as equal to 13½ vehicles each, or 337 tons. The average speed for the total journey is 47.1 miles per hour, and 43.7 miles per hour on the return. The 8.30 a.m. Southport to Manchester and the 5.40 p.m. back are similar trains to the above, the speed being 47.1 miles and 43.7 miles respectively.

Blackpool and Colne Service (Engine, Fig. 27 [*ante*]).—The 7.40 a.m. Blackpool to Colne is an important express train for residents in the Blackpool district who have business in the East Lancashire district. The train is composed of 8 ordinary bogie stock, equal to 200 tons, and four bogie carriages are slipped at Blackburn. After leaving Lytham the first stop is at Rose Grove, a distance of 35 miles 215 yards, which distance is run at an average speed of 42.1 miles per hour.

Goods Trains:—11.30 *a.m. North Docks to Salford, and* 2.0 *p.m. Salford to Liverpool*.—These trains are worked by coal engines—Fig. 31 [*ante*]—and run from Aintree to Salford and back, a distance of 37½ miles in each direction. On the return journey from Salford the load is limited to 350 tons, which is equal to 43 loaded wagons of goods, to enable the train to be run from Hindley Junction to Aintree sorting sidings at an average speed of 34 miles per hour. This includes travelling up the bank of 1 in 91 from Westwood to Orrell West. With 4-cylinder engines 6-wheel coupled—Fig. 30 [*ante*]—with loads of 50 wagons, equal to 400 tons, much higher speeds have been attained, an average speed of over 40 miles per hour having been run, and, for a distance of 6 miles, 60 miles per hour. The goods, which are brought in from the Manchester market the same morning, are loaded in the Salford Yard up to a few minutes before the departure of the train, and the quick transit to Liverpool is to enable them to be shipped on vessels leaving Liverpool the same day.

10.40 *p.m. Hull to Moston* (*Manchester*).—This train is worked by a coal engine—Fig. 31 [*ante*]—and conveys traffic from Hull and Goole, and also exchange traffic for the Hull and Barnsley line. It is classified to work a load of 800 tons, equal to 100 loaded goods wagons, from Hull to Hebden Bridge, and 745 tons from the latter point to destination. The train is frequently loaded up to its maximum of 120 wagons, and its booked speed throughout the journey averages 22 miles per hour. The train makes four traffic stops throughout its journey of 95 miles.

8.40 *p.m. Aintree to Horbury*.—This train is worked by a coal engine—Fig. 31 [*ante*]—and conveys important traffic from Liverpool for stations beyond Wakefield and North-Eastern line, York and Newcastle districts. It is booked to run from Aintree to Horbury without a stop, a distance of 71 miles, with a classified load of 400 tons, or equal to fifty loaded goods wagons at a booked average speed of 23½ miles an hour, and has to be hauled up gradients of 1 in 85 and 1 in 97. Great importance is attached to the prompt running of the train, and a good path is invariably provided.

10.45 *p.m. Goole to Liverpool*.—This train is worked by a coal engine—Fig. 31 [*ante*]—and conveys continental traffic loaded at the ports of Hull and Goole, which is consigned to Manchester and Liverpool and surrounding districts. From Goole to Liverpool, a distance of 102 miles, the train has one booked stop, and travels at an average speed of 22 miles per hour, with a load of 800 tons, equal to 100 wagons of goods, from Goole to Brighouse, a distance of 41 miles, afterwards running the remaining 61 miles without a stop, with a load of 745 tons, equal to ninety-three wagons of goods. The greater portion of the distance travelled is on the ascending gradient.

Table V.—*Summary of Trains Detailed above.*

Passenger or goods.	Train.	Load behind drawbar.	Average speed.	Maximum gradient.
		Tons	m.p.h.	1 in
Passenger	2.10 p.m. Liverpool to Hull	375	55.4 Liverpool to Manchester; 48.9 throughout	50
„	10.55 a.m. Liverpool to Newcastle	275	46.1	50
„	12.42 p.m. Newcastle to Liverpool	275	48.9	84
„	8.5 p.m. Leeds to Fleetwood	350	—	50
„	8.10 a.m. Blackpool to Manchester	375	45.0	100
„	8.10 a.m. Southport to Manchester	337	47.1	93
„	7.40 a.m. Blackpool to Colne	200	42.1	100
Goods	2.10 p.m. Salford to North Docks	350	34.0	84
„	10.40 p.m. Hull to Moston	800	22.0	150
„	8.40 p.m. Aintree to Horbury	400	23.5	85
„	10.40 p.m. Goole to Liverpool	800	22.5	84
„	10.20 p.m. Salford to Hull	960	22.0	50
„	10.55 p.m. Aintree to Leeds	575	22.0	100

10.20 *p.m. Salford to Hull*.—This train is worked by a coal engine—Fig. 31 [*ante*]—and conveys traffic from Salford and Manchester for Goole, Hull, Doncaster, and the Hull and Barnsley line. It is booked to run from Miles Platting (Manchester) to Pontefract, a distance of 55 miles, without a stop, and conveys loads up to the maximum of 120 wagons at a booked average speed of 22 miles per hour. Throughout the journey from Salford to Hull, a distance of 100 miles, there are four traffic stops. The connectional traffic conveyed by this train is very important.

10.55 *p.m. Aintree S.S. to Leeds*.—This train is worked by a coal engine—Fig. 31 [*ante*]—and conveys fruit and other important market goods for the Halifax, Bradford, and Leeds markets. To Leeds is a distance of 80 miles, and the first stop for traffic purposes is at Halifax, 63½ miles; a stop, however, is made at Accrington for examination purposes. A through load of 575 tons, equal to seventy-two loaded wagons of goods, which is based on the rising gradient of 1 in 100, from Bamber Bridge to Hoghton, is conveyed by this train, and, as a good path is kept, a prompt arrival at Halifax and Leeds is regularly maintained.

Table VI.—*Loads Hauled by Goods Engines over Various Sections.*

Section of road (see page 119 [*ante*]).	Coal engines—Fig. 31. Through load.	Coal engines—Fig. 31. Local goods vary according to grade. From	Coal engines—Fig. 31. Local goods vary according to grade. To	6-wheeled goods—Fig. 25. Through load.	6-wheeled goods—Fig. 25. Local goods vary according to grade. From	6-wheeled goods—Fig. 25. Local goods vary according to grade. To
Fig.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
3	429	429	1000	267	267	772
4	790	790	1000	475	475	750
5	440	440	956	275	275	600
6	509	509	737	319	319	468
7	341	341	1000	210	210	760
8	561	561	1000	353	353	645
9	341	341	1000	210	210	658
10	206	206	735	120	120	480

APPENDIX II.

Wear and Tear of Boilers.

This may be divided under two headings, namely, Grooving and Cracking, by reason of expansion and contraction; and Pitting brought about by deposits which are carried in solution and suspension in the water. The pitting at the smoke-box end is produced by chemical reactions going on in the mud which is deposited, and pitting round the stays and sides of wrapper plates, probably by chemical and electrical actions. The diagram—Fig. 59—shows the pitting and grooving of boilers and fire-boxes. So serious, a few years ago, was pitting in the bottoms of boiler barrels that the author decided to carry out a number of experiments with a view to eliminating the same. For example, cementing the bottoms of the barrels, using nickel steel plates, inserting steel and copper tubes mixed, and also suspending zinc blocks, but without any material improvement. Subsequently, he then selected a number of boilers, and lined the barrel bottoms with thin Low Moor iron sheeting, also old copper plates and lead sheeting. In three years the Low Moor iron sheeting was completely eaten through, and when examined resembled a riddle. The old copper plate, of course, remained intact, but the lead sheeting in twelve months' time had entirely disappeared. Before this disappearance, however, complaints were made to the author that the gauge glasses were being coated with a white film, which obscured the water levels, and upon scraping sufficient from the inside of the gauge glasses, in order to make a qualitative analysis, it was discovered to be lead carbonate. The author was induced to try lead on account of his knowledge of its acid-resisting properties; as traces of acid had been found in some of the waters used, he did not anticipate that carbonic acid gas would be

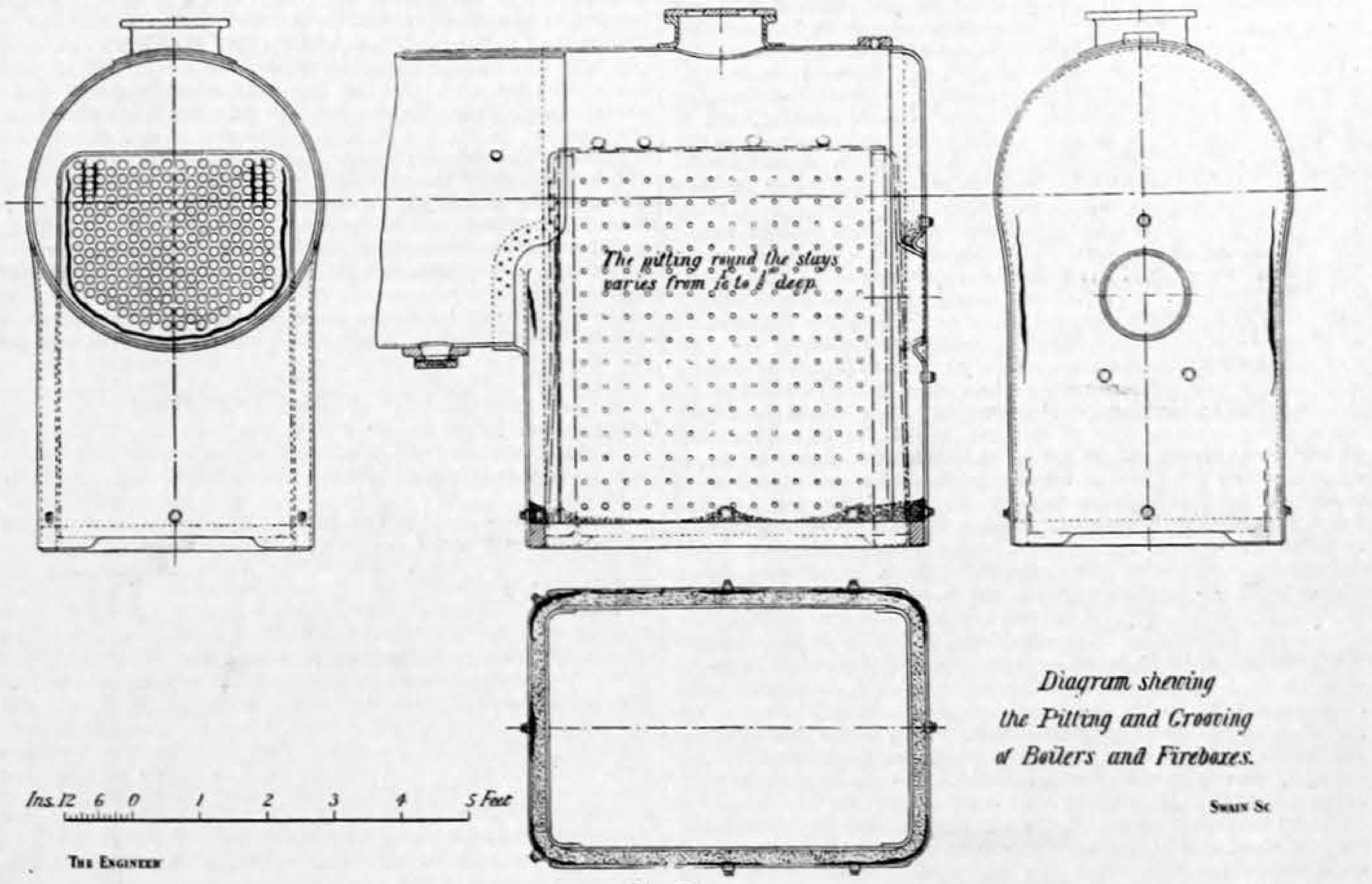


Fig. 59

Table VII.

Substance.	Bottom of barrel. Smoke-box plate.	Bottom of barrel. Centre plate.	Bottom of barrel. Fire-box plate.	Side of barrel. Smoke-box plate.	Side of barrel. Centre plate.	Side of barrel. Fire-box plate.	Crown of loco. fire-box.
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Silica	3.9	4.5	6.0	21.6	19.1	18.6	5.5
Oxides of iron and alumina	71.5	60.0	26·5	9.9	24.9	6.9	3.0
Sulphate of lime	2.1	5.8	48.8	1.9	4.8	2.2	68.0
Carbonate of lime	16.0	18.3	4.2	21.5	15.3	10.7	0.4
Lime other than carbonate or sulphate, calculated as hydrate	—	—	—	29.9	10.1	34.1	—
Carbonate of magnesia	7.0	5.6	7.4	—	—	—	9.0
Hydrate of magnesia	—	5.7	7.1	12.5	26.0	21.1	14.0
Total	100.5	99.9	100·0	97.3	100.2	93.7	99.9

* The Institution of Mechanical Engineers.

generated in the bottoms of the boiler barrels to such an extent as to combine with the whole of the lead. From this discovery, a cycle of chemical reactions was formulated, and recognised as a reasonable explanation of the immense amount of pitting that goes on in locomotive and other boiler barrels. Table VII. gives the analysis of deposit fr.om six different positions of the boiler barrel

Priming.—To ascertain the real cause of priming, the author has carried out investigations which may be of interest. Observations were made on several boilers of different designs, when it was found that design had little effect on priming, and that the real cause—provided that care was exercised in handling the engine, and the water level in boiler not exceeded—depended on the quality and quantity of water evaporated. A chemical analysis of two waters experimented upon is given below :—

	Grains per gallon. No. 1.	No. 2.
Carbonate of lime	4.9	3.8
Carbonate of magnesia	0.5	0.5
Sulphate of lime	3.7	3.2
Sulphate of magnesia	2.5	2.0
Oxides of iron and alumina	0.1	nil
Scale-forming matter	11.7	9.5
Sodium chloride	5.7	2.8
Total dissolved solids	28.0	16.0

It will be noticed that, so far as scale-forming matter is concerned, there is not a great variation in the two waters, but No. 1 caused priming much sooner than No. 2. The boiler fed by the former primed badly at the end of four days' work, whereas with the latter the engine ran six days before priming occurred. In both cases the daily evaporation was much the same. Seeing that priming occurred much sooner in the case of No. 1 than No. 2, and that the proportion of scale-forming matter was nearly the same in the two waters, the conclusions drawn were that these scale-forming constituents did not produce priming. The subject

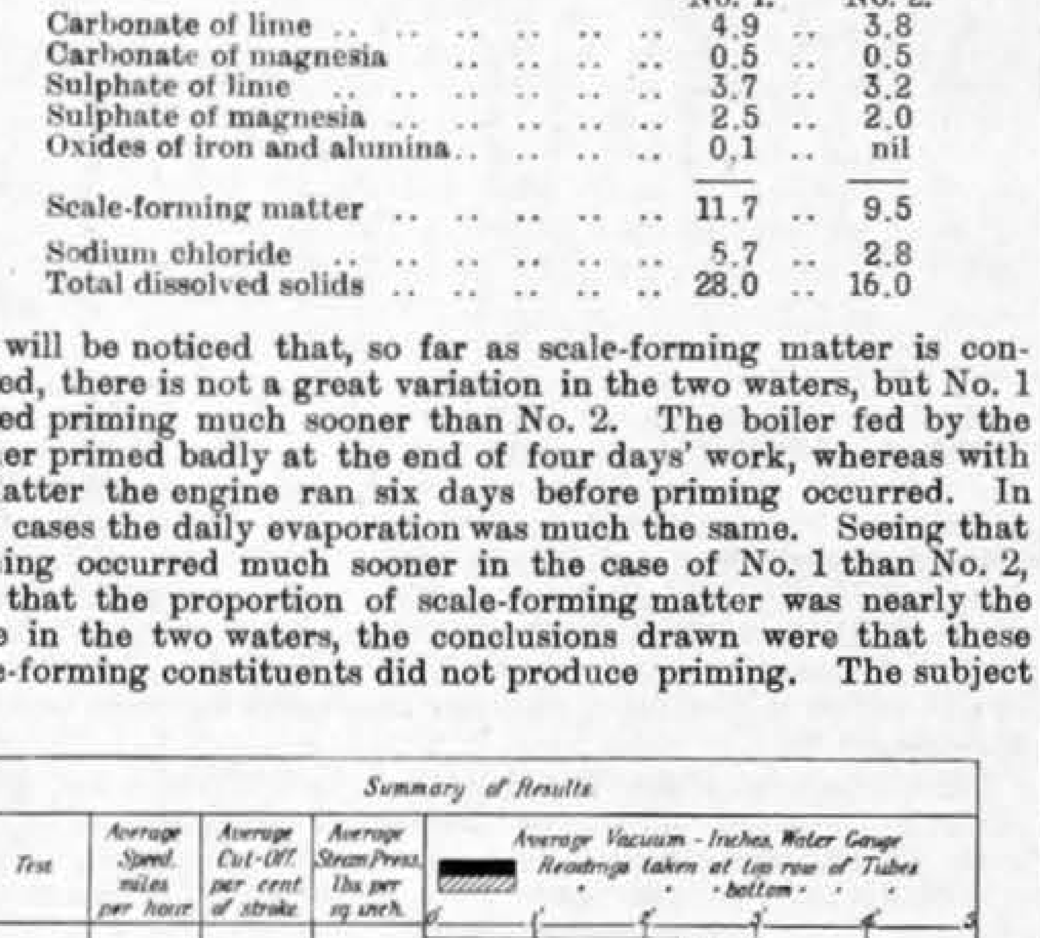


Fig. 62

was next investigated in the light of salts other than scale-forming. These are best described as soda—or soluble salts—the predominating constituent being the sulphate. In order to ascertain to what extent these particular salts influenced priming, very accurate measurements were made of the water collected and evaporated. It was also analysed for the quantity of solids carried into the boiler.

TABLE VIII.—*Showing the Gradual Concentration of Soluble Salts up to the Point of Priming.*

Engine No.	Class of engine.	Day.	Grains of soluble salts per gallon of water in boiler.	Remarks.
1402	10-wheel bogie passenger	1st	46	No priming
,,	,, ,,	2nd	117	,,
,,	,, ,,	3rd	164	,,
,,	,, ,,	4th	210	,,
After 4th day boiler washed out to prevent priming.				
281	Radial passenger tank	1st	127	No priming
,,	,, ,,	2nd	194	,,
,,	,, ,,	3rd	269	Primed badly
262	,, ,,	1st	184	No priming
,,	,, ,,	2nd	266	Primed badly
606	,, ,,	1st	132	No priming
,,	,, ,,	2nd	230	Primed badly

APPENDIX III.

Smoke-boxes, Brick Arches, and Ashpans.

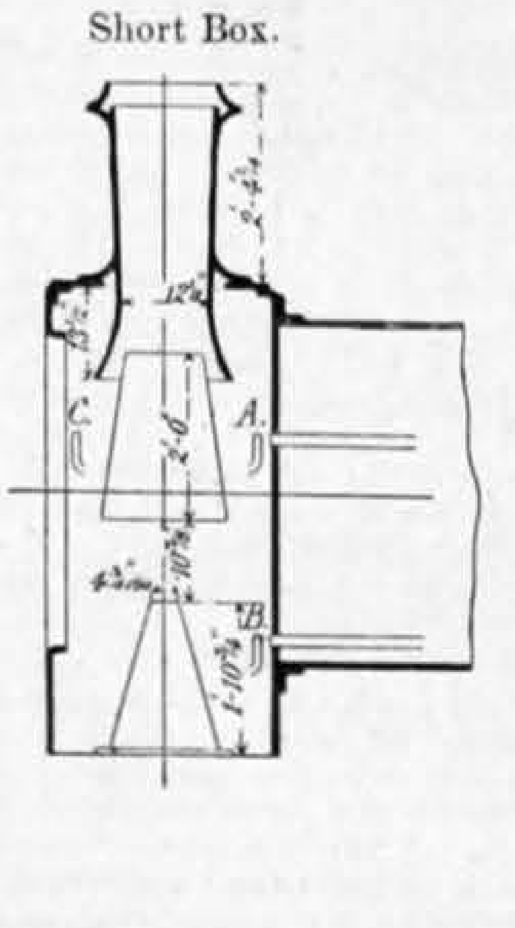
The success of an engine entirely depends upon the boiler, and the excellence of the latter turns on the subject of this Appendix.

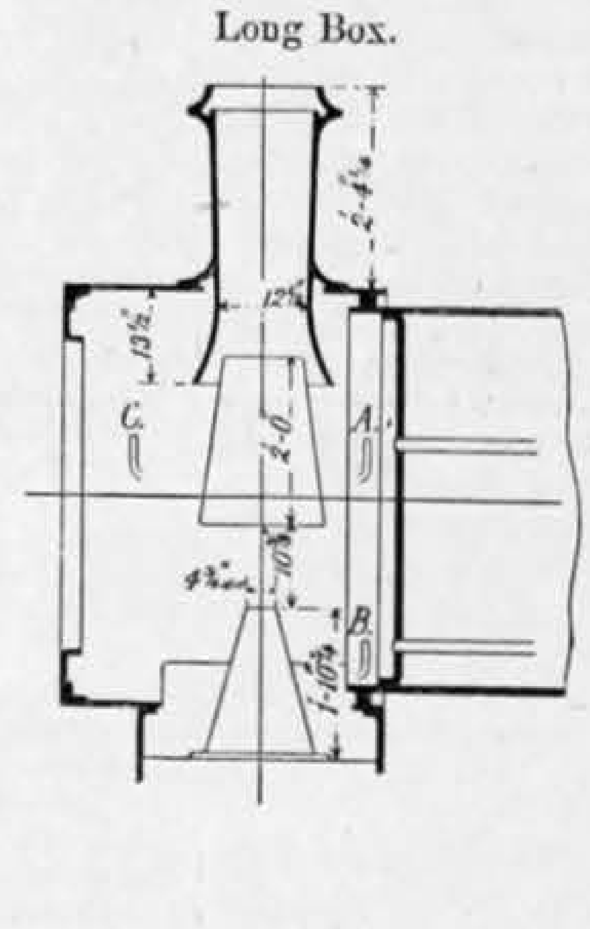
The primary function of the smoke-box and its equipment is the production of draught, to economically burn the fuel at a proper rate, and at the same time to maintain satisfactory steaming when working under all conditions of service. These qualifications are dependent largely upon proper proportions, the location and diameter of blast-pipe nozzle, its relation to chimney and tubes, and height and diameter of chimney. Blast pipes require to have an orifice sufficiently large to prevent back pressure in cylinders, and at the same time small enough to produce efficient draught. A proper disposition of the blast-pipe orifice in its relation vertically to the chimney top, together with its right height from the boiler centre line and a correctly proportioned chimney, will enable the orifice to be increased in diameter.

It must be remembered that an enormous amount of air enters the fire-box, and is immediately expanded six to eight times by rise of temperature, and upon arrival at the smoke-box and exit from the chimney it is two or three times its original volume; and as the office of the smoke-box equipment is to deal effectually with this air, which is a variable quantity, a combination must be discovered for each class of engine which will produce the best all-round efficiency. With a view of arriving at some conclusions on this question, the author has from time to time carried out experiments on certain classes of engines, with the following results :—

Long versus short smoke-boxes.—To ascertain the value of long and short smoke-boxes, observations were taken on two radial passenger tank engines—Figs. 18 and 19, page 121 (*ante*). Particulars are given in Table IX.

Vacuum in Smoke-Box Tests.





Test	Between Manchester and Bolton.					Between Bolton and Entwistle.				
	Vacuum in Inches Water Gauge.			Boiler	Cut-off,	Vacuum in Inches Water Gauge.			Boiler	Cut-off,
Type of Smokebox.	Top row of Tubes. A	Bottom row of Tubes. B	In front of Blast Pipe. C	Pressure, lbs. per sq. inch.	per cent. of Stroke.	Top row of Tubes. A	Bottom row of Tubes. B	In front of Blast Pipe. C	Pressure, lbs. per sq. inch.	per cent. of Stroke.
Short Type.	3"	3"	3"	157	39.2	3"	3"	3"	157	39.2
Long Type.	3"	3"	4"	175	39.2	4.4"	4.4"	5.2"	174	51.7

The Engineer Swain Sc

Fig. 60

Experiments on the position of Blast-Pipes.

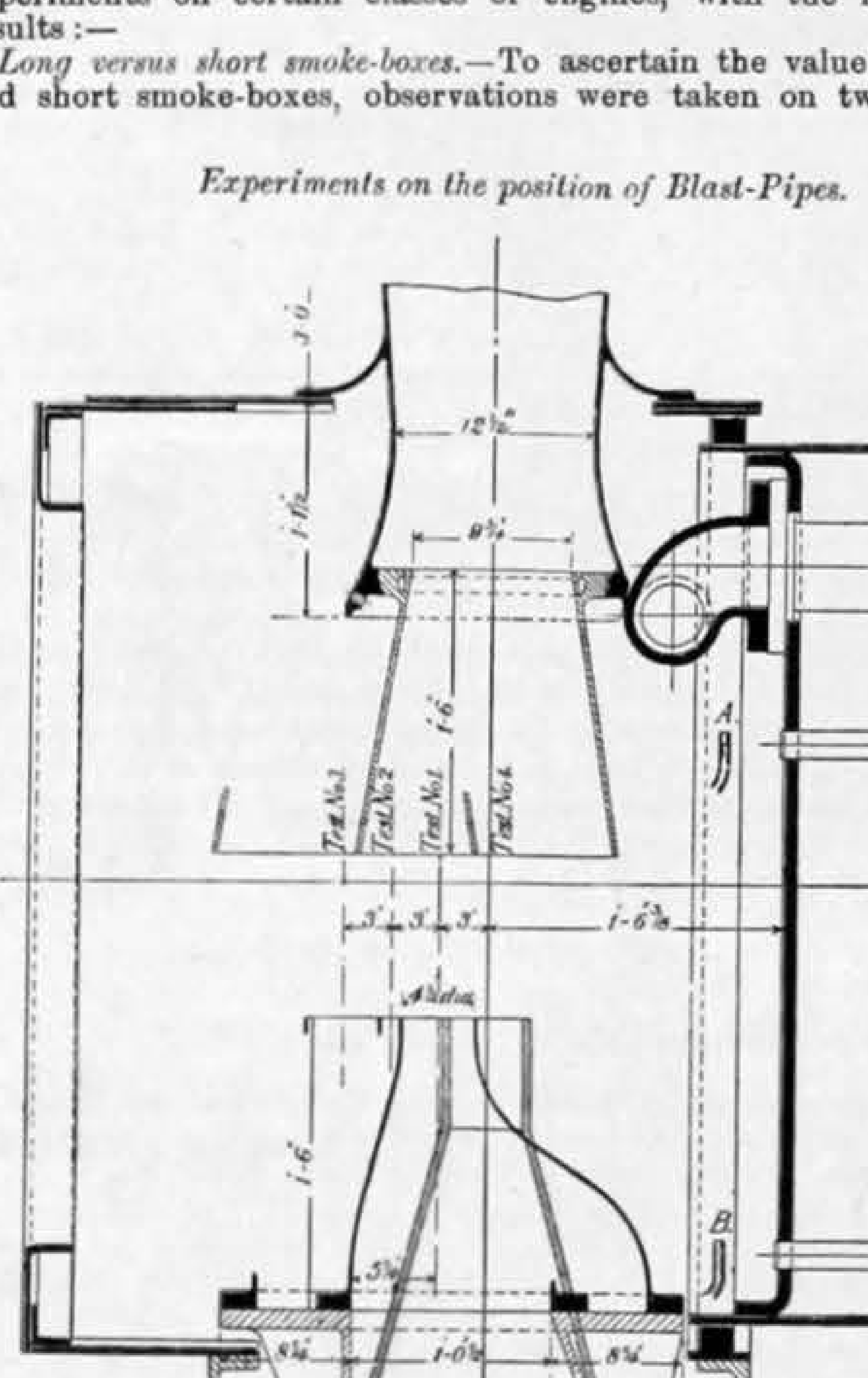


Fig. 63

TABLE IX.—*Long v. Short Smoke-boxes.*

Engine.	Length of smoke-box.	Cubical capacity of smoke-box.	No. of tubes.	Length between tube-plates.	Area through tubes.	Grate area.	Air space through grate.	Per cent. of air space.	Area through ashpan door opening.
Fig. 18	32½	cu. in. 100,190	220	11-0	sq. in. 388.7	sq. ft. 18.75	sq. in. 855.25	32	sq. in. 274.95
19	46½	111,390	220	10-9⅜	388.7	18.75	919.6	34	215·87

Both engines were equipped with identically the same blast-pipe, chimney, and hood, but the smoke-box of Fig. 19, page 121 (*ante*), had a capacity 11 per cent. greater than Fig. 18. The smoke-box arrangements of the two engines are shown in Fig. 60.

Vacuum readings were observed at points A, B, C, through pipes projecting into the smoke-box to the vertical centre line of the engine; the outer end of each pipe was connected by rubber tubing with one leg of a manometer, or "U" shaped glass tube, partially filled with coloured water, and the table underneath gives a summary of the results.

In perusing this table it will be noticed that the vacua are even, all over the tube-plate, indicating that the position of blast-nozzle, hood, and chimney appeared to be about right. With the extended smoke-box, a higher vacuum is recorded at C than at A and B, which tends to prove that the long box serves as a reservoir, thus assisting the maintenance of draught between each exhaust, and so modifying the intermittent character of the blast. This is verified by the action in the glass tubes. With the extended smoke-box the water remains quite steady, and only moves when the steam discharge up the chimney is altered; whereas with the short box the water is in a constant state of agitation, rising and falling with each exhaust. The vacuum in both smoke-boxes was about normal for the cut-offs of 39 and 51 per cent. respectively, but steam pressure was better maintained in the extended smoke-box engine.

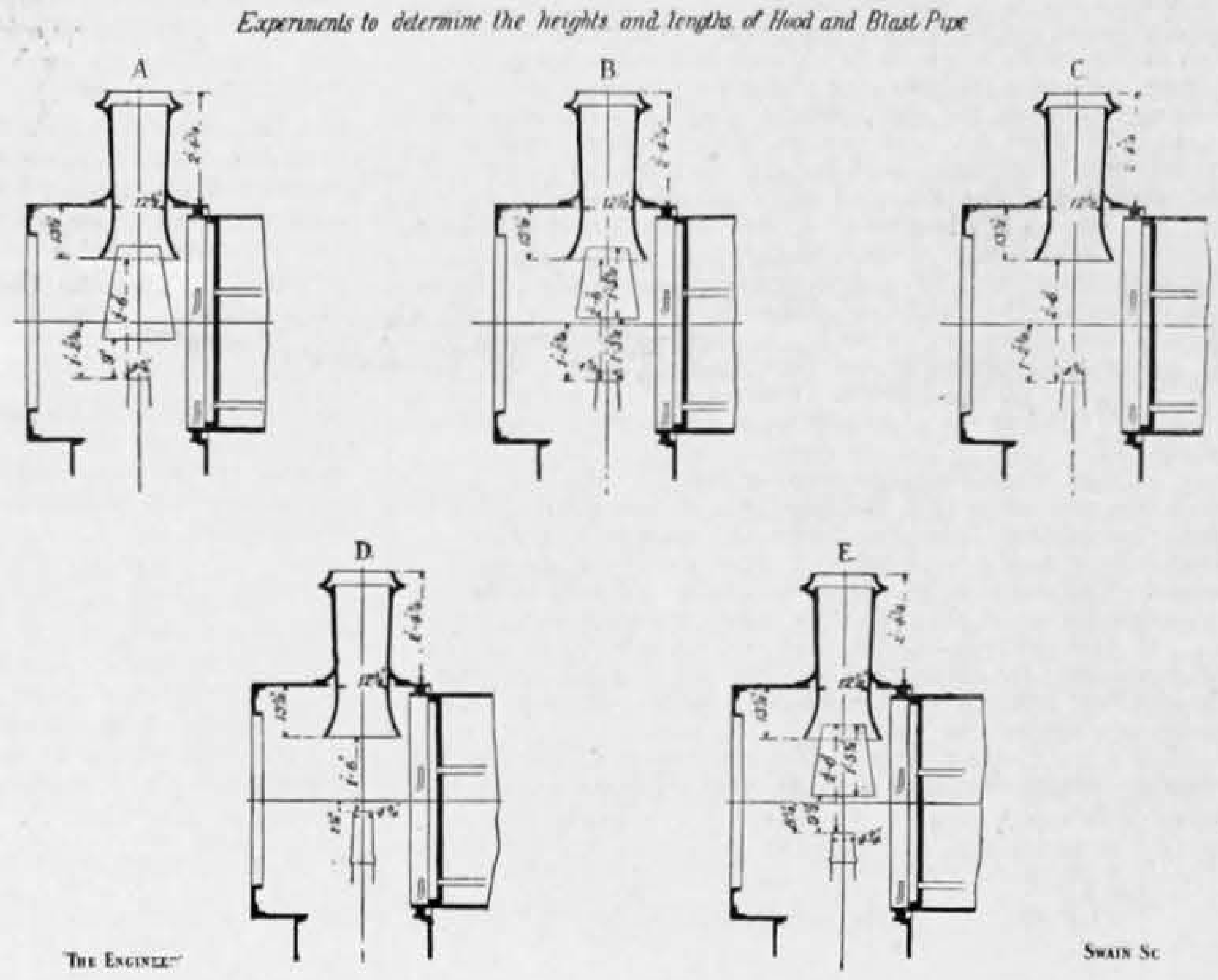


Fig. 61

Experiments to determine the heights and lengths of hood and blast-pipe in relation to tubes.—A series of experiments were conducted on one of the radial passenger tank engines with extended smoke-box—Fig. 19 (*ante*). Five different arrangements—Fig. 61—were tested as follows :—

A. Blast pipe 1ft. 2¼in. below horizontal centre line of boiler; hood 1ft. 11½in. long.
B. Blast pipe 1ft. 2¼in. below horizontal centre line of boiler; hood 1ft. 5½in. long.
C. Blast pipe 1ft. 2¼in. below horizontal centre line of boiler; without hood.
D. Blast pipe 2¼in. below horizontal centre line of boiler; without hood.
E. Blast pipe 9¼in. below horizontal centre line of boiler; hood 1ft. 5½in. long.

On the first four tests the loads were the same, namely, 160 tons behind the drawbar, but on test E the train hauled was 200 tons. The same chimney was used on all trials, namely, 12½in. diameter choke, tapered, and increasing 1.4in. per foot towards the top, length, 2ft. 4¼in. The blast-nozzle was 4¾in. diameter in all cases. Diagrams, letters A to E, show the different arrangements tried,

Table of Results of Tests.					
Position.		Test No. 1.	Test No. 2.	Test No. 3.	Test No. 4.
Vacuum Inches Water Gauge.	At top row of Tubes A.	6.5	6.3	5.6	6.9
	At bottom row of Tubes B.	5.0	6.8	6.0	5.9
Boiler Pressure.		lbs. 177.60	lbs. 181.50	lbs. 176.9	lbs. 180
Maximum Temperature.		880°F	860°F	860°F	850°F
Minimum Temperature.		600°F	620°F	580°F	560°F
Mean Temperature.		730°F	796°F	745°F	754°F

Fig. 64

and the table—Fig. 62 - gives the summary of results. The best conditions were obtained from test E arrangement, as regards the highest vacuum and least variation in the intensity of draught at the top and bottom row of tubes. Test C was also very satisfactory, considering the low vacuum maintained. This, however, is accounted for by the fact of the weather being calm on that occasion, enabling the engine to be operated at an earlier cut-off, and with less demand on the boiler.

Position of centre line of blast pipe in respect to smoke-box tube plate.—To ascertain the best position of the blast pipe in its relation to the tube plate, a number of experiments were carried out. The diagram—Fig. 63—shows the arrangement of the apparatus, and the table—Fig. 64—gives the results of the tests.

The tests were made under similar conditions in regard to route and load. The reversing lever was moved at the same places on the route, and vacuum readings taken accordingly. The weather was similar on all runs, and the same driver and fireman operated the engine. The table shows that No. 2 test gives the best results as regards even draught; so it may be concluded that the blast pipe placed nearly midway between the door and tube plate commends itself. The vacuum readings and smoke-box temperatures seem to be high, but this must be expected, owing to the class of work. Taking the four results, the moving of the blast pipe further from the tube plate has no very serious effect on the steaming of the engine; and if convenience is a consideration in designing smoke-box details, then the blast pipe may be removed without serious consequence.

Results of experiments on four-cylinder passenger engine—Fig. 30 (*ante*).—This engine when first put into service had a 5in. diameter blast nozzle standing 8in. below the centre line of boiler. The chimney was only 12½in. diameter at the choke, and had an extension in the smoke-box of 15in. This extension carried a hood 1ft. 6in. long. Further particulars are given below:—

Length of smoke-box..	68in.
Capacity of smoke-box	249,000 cubic inches.
Number of tubes..	235.
Length of tubes	15ft.
Area through tubes	554.0 square inches.
Grate area	27.0 square feet.
Air space through grate	9.47 „ „
Percentage of air space	35.
Area through ashpan, door open	394.0 square inches.
Minimum area of ashpan opening	63.0 „ „

On the first trial it was evident that the nozzle was too small, and it was decided to open it out to 5½in. This step, however, at first had a detrimental effect on the steaming, until the author tried a chimney of a different design. He retained the same pattern, but cut down the extension portion, to penetrate into the smoke-box 2in. only, which increased the choke to 13½in. diameter. He also belled out the entrance to 18in. diameter. It was apparent at once that this form of chimney, although not quite satisfactory, improved the steaming; therefore further investigations were conducted on the best height of nozzle, and eventually it was found to be about 4in. below centre line of boiler. During these experiments, complaints were frequent that the fire burnt dead at the back end of the fire-box, and conclusions were drawn that this was due to the restricted air space opening in the ashpan, where it is narrowed down in depth to clear the trailing axle. The author next decided to give additional air supply to the back end of grate. He therefore connected the front and back portions of the ashpan by an air duct. This addition increased the air supply opening over 300 per cent., and has proved very beneficial in promoting combustion. The ashpan and firebar arrangement with air duct for a four-cylinder passenger engine is shown in Fig. 65.

A further experiment has recently been made with a larger blast pipe and chimney. The blast pipe is cast with a bridge, so that the exhaust from the inside and outside cylinders is led away independently, and does not meet until near the top of the nozzle. The nozzle is 6in. diameter, and the chimney choke 16in., the same design of chimney with short extension being adhered to. At first this combination was not successful, but after several trials with varied heights of blast pipes, a position was discovered—viz., 6in. below centre line of boiler—which produced an excellent steaming engine.

These experiments go to prove the importance of ascertaining the correct positions and proportions of blast pipes and chimneys; for here is a case of an engine which would not steam with a 5½in.

Ashpan and Fire-bar Arrangement for 4-Cylinder Passenger-Engine.

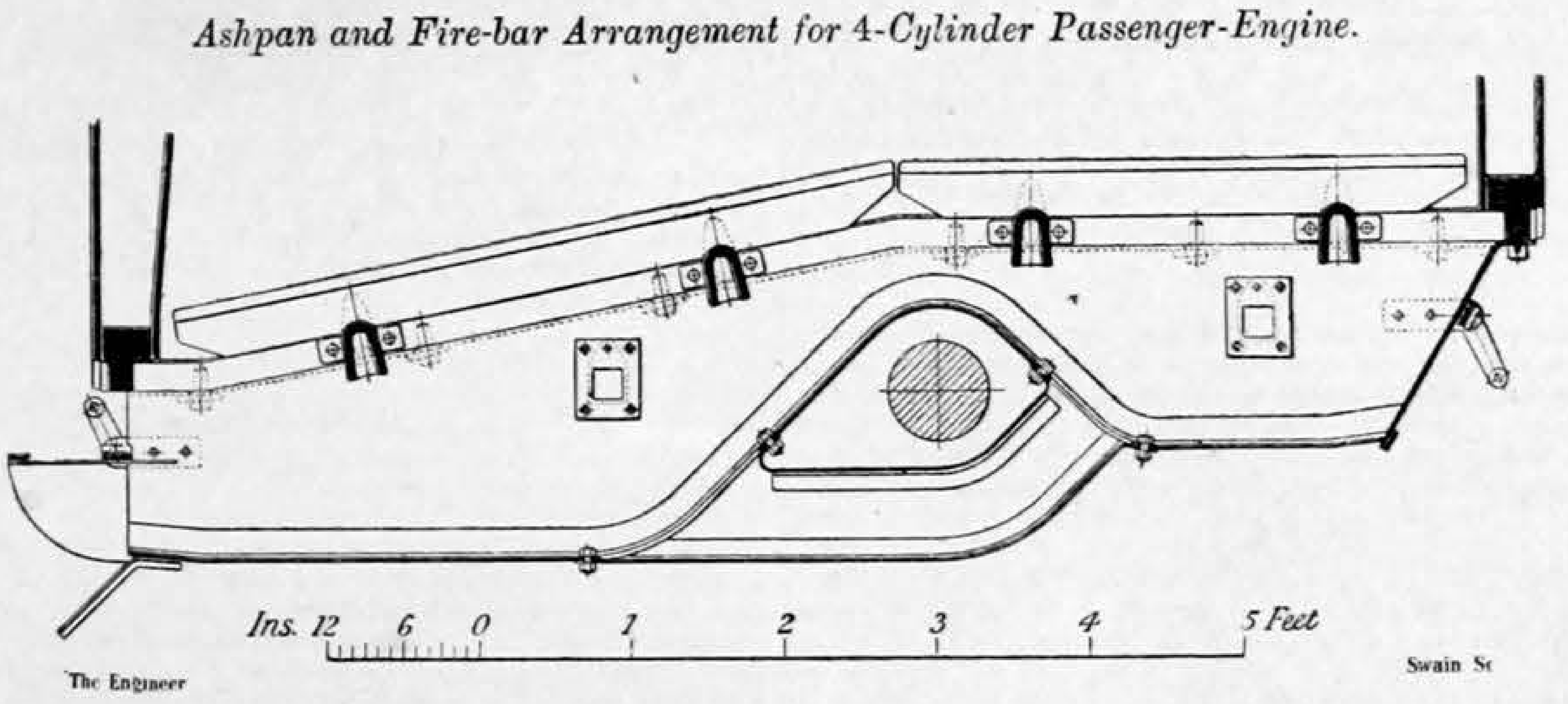


Fig 65

blast pipe, but which eventually, after numerous experiments, steamed well with a 6in. nozzle. Attempts have been made in America to standardise front ends, with some amount of success; but it appears to the author that each new design of locomotive demands some experimental work, in order to arrive at the best steaming position of blast pipe, diameter of chimney, &c.

Smoke-box doors.—These are much larger than ten years ago. They cannot be kept perfectly tight by the single crossbar and central bolt arrangement, and a number of dogs pitched equally round the periphery of the door is essential. The wear and tear of smoke-boxes has increased of late years, particularly that class with the sides fastened to the main frames of the engine. The round smoke-box, supported on a cast iron saddle, has much to recommend it. The author has adopted this design on several tank engines, and also on the four-cylinder passenger engine. This latter smoke-box has been clothed with asbestos and a thin clothing sheet, for the purpose of reducing cost of maintenance.

Brick arches.—All engines are fitted with brick arches. These extend from the tube plate to about half the length of the fire-box. The rake of the arch is governed to some extent by the position of the fire-hole above the grate. When this distance is small and the fire-box long it is necessary to incline the arch, so that there is no chance of throwing the fuel upon it. With the fire-boxes which have horizontal grates the arch slopes upwards, pointing to the top side of the fire-hole. In the four-cylinder engine the slope points to the top corner of the back plate. The function of the arch is to assist combustion by maintaining a high temperature, and to direct the gases round the fire-box, especially so that they impinge against the top and back plates. The fire-hole deflector is used to prevent the air passing direct to the tubes.

Ashpans.—All ashpans are made of ample dimensions, so that the accumulated ashes do not hinder air supply. The damper doors open as wide as possible to allow a maximum air supply, and for convenience of raking. The bottom is made to retain water for quenching the ashes, a small pipe being connected to the injector feed pipe, and led to the ashpan for that purpose. The damper door-handles are fixed on the fireman's side of the engine, and have a screw arrangement for adjusting the amount of air and for closing the door practically air-tight.

There is ample room for discussion and experiment on the subject of this Appendix. It is remarkable what a small amount of information is available.

The Naval Repair Ship Cyclops.—We omitted to state in our article on the naval repair ship Cyclops, in our issue of the 23rd ult., that the blocks mentioned in line three of the centre column of page 77 were supplied by the Carron Company, of Carron, Stirlingshire.

Main Drainage Extension in London.—The tenders for the southern low-level sewer No. 2 from Deptford to Battersea have now been received by the London County Council, and it is recommended that one amounting to £473,416 13s. 6d. be accepted. This sewer will be over seven miles in length, and is intended to relieve the existing low-level sewer, and so diminish the possibility of flooding in the low-lying districts through which it will pass. In view of the fact that for about five miles of its length it will pass through water-logged ground, it will be necessary to use compressed air in its construction. The contract time for the work is three years. The sewer forms part of the scheme of main drainage extension adopted in December, 1899, and when this portion of the work is put in hand the whole of the new sewers provided for in the scheme will either have been completed or be in course of construction.

MECHANICAL TRANSPORT IN THE COLONIES.

A Blue-book has recently been issued dealing with mechanical transport in non-responsible Government Colonies and Protectorates, and containing the replies of the Governors, &c., to a series of questions grouped under the headings of roads, tracks, bridges, nature of goods carried, fuel, water, labour, workshops, &c., addressed to them by the Secretary of State for the Colonies.

The development of these colonies, and in particular of the possessions in East and West Africa, is intimately connected with problems of transport and communications, and, recognising this, the Colonial-office some time ago took the necessary steps for securing information on the methods of mechanical transport other than railways, and the facilities and suitability for such afforded in the various colonies. The co-operation of the Mechanical Transport Committee of the War-office was secured for advisory and other purposes.

In the replies it is shown that the majority of the colonies considered are unsuited for mechanical transport of the kind contemplated. The reasons for such unsuitability are various, but have chiefly to do with the poor class of roads in existence at present. In some cases, however, it is stated that in the future, when conditions have altered and improved, such means of transport may be introduced advantageously. In others, the introduction of traction engines and motor cars, lorries, &c., would be inadvisable owing to the strong competition which would be experienced from transportation by means of the adjacent rivers. In not a few cases the Governors report that their particular colonies are more or less well suited for the specified purpose, but that so far enterprise is lacking in this direction.

The Governor of the East Africa Protectorate makes the suggestion that in his opinion the most satisfactory and economical method of dealing with road transport is by employing some form of mono-rail erected at the sides of the public roads. He claims for this method that no metalling of the roads would be required, and that the only detail of construction requiring especial care during the rainy season would be the track on the road on which the "balance wheel" of the car would run. This, he adds, could be satisfactorily attended to by laying down a band of sand running parallel with the rail, say, 1ft. in width and 1in. deep. The mono-rail rolling stock can be drawn by mechanical, animal, or manual traction.

Not the least useful part of the present volume is that containing the remarks of the Mechanical Transport Committee of the War-office on the reports received from the Colonies concerned, and its recommendations as to the most suitable methods which might be employed in each particular colony for introducing or increasing the advantages to be derived from this form of transport.

CATALOGUES.

Haslam and Schontheil, Western Mail Chambers, Cardiff.—From this firm we have received a new price list of electric light water-tight fittings suitable for various classes of service.

The General Electric Company, Limited, 71, Queen Victoria-street, London, E.C.—A little pamphlet giving prices, particulars, and illustrations of Freezor electric fans suitable for alternating and continuous current circuits.

Clarke's Crank and Forge Company, Limited, Lincoln.—All classes of cranks for steam and gas engines, motor cars, commercial motor vehicles, and launches, are illustrated in a little catalogue which has been forwarded to us by this company.

The Consett Iron Company, Limited, Consett, Co. Durham.—We have received a portfolio of circulars dealing with this company's manufactures. Illustrations, prices, &c., are given of chequered plates, sectional steel, fire-bricks, quarls, &c.

Jens Orten-Boving, 72-74, Victoria-street, London, S.W.—A new catalogue from this firm deals with Dr. Horn's patented tachometers, tachographs, engine counters, &c. Prices and full particulars relating to these instruments are given, and there are many illustrations.

The Brush Electrical Engineering Company, Limited, Loughborough.—The June issue of the "Brush Budget" is a special textile number, and it contains illustrations of dynamos and motors in operation in textile mills. Short and interesting articles accompany these illustrations.

John Cameron, Limited, Salford, Manchester.—A booklet of illustrations of the various kinds of machines made by this firm has recently been issued. It contains excellent photographic reproductions of ram and piston pumps, punching and shearing machines, gas engines, and gas producers.

Cookson and Co., Albion House, 59 and 61, New Oxford-street, London, W.C.—Some literature to hand from this company has reference to electro-magnetic separators suitable for various purposes. Illustrations, prices, and other particulars are given in a concise little pamphlet. Prices of dynamos, which may be used for working these machines when electric power is not available, are also given.

Tangyes Limited, Cornwall Works, Birmingham.—List No. 129 has reached us. It illustrates, describes, gives prices, weights, dimensions, and other particulars relating to Tangyes' "T" type gas engines and suction gas producers. We have also received a type-written report on a test carried out by R. Mathot on a gas engine and its producer manufactured by Tangyes Limited. The results given in the report are highly satisfactory.

The Consolidated Pneumatic Tool Company, Limited, 9, Bridge-street, London.—A well-compiled catalogue having reference to Franklin air compressors has reached us. These compressors are described in detail, and there are illustrations of the component parts. The various types of Franklin compressors are dealt with, and there are tables giving capacities, dimensions, floor space required, piston displacements, &c., for each type.

The Avonside Engine Company, Limited, Fishponds, Bristol.—An illustrated catalogue of locomotive engines of all sizes, types, and gauges, has reached us. It is a well got up publication containing nearly 120 pages, which bear illustrations of locomotives, tables of dimensions, code words, &c. Full particulars are also given of Avonside steam railway motor cars and exhaust heat boilers. Instructions for cabling are included at the end of the catalogue.

Capel and Co., 168, Dalston-lane, London, N.E.—This company has sent us its list pertaining to combined electric lighting sets suitable for either petrol, paraffin, alcohol, naphtha, methylated spirit, town or suction gas. Also lists having reference to a petrol or paraffin agricultural engine for farm work, pumping, &c., and the company's new continental type suction gas engine and regenerator gas plants. A complete specification with illustrations is given in each case.

Adams Manufacturing Company, Limited, 106, New Bond-street, London, W.—This is a catalogue which illustrates and describes some standard types of "Igranic" motor starting and controlling apparatus for alternating and direct-current circuits. Numerous different kinds of starters are dealt with, including self-starting rheostats. Prices, dimensions, &c., are given in tabular form. From this catalogue a starter may be selected to suit almost every ordinary requirement.

Erith's Engineering Company, Limited, 70, Gracechurch-street, London, E.C.—From this company we have received a well got up little catalogue dealing with Erith's grateless underfeed stokers, which are claimed to respond automatically to widely varying loads. We are informed that these stokers are in use in connection with the steam plant at the Port Huron Tunnel, where the electrical load varies in 14 minutes from 0 kilowatts to 1950 kilowatts, and that they automatically respond to this remarkable load variation.

Witting Brothers, Limited, 49, Cannon-street, London, E.C.—A pamphlet has reached us which has reference to a pump valve of which Witting Brothers, Limited, have acquired the rights of manufacture, and sale in Great Britain and the Colonies. These valves are suitable for all kinds of high and low-speed pumps, also for blowing engines, compressors, &c. They are claimed to increase greatly the capacity and efficiency of pumps, and to ensure silent working. The pamphlet gives a concise description of the valves.

The Cradley Boiler Company, Cradley Heath, Staffordshire.—A copy of this company's latest catalogue of steam boilers, &c., has been forwarded to us. It has reference to Lancashire boilers, Cornish boilers, colonial or brush boilers for wood fuel, colonial tubular boilers for burning wood externally fired, vertical boilers of various constructions, locomotive-type boilers, horizontal multi-tubular boilers, dry back marine return tube boilers, marine return tube, or Scotch boilers, Cornish Trentham hot water boilers, oil tanks, steel buoys, donkey boilers, &c. It is a well got up publication.

The British Steel Piling Company, Dock House, Billiter-street, London, E.C.—A copy of this company's catalogue of steel sheet piling and pile driving accessories has reached us. The catalogue has been drawn up specially to meet the requirements of those residing in the Colonies and abroad, and full details are given to enable engineers to choose the machine or piling most suited for specific purposes without loss of time in writing home for particulars. There are many excellent illustrations, some of which show work which has been carried out with the company's steel sheet piling.

B. R. Rowland and Co., Limited, Reddish, near Manchester.—This firm has sent us a copy of an illustrated catalogue of emery and corundum grinding wheels and machines. All grinding wheels are made of carbo-corundum, pure crystal Canadian corundum, and genuine emery. Carbo-corundum is made by an electro-chemical process, and is said to be much harder than emery and natural corundum. It is infusible at the highest heat and is insoluble in all liquids. In addition to full particulars and illustrations of machines turned out by this firm, the book contains full instructions for ordering abrasive wheels.

The India-rubber, Gutta-percha, and Telegraph Works Company, Limited, Silvertown, London, E.—This company's latest price list of mechanical rubber goods has reached us. Among other things it has reference to india-rubber sheet, insertion sheet, washers, india-rubber buffers, special shaped buffers and pads, solid india-rubber cord, india-rubber valves, large roller covering, trolley wheel covering, steam hose, suction hose, hydraulic hose, vulcanised machine belting, steam packing india-rubber brake blocks, corrugated matting, india-rubber tubing, acid tubing, draught tubing, india-rubber gloves and gauntlets, &c.

The A.E.G. Electrical Company of South Africa, Limited, Caxton House, Westminster.—Some useful price lists have reached us having reference to slow speed three-phase motors, lift controlling gear, large three-phase induction motors, electric annealing and tempering plants, iron switch cases, single-phase and two-phase induction motors, and small continuous-current motors and generators. The first part of each of these lists is devoted to illustrations and descriptions of the machines and apparatus with which they deal, whilst the remaining pages give tables of prices, dimensions, and other particulars necessary for ordering.

B. and S. Massey, Openshaw, Manchester.—The fourth of this firm's admirable series of catalogues has just come to hand. It deals with drop stamps, &c., for die work, and is numbered 1600 H. Our readers are familiar with the three earlier catalogues dealing with steam hammers, power hammers, and hand saws. The contents of the newly-issued catalogue include, besides a well-written introduction on the art of stamping in dies, chapters on steam drop stamps, friction drop stamps, board drop stamps, double-acting steam stamps, trimming presses and furnaces, sundry notes and a telegraphic code. Engineers who are not fully familiar with the multifarious types of article which can be produced cheaply and efficiently as stampings will find on pages 40 to 45 some excellent examples of work with weights and dimensions. The book is equally as well produced as its predecessors.

Contracts.—The Underfeed Stoker Company has recently received orders for its stokers from James Buchanan and Co., Limited; Bryant and May, Limited, Bow (repeat order); the Treloar Cripples' Home, Alton; the Western Infirmary, Glasgow; James Keiller and Sons, Limited, Silvertown; the General Post-office, Mount Pleasant; the Carlisle Corporation, and the Bath Corporation.—The Mirrlees Watson Company has recently received orders for thirteen sets of condensing plants of different types, varying in size from 10,000 lb. to 43,000 lb. of steam condensed per hour, the last named plant being a repeat order.—John Booth and Sons, of Bolton, Lancashire, have recently completed an order, secured through their London agent, for steel-frame buildings, bunkers, &c., for a large generating station to be erected by them near Dawson City, in the Klondyke. The order includes engine-house, boiler-house, and 1000-ton capacity bunkers. The material has been forwarded by the new route across the isthmus of Tehuantepec, Mexico, to Salina Cruz, where it will be re-shipped and carried up the Pacific by special steamer to Skagway, Alaska.

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

(*From our own Correspondent.*)

Work Resumed.

This week work has been resumed since the holidays, so that the wheels of trade are once more beginning to revolve. There was rather more hopeful tone on 'Change in Birmingham on Thursday, but taking things all round business cannot be considered to be anything but quiet. However, here and there there are indications of better times ahead. The improved reports from America and the prospects of a good English harvest, now that the weather has picked up after the cold spring, are both factors in favour of commercial betterment.

Orders for Cable Iron.

Some good orders for cable iron are understood to have been placed in this district in connection with the equipment of the new "Dreadnoughts." These would be for best cable bars, which is one of the highest qualities of iron made in the Midlands. Rivet iron is also in better request than recently. The basic price for ordinary marked bars is still £8, with 12s. 6d. extra for Earl Dudley's L.W.R.O. brand. Unmarked bars are quoted £5 17s. 6d. to £6, with a moderate demand.

The Galvanised Sheet Trade.

The condition of open quotations in the galvanised corrugated sheet trade still obtains, there being no longer any Association figure. The general quotation in bundles f.o.b. Liverpool for 24 gauge is £10 10s. to £11, but instances have occurred of less being accepted. The foreign trade is much better than it was a year ago, the July shipments having improved from 28,081 tons to 39,501 tons, and the seven months' exports from 220,199 tons to 270,995 tons. The corresponding increase in value has been from £393,332 to £546,036, and from £3,075,767 to £3,750,049. So far this year there has been a considerable increase in the exports to the Argentine Republic compared with a year ago—from 37,920 tons to 56,200 tons. There has also been a slight increase with India—from 53,764 tons to 54,396 tons. Trade has also grown very much with Australia—namely, from 32,864 tons to 48,420 tons. Whether the Association will be re-formed or not remains to be seen, but at present there seems to be no encouraging prospect in that direction. Plain black sheets are in very quiet demand, and prices are weak, although quotations remain nominally as follows:—Singles, £7 to £7 2s 6d.; doubles, £7 2s. 6d. to £7 5s., and trebles, £7 15s. to £7 17s. 6d.

Other Kinds of Manufactured Iron.

There is a quiet inquiry for hoop iron at £6 15s., for gas strip at £6 5s. to £6 7s. 6d., and for slit nail rods at £7.

The Steel Trade.

A fair amount of work is in hand for steel sections, and quotations are maintained. Angles are quoted £5 10s. to £5 15s.; girder plates, £5 15s. to £5 17s. 6d.; joists, £5 10s. to £5 15s.; mild bars, £6 7s. 6d. to £6 17s. 6d.; and boiler plates, £7. The call for semi-finished steel has quietened down. Bessemer sheet bars are still quoted nominally £4 12s. 6d. and Siemens £4 15s., but there is a great deal of continental competition, and continental supplies are being obtained in increasing quantities at considerably below these figures.

The Pig Iron Trade.

Improved American advices are having a good influence upon the pig iron trade, which is, therefore, showing more life. Quotations are about the same as recently, cold blast being quoted 110s.; best all-mine, 80s. to 81s.; part-mine, 48s. to 49s. 6d.; and Staffordshire common, 46s. There is rather more inquiry than recently for Northamptons at 45s. 6d. to 47s., and for Derbyshires at 47s. 6d. to 48s. 6d. There is little life in North Staffordshire descriptions, which are quoted 49s. to 50s.

The Midland Railway Carriage and Wagon Company.

At the yearly meeting of this company, held in Birmingham on August 10th, Mr. H. F. James presiding, a dividend was declared on the ordinary shares at the rate of 7½ per cent., and a bonus of 10s. per share, also a dividend on the preference shares at the rate of 6 per cent. The gross profit was £26,830 7s. 6d., which, with £4152 0s. 4d. brought forward, made a total of £30,982 7s. 10d. The division on the ordinary shares (including bonus) is equal to 12½ per cent., or the same as has been declared for 12 years without a break. The large new works at Washwood Heath have been started. Colliery wagons forms one of the chief departments of the company's business.

East Worcestershire Water Supply.

In their sixtieth half-yearly report the directors of the East Worcestershire Waterworks Company state that during the half-year ended June 30th there have been laid on eighty-three additional services, making a total of 7581, exclusive of the districts supplied in bulk. Extensions of the mains have been made at Redditch in three new roads, and a new concrete coal-yard has been put down at Burcot. The directors have considered the question of increasing the yield of water at Burcot, and have decided to sink a shaft near No. 3 borehole, and to be connected therewith at a depth of 100ft. When this is completed, the borehole, which is now 400ft. deep, can be carried further, possibly into the pebble beds.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

MANCHESTER, Thursday.

A "Bullish" Market.

It would appear as if the long looked for "boom" in pig iron has at last set in. Although the attendance on the Iron Exchange yesterday was greatly under the average, there was no mistaking the fact that inquiry was strong, if not active, and it was reported that there had been some anxiety manifested by consumers to cover not only present but prospective wants over a fairly long period. The announcement that the duty on pig iron into the United States had been reduced 1½ dol. per ton, coupled with the settlement of the coal dispute in Scotland, has had much to do, it is said, with the long-deferred improvement. Shipments, especially from the East Coast, have been unusually heavy, and both foundry and hematite iron have registered higher figures on the week. There is also an advance of about 6d. per ton in Scotch brands, which buyers, however, pay very reluctantly. Lincolnshire and Derbyshire are also a shade firmer. West Coast hematite is held for full rates, although the demand is by no means brisk. Forge iron rules in sellers' favour, but there is little business on spot.

Finished Iron and Steel.

There is a quiet steady business passing, and plates for tank, girder, and bridge work are quoted 5s. per ton higher.

Copper, Lead, and Tin.

The position of manufactured continues quiet, and there is no change in price in any department. Lead: Sheet is dull and unchanged. Tin: English ingots are a turn dearer.

Quotations.

Lincolnshire No. 3 foundry, 52s. 6d.; Staffordshire, 51s. to 51s. 6d.; Derbyshire, 52s. 6d. to 53s.; Middlesbrough, open brands, 58s. 4d. to 58s. 7d. Scotch: Gartsherrie, 60s. to 60s. 3d.; Glengarnock, 59s.; Eglinton, 58s. to 58s. 6d.; Dalmellington, 58s. to 58s. 6d., delivered Manchester; West Coast hematite, 58s. 6d.; East Coast ditto, 56s., both f.o.t. Delivered Heysham: Gartsherrie, 58s. to 58s. 3d.; Glengarnock, 57s.; Eglinton, 56s. to 56s. 6d.; Dalmellington, 56s. to 56s. 6d. Delivered Preston: Gartsherrie, 59s. to 59s. 3d.; Glengarnock, 58s.; Eglinton, 57s. to 57s. 6d.; Dalmellington, 57s. to 57s. 6d. Finished iron: Bars, £6 10s.; hoops, £7 12s. 6d.; sheets, £7 15s. to £8. Steel: Bars, £6 5s.; Lancashire hoops, £7 5s; Staffordshire ditto, £6 17s. 6d. to £7; boiler plates, £7 2s. 6d.; sheets, £7 17s. 6d. to £8; plates for tank, girder, and bridge work, £6 5s.; English billets, £4 12s. 6d. to £4 15s.; foreign ditto, £4 10s. to £4 12s. 6d.; cold-drawn steel, £9 5s. to £9 10s. Copper: Sheets, £71; tough ingot, £62 to £62 10s.; best selected, £62 to £62 10s. per ton. Copper tubes, 8¼d.; brass tubes, 6⅝d.; condenser, 7⅞d.; rolled brass, 6¼d.; brass wire, 6¼d.; brass turning rods, 6¼d.; yellow metal, 6d. per lb. Sheet lead, £17 7s. 6d. per ton. English tin ingots, £132 per ton.

The Lancashire Coal Trade.

There was practically no business passing on the Coal Exchange on Tuesday. The hot weather caused a slump in house coal, and prices in all departments were quite nominal.

BARROW-IN-FURNESS, Thursday.

Hematites.

Although the hematite iron trade remains quiet, there is a stronger feeling, and the opinion is generally entertained from evidences which are presenting themselves on every side that the trade is on the eve of a much more active state of things. The home demand is largely regulated by the volume of steel makers' requirements. These are at present moderate, but they are expected to be greater. On continental account a fairly good business is being done with armour-making firms and with engineers. Sales to colonial users of metal are not large, and the business doing on foreign account is small. There are, however, better prospects from America, and it is expected good business will soon be done with that country. Prices are rather firmer, although quotations show no improvement, except in warrants. Mixed Bessemer numbers are at 58s. net f.o.b. nominal, and warrant sellers are at 57s. net cash, buyers 56s. 9d. The sales of warrant iron are few. Most of the trade being done between producers and consumers. In special hematite iron there is a moderate trade, and prices are at about 60s. to 61s. 6d. per ton, while specially good classes realise more money. There has been an increase of 500 tons in warrant stocks, which now stand at 13,510 tons. The stocks held by makers show slight increases, but the bulk of iron held in makers' yards is comparatively slight, and is well below a week's production of the twenty-six furnaces in blast. Ferro-manganese is selling fairly well, and there is a fair demand for spiegeleisen as well on home as on foreign account. Iron ore is in fair sale, but commoner sorts find but a poor market. Good average classes of native ore realise 11s. net at mines, medium 13s. 6d., and best 17s. per ton.

Steel.

No. 1 rail mill at the Workington Iron Company's works—Cammell, Laird and Co—has been restarted this week. It is probable now that the combine has been formed No. 2 mill will not again go into operation, but the company own also the Moss Bay Works, where the rail mill is working. The Bessemer and rail department of the Barrow Steel Works is running, but none of the firms in this district is over well supplied with orders. The outlook, however, is said to be better than of late. In merchant steel very little business is being done, while the plate mills are at a standstill, and probably will remain so until shipbuilding is better employed than at present.

Shipbuilding and Engineering.

Shipbuilders are expecting new orders, but business is difficult to get, and most of it takes a deal of negotiation. There is very little work at present in hand in the shipbuilding yard of the Vickers' works, but engineers are growing busier every week. This is mainly in the gun-mounting department. Marine engineering is quiet.

Shipping and Coal.

The shipments of iron and steel from West Coast ports last week amounted to 8149 tons—iron, 4970 tons; and steel, 3179 tons—as against 7310 tons in the corresponding period of last year, an increase of 839 tons. For the year to date the shipments aggregate at 359,379 tons, against 305,567 tons for the corresponding period of last year, an increase of 55,812 tons. Coal and coke in moderate sale at late prices.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

After the Holidays.

Most of the large firms got back to work about the beginning of the week, but there is still a holiday feeling about, as is usual at this time of the year, and this, coupled with a general slackness of trade, causes an absence of briskness even after Bank Holiday. In a good many quarters there has been shown a disposition, owing to the broken time worked, to make Bank Holiday the vacation of the year.

Coal Shipments.

Shipments of coal at present are rather heavy, owing partly to the check experienced a few weeks back by the various stoppages. The majority of the pits supplying steam coal are working as much time as the local "feasts" will allow, and the miners, having, in football phrase, had their "kick-off," are settling down. Prices for immediate delivery, not on contracts, continue from 9s. to 9s. 6d. per ton at pit. From the figures supplied by the Hull Chamber of Commerce, referred to elsewhere, it will be seen that the export trade continues satisfactory. That tendency is maintained in the latest return available for the week ending August 3rd, which shows a total of 103,696 tons, compared with 55,166 tons for the similar period of last year. The exceptionally large trade done with North Russia keeps well up, Cronstadt, for the week concerned, leading the list of foreign deliveries from Hull with a total of 23,111 tons. Alexandria follows with 13,022 tons, and Rotterdam is third with 11,453 tons. The trade rupture in Sweden has thrown more material on the market, but this, again, has been counteracted to a considerable extent by the stoppages alluded to at certain pits. The demand for trawlers' purposes is stated to be scarcely as active as it was.

House and Gas Coal.

With the settlement of labour difficulties, the holidays, and the exceptionally warm weather, the demand for domestic fuel has naturally abated somewhat, both on metropolitan account and also from country stations. But a very good business is still doing, for the most part in the higher grades of coals, in which quotations are not affected. Best Barnsley, 11s. 6d. to 13s. per ton at pit; secondary sorts, from 10s. to 11s. per ton at pit. For secondary sorts are rather a slow market, and values are scarcely so firm. The trade at present is largely on account of householders laying in winter supplies. Gas coal contracts may now be considered settled, prices, as before remarked, ranging generally from 6d. to 9d. per ton lower than last year. Sales from the district have been fairly up to the average, but not more.

Small Coal and Coke.

Coal prices are maintained, best washed making from 10s. 6d. to 11s. per ton, and unwashed from 10s. to 10s. 6d. per ton. Small coal is also in fair demand, partly for coking purposes and Lancashire and Yorkshire cotton and woollen mills' requirements, which do not seem to have abated very much. For the latter qualities, the quotations previously given, from 4s. 6d. to 5s. 6d. per ton are maintained. Coking smalls are in rather better supply than during recent weeks.

The Iron Market: Advance in Lincolnshire Iron.

At a meeting on Friday last the Lincolnshire Ironmasters' Association advanced all pig iron prices 6d. per ton, except basic, which was not altered. The official quotations are now as follows:—No. 3 foundry, 50s. 6d. per ton; No. 4 foundry, 49s. 6d. per ton; No. 4 forge, 49s. 6d. per ton; No. 5 forge, mottled and white, 49s. 6d. per ton; basic, 50s. 6d. per ton net delivered in Sheffield or Rotherham. The much better trade reports from the United States, and the general impression that things are likely to improve here, are responsible for this slight advance in pig iron. So far, however, the advance has not stimulated the demand. The Derbyshire makers are also disposed to ask for a little more, but official quotations remain unchanged, with prices firm, and little disposition to press sales. Derbyshire No. 3 foundry, 49s. 6d. to 50s. per ton; No. 4 forge, 48s. 6d. to 49s. per ton net, delivered in Sheffield or Rotherham. The finished ironworks are no better off, more work being much wanted. Bars remain at £6 10s per ton; hoops, £7 10s. per ton; sheets, £8 10s. per ton.

Steel, &c.

The position of the steel trade has not changed. Several of the works are moderately placed; others are not quite so well off. The trouble in the Swedish iron industry still continues, and is being watched with the liveliest interest in Sheffield, where Swedish iron is so largely used by steel manufacturers. Sheffield firms have received advices from Sweden that they must expect no more shipments at present, although consignments are awaiting despatch. On the question of delivery, the view is expressed in Hull—the port to which Sheffield shipments are sent—that there may be nothing more than a shortage of supply for a time, and that it is not likely to prove serious. This view, it is hoped, may be justified by events. The new armour-plate orders, mentioned in this column a fortnight ago, are finding work in the early stages, following on completion of the previous orders. There is nothing further being done in naval or military matters, and nothing is expected of any moment until the Budget is settled one way or another. Railway material and general marine requirements continue meagre. Generally, there is a feeling of expectation that the iron and steel trade may show better after October.

The Master Cutler Elect.

The annual meeting of the Cutlers' Company was held on Tuesday at the Cutlers' Hall, the Master Cutler, Mr. Douglas Vickers, presiding. Mr. Herbert Barber, of the firm of Daniel Doncaster and Sons, was unanimously elected Master Cutler for the ensuing year. The installation will take place on the first Thursday in October.

NORTH OF ENGLAND.

(*From our own Correspondent.*)

Cleveland Pig Iron.

Traders have become very cheerful about business matters, and the evidence is certainly in favour of the opinion that the depression is disappearing, and that a period of increasing demand and rising prices has been entered upon. The tone is now undoubtedly buoyant, and consumers who have long held back are in the market as buyers desirous of purchasing for delivery even further ahead than the producers care to go. The upward movement is enhanced by the good reports from the United States, the rise in the prices of other metals, particularly copper, which rose 30s. per ton on Wednesday, and the improvement in the Board of Trade returns. Added to this there is an increase of activity in the market for manufactured iron and steel. In the circumstances buyers will probably not reap any advantage by waiting; on the contrary, they are likely to have to pay more. The price of No. 3 Cleveland pig iron has this week for the first time this year touched 50s. per ton, the nearest approach to that prior to this month being 49s. 3d. early in January. Cleveland warrants have reached 49s. 11½d. cash buyers, and 50s. cash sellers, an advance of just 4s. per ton on the minimum of the year, that minimum being reported about the middle of March. A good many orders have been placed this week for Cleveland pig iron, and the tone of the market is more buoyant than it has been at any time this year, and, in fact, during last year also. Makers could readily secure orders for next year's execution if they would accept anything like the current price for early delivery, but that they are not prepared to do; they do not want to tie their hands in the face of a rising market, which seems to be influenced more by genuine orders than by speculation. Producers ask 6d. per ton more for delivery over the next three months than they will take for prompt, and 1s. more is asked for delivery up to the end of the year. No. 1 is at 52s. 6d., No. 4 foundry at 49s., No. 4 forge at 48s. 9d., and mottled and white at 48s. 3d., all for early delivery, the forward quotations being 6d. to 1s. above these. On the whole, it can scarcely be doubted that a period of improving trade has been entered upon.

Hematite Pig Iron.

After a long period of very unsatisfactory trade the makers of East Coast hematite pig iron are this week able to give more favourable reports of their business, as during the last few days they have booked fair orders, some of the leading consumers having come into the market. It is generally believed that consumers will not gain anything by holding out longer, for it is hardly likely that prices will be lower—on the contrary, the tendency is upwards, and the longer buyers wait the more they will have to pay. Consumers of hematite iron have themselves been able to book good contracts, and thus need the iron. On this account more disposition to buy is manifested than has been known for months, and it must be acknowledged that mixed numbers East Coast hematite pig iron at 55s. per ton for prompt delivery is cheap, compared with the prices ruling for other descriptions of pig iron. Mixed numbers in the ordinary course should be 10s. per ton dearer than No. 3 Cleveland pig iron, but now is no more than 5s. above. The price of mixed numbers for autumn delivery is 56s. per ton. No. 1, for prompt, is at 55s. 6d., and No. 4 forge at 54s. 6d., with 1s. more for autumn delivery. Orders having been secured for hematite pig iron, the makers have bought Rubio ore more freely, and the merchants have put up their quotations in consequence, 16s. 3d. per ton c.i.f. Middlesbrough having become the general price, and some quote 16s. 6d., the advance this week being thus 3d. per ton, though pig iron prices have not yet been put up. Ironmasters have also to pay more for their coke, the sellers having raised their quotations to 15s. 9d. per ton delivered at Middlesbrough furnaces.

Shipments of Pig Iron.

The exports of pig iron from the Cleveland district have begun to be brisker, and for the remainder of the year are likely to be better than they were in the corresponding months of last year, the second half of 1908 being a very poor time. Deliveries are increasing, though not yet to the Continent, except Italy, and the probabilities of their being active to Germany this year are not encouraging. Scotland and Wales are taking more. It is not likely that the reduction in the United States import duty on pig iron will lead soon to any American demand for Cleveland pig iron, for the pig iron producers in the States will be able to meet American requirements considerably in excess of the present, seeing that there is a good deal of idle plant. However, Cleveland makers are looking for active shipments during the coming autumn. Up to 11th inst. the August exports amounted to 36,162 tons, compared with 31,845 tons last month; 33,297 tons in August, 1908; and 40,633 tons in August, 1907, to 11th.

Pig Iron Stock.

Cleveland pig iron is not going so rapidly into Connal's public store as it was, which is a satisfactory feature, and it is likely that during the autumn this stock will be reduced. The quantity held on 11th was 264,556 tons, an increase this month of 5385 tons. At the end of August last year only 61,963 tons were held. The stock on Wednesday consisted of 257,601 tons of No. 3, 5349 tons of No. 4 foundry, and 1606 tons of other Cleveland iron not deliverable as standard. It is rather unusual to find the stock of qualities other than No. 3 increasing.

Manufactured Iron and Steel.

More cheerful accounts of business are given by producers of finished iron and steel than have been forthcoming for a long time, and in most branches demand shows improvement, and the output has increased. This is more particularly the case in the nail, sheet, plate, and angle making branches, and prospects of the increased buying going on are encouraging. No advances in prices can be announced yet in this district, but they are likely to be made soon in plates, especially as the Scotch plate makers have raised their prices for export half-a-crown per ton. In the North of England the makers quote £5 15s., less 2½ per cent., for steel ship plates for home consumption, but £5 12s. 6d., less 2½ per cent., will be accepted where the plates have to be exported. Steel ship angles are firm at £5 7s. 6d., less 2½ per cent. f.o.t. Iron ship plates are at £6, and iron ship angles at £6 15s., both less 2½ per cent. f.o.t. A somewhat better inquiry is reported for iron and steel bars, the former of which is quoted at £6 15s., and the latter at £6, both less 2½ per cent. f.o.t. Owing to the revival of the shipbuilding industry there is more being done in rivets and packing iron and steel, as well as plates and angles. Iron ship rivets are £7 5s., packing iron and steel £5 5s. Next week most of the finished iron and steel works, engineering establishments, shipyards, and foundries on Teesside will be idle for the annual holidays which are given on the occasion of Stockton August races. The Eston Steel Works will be laid off as well as the Cargo Fleet Steel Works, and during the week alterations are to be made at the former establishment. The Ormesby Rolling Mills Company, Limited, has commenced the erection of its works on a site adjoining the Cargo Fleet Works. The concern, it is stated, is an offshoot of the Cargo Fleet Iron Company, and will utilise the crop ends, &c., from the Cargo Fleet Works.

Coal and Coke.

A steady and satisfactory business is being done in most branches of the coal trade, and prices have got back to something like the figures that ruled before the Scotch labour difficulty began to disorganise trade. Consumers are coming forward more freely and are disposed to buy further ahead than the colliery owners care to go. They are not keen about selling into next year, for they are inclined to wait until they can judge how the application of the Eight Hours Act is going to affect them. That Act does not come into force in Northumberland and Durham until half a year after it took effect elsewhere. For early f.o.b. deliveries of best steam coal 12s. 6d. per ton is quoted; for best gas coals, 11s. to 11s. 3d., f.o.b.; for bunkers and coking coal, 9s. 9d. to 10s. All are in fair request. The supply of coke is hardly equal to the requirements, and the price of furnace coke has been advanced to 15s. 9d. per ton, delivered equal to Middlesbrough, while foundry coke is up to 17s. 6d. f.o.b.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The General Trade Outlook.

A BETTER and more hopeful feeling characterises almost all departments of trade. Not that there is yet any marked improvement in business generally, but the outlook is decidedly more encouraging. The settlement in the coal trade affords a guarantee that contracts may be undertaken with confidence. Advices from the United States continue satisfactory, and the increase in the Board of Trade returns goes to confirm the general impression that business is taking a turn for the better. The stronger tendency in the metal and stock markets is likewise of hopeful augury.

The Iron Market.

The Glasgow pig iron market has this week continued comparatively active, and prices have touched higher figures, although they show occasional fluctuations ascribed to operators taking profits on the rise. A feature of the business has been the apparent anxiety to purchase iron for future delivery. Business has been done in Cleveland warrants at 49s. 9d. to 50s. 0½d. cash, 50s. to 50s. 4d. one month, and 50s. 5d. to 50s. 8d. three months. Sales have also been made at 49s. 10d. and 49s. 10½d. for delivery in eight days, 49s. 11d. fourteen days, 49s. 9½d. and 49s. 10½d. twenty-one days, 50s. 0½d. for September 22nd, and 50s. 2d. thirty days. A lot of Cumberland hematite was done at 57s. 3d. for delivery in three months, and there are sellers at 57s. for cash. Standard foundry pig iron has been offered at 49s. per ton.

Scotch Makers' Iron.

The business in Scotch makers' pig iron has been on a rather better scale in the last few days. It is reported that the demand for No. 1 qualities of iron has improved, and that makers have been obtaining 1s. to 2s. per ton more than the prices recently current. The shipping business has so far been rather disappointing, but it may, perhaps, be inferred from current inquiries that an improvement in this respect may be experienced. The Germans are as likely to be sellers as buyers of pig iron, but an increase in the shipments to Canada and the United States seems to be anticipated. A Scotch firm is reported to have purchased a large quantity of German made basic pig iron for delivery in the United Kingdom towards the end of the present year. Fair quantities of Scotch pig iron are being taken for consumption in England, and, on the other hand, there is an increase in the quantity of English pig iron coming into Scotland. A number of the Scottish ironmasters have intimated an increase in their prices of 1s. per ton. It would seem that the figures of the makers' brands have recently been nominally somewhat above the prices at which actual business has been done, at least with merchants, so that the quotations do not show so much alteration as the makers' increase would seem to justify. Monkland, f.a.s. at Glasgow, No. 1, is quoted 56s.; No. 3, 54s.; Carnbroe, No. 1, 57s. 6d.; No. 3, 54s. 6d.; Clyde, No. 1, 60s. 6d.; No. 3, 54s. 6d.; Gartsherrie, No. 1, 61s.; No. 3, 55s.; Calder and Langloan, No. 1, 61s.; No. 3, 56s.; Summerlee, No. 1, 62s.; No. 3, 57s.; Coltness, No. 1, 88s.; No. 3, 57s.; Glengarnock, at Ardrossan, No. 1, 62s. 6d.; No. 3, 57s.; Dalmellington, at Ayr, No. 1, 59s.; No. 3, 54s.; Shotts, at Leith, No. 1, 61s.; No. 3, 56s.; Carron, at Grangemouth, No. 1, 63s.; No. 3, 56s. per ton. There are 80 furnaces in blast in Scotland, compared with 72 last week, and 76 at this time last year. Of the total 38 furnaces are making ordinary, 37 hematite, and 5 basic iron.

Pig Iron Shipments.

The shipments of pig iron from Scottish ports in the past week were small, amounting to 3329 tons, compared with 5427 in the corresponding week of last year. There was despatched to China and Japan 550 tons, Australia 365, Germany 230, Canada 170, India 80, France 20, Russia, Holland, and Spain and Portugal 10 each, other countries 243, the coastwise shipments being 1641, against 3646 in the corresponding week of 1908. The arrivals at Grangemouth of pig iron from Cleveland and district amounted to 11,848 tons, showing an increase over the imports of the corresponding week amounting to 5560 tons.

Finished Iron and Steel.

The demand for finished iron has been more encouraging, although it still leaves much room for improvement, taking into account the capacity of the Scottish works. The outlook in the steel trade is more satisfactory. Considerable sales of steel material are reported to have been made for shipment to Canada and elsewhere, and the inquiries would indicate that there is further business to be done. The price of steel ship plates for export has been advanced 2s. 6d. per ton, and is now £6, less 2½ per cent.. An increase in specifications for shipbuilding steel is reported. The 2000 tons of steel plates, which are to be made at Parkhead for the Dreadnought Colossus, now being built at Greenock, will materially add to the employment at the East End works. It is said that there is considerable difference of opinion between sellers and buyers of Scotch hematite as to prices. Stocks are known to be large, but makers seem inclined to hold for firm prices. The current quotation is 57s. per ton for delivery at the West of Scotland steel works, and local steel makers have been purchasing more freely as their requirements are increasing. The difference of opinion as to prices has reference to future delivery rather than to cash transactions.

Tubes and Sheets.

The trade in tubes has been improving, and makers are now doing a large business. This has not been obtained, however, without keen competition and a beating down of prices, which are said to be hardly remunerative. There is an increasing demand both for plain and galvanised sheets.

The Coal Trade.

There is a moderate business passing in the coal trade. A number of consumers have stocks in hand, and are therefore not in the market. The coastwise and Irish trades are dull, owing to former extra purchases in anticipation of a strike. Still there is a hopeful feeling in the market, and prices are fairly well maintained. At Glasgow harbour the f.o.b. prices are for ell coal 9s. 6d. to 10s., and steam and splint, 9s. 9d. to 10s. 3d. per ton.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Present Coal Trade, Cardiff.

IT is gratifying to record a growing strength and solidarity of trade, and if supplies had only come up to needs, the week's return would have been substantial. On Monday higher figures were talked of on 'Change, Cardiff, and on Tuesday were put into execution, and in some cases obtained. Best quality coals, steam, still command the chief interest; dry coals are in demand. In small coal there is no alteration; anthracite firm. Patent fuel commands about 15s. There is little movement either in No. 3 Rhondda or in house coals. The latest coal prices are as follows:—Best large steam coal, 17s. 9d. to 18s; best seconds, 16s. 6d. to 17s.; ordinary seconds, 15s. to 15s. 6d.; best drys, 16s. 6d. to 17s.; ordinary drys, 13s. 9d. to 14s. 6d.; best washed nuts, 13s. 9d. to 14s. 9d.; seconds, 13s. to 13s. 6d.; best washed peas, 12s. 6d. to 13s.; seconds, 11s. to 12s.; very best smalls, 9s. 6d. to 9s. 9d.; best ordinaries, 7s. 6d. to 8s. 3d.; inferior sorts, 6s. 9d. to 7s. 3d.; best Monmouthshire black vein, 16s. to 16s. 3d.; ordinary Western Valley, 15s. to 15s. 6d.; best Eastern Valleys, 14s. to 14s. 3d.; seconds, 13s. to 13s. 6d. Bituminous coal: Very best households, 16s. 6d. to 17s.; best ordinaries, 14s. 6d. to 15s. 6d.; No. 3 Rhondda, 17s. 6d. to 17s. 9d.; brush, 13s. 6d. to 14s.; smalls, 10s. 9d. to 11s.; No. 2 Rhondda, 12s. 9d. to 13s.; through, 10s. to 10s. 6d.; smalls, 8s. 9d. to 9s. Patent fuel, 14s. 6d. to 15s. 6d. Coke: Special foundry, 24s. 6d. to 27s. 6d.; foundry, 19s. to 22s.; furnace, 17s. to 18s. Pitwood, 19s. to 19s. 6d.

Last Week's Coal Trade.

The chief pits began to be worked on Monday and work was slowly resumed, but so many colliers were holiday-making, or occupied as volunteers, that the output and despatch were materially affected. As compared with last year there was a small increase. Swansea only despatched 44 000 tons of coal, a little less than 5000 tons patent fuel, and Newport's coal despatch was limited to about 37,000 tons. Port Talbot showed a great falling off, a decrease of close upon 12,000 in exports and 1530 in imports. In a visit to the minor ports at the end of the week and the districts of Neath, Briton Ferry, and Port Talbot I was impressed with the promising condition of all but one—Porth Cawl—which started on its career as a promising port, but is now diverted into a seaside visiting place with small and unfrequented dock so far as coal business is concerned. That and the Glamorgan Canal are taking little part in coal development.

Newport Coal.

Much to the satisfaction of the trade, there is an increased firmness visible, and more animation in business. Small steams are in strong request, the requirements being chiefly for bunkering. Latest quotations:—Best black vein, 15s. 9d. to 16s.; Western Valleys, 14s. 9d. to 15s.; Eastern Valleys, 13s. 9d. to 14s.; other sorts, 12s. 9d. to 13s. 3d.; best smalls, 8s. 3d. to 8s. 6d.; seconds, 7s. 3d. to 7s. 9d.; inferiors, 6s. 9d. to 7s. Bituminous coal: Best house coal, 15s. to 15s. 3d.; seconds, 14s. to 14s. 3d.; patent fuel, 14s. 6d. to 15s. Coke: Foundry, 18s. to 18s. 6d.; furnace, 16s. 6d. to 17s. Pitwood, 20s. 6d. to 21s. 6d. The latter is in steady request and firmer; merchants satisfied with the prospects of better trade and firmer prices. In the past time wood has been clinging to such low figures as 15s. or 17s. 6d. Italy, France and Ireland were marked contributors this week.

Swansea.

There was a large attendance when business was resumed this week, and the general opinion was that prospects were good. There was a firmer market. Complaints of short supplies were rife. Latest quotations were:—Best malting, 23s. to 24s. net; seconds, 21s. to 22s. net; big vein, 18s. 6d. to 20s. net, less 2½; red vein, 12s. to 12s. 6d., less 2½; machine-made cobbles, 23s. to 23s. 6d. net; Paris nuts, 23s. 6d. to 25s. net; French nuts, same; German nuts, 23s. 6d. to 25s.; beans, 17s. 6d. to 18s. net; machine-made large peas, 10s. to 11s. 6d. net; fine peas, 10s. to 10s. 6d. net.; rubbly culm, 5s. 6d. to 5s. 9d., less 2½; duff, 3s. to 3s. 3d. Other coals:—Best large, 15s. 6d. to 16s., less 2½; seconds, 13s. 6d. to 14s. 6d., less 2½; bunkers, 10s. to 10s. 9d., less 2½; small, 8s. to 9s., less 2½. Bituminous coal: No. 3 Rhondda, 17s. 6d. to 18s. 6d., less 2½; through, 14s. 6d. to 15s., less 2½; small, 9s. 9d. to 10s. 3d., less 2½. Patent fuel, 13s. 6d. to 14s., less 2½.

Iron and Steel.

The Welsh industry—like that of other districts—continues to be interested in the developments that are taking place in the trade, which one of the old school, contrasting it by the side of the labours and successes of the Guests, the Crawshays, the Hills, and Vivians, says is more like a speculation than an industry. By the formation of a ring, in which the leading iron-masters of the county are controllers, and into which, I believe, the Americans and Canadians are entering, the whole trade is transformed. Dowlais and Cyfarthfa are now united, and if Dowlais gets more orders than it can manage, Cyfarthfa will have a share. On Tuesday there was a return to work after the long holidays, but, much to the regret of all concerned, they were notified that the outlook was bad on account of the stagnant condition of things, especially of the metallurgical trade. Swansea metal prices:—Welsh hematite delivered, 60s. to 61s; mixed numbers, 56s. 6d. cash, 56s. 6d. one month; Middlesbrough, 49s. 10½d. cash, 50s. 1½d. one month; Scotch, 55s. cash and month; Siemens steel bars, £4 8s. 9d. to £4 10s.; East Coast hematite, 59s. 6d. c.i.f. Rubio at Newport and Cardiff, 15s. to 15s. 6d.; seconds, 14s. to 14s. 6d. Pig iron has been coming in from Middlesbrough and Grimsby. Despatches of steel rails, which remain at syndicate price, were made this week from Cardiff to Madras and Colombo, cargo 3000 tons; 100 tons to Schull; 1700 tons steel received from Bruges. Other quotations:—Copper per ton, £59 cash; £59 18s. 9d. three months; lead, £12 17s. 6d. per ton; Spanish £12 7s. 6d.; spelter, £21 18s. 9d.; silver, 23¼d. per oz.

Tin-plates.

Midland works owned by the Morristown Tin-plate Works have been started after being idle for two years. There has been marked increase in the galvanised iron trade. Last week the business was as follows, according to harbour returns:—Received from works 66,909 boxes; shipped, 107,435 boxes; stocks, 166,719 boxes. Quotations: Block tin, £133 10s cash; £135 5s. three months. C. A. roofing sheets, £8 5s. to £8 7s. 6d.; big sheets for galvanising, £8 7s. 6d. to £8 10s. per ton. Finished black plates, £9 5s. Galvanised sheets, 24 g., £10 10s. to £11, nominal, per ton. Lord Glantawe, on Monday, pointed out to the harbour meeting that, on the whole, the month's work was quite as satisfactory as the previous, and there was no reason to be despondent. In some cases there had been fallings off, and instanced the United States, where the loss was 2000 tons, but there was a total increase of 1875 tons. Swansea suffered less than other ports. The holidays have had a disturbing influence on trade. Another new mill will be started at Aber this or next week. Spelter works are recording continuous work. Five days' work registered at the Upper Bank and Morfa Copper Works.

The Newport Dock Accident.

The disaster now forms the subject of a coroner's investigation, and is expected to last another week. In the absence of two important witnesses there may be more delay, as it is imperative that the inquiry shall be of a most searching character. The death of Radcliffe is, on that point, much to be regretted. Lord Tredegar, referring to the occurrence in his usual sympathetic manner, said a few days ago that 35 men were still buried in the trench.

Important Contracts for Newport Dock.

These include a new pumping installation and electric light under one roof on the east side of the main entrance. This is to be one of the largest in the kingdom. There will be two pumps arranged to work independently of one another, each of which will be able to pump 50 million gallons of water from the river into the dock in five hours, and of pumping dry the new graving dock when constructed in 1 hour 10 minutes.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, August 1st.

A REVIVAL of building operations has recently set in which is calling for larger quantities of iron, steel, cement, timber, hardware, &c. Much of this activity was delayed for various reasons, political, commercial and financial. All restraining influences have disappeared, and work is now under way, which it is expected to be finished before the winter. The volume of railway traffic exhibits a favourable expansion, and as the crop moving season is near at hand the crop carrying roads will be overcrowded. The cotton movement when it begins will be heavy, but as much of it will be warehoused it will not reach this city as rapidly as in former years. A movement is being made to transfer the supremacy in cotton dealing from this city to New Orleans. It is largely a question of capital for iron. The demands for basic and Bessemer have taken up all capacity, and the probability of an advance of 50 cents per ton has stimulated negotiations for deliveries during the last quarter of the year. Steel making is now reaching towards its maximum output. All consumers are now looking forward to possible requirements of raw material with the thought of contracting before important advances occur. The present output of the blast furnaces is estimated to be within 8 per cent. of that of 1907. With the additional capacity of furnaces being and to be built the possible production for next year will be very much more than at present. The advances just made in Southern irons point to a probable advance in Northern irons.

A condition which is affording a strong undertone to the entire market is the knowledge of a multitude of contemplated improvements calling for iron and steel. The railway companies are earnestly considering extensions and re-equipment plans, which are significant of large business with the rolling mills. Wire products are very active, and the recent advance in prices seems to stimulate demand. Pipe makers continue to book large orders. The latest inquiry yesterday was for 10 miles of heavy steel pipe. The Philadelphia Company at Pittsburg has just placed an order for 20 miles of 8in. pipe. Exceptional activity in the locomotive plants has stimulated orders for tubes. Last month's daily average of copper exports was over 1000 tons a day, the figures being 33,800 tons. Lake is 13¼; electrolytic, 12⅞; and casting 12⅞. Tin, 29.20; receipts during the past month, 2847 tons.

PERSONAL AND BUSINESS ANNOUNCEMENTS

THE British Asbestos Company, Limited, has transferred its warehouse and offices to 132, Commercial-street, London, E., to which address it is desired all future communications may be addressed.

WM. WHITWELL AND CO., Limited, Thornaby Ironworks, Stockton-on-Tees, have appointed Mr. Frank Robinson, Exchange Buildings, Birmingham, as their agent in Birmingham and district.

EXTENSION OF HANGO HARBOUR.—In December, 1908, the work on the quay of Hangö was terminated, and thus the greatest enterprise in harbour building in Finland was completed. In 1902 £140,000 were granted by the Finnish Senate for the extension. The work to be done was to unite the hill Drottningberget with the islet Högholmen by a pier across the water, which has a depth of up to 79ft., and to blast the rocks on Högholmen to a level with the pier, as well as to improve the surface of the islet. The granite arm now extending into the sea supplies the town with a safe quay 555 yards long. The granite wall sheltering the pier from the waves stands 18ft. above low water and 9ft. above the pier. In connection with these extensions, large modern warehouses have been erected, among which that intended for butter is the largest. Much care has been taken to make it proof against changes in the outside temperature, the inside chamber being kept at 7 deg. Cent. The total cost of this warehouse was £24,000. Further out in the sea, on the side where the waves are highest, there is a breakwater, built out of solid granite blocks. These extensions will probably satisfy the demand, not merely now, but also for some time to come.

NOTES FROM GERMANY, FRANCE, BELGIUM, &c.

(*From our own Correspondent.*)

Iron and Steel in Silesia.

Quietness has been the order of the day in nearly all departments of the iron industry. Consumers do not care to purchase more than is required for the hand-to-mouth business they are doing, and, though the blast furnace works declare their intention to maintain firmly the present quotations all through the third quarter, concessions are likely to be granted in cases where forward orders are in question. An irregular business has been done in bars and sectional iron. At several rolling mills the working hours have been limited, but stocks nevertheless increase. Prices are complained of as being unremunerative. Girders remain dull, but the plate market has shown more life, demand having increased over that of last month. The attempt of the pipe foundries to bring about higher prices has met with but little success.

Rheinland-Westphalia.

Both raw and finished iron have been only moderately inquired for on the Rhenish-Westphalian market. Semi-finished steel is in steady but somewhat limited demand. On local account little is bought, for there is no life now in the building trade, and the keenness of English competition prevents a favourable business being done on foreign account. Though some extensive orders for the State Railways have been secured, employment at the railway shops continues unsatisfactory.

List Rates.

The following are the present list quotations per ton at works :—Red iron ore, 50 per cent. contents, M. 11.50 ; spathose ore, M. 10.90 ; roasted ditto, M. 15 50. net at mines ; spiegeleisen, 10 to 12 per cent. grade, M. 63 to M. 65 ; white forge pig, M. 55 to M. 58 ; iron for steel making, M. 55 to M. 59 ; German Bessemer, M. 56 to M. 58 ; basic, free place of consumption, M. 49 to M. 50 ; Luxemburg forge pig, free Luxemburg, M. 44 to M. 46 ; Luxemburg foundry pig, M. 46 to M. 48 ; German foundry pig, No. 1, M. 56 to M. 58 ; No. 3, M. 55 to 57 ; German hematite, M. 57 to M. 59 ; good merchant bars in basic, M. 97 to M. 102 ; iron bars, M. 122.50 to M. 125 ; hoops, M. 120 to 122.50 ; steel plates, M. 104 to M. 110 ; boiler plates, M. 114 to M. 120 ; sheets, M. 117.50 to M. 125 ; iron wire rods, M. 127.50.

Coal in Germany.

Coal for industrial puposes meets with fair demand, and altogether there has been more life in the coal trade since the beginning of the present month. House coal is likely to meet with improving demand now, for on September 1st the advanced winter quotations are to come into force.

Dullness in Austria-Hungary.

Local as well as foreign demand continues exceedingly limited, girders, however, forming an exception. German import of iron is reported to have been weaker than previously. While accounts from the iron market continue depressing, a pretty satisfactory condition is reported to prevail in the coal industry, though here, too, a falling off in demand has been felt. In pit coal 680,000 wagons have been produced in the first six months of the present year, or 20,000 wagons less than in the corresponding period last year. Export was 13,500 wagons lower, but 2000 wagons less have been imported than last year. In coke the decrease is more marked ; 9000 wagons have been produced, which is 4000 wagons less than in the same period last year. Imports from Rheinland-Westphalia and Upper Silesia are 8000 wagons less, but exports from Austria-Hungary have also been 1500 wagons less. This shows the decrease in the consumption of coal to have been 12,000 wagons. The falling off in the output of brown coal was 80,000 wagons, or 6 per cent. ; this is partly due to the catastrophe in the pits of the Brüx district. Export in brown coal shows a decrease of 58,000 wagons, inland consumption being 22,000 wagons lower than in the corresponding period last year.

Improving Tendency in Belgium.

The situation has been a little more satisfactory on the iron and steel market, orders coming to hand more freely, and producers begin to show more confidence in the future. Quietness prevails in the pig iron trade, foundry pig is in slow request at 66.50f. p.t., while basic realises 67.50f. p.t., and forge pig 61f. p.t. Sales in semi-finished steel are effected at 95f. to 110f. p.t. ; for orders of 1000 t. a discount of 7.50f. p.t. is granted to consumers, and for less than 1000 t. 5f. p.t. are given. Though the finished iron market is wanting in animation, a fairly regular employment has been maintained at the majority of the shops. For merchant bars £4 9s. 6d. is quoted as before, girders are in moderate request. The Belgian State Railway Administration has given out orders for 60,000 t. rails, and private companies placed contracts for 40,000 t., the Congo Colony has also granted contracts for about 39,000 t. to Belgian steelworks recently. The deliveries in house coal have continued extensive, and the Belgian coal market is altogether more lively than before. Foreign trade in coal during the first six months of the present year has been pretty favourable, 2,796,110 t. being imported, against 2,679,821 t. in last year ; exports were 2,456,029 t. against 2,177,821 t. in the corresponding period last year.

The French Iron Industry.

No change can be reported to have taken place on the iron and steel market ; all departments remain in good occupation. Quotations are the same as before. In the East and North the works are chiefly engaged in the production of basic, and three additional blast-furnaces have been blown in since the beginning of the year. The total output per day remains at 10,500 t.

Coal is in regular and pretty lively request in France.

The Junior Institution of Engineers.—The summer meeting of the Junior Institution of Engineers in the Midlands opens on Saturday morning, August 14th, at Leamington, with a welcome by the Mayor, Councillor Alfred Holt, J.P. In the afternoon Warwick Castle is to be visited, and in the evening there will be an illuminated concert in the Jephson Gardens, by invitation of the Town Improvement Association. On Monday morning the Muntz Metal Company's works and Joseph Gillott's pen manufactory in Birmingham are to be visited ; in the afternoon the James Watt Museum. On Tuesday morning the members will be received at Redditch by the Birmingham Local Section of the Institution, and will visit Shrimpten's needle manufactory, and J. Warner and Sons' fish hook and fishing tackle manufactory. Wednesday morning will be occupied in a visit to the mechanical, electrical, and civil engineering departments of the Birmingham University ; the afternoon being devoted to visits to the Austin Motor Company's works, and the works of the Birmingham Small Arms Company. On Thursday Coventry will be visited, the morning being spent at Herbert's machine tool works, and those of the Triumph Cycle Company, and the afternoon in visiting the new gasworks of the Coventry Corporation at Foleshill, and Rotherham's watch factory. Cadbury Brothers entertain the members on Friday morning at their Bourneville Works, and for the afternoon Elkington's electro plating works will be open for visiting. The Institution's summer dinner takes place in the evening at the Great Western Railway Restaurant, Birmingham ; and on Saturday morning the Summerlane Electricity Works of the Birmingham Corporation will be seen, the afternoon being occupied with a visit to the electrical signalling apparatus of the Great Western Railway at Snow Hill Station.

BRITISH PATENT SPECIFICATIONS.

When an invention is communicated from abroad the name and address of the Communicator is printed in italics.

When the abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent-office Sale Branch, 25, Southampton-buildings, Chancery-lane, London, W.C., at 8d. each.

The first date given is the date of application ; the second date at the end of the abridgment is the date of the advertisement of the acceptance of the complete specification.

Any person may on any of the grounds mentioned in the Acts, within two months of the date given at the end of the abridgment, give notice at the Patent-office of opposition to the grant of a Patent.

STEAM GENERATORS.

21,290. October 8th, 1908.—Improvements in Means for Consuming Smoke, Sherard Osborn Cowper-Coles, of Grosvenor Mansions, 82, Victoria-street, Westminster.

This invention relates to means for consuming smoke in the furnaces of boilers and the like. A represents the furnace and B the fire-bridge thereof. C is a gas pipe which extends from the front of the furnace below the grate D to the fire-bridge B, up which it passes so as to supply gas to a series of outlets or nozzles E, through which the jets of gas issue in a rearward direction, as indicated by the arrow. F is an air pipe, which also extends from the front of the furnace below the grate D thereof, and

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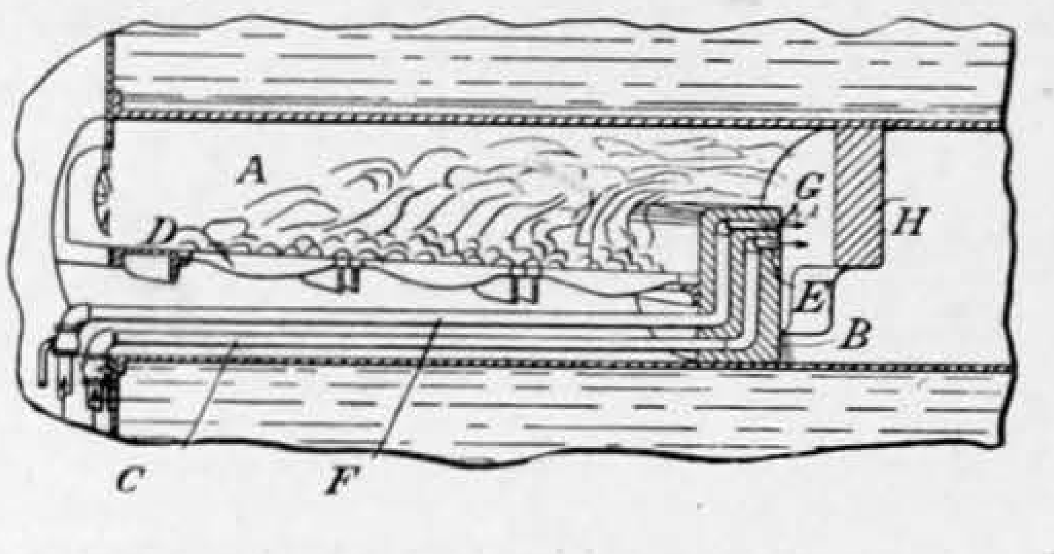

passes up through the fire-bridge B, as in the case of the gas pipe C, the air pipe F communicating with a series of holes or nozzles G placed above the gas nozzles E through which a series of air jets issues in a rearward direction from the fire-bridge B. H is the firebrick partition which extends from the top of the flue downwards to the point below the plane of the gas nozzles E. This partition may be solid as illustrated, or perforated, or provided with a ribbed or corrugated surface. The gas and air jets are projected in a horizontal direction, and the fire-brick partition H is consequently placed upright, so that the jets are projected against it in a direction at right angles, or approximately at right angles, to its surface. A modification of the invention is also dealt with.—*July 21st*, 1909.

23,650. November 5th, 1908.—Improvements relating to Boiler and the like Furnaces, Richard Jackson Eskrigge, of 159, Victoria-road, New Brighton, Chester.

In certain types of forced-draught furnace arrangements it is found that the air pressure below the fuel is higher towards the rear or fire-bridge end of the furnace than it is towards the front end thereof. As a consequence (the air spaces between the fire-bars being uniformly wide throughout the grate area), it is necessary, in order to prevent the undue passage of air through the fire

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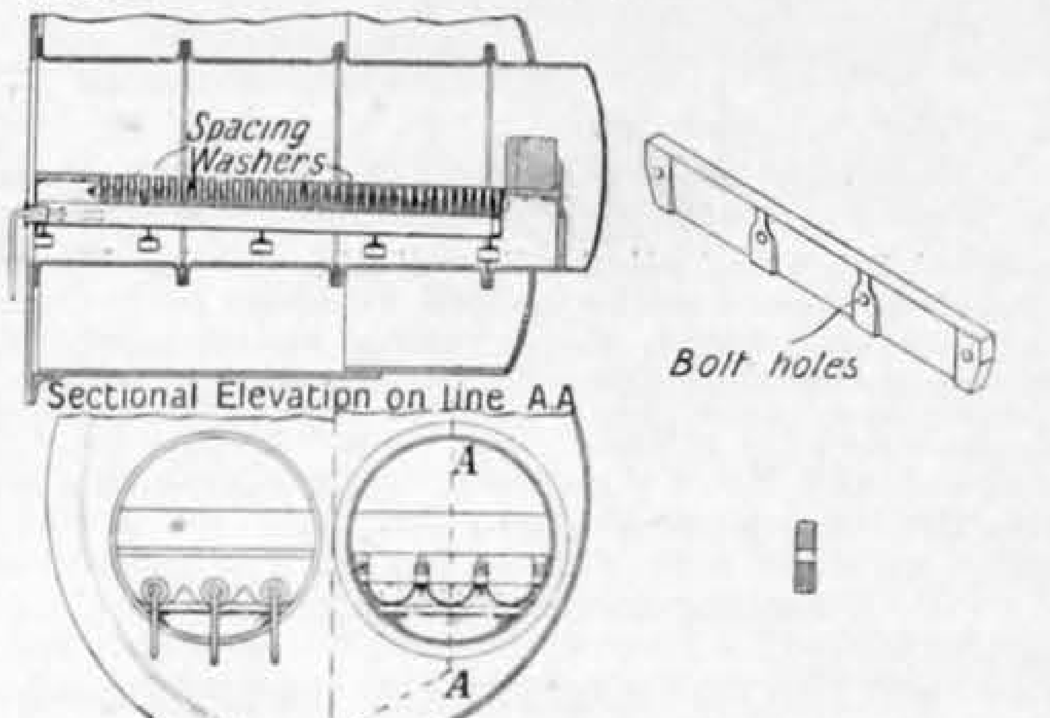

at the rear end, to keep the fire thicker there than elsewhere. This is objectionable, especially with hand firing, being a cause of imperfect combustion and emission of smoke. According to this invention, the fire-bars are arranged transversely to the furnace, and the width of the air spaces is graded, not by varying the thickness of the bars, but by spacing them further apart at the front and closer together towards the rear or fire-bridge end of the furnace. The bars are also bolted together into a single structure, and air troughs or ducts provided below the bars to convey the air under pressure to the fire.—*July 21st*, 1909.

DYNAMOS AND MOTORS.

11,904. May 20th, 1909.—Improvements in Commutators for Dynamo-electric Machines, *Siemens - Schuckert Werke, G.m.b.H., of Askanischer Platz 3, Berlin.*

The contact surfaces of the rings R and K are, according to this invention, shaped to conform to a portion of the surface of a

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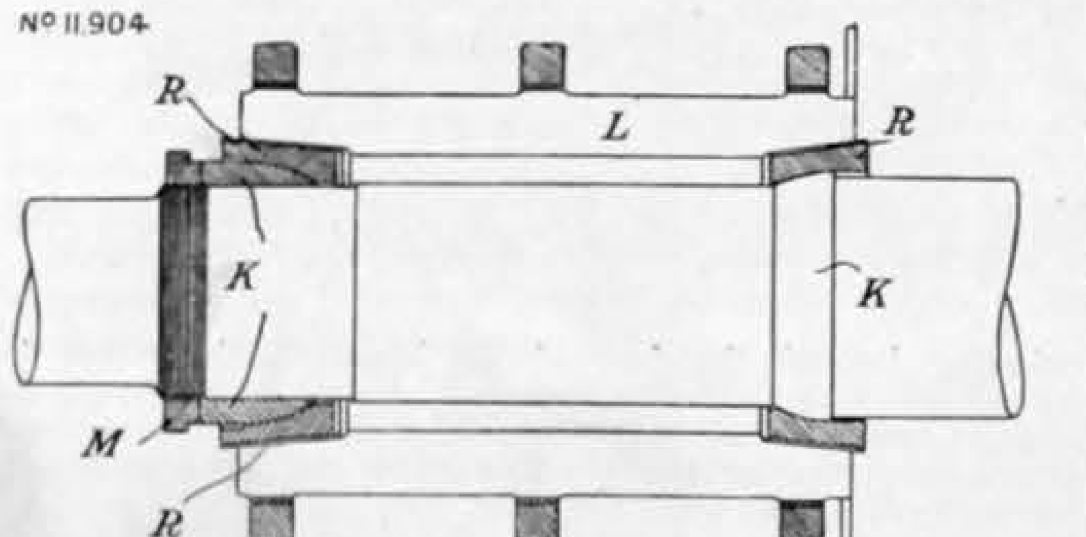

sphere, the centre of which is situated in the axis of the shaft as shown. Any sliding movements which take place will not tend to impair the mechanical connection between segments L and shaft, as the spherical surfaces will slide over each other in an even manner without the production of severe local pressures between the surfaces, and with practically no tendency to grind parts of the surfaces away. One end of the commutator may conveniently be secured as shown at the right-hand side in the engraving. Here the ring K is turned with and forms a part of the shaft, and slots may be cut in it or not, as desired. The whole of the tightening up is effected by the nut M on the left-hand side.—*July 21st*, 1909.

13,231. June 5th, 1909.—Improvements in and relating to Brush Holders for Dynamo-electric Machines, the *Allgemeine Elektricitäts-Gesellschaft, of Friedrich Karl-Ufer, Berlin.*

This invention relates to brush-holders for dynamo-electric machines and has for its object an improved device whereby the relative positions of the tensioning device and the brushes are not altered for various angles which the brush-holder box may make with regard to the commutator or slip-ring surface. The brush

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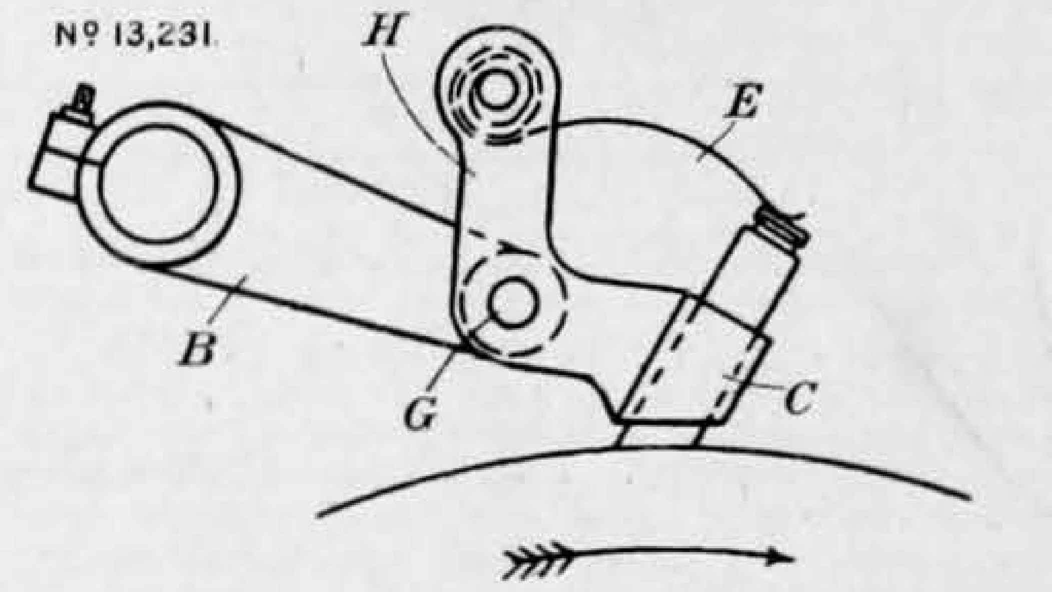

box C for guiding the brushes is carried by an adjustable member H, which also carries the tensioning device E. The member H is pivoted to the fixed member or yoke B at G, and is made adjustable, so that it can be set at varying angles. It will be seen that if the adjustable member H is moved, so as to alter the angles which the brushes make with the commutator or slip ring, the spring E will also be moved and will not alter its position with relation to the brush, and therefore for the various angles at which the adjustable member may be set, the direction and pressure of the spring E will be the same.—*July 21st*, 1909.

TURBINE MACHINERY.

14,964. July 14th, 1908.—Improvements in Turbines, Belliss and Morcom, Limited, and Reginald Keble Morcom, of Ledsam-street Works, Birmingham.

The present invention relates to means for spacing guide-blades and vanes of turbines secured by a crushing operation within grooves formed in the stator and rotor elements of turbines, the means for spacing also serving to cover unoccupied portions of such grooves. The blades A are secured by a crushing operation in undercut grooves B by the bifurcated ends of their shanks being spread apart by a central ridge C or by an inserted rod D. Previously to or whilst the shanks of the blades or vanes are being

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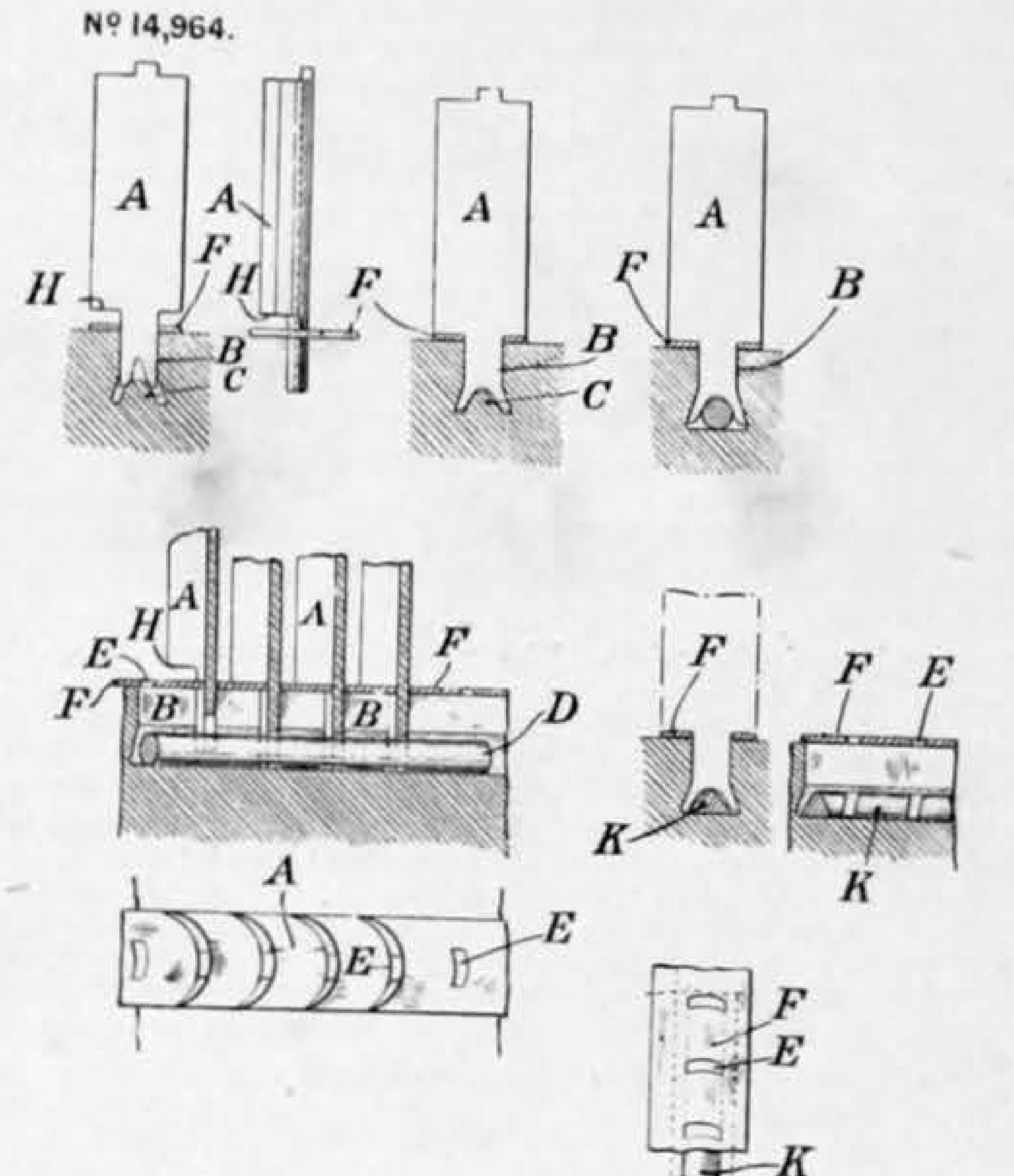
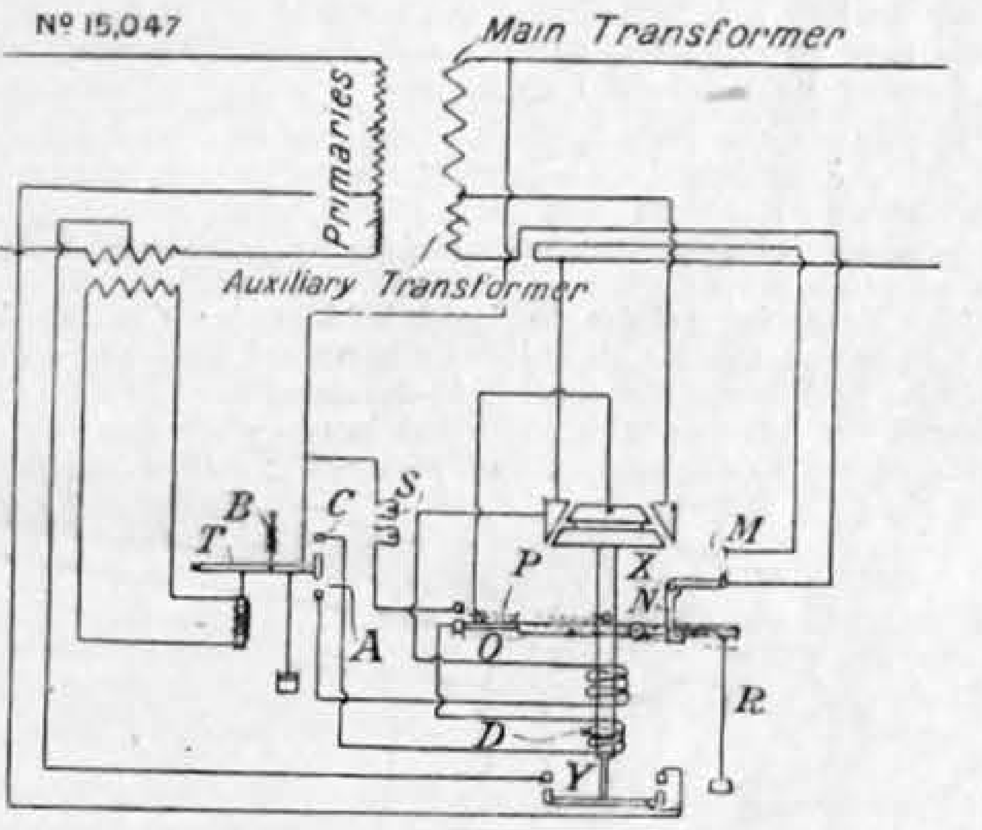


inserted into the groove, the shanks are threaded through apertures E, formed at a uniform distance apart in a strip F. Preferably the strip F is equal in width to that of the unreduced portions of the blades A. On the blades or vanes being forced into the groove B the strip F will be pressed by the shoulders H of the unreduced portions of the blades or vanes closely against the surface of the turbine element on each side of the groove, thus the strip not merely serves the purpose of spacing the blades or vanes, but also that of covering the unoccupied portions of the groove. As shown in the three lower right-hand engravings, the spacing strip F may be used in conjunction with a notched spreader rod K, which rod itself is adapted to space the lower extremities of the shanks.—*July 21st*, 1909.

TRANSFORMERS.

15,047. July 15th, 1908.—Improvements relating to Alternating Electric-current Distribution, John Sedgwick Peck, of Westinghouse Works, Trafford Park, Manchester.

This invention relates to alternating-current electric distribution systems, and in particular to systems in which main and auxiliary transformers are employed. If the load on the supply circuit be reduced below a predetermined value, the relay switch A is moved under the action of the spring B, so as to bring its contact member T into engagement with the contact C, and a circuit will thereby be completed through the opening coil D, so as to open the switches X, Y, and put in the main transformer. If at any time during operation under light-load conditions the current traversing the auxiliary transformer is sufficient to blow the fuse M, the bell-crank lever N will release contact member O of the switch P, and this contact member will be moved by the weight R so as to close the switches X and Y, and also break the circuit through the opening coil D, and complete a circuit through the indicating lamps S. The attention of the attendant will thus be drawn to the fact that the auxiliary transformer circuit has been interrupted, and it will be impossible

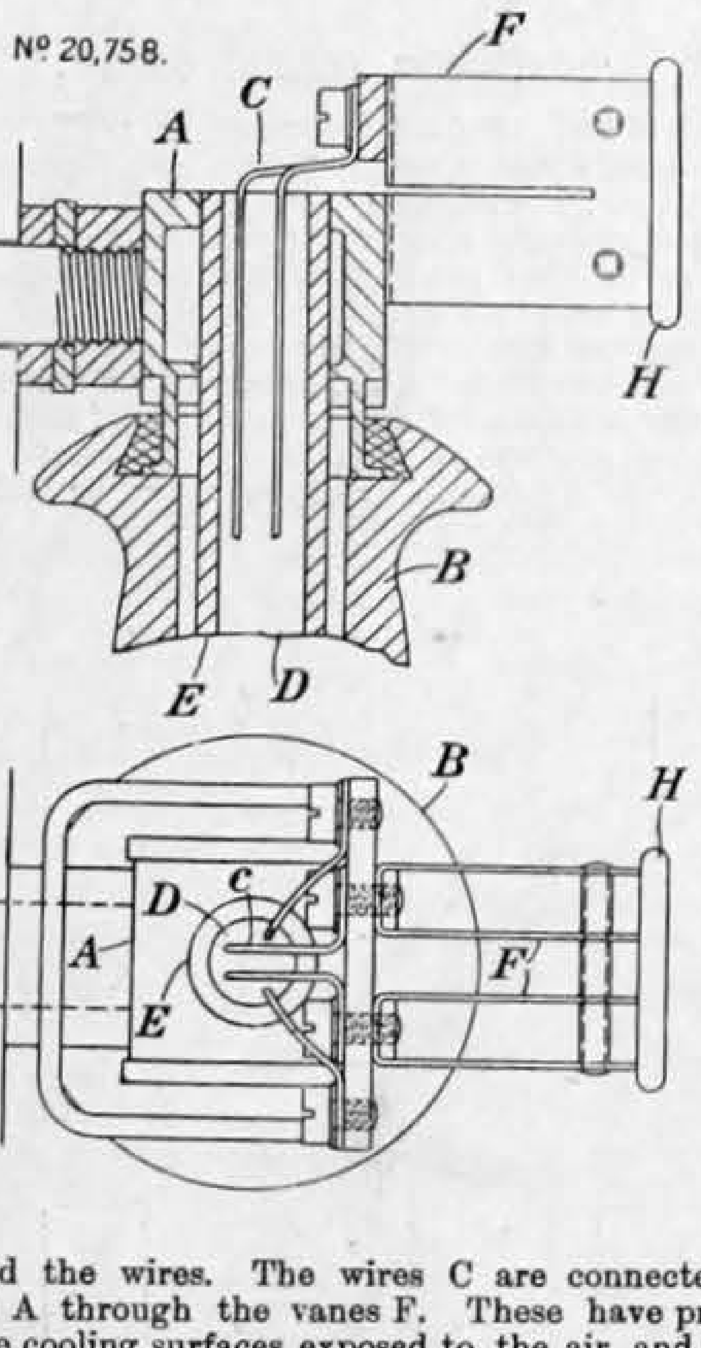


to complete a circuit through the opening coil D, so that the switches X, Y will remain closed. The indicating lamps may, of course, be replaced by an audible signalling device if desired, or may be omitted entirely. There are three other illustrations.—*July* 21*st*, 1909.

SWITCH GEAR.

20,758. October 2nd, 1908.—IMPROVEMENTS IN ELECTRICAL FUSES, Bertram Thomas and Eustace Thomas, both of Worsley-street, Hulme, Manchester.

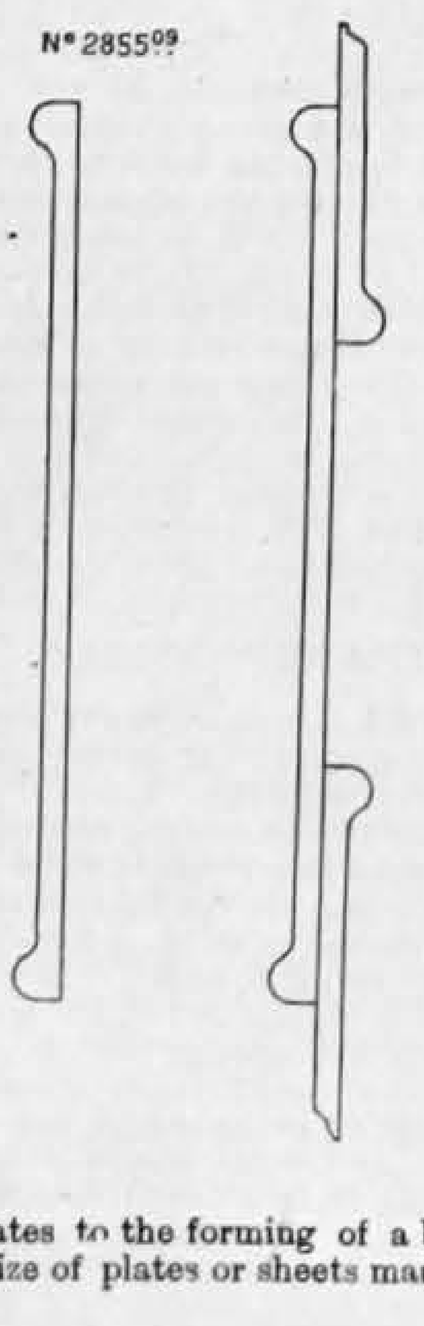
This invention has for its object the improvement of fuses for the protection of electrical circuits and may be applied to any suitable type of fuse, as, for instance, that known as the "tubular" fuse. The contact block A is cemented or otherwise secured to the insulating handle or tube B. The fuse wires or strips C pass through the aperture D, a tube of asbestos or other suitable material E being preferably interposed between the handle



or tube B and the wires. The wires C are connected to the contact block A through the vanes F. These have preferably, as shown, large cooling surfaces exposed to the air, and the cross section is such as to cause little internal electrical heating. Insulating material H may be applied to prevent accidental contact between the hand and live metal. The heat conducted from the fuse wires to the outer ends of the vanes has to travel over a long path before it can reach the contact block A, and the temperature attained by the block A and any contact clips used therewith is correspondingly diminished.—*July* 21*st*, 1909.

SHIPS AND BOATS.

2855. October 24th, 1908.—IMPROVEMENTS IN BUILDING IRON, STEEL, OR COMPOSITE SHIPS OR OTHER STRUCTURES, James Edward Scott, shipbuilder and shipowner, of Greenock, and of 52, Coal-exchange, E.C.

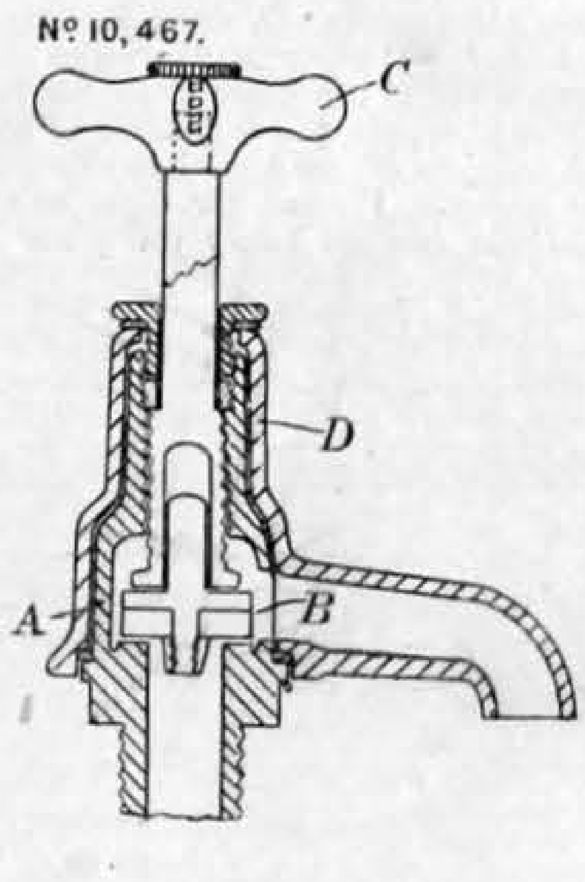


This invention relates to the forming of a bulb on each longitudinal edge of any size of plates or sheets manufactured of steel, iron, copper, zinc, brass, bronze, white metal, or aluminium. By the application of these bulbs the moment of inertia of each plate or sheet will be increased 40 per cent. In corrosive metals deterioration will be reduced to a minimum. In riveted landing of these double bulb plates it will be sufficient to have single instead of double riveting, with larger and wider spaced rivets, owing to the edges of the plates or sheets being 40 per cent. stiffer than ordinary plain rolled plates. The left-hand engraving represents the new section of double bulb plates, and the right-hand engraving represents double bulb plates overlapped for riveting.—*July* 21*st*, 1909.

MISCELLANEOUS.

10,467. May 14th, 1908.—IMPROVEMENTS IN TAPS AND VALVES, Moses James Adams, The Red House, Stocksfield-on-Tyne.

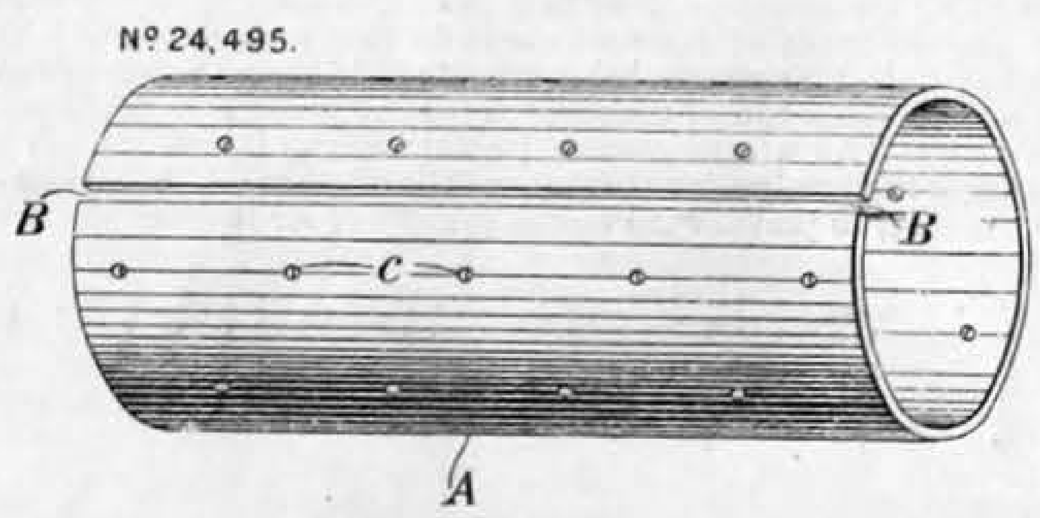
The object of this invention is to produce a tap which shall have the strength and utility of the taps usually employed, and yet shall be perfectly free from the trouble of tarnishing. A tap body of gun-metal or other suitable material is placed within a casing



of cast iron or suitable material which is coated with a glass or porcelain enamel applied at great heat, thus presenting the appearance and effect of porcelain. A represents the tap with outlet B and head C, the enclosing body of cast iron or other metal enamelled or of porcelain material is shown at D, so that to all intents and purposes the tap is porcelain-like and can be quite readily cleaned.—*July* 21*st*, 1909.

24,495. November 14th, 1908.—IMPROVEMENTS IN OR RELATING TO BEARING BUSHES, James Bowack, of 45A, Temple-road, Cricklewood.

This invention relates to bushes for the reception of shafts, axles, and the like, and has for its main object to construct them so that they are free to expand circumferentially when heated, thereby avoiding undue friction and consequent wear. A is the



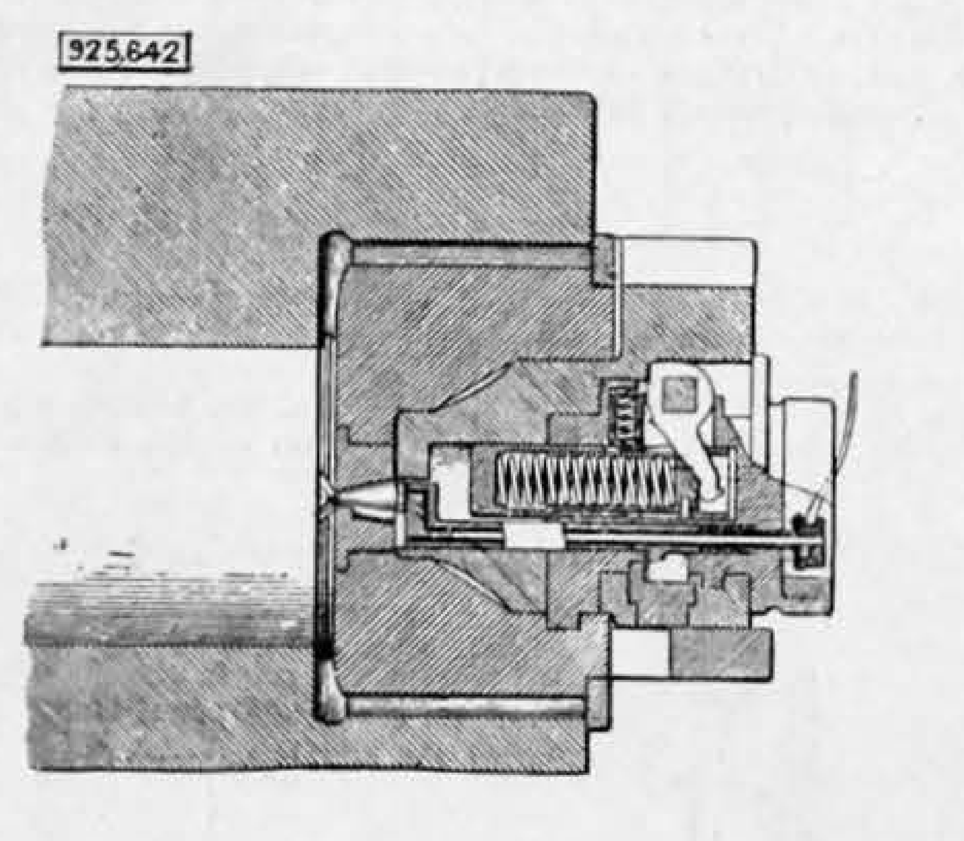
bush, and B is a longitudinal split or division therein. The provision of this space B enables the bush to expand freely circumferentially when heated, and to contract and thus avoid the friction and consequent wear which would be set up by the axle or shaft revolving in the bush if the latter were solid. Moreover, the space or division serves to distribute lubricant over the surface of the shaft. C C are the perforations through the bush for lubrication purposes.—*July* 21*st*, 1909.

SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

925,642. FIRING MECHANISM FOR GUNS, *A. Y. Leech, jun., Washington, D.C., assignor to United States Ordnance Company, Washington, D.C., a Corporation of Virginia.—Filed December* 24*th*, 1907.

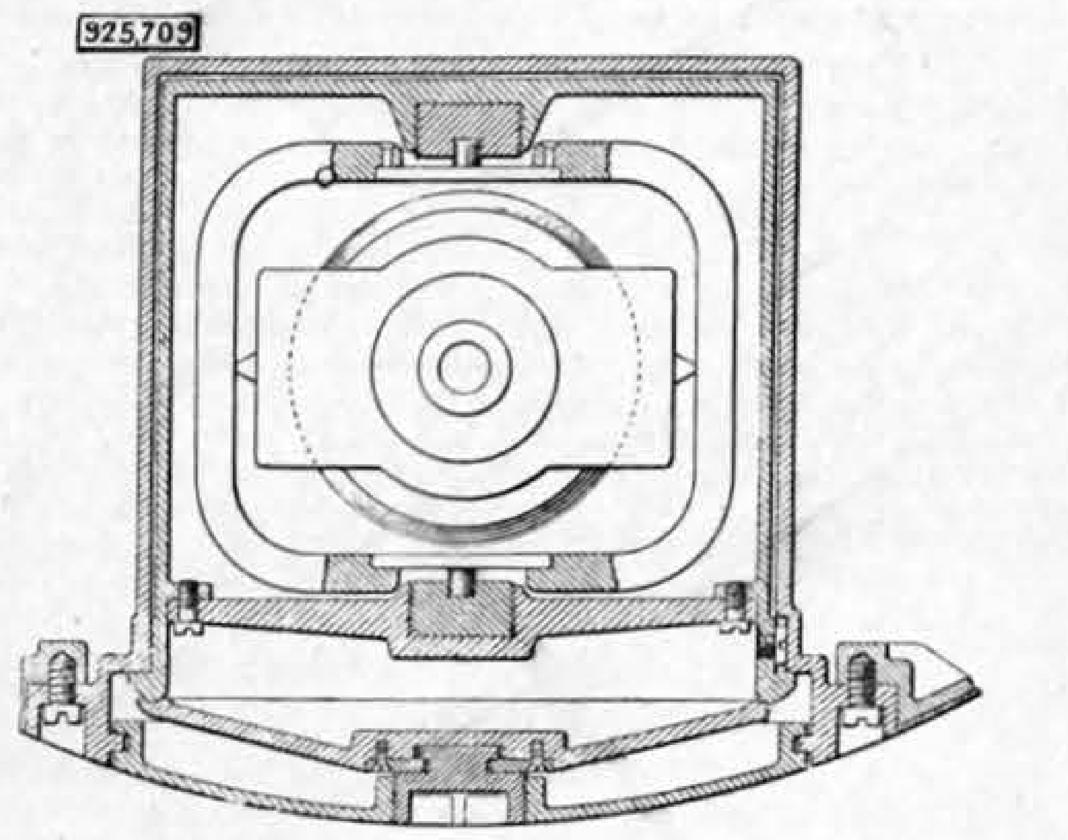
The inventor claims the combination with the rotatable breech block of a gun, of a firing pin having a contact point normally



projecting beyond the face of the breech block, means for connecting it with an electric conductor, means for retracting the firing pin before the initial rotation of the block in unlocking, and for gradually moving the pin forward as the block is locked. There are twenty-two other claims.

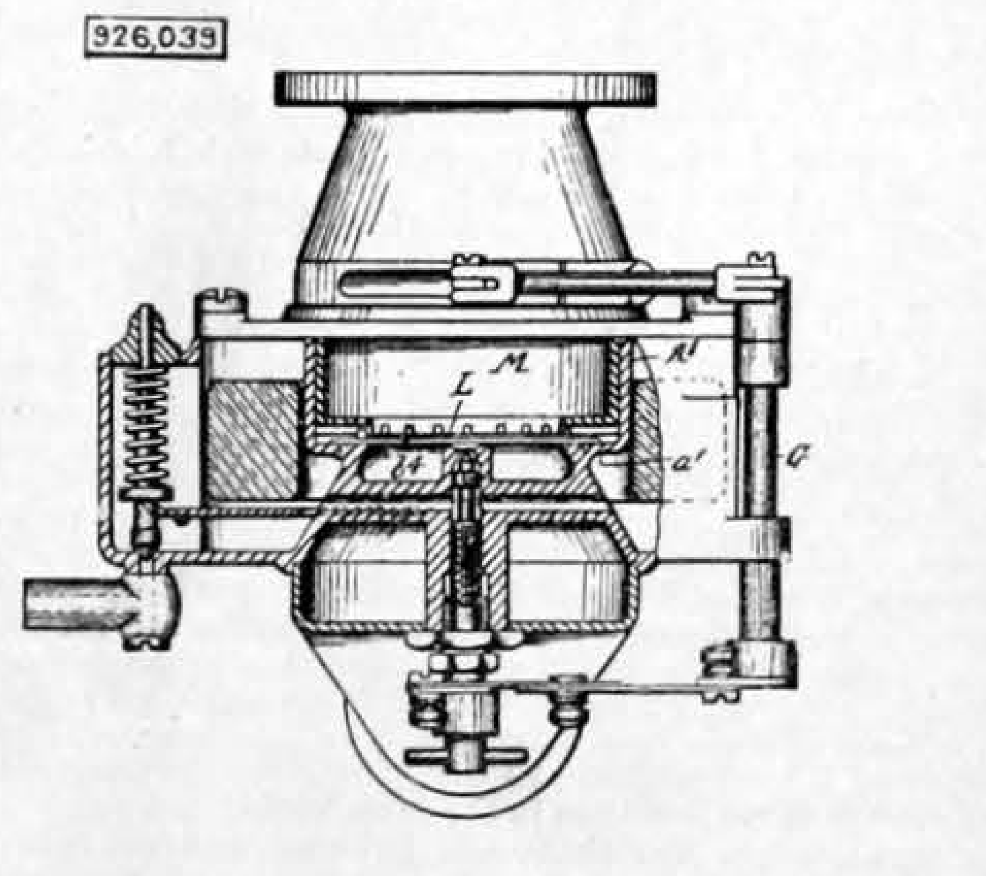
925,709. GYROSCOPIC STEERING GEAR, *F. M. Leavitt, New York, N. Y., assignor to E. W. Bliss Company, Brooklyn, N. Y., a Corporation of West Virginia.—Filed April* 30*th*, 1907.

This is an invention intended a parently for the steering only of torpedoes. There are ten claims, and the fifth of these gives a good general idea of the invention:—The combination with the shell or hull of a torpedo having an opening, a casing fixed therein with its interior chamber communicating with said opening, a gyroscope, and its support adapted to enter said chamber, a hand-hole cover for closing said opening, a movable part for holding said support in place, and a screw connection between it and the hand-hole cover.



926,039. CARBURETTER. *E. F. Warren, Detroit, Mich., assignor of one-half to M. E. Garrett, Wayne County, Mich.—Filed July* 22*nd*, 1908.

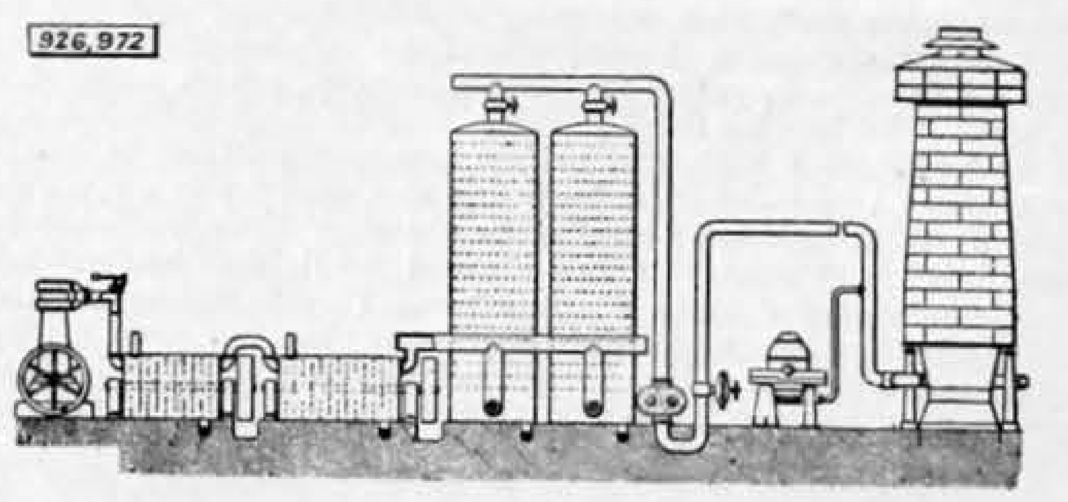
There is only one claim. It is as follows:—In a carburetter, the combination of an annular gasoline reservoir, having a vertical portion A^1 of its inner wall and an annular ledge a^1 around its inner wall, said wall and ledge surrounding a central opening, leaves L pivoted on said ledge, a nozzle b^4 having its delivery end



located adjacent to the centre of said opening, a needle valve in said nozzle, an annulus M having a vertical and a horizontal wall, the vertical wall of said annulus fitting against and within the vertical wall A^1 and its horizontal wall lying over and adjacent to said leaves and adapted to actuate the same, a shaft G pivoted in bearings on the outside of said annular reservoir, a lever on one end of said shaft connected and adapted to actuate the annulus M, and a lever arm on the other end of said shaft connected with and adapted to actuate the needle of said valve.

926,972. METHOD OF AND APPARATUS FOR DRYING AIR, *D. Baker, Philadelphia, Pa.—Filed June* 21*st*, 1907.

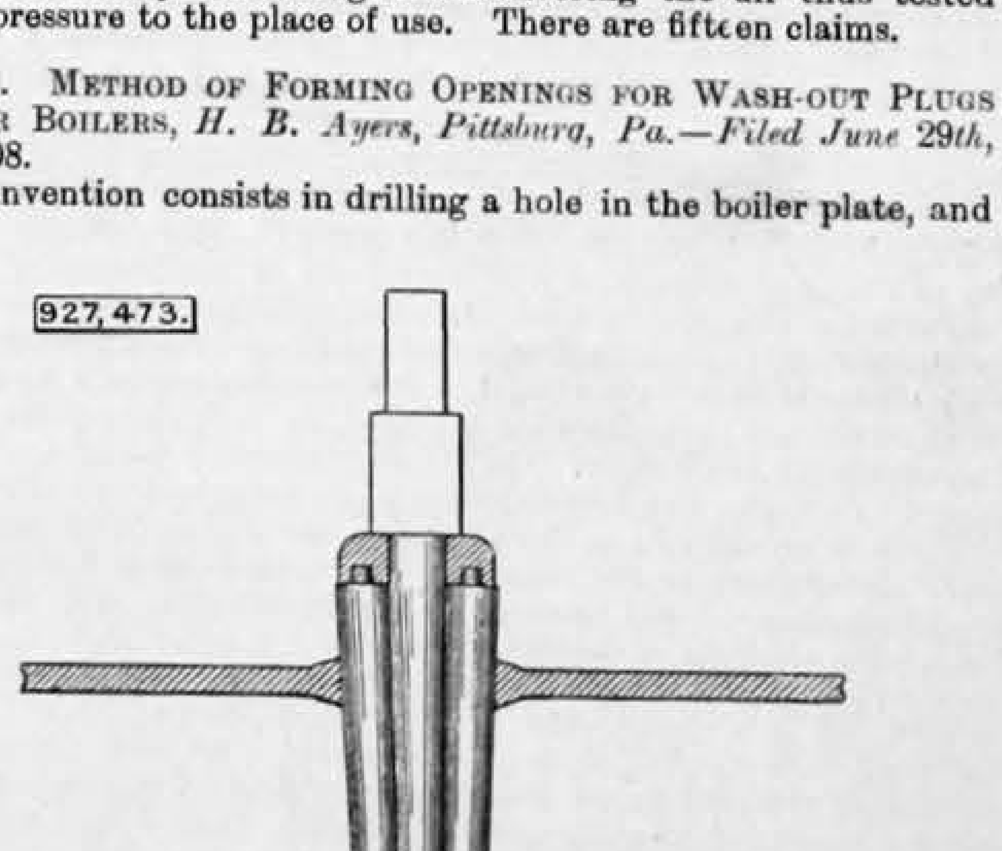
This patent is for a method of treating air for metallurgical purposes, which consists in compressing it, reducing the temperature of the compressed air to remove the heat developed by



compression, subjecting the air to a further cooling action, removing any mechanically suspended water carried by the air, maintaining the air at a constant pressure while being cooled and dried, and finally measuring and delivering the air thus tested under pressure to the place of use. There are fifteen claims.

927,473. METHOD OF FORMING OPENINGS FOR WASH-OUT PLUGS FOR BOILERS, *H. B. Ayers, Pittsburg, Pa.—Filed June* 29*th*, 1908.

The invention consists in drilling a hole in the boiler plate, and



then enlarging it with a roller expander, which sets up the metal and thickens it as shown. There are two claims.