SECTION 2.

Modern Manganese Steel Trackwork.

Patent-rolled Imperial manganese steel rails. Railway Switches, Crossings and Lay-outs.

IMPERIAL

Edgar Allen & Co. Ltd.,

Imperial Steel Works,

Sheffield

IMPERIAL

Manganese Steel

Railway Switches & Crossings.

IN the preceding portion of this publication the history of Permanent Way has been traced from its beginning to the present day. It is only fitting that one of the most important developments in permanent way practice namely, rolled manganese steel rails and trackwork made therefrom, should be dealt with more fully than was possible in the paper "A Century of Permanent Way." This we propose to do in the following pages.

The enormous amount of traffic dealt with by the railways of the world, rendered it inevitable sooner or later that rolling stock of greatly increased carrying power would be introduced. Locomotives with a much higher hauling capacity than ever before were designed and put into use. This meant heavier axle loads, with the result that rails which had given satisfactory results under the old conditions were unable to withstand the wear and tear inflicted upon them by the new.

Rails of greater weight per yard were substituted of necessity for the lighter sections. But despite this, there were places in the main line tracks, such as junctions and curved portions enabling trains to pass over from one set of tracks to another, that could not be said to stand the strain successfully. These places were, and still are, a source of continual worry and anxiety to everyone concerned with their maintenance, from the permanent way engineer down to the platelayer who looks after them and keeps then in running condition. While this is true of all junction work in busy parts of a line, it is emphasised in the case of electric railways, such as the Underground Railways in London and other large cities. Here the problem is specially serious, and many of the switches, crossings, and curved rails in the track wear rapidly and have to be replaced every three to six months. The anxiety so rapid a decline in efficiency brings to those responsible for maintaining a fast and regular train service, and for the upkeep of the track, can be readily understood. The cost of frequent renewals with complicated switch and crossing work is enormous. The road is never in good running order for more than a few weeks at a time, and consequently the rolling stock suffers considerably.

Furthermore, on a busy railway it is far from easy to renew the permanent way. Renewals must, of necessity, be made when traffic is suspended, which is usually during the early hours of the morning. But on some railways, where traffic is heavy and frequent, even this is not always possible, and the work can only be done on Sunday mornings during a short period between the stopping of the last train on Saturday night and the starting of the first train of the ordinary Sunday morning service. The work is not, therefore, carried out under the best conditions, and being necessarily hurried, much having to be done in a very short time, costs more.

To overcome these disadvantages, various alterations were made in the composition of the steel rails then in use. The intention was to make them harder and more resistant to abrasive wear, but beyond a certain limit consistent with safety it was found impossible to go. The harder the steel, the more risk there was that the rails would break under the tremendous strain they were called upon to bear. To meet these abnormal conditions Edgar Allen & Co., Ltd., went into the question of making rails in manganese steel.

Tramway systems had encountered precisely the same difficulties as those which confronted the railways, and junctions made in Edgar Allen Imperial cast manganese steel had been employed with eminently satisfactory results to overcome the trouble. It was, therefore only natural that the railways should regard favourably the use of the same material. Trial crossings cast to the required angles were put down in the track, and their behaviour and resistance to wear carefully noted. The results were gratifying.

Edgar Allen Imperial manganese steel with its tensile resistance of 55 tons and over to the square inch, and a correspondingly high elongation of 40% in four inches, soon proved its possession of enormous resistance to abrasive wear, for although so hard that it could not be machined in the usual way, it was so tough that it could be bent double while cold without breaking.

Rolling Manganese Steel Rails.

But there were limits to the use of castings for modern railway permanent way.

Some railway engineers would not experiment with manganese steel because of their strong objection to using castings of any sort in the track. They maintained that a casting could not be guaranteed against failure at some time or other under actual traffic conditions. Another objection was that cast rails, being less flexible than the ordinary steel rails to which they were connected, caused shock when a fast train passed over them. Apart from this, it was added, a heavy casting damaged the wooden sleepers, owing to its lack of flexibility.

A final argument against the use of castings was that if after an accident or derailment a cast manganese steel crossing got damaged, it would be impossible to repair it, the only alternative being to replace it with a new one. These were serious disadvantages, no doubt, but Edgar Allen & Co., Ltd., were not content to let manganese steel railway trackwork drop. The question of rolling rails in manganese steel next commanded their earnest attention.

Costly experiments demanding much thought, care, and time were conducted, and at last success crowned their efforts. Rails rolled in manganese steel were produced, and laid in the track of one of the London electric railways at a point where the conditions were of the worst, and where rails of ordinary steel were rendered wholly useless in about 12-15 weeks. The results were astounding, and led to the placing of a large contract for the renewal, in Imperial rolled manganese steel rails, of the junctions at the railway terminus. A full account of the test is given further on.

The first cost of Edgar Allen Imperial manganese steel rails was high compared with that of ordinary steel rails, but their exceptional strength, resistance to abrasive wear, and consequent long life, with all the saving due to cutting out the necessity for frequent renewals, in itself a most expensive item in the upkeep of track, made them by far the more economical.

Reducing Cost by Patent Process.

Having surmounted the great difficulties of rolling manganese steel, attention then concentrated upon reducing the cost of production and improving the quality of the product. Further experiments were initiated, and eventually a process was devised that greatly reduced the cost of rolling, and that gave at the same time a larger output with much better results. This patented process, controlled in Great Britain and Europe

by Edgar Allen & Co., Ltd., has considerably reduced the cost of Imperial manganese steel rails although the first cost is still high in comparison with that of the ordinary type.

Advantages of Imperial patent-rolled manganese steel rails.

This high first cost is, however, easily covered by the advantages enumerated below.

One of the most important advantages is that points and crossings can be built up to the Railway Company's standard design exactly as they are built up from ordinary steel rails. They are as flexible as any other part of the track ; no shock takes place when fast trains pass over them ; neither do the wooden sleepers sustain any damage. Should a point or crossing get damaged at any time, that particular part which sustains the damage can be replaced, without its being necessary to scrap the remainder, which is unavoidable when cast manganese steel is used.

To use patent rolled manganese steel rails in the most economical way, it is advisable to adhere to one of the standard sections, thereby reducing the cost of rolling. It is, of course, as remarked above, possible to roll rails to suit the section adopted by any particular railway, but standard sections are certainly cheaper to produce.

Corrosion Tests.

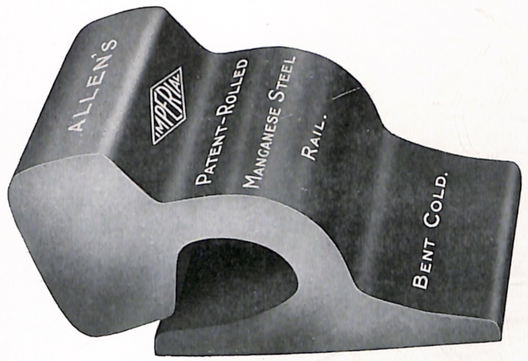
The question of corrosion, while not of supreme importance on busy lines, is nevertheless worth consideration where long tunnels occur. If it can be proved that even here Imperial manganese steel rails more than hold their own with those of ordinary steel, a further proof of the economies effected by using them will have been obtained. As a matter of fact this point *can* be proved. A corrosion test was carried out some time ago by the Furness Railway (now taken over by the L.M. & S. Railway), and the results should be examined with care. 90lbs. section Bull-head British Standard Imperial patent-rolled manganese steel rails 2′ 6″ long were tested against 95lbs. section Bull-head British Standard Barrow hematite Bessemer rails 2′ 3″ long. They were left hanging in a tunnel, and the following results were obtained :—

	Manganese Steel Rails.			*Bessemer Rails.*		
	Qrs.	Lbs.	Ozs.	Qrs.	Lbs.	Ozs.
March 22nd, 1918	2	16	12	2	8	8
January 23rd, 1919	2	16	12	2	8	0
July 21st, 1919	2	16	11	2	7	4
November 21st, 1919	2	16	4	2	6	4
March 21st, 1920	2	16	4	2	6	4
August 21st, 1920	2	15	12	2	3	4
	0	1	0	0	5	4

Now the great point about this test is that the Imperial rails were not new. They had been selected at random from stock in 1918, and many of them had already been exposed to the weather for six years when first submitted to the test. The ordinary steel rails were new. But in spite of this preliminary handicap, the manganese steel rails lost $4\frac{1}{4}$ lbs. less in the specified period than the Ordinary rails. So that in addition to their advantage of greater resistance to wear, etc., definite examples of which will be found on a later page, Imperial rails are actually less subject to corrosion than Bessemer rails, another factor in lengthening their life.

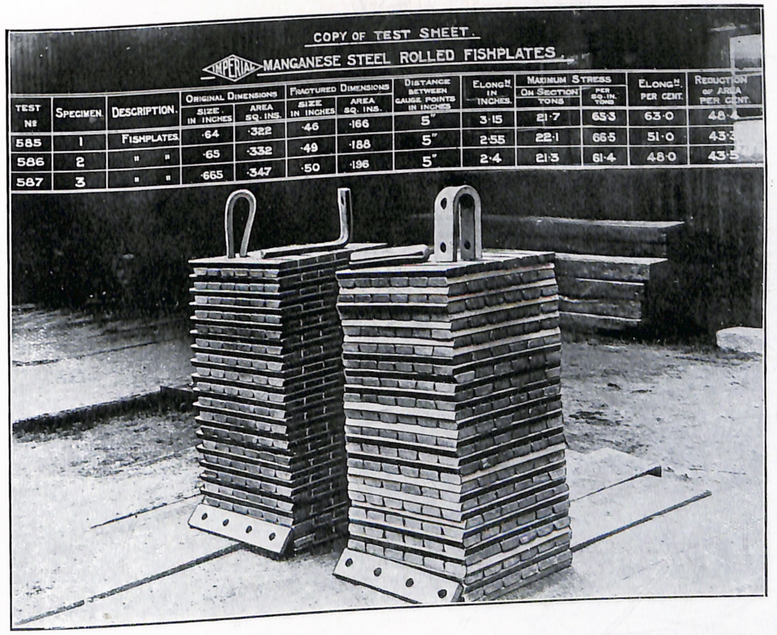
Mechanical Tests

OF



TEST PIECE OF 85LB. SECTION RAIL.

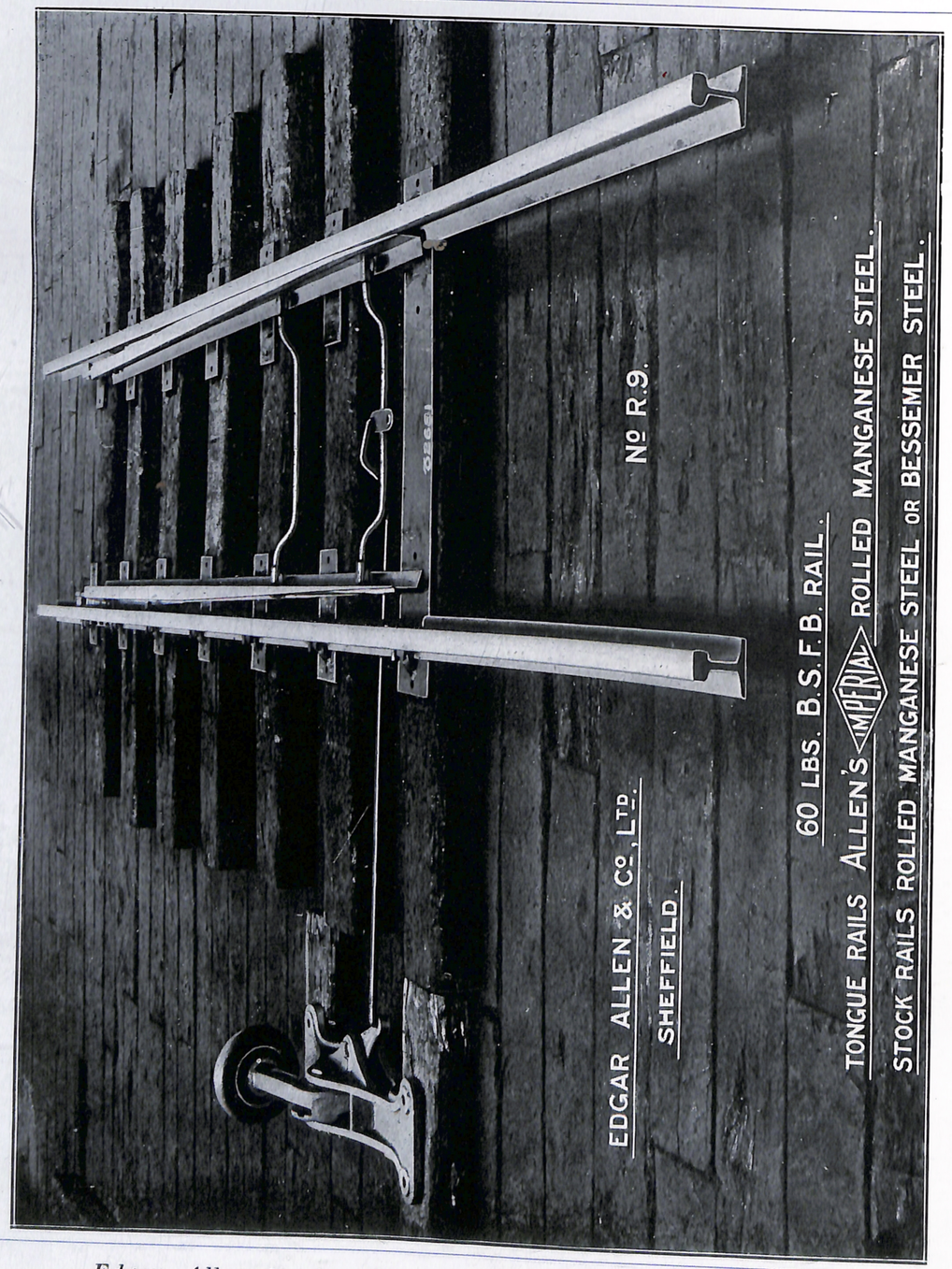
Edgar Allen
Imperial
Manganese Steel Fishplates
AND
Patent-Rolled Rails



COPY OF TEST SHEET.

IMPERIAL MANGANESE STEEL ROLLED FISHPLATES.

TEST Nº	SPECIMEN.	DESCRIPTION.	ORIGINAL DIMENSIONS SIZE IN INCHES	ORIGINAL DIMENSIONS AREA SQ. INS.	FRACTURED DIMENSIONS AREA IN INCHES	FRACTURED DIMENSIONS AREA SQ. INS.	DISTANCE BETWEEN GAUGE POINTS IN INCHES	ELONGN. IN INCHES.	MAXIMUM STRESS ON SECTION TONS	MAXIMUM STRESS PER SQ. IN. TONS	ELONGN. PER CENT.	REDUCTION OF AREA PER CENT.
585	1	FISHPLATES	·64	·322	·46	·166	5″	3·15	21·7	65·3	63·0	48·4
586	2	" "	·65	·332	·49	·188	5″	2·55	22·1	66·5	51·0	43·3
587	3	" "	·665	·347	·50	·196	5″	2·4	21·3	61·4	48·0	43·5



How Manganese Steel Rails are Made.

THE foregoing is a brief history of the conditions which led to the introduction of Edgar Allen Imperial patent-rolled manganese steel rails; that which follows is an attempt to describe briefly, in language intelligible even to the non-technical reader, how these rails are made.

The material of which the rails are composed is acid steel, manufactured from the best Cumberland hematite iron, with an admixture of manganese to the extent of 11% to 13%.

The steel is made in the Bessemer converter, from which it is cast into ingot moulds which have fire-clay heads. These heads serve to keep hot metal in the tops of the ingots, and contain a reserve of liquid steel from which the ingots are "fed." Without this "feeding" of the ingots, cavities taking the form of long pipes down the centre of the ingot would form as the metal in the ingots contracted on cooling, and the feeding serves, therefore, to eliminate "piping." In this respect the fire-clay heads correspond to some extent with the "dozzlers" used in the manufacture of crucible tool steel. Samples of the steel are taken at the time of casting the ingot, and a careful analysis of these is made in order to ensure that the composition of the steel is correct.

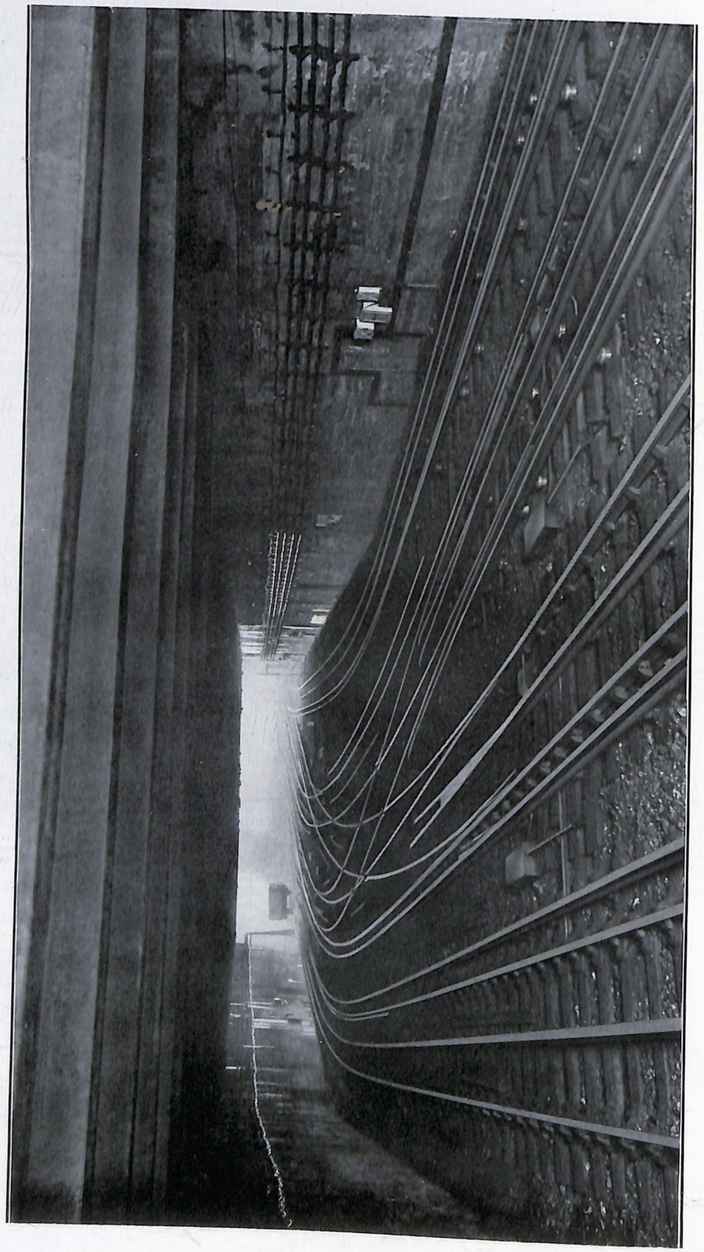
If this is found to be the case, the ingots are then charged into the soaking pits. A soaking pit is a gas-heated furnace in which steel ingots are heated up very gradually in order that the heat may thoroughly penetrate or soak into the steel. If not thus heated there would be a liability to fracture during the operation of rolling. In these pits the ingots are heated up to the rolling temperature, sufficient time being allowed to ensure that they shall be thoroughly heated throughout.

Each ingot is then taken to the mill, where by a special process it is rolled direct into the finished rail. Next, after being sawn into the required length, it is quenched or hardened in water. This quenching is a process of considerable importance, the temperature of the rail before it enters the water being 900-950°C. It has the effect of making the manganese steel ductile when cold, the very opposite effect to that which would be produced if ordinary steel were treated in the same manner. Although perfectly ductile, Imperial patent-rolled manganese steel rails are too hard to machine.

From Rails to Switches and Crossings.

From the quenching tank the rails are taken to the straightening machines. Rapid quenching is always liable to throw a long piece of steel slightly out of the straight, owing to the sudden contraction of the material. The straightening machines take out any twist or warp that may have occurred. From these machines they go to the inspection racks, where they are scrupulously examined by competent engineers to make sure that they are free from defects. They are also subjected to severe drop tests. Having been passed by the inspector, they are then ready for manufacture into switches, crossings, junctions, etc., or to be curved ready to be laid direct into the track, as the case may be.

The utmost care is exercised from start to finish in the manufacture of Edgar Allen Imperial patent-rolled manganese steel rails, each process being under the direction of skilled technical men, and carefully superintended by them to guarantee that the best possible results are obtained. After the rails have been cut to the lengths required for switches and crossings, they go to the marking-out tables and to the "marker-out," a skilled man who has a fully detailed drawing of the switch or crossing required. He proceeds to mark lines on the rails to indicate what surplus material may, in the first place, be removed by the oxy-acetylene burning process; and to show also the position of the bolt-holes, etc.



LAY-OUT FOR A LONDON ELECTRIC RAILWAY. ALL IN EDGAR ALLEN IMPERIAL PATENT-ROLLED MANGANESE STEEL RAILS.

The rails are then holed and burned as indicated, and passed on to the hydraulic straightening machines, where they are carefully straightened, any required setting being put in. Thence they again go to the marking-out tables, and lines indicating the finished shape and dimensions of the rails are marked on them in readiness for the grinding machines. As Edgar Allen patent-rolled Imperial manganese steel is too hard to be machined in the ordinary way, all the finishing work on it must be done by grinding, an expensive process that calls for trained and highly skilled men, in addition to specially designed grinding-machines. After machine grinding to dimensions, the rails go to another set of grinders and are carefully fitted together, the switch or crossing is assembled, and all the component parts are fitted and checked over to the dimensions given on the drawing. The finished work is then taken to the inspection racks and is checked over by the shop inspector before being put forward for inspection by the customer's engineer.

When lay-outs are being supplied, the survey particulars of the site where these are to be laid in the track are reproduced in the Edgar Allen setting-out yard, and the work is laid out in relation to these. Accuracy is thus ensured, and the lay-out can be put into the track with the minimum of trouble and delay to the traffic, which in these busy days are matters of very great importance.

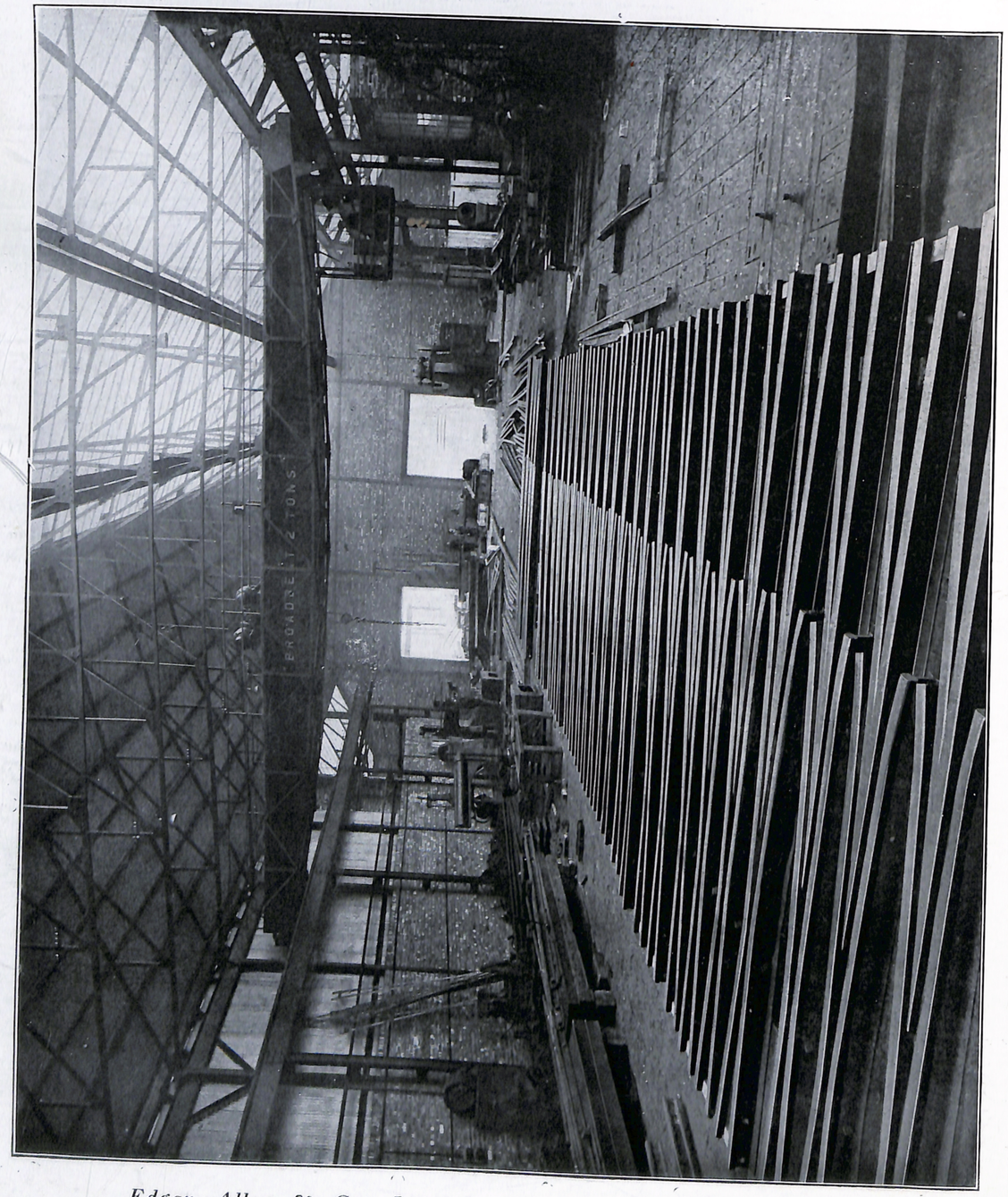
Skill and Service.

Increased Output, Newer Methods, Larger Plant.

SINCE the first pair of switches and built-up crossings were made, there have been many alterations in workshop procedure. Improvements have been introduced, and the attention of railway engineers the world over having been attracted to Edgar Allen Imperial patent-rolled manganese steel rails, many orders for complicated junctions have been placed with the manufacturers. The need for increased output to cope with these orders has led to more experiments, and as a result further improvements have been discovered, not only in the treatment of the rails, but also in the machines used in the various processes. The Edgar Allen shops have been entirely reorganised for the production of these rails and junctions. New workshops embodying the latest ideas in their design and fully equipped for the manufacture of railway special trackwork are in operation.

The site on which these works are built covers an area of some 14½ acres, is served by the Sheffield and District Railway, and is adjacent to the Imperial Steel works. Broadly speaking, the buildings comprise large machine and grinding shops ; a construction shop, where lay-outs are put down to the survey dimensions ; electric transformer and boiler house ; and the various auxiliary buildings such as stores, ambulance rooms, time offices, etc., and general offices. In the designing of all these buildings the aim has been to study, as far as possible, the health and comfort of those who have to work in them. For instance, the roof glazing has been so arranged as to give the maximum daylight possible without sun-glare. All the shops and offices are adequately heated by steam units and low pressure hot water respectively. The sanitary arrangements provided for the workmen are of a first-class and up-to-date nature, the latrine buildings being lined with glazed brickwork, etc., lighted and ventilated from the roof by a large-sized lantern.

The Machine Shop is 425′ long × 80′ wide × 23′ 6″ to eaves. It is partitioned into three sections to suit the various processes of manufacture. Foot walks have been provided inside and outside for ease and safety in cleaning the roof glass. The Grinding and Despatching Shop is 375′ long × 80′ wide × 23′ 6″ to eaves.



Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.

Skill and Service *(continued)*

The Construction Shop has been specially designed to facilitate the convenient, safe, and rapid handling of material required in the lay-out and fitting up of special trackwork. The building is 150′ long × 80′ wide × 23′ 6″ to eaves. The floor area is 11,612 sq. ft., roof glazing 5,500 sq. ft., side glazing 1,281 sq. ft., the cubic contents being 343,000 cubic feet approximately. This shop is completely equipped with grinding machinery, rail benders, drills, etc.

The combined floor area of the buildings is 62,538 sq. ft., roof glazing 41,000 sq. ft., the cubic contents being 1,821,000 cubic feet approximately. The shops are well-fitted up with the latest type of machine tools, the grinding machines in particular being of special design, the result of years of experiment and observation.

It is unnecessary to describe in detail the various mechanical improvements introduced, but it may safely be claimed that these shops are second to none, and any reader of this book who would care to pay a visit for the purpose of satisfying himself as to the efficiency of the men, machines and methods, will be welcome at the Imperial Steel Works.

Men who Mattered.

The above paragraphs will show that so far as mechanical means are concerned, everything possible has been done to ensure that the production of Edgar Allen Imperial patent-rolled manganese steel rails shall be carried out with maximum efficiency. However, the problem has not been a purely technical or mechanical one. The human element has also had to be considered. Not every man possesses the skill and experience necessary to perform these intricate and important operations. Men had to be carefully selected and trained for the work, and it was no easy task to discover them. Many were tried and found wanting in the ability and natural aptitude requisite for the task. But eventually, men who took a keen interest in the various processes were chosen, and now, after long practice and experience, Edgar Allen & Co., Ltd., have a staff skilled both technically and practically. In the following pages will be found illustrations of work actually done, the best possible testimony to their skill.

Edgar Allen Service.

Enquiries are invited for Edgar Allen Imperial patent-rolled manganese steel rails, switches and crossings, or junctions built up in them. Plans showing what is required will be most carefully considered, and a quotation will be submitted. If necessary a representative will be pleased to visit the enquirer to discuss practical details.

Rails of practically any section, both flange (or vignole) and bull head, can be rolled ; but it is preferable, on account of the extremely heavy cost of preparing the necessary rolls for special sections, to adhere to sections in general use on the large railways for which Edgar Allen & Co., Ltd., already have the rolls.

On the last page will be found a list of Edgar Allen catalogues and publications. These represent the method adopted by the Edgar Allen Service to enable customers to use Edgar Allen products to the best advantage. Each of these publications contains practical advice and information, and will be found invaluable to those interested in the material or materials with which it deals.

How to Order Special Railway Trackwork.

AT the Imperial Steel Works, Edgar Allen & Co., Ltd., are constantly receiving enquiries for special railway trackwork in Imperial manganese steel, but unfortunately a general lack of information accompanies them, and this suggests that a short article indicating the particulars necessary to enable designs and estimates to be prepared will not be out of place.

An enquiry came a short time ago asking Edgar Allen & Co., Ltd., to submit prices by return for switches and crossings "as supplied to the East." This was all the description given, and the difficulty will be perceived at once when it is stated that the sections of rails in use in the East vary from 20 to a 100 lbs. per yard, while the fittings for the trackwork are of many varying designs. It was, of course, impossible in the circumstances to give even an approximate price; yet this particular enquiry was only one of many that are sent without the essential information. Given below, therefore, are the particulars that should be stated in an enquiry for trackwork, in the hope that this information will be of help to those less experienced in the ordering of this complicated material, but requiring quotations, and that it will save much valuable time and correspondence.

To begin, then, a set of switches consists of 2 stock-rails, 2 tongue-rails, connecting rods, chairs, and various small fittings to fit the switches together. When enquiring for switches to replace a number already in use, the following information should be given:—

Gauge of track; section of rail; weight per yard or metre; length of the tongue and stock-rails; type of chair required (cast iron or pressed steel); number of rods; and, if lever boxes are required to operate the switches, the type of box.

Generally where the trackwork is already in use and replacements are needed, detailed drawings of the switches exist showing exactly what is required. Copies of these should be sent with the enquiry. An estimate can then be prepared for the purchaser's exact requirements and a close price quoted. If this price is accepted the work can be put in hand without loss of time, with the assurance that what the customer requires is being supplied.

Turning now to crossings, there is also much information omitted in the majority of the enquiries for these that come to hand. For estimating purposes it is essential that the manufacturer should know the section and weight of rail, angle of crossing, overall length, type of crossing required, whether on chairs or mild steel plates, or without either.

Again, as in the case of switches, if the crossings are required to replace existing ones, a drawing should be sent showing full details of the overall length; the lengths of the point-rails, splice-rails and wing-rail; and the opening at each end of the crossing; the timber spacing should also be given so that the chairs (if required) may be fixed to suit.

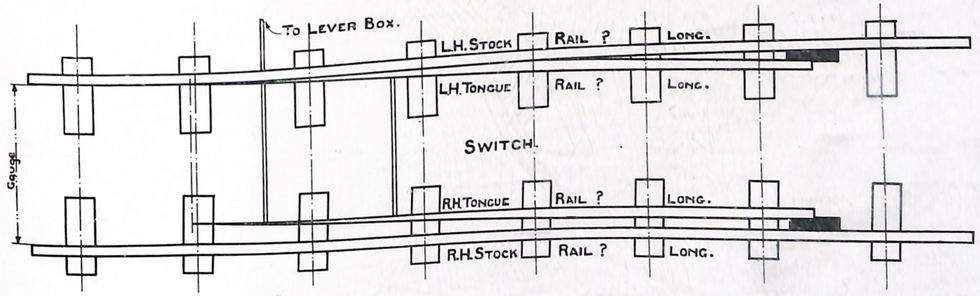
When ordering, the hand (*i.e.*, left or right) of the crossing should be given. This is generally determined by the side on which the splice-rail comes when looking at the crossing towards the nose. The sketches on page 49 should make this clear.

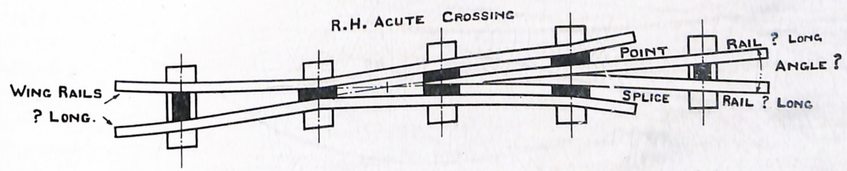
What has been written here refers to switches and crossings required for renewals. In cases where, as there is no existing standard, designs are needed, the length of the switch and the angle of the

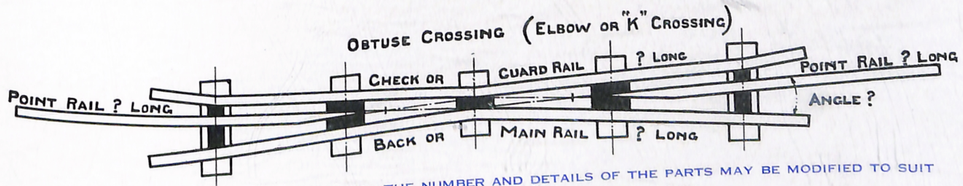
crossing desired should be given in addition to particulars of the rail-section, and if possible, some general information as to the working conditions should also be supplied. The observation of these simple points will materially help the draughtsman to prepare a suitable design.

In a recent instance Edgar Allen & Co., Ltd., were asked to prepare a design for a crossing in cast manganese steel. The weight of the rail and angle of the crossing were given, and it was stated that they were free to put forward the design they thought best. A drawing was prepared, showing the Edgar Allen proposal, and a price quoted. A reply came to the effect that the overall length of the proposed crossing did not agree with that already in use. Would Edgar Allen & Co., Ltd., prepare a modified design? This was the first intimation that the crossings were to replace existing ones of unsatisfactory design, but still the overall length required was not given. Before this business was settled three drawings had to be prepared, whereas if the essential dimensions had been given at the outset and a diagram-drawing of the existing crossing had been sent with the enquiry, much valuable time would have been saved, and the material would have been delivered several weeks earlier.

Below are given diagrams showing a set of switches and crossings with the various parts named. In the case of complete layouts, it is essential that a drawing should be sent giving full survey particulars in addition to those already stated, and this drawing should clearly indicate the portion of track required to be supplied.







THESE DIAGRAMS ILLUSTRATE TYPE ONLY. THE NUMBER AND DETAILS OF THE PARTS MAY BE MODIFIED TO SUIT THE CUSTOMER'S REQUIREMENTS.

Table giving the Trigonometrical value of Crossing angles when the "Inclination Number" is measured in each of the three separate methods.

IN permanent way work there are two ways in which the angle of a crossing is usually stated, namely—either by giving the angle in degrees or by stating it in term of the slope or "inclination number." Unfortunately there is no single method agreed upon by which the value of the angle stated as an inclination number shall be determined, consequently any one of the three following methods may be used; but it should be mentioned that the method generally employed in England is that shewn in the diagram, column 2.

In the first method, as tabulated in column 1, and as illustrated by the diagram at the head thereof, the spread "Y" is measured at right angles to one of the limbs "X" and the ratio $\frac{X}{Y}$ gives the value of the angle when measured by the "right angle" method.

In the second method, the spread "Y" is measured at right angles to a distance "X" measured along the centre line and the ratio $\frac{X}{Y}$ now gives the value of the angle measured by the "centre line" method.

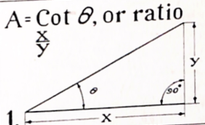
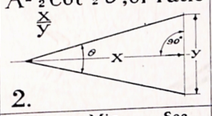
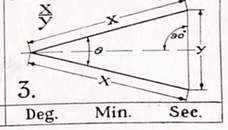
In the third method, the spread "Y" is again measured at right angles to the centre line but the distance "X" is measured along the crossing limbs. The ratio $\frac{X}{Y}$ now gives the angle as measured by the "sides method." It must be obvious that if an order is received for a crossing, the inclination number of which only is stated, a crossing measured by any one of the three methods already detailed may be required.

A reference to the table will show that the sharper the angle becomes the greater is the discrepancy possible in the true value due to using different methods, so that in the case of a crossing angle 1 in 2 a difference of 2 degrees may occur. Clearly, then, in the sharper angles a crossing measured by one method may be wholly unsuitable to replace a crossing of the same inclination number but measured in another method. In the case of a crossing angle 1 in 8, the maximum discrepancy possible using any method is only a few minutes, and this, in the case of a single crossing, may not be of any particular importance. Occasions do arise, however, when the precise value of any crossing is required, possibly as a basis for further calculations, and if the information is not then forthcoming the contractor is rather at a loss, especially when dealing with customers abroad.

It is best, therefore, when ordering crossings, either to give the angle measured in degrees, or else to make clear by means of a diagram similar to those shewn in the tables, the particular method followed when fixing the inclination number.

The table given on the next page has been especially calculated for insertion in this catalogue, and its accuracy can be guaranteed to the nearest second.

Table showing Inclination No. of Crossings with degree equivalents.

A=Angle, or Inclination Nº of Crossing.	Method of Measuring angles.								
	A=Cot θ, or ratio $\frac{X}{Y}$  1.			A=$\frac{1}{2}$ Cot $\frac{1}{2}\theta$, or ratio $\frac{X}{Y}$  2.			A=$\frac{1}{2}$ Cosec $\frac{1}{2}\theta$, or $\frac{X}{Y}$  3.		
	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
1 in 1 ..	45	0	0	53	7	48	60	0	0
1 ,, 1¼ ..	38	39	35	43	36	10	47	9	23
1 ,, 1½ ..	33	41	24	36	52	12	38	56	33
1 ,, 1¾ ..	29	44	42	31	53	27	33	12	11
1 ,, 2 ..	26	33	54	28	4	21	28	57	18
1 ,, 2¼ ..	23	57	45	25	3	27	25	40	45
1 ,, 2½ ..	21	48	5	22	37	12	23	4	26
1 ,, 2¾ ..	19	58	59	20	36	35	20	57	5
1 ,, 3 ..	18	26	6	18	55	29	19	11	17
1 ,, 3¼ ..	17	6	10	17	29	32	17	41	59
1 ,, 3½ ..	15	56	43	16	15	37	16	25	35
1 ,, 3¾ ..	14	55	53	15	11	21	15	19	28
1 ,, 4 ..	14	2	10	14	15	0	14	21	41
1 ,, 4¼ ..	13	14	26	13	25	11	13	30	46
1 ,, 4½ ..	12	31	44	12	40	49	12	45	32
1 ,, 4¾ ..	11	53	19	12	1	5	12	5	5
1 ,, 5 ..	11	18	36	11	25	16	11	28	42
1 ,, 5½ ..	10	18	17	10	23	20	10	25	55
1 ,, 6 ..	9	27	44	9	31	38	9	33	37
1 ,, 6½ ..	8	44	46	8	47	51	8	49	25
1 ,, 7 ..	8	7	48	8	10	16	8	11	32
1 ,, 7½ ..	7	35	41	7	37	41	7	38	43
1 ,, 8 ..	7	7	30	7	9	10	7	10	0
1 ,, 8½ ..	6	42	35	6	43	59	6	44	41
1 ,, 9 ..	6	20	25	6	21	35	6	22	10
1 ,, 9½ ..	6	0	32	6	1	32	6	2	2
1 ,, 10 ..	5	42	38	5	43	29	5	43	55
1 ,, 10½ ..	5	26	25	5	27	10	5	27	32
1 ,, 11 ..	5	11	40	5	12	19	5	12	38
1 ,, 11½ ..	4	58	11	4	58	45	4	59	2
1 ,, 12 ..	4	45	49	4	46	19	4	46	34
1 ,, 12½ ..	4	34	26	4	34	53	4	35	6
1 ,, 13 ..	4	23	55	4	24	19	4	24	31
1 ,, 14 ..	4	5	8	4	5	27	4	5	36
1 ,, 15 ..	3	48	51	3	49	6	3	49	14
1 ,, 16 ..	3	34	35	3	34	48	3	34	54
1 ,, 17 ..	3	21	59	3	22	10	3	22	15
1 ,, 18 ..	3	10	47	3	10	57	3	11	1
1 ,, 19 ..	3	0	46	3	0	54	3	0	58
1 ,, 20 ..	2	51	45	2	51	51	2	51	54

The Testimony of Baker Street.

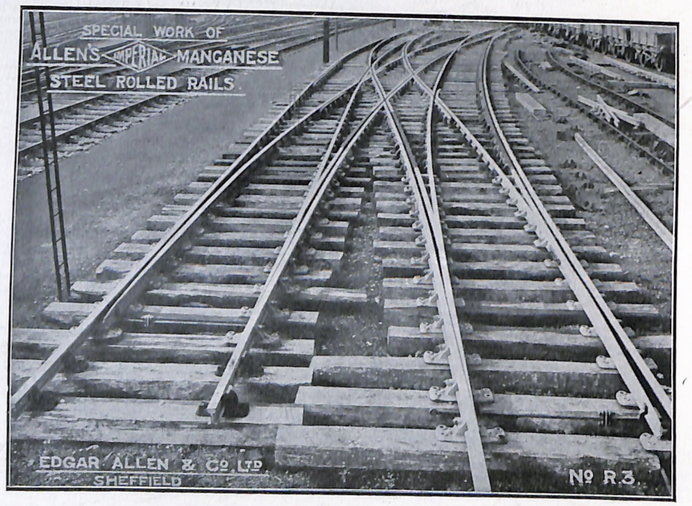
THE lay-out shown below was built up in Edgar Allen Imperial patent-rolled manganese steel rails, and laid in at BAKER STREET STATION on the Metropolitan Railway in November, 1912. Up to the present time (1926), this lay-out has been in position 14 years and 9 months. The Engineer of this Railway, writing of it in March, 1919, said :

"*Judging from the small amout of wear observable at present, they will last another five years.*"

Continuing, he said :

"*Bearing in mind the fact that in the Old Baker Street Station we had to renew Switches, Crossings and angles every three to six months, the saving in rolled Managanese is very great.*"

It will be seen that these remarks have been fully justified, the junction still remaining in the track.



THE BAKER STREET LAY-OUT.

This lay-out is in a curve not exceeding 10 chains radius, and the average number of trains passing over it per day is 998. No further remark is needed to indicate the enormous saving in renewals effected by the use of Edgar Allen Imperial patent-rolled manganese steel rails.

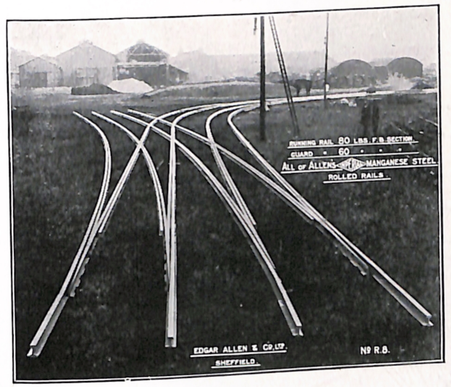
Where high price is economical.

As previously stated, the first cost of switches and crossings in Edgar Allen Imperial manganese steel is high compared with those made of ordinary steel rails. But for places in the permanent way subject to excessive wear their great economy is conclusively proved. In working out the actual saving effected, it is necessary to take into consideration the much longer life of switches and crossings made of manganese steel. This longer life avoids the continual replacing of material, which is often highly inconvenient and always expensive.

The adoption of Imperial patent-rolled manganese steel rails is specially advisable in parts of the permanent way subject to corrugation or corrosion.

All lay-outs are constructed complete at the Imperial Steel Works exactly as they will be laid on the site. This ensures perfect accuracy in the fitting, and avoids all trouble in laying down.

Length of Life of Imperial Patent-Rolled Manganese Steel Rails.



As an instance of the enormous wear resisting powers of these rails, we may mention the case of two rails 45 ft. long and 95 lbs. B.S. Bull Head section, placed in one of the worst positions on one of the largest London Electric Railways, and left in position for nine months. The loss of woight during this period was 14 lbs. and 22 lbs. The hardest rails previously obtainable placed in the same position and for the same period of service lost 135 lbs.

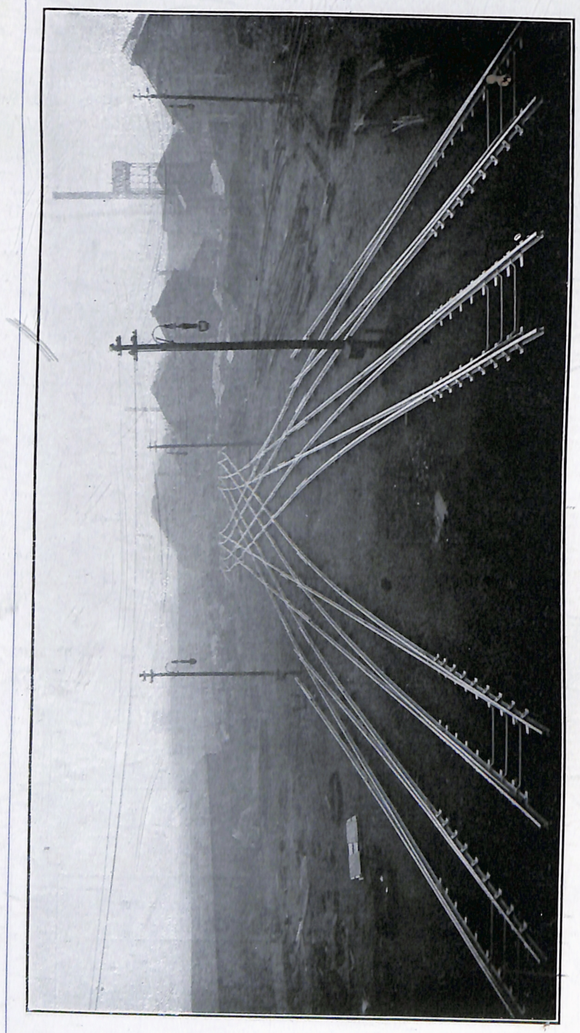
Drop Tests

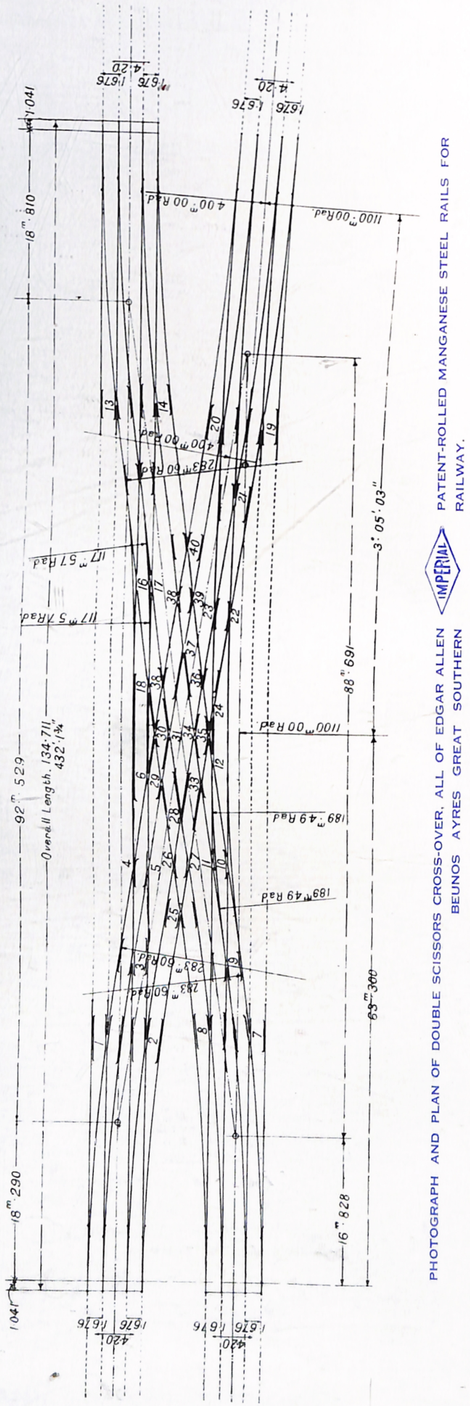
OF

Edgar Allen Imperial Patent-Rolled Manganese Steel Rails.

DESCRIPTIONS OF RAIL AND CONDITION OF TEST	WEIGHT OF TUP	HEIGHT OF DROP	NO. OF DROPS	DEFLECTION IN INCHES		
B.S.S. Flat Bottom Rails, 85 lbs. per yard ..	1 ton	24′ 0″	3	$5\frac{3}{4}$″	$11\frac{7}{8}$″	$18\frac{3}{8}$″
Edgar Allen IMPERIAL patent-rolled manganese steel 3′ 6″ bearings	1 ton	24′ 0″	3	$5\frac{3}{16}$″	$10\frac{1}{8}$″	$15\frac{1}{8}$″
B.S.S. Bull Head Rails, 95 lbs. per yard ..	1 ton	7′ 0″ & 20′ 0″	3	$1\frac{3}{8}$″	$4\frac{3}{4}$″	$7\frac{7}{8}$″
Edgar Allen IMPERIAL patent-rolled manganese steel 3′ 6″ bearings	—	—	3	$1\frac{3}{8}$″	$4\frac{7}{8}$″	8″

FOR DETAILS SEE PAGE 55.





FOR DETAILS SEE PAGE 55.

PHOTOGRAPH AND PLAN OF DOUBLE SCISSORS CROSS-OVER, ALL OF EDGAR ALLEN BEUNOS AYRES GREAT SOUTHERN RAILWAY.

PATENT-ROLLED MANGANESE STEEL RAILS FOR

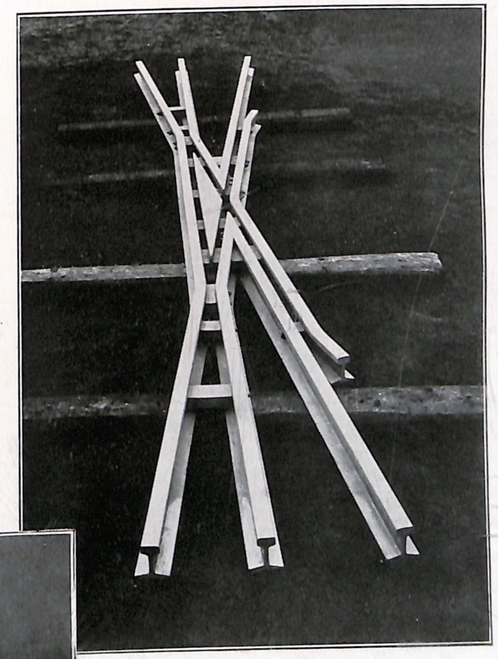
IMPERIAL

Details of the Double Scissors Crossover for the B.A.G.S. Railway.

(as illustrated on page 54)

Section of rail, 100 lbs. per yard.

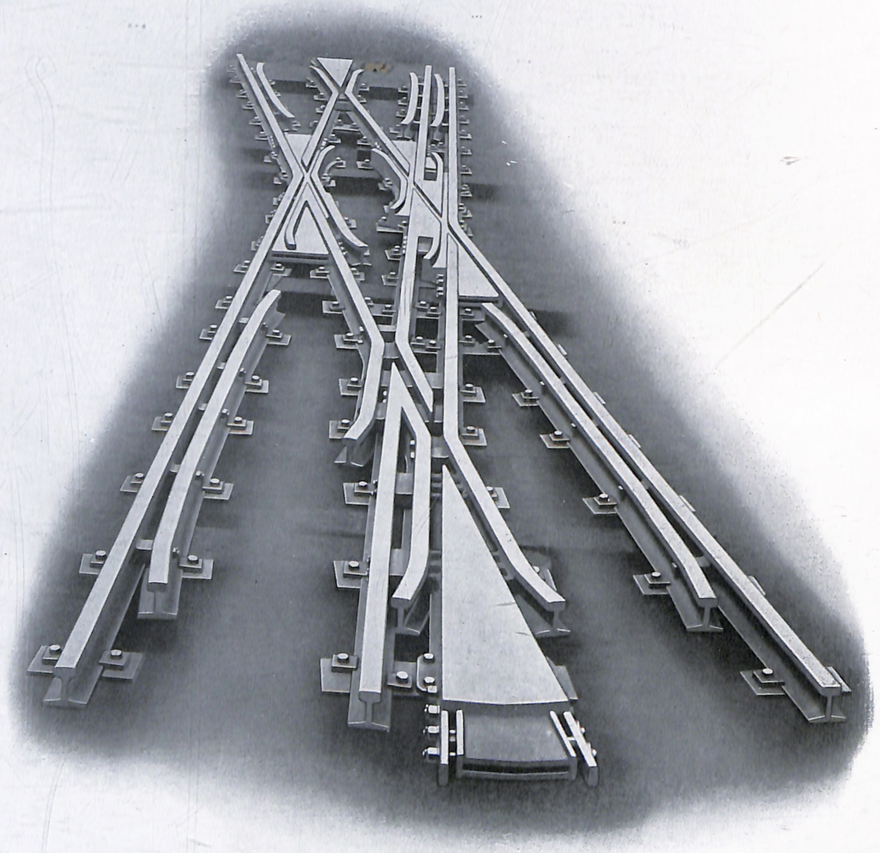
The lay-out comprises eight sets of 18ft. switches, four sets of 12ft. switches, 22 acute crossings, fourteen obtuse crossings, and also closure rails. The whole work thus includes eight turn-outs and eight diamonds, two of which have slip roads.



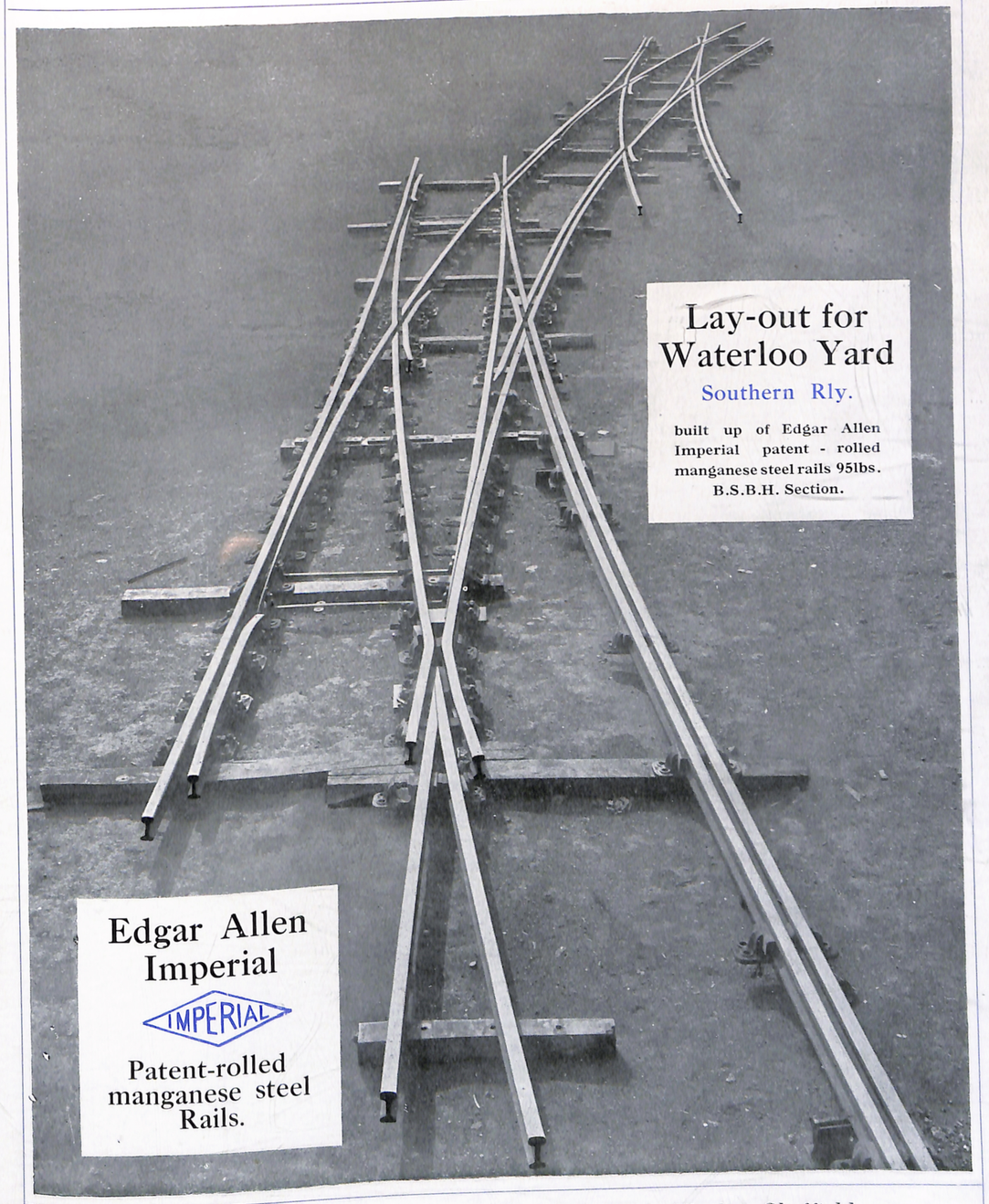
One of the compound triple crossings weighs 2½ tons and the other about 32 cwts.

A cast Imperial manganese steel centre piece is used in one of the triple compound crossings instead of the long point and splice rails forming the vees for the acute crossings, as the distance between the two crossing noses is too short to allow of the built up design being used.

The total weight of rail in the lay-out is approximately 100 tons. It is believed to be the largest lay-out in the world built up entirely in rolled manganese steel rails.



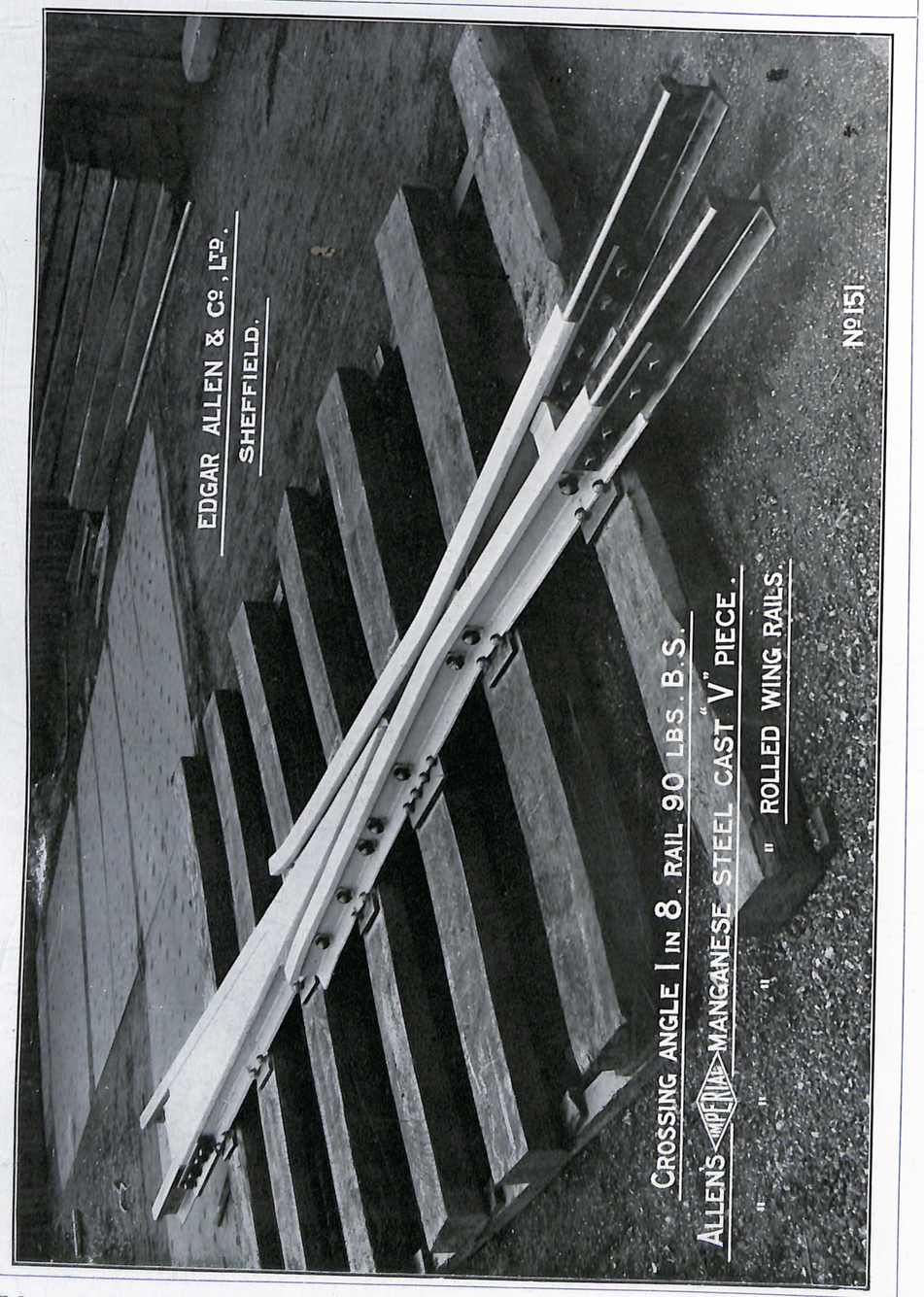
DOUBLE-GAUGE DIAMOND CROSSOVER BUILT UP OF
EDGAR ALLEN IMPERIAL PATENT-ROLLED MANGANESE STEEL RAILS AND IMPERIAL
CAST MANGANESE VEE-PIECES.

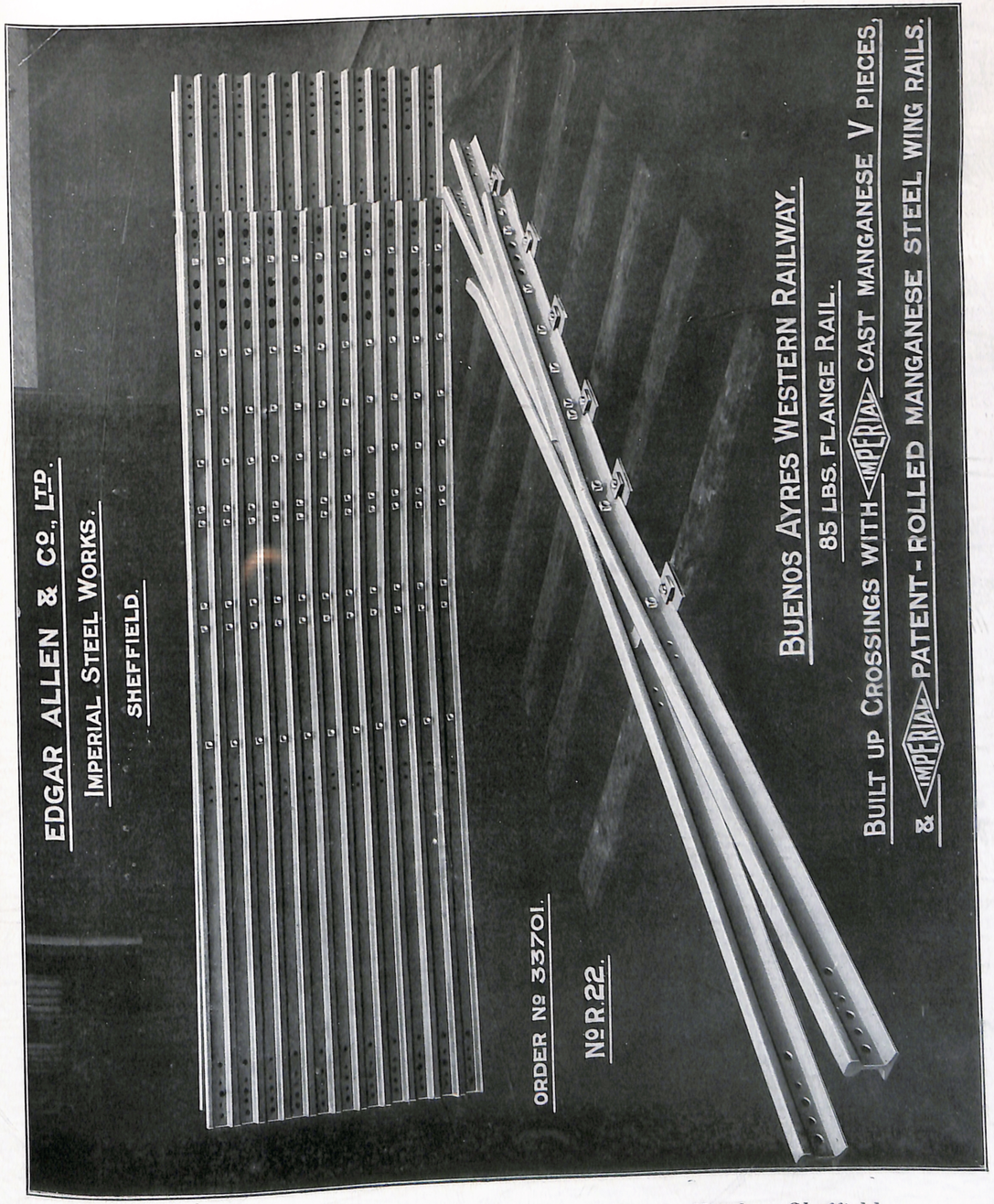


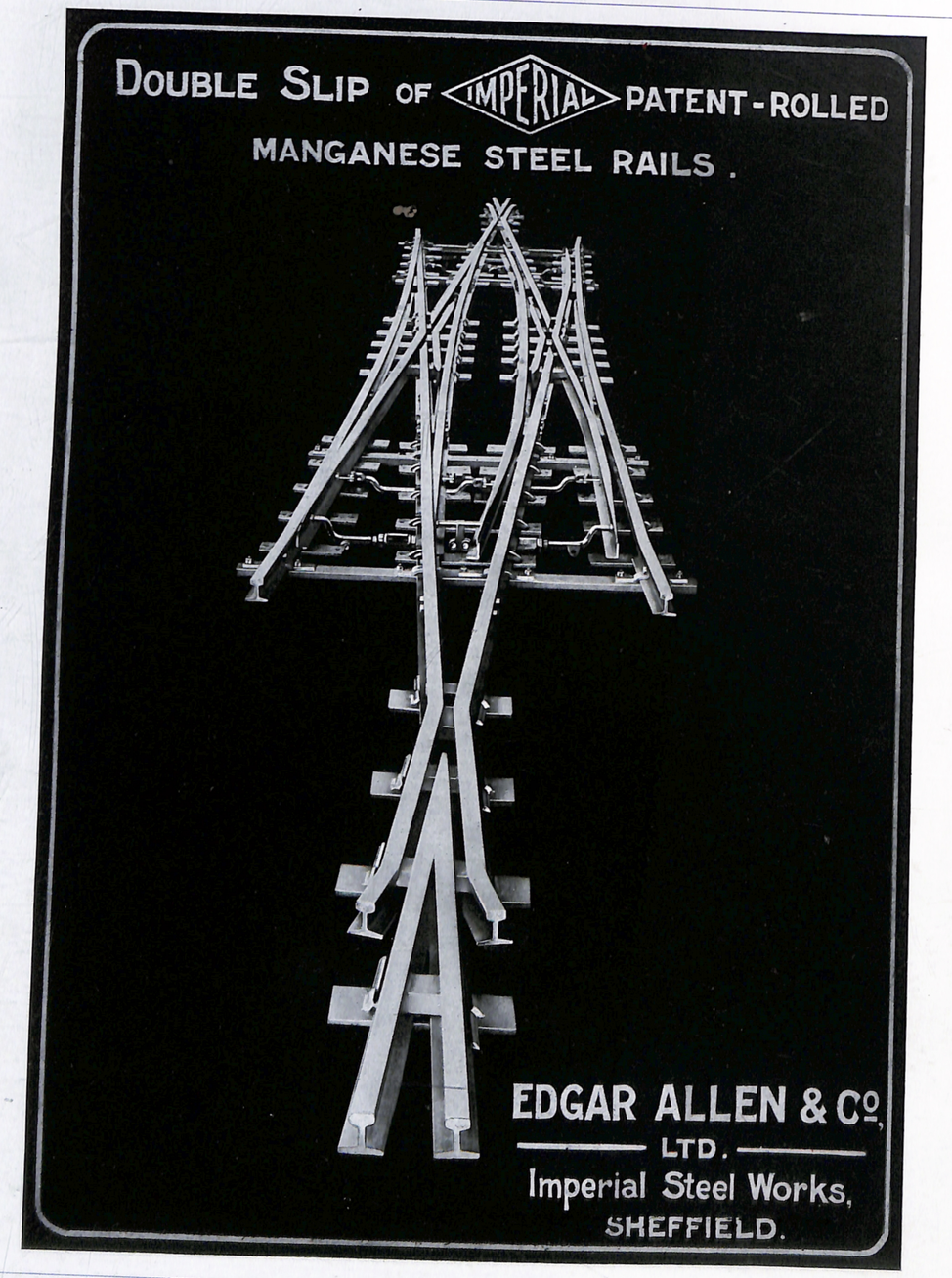
Manganese Steel Cast V-piece.
Patent-Rolled Manganese Steel Wing Rails.

IMPERIAL
TYPE AS SUPPLIED TO INDIAN RAILWAYS.

Built-up Crossing { Edgar Allen " "

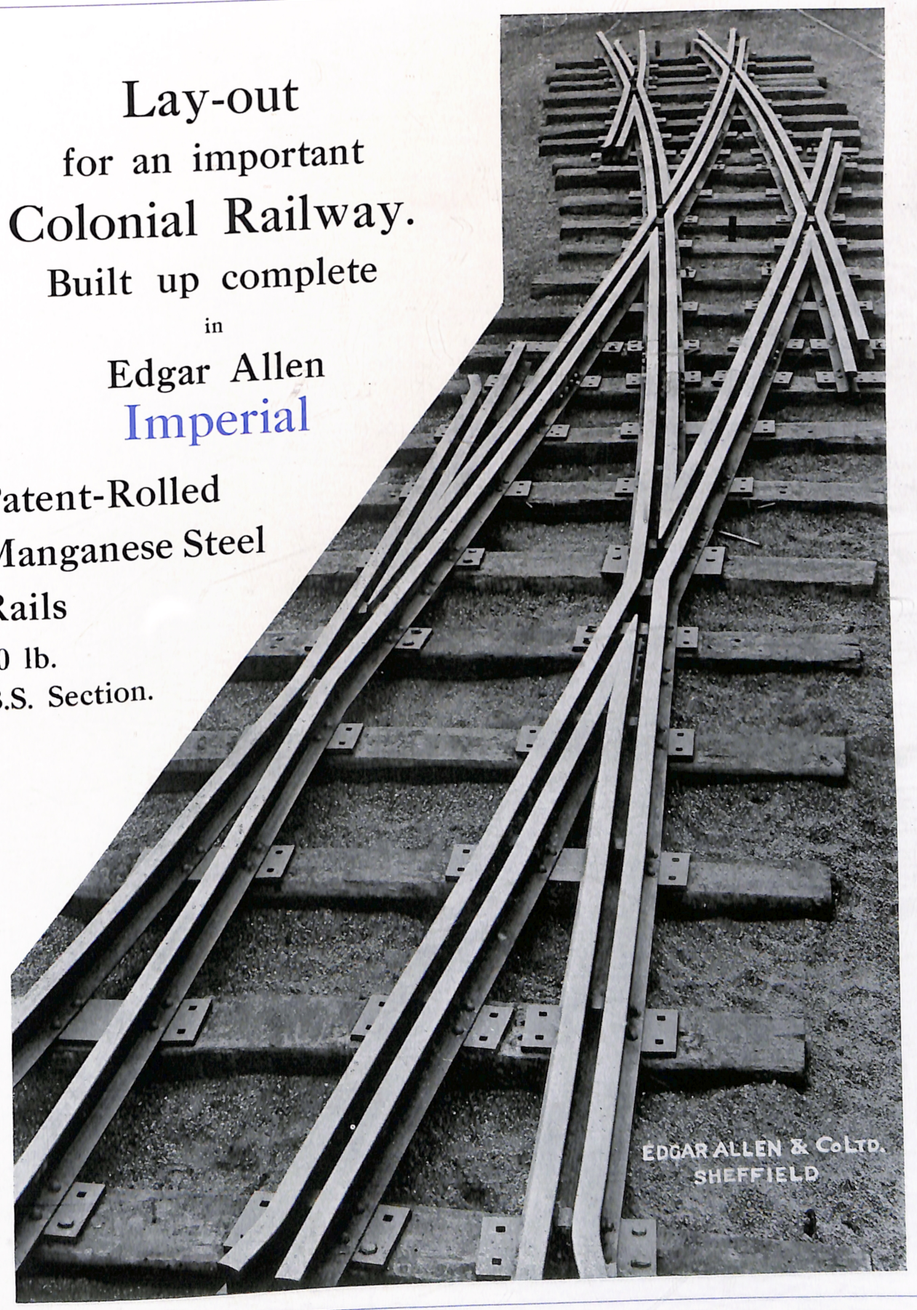




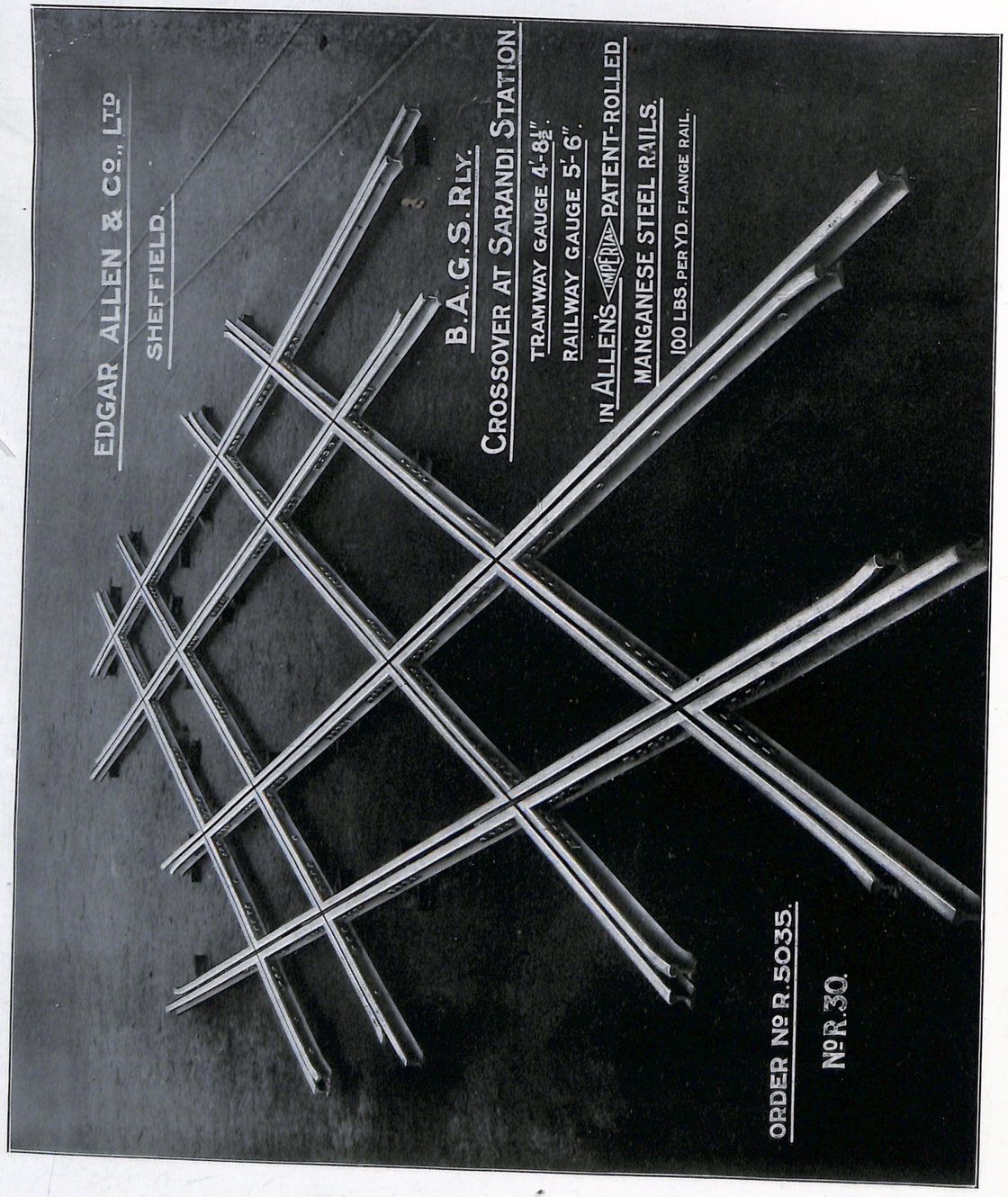


Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.

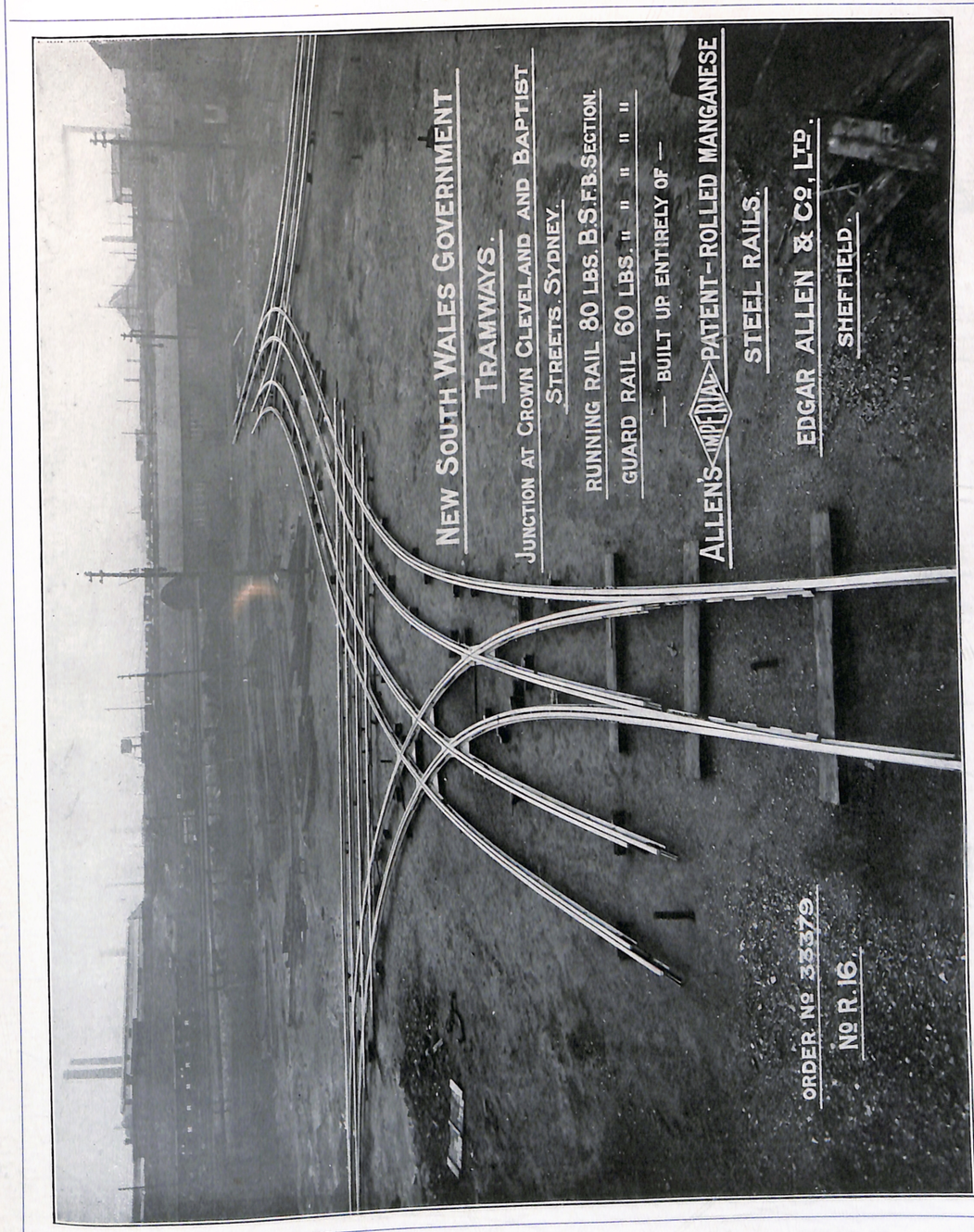
Lay-out
for an important
Colonial Railway.
Built up complete
in
Edgar Allen
Imperial
Patent-Rolled
Manganese Steel
Rails
80 lb.
B.S. Section.



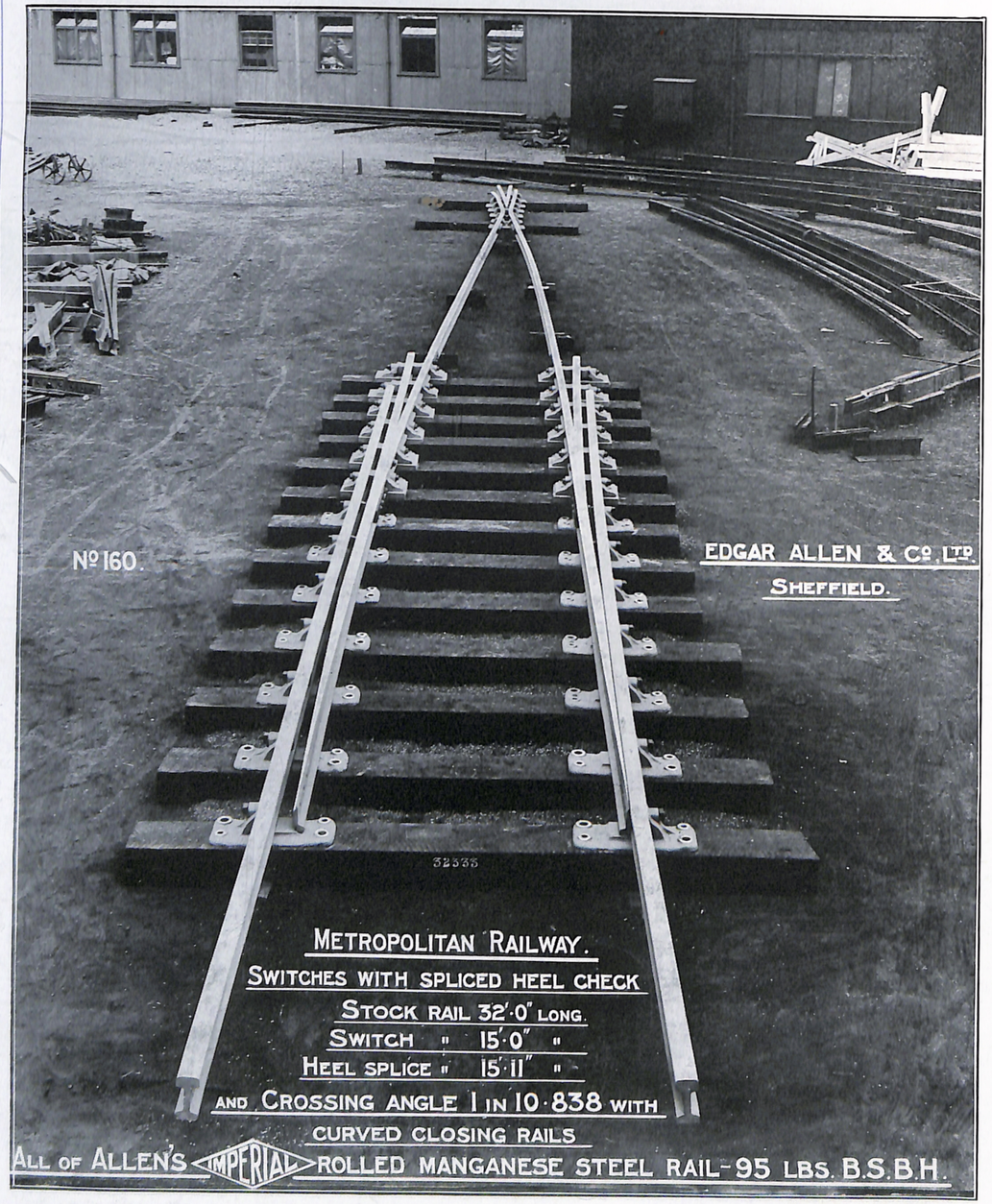
Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.



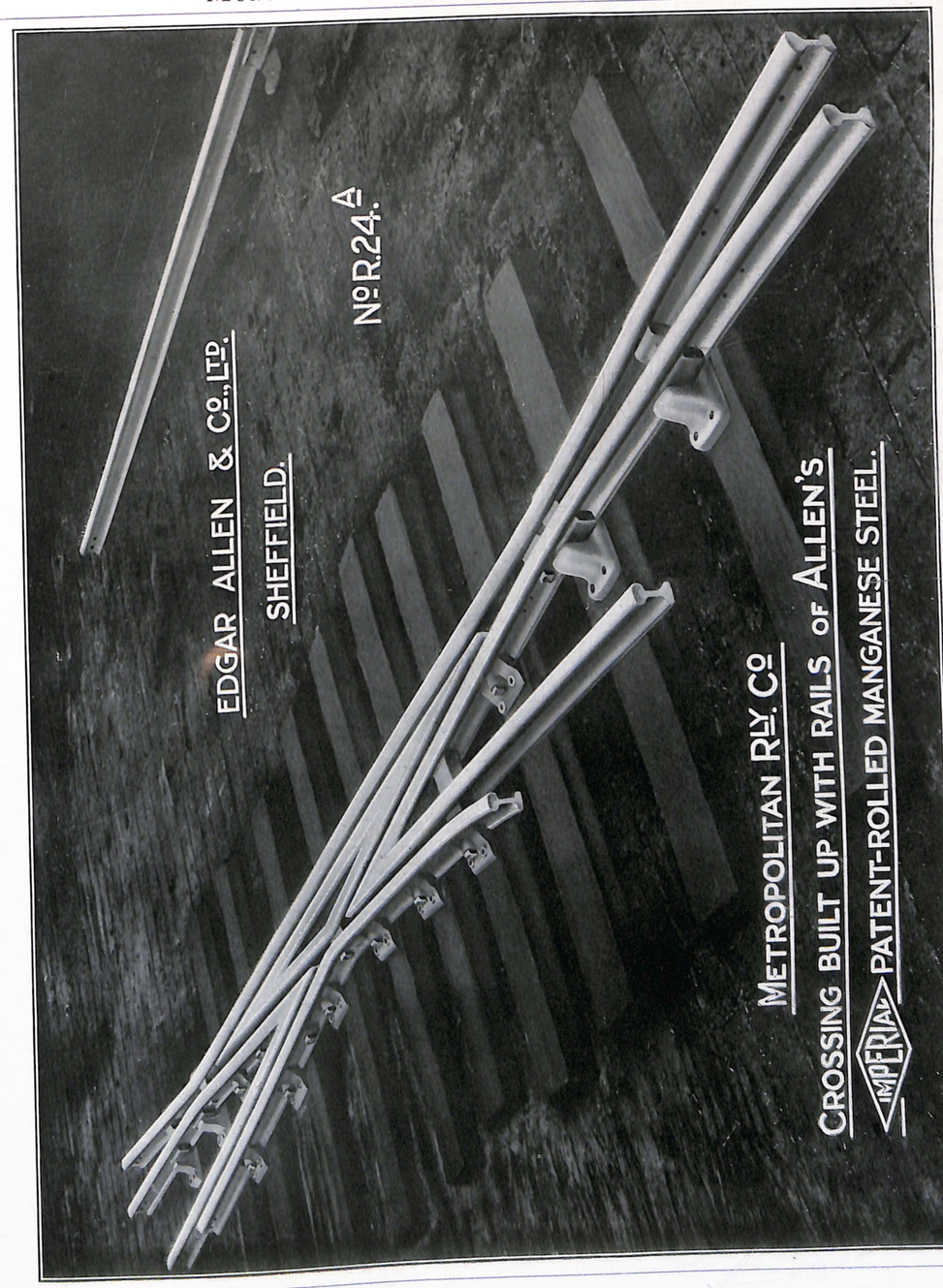
Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.



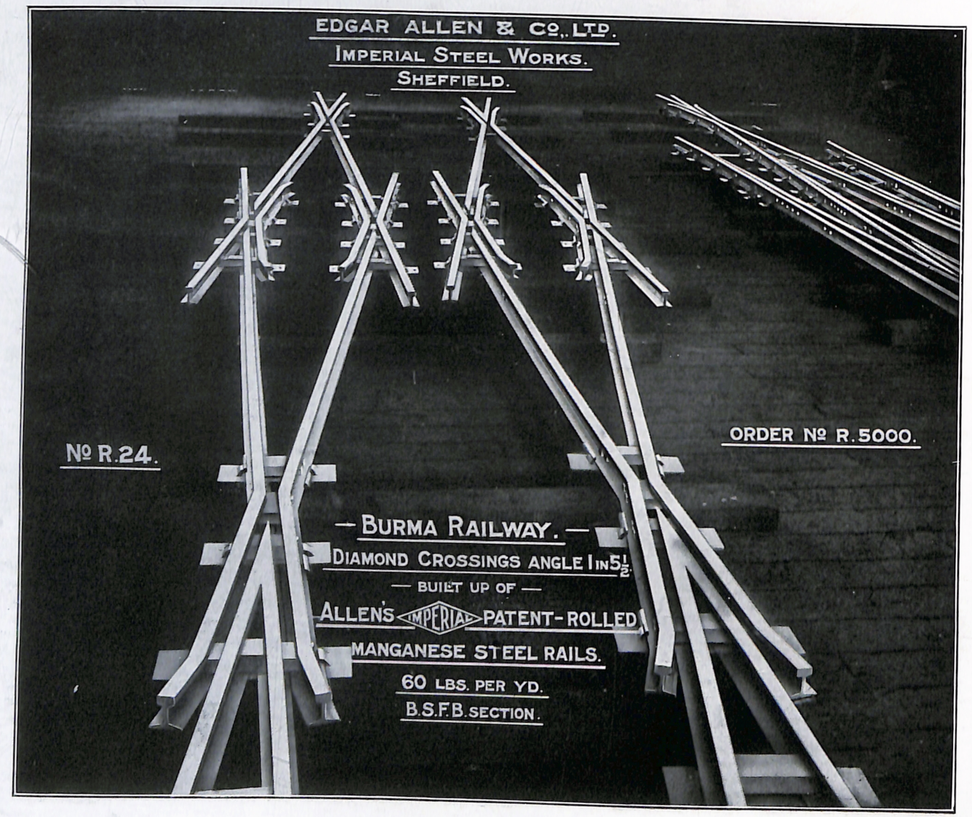
Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.

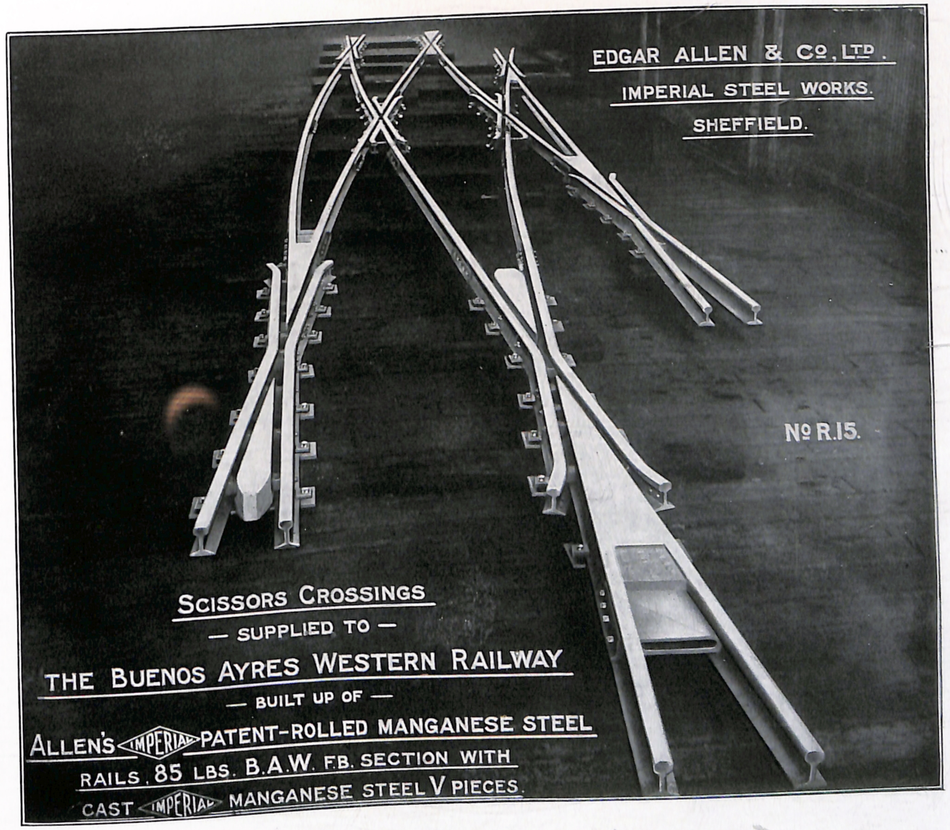


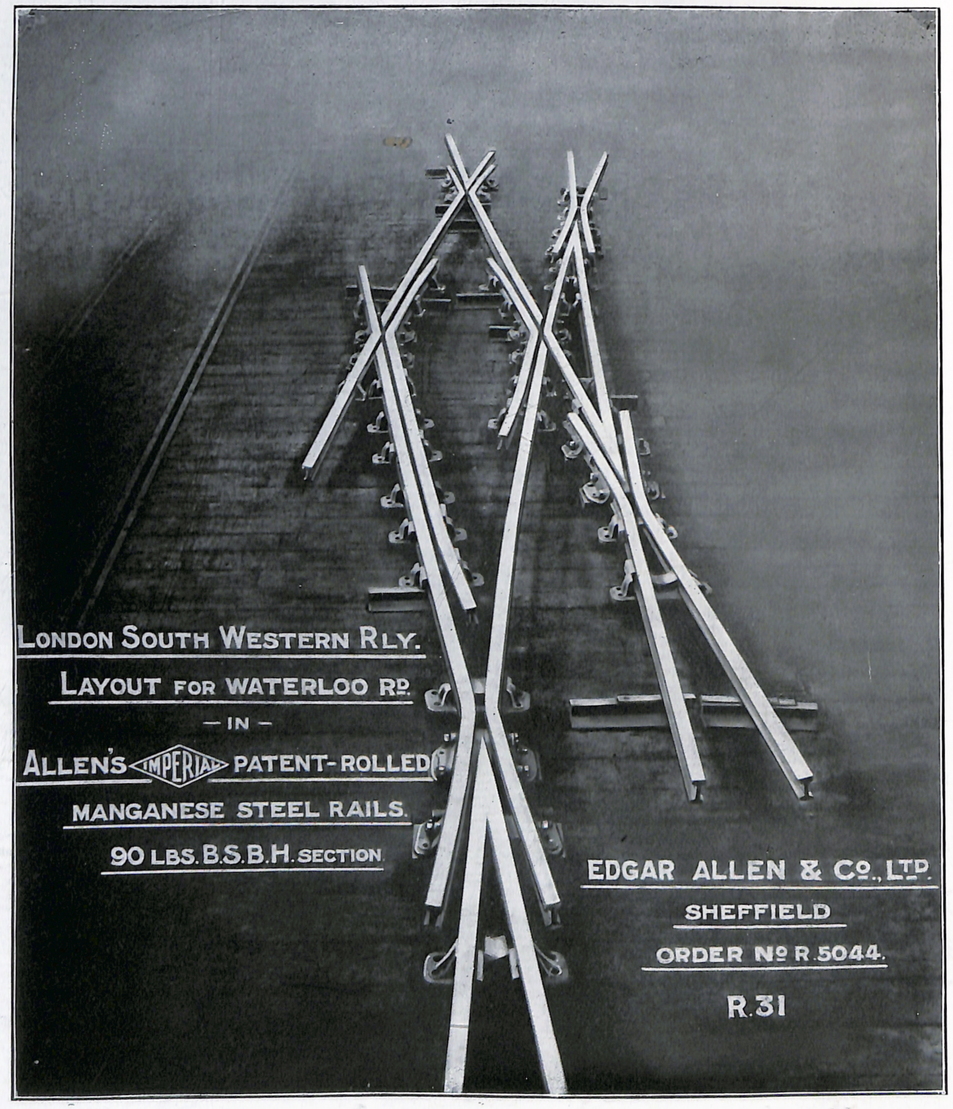
Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.



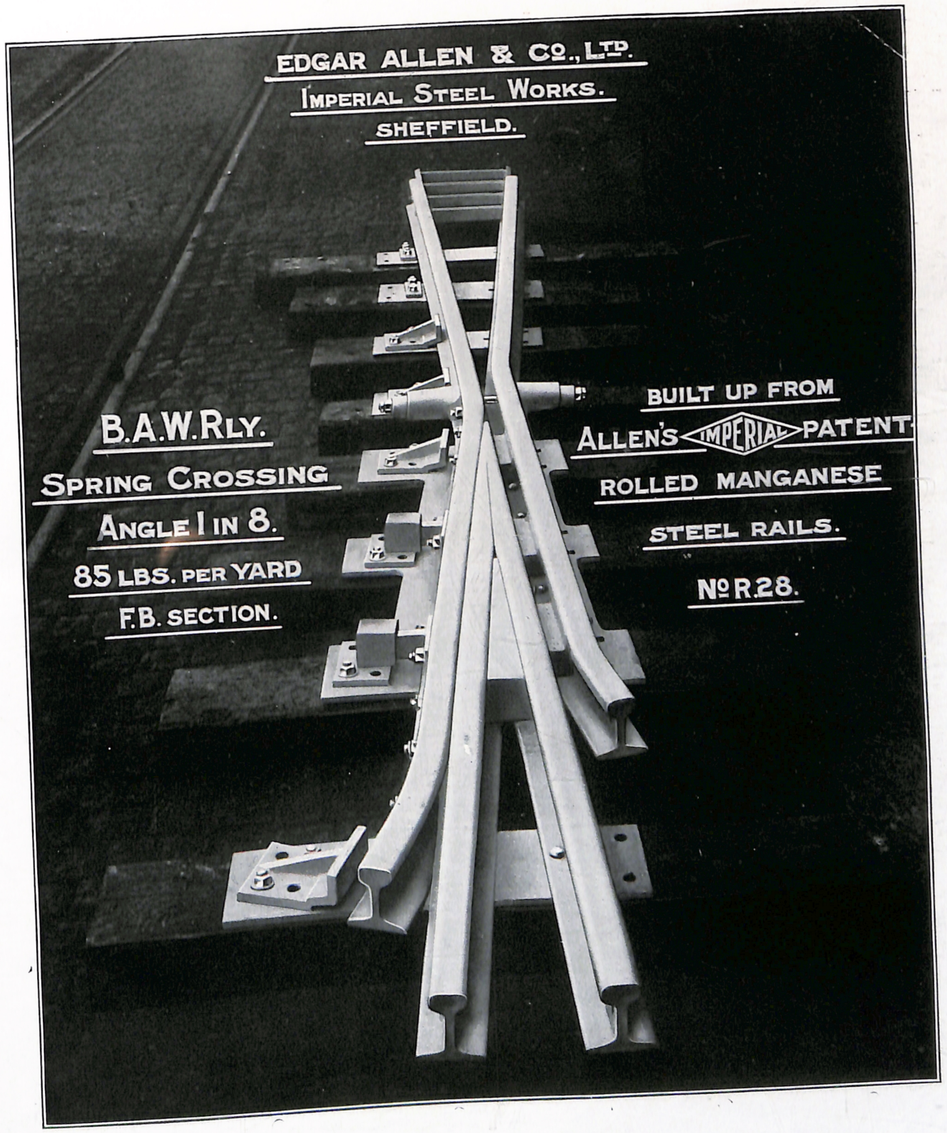
Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.


EDGAR ALLEN & Co., LTD.
IMPERIAL STEEL WORKS.
SHEFFIELD.
Nº R.24.
ORDER Nº R.5000.
— BURMA RAILWAY. —
DIAMOND CROSSINGS ANGLE 1 IN 5½
— BUILT UP OF —
ALLEN'S IMPERIAL PATENT-ROLLED
MANGANESE STEEL RAILS.
60 LBS. PER YD.
B.S.F.B. SECTION.


EDGAR ALLEN & Co., LTD.
IMPERIAL STEEL WORKS.
SHEFFIELD.
Nº R.15.
SCISSORS CROSSINGS
— SUPPLIED TO —
THE BUENOS AYRES WESTERN RAILWAY
— BUILT UP OF —
ALLEN'S IMPERIAL PATENT-ROLLED MANGANESE STEEL
RAILS. 85 LBS. B.A.W. F.B. SECTION WITH
CAST IMPERIAL MANGANESE STEEL V PIECES.



Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.



Edgar Allen & Co., Limited, Imperial Steel Works, Sheffield.

List of Railway Companies who have placed Contracts for

Edgar Allen Imperial Manganese Steel Switches and Crossings, etc.

BRITISH RAILWAYS.

Admiralty, Devonport.
Great Western Railway.
Great Northern Railway.
Midland Railway.
London and North Western Railway.
Lancashire and Yorkshire Railway.
Great Eastern Railway.
Metropolitan Railway.
Metropolitan District Railway
London, Tilbury and Southend Railway
Central London Railway.
Midland Great Western Railway of Ireland.
North Eastern Railway.
London and South Western Railway.
Mersey Railway.

INDIAN AND COLONIAL RAILWAYS.

Indian State Railway— Eastern Bengal.
,, ,, ,, North Western
,, ,, ,, Oudh and Rohilkund
,, ,, ,, Great Indian Peninsular
Assam Bengal Railway.
Bengal North Western Railway.
Bombay, Baroda and Central India Railway.
East Indian Railway.
Burma Railways.
South African Railways.
Victorian Railways.
New South Wales Government Railways and Tramways.
Queensland Government Railways.

NORTH AMERICAN RAILWAYS.

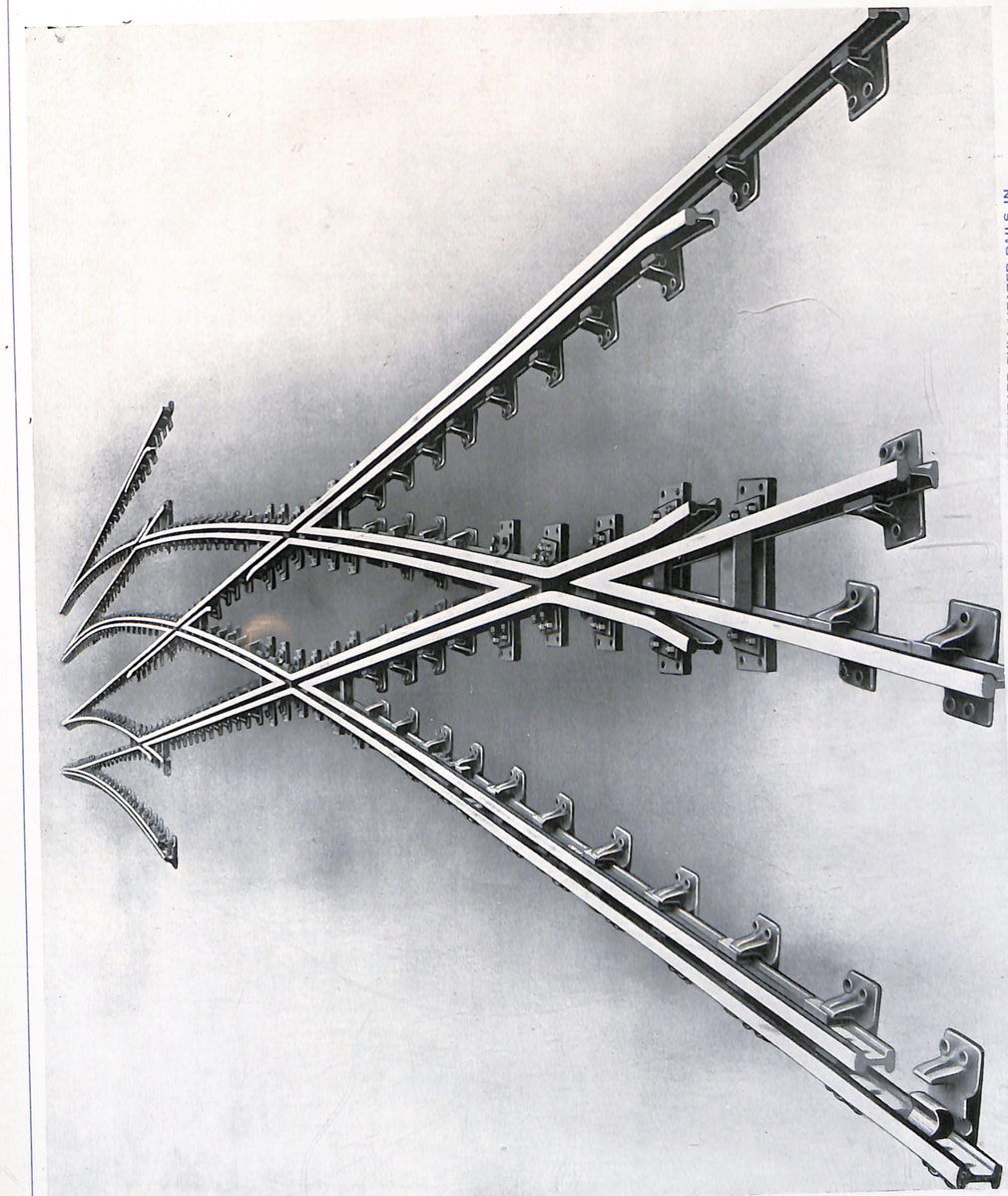
Canadian Pacific Railway.
Toronto, Hamilton and Buffalo Railway.
Grand Trunk Railway.
Hudson Railroad Co., Ltd.
Transit Development Co., New York.

SOUTH AMERICAN RAILWAYS.

Central Argentine Railway.
Antofagasta Chili and Bolivia Railway.
Western Railway of Havana.
Buenos Ayres Great Southern Railway.
Central Railway of Brazil.
Paulista Railway (Brazil).
Leopoldina Railway.
Buenos Ayres Pacific Railway.
Chilian State Railways.
Buenos Ayres Western Railway.
Cordoba Central Railway.

CONTINENTAL AND FOREIGN RAILWAYS.

Portugese Railways.
Portugese State Railways—Minho e Douro.
Northern Railway of Spain.
Madrid, Saragossa and Alicante Railway.
Compania de los Ferrocarriles de Medina del Campo a Zamora y de Orense a Vigo.
Compania de los Ferrocarriles Vascongados—Spain.
Metropolitan Railway—Paris.
Ceinture Railway.
Paris, Lyons and Mediterranean Railway.
Moscow Kazan Railway.
Roumanian State Railways.
Electrische Spoorweg Maatschappij, Haarlem-Holland.
Danish State Railways.
Norwegian State Railways.
Ferrocarrils Santander a Bilbao.
Imperial State Railways of Japan.
Metropolitan Madrid Alfonso XIII. Railway.
Gran Metropolitano de Barcelona Railway.



DOUBLE JUNCTION FOR MERSEY RAILWAY, BUILT UP OF 100-LB. BRITISH STANDARD BULL-HEADED RAILS IN EDGAR ALLEN'S PATENT-ROLLED IMPERIAL MANGANESE STEEL.

Edgar Allen
Catalogues and Publications.

Catalogue "G." The Edgar Allen Steel Book. Tool steel, files, saws, twist drills, etc. There is a right steel for every tool. This book helps you to choose the right steel.

Stag High Speed Steels. An Illustrated hand-book describing the Edgar Allen high speed steels and their heat-treatment, together with details of tools, ready-hardened lengths, tool-holder bits, etc. Contains temperature chart and tables of speeds and feeds.

Special Alloy Tool Steels. A 28-page booklet giving details of purposes for which these intermediate steels are economical, best heat-treatments etc.

Facts about Files. Tells you how to get the most work out of Edgar Allen files, and why it pays to take care of them.

Drill Data. A hand-book giving the history of drills and hints how to use them correctly, a table of speeds and feeds, sizes, notes on grinding, etc.

Screwing Tackle. An illustrated price list.

Catalogue "A." Sectional catalogue. Contains indispensable information about ore and general crushing and grinding machinery. *Experimental plant at customers' service.*

Catalogue "C." The Edgar Allen Steel Foundry Book. A 40-page treatise on steel castings, for buyers and engineers.

Catalogue "D." Steel for Motor Cars and Aircraft. Describes the Edgar Allen Motor car and aircraft steels, many of which are of great service in general engineering work.

Imperial Manganese Steel. Describes the peculiar characteristics of Edgar Allen Imperial manganese steel, and how to save money by using it.

Catalogue "E." Cement plant, rotary kilns, rotary dryers, etc.

Catalogue "H." Tramway trackwork (10s. 6d.)

Saw Service. Treats of kinds of circular saws for different purposes, shapes of teeth, economy in running, etc.

Cutters and Reamers. An illustrated price list.

The Edgar Allen News.

This is a steel and engineering technical journal, published every month and containing articles of practical value on steel and steel products. A specimen copy will be sent, post free, on receipt of the request form correctly filled in

Write for whichever interests you.

Edgar Allen & Co. Ltd.,

Imperial Steel Works,

Sheffield.

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