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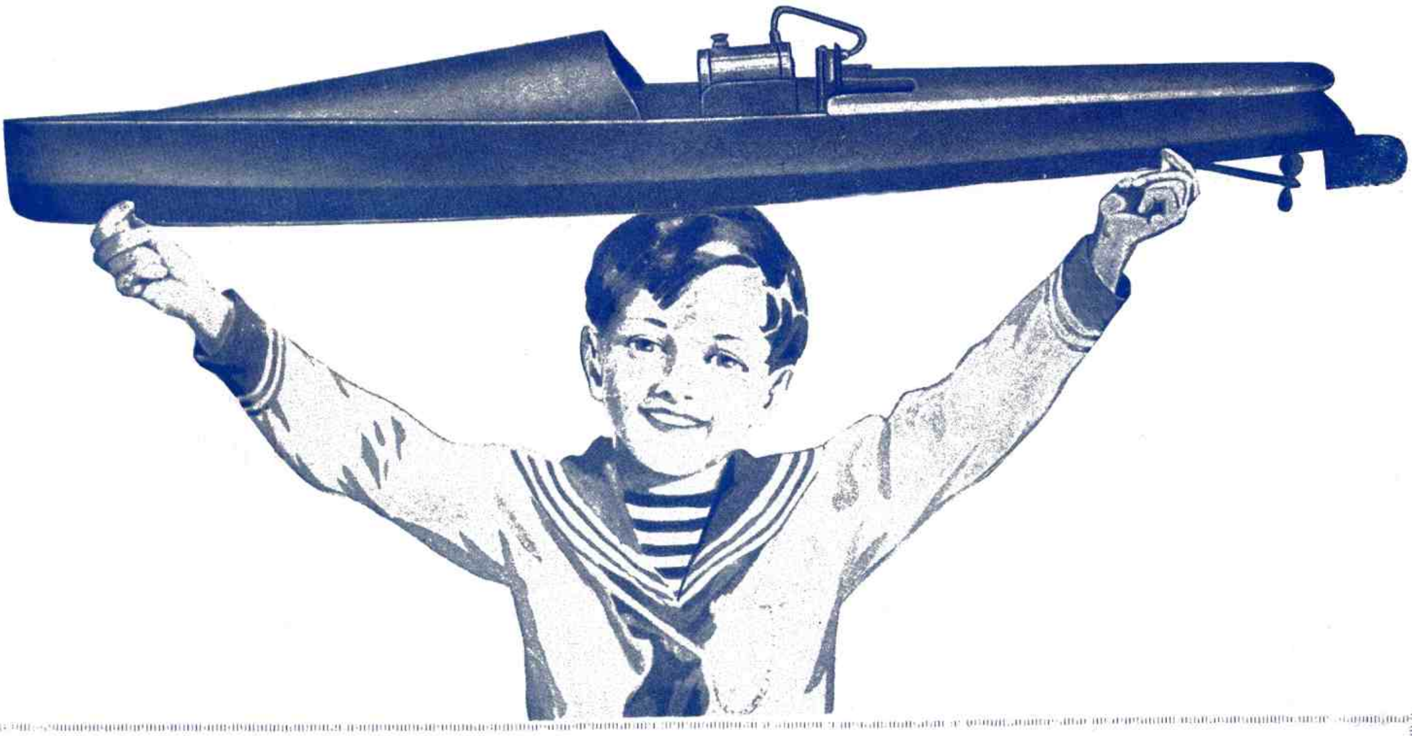

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MECCANO MAGAZINE

PUBLISHED
IN THE INTERESTS
OF BOYS

Vol. X, No. 3.

March 1925

THIS month our cover shows the "*Mammoth*," a giant Pontoon Crane belonging to the Mersey Docks and Harbour Board, who kindly supplied the photograph used as a basis for our cover. The illustration shows this great crane hoisting a massive dock-gate into position at the Liverpool Docks—an incident that occurred recently. The "*Mammoth*" was described and illustrated in the "*M.M.*" for November 1921. It is a self-propelling floating crane, capable of handling loads up to 200 tons, and is of the derricking-jib type. A valuable asset to the Port of Liverpool, it is constantly called upon to perform heavy weight-lifting feats. The crane is carried on a pontoon 154 ft. in length, with the crane arm so placed that the maximum outreach may be obtained either over the side or over the stern of the vessel. This feature in its construction is particularly valuable in handling heavy loads over the gates of large graving docks, in narrow entrances, and in restricted places. For further particulars of this great crane my readers are referred to No. 21 of the "*M.M.*" This month our magazine might almost have been announced as a special "Floating Crane" number, for in addition to our coloured cover showing the "*Mammoth*," we have an article on the largest floating crane in the world, recently built in this country for the Japanese Government, and also an article describing the construction of a Meccano model of Crane-Lighter No. 4, the property of the Admiralty. Cranes of all types have always been favourite objects with my readers and tens—or even hundreds—of thousands of Meccano models of cranes must have been built at one time or another. I have no doubt that the interesting information contained in this issue will result in the construction of a further large number of models, which this time will effectively reproduce the magnificent Crane-Lighter No. 4 in Meccano.

Our Cover

I have recently read that from a list of 500 of the world's greatest inventors, scientists, and philosophers, Mr. Henry Ford has chosen 21 names. The first three are Luther Burbank, Thomas A. Edison, and John Burroughs. Other names in his list of honour are:—Darwin, Da Vinci, Fulton, Bell, Wright, Diesel, Curie, Newton, Pasteur, Ampere, Franklin, Whitney, Marconi, Kirby, Faraday, Otto, Dunlop and Galileo. When I read the list I wondered how many of my readers are familiar with all these famous names selected by Mr. Ford—who, by the way, surely deserves a "place in the sun" also. In order to discover this, I offer a prize of a cheque for a guinea for the best account of these men—dates and places of births and deaths (where possible), and a description of their greatest achievement—allowing fifty words only for each name. Now boys, get out your encyclopædias, visit your reference libraries—or, if both these fail you, ask father! (Perhaps this is a case where I should call him "dad," for I saw that a writer recently stated: "When father has money we call him 'father.' When he takes the collection at church, we call him 'Papa.' If he goes shopping with mother and pushes the 'pram', we call him 'Pa.' But if he buys us Meccano, and gives us a hand with the models till his fingers ache from screwing up the bolts with them, instead of using a screwdriver, we call him 'Dad!'"—So "dad" let it be in this case!) Send in your efforts before 31st March and mark your envelopes "Inventors." Overseas readers may have until 30th July for sending in their entries—a distant date certainly, but one that gives my young friends in the wilds of Australia and New Zealand a chance!

Famous Engineer's Choice

Those Meccano boys who paid a visit to Wembley (and also readers who were not so fortunate) will be interested in the figures that have just been published showing details of the food consumed at the world's greatest exhibition. The caterers state that sometimes they had to deal with as many as 300,000 people in one day, and that as there was no storage at Wembley everything had to be taken there fresh each day. In the course of a single week, visitors consumed 75 tons of meat, 260 tons of bread, 40 tons of potatoes, 5 tons of tea, 300,000 tins of sardines, 500,000 bottles of mineral waters, and 2,000,000 small cakes! Over 2,000,000 meals were served each week, and the caterers provision vans made 70 journeys a day between Wembley and London. We are better able to imagine the amount of crockery that was required when we learn that the breakages during the exhibition included 450,000 tea-pots, 1,378,000 cups, 410,000 saucers, and 1,480,000 glasses! The same firm is not undertaking the catering this year.

Wembley Figures

I am at all times pleased to consider articles, photographs, and sketches for publication in the "*M.M.*" Many articles are sent to me from time to time, but many of these are unsuitable. They are either too "high-brow," or, on the other hand, not of sufficient general interest to the majority of my readers to enable me to print them. For instance, although interesting to me personally, a description of your pet rabbit, an article about your garden, or an account of what you did last Saturday afternoon, are not of sufficient general interest to 100,000 readers to warrant my publishing them in these pages. I like to hear from you all about these things in your happy letters to me, but the articles that I want for publication are those that deal with any new engineering structure in your district, anything connected with Meccano—such as some new application or some particularly interesting movement—articles on railways, locos, electricity, Radio and similar subjects. These will all be welcome—the more so if your articles are typed or neatly written on one side of the paper only. In each case your name and address should be clearly shown—this is a necessary remark because it is surprising how often contributors forget these important details and then write a strong letter asking me why the contribution has not been acknowledged or returned! Payment will be made at our usual rates for those articles that are published. One other point: All articles and sketches submitted should be original, that is, they must not be copied from or modelled on an article that has already been published, as the author of the original article has the copyright of it, and it is illegal to "lift" it, either as a whole or in part, without his permission. This also applies to articles published in the "*M.M.*," of course, and if your article is accepted it is copyright, and cannot be reprinted by any other magazine without permission. Wherever possible I am always pleased to give permission for articles to be reprinted in other magazines—whether they are regular magazines or Meccano Club magazines—but articles must not be lifted from the "*M.M.*" without this permission.

Contributions Wanted

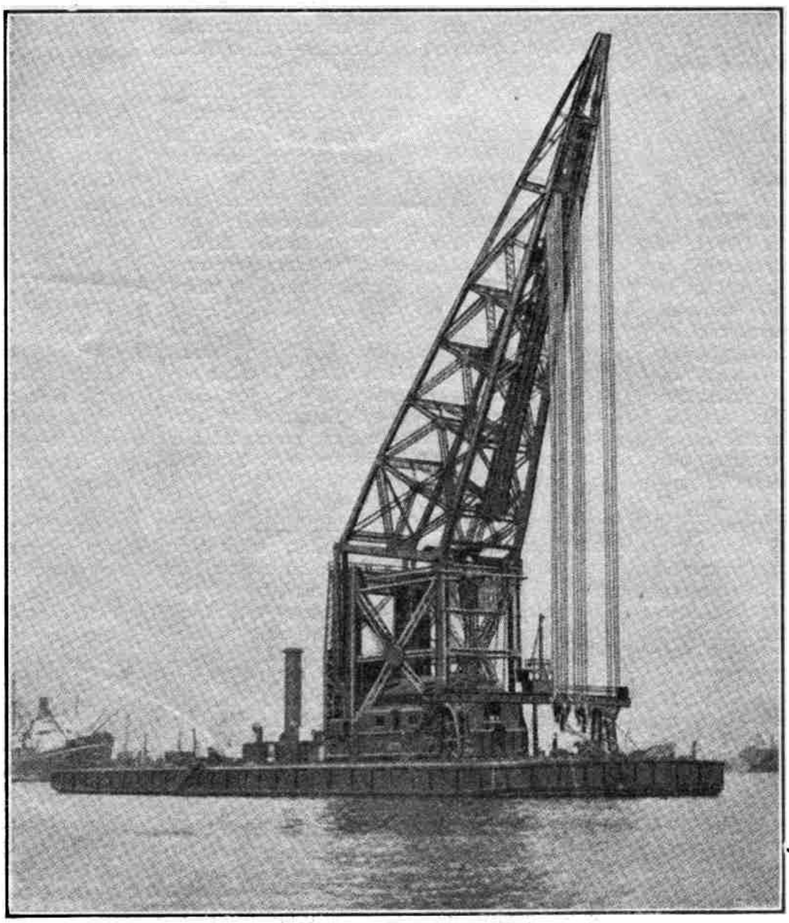
The Largest Floating Crane in the World

A 350-Ton Giant for Japan

THERE is no more interesting member of the large family of giant cranes than the self-propelled floating crane. Whereas the larger land cranes have a very limited radius of movement, the floating crane is able to steam slowly and majestically to any part of a harbour or dockyard and take up the best position from which to tackle the work to be done. This freedom of movement makes the floating crane of the greatest possible value in the construction of the huge battleships and passenger and cargo liners of the present day, and indeed it is doubtful whether these monster vessels could be built and equipped without the aid of such cranes. Their value is also very great in various operations of ship repairing.

Floating Giants

Many giant floating cranes have been built during recent years for various naval dockyards, great ship-building firms and harbour authorities. Those Meccano boys who have been regular readers of the *"M.M."* from its early days may remember that in the September — October issue, 1921, we illustrated and described an immense crane of this type belonging to the British Admiralty. This crane was designed to lift a load of 250 tons over a radius of 100 ft. and to a height of 77 ft. 6 in. above the level of the water. On test, however, it proved capable of lifting 312 tons. The proportions of this crane were so well designed and its weight was so well distributed that even when the crane-arm was lifted to its greatest extent without a load, and at its minimum reach athwart-ships, the deck was inclined only four degrees in a direction of depression on the side behind the elbow. Another crane of very similar capacity was built in 1923 for the United States Navy department. An unusual feature about this crane is that it is built on to the hull of an old battleship.

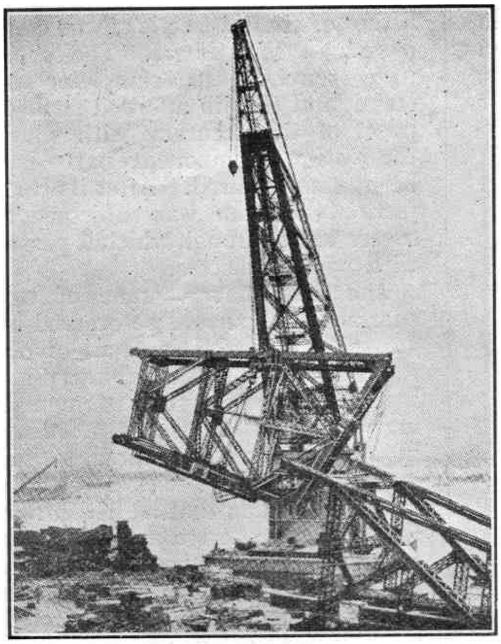


Completed Crane with Jib fully raised

The Mersey "Mammoth"

Another interesting floating crane is the "Mammoth," belonging to the Mersey Docks and Harbour Board. This crane is capable of handling loads up to 200 tons. It is of the derricking-jib type, and is able to deal with heavy loads over the gates of large graving docks, which is a very valuable asset, particularly in ship repair. It is also capable of lying alongside the largest vessels and delivering loads up to 60 tons from the hold of the vessel direct on to the quay. This crane was built in Holland, and on a trial trip on the River Meuse it was shown that its two sets of triple-expansion marine type engine were capable of propelling it at an average speed of nearly five miles per hour. It is interesting to know that the crane was towed from Schiedam to Liverpool without the jib being dismantled.

One of the most interesting feats accomplished by the "Mammoth" was the transporting of a lock gate across the Mersey. The gate was removed from the Alfred Dock, Birkenhead, to the Brunswick Dock, Liverpool, in three sections, for strengthening and various repairs. The necessary work was carried out, and half of the gate, weighing approximately 190 tons, was transferred by the "Mammoth" back to the Alfred Dock. Later the "Mammoth" successfully transferred the second half of the gate



Lifting Lower Section of Jib

without any difficulty. On each occasion the crane raised the half gate from the dock wall and swung it on to her own deck where it rested vertically in an improvised cradle. The crane was towed across the river by a pair of tugs with a third tug astern. Another feat of the "Mammoth" was that of lifting into position a bridge section weighing 152 tons at New Brighton Ferry.

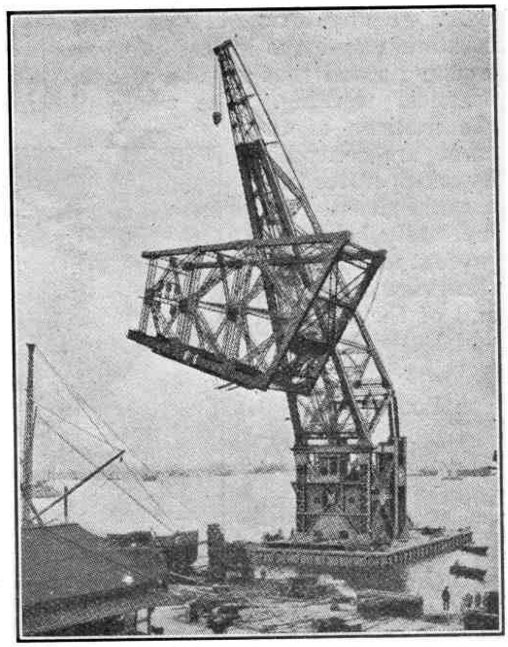
Monster to Lift 350 Tons

The increasing tonnage of modern vessels has led to a corresponding growth in the size of cranes, and last year Messrs. Cowans, Sheldon & Co. Ltd., of Carlisle, designed and built for a Japanese shipyard the floating crane shown in our illustrations. This monster is capable of lifting no less than 350 tons. It was partially erected in the builders' works at Carlisle, and was finally erected in Japan under the supervision of one of the builders' engineers. The Japanese firm to whose order the crane was built, Mitsubishi Shoji Kaisha Ltd., themselves constructed the pontoon and propelling machinery to plans prepared for Messrs. Cowans, Sheldon & Co. Ltd., by Sir W. G. Armstrong, Whitworth & Co. Ltd., of Newcastle-on-Tyne.

Main and Auxiliary Lifting Gears

The following details of this crane, for which we are indebted to "*The Engineer*," give some idea of its vast size and power. It is capable of lifting and revolving through a complete circle with loads up to 350 tons at 100 ft. radius, or 300 tons at 121 ft. radius. It can lift either of these loads through a vertical distance of 140 ft. The main loads are lifted on two independent blocks, each of 175 tons capacity, the operating machinery being arranged so that these blocks may be used either coupled together or independently as desired.

An auxiliary purchase of 50 tons capacity is provided at the end of the jib at a distance of about 40 ft. in front of the main purchase, and this block is arranged for a vertical lift of 200 ft. There is also another purchase of 50 tons capacity. This is carried on a trolley that travels along the underside of the jib to a sufficient extent to move the load through a distance of about 75 ft. measured horizontally. This feature enables the crane to deal with comparatively small loads at high speed without any necessity for using the derricking motion.



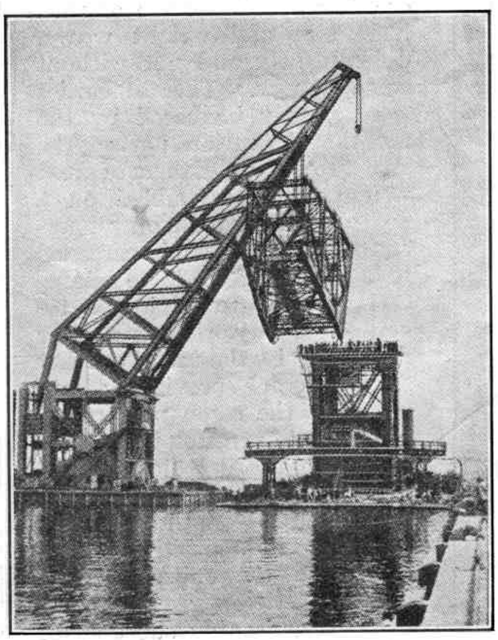
Jib in mid-air

Nine Sets of Engines

The jib is capable of derricking in from the maximum radius of 121 ft. to a minimum radius of 50 ft., and when in this position the overall height to the top of the crane is 240 ft. The whole crane is mounted on a roller path having a diameter of 50 ft., and fitted with special machinery that enables the crane to be revolved with its load through a complete circle in either direction.

Each individual motion is operated by an independent set of double-cylinder engines. These are fitted with link motion reversing gear, and altogether there are nine such sets of engines.

The jib is raised and lowered by means of two steel screws 49 ft. in length and 14 in. in diameter, placed at the back of the crane and driven from the engines through a train of gearing.



Jib swung round ready for Lowering

The superstructure consists mainly of a rectangular braced frame supporting the jib and carrying the guides for the cross-head. It is 66 ft. in height, measured from the roller path to the jib foot pivot. The whole of this portion of the crane had to be designed with the greatest possible care because of the various forces it had to withstand—these being much greater, indeed, than in any previous floating crane.

Hydraulic Brakes

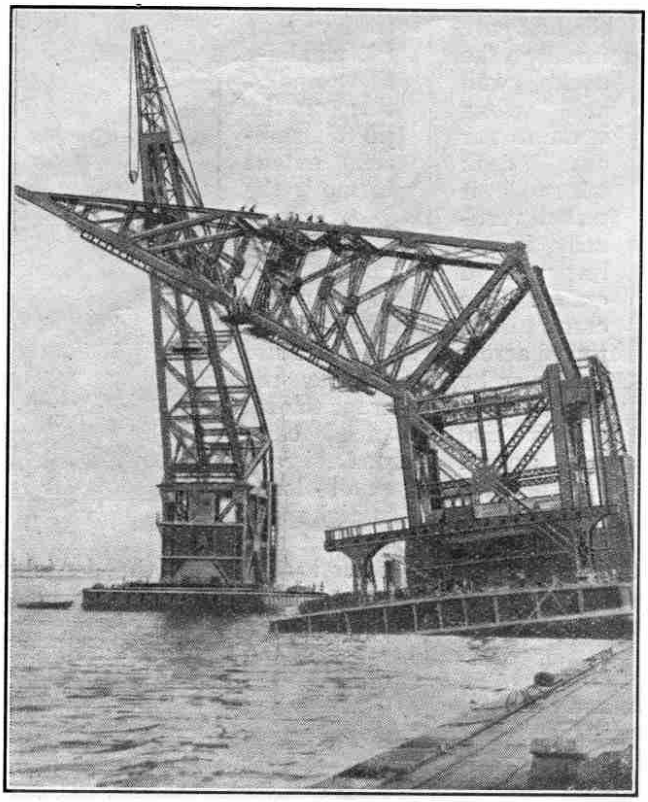
The main and auxiliary lifting gears are each fitted with specially-designed hydraulic brakes to control the lowering of the loads. These brakes are powerful enough to enable any load to be sustained with safety or lowered with precision at any space between the maximum and the lowest possible creeping speed that may be used in practical working. The whole of the motions of the crane are controlled by one operator from a cabin situated immediately below the jib foot and giving a clear view of the load and of the site over which the crane is working.

The Pontoon

The pontoon itself is 270 ft. in length and 92 ft. in width, with a draught of about 10 ft. Its size is such as to render unnecessary any moving or water ballast which usually has to be adjusted by the operator.

Behind the crane a large portion of the deck area is arranged so that it is possible to carry a deck load of some 700 tons. The propelling machinery, which is placed amidships, consists of twin-screw compound engines supplied with steam from two single-ended boilers at a pressure of 150 lb. per square inch.

The hull is built entirely of steel, and is divided by bulkheads into water-tight compartments. The deck equipment includes a steam windlass, steam capstans, steam and hand-steering gear, davits, lifeboats, and all the accessories necessary for a sea-going vessel. The ship is navigated from a steel bridge extending the full width of the deck and situated immediately in front of the crane base.

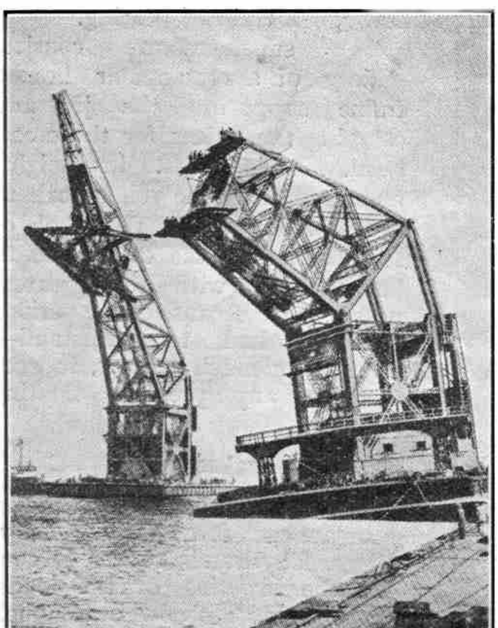


Jib in Position

Erecting the Crane

As may be imagined, the erection of a structure of such huge size and weight was a difficult task and not without some danger. The difficulties were greatly increased by the fact that the various parts of the structure, many of them of great weight, were assembled on a floating base, which, on numerous occasions, had to be careened to a sufficient angle to enable certain parts to be joined together. The work was greatly facilitated by the use of another floating crane previously supplied by the same makers.

The first operation in the task of erecting the jib, which weighed over 300 tons, was to lift the lower section from the quay side and place it in position for securing to the superstructure. This operation was carried out in the remarkably short space of six hours. The next task, the lifting of the top section, was completed in four hours. The short time required to complete the erection of the jib afforded striking proof of the accuracy with which the various component parts had been manufactured. After its completion the crane was subjected to severe tests, through which it passed with perfect success.



Attaching upper section of Jib

The fact that a crane of this enormous size should be ordered by Japan is a notable instance of the rapid strides that that country has made during recent years in engineering work of all kinds, and not least in the building of warships and merchant vessels. It is also a matter for pride that a British firm was chosen to design and build this crane, and that when the various sections of it reached Japan after their long journey, and were erected, the gigantic machine worked exactly in the perfect manner aimed at by its designers.

(The photographs illustrating this article are reproduced by courtesy of "The Engineer.")

Wireless Aids Fishing Industry

Wireless seems destined to work something like a revolution in the fishing industry. The movements of fish are notoriously irregular and uncertain. For no apparent reason large shoals of fish will suddenly leave one part of the sea, where previously they have abounded, and travel to another part where before there was hardly a fish to be caught. Before the coming of wireless there was no means of quickly reporting these changes of fishing ground, and consequently, while one trawler might find herself in the midst of an enormous shoal, another might have absolutely no luck at all. To-day, many of the larger trawlers are fitted with wireless, so that reports of shoals of fish may be promptly transmitted from one vessel to another. At the same time such trawlers can communicate promptly with their owners in case of need.

Possibly in years to come every large trawler will be fitted with wireless, and in that case we should hear fewer of the sad stories of fine vessels leaving Hull or Grimsby for Iceland waters and never being seen or heard of again. There is no doubt that the crew of many a trawler might have been saved if a wireless call for help could have been sent out over the raging seas.

Receiver with Five Crystals

The would-be purchaser of wireless sets or accessories nowadays finds himself in the midst of such an embarrassment of riches that he has difficulty in making his final selection. The crystal detector, whether used alone or as the foundation of a valve set, is now more popular than ever as the result of the establishment of so many relay stations. The Service Radio Co. Ltd. (67, Church Street, Stoke Newington, London, N.16), lists a series of crystal detectors that should meet every possible requirement. In particular may be mentioned a "multi-crystal" device by means of which any one of five different crystals can be brought into adjustment immediately as required by the turn of a small handle. This firm also supplies excellent single-valve and two-valve amplifiers to increase the strength of reception, the two-valve amplifier making possible the use of a loud speaker. Yet another ingenious appliance is a "multiphone" arrangement that enables several pairs of telephones to be readily connected to one receiver.

"Flying Scotsman" at Work Again

Famous Wembley Exhibit Returns to Duty

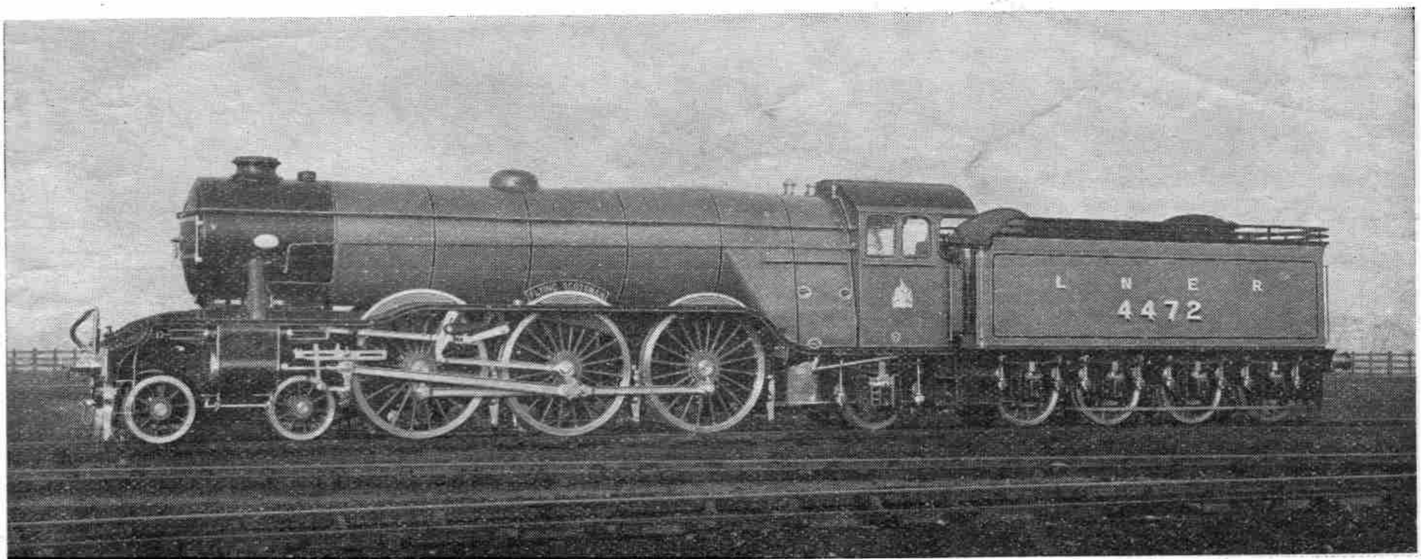


Photo courtesy] [*L.N.E. Rly. Co.*

After a long rest at Wembley, this fine L.N.E.R. Three-Cylinder Express Passenger locomotive, the "Flying Scotsman," is back at work again, hauling its heavy loads every day between London and Edinburgh

LAST month we described the rolling-stock of the new "*Flying Scotsman,*" claimed to be the most comfortable and luxurious train in the world for passengers paying ordinary fares. Our description of this train would not be complete unless we included some mention of the splendid locomotives that haul it to and from Scotland every day. We illustrate on this page one of the finest, and incidentally the largest, locos in Great Britain. This loco, No. 4472, bears the same name as the train it pulls, and it must be familiar to a large number of our readers. Indeed, many who read these pages have climbed up into the cab of the loco., as it stood silent and dignified in the Palace of Engineering at Wembley. Now it is busy again with its daily task of carrying hundreds of passengers between London and Edinburgh.

Driving Wheels 6 ft. 8 in. diameter

No. 4472 is indeed a handsome piece of mechanism, and no doubt the impression of great power that the design conveys is further increased by the fact that the crown of the fire-box slopes upwards from the cab, while the first part of the boiler drops slightly from the fire-box towards the smoke-box. This brings the smoke-stack in line with the top of the cab, 13 ft. 4 in. from rail level, resulting in a very graceful outline.

As most of our readers know, the "*Flying Scotsman*" belongs to the now famous fleet of the "Pacific" type locomotives (4–6–2), owned by the London & North Eastern Railway Company. Its number denotes that it belongs to the section that was known before the amalgamation as the Great Northern Railway. We may mention in passing that the locomotives of the respective constituent groups of the L.N.E.R. are indicated by their numbers—N.E.R.–1–3,000; G.N.R.–3,001–5,000; G.C.R. and G.N.S.R.–5,001–7,000; G.E.R.–7,001–9,000; N.B.R.–9,001–11,000. The "*Flying Scotsman*" is fitted with a super-heater having a heating surface of 525 sq. ft. which brings the total heating surface, including the 168 boiler-tubes, firebox, etc., to 3,455 sq. ft.

In working-order the engine with tender weighs 148 tons 15 cwt. The steam working-pressure is 180 lbs. per sq. in., and there are three cylinders, each 20 by 26 in. and each driving the centre pair of coupled wheels.

The diameter of the wheels of the leading bogie is 38 in., of the coupled drivers 80 in., and of the trailing wheels 44 in. The 8-wheeled tender carries 8 tons of coal and 5,000 gallons of water.

The locomotive was built to the designs of Mr. H. N. Gresley, Chief Mechanical Engineer to the Company, and has proved very successful; indeed, large numbers of the same type are now in course of erection.

"Atlantic" Locos Outclassed

Although the London & North Eastern Railway did not employ "Pacific" locomotives earlier than 1922, the type has been recognised since 1908. In that year the Great Western Railway introduced the first "Pacific" locomotive in this country in the form of the "Great Bear," which locomotive was described and illustrated in our issue of January 1923.

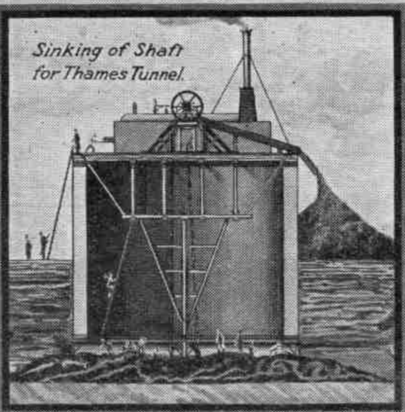
The term "Pacific" was coined for the 4–6–2 class from the fact that the type was first exploited in that part of the British Empire set in the Pacific Ocean, principally in New Zealand and West Australia, and was singularly appropriate in that it followed the earlier "Atlantic" class, or 4–4–2, originating on the Philadelphia-Atlantic City line in America.

The evolution of the "Pacific" has been very rapid indeed since those days. From the point of view of speed and strength it has proved very satisfactory, and the locos. of this type have entirely outclassed the "Atlantics" in the race to keep pace with the requirements of modern railway traffic. With but few exceptions, the "Pacifics" are now recognised as the standard type for express passenger locomotives the world over.

American "Pacifics"

In the United States and Canada, "Pacifics" are used to haul some of the heaviest express trains over considerable distances, including many exceptionally steep gradients. The "Pacifics" recently built for the Philadelphia and Reading Railroad work fast passenger trains, which often exceed 600 tons in weight, at an average speed of 60 miles per hour over the shorter routes. These locos have boilers of the Belpaire wide fire-box type, equipped with 436 tubes and superheater. The cylinders measure 27 in. by 28 in. and are supplied with steam at a pressure of 205 lbs. per sq. in. The locomotive with tender weighs 467,890 lbs. in working order and exerts a tractive effort of 44,460 lbs.

It is difficult to say whether future railway conditions in this country will necessitate the construction of even more powerful locomotives—and consequently with greater wheelbases—but at present the 4–6–2 arrangement seems to meet the most exacting requirements of passenger traffic.



Lives of Famous Engineers

XIV
M. I. BRUNEL
CONSTRUCTS THAMES TUNNEL

In our last article we saw something of the earlier work of Sir Marc Isambard Brunel and we learned how his keen brain was continually seeking to substitute machinery for hand labour in every possible direction. This month we are to consider the greatest of his many achievements—the construction of the Thames Tunnel. Our subsequent articles will deal with the great achievements of I. K. Brunel, including the Great Western Railway and that impracticable monster "The Great Eastern," a steamship, which—as we shall see—was many years in advance of her time.

THE original idea of uniting the counties of Kent and Essex by a tunnel beneath the Thames is generally attributed to a Mr. Dodd, who wrote a report on the matter in 1798. Dodd proposed to tunnel the river between Gravesend and Tilbury, the total distance of the tunnel to be 900 yards.

Early Attempt Fails

In 1802 a Mr. Vazie put forward a suggestion for a tunnel from Rotherhithe to Limehouse, and a company was formed to further the project. In order to explore the ground it was considered necessary that a drift-way should be constructed, which later should form the drain to the tunnel itself. A shaft 11 ft. in diameter was accordingly sunk to a depth of 42 ft.

Shortly afterwards, owing to the foolish policy of the directors in substituting an imperfect steam engine of very much less horse power than had been demanded by the engineer, water broke in and it was with the utmost difficulty that work could be proceeded with.

For some time the directors hesitated as to whether to continue the work or abandon it, and ultimately Vazie was removed from his position as engineer and superseded by Trevithick. Work on the drift-way was resumed, at first with success, but later the bed of the river gave way and water again inundated the drift. The hole was filled up by throwing into it clay in bags and work was resumed, but shortly afterwards the roof gave way a second time. Sand and water rushed into the drift-way with such violence that in a few minutes the water rose almost to the top of the shaft. Once more the hole was filled and work recommenced, but ultimately the bursts of water became so frequent and unmanageable that the work was abandoned.

Brunel's Proposals

About this time Brunel's attention was drawn to the question. The first reference to the tunnel in his diary is dated 12th February, 1823. From then onwards the entries became more and more frequent, showing that the matter was gradually absorbing the whole of his attention. By the close of the year he had so far matured his designs, and had enlisted so much support from various influential persons, that a public meeting was called for the purpose of forming a company. The first general meeting of the company was held on 18th February, 1824, and about a month later the Bill for the incorporation of the company, having passed without opposition through both Houses of Parliament, received the Royal Assent.

Brunel was appointed engineer to the company at a salary of £1,000 per annum for three years, the utmost limit that the directors contemplated as necessary for the completion of the work.

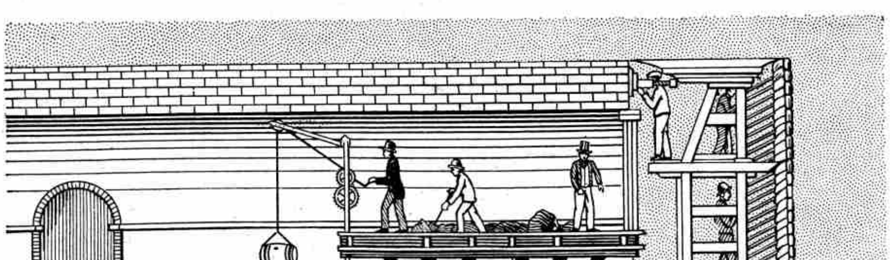
Sinking the First Shaft

On 16th February, 1825, the ground for a distance of about 140 ft. from the river wharf at Rotherhithe was cleared for the construction of a shaft 50 ft. in diameter. The brickwork to form the lining of the shaft was built on the surface of the ground, and as the earth was excavated from within and beneath the structure, it gradually sank to its final position. The brickwork was 3 ft. thick and was bound together by iron and timber ties. Built into it were 48 perpendicular iron rods 1 in. in diameter, bolted to a wooden curb at the bottom of the wall and to another curb at the top. When the brickwork shaft was completed to its height of 42 ft., the blockings on which it rested were removed, the gravel was excavated and hoisted up, and the shaft descended by its own weight.

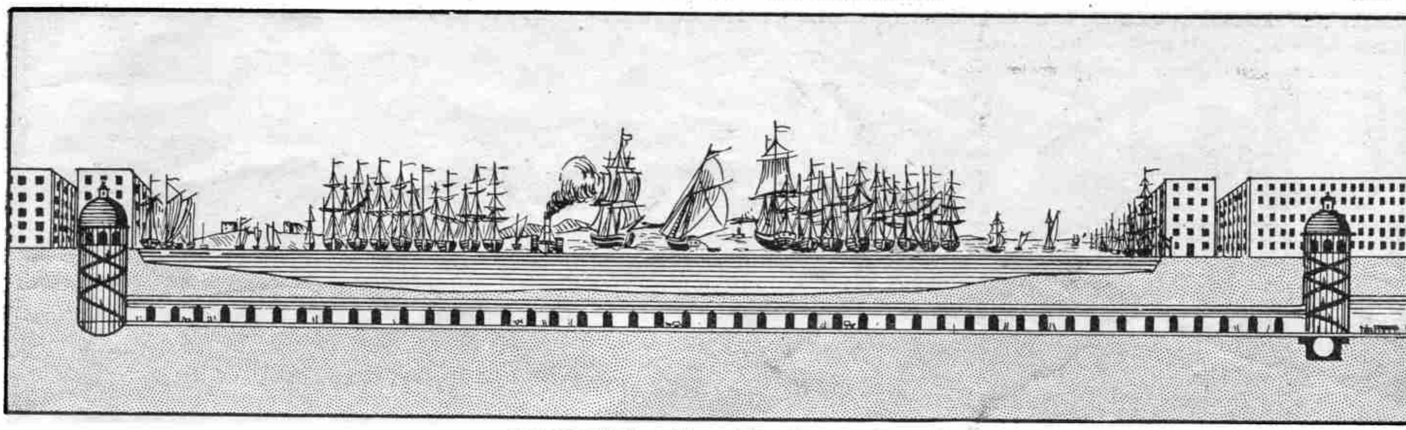
The shaft was sunk 40 ft. in this manner, the remaining 20 ft. being constructed by under-pinning, in order to leave the opening for the tunnel. This was completed on 11th August, and preparations were then made for constructing a reservoir at the bottom of the shaft for receiving the permanent pumps. The reservoir was completed on 11th October, and the hole was closed by a dome, an opening being left for the four pumps and for examination.

Ship-worm Suggests Idea of Shield

During these operations the great shield, by means of which the tunnel was to be driven, was being constructed by Maudslay. On 15th October, 1825, two of the twelve frames of which the shield was



Section showing shield, propelling screws and movable stage



Longitudinal section of the Thames Tunnel

composed were lowered into the shaft and placed in position. As this remarkable shield was a most valuable invention we must turn our attention to it, so that we may understand the important part it played in this particular work.

One day Brunel was passing through the dockyard at Chatham, when his attention was attracted to an old piece of ship timber that had been perforated by that well-known destroyer of timber, the *Teredo navalis* or "ship-worm." He examined the perforations, and subsequently the animal itself, with the greatest interest. He found the animal armed with a pair of strong and hard valves to which, by using its foot as a fulcrum, it was able to give a rotary motion by a set of powerful muscles. These valves then acted on the wood in a similar manner to an auger and slowly but surely penetrated it, no matter how hard it might be. As the particles of excavated wood were removed they were passed through a longitudinal fissure in the worm's foot, which formed a canal to the mouth.

From the action of this animal Brunel conceived the idea of a shield of iron, with auger-like cells for the miners. His idea was that the shield would be forced forward with a rotary motion by hydraulic presses, displacing only as much ground as the shield would occupy in its place. In 1818, he took out a patent for this machine, which subsequently became one of the most famous of his inventions.

Construction of the Shield

The shield employed in excavating the Thames Tunnel consisted or twelve independent structures or frames made of cast and wrought iron, each 22 ft. in height and a little over 3 ft. in width. These frames were placed side by side against the face of the excavation, occupying its whole area, and also the top, bottom and sides for 9 ft. in advance of the brickwork, which was completed close up behind the shield as it advanced.

Each frame stood on two feet, which rested on the ground, and each frame was divided vertically into three cells by means of cast iron floors. In each of the 36 cells thus provided, a miner stood and worked at the material in front of him.

The sketch on page 110 will give some idea of the construction of one of these frames. On the right, pressing against the ground to be excavated, were "poling boards" held in place by "poling screws" resting against the cast iron frames. The poling boards were 3 ft. in length, 6 in. in width, and 3 in. thick and were arranged horizontally. There were more than 500 of them, and they covered the whole surface in front of the frames.

Method of Working

The method of working was as follows: Standing in their cells the miners took down one, or at the most two of the poling boards, beginning at the top of the cell, excavated the earth a few inches and then replaced the poling boards, pressing them against the new face by means of the poling screws. In this manner the excavation was carried out without depriving the ground of support except at the point at which the miners were actually at work.

When everything was ready for a move, the frames were pushed forward by means of large hydraulic screws, one at the top and the other at the bottom, abutting against the brickwork of the tunnel. A movable stage immediately behind the shield to receive the building materials for the upper portion of the work was also utilised, as shown in the drawing.

The Tunnel Commenced

On 28th October the 12 frames were in place, but the fitting and adjusting of the parts, and the construction of the entrance to the tunnel, occupied some time, and it was not until a month later that the shield commenced to move forward.

Steady progress was made from this time, in spite of very serious difficulties resulting from the inrush of water and from the variable nature of the ground encountered. The work was mainly superintended by Brunel's son, I. K. Brunel, whose energy and keen intelligence were of the greatest value to his father.

To describe in detail the various little mishaps that occurred from day to day, and the methods employed to counteract them, would soon become very monotonous even to our keenest reader. We will therefore content ourselves with saying that the shield pushed its way steadily forward without any very serious mishap throughout 1826 and up to the May of the following year, when the first serious irruption of the river occurred.

First Irruption of River

During the early days of this month work became more and more difficult and dangerous. On the 18th a party of visitors inspected the shield and the workings about 5 o'clock in the evening, and although this visit caused great anxiety to those in charge, it was concluded without mishap. Scarcely had the party left, however, than disaster occurred. A miner in one of the frames suddenly called for assistance and another miner was ordered to go to him at once. Before he could do so, however, there poured in such an overwhelming rush of slush and water that the men were driven out.

Of the subsequent happenings, Mr. R. Beamish, in his life of Sir M. I. Brunel, gives the following account:

"I made an effort to re-enter the frames calling upon the miners to follow; but I was only answered by a roar of water, which long continued to resound in my ears. Finding that no gravel appeared, I saw that the case was hopeless. To get all the men out of the shield was now my anxiety. . . . . On we sped. . . . . At the bottom of the shaft we met Isambard Brunel and Mr. Gravatt. . . . . We turned. . . . . The spectacle that presented itself will not readily be forgotten. The water came on in a great wave, everything on its surface becoming more distinctly visible as the light from the gas-lamps was more strongly reflected. Presently a loud crash was heard. A small office, which had been erected under the arch about 100 ft. from the frames, had burst. The pent-up air rushed out; the lights were suddenly extinguished and the noble work which, only a few short hours before, had commanded the homage of an admiring public, was consigned to darkness and solitude.

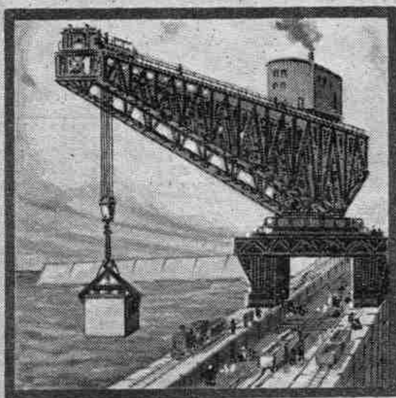
A Brave Rescue

"It only remained to ascend the shaft, but this was not so easy. The men filled the staircase; being themselves out of danger, they entirely forgot the situation of their comrades below. For the first time I now felt something like fear, as I dreaded the recoil of the wave from the circular wall of the shaft, which, if it had caught us, would inevitably have swept us back under the arch. With the utmost difficulty the lowest flight of steps was cleared, when, as I had apprehended, the recoil came, and the water surged just under our feet."

Repairing the Damage

In order to ascertain the actual condition of the bed of the river an examination was made by means of a diving bell on the day following the irruption, and a hole was found extending from about the centre of the tunnel excavation to a considerable distance eastward. In some parts the sides were vertical and no gravel was found, even on the adjoining undisturbed bed of the river, thus confirming the observation of the local watermen that a dredged hole had been encountered.

(*Continued on page* 120)



Giant Block-Setting Cranes

Their Work in Constructing Harbours and Breakwaters

IN our previous instalments we have learned something of the different types of breakwaters and the useful purposes they serve. Last month, too, we saw something of the early history of Dover Harbour, and we mentioned that this has long been recognised as an important harbour, one reason being that it is the nearest point on the English coast to France. This month we describe in greater detail the construction of the great Admiralty Harbour at Dover, which work is one of the triumphs of modern engineering.

Government Builds Harbours

The construction of the breakwater at Dover is quite different from the construction of the mound breakwaters with which we have previously dealt. Such harbour works as those at Plymouth and the breakwater at Algiers, for instance, which were carried out in the early part of the last century, were breakwaters of the simplest type. They were, indeed, very similar to those that had been constructed in earlier times, except that they were, perhaps, more massive.

Until comparatively recent years very little attention was given to the subject, for harbours had not been thought necessary until such time as trade developed. Then it was that the requirements of our Navy and mercantile marine demanded greater consideration should be given to such matters. Public attention was very strongly drawn to the necessity for the construction of harbours of refuge on the coasts of Britain by a letter from the Duke of Wellington, written in 1842, which drew special attention to the unprotected and defenceless state of the shores of this country. Three years later the Government took measures to construct several harbours at important places on our coast, amongst which was included Dover. Incidentally, it may be mentioned that this decision led, as a matter of course, to the undertaking of similar work by foreign powers in various parts of the world. Shortly afterwards the construction of harbours in our Overseas dominions—at such ports as Table Bay, Madras, and Colombo—was planned and carried out.

The Discovery of Cement

In 1824 a discovery that was to have a far-reaching effect on harbour construction had been made by Joseph Aspdin, a Leeds bricklayer. Aspdin found that by mixing limestone with clay, he was able to make a cement that possessed considerable advantages over any other similar material then known. He had found the master secret that gave the world the very valuable constructional material known as "Portland Cement"—a name derived from the fact that the cement, when set, closely resembles the well-known building-stone quarried at Portland, in Dorsetshire. Cement is particularly useful for the construction of such engineering works as docks, harbours, railways, irrigation-works and the like. Combined with steel-girders, introduced to give greater strength to the structure, it is capable of almost endless development, and in this form is known as "ferro-concrete."

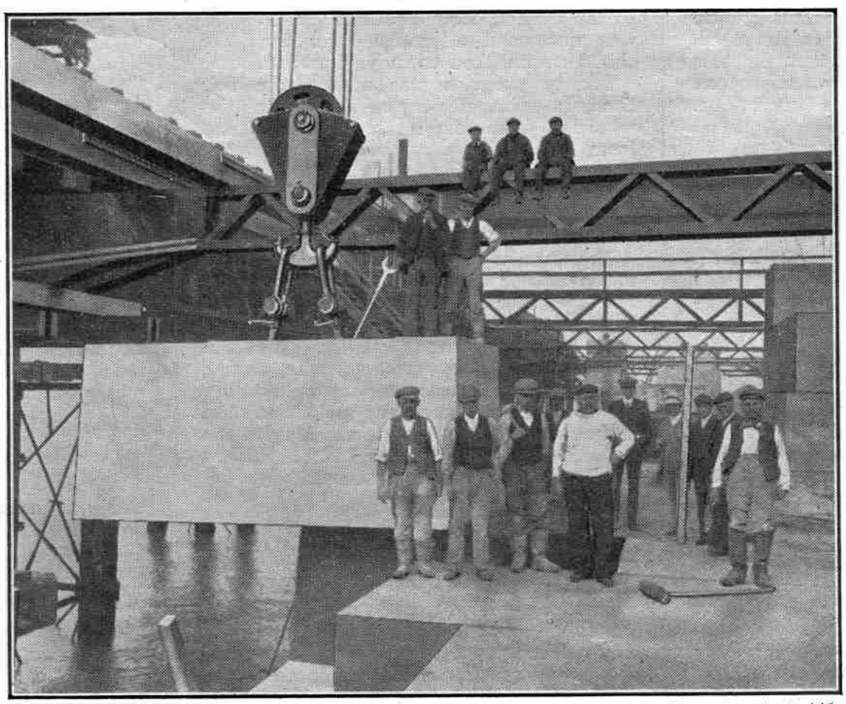
Concrete itself is no new discovery, for it was known to the Roman engineers. The domes and vaults of the baths of Ceracella and Dioceletian—amongst the chief sights of Rome to-day—are built of concrete, as is the huge dome of the Pantheon at Rome, one of the world's greatest buildings.

Although so many centuries have elapsed since these buildings were constructed they remain perfectly serviceable—indeed, many of them are probably in even better condition to-day than when first erected. It is believed that Portland Cement is even more serviceable and enduring than the concrete of the Romans, and in these circumstances it is not surprising to find that it is used so largely in the construction of harbour-works to-day.

Using the Diving Bell

If modern engineers had not adopted Portland Cement for this purpose, in place of the primitive form of breakwater construction, Dover Harbour—and many others of a similar type—could never have come into existence. The successful construction of these harbours was made possible practically entirely by the use of large concrete blocks, such as are illustrated on this page.

At Dover, blocks weighing over 40 tons were used. They were laid in layers (or "courses," as they are called) up to high water level and topped by a solid mass of concrete. Although the greater part of both sides of the breakwater is faced with granite, only the outer part is so faced, above low-water level on account of the great expense involved. The first or foundation course was laid on the carefully-levelled solid chalk. This operation, which required a long time and involved



Photo] [*Messrs. Pearson & Sons Ltd.*

Setting the Last Block at Dover Harbour

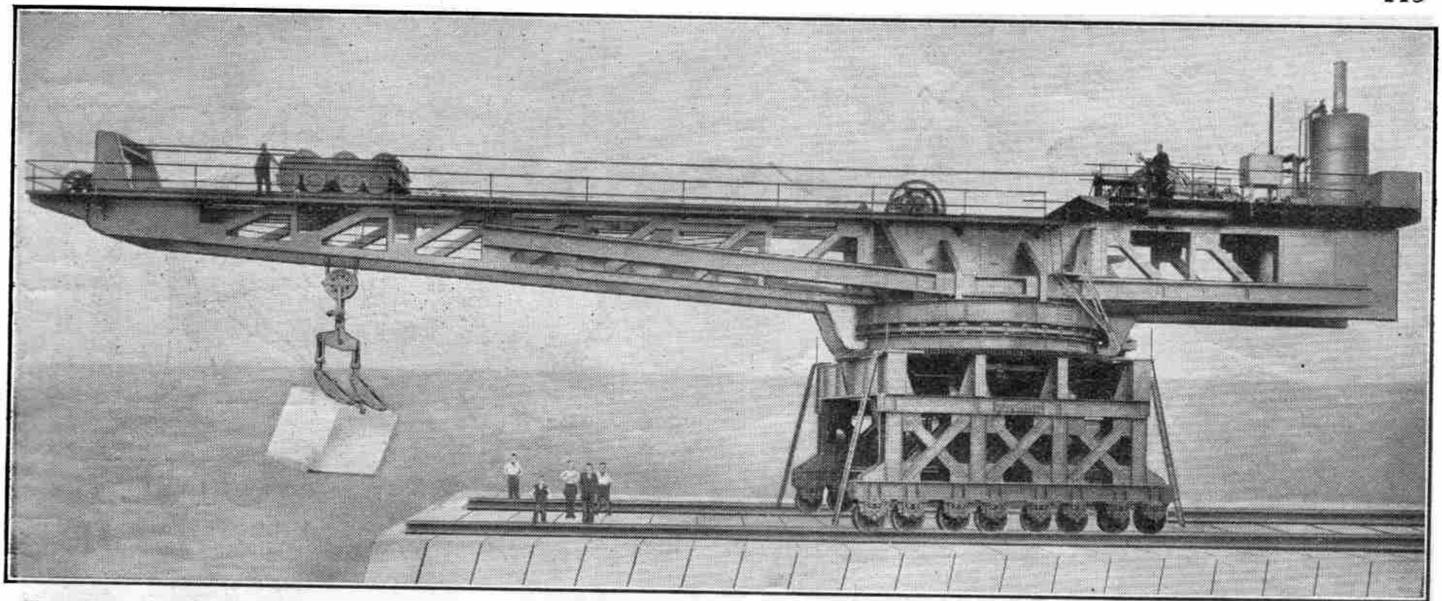


Photo courtesy] *[Messrs. Stothert & Pitt Ltd.*

A Giant "Titan" Crane, setting a concrete block on the end of a breakwater

great expense, was carried out by divers who descended in diving-bells.

A diving-bell is an appliance that represents the present-day form of the earliest contrivances used to enable divers to remain under water any length of time. In its modern form a diving-bell consists of a bottomless iron box, weighing five tons or more. The divers take their places inside the bell, which is then lowered by a crane into the water. The pressure of the air in the bell prevents the water flooding it, just in the same way that the air in a tumbler keeps out the water if the tumbler is lowered below the surface of the water in an inverted position. Air is supplied to the men in the diving-bell by means of a pipe connected to a pump worked from above water, exactly as in the case of a man wearing a diving suit. As there is no bottom to the bell, the divers can stand and work on the sea floor in comfort, clearing and levelling it as required.

In the Dover Harbour works the largest diving-bells weighed 40-tons and contained four men comfortably. They were fitted with electric light, and telephones enabled the movements of the diving-bell to be directed by the divers themselves.

Construction of Dover Harbour

Each face of the walls of the breakwater at Dover is slightly inclined and each breakwater is surmounted by a parapet. When a westerly gale is raging these parapets protect the boat-trains that run on to the paved quay alongside the mail steamers, thus enabling them to discharge their mails and passengers under sheltered conditions.

The first part of the harbour works, which was completed in 1871 at a cost of £680,000, consisted of a breakwater 2,100 ft. in length, extending to a depth of about 48 ft. at low water. For some years this breakwater served the purpose required, but the continued increase in the amount of shipping, and the additional requirements for strategical purposes, rendered further work necessary.

Between 1898 and 1909 an additional scheme was carried out and two other breakwaters were built, enclosing a large area of anchorage, now known as the Admiralty Harbour, the construction of which was a great engineering feat. We are better able to gain some idea of the magnitude of the task that confronted the engineers when we learn that the total length of the breakwater is over two miles. The finished harbour is over 610 acres in extent and is sufficiently extensive to shelter a whole fleet. The work included the extension of the former breakwater by 2,000 ft., the reclaiming and excavation of a large portion of the chalk cliffs immediately behind the harbour, the building of a new breakwater at the south end, and a new breakwater, 3,850 ft. in length, at the east end.

Travelling Gantry Cranes Used

The breakwaters are between 50 and 60 ft. in width at their bases, and from 80 to 90 ft. in height. They are constructed of 42-ton concrete blocks, which were formed in special block-making yards erected under the shelter of the cliff. The blocks, which measure 14 ft. by 7 ft. by 6 ft., consist of a mixture of gravel, sand, and cement. This was poured into wooden moulds in liquid form, and when the mixture had set—for which a week was generally required—the sides of the moulds were removed and the blocks were ready for transport to the point at which the work was proceeding.

For transporting these huge blocks along the quay, huge Goliath cranes were employed, a type of crane which, under the name of Travelling Gantry Crane, is familiar to all our readers, model No. 728 in the Meccano Manual being an excellent reproduction.

The cranes ran on a track supported on a special platform, which, in view of the fact that the cranes weighed 100 tons unloaded, were very substantially supported. In the first place, ironshod piles, 100 ft. in length and 20 in. square, were driven into the sea floor in groups of six on each side of the line on which the breakwater was to be built. Each group was separated by a distance of 50 ft. and between the two lines of piles was a clear 70 ft. In all, the scheme required half-a-million cubic feet of timber, which was specially selected by an expert sent over to Tasmania for the purpose.

When the massive piles had been satisfactorily driven home by the powerful pile-drivers, cross-girders were placed from one row to the other. These were then braced diagonally by strong ties and laterally by lattice girders, and heavy timber flooring was laid down to take the two 100 ft. tracks for the Goliath cranes.

In effect, therefore, two solid piers had been erected with wooden supports and timbered floors, and braced one with another with cross girders. These enabled the gantry cranes to travel out to the end of the piers and to drop concrete blocks at any desired point between the shore and the pier ends, an operation made clear by the sectional view in Fig. 1. As the blocks were laid, the cranes advanced and so laid succeeding tiers, each tier being built up to the level of the finished breakwater before the next was proceeded with.

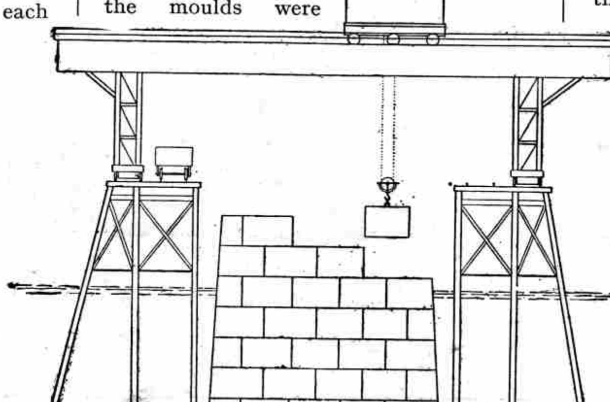


Fig. 1. Diagram showing how a Gantry Crane sets Concrete Blocks*

* This diagram, and that on page 140 are reproduced from "Engineering for Boys," by permission of Messrs. T. C. & E. C. Jack Ltd.

Keying the Blocks

The blocks were "dove-tailed" or fitted one into the other on all sides, in order to give the breakwater solidity to resist the fury of the waves,

(Continued on page 140)

The Meccano Idea

Steel Houses with Interchangeable Parts

by Stanley R. Money

Last month, by the courtesy of the Editor of the "Westminster Gazette" we were able to print an account of the remarkable invention of Mr. J. C. Telford, O.B.E., the eminent engineer who was the first to apply the Meccano idea to the housing problem. In an interview, Mr. Telford laid emphasis on the fact that his houses are built entirely on the Meccano principle, the whole structure being made of braced steel plates with turned-in flanges by which they are bolted together, exactly as in the case of Meccano plates.

No doubt Meccano has been the starting point of many inventions, but steel houses built on the Meccano principle are surely an entirely original and unlooked-for development. The article on this page, which has been specially written for the "M.M." by a member of Mr. Telford's firm, describes the construction of these Meccano houses, and I feel sure that it will be of considerable interest to all our readers.—Editor.

IN these times when brick houses cannot be reproduced in sufficient numbers to cope with the demand, another type of building, in the form of a steel house, may now be employed, thanks to the invention of the Meccano house. The inventor is Mr. J. C. Telford, O.B.E., M.Inst.C.E., of Messrs. Braithwaite & Co., Engineers, Ltd., who are producing these houses under the name of the "Telford ALL-Steel House."

In an interview Mr. Telford said: "Each house consists of a living room, kitchen, bathroom, scullery and coal cupboard on the ground floor, with three good bedrooms above. Everything possible is made of steel, even to the staircase, and every component part is made on the mass-production principle and has only to be fixed in place by bolts, exactly as the boy builds his wonderful Meccano bridges and cranes."

Method of Construction

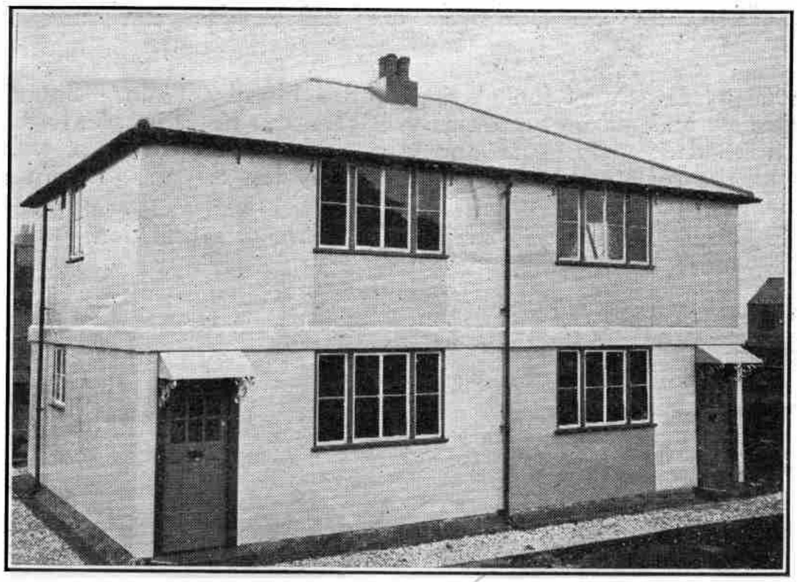
The construction consists of steel plates forming the outer walls, and, in the case of two or more houses in a block, the main partition walls separating each house. The plates are so constructed that, in addition to forming the walls, they also provide both the vertical and horizontal weight-sustaining members of the entire structure. The inner walls are of thick asbestos or similar lining sheets secured to the framework. Between the outer steel plates and the inner asbestos sheets is hung an intermediate protective lining, this being fixed to the back of the inner framework. The windows are steel casements in wood frames, and the doors, cupboards, etc., are in wood. Chimney breasts are of steel construction similar to the main walls, with flues and chimney heads of cast iron. In the standard type house the roof also is of steel plates, but if desired it may be constructed in the ordinary way with slates or tiles.

How the Houses are Erected

The chief advantage of these Meccano type houses lies in the fact that they are so simple to erect that no skilled labour is required. They are cheaper than brick houses, and one pair of these houses may be erected and ready for occupation within ten days of the foundations being completed.

The method of erection is as follows: The site is first prepared and levelled, and then a concrete raft or platform, which extends outward for 2 ft. beyond the walls of the house, is laid down, together with the necessary drains. The units for building the walls are similar to shallow steel boxes, consisting of steel plates 3 ft. 6 in. wide by 8 ft. 2 in. high, and with a 2½ in. flange all round. These plates, together with the door and window frames, are sent from the works ready marked to correspond with a key plan provided. Thus the erection of a Meccano house is as simple as the building of a Meccano model from the instructions given in the Manual. The plates are held vertically with the flanges to the inside of the house. By means of these flanges adjoining plates are bolted together and to the concrete foundation, a special composition being introduced into the joints to render them absolutely weather-proof. The ground floor consists of boarding screwed into creosoted wood fillets let into the concrete raft.

When the erection of the ground floor walls is completed the top flanges of the plates are tied across by means of the horizontal stringer course and the floor flitch beams which run the whole width of the house. From these beams the first floor walls and roof are erected. The staircase is made of steel on to which wooden treads are bolted.



The Telford ALL-Steel House

Painting to Last Five Years

The outer face of the steel plates is prepared and painted with a special rust-resisting paint and finished warm stone colour, and sand is sprinkled on the walls while wet. The doors and window frames are painted to suit the tastes of purchasers. The up-keep of the exterior painting is small, as the paint manufacturers have gone carefully into the cost and find that a pair of houses can be painted one coat, including labour, for less than £4. This paint will last at least five years, even where the house is near the sea or in districts where the air is laden with chemical fumes. The inner faces of the plates are protected from rust by bitumastic or other solution. The maintainence charges of these houses should be low compared with those of houses of brick or concrete construction, for there is no rough cast to replace, no brickwork to be re-pointed, no timber facings to be renewed and no re-plastering of interior walls, ceilings, etc. All that is required for the Meccano house is a re-coating of the exterior plates with the solution originally used in the manufacture.

Interchangeable Parts

The walls of the rooms consist of thick sheets of asbestos or other similar material screwed to a wooden framework bolted inside the steel plates. A sealed 6 in. cavity is left between the outer walls, thus rendering the house free from condensation. This cavity is in contact with the roof, the exterior of the chimney flue and the interiors of the grates. The chimney flues are made of cast iron pipes, and any heat transmitted by the chimney is re-transmitted round the house by virtue of the contact of these flue pipes with the air in the cavity or roof space as the case may be. The sealing of the cavity at all points ensures complete protection against vermin.

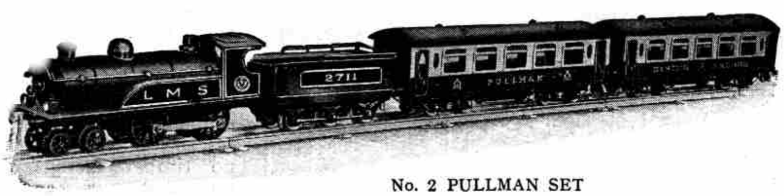
(*Continued on page 137*)

HORNBY CLOCK WORK TRAINS

THE TRAINS WITH THE GUARANTEE

YOU can have any amount of fun playing with a Hornby Train. Shunting, coupling-up the rolling stock and making up trains will give you hours of pleasure. Hornby Trains are beautifully finished, strongly made, and will last for ever. One of their most valuable features is that all the parts are standardised, and any lost or damaged part may be replaced with a new one.

Every train is guaranteed, and you are therefore sure of satisfaction if you buy a Hornby.



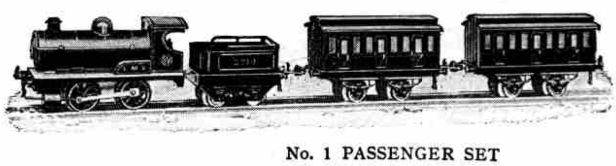
No. 2 PULLMAN SET

No. 2 Pullman Set

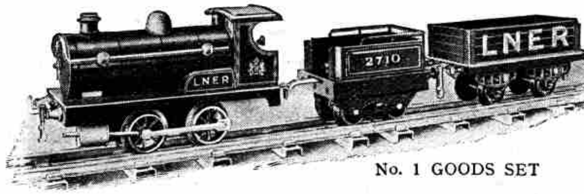
The No. 2 Loco with Tender measures 17 in. in l[illegible]h. The Loco is fitted with superior mechanism and the accura[illegible]y-cut gears ensure smooth running. Loco, Tender and Coaches are superb in appearance and finish, enamelled in colours and stoved at a high temperature to ensure durability. The Loco is fitted with reversing gear, brake and governor.
Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each set contains Loco, Tender and two Coaches, with set of rails to form a circle of 4 ft. diameter. Price 60/-.

No. 1 Passenger Set

The Loco is fitted with reversing gear, brake and governor. Loco, Tender and Coaches are superb in appearance and finish, enamelled in colour and stoved at a high temperature to ensure durability. The doors of the Coaches open.
Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each set contains Loco, Tender, two passenger coaches and set of rails consisting of two straights and curves to form a circle of 2 ft. diameter. Price 30/-



No. 1 PASSENGER SET



No. 1 GOODS SET

No. 1 Goods Set

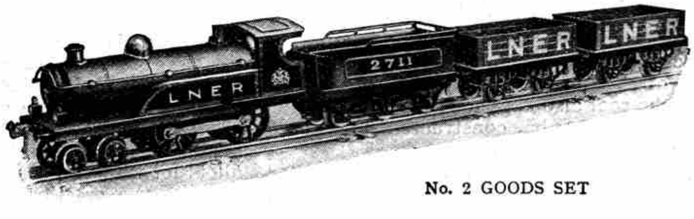
Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each Loco is fitted with reversing gear, brake and governor. Each set comprises Loco, Tender, one Wagon, and set of rails as in the No. 1 Passenger Set. Price 22/6

No. 1 Hornby Loco	Price 15/-	Hornby Passenger Coach	Price 5/-
„ „ Tender	„ 2/6	No. 1 Hornby Wagon	„ 2/6

No. 2 Goods Set

Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling stock. This set contains Loco, Tender and Rails as in the No. 2 Pullman Set, and two Wagons. Loco fitted with reversing gear, brake and governor. Price 37/6

No. 2 Hornby Loco ...	Price 22/6	Hornby Pullman or Dining Car ...	Price 15/-
„ „ Tender	„ 3/6	No. 2 Hornby Wagon	„ 2/6



No. 2 GOODS SET

Ask to see Sample Sets at your Toy Store

MECCANO LTD., BINNS ROAD, LIVERPOOL

VI. MECCANO AND HORNBY LAYOUTS

IN the previous articles of this series we have endeavoured to show some of the many ways in which Hornby track may be laid out, and also to give suggestions as to the best methods of working a layout so as to obtain the greatest amount of fun. It is probable that the majority of boys who are the happy owners of a Hornby Train set are also Meccano enthusiasts, and in this article we intend to show how the two may be combined with the most interesting results.

Loading and Unloading Wagons

The fun of running a Hornby Goods Train, for example, may be increased very greatly by the use of one of the many types of Meccano Cranes for the purpose of loading and unloading the wagons. Several of the simpler types of crane may be set to work in this manner by the exercise of a little ingenuity.

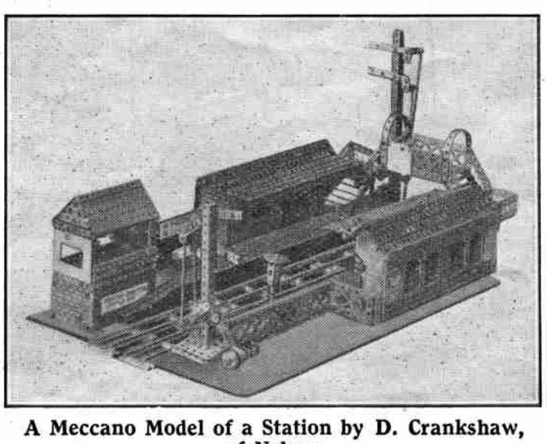
Among these are Models Nos. 30, 38 and 42, which can be made with a No. 0 Outfit; and 105, 113, 119 and 127, made with a No. 1 Outfit. The simplicity of all these cranes makes the various loading and unloading operations quite a straightforward matter. Of course very many other Meccano cranes may be used for this purpose, and we only mention the foregoing models as being easily and quickly built with small outfits.

As regards the loads for the wagons, the miniature Meccano Sacks (part No. 122) are very useful, and in addition an almost infinite variety of loads of different kinds may be improvised from materials to be found in every house. Empty cotton reels may represent casks and barrels, and beads or dried peas make excellent material for tipping wagons.

A particularly interesting combination consists of a Hornby Goods Train and a Telpher Span (Models Nos. 36 or 108). The Telpher Span may be connected up across the room and made to convey material from, say, an imaginary quarry to a goods siding, ready to be loaded into the wagons by means of one of the cranes already mentioned.

Fun with Telpher Span

This operation may be made a great success if two or more boys are working together. The material may be brought from the quarry, loaded into the wagons and then the train despatched to its destination. There the wagons may be unloaded at once, or they may be shunted into a siding and another train of empty trucks made up. In the meantime the Telpher Span is at work bringing fresh material for a second load. With a little experiment in timing the various operations the process may be developed on quite realistic lines. There are also possibilities of a similar character in the Endless Rope Railway (Model No. 109).


A Meccano Model of a Station by D. Crankshaw, of Nelson

A goods warehouse is a very useful addition to any railway, and for this purpose Model No. 406 can be recommended. Many extremely interesting operations may be carried out by means of this warehouse worked in conjunction with a crane. One of the best schemes consists in combining the warehouse with the Overhead Crane, Model No. 116.

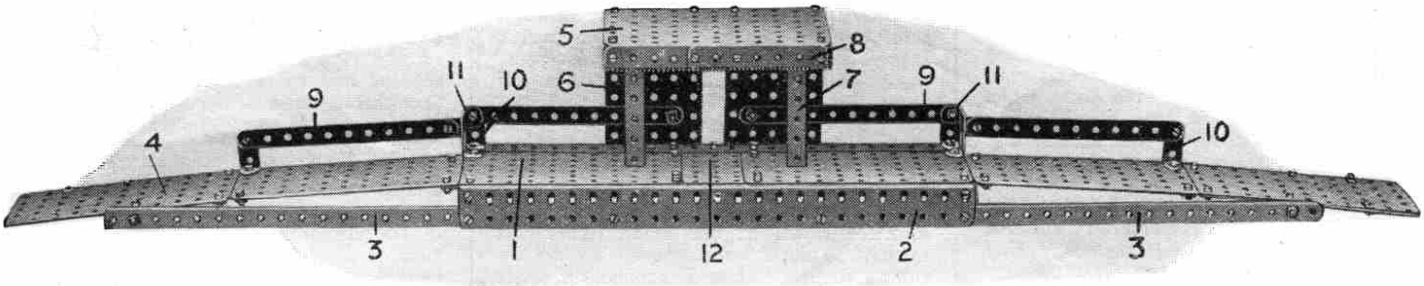
Goods Warehouse Combined with Crane

It will be found that the two models need slight alteration in order to make them work well together. One of the Flanged Sector Plates forming the base of the crane may be reversed so as to come inside the upright Strips instead of outside. This will enable the crane to be brought close up to the rails on which the wagon to be loaded is standing. The other Flanged Sector Plate may then be removed and the uprights bolted by means of Angle Brackets to the $5\frac{1}{2}''$ Strip in the base of the Warehouse, in order to allow the crane to travel far enough forward to lower its loads into the warehouse cage. Before this can be done successfully, however, the $5\frac{1}{2}''$ Strip bolted to the Angle Girders at the level of the first floor of the warehouse must be moved a good deal higher up in order to allow of the unobstructed movement of the crane.

The more elaborate warehouse, Model No. 372, also may be adapted in a similar manner, but of course this model is only available to boys fortunate enough to possess a No. 7 Outfit.

Boys who have large outfits may be recommended to experiment also with the following models: Gantry, No. 425; Travelling Gantry, No. 575; and Travelling Crane, No. 526. The Dredger, Model No. 762, should not be overlooked,

(Continued on page 119)



" Windsor Station " reproduced in Meccano. The following parts are required :—

6 of No. 1	2 of No. 9A	6 of No. 12B	3 of No. 52A	1 of No. 72	2 of No. 110
4 " " 2	1 " " 9B	82 " " 37	2 " " 53A	2 " " 103B	2 " " 124
2 " " 8	8 " " 12	2 " " 48B	4 " " 70	1 " " 103H	

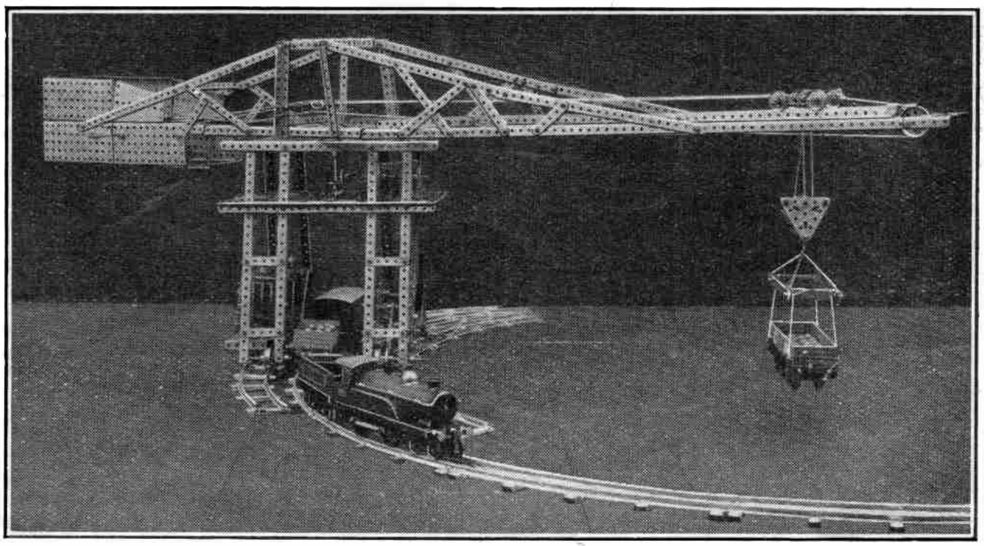
Miniature Railways—*(Continued from page 117)* for if carefully adjusted it forms a remarkably effective combination with a railway.

Layout including Forth Bridge

For Exhibition purposes there is nothing more effective than the Forth Bridge, Model No. 722, in connection with a fairly extensive layout, and this combination may be strongly recommended to those Meccano Clubs which have not yet launched out in this direction. The spectacle of Hornby Trains running over this bridge never fails to attract a great deal of attention, and has often been the means of making people realise for the first time how great are the possibilities of combining Meccano with the Hornby system.

A Meccano Station

Two of the layouts illustrated in last month's Model Railway article required two stations. Many readers who have Hornby Train sets have only the one " Windsor " station and we have frequently been asked for a design for a station in Meccano. On this page we therefore reproduce a photograph of a very fine station built entirely in Meccano. This station is approximately the same length as the " Windsor " station and the platform is the same height. The two stations therefore may be placed facing one another thus forming a very effective double-road station.



A Fine Model, from the 1924 Model-Building Contest

Constructing the Station

The main platform is composed of 5½″ × 3½″ Flat Plates (1), bolted to 12½″ Angle Girders, and supported by 12½″ Flat Girders (2) forming the sides. Secured at each end of the front Flat Girder (2) are 12½″ Strips (3) overlapped 8 holes, which, by means of Angle Brackets bolted in the second hole from their outer ends, hold in position the approaches (4). The latter are constructed with 5½″ × 2½″ Flat Plates butted together and mounted on further 12½″ Strips, which are overlapped 3 holes and bolted to the main platform.

The shelter (5), the roof of which is formed by a 5½″ × 3½″ Flat Plate, is supported by two 4½″ × 2½″ Flat Plates (6) bolted to the main platform. The roof also rests upon 3½″ Double Angle Strips (7) and has for ornamentation two Rack Strips (8) bolted by Angle Brackets to its outer edge.

The rails enclosing the platform are constructed from 5½″ Strips (9) supported by 1″ × ½″ Angle Brackets (10). The corners of the main platform are negotiated by means of 1″ reversed Angle Brackets (11). The space between the two large Flat Plates (1) in the main platform is bridged by a 2½″ × 2½″ Flat Plate (12).

A 1½″ Flat Girder is bolted across the top of the opening at the back of the shelter, and in order to add further to the appearance of the model, steps lead down from this opening to ground level. These steps may be constructed by bolting a 4½″ Angle Girder to the back of the platform, in the second hole from the ground. To the projecting flange of this Girder a second 4½″ Angle Girder is bolted, and to the latter a further 3½″ Angle Girder is then secured.

Wayside Stations

No doubt Meccano boys will find many ways in which this model may be improved, such as in the addition of name-boards, seats, etc., but we have purposely made the model as simple as possible, well knowing that such obvious details usually suggest themselves to our readers without any help from us !

It is possible that some ambitious readers will also start building wayside stations, island platforms, and all kinds of railway buildings with Meccano. For a wayside station the model described above may prove a little large, except, of course, for those boys who are the fortunate owners of almost unlimited stretches of track! This defect, however, may very easily be remedied by shortening the " approaches " on either side of the platform. Quite an effective arrangement is obtained, for example, by using one 5½″ × 2½″ Flat Plate instead of two for the slopes at each end. Where parts permit, an excellent plan, of course, is the addition of booking offices and other familiar features of a railway station.

Island Platforms

" Island " platforms are very simple to construct. The roof, shaped like an extended V inverted, should be supported by columns—constructed from, say, Meccano Rods held in position by Cranks—arranged down the centre of the base. In this way the base is divided, as it were, into two platforms, which may be used for the " Up " and " Down " lines.

As another example of this type of Meccano model we illustrate a railway station which, readers will remember, was constructed by D. Crankshaw, of Nelson, for our big model-building competition last year. Comprising two platforms, signals, footbridge, signal-box, etc., the model shows many new and ingenious uses of Meccano parts.

Lives of Famous Engineers

(*Continued from page* 111)

In order to fill up this hole, bags filled with clay were thrown into the river in great quantities, and by 11th June, when about 19,500 cubic ft. had been thrown into the hole, pumping was successfully resumed. By 25th June the water was completely removed from the shaft and from about 150 ft. of the tunnel. The next step was to clear the deposited rubbish from the cells of the shield frames, during which operation the ground frequently slipped in and permitted a great increase in the quantity of water.

By the end of July matters were again in working order, but a few days later Brunel, utterly worn out with the incessant labour and anxiety to which he had been exposed, was seized with a very serious illness and was confined to his room for many weeks. Work was carried on in the meantime, but under much greater difficulties than before owing to the extreme foulness of the air. The central ventilator had been choked by the irruption and a timber one to supply its place had not been completed. In spite of this, however, the work proceeded, slowly but surely, during the months of October, November and December.

Second Irruption

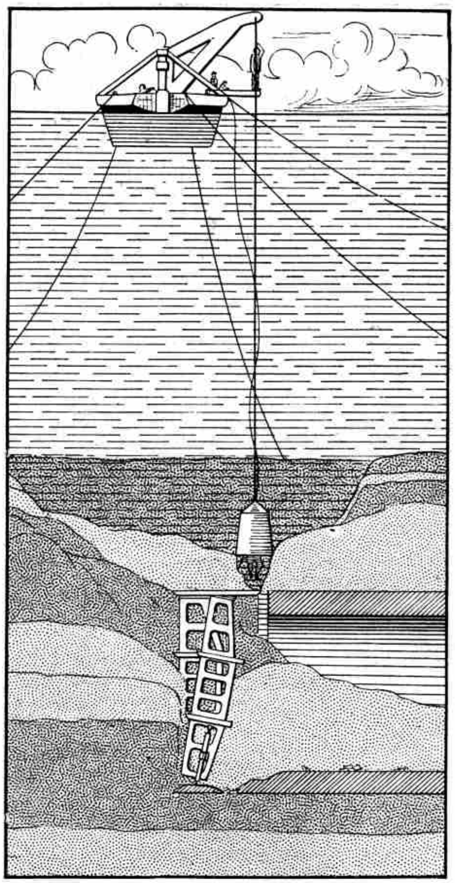
As the year closed, the west side of the excavation became increasingly troublesome, however, and on 12th January, 1828, a second and more serious irruption occurred which put a stop to the work for seven years. The particulars of this accident are thus described by Isambard Brunel (junior) in a letter to the directors of the Tunnel Company.

"I had been in the frames with the workmen throughout the whole night, having taken my station there at ten o'clock. During the workings through the night, no symptoms of insecurity appeared. At six o'clock this morning (the usual time for shifting the men) a fresh set or shift of the men came on to work. We began to work the ground at the west top corner of the frame: the tide had just then begun to flow; and finding the ground tolerably quiet, we proceeded by beginning at the top, and had worked about a foot downwards, when, on exposing the next six inches, the ground swelled suddenly, and a large quantity burst through the opening thus made. This was followed instantly by a large body of water. The rush was so violent as to force the man on the spot, where the burst took place, out of the frame (or cell) on to the timber stage behind the frames. I was in the frame with the man, but upon the rush of water I went into the next box (or cell), in order to command a better view of the irruption, and seeing that there was no possibility of then opposing the water, I ordered all the men in the frames to retire.

A Thrilling Experience

"All were retiring, except the three men who were with me, and they retreated with me. I did not leave the stage until those three were down the ladder of the frames, when they and I proceeded about twenty feet along the west arch of the tunnel. At this moment the agitation of the air, by the rush of water, was such as to extinguish all the lights, and the water had gained the height of our waists.

"I was at that moment giving directions to the three men, in what manner they ought to proceed in the dark to effect their escape, when they and I were knocked down, and covered with a part of the timber stage. I struggled under water for some time, and at length extricated myself from the stage, and by swimming and being forced by the water, I gained the eastern arch where I got a better footing, and was enabled, by laying hold of the railway rope, to pause a little, in the hope of encouraging the men who had been knocked down at the same time with myself. This I endeavoured to do by calling them. Before I reached the shaft the water had risen so rapidly that I was out of my depth, and therefore swam to the visitors' stairs, the stairs for the workmen being occupied by those who had so far escaped. My knee was so injured by the timber stage that I could scarcely swim, or get up the stairs, but the rush of the water carried me up the shaft. The three men who had been knocked down with me were unable to extricate themselves, and I am grieved to say, they are lost; and I believe also two old men, and one young man, in other parts of the work."



Examining river bed from diving bell after irruption

Company's Funds Exhausted

As in the case of the previous irruption the hole was filled up by clay and gravel, about 4,500 tons being required in this instance. The tunnel was then pumped clear of water, but as the funds of the company were exhausted it was determined that the frames should be bricked up and work stopped pending an appeal to the country for the funds necessary to complete the scheme. The general public and many eminent persons, including the Duke of Wellington, displayed great enthusiasm in the matter, but the necessary money was not forthcoming and the scheme had to be abandoned until more favourable times.

Government Assistance

After considerable pressure had been brought to bear upon them the Government decided to come to the assistance of the company, and consented in 1834 to make a loan to the company of £246,000, the first instalment of £30,000 being advanced in December 1834. Isambard Brunel by this time was so busily engaged on independent engineering work that he was unable to resume his tunnel labours, and when work was once more commenced, in January 1835, Richard Beamish, Sir Marc Brunel's biographer, was appointed resident engineer.

The old shield was removed and a new one containing many important improvements was substituted. The remaining portion of the tunnel was steadily excavated, in spite of three more irruptions of the river. In October 1840, the shaft on the Wapping side of the river was commenced. This differed from the Rotherhithe shaft in that it was made slightly conical in shape to reduce friction, and was sunk to the required depth, 70 ft., without resorting to under-pinning. The shield was then brought up to the brickwork of the shaft and the difficult operation of effecting a junction between tunnel and shaft was satisfactorily accomplished. The tunnel was opened on 25th March, 1843—a little over 18 years from the commencement of the work.

In fifteen weeks from the day on which the Thames Tunnel was opened more than one million persons from almost all the civilised nations of the world had visited it. and paid tribute to the genius of its designer.

Before the tunnel was finally completed Marc Brunel received the honour of knighthood, upon which he received hosts of congratulations from his many admirers and friends. His old friend Earl Spencer, writing to him on this occasion said: "You have fairly earned your title by long continued and able services to the country; and it is a memorial of those services and consequently highly honourable to you."

Brunel's Declining Years

With the completion of the Thames Tunnel, Sir Marc Brunel's professional career may be considered to have terminated. He steadily declined all offers of employment connected with any of the great engineering undertakings of the day, and settled down in London, in a house facing St. James's Park, to enjoy his remaining years in peace. In 1845 he had a serious attack of paralysis and had to withdraw altogether from general society. From this time he gradually sank, and died on the 12th December, 1849, in his 81st year.

Sir Isambard Brunel was below middle stature and had a conspicuously large head. His forehead was so striking that his biographer, Beamish, tells us that a certain Irishman exclaimed to him: "Why, my dear fellow, that man's face is all head!" His habits were simple and unostentatious. He was a great favourite in society on account of his quite humour as well as his extensive knowledge.

(*Continued on page* 139)

Electricity or Steam

MR. R. H. SELBIE, C.B.E., General Manager and Director of the Metropolitan Railway, discussing in "*Modern Transport*" the question of the relative merits of electricity and steam for heavy suburban passenger traffic, says his personal view is that there is scarcely any case of a suburban line running out of London that would not repay the cost of electrification. At the same time he admits that it is impossible to lay down hard and fast rules to decide the electrification question generally.

Mr. Selbie believes that on a line that has reached its normal capacity for steam working during, at any rate, the rush hours, and where the traffic demands even more trains, an adequate electrical service could be provided at a lower price than with steam power. The problem to be solved is that of increasing the train-carrying capacity of a line without widening it or having to enlarge the terminal stations, and the solution lies in the substitution of electricity for steam power. One of the chief advantages of electrical working, says Mr. Selbie, is that by the use of electric trains on the "multiple unit" principle—that is with motors and driving apparatus at each end—the shunting of engines is obviated, and the occupation of platform roads is reduced by half. Further great advantages of electric trains are quicker acceleration and greater flexibility, due to the ease with which the composition of the trains can be adapted to meet the varying needs of traffic at different periods of the day.

Mr. Selbie concludes: "The long-distance traffic on the trunk lines of the country is handled to-day in a way that leaves little to be desired, and if the same spirit of enterprise that has brought these services to their present state were to be applied to the problem of short distance and suburban traffic, the result could not fail to be to the advantage both of the public and the companies themselves."

* * * *

New Locos for Home and Abroad

Three new locomotives have recently been completed for service in Nigeria. They are of the side tank shunting type and have been specially designed for service on the Nigeria ferry slipways. They are built to the 3 ft. 6 in. gauge and the wheels are 3 ft. 6¾ in. in diameter.

Thirteen passenger tank engines of the 4–6–2 type are being constructed at Newcastle-on-Tyne for the L.N.E.R.

Twenty locos of the 4–6–0 type are being constructed in Glasgow for the Southern Railway.

Two large and exceptionally powerful Garratt locos are being constructed in Manchester for the Bengal-Nagpur Railway in India. These locos are to be of the 2–8–0–0–8–2 type, and in working order weigh approximately 170 tons. They will be fitted with four cylinders and the coupled wheels will have a diameter of 4 ft. 8 in. The engines will be capable of hauling a train load of 1,500 tons on a gradient of 1 in 100.

* * * *

Conversion of Southern Locos

A number of Southern Railway four-cylinder 4–6–0 type locos, with driving wheels 6 ft. in diameter, are to be converted into two-cylinder super-heated locos. As an experiment one of these locos, No. 449, has been converted by re-arranging the cranks, so that eight light exhaust discharges take place during each revolution of the driving wheels, instead of four heavy "puffs," as is the case with the original four-cylinder—and also in two cylinder—locos. The re-arrangement gives a more uniform torque and a more regular draught than can be obtained with cranks set in ordinary fashion.

The re-arrangement of loco No. 449 has enabled it to easily haul heavy goods trains out of the difficult yard at Salisbury, which could not be done under the old arrangement. The re-arrangement has also proved equally satisfactory in handling passenger trains at speed.

* * * *

Electric Locos for Swiss Railway

An order has been placed in Geneva by a Swiss Railway Company for two large electric locos, each of 4,200 h.p. These locos, which are to be equipped with single-phase motors, will be the largest locos of this type and will be used for both goods and passenger traffic in the mountainous part of the Lötschberg Railway. Their normal speed will be 50 kilometers (about 30 miles) per hour, and their maximum speed 75 k. p.h. (about 45 miles). They are designed to haul loads of 560 tons on a gradient of 2.7% at a speed of 50 k. p.h. The locos will be of the 2–6–6–2 type and will be equipped with six twin motors, each of 700 h.p., with a total tractive effort at starting of 24 tons. The weight of the mechanical parts will be 67 tons, and of the electrical parts 68½ tons.

* * * *

Twenty Compound Locos for L.M.S.

At the L.M.S. Horwich works 20 four-cylinder super-heated passenger engines are being built, and it is expected they will be finished very shortly. The construction of twenty further locos will then be commenced. These latter will be of the 4–4–0 compound passenger type, of Midland design. They will be fitted with short chimneys, dome, and cab, to allow them to pass through all tunnels and under all bridges on the L.M.S. system.

* * * *

Rockley Viaduct

The Southern Railway reports the completion of the new viaduct at Rockley. The viaduct, which has a clear span of 130 ft., takes the place of an old viaduct of seven spans and is formed of three bow-string girders of the through type. The ends of the girders are supported on cylinders that were only sunk to a depth of 80 ft. in sandy strata after considerable difficulty. The total weight of steel work in the bridge is 500 tons.

In the tests made by the Railway Company before the bridge was opened, six different types of locos were run over the viaduct at speeds varying from a crawl to 79 miles per hour. At one time the bridge was called upon to bear the weight of three locomotives—nearly 400 tons!

* * * *

Over 400 miles of new branch line were opened during the past year by the Canadian Pacific Railway.

* * * *

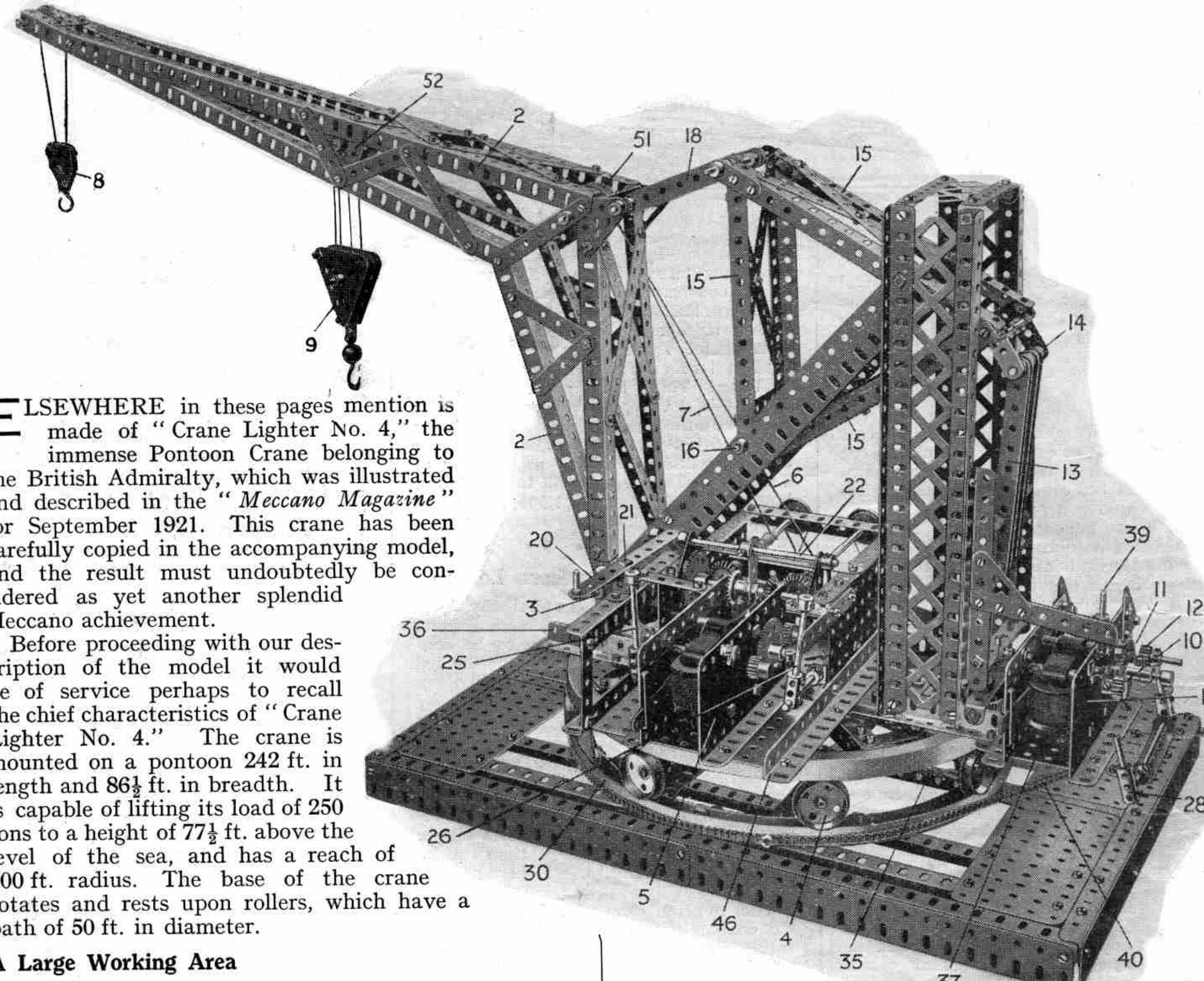
New Southern Rolling Stock

Two new corridor trains for service on the S.E. & C. section of the Southern Railway have recently been turned out from the carriage shops at Eastleigh. Each train consists of four first and third-class composites, two third-class and two third-class brake carriages.

The design of these carriages, which are part of an order for 77, follows the existing type, except that their width is 5¼″ greater than previously. The carriages have corridors throughout and are intended for main line service. Incidentally, it is announced that stock 8 ft. 6 in. in width may now be run over practically the whole of the Southern Railway system.

A NEW MECCANO MODEL

PONTOON CRANE



ELSEWHERE in these pages mention is made of "Crane Lighter No. 4," the immense Pontoon Crane belonging to the British Admiralty, which was illustrated and described in the "*Meccano Magazine*" for September 1921. This crane has been carefully copied in the accompanying model, and the result must undoubtedly be considered as yet another splendid Meccano achievement.

Before proceeding with our description of the model it would be of service perhaps to recall the chief characteristics of "Crane Lighter No. 4." The crane is mounted on a pontoon 242 ft. in length and 86½ ft. in breadth. It is capable of lifting its load of 250 tons to a height of 77½ ft. above the level of the sea, and has a reach of 100 ft. radius. The base of the crane rotates and rests upon rollers, which have a path of 50 ft. in diameter.

A Large Working Area

By raising or lowering the jib the reach of the crane is altered, thus enabling loads to be picked up from the deck of the pontoon at, say, a reach of 50 ft., swung round and lowered into place at a reach of 100 ft. The crane, as erect as possible, picks up its load and swings round in line with the place where the load is to be dropped. The jib is then lowered, extending the reach of the load as it hangs, until it is immediately over the spot where it is finally deposited.

Hauling is accomplished by steel ropes, the maximum effort being made with the jib inclined at an angle of 40 or 45 degrees to the horizontal. When a heavy load is on, both steam and hydraulic brakes control the movements with wonderful precision.

The Meccano Model

Those of our readers of sufficiently long standing who are able to turn up "*M.M.*" No. 20 and compare the illustration on page 6 with our new Meccano model will be struck by the accuracy and realism of its reproduction in Meccano. Every movement of the original has not only been carefully copied, but identical methods are employed to bring about the required results, with the exception that in the Meccano model electricity takes the place of steam engines as the source of power. In this connection it may be mentioned that this model incorporates two electric motors—a unique arrangement that has not hitherto been introduced into any other published Meccano model. The two motors function quite separately from each other and are employed for entirely different purposes. The use of separate motors eliminates a great deal of gearing that would otherwise be necessary. Both the motors may, of course, be run off the same accumulator. The model is complete in every detail—the wonderful rocking-bar, giving great leverage and movement at the expenditure of the