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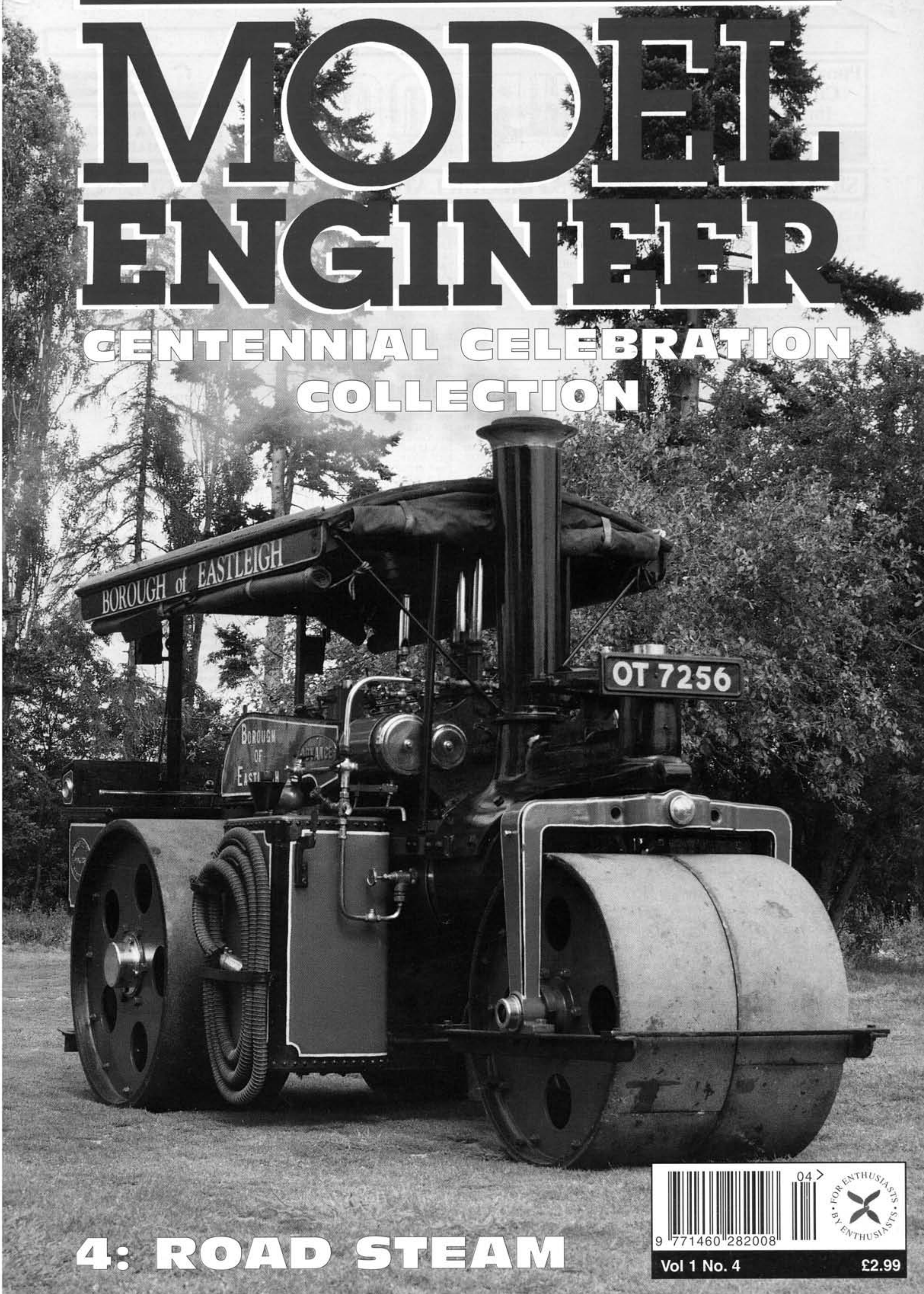

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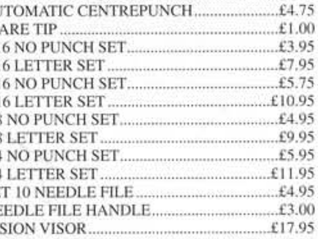

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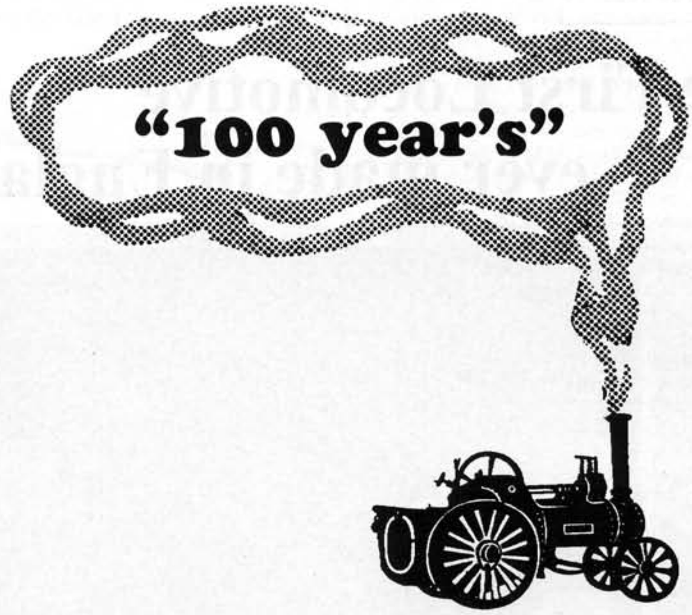


A full set, one hundred years, of 'Model Engineer' resides on nine long steel shelves in the Nexus offices. These shelves, if laid end to end, would reach from my back door to the bottom of my garden! Such was the sight that greeted me a week or two after accepting the invitation to compile the traction engine issue of the centenary series. To be honest I was surprised to have been asked, I felt there were plenty of folks more worthy and experienced than myself.

A good deal of thought has gone in to how to present Traction engines and their modelling over a century, as the advert for the issues puts it. I had been given the same brief as everybody else, that is to do your own thing. The only quantitative bit of the invitation was that I had one hundred pages. So how about the one hundred best traction engine models? No, bad idea, as with a child in a sweet shop it is wonderful for a bit but after a while it might get a bit indigestible. What about a page for each year of publication? In which case every article would have to be edited down to no more than a single side; with much of what I had read there would be little chance of that.

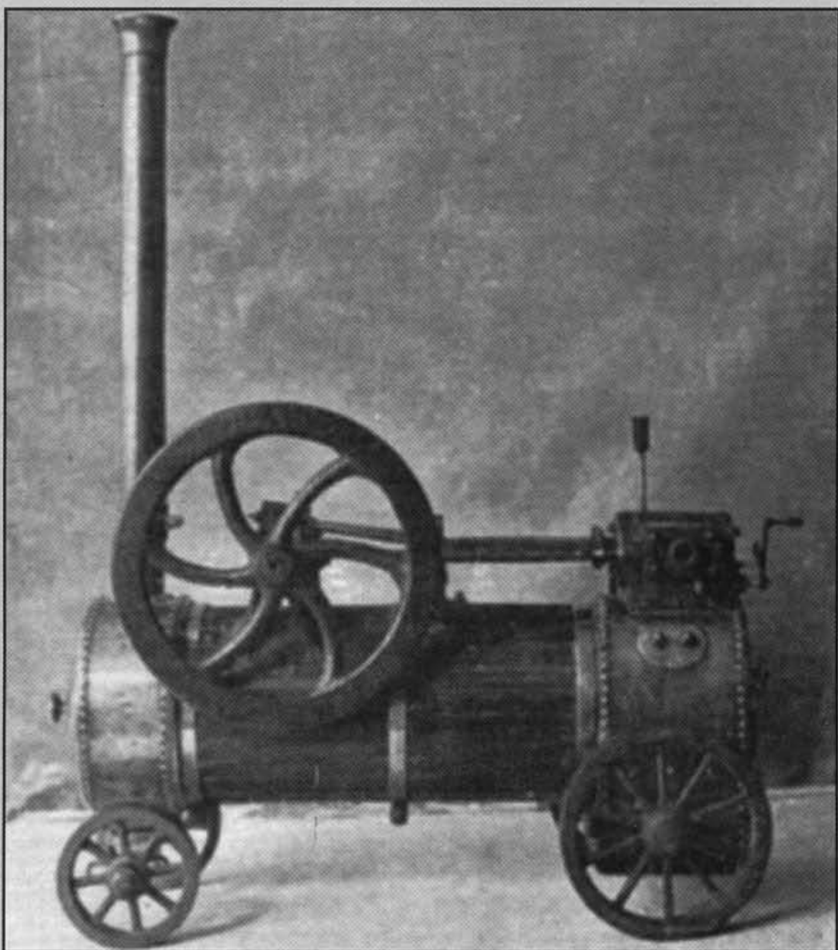
The answer slowly dawned, deduced from the enjoyment I had derived from reading *Model Engineer* over the years. What I believe I like the most is the variety; so many different approaches, so many different topics, so many different authors. I have concluded that my hundred years should mirror this variety as much as possible. The texts chosen are not necessarily in chronological order, I did try but quickly gave this up. Dates for each inclusion are indicated at the end of the piece.

By far my greatest difficulty was in selecting the top class models for inclusion. However I approached the task, I always had far more text and photos than page space. One decision however was straightforward- the work of Mrs Cherry Hinds is so exquisite that it surely must be the backbone of any selection. Many a journey back from the Model Engineering Exhibition has been spent discussing her work. I am sure you have had the same thoughts, you know the bits are just so small, the thing actually works, how ever does she do it, since Mrs Hinds, work is so special, I have requested that this issue has a colour section devoted to her models.

Since construction series are so popular in *M.E.*, to include a flavour of these was considered essential. I have therefore included Bill Hughes, articles on traction engine accessories, useful to all traction engine modellers. There have also been many historical narratives over the years, of various sorts, on traction engines. Presently this slot is so ably filled by John Haining with his historical asides. After much head scratching I eventually chose some of Ronald Clark's *Traction engines not so well known series*, using some of the more obscure examples that I imagine many readers may be unaware of. Also included are one or two texts on full size engine restorations and an account of the now defunct Gladiator Club. To introduce all that I have chosen would take too long, so without any further ado let us start at the beginning.......

August 19 1902

The First Locomotive ever made in England



Reader C.J. Randall of Hornchurch sent this picture of a working model portable entered in the Paris Exhibition of 1856. The model was built by his grandfather. Below is the medal which was awarded to him.

We are indebted to Sir Richard and Mr. George W Tangye for permission to reproduce the following most interesting account of the famous model locomotive built by William Murdock, the first locomotive ever made and run in England. Murdock's original model, which is an historical relic of the greatest interest and importance, is now being exhibited by Messrs. Tangyes Limited, at 35, Queen Victoria Street, London, E.C. William Murdock was the well-known assistant to James Watt, and second only in importance to Watt himself. He invented numerous devices in connection with steam engines, amongst others the "D" slide valve, and "Sun and planet motion," and was also the first to use coal gas as an illuminant.

The date of construction is not definitely known. Mr. Murdock's son, when living at Handsworth, informed Dr. S. Smiles that this model was invented and constructed in 1781, but, after perusing the correspondence of Boulton and Watt, Dr. Smiles has inferred that it was not ready for trial until 1784.[1] The model had been continuously in possession of the Murdock family till 1883, when it was purchased

from Murdock's great grandson by Sir Richard and Mr. George Tangye. It has since been exhibited at the Melbourne Exhibition of 1889, and at the Birmingham Art Gallery. A copy has been made by students at South Kensington and placed in the museum there.

A note referring to this in the South Kensington catalogue reads as follows:- "This is a copy of the original experimental model made by William Murdock in 1781-6. At the time, Murdock was at Redruth, erecting pumping engines for Messrs. Boulton and Watt, and in August, 1786, the firm's agent writes: 'William Murdock desires me to inform you that he has made a small engine of ¾ in. diameter and 1½ in. stroke, that he has applied to a small carriage, which answers amazingly.' In September of the same year, Boulton, in writing to Watt, says that Murdock had make his steam carriage run a mile or two in River's great room, making it carry the fire shovel, poker and tongs. William uses no separate valves, but uses the valve piston, something like the 12-in. little engine at Soho, but not quite.' There is good evidence that, altogether, Murdock constructed three locomotives, the last of considerable size : but, under pressure from Boulton and Watt, he ultimately abandoned the invention"[2].

James Watt had, ever since he was twenty-three years of age, when Dr. Robison, of Glasgow University, called his attention to the subject, given much thought to the application of his steam engine to road locomotion, and in 1769 he took out a patent describing a locomotive;[3] but being busy upon other work and experiencing troubles respecting the validity of his previous patents, he did not follow up the matter.[4] William Murdock had doubtless heard of Watt's original speculation, and at Redruth, during his leisure hours, proceeded to construct a model locomotive after a design of his own - of small dimensions, but sufficiently large to demonstrate the soundness of the principles on which it was constructed. The result of his labours is the engine now shown.[5]

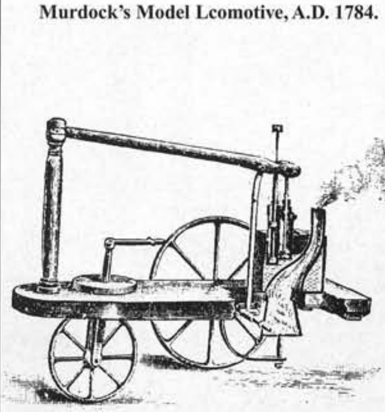
An attentive examination of the model well repays one, and reveals many beautifully simple contrivances, showing Murdock's genius for the adaptation of simple means to secure his desired ends. The height of the small locomotive is about 14 ins., its length 19 ins., and the extreme width over, the driving wheels is 7 ins. It consists of an oblong board, mounted upon three wheels, two driving wheels at the rear attached to a cranked axle, and one steering wheel in front arranged under the board, and running in a swivelling fork, which can be set by a tiller handle above. Behind the driving wheels is the boiler, which is a rectangular vessel, 3⅜ ins. high, 4¼ ins. long, and 3⅛ ins. wide, constructed of brazed copper. Through the boiler a flue passes obliquely, contracting from a circular chamber forming the firebox to a small funnel in the top of the boiler, which serves to carry off the products of combustion from a spirit lamp, arranged to burn within the firebox. The steam cylinder of the engine is mounted on the top of the boiler, and the lower part passes into it, and is surrounded by steam. The piston-rod passes upward, and is attached to the end of a vibrating beam; this beam passes to the front of the carriage, and is pivoted in an upright pillar. The little engine is worked by the expansive force of steam only, which is discharged into the atmosphere after it has done its work of alternately raising and depressing the piston in the cylinder. The diameter of the piston is ¾ in. and the length of its stroke is about 2 ins.[6] As the piston moves up and down, it causes the beam to rotate the driving wheels, by means of a connecting-rod attached to the cranked axle.

The steam valve is very ingenious, and it is driven from the beam by a projecting rod, so arranged that the valve is moved at the termination of every up and down stroke by the last portion of movement of the beam upwards or downwards. It is a piston valve with two pistons, ground to work easily, but pressure proof, in the valve cylinder. The space between the pistons is in constant communication with the boiler, and the steam is admitted by two ports - one at the top and one at the bottom of the cylinder - so arranged that when the piston valve is up, the steam enters the upper port, and drives down the piston, while the exhaust steam from the under side discharges from the cylinder by the lower port into the air through a tub connecting the two pistons of the valve.

This is probably the earliest (piston) slide valve used in a steam engine, as at the date of its construction, Boulton and Watt did not use Murdocks "D" slide valve in their engines - the patent for the latter not being taken out by Murdock till 1799 (Patent No. 2340), about 15 years later.[7] In this model the idea of the slide valve had certainly entered Murdock's mind.

The safety valve is let into the boiler near the steam cylinder, and it is held down by a little tongue of metal - a very efficient and simple contrivance. A leaden weight is placed above the steering wheel to balance the machine, and to prevent it tipping over when the water is in the boiler. The wheels are constructed of brass tube brazed together. Every part of the engine is both well designed and well made. It is interesting to notice that at some time the wood under the boiler has been on fire, and it still shows the marks of charring. It has evidently been pieced and protected by an iron plate to prevent a similar mishap. In Dr. Smiles' *"Men of Invention and Industry,"* published in 1884, he gives interesting accounts of two experiments with this locomotive. "The first was made in Murdock's own house at Redruth, when the little engine successfully hauled a model wagon round the room." The second experiment was made in the lane leading to the church, and in front of the house afterwards inhabited by the parents of Messrs. Tangye.[8] This trial is thus recounted by Dr. Smiles in the book just mentioned: "Another experiment was made out of

Murdock's Model Lcomotive, A.D. 1784.



doors, on which occasion, small though the engine was, it fairly outran the inventor. One night, after returning from his duties at the mine at Redruth, Murdock went out with his model locomotive to the avenue leading to the church, about a mile from the town. The walk was narrow, straight and level. Having lit the lamp, the water soon boiled, and off started the engine, with the inventor after it. Shortly after he heard distant shouts of terror. It was too dark to perceive objects, but he found on following up the machine that the cries had proceeded from the worthy vicar, who, while going along the walk, had met the hissing and fiery little monster, which he declared he took to be the Evil One in 'propria persona' ".

When Watt was informed of Murdock's experiments he feared that they might interfere with his regular duties, and advised their discontinuance. He afterwards said that if Murdock was resolved to continue them, the firm of Boulton & Watt would advance £100, and would establish a locomotive engine business with Murdock as a partner, if within a year Murdock succeeded in making an engine capable of drawing a postchaise, carrying two persons beside the driver, with fuel for four hours and water for two hours, at the rate of four miles per hour.[9] From 1786, however, Murdock, as well as Watt, dropped all further speculation on the subject of road locomotion, although persuaded of its practicability, and left it to others to work out the problem of the locomotive engine.

Murdock's model remained but a curious toy which he took pleasure in exhibiting to his intimate friends,[10] and after his death it was kept by his descendants until it came into the hands of Sir Richard and Mr. George Tangye, as before mentioned. ●

[1] Smiles' "Men of Invention and Industry," 1884, P. 134.

[2] S.K. Museum Cat. Mech. Engineering Collection, 1901 edit., P. 45.

[3] Smiles' "Lives of the Engineers," Vol. iii, P. 74.

[4] Smiles' "Lives of the Engineers" 1878, Vol. iv, p.267.

[5] "Men of Invention and Industry," P. 133, 1884

[6] "Men of Invention; and Industry, " P. I 34. The S K. Museum catalogue says that stroke is 2.125 ins. (See footnote, p. 82 ante.)

[7] "Men of Invention and Industry", p.139.

[8] Sir Richard Tangye, "One and All," p.17, 1880

[9] "Lives of Boulton and Watt." Smiles, p.337.

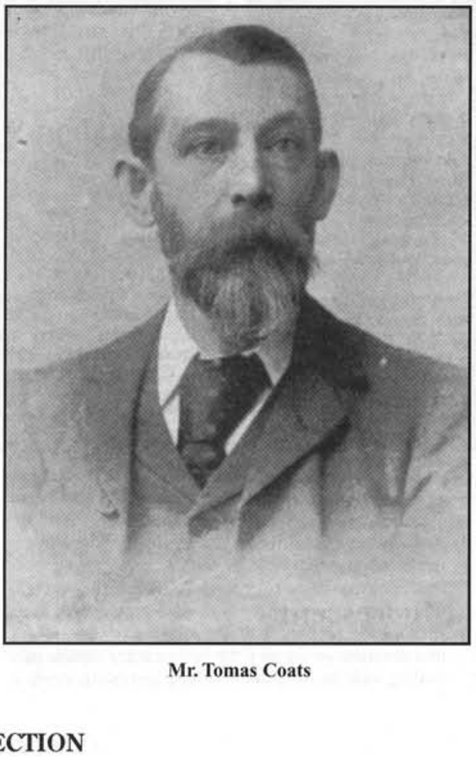
[10] "Men of invention and Industry," p.135.

January 1899

Model Engineers and Their Works

Messrs. T. and C. J. Coates.

If all the model-making and model-loving enthusiasts who have made a pilgrimage to the famous machinery section of the South Kensington Museum were asked which of the exhibits aroused in them the keenest feelings of interest and admiration we feel tolerably certain that the majority of the replies would give the place of honour to the sectional model of a London and South Western express locomotive made by the gentleman whose portrait we are pleased to be able to present herewith to our readers. The great publicity given to the handiwork of Mr. Thomas Coates led us to think that some information regarding the conditions and methods pertaining to the production of his models would be of special interest to his many admirers who are supporters of this journal, and we therefore wrote him requesting the favour of an interview for the furtherance of our purpose. His reply, kindly and courteous in the extreme, was pointed with a moral. He wrote: "While I shall be happy to give you the fullest of particulars regarding the models we have made, I am afraid the information will not be of much practical service to your readers as we can only ascribe our success to a lifelong training and experience coupled with an intense personal liking for this particular class of work." While we agree that it will be given to but few of our readers to equal the beauty of workmanship to be found in the models made by the subjects of this sketch, yet we feel that the presentation of such a high ideal will, in itself, act beneficially in encouraging each and all to do their best. It will be noted that in the foregoing extract from Mr. Coates' letter he uses the plural "we," thereby implying that he does not work alone. Nor does he for he, has a most skilful and valued co. worker in the person of his brother, Mr. Charles James Coates. We had hoped to be able to give this gentleman's portrait, but there are limits to the editorial powers of persuasion, and Mr. Coates' modest refusal of our request proved unalterable. Many amateurs in speaking to us with regard to Messrs. Coates' work have expressed the opinion that to make such models a most elaborately fitted workshop is necessary, and that no one with but a moderate equipment of tools could in any way hope to equal their productions. The best reply to such a statement is a description of the actual workshop where these models are made, and we would willingly forge any expressions of doubt which might arise in the reader's mind if he were introduced to the unpretentious is building at the bottom of the garden of Mr. Coates' house at Wallington, which though only measuring some 12 by 15 feet, really serves as pattern-making shop, foundry, and turning and fitting shop, all combined in one. Nor is the equipment so complicated as the imaginative reader might expect, for it consists of two treadle screw-cutting lathes, one of 3 in. and the other of 4 in. centres, one small milling machine, a substantial vice-bench, a natural draught furnace for melting metal, some assorted moulding boxes, and a kit of small tools contained in various drawers and boxes. But such a plant, small though it be, can accomplish much when used with the necessary knowledge and skill.



Mr. Tomas Coats

Probably most of our readers have heard the time-honoured story of the great painter who, when asked by a less successful artist what he mixed his colours with to obtain such wonderful results, replied, "With brains, Sir!" The same response might well be applied in the present case to any inquiry as to the possibility

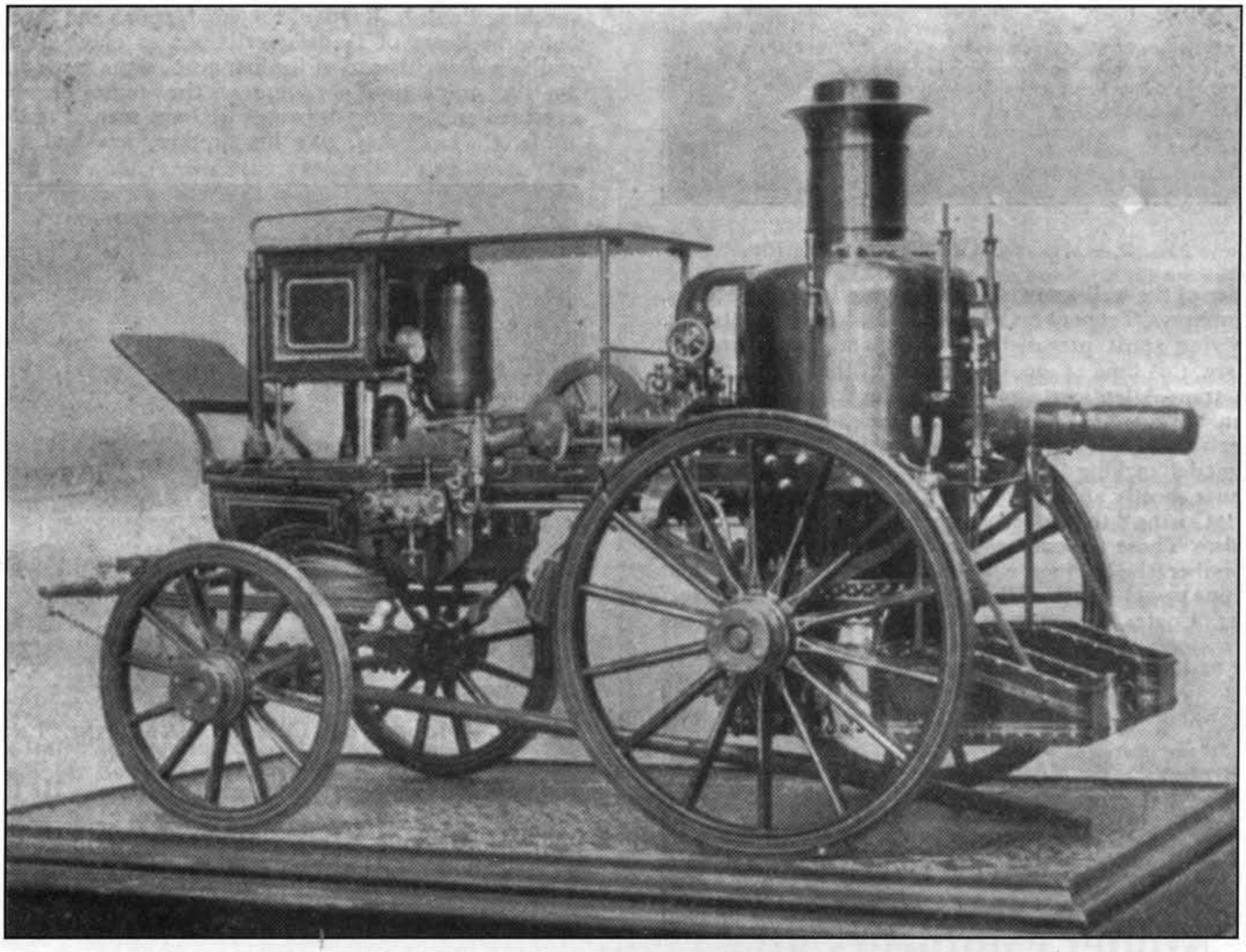


Fig. 1 Model of Steam Fire Engine, horizontal pattern.

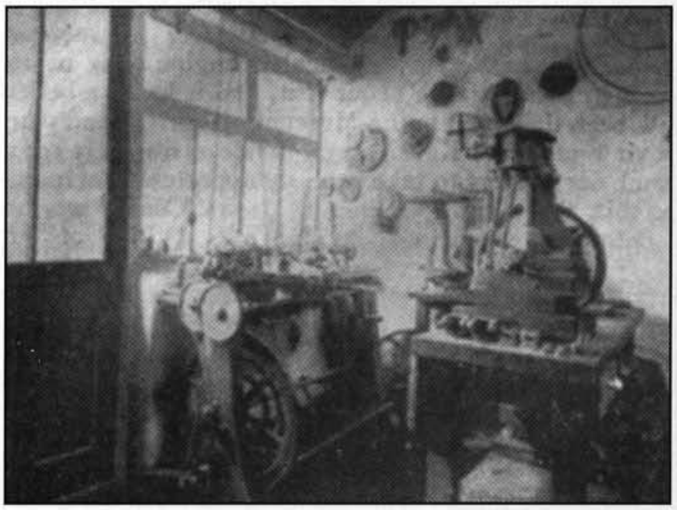


Fig. 2 Messrs. Coates' Workshop

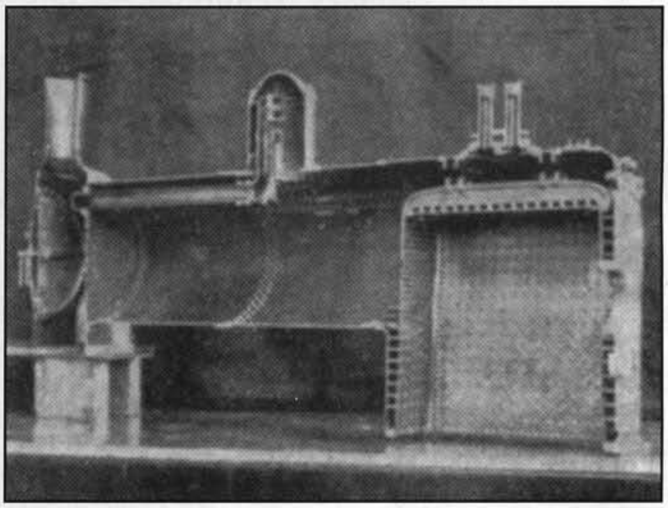


Fig. 3 Boiler of L.S.W.Ry. Model Loco, in Course of Construction

of producing such excellent work with, apparently, such a modestly equipped workshop. The tools themselves are as accurate as skilful adjustment can make them, though we may remark, in passing, that as regards the lathes this accuracy is due to the careful attentions of the present users, and not to those of the original makers. The milling machine above referred to has been specially designed by Mr. Coates for model-making requirements, and will do anything from engraving the smallest letters on an engine's name-plate to the cutting of the most intricate piece of toothed gearing. All the smaller castings used in the models, both in brass and iron, are made on the spot, the furnace being capable of dealing with 20 Ib. of iron taking about two hours to melt this quantity. For larger castings than this, Mr. Thomas Coates has recourse to the resources of a neighbouring firm of iron founders, though even in this case he personally prepares the moulds and superintends the melting and pouring of the metal. A question from us as to the quality of the iron preferred for model-making elicited the information that Mr. Coates uses a

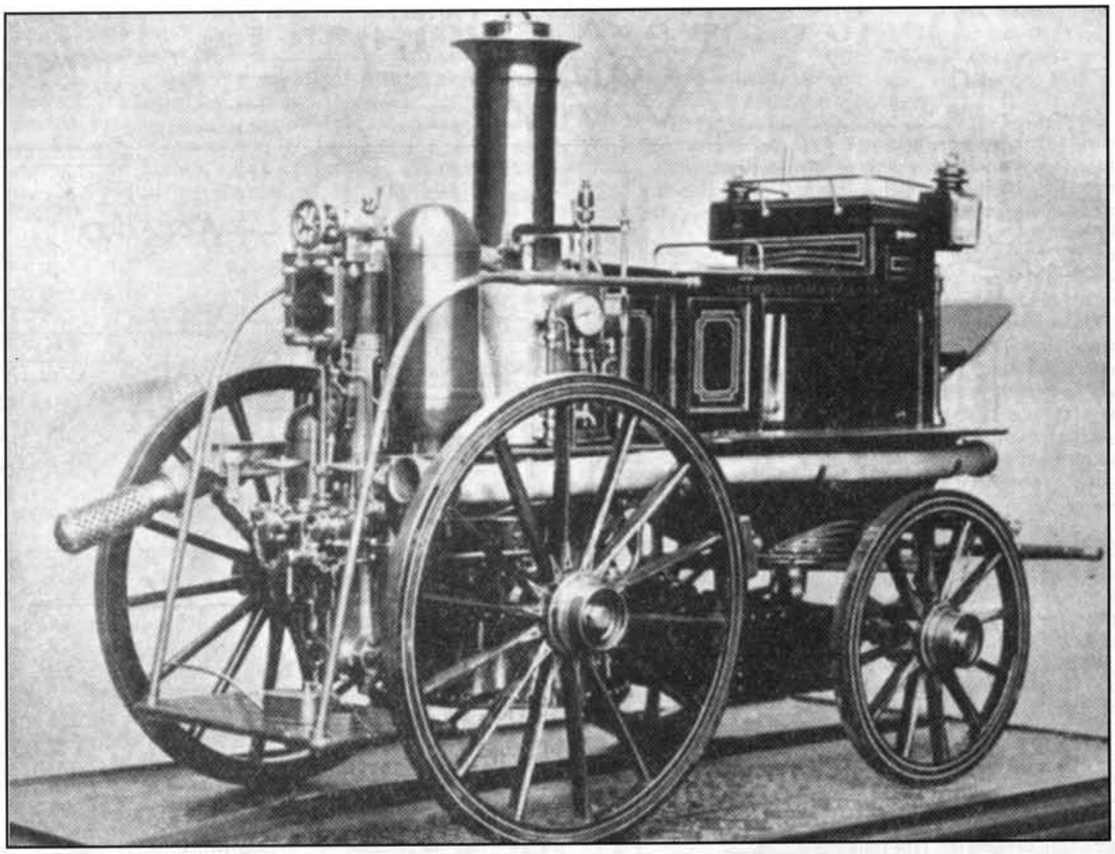


Fig. 4 Model of Vertical Pattern Steam Fire Engine.

mixture of two grades of No. 1 pig iron, from which the sulphur and phosphorus are subsequently refined out.

Before entering into detailed descriptions of models made by the subjects of our interview, we think, perhaps, a few notes of a personal character will not be out of place. Although both these gentlemen have for many years past been resident in England, it was in Russia that they received their early training, their father having occupied the responsible position of chief superintendent engineer to the Imperial State Paper Factory at St. Petersburg. Some five thousand hands are here employed in the manufacture of all the paper and stationary required by the Russian Government, and the engineering workshops attached to this huge factory the Messrs. Coates made their first acquaintance with the uses of hammer, chisel, and lathe.

Following their subsequent careers individually learned that Thomas Coates left St. Petersburg in 1869 to take up a position with Messrs. Smith, of Hamburg, where he was concerned in the construction of a number of gasometers for the principal German gasworks. A year later he joined the steam-yacht "Trave" as chief engineer and after tasting the joys and sorrow of a seagoing engineer, came over to England and entered the service of the well-known marine engine builders, Messrs. Humphreys, Tennant & Co., of Deptford, as draughtsman. A roving spirit prevailed, however, as he returned to the sea, this time as second engineer of the German Eagle trans-Atlantic steamer "Goethe". After making seven voyages to America and back, he, fortunately, conceived the idea of settling down in England to take up model making commercially. We say fortunately, because shortly after Mr. Coates resigned his position on the "Goethe" the vessel was wrecked and lost with all hands. Those of our readers who are old enough to remember the "Goethe", will probably recollect that this fine vessel was then the "greyhound of the Atlantic." Mr. Coates, however, was not yet finished with the sea, for, the Egyptian war then being in progress, he was offered and accepted the post of, practically, chief engineer to H.M. troopship "De Bay", though, as is usual in such cases he was nominally second to a government chief.

This interesting experience over, he joined the staff of the old-established firm of Messrs. James Watt and Co., with whom he remained until 1894, a period of twelve years. While with this firm he did a considerable amount of experimental model making on their behalf, and also conducted many of the contractor's trials of the important waterworks pumping plant for which Messrs. James Watt & Co. were celebrated. Mr. Coates allowed us to peep at the testimonial the firm gave him when he left their service, but about this we will say no more than that the opinions of his abilities therein expressed were such as of which any engineer might well be proud. Even in his apprenticeship days Mr. Coates indulged in model making to a considerable extent, and he told us that it is quite 34 years ago that he turned out his first piece of work of this kind. Since 1894 Mr. Coates has been exclusively engaged in modelling for the South Kensington Museum, though in his spare time he has done work for the authorities for at least ten years past.

Finally Mr. Thomas Coates is a proficient linguist, talking English, Russian, French, German, and Swedish, holds the Board of Trades certificate as chief engineer, and is a draughtsman of the first rank, as he proved to us by the production of some of the most beautifully executed engineering drawings we have seen.

Mr. C. J. Coates, like his brother, has had a very varied experience both on sea and on shore. He learnt to use his tools in the Imperial Factory at St. Petersburg, and subsequently, spent several years in engineering workshops in Germany. He also was on board the "Goethe," filling the post of third engineer, and in more recent times has taken part in many official trials of torpedo-boats. Space will not permit us to mention all the firms with which he has been associated, but we have mention such names as Bryan Donkin & Co., Thorneycroft's, Merryweather's, Rennie, and James Watt and Co., by all of which firms he has at one time or another, been engaged, to show that his experience in the highest class of engine building has been considerable. For the last ten or twelve years, however, he has devoted his time entirely to model-making.

It will probably clear up an often-discussed point if we explain that Messrs. Coates do not now look upon their model-making as a source of profit. While it is true that a price is put upon the models they supply to South Kensington, their chief object in undertaking the work is to be found in their intense love for model-making as a pastime, or, rather, we should, perhaps say, as a mechanical art.

In Fig. 4 we show another model of a steam fire engine, which has been very generally admired. It is a scale reproduction of one of Messrs. Shand, Mason and Co.'s vertical pattern Metropolitan Fire Brigade engines, the scale being 2½ in. = 1 foot. The machine is carried by large wheels on mail-coach axles, with a fore-locking carriage, and is generally arranged for rapid travelling, two horses being employed. The delivery hose is stored in a central box, which also contains a tank for the suction hose are carried one on each side beneath the fireman's footboard, and a coal bunker under the fore carriage holds a supply of fuel conveniently near the turnace door. The box seat is utilised as a tool store, and two short branch pipes with nozzles are carried, one on each side of the box, and two long ones over the hose box. The pole terminates in a special form of trap, by which a horse that has fallen can be quickly released, and the hind wheels have a powerful lever brake.

This model is in all respects a complete working machine, even to the pressure gauges and injector. The boiler is of copper, with 70 cross tubes, and was tested to 300 lb. per square inch. It burns coal, and has raised steam from cold water in seven minutes. The engine throws a continuous jet 3-16ths in. diameter to a height of 65 feet, when running 360 revolutions per minute. Mr. Thomas Coates has also contributed a very fine model manual fire engine to the South Kensington Museum. ●

February 15 1901

Design for a Model Road Loco.

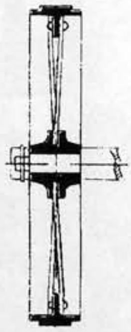
By "ALPHA"

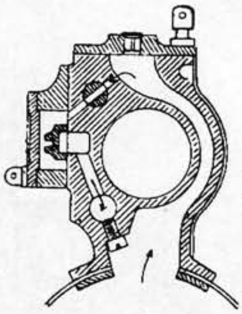
The model shown by the drawings and described below, will, I hope, be of service to those model engineers who are wishing either to build an engine similar in its main features to a showman's road loco, or to posses a compact and portable engine and dynamo combined for electric lighting purposes; the dynamo being placed on the base attached to the smoke box extension.

Cylinder. - This is in one casting, with the jacket and throttle valve casing. This valve, or rather regulator, is cylindrical, and is provided with two holes drilled obliquely through from top of jacket casing, communicating with valve casing as shown. The cylinder is bored out and the flanges faced in the lathe; the valve casing is separate and is secured to cylinder by studs and nuts. Flanges and cover on top of the cylinder jacket forming safety valve seat and attachment, are secured by hexagonal-headed screws. The four bar type of guide has been adopted in this design. It is seldom now used on other types of engines, having given place chiefly to the cylindrical bored guide, which seems likely to supersede it in the road locomotive. The front ends of the bars, which are of wrought iron or steel, are attached by bolts and nuts to a cast brass bracket, carrying the weigh shaft bearings. The cross-head is of brass, having piston-rod screwed into it; the crosshead pin is of steel and is secured by a nut. The connecting rod may be either brass or gunmetal, and is more than 3½ times the stroke, so as to reduce the angular pressure on the guides as much as possible; it has a marine end laying hold of crank pin. The crankshaft is of steel, the crank webs being of a circular pattern so as to admit of finishing in the lathe. Part of the crankshaft (where it enters the first pinion) has two flats formed on so as to admit of a sliding motion on part of same. It may, if preferred, be formed square. The crankshaft is carried in bearings, or brackets as they are sometimes termed, let into and secured to the horn or side plates.

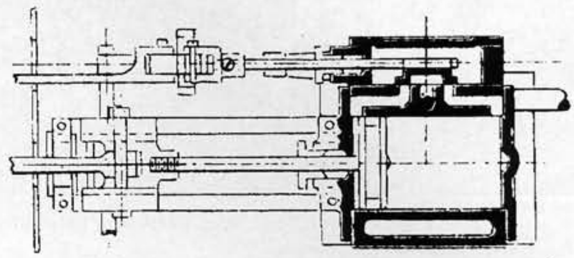
The eccentric sheaves are set and secured by steel set-screws with hardened points; straps are of brass and have eccentric rods screwed into them; these rods are cast, have forked ends, and are rectangular in section. Care must be taken to make them exactly the same length measured from the centre of crankshaft to centre of each eye respectively. The reversing lever and rod will look much better if made of wrought iron or steel; valve spindle is of steel, and is guided, the guide bracket being attached to valve casing. The safety-valve is placed on the top of cylinder, and is of the spring balance type.

Boiler is made from the best sheet brass, 1-16th in. thick, and has six tubes ½-in. internal diameter. The outside firebox plates are continued upwards and backwards to form box brackets to carry gearing; they are stiffened by two crossplates, one at each end, rivetted or bolted to the side plates. The furnace is fired by a spirit lamp having two rectangular burners fed from the removable container carried in the tank. This tank is attached to the side plates, together with the drawbar attachment, by bolts and nuts, 3-32nds in. diameter. The firebox is provided with firehole and vertical sliding-door and is stayed with ⅛ in. diameter brass stays. A feed pump is placed in the water-tank under boiler and delivers though check valve into boiler barrel. A water-filling hole and plug is placed in front of cylinder; the steering gear is attached to water-tank, and is actuated by means of the steering and worm wheels as shown. The funnel is of brass, attached by screws to a stool or seating on smoke box; it must be provided with a steam blower. The boiler must be provided with a water-gauge, pressure-gauge to 35 lb., and a blow-off cock placed just above firebox ring.





Section of Fore Wheel



Sectional Plan of Cylinder, Steam Chest, and Crosshead

Gearing. - The gearing is made as simple as possible, only one speed being provided, the variations that might be required for a model being obtained by notching up. All other indispensable appliances in the actual machine, such as differential gearing, spring mountings, & c., being omitted, the first pinion is carried on the crankshaft and is thrown in and out of gear by shifting gear, worked by a pivoted sliding lever held by a pin in the required position. The first spur wheel and second pinion are fixed to the second motion shaft, the second pinion gearing with the large spur wheel on driving axle; both spur wheels are partially covered in for neatness and as a protection from dust.

The driving-wheels are built with two T rings cast in brass, having diagonals rivetted to the opposite stalks of the T rings. Opposite ends are secured by being cast in the bosses; the driving-wheels do not resolve on the shaft, but are fixed by keys and round nuts having solid ends.

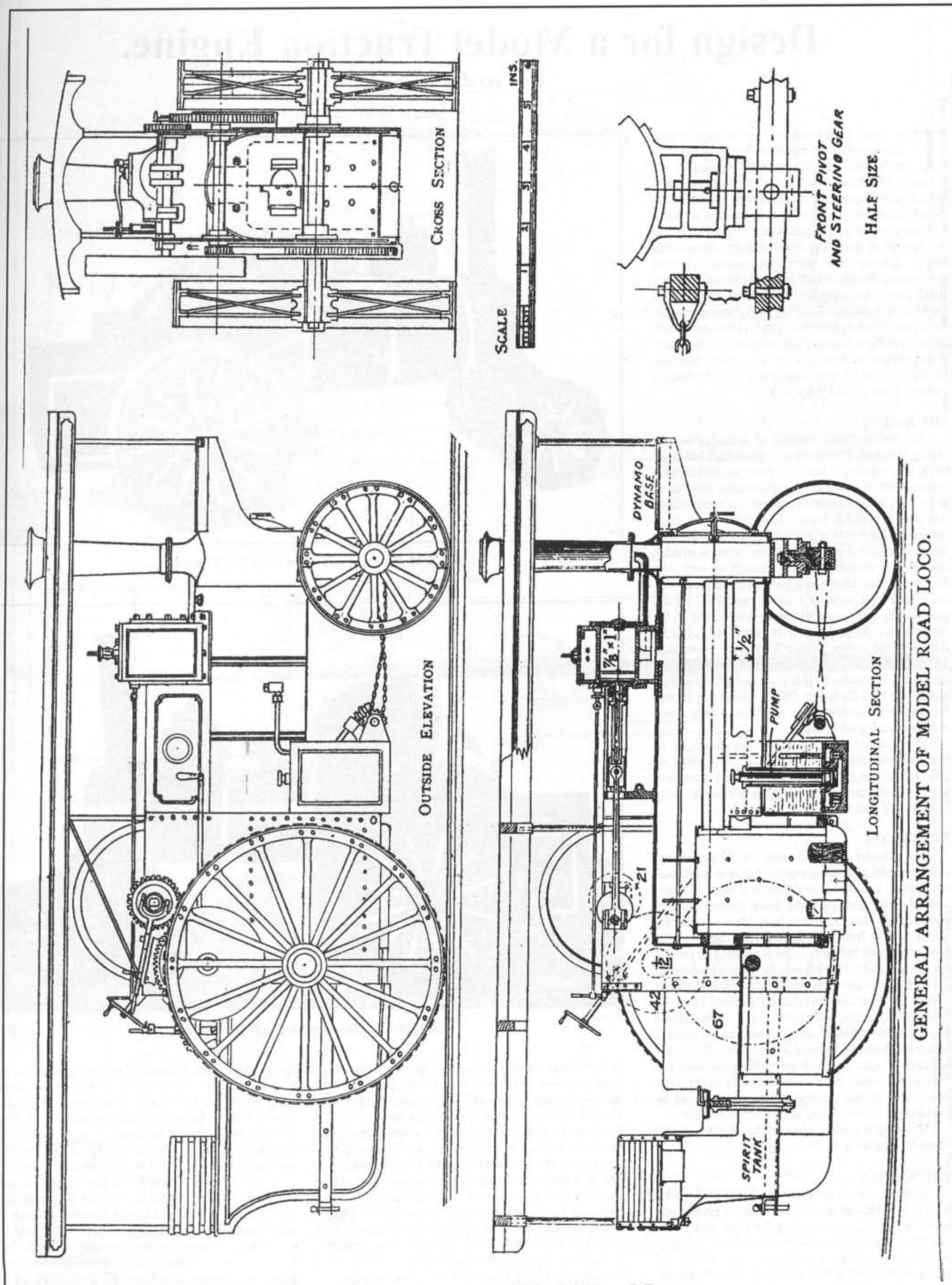
The fore-wheels have cast brass tyres, formed as shown, with spokes secured in a similar manner as driving wheels. These wheels revolve on their axle, which is rectangular in section in it's central portion. This axle is mounted on a pinion, whose centre line is at right angles to that of the axle, so as to allow the wheels to adapt themselves to inequalities in their path; the pin is fixed to a brass casting, which has a vertical pin passing through the saddle-casting, carrying smoke box.

A shade or shelter is fixed over the entire length of the engine. It has a zinc roof secured to the roof sticks by small brass wood screws. The ends of the polished brass columns are secured to these sticks or cross-beams; there should be an opening formed in the roof to allow the funnel to pass through. ●

The following are particulars of engine and boiler:

Bore of cylinder	⅞ in.
Stroke of cylinder	1 "
Diameter of piston-rod	3/32 "
Holes in regulator (2)	3/32 "
Width of steam port	1/16 "
Width of exhaust port	3/32 "
Diameter of valve spindle	5/64 "
Lap of valve	1/32 "
Travel of valve	3/16 "
Diameter of crankshaft	¼ "
Diameter of flywheel (iron)	4 "
Width of flywheel (iron)	½ "
Thickness of boiler plates	1/16 "
Number of tubes	6
Working pressure per sq. in.	35 lb.

Steel motion shafts and bronze gearing.



General Arrangement of Model Road Loco

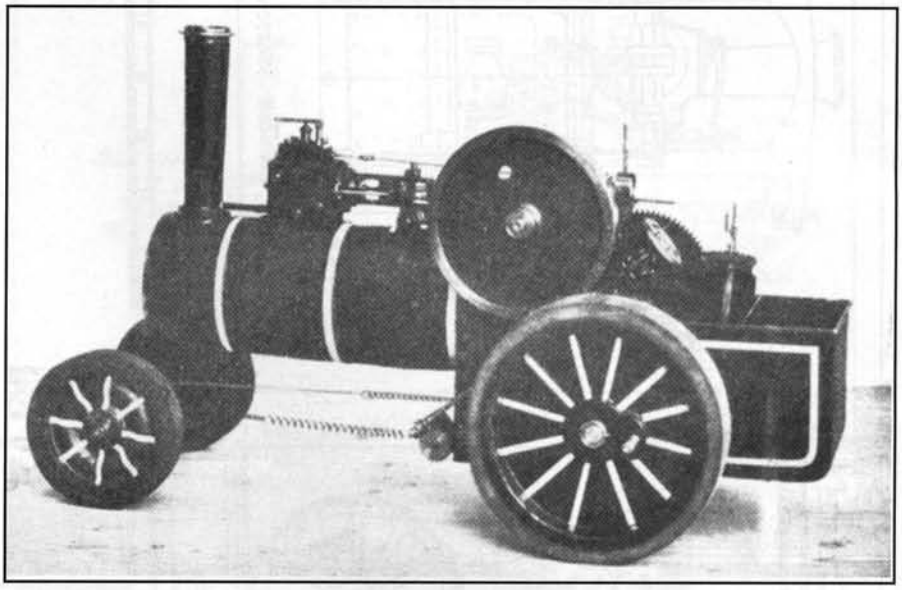
December 1 1901

Design for a Model Traction Engine.

By Tyrrell Cooke

The object of this design is not so much to provide an accurate model in every detail as a really good working engine, very strong, and of many capabilities; one that will give to its owner a great deal of pleasure by it's serviceability, and yet be easily within the power of most amateurs to build, with only a little outside assistance.

Instead of studs and nuts, ordinary cheese-head bright screws are used throughout (British Association thread), which can be procured at a very small cost. An enormous amount of time is thus saved in the building. They are amply strong enough, have a very neat appearance, and it is not much trouble to keen them bright where necessary. The general proportions of the engine are as nearly as practicable the same as the up-to-date practice of the leading makers: scale about 1½ ins. to 1 ft.

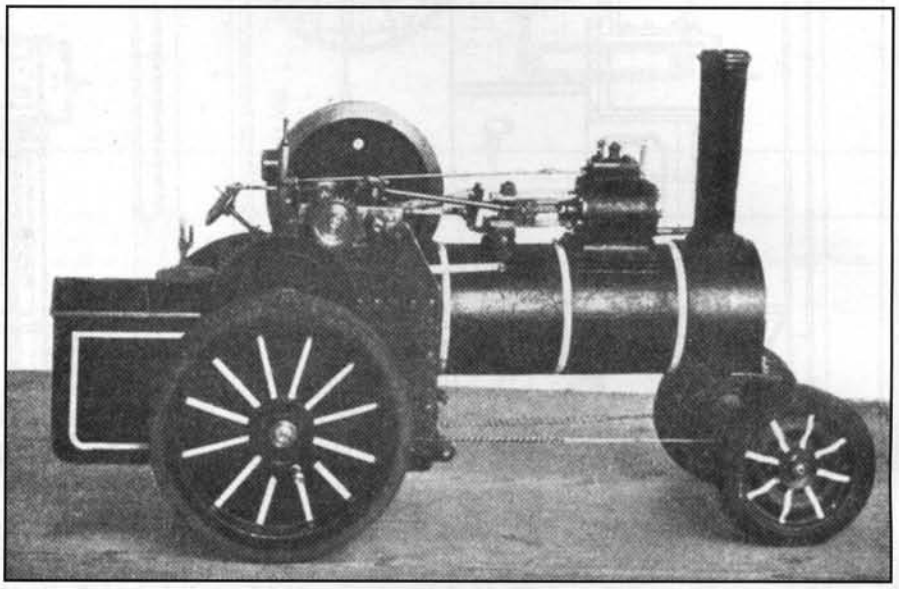


A Model Traction Engine (Left Hand View)

THE BOILER.

The firebox shell consists of a malleable iron casting, or steel, if necessary or preferred, full ⅛ in. thick, into which the barrel (a piece of steel tube) is screwed; the sides are left open to enable cross tubes to be used in the firebox, which, as has been pointed out in your valuable paper, are a great aid to quick steaming. Each side of the casting is machined true, which is easily done in the lathe, or on a planing machine by anyone fortunate enough to own one. The side plates, after being hammered perfectly flat, are screwed on, making a steam tight joint on the casting. By this means all the work necessary to the side plates - drilling, fixing brackets, etc. - can be done off the boiler, which is a great advantage. Further, it is so much more easy to erect the motion, as you can guarantee the side plate being flat and true, and in line with the boiler, and I consider this greatly facilitates the building of the engine, and goes a long way to ensure good running.

The firebox, tubes, & c., are not shown, as so many of your readers will have their own views on this portion; but I shall be pleased to furnish mine to any applicants, suffice it is to say is intended to carry quite 100 lb.. pressure.



A Model Traction Engine (Right-hand view)

THE ENGINE.

The cylinder and valve chest are in one casting, correct model of existing engine; but as it is difficult to a true-up a recessed valve face, it is made of a separate block of brass, ports cut, faced up true, and then sweated right into the steam chest, when it is an easy matter to drill from cylinder ends into steam ports; this can be done before cylinder is bored. The bore of the cylinder is 1⅛ ins.; but may be made a little more; the stroke is 1½ ins. The brackets for crank-shaft and first-motion shaft can be made out of plain 1¼-in. by ⅜-in. flat iron; caps ⅜ in. square, or ⅜ in. by 7-16ths in., fitted on, and holes bored to take round brasses, which are bored and turned in the lathe. If it is not desirable to make a pattern for intermediate shaft and main axle bracket, this also can be made of plain flat iron, but it should be ½-in. thick, and it would be advisable to fit with brass bushes driven in tight.

No pump is shown, a hand-pump in tender being about the best thing to use.

THE WHEELS.

To make correct models of the usual cross-spoke wheels is a difficult matter, and requires proper patterns for moulding and casting the hubs, and I consider that solid cast iron wheels (of course, relieved by hub and rim like a solid cast -iron wheels (of course, relieved by hub and rim like a disc flywheel), nicely painted and lined out with imitation spokes, answer the purpose very well, especially as weight is an advantage with this engine, giving it greater haulage power; but I have shown how they can be made with cross spokes, and without special patterns. The hubs, which must be round, if no patterns at all are made, or a pattern can be made shape of the hub shown in drawing for hind wheel, are first bored to take a piece of brass tube which will fit axle, and then split by a parting tool where the spokes go. The middle piece is recessed at each end deep enough for the spokes to lay in, leaving a thin lip on outside edge; this lip is filed away for the spokes to fit in exactly in their right positions (see Fig. 4 showing four spokes in position). Spokes are tinned on ends, laid in position, and the recess filled up with solder which cannot run away because of the lip and the cross-tube in centre. When spokes have been fixed, the back and front caps an also be sweated on, being held in correct position for soldering by means of the cross tube, which has been fixed at the same time as the spokes through the melted solder adhering to it. The rims are made of strip brass-say, ⅜ in. by ⅛ in., or a bit thinner if obtainable, two being bent on the flat and two edgeways. Spokes are rivetted to the two rings bent edgeways, which can then be turned true in the lathe before the outside tyre is put on (see Fig. 5). This tyre can be bent from a flat strip of brass; it is clamped tightly on the rings, and while held in position the flat rings are then inserted and rivetted to the outside tyre. If the joints at AA be now well soldered all around, it will be as serviceable as if solid tee-rings had been used, and will have the same appearance. ●

FIG. I.

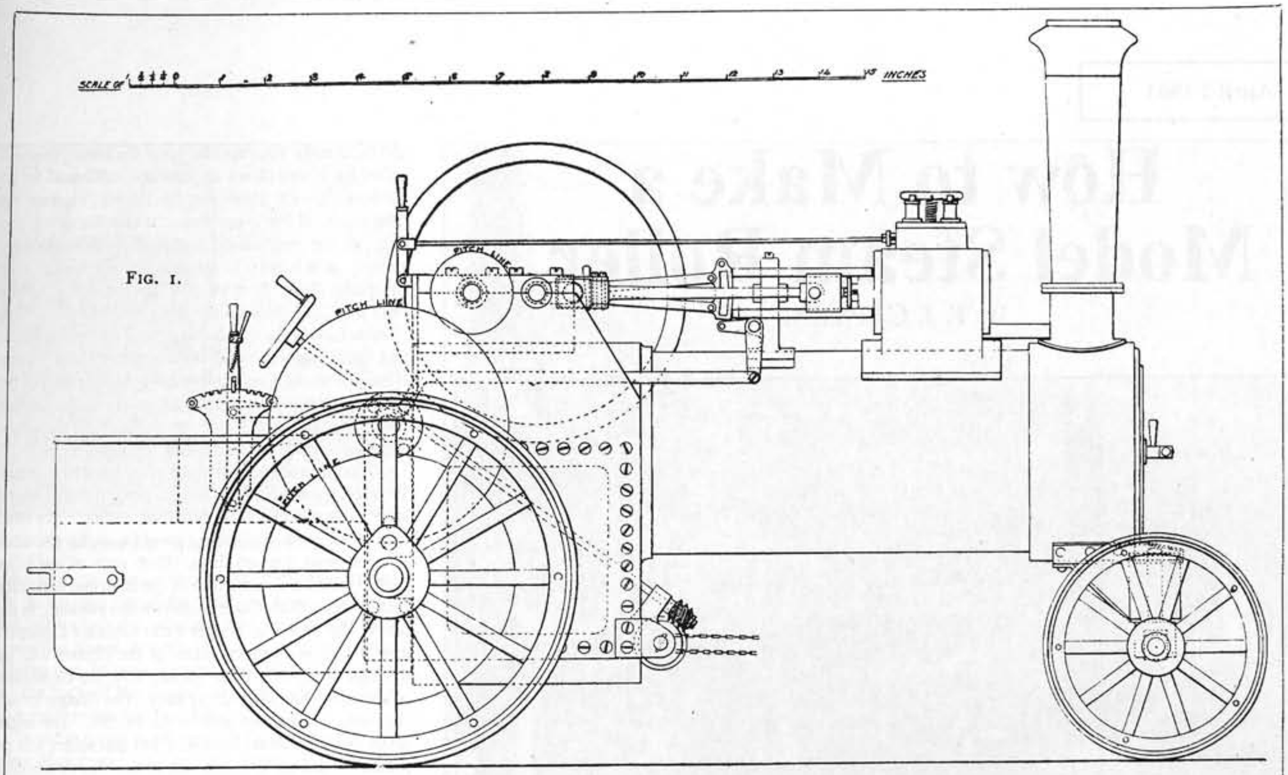


FIG. 2.

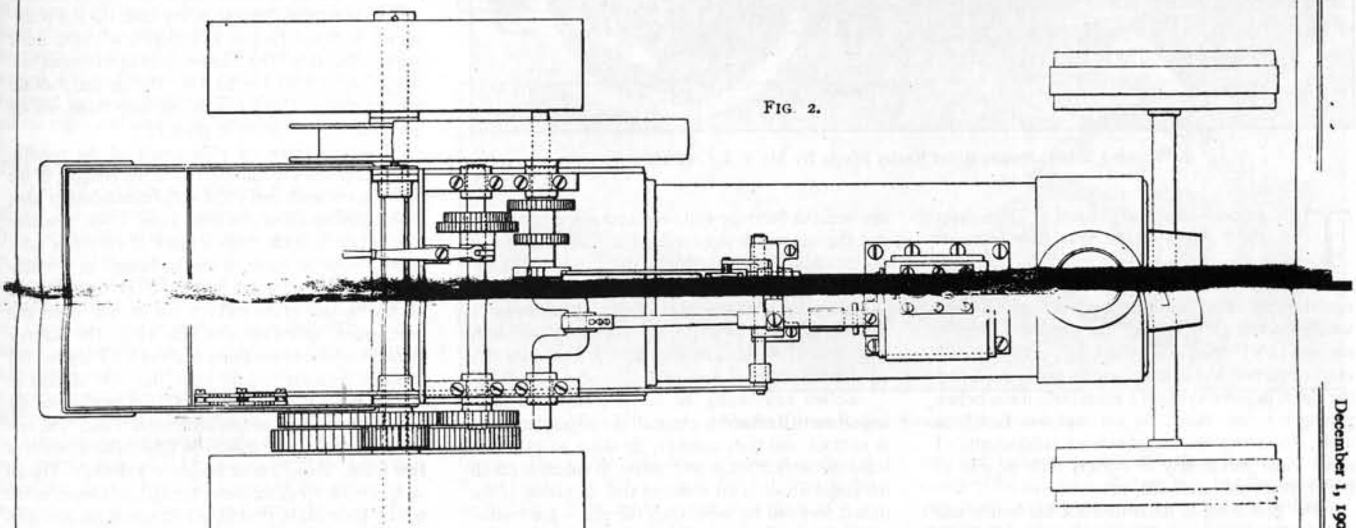
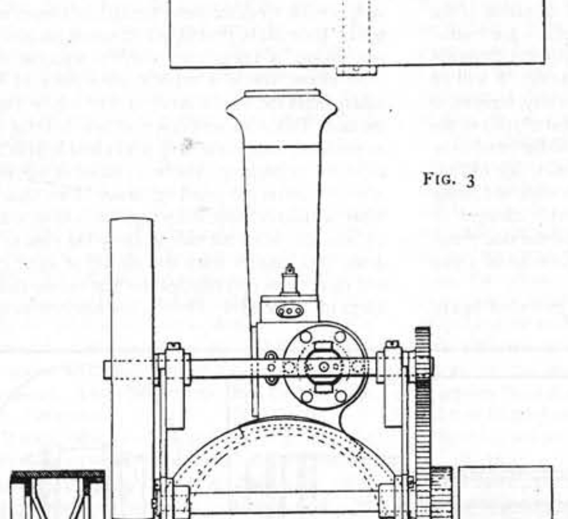


FIG. 3



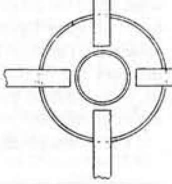


FIG. 4.

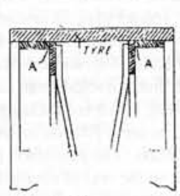


FIG. 5.

A DESIGN FOR A MODEL TRACTION ENGINE.

(For description see page 250.)

FIG. I.—OUTSIDE ELEVATION OF ENGINE COMPLETE. (Right-hand Side.)

FIG. 2.—PLAN SHOWING GEARING AND SPEED-CHANGING ARRANGEMENT.

FIG. 3.—BACK END ELEVATION SHOWING LEFT DRIVING WHEEL IN HALF SECTION.

FIG. 4.—PORTION OF HUB OF BUILT-UP WHEEL SHOWING FOUR SPOKES IN POSITION.

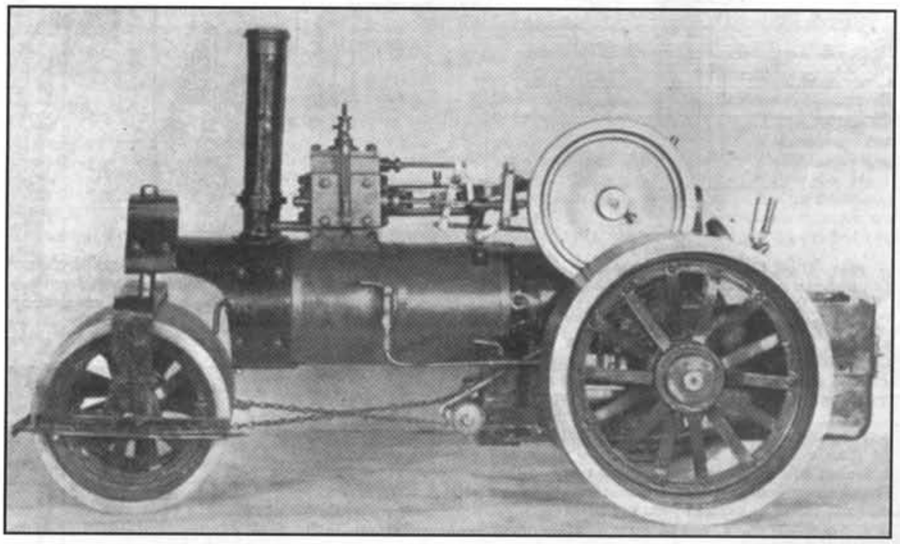
FIG. 5.—SECTION OF RIM, WITH T-FLANGES AND SPOKES OF BUILT-UP WHEELS.

[NOTE.—The Gear Wheels in Fig. I appear only as "Pitch-lines" to avoid confusion. Their positions are clearly indicated in the succeeding illustrations.]

April 2 1903

How to Make a Model Steam Roller.

By F. J. CAPARN.



A Working Model Steam Road Roller Made By Mr. F. J. CAPARN

THE model I have just finished is 22 ins. over all, and it stands 18 ins. from floor to top of chimney.

My first advice to those intending to build a model steam roller is to get out a set of full-sized working drawings, no matter how rough they are. In my own case I regret to say that I did not do this, and, in consequence, had to make several parts over again; the steam jacketed cylinder I made three times before getting it to my liking. Do not stick too closely to scale, if you want the model to work satisfactorily - I mean more particularly in matters such as size of boiler, tubes, nuts and bolts, etc.

The first thing to do is to make the boiler: this must be about to scale so far as outside dimensions go. You cannot take liberties with a traction engine boiler in the way that you can with a locomotive, as it would look very bad if out of proportion.

In my model, I made the barrel 6¼ ins. long by 3 ins. diameter, of 3/64ths in. copper plate, double-riveted seam, ⅛-in. copper rivets, ⅜ in. pitch. A more simple plan would be to buy a piece of 3 in. solid drawn copper tube. This is stronger than a riveted seam, and the overlapping joint is not there, which is a blessing when fitting the other plates. The outer firebox or wrapper plate is 3½. ins long by 2⅞ ins. The smokebox proper is 1½ ins. long, and 4 ins. to the end of overhang; the firebox is of 1-16th in. copper, 3¾ ins. high by 2 ins. by 2⅞ ins.

First turn a piece of hard wood, 2¾ ins. diameter, and a little longer than the barrel, so that the end of it can be held in the vice while you are bending your barrel-plate round it; this can easily be done with a tinman's mallet if the plate is first annealed. This is done by getting it to a dull red heat, and then plunging it into cold water.

It is a great help to make a set of cardboard templets, which will be found very useful in marking off the plates. Hard wood blocks should be made to flange all the boiler plates over, and frequent annealing will be necessary where there are awkward corners to go round, such as the throat plate and the firebox plates. So much has been said about flanging copper plates in previous numbers of THE MODEL ENGINEER that any remarks from me will be unnecessary, other than that the amateur boiler-maker will find most useful and practical hints in the No. 6 MODEL ENGINEER Handbook on "Boiler-Making."

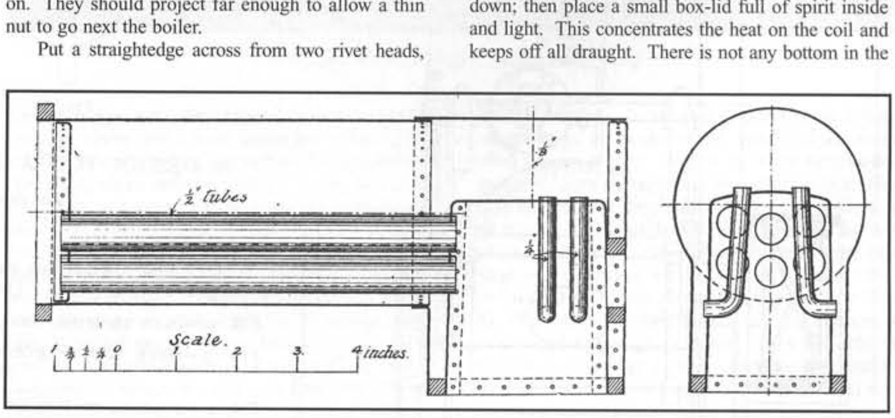
In my model, I spaced the rivets in the firebox ½ in. apart and then brazed it, but soft solder will do if well sweated in with a blowlamp; in that case, the rivets should be spaced ⅜ in. apart.

Before assembling the boiler plates it is most important to thoroughly clean all the edges that come in contact, and then carefully tin them so as not to leave the surface rough and lumpy. It is best to tin all the edges about ½ in. wide, so that a portion of the tinned part can be seen when the plates are riveted together. Of course, tinning is not required if you are going to braze - only a careful cleaning. It will be necessary to put one ⅛ in. brass wire stay, screwed at each end through the centre of the barrel, two in the front and back of firebox, which can also be of ⅛-in. wire, and four 3.16ths-in. stays on each side of firebox - all stays having nuts on both ends and being soldered. The four side stays are made stronger, so that they can be used as studs to bolt the side plates on. They should project far enough to allow a thin nut to go next the boiler.

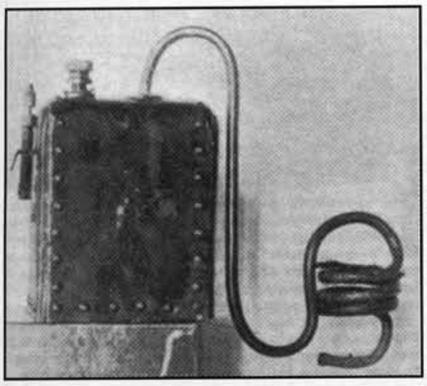
Put a straightedge across from two rivet heads, and then make your nut the same thickness; this will allow for a thin sheet of asbestos millboard to go between the side plates and the firebox, clearing the rivet heads. If this is not done, the side plates will rest only on the rivet heads. Leave the side studs long enough, as it is easy to cut them off afterwards. The side plates should be made of 3.32nds in. brass. Set the front tube plate far enough in the barrel to allow for a ¼-in. square brass ring being pinned to the outside to take the smokebox, which is made of 1-16th in. copper. It is made strongly, as it has to carry the front end of the boiler and the strain of the steering chains. The firebox tube plate is drilled 1-16th in. smaller than the tubes, and then reamed out with a taper reamer.

The tubes are turned to the same taper and tinned. Wipe off the solder with a cloth while it is in a liquid state so as to leave a smooth, thin coating. The front tube plate may be drilled to a good fit, so that the tubes will just pass through them. Both ends of the tubes must be tinned, also the face of the front and back tube plates; this will facilitate matters when sweating in the tubes. The four ¼ in. copper water tubes are L-shaped, and are taken from the sides of the firebox and up through the crown; these greatly help the circulation of the water, and also Act as stays. The firebox crown will only require one stay in the middle. The water tubes would be better brazed in, but soft solder will do if care is used not to run the water too low. A fire hole is more ornament than use in this case; but if it is dispensed with the firebox will require a couple more stays on that side. The chimney is of sheet copper, riveted; it tapers from 1 in. to ⅞ in. The cap and joint are brass castings. This boiler, if carefully made, will be quite safe to work at 30 lb. pressure.

The accompanying photograph of the paraffin blow-lamp will explain itself as to the bending of the coil. This is made from ¼ in. solid drawn copper tube, thoroughly annealed and bent round a 1-in. mandrel. The nozzle is made from a piece of very fine tube, about 1-40th in. bare. It can be bought at a watchmaker's; they use it for bushing clock spindles, etc. On the top side of the coil is a disc of ⅛ in. mesh iron wire gauze, lashed on with iron wire. The distance from the nozzle to the gauze is about 1 9.16ths in. The distance depends greatly upon the size of hole in nozzle; but it is quite easy to pull out or close up the coil a little until the proper distance is found. The vertical part of the pipe should be filled with a bunch of fine wires. These can be bought at a florist's. The oil tank is made from the same strength of copper as the boiler. It should be riveted, and all seams sweated with soft solder. A Lucas cycle valve is soldered into a short elbow, which is made from a piece of ⅜ in. square brass rod, turned down to ¼ in. where it enters the tank. This is put well down, so as to hide the valve as much as possible; the lamp works best at from 5 lbs. to 10 lbs. air pressure. The best method of lighting up is to procure an old round tin, about 2½ ins. diameter. Make some good sized holes near the bottom to admit air, and slot down the side to allow the pipe to pass down; then place a small box-lid full of spirit inside and light. This concentrates the heat on the coil and keeps off all draught. There is not any bottom in the



Boiler of Mr. F. J. Caparn's Model Steam Road Roller.



Oil Burner For Model Steam Roller

tender, as the tank has to be pushed up from the underside. In my case I stand the model on a piece of 11-in. plank, with a hole cut out under the tender and firebox; the wood is rested on some bricks at each end, so that the lamp may be passed up into position: it is hooked over the back of the tender; the lamp should not be filled much more than half full.

To make a snap headed punch for riveting, procure a piece of cast steel ¼ in. by 3 ins., countersink the end, then take an old bicycle ball the same diameter as rivet head, place it in a countersunk hole in a piece of scrap iron; now heat the punch to a good red, place the countersunk end on the ball and tap the other end with a hammer; this will leave a highly finished hollow, thin off the edges and temper to dark straw.

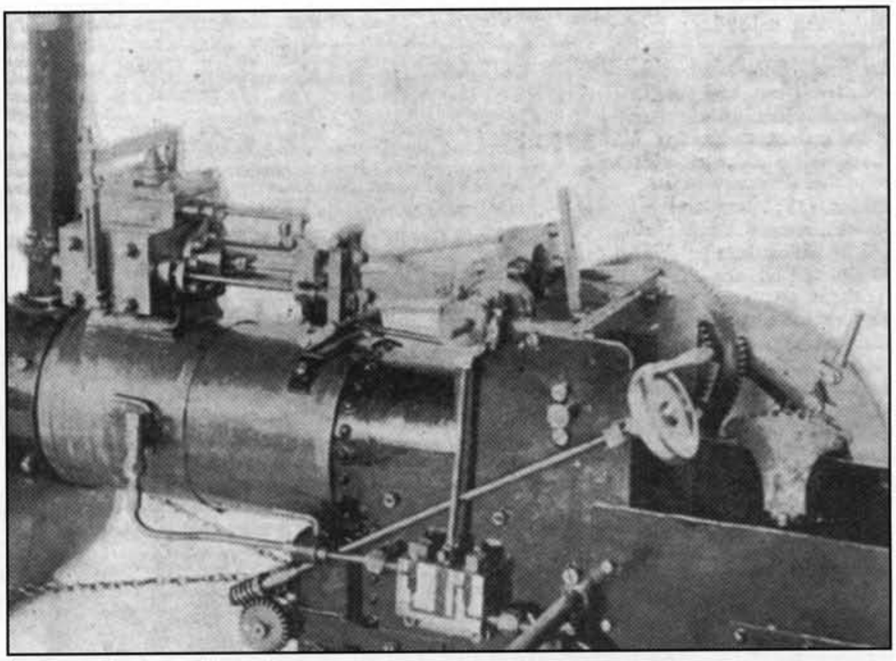
THE ENGINE.

The cylinder is steam jacketed, ⅞ in. bore, 1 ½ in. stroke. The jacketing is done in a very simple way. Bore the cylinder to take a piece of triblet brass tube ⅞ in. inside, this must be a nice fit, then chamber the hole to a distance of about 3-16th in. from each end, the chambering should be 3-32nds in. clearance between the liner and cylinder casting, then drill three ¼ in. holes close together in the underside of the casting, which will come opposite three similar holes in the boiler, to connect the boiler with the steam jacket, also drill two ¼ in. holes in the opposite side of the cylinder to connect the jacket with the top steam chest; the liner may now be sweated in. In the centre of the cover of this steam chest is fitted the seating of the spring balance safety valve, a suitable boss should be cast on for the purpose. The starting valve is also in this chest; it is made by drilling an L-shaped hole to connect it with the slide valve steam chest, a piece of brass is then made to slide over the hole exactly similar to a slide valve, except that it is not hollow.

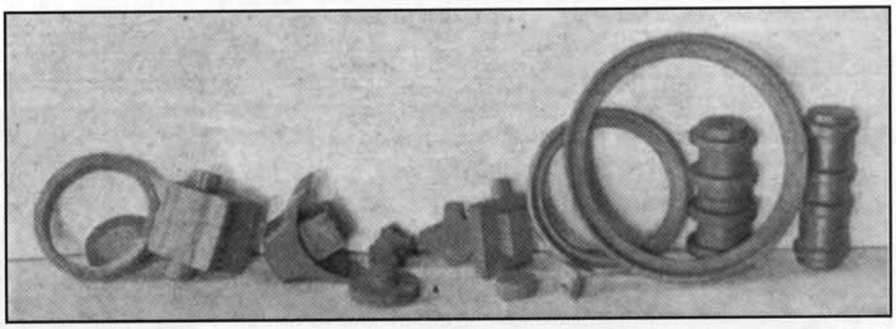
The saddle portion of the cylinder is ground out to a fit in the following manner: turn down a piece of soft wood to 2¾ ins. or ¼ in. less than the diameter of boiler barrel, glue a piece of carborundum or emery paper round the wood and when dry commence to grind out the saddle. If a little red lead mixed with lubricating oil be smeared on the boiler and the saddle tried on occasionally, the red lead will show where the grinding is most needed. Carborundum paper will do the work much quicker and better than emery and at very little more expense. It may be obtained from the Liverpool Castings Company.

The slide valve is of the ordinary D pattern, the travel of valve is 3-16ths in. the tap is 1-32nd in. Steam ports are 1-16th in. by 5-16ths in. diameter of valve spindle 5.64ths in. The valve spindle passes right through the steam chest and into the boss in the front end. This forms a good stay. There is also another stay just in front of the link motion. The valve spindle is screwed into a short piece of ¼ in. round steel. This is turned down to 3-16ths in. where it passes through the guide. The other end is filed out into a fork to take the brass block of the expansion link.

All the forgings are of mild steel. This is, if anything, easier to work than iron and takes a much better finish. The lifting links have a boss at each end. These I milled on with a hollow rose bit. I made this by drilling a hole up the centre of a piece of ½ in. round steel, the size of the boss I wished to have, then faced up the end, and filed it like a rose cutter. The reversing is done by the ordinary Stephenson link motion, the reversing lever being on the tender.



View Showing Machinery of Model Steam Road Roller.



Model Steam Roller–Some of the Patterns.

The crosshead guide is cylindrical; it is bored out and turned on the outside, then the sides are cut away to a distance of ⅜ in. from each end. The crank end is nicely rounded off, and the cylinder end screw-cut inside; the cylinder cover is also screw-cut to take it. It is necessary to screw-cut these threads, otherwise the slides will not be in alignment. The crosshead is turned to a nice fit in the guides; it is milled out on each side to take the connecting rod fork. This milling is done with the same kind of cutter as the one used to make the bosses, with the exception that a pin is fitted into the hole. This pin is made to fit the hole in the crosshead intended for the connecting rod pin.

The piston rod is made of silver steel 3-32nds in.; it is screwed tight into the crosshead, and the latter is turned when in place. The piston is also screwed on with a lock nut at the back, and turned in its place; the piston is turned to a tight fit, and ground in with grindstone dirt. to a sucking fit. There are two grooves in piston filled with lamp wick. It is not advisable to use piston rings in so small a model, as it is impossible to fit them well enough to be of any use.

The connecting-rod is made from ⅜ in. mild round steel. It is first jumped up a little at one end for the fork. This is done by heating for a short distance up, and hammering the end; then flatten out the centre of the rod, cut it off about ⅜ in. past the flattened part, heat that end, put the flat part in the vice, and hammer the end out to the required thickness; the parts not wanted can be easily dressed off with a Hacksaw, leaving the end T-shaped, and about ⅛ in thick in the cross-piece. The rod is then centred and turned, and the end faced up to receive the brasses; these are faced up and fastened to the connecting rod with two bolts, a strip of steel going outside to clamp all tight; then bore the hole for the crank-pin, mount on a mandrel, and face, up the sides, leaving a small collar on each side near the crank pin. This ensures the connecting rod brasses running clear of the crank webs.

The crankshaft is ¼ in. mild steel. The crank is built up and brazed.

In my case I made the shaft and crank-pin to drive tight into the webs, and dispensed with the pins. I held the two webs in a hand-vice, and drilled them both together; ¼ in. holes for both shaft and pin; then drove the shaft through, and set the webs to the right position, ¼ in. apart; then put in the crank-pin. If these drive in too easily, burr up the hole a little with the round end of a hammer. I then brazed and cut out the piece of shaft between the webs.

If the holes have been drilled the right distance apart the crank pin may do without further turning, but it is not much trouble to do this. The shaft will want cleaning up round the brazed parts and reducing at the main bearings to 3-16ths full. A small pinion is splined on to the end of the shaft and fitted with a forked lever for throwing the engine out of gear. ●

April 1898

An Ingenious Model.

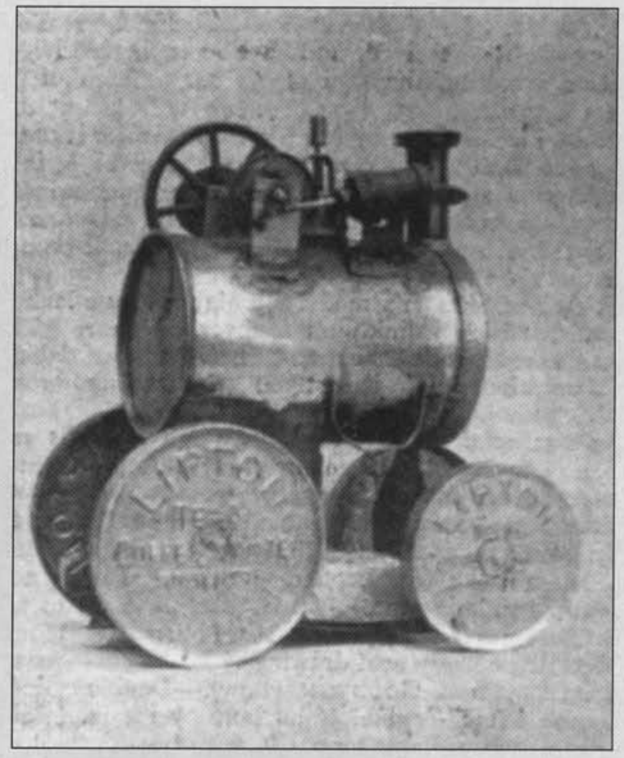
If ingenuity alone had been the deciding merit in this competition, the prize would undoubtedly have been carried off by Mr. G. Hayler, of Long Eaton, Derbyshire. This reader, in sending in his competition, writes:

" I beg to state that I am not able to draw the different parts, nor in a position to have it photographed, so I have taken the liberty of sending it to you for inspection, as I think you will be able to judge better from seeing the actual engine than from my description. I can produce plenty of evidence to show that it will work for about an hour without attention. The different parts are made with:

BOILER	¼ - lb coffee tin.
WHEELS	¼ and ½ lb. tin lids.
CHIMNEY	Umbrella top.
FLY-WHEEL	A toy wheel.
CRANK DISC	A metal polish tin lid.
STEAM PIPE	Indiarubber tube.

and also a knitting needle, bicycle spoke, piece of brass lamp, piece of gas piping, screw and stopper out of an oil tin, a cartridge end (the driving pulley), the end of a horsehair watch chain, and the spring from a tobacco pipe top. The cylinder I had given to me."

Although we have not had this model under steam, our inspection thereof gives us no reason to doubt its capacity for steady work, and we think the maker is entitled to no little praise for the ingenuity and patience he has displayed in constructing a working engine from such a homely and apparently incongruous collection of materials thought sufficiently well of his efforts to take a photograph of the model as received by us, and this we reproduce herewith for the benefit of our other readers.

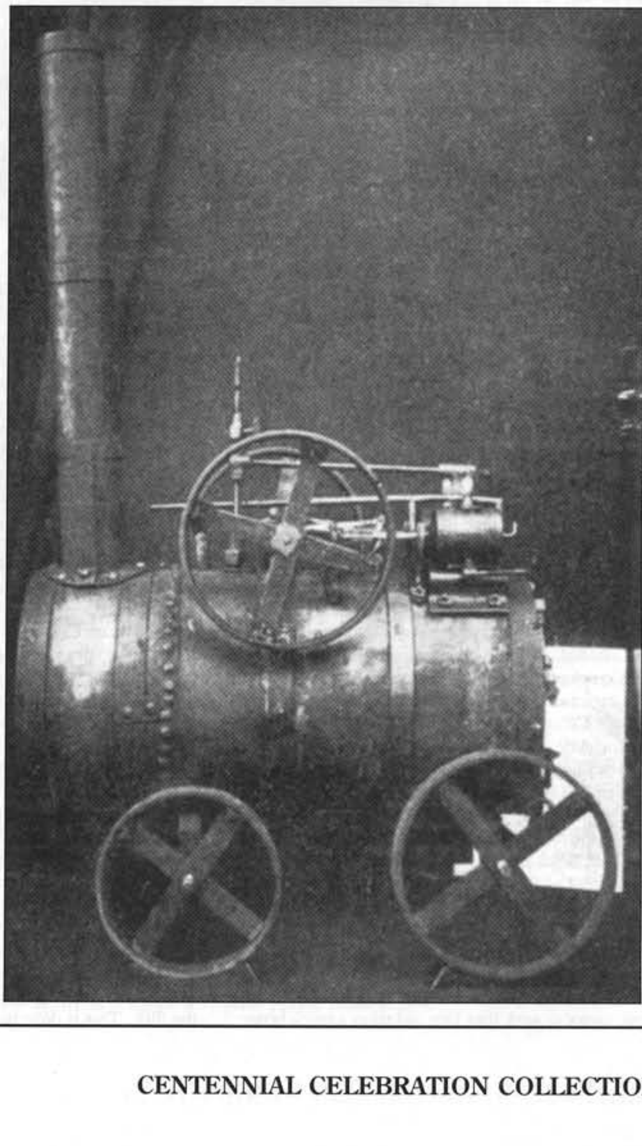


October 1 1901

Model Portable

In the case immediately adjoining Mr. Croall's model is what is perhaps the most remarkable model in the whole exhibition. It is a working model of a portable engine made from scrap metal by a native Burmese boy entirely without help and with the rudest and scantiest outfit of tools one can conceive. The model is exhibited by Messrs. Dübs & Co., the well-known locomotive builders, to whom it was sent by the gentlemen for whose inspection it was made. Perhaps the best idea of it's origin and construction may be gained from the letter which Messrs. Dübs received from Mr. C. E. Cardew, M.I.M.E., the loco. and carriage superintendent of the Burma railways Company, and which I venture to quote as follows: "I brought it home some four and a half years ago, and this is its history. It is a working model of a portable engine made by a Burmese weaver boy, about 18 years of age, living at Prom in Lower Burma. This boy gave it to me; he and his relations coming down one Sunday all in their best silks for the occasion! He wanted me to accept it as a proof that he was a fit subject for an apprenticeship in the railway workshops at Insein. I readily complied with his wish, and gave him the desire of his own and his parents' hearts".

"The boy, when he made the model, had never received the smallest mechanical training from anyone. Not only did he make the whole of it, but also several most ingenious tools of a rough nature for accomplishing the work, including a small ground lathe worked by a bow, the same as a Punjabi hand drill. He told me that he took ideas from portable engines he had seen in mills, modified by a study of our locomotive engines at Prom, and of the engines of river steamers on the Irawadi".



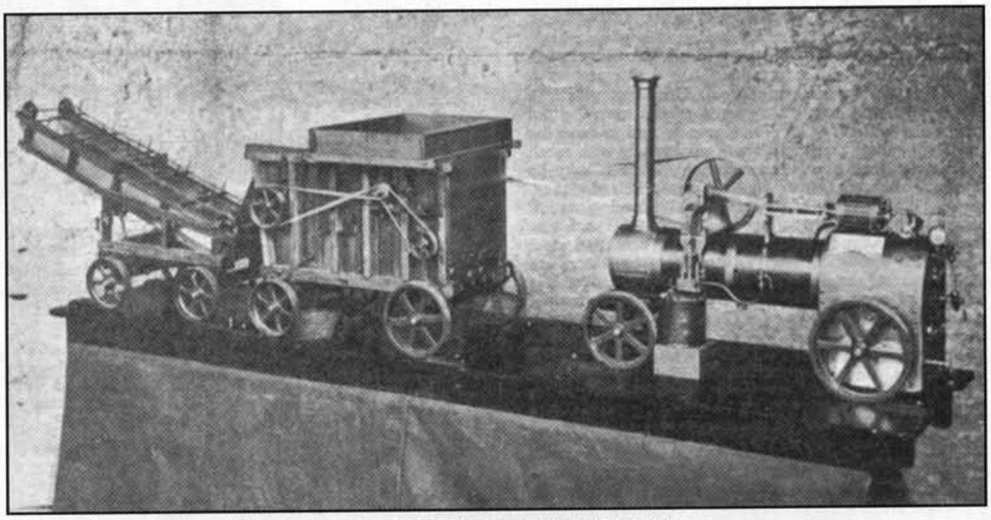
MODEL PORTABLE ENGINE MADE BY A BURMESE LAD AT 18 YEARS OF AGE.

January 29 1903

A Model Steam Threshing Plant. By T. Duddles.

The model threshing plant shown in the photograph reproduced herewith, was made practically from memory. It is twenty - eight years since I saw such a machine at work, and, to help me in constructing the model, I only had a guide to the external proportions some photographs taken from manufacturers' catalogues. The set consists of a portable steam engine, threshing drum, and straw elevator, and with the belts in place, the models occupy a space 6 ft long. The whole affair works splendidly and I have to run the engine at a very low pressure of steam, as it is much too powerful for the machines. The thresher will thresh ears of corn, but does not clear the chaff away so well as a real one, the fan, which is about to scale, being too small to be effective. As will be noticed in the photo, the engine has a single cylinder and is fitted with a pump working from the main shaft by an eccentric, a small tank being placed under it to hold the feed water. The boiler is fitted with a water gauge, steam gauge, and stop valve. To preserve the proper distance between the models whilst at work and the belts fixed, under all the wheels I have arranged scotches, which are secured to the table upon which the models stand.

This set is only one of many steam models I have made, and in a future issue I shall be glad if our editor would reserve space for a more complete description of my engines.



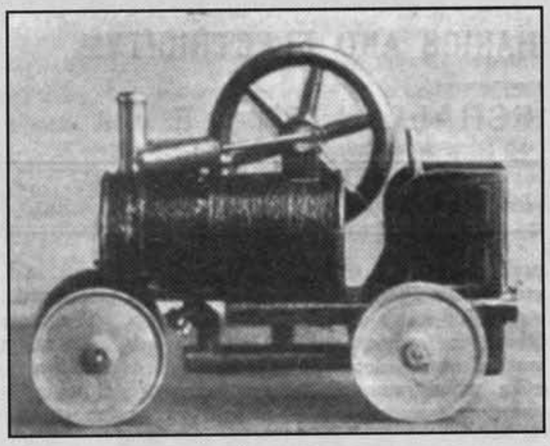
A MODEL STEAM THRESHING PLANT

March 19 1903

A First Attempt.

The model shown in the accompanying photo was made out of odds and ends by F. Thane, a lad living at St. Ives, Hunts, and works very well indeed. The boiler is made from a cocoa tin, and the crankshaft from ⅓ steel rod with a ⅛ in. brass webs. The cylinder, as will be seen, is an oscillating one, and the flywheel is a hand wheel from an old steam valve. The wheels were cast in lead (using some small wooden boxes as moulding boxes) and ordinary moulders sand, and are coupled to the crankshaft with a belt and pulleys, so that it will travel along a smooth table.

We thank our correspondent, Mr. E. A. Ebsworth, for sending on the photograph, and may say that we are always open to encourage beginners in model making in every possible way.

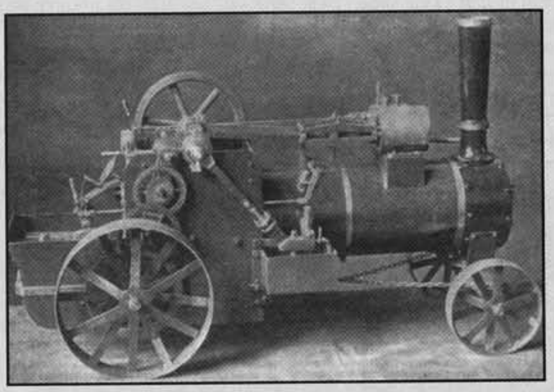


A BEGINNER'S MODEL STEAM ENGINE.

June 4 1903

A Model traction Engine made by Mr. T Duddles.

I tried to keep the cost down, and managed fairly well, considering I had no drawings or measurements, making each part as I reached it out of what stuff I had in hand. The cost was as follows:- 7/- for castings; 3/- for scrap metal, which I bought as a job lot from a dealer, and from which I made boiler, tender, horn plates, and all motion parts and bearings. The shafts cost 6d., and were cotton spindles and old paper tins. Sixpence was spent in purchasing the old Dutch clocks; the rivets ran away with another 2d, the screws being an assorted lot I bought in the Farringdon Road for 3d. I paid 1s. 2d. for an assorted parcel of old "printer's rule" (strip brass), from which I made the levers, connecting-rod, & c. Although I did not exceed the estimated price by much, no doubt some of our readers with plenty of scrap could do it much cheaper. The engine is not made to scale, but to suit material I had in hand. The chief dimensions are as follows:- Length of engine over all, 23 ins.



A MODEL TRACTION ENGINE MADE BY Mr. T. DUDDLES.

Outside firebox, 6½ ins. high, 5 ins. wide, 5 ins. long.
Inside firebox, 3¾ ins. high, 4⅞ ins. wide, 4½ ins. long.
Tender, 5¾ ins. long on top, 4 ins. deep.
Boiler barrel, 4¼ ins. diameter, 9½ ins. long.

Length of smokebox, 2¼ ins.
Height of Chimney, 6⅝ ins.
Horn Plates, 7¾ ins. high, 6 ins. wide.
Hind Road Wheels, 6¾ ins. diameter, 1½ ins. wide on rim.

March 23 1905

A Miniature Road Locomotive.

By Robt. W. Briggs.

The model traction engine and truck illustrated herewith, and which my father built, is driven by me in the country lanes in our neighbourhood. The engine was made about five years ago, and at that time I used to drive it entirely from the tender; but since then I have grown, so I sit on a seat on the front of the truck. I put my feet in the tender, and my sister sits behind in the truck; and with both on board the engine climbs all the hills about our place - and some are very steep. On the level roads I can go six miles an hour, and sometimes I take three or four children, and the engine draws them easily at three or four miles an hour. I can raise steam from cold water in about twenty minutes, and I use coal and coke for fuel, and have no difficulty in keeping up a full head of steam. The usual working pressure is 75 lbs. to the sq. in., but sometimes I have 80 or 90 when travelling over heavy roads or fields. The tank under the foot plate in the tender holds 1½ gallons of water, and a tank in the truck carries 2 gallons and as the engine uses about a gallon a mile, you will see that my sister and I can go three or four miles without stopping for water. Recently the engine ran six miles with three children, and brought back 4 gallons of petrol as well, and this was on a very stiff road.

Two speeds are fitted - one giving five miles an hour, and the other two and a half; link reversing gear is provided, and I usually run with the lever linked up a notch or two. All working parts have the usual lubricators, test cocks, &c., pressure and water gauges; the latter is now fixed at the side, as it was difficult to see when at the back of the boiler. The feed pump is always pumping, either into the boiler or back to the tank, and can be regulated so that it feeds as required.

The following are the leading dimensions:- Boiler, 3-16th mild steel, 25 ins. long by 7½ ins diameter.

MR. ROBT. W. BRIGGS' MINIATURE ROAD LOCOMOTIVE

Tubes, 20½ in. inside, solid drawn copper.
Firebox, 9 ins long by 7½ outside.
Cylinder, 3 ins. stroke by 2 ins bore.
Flywheel, 10 ins diameter.
Driving wheels, 20 ins diameter, mounted on ball bearings.
Leading Wheels, 10 ins. diameter, mounted on roller bearings operated by chain and worm gear, and spring mounted.
Length of engine over-all, 4ft.
Height to top of chimney, 2ft. 9 ins.
Width over-all, 2ft.

Power is transmitted by means of steel tooth gearing from the crankshaft to the countershaft, and then by a small sprocket wheel and roller chain to a large sprocket wheel keyed to the main shaft.

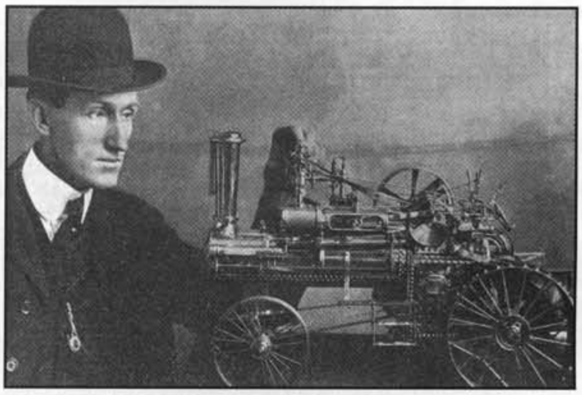
July 26 1906

An example or American Model Making.

In a well-equipped workshop at the rear of his premises in Braymer, Missouri, U.S.A., where Mr. S. M. Coffman carries on business as a jeweller and optician, the working model traction engine, of which a photograph is herewith reproduced, was built by him, the work occupying about ten months of his spare time.

The model is built to a scale of 1½ ins. to the foot or exactly one eighth full size of a 12 h.p. engine. It is interesting to note that the total number of parts for the complete model is 3.150 of which 882 pieces are contained in the two rear wheels, 41 in the differential gearing; there are 30 flue tubes, besides water and steam gauges, governor, safety valve, lubricators, pump and whistle. Many difficulties were experienced in it's construction, as numerous special tools had to be made. It is nearly all built-up work, the only castings employed being the three elbows in the steam pipe. One of the difficulties being that of procuring a glass tube 1-16th in diam. for the water gauge, this was, however, drawn out from a ¼ in. tube.

The engine that this represents is set to carry 130 lbs. pressure to the square inch. It would have been much easier to have made this steam gauge register 130 actual pounds to the square inch, but it was not desirable to carry such a high pressure on the model, so the registration was increased as many times as the size of the gauge was decreased, being one-eighth. This gauge is one



MR. S. M. COFFMAN AND HIS MODEL TRACTION ENGINE.

of the drawn-tube type and the tube is drawn very thin. The internal diameter is 1-1000th in. by 3-32nds in. and even then it was necessary to use compound rack and pinions, so when the gauge shows 130 there is 161/4 lbs. actual pressure and the pop valve acts. The differential piece of work, as the milling machine and wheel cutters to make all of the gears must be included in the time spent in construction of the model.

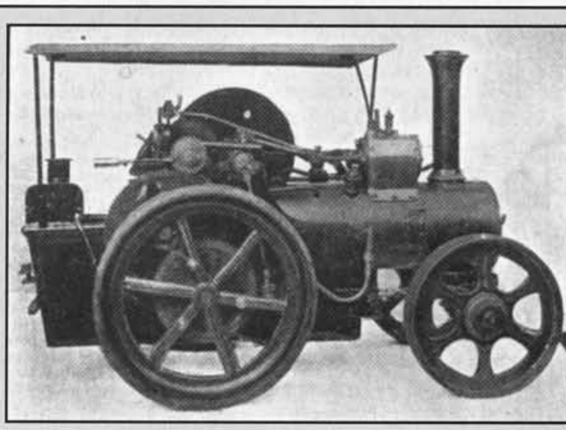
September 12 1907

A Model Traction Engine. By H. Stevens.

The model steam traction engine shown in the photographs is 18 ins. long overall, and about 14 ins. high to roof. The boiler is of copper tube of the usual pattern, fitted with three 1 in. tubes through barrel, and is fired with a spirit flare in the firebox. It is riveted and sweated and has been tested to 80 lbs. by the gauge. As in the real engines, the firebox sides extend upwards to receive the bearings.

To briefly describe the engine, the cylinder is a gun metal casting, 1 in. bore by 1½ in. stroke, slide-valve having about 3-16ths in. travel, steam ports 3-16ths in. (round), being chiselled out oblong at the valve face.

The crank is a steel forging turned up ¼ in. diameter. Reversing gear is by slip eccentric. The gearing was taken from old sewing machines and fitted in very satisfactorily, gearing down 14 to 1. This may appear very low, but the engine travels at a good rate and hauls well, the rear road wheels (cast iron) being 7 ins. diameter. The engine is fitted with throwing-out lever, regulator, and the usual fittings, including feed pump. I may add that the steering is affected by a worm gear, as in the originals.



A VIEW OF MR. H. STEVENS' MODEL TRACTION ENGINE

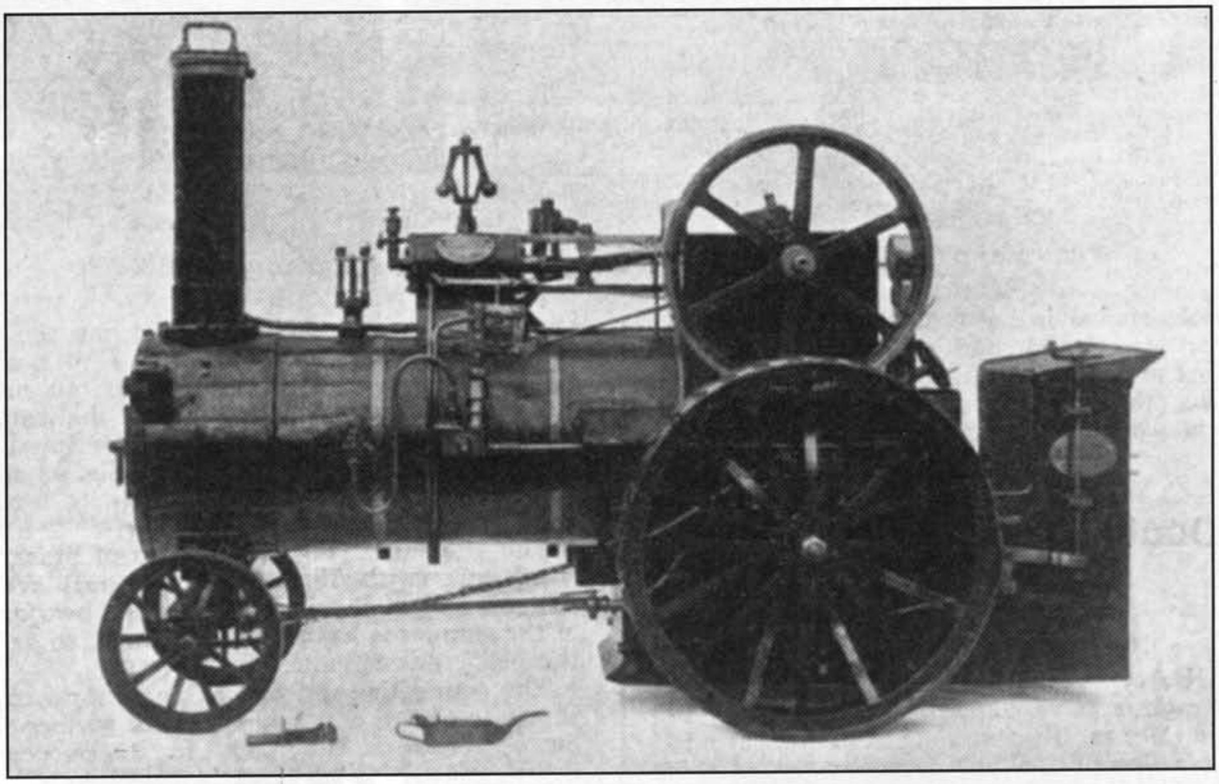
August 13 1908

A Model Traction Engine. By Stanley Francis.

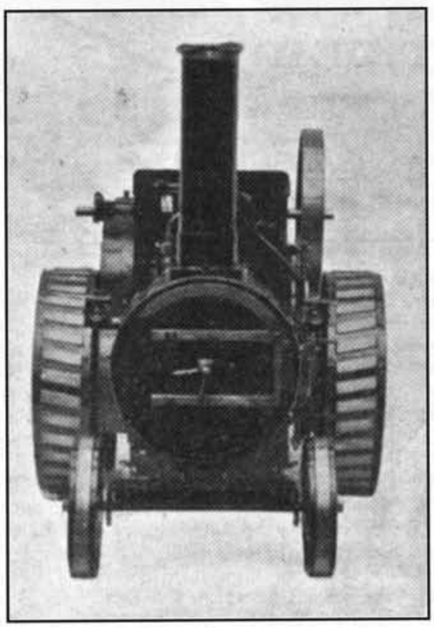
The following particulars of an exceptionally well made model traction engine will be read with interest by many readers, especially when they bear in mind that the builder is an apprentice engineer, only 17 years of age. The workmanship appears to denote a great skill and constructive ability.

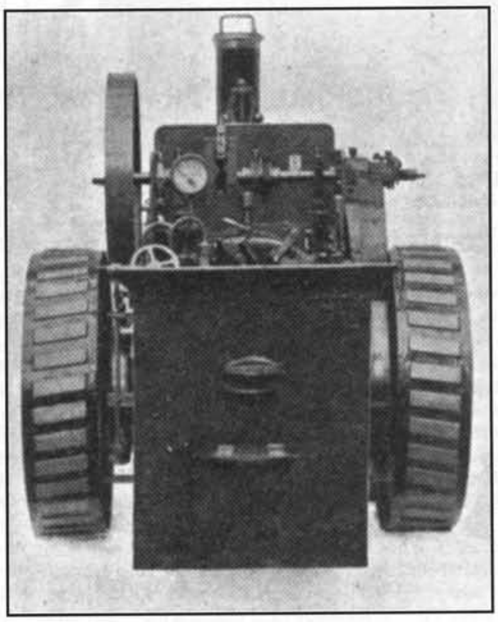
Barrel, 14 ins. by 5 ins. of sheet copper, full 1-16th in; one 2 in. tube runs through base of boiler to smokebox. Firebox is 6 ins. long, 7 in. high, and 5 ins. wide, and burns small lumps of coal very freely. There is a water tank under tender holding one pint of water which is kept hot by firebox and fed to boiler by a pump worked by eccentric on crankshaft. A screw-down valve cuts off water supply when boiler is full. Cylinder bore, 1 in. ; stroke, 1¾ ins. Driving wheels, 8 ins. diam. link reversing gear. Working pressure, 10 to 20 lbs. Length of engine, 2ft. 4 ins. Two 3-tap water gauges are fitted as well as two water and one steam cocks. Cylinder is lagged with copper and tightly packed with asbestos. The brake has seven blocks of wood on a steel band acting on a gun metal drum attached to axle.

The engine runs remarkably well and draws a truck laden with two bricks easily. All the turning was done on a 3½ in. gap-bed back-geared screw-cutting lathe, with overhead motion driven by a 3 h.p. Crossley gas engine, which also drives emery wheels a grindstone, circular saw (bench), etc.



MODEL TRACTION ENGINE "DREADNOUGHT," BY STANLEY FRANCIS



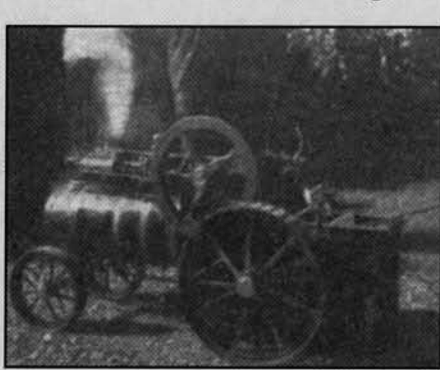


FRONT AND END VIEW OF MODEL TRACTION ENGINE "DREADNOUGHT"

September 5 1912

A Useful Model Traction Engine. To the Editor of the Model Engineer.

Dear Sir,- I enclose some photographs of a model traction engine I made recently; perhaps it may interest some of your readers. The engine has a cylinder 2 ins. diameter by 3 ins. stroke, and is built on the lines of Messrs. John Fowler & Co.'s road engines. In making the boiler I called in the assistance of the village blacksmith, who was particularly clever in working iron, and with his help I managed to flange all the plates in the same way as the large boilers are built. My friend the blacksmith had found that for small bent-iron work requiring welding and working up it only paid to use the best iron; he had tried ordinary grades and found that frequently just as he was finishing off a scroll of some intricate piece that it would break, and all his time be wasted. I procured some 1/8 in. charcoal iron for the plates and was able to flange them easily and make a good job of them. Drilling the holes for the rivets was a tedious job. I had only a breast drill, which I rigged up on a beam, hanging weights at the end, and in this way obtained the pressure required.



THE TRACTION ENGINE UNDER WAY

A GOOD LOAD.

The valve motion is made from tool steel and was very hard to file, but when finished the result was the most satisfactory. The road wheels are built up in the usual way, the cast iron bosses being cast round the spokes which were laid in the mould. The engine has correct steering gear worked from the foot plate; the firebox is 5 ins. by 5 ins. and burns coal splendidly. There is no difficulty keeping up steam, even when the feed pump is working and the engine dragging a good load.

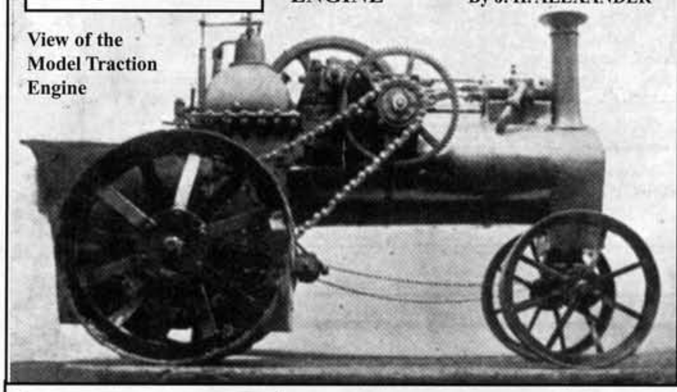
One of the photos shows the engine dragging a train of small carts, on which children are riding. This was at a bazaar, and caused great delight amongst the children. It travelled at a slow walking pace, with a load of ten children on the ordinary gravel path. The large road wheels are about 12 in. in diameter, and the whole engine is about 3ft. long; it has steam and water gauges, and the usual boiler mounting. I find at 40 lbs. pressure lagged, painted and lined, and looks quite smart.- Yours faithfully,
L. H. Sutton.

ANOTHER VIEW OF ENGINE

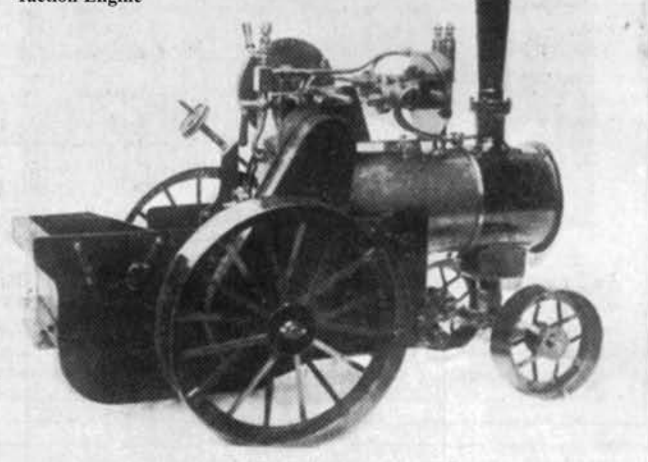
August 13 1914

A WORKING MODEL TRACTION ENGINE

By J. H. ALEXANDER



View of the Model Traction Engine



Side view of the Model Taction Engine

November 23 1922

A Model Traction Engine Built under Difficulties.

By Thos. S. Cooper.

I am giving a photograph of a small model traction engine which I have constructed during the past six months, while lying on my back in bed. Ever since my discharge from the R.A.F. in the Autumn of 1919 I have been confined to my bed, and one of the things which has greatly helped to preserve me from absolute boredom has been my weekly perusal of *THE MODEL ENGINEER.*

The photographs and descriptions of the models shown at the Exhibition early this year so fired my enthusiasm that I decided that bed or no bed I would make something - if only a mess! I purchased two nicely finished oscillating cylinders from Messrs. Bassett-Lowke, Ltd., and began to prepare the working drawings. When these were completed I got the necessary hand tools and materials (mostly scrap) together, and had a small Goodhall Pratt 0-3/8 bench hand drilling machine clamped to the near edge of my bedside table. I also had a small metal tray handy for the soldering work. The difficulties which I encountered were many and varied, but in spite of them all the engine continued to grow. The making of the road wheels, for instance, was a somewhat ticklish job. There are seventy-two parts in the four wheels, including tyres, spokes, inner and outer flanges, bushes, etc. These were all made up from sheet tin and brass strip and tube which was then soldered together to form the complete wheels. The chief dimensions of the finished engine are as follows:-Length over-all 15 ins., height to chimney top 12¼ ins., width over-all 8½ ins., road wheels (hind) 6 ins. diameter, 1⅜ in. tread. Road wheels (front) 3 ins. diameter, 1 in tread. Cylinders (oscillating twin) 7-16ths in. bore by 1¼. in. stroke, boiler diameter 3 ins., length 8¼ ins. Spirit-fired, fitted with twin spring-loaded safety valves pressed at 25 lbs. The model works well at this pressure and looks quite realistic when running with the panting exhaust issuing from the chimney. By moving the fork clutch fitted to the gears the model can be worked in a stationary position as in an up-to-date practice. Now I have found out what can be done in bed I shall certainly attempt something more ambitious in the near future. I will conclude by again mentioning the great amount of interest and help which I have derived from the pages of M.E during my illness and I sincerely wish it success.

January 11 1923

A Model Compound Steam Tractor.

By A. W. G. TUCKER.

The Tucker Tractor, as the smokebox name ring proclaims, is an interesting model and includes much of what was considered good practice of the day. It is fascinating reading, full of technical curiosities. The boiler has phosphor bronze castings for tubeplates and (dry) backhead. The cylinder block is also phosphor bronze with mild steel pistons and cast iron rings. The material for the liner is not recorded. The hornplates are made from cast steel. Other less common features include a smokebox superheater and a feedwater heater. Mr Tucker is not straight jacketed by the true to scale philosophy. Due to lack of space I must own up to having to omit some of the description, I hope readers will forgive me.

As an aside I like his observation that now he has bought a car ". upon which most, of my spare time is spent, either in the driving seat or else in the workshop making 'better parts' for it or attempting to 'improve' it in some other way or another". I wonder what Mr Tucker would make of today's car engines.

The model about to he described is the outcome of a desire that obtained a severe grip on the writer in 1900 when no facilities for model making were available to him, and consequently had to lay dormant for a very long time; it however all came back in 1918 when looking over the past issues of THE MODEL ENGINEER, I came across the description of Mr. Copus's model tractor in the issue for October 24, 1912. I had just finished an O-gauge high pressure tank locomotive, and had got rather fed up with the small details involved in the making of same, and that coupled with the mediocre success of the engine under steam made me decide to build to a much larger scale than that which obtains in a steam locomotive for 0 gauge.

An outline drawing of a Clayton and Shuttleworth tractor published some years ado in The Engineer was unearthed among my extensive files, and from the dimensions given a scale was made which enabled me to get the general proportion of the engine somewhere about correct, and the conclusions arrived at fixed the scale 2 ins. to the foot.

This gave me a size of driving wheel (the largest diameter on the job) that was capable of being turned in my 3.½ in. centre prewar pattern Drummond lathe. Another point about adopting 2 in. scale meant that 1/16-th- in. bolts represented ⅜ in. bolts to scale on the real engine, and one is enabled to keep most details strictly to scale.

The preliminary drawing I made dated March 25, 1918, agrees very closely with that of the engine in its present form, and if I might say so I am quite satisfied with the general proportions, and the kind judges at the last M.E. Exhibition apparently, had similar thoughts, and awarded me a silver medal for exhibiting "a representative model and for general excellence."

I am very much afraid it is my first and last silver medal though, as since the tractor was completed I have bought a car, upon which most of my spare time is spent, either in the driving seat or else in the workshop making "better parts " for it, or attempting to "improve" it one way or another. Some unkind friends call it tinkering.

The drawings which I have recently prepared were made from a folder full of workshop sketches, showing sundry details from which the engine was actually made, and have been prepared with a view of showing the maximum amount of detail in a minimum of space. Anyway, I think the drawings in conjunction with the photographs leave very little not fully illustrated.

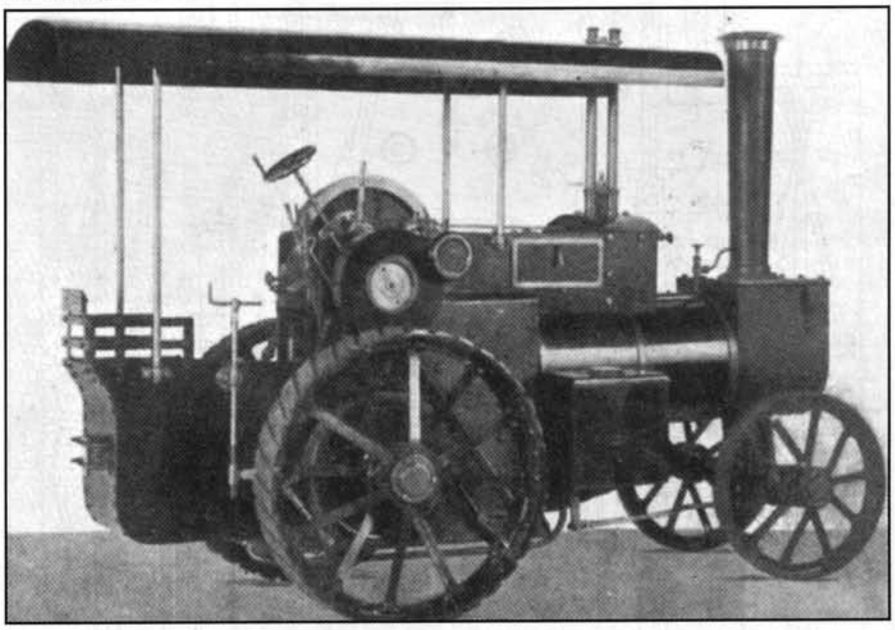
Like the gentleman who recently wrote to the M. E., " I agree that the best method of procedure when making a model of this description is to get on and get some part finished and running."

Accordingly the engine proper was the first thing tackled. With the design here adopted, which to the best of my knowledge is original, the engine would be completely finished off before the boiler was ever thought about, as the boiler top does not form the bed plate as in the prototype. This was a great advantage and simplified things considerably.

The crankshaft was the first detail taken in hand, and considering life was far too short to turn one out of a forging, it was built up out of silver steel, and boiler plate for the webs, milled the necessary keyways out by bolting it on the crossslide and a suitably ground twist drill in the lathe spindle. The crankshaft is fastened together in the usual way by force fits, pinning and sweating.

The side frames and bearings call for no special comment, except that the bearings are plain phosphor bronze bushings held in L rings and the seating slightly radiussed to make them self aligning.

The frames are made up of 1-16 -in. cast steel plate and extend from the front of the cylinders to the main frames carrying the back axle and tender.



Model 2-inch Scale Compound Steam Tractor

Inspection doors are fitted to the engine side frames in way of the link motion to facilitate assembling the valve gear and oiling. These are clipped on the bottom and a latch catch at the top, which cannot allow the doors to drop off. The doors are sheet brass, with another sheet brass edging soldered on and polished up, the centres being painted.

The cylinders are made from a plain phosphor-bronze block. The H.P. cylinder 1.1-16 in. bore, and L.P. 1.⅛ ins. with a stroke of 1.⅜ ins. There are numerous drillings in the cylinder block to form the various ports and passages.

The steam and exhaust pipes are connected by flanges on the underside of the block.

The H.P. cylinder is jacketed with H.P. steam on its way up to the regulator, and safety valve chest which is bolted to the top of the cylinder block.

The regulator valve is of the plain slide valve type with the valve held on its face by a phosphor bronze leaf spring riveted to the cover.

The safety valves are double column Ramsbottom type, the valves being made from ¼ in. bronze balls and the seatings are brought up to a sharp knife edge.

The spring being in compression makes it a very simple matter to adjust the blowing off pressure. The escape pipes are polished brass tubes and run right up through the canopy.

The slide valve chests are made separately with loose covers, and all the steam ports are milled.

The slide valves are made from nickel bronze in two pieces, a rectangular washer being cut out to required dimensions, and a thin backplate silver-soldered on. These are held up to their seats also by phosphor bronze leaf springs and are driven by buckles from the valve spindles, the H.P. ports, being 3/8 in. deep and the L.P. 5/16th in.

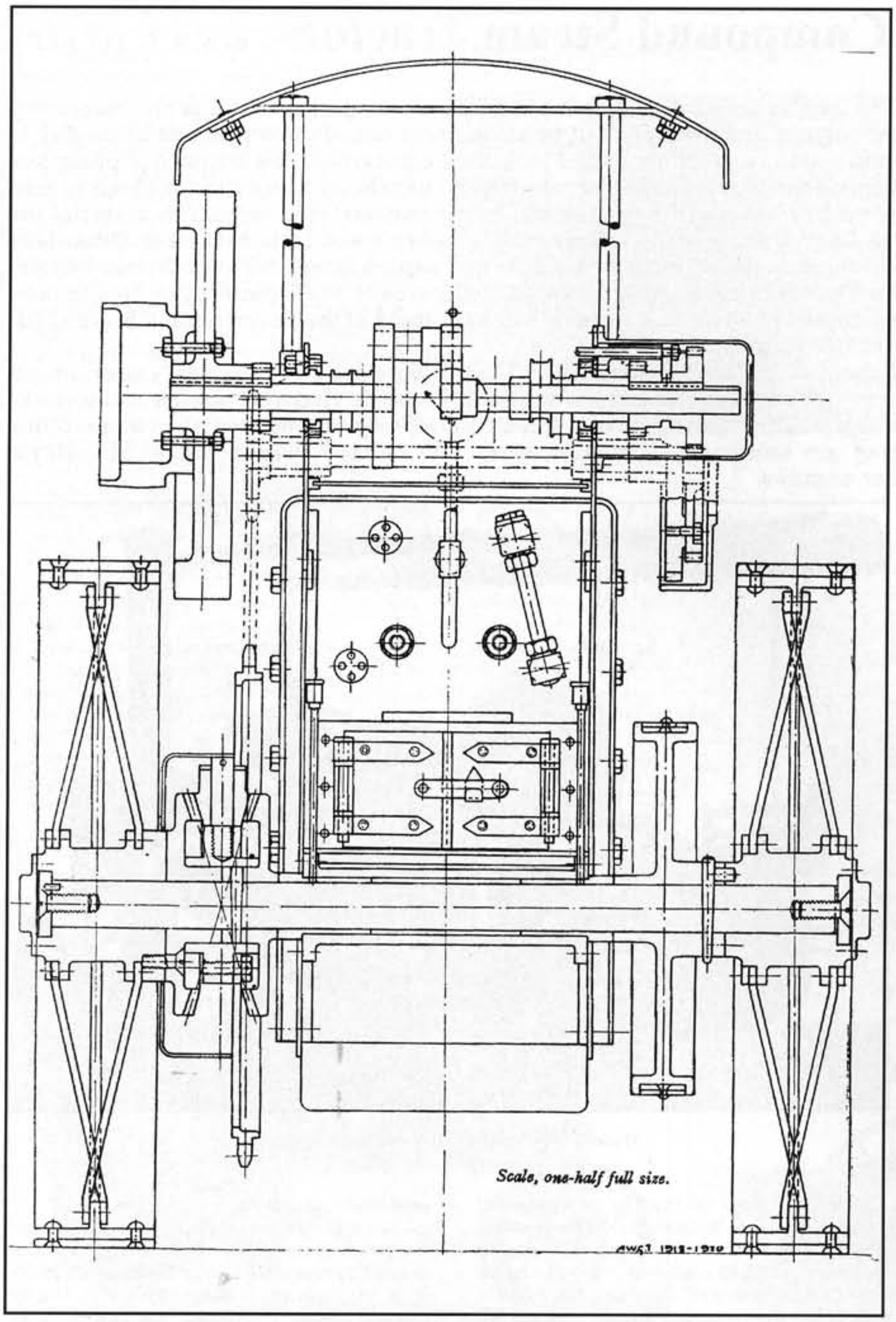
The pistons are built up in three portions, made of mild steel fitted with two castiron piston rings. They are secured to the piston rods by forced fits and taper pins put in half and half.

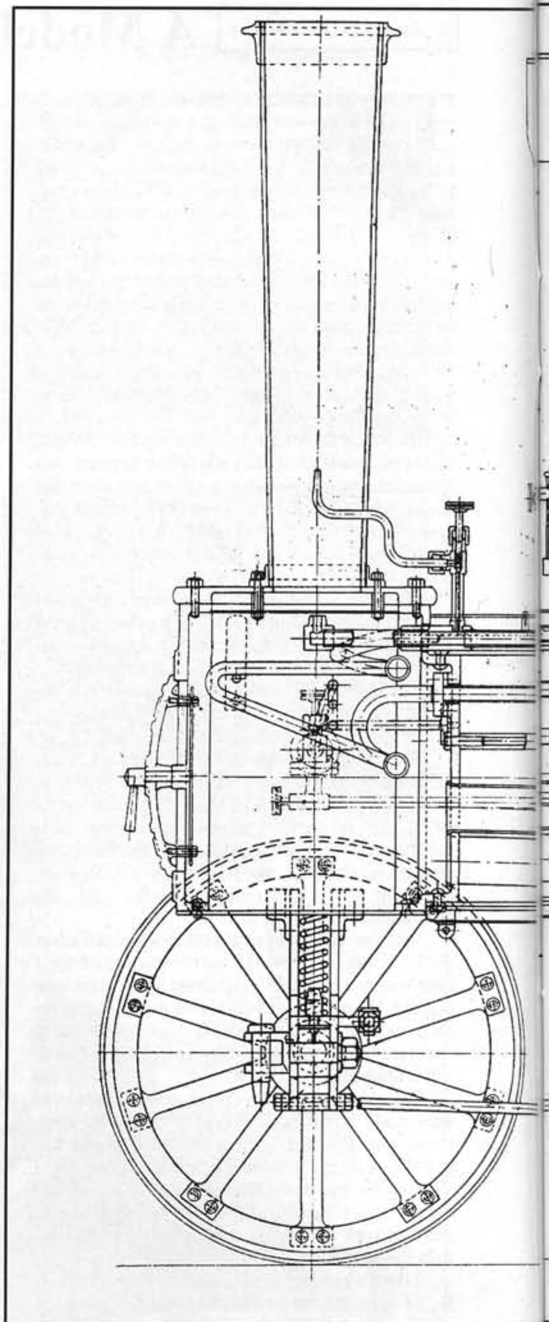
The front cylinder covers are spigoted in to a counterbore turned at the same time as the cylinders were being bored, and are held in place by the bolts on the circular flanged guides, which are in turn spigoted on to the cylinder covers. This eliminated considerable trouble which is frequently experienced when attempting to line up slide bars of the usual type.

The crossheads were machined from mild steel the slots for the connecting rods being milled out in the usual way on the lathe.

For oiling the cylinders a priming plug is fitted on the top of the casing which covers over the cylinders, and also a Roscoe type lubricator which communicates to the passage from the regulator, valve down to the H.P. steam chest.

A bypass valve is also fitted to pass H. P. steam





Rear Sectional Elevation of Model 2-inch Scale Compound Steam Tractor.

from the H. P. chest into the L.P. chest; this is not controlled from the footplate however.

The back cylinder cover is made from plain sheet brass in one piece, and in the centre of each cylinder bore a collar stud is fitted, on which is screwed polished mild steel dummy cylinder cover casings which hold on the casing plate, and give a very neat appearance to the front end of the cylinders. The valve spindles work in one long guide. Again aligning troubles were eliminated by adopting this form of construction. The valve gear is the ordinary Stephenson pattern, eccentrics being 13-16-th-in. diameter and ¼-in. wide. Great care was taken to get the eccentric rods exactly the same length and also the setting of the sheaves. The care taken was amply rewarded when the engine was first tested; under steam the engine could be throttled down to run in either direction at 70 r.p.m. and would run when linked up, to within 1-32nd in. either side of the neutral slot on the reversing quadrant; results which I had never even thought would be possible of attainment.

The valve gear has worn very well, considering the running the engine has done. The link motion is all cut from cast steel and oil hardened, as are also all the pins. The following are details of the valve settings adopted:

	H. P.	L. P.
Lap	1/32	1/64
Lead	1/100	1/100
Angle of advance	19°	11½°
Travel, 17164 in.	Ports, ⅛ in. wide.	

The reversing shaft is made from silver steel, and the three levers were made a tight fit on the shaft, and then silver-soldered to the correct position, and the ends of the shaft are carried in two bearings attached to the side frames. The reversing quadrant is suitably notched and is fitted with a trigger handle, the motion of the lever is arranged so that when the engine is going forward the lever is forward.

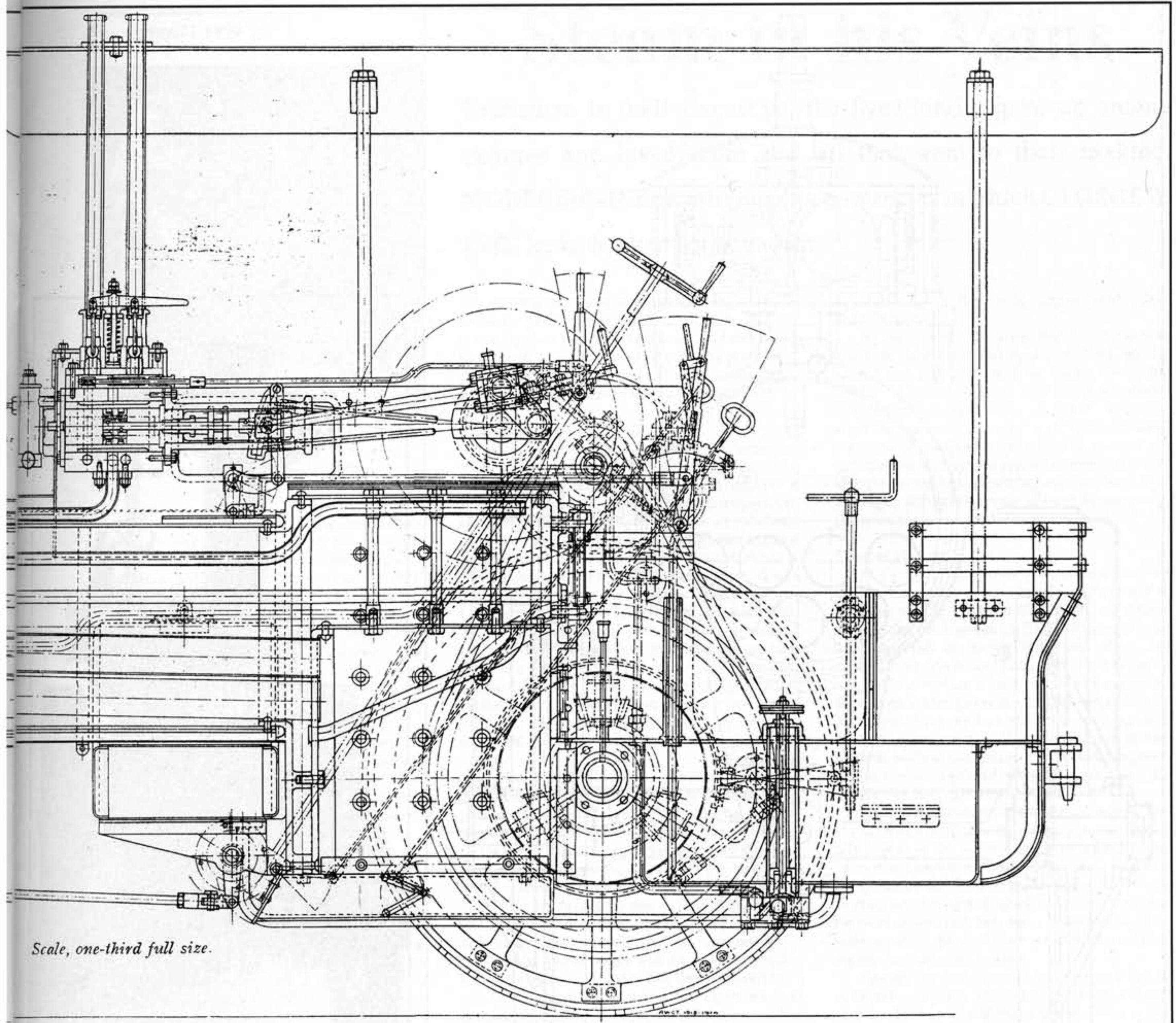
The connecting rods are built up marine pattern. The rods were made from ¼ - in. by ⅛- in. thick mild steel tapered down, and the tee end was screwed on to the end and riveted over, and the whole silver-soldered; the connecting rod bolts being 3-32nd in. diameter.

All the motion is fitted with small oil cups and leads from the cups to the bearings when they cannot conveniently be fixed on the parts to be lubricated. Needless to say, the oiling is not neglected when the engine is running, as the job has been delegated to the younger member of the family who never shirks his duties where oil cans are concerned.

Two gear ratios are fitted to give the engine two speeds, and a neutral position in between. The ratios between the crankshaft and driving wheel shaft being 8 to 1 and 14.2 to 1. This gives road speeds equal to 2 and 3½ m.p.h. with the engine running at 1,000 r.p.m.

The whole of the gearing was cut with 18 D.P. cutters. This was beyond my capacity and had to be put out.

The sliding pinion is housed in a brass casing



Side Elevation of a Model Compound Steam Tactor, Built to a Scale of 2 Inches to the foot, by A. W. G.

with control lever mounted on a small bracket formed inside of it, the gearshift lever working on a quadrant and the position maintained by a loose pin.

The wheels on the first motion shaft are similarly cased, and the shaft is on the main engine side frames, to which is also attached the handreversing lever.

Under the whole of the motion an undershield is fitted to prevent oil and water dripping on to the boiler, and assists considerably in keeping the engine clean.

The flywheel is 5½ in. diameter C.I., with polished rim, and a belt pulley is fitted for driving stationary models.

It will thus be clear that the whole engine can be absolutely finished off and tested before anything in connection with the boiler is put in hand.

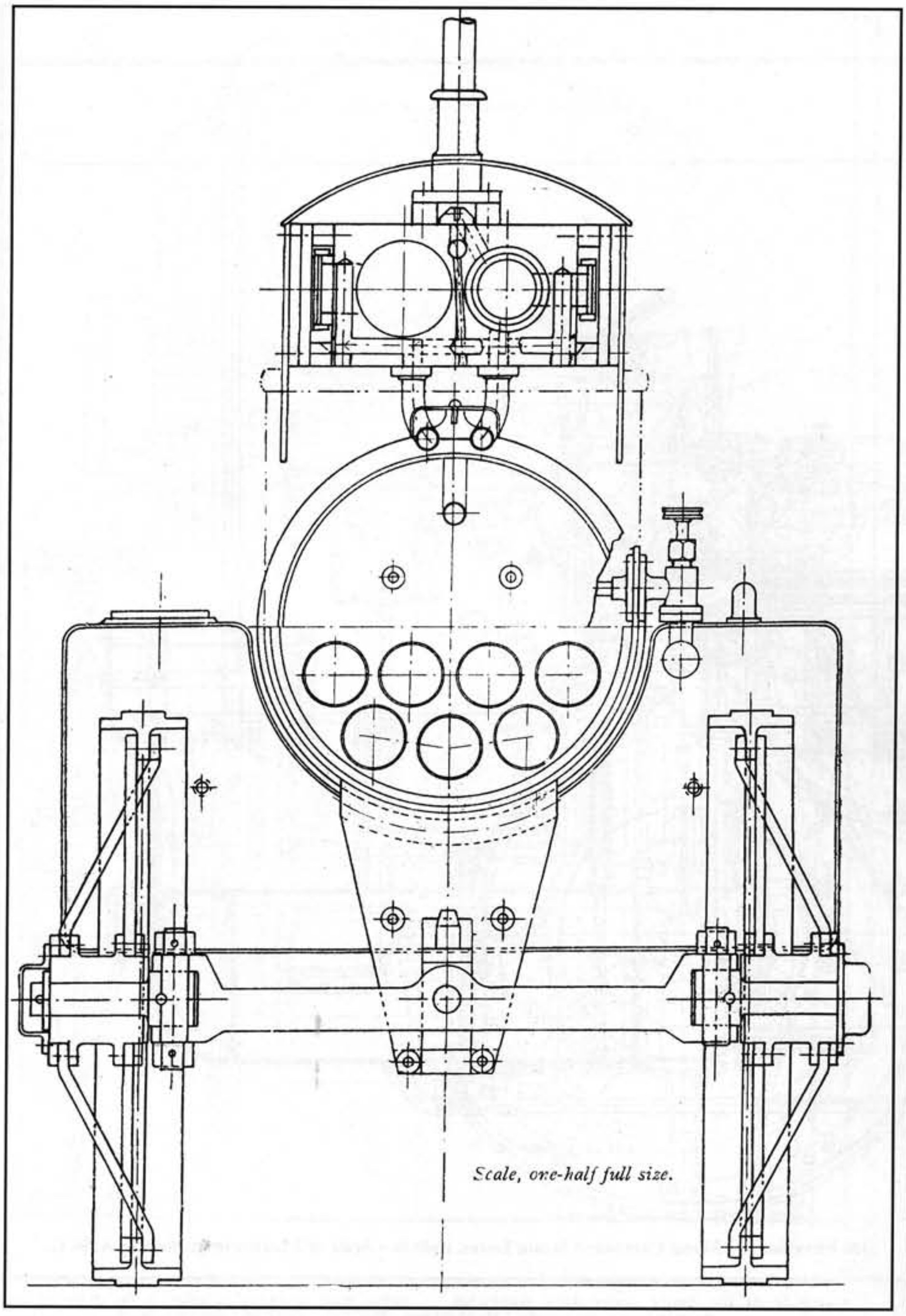
After the engine was tested under steam, the results being so good, gave me considerable encouragement to go ahead with what proved, without doubt the largest part of the undertaking, namely, the boiler.

This, I am afraid, did not get put through in the same expeditious way in which the engine was, as the magnitude of the boiler undertaking somewhat appalled me; the more I thought about it the worse it appeared. The boiler is built from 1-16 -in. thick copper plates, together with ⅛ in. thick phosphor-bronze castings for the tube plates, etc. This, I think, was the most simple way of building a locomotive boiler of this pattern. A Belpaire firebox was embodied in the design to simplify the staying as far as possible. The shell was bent from flat plate and a butt strap fitted on the underside. The outer wrapper for the firebox was similarly bent, as also was the firebox plate. Seven very thin 11-16th- in. bore tubes form the fire tubes.

The heating surface was further augmented with four ¼-in. water tubes, which are fitted in the firebox and come from just under the main tubes to the back end of the firebox. The riveting throughout was made full strength, ⅛ -in. rivets, ⅜-in. pitch, but in addition all the joints where accessible are silver-soldered, the exceptions being the joints on the outer wrapper plate, along the foundation ring and round the back of the firebox wrapper plate. The boiler is designed to burn solid fuel, and from my experience with this engine there is nothing to equal it; only one gets rather busy supplying its wants in the shape of coal and water, and I used to think that the coal would have to be fed in scale model lumps, but I have found that these were quickly ejected up the chimney and the larger the lump put in the longer it lasts, which is quite a point with solid fuel boilers.

The staying of the Belpaire firebox was carried out by a method I have not seen described before. I wanted everything in the inner firebox silver-soldered, and I could not see how the stays were going to be so treated if the staying was carried out in the usual manner.

Tubular distance pieces made of ¼-in. brass rod tapped up each end were prepared, and a stud fitted to the end adjacent to the inner firebox. These were all secured to the inner firebox, nuts put on, and each one silver-soldered on from the water side. The two units, the outer one consisting of the smokebox tubeplate, shell, throatplate, and outer firebox wrapper; the inner one consisting of the firetubes, firebox, complete with backplate and foundation ring was then assembled and the stays faired up until they coincided with the holes previously drilled in the outer fire-



Part Sectional End Elevation of Model Compound Steam Tractor

A Front View of the Tucker Tractor

box wrapper. Studs were then screwed in from the outside and nuts fitted on, and the ends caulked with soft solder. The boiler was tested to 200 lbs per sq. in., and beyond a few slight weeps through the joints that were caulked with soft solder nothing untoward has happened except when a friend of mine who acted as temporary stoker made up such a huge fire that the steam was being generated at such an enormous rate that it could not get away fast enough via the engine and safety valves, so that the gauge glass burst and did the necessary relieving, but not before some of the soft solder on the firebox wrapper melted, and the top of the wrapper plate bulged out 1/16 in. between the stays. The steam gauge pointer was also trying hard to go round a second time, but the zero stop prevented it from doing so.

A hairpin superheater is fitted in the Garrett type smokebox as also is a feed heater. The superheater is arranged well above the fire tubes, so that these can easily be kept clean. The reason for adopting the Garrett smokebox was that it gave plenty of space in which to put the superheater, and it also simplified the manufacture of the chimney base in no uncertain way.

It will also provide an easy means for attaching a dynamo bracket on, when that useful fitment is added. A large steam space was provided above the firebox by raising the outer firebox roof.

The boiler fittings consist of a water gauge with a 7-32nd-in. outside diameter glass tube, which gives very reliable readings, a 3/4-in. pressure gauge, water blowoff cock, and steam blowoff cock. The feed check valve is bolted to the side of the smokebox, and is fitted with a screwdown spindle, and a small needle valve to bypass the water to the atmosphere to test the working of the pump. A blower valve is also provided just behind the chimney, this is an essential fitting on a coal fired boiler.

The fire doors are hinged in the usual manner and the bottom of the footplate is arranged to be on a level with the bottom of the firehole door, so that any fuel spilt on the footplate can easily be brushed into the firebox. This, of course, allows a slight air leak, but not so much as there would be with having fire doors that could not be closed due to coal getting jammed in the way.

I also found it necessary to add a further safety valve direct on the back of the firebox. The boiler makes so much steam that the safety valves provided on top of the cylinders were quite incapable of carrying off the surplus steam generated without a large rise in pressure. This valve is set to blow off at 120 lbs. per sq. in. and main valves being set to relieve at 100 lbs. per sq. in.●

May 21 1959

Steam in his Veins

Craftsmen to their fingertips, the Eves family grew up among engines and loved them and all that went to their making. MODEL ENGINEER introduces a new series in which GEORGE W. EVES looks back to his boyhood.

Arthur Eves with the oil feeder of the Fowler traction engine built by the three Eves brothers. It was shown at the ME Exhibition 1923

It might well have been the opening shot of some mighty movie epic such as we are all so familiar with these days' except for the fact that epics were the exception rather than the rule way back in 1921. The scene was an old English garden in autumn, where the last roses were shedding their petals and huge sunflowers looked down on flower borders long past their summer glory. On all sides there were golds, russets and deep reds... those lovely colours that so few artists have ever recaptured. Along a red bricked path through this colourful scene, slowly moved a tall grey-headed gentleman of charming mien. His footsteps were heavy, his shoulders sagged under an invisible burden, and in his clear grey eyes, lurked a great sorrow. For he still mourned the loss of an only son whose promising career was suddenly ended during the tragic campaign in the Dardenelles.

Dramatic moment

Hard in the wake of this elderly man, trailed a crocodile in the form of we three brothers, Arthur the eldest, Fred next, with me the youngest bringing up the rear. We shuttled to a halt before a low brick building, where Virginia creeper covered the old pantiled roof and hung low over the windows. It was some minutes before the door responded to the key, and a hefty shove was required to swing it inwards. Curiously we followed our leader inside and stood there in silence.

A great movie—did I say? Yes, it was just that. I saw what once upon a time must have been a well equipped workshop. Now alas it was sad to behold, for everywhere was dust and decay. In the windows energetic spiders had woven masterpieces in silk. Neat racks ranged along the walls filled with spanners, screwdrivers, files and all the bits and pieces we model engineers slowly but surely gather about us, and our greatest enemy, rust, was in complete mastery.

Unmistakable signs

The long bench was neat and tidy despite the dust, but the vice was such that one dare not touch it, lest it crumbled. Over the bench drill, some shreds of material tried in vain to hide the ravages of Time. A portable forge ranged along the far wall, its water-tank bone, dry, and yet, on the cindered hearth reposed the tools of that ancient calling in neat and orderly array. Wherever I looked, I saw unmistakable signs that this, several years ago, had been the home of an eager model engineer. The last item to arrest my wandering eyes was a small pile of rubbish swept up under the vice, and beside it ready and waiting, the humble yet so essential workshop broom.

It seemed that we stood there for a long time in complete silence, each waiting for the other to speak. The reverent attitude of the old gentleman forbade us to do so. Then at last, without a word, he shuffled across the floor to a large cupboard. The door yielded unwillingly to emit a cloud of dust. He stood back from it for a few moments, and then dragged out a traction engine boiler, and a fair sized one at that.

The bits and pieces

For a second time only his rear was visible, but when he backed out again he had the bare bones of a tender obviously meant for the boiler. Then from a shelf he took down the chimney barrel, a roughed-out crankshaft, a front wheel, and lastly, a rare old chunk of metal which I could see was the cylinder casting. We looked down, on those pathetic bits and pieces. It was all that remained of a shattered dream. It was some minutes before that aged voice told us in broken, hesitant words how his son set his mind on building a 3 in. scale model of the Fowler agricultural engine, which used to pull the threshing machine round the parish, of his failure to obtain drawings, and how, urged on by that great something all model engineers are familiar with, yet for which there are no words, he had set about the task with only the original at odd intervals to work from.

Who wouldn't ?

There was pride in his narrative: "But he made good progress as you can see," indicating the boiler at his feet, and then half caressing the cylinder casting on the bench. " and he made the pattern for this himself." To ease the tension, I picked up the dusty front wheel to see how it was made, and over my shoulder I heard: "... he made those rims in here on that forge," and I could see the pounding bellows, flying sparks. and resounding clangour on the now rusty anvil.

"He had a bit of bother with the crankshaft," continued the voice.

And who among us would not appreciate that understatement after a first attempt? "Spent all his spare time out here, he did, and then came the war." I saw the light drain from the old chap's eyes. With an effort came the whispered words: "and he never came back."

I suppose there are words for such occasions as this, but I, a mere apprentice at a small country engineer's shop, had neither the education nor the words for such a moment. Arthur, then a blacksmith's mate and Fred, just picking up a living as a farm handyman after war service in the Royal Flying Corps, were no better placed than I. To my great relief, Arthur finally managed to tell the old gentleman how he had heard of this unfinished traction engine from many sources. But his halting words were cut short. The bits and pieces were all but given us. For what had once been cause for pride and joy, Time had turned into something unbearable.

Half-an-hour later, we filed out through the front gate. Arthur had the boiler wrapped in a sack on his shoulder, Fred had the cylinder and front wheel, leaving me to manage the chimney and crankshaft. To the railway station was a "tidy step," and our loads changed hands many times before we dumped our burdens on the station platform seat. Our timing was purest luck, for in a few minutes the little branch line train fussed to a standstill, two carriages and a tiny tank engine sandwiched between them.

As we heaved our loads into a compartment which in those days had hard perforated wooden seats, I was amused to hear the engine driver, and fireman in heated argument with the stationmaster-cum-porter-cum-signalman-cum-ticket collector, about the merits of "Gradus" and "Quite Content" peas. The journey home was full of incident, if you were the sort with eyes to see. We dropped off empty milk churns and took aboard full ones, and the skill of the porters rolling two churns along at the same time, was good value to any boy.

The "workshop"

At the top of our garden stood a black shed. We called it our workshop, but it hardly qualified for that. Our tools were few. We had neither lathe nor drilling machine and the floor was earth. These were the small beginnings that the grocer from next village had inspired in us. Mr Waller used to call at our house for orders. He arrived on a four cylinder FM motor-bike which, I remember, had an accumulator strapped on the rear carrier. After our first visit to his well equipped workshop with its new Drummond lathe, drilling machine, loads of materials needed in model engineering, and with models of all descriptions lining the shelves, our imaginations were fired.

From him we bought a vertical steam engine, 2 in. x 3 in., with a vertical boiler to supply it, and it didn't take long to set the whole plant up on a bench. What better after a day's work, than to repair to our workshop and get steam up? With 60 on the gauge, safety valve sizzling, the clicking ball valves in the clack boxes and the smell of warm oil, here was a haven indeed! If the night was chilly the small stove would be lit, a red glow coming from the mica window.

Already we had removed the dust and flaking paint from our newly acquired engine parts, and now they stood before us a challenge if ever there was one. I felt that something of the engine's beginnings had travelled with it, inasmuch as it was in just such another village as ours that a man had started to build it, without drawings or even a picture. If he could not get blueprints, we thought, it was useless for us to try. Those were days when no one ever ventured beyond his station in life, and ours were indeed humble.

Craftsmen all

Even had drawings been available, I doubt whether any of us would have made much of them. Arthur's smithy never had any. The blacksmiths there, great big fellows with fierce bristling beards, clad in tattered leather aprons, used rusty old tin templates which looked as though they had been handed down through countless generations. Yet their fireboxes went together like gloves, and like anything and everything they made which held either water or steam, they never leaked.

The same standards were applied in the adjacent fitter's shop. From casting to finished product it was an acquired sense of workmanship. Files were the chief tools of the trade and using them was an art which achieved results on a par with today's machines. I have seen a slide valve stuck to a surface plate, the latter as much as two burly men could lift, with only the merest trace of oil between them.

May 21 1959

The central figure in this picture is the writer as a youth. His brother Arhur is seen on the left, and a nephew is behind the wheel.

Work on the traction engine goes ahead. In this instalment GEORGE W. EVES catches the youthful exhilaration of making his first sound casting.

Redeeming bad workmanship with beer was a rare occurrence. Nevertheless we apprentices longed for it to happen, as it meant a bottle of lemonade apiece and little work the rest of the day. It meant also unmerciful leg-pulling—and heaven help the unfortunate one if he lost his temper. In a jiffy he would be hanging by his ankles from one of the roof beams until he apologised—and that meant another gallon of beer all round !

Despite all this frivolity, few today can match these men for pride of workmanship. On the outer fringes of this environment, where drawings other than rough sketches were unknown, and where the eye's ability was the criterion on all things, be it rod, framework, pillar or wheel, our model first took shape. Today, purists would pour scorn upon such ideas.

So you see, if our engine was to be finished it would have to be built along these controversial lines. Besides, we argued, if its creator started thus, why not we ? It was a challenge we had to accept. Our first move, obviously, was castings. By this time I had passed through carpenter's shop, and fitter's shop, and was now in the foundry, so though not in the upper grade of brass moulders, I had nevertheless got the idea.

Our decision to build a brass furnace at the top of the garden brought doubtful looks to the eyes of my parents, who visualised another such monster as we had at the works. On dark nights this lit the sky with a lurid glow with showers of man-sized sparks flung upwards and outwards, to the great peril of our chicken houses and apple sheds.

First there were patterns to make, like piston, cylinder covers, glands, etc. Having served one never-to-be-forgotten year in the wood shop, where the old chap could do more with a wood chisel than I could with a plane, I had some knowledge of wood turning.

The all-important lathe was another matter, but Arthur was one who never knew defeat. From a disused bedstead, the angle irons were hacked out for a lathe bed built up on oaken blocks. A U-shaped casting with a 1 in. hole through it, a 10 in. bolt, a chunk of cast iron with a ⅝ in. tapped hole formed the materials for our wood lathe in which we could swing stuff 24 in. long if need be. An old bicycle wheel, a crank fashioned from ½ in. round steel, and a hinged strap on a wooden foot-piece formed the treadle which was difficult to work until its creator had the bright idea of wiring an old dumb-bell in the wheel opposite the crank. Then even I could set the, spindle whizzing round evenly without much drop in the revs. But what a boost for our dreams ! Already I could imagine the surprised expressions on the faces of the villagers when I drove our engine up the road.

But a great deal of water was to flow under our ancient bridge before the dawn of that great day.

The first pattern

The success of our crude lathe was just the spur we needed. Old disused wood chisels rescued from the dim recesses of Dad's toolbox, were refashioned to meet the requirements of the wood turnery. A few nights later, after the wood had flown out of the centres three times to the dire danger of myself and anybody who might be watching, I was able to show my elders the pattern for the front cylinder cover.

After that there was no halting me. The earthen floor was soon lost under a carpet of clean smelling wood shavings, and a white blur of wood dust settled over everything. This made it necessary for whoever was stoking, to wipe the face of the steam gauge before the pressure could be observed. Our immediate neighbours, kindly folk interested in anything new, on hearing the whir of the spindle, and the thump-thump-thump as the treadle grounded in the shavings, peered in the doorway highly amused by the flying chips.

It wasn't long before we were having our breakfast eggs in wooden egg cups. This was followed up by the completion of orders from callers, who had seen my efforts in near orderly array on the kitchen dresser. But to this, my elders called a halt. We were, they said, building a traction engine.

While I was thus engaged, my brothers were building a brass furnace. Once again all the local sources of scrap were combed. A big oil drum from here, rainwater piping from somewhere else, and from Dartford Market, a dubious looking fan was purchased for five shillings. The drum was set deep in the ground and lined with fireclay. The pipe, which was now destined to take air from the fan, was fitted near the bottom of the drum and fed back some 6 ft to a concrete block to which the fan was bolted.

Power for the fan

The motive power for this was a rusty old bike, minus front wheel and all tyres. With two stout U-bolts, this was secured to a couple of timber uprights set well in the ground. The line-up was simple. Pedals to back wheel was by normal chain, and from the tyreless back wheel, a cord belt was mated to the fan. In order to enable him to see what he was doing, the "pedaller" had the seat where the handlebars normally are. With the three-speed hub, the gearing up was formidable.

Sunday morning we lit the furnace, for the first time. A zephyr-like breeze from the fan soon had the coke snapping and cracking but it wasn't long before sparks of considerable size sailed high in the air as the man on the saddle developed maximum revs, and I saw hasty movements in the ranks of those who watched. Next thing the roof of the chicken-house was on fire. Luckily a water butt was at hand and from thence onwards, the lid of the dustbin was pressed into service to combat this new hazard. In less than half an hour, Arthur removed the lid and beheld a nest of white hot coke that seemed sufficient to smelt steel. The following day I posted an order for a small crucible to a firm in Battersea. A week later we had made all the gear and were ready for the first test. The modified fan was voted a great improvement.

In next to no time we had the nest of white hot coke in which our brand new crucible was annealed, filled with gunmetal scrap, and bedded down. Coke was built up round the crucible until it was almost lost to view, the distorted dustbin lid put over the furnace, and the long blow commenced.

Safety precautions

I noticed that Fred, who was first man on the pedals, took a good look at his watch. I also saw Dad nailing a large sheet of steel on to the roof of the henhouse. Evidently he was taking no chances. But Arthur sat on the upturned bucket which as yet was not needed, and from a safe distance surveyed the scene before him with considerable satisfaction. The drone of the fan was deep and soothing.

By this time, we had a crowd of interested onlookers, including several men from the works, all eagerly awaiting results. "Drivers" changed seats on the "engine" at frequent intervals, whilst from the little sweet shop along the road, I brought bottles of ginger beer to counteract the heat, fumes and sparks. I noted with a little dismay that we had burnt a hole through the dustbin lid. That would need a good deal of explaining away later on. Meanwhile under critical eyes, for my time in the foundry was only a matter of months, I had moulded the cylinder cover, dried it, cut sizeable runners, and finished it off with chalk and water-paste before final drying. I closed the mould, fixed pouring cup, and held the whole lot down with some small weights borrowed from the nearby coal-yard. Arthur who was furnaceman, announced that the crucible was ready. Now for it! Off dustbin lid! The white-hot pot was lifted from its white-hot bed and the pouring tongs grasped its middle. Quickly I skimmed off the dross, and amid considerable leg pulling the mould was poured. The surplus metal which, I noted gleefully, still held its molten state, was poured into a hastily dug hole in the foundry sand.

After that we stood back and wiped perspiration from our brows. I watched the steaming mould with more trepidation than any, for I knew that whatever laid in the sand now slowly cooling off, would provide the shop next week with all sorts of comment. Everybody was most anxious for me to open the mould there and then, but I said firmly: "After dinner," and the party dispersed reluctantly.

A couple of hours later, I savoured to the full the sweet fruits of success, for I took from the still hot sand a perfect casting, clean as a whistle. When tapped with a metal bar it gave forth the sound by which a moulder knows his casting is solid and free from blowholes. When the grocer called next day Arthur showed him our first casting, and he gave us permission to use his lathe. This was indeed a wonderful gesture, one for which I have ever been grateful. Without that kindly thought, there would never have been any traction engine. Our home-made lathe coped with the wood turning, but nothing more.

I spent the whole of the following Saturday afternoon in our friend's workshop. The lathe, to me, was the last word, especially after the ponderous machines I had worked on.

With scale-sized cuts and the self-act working, I was exhilarated to see the newly turned gunmetal gleaming in the pale sunshine. The whole operation was carried out as I had seen it done where I worked, including the register and a scribed circle to show where the studs would be located. I think I grew a couple of inches to find when I removed the cover from the chuck, that my careful use of the callipers had resulted in a perfect fit between cylinder and cover register.

I would very much have liked to drill the stud holes in the bench drill, but was halted by the thought that such action might have been regarded as taking advantage of a favour. So cleaning down the lathe, I slipped off the belt, locked up the workshop and walked home, feeling 10 ft tall.

Drilling the stud holes

In the workshop my brothers were setting out the guide bars. They examined the register just to make sure there was no fluke about it, before it was passed as worthy of using.

That evening we drilled the stud holes with a small breast drill, starting with a small one, then opening them up by slow stages. A second pair of eyes were necessary in order to keep the drill straight, and I thought how easy this would have been on Mr. Waller's bench drill.

Transferring the holes to the cylinder was done in exactly the same way. Great care was exercised in order not to break into the steam jacket. But our efforts to make studs were not so good. Stuart Turner's studs were things of beauty in my eyes, but despite the fact that we had sunk hard cash in a new die, somehow our endeavours never came anywhere near those which came to us from Henley-on-Thames in a white linen bag. In the end, I oiled up the die and the mild steel rod.

Suddenly we seemed to be working hard. Making up guide bars, and the bracket which is part and parcel of it, carrying valve spindle guide, and the link lifting shaft, called aloud for a blue-print. In its absence, the eye came into it. We hacked out things from steel plate ranging from 1/8 in. to 3/8 in. The wastage in the hacksaw department was best forgotten, and the sound of the file prevailed.

More patternmaking

Where I worked, a fitter was judged on his ability to file flat. In turn, I struggled in their wake, and on one engine I had extra practice. I often heard it said that by the time a man was treading on his beard, he could justly claim to be master of the art. I still think there's a lot of truth in it. I was rather glad when the need for casting arose so that I could leave the metal fabrication of the bracket to those with more power than I in their elbows. Patternmaking is fascinating work, and so for that matter is foundry work, particularly when it's for yourself.

I made the wood shavings fly making patterns, and moulding them ready for the Sunday morning's cast (we always did our foundry work on the Sabbath) and the following Saturday afternoon found me making the brass fly in our friend's lathe. I remember arriving there on one occasion, to find a perfect replica of an Aveling and Porter compound traction standing on the bench, so small that it would have sat in the hand of a man. Another time there was the loveliest of table engines, all graceful pillars, shafts, discs and columns, that only an artist could have fashioned.

Yes, there was always much to see at Mr Waller's, which prompted me to keep up my standard of turnery to the shining examples that looked over my shoulders from both shelf and bench. In these surroundings the piston rod, piston, steam chest covers, glands, slide valve assembly, safety valve, and steam flanges were made. Meanwhile my brothers had brazed up the motion bracket, crosshead, and lifting links.

Our greatest asset at this point was the presence of that cylinder. It was as a foundation is to a house. Without it, I don't think that traction would ever have been, completed.

Parts relating to the motion were made to it for size, length and breadth, and the non-existent drawings were forgotten. We had to build a strong bench on which to set up the boiler with chocks under its barrel and hornplates. It could then be viewed at a distance.●

June 18 1959

GEORGE W. EVES recalls the Blacksmith's shop and the skilled man at the anvil.

We decided that things would have to be different if our traction was ever to be finished. We could not possibly stop kindly callers who came uninvited at all hours, but it meant a cessation of all work. We decided to continue working whoever arrived. But that was easier said than done. We welcomed rainy nights when nobody stirred abroad. It was then that the sounds of filing were loudest. The cylinder was machined and assembled. It looked remarkable to our eyes.

The fact that the hornplates were already slotted for the main bearings was a great help in getting the cylinder mounted correctly. But the line up of levels, plumb lines and squares to get the whole thing on the crown of the boiler was a very long job, and the task of drilling the boiler for the holding down studs even longer. So whilst my elders shut one eye and then the other, I turned to patternmaking. Main bearings, big-end bearings, eccentric sheaves and straps were quite straightforward, but the chimney top, which should have been easy, became a problem.

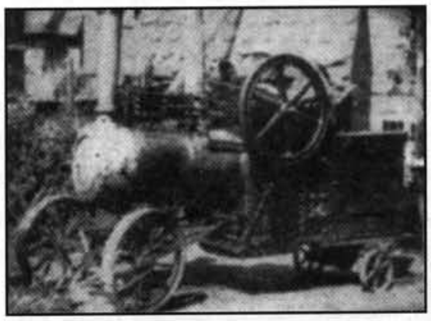
Foundry work appealed to me no end. Outside in the lean-to, I had accumulated all the clutter of that ancient craft. On Sunday mornings there would be at least half-a-dozen moulds ready and waiting, and not all of them for the engine either, for china ornaments can become things of rare beauty in burnished gunmetal. These " foreigners" were viewed with disfavour by my brothers, but Mum thought me no end of a clever boy.

I never lost the magic of the great moment when, after the sweat, grime and dust of casting, I was able to hold in the tongs, a gleaming casting that would be one more step in getting John, as we called our model, towards completion. Such was the standard of my teaching, that I never once had a bad or even indifferent casting. Good work, good castings was always the rule.

In my role of pattern maker, foundryman, turner, I was always well ahead of the fitters, and thus took care of the inquiries and small orders that flowed between us and, the suppliers afar off. My efforts at making hexagon nuts were about on par with my endeavours in the stud world, so that Saturday afternoon found me sending hard won pocket money through the Post Office. Behind the heavy brass grille, a village lass of whom Tennyson would have written a sonnet on the spot, would beam on me as she handed out the postal order: "Stuart Turner's again ?" Thus, whatever the engine's requirements, it would be passed to me.

One winter's night, when the fire glowed bright in the workshop stove, there was borne on the still air, the crackling exhaust of an approaching motor-bike. There was no mistaking Ernie. His joy in life was to buy up the most disreputable looking motor-bike, and strip it down to the last nut, bolt and washer. In his father's workshop, the cylinder would be rebored, an oversize piston fitted, and everything else which was worn would be replaced with home-spun replacements to be followed by re-building.

Comfort and appearances were things which never bothered Ernie. Performance was the thing, and as soon as the machine was ridable, over to our place he would thunder. That was about the word. Straight exhaust, no silencer, mudguards, or anything unnecessary unless it was the black bulbed horn, required by law. We grew to know his approach, and tonight his coming was heralded from afar.



" The square nuts make me shudder" comments George Eves about this picture of the unfinished traction engine.

The door opened and he staggered in with a heavy looking load on his back. Gingerly he lowered it on to one of the wine casks.

" There's a drilling machine for you. The old man picked it up with some scrap he bought today."

It was typical of him. From its many coverings, we brought to light a small drilling machine. It was in a shocking state, but pioneers are prone to see things in a rosy light. It was gear driven, had a handle on the side, and a heavy wheel on top of the spindle. No chuck as we know it today, but a tapered square recess. From then on all the drills in our establishment were ground to fit it—another job for me in stolen minutes at work, where the emery-wheel was handsomely driven by a 2 in. leather belt. Bolted to our bench, the drill made us look a bit above the normal workshops in the village, even although we had to turn it by hand.

The valve gear

What a blessing it was after the breast drill! It was on this machine that Arthur drilled out the Stephenson link from plate. Today it still produces even exhaust beats which cause onlookers to slightly incline their heads to lend an appreciative ear. A tremendous amount of work went into that valve gear, which was hacked out of plate ¼ in. thick.

In my year in the blacksmith's shop, where all the bits and pieces appertaining to agricultural engines and machinery were fashioned from plate and bar, the sound of the ringing anvil predominated. Mighty men were the blacksmiths, grimy sweating giants with arms and hands almost as tough as the metal they worked. Their stout leathern aprons were buckled on with brass clips and they chewed incessantly—but it was not gum. In this place, giant machines sheared up steel plate with a great grinding of gears, but the doyen of them all was the steam hammer whose blows could be light as a feather fall or, when necessary, make the dim interior shudder with their thunderous poundings.

Delicate control

Indeed, it was a very wide-eyed boy who one day saw the hammer man put his watch on the anvil, glass upwards, and then bring down the hammer so delicately that the watch was pinned down and still the glass remained whole. This was a favourite way to impress visitors, as I found out later. The boss always steered his callers towards the smithy, and gallons of beer were the outcome of such a feat.

In spite of all our planning and scheming, we could not make faster progress. We were the village handymen. Arriving home some night, we would discover that Mrs. Smith had left her ancient sewing machine for Arthur to look at, which usually meant a major repair job. There was always a strange clock of one sort or other ticking away on the mantelpiece.