MODEL ENGINEER

CENTENNIAL CELEBRATION COLLECTION

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7: Stationary Steam Engines

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Cover shot: Marine reversing engine built by Lieut Commander Barker. Now in the Society of Model & Experimental Engineer's collection. (Photo: Robert Shackle)

MODEL ENGINEER

CENTENNIAL CELEBRATION COLLECTION

The building of model stationary engines goes back to the dawn of the industrial revolution. Pioneers such as Newcomen, Watt and Trevithick all built models of their ideas before embarking on the full size engine. James Watt was an instrument maker (the precision engineer of his day) at the university in Glasgow when he was asked to repair a couple of Newcomen engines which had ceased to work. In repairing these models he realised that the efficiency could be improved by the use of a separate condenser and the rest is history. The model that proved his theory is now at the Science Museum in London and it made his fortune.

This story illustrates another early use of the model stationary engine, that is for educational use. Technical colleges and institutes up and down the country had models of engines (many sectioned to show the internal workings) for the use of students. Most of these have been swept away in the name of progress and can now be found in the various technology museums around the country.

Building model stationery engines has always been popular with the model engineer. The reasons are not hard to see. A small vertical or horizontal engine is ideal for the beginner on limited means and equipment. The cost of materials and castings are relatively low so that mistakes and errors do not cost a fortune to put right and it can often be built with the simplest of tools, especially if it comes as a part built kit where the complicated machining has been carried out by the manufacturer. Except for the more complex models, the finished results can be operational in a matter of months or weeks rather than the years necessary to build a model locomotive, and there is nothing better to encourage a beginner than to see his (or her) handiwork running under steam or compressed air.

After a bit of experience the model engineer can move on to more complicated engines and can embellish his model with access ladders and landings, scale lubrication systems and something for the model to drive, be it a dynamo, water pump or fan, and if encased in a glass case it can be an attractive addition to the lounge or sitting room. There can be few household authorities that would refuse pride of place for your handiwork. If a hidden electric motor is used to drive the model at scale speed it is a talking point with visitors. One disadvantage of this is that friends and neighbours then know that you like tinkering with mechanical things and the 'odd jobs' appear which stops you getting on with the next model.

The variations of stationary engines seem endless. Vertical, beam, oscillating, horizontal, diagonal and radial, simple expansion, compound, triple expansion and quadruple expansion, uniflow, high speed, low speed, engines that are designed not to complete a revolution, the list just goes on. The books written by the late George Watkins show many of the variations in an industrial environment and give the model engineer many ideas for a model that is different from the 'run of the mill' designs. As an example, a number of beam engines had an increase in power by the addition of a 'pusher' cylinder being added at a later date. I do not recollect ever seeing this on a model. These books are, as far as I am aware, out of print, but can occasionally be found at a specialist secondhand bookshop or at your local library through the book search service.

There have been many engines described in the Model Engineer in the last 100 years, a lot in considerable detail and it seems a great pity that these engines are often overlooked by the model engineer of today. Castings for these early engines were marketed by companies long since forgotten but with today's fabrication techniques it is not difficult to build up items that would otherwise be castings. The manufacture of patterns can be a straightforward procedure and adds another skill to the modeller's armoury. Although in the past every town had a jobbing foundry where the 'one off' was welcomed (often for the price of a packet of Woodbines) foundries are now fewer and farther apart. They can still be found and being a member of a local model engineering club will often be a good contact to the nearest foundry. Possibly the society itself has the facilities to produce good quality castings and a workshop to machine the larger components.

In selecting items for this volume I have tried to show the development of the hobby through published designs. The oldest range that is still being marketed is that produced by Stuart Turner (now Stuart Models). It is surprising how far back some of these designs go, some are not far off celebrating their own centenary. It shows how far advanced Stuart Turner was in his thinking. I have also selected some of the more unusual and original designs published in 'ours' over the years. Copies of these articles (and many more) are available from Nexus Special Interests Ltd. If my research encourages readers to build some of the masterpieces of the past then my time will have been well spent.●

GERRY COLLINS

Readers are asked to note that some of the designs featured are from an age when rules and regulations were far more relaxed than today. Anyone contemplating building any of the designs shown should satisfy themselves that the information given meets with today's design and boiler test requirements. The publishers and editors cannot be held legally responsible for the information published herein.

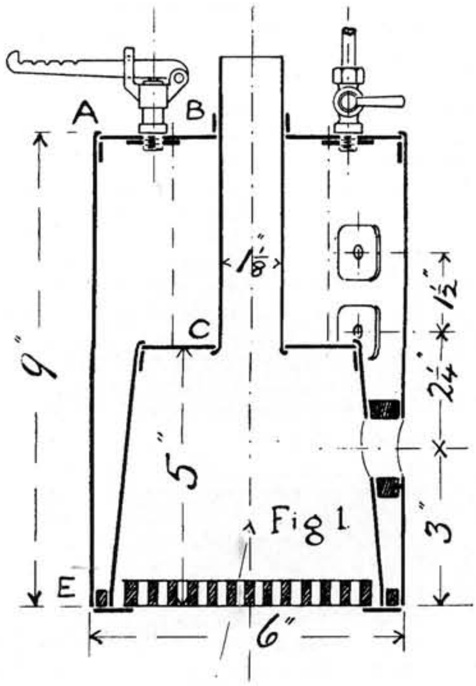
February, 1898.

How to Make a Small Vertical Boiler.

By E. L. Pearce.

THE boiler I am about to describe is intended to work at a pressure of 15lb to the square inch, and will drive an engine with one cylinder of about 1 in. diameter and 2 in. stroke. The fuel can be either charcoal or methylated spirit. I have adopted a form of construction in which there is no brazing or difficult flanging, and riveting and soldering are substituted as being more within the scope of an amateur.

The boiler should be made from soft sheet brass, which is nearly as easy to work as copper, and takes the ordinary tinman's solder more readily. Hard or springy brass can be softened by making it red hot and allowing it to cool slowly.



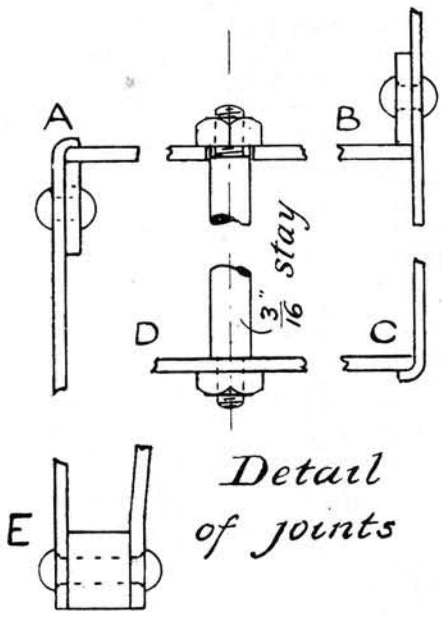


Fig. 5–Details of Joints.

We start with a design for a vertical boiler published in the second issue of the Model Engineer and Amateur Electrician. I have shown this only to illustrate the changes that have occurred in the last 100 years. Imagine presenting a boiler made of brass and with the joints shown to your local club boiler inspectors, although there can be little doubt the mechanics of the design are sound for the low pressure involved.

E. L. Pearce was a well-known author in the early days of M.E. and he described the construction of a 3½ in. gauge C.R. Dunalastair in 1901. He could claim to be the founder of The Society of Model Engineers (now S.M.&E.E.) as it was he who suggested to Percival Marshall that it should be feasible to start model locomotive clubs amongst amateur engineers. This proposal was soon extended to include: "The construction and working of model engines, electrical apparatus, tools and kindred subjects". He was a founder member of the society and was elected to serve on the first committee in November 1898.

The rivets can be made from soft brass wire 3-32nds in. to 1/8 in. diameter as follows:- First cut off enough short pieces about 3/8 in. long. Then form the heads by putting in the hole drilled in the block of steel 1/4 in. deep, and with the light riveting hammer tap all round till the head is about the right shape, and finish off with two or three blows on the hollow ended punch. Put the rivet through the hole in the shell from the inside which it should fit closely, and while the head is resting on the holding-up punch, rivet over the projecting end and finish off.

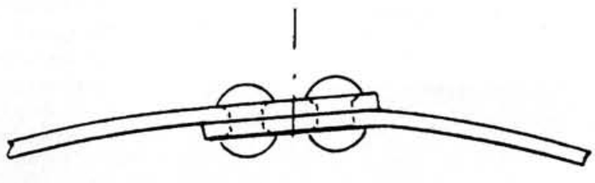


Fig. 4. – Method of making joints.

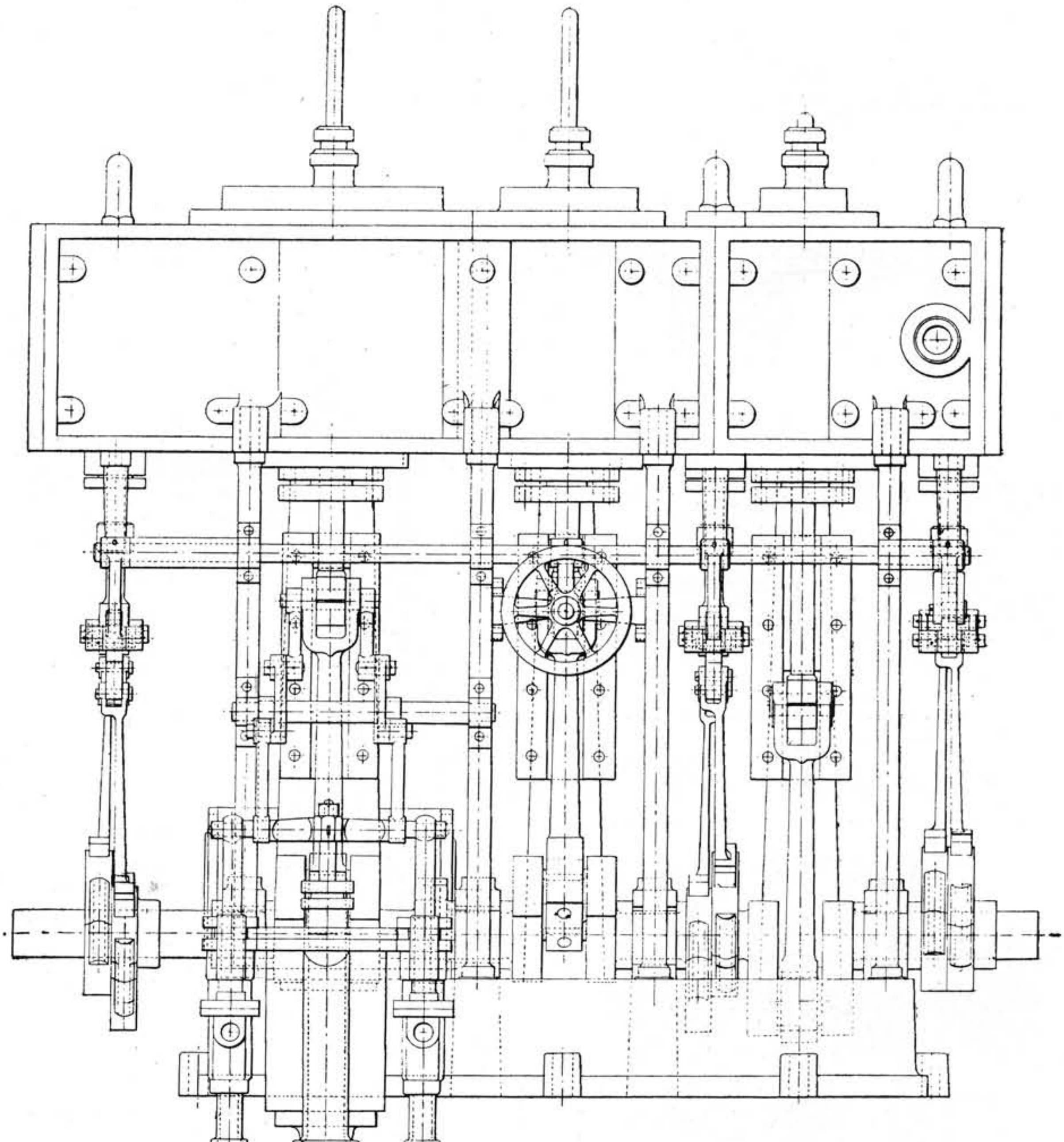
The fittings necessary for this boiler are a safety valve 1/4 in. diameter inside, steam pipe and tap, two small taps for testing water level, and a screwed plug, which can be removed when the boiler is to be filled with water. These can be bought ready made, but anyone in possession of a good lathe could make them himself. The chimney may consist of a thin brass tube from 6 in. to 8 in. long, fitting over the projecting portion of flue. Its appearance will be improved if a turned brass cap be fitted to the top.

A small pressure gauge, if of good make, would be a valuable addition.

When the boiler is complete it can be tested very well with a pneumatic tyre pump by substituting a suitable nipple for one of the small taps, the safety valve being plugged, and if previously filled with water any defects in the joints will show themselves after a stroke or two with pump. The points where leakage occurs can be marked and re-soldered when empty.

For model engineers used to very basic drawings and designs the publication of detailed designs such as this must have done wonders for the circulation. Although described as a model, this engine would have driven a reasonable sized boat with high pressure cylinder 1½ in diameter intermediate 2.3 in. and a low pressure cylinder 3.8 in. diameter. The piston rods were ½ in. diameter It would make an impressive model even today.

A New Model Triple Expansion Marine Engine.

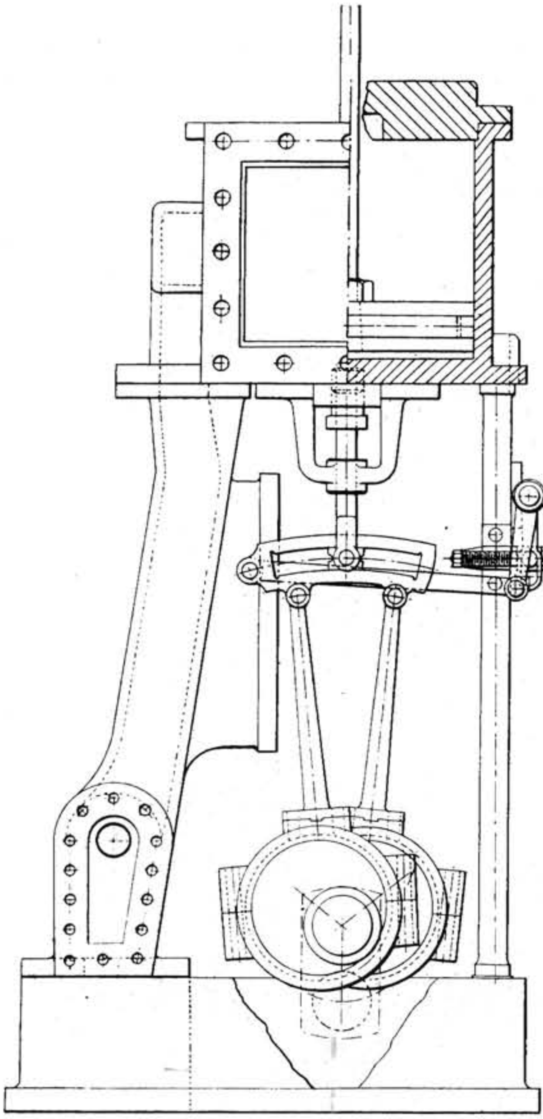


Front Elevation

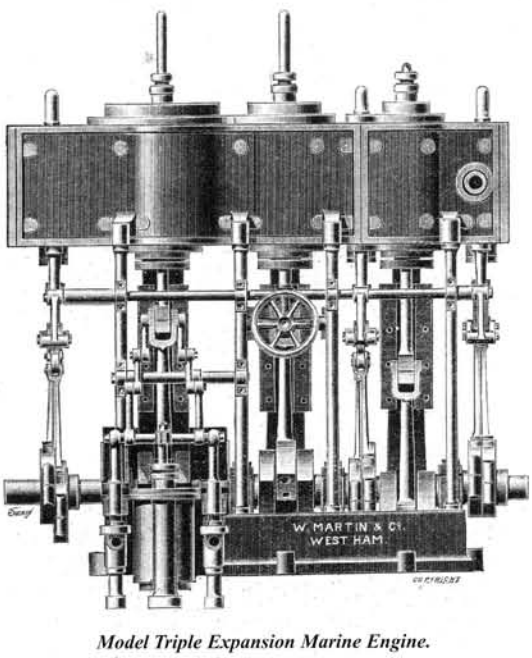
March, 1898.

A New Model Triple Expansion Marine Engine.

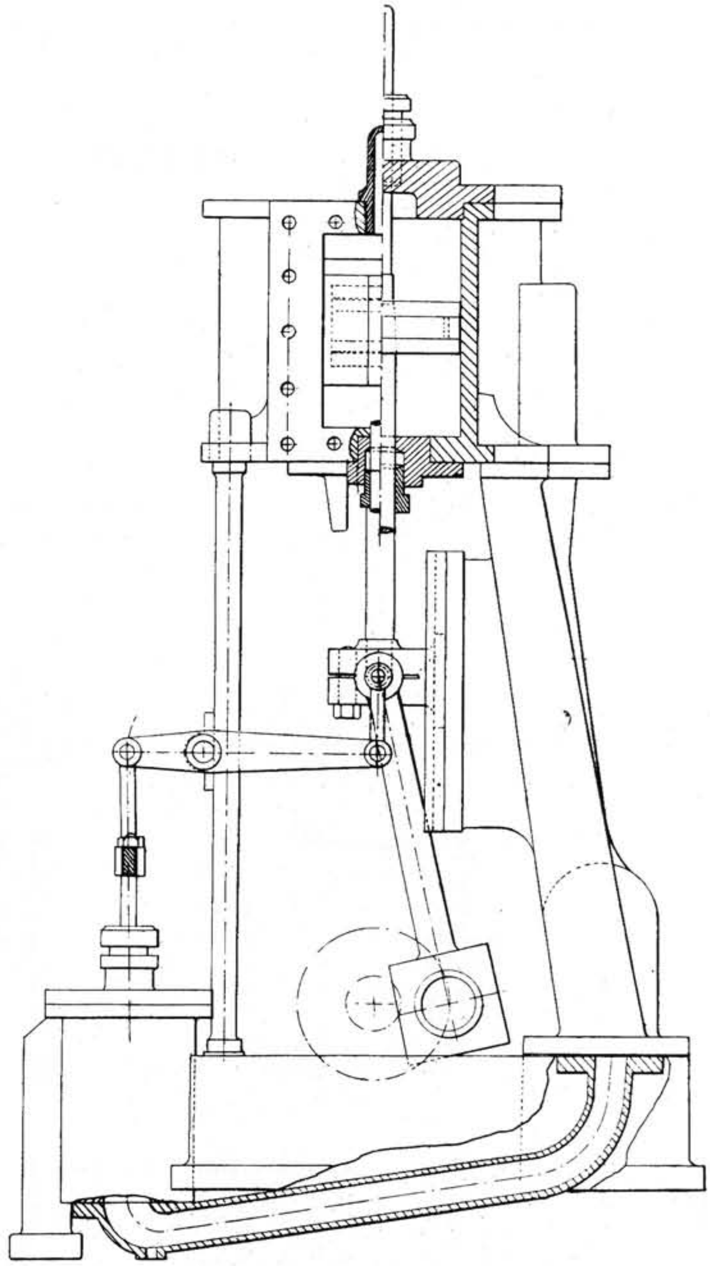
THE accompanying drawings show a new model triple expansion engine, which is practically a scale model of the engines of the steamship, "City of New York". Our drawings are ⅓ of the full size of the model, and the model itself is 1-30th of the full size of the real engine. The model is complete in all details, and is provided with condensers, and air and circulating pumps. The diameters of the cylinders are, high pressure 1.5 in., intermediate 2.3 ins., and low pressure 3.7 ins., while the stroke is 2 ins. The piston rods are of steel ½ in. diameter, with tail end 5-16ths in. diameter, and the taper of the cone in piston is ¾ in. to the foot. The condenser has a capacity of ⅓ of the low pressure cylinder, and the circulating pumps are 1-19th the area,



Eccentric Gear H.P.C. shown from the reverse



Model Triple Expansion Marine Engine.



Section at Intermediate Valve box.

and air pump ⅓ the area of the low-pressure cylinder. The crank shaft is ⅞ in. diameter, and the crank pins ¾ in. diameter.

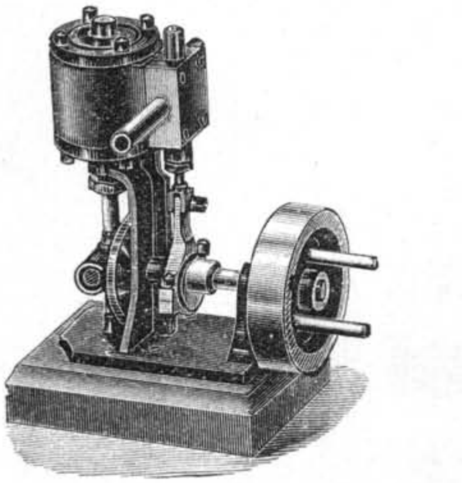
The cylinders are made exactly to scale, but there is a slight variation in excess of scale in the crankshaft, and also the bed and standards are slightly altered to suit the appearance of the model. Complete sets of castings and parts for this engine are being supplied by Messrs. Martin & Co., East Road, West Ham, the sets including iron and gunmetal castings, and forgings for cranks, link motion, and valve gear, together with full size drawings. We have had an opportunity of inspecting one of these sets and can cordially commend them to those of our readers who wish to construct an accurate and well-proportioned model. The castings and parts are clean and sound, and will present but little difficulty in working up to any amateur of average skill and intelligence. In our next issue we hope to give an engraving showing a front elevation of the finished engine. We ought also to add that, of course, the copyright of the drawings reproduced herewith is the property of Messrs. Martin & Co.

John Bateman and Company and Whitney's Scientific Exchange of London were two of the companies that took early advantage of the advertising potential of Model Engineer. Whitneys was established in 1875. Amongst other things, it dealt in new and secondhand model steam yachts and boilers. In 1903 its two cylinder launch engine (1¼ in. bore x 1 in. stroke) cost £5.00, a considerable amount of money for those days.

April, 1898.

Launch Engines and Donkey Pumps.

ON the occasion of a recent visit to Whitney's Scientific Exchange, 117, City Road, London E.C., we were shown some capital little models of launch engines and donkey pumps, well made and finished, and marked at very moderate prices. Our illustration shows



the smallest size of launch engine, which is suitable for boats up to 2½ ft. long. The sliding crosshead arrangement enables a very compact engine to be produced, and no portion need stand above the deck. The bore of the cylinder is ⅝ in., and the stroke ½ in., and the height over all is 3⅝ ins. The price is 17s. 6d. The donkey pumps are made in both horizontal and vertical patterns, and are excellent little models. Whitney's Model Engine list will be sent post free to any reader who applies.

October, 1898.

Cheap Set of Castings.

THE sum of 1s. 9d. is a very modest amount to pay for a complete set of castings for making a model horizontal steam engine, yet for this price a capital set can be made from Mr. R. W. Parks, Cornfield Road, Eastbourne. A sample set of these castings has been submitted for our inspection, comprising cylinder (½ in. bore, 1 in. stroke), flywheel, connecting rod, cross-head, cylinder covers, piston, crank-arm, eccentric and strap, pulley, bearings, slide-valve, and valve-chest. The castings are in brass, and are particularly clean in appearance. As full working instructions accompany each set, there should be no difficulty in fitting them up to form a satisfactory working model. Larger sets are supplied at proportionate prices.

1s 9d would be 7¼p in current money.

John Bateman and Company had been established nearly 125 years when the Model Engineer appeared on the streets. In 1774 the Model Dockyard was founded at 31 Fleet Street for the purpose of supplying the requirements of the model-loving enthusiasts of the day. The business was acquired by John Bateman and incorporated into his own undertaking. John Bateman had been honorary engineer to the old Royal Polytechnic in Regent Street until its closure. The company undertook commissions from the Government and others for models for training and instructional purposes. It may be mentioned (and I quote) "...that the interesting employment now practised by so many amateurs, and at our public schools and polytechnics of making working models and from castings, originated with this firm in the 'sixties'". I wonder what happened to all these exhibits?

January, 1899.

Model Engineers and Their Work. - II.

Messrs. T. and C. J. Coates.

In the early issues of Model Engineer, Percival Marshall ran a series entitled "Model Engineers and their Work". Running over several issues the articles were partly biographical, partly descriptions of their work and partly hints and tips. Thomas and Charles James Coates were part of that rare breed (for the 1890's) professional model engineers making models mainly for the Science Museum. They came originally from Russia where they received their early training at the Imperial State Paper Factory in St. Petersburg where their father was chief superindent engineer. Their workshop was very modest but the work they produced received high awards and would do so even today.

Two of the models described are applicable to this part work, a horizontal engine with 'Corliss' valve gear, and a model of a high speed electric light engine with both Hackworth and Marshall valve gears, but I recommend that you read the complete set of articles in Volume II, I am sure that they will be a source of inspiration.

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 forgive any expressions of doubt which might arise in the reader's mind if he were introduced to the unpretentious 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 ins. and the other of 4 ins. 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.

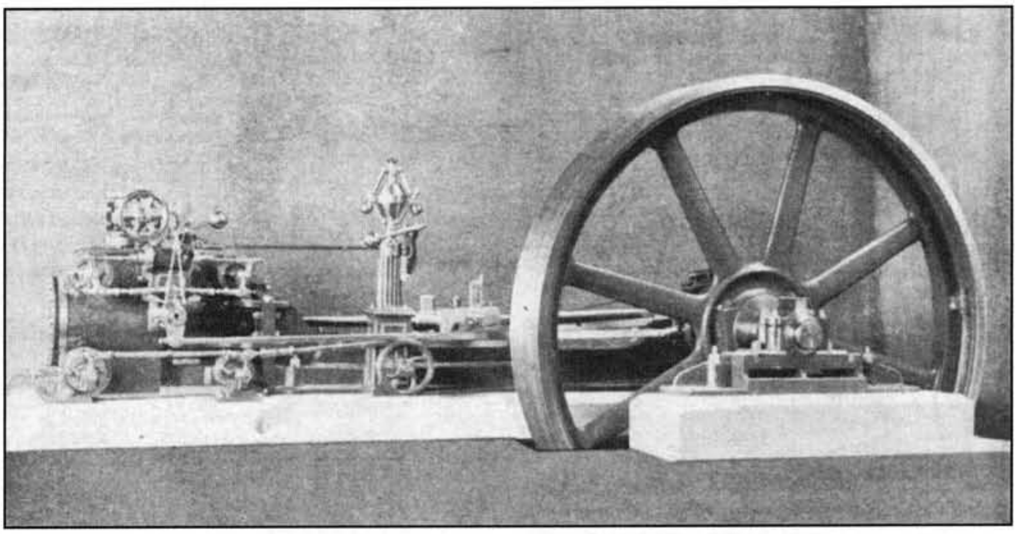


Fig. 9 – Model of Horizontal Engine With "Corliss" Vave Gear.

A model of quite a different type, but of considerable interest as showing the versatility of the subjects of this article, is that shown in Fig. 9, which is a photograph of a horizontal steam engine fitted with Corliss valve gear. This model is also to be seen in the South Kensington Museum. The original of the engine represented was made by Messrs. John Musgrave & Sons, of Bolton, for driving a jute mill in Calcutta.

At the time of our visit, we found that the work in progress consisted of a compound direct-driving vertical electrical light engine, being a model to the scale of 2 ins. to 1 foot of the engines made by the Brush Electrical Engineering Company. The full sized engine gives 300 h.p. at 250 revolutions per minute. The model varies somewhat from the original in that it is fitted with two distinct types of valve gears - viz., the 'Hackworth' gear and the 'Marshal' gear, one being fitted to the high-pressure cylinder and the other to the low-pressure.

Mr. Coates called our attention to the fact that in several parts of the castings of this engine, as also in other models, the metal is less than ⅛ in. thick, and therefore requires extreme care and accuracy in the preparation of the patterns and core-boxes, and in inserting the cores when moulding. Indeed, so great is the necessity of accuracy in the construction of the cores that a special method of producing them has to be adopted. As most model makers are aware, the usual plan is to cut or build up the core box straightaway from pieces of wood, and only checking the correctness of the work by the ordinary use of templates and foot rule. Sand is then rammed into the box so made to form the core for use in the mould.

Fig. 11 – Model of High-Speed Electric Light Engine.

Mr. Coates has a more certain method of producing correct cores, which, though it may at first seem unnecessarily elaborate, has on many occasions proved the means of preventing considerable annoyance and the loss of time and money due to spoilt castings, which would probably have resulted from the employment of a less accurate plan. The following is his modus operandi. He first makes as carefully and as exactly as possible, a wooden model of the core itself, complete with all the necessary prints; from this model he makes a plaster-of-paris mould in halves, thus forming a core box: he then makes a casting, in zinc or iron, of each half of the plaster box, thus giving him a strong and absolutely accurate core box in which to ram the final sand cores. When one is dealing with castings of which the thickness is in places less than ⅛ in., it will easily be seen that the difference of only 1-32nd in. in the accuracy of the shape of the core or the placing of a print would be sufficient to render the casting useless, and the need of such great care in the preparation of the core boxes becomes evident.

In this connection we may add that it took just a week to prepare the mould for casting the cylinders of the compound electric light engine referred to. The pattern and core boxes took five weeks to make, and the moulding required a five-part box for its successful accomplishment.

A Model Steam Hammer, and How to Make it.

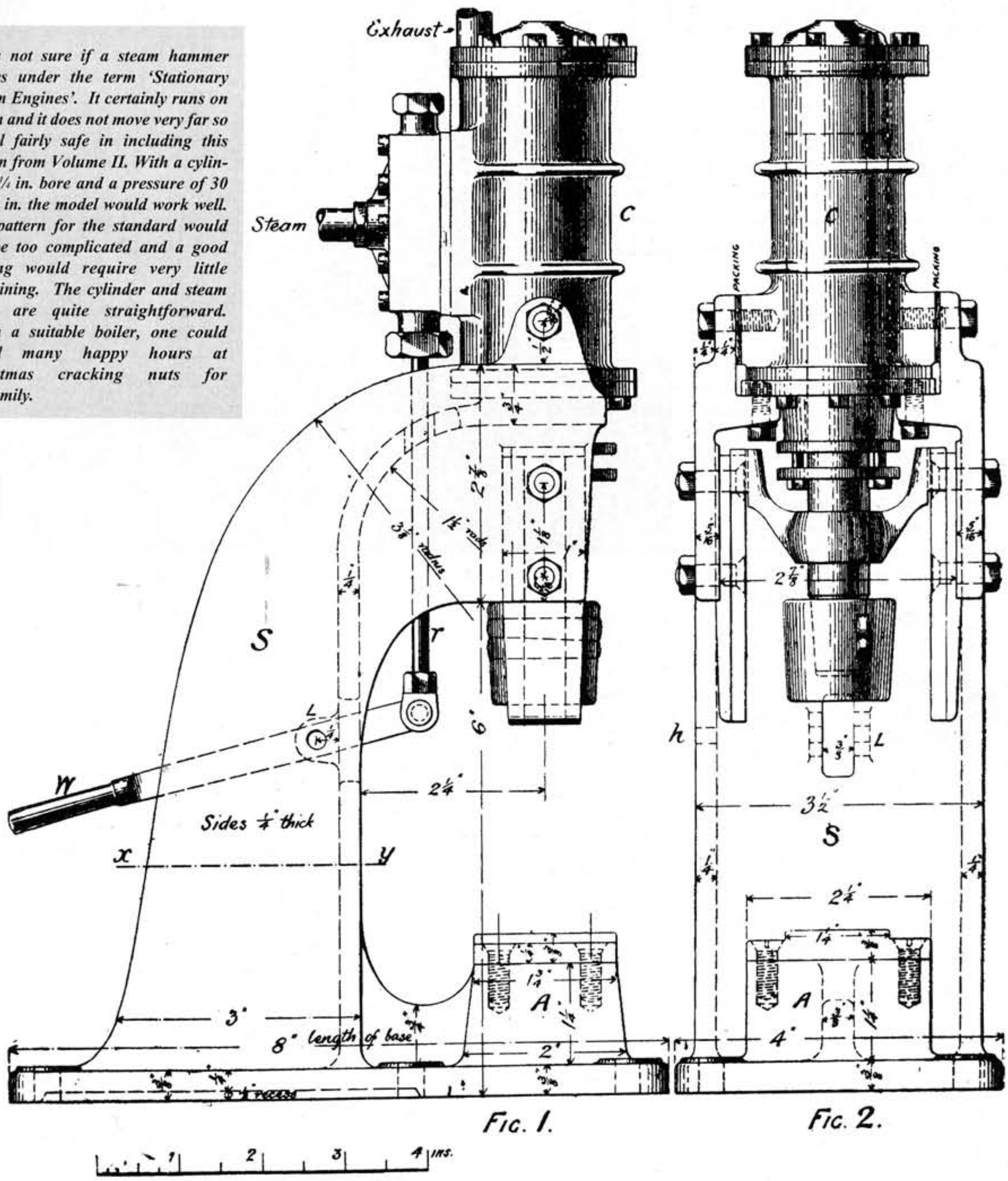
By F. E. P.

IN THE subject of the present article - a working steam hammer model - the design has been kept so closely to the general lines adopted in actual machines, that the finished hammer may be expected to look thoroughly workmanlike and effective. Owing to the massiveness of steam hammer design, also, there is less need to make the various details of greater strength in this reproduction. A type of single standard hammer has been chosen for copy, as presenting less difficulty and being more manageable than the larger double standard pattern. In the present article, general information only on the construction will be given, description of the details being held over till the next issue.

The slide-valve in the model is of the ordinary steam engine type, instead of that usually in use on steam hammers, which would require too complicated a casting. The valve is worked by the valve-rod (r, Fig. 1), and working lever (W), which latter has a slot in the valve-rod end to allow sufficient play for the valve-rod pin.

The best results will be obtained with a high pressure of steam. The details which will be given will be strong enough in every particular; and, although it may be worked with 10lbs, a pressure of 30 lbs, on the square inch will make the hammer a 'working' model in the real sense of the words.

I am not sure if a steam hammer comes under the term 'Stationary Steam Engines'. It certainly runs on steam and it does not move very far so I feel fairly safe in including this design from Volume II. With a cylinder 1¼ in. bore and a pressure of 30 lb/sq. in. the model would work well. The pattern for the standard would not be too complicated and a good casting would require very little machining. The cylinder and steam chest are quite straightforward. Given a suitable boiler, one could spend many happy hours at Christmas cracking nuts for the family.



A MODEL STEAM HAMMER.

General Arrangement Drawing.

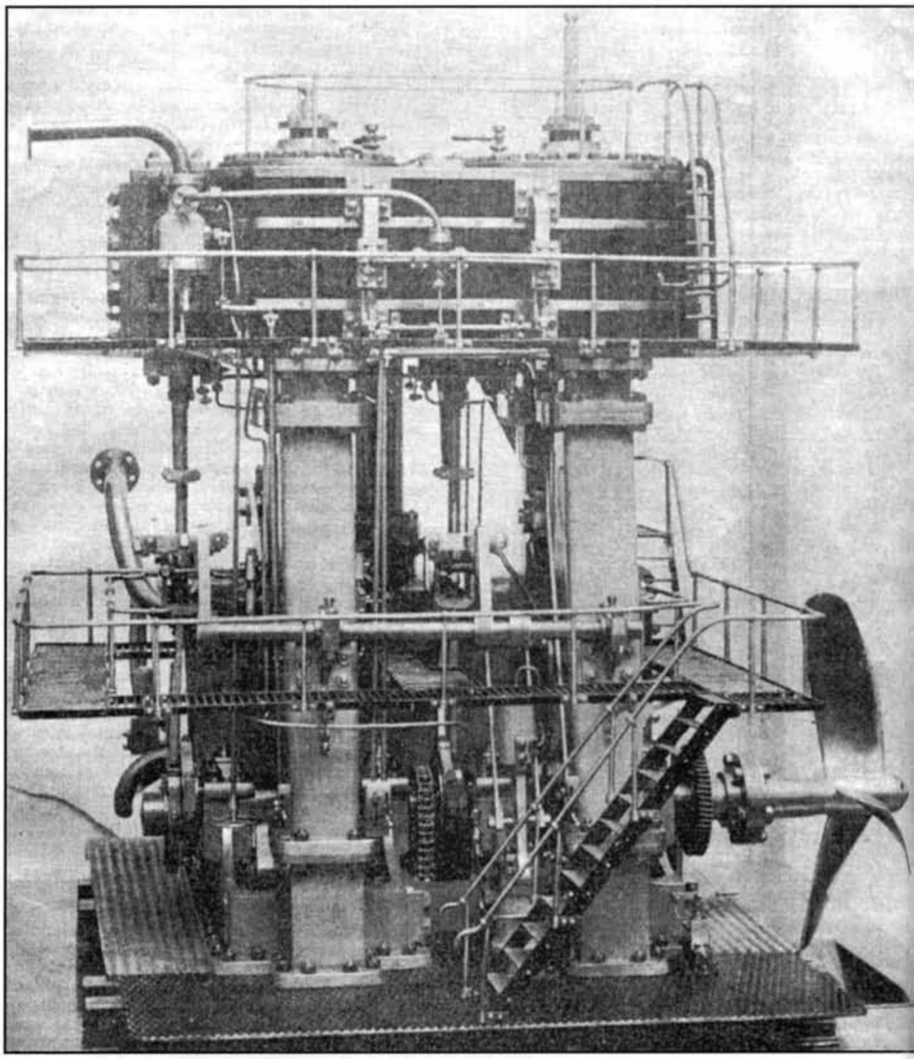
November 15, 1900.

A Splendid Marine Engine Model.

THE accompanying photographs show an interesting model of a compound marine engine made by one of our French readers, M. Auguste Boitel, of Saint-Omer. M. Boitel has a strong liking for model making, but has never received any instruction in metal work. We think our readers will agree that he is to be congratulated on the beautiful model he has built. His workshop is only fitted with a lathe and a drilling machine.

M. Boitel had previously made several models of steam engines, boats, locomotives, etc., all carved out of wood. The compound marine engine now illustrated is his second model made in metal, the first being a single cylinder steam launch engine. The working drawings of the marine engine were made from a sketch published in Engineering representing a compound marine engine of 1,600 h.p., the scale adopted for the model being ¾ in. = 1ft. The bed-plate, columns, cylinders, and condensers are in cast iron, while the air, circulating, and other pumps and all bearings are in gunmetal. All other parts are of steel or iron. The reversing link shaft is moved by a small steam cylinder with oil compressor.

In a later issue we hope to be able to give to our readers the drawings and description of a model of small breech-loading gun made by the same amateur.



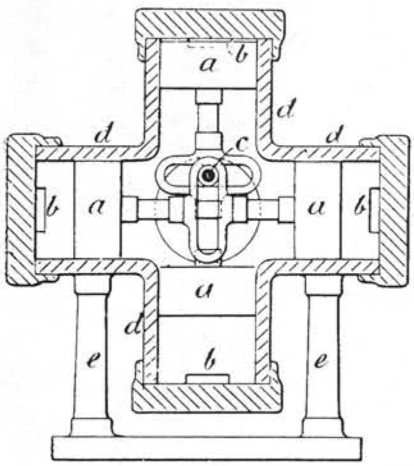
Model Compound Marine Engine, By M. A uguste Boitel.

June, 1900.

"A Novelty Iin High Speed Engines."
To The Editor of The Model Engineer.

Dear Sir, - In the Model Engineer, of January, 1900, appears an article entitled "A Novelty in Small High Speed Engines," and treating of an engine "invented" (?) by a Mr. Hoyt. Permit me to state that for some time motors, practically the same as the above-mentioned, have been applied by M. Megre, of Paris, to his steam motor cars. I herewith enclose a sketch of such a motor. As you will see, there are four single-acting cylinders. The piston-rods are united by an elliptical link, in which the crank moves. The valve motion is situated behind the cylinders, on the axle, and is actuated by a single eccentric. The crank is of the disc pattern, and around the crank-pin, to avoid friction, a roller is attached. While one piston is beginning the exhaust, and the opposite one the admission period, the two other pistons are both in the middle of their stroke. It, therefore, follows that there is no dead centre, and the motion is uniform. As to power, an engine with cylinders 4 ins. in diameter and 2½ ins. stroke, running at 1000 revolutions per minute, at a steam pressure of 225 lbs. per square inch, gives out 20 h.p.You will see from the sketch that if two opposite cylinders were taken, and their pistons approached to one another until the link were part of the pistons, we would have the engine 'invented' by Mr. Hoyt, excepting the double axles. - Yours very sincerely,

De Steeg, Holland. C.A.B.



By Volume 3 the fame of Model Engineer was spreading far and wide. Here are two examples of models from overseas readers. The compound marine engine is a superb example of the model-makers art.

January 1, 1901.

Practical Letters From Our Readers.
A Hint for Amateur Steam-Engine Users.To The Editor of

The Model Engineer.

Dear Sir, - Some time ago I built a ½ h.p. horizontal steam engine, with the intention of using same to drive a lathe; but, as my workshop is rather small, I found there was not sufficient space for the boiler.

I eventually got over this difficulty by taking out the whole of the fire-place, and the loose bricks and mortar behind it. This left ample room for the boiler to be fixed immediately under the brickwork chimney. This arrangement turned out to be very satisfactory, as most of the heat thrown out by the boiler passed up the chimney, and the temperature of the room was only slightly affected when the engine was running.

Perhaps this suggestion may be of use to some of your readers whose workshops are anything but roomy. -

Yours faithfully, F. H. R. Mann

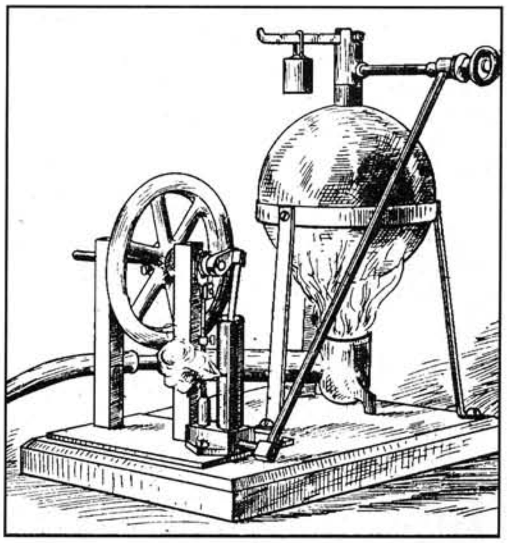
Forest Gate.

A Home-Made Steam Engine.

By George M. Hopkins.

A STEAM engine carefully made is a piece of mechanism to be proud of, no matter what its particular design may be. A double-acting engine of good proportions, with a bored cylinder and forged crank and crankshaft, and other parts made in keeping, is of course, the better form of steam engine to make, but, as we are presuming that not every amateur has the facilities for building such an engine, a description of a simple single-acting engine which could be made by any boy handy with tools is given. It can be made with an ordinary light foot-lathe, as no boring is required, nor is there any turning to be done that does not come within the range of such a lathe.

A view of the engine and boiler together is given, and also a sectional view showing the construction of the valve and valve-operating cam, and the steam passages in the base.



General View of Home-Made Steam Engine.

Volume 4 covering the first half of 1901 is a gem. It is difficult to know what to leave out rather than what to include. We have a design for a simple uniflow engine that can be built using a simple lathe (although with modern plastic ballcocks the boiler could cause a headache). A boiler heated by the sun and two methods of filling a boiler, one is most ingenious. But what have we left out? A high speed electric light engine, details of castings for a horizontal engine by Brearley & Stevenson, a simple way of keying a flywheel to a shaft without cutting a keyway in the flywheel, making a simple electric beam engine, the list just goes on and on. How about a water motor for driving a sewing machine? Obtain a copy of Volume 4, it's a good read and full of ideas.

The cylinder consists of a piece, A, of mandrel-drawn steel tubing (which needs no boring) 2¼ ins. long and ½ in. internal diameter. The thickness of the metal forming the tube is 1-16th in. This piece of tubing is fitted to a boss, a, about ⅛ in. high, formed on the brass block, near one end. This block is 1½ ins. long and ½ in. thick, and is provided with lugs for receiving screws, by which it is attached to the baseplate. In this block are formed the steam passages, b, c, and valve chamber. The hole drilled from the front backward and forming the passage, b, receives the steam supply pipe, B. A hole is drilled from the rear end of the block forward to a point about opposite the centre of the cylinder, forming with the hole, d, the steam duct, c d. Near the rear end of the block is drilled a 5-16ths in. hole, from beneath, which forms the valve seat, e, just beyond the passage, b. A 3-16ths in. hole is started at the valve seat, e, and continued to the top of the block. This smaller hole is counter-bored from the top with a 5-16ths in. drill, leaving the valve chamber. The counter-bored portion of this hole receives the plug, f, which is bored longitudinally to receive the valve stem, g, of the conical valve, e. The valve stem is about 3¼ ins. long, and is provided with the adjustable collar, h, between which and the plug, f, is placed a spiral spring which tends to keep the valve normally closed. The steam passages, b and c, are closed with screw plugs, as shown.

To the steel tube which forms the cylinder is fitted a piston of cast iron. It is about 1⅛ ins. long, and packed by the steam or water contained in the grooves in the piston. The upper end of the piston is slotted to receive the lower end of the connecting-rod, which is pivoted therein upon a ⅛ in. pin passing through the piston and lower end of the connecting-rod, as shown in dotted lines in the sectional view. The brass block which supports the cylinder has lugs on opposite sides receiving screws, which pass through them into the baseplate. This plate is 4 ins. wide, 5 ins. long, and ⅛ in. thick. At the rear of the valve chamber is a post formed of a ½ in. square brass rod 4⅜ ins. long, secured to the baseplate by a screw passing upward through the plate into the end of the post. A similar post is placed near the rear end of the baseplate. The ends of the posts are squared in the lathe. Both posts are bored transversely near the top to receive the shaft, which is ¼ in. in diameter and 5 ins. long. The space between the posts is 2 ins., and the distance between the shaft and baseplate is 3⅞ ins. On the shaft, between the posts, is placed the iron flywheel, which in the present case consists of an old valve wheel 4½ ins. in diameter, bushed to fit the shaft and fastened with a setscrew.

The end of the shaft which projects beyond the post over the cylinder carries a ½ in. crank, on which is placed a connecting-rod. This rod measures 1⅝ ins. between the centres of the holes for the crank pin and the pin in the piston.

In the side of the cylinder are drilled three 1-16th in. holes in a horizontal line, and close together to form the exhaust port of the engine, which is entirely uncovered by the piston when it is in the position shown in the engraving. The exhaust remains open for about a quarter of the revolution. This port is left exposed for clearness, but it may be covered by a hollow ring which encircles the cylinder and receives an exhaust pipe.

On the shaft is placed a cam, in whose boss there is a circumferential groove, and upon the upper end of the valve stem is placed a fork, the upper ends of which slide in the groove in the boss of the cam. A stud inserted in the fork has upon it a roller which rolls on the higher part of the cam and opens the valve at the proper instant. This cam opens the valve just before the piston reaches the lower limit of its stroke, and allows the valve to close just before the exhaust is opened by the piston.

The boiler of this engine consists of a copper float to be found in the market, made by an electrolytic deposit of copper. Such a float forms a seamless boiler capable of withstanding a great pressure - say 100 lbs. The boiler is mounted in a tripod made of band iron, and is furnished with a safety valve ¼ in. in diameter, the lever of which is about 2 ins. long, and graduated and weighted so that it will blow off at 35 lbs., thus ensuring perfect safety. (The ordinary copper float is not recommended.) A brass steam pipe ⅛ in. internal diameter, is screwed into the safety valve casing below the valve seat, and has at its end a miniature angle valve which is connected to the engine by the inclined pipe, and by elbow and nipple which extends into the base. As the angle valve is a troublesome piece of work, an ordinary stopcock is recommended in its stead. It should be placed in the inclined pipe.

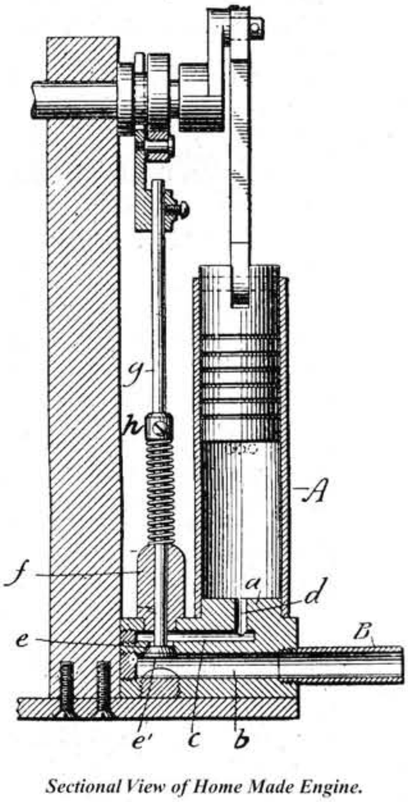
The best burner for this boiler is an Argand bas Bunsen burner like that shown. Of course, an alcohol lamp will answer, but it is not as safe as the gas burner.

Both engine and boiler should be mounted on a suitable baseboard.

The engine is capable of making 1000 or 1,200 revs. per minute. It must be well balanced for this speed.

The boiler is filled, when cold, through the safety valve opening by means of a funnel having a slim corrugated tube. The boiler should be about two-thirds full of water at the start.

It is obvious a larger engine could be made on the same principle; but the front support for the shaft should be made A shaped and placed next to the crank, and the cam should be placed between the support and the flywheel; the shaft support would then extend over the cylinder base. - *The Scientific American.*



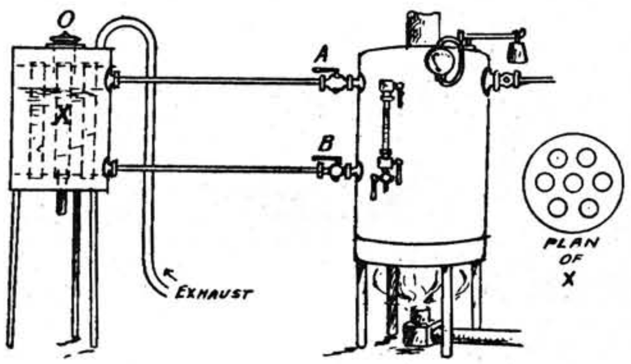
Sectional View of Home Made Engine.

June 1, 1901.

A Feed-Water Apparatus for Model Boilers.

To The Editor of The Model Engineer.

Dear Sir,- I enclose a sketch of a method I have thought of for refilling small model boilers while under steam, thus saving the bother of stopping the engine and burning one's fingers. In the drawing X is a cylinder of metal



(stout brass tube) having seven tubes soldered in through which the exhaust steam passes, thus warming the water in the heater. When the two taps A and B are opened the water will fall until it is the same level in both boiler and heater. The apparatus would work better if the heater X were placed higher than the boiler. When the boiler has been refilled and the taps closed, more water is put into the heater through the screw stopper O. By the time the boiler requires refilling the water in X will be hot again. It must be remembered that the vessel X will have to stand nearly the full boiler pressure. - Yours truly, "Chemical".

Kirkstall.

May 15, 1901.

A Model Donkey Pump.

By George W. Halpin.

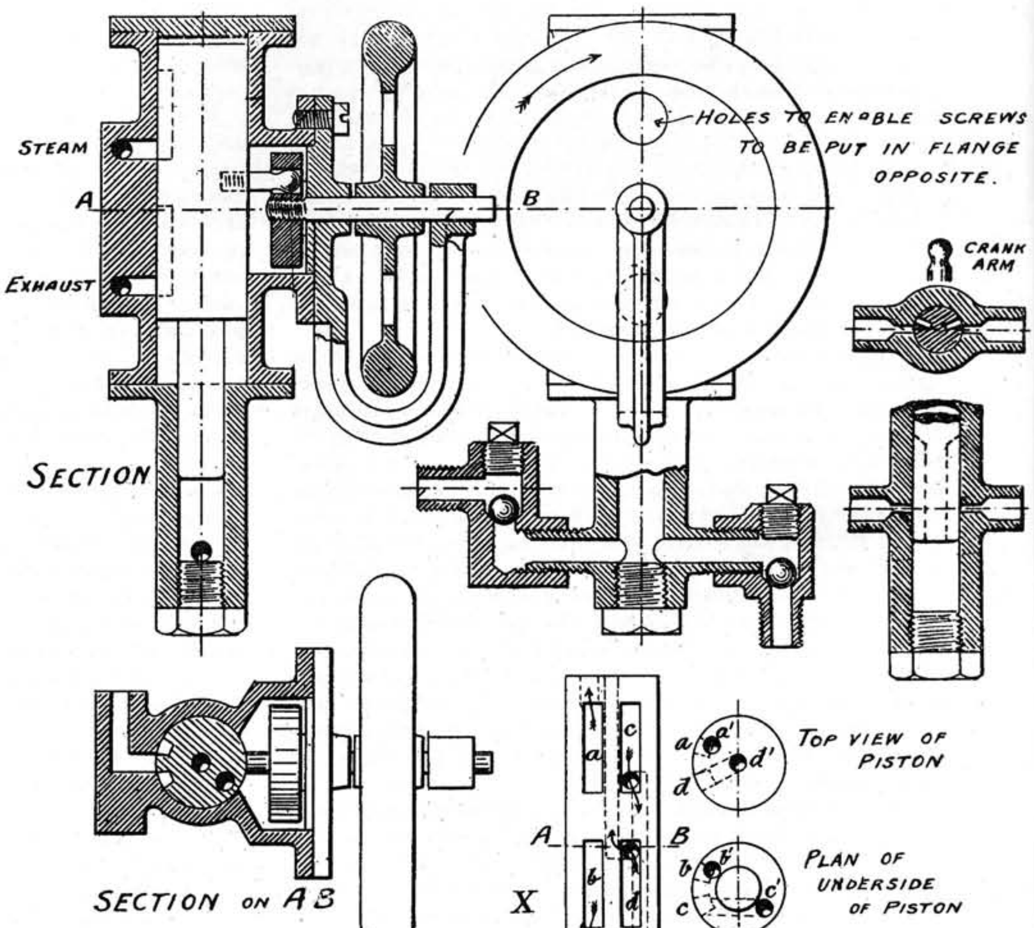
NOW that water-tube boilers are all the rage it becomes necessary to provide some means of keeping up the water level, and this, as well as the fact that it is a nice model to make, determined me to make one for my model steam launch. The type I fixed upon is that known to engineers as the "Dolphin," as it appeared to me to be easy to make, and have very little friction, there being no valve, guide, crosshead, connecting-rod, or eccentric, and in this particular specimen no stuffing boxes. The drawings, which are full-size, ought to show the construction very clearly, and if any other size be wished for, all that is necessary is to make a scale on paper, giving the required diameter of cylinder. The one in question is ½ in. diameter cylinder, ¼ in. pump plunger, with 5-16ths in. stroke.

The construction presents no difficulties, but care is necessary to have the cylinder and pump perfectly in line.

May 1, 1901.

An Engine Worked by the Sun.

THAT the sun's rays may be focused and used to evaporate water in a boiler, and thus produce power, has been demonstrated frequently on a small scale, but the cost of such an apparatus, even under the most favourable conditions, forbids practical employment of such motors. A large arrangement of this kind, says the Mechanical Engineer, has been erected at South Pasadena, Cal. It consists of a large conical or umbrella-shaped reflector, with a tubular-shaped boiler in a position corresponding to the handle of the umbrella, to absorb the reflected heat. The reflector is set in the meridian, on two framed supports or towers, and rests on an equatorial mounting, like a telescope, the axis being due north and south, and the machine turning east and west in following the sun, which is automatically effected by clock mechanism. The reflector is 33ft 6ins. diameter on top and 15 ft. on the bottom. It contains 1,788 mirrors about 3½ ins. by 24 ins. in size. The weight of the reflector is about 8,300 lbs. The boiler is 13 ft. 6 ins. in length, with a capacity for 100 galls. of water and 8 cubic ft. additional steam space. The boiler is made of firebox steel, covered with lampblack. Steam can be raised in about an hour after sunrise. The engine is geared to a pump for the purpose of testing the rate of work which the machine is capable of doing. According to newspaper accounts, the all-day average work performed by the engine is 1,400 galls. of water lifted 12 ft. per minute, which, if correct is at the rate of 4 h.p.



Details for Model Donkey Pump.

Compound Engines for Model MarineWork.

By "Eos" (New Zealand).

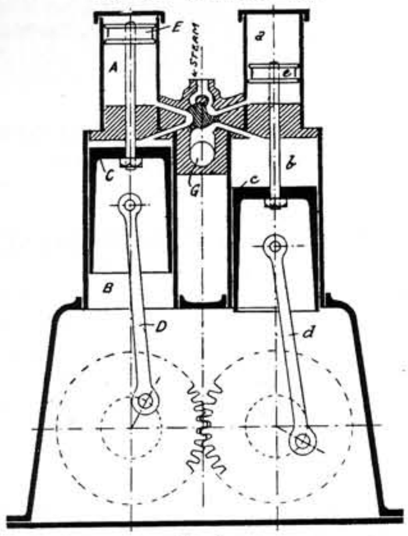


Fig. 1

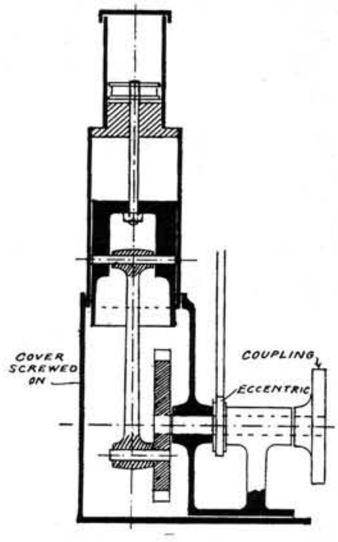


Fig. 2

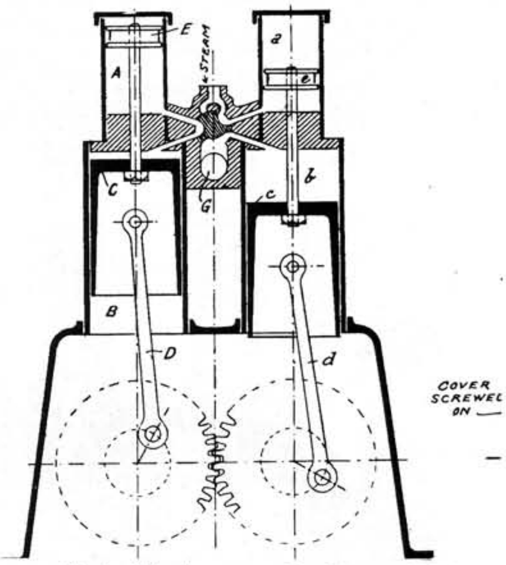


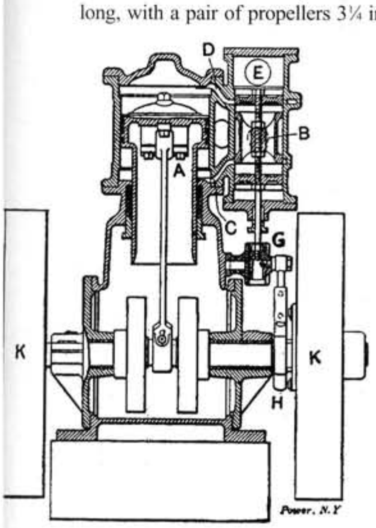
Fig. 3 – Valve Arrangement For Compound Marine Engine.

A Novelty in Compound Engines.

THE engine illustrated in section below is a single-acting compound. A is the cylinder; B, valve chest; C, high pressure steam port; D, low pressure steam port; E, exhaust pipe; G, valve stem guide; H, eccentric; K, fly wheels. In operation steam is admitted to valve chest B between the two ports, and enters to lower side of piston or high pressure end of cylinder through steam port C; after driving piston to end of stroke, returns through slide valve, and passes through steam port D to lower pressure end of cylinder, and passes to atmosphere through exhaust pipe E.

The piston has a trunk on lower end, inside of which the upper end of connecting-rod is attached, the cross-head bearing for connecting-rod is adjusted through a hand hole on front of the engine, the space between outside of trunk and inside of cylinder forming the high pressure, and space on top of piston forming the low pressure. The connecting-rod and cranks are enclosed by frame of engine, keeping them free from dust. This frame is supplied with oil, which lubricates the trunk, connecting-rod, and crank-pin. The flywheels act as driving pulleys. The engine has no guides, and takes up very little room in height. These engines are built to run at any speed desired, and can be either supplied with an ordinary ball governor or a shaft governor. The M. Garland Co., Bay City, Mich., are the builders - Power, N.Y.

We will take as our subject a twin-screw engine to drive a launch about 5 ft. long, with a pair of propellers $3\frac{1}{4}$ ins. diameter; assuming a boiler pressure of 50 lbs. The cylinders should be $\frac{5}{8}$ H.P., $1\frac{1}{8}$ L.P. by $\frac{3}{4}$ stroke. So we will take these sizes to work upon. The points to be considered to ensure good working are:



Firstly, the reduction of working parts to the fewest possible consistent with effective running, thereby simplifying making and reducing risk of derangement.

Secondly, make all steam passages as short and direct as you can, and of sufficient area not to choke or wire draw the steam (a very common fault in model engines).

Thirdly, get rid of as many stuffing-boxes as you possibly can. Very few 'model engineers' realise what an effective brake a stuffing-box sometimes makes!

Fourthly, balance the engines as perfectly as possible. This applies to all high speed engines, but more particularly to boat work. It is poor practice to put a machine in your craft that might with reason be called a steam hammer rather than an engine.

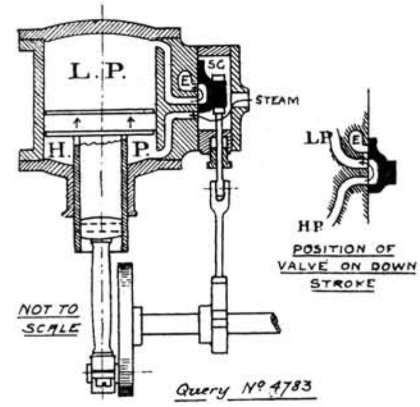
Lastly, cut off all ornamental and useless parts; these only make weight that can with greater profit go into the boiler.

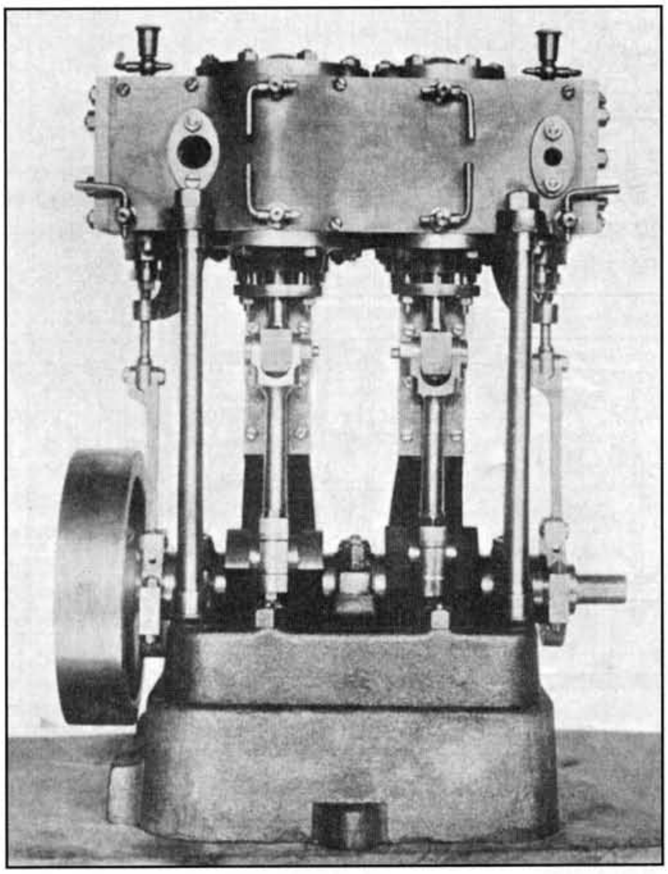
The second half of 1901 continues the dilemma of what to print. There was a large amount of interest in compound engines so I have concentrated on a couple of interesting designs with trunk pistons.

The design published in the issue of 15th November is described as a single acting compound but with the high pressure acting on the underside and the low pressure acting on the topside of the piston surely it could be described as double acting? The engine is described as a novelty but in the same issue in the query column, Mr. H. H. of Forest Hill is asking for advice for a similar design, only this time using a slide valve rather than the piston valve used in the American example, a case of great minds thinking alike.

November 15, 1901.

(4783) **T. B. D. Engines and Boiler** - H. H. (Forest Hill) writes: If you think the enclosed design for the compound engine is worth it, I shall be pleased for you to publish it in your columns. What I want to know is the correct diameters of trunk piston and the main piston; these being chosen to give the correct ratio between the capacities of the H.P. and L.P. cylinders. On the upward stroke the slide-valve allows the live steam to enter the lower part (H.P.) of cylinder, the L.P. side meanwhile exhausting to port E, and on the downward the steam passes from the H.P. to L.P. side as shown, the steam and exhaust ports being closed. I am building a model T.B.D., length, 40 ins. beam $4\frac{1}{2}$ ins.





March 15, 1902.

Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST invariably be attached, though not necessarily intended for publication.]

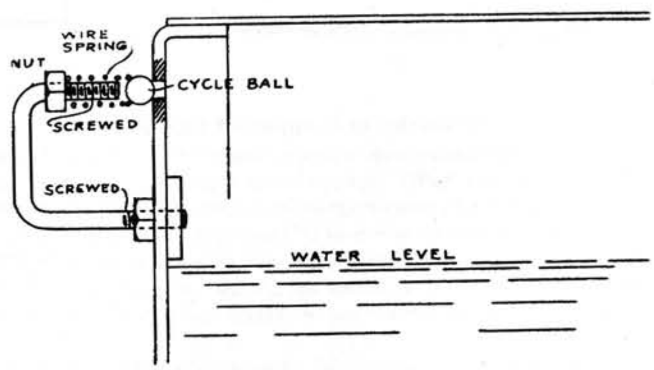
Having more than the allotted space for 1901 I will only include one item for Volume 6. This is how NOT to do it. I suggest that you do not present this to your local club boiler inspector for approval. I am surprised that P.M. published this, perhaps he was using the usual editor's ploy, publish something controversial in order to generate correspondence and help fill up pages. Volume 7 is again full of good things, particularly a couple of high speed compounds and generators. I must, however, include the first description of a model from that great pioneer Stuart Turner, one of the few names from the early days that is still supplying model engineers today.

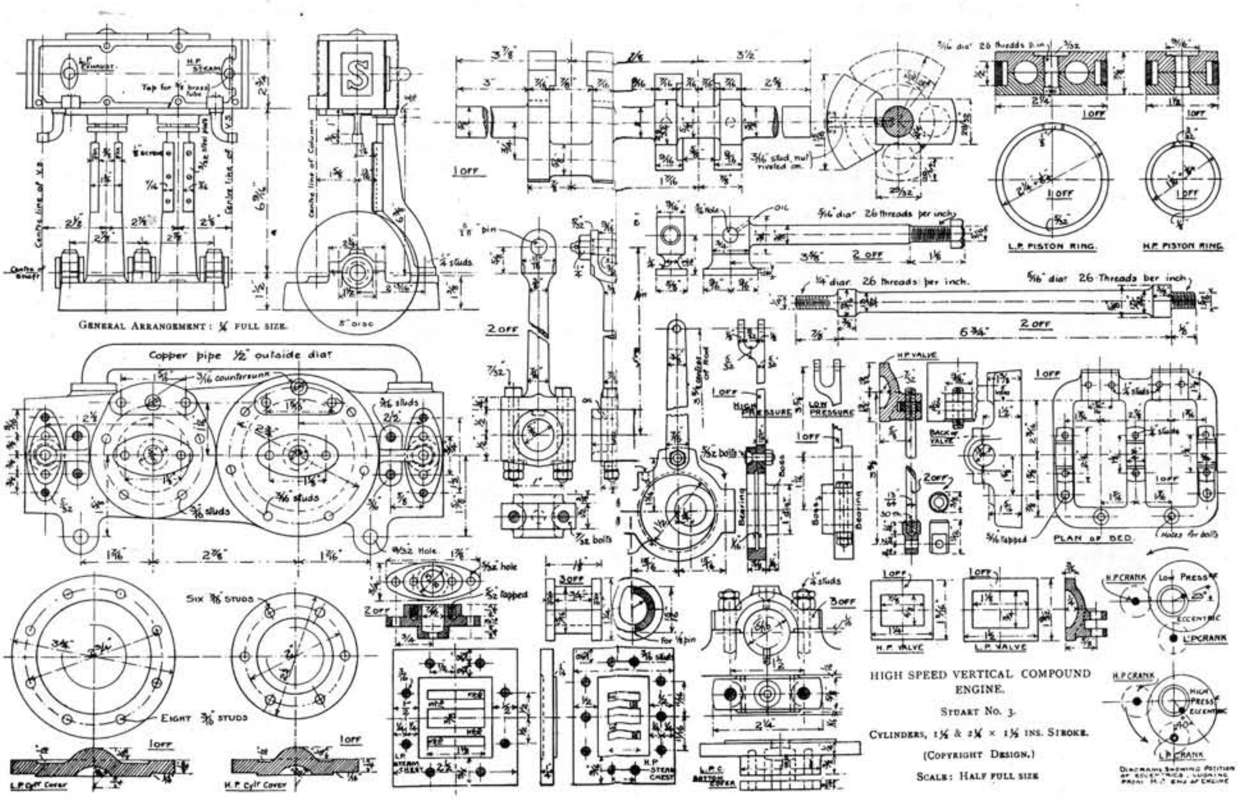
A Simple Safety-Valve for Model Boilers.

To The Editor of The Model Engineer.

Dear Sir, - Below is sketched a small safety-valve, which may be of interest to my fellow model makers. The valve is an ordinary ¼ in. cycle ball, and fits into a hole in end of boiler. This valve is very easy to make, and works well, but the surface the hole is drilled in must be flat. I have been a regular subscriber to your journal from the first number, and find each number of more interest than the last - Yours truly, T.

Birkenhead.





Starting the two volumes for 1903 I am, once again, in trouble, deciding what to include and what to leave out. In Volume 8, covering the period January to June we have articles on watertube boilers, Highly Superheated Steam (800°F), steam turbines, model engineering in Russia etc, etc. We must start with a design for a model compound Undertype Engine, designed by that great name in the model engineering world Henry Greenly and the subject of a superbly coloured supplement, the colours representing the materials of the various parts. Greenly was, at this time, Secretary of the Society of Model Engineers (later to become the S.M. & E.E. in 1910). I am surprised that this type of engine is not more popular than it is. To my mind it is a very attractive and compact model and deserves a wider following. I have included an interesting compound engine with semi-rotating valve. A water tube boiler and designs for steam turbines, but have had to omit other equally interesting items, even so I have taken three pages for one volume.

January 1, 1903.

Design for a Model Compound Undertype Engine and Boiler.

By Henry Greenly

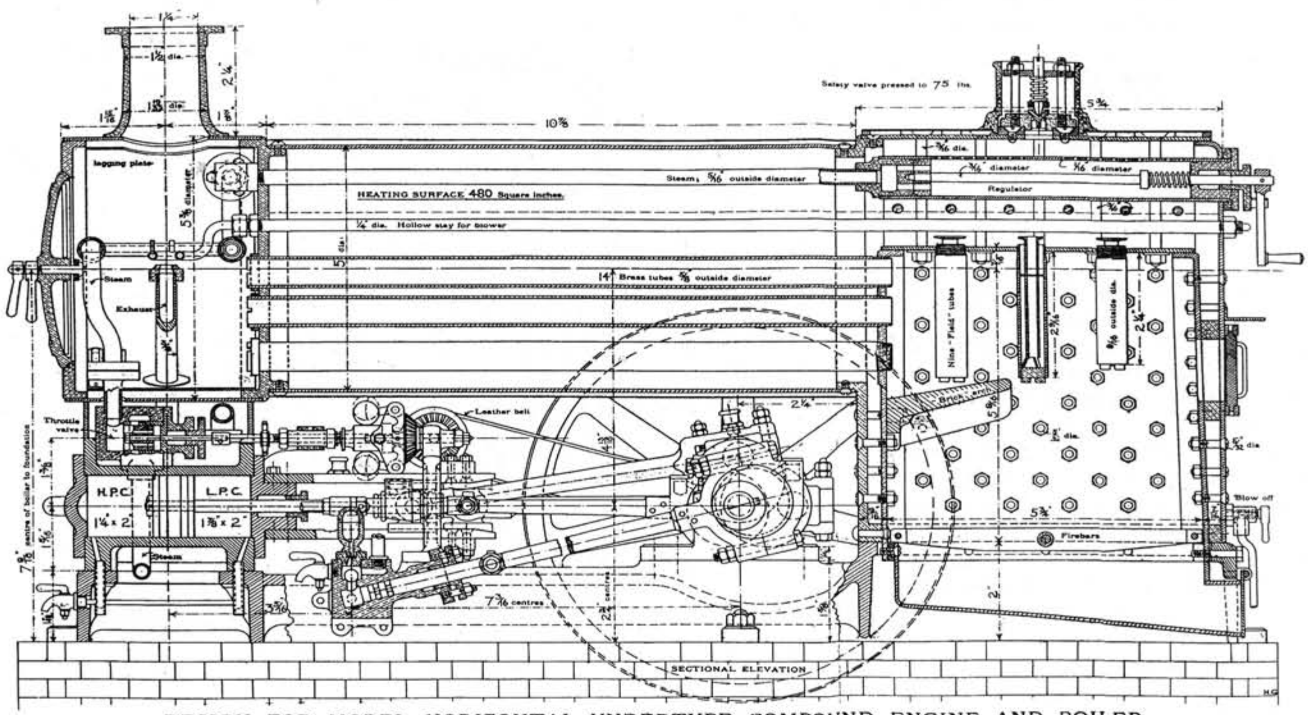
I. - General Considerations of the Design.

To locomotive enthusiasts model stationary engines do not, as a rule, appeal; but all the same, I think, and this has been my experience, that for those who for various reasons have not the conveniences for laying down a model railway track, the design presented herewith should provide directions for the construction of a really good model engine and boiler, from which as much amusement and instruction may be obtained as with a model railway locomotive. During the few times I have had the privilege of working the model tank locomotive recently illustrated, I have had my knowledge of the working of model steam engines immensely increased by running the engine braked down upon friction rollers. In this position, the engine can be driven with ease, and where, as in the case of the larger models, every beat, increase of fire and work, should make the engine respond up to its maximum output, the temporary failures and successes, dependent upon the efficiency of the manipulation, should lend an interest to the working of the model under consideration, second only, speaking for myself as a lover of the locomotive, to being on the footplate of the real locomotive or working a model on a suitable track.

June 4, 1903.

The Curious History of a Small Boiler.

IN A recent Board of Trade Report, the following account of an official enquiry into the explosion of a small vertical boiler was given. The boiler was made of iron, being 1 ft. 8 ins. high and 2 ft. 3 ins. diameter. The shell was in one plate ⅛ in. thick, the top and bottom plates being each also 1/8 in. thick. The age was unknown; there had been no repairs nor inspection. It appears to have been purchased about eleven years ago by a machinery agent at an auction sale. This person made no use of it, but kept it five years, when he disposed of it in part payment for work done. This person kept it two years without using it, and in turn sold it to a greengrocer, who parted with it for 5s. 6d. to a mill hand for scalding food for pigs. It was again sold to another operative for 12s., for a similar purpose, certain repairs, being agreed to be executed in the amount. The mill hand, after the repairs, steamed it with the safety valve blowing at 32 lbs. per square inch, and handed it over, stating that it was safe for a pressure of 25 lbs. per square inch. After working the boiler for some time in the usual way it suddenly exploded, with the pressure gauge registering 17 lbs. per square inch, the bottom angle iron fracturing all round in the angle, the top remaining attached to the shell, and the horizontal ring to the bottom plate. In the opinion of the Board of Trade Inspector, the vessel was not safe for any pressure, and the fracture was caused by a panting action, due to the boiler being unstayed. Unfortunately, one man died from injuries received, and two others were severely scalded. The Commissioner took occasion to remark upon the grave risks incurred in using boilers by persons designated as casual steam users, and that such persons, beyond all others, should first have a competent adviser to ascertain if the boiler can be worked in safety.



DESIGN FOR MODEL HORIZONTAL UNDERTYPE COMPOUND ENGINE AND BOILER

SCALE: HALF FULL SIZE

January 8, 1903.

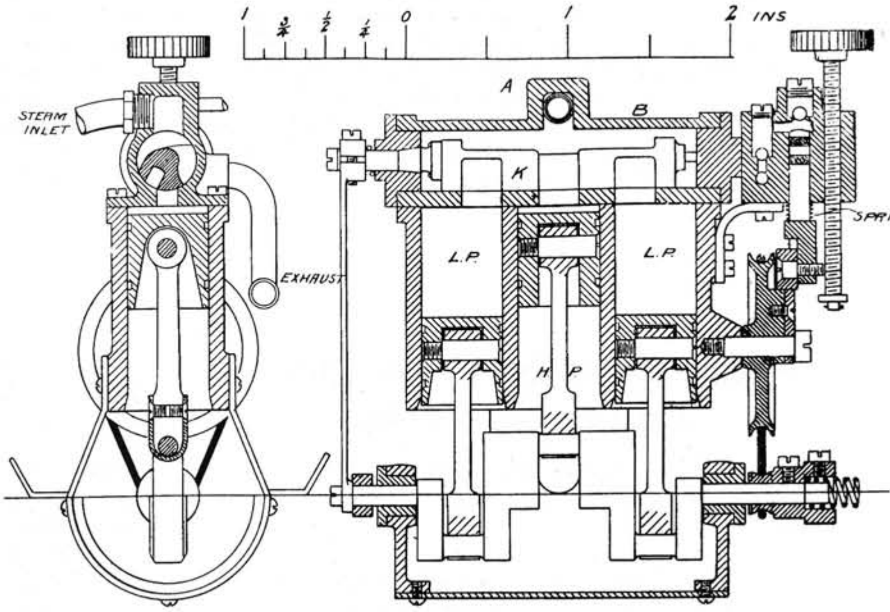
Design for a Model Compound Launch Engine.

By O. D. North

THERE is always considerable difficulty in designing engines for small high speed model steamboats. The difficulties lie in the inefficiency and weight of the ordinary type of engine, in the accurate regulation of the feed water, and in the fact that an ordinary type of engine, driving a single screw, gives the boat an ungainly list.

There are two main ways of minimising this. Firstly, by using twin screws, turning in opposite directions. This method has already been discussed in The Model Engineer, and it will suffice to say that its disadvantages lie in the increased friction, due to the use of gearing and the difficulty of keeping a straight course, unless both propellers are of exactly the same pitch.

The second way of reducing the list of the boat consists in decreasing the torque or twisting force on the shaft, by increasing the revolutions of the engine and using a screw of finer pitch.



CROSS-SECTION. LONGITUDINAL SECTION.

Design for a Model Compound Launch Engine.

To come to the engine itself, it will be seen from the drawing that it has three single action cylinders - one high pressure, and two low pressure. By means of a kind of Corliss valve placed across the tops of the cylinders steam is first admitted to the middle cylinder, then passed to the two outer ones, and finally exhausted through the two pipes shown. The valve is rather difficult to explain, but perhaps the drawings will make it clear; it has a groove long enough to cover all the cylinder parts cut in it, and when this groove is over them the steam can pass from the centre to the outer cylinders. When the valve has been rotated through an angle of about 45 degs. it uncovers the centre part to the steam, and also uncovers the outer parts to two pockets (which are always partly over the exhaust passages), thus allowing the steam to escape. In order to prevent the steam from leaking past the valve rod (or rather axle), it is made taper like the plug of a tap, and kept pressed tight by spring outside.

February 5, 1903.

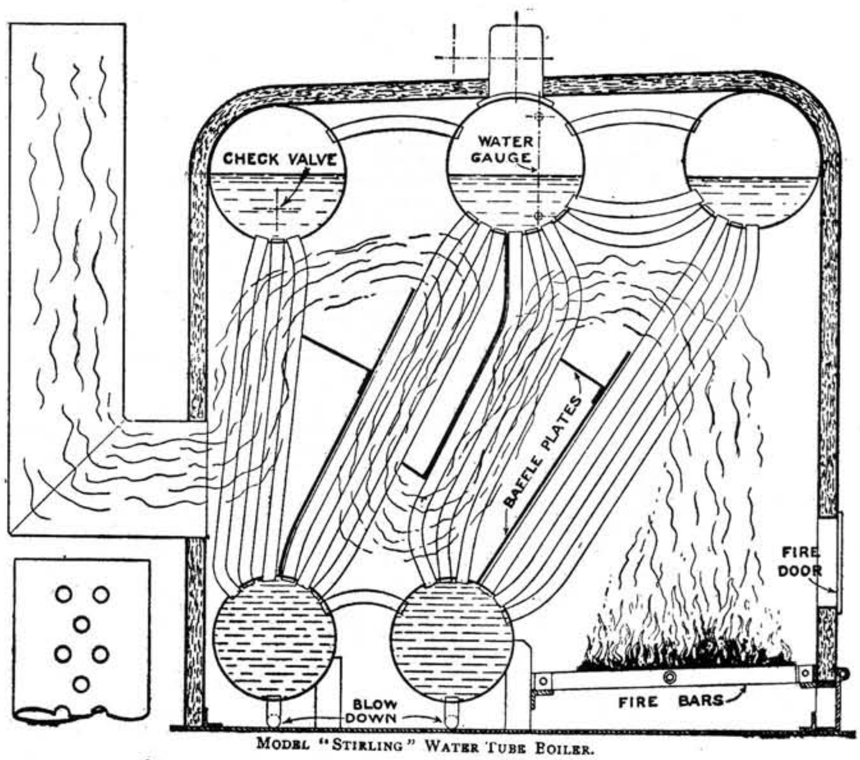
Queries and Replies.

[Queries on subjects within the scope of this journal are replied to by post under the following conditions; - (1) Queries dealing with distinct subjects should be written on separate slips, on one side of the paper only, and the sender's name should be inscribed on the back. (2) A stamped addressed envelope should invariably be enclosed. (3) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the reply can be forwarded. (4) All queries should be addressed to The Editor, The Model Engineer, 6 Farringdon Avenue, London E.C.]

The following are selected from the queries which have been replied to recently:-

[8046] Model "Stirling" Water-Tube Boiler. C. C. (Chiswick) writes: Would you kindly give me a sketch for a model of a "Stirling" water-tube land boiler?

We append a sketch of the original "Stirling" boiler and also a smaller drawing of the improved type, particulars which we did not receive until after making you the first sketch sent on to you by post. The tubes should be staggered, as shown in the detail, and the baffles which may be sheets of wrought iron, should be placed in the positions indicated by the heavy black lines. The improved boiler has one drum the less, which somewhat simplifies the construction without interfering with the circulation. The chief advantages claimed for this boiler are that the gases with the lowest temperature meet the coolest water, the gases also have a lengthy passage reducing the up-take temperature to the lowest degree possible and the lower drums provide ample space for the mud and sediment which may be present and allow it to collect in a position where it can do no harm and be easily blown off.



MODEL "STIRLING" WATER TUBE BOILER.

(Query No. 8046.) *(Scale: HALF FULL SIZE.)*

The Model Steam Turbine Competition.

Designs for Model Steam Turbines.

In the early years of "OURS" the editor ran a regular series of competitions on various subjects. In 1903 one of the competitions was to design a steam turbine. There were over 14 entries and the standard of the best was very high as can be seen here. The manufacture of these designs, even today, would tax the average model engineer, imagine making one of these engines with the limited equipment of the day. The prizes for these competitions were sometimes substantial, on one occasion a lathe was offered as first prize.

April 9, 1903.

A Model De Laval Type Steam Turbine.

THIS is a fairly simple machine to construct, and will recommend itself to a considerable number of model makers. It consists of a disc mounted on the centre of a flexible steel shaft, the supports of which are placed at a considerable distance from the disc. As it is impossible to accurately balance the wheel, this construction is necessary to take up the vibrations which arise through this inaccuracy and the extremely high speed at which it works.

The vanes, which are made of gunmetal, are fixed around the rim of the disc, and the steam is blown against them from a number of nozzles arranged around the circumference. In our case there are two nozzles, one at the top and one at the bottom of the wheel. It would be advisable to cast four bosses to the circular chamber to which the steam pipe is connected, and two of these could be left blank, so that they could be bored at any time to increase the power of the motor.

Fig. 6 is a sectional end elevation. This view also shows the governor and throttle-valve, which are very simple. The governor consists of two balls, connected to the two ½ in. diameter discs by two thin pieces of spring steel wire. Its action is similar to the ordinary Pickering governor action. The disc next to the driving pulley is rigidly keyed to the governor spindle, the other, nearest the throttle valve, is allowed to slip along the spindle. Fig. 8 shows a plan of the governor, and from this it is not difficult to see how it acts.

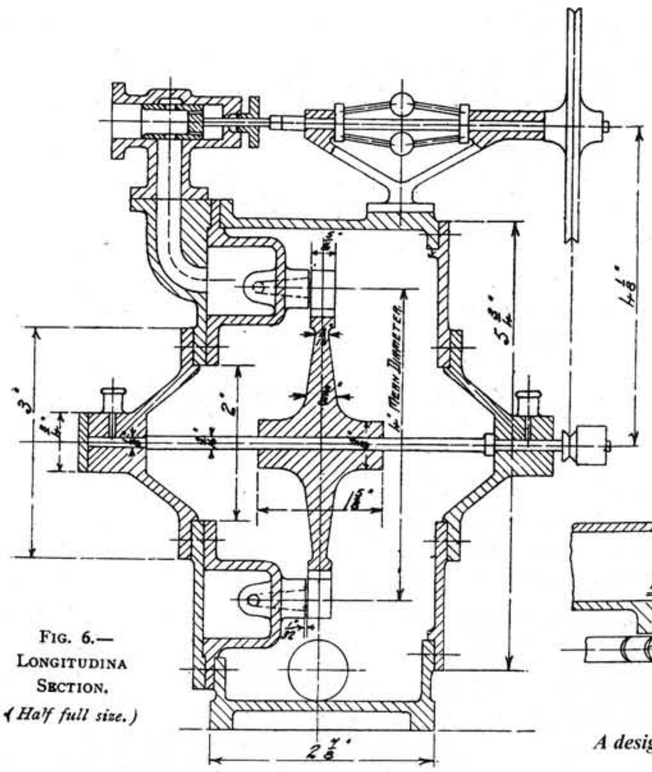


Fig. 6.—Longitudina Section. (Half full size.)

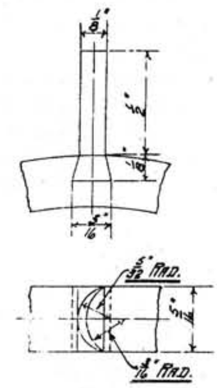


Fig 9.—Enlarged Drawing of Blades.

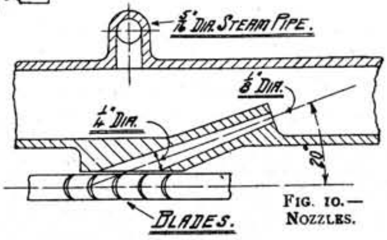


Fig. 10.—Nozzles.

A design for a Model De Laval Steam Turbine.
By David Shannon.

Fig. 8.—Governor.

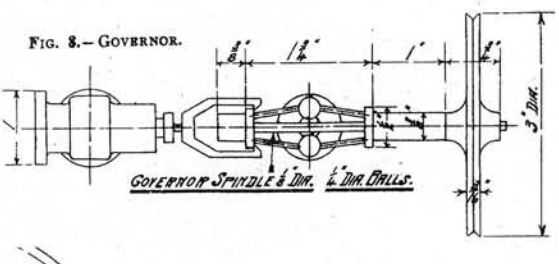
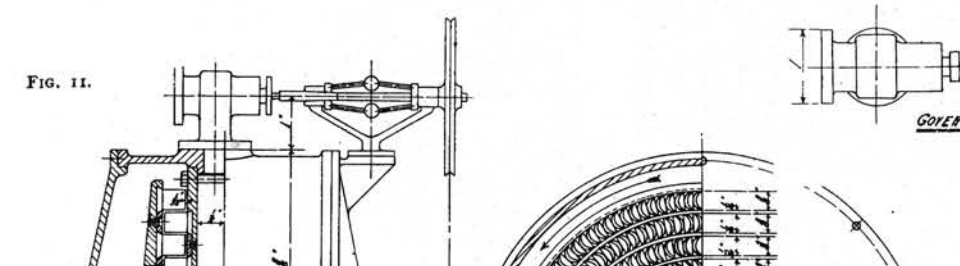


Fig. 11.



A Design For An Outward Radial Flow Model Steam Turbine
By David Shannon.

A ¾ in. diameter steam pipe is shown; but this only depends upon the power required to be developed. The steam pressure should be about 50 lbs. per sq. in.; and here it might be stated that a motor of this description works best and most economically with low pressure steam. The speed of this machine will be in the neighbourhood of 20,000 revolutions per minute, and must be geared down. The fixing for the blades must, therefore, be strong, since the centrifugal force is so great, and, consequently, the tension on the screws is high. As many screws as can be conveniently got on should be used in securing the rings to the wheel for holding the vanes. The ring for holding the stationary vanes need not have nearly so many, as the tension on these is small, being only that due to the flow of the steam.

August 27, 1903.

A Powerful High-Speed Engine and Flash Boiler.

By H. R. Ricardo.

AT ONE time I was bitten with the desire to build a fast steamboat. My first attempt consisted of a brown paper boat, 4 ft. 6 ins. long, 9 ins. beam, with a pinnace type boiler, 7 ins. by 10 ins., and a single cylinder double-acting engine 1¼ ins. by 1¼ ins. This was fairly satisfactory; but the boiler did not give enough steam, and after about a dozen sails the brown paper began to get sodden from various causes. My second attempt was more ambitious, and consisted of a wooden hull 6 ft. by 9 in. beam fitted with a two-cylinder double acting engine and a water-tube boiler of the Yarrow type; this boat took a year to complete, and was a failure. The engine was too complicated, and the friction very great; besides, I found it almost impossible to keep all the 132 tubes of the boiler tight. I had intended to use a pressure of about 100 lbs. per square inch; but could not get anything like this owing to leakage in the boiler and the violent priming. After a few attempts, I gave this up as a bad job, and started another engine and boiler for the same boat, with which I propose to deal in this article.

Figs. 2 and 4 show the general arrangement of the engine; the cylinders are 1⅛ ins. bore 1¼ ins. stroke; the speed is anything up to 5000 revs. per minute, and the pressure about 400 lbs. per square inch. Under these conditions the engine develops about 1 h.p., and weighs 7 lbs. without the flywheel. The flywheel shown in the drawing, of course, is not to be used in the boat, but was fitted to drive my lathe. The inlet valve is opened by a cam and closed by the pressure of the steam. The exhaust takes place through a number of holes 3-16ths in. diameter bored through the liner into the annular space around it. From here it passes through a ⅜ in. hole in the side of the cylinder; this gives a perfectly free exhaust, and, moreover, keeps the lower part of the cylinder warm. On the upstroke the piston compresses the steam left in the cylinder until its pressure rises above the boiler pressure, when the valve lifts and allows it to blow back into the boiler thus avoiding excessive compression pressure. The advantage of this compression is two-fold:- Firstly, it keeps an even pressure on the crankshaft, so much so that I have had it running at full speed with the crank-shaft resting on V-blocks. This steady, downward pressure saves the bearings from wear and reduces vibration to a minimum. Secondly, the heat caused by the compression prevents any loss of power through condensation, which is the chief trouble with small engines. The crank-chamber of this engine is an aluminium casting; the cylinders, pistons, and liners, are of cast iron, and the crank shaft is of cast mild steel, which is cheaper and easier to work than a forging, and I believe quite as good. I have not yet tried this engine in a boat, but mean to do so soon. At present I am building a small, light car for one, which it ought to be able to drive at a good speed. Fig. 11 shows a section through the boiler and burner. This consists of four coils of seamless steel tubing ⅛ in. by ⅜ in. - 36 ft. in all, coiled grid iron fashion; also one coil of 8 ft. for vapourising the paraffin for the burner. The boiler is encased in a rectangular casing 14 ins. long, 7½ ins. wide, and 7½ ins. high; this is made of sheet iron 18-B.W.G., lined inside and out with asbestos. About ½ in. from the top is a steel plate perforated with a number of ½ in. holes; this acts as a baffle, and tends to prevent down-draughts, which interfere with the working of the burner; from it also the boiler coils are suspended by six long bolts.

Sheet iron baffle plates are placed between the coils, in addition to the top plate. The burner consists of two parts - a small pilot lamp with its own vapouriser of the Hecla type; this is used for starting and for keeping the boiler and vapouriser hot when the engine is not working; and the main burner, which is shown in Fig. 12. This consists of five 1 in. tubes 12 ins. long, opening into a rectangular header at one end. (In the diagram four of the tubes are shown in section.) Four of these tubes have closed ends, and are inside the firebox; the fifth is open ended, and is outside it. The four tubes inside the firebox have saw cuts across their upper side every half-inch. At the mouth of the fifth tube is a small nozzle having a hole of about 1-40th in . in diameter (the

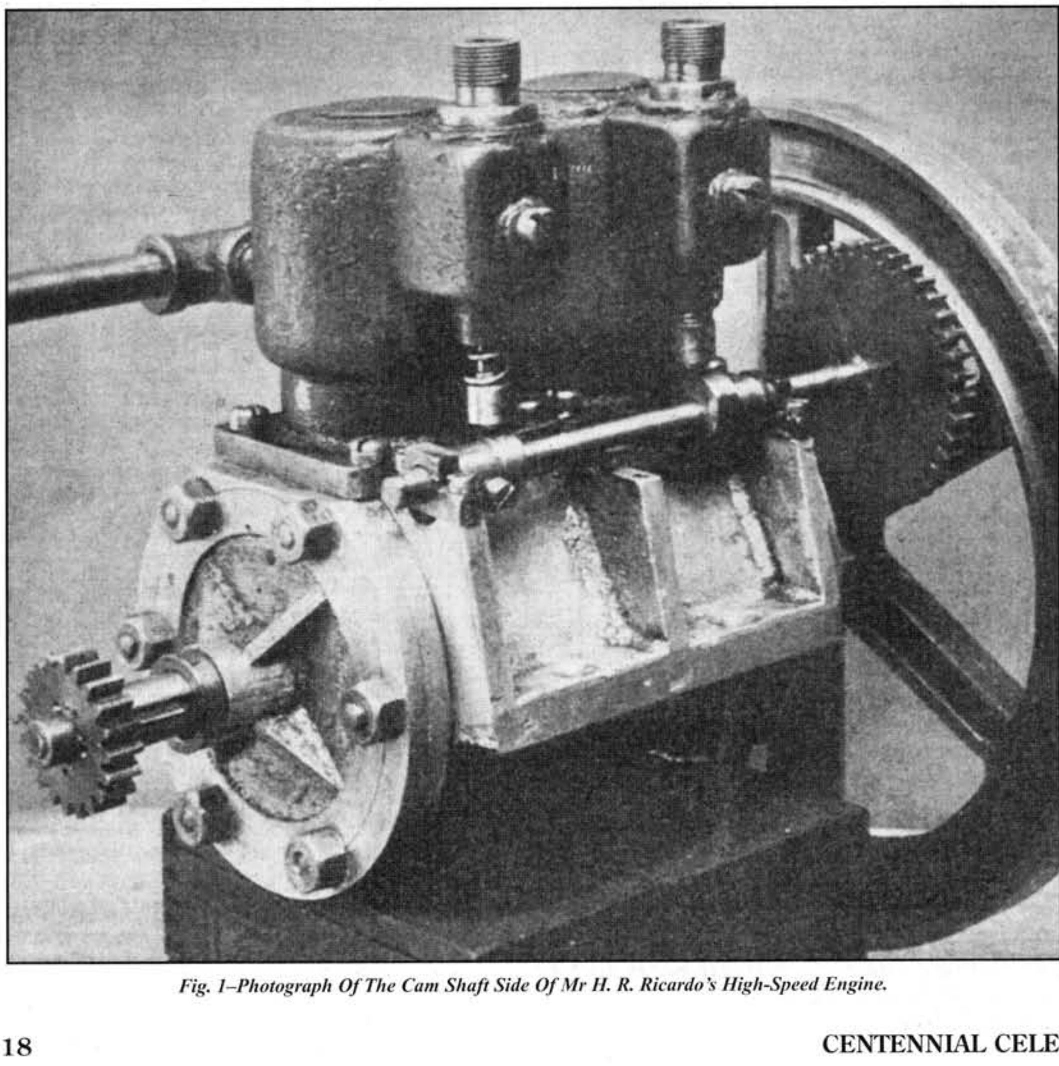
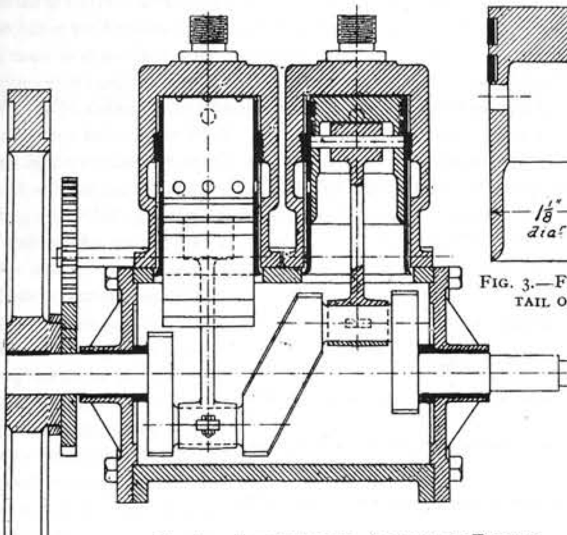


Fig. 1–Photograph Of The Cam Shaft Side Of Mr H. R. Ricardo's High-Speed Engine.

Over the years the Model Engineer has been home and mentor to a number of well-known names in engineering. In 1903 an article by H. R. Ricardo was published detailing a high speed uniflow engine with poppet valves and a flash steam boiler. He later became Sir Harry Ricardo and founded the world renowned engine consultants and development engineers that bear his name.

In view of the current discussions on safety and boiler testing it would probably be better if those of a nervous disposition did not read this article. Working pressures of 400 p.s.i., the boiler being well lagged with asbestos and not fitted with a safety valve, a relief valve having an adjustment up to 500/600 p.s.i., and very high pressures that seemed to fade away although the joints appeared to be steam-tight.
Are we letting the scaremongers spoil what is a perfectly safe hobby?



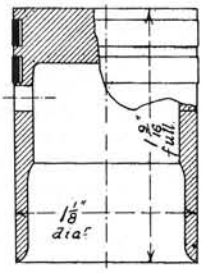


Fig. 3.—Full-size Detail of Piston.

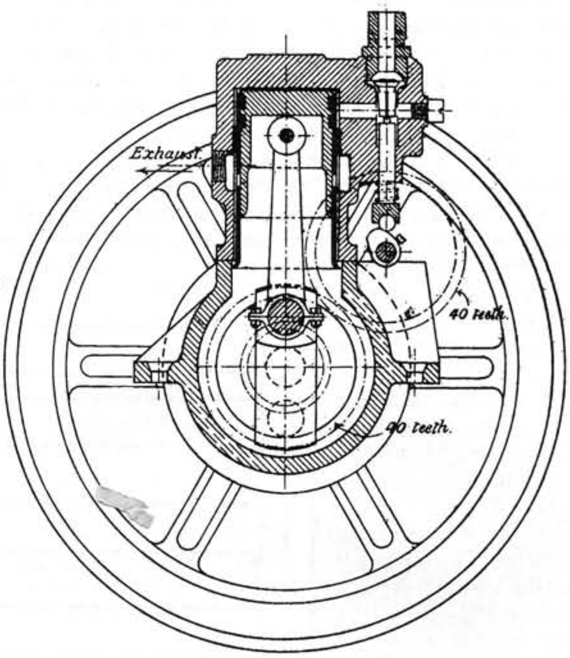
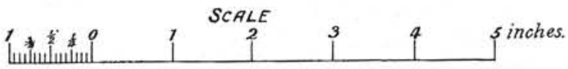


Fig. 4–Cross-section through Centre Line of Cylinder.



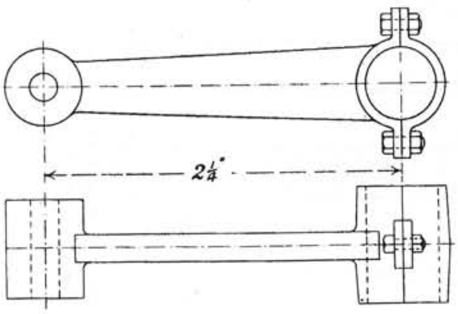


Fig. 5–Full-size Details of Connecting Rod.

A POWERFUL HIGH-SPEED STEAM ENGINE.

By H. R. Ricardo.

(For description see pages 204 *to* 208.*)*

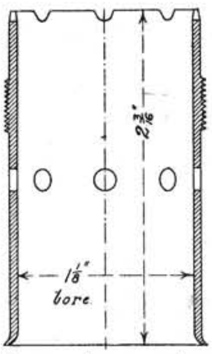


Fig. 7.—Cylinder Liner (Full Size).

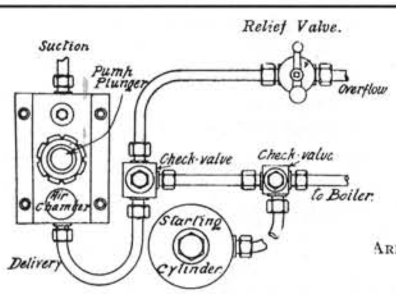


Fig. 8. Boiler Feeding Arrangements.

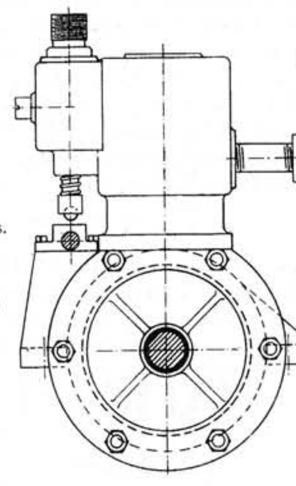


Fig. 9.—End View of Engine.

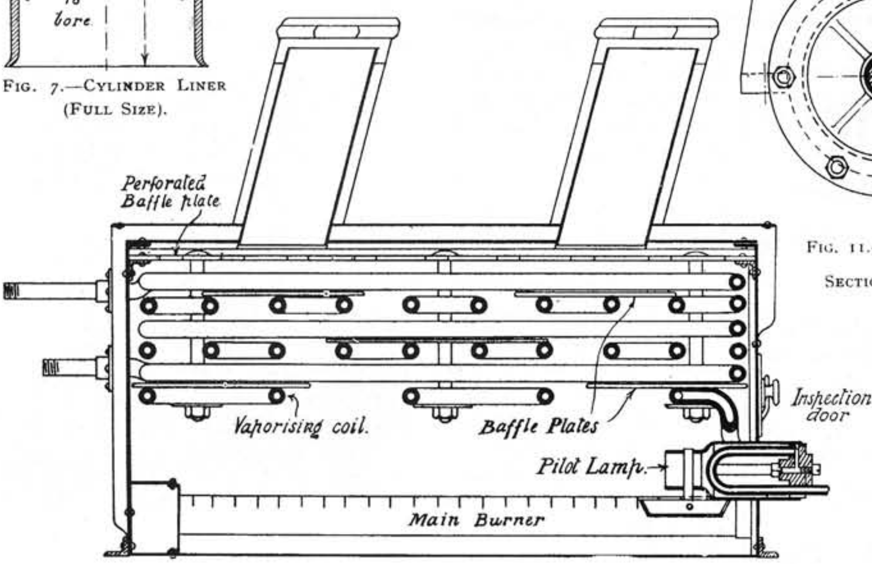


Fig. 11.—Longitudinal Section of Boiler.

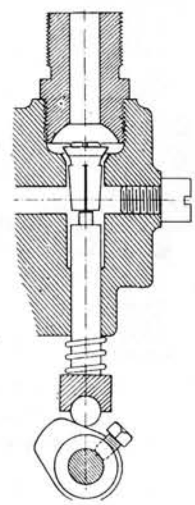


Fig. 10. Detail of Engine Valve (Full Size).

Mr. H. R. Ricardo's High-speed engine and Flash Boiler.

exact size can only be found by experiment). This nozzle is connected to the end of the vapourising coil by as short a length of tubing as possible. The action of the burner is as follows:- First, the pilot lamp is lighted and the vapourising coil heated nearly to redness; this takes about seven minutes. After this, paraffin is turned on to the vapourising coil at a pressure of about 50 lbs. per square inch; the vapour then issues from the burner nozzle down the open-ended tube, carrying a large supply of air with it. The vapour and air mix together in the header, and then issue from the saw-cuts in the four tubes in the firebox, forming a sheet of intensely hot blue flame absolutely smokeless and almost noiseless, only a faint, hissing sound being audible. In three minutes the boiler is hot enough to start. The boiler casing is entirely enclosed, all the air that is required being drawn in through the open ended tube.

There is an inspection door above the pilot lamp, and this is kept open whenever the lamp is in use; otherwise, it is apt to smoke. The whole boiler is heavily lagged with asbestos, and has a light, brass casing fitted over it and over the funnels. A pressure gauge is not of much use with this type of boiler, owing to the rapid fluctuations of pressure. I tried fitting a steam drum to steady the supply of steam, but found it of little use and often troublesome, as well as being rather dangerous on account of the fearful pressures to which it was often subjected. I do not use a safety-valve; I found it difficult to keep tight, and also, if any of the 'red hot' steam touched the spring, it immediately rotted it. The lubrication of the engine presents no difficulty so long as the crank chamber is kept quarter-full of good thick oil of the type used for air-cooled petrol motors. The valves of the engine need no lubrication and are better without it, for it only burns up and causes them to stick. Fig. 8 represents the feeding arrangements, which consist of a force-pump, two check valves, a relief valve, and a starting cylinder. I use the starting cylinder instead of a hand pump; it is less trouble to make, and much more convenient to use. It consists of a strong, brass cylinder containing about half-a-pint of water, kept under an air pressure of 120 lbs. per square inch. To start the engine all that is necessary to do is to turn on the water supply from the cylinder to the boiler. A few drops of water serve to start the engine, and then the force pump, which is geared 3 to 1 off the engine, keeps it going. Thus, half-a-pint of water in the starting cylinder lasts for a long time, and it is only necessary to occasionally give it a few strokes with a foot pump to keep up the air pressure; this is much less trouble than continual hand pumping. It will be seen that, on leaving the force pump, the water has the choice of two directions: either it passes into the boiler, where it is instantly flashed into steam, or it may pass through the relief valve and back into the tank. This relief valve has an adjustable spring, so that it may be loaded to any pressure up to 500 or 600 lbs. per square inch; thus, by varying the loads on the spring, the pressure in the boiler can be adjusted to a nicety, though, of course, it fluctuates with each stroke of the pump. I find it much the best plan to arrange the check valve between the boiler and the relief valve; for when the stop valve is shut down, the pressure of steam in the boiler rises somewhat, but cannot escape, and is ready for use when the engine is next started. On the other hand, if the relief valve is placed between the check valve and the boiler, the sudden kick back when the water enters the boiler causes the relief valve to open and discharge it all before any quantity of steam has been generated, so that it is necessary to keep a very heavy load on the relief valve, and even then its action is erratic if the boiler is very hot. Of course, the danger of putting the check valve between the relief and the boiler is that if there is any water in the boiler when the stop-valve is shut, the pressure may rise to an alarming degree. This is all very fine in theory, but in practice steam at very high pressures seems to fade away mysteriously although the joints may appear to be quite steam-tight.

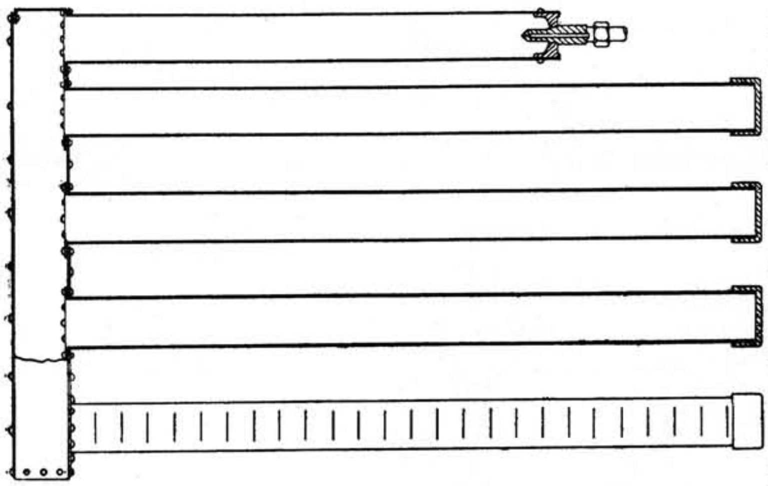
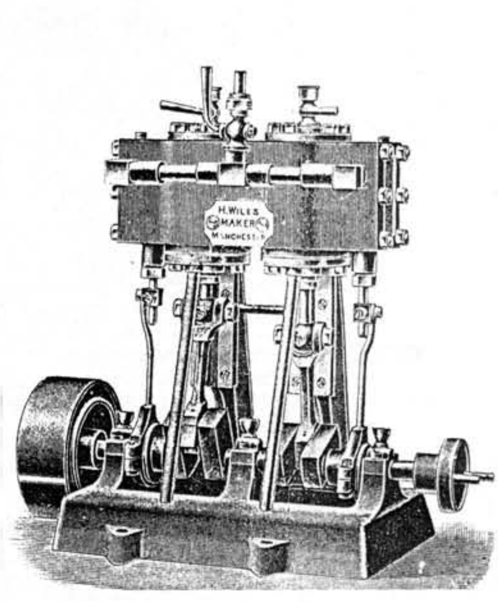


Fig. 12–The Main Oil Fuel Burner

Besides, the tubes can easily stand 10,000 lbs. per square inch, so there is no danger of their bursting. Of course, it is not advisable to start the engine again until the pressure has steadied down a bit; in other words, after the engine has been stopped by the stop valve, it must not be re-started for at least thirty seconds.

Wiles' Bazaar & Model Dockyard, 36 and 38, Market Street, Manchester, have issued a very good catalogue of model engines, steamboats, yachts, and fittings, comprising 100 well illustrated pages. In addition to model boiler and other fittings, several new models of Messrs. Wiles' own manufacture are listed, - a twin cylinder (4⅞ ins. by 1 in.) launch engine. The other specialities include single cylinder launch and high-speed vertical engines, horizontal engines and boilers, and a new design of single express locomotive. Amongst some of the novelties listed are switchback railways suitable for house or garden, upon which children may ride, model shell-throwing cannon, electric trains, and steam motor lorries and omnibuses. Model locomotives, steam and clockwork, and also model yachts and fittings, are well catered for in this catalogue, which will be sent post free to any reader on receipt of 6d., which will be returned to customers of goods to the value of 10s. and over.



MESSRS, WILES' TWIN-CYLINDER LAUNCH ENGINE.

March 24, 1904.

Volume 10 contains several unusual designs of which I include just two in this part work. Anyone contemplating building something different could do worse than to recreate these designs from the past.

Design for a Model Rotary Steam Engine.

By N. Fearnley.

ALTHOUGH the "rotary" form of steam engine is not of great practical value in large of 'working' size, yet a small power engine of this type, if carefully made, will give a very good result with fairly high pressure steam, and working at a good speed.

The main drawbacks to the engine for commercial use in large sizes, are (1) the large amount of friction between the 'piston' and the walls of the piston chamber, and (2) the large amount of steam required for each revolution. Its chief advantage is its entire lack of reciprocating parts, and therefore its lack of vibration when running.

In a model or engine of small power the drawbacks - to a great extent - vanish, while the advantages remain. The smaller the diameter of the piston chamber the less will be the friction between the piston and the wall surfaces, owing to the lower linear velocity of the moving parts, and also the smaller the diameter the less wasteful of steam will the engine be.

A number of models of rotary engines of various types may be seen in the collection at South Kensington, but they all differ in some respects from the design given here, which is, to the writer's best belief, original.

Rotary engines of this type in the Museum collection have a 'trap door' arrangement which prevents the live steam from passing round into the exhaust, and also from acting on the back of the 'piston'.

It is also the duty of this 'trap door' to resist the action of the steam and so cause the piston to move round in the opposite direction. In the design given here a brass drum - from which a section has been cut - takes the place of the 'trap door' which in practice soon succumbs to the violent treatment meted out to it by the piston when the engine is working at a high speed.

The drum, on the other hand, is geared equally with the main shaft and is so actuated mechanically and there is no extraordinary wear and tear when working.

The drawings are self-explanatory, and the general arrangements are to a scale of half full size, the details being fully dimensioned. (I have purposely omitted certain dimensions which can be easily obtained, in order that the drawing may be as simple as possible to read.)

The action of the engine is as follows:- Steam is admitted (at good pressure, say, 40 lbs.) at the point S in valve diagram. The exhaust is open during the whole revolution, and the exhaust pipe should be made as large in diameter as possible. With the disc valve shown, 'cut off' takes place at half revolution, but this point can be accelerated or retarded by shortening or lengthening the slot in the disc.

The drum A, with piston cast on, is geared equally with drum B, and the drums are so arranged on their shafts that the gap B just allows the piston to pass and then closes immediately behind it.

To the back of the piston is fastened a brass plate, and between these is clamped a square piece of leather packing. The bed is shown extended (in dotted lines, Fig. 1, page 276), to suit dynamo or other driven machinery. In presenting this design, I must warn would-be makers that the engine will not prove very economical in steam consumption as compared with a reciprocating engine of equal power, but would again point out that it possesses advantages over the more common form of engine, which should not be forgotten. Extreme simplicity of construction is also a decided point in its favour.

To searchers after novelty, the design will, I venture to hope, be of interest and open up a channel for the exercise of their experimental genius.

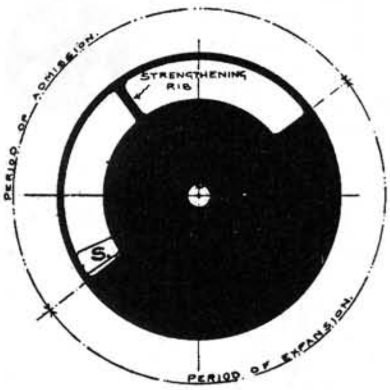


Fig. 11–Diagram of Steam Valve.

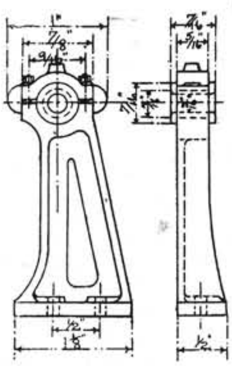


Fig. 5.—Bearing B: one off.

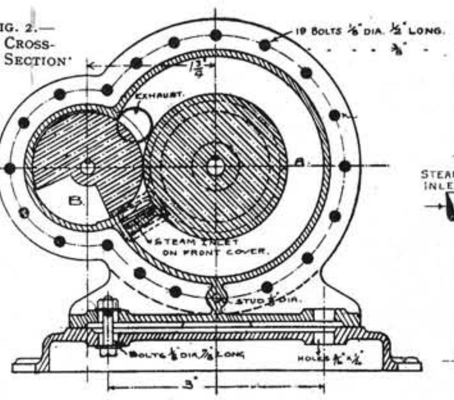


Fig. 2.—Cross-Section.

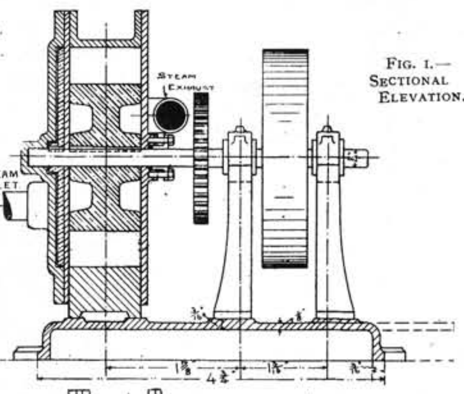


Fig. 1.—Sectional Elevation.

DESIGN FOR A MODEL ROTARY STEAM ENGINE.

By N. Fearnley

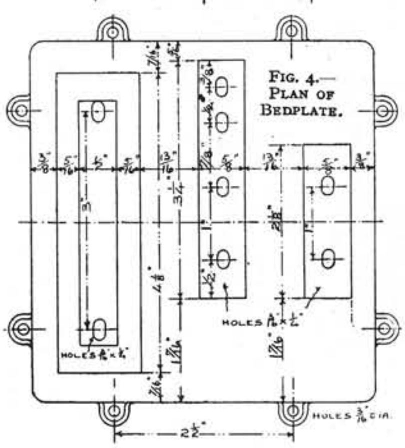


Fig. 4.—Plan of Bedplate.

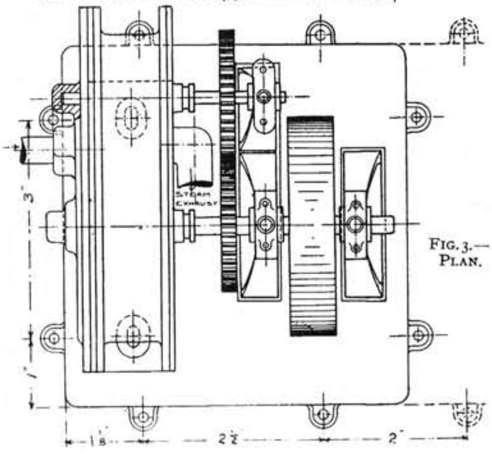


Fig. 3.—Plan.

A New Type of Model Engine.

By F. J. Payton.

A DOUBLE-acting model engine with a fixed cylinder, without some sort of a mechanical valve motion, is certainly a novelty, and whilst the diagrammatical sketches here reproduced make the design for such a model appear somewhat complicated, the engine is really very simple. A horizontal

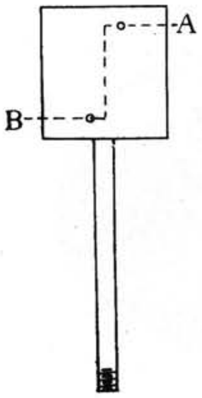
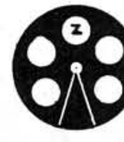


Fig. 1



SECTION A.B.
Fig. 2

engine of this design would probably be easier to construct than one of the vertical type, which, however, was required and adapted in the present instance.

The diagrammatic Figs. 5 and 6 are only produced to show the various ports and passages, and to give a clear understanding of the general arrangement and working of the engine.

If a horizontal engine were required, it could be

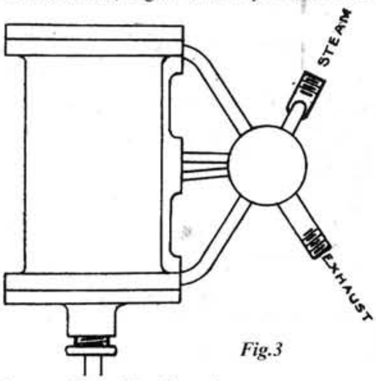


Fig. 3

made something after this style.

Figs. 3 and 4 show the arrangement of the pipes, etc., in the actual engine of the marine type, it being always desirable to place the piston valve horizontally. The crosshead, connecting-rod, crank, and flywheel (which are omitted from the sketches) will be exactly like an ordinary engine, except that the piston being proportionately heavy a suitable balance

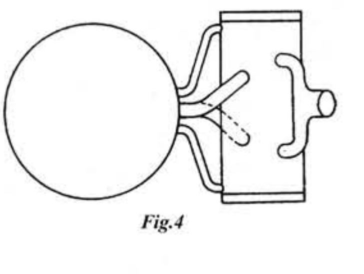


Fig. 4

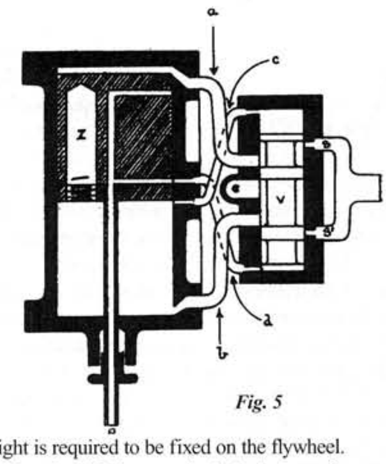


Fig. 5

weight is required to be fixed on the flywheel.

Figs. 1 and 2 show particularly the ports for actuating the piston valve. It will be seen by the diagram sketches these passages come opposite the connecting pipes d and c, and lead to the hollow piston-rod. The fire circles Z are holes drilled in the piston to lighten it, the openings afterwards being plugged up, as shown in Figs. 5 and 6.

To explain the action of the valve under working conditions, we will first give attention to Fig. 5. The piston is now at the top of the cylinder. Steam is entering S, and passes round the piston valve V to the cylinder by-pipe a. The piston of the engine now descends, and the exhaust is passing through pipe b, and the centre portion of the valve V to the exhaust pipe e.

When the piston reaches nearly to the bottom of the cylinder, the port connecting the bottom of the valve casing to the cylinder is uncovered by the piston in the cylinder, as shown in Fig. 6. Steam is then admitted beneath the piston valve, which forces it to the other end at the valve casing, and the steam which was previously on the upper side of the piston valve escapes through pipe c', to the piston rod of the engine.

Immediately the valve has moved to its new position steam is admitted to the bottom of the cylinder through S''', and by the pipe b' (Fig. 6). The piston at once rises, and the steam above the piston exhausts through pipe c' to e.

The engine will run in either direction, it being only a question of giving the flywheel a start in the way it is desired to go. With a double engine the cylinders can be placed quite close together with the valve casings at the back, which would make a very neat arrangement; and as there would be no eccentrics the crankshaft is quite free for suitable bearings.

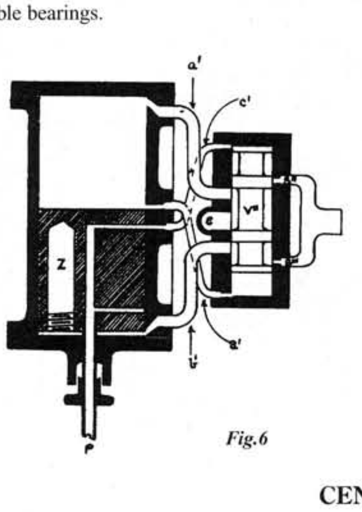


Fig. 6

July 27, 1905.

Piston Rings for Small power Steam Engines.

By Samuel Keighley.

I SHOULD like to bring before your notice the piston ring I have designed. I have tried them both in large and small engines, and several are working at the present time.

The ring is cut into four quarters, as you will see by the photographs and drawings. The ring itself I prefer to make of cast iron; into these are fitted four vee-pieces, for the purpose of adjusting the wear that takes place. These vees are thrust out by spring coil, as shown, or by spiral springs bedded into boss of piston body. The novelty of this ring lies in the fact that each vee-piece is dovetailed into each portion of the ring, thus maintaining a more equal expansion of the ring. If one portion tended to expand more than another, the fact of their being dovetailed in the manner shown would lock that portion and retain it till the opposite side expanded. This also allows uniform wear on all parts of the ring.

Another advantage is that there is no passage for steam - as the ring wears the vee-blocks follow up the gap, thus keeping the ring practically as tight as a solid ring, with the advantage of being as elastic as possible. I may mention that this ring can be employed for pumping, instead of bucket leathers. The photographs were taken from a piston 4 ins. in diameter.

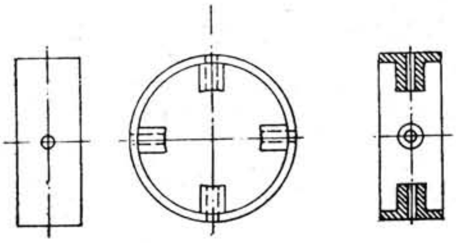


Fig. 1–Guide Ring.

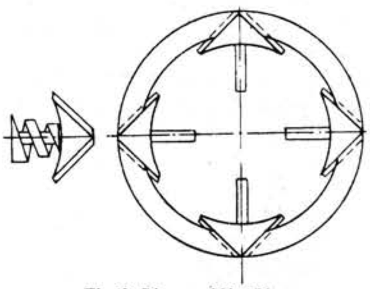


Fig. 2–Ring and Vee Pieces.

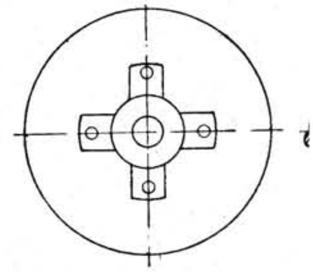


Fig. 3–Piston Body without Guide Ring.

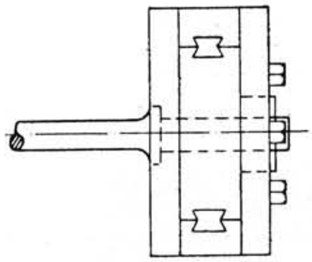


Fig. 4–Piston Complete.

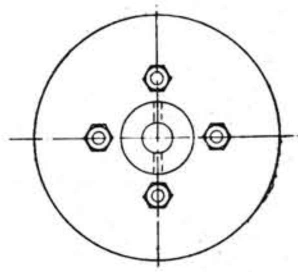


Fig. 5–Piston Body with Lid on.

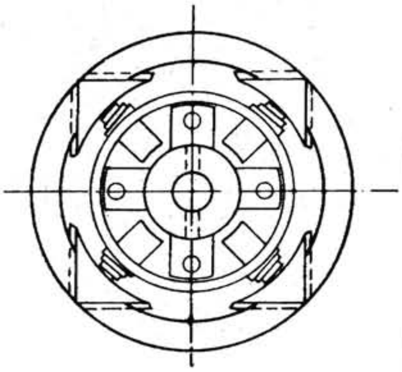


Fig. 6– View of Ring Complete.

August 10, 1905.

A Miniature Steam Engine.

THE accompanying photograph shows a miniature steam engine, the building of which occupied the odd moments of Mr. Charles E. Fish, of Baltimore, Md., USA., for over two years. It is a vertical compound, with cylinders ⅜ in. and ⅝ in. in diameter and a stroke of ⅜ in. The valve travel is 7-64ths. The number of separate parts, counting nuts, bolts, screws, &c., is 368, the total number of pieces used in its make-up being 454. The smallest stud bolts are .027 in. in diameter, the largest .05. All the studs are fitted with hexagonal nuts that measure 1-16th in. across the squares for the smallest, to 3-32nds on the largest. There are 76 hex-headed cap-screws and bolts of different diameters and length, the smallest being .035 in. in diameter and 1-16th in. in length, and the largest .041 in. in diameter and ½ in. in length, the head of each being filed to fit a wrench with an opening of 3-64ths for the smallest and 1-16th for the largest. Altogether there are 68 studs, 52 cap-screws, 24 bolts, and 114 nuts to hold the engine together.

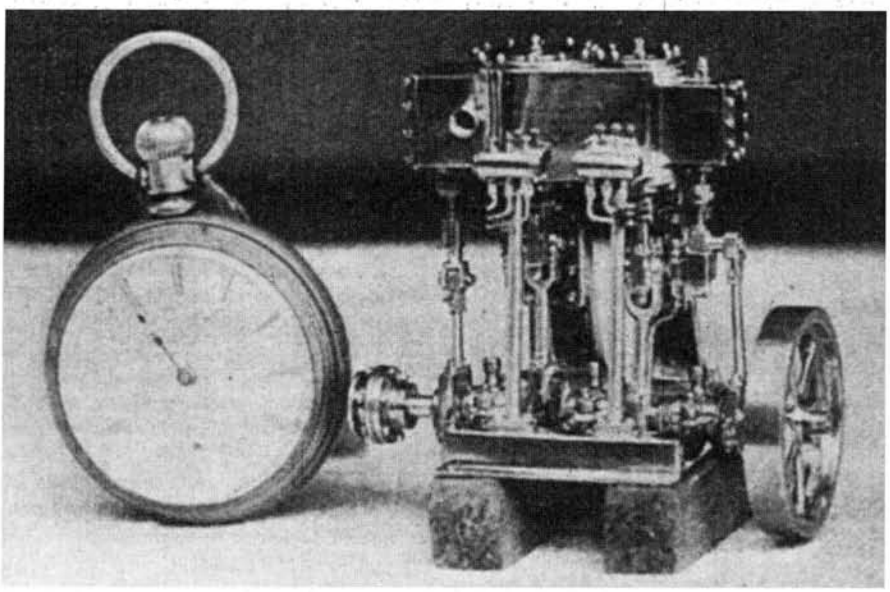


Fig. 1–Mr. Chas. E. Fish's Miniature Steam Engine.

The cylinders, back columns, base, valve-stem brackets, and eccentric straps are made up of pieces of sheet brass and tubing sweated together with hard solder and finished by nickel plating; the other portions, such as the connecting-rods, front columns, shaft, eccentric rods, valve stems, piston-rods, &c., are made of machine steel. Some of the main dimensions are as follows:-

Connecting-rods, 15-16ths in. between centres; cylinders, 11-16ths in. centre to centre; height of engine from centre to shaft, 2⅜ ins.; height of engine over all 3⅛ ins.; crankshaft, 5-32nds in. in diameter by 3 ins. long; high-pressure eccentric rod, 15-16ths in. long; low-pressure eccentric rod, 9-16ths in. long; piston-rods, 1-16th in. in diameter; valve stems, 1-32nd in. in diameter.

The work is done so nicely and the engine runs so smoothly, that it can be run as slow as 100 revolutions per minute, and it is strong enough to run with an air pressure of 110 lbs. per sq. in. Under this pressure it has shown, with an indicator, a speed of 4,700 revolutions per minute, and without the indicator attached runs considerably higher. All the work was done without the aid of a magnifying glass.

Over the years of Model Engineer there have been many articles on engines built to normal conventions. In researching through the back numbers there are a number of designs breaking with the norm that deserve a wider audience and perhaps some of our readers will recreate some of these designs of the past. One such engine was described in 1906. I am not quite sure how to describe it, I suppose it is a form of sleeve valve. The other contribution from the same issue is one that we have all been faced with, the removal of a broken drill from a casting.

April 5, 1906.

A Novel Design for a Small High-Speed Steam Engine.

By Henry F. Jay.

PERHAPS after so long spending their spare time at constructing the ordinary type models, some readers of ours would like to enter on to something new, or rather different than the rest, which would cause increased interest and excitement while constructing, and anticipations which - judging from my own standpoint - are certainly pleasant, as to whether your intrusion into the mysterious is going to 'go'. I do not use the word 'success', as this covers such a wide range of particulars that it can hardly be used in the model world, in any case in connection with a model which has previously only been on paper.

Herewith is given a photograph of a high-speed two-cylinder engine of a novel design; also two sketches. Fig. 2 helps to explain the working of the particular gear differing from other engines; whilst Fig. 3 is a device which, although not yet fitted up, is in course of construction, and will shortly come into use.

Referring to the photograph of engine, it looks much the same as a model of any ordinary high-speed engine, only the cylinders appear to be lower down. The usual drain cocks are on cylinders; also two drain cocks on crank chamber, as well as an overflow pipe. The steam and exhaust pipes are also shown, the exhaust being about two and a half times the internal diameter of the steam. One flywheel is used at present, the shaft being left as long at the other end for pulley wheel, coupling, or even another flywheel if required. The cylinders are 3¼ in. bore 1½ in. stroke, lagged with asbestos and wood, the steam chest being lagged with asbestos covered with blue steel. The crankshaft is ⅝ in. diameter, and in two pieces, with coupling in centre. The flywheel is about 8 ins. diameter, and the weight is about 20 lbs. The engine is totally enclosed, having specially constructed glands for the shaft to pass through the crank chamber, in order to guide back any liquid having a tendency to come through. As will be noted the engine is splash lubrication, the surplus oil and water passing out through the overflow pipe seen on the photograph. The crank chamber may be partially or entirely drained by means of the other two lower cocks. It will be seen that all cylinder drains are brought to one common outlet near by other outlets, for convenience of disposing of the waste. The two cylinder lubricators can be seen over the exhaust pipe, which are the only lubricators on the engine, these not really being required, as the splashed lubrication has access to every working part, except perhaps the trunks. The cylinders appear perhaps a little far apart, but this is due to my wishing to have a coupling in the centre of shaft line between cranks.

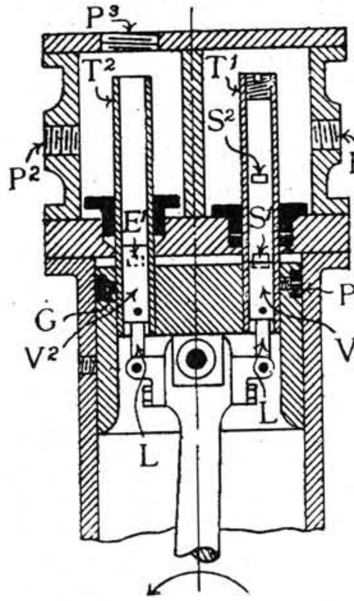


Fig. 2

SECTION THROUGH CYLINDER AND STEAM CHEST.

I now propose to leave the photograph and get along with the real point in these notes, viz., the arrangement of trunks and valves controlling the steam distribution. For that we will refer to Fig. 2. These sketches are not in any way in proportion; also several details, such as bolts, etc., have been left out, as they are only to assist my explaining the actual working. In Fig. 2 a portion of one cylinder with steam and exhaust chests are shown, together with piston trunks, valves, etc. The ports in the trunks are shown by the squares S^1 and S^2 in the case of the steam, and E^1 in the case of the exhaust side. The valves are shown in position inside the trunks. Split rings are used in gland on steam side, and ordinary packing on the exhaust side. This engine was originally intended for reversing and both trunks were left open at the top, and a simple reversing hand-valve placed between the cylinders changed the steam and exhaust sides, but this was not at all satisfactory, having so much back pressure; so I resolved to change it into an undirectional high-speed engine. Now not having the reversing problem to deal with, I was able to work my steam and exhaust trunks to the best advantage, so plugged up the top of the steam trunk, and cut ports S (four in number) in such a position so as to cut off the steam at about ⅓-stroke, as will be shown. The sketch shows piston at the top of its stroke ready for downward movement. The cylinder is thrown out of centre with the crankshaft, so, although the connecting-rod appears at dead centre, the crank is in reality slightly over in the direction of arrow which way the engine revolves. This is to give the valve the necessary lead, and gives the steam a better effect; as when the valve (V^1) has allowed of a full port (S^1) opening the crank is ready for its downward movement. As will readily be seen, the majority of the valve travel occurs at top and bottom of stroke.

Now as to the action whilst running. Live steam enters at P^1, passes through port S^2 (of trunk) and again through port S^1 to top side of piston; port E^1 is closed by exhaust valve. Piston moves downward and at third of stroke the steam is cut off by port S^2, passing into gland. Steam expands for the rest of stroke. At bottom of stroke connecting-rod is thrown over, V^2 being drawn down and V^1 pushed up by their links LL.

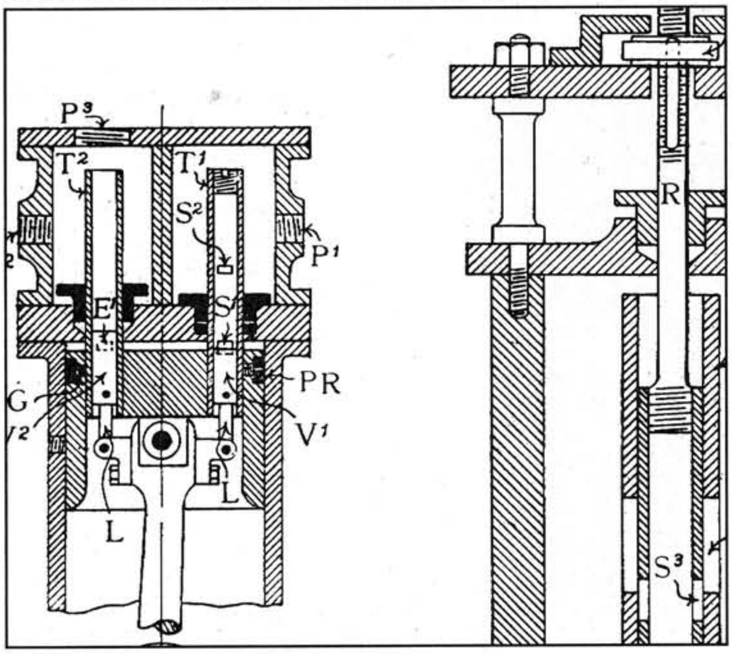


Fig. 1–Mr. Henry F. Jay's Small High-Speed Steam Engine.

This allows exhaust steam to flow through E^1 up trunk T^2, and out of ports P^3 or P^2 as desired (in the actual case P^3 is used). This goes on for the whole of the up stroke, E^1 being closed again before S^1 is opened, and the cycle is repeated, the engine being single acting, with a trunk piston forming its own guide. P R are the spring piston-rings, and G a small grub screw to fix the trunks, not much hold being necessary.

Fig. 3 is a sketch of a gear I have under construction for varying the cut-off. It shows an enlarged view of the steam chest with gear fitted. The inner trunk T^2 is capable of being moved up and down by means of the wheel W acting on the top screw. It will be easily seen that by drawing this up earlier, and by pushing it down later, cut-offs are obtained. The range of cut-off is limited by length of trunks, steam chest, and thickness of gland, as if port S^2 were long enough it would connect the steam chest with cylinder, but, within reasonable limits, I think there is every reason why this gear should work.

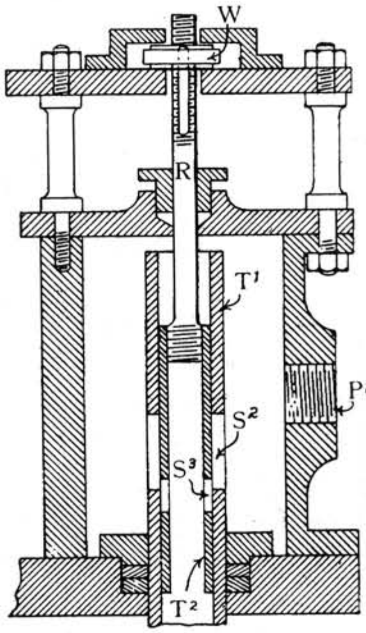


Fig. 3–Arrangement for Varying Cut-off.

If I were again constructing this engine I should, of course, only have one trunk, and make the one valve serve for exhausting on inside of hollow piston, passing through a slotted port in a suitable position through cylinder wall. It is very clear then that this principle may be applied to simple, compound, triple, etc., engines, placing one cylinder above another, and having a trunk, and line of valves passing through, having a series of hollow pistons as receivers. A steel piston-rod would then be required in the centre, connecting all pistons up.

In conclusion, I may point out that as a single acting engine the bearings are always in constant thrust, the area of trunk always being under the influence of steam. The above engine works remarkably well with 100 lbs. per sq. in. steam pressure, making some 1,000 r.p.m. All the castings were supplied to my own patterns by a firm advertising in this Journal, as well as fittings, bolts, etc.

April 5, 1906.

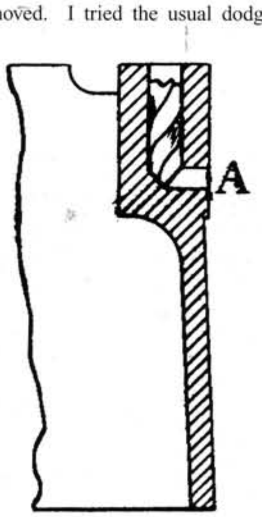
Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume, if desired, but the full name and address of the sender MUST invariably be attached though not necessarily intended for publication.]

Removing a Broken Drill.

To the Editor of The Model Engineer.

Dear Sir, - While engaged in drilling the main bearing stud holes in a small Stuart Turner vertical engine bed, I had the misfortune to break a twist drill off in the hole. Of course it broke off below the top of the hole (they mostly do). Fig. 1 shows a rough section of a portion of the bed showing the broken drill and how it was removed. I tried the usual dodges of jarring it out, etc,



METHOD OF REMOVING BROKEN DRILL

including softening the piece and drilling out. This latter is useless as the softened drill is still harder than the cast iron, and a drill slips off it and into the softer metal at the side. A young friend of mine who was looking on suddenly suggested drilling a hole in the position shown at A, and starting the broken piece with a punch. This was perfectly successful, and the small hole can be filled up with a bit of lead. Trusting this may be of use to other readers.

Yours faithfully, E. W. Fraser.

Clapham, S.W.

September 20, 1906

January 25, 1906