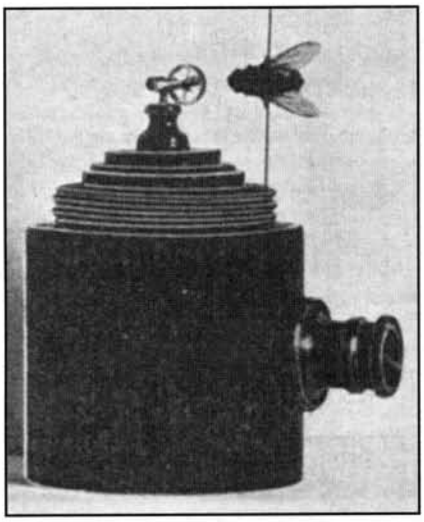
August 23, 1906.

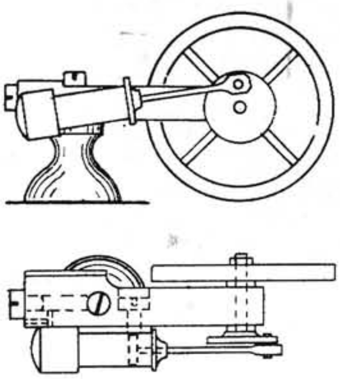
The Smallest Engine on Record

SOME time ago we illustrated a diminutive model oscillating engine having a cylinder bore of about .04 in., and the flywheel 7-16ths in. diameter. We now reproduce a photograph of what we think may rightly claim to be the smallest



A Diminutive Steam Engine

engine in the world. It is made of gold and steel by a Toronto watchmaker, Mr. T. H. Robinson, of 526 Yonge Street. It is smaller than a common house fly. The comparison may be seen by the photo. The smallest cartridge used in that country, the rim-fire "22 short," will easily slip over the entire engine and flywheel. The stroke is 1-32nd in.; bore of cylinder, 3-100th in.; diameter of flywheel, 3-16ths in.; weight, 1gr.; speed, 6,000 r.p.m. - that is 100 per second. When running no motion is visible, but the vibrating piston emits a note similar to that made by the mosquito.



AN ENLARGED DRAWING OF MR. H. J. ROBINSON'S DIMINUTIVE ENGINE.

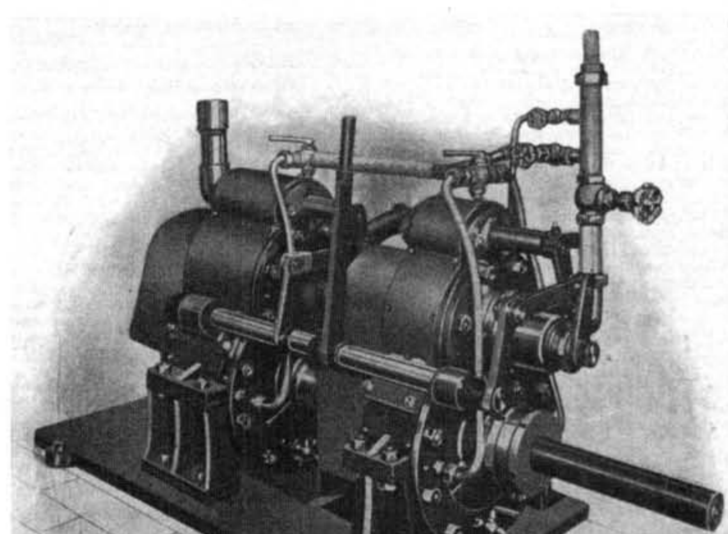
The horse-power is 1-498000th, and the complete engine weighs just 4gr., Troy weight - about the weight of a match. This means that it would take 120 such engines to weigh 1 oz., 1,920 engines 1 lb., or 3,840,000 engines to weigh one ton. The measurement of speed and horse-power has been made by Dr. C. A. Chant, of the physical department of Toronto University. The engine bed and stand are of gold; the piston-rod, cylinder, shaft and centre of flywheel are of steel; the rim of the flywheel is gold. The feed is through the stand of the engine bed, which is hollow; this is mounted on a brass tube which is encased in ebony furnished with a screw top for purpose of safety in carrying. Compressed air has been used to run it and connection is made through the ebony casing.

Two hardened and ground steel bearings are inserted in the gold engine bed for the shaft to run in. These are counter bored from the inside, which further diminishes the friction as well as forming a self-contained oil well - the oil hole being placed midway between them on top. Seventeen parts are employed in the engine.

November 8, 1906.

The Latest in Engineering.

THE Palindrome Direct Expansion Reversible Rotary Engine. - A preliminary notice of this interesting steam engine was given in The Model Engineer about a year ago, and we are now able to give some further particulars. There are two principal parts - viz., the piston and the valve. These rotate in opposite directions and in the same plane, with their centres parallel; they are geared together by spur wheels of equal size. In a simple engine there would be one piston and one valve; for a compound, triple, or quadruple engine there would be two, three, and four pistons and valves, arranged in line - in fact, a repetition of the single engine with suitable proportions, except that the one pair of gear wheels would suffice. The piston consists of a circular boss provided with a fixed flat vane, against which the pressure of the steam is exerted; this vane moves in a circular chamber which forms the cylinder, and is steam-tight. The valve is cylindrical in form, and hollow, like a circular box; it rotates upon a fixed tube, through which the steam enters. Ports are cut in the tube and the valve, so that as the latter rotates the steam admission is opened or closed at the correct moment. The valve and boss of the piston roll in contact with one another, a space being cut away in the valve to permit the vane of the piston to pass. Two exhaust ports are provided, one on either side of the point of inlet; but only one is in use at a time, depending upon the direction in which the piston is rotating. The point of cut-off for admission of steam is altered at desire by means of an inner tube, which is fitted inside that upon which the valve rotates. This inner tube is moved through a limited amount of rotation by means of the lever seen in the centre of the illustration, and its position determines the direction in which the piston rotates. The working of the engine is as follows:- Steam being admitted through the stop valve passes through the centre of the engine valve, and presses against the vane of the piston upon one side or the other, according to the position of the reversing lever. The piston then rotates, and in doing so also causes the valve to rotate, as the two are geared together by the equal spur wheels already mentioned. After certain movement has taken place the valve port reaches the point of cut-off, and the steam being confined in the circular chamber, expands and drives the vane through the remainder of the revolution. As soon as the vane passes the exhaust port the steam discharges; the vane then enters the space in the valve



THE PALINDROME REVERSIBLE ROTARY ENGINE.
Compound Marine Type, 10 B.H.-P.
About 1-12th actual size)

which has meanwhile been rotating, and passes to the working position, when the cycle of operation is repeated. Thus the valve only controls the admission of steam; exhaust is independent, and not controlled in any way except by the reversing lever which opens the port required for use and closes the other. If the engine is compound or triple, etc., the exhaust goes from the high to the intermediate and low-pressure cylinders in the usual way, the vanes of the pistons being set at suitable angles to each other. The cocks shown in the illustration are for starting purposes, to admit steam to one side or other of the vanes if required. Great things are expected from this engine by the inventors, and a syndicate is, we understand, being formed for the purpose of exploiting the invention, which is patented in Great Britain and abroad. It is of interest at the moment in connection with THE MODEL ENGINEER Speed Boat Competition, as Mr. Henry R. W. Bruce - one of the acceptors of Mr. Arkell's challenge - intends to use a small scale "Palindrome" engine in his boat. He is confident of obtaining some remarkable results, and we hope to publish complete drawings and details of his engine after the race has taken place. In response to an invitation from Mr. Bruce one of our experts has recently inspected two of these engines running under steam - one, a single cylinder type of 16 b.h.p., and the other a compound engine, as illustrated here, to give about 10 b.h.p. Both are non-condensing; speed of either 500 r.p.m. approximately; no holding-down bolts being used. The sizes over all are as follows: The single engine is 4 ft. 6 ins. by 3 ft. high by 2 ft. wide; the compound engine is of similar length, but 2 ft. 6 ins. high by 18 ins. wide. Mr. Bruce will be pleased to show these engines under steam to any reader by appointment at Miller's Wharf, Lower East Smithfield, London, E.1. (near Tower Bridge).

December 3, 1908

Many model engineers have started in the hobby by building a Stuart Turner 10H or 10V engine. It may surprise readers to learn that the 10V was first produced in 1908 when 1,000 sets of machined parts were going through the works. I wonder how many sets have been produced in the intervening 90 years and how many have been completed?

The news of the Trade.

"Stuart" Developments.

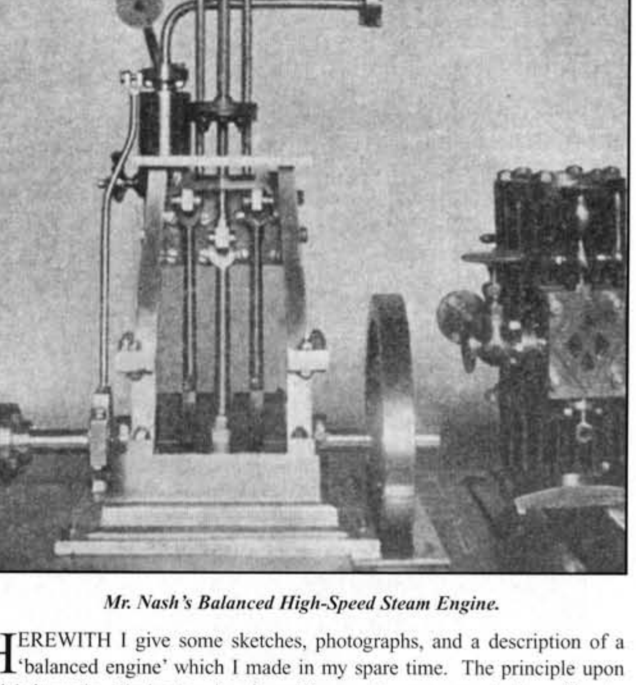
ON THE occasion of a recent visit to the new works of Messrs. Stuart Turner, Ltd., at Henley-on-Thames, we found considerable evidence of the rapid strides this firm has made. The new premises opposite the Town Hall are not only much larger than those previously occupied, but important additions have been made both to the power and machine tool plant, which will enable a considerably increased output to be maintained. Not the least noteworthy of the improvements is the extension in office, stores, and packing accommodation, a development which has been rendered absolutely necessary by increasing business. At the time of our visit we saw a large portion of the 1,000 sets of machined parts for the new No. 10 "Stuart" vertical engine going through the works, and the systematic way in which this line was being dealt with was very interesting. This engine possesses all the excellent "Stuart" characteristics of good design and first-class materials, and in view of the price at which it is being offered, it should prove remarkably popular; in fact, no one need now be without a "Stuart" engine. The special machinery for carving boat hulls was shown in operation, and we also saw two new hull models which are to be placed on the market. One of these is an excellent tug-boat design, which we can strongly recommend to those who wish to build for good appearance and easy comfortable steaming, without special consideration is of high speed. In the tool and precision room we saw a beautiful sectional model being built to special order for the South Kensington Museum. Of this we hope to give further particulars in an early issue, so we will content ourselves for the moment with saying that it was a splendid example of the highest class workmanship and finish. A number of the excellent "Stuart" gas engines and vertical steam engines of various sizes were in progress in the works, testifying to the strong demand for this company's productions.

Volume 22, the first half of 1910 is another classic volume for the stationary engine enthusiast. I have included two items. Firstly, a balanced high speed engine by a J. Nash. This is a super little engine which deserves a wider audience and is an example of work from an overseas reader, in this instance, Argentina.

April 14, 1910.

A Balanced High-Speed Steam Engine.

By J. Nash.

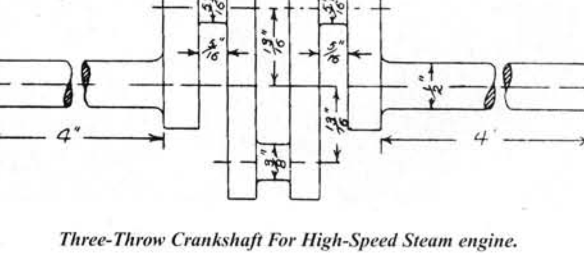


Mr. Nash's Balanced High-Speed Steam Engine.

HEREWITH I give some sketches, photographs, and a description of a 'balanced engine' which I made in my spare time. The principle upon which it works eliminates vibration. The prototype was made by a firm in Leeds, and run at the Paris Exhibition, at a speed of 500 r.p.m., without using any foundation bolts. I have run my model just placed on the floor, with 30 lbs. pressure, when she made about 300 or 400 r.p.m. without a move.

A glance at the sketch of the cylinder will show that it is fitted with three pistons receiving steam on one side only, and, providing the rings are a tight fit, there is no necessity for cylinder covers. Piston B is fitted with two steam-tight glands to allow the rods of A to pass, as is also piston A fitted with one gland to allow the rod of top piston to pass. The steam ports are ⅛ in. wide, and the exhaust ¼ in.

The first attempt I made with the crankshaft did not prove a success, as the webs closed when I tried to turn it; so I set to and cut one out of a piece of steel 2 ins. by ⅝ in., and just left enough forfinishing off in the lathe. Reference to

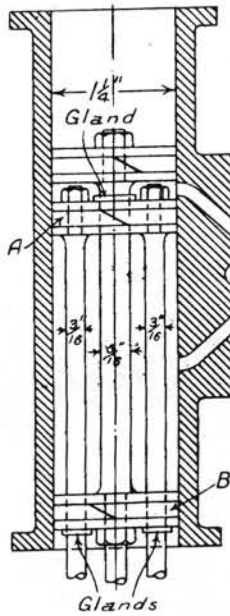


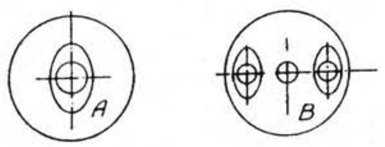
Three-Throw Crankshaft For High-Speed Steam engine.

the sketch will give some idea of the work I had.

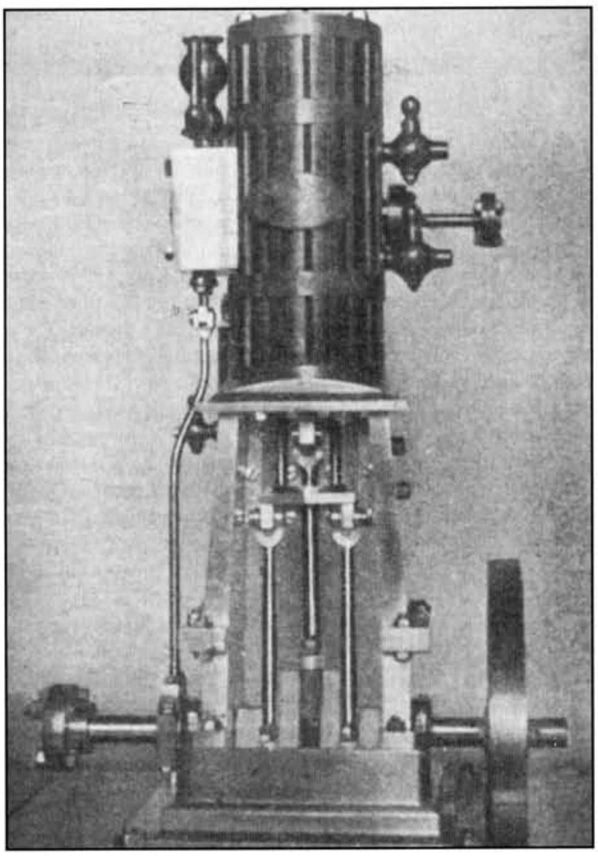
All fittings, such as stop valve, lubricator, nuts, etc., I had to make myself, because in this country (Argentine) one cannot buy small things for model making. The engine is polished all over, and presents a fine appearance.

SECTION THROUGH CYLINDER.





Plan of Piston, Showing Gland.



Front View Of Balanced High-Speed Engine.

April 7, 1910.

A Model Willans Engine.

By D. B. Brearley, A.M.E.A.

The Willans engine is single-acting, and is made with two or three cranks, each crank being driven by a complete engine. The sectional figure shows a "two-crank" compound engine with cranks at 90 degs. The down-stroke is the working stroke, and on the up-stroke provision is made to prevent any knocking as the various parts accelerate. The arrangement will be described later. It will be easily seen on looking at Fig. 4 that the steam is governed by a number of ports and piston valves, which valves work in a hollow piston-rod and are connected to an eccentric fixed on the crank-pin, as shown in Fig. 3. One must not get confused by the number of valves. really, there is only one valve to each cylinder, and this acts like one half of any ordinary D slide-valve, and is termed the distribution valve. All the other valves are called separation valves, and do not control the steam inlet or exhaust of any cylinder. On looking at Fig. 4 again, steam is entering the piston-rod from the steam chest through the ports a. The piston valve A does not control the steam at all. Therefore we will take no notice of this valve at present, but will describe its purpose later.

After the steam has passed through the ports a, as indicated by arrow, it comes on the top side of the piston valve B.

This valve is shown just opening the port b, and the steam is therefore in communication with the H.P. piston on the top side. The steam does the work required of it, and, of course, must be exhausted into the receiver. Therefore it must return through the same ports by which it entered, namely, b.

By this time, however, the piston valve B has opened the ports b from its under side, and the steam can therefore exhaust into the receiver through the ports c, seeing that the ports b and c are in communication with each other. The steam which is now in the receiver does not do any more work until the next stroke, which is just about to commence. It now continues its downward career through the ports d and e into the L.P. cylinder. The ports d and e are similar in action to the ports a and b, which control the H.P. cylinder, and the distribution valve D similar in action to the distribution valve B. Therefore,

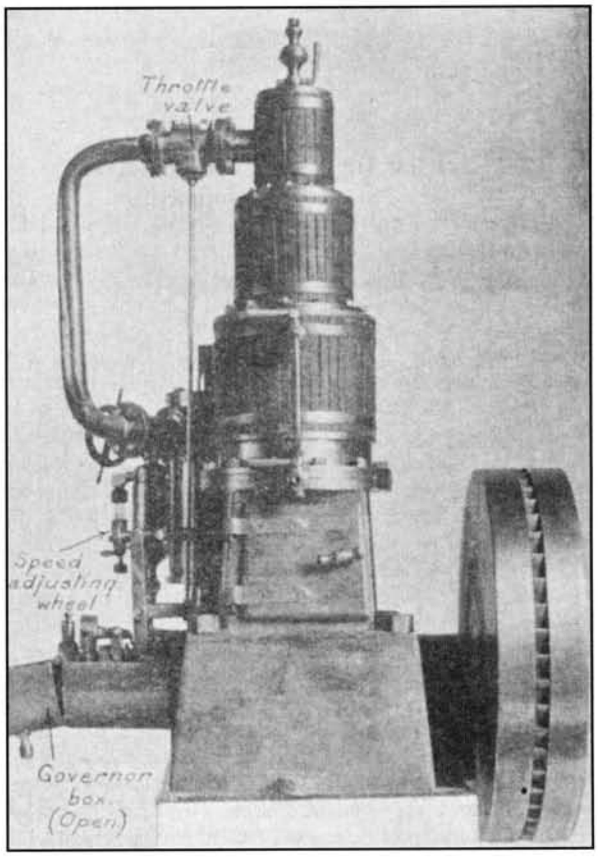


Fig. 1–A Model Williams Engine.

if you see how the steam enters and exhaust from the H.P. cylinder, you will see how the steam enters and exhausts from the L.P. cylinder. The action is the same. The exhaust is shown at f, and E is a piston crosshead for eccentric rod.

Now, as regards the cut-off, I refer you to the ports a, which, on travelling downwards, come in contact with the gland, as shown at I, Fig. 3. It is quite easy to see that no steam from the steam chest can enter the H.P. cylinder after the gland once covers the ports. The cut-off is very rapid.

Now we come to one of the uses of the separation valves A and C. It is quite evident on studying the drawing that if there was no separation valve A, the H.P. gland could not cut off the steam to the H.P. cylinder, and the cut-off would be controlled by the distribution valve B, and this is not desirable, as the cut-off would then be constant, and could not be altered without altering the lap of the valve B or the eccentric sheaf, which is, of course, a fixture. The only practicable way, therefore, to alter the cut-off is by means of the gland, and this can be done by putting distance-pieces under the rings and the gland boxes. The rings for the glands are shown at H in Fig. 4. The inside ring is first turned to fit over the piston-rod, and then an outer ring is sprung over it, and this keeps the inner ring in compression round the piston-rod.

Another use of the separation valve A is to prevent knocking taking place on the eccentric sheaf, or straps, or the crosshead pin, fixed in E, Fig. 3. This is accounted for by the steam in the steam chest always bearing down on the separation valve A. To prevent knocking taking place on the main bearings, crank-pin, brasses, etc., this is done by means of an air-cushion. A cylindrical crosshead piston works in a cylindrical guide, as shown at J in Fig. 3. On the up-stroke there is compression in the space R. This keeps the same downward strain on the brasses as on the down-stroke. Therefore no knocking can take place. The small holes K are uncovered when the piston J is at the bottom of the stroke, and lets in "make-up air" which may have been lost due to leakage, on the previous stroke.

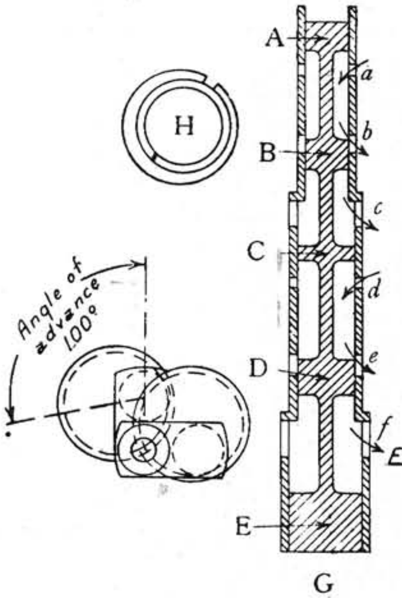


Fig. 4–Section Through Piston Valves.

In other words, the space R must be at atmospheric pressure at the beginning of every up-stroke. It is not necessary to fit piston rings round piston J. One or two grooves are all that is considered necessary. These fill up with oil from the crank chamber, and the friction which we get from rings is avoided.

The governor gear is of the centrifugal type, and acts direct on the throttle valve. The sleeve L which is fixed to the shaft carries the governor weights. These weights are held together by means of springs, and open outwards as the speed of the engine increases. As the weights open outwards, the sleeve Q moves along the shaft, and also moves the bell crank M, which, in turn, moves the throttle valve spindle S, and therefore the throttle valve P. The wheel N and springs attached thereto are for making the engine govern at a lower or higher speed. When the wheel N is screwed up, it helps the action of the governor, thereby giving a smaller port area at the throttle, and therefore a slower speed. The opposite result is obtained by taking the tension off the springs. The sleeve O does not revolve with the shaft. The nuts O are for adjusting the length of the governor valve spindle S. The middle nut contains a right and left-handed thread, and the other two are locking-nuts. When the spindle S is lengthened or shortened it alters the speed of the engine. Therefore, within certain limits, any set speed can be obtained at no load or full load. The throttle valve P is a double-ported one, and is shown shut. It is cylindrical, and must be a perfect fit, without any undue friction.

The Willans engine is used very largely for the generation of electrical energy. It will run for hours with practically no attention, and the wear is

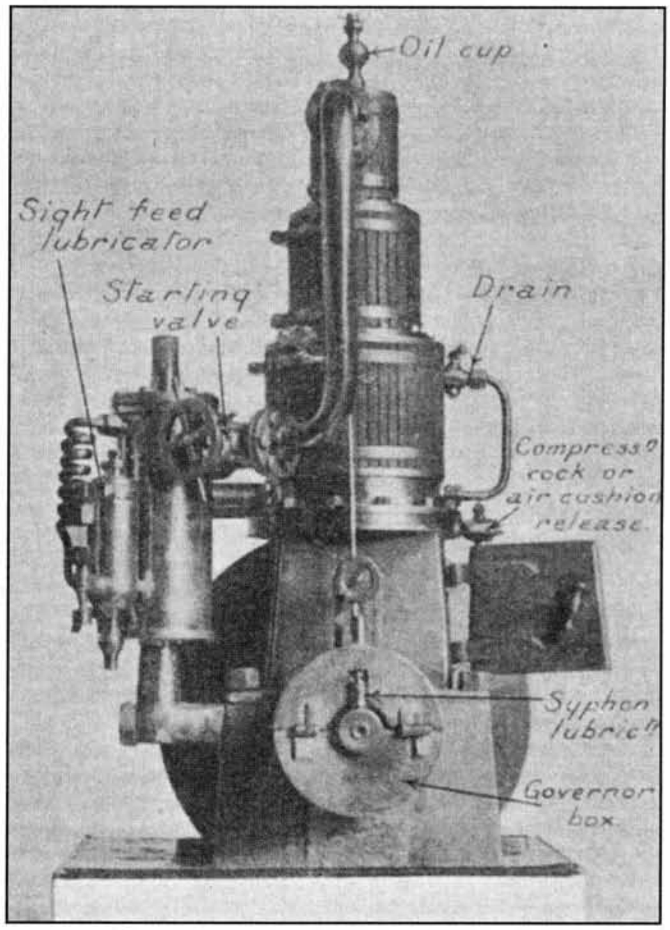


Fig. 2–Another View Of Model Williams Engine.

considered as nothing after years of constant usage. I heard of one engine running continually, night and day, for eighteen months without stopping. The engine is mostly cast iron, with the exception of the crankshaft, connecting-rods, brasses, and a few other small things. The piston-rods, pistons rings, are all cast iron. The photographs are of a small model which I have made. I made all the patterns, and got the castings locally. Of course, a good lathe is absolutely necessary. I do not wish for anything better than a 3½ in Drummond.

Accuracy had to be maintained throughout in my model, otherwise it would have jammed.

Now look at the photographs, and you will notice that the engine is built up of five different parts, bolted together, namely - the crank case in which the crankshaft works; the distance-piece which carries the door and the compression cylinder as shown at J in the drawing; the L.P. cylinder; the H.P. cylinder; and, lastly, the steam top or chest. Then, internally, the H.P. piston and rod, the L.P. piston and rod, and the crosshead guide-piston and rod are all bolted together. Then, inside the piston-rod there are the valves. Now, if any parts are the least out of line, what would be the result?

I think the model speaks well for the Drummond lathe, and I leave you to draw your own conclusions on the matter. The crankshaft was actually turned out of a solid piece of mild-steel shafting 2¼ ins. diameter. Where could one get such a small forging with the eccentric sheaf forged on the crank-pin? All machining has been done in my lathe. The engine runs well, and has had a trial run of 2½ hours under a pressure of 160 lbs. of steam.

The Willans engine is the second item from Volume 22. Probably more suitable for the more experienced worker it can be built on modest equipment as the article shows. Other items from this volume are, the continuing series of articles, The Steam Engine for Beginners by that classic writer on stationary engines H. Muncaster, A.M.I. Mech. E., unusual engine valves designed for a model aircraft engine that flew by flapping its wings, and a steam turbine blower. Beg, borrow (but do not steal) this volume, you won't be disappointed.

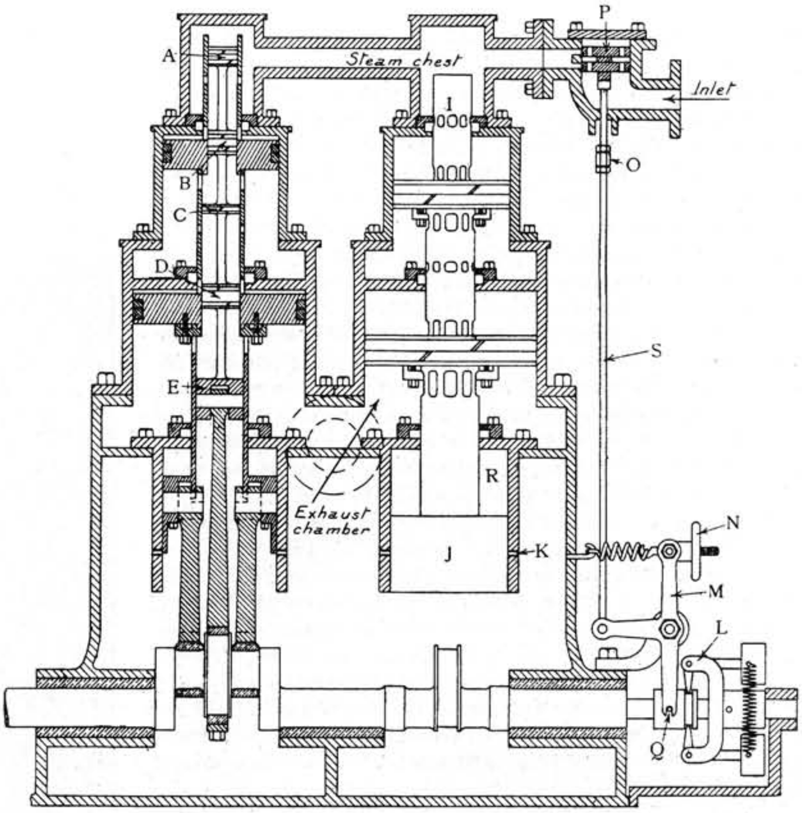
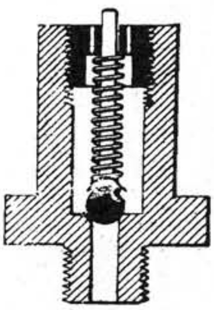


Fig. 3–Section Through Model Williams Engine. (Scale: Half full Size).

May 4, 1911.

The News of the Trade.

A New Safety Valve.



THE accompanying illustration shows a new form of model safety valve in which it will be seen that the valve itself is formed by a ball, kept on its seat by a cap and spring. The ball is of non-corrodable metal, and the pressure at which the valve blows off can be adjusted by the screw-cap. The design of this valve is very neat, and we should imagine it will become very popular for model locomotive and stationary boilers. It is made in several sizes and may be had from Messrs. Bassett-Lowke Ltd., Northampton, or the Liverpool Castings & Tool Supply Co., Liverpool, from each of which firms we have received a sample valve for inspection.

An explanation

Messrs. Goodwin's, of Leek, ask us to say that they are putting in a new engine at their works, and are making other alterations which has stopped their output for some days. This has caused a little delay in the execution of recent orders which they hope their customers will overlook.

September 14, 1911.

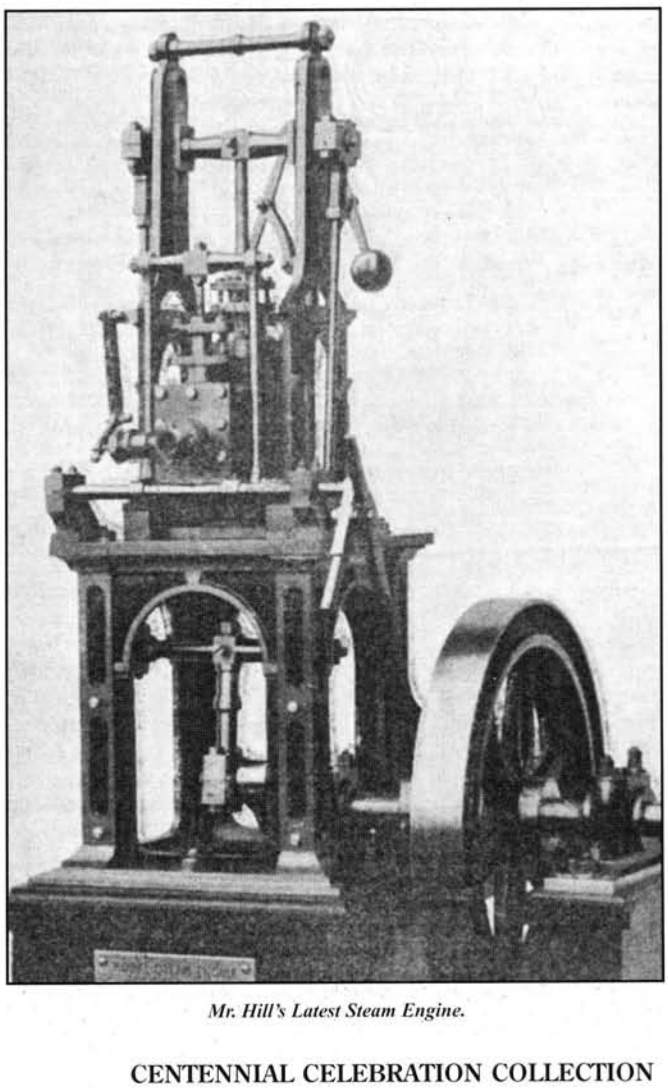
Practical Letters from our Readers.

Model making in 1846.

To the Editor of The Model Engineer.

Dear Sir, - Perhaps the enclosed photographs of two working models of steam engines may interest readers of The Model Engineer. Both models were constructed by the writer, the beam engine in 1846-7, at the age of 16 and 17, and the table engine in his 80th year. It was completed Christmas, 1910, and occupied nearly two years. While on the subject I should like to say a few words, with your kind permission, on the difficulties experienced by the young engineer aspirant more than sixty years ago. Tools were not within reach of his limited pocket-money, with the exception of a few fiddle or bow drills, a hand vice, a file or two, screwplate, a handleless flat iron, which did duty for a anvil, together with several other minor matters, etc. Of course, a lathe was out of the question, but a stock of iron and brass rod and hoop iron was essential, as bolts and nuts were made from wire and any pieces of brass that had been carefully hoarded up. I said bolts, but in fact they were all 'studs', pieces of wire screwed both ends. A good wrought iron nail, in those days, was considered a treasure. The valve crosshead of the little beam engine illustrated was manufactured out of one, after cutting off the head and tail.

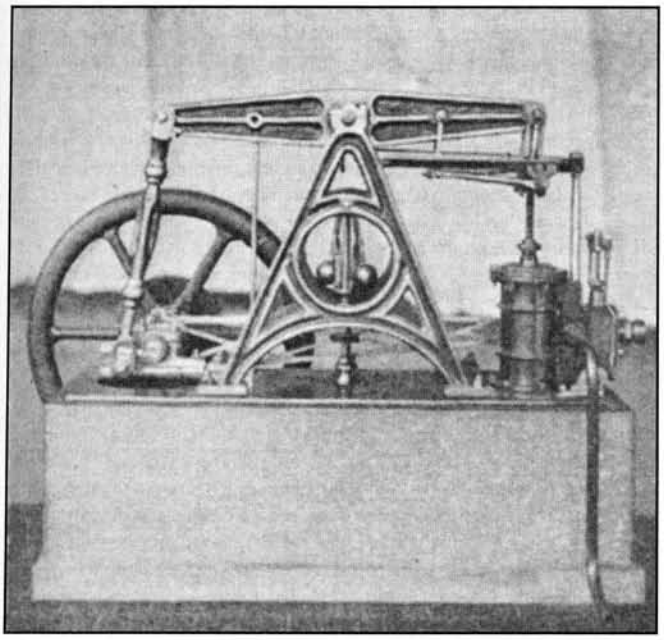
Referring to the making of this model. The cylinder was bored and turned by a gas fitter; diameter of bore, ¾ in.; stroke 2 ins.; length of beam, 9 ins.; diameter of flywheel, 7 ins.; castings, gun-metal. The drawings were pasted on the wood to form the patterns and then cut out with a pocket knife and



Mr. Hill's Latest Steam Engine.

finished with files and glasspaper. Your readers may remark how a knowledge of the working of a steam engine was gained in so young a lad? At a very early age an inborn love for everything mechanical took possession of all his thoughts, and wherever a steam engine could be seen - for there were many about London in the shop windows - there the young enthusiast was to be found. I could mention many places, but they have all disappeared long ago. I am afraid, Sir, I am taking up too much of your valuable space to say more, but with your permission later on I should like to say a few more words on model making at the present time. - Yours faithfully,

Edwin E. Hill



Model Beam Engine Made in 1846.

November 30th, 1911.

Practical Letters from our Readers.

Model Engineering in 1846

To the Editor of The Model Engineer.

Dear Sir, - In The Model Engineer of September 14th, last, you were good enough to illustrate two model stationary steam engines, the one, a small beam engine made in 1846-7 at the age of 16, and the other (somewhat larger) on the table principle, both constructed by the writer, the latter at the age of 80. It was completed December 1910, then in my 81st year. The two models were exhibited at the recent Model Engineer Exhibition, held at the Royal Horticultural Hall, Westminster. Doubtless many of the visitors may have noted the originals?

In describing the making of the small beam engine on the above date, I referred to the difficulties the boy with a mechanical 'bent' had to contend against. It is on this subject, with your permission, I should like to say a few words. It is sixty-five years ago since I started making the little engine mentioned above, viz., 1846, and the only means at that time available for a 'thirsting mind' intent and determined to gain the knowledge required for making the model were a few small 'handbooks' on the steam engine, bearing dates 1842-1846. But my favourite book (a very small volume) and which I still have, is entitled, "Historical and Descriptive Anecdotes of Steam Engines and of their Inventors and Improvers, by Robert Stuart, Civil Engineer, 1829." These, together with some penny tracts on the lives of eminent engineers - James Watt, Smeaton, Brindley, Stephenson, and others, comprised the only mechanical literature within reach of the working lad's pocket. I merely point out these matters as contrasting with the many great advantages enjoyed by the young model engineer of the present day. Metal shops were few and far between, 60 or 70 years ago, in London, where materials for model making could be procured, neither were there any means at the lad's disposal where he could obtain a gleam of light to guide him in his work of love; but he persevered, made mistakes, tried again and profited by his failures. So he filed away, drilled holes out of the centre, plugged them up and drilled again. The only available place to fix his small vice was on the corner of the kitchen dresser, but this being considered a nuisance had to be unshipped every time it was used; but the engine progressed. It took him a long time to ferret out the secret of the action of the vital parts of an engine - that is to say the working of the long D and the short D slide and other valves, also setting out the eccentric to give the necessary travel. He had often watched the movements of an engine where one could be found, and saw 'the wheels go round', but he wanted to know what was going on inside. Happening to see in an optician's shop a sectional wooden model of a condensing engine the secret was out.

In due course the little beam engine was finished. A block-tin boiler was made by a tinman, simply a cylinder, the only fittings being two old gas taps soldered in the top lengthwise - one for the steam-pipe attachment; the other doing duty for a safety valve, it being left partly open. The boiler was placed on the ordinary sitting-room fire and the model engine at once entered into life.

I shall have something more to say in reference to this rather ancient piece of mechanism before I close this letter; but, as an exhibitor and visitor to the Model Engineer Exhibition I wish to express the great pleasure I experienced on viewing such a splendid collection of model engineering, embracing all the beautiful electrical appliances which science has placed at the disposal of mankind.

On looking round this highly instructive and interesting exhibition one could not fail to admire the excellent display of highly-finished lathes, with all their various attachments and accessories, together with tools of every description, which ought to gladden the heart of not only the model engineer, but everyone interested in mechanical engineering. I think, therefore, great credit is due to those enterprising firms who have anticipated all the requirements and demands of the model maker, for without their aid those beautiful specimens of mechanical and electrical engineering could not be executed. The model engineer of the present day has every scientific door thrown open to him - technical evening classes, practical manuals and handbooks, on every subject, scientific or otherwise - and then he has the advantage of The Model Engineer Laboratory where every facility is offered for obtaining workshop practice and testing his skill. With all these advantages and opportunities the engineer student ought to be a happy member of society. I believe he is, and an intellectual one also. As machinery in motion has always an attraction, and is more interesting to visitors to the various mechanical exhibitions than when models are viewed in a state of immobility, I would suggest that, if possible, at future exhibitions some of the engines should be set in motion, similar to many in the South Kensington Museum. I am aware, however, a week's duration is a short time, but if some of the models were provided with fast and loose riggers or V pulleys, they might be set in motion from a small shaft supported on 'A' standards bolted on the back part of the stands or benches, the power to drive being supplied by a motor, similar to the arrangement in hairdressers' shops, for giving motion to the brushes. As an electrical current is in the building I thought, perhaps, the motor could be driven.

With regard to model making there are many interesting and instructive working models, otherwise than steam engines; for instance, the forms of water wheels, viz. - the overshot or bucket wheel, the breast wheel, and the undershot wheel. If these were arranged one above the other, a small quantity of water led into a trough above the upper or overshot wheel would, on discharging it, pass to the breast wheel, and from that to the lower or undershot wheel, thus setting into motion the three from one source. The water might drain into a tank out of sight and then be drawn off. There are many other similar matters, under the science of hydrostatics, that might be made by the amateur equally interesting as a steam engine. Cugnot's steam carriage, built in Paris by a French engineer in 1763, is another example, a model of which may be seen in the Patent Museum, South Kensington. Then, again, Newcomen's engine of 1705 would be an interesting model. This can also be seen in motion in the above Institution. There is one little matter that suggests itself to me with regard to the construction of models, and that is, the scale should not be smaller, or rather, the cylinders of engines should be limited to, say, 1 in. diameter. This arrangement would place the work more in the hands of the model engineer than the very small specimens probably made by those engaged in the making of mathematical and astronomical instruments. I think that if model machinery was made to represent more closely the original prototypes, it would convey to the uninitiated a better idea of the original, if the framing, foundation, or bedplates, etc., were constructed in iron, than in bright brass or gun-metal, to have employed cast iron in the construction of the table engine I exhibited, but was informed there would be a difficulty in obtaining good castings. I am sure, however, now, good clean model castings can be obtained, as I note by advertisements in the columns of The Model Engineer. I am afraid I am taking up too much of your valuable space, so will conclude my remarks by referring again to the model beam engine. I do so, because I wish to impress on the minds of all young aspirants who have real and sincere love for engineering - no matter in what branch - that this little engine eventually became the pioneer of a successful life in the engineering world. The Daily Telegraph October 14th 1911, in referring to the Model Engineer Exhibition, says "There are two models made by another man - one in the days of his youth (1846) and the other just completed on his 80th birthday. He regards the 1846 model with great affection, for when he made it he was in a most uncongenial occupation. Fortunately someone of influence saw the model and gave him the opportunity for which he craved. He has spent all his life, as a consequence, in the world he loved - that of engineering."

Every boy should ride a 'hobby horse' of some kind, and, for the matter of that, young men also. Let them by all means enjoy their manly sports and pastimes; they ought not to forget, however, that the cultivation of some branch of the useful Arts and Sciences will afford them a delightful and profitable recreation in any spare time they may have at their disposal, but let them bear in mind the mental race they have to run with the educated of their own and of other nations; let them nourish the desire for the acquisition of scientific knowledge, a useful ally which may some day help them in a greater or lesser degree to fight "The Battle of Life." - I am, dear Sir, your faithfully,

Edwin E. Hill 'Springbourne'
Brading, Isle of Wight.

I have kept my comments to the end but I feel that this should be compulsory reading for all those who complain that model engineering is too expensive and is dying out. It shows what can be done with 90% enthusiasm and 10% equipment. There will always be those who are fascinated by all things mechanical and have the desire to make models. They will ensure that model engineering will never die.

I do not know if this should be included as it is not designed to be 'stationary' but I have included marine engines so here goes. This would make an unusual model for a club stand. The original article described a flash steam boiler fired by a small blow-lamp but I would recommend compressed air for demonstration.

June 6, 1912.

A Model Steam Rotary Aeroplane Engine.

By Arthur Thornton.

A LONG-FELT want in the circles of model aeroplaning has been an efficient power plant of a reasonable weight and power. Electric and clockwork motors are useless; steam has been tried, but has not been sufficiently successful to become popular, so the elastic motor is still to the fore, and although it is successful on models made to suit it, it is impossible to build a scale model to be a good flyer if driven by an elastic motor, as the weight is scattered over too great a length of frame - thus in the case of a monoplane it makes the machine tail heavy. Now the engine about to be described will fill this gap, inasmuch as the position of the power plant on the model may be identical with that of its prototype, so that, other things permitting, the model may be as good a flyer as the prototype, as the balance of the two machines will be alike. Another feature is that from outside appearance the engine is an excellent copy of the famous "Gnome"; this fact alone is a great advantage as many good scale models are spoilt by fitting a dummy engine. Apart from these advantages I think that I can claim that this engine has the least working parts of any other engine; it is valveless; it has only one bearing, and each cylinder has only its piston with the connecting-rod and gudgeon pin. The engine being of the rotary type is supported by its crank-shaft which is fixed while the cylinders revolve round it; the bearing on the shaft together with the centre portion, or hub, forms the inlet valve, from which the steam is conducted through hollow columns to the cylinder heads. These columns also provide the only support for the cylinders. The bearing on the crankshaft referred to above is slightly tapered, and the hub is also tapered; the extreme end of the shaft is tapered out to take the crank against which works a washer with a square centre holding the hub in its place on the crankshaft. The taper portion of the shaft has an oblong port cut in the side to correspond with ports cut in the hub from which the steam is led to each cylinder in turn as the engine revolves about the crankshaft. The engine being described as a seven-cylinder, and there being but one crank and one crank-pin, the big-end of one of the connecting-rods is common to the other six connecting rods - "Gnome" fashion. The bore and stroke of this is ⅝ in. x ½ in.; the cylinders are built up of a very light gauge brass tube, as also are the pistons, which are ground in to a steam-tight fit and thickened slightly on each side to tap out to take the gudgeon pin. The cylinders have exhaust ports cut in their sides about a quarter of the stroke from the bottom, so that as each piston reaches this position it exhausts the steam once every revolution; thus it will be seen that there are seven impulses per revolution, so that, given fairly large ports, this engine can be run at a very high speed. One thing, however, must be considered, and that is, in a petrol rotary the motion of the cylinders through the air is a great advantage in cooling, but in the case of the steam rotary this is a great disadvantage, as cooling the cylinders means great loss of power, as it causes the steam to condense in the cylinders unless it is very highly superheated, which is often inconvenient, as it does not allow any soft soldering, as the heat of the steam is above the melting point of solder. Hot steam also raises a difficulty with lubricating, but as the engine is only run for shot periods at a time this need not be considered.

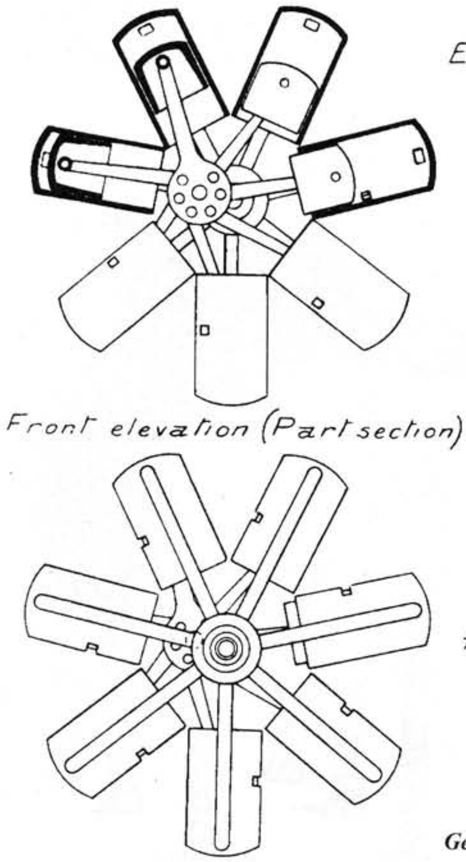
May 22, 1913.

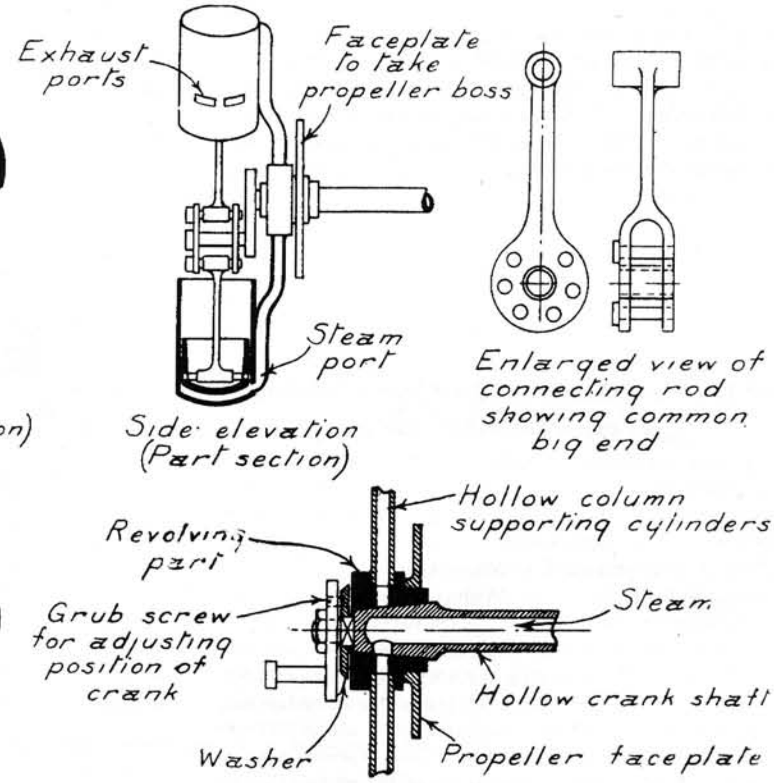
A 4-in. by 4-in. Single-Acting Steam Engine.

By Thos. Sibbald.

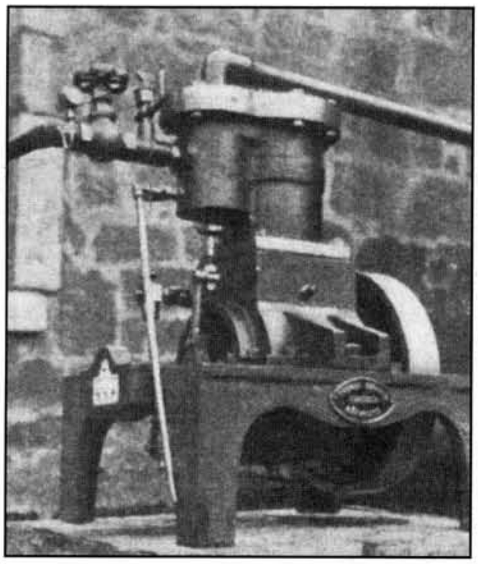
I give herewith a sectional drawing, and two photographs of the 4-in. bore single-acting steam engine which I have made. The reader will observe from the drawing that this is a very heavily made engine. The cylinder is 4-in. bore by 4-in. stroke, with piston type gun-metal valve, having two ports as shown; thus when engine is exhausting, steam is cut-off from valve, and as will be observed from the drawing steam enters through inside of valve, and exhausts over the top. This valve is shown plain in the drawing, but as it was inclined to blow a little bit, on testing, I had two phosphor-bronze rings fitted, one at top and one at bottom, and this was a great improvement.

The engine piston is fitted with three cast-iron piston rings ¼ in. square. The gudgeon pin is screwed into one side of piston, as shown, and is held in position by a set screw (not shown in drawing) as it was fitted as an afterthought, when I saw there was a possibility of pin working loose. Connecting rod is a forging, and is fitted with gun-metal bushes. The big end has only the gun-metal on front, as, being single-acting, there is not a great stress on that half of bush. Crankshaft is a solid forging, and is fitted with heavy phosphor-bronze bushes. Eccentric strap is gun-metal, with steel rod dovetailed in and held by screw, as plainly seen in photo. The engine is fitted with gauge glass on crankcase, which shows the oil level. The only relief cock fitted is that shown on valve chest.





General Arrangement And Constructional Details Of Rotary Engine.

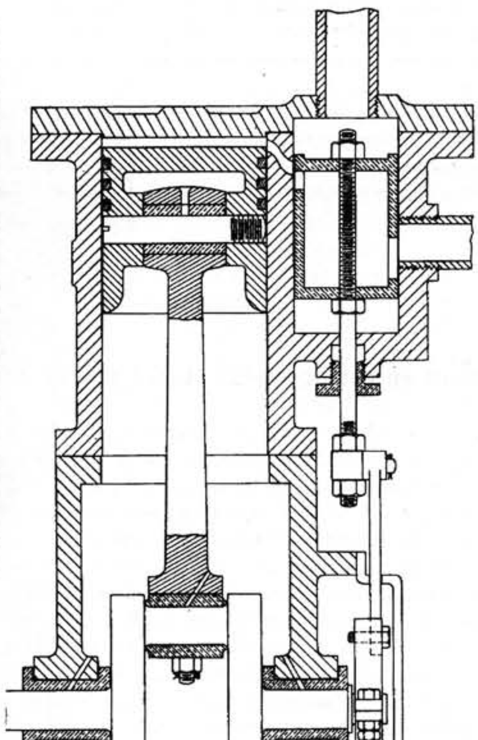


General View Of The Engine.

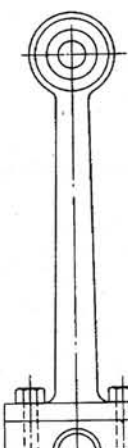
Crankcase is fitted with filling tube at back, and the stud shown in front of photo was where I intended putting on an oil pump; but this was never done. The flywheel is cast solid, and rim turned up bright, and as will be seen I fitted another bearing outside of fly-wheel. The bedplate is cast iron, and holes are bored in each corner for fixing down bolts. The old index shown attached to bedplate was fitted to count the revolutions per minute, and is coupled direct to crankshaft with small gun-metal spindle. It is quite easy to see the speed from this by timing it for a minute, as the small pointer running at engine speed has to make 100 revolutions before the first pointer, on the other train of wheels, arrives at one. On testing the engine I had her running over 800 r.p.m. without bolting down, but she was inclined to vibrate after she passed 450 r.p.m., at which speed she runs quite steadily.

In conclusion, I may say that I designed this engine and made drawings myself, and all the patterns were made by a friend. After I received the castings I had them machined at an engineering shop, but all the fitting was done at home.

The engine was made for a special purpose on my father's farm, but it was never required. It is built heavily as it was intended originally to run it with 400 to 500 lb. pressure.



Sectional View Of 4-in. x 4-in. Single-Acting Steam Engine. (Scale: ¼ full size)



SIDE ELEVATION OF CONNECTING ROD.

In the early days "OURS" was known as The Model Engineer and Amateur Electrician. By 1913 the word Amateur had been dropped and there were a number of articles concerning electricity and its applications. This unusual method of generating electricity would be an interesting demonstration on a club stand but I would recommend fitting a safety valve to the boiler and the regulator seems to be artistic licence.

July 3, 1913.

Curious Electrical Effects: A Hydro-Electric Machine.

To the Editor of The Model Engineer.

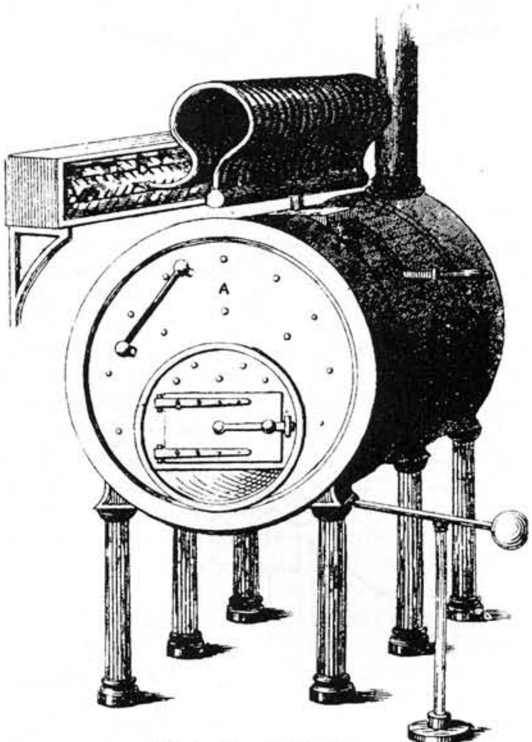
Dear Sir, - I notice in a recent issue a letter from Mr. H. Wooldridge with regard to "Curious Electrical Effects." I herewith give an illustration and also copy of the description of a machine which evidently is based upon the principle illustrated by Mr. Wooldridge's boiler.

[Extract from "Science Simplified," by John Emslie.]

"Fig. 5 represents the Hydro-Electric Machine and apparatus of recent date and construction and of immense power. It consists of a steam boiler, A, insulated on stout glass pillars. The steam is made to issue through a great number of bent iron tubes, BB, terminating in jets of wood. An insulated projecting conductor, seen on the right in the sketch, is placed in connection with the boiler for the purpose of collecting the excited electricity; and another conductor, D, formed of a metallic case having several rows of points, is placed immediately in front of the jets, to receive and carry off the opposite electricity of the steam, and prevent its return to the boiler, by which the excited forces would be utilised. The electricity thus produced is the result of the friction of condensed particles of water, whilst being driven by the still issuing steam through the jets, these watery particles performing the office of the glass plate or cylinder of the common machine and giving out vitreous electricity. The wood jets and the pipes act as the rubber, and give out resinous electricity."

This book is evidently very old, although no dates are given. I do not remember ever hearing or reading of one of these machines being put to a practical use. - I remain, your faithfully,

H. P. Marshall



A Hydro-Electric Machine.

I think that on occasions some model engineers take themselves and the hobby far too seriously, so I will probably be taken to task for including the following item from 1916. However, the story contains valuable engineering lessons. A cardboard engine will work subject to the suitability of fixing materials. Surfaces must be clean when soldering seams. A simple project will give encouragement to go on to better things. It is not often that you read a story that involves an 'exploded' boiler, even if it is helped by a tin opener!! This is an edited extract from "Mohandis" article, if you want to read the rest turn up Volume 34.

June 15, 1916

Reminiscences of an Unsuccessful Model Maker.

By "Mohandis".

PERHAPS the above title is too pretentious for these few jottings, for, I have a feeling that the only individuals entitled to indulge in reminiscences are venerable gentlemen with long white beards and distinguished careers. The reader will no doubt be relieved to learn that I possess neither of these qualifications. At first I thought that 'confessions' would convey my meaning better than 'reminiscences', but as the word has a flavour of shady deeds and guilty secrets, I abandoned it. To come to the point, let me explain that some time ago I was much struck by a remark in the Editorial column of The Model Engineer to the effect that much profit and instruction could be gained from a study of unsuccessful models. It happens that most of my own efforts at model-making belong to this unhappy category, so it appeared that I was particularly well placed for putting this opinion to the test.

The first model I propose to describe was by no means a conspicuous failure - indeed, I may say with due modesty that in some respects it was a remarkable success. It was nothing less than a working model of a horizontal engine, fitted with link reversing gear. Not a very startling achievement, do you say? Well, note the specification: Cylinder, cardboard (incandescent mantle box) with cardboard valve chest; slide-valve, cardboard; eccentrics cardboard; link-gear and bearings, fret-wood; piston-rod, crankshaft, etc., knitting needles; flywheel, lead, cast from wooden pattern. Observe that this engine really would work; the engine-driver applied his mouth to the "steam" pipe and blew furiously, whereupon the model puffed round in great style until the driver's wind was exhausted. Unfortunately the supply of the compressed air admitted into the cylinder in this way had the serious defect of being moist, with the result that it softened the seccotine with which the parts of the cylinder were stuck together, and thus brought about a 'seizure'. Nevertheless, I think that even this degree of success should give encouragement to the amateur who has the impression that lack of metal-working tools need debar him from producing working models.

Passing by various unconsidered trifles in the shape of needle telegraphs, small motors, and model yachts (though I must not omit to acknowledge the great help derived in the building of these from the M.E. handbooks), the next engineering achievement I contemplated was the erection of a travelling, slewing steam crane. I was quite familiar with the prototype of the model, having often gazed with deep interest at a crane of this class which was engaged on street excavations near my home. This model, I am bound to admit, was an utter and unredeemed failure, and, as so often happens in miniature steam engines, the root of the trouble lay in the boiler. Certainly the boiler-making materials at my disposal were unpromising; the shell consisted of a cocoa tin; the central flue or uptake at one time formed the telescopic handle of a toasting-fork; and the spirit lamp began life as a tooth-power box. I smile when I recollect what immense pains I took to provide a safety-valve of adequate size - it was a lever safety-valve equipped with a handsome brass lever (about twice as long as the diameter of the boiler) and a polished brass weight. In point of fact, the meagre quantity of steam generated found so many irregular means of escape, due to my neglectful soldering of the seams, that such a fitting was totally unnecessary.

The only satisfactory feature of the whole arrangement was the steam cylinder, and that I bought ready finished! The frames of the model were of brass, laboriously cut out of the solid sheet. The purchase of the small bits of brass wherewith to make components of this kind used always to be a trial to me. At that time I was an undersized schoolboy of undistinguished appearance (this latter characteristic I still retain); the establishment which I favoured with my patronage was a large firm of wholesale tin and coppersmiths. This shop was much visited by small and grubby boys from various neighbouring engineering works, with messages to give or commissions to execute, and to my unspeakable indignation I was not infrequently mistaken for these youths. Another exasperating feature of my transactions with this firm was the (in my opinion) totally uncalled for curiosity the assistants manifested as to the purpose for which I required my materials. I would explain quite explicitly that I wanted, for instance, a piece of 1/16 in. sheet brass, 6 ins. square, and not too hard. But that wasn't enough. These inquisitive gentry would insist on being told "what it was for." Such enquiries I parried as best as I could, for I had too little faith in the shopmen's sympathy with amateur engineers to admit outright that I was making a model steam crane.

On the other hand, I have grateful recollections of the reception I met with when I went in search of pieces of iron for making a motor. Boldly marching into one of the biggest firms of iron merchants in the city (a firm accustomed to handling 10 or 50 ton lots of metal) I demanded some such quantity of iron as this: 1 ft. of ½ in. round, 6 ins. of ¾ in. square, and 2 ft. of 1 in. by ¼ in. flat. And I got it! The horny-handed but kind-hearted yard attendant who took my order smiled paternally at what he considered the irresponsible caprices of youth, but he was quite ready to humour my whim, and I eventually bore off my stock of iron in triumph.

However, I am digressing, and although this is an indulgence to which the heading of this article entitles me, I must not abuse the privilege. But before I resume the melancholy history of the steam crane, let me introduce my junior partner, a faithful friend and ally (my junior by just one day), who helped in the making of all the models here described. As has been said, the model crane was an unequivocal failure. I believe we did once coax the cylinder into rotating the barrel, without load, but that was the limit of its capabilities. We determined, therefore, that even if the model had had an inglorious existence, it should at least terminate its career sensationally; in short, we proposed to have a realistic representation of a boiler explosion.

Manifestly the boiler would not explode under its own steam, on account of the leaks already alluded to, hence a tin-opener and an iron tea-tray were requisitioned for the purpose. With the former the boiler was ripped open, and the mangled shell, together with the dismantled components of the model, grouped chaotically on the table, the effect being heightened by a liberal sprinkling of boiling water from the domestic kettle. The stage setting being thus completed, the tea-tray was banged noisily on to the floor, and I rushed into the adjoining sitting-room, where the household was quietly passing the evening. Summoning an awe-struck expression appropriate to a herald of disaster, I announced to the party that the bang they had jut heard was caused by a boiler explosion, and invited them to come and view the wreckage. My powers of dissimulation were so feeble, however, that only one person rose to the bait: he was duly conducted to the scene of the accident, and until the conspirators' merriment became uncontrollable, he firmly believed that the boiler had actually burst.

After this episode I need hardly say that my enthusiasm for model engineering visibly waned, and it was completely eclipsed a little later by my acquisition of a new camera and a new bicycle.

May 31, 1917

How the "Weir" Feed Pump Works.

By H. Addison

IN THE course of the articles on "Some Designs for Model Pumps" which recently appeared in the Model Engineer, reference was made to the "Weir" steam pump, and as this has led to a request for further information regarding this machine, it is hoped that a detailed description will be of general interest. As was explained in the article in question (which appeared in the issue of September 16th, 1915), the Weir pump belongs to the class of direct acting steam pumps, the steam piston and pump bucket being directly connected without the intervention of a connecting-rod, and bearings, crankshaft and flywheel are entirely absent.

The external appearance of the pump is well shown in Fig. 1, while Fig. 2 is a sectional view. Referring to the latter, 11 is the steam piston, 10 the piston-rod, and 20 the pump bucket or piston. The pump delivery and suction-valve seats are shown at 14 and 16 respectively; each of these seats contains a group of small valves, as this plan gives a much greater area for the passage of the water than would be the case if only a single large valve were used in each seat. Since the pump is double acting, a set of suction and discharge valves is required for each end of the pump, and the two valve-chests are arranged side by side, as shown in Fig. 1; the lower end of the pump-barrel is connected with its respective valve-chest by the port shown in Fig. 2. The main suction flange will be noticed in Fig. 1, immediately below the valve-chests. There are two discharge branches, these projecting to the right and left of the pump, on a level with the valve-chest covers, as seen in the illustration; the discharge pipe is bolted to whichever of the branches best suits the run of the pipework, the other branch being fitted with a blank flange.

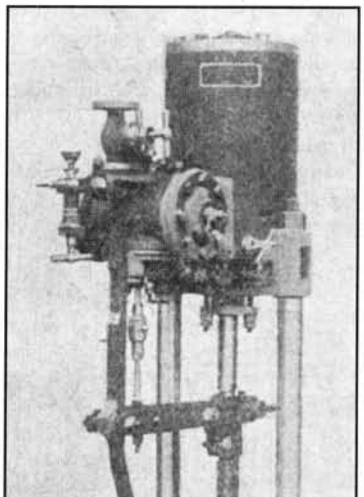


Fig. 1–The "Weir" Feed Pump.

Turning now to the most interesting part of the pump - the steam valve gear - it is evident that since the mechanism contains no revolving shaft, a slide-valve operated by an eccentric in the ordinary way is out of the question. To overcome this difficulty, the slide-valve in the Weir pump is moved by steam pressure, the steam for operating the valve being distributed by a small auxiliary valve mounted behind the main valve. This auxiliary valve receives its motion from a rocking lever coupled to the cross-head. Both valves are contained in a separate steam-chest casting bolted to the steam cylinder; the steam chest is shown at 1 in. Fig. 2, and occupies a prominent position in the photograph, Fig. 1. Referring to the sectional view, 24 is the steam stop-valve, and 25 is the exhaust steam outlet.

The details of the valve gear are represented diagrammatically in Fig. 3; this diagram is intended merely to give an idea of the principle of the mechanism, and the actual form taken by the parts can be left for discussion later. Referring to this figure (i) is a sectional front elevation of the valve chest, with the auxiliary valve removed; (ii) is a side sectional view, the pump being viewed in the same direction as in Fig. 2; and (iii) is a sectional plan. A is the main slide-valve, working horizontally over ports C, H and D, just the same as in an ordinary steam-engine cylinder. The ports D and C communicate with the upper and lower ends respectively of the main steam cylinder (these ports are also noticeable in Fig. 2), while H is the exhaust port. When the main valve is at the right-hand end of its travel, as shown in the diagram, port C is open to steam; consequently, the main steam piston is forced upwards, and water is discharged from the upper end of the pump-barrel. At the same time, since port D is open to exhaust, the steam from the upper end of the cylinder escapes into the exhaust pipe. In a similar manner, if the valve moves over to the left, D will open to steam, and C to exhaust; hence, the piston will move downwards. The cycle of operations is, therefore, precisely the same as with a simple slide-valve.

To enable the steam pressure to move the main valve A backwards and forwards, the valve has small pistons P R cast one on each end of it, the pistons working in suitable cylinders S T respectively. On the back of the main valve is the auxiliary valve B, which, in its turn, moves vertically over ports E, h and F. On reference to the front elevation, Fig. 3(i), it will be observed that port E is continued right through into the small cylinder S, while port F leads into cylinder T. (Note that in this view the auxiliary valve is removed.) The opening h is an exhaust port, communicating with the main exhaust port H.

Assuming the auxiliary slide-valve B to be in its lowest position, steam will be able to pass via port E into cylinder S, and the pressure thus exerted on piston P will force it and the main valve A over to the right. If the auxiliary valve B is now raised so as to open port F to steam and E to exhaust, the steam will now press on piston R, thus throwing the main valve over to the left again. In this way the auxiliary valve is enabled to control the movements of the main valve, which in its turn distributes the steam to the main steam cylinder. As has been said, the motion of valve B is obtained from a rocking lever 5 worked from the main crosshead 8 (see Fig. 2).

The operation of the gear is as follows:- When the main piston is the bottom of the stroke, the valves A and B occupy the positions shown in Fig. 3. As we have seen, in this position, steam is admitted to the underside of the main piston, which accordingly moves upwards, though the valves themselves remain stationary until half stroke. At this point the rocking lever 5 strikes a tappet on spindle 4 (Fig. 2), thus causing the auxiliary valve to move upwards also, until by the time the main piston has completed its stroke the auxiliary valve has uncovered port F in the main valve. This admits steam into the small cylinder T, with the result that the main valve is thrown over to the left, and since steam now has access to the upper end of the main cylinder, the main piston reverses its motion and begins to move downwards. A similar cycle of events occurs on the down-stroke.

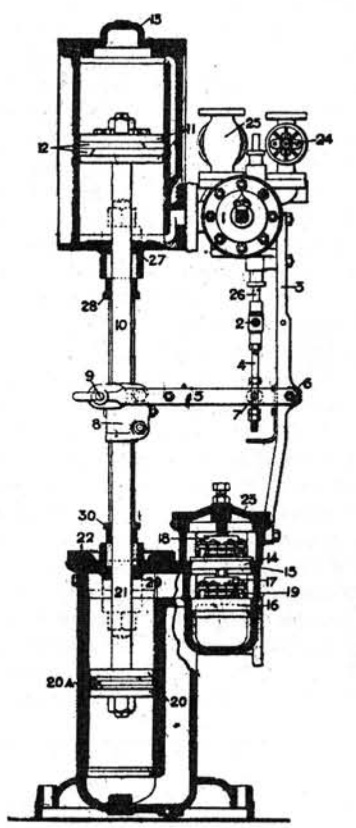


Fig. 2–Sectional View of "Weir" Pump.

We are now in a position to study Fig. 4, which represents the valve gear as actually made in the Weir pump; as corresponding parts in Figs. 3 and 4 have the same reference letters, it should not be difficult to follow the working. Referring first to Fig. 4 (i), this shows a section through the valve-chest, with both the main and auxiliary valves removed. The two steam ports C and D, leading to the bottom and top respectively of the main cylinder, and the exhaust port H are clearly visible. It will be seen from Fig. 4 (ii) and (iii) that the main valve A is really of circular shape, and the steam-chest face against which it works is therefore curved, instead of flat as shown in Fig. 3. For the same reason, the separate pistons P and R (Fig. 3) are no longer necessary, as the same purpose is fulfilled by the cylindrical ends of the valve itself. Fig. 5 (i) shows the shape of the ports on the curved front face of the valve, in elevation and perspective, and Fig. 5 (ii) gives corresponding particulars of the flat face on the back of the valve over which the auxiliary valve works. The openings cut in this flat face are arranged somewhat differently from those shown in Fig. 3, but they serve exactly the same purpose; thus C and D are the ports through which the steam passes on its way to the main cylinder; E and F represent as before the ports communicating with the small cylinders in which the ends of the main valve work; and H H are the exhaust ports.

The cycle of operations in the actual Weir valve gear is exactly the same as in the diagrammatic form illustrated in Fig. 3, with the exception that the auxiliary valve, besides distributing the steam which works the main valve, also serves as a cut-off valve. This result is obtained in the following manner:- We have seen that when the main piston has traversed half its upstroke, the auxiliary valve also begins to travel upwards. In the simplified form of the gear (Fig. 3) this only affected port E, but in the actual form it is clear that port C - (Fig. 5(ii)) - will also be gradually closed, and the motion is so arranged that at about three-quarter stroke the port is completely shut. Remembering that port C is the one through which steam enters the main cylinder, we see that in effect the auxiliary valve has cut off the main steam supply, and consequently for the remaining quarter of the stroke the pump is working expansively. In a similar manner the auxiliary valve cuts off the steam when the piston has completed three-quarters of its downstroke. This is an important advantage in actual working, as it obviously results in a considerable saving of steam.

In external appearance the auxiliary valve B (Fig. 4) resembles an ordinary steam engine slide-valve, and the only unusual feature is the shape of the exhaust recess. The object of this particular shape, which is shown in Fig. 5 (iii), is to bring the main valve to rest quietly at the end of its travel. A careful study of Fig. 5(ii) and (iii) will show that after the main valve has moved some distance on its way from say, right to left, the horizontal movement of the valve itself closes port E, thus imprisoning a quantity of exhaust steam in the bell or cylinder in which the left-hand end of the valve works. The steam so trapped forms a cushion and prevents the main valve from stroking the end

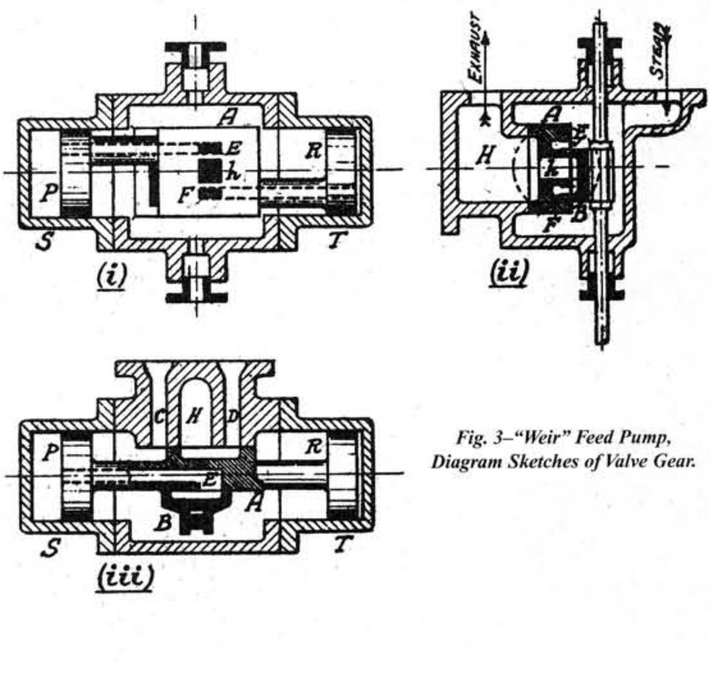


Fig. 3–"Weir" Feed Pump, Diagram Sketches of Valve Gear.

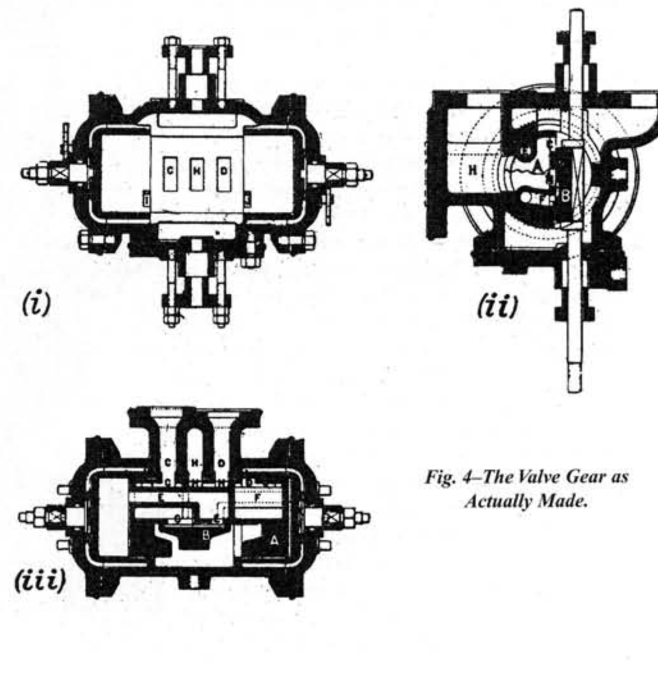


Fig. 4–The Valve Gear as Actually Made.

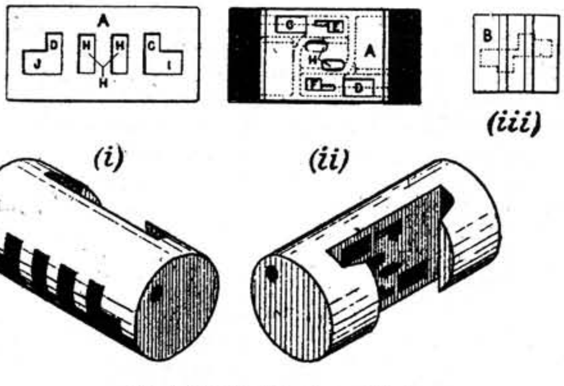


Fig. 5–Showing The Shape of Ports.

certain other pumps which can only be started by working the valve gear by hand.

In the article on Model Pumps to which reference has been made, it was stated that the Weir valve gear was "extremely ingenious, but somewhat complicated." No model engineer will dispute the first part of this description; and as regards the second, the gear is only complicated in the sense that it requires a little thought before its operation can be understood. The term would certainly be misapplied if it signified that the gear was made up of a number of small parts, for no valve mechanism could be simpler, or less likely to go wrong. The spectacle of a Weir pump in operation is very arresting, for the only prominent moving part visible is the piston-rod travelling slowly up and down at an average rate of about 13 double strokes per minute. At each end of the stroke the parts come to rest very gradually, and pause quite perceptibly before reversing their motion. Consequently there is no possibility of harmful inertia shocks being set up in the water-pipes, and this not only renders the pump eminently suitable for its duty of boiler-feeding, but also gives exceptionally long life to the water valves. Another noticeable feature is the almost absolute silence with which the machine does its work, in marked contrast to the clanking and bumping sometimes associated with other types of pump.

Figs. 1, 2, 4, and 5 are reproduced by kind permission of Messrs. G. & J. Weir Ltd., to whom the writer desired to express his great indebtedness.

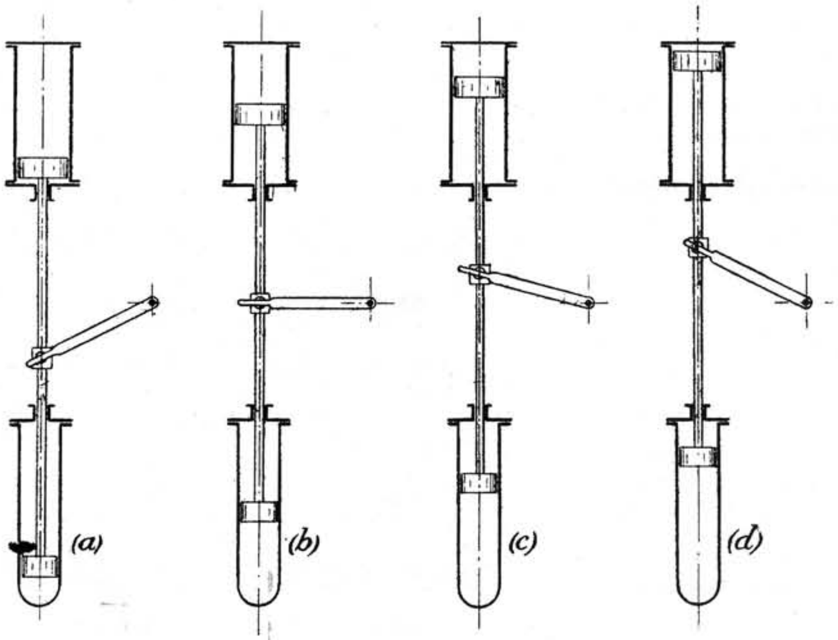


Fig. 6–"Weir" Feed Pump–Diagram Illustrating The Working.

It may seem extravagant to use three pages for one article but the action of some water pumps are not always easy to understand. A model of such a pump needs good and careful workmanship and would make a change from the usual steam engine. At one time they were a common sight up and down the country. I remember visiting factory boiler houses and seeing serried ranks of such pumps slowly feeding water into the boilers. The stokers were so skilled that they could match the water and steam rates to a nicety.

cover. Similarly port F is closed as the main valve moves from left to right.

Although in general it is advantageous to work the pump expansively, there are certain circumstances - e.g., when the pump is started from cold - when it is necessary to admit steam during the whole stroke. To enable this to be done, the small cylinders or bells in which the ends of the main valve slide are made loose, so that they can be rotated by means of external hand levers. These levers, or pointers are clearly seen in Figs. 2 and 4. In the bells are cut ports I and J (Fig. 4), and by revolving the bells the requisite amount these ports can be made to register with slots I and J in the main valve (Fig. 5 (i), thus enabling live steam to reach the main cylinder even though the ports C and D in the main valve have been closed by the auxiliary valve. Of course, when the pump is running normally, these ports I and J are out of operation.

The working of the pump under ordinary conditions may conveniently be summarised in the form of the accompanying diagram Fig.6, which shows the four chief positions of the crosshead.

These are:- (a) Bottom of stroke: Main valve is thrown over. (b) Half stroke: Auxiliary valve begins to move upwards, (c) Three-quarter stroke: Auxiliary valve cuts off steam supply to main cylinder. (d) Top of stroke: Main valve is thrown over.

The chief point to notice is that the main valve is at rest throughout both strokes of the piston, and it only moves from one end of its travel to the other when the piston reaches its highest and lowest positions. As the main valve can only come to rest at either end of its travel, the pump will always start immediately steam is turned on (provided, of course, the hand levers operating the bells are correctly adjusted). In other words, the Weir pump may be said to have no "dead centre," and in this respect it has a great advantage over

November 1, 1917

A Steam Motor Cycle.

By William Taylor.

FOR readers who may be interested in the construction and working of an experimental steam driven cycle made by myself, I have pleasure in giving the following few particulars.

I do not claim that my production was a marked success, owing to many well-known difficulties which occur in using steam for cycle propulsion.

The faults I will relate later, as they will be better understood after a description of the machine.

The frame, as readers may gather, was originally an F.N. with enclosed bevel drive slightly altered, giving the necessary room for boiler and engine to be mounted in line.

The boiler is of the multi-tubular type, 9 ins. diameter by 12 ins. high, having 120 $\frac{1}{2}$ in. copper tubes, carrying a working pressure of 500 lb. A seamless steel was used for its construction with screwed in ends electrically welded.

The burner, of simple type with pilot, was arranged for paraffin fuel.

The engine is of the single-cylinder double-acting type of $2\frac{3}{8}$ in. bore and $2\frac{1}{2}$ in. stroke, direct coupled to back tailshaft having a reduction gear of $6\frac{1}{2}$ to 1.

The circular tank, divided in two parts, contained fuel and water, the fuel being fed under pressure to the burner.

The boiler feed is pumped through two water heaters, first through an exhaust steam heater, and afterwards through a coil placed in the firebox. Superheated steam is used, having the superheater again the firebox.

The exhaust is condensed as much as possible by a surface condenser, the hot water being returned to the boiler, the uncondensed steam escaping.

The machine on trial would steam steadily at 25 miles per hour, a higher speed could be enjoyed for short spurts.

Several points make this cycle unsatisfactory apart from the excessive weight, trouble with burner in a high wind, exhaust steam, small water carrying capacity, and the wastefulness of the single expansion engine in steam at this high pressure. The rise in steam pressure on a sudden stop did not make one feel at ease in the saddle.

In my opinion the steam-driven cycle is far from satisfactory at the present time. If intending builders of a steam cycle would think of the merits of the well-known Indian and other petrol driven cycles, it may lessen their interests in the steam machine.

We have seen other unusual forms of steam transport so a steam motor cycle should not raise any eyebrows. With 500 psi working pressure the comment about the rise in pressure following a sudden stop is understandable. The Model Engineer carried many items about the Great War, mainly articles on mass production methods for shell bases and the like. A number of model engineers had set up small machining centres in their garden sheds so that a contribution to the war effort could be carried out in their spare time. The item from November 1918 is one of the many orders issued and publicised in the Model Engineer.

November 7, 1918

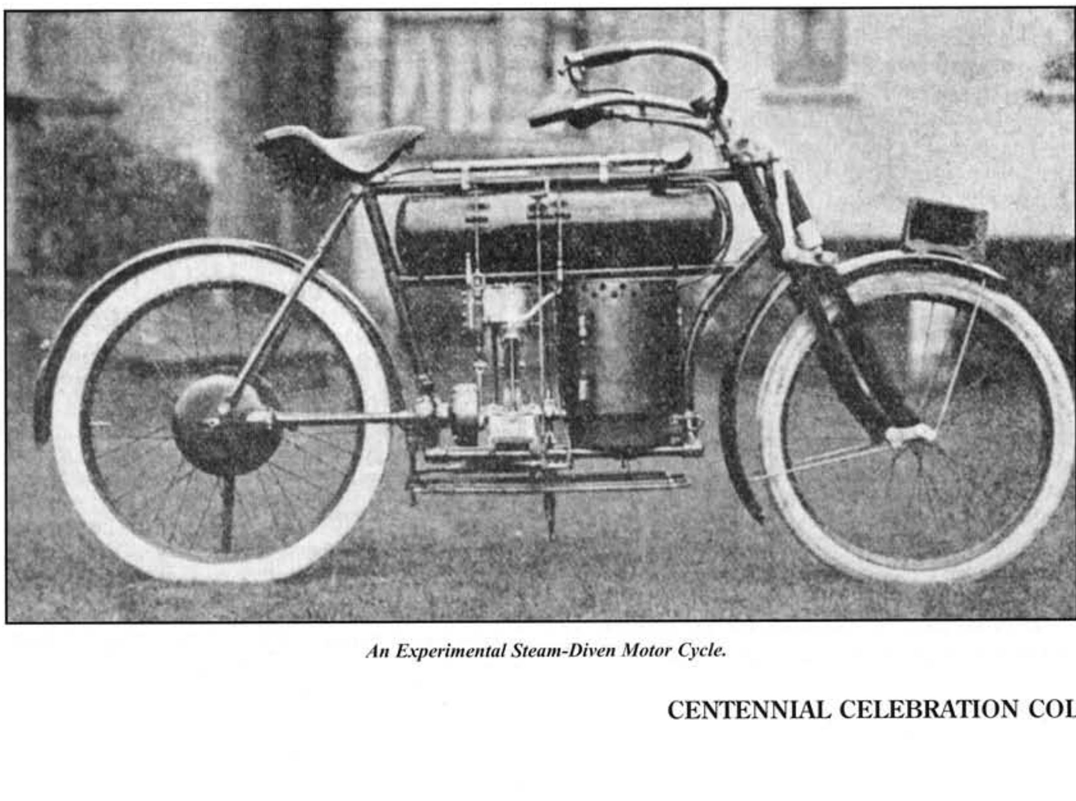
Second-Hand Boilers.

THE Minister of Munitions has issued an Order, dated 10th October, providing that no person may, without a permit, purchase, sell, or deal in any second-hand steam boiler of any type not being a boiler for use in any locomotive, motor car, or vehicle, or on a ship or other vessel.

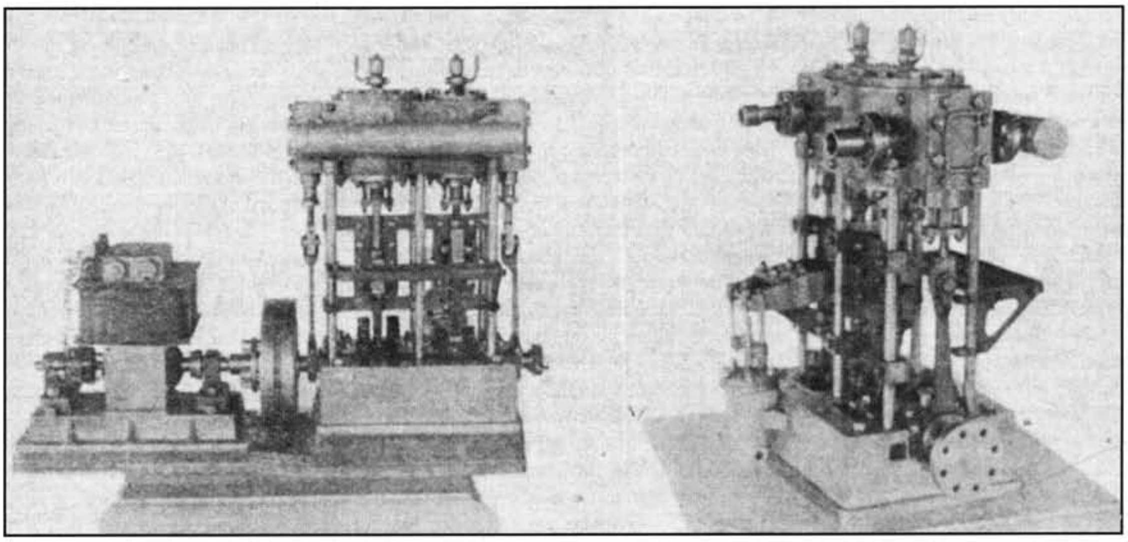
Applications for permits should be made to the Controller, Department of Engineering, Charing Cross Embankment Buildings, W.C.2.

A permit to deal generally as a second-hand boiler merchant may be granted to approved persons, who should also apply to the above address.

This Order does not, authorise any dealing in any boiler for which a permit is required under the Railway Material (Second-hand) Order, 1916.



An Experimental Steam-Diven Motor Cycle.



Compound Engine And Dynamo Built By A Reader In North China.

August 15, 1918

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 for publication]

Model-Making in North China.

To The Editor Of The Model Engineer.

Dear Sir, - As promised in a previous letter to your advertisement manager a few weeks ago, I herewith enclose photos of a high-speed compound engine, which may be of interest to your readers. This engine has been made, when overtime and circumstances permitted, over a period of about eight years, as I was always being transferred from one place to another. However, as I am somewhat settled for the time being, there is a chance of making a complete job of it, providing I can obtain material.

We are situate in the centre of a large anthracite coalfield, and these mines alone, produce about 3,000 tons per day, but to obtain this coal we have a large volume of water, which is being pumped night and day, to the tune of approximately 450,000 gallons per hour. I am in charge of the electrical equipment, comprising three power stations, and one of these is used for electrical pumping, driving 400 h.p. motors, connected direct to turbo pumps, of 75,000 gallons per hour capacity, with a speed of 1,500 at 3,000 volts, against a head of 650 feet. The total water being pumped by all units at the present time is about 450,000 gallons per hour. The electrical plant will very soon be extended by the addition of three turbines, and we shall then be able to cope with 600,000 gallons per hour, electrical only, with a total of approximately 4,000 kw. including auxiliary and lighting.

We are practically 500 miles from the nearest Foreign settlements, Pekin, Tientsin, and Hankow, so you will appreciate the fact that model-making is carried on at a disadvantage at such a distance from civilisation, and it is impossible to obtain anything in the model line, even from England, such as bolts and nuts, fittings, etc., etc., with the result that we makeshift the best way we can.

The engine in question is compound, at present, non-condensing, but you will notice a marine type air pump, worked off the h.p. engine, at the back. Cylinders are 1 in. by 1¼ in., by 1 in. stroke, and, complete, have over 170 holes, which were all drilled with a small size brace, fitted on a wood frame, with an adjusting screw at top to keep the drill square and to feed the cut. This includes the holes in cylinder covers and ports, which were afterwards chipped. The job throughout is made in mild steel and cast-iron, with split brasses. Eccentric sheaves are cast-iron, with steel straps. Crankshaft is built up, and fitted with balance weights. Speed about 1,000 r.p.m.; dynamo is of the usual bi-polar type, series wound.

Trusting the above short account may be of some interest to fellow readers of your valued paper, and wishing you every success during these troublesome times - Yours truly, DUPLEX

Honan, China.

The letter from 1918 is nothing unusual but it does go to show how far the Model Engineer had spread, in this case North China. An article on the pumping equipment at the coal mine would have been of interest. Going on to the next item from 1919, this is an interesting combination of steam and electricity. With modern electronics this could form an interesting project bringing the idea in line with today's technology.

April 3, 1919

An Electrically-Operated Steam Engine Governor.

By G. T. Garwood.

IN attempting to equip a small model steam engine with an efficient governor of ordinary design the writer was led to a conclusion that will probably be shared by the majority of readers, namely, that the centrifugal governor is very ill-adapted to the requirements of steam engines of the smaller types.

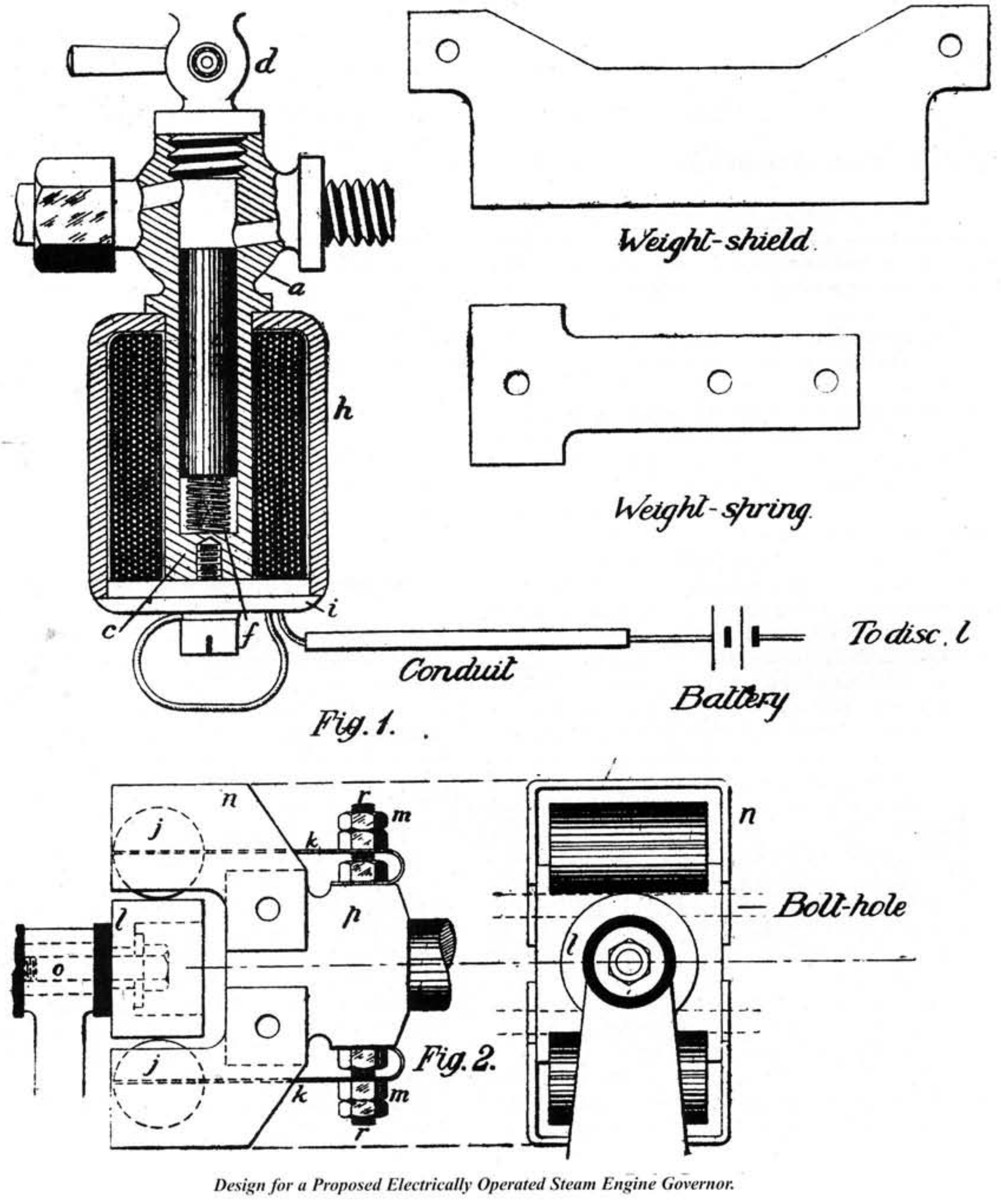
The trouble usually appears to lie in the excessive friction of the throttle valve-gear, and in the small effort exerted by the revolving weights. Frequently such a governor refuses to make its influence felt at all, and, at the best, its control is erratic and unreliable. It was in the hope of overcoming these defects that the writer devised the electric governor, with which this article deals. Fitted to a high-speed engine of 3/4 inch bore and 7/8 inch. stroke, the results exceeded all expectations, a remarkably even speed being maintained over a wide range of loads. The appearance of the engine is in no way spoiled by the addition of this governor, for the throttle actuating solenoid is switched in and out by a centrifugal device that has all the appearance of an ordinary shaft governor.

The only evidence of electrical additions to the engine is the wiring connecting the governor to the throttle solenoid, and this can be led through a conduit. The one solenoid used is completely encased in metal, and its appearance does not betray its electrical nature.

A novel feature of the design is the throttle valve. The steam entry is closed, as necessary, by the plunger of the solenoid already mentioned, which slides in a cylinder placed at right angles to the steam passage. The plunger being enclosed and solely under magnetic control, no actuating rods or stuffing boxes are necessary, and friction troubles are practically non-existent.

The principle of operation is very simple. When the engine speed falls below the normal, the governor closes a circuit, therefore energising the throttle solenoid and enabling it to withdraw the obstructing plunger from the steam pipe, against the action of a spring. The engine at once accelerates, until, when a slightly abnormal speed is attained, the circuit is broken and the solenoid becomes inert. The plunger is then pushed into the steam entry by the spring until the speed falls to normal once more. If the plunger were rapid in its action the engine would 'hunt' badly - that is to say, it would undergo wide variations in speed in regular cycles. In order to do away with this possibility, the solenoid plunger is made to serve as the piston of a dashpot, and a steadying action is thus obtained. When the engine is running at its proper speed, the governor makes and breaks contact continually, and the ultimate position taken up by the plunger at any load depends on the frequency and duration of the currents.

The constructional details are shown in the accompanying drawings. Fig. 1 shows the throttle-valve and solenoid. The body of the valve a is a gunmetal casting, and can, if desired, be made in one piece, with the stop valve. An alternative method of construction is to turn the body of the valve out of solid metal and to braze in place a length of gunmetal rod, which can afterwards be bored out to form the cylinder c. A simple lubricator d, screwed into the throttle, serves the dual purpose of oiling the throttle-valve and the main cylinders, the oil for which is carried over with the steam. The rather peculiar arrangement of steam passages should be adhered to. The plunger is a polished length of soft steel rod, and it has a fine hole drilled axially throughout its length in order to permit of the transfer of oil and water from one side to the other. This introduced the dashpot effect previously mentioned. The spring f is of fine steel wire, and should be just capable of raising the plunger when the engine is under steam. If too strong it will prevent the solenoid acting properly. Some little experimenting will probably be necessary before the most efficient type of spring is arrived at. Too much emphasis cannot be laid on the necessity for perfect freedom of action on the part of the throttle-valve. It should be remembered that it is unnecessary for the plunger, when raised, to completely bar the passage of steam - that is the stop-valve's function. Providing the steam passed by the closed throttle is insufficient to run the unloaded engine up to normal speed the governor will fulfil its purpose. This, however, does not alter the fact that as good a fit is desirable as is consistent with free working. The solenoid coil is protected by the polished iron casing h, iron being used because it affords a good path for the magnetism. A turned iron plate i, secured by a cheese-head screw, fastens the whole thing in position. A hole, with smooth edges, through



Design for a Proposed Electrically Operated Steam Engine Governor.

which the wires are led, is drilled in this plate. The casing h should not be too thin, and as it would be difficult to spin, it had better be turned up and bored out.

The centrifugal device, or governor, is shown in Fig. 2. The two cylindrical weights j, ported on the brass foil springs k, normally make contact with the brass disc l, but when revolving abnormally they fly outwards and break the circuit. Adjusting nuts are fitted at m, and the sheet steel shields n protect the delicately-mounted weights from injury. The disc l is insulated from the frame with ebonite, and is supported on a pedestal or standard which can be of any convenient design.

The hole in the disc through which the bolt o passes has a diameter considerably larger than that of o itself, in order to permit of the disc being centrally adjusted. The body p of the governor consists of a solid piece of mild steel, filed into shape and drilled. The weight springs must be very thin and springy, and their shape when straightened out is shown. The weight shields n can be made of ordinary tinplate, and the tin coating should be removed and the surface of the metal polished preparatory to cutting out the blanks.

The cylindrical weights can be cut from a length of brass rod, and slit with a very fine saw. The end of each spring should be sandwiched between the two halves of its particular weight, and the whole riveted together. Solder may not be used on account of the danger of softening the springs. The adjusting nuts m are carried at the ends of the two studs r, which serve the additional purpose of carrying the nuts which clamp the ends of the springs in place, and which also act as set-screws for securing the body of the governor to the shaft.

The whole, when assembled, requires careful adjusting. The engine should be belted to some convenient source of power and driven at its proper running speed. The governor should be connected in series with a battery and lamp, or galvanometer, and the nuts m adjusted so that the circuit is broken directly the engine gains the slightest speed. The throttle-valve can be tested by unscrewing the lubricator and observing whether the plunger rises properly under the action of the spring, and whether the solenoid, when excited, is capable of pulling it down. Assuming that all is in order, the gear can be assembled in place.

The electrical connections are very simple. One end of the solenoid coil is led to the frame (as shown), the other to the battery. The other lead to the battery is taken from the disc l. In order to ensure that good electrical contact is maintained between the engine-frame and the crank-shaft, it is advisable to screw one end of a flat spring to the frame at some convenient place so that the other end presses lightly on the shaft. This will ensure reliable electrical continuity between the shaft and the frame.

Upon running up the engine for test, very little adjustment should be required providing the governor and throttle-valve have been individually tested beforehand. Any minor adjustments that may be necessary should give no trouble - the throttle-valve spring is the feature which should be given the greatest attention. If everything has been correctly 'tuned' the arrangement will be found very satisfactory.

There are two points relating to the electrical design that have not been considered; the proper winding for the solenoid and the requisite amount of energy. The type of battery available will usually be known beforehand. Say, it is a four-volt accumulator, then the gauge and amount of wire to wind on the solenoid, in order that a reasonably strong current will be taken, can be easily calculated. The current required is relatively larger in the case of small throttle-valves than in those of larger size, and it is probable that a larger valve than that described would yield even better results. In order to economise space the solenoid employs no insulating bobbin. The wire (which should be double-silk covered) is wound on a former, after which it is solidified by being thoroughly soaked in enamel and baked hard.

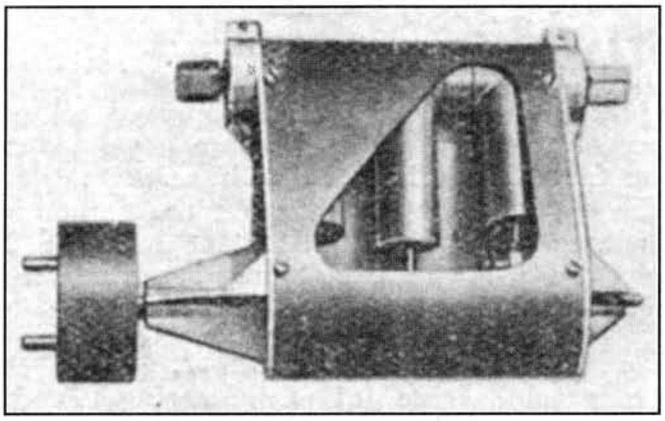
The illustrations to this article need not be considered as working drawings, that must be rigidly adhered to; the design given for the valve, however, is the result of considerable experiment, and should be followed closely.

In conclusion, the writer would like to add that he has made one other interesting experiment in the application of electricity to mechanical models - namely, the maintenance of constant pressure in a steam boiler by means of automatic electrical fuel control, and, subject to the Editor's approval, he hopes to place a description of this device before the readers of The Model Engineer at a not far distant date.

October 7, 1920

A New Feather-Weight Boat Engine.

THE illustration herewith shows a welcome departure in the design and construction of light-weight boat engines. They are being manufactured by Mr. L. Midson, 18, Malvern Road, Dalston, London, E.8., and are known as the "Midson X." The engine, a three-cylinder job, of (in. bore by 9-16th in. stroke, is patented). It is self-starting and reversible and weights only 7ozs.



The Midson X Lightweight Boat Engine.

Its overall measurements are: height, 3¼ ins.; length, 5⅛ ins.; width 1⅝ ins. Steam pressures up to 80 lbs. may be used. At very low pressure it will 'tick over' quite steadily. Boilers as small as 3 ins. by 6 ins. can be used to run the engine, but of course the provision of a larger size steam generator is advisable and would enable the engine to drive a 3 ft. 6 in. hull successfully. The casing is cut away in illustration to show the cylinders.

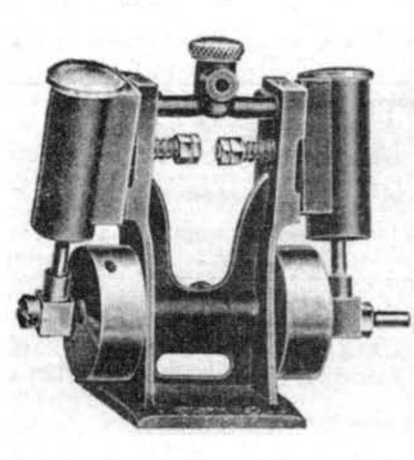
August 19, 1920

News of the Trade.

Two New Oscillating Cylinder Launch Engines.

The illustration herewith is of the double cylinder oscillating engine which has just recently been placed on the market by Messrs. Bassett-Lowke, Ltd., of Northampton, and 112, High Holborn, London, W.C.1. It is designed to provide an inexpensive but reliable engine for model launch work and other light duties. They run best at about 25 lbs. steam pressure, but up to 40 lbs. can be applied if so desired. It will be noticed that one crank-pin is of extra length, and thus provides a good drive on to the slotted dog attached to the propeller shaft. The hole just under the lubricator cap is threaded all ready for taking the screwed steam pipe.

A single cylinder engine of the same type precisely is also made, and for proportionally smaller and lighter boats will give equally good service. The principal dimensions are:- Bore, 7-16th inch by ⅝ in. stroke; total height, 2 11-16th ins.; width 1½ ins.; height from base to centre of shaft, ⅝ in. The overall lengths are respectively 3¼ ins. and 2¼ ins. Both engines are of brass throughout except the crank-pins, and are neatly finished in green enamel with flywheels, cylinder caps, and piston rods left bright. The price is 21s. and 35s. respectively.



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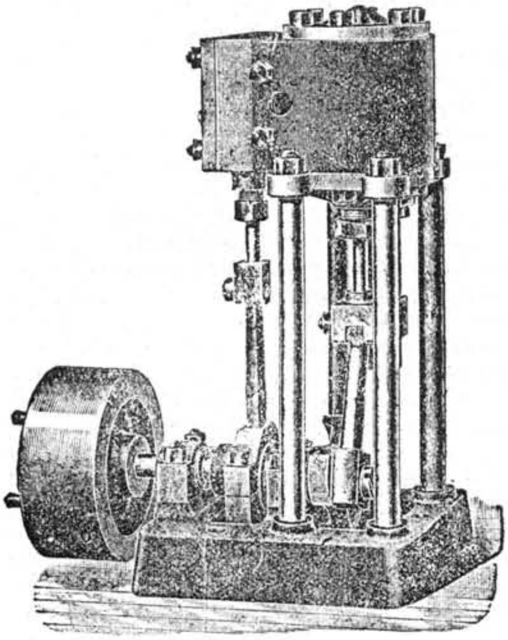

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NO LATHE REQUIRED.

When we introduced before the war our "Simplex" set of fully-machined castings and parts, we knew quite well that it was a splendid engine, and easily the finest value ever offered to the public, but even we ourselves did not appreciate how good this set was. To-day, **hundreds of well-satisfied owners, all over the world,** testify to the excellence and power of these models. Many Model Power Boat users have been highly successful in keen inter-club races when using the "Simplex" Engine Set. This year we have improved on these models somewhat, and to meet the demand of users of high temperature "flash" steam we have introduced another set, with cast-iron cylinder, in addition to the ordinary gun-metal set. Both sets are complete, and consist of a **Fully-Machined SET OF CASTINGS and PARTS for a Model Four-Column Launch Engine having a double-acting slide-valve Cylinder $\frac{5}{8}$-in. bore by $\frac{5}{8}$-in. stroke.**

The SET comprises—
Machined and bored cylinder, with ports cut, complete with turned covers, and steam chest and cover, faced ready for fitting up. Glands fitted. Four steel columns turned and screwed. Eccentric and strap turned and bored, bed-plate and bearings machined. Flywheel turned and bored for shaft. Crankshaft turned. Machined crosshead, slide-bar and connecting rod.

Complete with drawings, instructions, and all bolts, studs and nuts, lagging plate, etc.

Price in **Gun-metal**, recommended for use with ordinary Boiler	17s. 6d.
Price, with Cylinder in Cast Iron, Steel Piston, Steel Crank Disc solid with shaft, and special Flywheel, recommended for use with "Flash" Steam	21s.
Finished Engines	£3 3s.

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66, Farringdon St., London, E.C.4.

This may not qualify but it is certainly stationary. It is interesting to see that the early developers of the electric motor first used the principles of the steam engine to provide rotary motion from electricity. The efficiency was very low, the heat loss from the coils do not bear thinking about.

An Interesting Model Four-Throw Magnetic Engine.

By G. Gentry.

THIS model is the property of Mr. W. C. Jackson, of Worthing. Incidentally, it may be mentioned here that this is not the most interesting piece of apparatus possessed by Mr. Jackson, and which the writer is enabled by that gentleman's kind co-operation, to place before readers of the paper. But these other matters are reserved for another time and place. Nevertheless, we are much indebted to Mr. Jackson for providing facilities for taking the annexed photograph, given here in Fig. 1.

Apparently this motor is an exact replica, and probably one of a number made by the same man, of a model in South Kensington Museum, stated to have been made by Mr. T. Allen, in 1852, and presented by him to the Science Museum in 1857.

The construction and working are as follows: There are four cranks, in an overhead shaft, actuated by four armature rods, which are attached by connecting rods, and act exactly in the same manner as piston rods. The armature rods each carry a system of four circular armatures, like tandem pistons, excepting that they are not attached to the rod like a piston would be, but, being only single-acting, drive the rod by resting on shoulders of the same; otherwise they are free of the rod, and allow the same to slide freely through them. The analogue of the cylinder of a steam engine takes the form of a group of four electro magnetic bobbins, fitted with pole pieces; each group of four - being two north and two south - are apparently wound in series, and grouped tandem-fashion in a frame, to act by magnetic pull on the armature, the armature rod passing midway of the four bobbins. There is a fixed sixteen-segment commutator upon the outside of one bearing - the nearer in the picture - which gathers the current from the frame of the motor by means of a rotating wheel brush, which is carried on an arm projecting from the shaft. From this commutator, which is, of course, insulated from the frame, the current is led by sixteen insulated leads to the like number of groups of four bobbins, forming each a separate electro magnet. It will now be seen that, as the machine revolves, each magnet in turn is energised as the wheel brush passes its commutator segment, and only that particular magnet at that part of the revolution. The leads from the other end of the magnet windings are grouped together into a common negative, which passes through a switch (the handle of which is seen to the left of base) back to the driving generator, the other pole of which is in contact with the frame.

Fig. 2, a diagram, shows the cycle of working, although it would be as well to notice two other points before looking into this matter. First it should be seen that the four cranks are at 90 degrees to each other, in order of succession, and that, as seen on the farthest rod in the picture, the stroke space between the armatures and their magnets varies. The top one has approximately half the space of the one below it, one-third the space of the one below that, and one-fourth of the bottom one. The object of this is that the magnetic pull goes off so rapidly as the armature is removed from the magnet poles that only the short pull, as exemplified in the top space, is used in all four cases, and these in succession. Turning to the diagram, the four crank pins are represented by the numbers 1, 2, 3 and 4, the direction of rotation being as the arrow. Crank No. 1 is just going to take the pull, which it gets while passing through the arc 1 to 4. When it reaches 4 the position of crank 2 is then at the point 1, and, in its turn, takes the pull. Returning, however, to crank 1 in position as in Fig. 2, and also as in the farthest crank in the photograph. It takes its pull from the top magnet alone while passing from 1 to a. When the top armature reaches the poles it is left there, and the pull is then taken by the next magnet below, which does the work from a to b, and, in its turn, has its armature left on the poles. Similarly the next magnet pulls from b to c and the bottom one from c to 4; when the current is shunted to the top magnet of the next in series, which will be the nearest one in the picture, and correspond to No. 2 in the diagram. The cycle of operations in all four cranks is just as described for the first one. There are therefore sixteen separate pulls per revolution, all taken through the most effective quarter revolution of one of the cranks, four pulls to each crank, and each pull made by a separate magnet. The timing can be arranged by varying the position of the brush arm, so that the pull of the first magnet is a little in advance of the 45 degree position, when, of course, all the others follow suit; but any great variation here would make for inefficiency, as the pull would come on nearer the top dead centre, and leave off further from the bottom one.

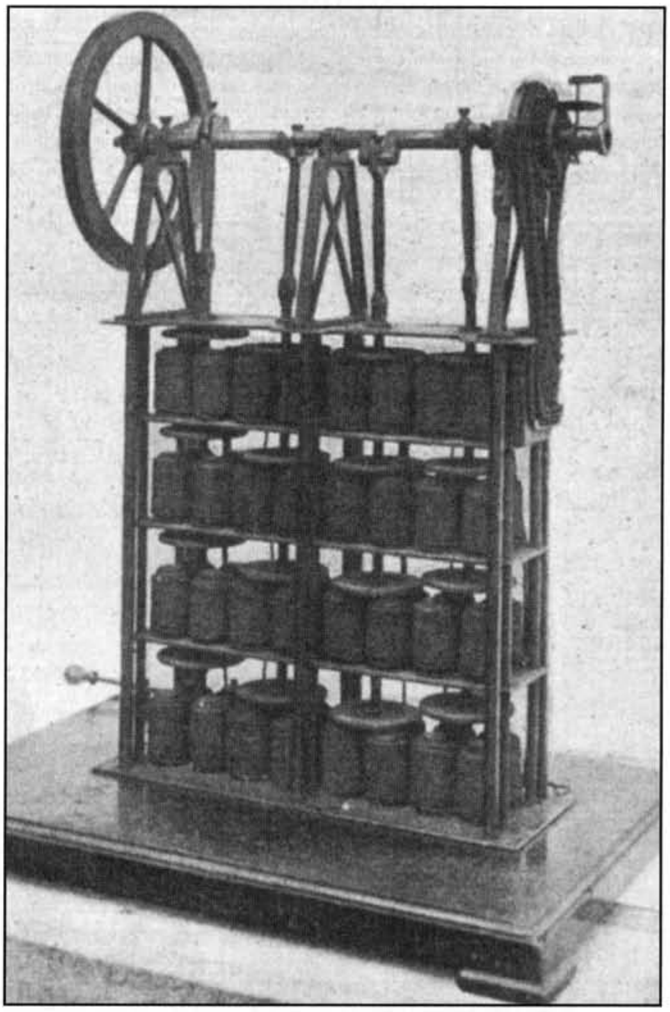


Fig. 1–General View of the Model Magnetic Engine.

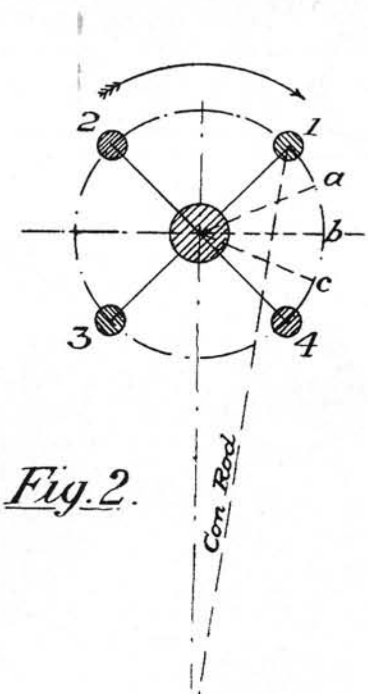


Fig.2.

Diagram showing the series of Impulses per Revolution.

September 28, 1922.

Explosion of a Model Stationary Boiler.

Reports of boiler explosions are very rare because such happenings are, fortunately, very few and far between. Here we have one from 1922. Before the doom and gloom merchants put pen to paper look at the facts. A boiler made of brass, soft soldered without any other form of fixing and not tested, a safety valve that had stuck fast and a second-hand boiler of unknown provenance. Under today's rules and regulations such an accident could not happen.

WE have received particulars of the explosion of a model boiler, which occurred in the London district last March, and give illustrations showing the condition of the remains. This boiler was of horizontal, cylindrical type, length 7½ ins., diameter 2 ⅞ ins., externally fired by a three-wick lamp enclosed in a sheet-tin casing. The shell was made of sheet brass 3-64th-in. thick joined by a single longitudinal seam 5-32nd in. width, one edge having been shouldered down to form the joint. The end-plates are of brass 1-16th in. thick, without flanges; they merely butted against the shell. The joints were all held together by soft solder, no screws or rivets having been put in. Fittings were a safety valve, steam and test cocks, and water-filling plug. The owner, a youth between fourteen and fifteen years of age, who is serving an apprenticeship to his uncle, a motor engineer, had purchased it second-hand.

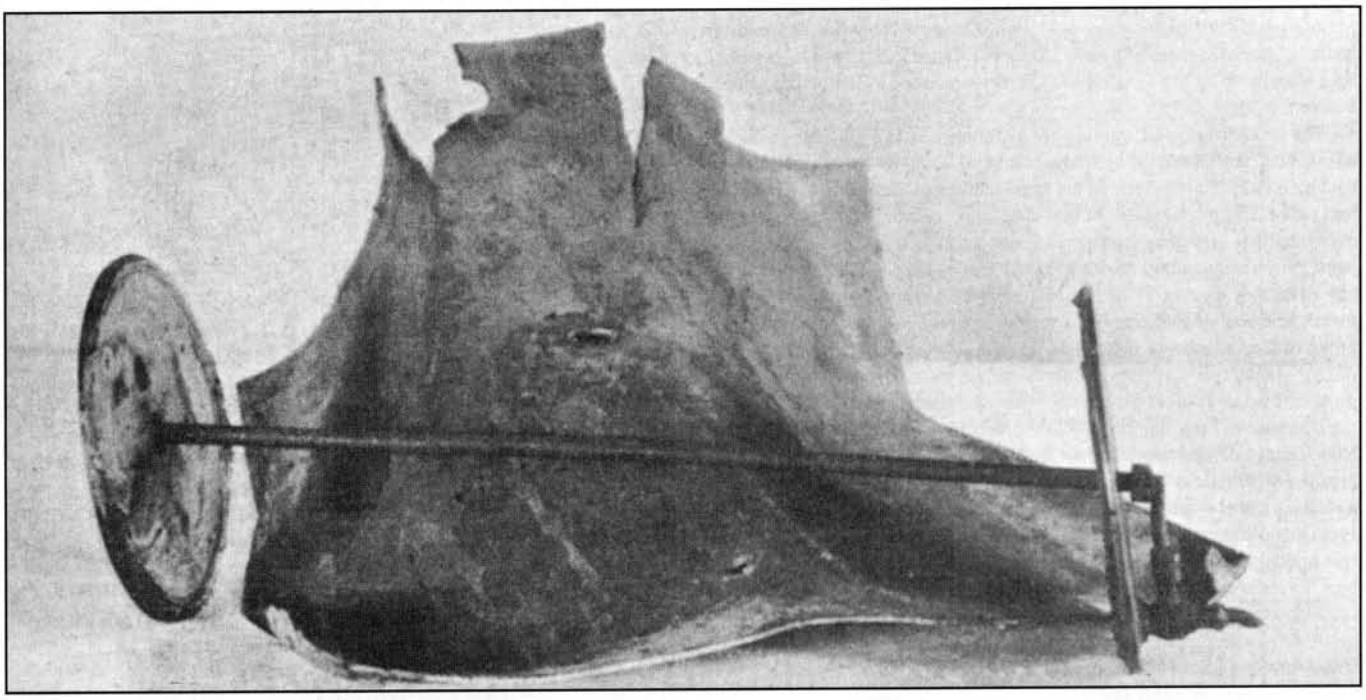


Fig. 1–Explosion of a Model Boiler: The Shell (showing inside surface), Stay, and End Plates after the occurrence.

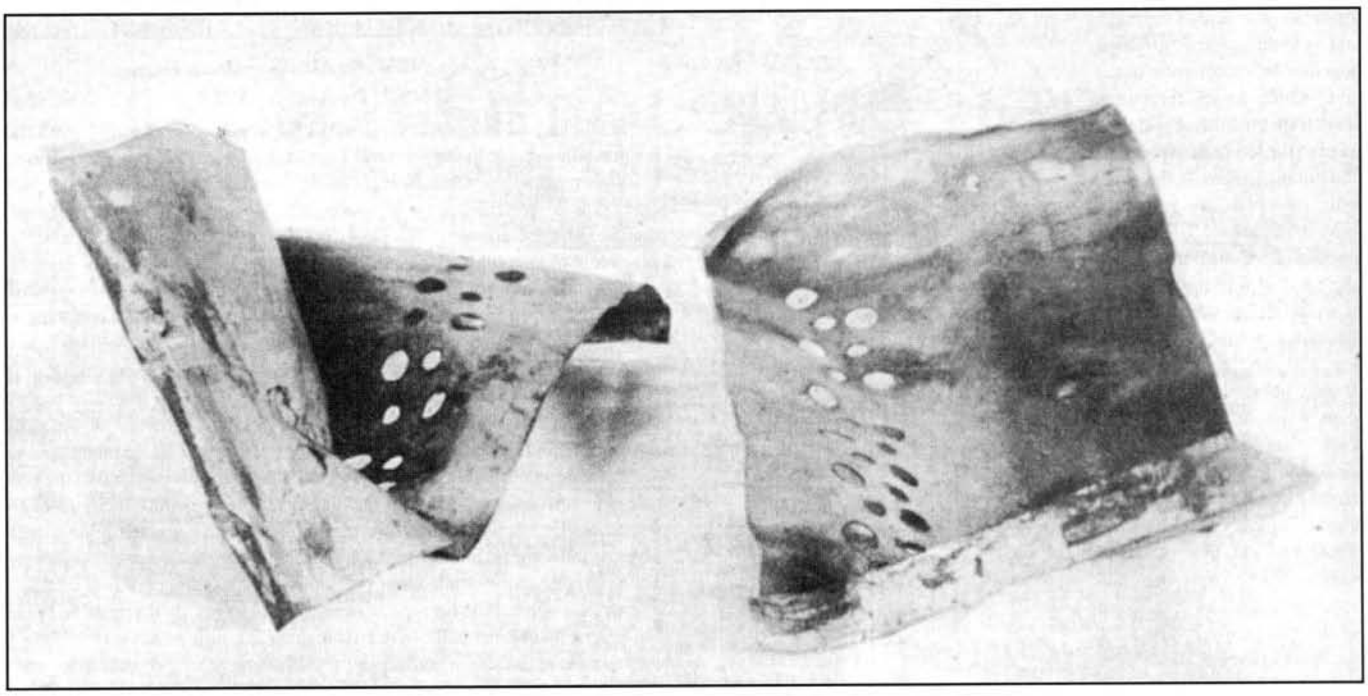


Fig. 2–Explosion of a Model Boiler: the casing after the occurence.

He was using it in an upper room of a house to drive a single-action oscillating engine when the boiler exploded, giving a report which alarmed the neighbourhood. The engine was blown to pieces through the window, one or two of the parts being afterwards found in a neighbouring garden. The shell of the boiler was opened out by the force of the explosion and driven upwards; it struck against a beam and was bent to a reverse curve along the line of holes shown in the photograph, Fig 1; with the exception of the test cock the fittings were blown out and disappeared. When purchased there was no stay, but a friend insisted that one should be fitted and also said that the boiler was not to be worked until it had been tried with his pressure gauge. The youth fitted a longitudinal stay, 5-32nd in. diameter, with nuts to hold the end-plates, but was too much in a hurry and did not wait for the latter precaution. He rigged up his engine cylinder with a wood frame and was endeavouring to get it to work when the boiler blew up. So far as we can judge from an examination of the parts and the hearsay evidence, the accident was caused by the pressure rising to an amount when the temperature of the steam became high enough to render the solder plastic. The longitudinal seam probably gave way first and the bursting force of the steam opened out the shell, ripping it away from the end plates. Apparently there were three definite causes which led up to the accident. The engine cylinder was fitted with a long piston; this tended to stick; the safety valve was of the internal spring type and had a somewhat acute angle to the valve; it was blowing off steam, and as the engine did not work the youth gave the valve a tap with a hammer to stop the escape, with the result that the valve stuck fast. The pressure of steam might have been relieved by the cylinder face blowing away from its seating, but he had prevented this by screwing up the adjusting nut. There seems no doubt that he had stopped all escape of steam and was entirely occupied with the engine; meanwhile the pressure increased to a dangerous amount. The boiler having been freshly charged, there was probably a considerable quantity of water, and this would have a large amount of energy stored in it.

Fortunately there has been no serious damage; the youth was cut and scalded about his right arm, but is not at all upset or perturbed. Fig. 2 shows the tin casing in the condition as it was found after the explosion; the lamp has survived. Fig. 3 is a sketch indicating the arrangement of boiler and casing, and also kind of lamp and safety valve. The occurrence shows that Fboilers which have joints and fittings held by soft solder should only be worked at a very low pressure, also that longitudinal joints in the shell should be riveted. If the shell of this boiler had been a seamless tube all that would have probably happened would have been leakage at the end joints, or blowing out of the fittings; though cracks in the metal seem to indicate that it had become brittle - a condition liable to develop in brass boilers.

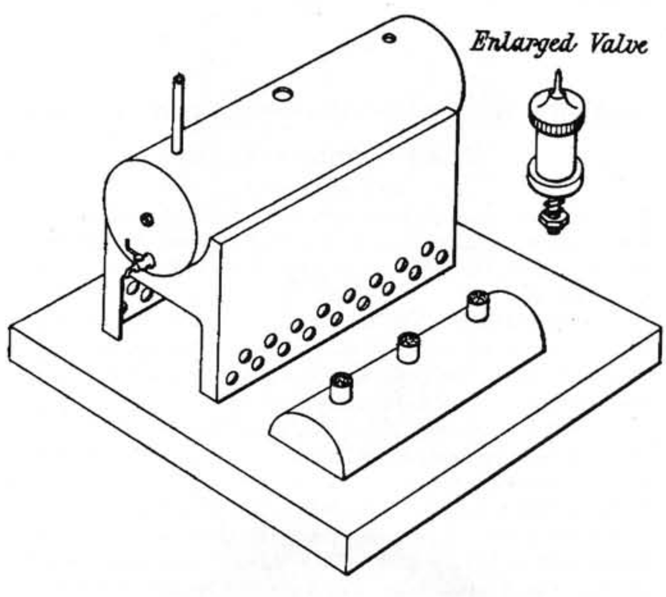


Fig. 3–Sketch illustrating the Boiler and Type of Safety Valve.

A Light-Weight High-Powered Steam Engine, With Frictionless Guide.

By A. J. Middler.

I INTENDED to repair a piston valve engine which was made about 1909, and which was a winner of a diploma at The Model Engineer Exhibition of 1911. At that time the guide as shown in the present illustrations (Figs. 1 and 1a) was not then fitted.

I commenced fitting a liner and piston to the cylinder, and renewing the valve-chamber, with the result that the whole engine was ultimately scrapped, with the exception of the guide segments and the toothed quadrant - all that now remains of my hard-worked engine.

Concerning the present engine, which is 15-16th-in. bore by ½-in. stroke, weighting 4 ozs., the following brief notes apply: A short length of tool steel of 2 ins. diameter was chucked in the lathe, and the cylinder bored out; then the inside of the bottom cover was finished off at 30°, and a hole for the piston-rod drilled. The metal between the flanges was turned out, and the cylinder walls and top flange were taken out to thickness. The cylinder was parted off, leaving about 1-16th for finishing the stuffing-box and cylinder bottom, which was done by putting the open end of the cylinder on the expanding jaws of the S.C. chuck. I would advise tapping out the stuffing-box instead of screwing it on the outside - an awkward job, which was done with the intention of fitting metallic packing. The ports were next cut through the cylinder wall, the upper one being formed by filing into the edge of the bore and flange until an opening large enough was made to take a very thin file. The lower port was drilled and the material between the holes was chipped out, and the port filed to size, a bar 1-16th broad being left in the centre of each.

The valve-chamber block, made from high-speed steel, was next taken in hand. First it was filed to fit between the cylinder flanges and then drilled to 7-32nds. The ports were cut by using two blades together in the saw-frame, and filed to the required width (Fig. 2). Two staple-like bits with legs to fit the port slots (Fig. 3) are made from mild steel, fitted in position and brazed, care being taken that the spelter does not flow into the port. The service metal is sawn off, and a piece of 7-32nd-in. round rod is lightly driven into the valve-chamber and cut off flush with the ends. A few holes are drilled in the parts to be cut out for the two steam passages and the remaining metal is chipped out and filed. The round piece is next driven out, and the chamber-block is fitted against the outside of the cylinder, in line with the two ports already cut. A hole is drilled through the top and bottom flanges into the valve-chamber and filed fair with it. The chamber piece is tied to the cylinder, which is filled with fireclay and the whole brazed. Care must be taken not to use too much spelter, as the lower passage is now inaccessible. After brazing, the cylinder should be immersed in sulphuric acid overnight to remove the borax. The hole for the steam-pipe is drilled and tapped and the valve-chamber reamered out to ¼ in.

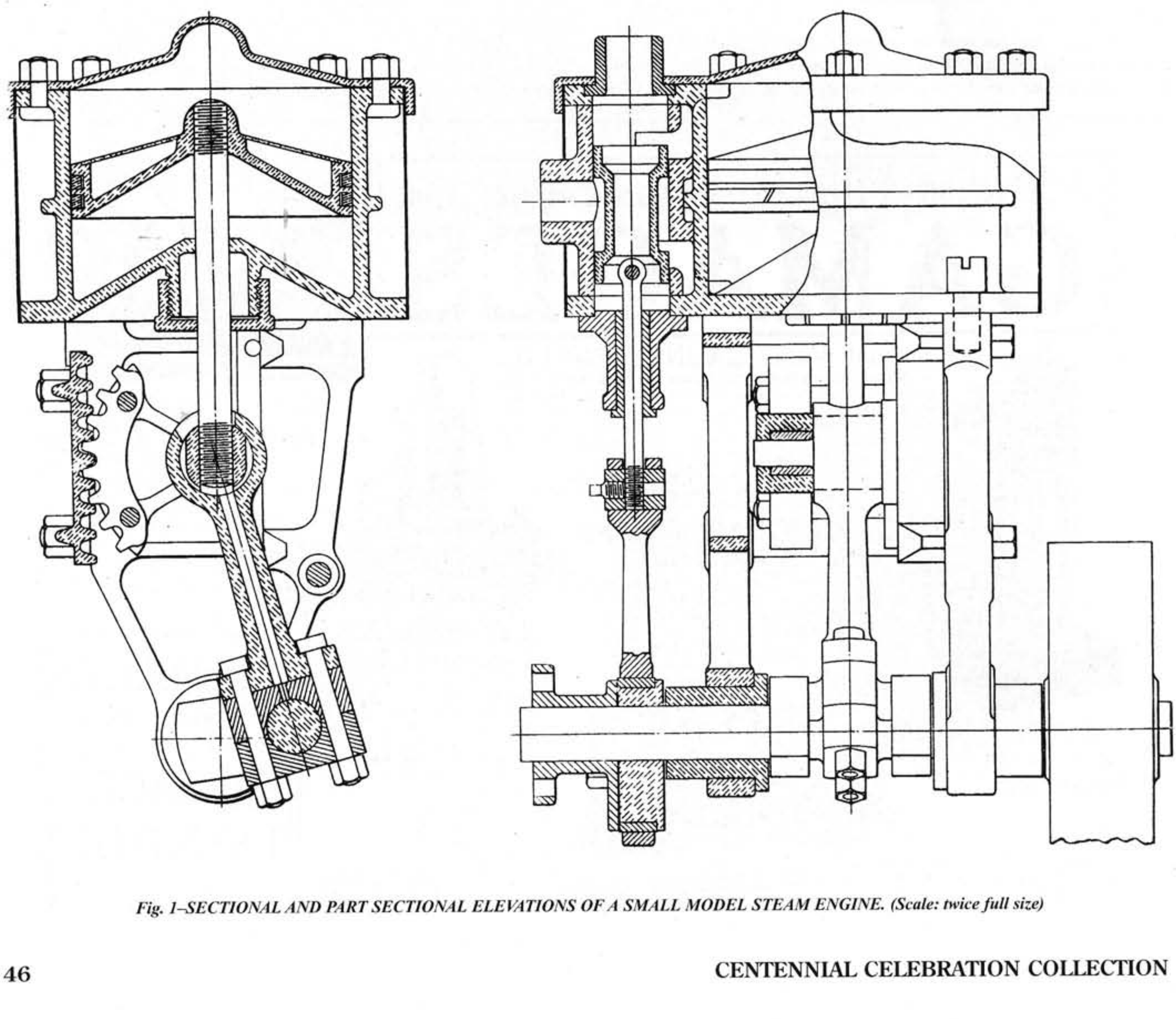


Fig. 1–SECTIONAL AND PART SECTIONAL ELEVATIONS OF A SMALL MODEL STEAM ENGINE. (Scale: twice full size)

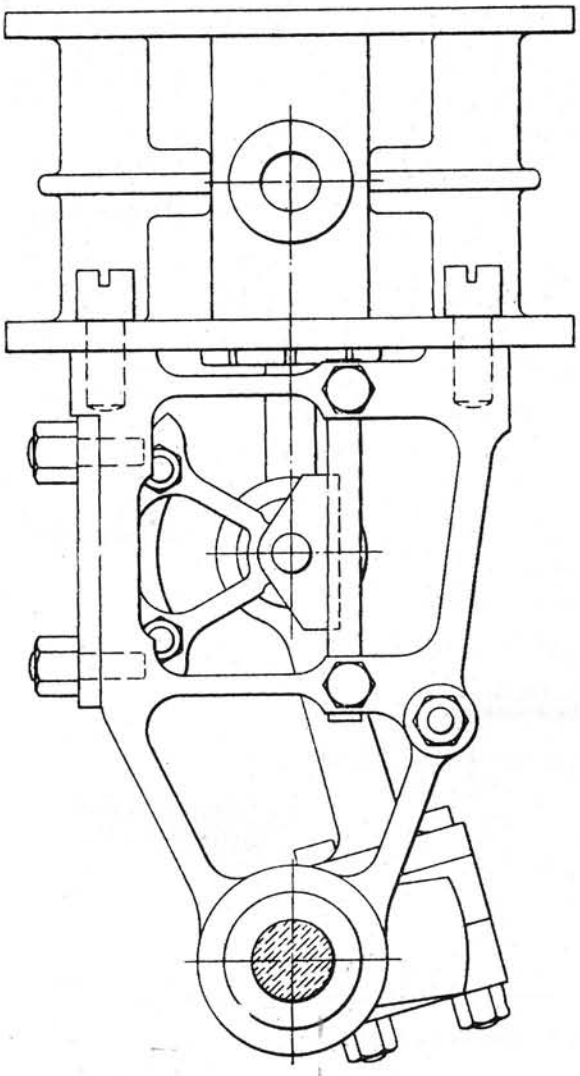
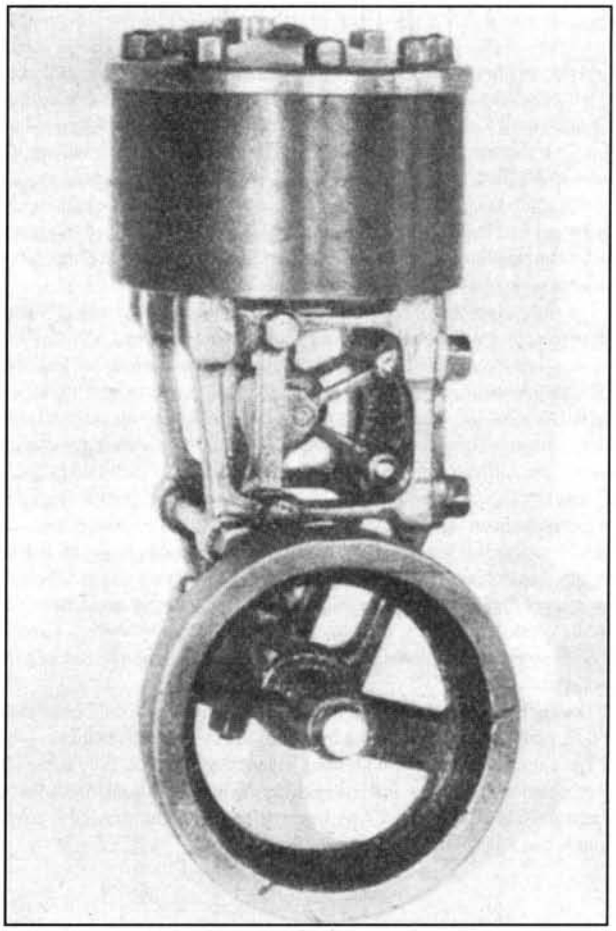
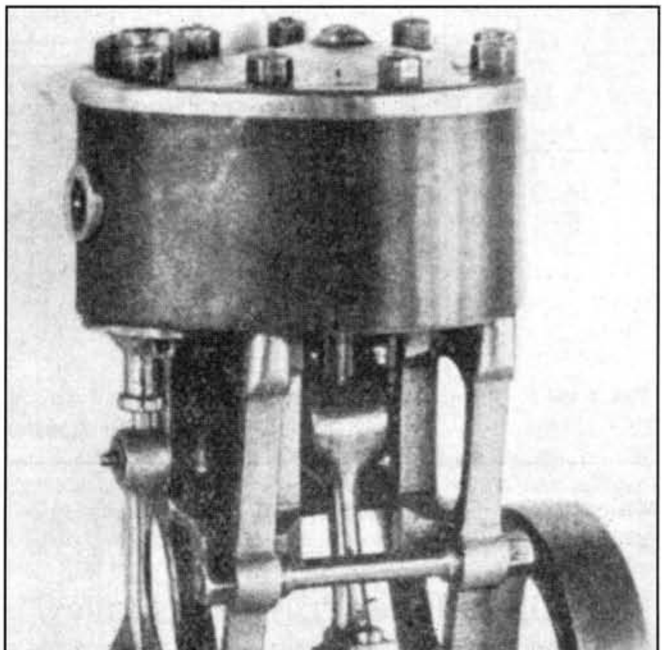


Fig. 1a–Elevation of Small Model Engine without Flywheel. (Scale: Twice full size.)



Two Views of the Model Light Wight.



High Powered Vertical Steam Engine.

The recess for the spigot of the exhaust-thimble is turned out by mounting the valve-chamber on a mandrel held in the self-centring chuck. This thimble is necessary on account of the short distance between the top port and the valve-chamber, and leaves no possibility of the joint blowing out.

The two frames are next marked off on two pieces of spring steel, which are sweated together, and spaces are drilled and filed out, a little being left for final finishing. The top, which joints the underside of the cylinder, is squared, and holes for the cylinder holding-down bolts are marked off and drilled and tapped.

The open end of the cylinder is put on a S.C. chuck, and by working the scribing block on the slide-rest a line is put on through the centre of the cylinder and valve-chamber, and holes for the holding-down bolts are marked off. The frames are now bolted to the cylinder, which is again put on the S.C. chuck, and, picking up the centre line on the cylinder, a line is run down the frames. The top flange of the cylinder is now set on the surface plate, and the distance of the crankshaft centre is scribed on the outside of each frame, through the vertical line already put on, and the holes for the crankshaft bushes are drilled. The holes for the front horizontal stay are marked off and drilled and the stay fitted. The crankshaft bushes of phosphor-bronze are made a driving fit in the frames. The two rocking pieces (Fig. 4) are of mild steel, first turned in the form of a disc and the superfluous metal sawn off, one disc being required for each rocker. The cross-head (Fig. 5), guide slipper (Fig. 6), and toothed quadrant are of mild steel, case-hardened, the latter being necessary to register the travel of the rockers on the guide thrust plate (Fig. 7), and to prevent them from skidding. The guide thrust plate is made of tool steel and tempered, the teeth being milled out. The tempering and case-hardening is done after all the parts are fitted. The studs for holding the thrust plate are put in last. Setscrews are used while fitting these, allowing the faces of the frames to be filed easily. The connecting-rod is turned from mild steel, the first operation being the drilling of the hole up the centre, of which one side is flattened and the crosshead hole drilled. The top end is filed to shape by using a hardened jig, which has a shoulder equal to the outside of the top end and a pin which fits the crosshead hole.

The piston is made of nickel steel, as also is the top disc, which is brazed at the same time as the piston-rod, any spelter being skimmed off in the lathe. The piston rings are of hard phosphor-bronze and are a somewhat fragile job. So far they have answered well enough, although I will fit cast iron ones if they fail to stand up. The cylinder cover (steel) is formed on the jigs (Figs. 8 and 9) shown. There are held in the jaws of the vice, while the flange is formed, just sufficient metal being left for the flange, which makes this job very easily done. The piston valve is of high-speed steel, and is lapped into the valve-chamber. The steam lap is about .03, while the exhaust has a fraction of negative lap, say, about .001. As it is not possible to get an indicator diagram, I have made several piston valves, the one at present fitted being the third one tried. The two cradles (Fig. 10) are made of mild steel plate. These grip the crankshaft bushes, the levers being held down by springs fixed into the holes in the under pieces, and pulled on to the nick on the end of levers, as shown.

The engine is prevented from turning by a torque rod fixed on the side of the hull, and held at the other end by one of the cylinder cover studs.

The engine has been through some severe tests, and has fully come up to my expectations. It is now in a metre (length) aluminium boat, of 3¼ lbs. displacement. This I have fitted with fresh water feed tanks, making it possible to run her in Fraserburgh Harbour.

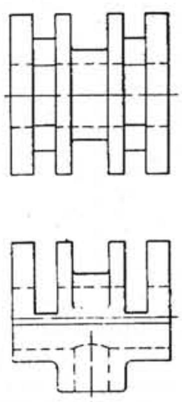


Fig. 2. The Steam Ports.

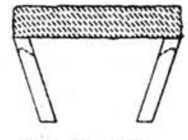


Fig. 3.—The Staple-like Bit.

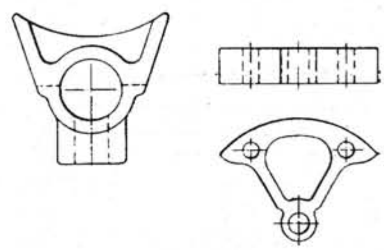


Fig. 4.—One of the Rocking Pieces.

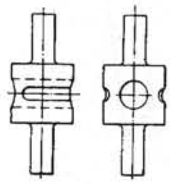


Fig. 5. The Crosshead.

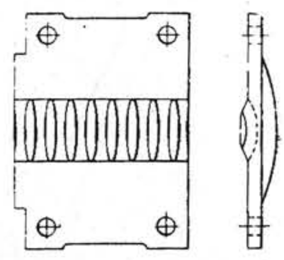


Fig. 7.—The Guide Thrust Plate.

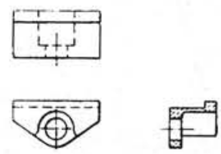
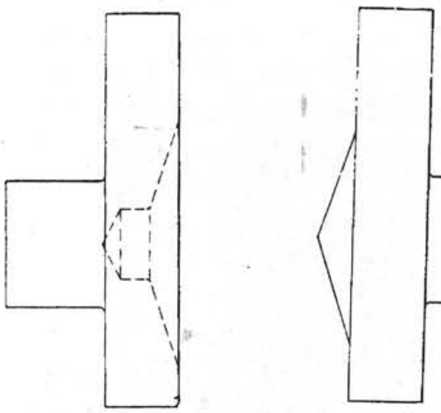


Fig. 6.—The Guide Slipper.



Figs. 8 and 9.—Showing Jig for Forming Steel Cylinder Cover.

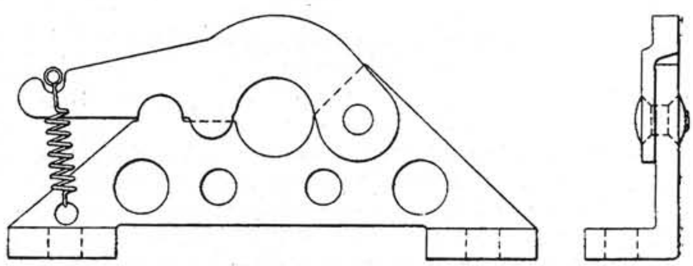


Fig. 10.—One of the Two Cradles.

(All these drawings are actual size.)

March 6, 1924.

Making Model Pressure Gauges.

By Howard L. Eeles.

HAVING made some model pressure gauges and found them successful, the following description of those exhibited at the exhibition held by the Reading S.M. and E.E. may interest some readers.

The part Fig. 1 in the drawings holds all the working parts and also forms the connection from tail-pipe to the expanding tube. It was made as follows:- A piece of brass 1 1-16th in. long was cut from a ¼-in. by 5-16th-in. section bar, one end of which was filed up square and a line scribed along the centre of the length of its section. A centre dot being made on this line 3-32nd in. from one end, the piece of brass had next to be held in an independent chuck and set so that the centre dot ran true, after which it was turned along for a distance of ⅜ in. to a diameter of 3-16th in., and screwed with a fine thread. While in this position it had to be coned out at the end for the union nipple and drilled up for a distance of ½ in. with a 1-16th-in. drill. This is shown by dotted lines in the drawing at A, Fig. 1.

After taking out of the chuck it was filed to the shape shown in the drawing, and the two 1-16th-in. holes drilled and tapped, leaving the two smaller ones till later.

The next thing to be taken in hand was the pivot bearing Fig. 2. This was made from a piece of brass 1-32nd in. thick, and the holes set out to the dimensions shown. After drilling and countersinking the 1-16th-in. hole A, Fig. 2, it was screwed to the part shown in Fig. 1 with a countersunk head screw by the already tapped hole B, Fig. 1, and the remaining holes drilled right through into Fig. 1.

The one (B, Fig. 1) is for the pivot to work in. Its diameter is 3-64th in. It was drilled right through at C, Fig. 1, which forms the other bearing, and when done in this matter with a twist drill assures perfect alignment.

Before taking this apart, the hole must be drilled for the pin, which is a short piece of 3-32nd-in. brass wire soldered in. This keeps the bearing in line.

We come now to the most troublesome part, namely, the expanding tube, which is shown in Fig. 3 before being bent.

The first thing wanted for this is a piece of brass foil 4-1,000th in. thick. I found the sort used for brazing answered the purpose well. A strip should be cut wide enough to bend round a piece of spring steel 3-16th in. wide by 5-1,000th in. thick and allow 1-64th-in. lap.

The spring steel must, first of all, be blued by holding it in the flame of a spirit lamp; this prevents the solder from sticking. The brass strip should be bent round the spring in such a way that the lap comes along the centre. A good plan is to roll it on a piece of plate glass or other flat surface, using a short length of bright steel bar for the roller. I found the best way to solder up the tube was to run plenty of solder along the seam with a small screw-driver (in place of the soldering iron, which was too clumsy) using plenty of Fluxite, after which the superfluous solder can be wiped off by heating the tube up and drawing it between a piece of rag which has been dipped in the flux.

The next thing is to double up and solder one end (shown at A, Fig. 3) and solder it so that the seam comes inside. This, of course, is done, while the spring is still in the tube, with a mouth blow-pipe.

latter being the size of the short end of the pivot which was soldered therein. The hole was then drilled through, using the steel strip as a form of jig.

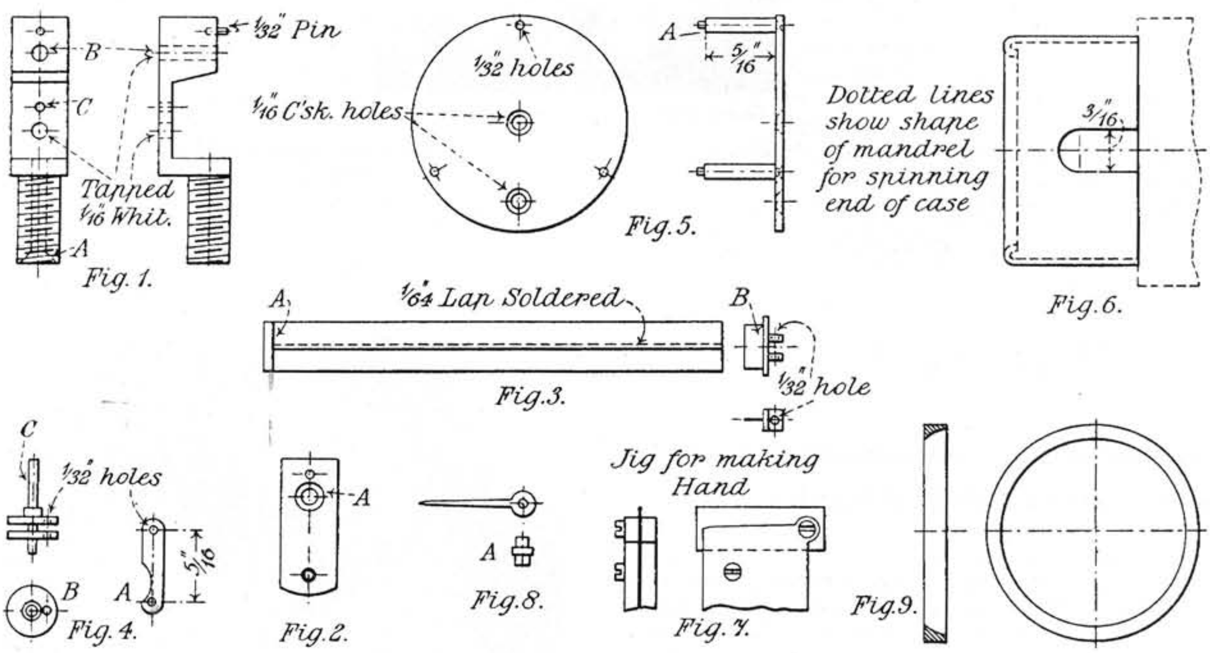
The most difficult and important parts having now been made, they were assembled and hydraulically tested up to 100 lbs. per sq. in., found all right, and put aside until the case was made. In putting the link into position the nick must, of course, come inwards so as to clear that part of the pivot which comes between the two flanges. The pins were short pieces of 1-32nd in. brass wire.

Some discs were next cut out (the size of the inside diam. of 1-in. telescopic tube which was used for the case) for the dials and backs. The former are of 1-32-in. sheet zinc, and the latter of brass of the same thickness; these were turned out in the lathe, and it is advisable to make a few spare ones in case of wasters.

A brass disc must be drilled to the dimensions shown at Fig. 5, and the two 1-16th in. holes must be countersunk at the back to take the screws which hold Fig. 1. The 1-32nd-in. holes round the edge are to take the little pillars which are riveted in: their function is to hold the dial in place. I turned these out of 3-32nd-in. brass wire, and they can be seen in the drawing at A, Fig. 5, riveted in place.

I have not given a sketch of the dial, as it is the same as Fig. 5. with the exception of the two 1-16-in. holes, instead of which is a 7-64-in. hole drilled ¼ in. from the centre for the pivot to project through.

A piece of mild steel was next turned along for a distance 9-16 in. in the chuck (to a good fit in the bore of a piece of telescopic tube (1-in. outside



Details of Component Parts of Model Pressure Gauges.

Before taking out the piece of steel the tube must be bent round, as shown in the photograph, by drawing it between the thumb and fingers, at the same time curving it inward. It is not possible to bend it correctly to shape at this stage, but when got round as far as possible the small hole A, Fig. 1, must be continued through into the bottom of the tube to allow pressure to pass into it. In doing this see that the spring steel is pushed down as far as it will go, otherwise the drill may go right through.

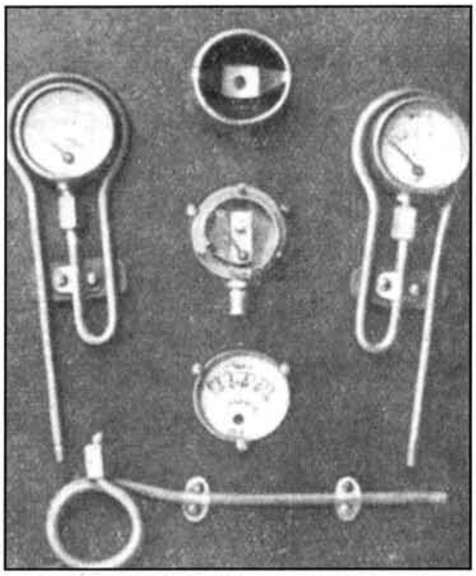
After this has been done the piece of steel can be drawn out and the other end blocked by soldering in the piece B, Fig. 3, which also forms the connection for the link A, Fig. 4. Both of these pieces are made from brass. It is a simple job, and needs no explanation, as the shape and dimensions can be seen in the drawings at A, Fig. 3, and A, Fig. 4.

B, Fig. 4, shows the hand-pivot, which is turned out of a piece of brass bar. The end on which the hand or pointer fixes (C, Fig. 4) is turned slightly taper. The method I used to drill the 1-32nd-in. hole was as follows:- In a strip of mild steel about one inch wide, two holes were drilled a full 1-16th in. apart, one of which was 1-32nd in. diameter and the other 3-64th in. diameter, the

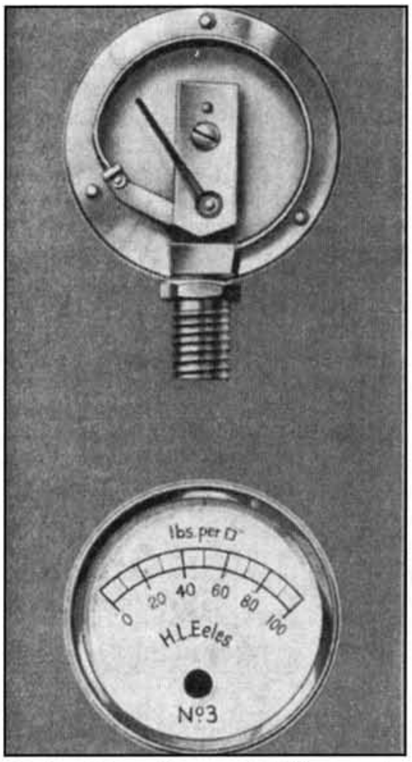
diam.) with a ridge round its face; this is shown by dotted lines in Fig. 6. On to this was driven a 11-16th-in. length of telescopic brass tube which had previously been annealed, this left 3-32 in. projecting beyond the end of the mandrel, which was spun over the ridge by gradually pushing it inward while revolving at high speed with the narrow rounded pean of a small riveting hammer, lubricating freely with oil. I found that the hammer had to be smoothed now and again by rubbing it on an oil-stone, as it became rough in use and would, if not prevented, grind the brass tube, resulting in an unsightly finish. I also made a tool to finish off with, from a piece of cast steel nicely rounded and polished on the end and hardened. All that now remains to be done to this is to make the 3-16-in. slot to take the threaded part of Fig. 1.

A sketch of the jig used for making the hand or pointer will be seen in the right-hand bottom corner of the drawings. It consists of two pieces of cast steel ⅛-in. thick, clamped together by two 1-16-in. screws and filed to the shape of half the hand, and hardened.

The hand is made from a piece of clock spring, which must be annealed, and a 1-16-in. hole drilled in the centre near to one end. It can then be placed



A Group of Model-size Working Pressure Gauges.



Enlarged View of Pressure with Dial removed.

between the two pieces of steel, as shown in the sketch, so that the screw A, Fig. 7, goes through it. The screws being tightened, it was held in the vice, and the part shaded in the sketch filed away, after which it was reversed and the other half served in the same way, and then taken out and oxidised over a spirit lamp. It is now ready for its brass bush A. Fig 8, which was turned up and drilled through 1-32 in. and then reamered out taper to fit the pivot.

The brass ring shown in Fig. 9 completes the gauge. It is 1/8 in. wide and was parted from a tube 5-64 in. thick. It functions as a distance-piece to separate the hand from the dial and the glass. It is bevelled inward to the section shown and polished inside.

After the dial had been enamelled white the gauge was assembled and marked out from a standard gauge. I did this by connecting the home-made gauge and a standard testing gauge up to a pump, and while a friend worked the pump and read out the standard gauge readings, I made a pencil mark at every 20 lbs. This was afterwards marked with Indian ink.

One photograph shows the gauge with the dial off; the thin nut seen on the tail-pipe connection is for holding the case on.

This completes the gauge. The tail-pipe and union will now be wanted; mine was made of 1/8-in. outside diam. copper tube, but a description of this is unnecessary.

I will now give a short description of the tools used in the making of these gauges. My lathe is an old 4-in.-centre hand lathe, with a lever type tailstock, the barrel of the latter having about a 1-32-in. play. The small drills were made from piano wire, and the chuck, which is an independent, was made from a worn-out 2-in. self-centring chuck, by driving an iron ring on the chuck body, in which was screwed three screws to operate the jaws. I used this chuck for drilling as well as for holding part to be turned, so that everything had to be trued up, and I think those who possess a precision lathe will find the job less tedious than I did. By the way, does any reader know if very thin eliptical tube can be obtained in small quantities for making the expanding tube? If it could a simpler and better job could be made, although I find the tube made in the way described stands over 100 lbs. pressure all right.

September 25, 1924.

Workshop Topics.

Machining the Components of a Model Vertical Steam Engine.

IT IS proposed in this note to deal with one operation in machining the flanges and slides of a standard bracket (sometimes termed the column) of a model steam engine. Fig. 1 shows the type of engine, in which view the standard brackets are tinted. They may be either in cast-brass or cast-iron. There will be required a lathe, fitted with a true-running face-plate, on which is bolted a truly square angle-plate, as seen in Fig. 2. In the same view is also seen a balance weight bolted to the face-plate immediately opposite the angle-plate. This is added in a case where the lathe is run on single gear, as when the brackets are small and of brass or gunmetal. It may consist of any scrap material bolted tightly to plate in such position that when the job is mounted the contrivance is in balance or nearly so. This is to avoid undue vibration in running.

The surfaces a (in Fig. 1) must first be slightly draw-filed to flatten them. Take off as little as possible, but just enough to make sure that the surfaces rest evenly and without rocking, on a flat surface.

Dealing with the bottom or foot-flange of casting first. Fig. 3 shows the setting up in three views, with the job indicated tinted. The surface a is set down on to the angle-plate, the foot-flange being outward and head-flange up against face-plate, as seen in the side view. The angle-plate is so set that the lathe axis comes about midway between top and bottom flanges of the job. Dress up both flanges first with a file, taking off most of the scale and first bevelling off the four edges. In the plan and front view is indicated the method of clamping. Put one clamp first, as seen in plan, using packing under its further end between it and angle-plate, either same thickness as slide-flange on job, or a little thicker (not thinner, in any case). Clamp this just tight enough to allow of moving the job so that it can be adjusted on the opposite

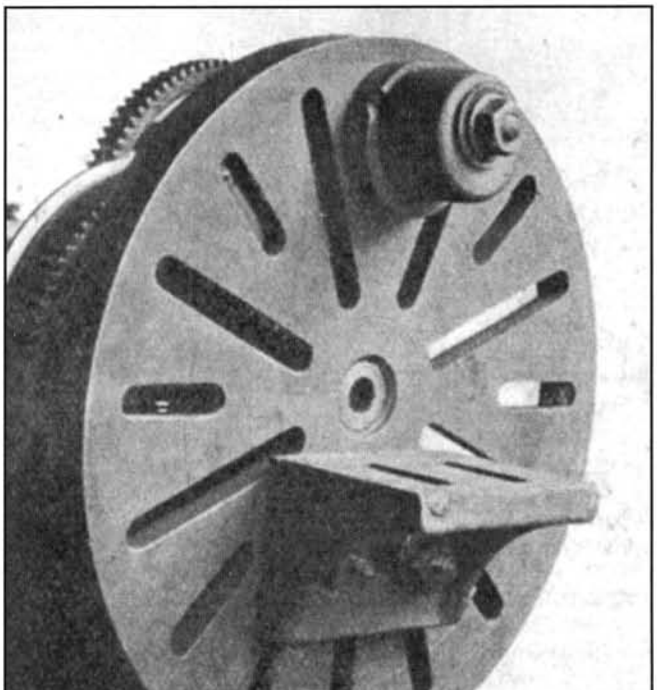


Fig. 2–An Angle-plate Mounted on a Faceplate and Balanced.

edge to a small try-square set on the face-plate. When in correct position to the square, it should just touch face-plate, and can then be tightened down. Now add a second clamp on the near side (not shown in the drawings) and tighten that. Because the direction of impact on the job is as the arrow shown on the plan, a stop (indicated dotted in the same view) should be bolted to the face-plate, set touching the side of top flange of the job. Any tendency to swivel under the clamps is thus met.

The job should be roughed out first by a facing cut on the bottom flange face, using a pointed roughing-out side-cutting tool, or a knife tool, and finished with a round-nose side-cutting tool. The dimension b in Fig. 1 should be taken off the drawing, and the facing carried out till this dimension shows by rule between the offset point on the bracket and a second rule held edgeways flat on the faced flange, as seen in the side view.

The second operation, that of facing the top flange, will be published in this column next week, followed by a third note showing how to machine the slide.

In the issue of 25th September 1924 there started a series under the Workshop Topics banner. This series which ran until 7th May 1925 showed a number of machine set-ups which is useful to the beginner even today. Only the initial article is reproduced here but it is highly recommended that anyone building a stationary engine for the first time should obtain the complete series of articles - they will find them most useful.

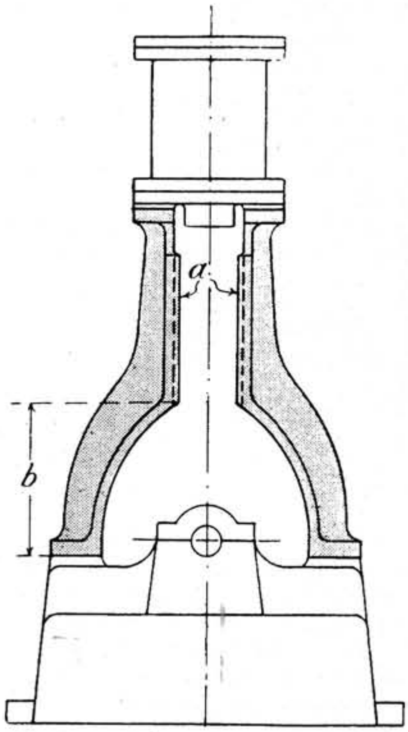


Fig. 1–Tpe of Vertical Engine with Double Standard Bracket.

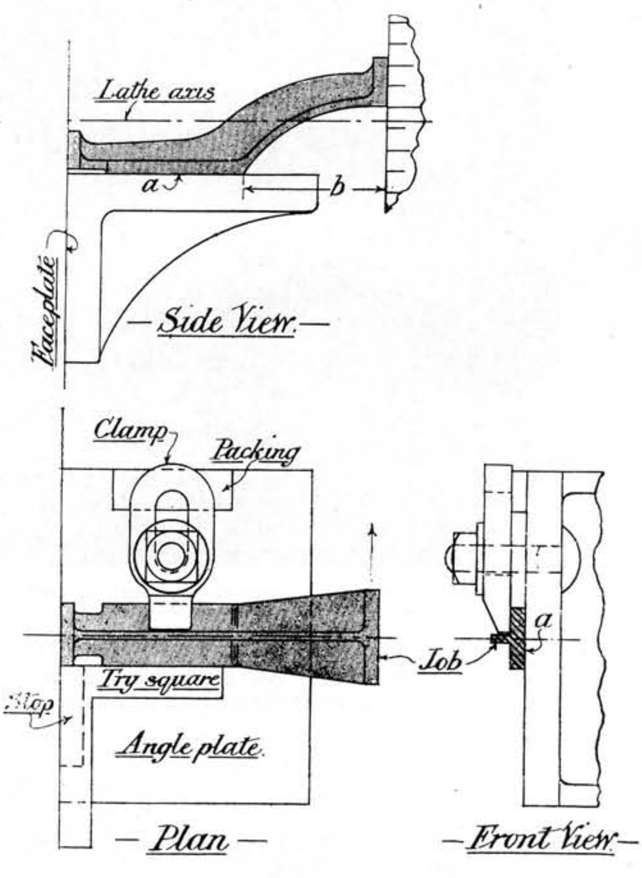


Fig. 3–The Setting-up of a Standard Bracket to Face the Foot Hinge.

January 1, 1925.

MODEL SIDE-LEVER MARINE ENGINES.

By W. T. Barker, R.N. (Member, S.M. & E.E., London).

The late Lt. Com. W. T. Barker was one of the greatest model engineers of all time. His series of models showed the development of the marine engine and although not scale models of particular engines they displayed the typical practice of the period modelled. These models can today be seen in the Liverpool Museum.

THE model now to be described can make no claim to anything in the way of scale reproduction of a prototype, but at least it illustrates pretty well the prominent general features of the class with a fair amount of detail. Unfortunately, also, it departs in several particulars from what was standard practice. This happens because I made my drawings mainly from recollection of Watkin's old paddle tugs Cambria, Iona, and others on the Thames familiar to me whilst serving my time, aided by some rough notes and sketches taken many years later from a hoary old-timer I came across when on the China Station. Construction was well under way before I was able to examine the splendid models in the Science Museum, which showed me a number of defects in my own, only a few of which could be corrected without wholesale scrapping of parts. I am rather sorry now I did not do this.

The full title of this model is rather a mouthful, viz.:- "Twin, indirect-acting, jet-condensing, disconnecting, side-lever engines," and the principal dimensions are:-

Cylinders: 1½-in. bore by 3-in. stroke.
Slide valves: ½-in. stroke.
Cylinder to crankshaft: 8-in. centres.
Side levers: 8¼-in. centres.
Crankshafts and pins: ½ in. diameter.
Air pumps: ⅞-in. bore by 1½-in. stroke.
Feed and bilge pumps (two of each): ⅜-in bore by 3/4-in. stroke.
Side or connecting rods: 5⅞-in. centres.
Crank rod or pitman: 7¼-in. centres.
Engine centres athwartships: 6⅞ ins.

Full-size drawings of the complete engine and of the principal details were first got out and then patterns were put in hand. Most of the wooden ones I got made for me by a pattern-maker, not being myself a competent woodworker. The more elaborate ones needed for the superstructures, braces and one or two other parts on which I thought it would not be possible to do much subsequent profiling, I made myself of brass. Sketches of the rest of the