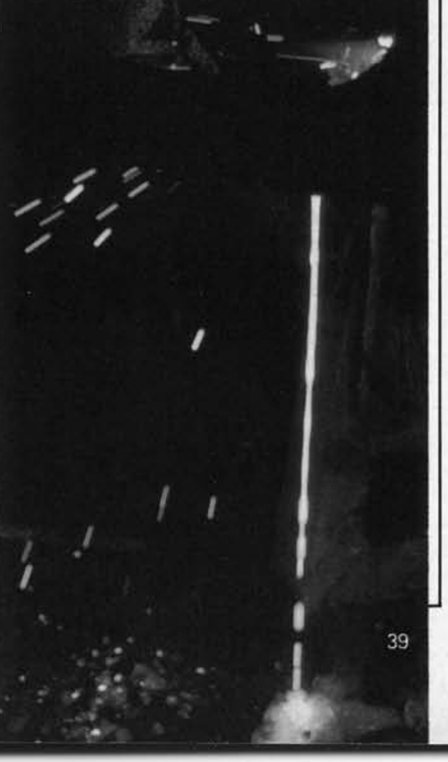
A FOUNDRY IN THE FENS

There is an enormous range of specially produced castings available for a wide variety of engineering models. Commercial suppliers offer them for everything from locomotives to traction engines, workshop tools and equipment to stationary engines. They are so commonplace that we probably take them for granted. But just what goes into the production of a model engineering casting?



The majority of model engineering involves the use of castings and they are something very much taken for granted by the average modeller. I have often wondered how much the modeller knows of the castings which he uses and thought this might be a good time to show what is involved. To do so involved a trip to a foundry in fenland where one of those involved is Phil Gibbons. Phil is himself a model engineer and all his life has been involved in foundry work. Many of the regular suppliers of model engineering castings use the services of the foundry and many individual modellers also take patterns along for castings to be made.

At the foundry it was possible to watch the patterns being set into moulding boxes and later to see the hot metal being poured into the boxes and the finished castings removed. The metal is only melted on an average twice a week. Doing so is an expensive process, therefore as many moulding boxes as possible are made up and then the metal pouring is carried out only when sufficient moulds are ready.

For successful castings, patterns must be correctly made. It is essential that they are made in such a way that they will come easily from the moulding boxes without pulling the sand out with them, and that, when withdrawn, a nice sharp image remains. Professional pattern makers have this off to a fine art but many of the patterns I saw at the foundry were made by amatuers and did not conform to normal pattern making standards. Most foundries would probably have rejected these and that would have been the end of the matter. The operators at this foundry are all highly skilled and will take a pattern which is not quite right and build the sand round it using tiny trowels to get the desired result. This is a very time-consuming process and needs a great deal of skill but it is a task which is cheerfully carried out by the operators.

For metals melting at lower temperatures small furnaces heated by gas are used; for cast iron, however, there is a cupola. This is rather like a long tubular furnace. Coke is lit at the bottom of the cupola and on top of this is placed pig iron. More coke follows and the end result is layers of coke, pig iron and some limestone which acts as a flux. A small amount of scrap is also used to get the right balance on the finished cast iron. As the furnace heats up so the iron melts and drips through to the bottom where it is tapped off into ladles which are used to fill the moulds.

The molten iron comes from a hole at the bottom and this is plugged to prevent the iron continuously dribbling out, the plug being removed as the metal is required. Plugging and unplugging this hole is, like all the other operations, highly skilled. It was fascinating to watch the operators who knew exactly how much to put in the alternate layers of coke and metal and exactly how to tap off the metal as required to fill the moulds. Filling these, too, was a highly skilled operation.

KEY TO COLOUR PICTURES ON PREVIOUS PAGE.

Top left, the metal-pouring crucibles are heated by soaking them in paraffin and setting fire to it, Failure to do this would mean they might crack when the hot metal was poured in, possibly causing serious injury to the operator. Top centre, a small hole is made in the sand packed in the spout of the cupola and the metal starts to trickle from it; at this stage, the trickle is merely clearing some of the impurities from the metal. Top right, a larger hole is now knocked in the sand and the metal runs into the crucible which will be used to transport it to the moulds. When the crucible is full the spout is repacked with sand. Bottom left, hot metal is poured into the moulds. Botton centre, steady progress is made down the line of boxes. Bottom right, from time to time, slag is allowed to run off the back of the cupola to keep the metal clean.

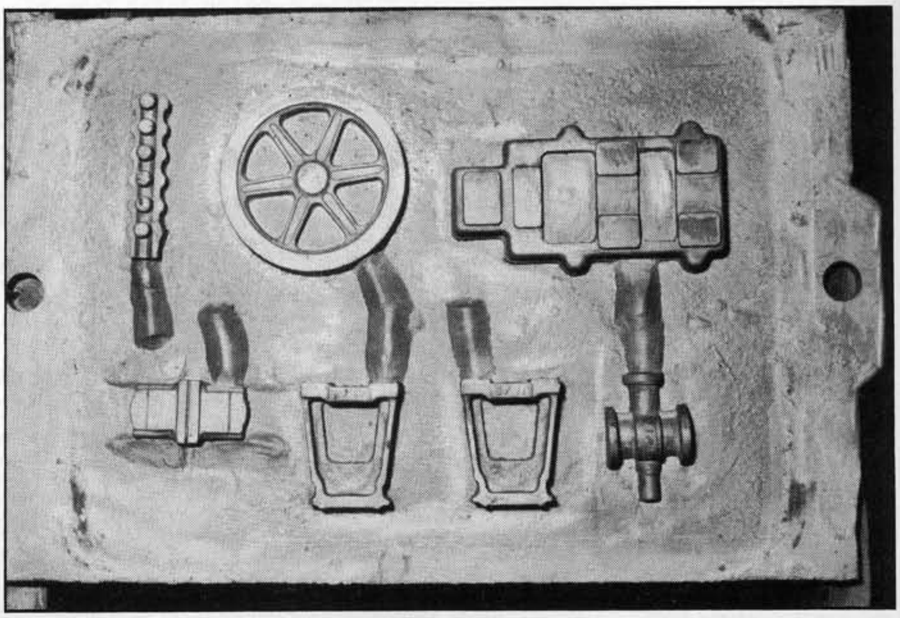
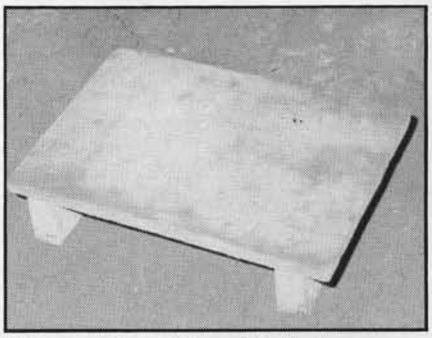
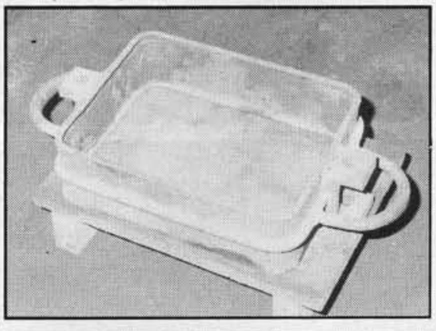


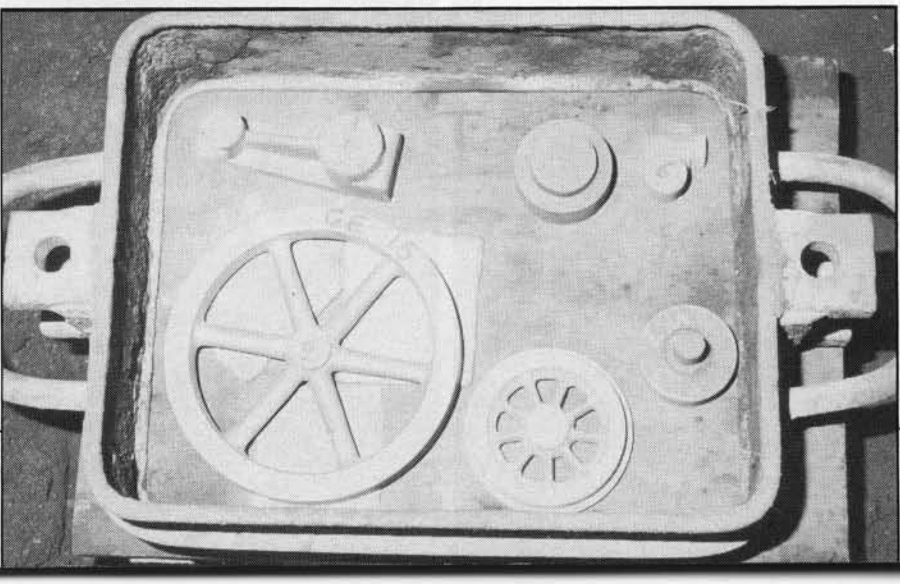
Photo above shows the patterns for the parts of the Hick engine of 1851, the construction of which was described in Model Engineer. The original patterns were of wood which quickly wore, so new ones were made in the form of a complete set on a single board which can be dealt with as a unit, thus saving a great deal of time. The technique is only of value when numerous castings are to be made of the one item.



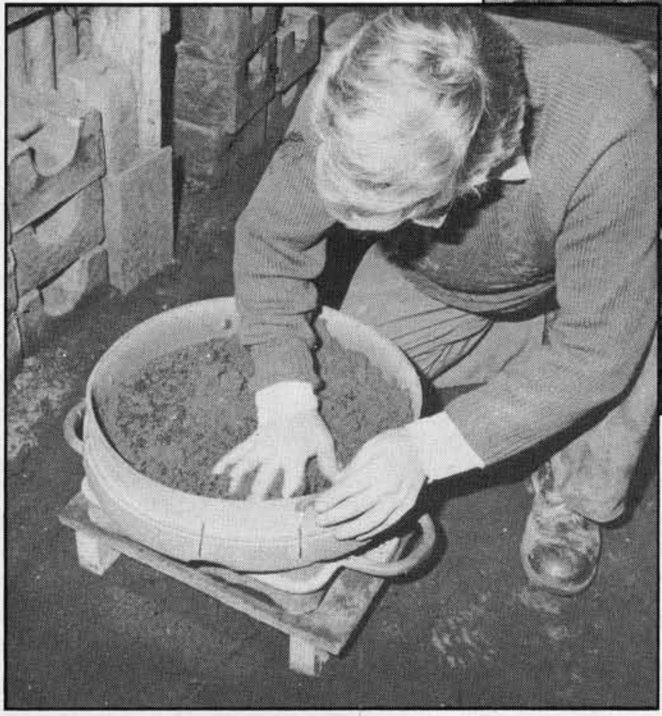
There are two different techniques involved in making up moulding boxes ready for casting. In one method, the moulder starts with a board such as this (above).



Next, a moulding box is laid on the board; these boxes are of thick forged steel construction (left). Below, the individual patterns are laid on the board. As many as possible are placed in the box but the operator must allow sufficient space between each for the sand to be supported, otherwise, when the metal is poured, it will collapse into the recesses left as the pattern is withdrawn.



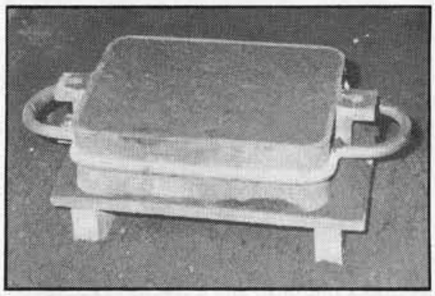
A FOUNDRY IN THE FENS



At left, an operator shakes special sand over the patterns to help release them, then fine bonded sand is sieved over the top of this.

Below, the fine sand is carefully packed by hand round the sides and edges of the pattern, being pushed down quite hard.

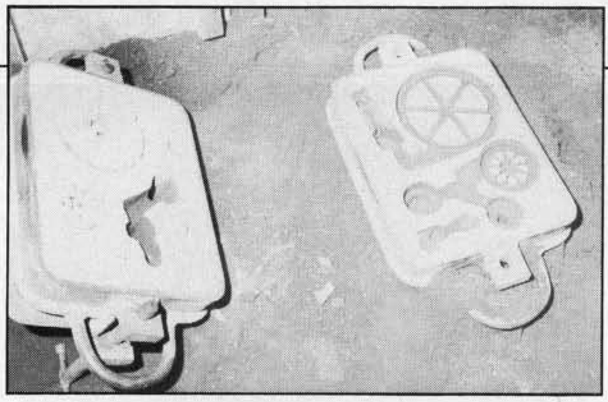
Above, at this stage, a coarser sand has been placed on top and this is rammed down.

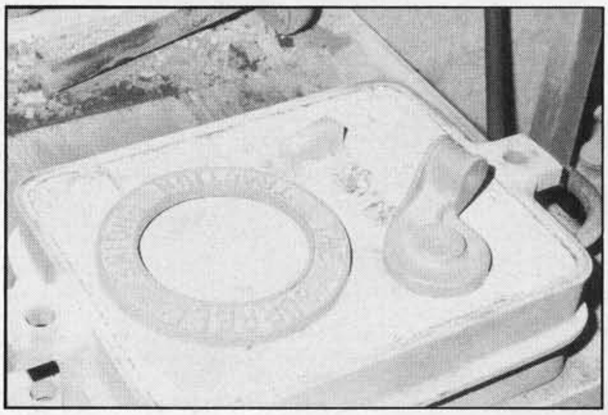


The casting box is complete when the sand is level with the top (above).

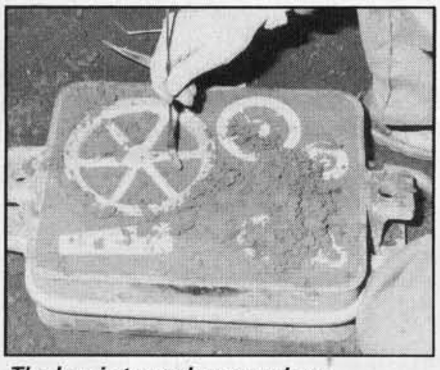
From time to time the slag which formed as a result of the limestone mixing with the sand on the pig iron and with the coke, was tapped off at the back of the cupola. As the iron is tapped off into the ladles small amounts of aluminium are mixed in to help it flow into the moulds. Sometimes nickel or chromium is added as well to give the casting the right properties for the job for which it is required. The whole affair is fascinating and makes one realise just how much skill and work is involved in those castings which we all take so much for granted…

After the stages shown below and the box has been turned over, separating powder is shaken over the box and a second layer of sand rammed in. When this is completed, the box can be opened and the patterns withdrawn as shown at right. In the next picture down on the right, we see what happens when the patterns to be cast are of such irregular shape that they will not lie flat on a board. In this instance the operator must build up the sand around them on the underside. This picture shows a set of patterns in a box already filled with sand into which they have been forced.



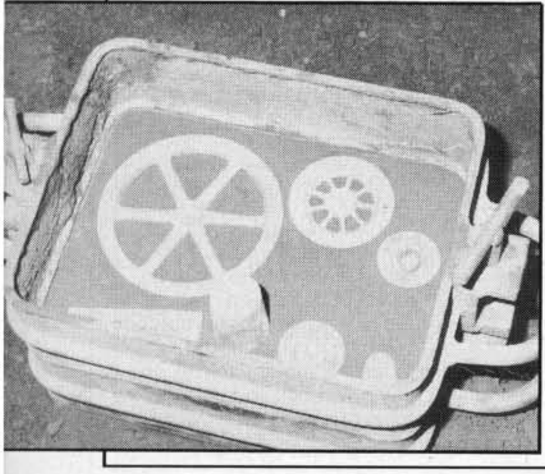


Next, separating powder is shaken over the patterns (below).

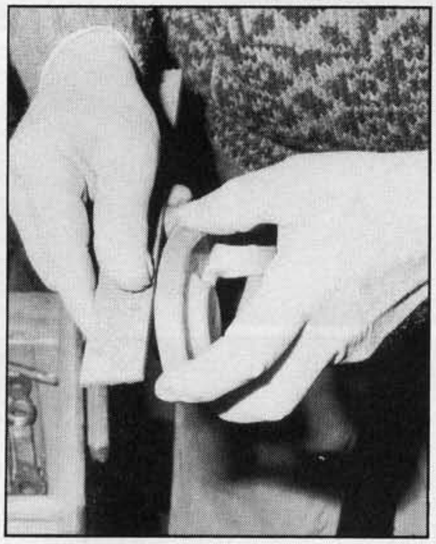


The box is turned over and any discrepancy in the packing of the sand around the pattern is rectified by hand by the moulder. With a badly made pattern this can involve considerable work.

The second part of the box is now placed on top and located with 'T' shaped pins. At this point a special plug is inserted to allow the metal to run into the box when complete. The positioning is critical to prevent sand collapsing into the pattern recesses.



If the pattern cannot be used as it stands, some minor adjustment must be made by the moulder (below).



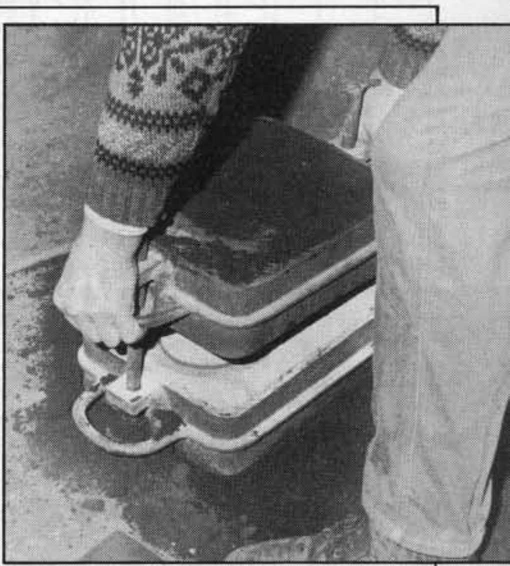
The second part of the box is now put in place (below); the plug for the metal to run has also been set in the sand.

... followed by fine bonding sand sieved over the top (below).

Then coarser sand is shovelled on (below).

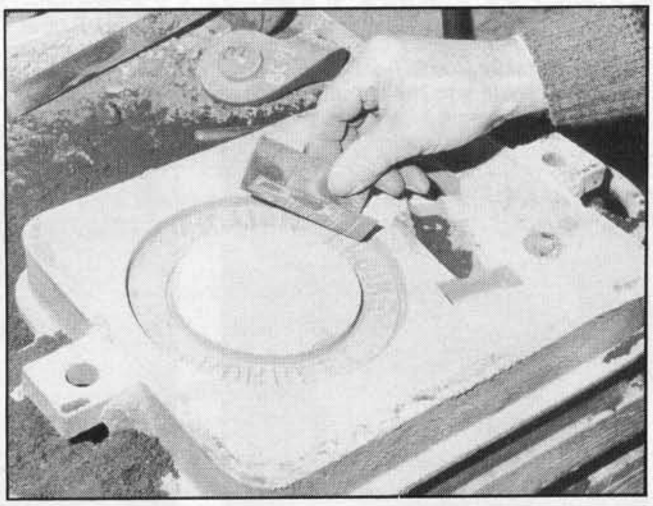
The sand is now rammed down firmly around the patterns with a small-headed rammer that will fit between the individual items, packing the sand into all the corners.

In the photo above, the boxes have been separated and any faults in the sand impressions made good with a tiny trowel.

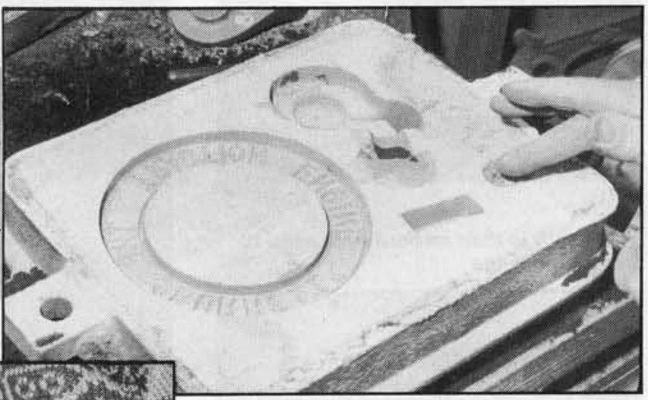


Next, the top half of the casting box is carefully positioned over the bottom half and the two sections locked together. Cups for the metal to be poured in are placed on the finished boxes (below).

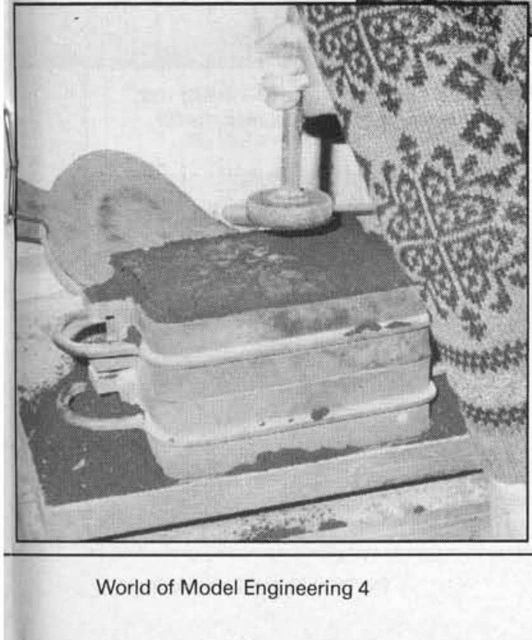
This is how the casting box with its impression of the patterns looks when they have been withdrawn. Further building up may be required at this stage (right).



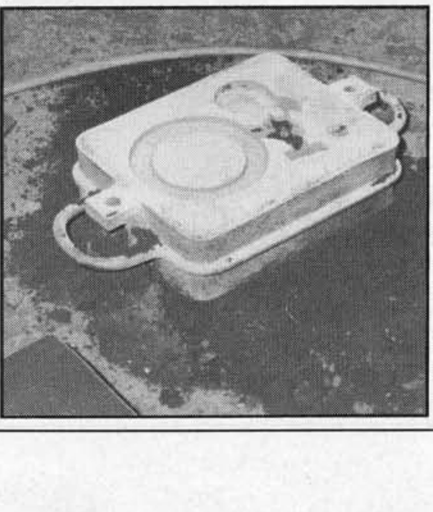
After the smaller rammer, a larger-headed ramming tool is used on the bigger area of the casting box (below). At right, grooves are cut in the sand to allow the hot metal to run from one pattern to the next.

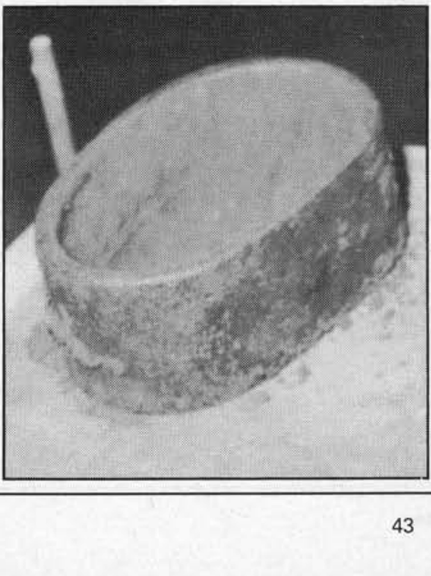


These cups (below) consist of a cast iron ring packed with a mixture of sand and clay to allow the heat to be absorbed.



The completed bottom half of the box is laid on sand on the foundry floor (below).

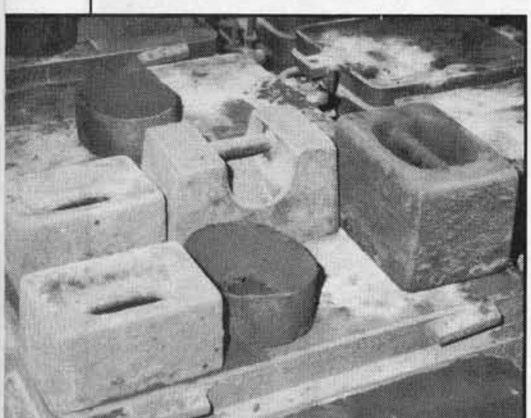




A FOUNDRY IN THE FENS

The finished boxes are laid ready for casting; note the patterns awaiting use on the walls of the foundry.

Where extra large castings which require a lot of metal are involved, weights prevent the sand lifting as the metal is poured into the boxes.



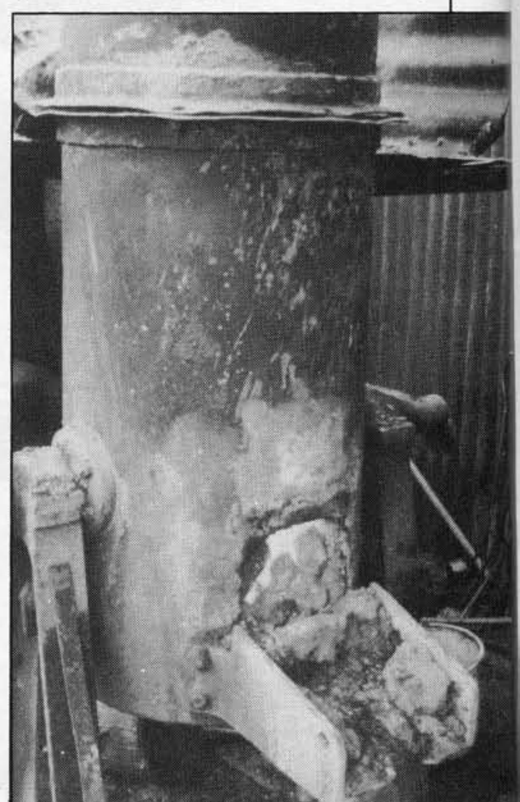
While the boxes are being prepared, the cupola is also being readied with layers of iron, limestone and coke.

A spout is made in the cupola through which the molten metal will run; it is constructed from a mixture of sand and clay.

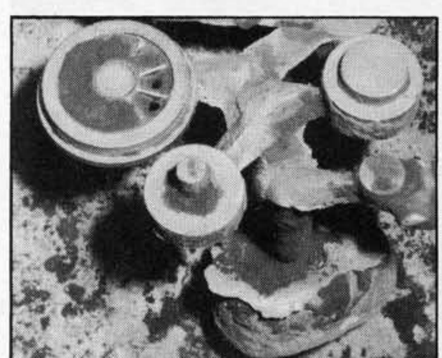
As the metal begins to heat up, it starts to trickle into the spout (below).

The spout is then packed with sand to prevent leakage.

... and rammed home very firmly (above). Below, the work is completed and the furnace allowed to fall out of the cupola; when this starts in earnest, you stand well clear!



Finished castings prior to having the sand knocked off and excess metal removed.



A CRAMPTON LOCOMOTIVE

Model engineer Ralph Ley chose an unusual subject for this 5 inch gauge project; magnificent own-design model posed many problems, all skilfully overcome.

There are many published designs of model locomotives and most have been built in their hundreds. There is much to be said, however, for designing and building one's own model, and this is the tale of just such a model.

Ralph Ley is a man who always likes to do his own thing when it comes to model engineering and his varied collection of models are all to his own design. The idea of the Crampton came to him when he was shown a tiny drawing of the locomotive and from that the model which is the subject of this chapter was born. But first let us discuss what a 'Crampton' is.

In the early days of steam railways there was a search for locomotives that were more powerful as well as for those that would go faster. To some extent in those early years research went in two separate directions, one for power and one for speed. In later years locomotive designers built locomotives that could both travel fast and haul heavy loads as well.

One way in which additional speed was obtained was by increasing the diameter of the locomotive driving wheels and wheels up to eight feet in diameter and even slightly larger were used in the attempt to gain speed.

One designer who was involved in the design of locomotives for speed was Thomas Russell Crampton and he too used large diameter wheels in an attempt to increase speed. The 'Crampton' locomotives, although originating from Swindon on the Great Western Railway, were extensively used in many places. In particular they found favour on the London North Western Railway and on the Nord Railway in France.

The design was unusual to say the least with the boiler slung very low to keep the centre of gravity down and so stabilise the effect of the large wheels. Design of locomotives varied from railway to railway but unfortunately, in England at least, they did not last all that long. In France they fared rather better and one is preserved in that country and occasionally is used to haul special trains.

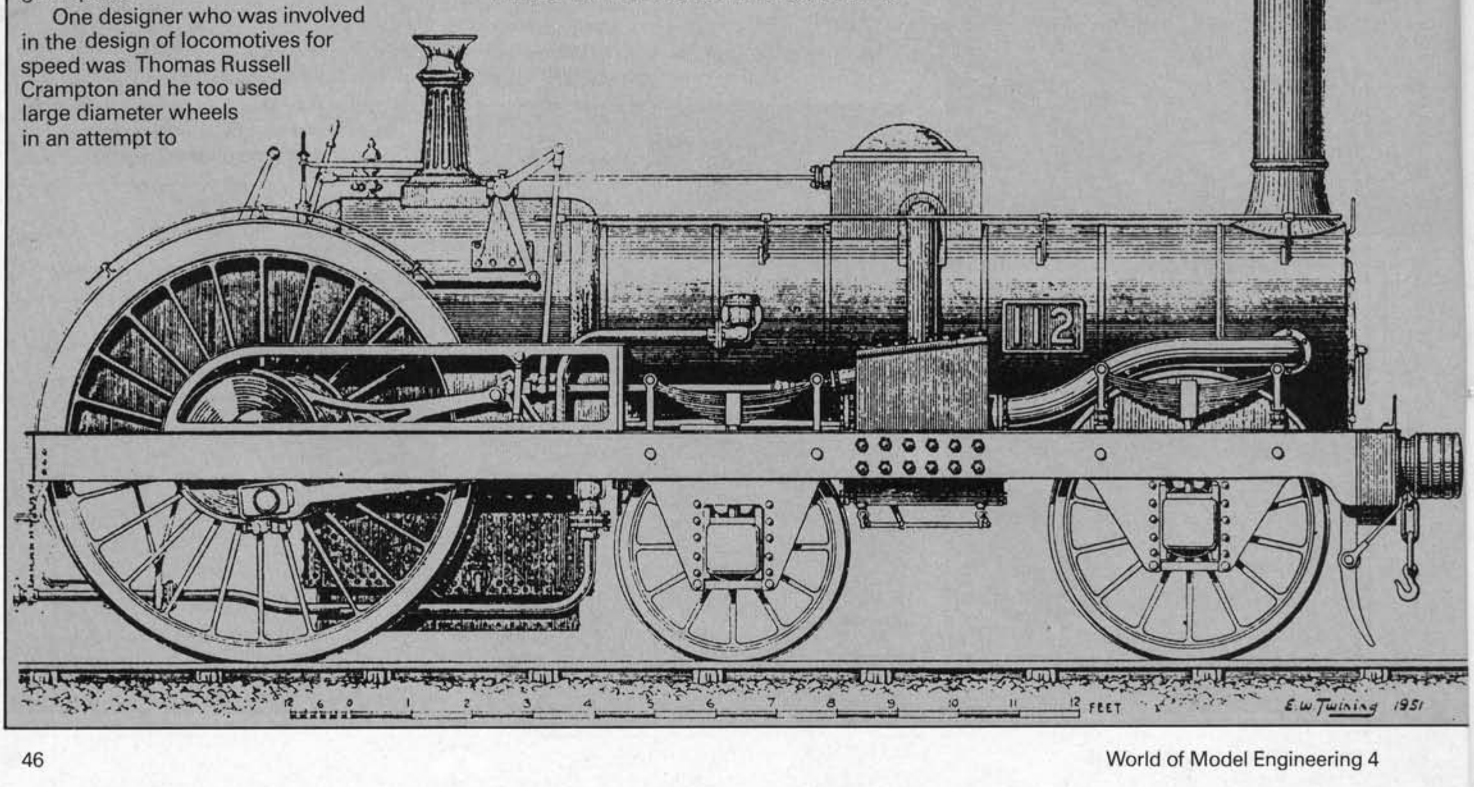
One of the most famous of the Cramptons was a locomotive called 'Liverpool' and it is on this that Ralph's model is based. I say 'based' because it is called 'Lilliput', not 'Liverpool'. Ralph has, in my opinion, a very good reason for this. Anyone who has built a model of no matter what standard will be aware of the wise onlooker who can tell you exactly what is wrong with the model that has taken you so many hours to build! The person concerned usually has never built a model in his or her life. Such comments, as far as locomotives are concerned, can be very silly anyway as, during their lives, most locomotives were rebuilt in various forms and two engines of the same class can have many differences. There can also be many alterations to the individual locomotive during its lifetime so stating *exactly* how a model should look is difficult because one can never be quite sure where minor differences are concerned.

However, back to the model in question and although named differently by the builder it is a remarkably good replica of the original 'Liverpool', the only real difference being that Ralph has lagged the boiler with wood because he likes to see boilers lagged that way on early locomotives. He does not believe 'Liverpool' ever was lagged that way, but it could well have been at one stage...

Having found a small drawing of the locomotive he was able to obtain a larger one and set about drawing all the parts that would be required. Slowly the model took shape. As it is not a standard model little was available in the way of castings and he was obliged to make his own patterns and have the various parts cast where necessary. Much of the rest is fabricated from stock material. The cylinders are an exception: he used castings from 'Simplex', an 0-6-0 tank locomotive, and was able to modify them to his requirements.

The leaf springs are all working on the locomotive and made from individual sprung steel leaves, the power of the spring being calculated before construction. Wood has been used at points only where it would have formed part of the construction of the original locomotive.

The result of all this effort is a model of exhibition standard but made as a working locomotive. In spite of his attention to detail Ralph believes that his models should be capable of doing their stint on the club track for passenger hauling and 'Lilliput' will be used alongside other club locomotives for this purpose.



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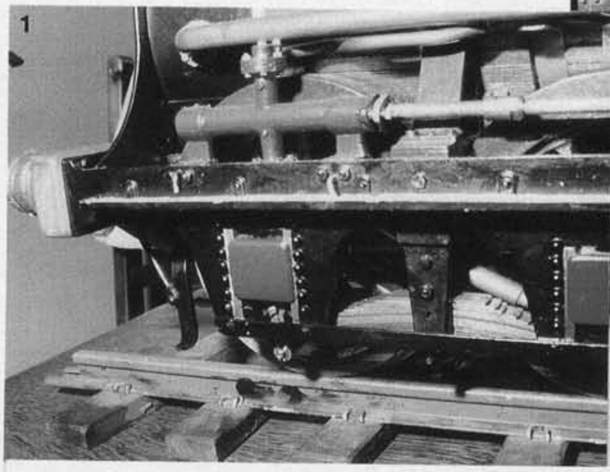

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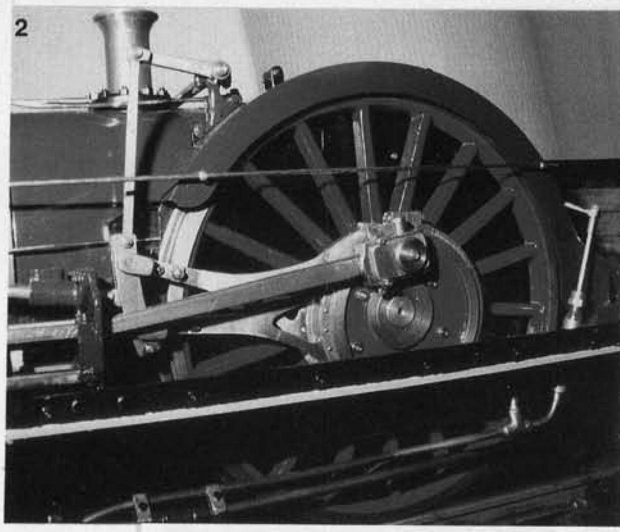

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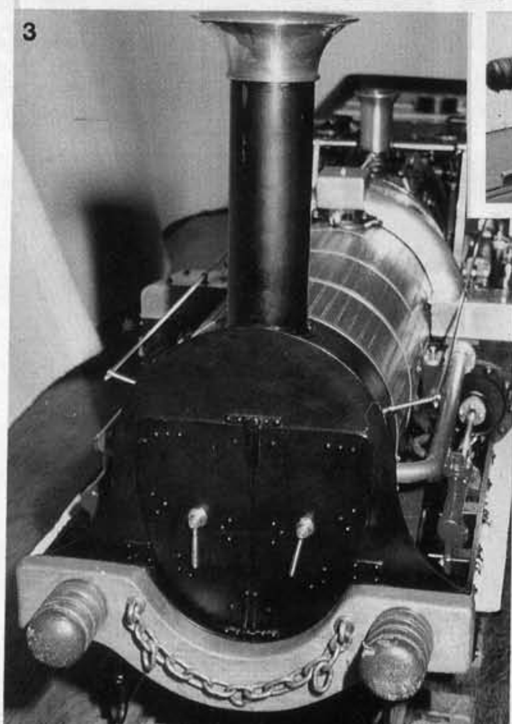

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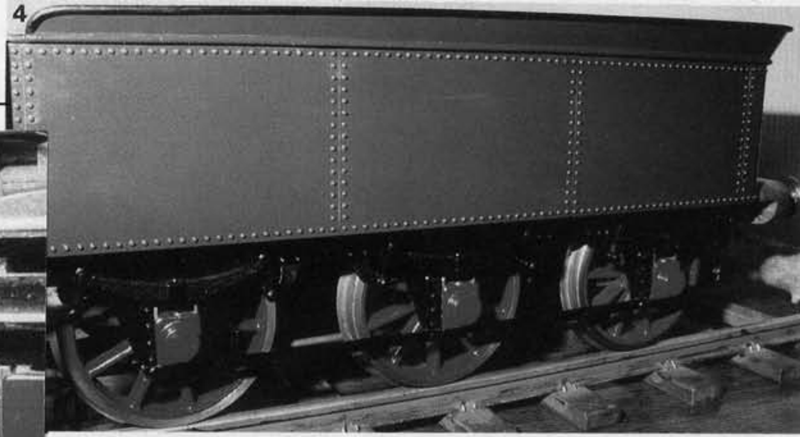

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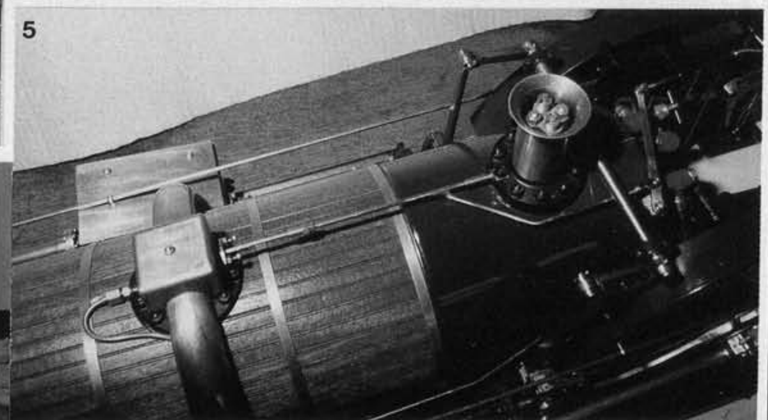

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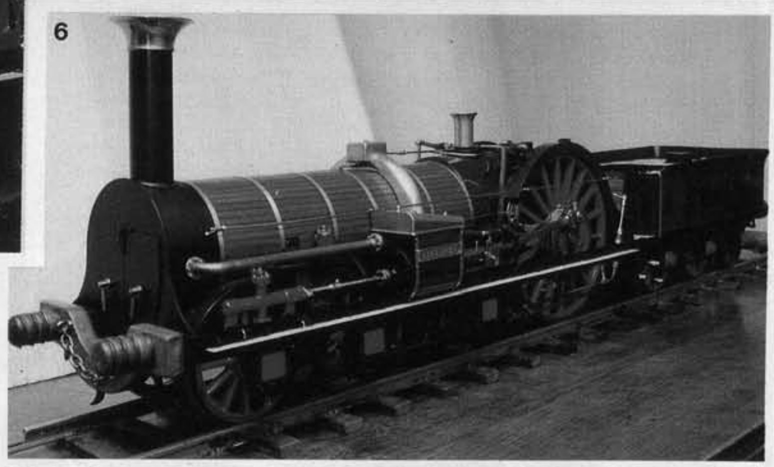

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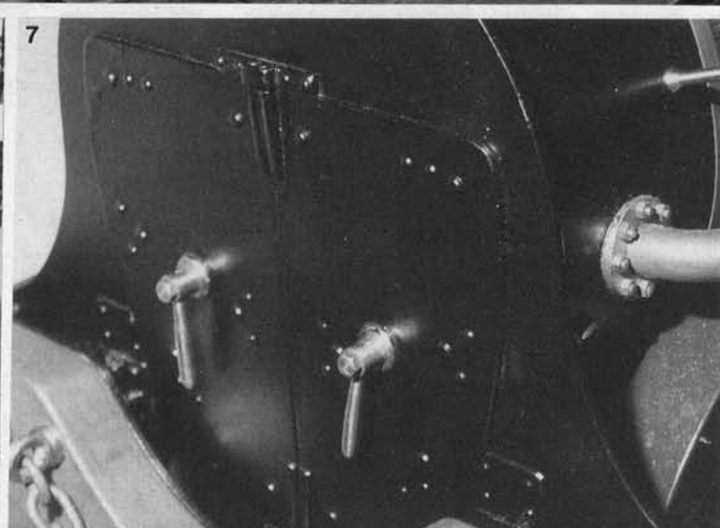
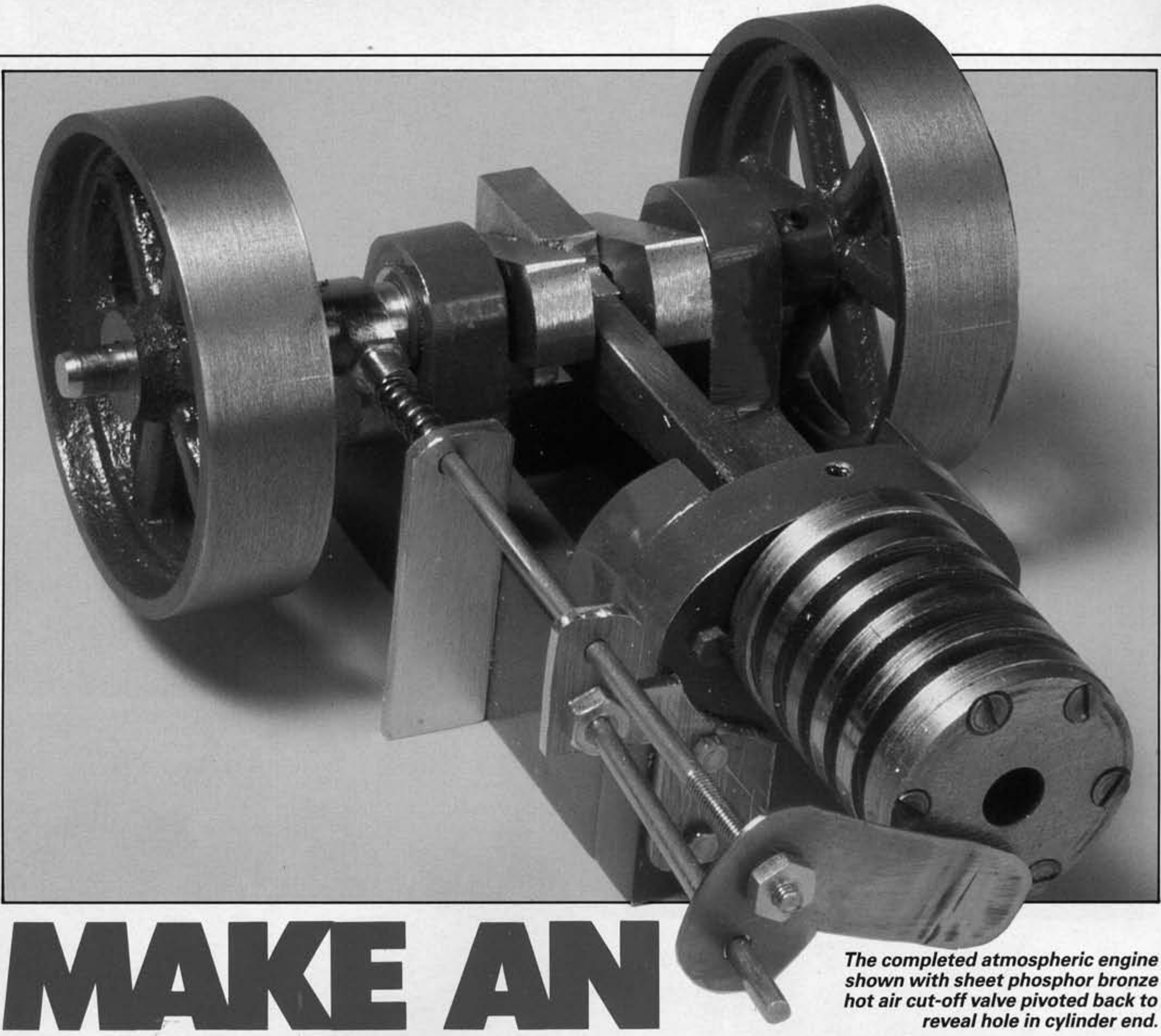


1. A close-up view of the front suspension. The correct number of leaves of spring steel of an accurate thickness have been used and the locomotive rides perfectly. The fitting above the spring is a pump operated by the extended piston rod and called for accurate fitting to avoid binding. 2. The splasher over the large driving wheel with the eccentrics over the axle extension. 3. The buffer beam is shaped from wood and the buffers are from leather bound with steel strip. 4. The rivet detail on the tender called for great care in preventing the tools marking the parent metal. 5. The safety valve is correctly formed and cased over as per the original locomotive. 6. Overall view of the completed model. 7. The smokebox opens on both sides, unlike more modern locomotives which had just one pair of hinges. The exhaust pipe fits to the smokebox with a flange fitted to studs.



The completed atmospheric engine shown with sheet phosphor bronze hot air cut-off valve pivoted back to reveal hole in cylinder end.

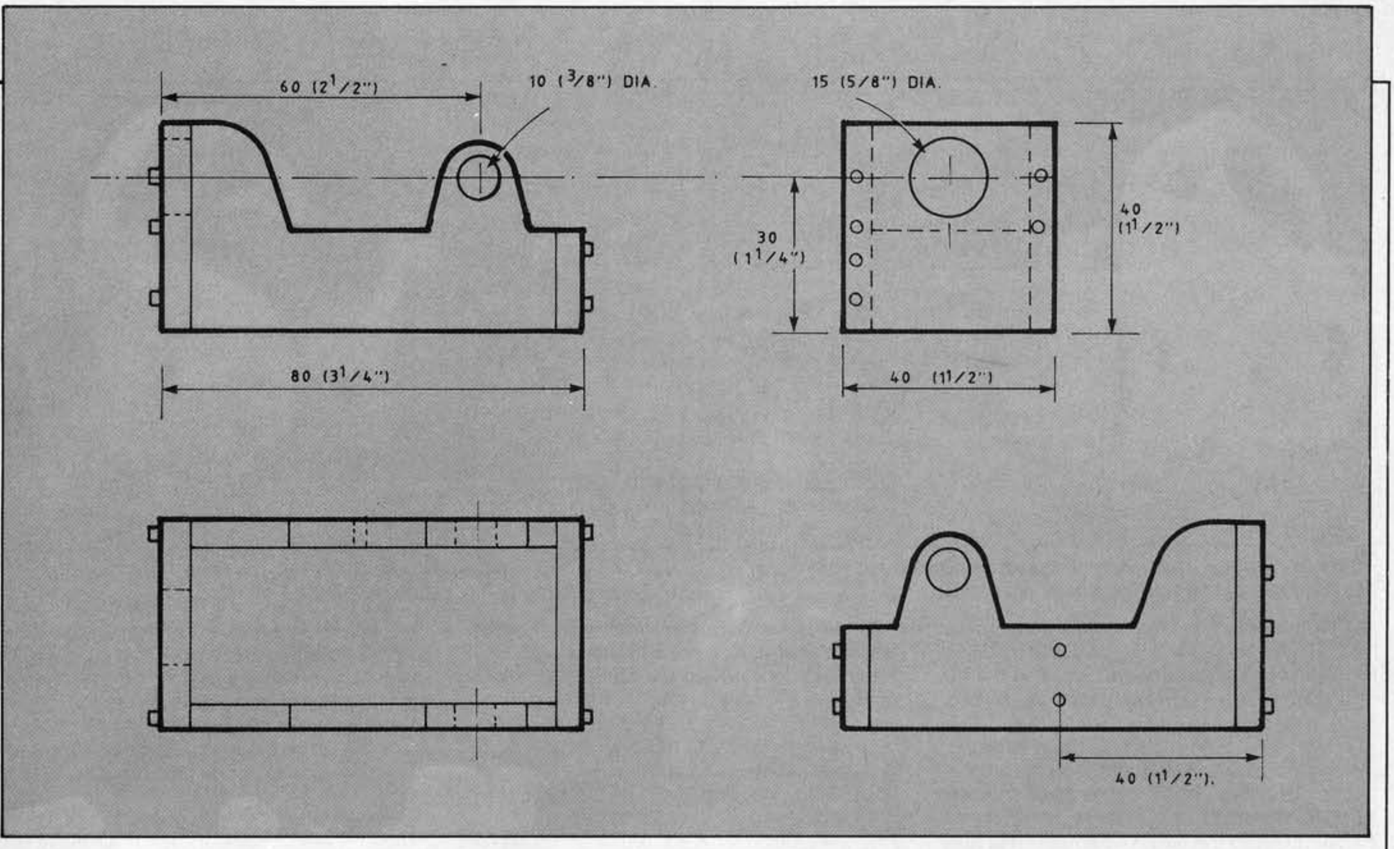
MAKE AN ATMOSPHERIC ENGINE

This ingenious little engine is easy to make and a rewarding workshop exercise involving a range of pleasurable techniques. It runs nicely, too!

During the late eighteenth and early nineteenth centuries there was a period of experimentation in an attempt to construct a really efficient form of power. There were many ingenious devices tried out and most are now lost in history because, quite frankly, they were not efficient. The hot air engine, for example, was made to run and numerous versions were experimented with but the engine would never develop sufficient power to make it a viable proposition.

The steam engine, of course, became the main source of power for many years but this too remained for a considerable length of time as a comparitively low powered machine. When first built it relied on the power of the vacuum rather than that of steam. The cylinder was filled with steam which was then condensed so causing a vacuum in the cylinder, the pressure of air on top of the piston then drove it into the vacuum and a flywheel or beam arrangement was used to continue the cycle. The reason this method was adopted was because, at that stage, the steam being used was very low pressure – not much above that of the atmosphere.

Later, steam was used at a higher pressure and the use of a vacuum was dispensed with. From steam the internal combustion engine was produced and for a while these operated on ordinary gas using



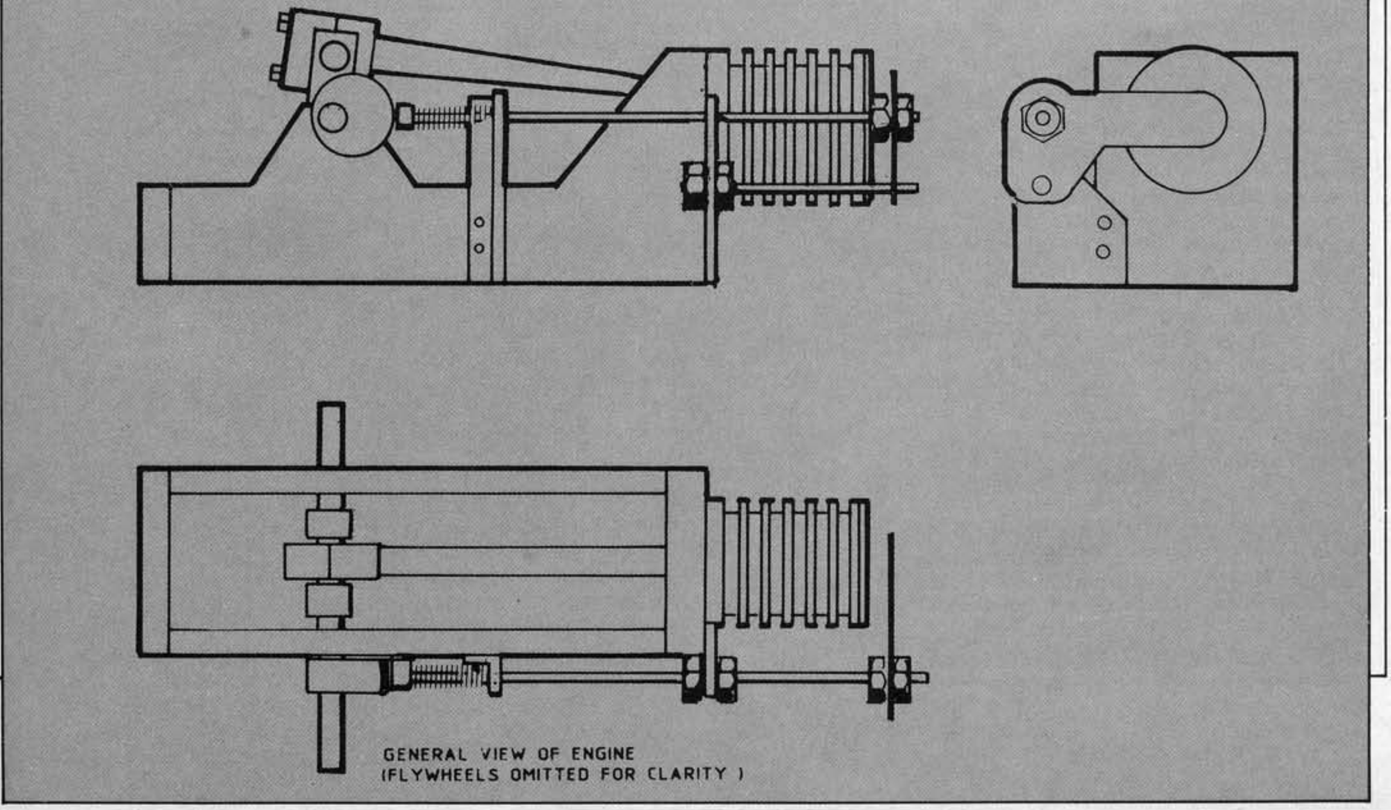
much the same principle as the petrol engine except that gas was the fuel used. Such engines were very convenient in pumping stations and electric lighting plants in or near a town as the ordinary gas supply could be used thus saving the need to have fuel brought to the site where the engine was stationed.

During the early period of experimentation a type of engine had been tried which, like the early steam engines, relied on atmospheric pressure for its operation. Hot air was passed into a cylinder and when the piston was at the far end of its stroke the air cut off and rapidly cooled. A vacuum was created and this drew the piston forward. The model described here is a very simplified form of such an engine. It is easy to make and odd bits of metal can be pressed into service for its construction. It does not require precision engineering except for the piston and cylinder bore. All bearings, etc., can be quite loose fitting and, indeed, if they are made too tight the engine will not work. This is in keeping with the full-sized engines which were eventually abandoned because of the lack of power generated. In the case of the model a good fit for the piston in the cylinder is essential if it is to operate, but at the same time it must not be stiff.

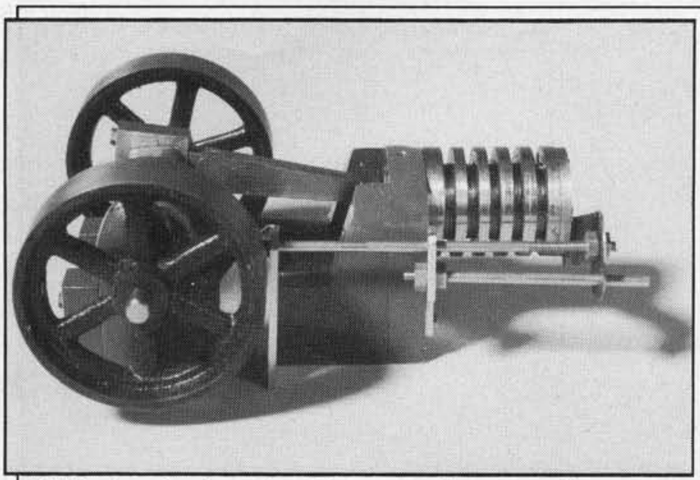
On the model I used ¼in alloy plate for the frames. Not every reader will have such material lying around and the frame can be made of steel sheet, or even wood if that is all that is to hand. The only parts that will get any wear are the bearings where the crankshaft fits and as these will be bushed anyway it can be seen why the material used for the frame is of little importance. As it is bolted together, thinner sheet can be used and either joined at the corners by bending at right angles or with small section angle.

The hole in the front end of the frame for the cylinder should be bored on the lathe in order to get it really true if ¼in. thick material is used. The ends can be bolted on as in the case of the one I made. I have used 8BA bolts for most of the work including bolting the sides together. When making the sides it is essential that both bearing holes are level with each other and with the centre of the cylinder bore. Small bronze bushes can be put in the holes as bearings for the crankshaft. Here again I have made mine a little differently as I happened to have a couple of small ball races but these make little if any difference to the way the machine runs.

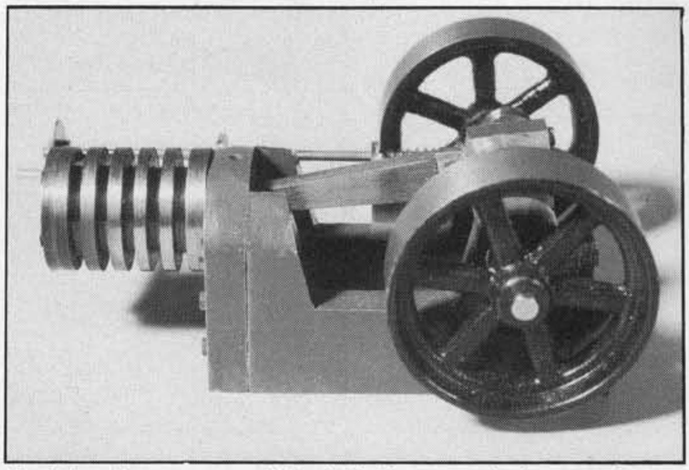
The cylinder was made from mild steel. I turned the cooling fins and the step to fit



GENERAL VIEW OF ENGINE
(FLYWHEELS OMITTED FOR CLARITY)



Finished engine from the side; note rudimentary valve gear – valve plate is from phosphor bronze sheet.



And the other way round! Model looks attractive in green for the frames and red for the flywheels.

line things up. The short length can either be silver soldered into position, or held with a retaining compound which is the method I used – namely Loctite 601. When set the longer bar can be drawn out.

Holes are then drilled for the two grub screws that will hold the other lengths of rod in position. Note that the screws should go in towards the edge of the bar rather than direct to the largest diameter. It is now possible to put the small part of the crankshaft in position and then finish it with the two outer sections retained with the grub screws.

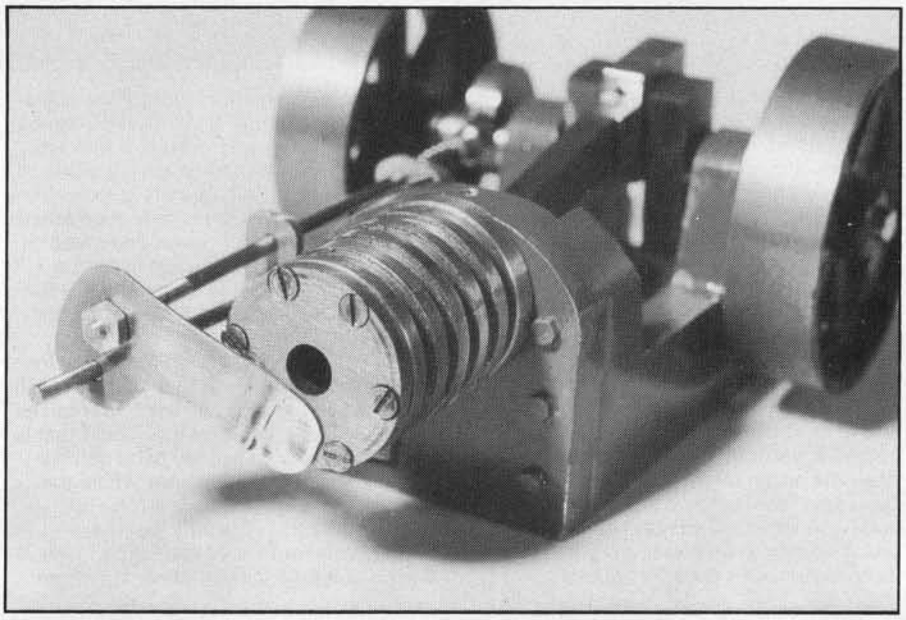
The valve which will cut off the hot air and so create the vacuum as the air inside the cylinder rapidly cools, is made of a piece of phosphor bronze sheet. Any thin sheet will do but bronze is a little springier than most. The shape can be seen on the drawings. It is operated by a rod which is moved with a cam. This is simply a piece of steel round bar drilled off centre and then filed to shape. A bigger throw might have helped to get the air in the cylinder a little warmer but I was worried that this might get the balance of the engine all wrong, it already being slightly off balance as the heavy part of the cam runs in tandem with the big end which means they do not counterbalance each other in the normal way.

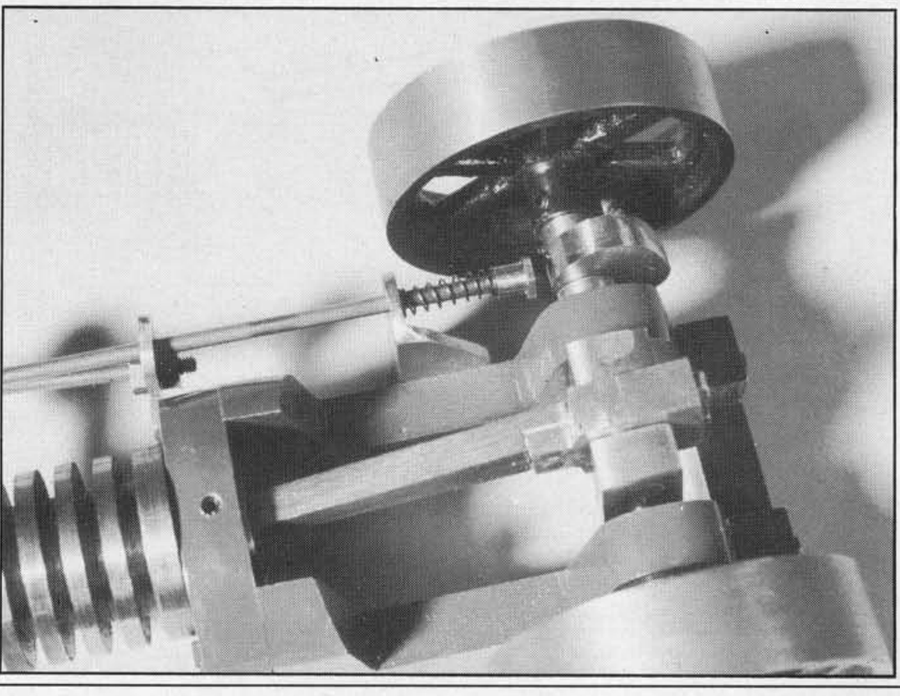
Two pieces of brass, one flat the other an angle, are used to support the push rod as well as a guide rod which prevents the valve from slopping about all over the place. Making these is a straightforward drilling and filing job with one hole which holds the guide bar being tapped. The push rod is an ordinary piece of bar threaded at each end. At the valve end the thread should be long enough to allow adjustments to be made; at the other end it simply takes a brass bearing which prevents wear as well as allowing the rod to be pushed more easily. A spring is fitted between the piece of angle and the brass push piece and this allows the valve to return and seal off the hole in the cylinder end. The strength of this spring will probably need to be found by trial and error; it needs to allow the engine to work easily while not making it so tight as to be difficult to turn over.

The flywheels can be turned from mild steel. It may be possible to obtain castings for small wheels of a suitable size and I managed to get hold of a couple. Solid flywheels will, in all probability, do a better job than spoked ones as they will give added momentum. Mamod flywheels are about the right size but whether or not they have sufficient weight for the job I do not know.

The engine needs to be adjusted so that the valve snaps shut just as the crank reaches back dead centre. It is essential that the valve is airtight or the engine will not

For running, the hot air cut-off valve seats over the hole in the cylinder end.





work. Some slight slop here will help as the vacuum will then pull the valve in over the hole.

The burner can be made up from brass or, alternatively, something like a lozenge tin can be used. The tube must be quite thin and the flame must burn between the open valve and the hole in the cylinder end. Ordinary household bandage makes a nice wick if a proper one cannot be obtained. Ideally the engine should be mounted on a plinth in order to get sufficient height to use a deep burner which will last for some time while in place; as it is, the height limits the engine's running time.

To operate the engine, light the burner which has, of course, been filled with methylated spirit, the flame going between the valve and the hole in the cylinder cover. Give it a few minutes to warm up and then rotate the engine. It will need quite a bit of rotating to get things warmed up properly but, once going, will keep running until the burner dries up. Some adjustment of the flame height or distance from the hole will alter the running speed and this is really a matter of trial and error. Running may well be accompanied by a crackling sound but that is quite normal and is usually a good sign!

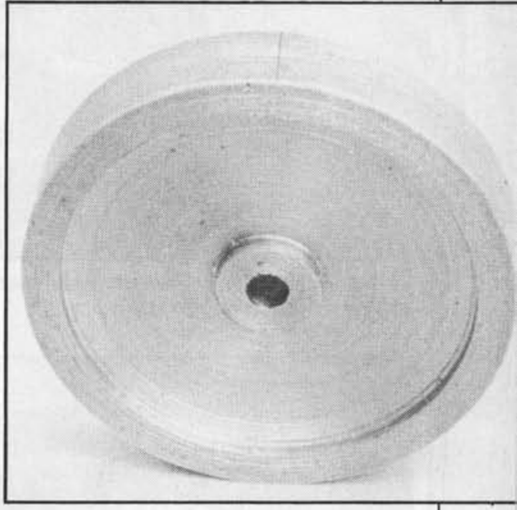
I always believe that, where a model such as this is described, it is nice to try and improve on it – and there is room for improvement here. If the valve can be made to open slightly further away from the hole it would, no doubt, make it run better. Equally, if it can be induced to snap on and off quickly it will also make for better running. Some form of balancing of the big end will also make things far smoother, so the reader can see that, whilst this engine goes very well, it could certainly do better with a little experimentation.

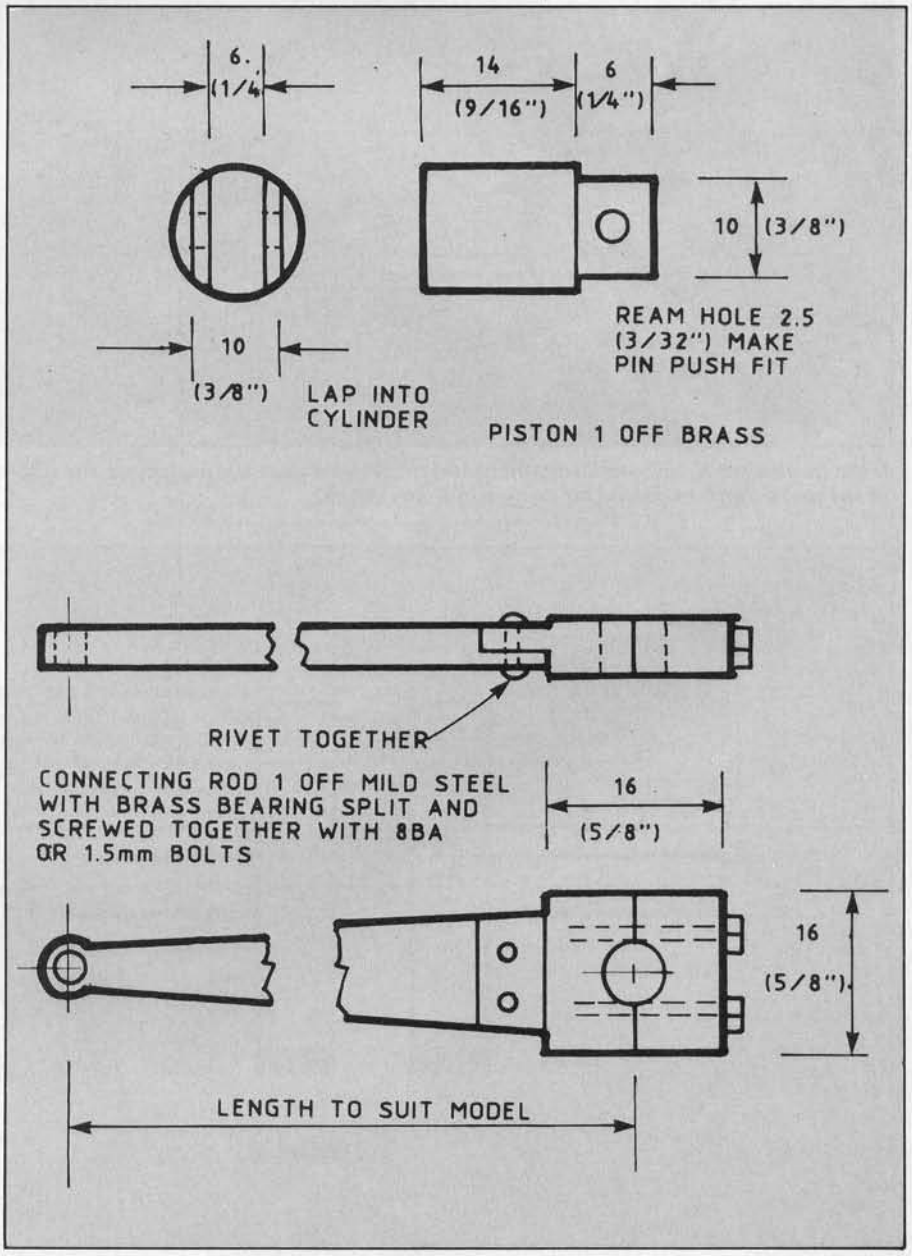
Small doses of thin oil on the piston are essential in order to keep it airtight – and unless it is the engine will not operate properly. Since making the engine I have discovered that oil is essential in the bore of the cylinder if it is made of either mild steel or cast iron. The cooling of the cylinder results in considerable condensation and rust rapidly occurs and prevents easy running. A thin film of oil should prevent the formation of rust while a touch of oil on the cam also helps to keep the engine in good order.

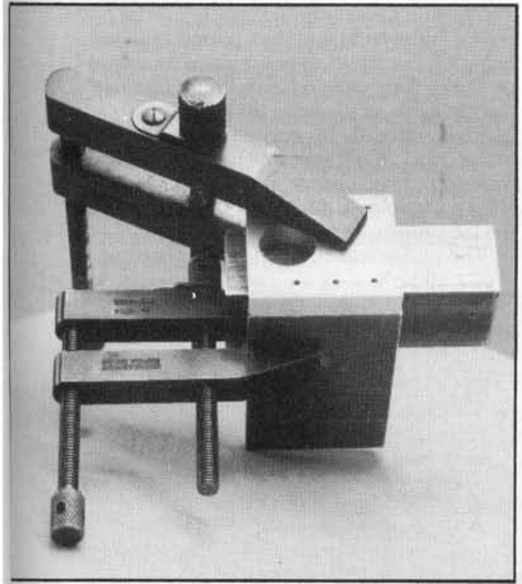
The model is ideal for those with small lathes like the Cowell, Unimat, Toyo, etc. It does not require any complicated tooling for its construction and sizes may be adapted according to available material as long as proportions are kept roughly the same. Running can be improved if cooling can also be improved and, in fact, the ability of getting work from the engine is directly proportional to the ability to cool the cylinder quickly.

Better cooling can be obtained in two ways: Thinner fins with gaps of roughly the same width will improve cooling quite a bit but even better would be some form of water jacket. This will almost certainly mean making the cylinder from brass or aluminium and will have a second advantage as the formation of rust inside the cylinder will no longer be a problem.

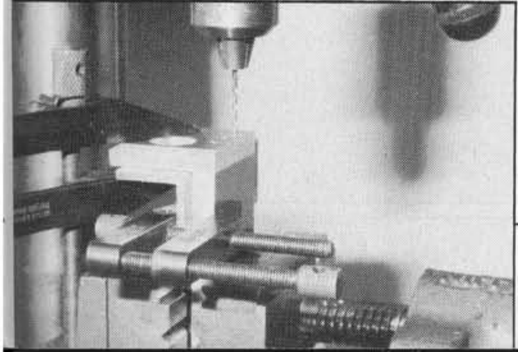
Solid flywheels are less attractive but more efficient.

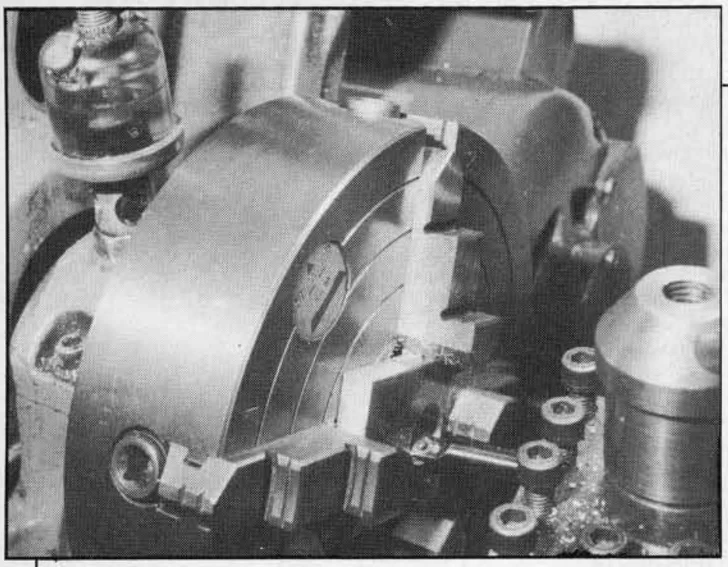




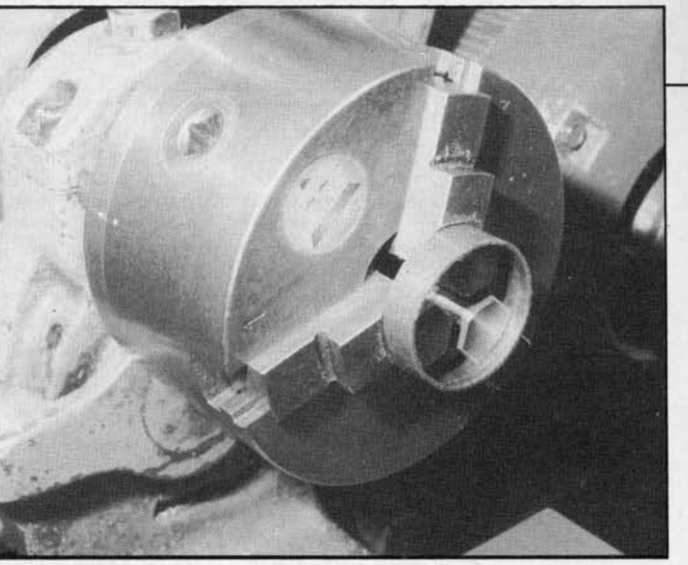


To get the body square, first drill the holes in the end components and clamp to a piece of angle iron which has been checked for squareness (above). Then both the angle and the side are held in the vice and a drill passed through the holes in the end-plate (below).

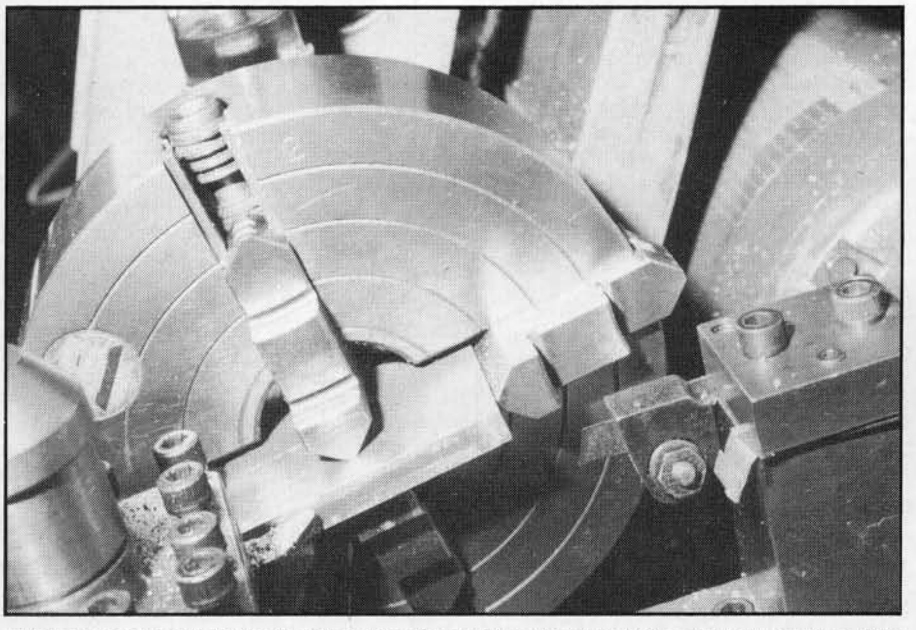




To ensure that it is square, the hole that accepts the cylinder should be bored on the lathe.



The section of tube for the burner can be machined using the outside of the chuck jaws to hold it.

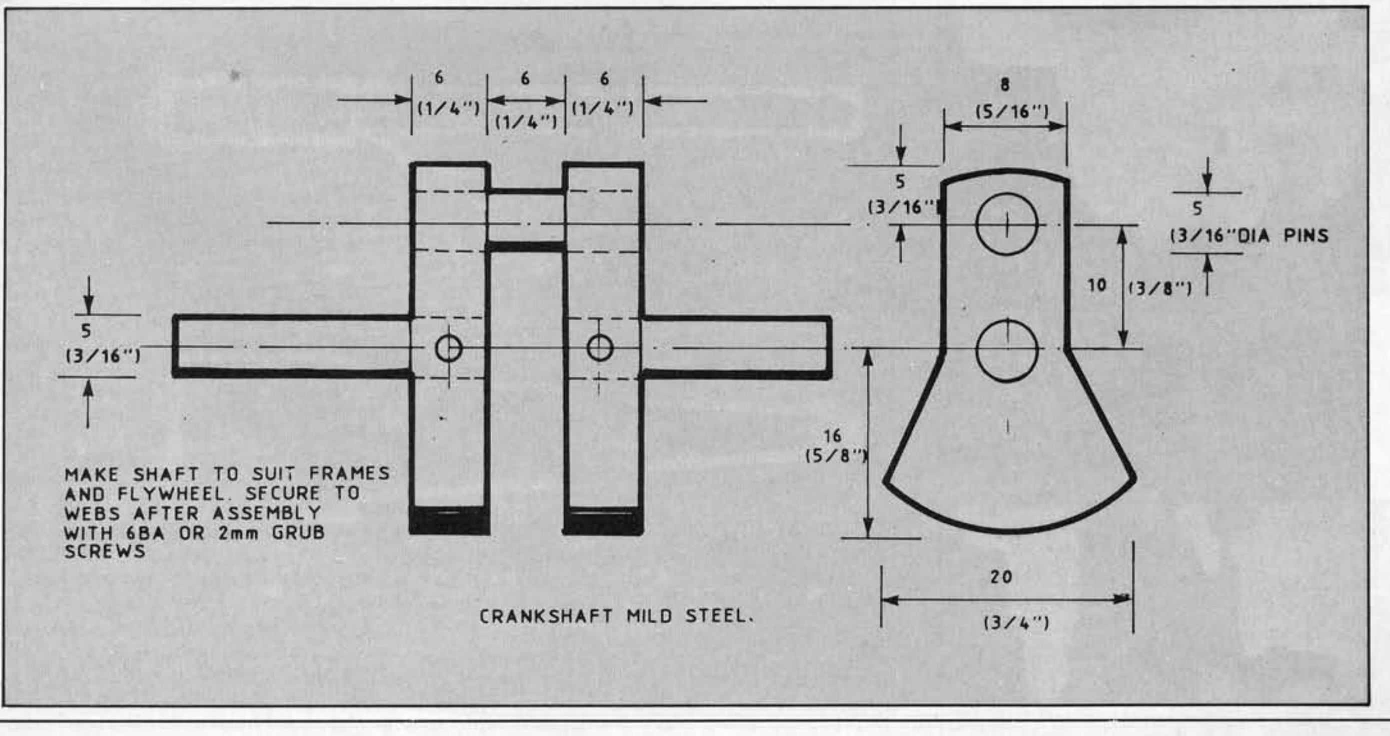


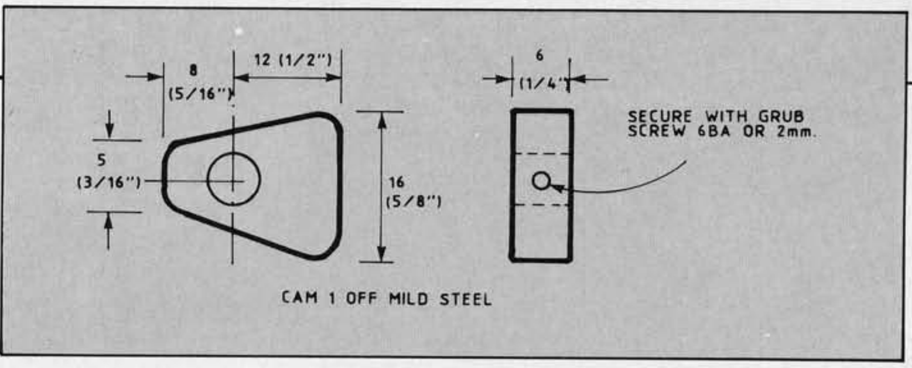
If the frames are to be bolted together from thick sheet as in the prototype, the edges of the metal can be squared off using a four-jaw chuck.

the frames first and then bored the cylinder; I would not advise drilling and reaming as the bore needs to be very smooth. If a small wooden lap can be made up then it can later be lapped. Such a tool can be made from a piece of dowel of the same diameter as the cylinder bore. Drill a small hole at one end to fit a wood screw into later, then with a very fine saw cut along the wood. When the screw is wound in it will now open the wood as required. The dowel is covered with grinding paste and run up and down inside the bore until it is perfectly smooth. (The bore, not the dowel!) The lapping can either be done with the cylinder in the lathe or, as I prefer, with the cylinder held in a machine vice and the lap held in the drilling machine.

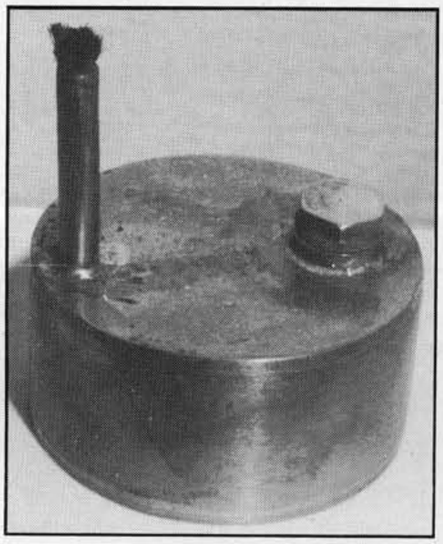
The end cover for the cylinder can be drilled in the lathe and then parted off. The holes for the retaining screws can be drilled on the drilling machine. If indexing facilities are available on the lathe they can be spotted with a centre punch while still held in the chuck; if not they will have to be marked out and centre punched. I have shown six holes but four would really do the job equally well.

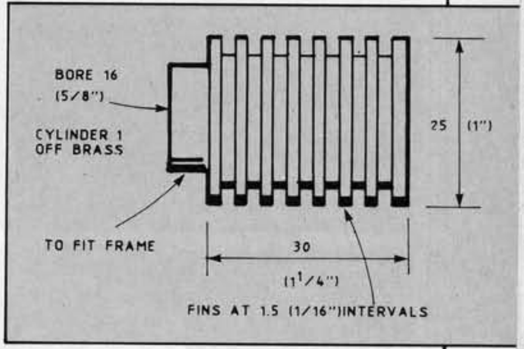
The piston was turned from bronze but





The burner.





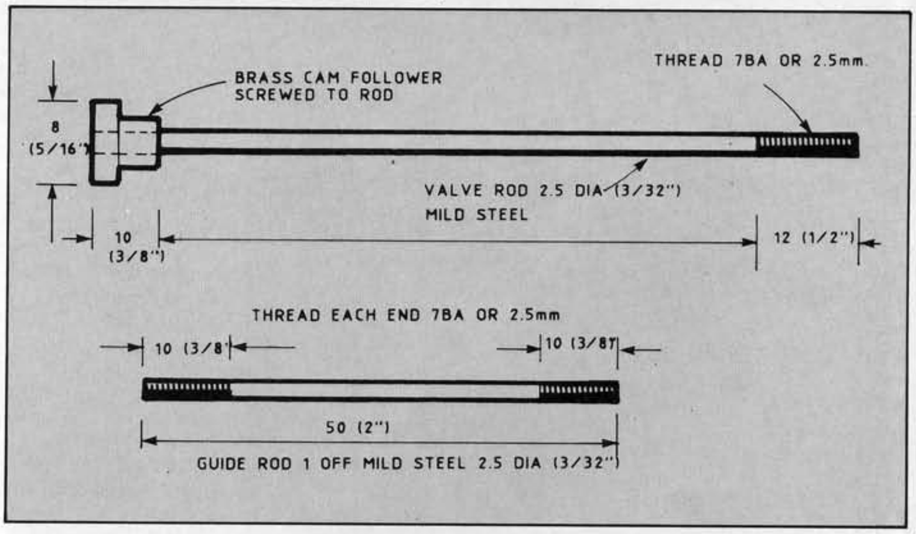
brass could be used. A step was turned on it for the connecting rod fitting. The piston must be a good fit in the cylinder as success or failure will depend on this. It is essential that small cuts only be taken in order to ensure accuracy. The end of the piston for the connecting rod pin can be cross drilled and reamed so the pin will be a push fit. The slot can be milled or, if milling facilities are not available, filed. Although I have not yet dealt with the connecting rod, the pin is worth a mention. I have already pointed out that it needs to be a push fit in the piston, but it must be a running or free fit in the connecting rod. Getting this exactly right is quite a challenge for a beginner as either the lot is too tight or else it just drops through! If the latter happens lay the pin on a hard surface and tap one end with a hammer to just flatten it a little so that it will just hold in the piston when pushed in. Take it easy though – if it is too flat and then forced into the piston there could be some distortion.

The connecting rod is a straightforward filing or milling job. It must be made in conjunction with the big end bearing as the length may need to be adjusted. It will need to be of such a length that the piston will stop just short of the cylinder end when the crank is as far forward as it will go.

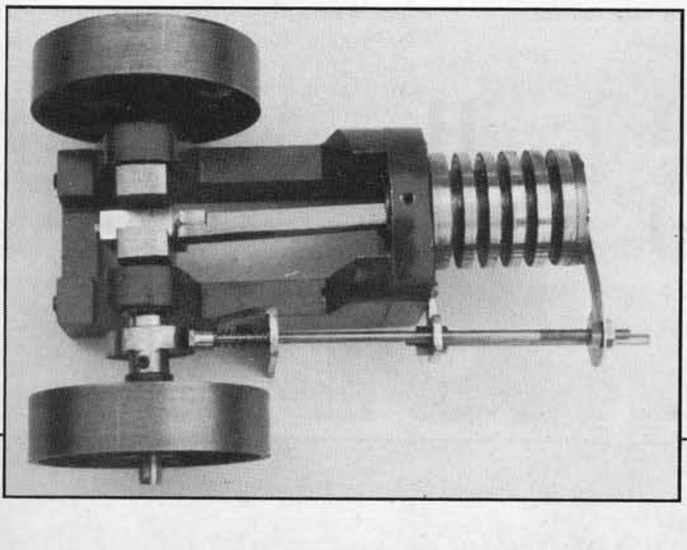
The big end would normally be made by cutting a piece of metal and then soldering it together again while it was shaped and drilled for the crankshaft. Instead I used two short pieces of stock bar. I drilled one using the tapping sized drill and then clamped them together with a toolmaker's clamp while I continued the holes right through the second piece. I opened one pair of holes out to clearance size and tapped the other then screwed the pieces together and drilled for the crankshaft with the work mounted in the four-jaw chuck on the lathe. Do not be tempted to use the drilling machine if you can avoid it as the chances of getting the hole square are very low. Both the big end and the connecting rod were drilled for the countersunk rivets which hold them together but they could just as easily be silver soldered to each other if one so wished.

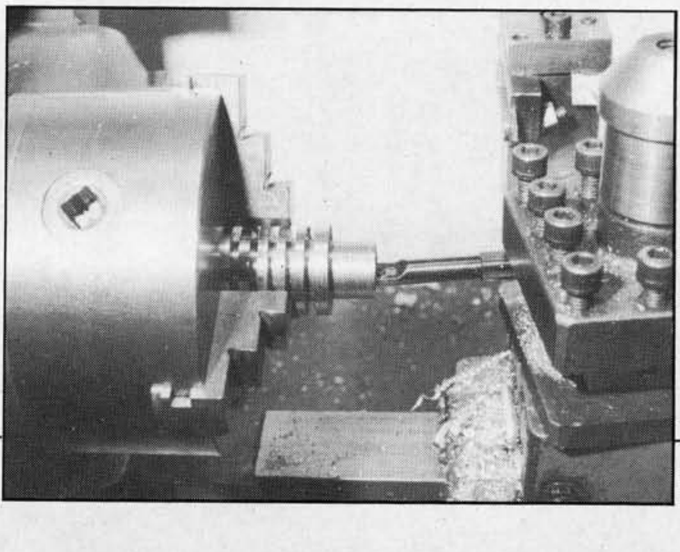
The crankshaft took a bit of fiddling as, owing to the fixed bearings in the frame, it has to be assembled *in situ*. Normally split bearings are used and the crankshaft laid in with the tops of the bearings then being bolted on. Fortunately the nice hefty size of this crankshaft eased the way and I started by marking out a piece of stock sized material for the two holes for the shafts and drilling it with a ⅛th or 3mm drill.

I had not at this stage cut the metal to length and I clamped it to another piece of the same section and drilled through this using the original holes as a jig. The four holes were then drilled and reamed to finished size and the bars cut to size, and filed to shape. A piece of rod for the crank was trimmed to length in the lathe and another longer one cut; the short length was put in place using the longer one to



At left, the completed engine; note valve rods and guide bars. It is most important that the finish on the cylinder is as near perfect as possible. It must therefore be bored rather then drilled and reamed. Several passes of the boring tool (below right) at the final setting are essential for a good finish that can then be honed with a wooden lap.





UNUSUAL STEAM MODELS

One of the beauties of steam as a source of motive power is the wide variety of applications to which it can be put. Commonest are live steam locomotives, traction and stationary engines but model engineer Gordon Howell has used steam successfully to power these very unusual models.

◀ 1

◀ 2

▲ 3

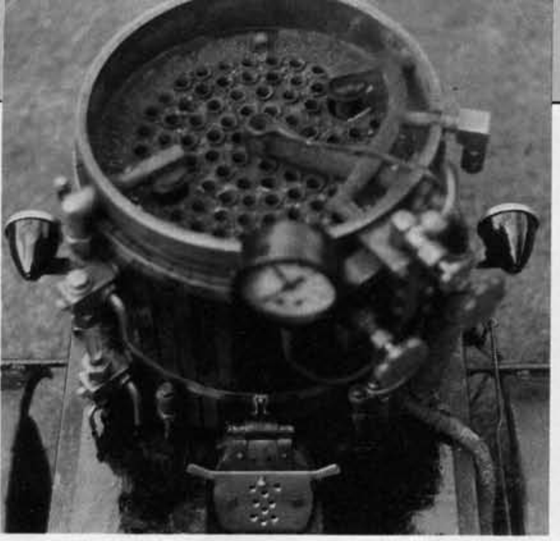
Top, Gordon Howell with the Atkinson Tractor and trailer enjoys the sunshine at a steam rally. Above, the Atkinson rig at Stoneleigh Park; the unusual control system can be seen clearly at the rear of the tractor. The trailer is made from wood for lightness. At left, Gordon (in the 'grease-top') next to Reg Dimmer who designed the boiler and engine with Mr. Powell at his home and private railway track.

This chapter introduces a most unusual series of models built by Gordon Howell. I first saw one of the models at a rally of The Model Road Vehicle Society and it fascinated me. At the time, Mr Howell could not be seen but hearing of my interest he very kindly sent along the details and some photographs. I am sure readers will find the story as fascinating as I do.

He has an absorbing interest in oscillating engines. Now it would seem that we both share the same opinion here, that the oscillating engine is a much maligned thing. This, without doubt, arises from its use as a toy, particularly during the 1920s and '30s. A properly designed engine can, however, be very powerful and has many advantages over the more conventional types as there are less parts to wear or to go out of adjustment. Anyway, he decided that such engines were to be the basis of the power in his models and has more than proved his point.

One of his first models was a five inch gauge locomotive with two oscillating cylinders mounted on the frames, driving directly via the piston rods to the crank axles and found to be quite capable of hauling several people. Some years ago a four cylinder oscillating engine design appeared in *Model Engineer*; it was very small, and a friend of Gordon's, Reg Dimmer, offered to re-design it to make it suitable to drive a steam wagon of $2^1/_2$ inch scale. Once the drawings arrived work started.

The engine is quite large with $1^3/_8$th inch bore and 2 inch stroke and is in the form of a V4. It is single-acting. Although intended originally for another model it was subsequently mounted in a model of an Atkinson Steam Tractor. This is based on one owned by J. B. Bibby Ltd who dealt in animal foodstuffs. The firm had a number of wagons which they could well have carried out conversions on and, in fact, the tractor was in all probability a cut down wagon.



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At left, the boiler on the Atkinson Tractor. This photograph clearly shows the firehole door arrangement. The rod between the chassis and mudguard operates the draincocks while the tubes, which can be seen lying across the top of the boiler, are for superheating. Above, it all started for Gordon with 5 inch gauge locomotives. Here we see the first model (named 'Wapiti') with two oscillating cylinders of $1\frac{3}{8}$ inch bore and $2\frac{1}{2}$ inch stroke. They are double-acting and reversible via a valve. The boiler works at a pressure of 90 psi, all to the great delight of the youthful passengers!

Being a tractor there was nowhere for the driver to sit and so a suitable trailer had to be produced. This meant that the controls were difficult to get at as the driver was a long way from the cab. Extensions were therefore made and these, too, are of interest. The regulator is in the form of a joy stick; the lever is pushed to go and pulled to stop the vehicle. The same lever works the Ackerman steering – whichever way it is pushed, the vehicle turns in that direction. Reversing is via gears rather than reversing the rotation of the engine. The vehicle is to be fitted with a steam brake in the near future, operated from a lever at the side.

The amount of water the pump puts into the boiler is controlled via a push-pull type of rod and an injector is controlled in a similar fashion but via bevel gears. The fire hole door is hinged upwards with a clip to hold it in position and coal is pushed via a chute into the fire.

The cab is removable after taking off the chimney ring which is a push fit and the smokebox can be removed completely for cleaning, and to allow cleaning of the tubes in the vertical boiler. The floor of the cab can be lifted off to get at the engine. The coal bunker and tool box also lift off to get at the chain for oiling purposes, the whole operation taking only a minute or so. A gearbox has been fitted and this is an 'Albion' as used in garden machinery and motor cycles until about 1950.

The boiler is made of steel and is thirteen inches tall and eight inches diameter and is constructed from, at the minimum, $\frac{1}{4}$ inch material. The inner firebox is six inches diameter and there are 79 $\frac{3}{8}$th inch diameter tubes. It is tested to 300 lbs per quare inch. In use the safety valves release the pressure at 120 lbs per square inch.

Since making the Atkinson Tractor, Reg Dimmer who has also made an Atkinson Tractor but with a two cylinder double acting engine, has designed a compound oscillating horizontal engine with cylinders of $1\frac{1}{2}$ and 2 inch bores and $2\frac{1}{4}$ inch stroke. This has now been put into a six wheel Yorkshire Steam Wagon by Gordon. The engine has a change-over valve which allows it to be operated as a two cylinder high pressure engine for ease of starting. The Yorkshire wagon has been named 'Louise' and the Atkinson Tractor is called 'Natalie' after Gordon's grand-daughter.

There is no doubt that the models are absolutely authentic looking and are very attractive. The work involved in their construction has been very much simplified by the use of oscillating engines and maintenance has also been reduced to a minimum.

▶ 6

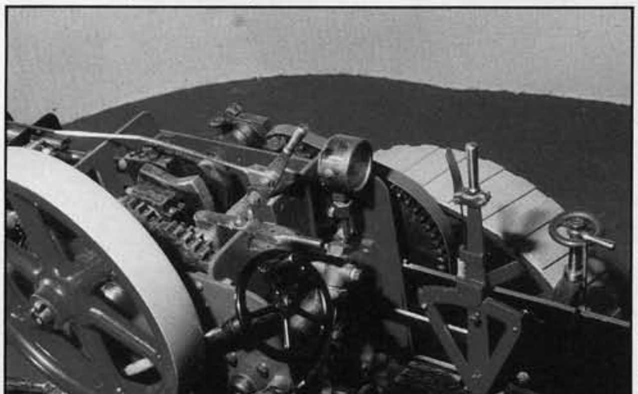
▶ 7

Above, the Atkinson Steam Tractor. This view shows the operation of the pump and lubricator via the gearbox; the rod to operate the pump valve can be seen running along the side of the model. At right, the six-wheeled Yorkshire Steam Wagon fitted with oscillating compound engine and carrying the 5 inch gauge saddle-tank.

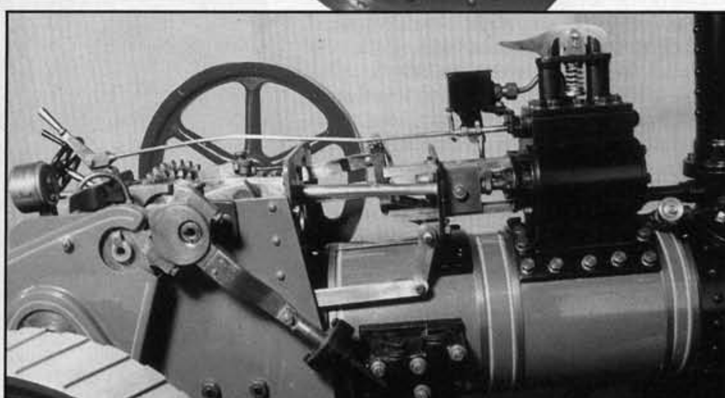
THE TRACTION ENGINE

MINNIE

In this overall view of the engine, note the pump which has been reduced in size to bring it more into line with a full-size replica. Other additions are the gear cover, which can be seen directly above and behind the hind wheel, and the spark-arresting cap on the chimney which is also in line with full-size practice. The chain, which can be seen under the boiler, acts as the steering mechanism. 'Minnie' is one of the best-selling Model Engineer Plans Service plan sets of all time and it's easy to see why...

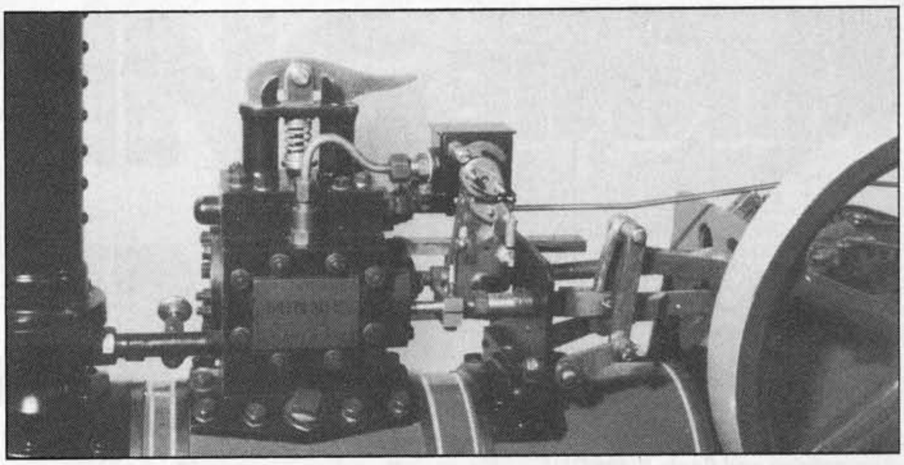


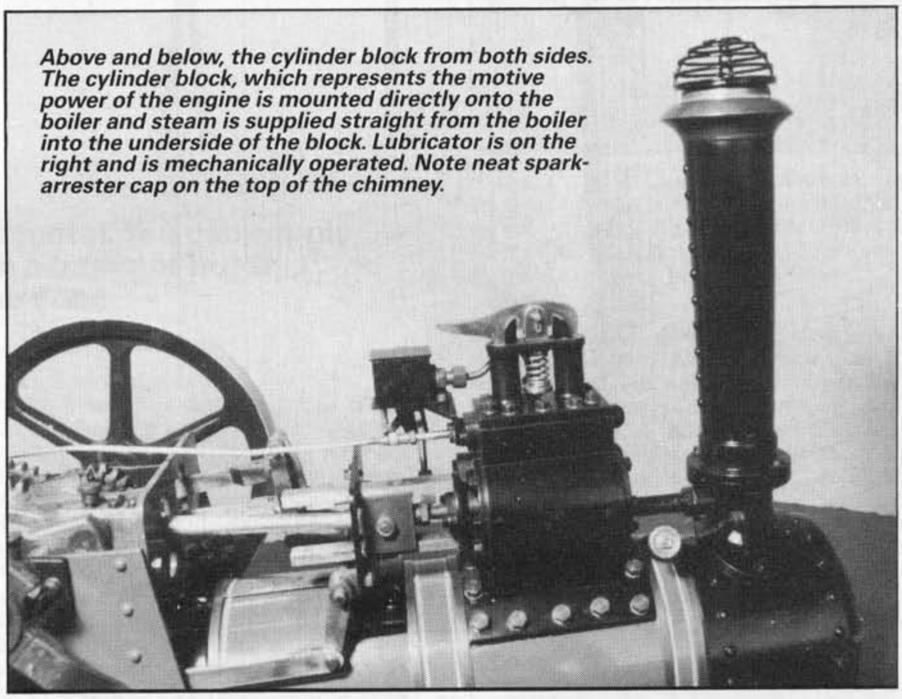
The carefully constructed footplate of the engine. Note the quadrant for forward or reverse running; unlike a car which reverses on the gears, a traction engine reverses on the engine and uses the same gears for forward and reverse. Not often employed for running purposes, reverse is used when the winding drum is in operation.



The winding drum, when is use, carries a cable and was used for winching purposes. Note the pump in this study of Tony Meek's splendid version of the engine; as supplied the castings are a little oversized and he has gone to great pains to reduce it to nearer scale proportions – with excellent results. Top class paint and lining job plus neat pipe-work round off an outstanding model.

The late Len Mason's pretty little 1" scale "Minnie" has been built in hundreds over the years. Few have been made to higher standards than this example by Tony Meek

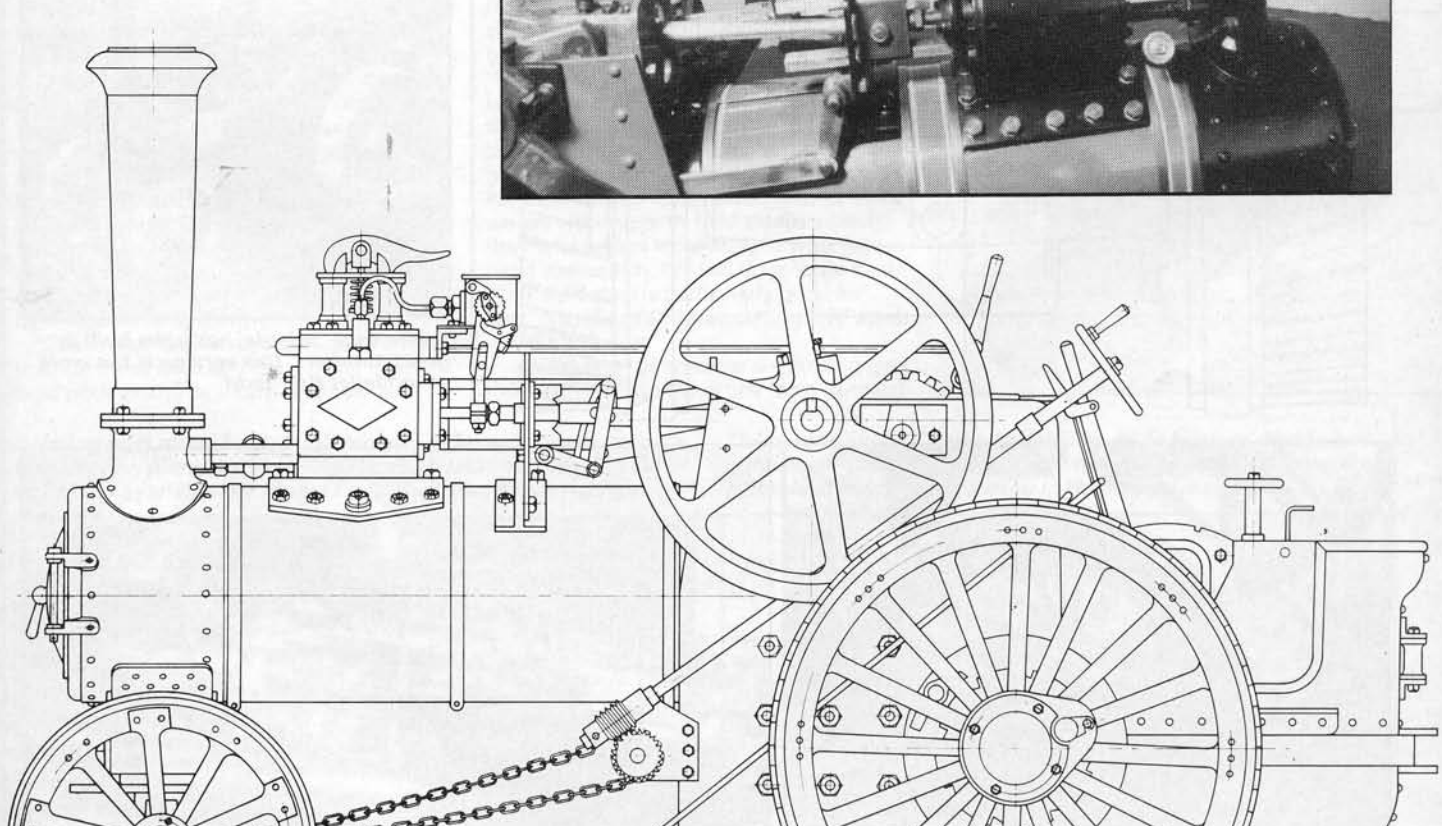




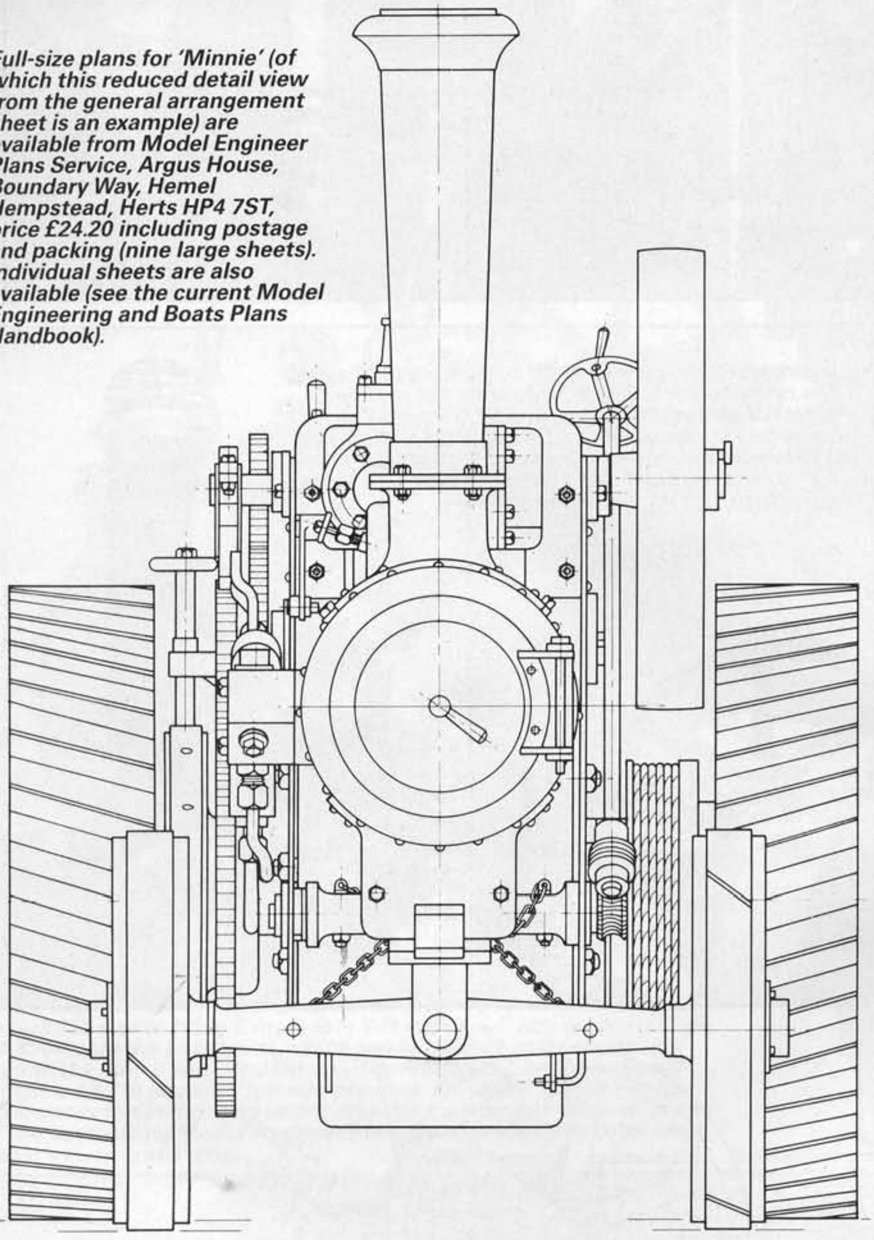
Above and below, the cylinder block from both sides. The cylinder block, which represents the motive power of the engine is mounted directly onto the boiler and steam is supplied straight from the boiler into the underside of the block. Lubricator is on the right and is mechanically operated. Note neat spark-arrester cap on the top of the chimney.

Traction engines are fascinating machines and make lovely models. Whilst it is nice to build large models and there is no doubt they do haul well and look good, they also have their problems, such as initial outlay and equipment required for the construction. There is also the question of storage after the model is built as they are not easily picked up and carried around. There may well be, particularly for the comparitive beginner to traction engine building, a case for starting with something somewhat smaller which, whilst still a good replica of a typical traction engine, can be made comparitively cheaply at home with the normal sized equipment found in the home workshop. Starting with such an engine will also enable the layout of the gearing, etc., and the mounting of the cylinder block to be studied, these being items that often cause problems to first-time builders.

Some years ago the late Len Mason described at length in the *Model Engineer*



THE TRACTION ENGINE
MINNIE

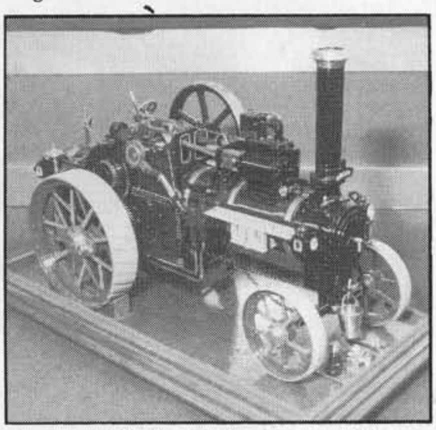


Full-size plans for 'Minnie' (of which this reduced detail view from the general arrangement sheet is an example) are available from Model Engineer Plans Service, Argus House, Boundary Way, Hemel Hempstead, Herts HP4 7ST, price £24.20 including postage and packing (nine large sheets). Individual sheets are also available (see the current Model Engineering and Boats Plans Handbook).

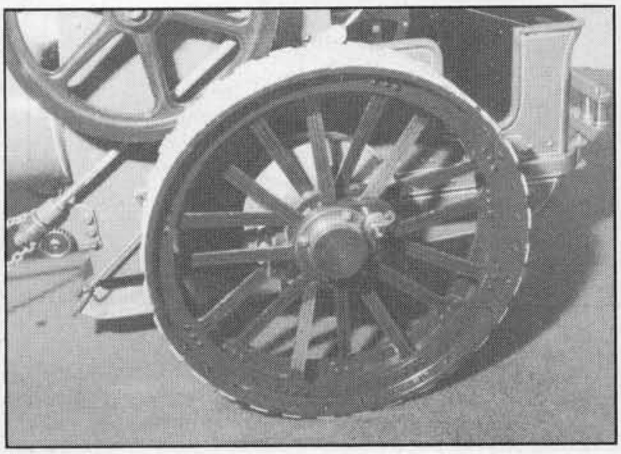
the construction of a freelance model called 'Minnie'. It is not possible to have a scale for a freelance model as it is not scaled from anything in particular. 'Minnie', however, if it had been an original prototype would be about one twelfth scale or one inch to the foot. At this size it makes a handsome little model. It is quite capable of running and indeed is coal fired for such a purpose. It will haul a passenger on reasonably level ground and has an operating winding drum.

It has been built in thousands and is a deservedly popular engine. Many modellers have converted it into a showman's type engine and it is also possible to buy castings to make it into a steam-roller. It can be constructed in most home workshops and if, when the model is finished, one does not feel it should be dirtied up by coal firing then it can be used as an attractive ornament in the house.

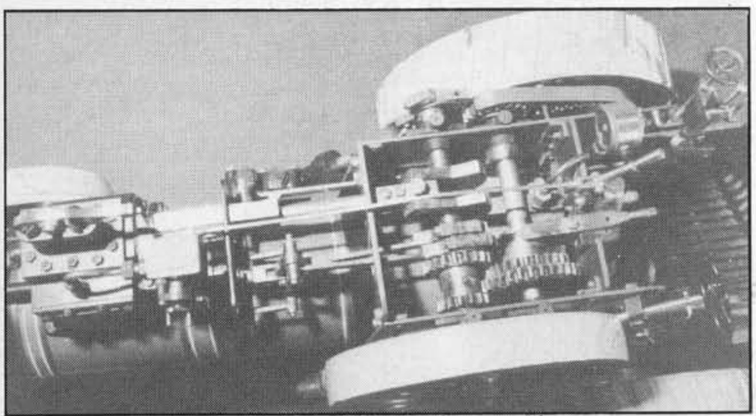
The model featured mainly here was built by Tony Meek to an excellent standard and shows just how attractive this little engine can be. Tony has taken a great deal of care to ensure that the model follows full-sized practice and has added some details which are not included in the original articles.



As we said, 'Minnie' has been built in great numbers; this version is the work of modeller Bob Todd.



Close-up view of one of the hind wheels and part of the flywheel, the latter keyed to the crankshaft. Wheels are made up on a jig to space spokes correctly and are riveted together neatly. Pin on right-hand side of the hub is the driving pin.



This view ot Tony Meek's 'Minnie' looks down on the gearing of the traction engine. Most traction engines have two gears which are engaged through the lever on the right. The gears slide along a shaft which enables them to engage with other gears connected to the road wheels. Model Engineer Plans Service drawing set for the model, show all the parts you have to make together with their dimensions.