BASIC CLOCK-MAKING

Although it looks highly complicated, the clock – and the principle on which it operates – is, in fact, quite simple. These notes hopefully, will, encourage you to make one

The construction of clocks is a subject in which many model engineers engage, and surely many more would like to but might feel that the subject is too complicated. When we visit exhibitions we frequently see fine examples of this side of the hobby, more often than not with plenty of highly polished brass in evidence and the objects cannot fail to attract our admiration. It is true that many of the clocks we see on display are quite complex but, of course, the builder had to make a start somewhere. I too thought the subject beyond me until I visited a friend one day and admired a grandfather clock displayed in his hall. He told me that he had never attempted such a thing before and that the complete clock had been constructed using only hand tools!

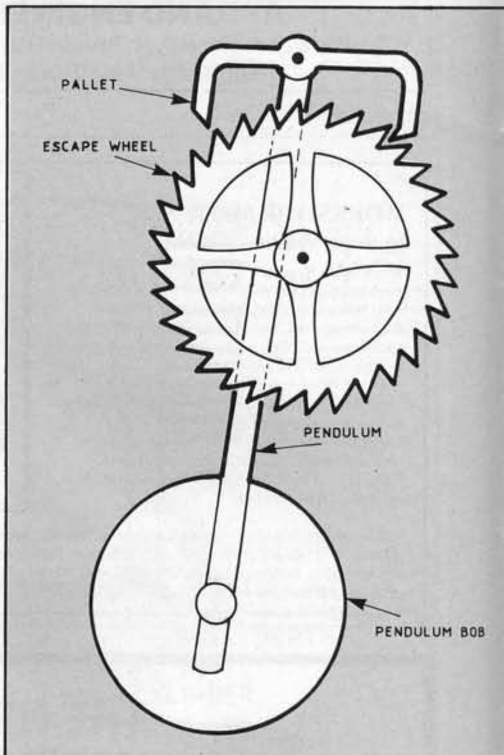
This made me decide to try and unravel the mysteries of the subject and I was pleasantly surprised at just how simple a clock can be if one so wishes. It need consist of just a few gear wheels and a device called an escapement. It can be weight driven and time-keeping can be obtained by trial and error. What, then, does a clock consist of?

A spindle that will rotate once per minute can be made to indicate seconds of time. The most basic method of achieving one rev per minute is to supply power to the shaft, say, by winding cord around it and fitting a small weight to the free end of the cord. Of course, the shaft will spin freely like this, so the next step is to fit it with a wheel having sixty coarse teeth around it. This is known as an 'escape wheel'. Now place a rocking lever with two claws to engage one at a time with those teeth. This is known as a 'pallet'. As it rocks, the escape wheel turns one tooth at a time.

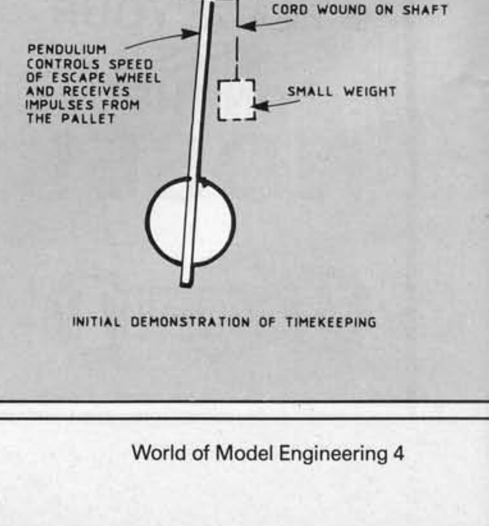
Each tooth must represent one second of time, so the pallet is coupled to a pendulum that will take one second to swing to and fro. This is a convenient figure, for, should the shaft be made to record minutes, the escape wheel would have to be very large to carry more teeth and the pendulum very long, to swing more slowly. Obviously, a clock should record hours *and* minutes, so gearing has to be used between the seconds shaft at 1 rev per minute, at a ratio of 60:1 to a minute hand which turns once per hour, then a 12:1 set of gears to make an hour hand rotate once in 12 hours.

A lovely example of an eight-day skeleton clock seen at last year's Midlands Model Engineering Exhibition. More basic designs are not difficult to make and there are plenty of plans available but, if the idea still scares you, there are some excellent kits on the market!

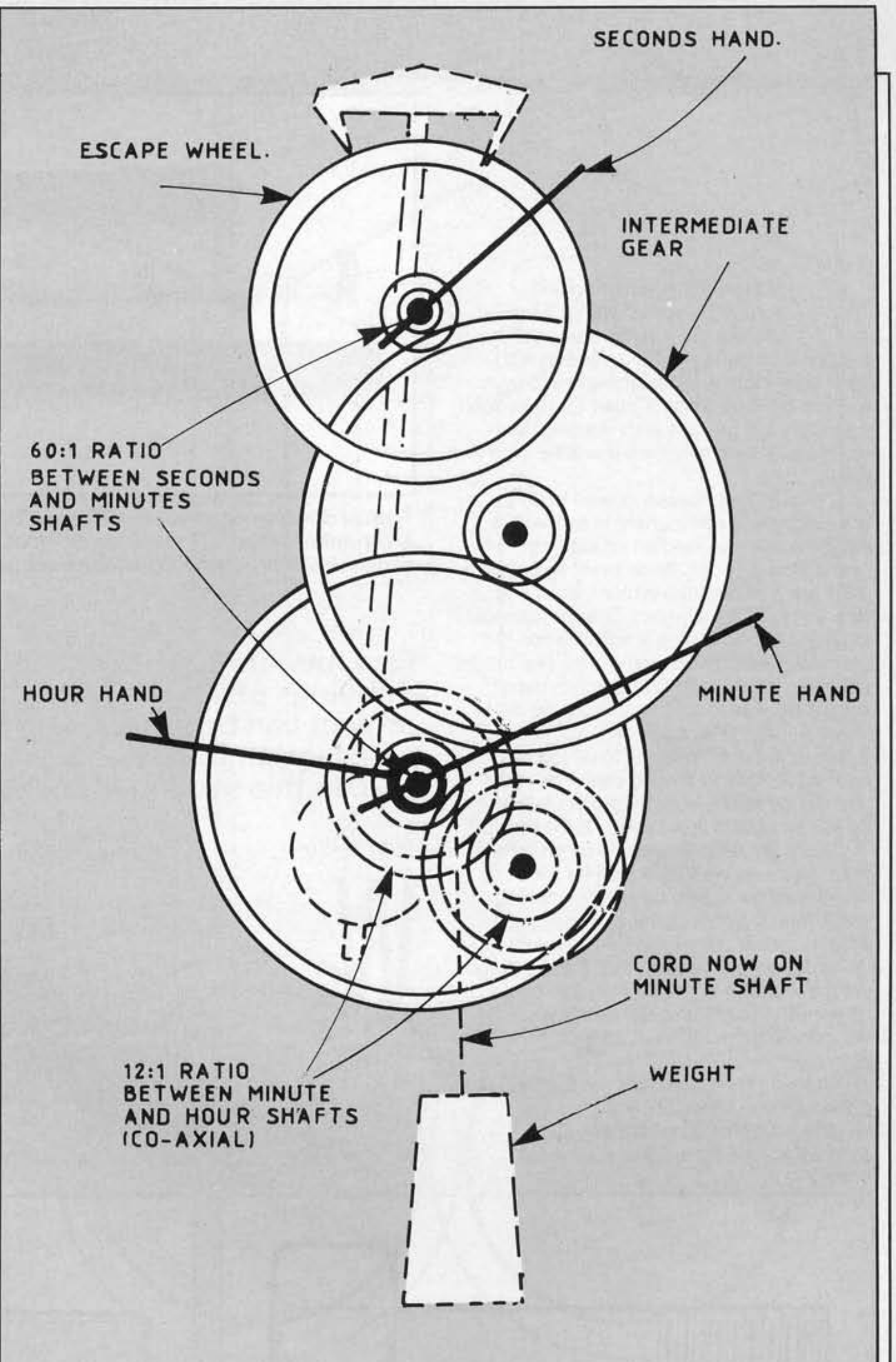
Now that cord, which, only for the purpose of explanation, was first wound on the seconds shaft, would unwind so many times, that the weight would be on the



PRINCIPLE OF THE PENDULUM AND ESCAPEMENT – THE HEART OF A CLOCK



INITIAL DEMONSTRATION OF TIMEKEEPING



PRACTICAL DEVELOPMENT FOR EXPERIMENTS

floor in a few minutes. A drum fitted to the minute shaft can be used to wind the cord, which then needs more weight to drive the clock. Some clocks have this drum on a separate shaft geared to the minute hand shaft. The amount of weight used to keep the clock going need be only just enough to cause the escape wheel to give tiny impulses to the pendulum to keep it swinging. Getting the clock to keep proper time is done by sliding the weighted 'bob' of the pendulum up for faster or down for slower action.

A peg connected to one of the gears driving the hours spindle can be induced to strike a gong as it passes a given point and we have a chiming clock. The theme can be extended to give all sorts of combinations, such as a whole chime of bells or to trigger a separate alarm.

Some clocks are spring-driven, of course, and the beginner is not advised to tackle these to start with. The principle of operation is exactly the same except that the spring unwinds to act as a drive, the unwinding being regulated in a similar fashion but the regulating device will usually carry a hair spring to help balance things out. Anyway, it is not the purpose of this chapter to become involved in advanced clock-making but rather to encourge the beginner to make a start. There are many plans that can be used that will help those wanting to have a go and not wishing to work everything out for themselves.

Something that always worries the beginner is the fact that there seems to be a need for a great deal of accuracy when making clocks. This is not entirely true. Certainly, work must be accurate but not to the high degree that one would imagine. After all, freedom of movement is essential if a successful clock is to be made. The two spindles, for example, need to be a good running fit with no slop, but equally must not be too tight. This can be achieved by running them in using an electric hand drill to rotate the inner one whilst using metal polish as an abrasive.

The spindles holding the gears will have to run in bearings. The watchmaker will use jewels to get long-lasting bearings but the beginner to clock-making need not go this far. Hard brass should be used for the support and the spindle itself should be made of steel and hardened. Proper pivot steel which is already hard can be obtained but it is not essential to use it. Many bearings used in clocks are of the pin-point type. If a bearing should pass right through the supporting female section then there is no reason why a bush should not be inserted to give a longer lasting surface.

Hands can be connected to spindles with small split bushes and can be filed from brass or steel. They can also be purchased if required but, in that case, the spindles will have to be made to match the hands rather than the other way round.

The finished clock can be put in a suitable case made of wood or brass, or left open in skeleton form – a very attractive alternative. Brasswork should be highly polished and laquered to prevent tarnishing while steel parts can be polished and laquered or just heated until they turn blue and then laquered to prevent rusting. Special chemicals for colouring metals can be obtained and these give a lasting, non-tarnishing finish.

All in all then, clock-making is not quite as difficult as it sounds. I said at the beginning of this 'Special' that model engineering included experimenting and this is an ideal chance to experiment. Little material is needed, the outlay is not high and, for a start, even scrap material could be pressed into use. Nor is there any reason why one's first efforts in this side of the hobby should not be made in wood.

The making of gears may be something which the novice will find difficult to understand but suitable cutters can be made which enable them to be cut at home. I can thoroughly recommend the book *Gears and Gear Cutting* by Ivan Law which is number 17 in the Argus Books Workshop Series, as a guide to the subject of gear making. The author is one of the country's leading experts on the subject and the book is written in simple, easy to understand terms.

It will also be necessary to know how to lay gears out so that they will mesh correctly. This, too, is not at all difficult and can easily be mastered in a few minutes. All that is needed is a small lathe and some simple hand tools to make the clock of your choice. Even if the reader does not wish to actually design and make his or her own clock then the text above will, I hope, enable him to have a better understanding of commercially available drawings and so start with greater confidence in the fascinating area of clock-making.

Typical drawing pens, essential tools for the model engineering draughtsman. Most art/graphic shops will stock them – look for the Rotring 'Rapidograph' range or similar instruments by Staedtler, both good makes.

Few models can be made without reference to working drawings of some sort; certainly, no model engineering project can be accomplished successfully. There's great satisfaction to be had from creating your own drawings and, in this section, Stan Bray explains how it's done.

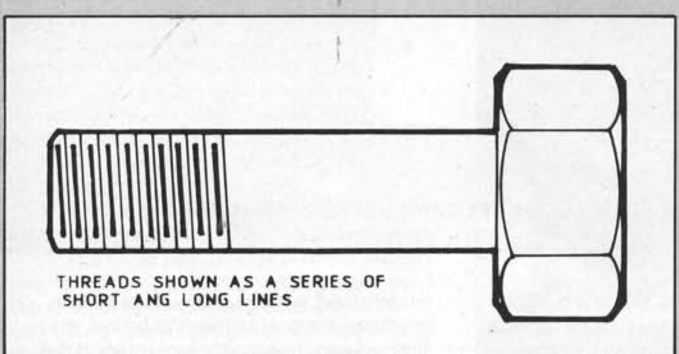
WORKING DRAWINGS

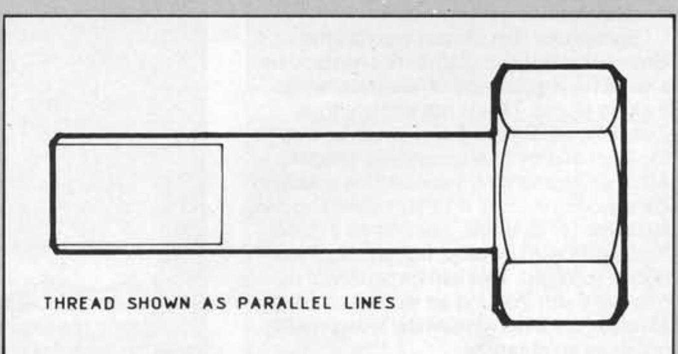
Most model engineering will involve, in some way or another, the use of working drawings. It may be that there will be a need to read such drawings or, if designing one's own models or equipment, a need to make such drawings. Let us start with reading them since, unless we can read, it will be hard to draw!

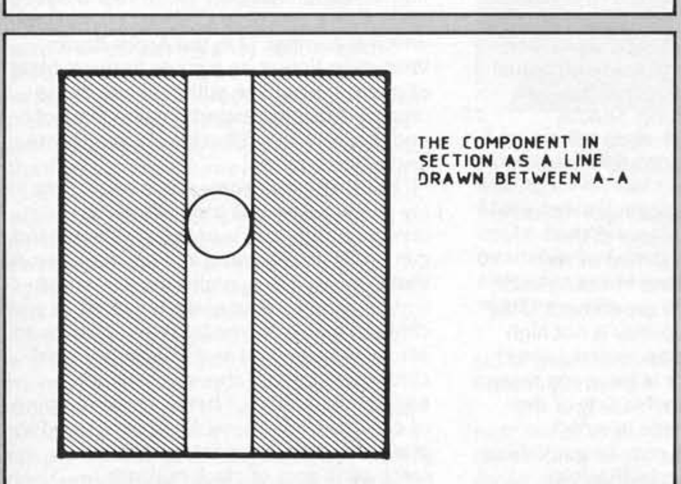
It should be possible to read from a drawing how a component is formed as easily as one can read an article in a newspaper or book. At an early age most of us learn to read the written word and take doing so for granted. The professional engineer takes reading a drawing for granted in exactly the same way. The model engineer or even the home handyman should be able to do just that. As an aid to this a standard has been laid down by the British Standards Institute to which all working drawings should conform. I say 'should' because, alas, they do not always do so, and some leave much to be desired.

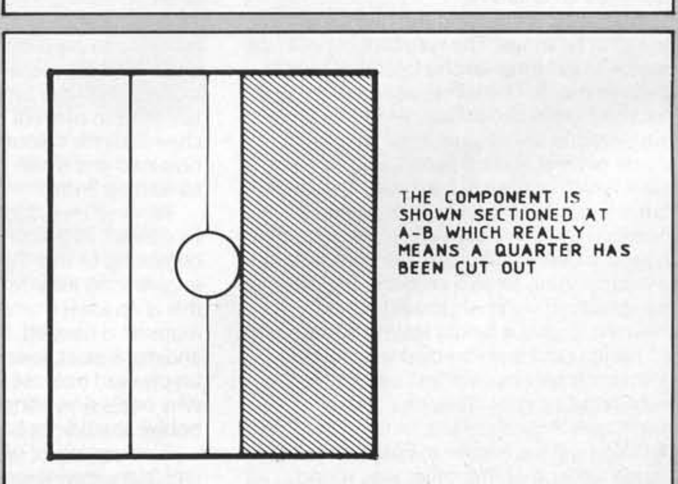
There are several reasons for this. For a start they may well be drawn by a model engineer who has no training in making such drawings. He or she will understand what is meant but others will be unable to do so. It may be, as well, that the drawings we are working to are copies of very old ones produced before standards were set. Here again there are likely to be discrepancies.

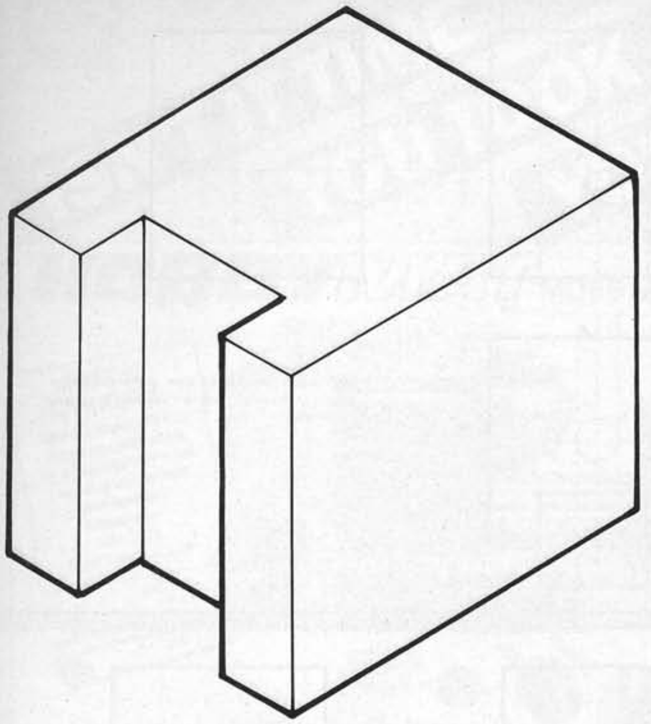
Allowing for these facts, on the whole a good working knowledge of the requirements for correct drawing techniques will allow us to read most



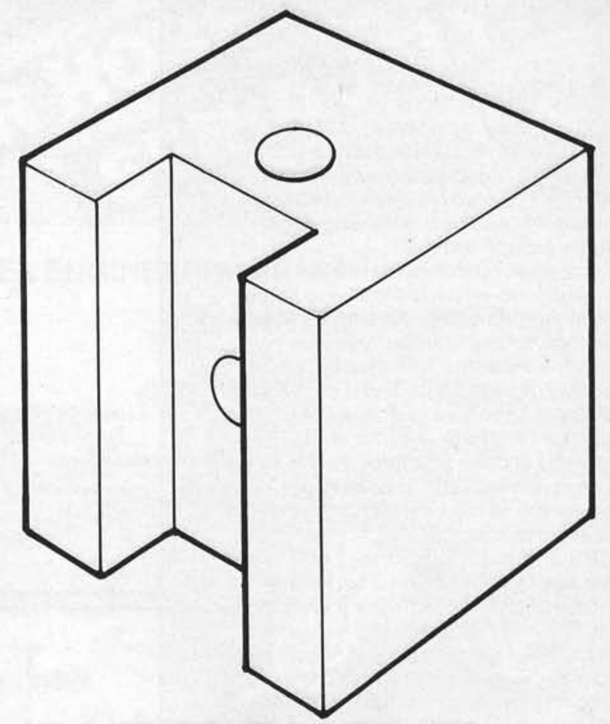








THIS FORM OF DRAWING IS CALLED ISOMETRIC. IT CAN BE USED FOR SIMPLE OBJECTS BUT IS OF NO USE FOR MORE COMPLEX SUBJECTS

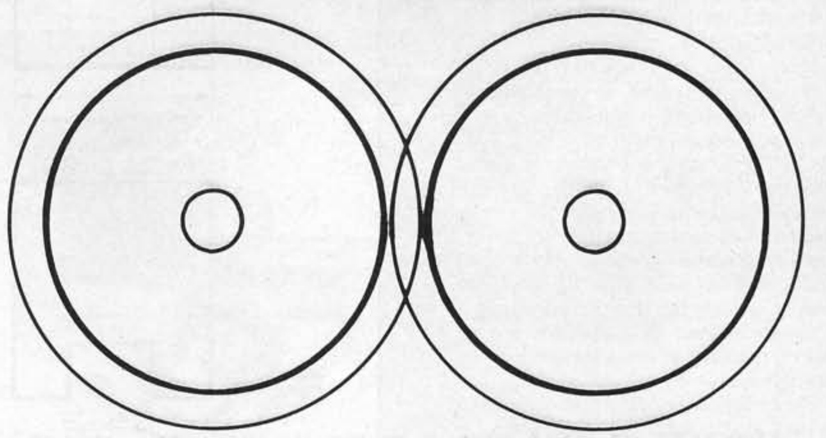


A SIMILAR COMPONENT WITH TWO HOLES ADDED

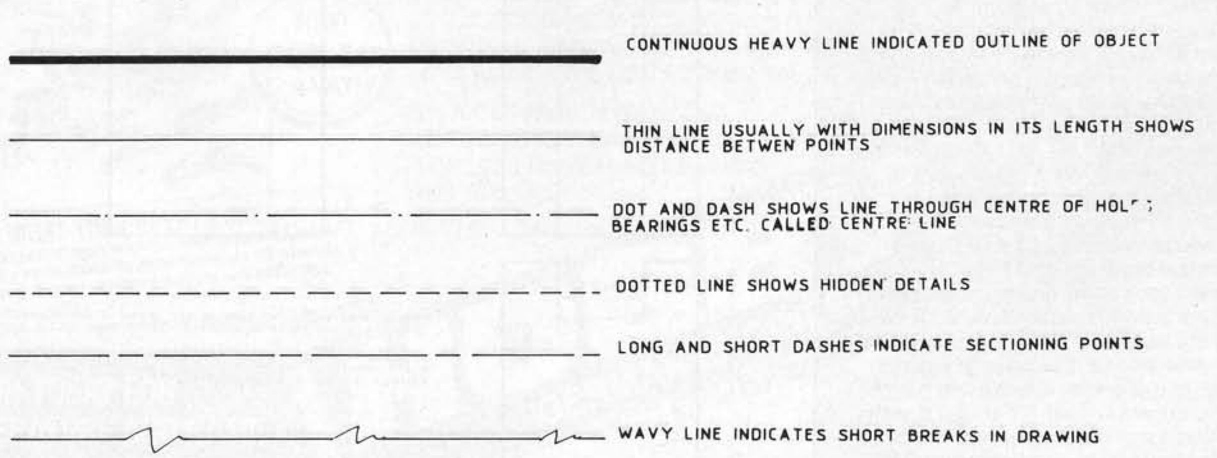
drawings and will also help in reading those that do not conform to the required standards.

There are several ways in which drawings are shown. For most engineering work in England we use what is known as the 'first angle projection method'. This means we take an object and draw it on one face, preferably the face that could be considered the main one. The object is turned over so that the top part in relation to the above face is in view and again drawn this time directly underneath the first drawing. We then assume that the object is rotated one turn to the right and that the face is drawn next to the first drawing.

The Americans use a system called 'third angle projection' which is similar but involves rotating the object to be drawn



GEARS ARE ALWAYS SHOWN IN THIS FORM ON DRAWINGS



through three faces instead of one. Both systems seem to work equally well. Sometimes objects are drawn in relief, particularly where smaller models are concerned and this type of drawing is usually called 'isometric'.

The main outline of the subject is shown as a continuous line, a somewhat lighter line at the side giving dimensions. Where bearings or other circular holes are concerned a centre line is used. This consists of a long dash and a dot. Hidden detail will be shown as dotted lines. It is necessary to study all views of the drawings in order to appreciate the shape of an object fully and to be able to understand all the internal parts as well as the external shape.

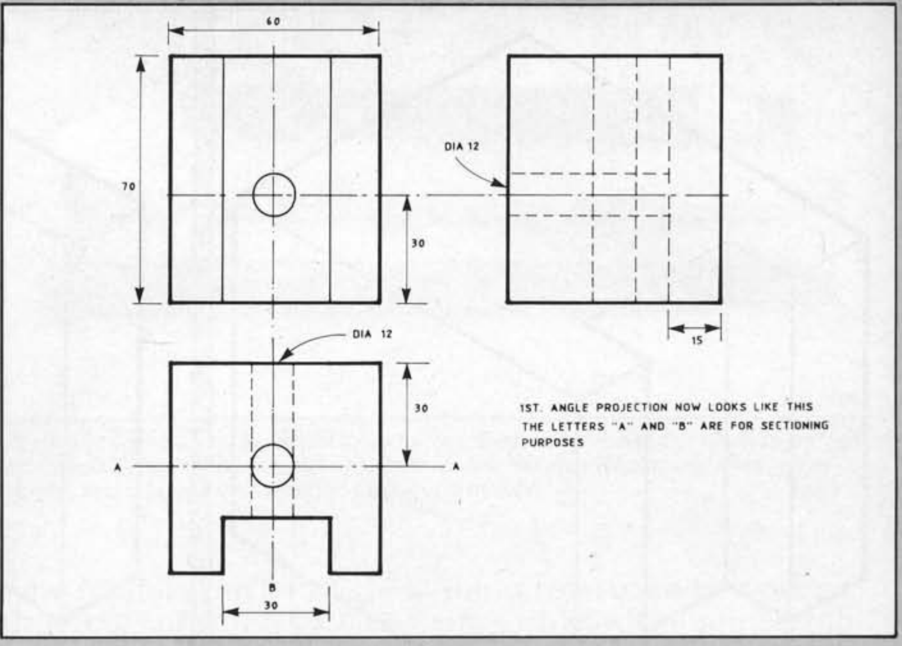
If a drawing is particularly complicated it may be drawn in section. This means literally as it would appear if it were cut in half. The fact that a drawing is done this way is indicated with sloping lines and, in order to differentiate between the various parts, this shading may be at differing angles in some cases. Sometimes a component will be shown in both ordinary form and then partly in section. Where the cutting away takes place will usually be indicated on the drawing by reference to letters and worded "Section as at a" or whatever letter is used.

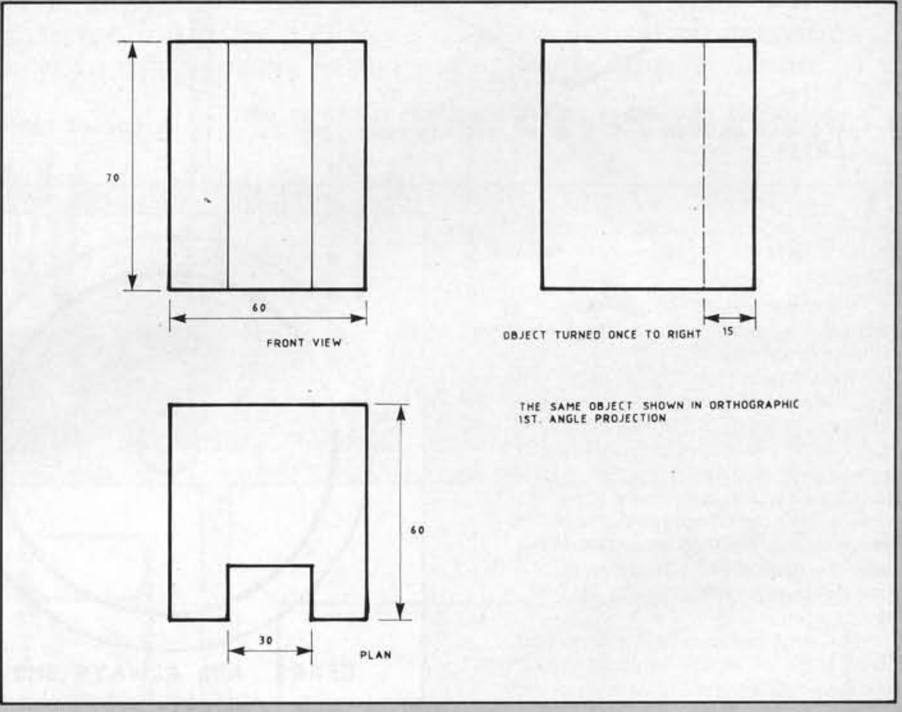
If one is making one's own drawings it is, of course, necessary to conform to the system. However, if it is likely that a friend might want to use them or, indeed, even if they are likely to be used again at a later date then it is as well to use the standard method. They should be drawn on plain paper and dimensions clearly shown. If any quantity of home drawings will be produced it will be as well to use a drawing board. Certainly the use of a compass, protractor and set squares is advised, or it may be possible to use a modern alternative.

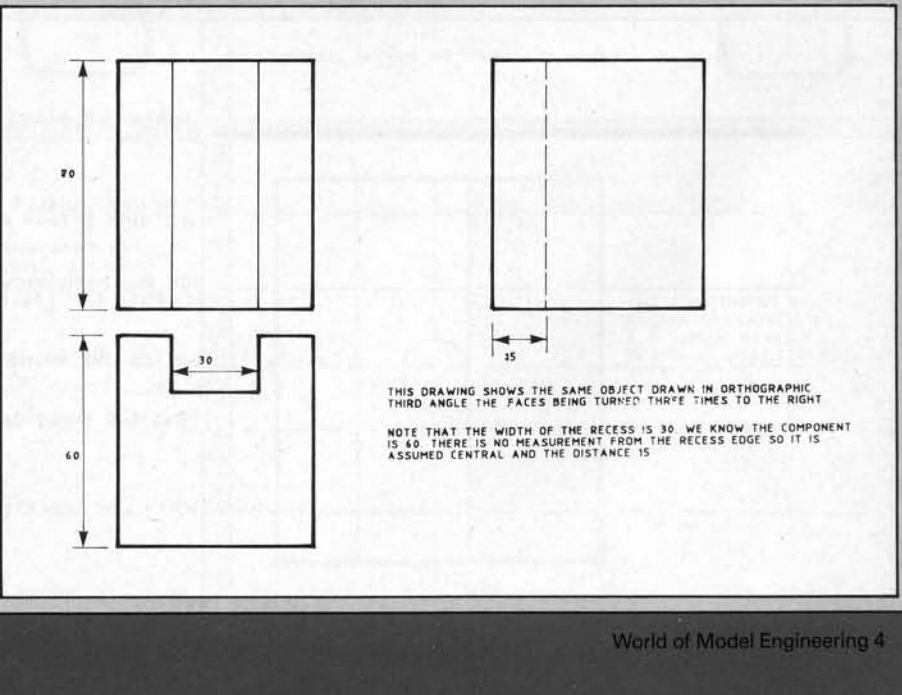
Pencil can be used for home drawing and will reproduce quite well if photocopied. A 2H grade is possibly about the best grade to use; do not be tempted to use an HB grade or anything similar to that as it is too soft. The lines created will be oversized and also the pencil will easily be rubbed off or smudged with the fingers. Drawing pens give a good permanent result but some are expensive to buy. There are cheaper options which are quite suitable for normal drawings and are easy to use. Most have very quick drying ink and this is an advantage.

Where reproduction of drawings is anticipated, they should be done on draughting film. This is a little more expensive than paper but is superb for reproduction work. It is also possible to make alterations to the drawings as special erasers are available. As the finished lines stay on the surface of film rather than being slightly absorbed as they are with paper it is as well to use a spirit based inked pen. Water based inks will run if they get damp.

The subject of drawings is not hard to understand and is worth a little effort. The end results in the form of a good, clean and neat drawing can be most satisfactory.





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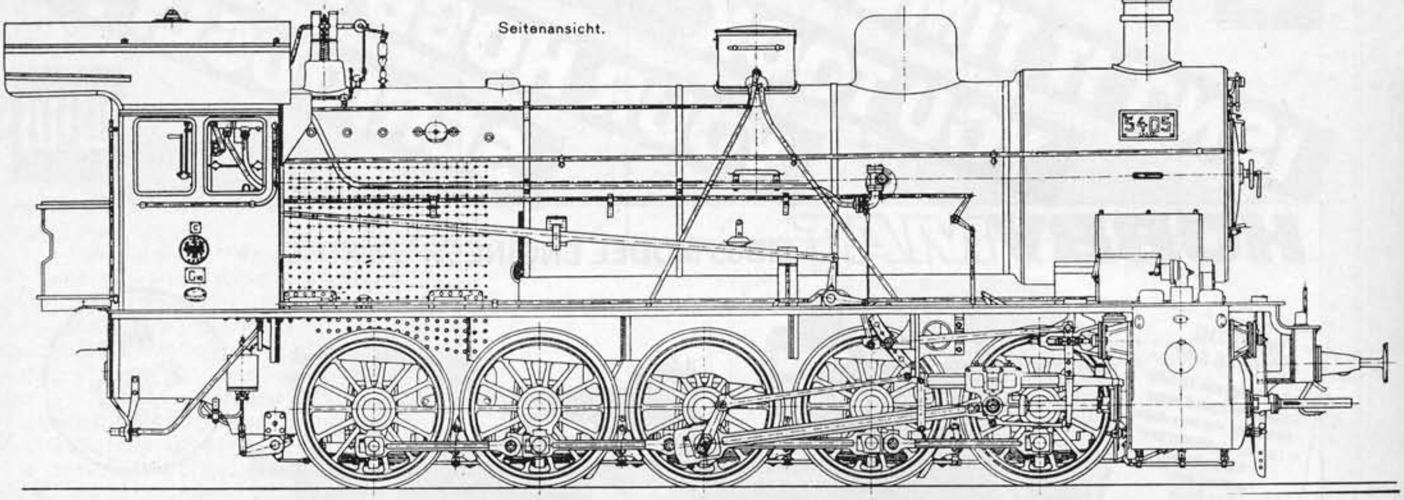
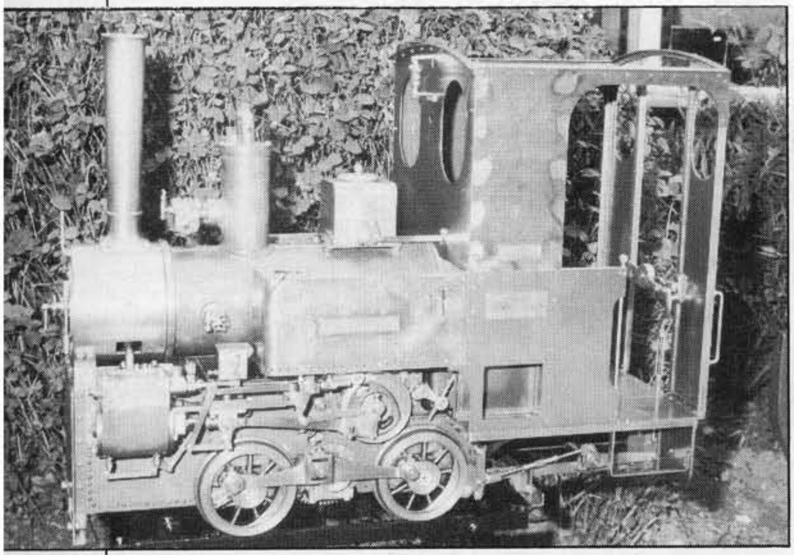
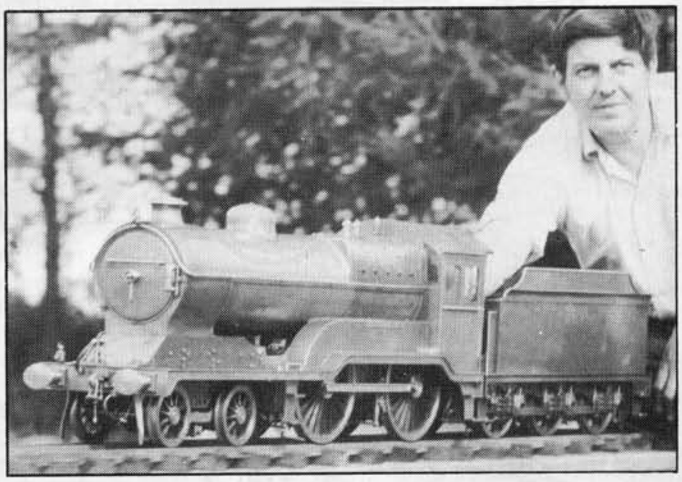
How's this for an unusual prototype – a Prussian 0-10-0 locomotive.

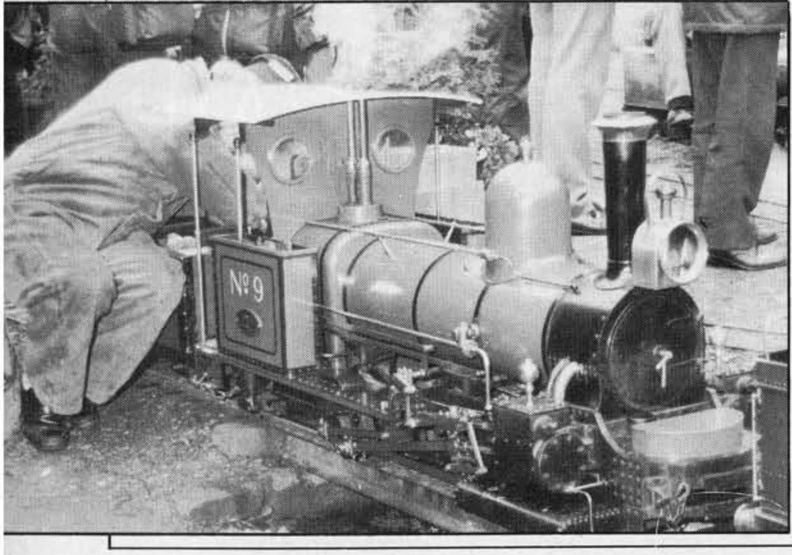


THE WORLD OF MODEL LOCOMOTIVES

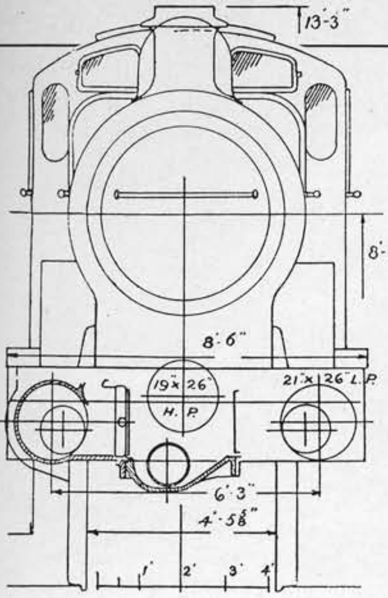


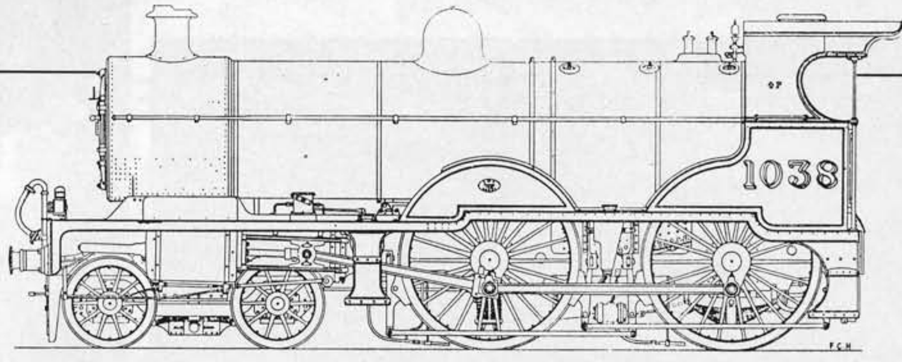
The wide world of full-size steam, offers endless choice for model engineers; here are some examples drawn from all corners of the globe illustrating the simple and the complex, the familiar and the unusual





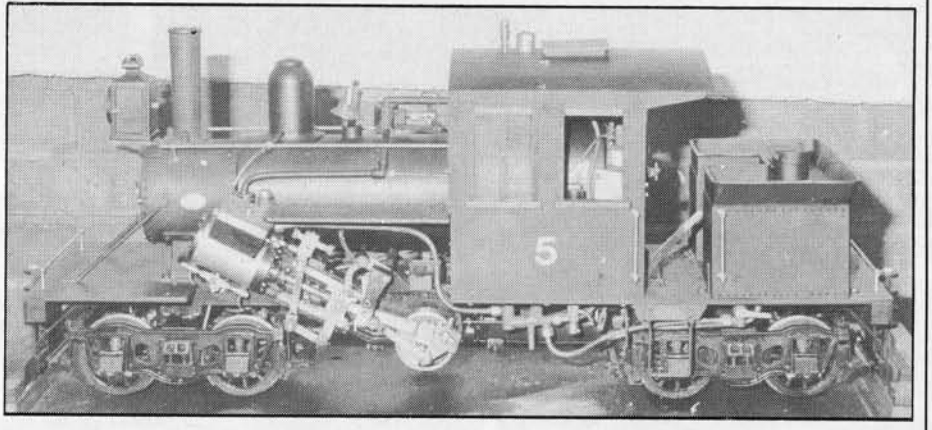
Above, seen at Chingford some years ago, this model of an ex-London North Eastern Railway 'Director' Class locomotive is a very fine example of the art of model locomotive building. At the time it still had to be painted. Above left, a rather unusual rack-type locomotive as used in Switzerland and other Alpine countries. Built by Ken Swan to run on 7¼ inch gauge track, it has a gear underneath which meshes with a rack on the track so that it will not slip on the very steep inclines. At left, this very fine model of a narrow gauge locomotive is massive; again it has been built to run on 7¼ inch gauge track and is a replica of a Darjeeling locomotive, used in India at the highest altitudes that railways ever reached.

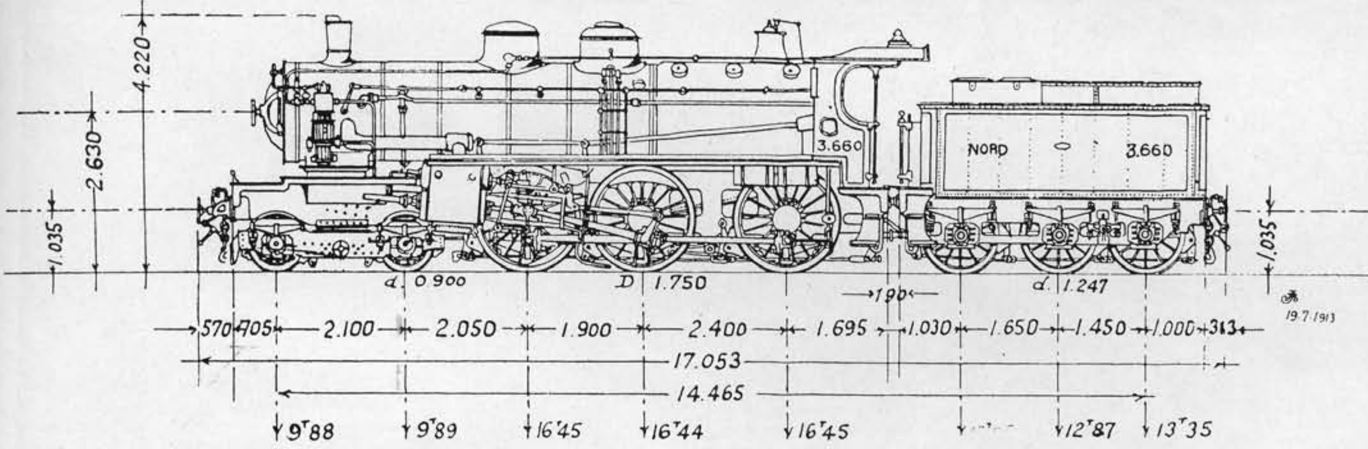




From the complicated to the relatively straightforward; this drawing depicts a Deely four-cylinder compound.

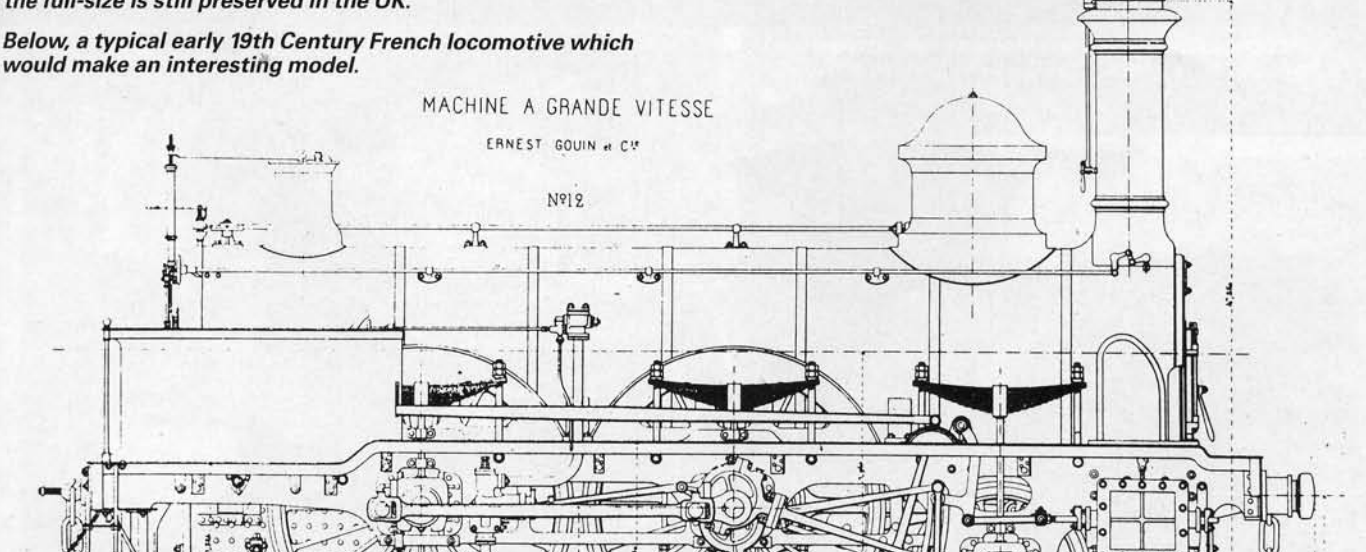
At right, a rather unusual North American Climax type locomotive built by the late Fred Beard from measurements taken from a full-size preserved original locomotive. It is driven by the front bogie truck via gears from the engine, the idea being to make it sufficiently flexible to run on badly laid logging railway tracks.





Drawing above shows a French Nord Compound – an example of the full-size is still preserved in the UK.

Below, a typical early 19th Century French locomotive which would make an interesting model.



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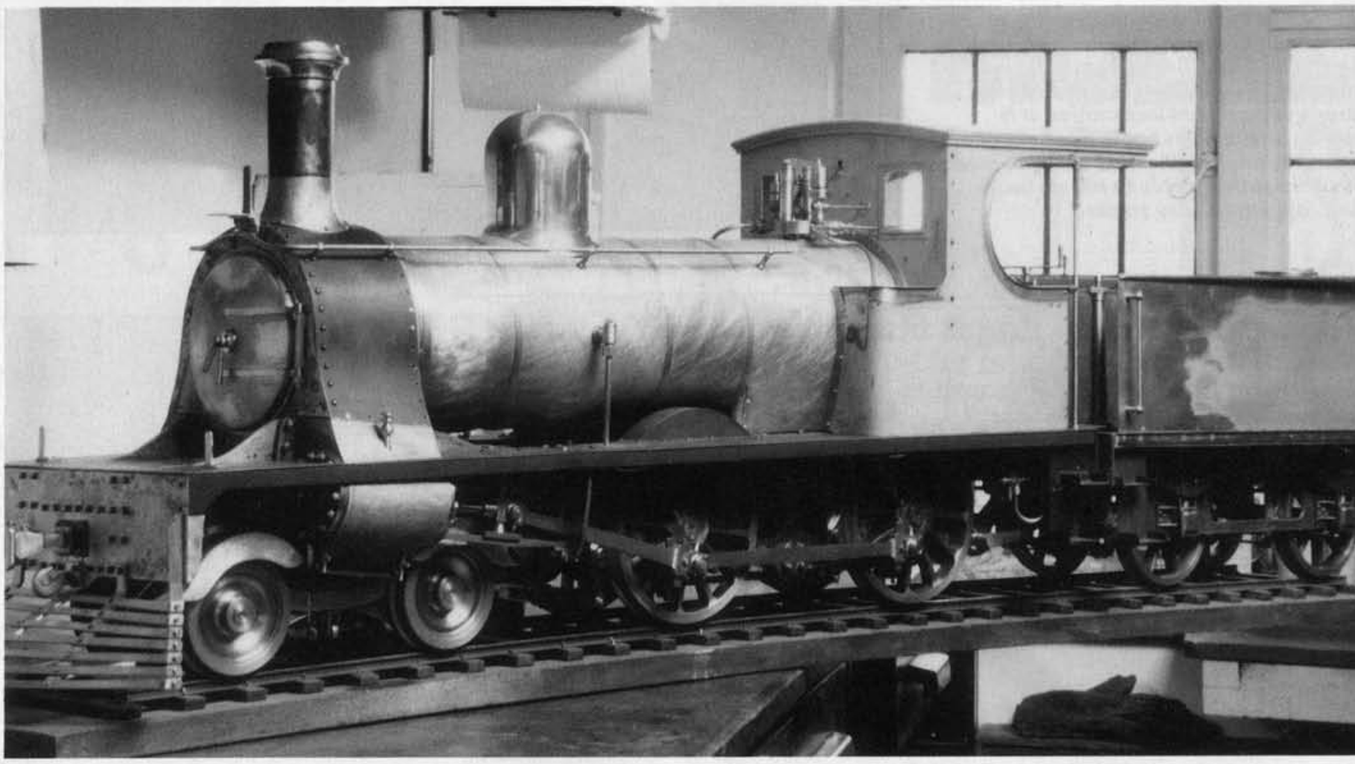

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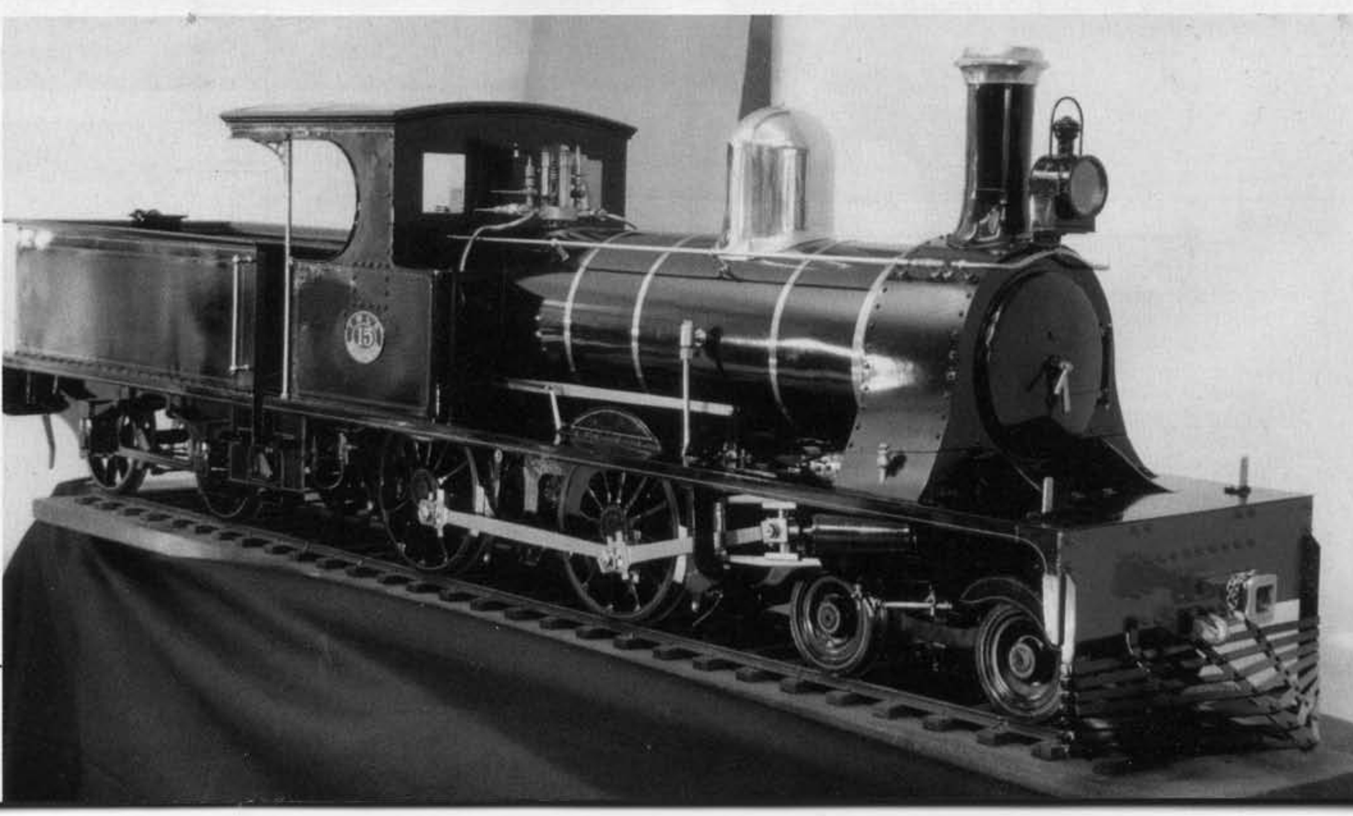
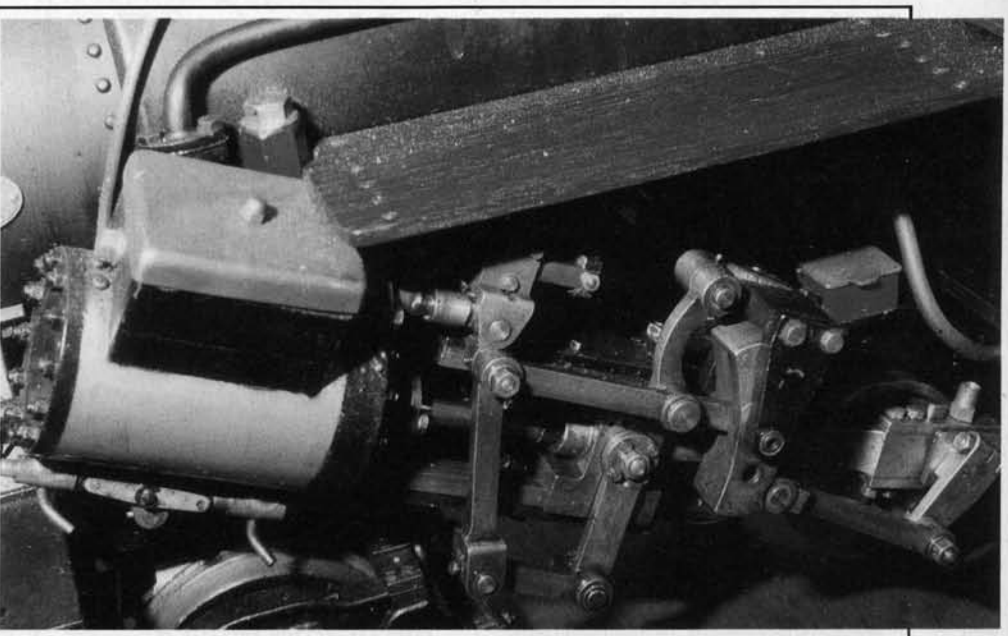


Photo 1. A tiny 16mm to the foot scale narrow gauge locomotive built by R. J. Bristow; model is steam-driven. Photo 2. Model engineer Bill Clothier and his superb North American 2-6-0 locomotive. Photo: Noel Taylor. Photos 3 and 4. Here's a most unusual model. It is a British Hunslett, bought by Peter Du Pen in a part-finished and dilapidated state and restored by him to the immaculate condition you see in photo 4. The product of extensive research in which Hunslett kindly assisted, the model would seem to have originated in the USA as all the nuts and bolts are from there! The full-size original was built by Hunslett in the UK for Tasmania. Photo 5. A close-up study of the valve gear and cylinders of the late Fred Beard's North American Climax locomotive, also shown on previous page. Photo 6. Just for a change, here's a typically British subject by Tony Meek; it's a Great Eastern 2-4-0 built to run on $3^1/_2$ inch gauge track. Photo 7. A peep inside the cab of Tony Meek's 2-4-0; although it is not fitted out with controls of scale proportions (to allow the model to be driven more easily), it is, however, finished to as near the original as the necessity for such fittings will allow.

5



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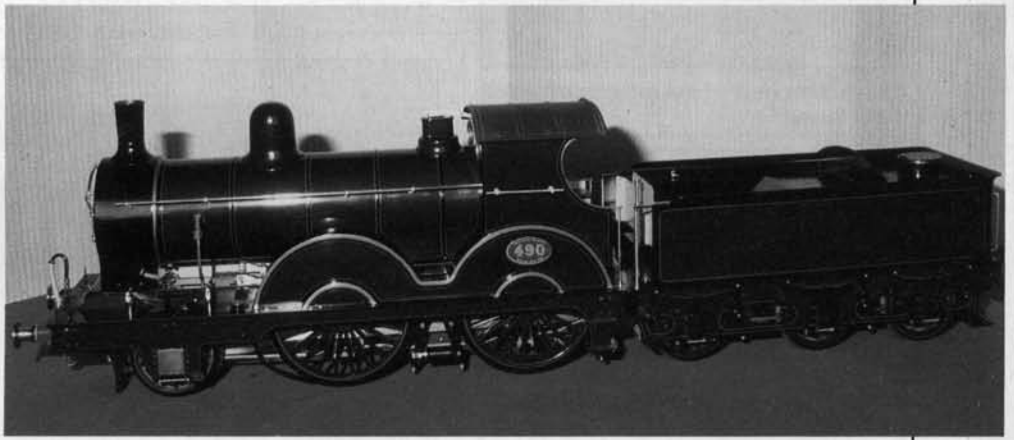

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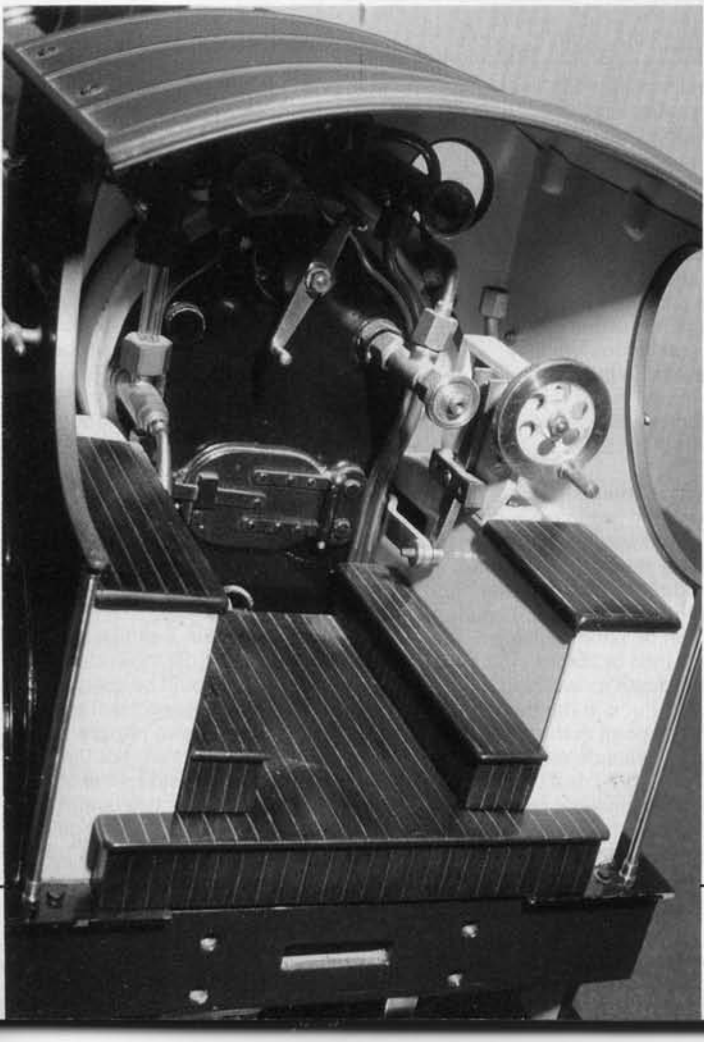
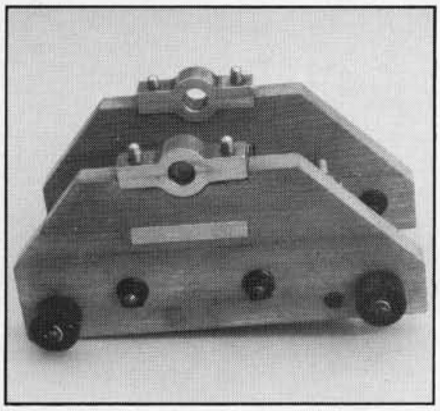


Whilst many modellers all over the world make models of British locomotives – mainly because drawings are easily available – some prefer to model prototypes from their own country. Below we see Bernard Aidley of Cape Town, South Africa with a very fine model of a South African Railways Class 15F. The track gauge of SAR is only three feet and, as a consequence, models of a given scale work out much larger than their British couterparts. This example runs on $3^1/_2$ inch gauge track but is the equivalent of a British model built to 5 inch gauge. Photo 8.

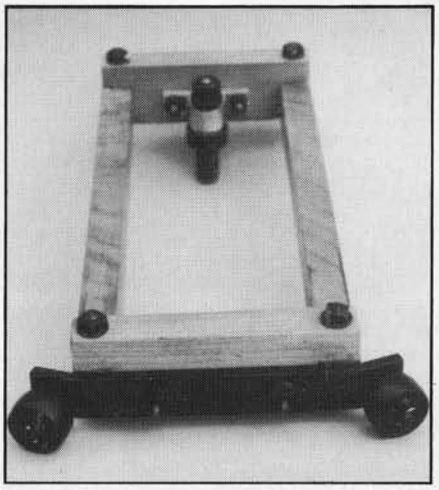
8

MAKE AN
ARMSTRONG MUZZLE LOADER

This attractive model by John Harman requires a variety of basic model engineering skills to make. The result is a fine decorative replica



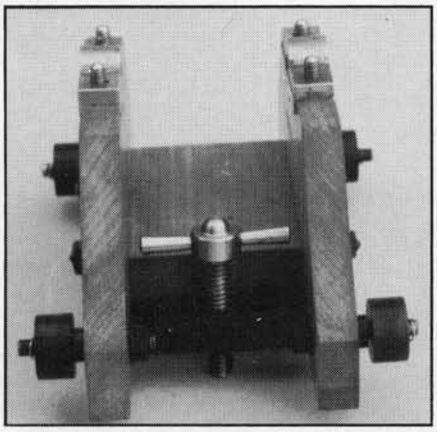
Above, side view of the fully constructed main frame.

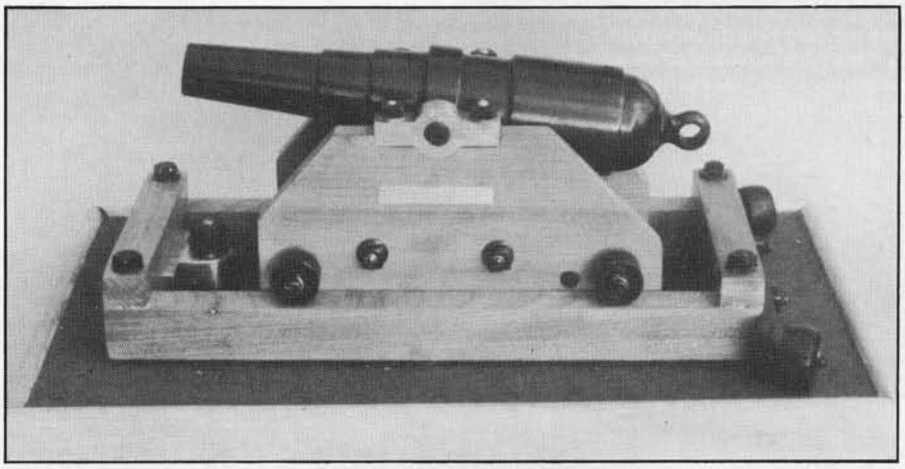


End view of the swivelling base.

This delightful model gun was originally featured in a small sketch in the *Model Engineer* in 1938. Using that, full-sized drawings were made and the gun proved to be an interesting model to make – an unusual sort of model that looks good on the mantlepiece.

End view of the main frame showing levelling adjuster.





In order that the model be made to look authentic it should be assembled using square-headed nuts and bolts and it is suggested that these are made first. Repetition work such as this can be rather boring and it is far better to get these sorts of job over early! A specially shaped parting-off tool also produces the domed finish and can be kept for further use as required. There are some commercially made square nuts available but generally these are made for model horse-drawn vehicles and are rather too thin for this model which requires them to be quite heavy.

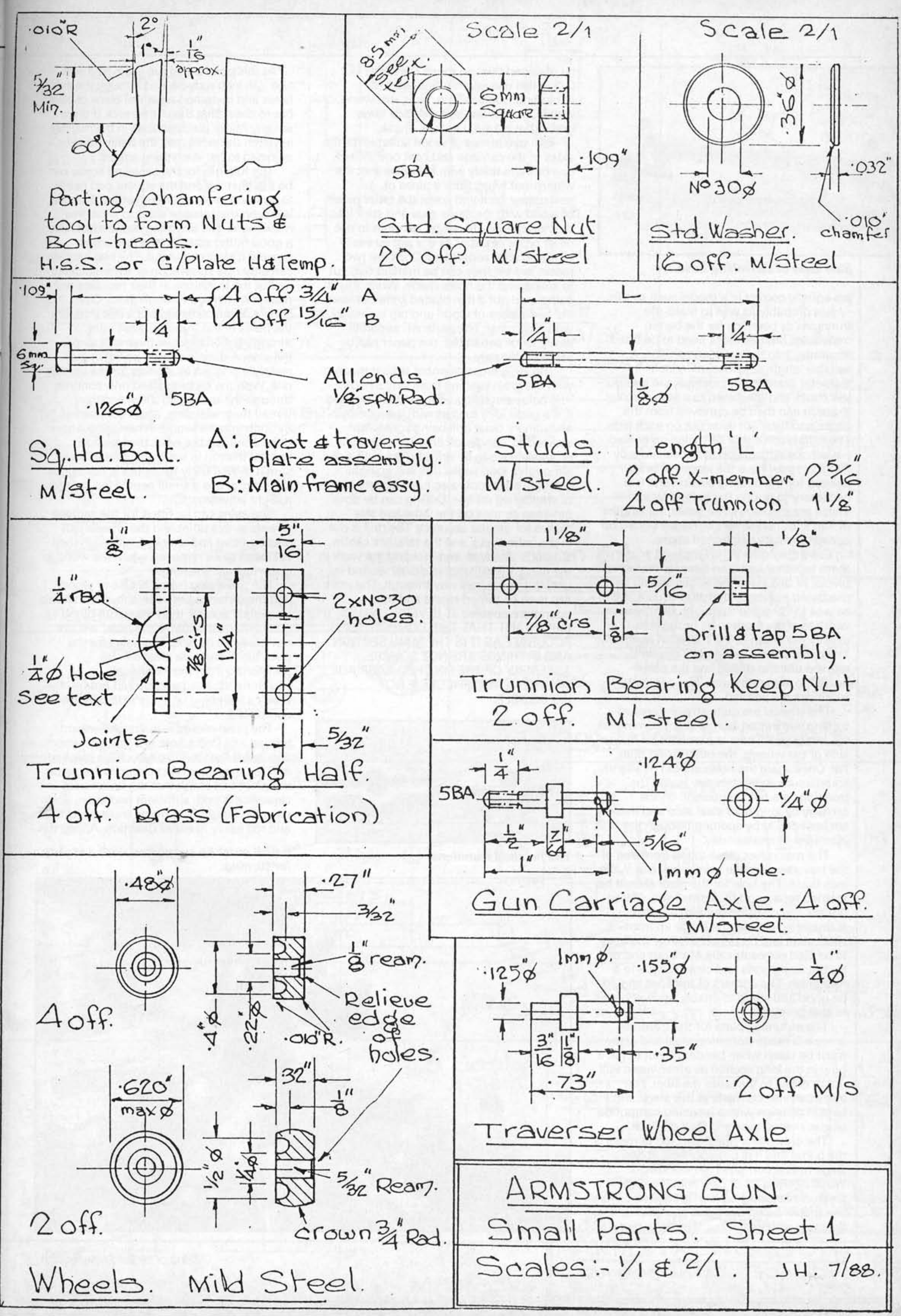
The nuts and bolts are made from square bar and this can be mounted in the four-jaw chuck for machining. Possibly a better idea is to make a steel collet; the nuts can then be produced much more quickly in the three-jaw self-centering chuck. The collet should be 1/2 inch or 12mm outside diameter and about 1 inch or 25mm long. It *can* be longer and making it so will help with the metal holding. Put it in the three-jaw chuck and mark the point in the metal that coincides with the nearside edge of the number one jaw. Drill the bar 8.5mm right through its length. Remove it from the chuck and split it lengthways with a junior hacksaw. Check that the split will be in such a place that it will not be in line with any of the chuck jaws. Take the burrs off the slit and return the collet to the chuck making sure that the mark lines up with the number one jaw. The square bar can now be put into that and when the chuck jaws are tightened the collet will grip the material. When this sort of collet is used it is sometimes an advantage to put Plasticine on the jaw sides to keep the collet in position when the metal is moved through.

Having got the gripping of the metal sorted out, the actual making of the nuts is not too difficult. Drill and tap the bar 5 BA or 3.5mm going as deep as practical without breaking the tap. Chamfer the end of the bar with the parting tool and then part off 7/64ths of an inch long. It should be possible to make at least two and possibly three nuts at one setting.

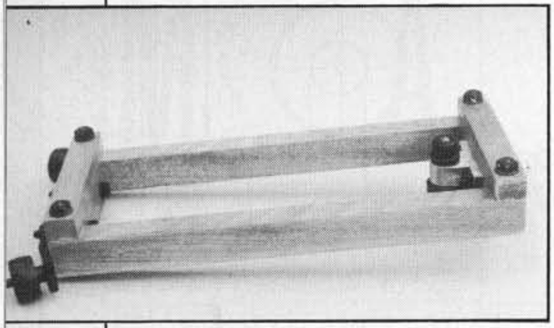
As the model is for display purposes, it is as well to polish the flats before machining. The ultimate finish can be either bright or black but either way a good finish will be needed. The thread at the underside of the nuts should be slightly countersunk. This can be done in the drilling machine by either gripping them in a small machine vice or they can be held with a spanner whilst resting on a piece of wood, a small panel pin being used to prevent them coming out of the spanner.

Bolts can be made in a similar manner – do not forget to round off the ends. A tailstock die holder should be used to form the threads in order to keep them square. The heads of the bolts also require rounding off; as the bolts are not threaded full-length they can be held by the shanks in the three-jaw chuck for this operation.

An alternative to bolts is to use studs with a nut on each end. Both constructions



·010"R
2°
1°
1/16"
approx.
5/32"
Min.
60°
Parting/Chamfering tool to form Nuts & Bolt-heads.
H.S.S. or G/Plate H&Temp.
Scale 2/1
8.5 mm
See text
6mm Square
5BA
·109"
Std. Square Nut
20 off. M/steel
Scale 2/1
·36"ø
Nº 30ø
·032"
·010" chamfer
Std. Washer.
16 off. M/steel
·109"
4 off 3/4" A
4 off 15/16" B
1/4
6mm Sq.
·126ø
5BA
Allends 1/8" sph. Rad.
Sq. Hd. Bolt.
M/steel.
A: Pivot & traverser plate assembly.
B: Main frame assy
L
1/4"
5BA
1/4"
5BA
1/8"ø
Studs.
M/steel.
Length 'L'
2 off X-member 2 5/16"
4 off Trunnion 1 1/8"
1/8"
5/16"
1/4" rad.
2 x Nº 30 holes
7/8" crs
1 1/4"
1/2"ø Hole See text
Joints
5/32"
Trunnion Bearing Half.
4 off. Brass (Fabrication)
1 1/8"
5/16"
7/8" c'rs
1/8"
1/8"
Drill & tap 5BA on assembly.
Trunnion Bearing Keep Nut
2 off. M/steel.
1/4"
·124"ø
5BA
1/4"ø
1/2"
7/64
5/16"
1"
1mm ø Hole.
Gun Carriage Axle. 4 off.
M/steel.
·48ø
·27"
3/32"
1/8" ream.
Relieve edge of holes.
·010"R.
·22ø
·4ø
4 off.
·620" max ø
·32"
1/8"
5/32" Ream.
1/2"ø
1/4"ø
crown 3/4" Rad.
2 off.
Wheels. Mild Steel.
1mm ø.
·125ø
·155ø
1/4"ø
3/16"
1/8"
·35"
·73"
2 off M/S
Traverser Wheel Axle
ARMSTRONG GUN.
Small Parts. Sheet 1
Scales:- 1/1 & 2/1.
JH 7/88.



Side view of swivelling base.

are equally correct in a model such as this.

It is probably as well to make the trunnions or bearings for the barrel mountings next as these need to be fitted accurately into the wooden carriage. A suitable length (2 inches) of $\frac{1}{2}$ inch diameter brass is put crossways in the four-jaw chuck and machined to a semi-circular shape. It can then be removed from the chuck and flats $\frac{1}{8}$th wide put on each side. These flats can either be milled on or filed – it is not a difficult job to get accurate by filing. We now have the length of brass needed for the bearing section and it is necessary to put on the bolting faces. These are made by silver soldering lengths of $\frac{3}{8}$th x $\frac{1}{8}$th brass on both sides butted up against the flats mentioned above.

Cut the lengths in half and soft solder them together and then bore for the barrel pivots. At this stage the edges should be machined to ensure that all is square. It is as well to leave the trunnions slightly over width to allow them to be brought to exactly the width of the frame on assembly. The holes for the fixing bolts can be marked out and drilled and the parts heated to separate them. Two complete trunnions are needed.

The wheels are quite straightforward turning work apart from a slight doming on the larger pair. There is a small relief in one side of the wheels, the other being quite flat. Once again the holes should be slightly countersunk to remove any burrs. The trunnions are held in position on the carriage by long mild steel strip and these are best drilled by spotting through the trunnions after assembly.

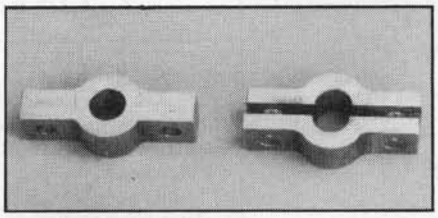
The main pivot block at the front end of the traverser is made from a piece of $\frac{5}{16}$ths inch brass. The hole for the pivot should be reamed for a good fit. A small shouldered button, $\frac{1}{2}$ inch diameter with a $\frac{1}{4}$ inch diameter spigot, can be made up from silver steel and hardened to allow the boss to be filed concentrically. Mark out and drill for the fixing bolts and clean the job to a nice finish. The corners of the boss should be good and sharp to enable the bolt heads to seat properly.

The mounting plate for the traverser wheels is made from strip steel and care must be taken when bending it not to get a bow in the long section as otherwise it will not fit nicely to the cross member. The axles can also be made at this stage and held in position with a retaining compound or else riveted over and filed off flush.

The only major metal part left to make is the barrel and it is possibly best at this stage to first complete the woodwork. Wood needs a lot of care with the final finish, if necessary several grades of sandpaper being used and possibly finishing with wire wool. If mahogany can be obtained then so much the better but failing this use another fine grained hardwood, such as lime, pear, rosewood, or walnut. Do not use soft wood or large grained wood such as teak or oak.

Take two pieces of wood suitable for the sides of the carriage and coat one side of one of them thinly with PVA glue (not the waterproof type). Stick a piece of newspaper on it and cover the other piece of wood with the same glue and stick it to the newspaper. Do not be tempted to use other types of paper as it is not so easily removed after separating. Once the two pieces are set they can be marked out, cut to shape and the holes made, When this is completed put a thin bladed knife between the two pieces of wood and tap it smartly with a hammer. The parts will separate easily. Once separated, the paper can be sanded off easily.

The large cross-member is best made with the grain running from side to side. The holes can be carefully marked out and it is a good idea to start with a centre drill, an ordinary twist drill being somewhat inclined to wander off line. The holes will probably have to be drilled from both sides; although a long series drill will go right through, such tools also have a nasty habit of wandering off line. Drilling can be done between centres on the lathe and this makes for greater accuracy. The drill is put in the lathe chuck and the tailstock centre supports the other end. Holding the work in the hand, the tailstock is slowly wound in until the drill is half-way through. The work can then be turned round and the operation repeated. IT IS VERY IMPORTANT THAT THIS COMPONENT IS ACCURATE AS IT IS THE MAIN SECTION AND IF THINGS ARE NOT SQUARE, ASSEMBLY OF THE FINISHED CARRIAGE WILL BE VERY DIFFICULT, IF NOT IMPOSSIBLE.



The finished trunnions.

At this point a trial run is advised with two $\frac{1}{8}$th inch rods passed through the axle holes and rested on a parallel piece of steel bar to check that there is no rock. If there are any minor discrepancies in the manner in which the axles rest, the holes must be adjusted to get everything square.

The fulcrum for the elevating screw can be the next job and the square part needs to be fractionally shorter than the distance between the carriage sides to allow free movement. The elevating screw must have a good fitting screw in the fulcrum to prevent it slopping about. The two handles can either be screwed in or silver soldered.

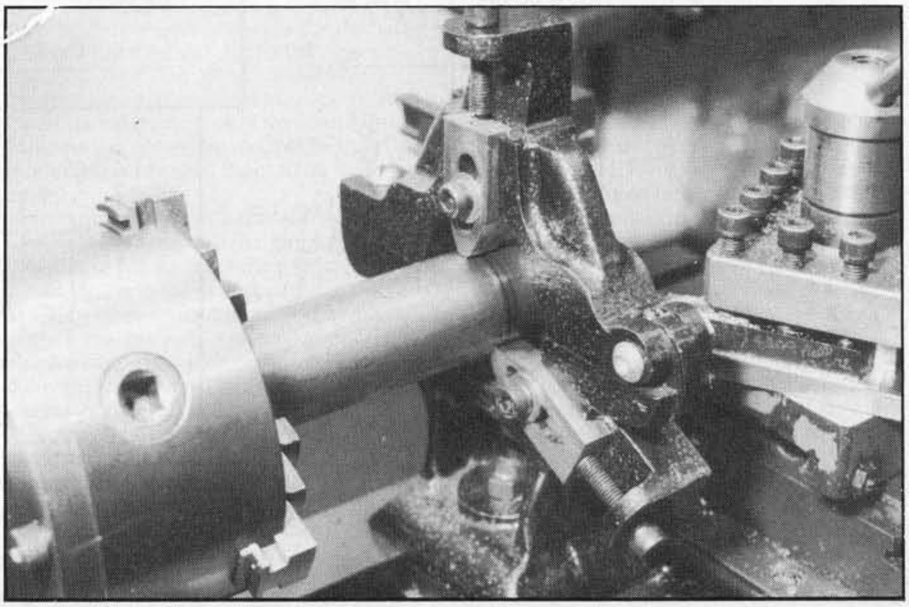
Put the trunnions in their recesses and pass a $\frac{1}{4}$ inch rod through them. Check it is square. When satisfied put a drill through the holes in the trunnion. Pass right through until it reaches the metal strip in the side. A dimple should be left in the metal strip to act as a guide for the tapping drill. With the tapping sized drill, continue through the metal into the wood then thread the metal strip, again continuing through into the wood. When all four have been done put the bolts through and revolve the rod in the trunnion and make sure it moves fairly freely but is not sloppy. If it is tight, use a small needle file to make a slight adjustment.

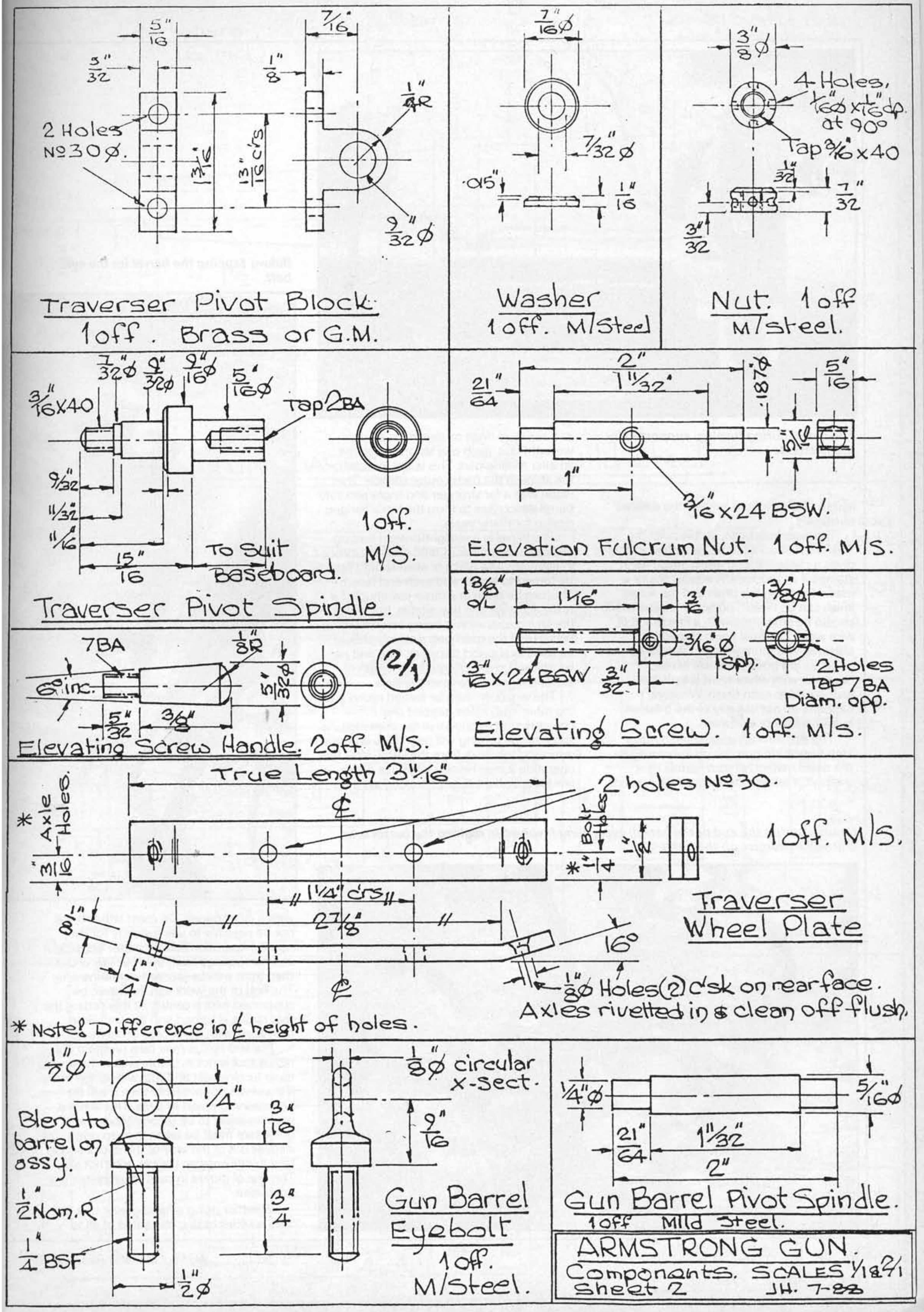
The axles can be fitted for the carriage wheels at this point and the wheels can also be fitted and checked, although they will need to be removed when the wood is given its final finishing.

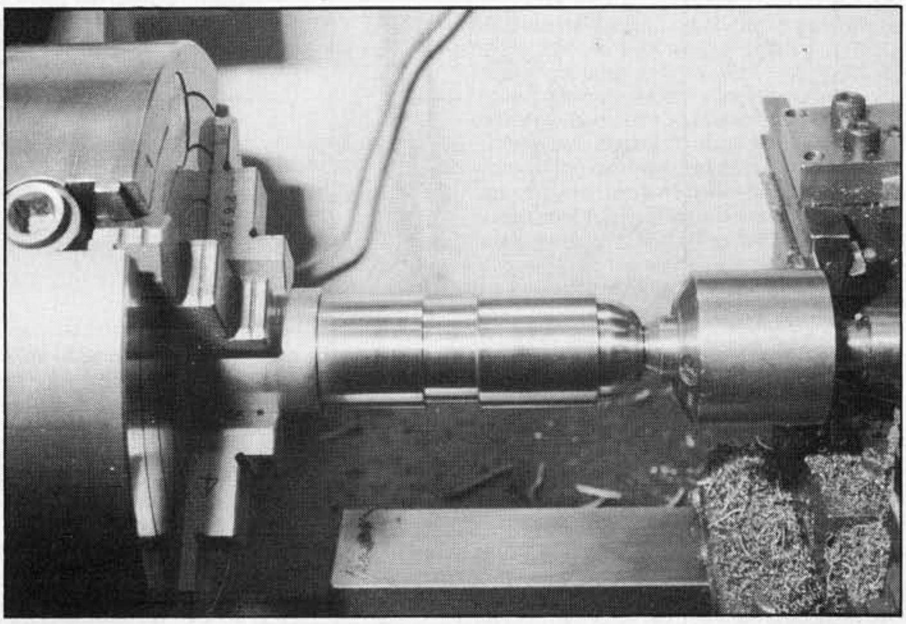
The traversing frame is also of wood and the distance between shoulders should be slightly greater than the width of the gun carriage otherwise the latter will not run freely on its rails. The holes for the pivot block and axle plate can be transferred from the individual components. The parts should not be finally assembled until the side rails are completed.

The pivot mount is a straightforward turning job. Drill a hole in a piece of wood and insert the lower spigot of the pivot into it. Place the assembled traverser frame on the pivot and check that the underside clearance is both sufficient and even, along its entire length. The frame must sit level and roll easily in either direction. Adjust the

Barrel must be supported with a steady for turning.




5"/16
5"/32
7/16"
1"/8
1"/4 R
2 Holes No 30 Ø.
13/16
13"/16 c'rs
9"/32 Ø
Traverser Pivot Block.
1 off. Brass or G.M.
7"/16 Ø
7/32" Ø
.015"
1"/16
Washer
1 off. M/Steel
3"/8 Ø
4 Holes, 1/16" Ø x 1/16" dp at 90°
Tap 3/16 x 40
1"/32
7"/32
3"/32
Nut. 1 off
M/steel.
7"/32 Ø
9"/32 Ø
9"/16 Ø
5"/16 Ø
3/16" X40
Tap 2BA
9/32"
11/32"
11/16"
15"/16
To Suit Baseboard.
1 off.
M/S.
Traverser Pivot Spindle.
2"
21"/64
1 11/32"
.187 Ø
5"/16
5/16"
1"
3/16" x 24 BSW.
Elevation Fulcrum Nut. 1 off M/S.
1 3/8" o/L
1 1/16"
1/8'
3/8" Ø
3/16 Ø Sph.
3"/16 X 24 BSW
3"/32
2 Holes Tap 7BA Diam. opp.
Elevating Screw. 1 off. M/S.
7BA
1"/8 R
6° inc.
5/32 Ø
5"/32
3/8"
2/1
Elevating Screw Handle. 2 off M/S.
True Length 3 1/16"
2 holes No 30.
* Axle Holes
M/16
Bolt Holes
1/2
* 1/4
1 off. M/S.
1 1/4" c'rs
2 7/8"
1"/8
1"/4
16°
Traverser Wheel Plate
1"/8 Ø Holes (2) c'sk on rear face.
Axles rivetted in & clean off flush.
* Note! Difference in ℄ height of holes.
1"/2 Ø
1/4"
3"/16
Blend to barrel on assy.
1"/2 Nom. R
1"/4 BSF
3"/4
1"/2 Ø
1"/8 Ø circular X-sect
9"/16
Gun Barrel Eyebolt
1 off.
M/Steel.
1/4" Ø
5/16" Ø
21"/64
1 1/32"
2"
Gun Barrel Pivot Spindle.
1 off Mild Steel.
ARMSTRONG GUN.
Components. SCALES 1/1 & 2/1
Sheet 2
JH. 7-88



The barrel during turning, supported by the tailstock.

length of the pivot to achieve the desired position.

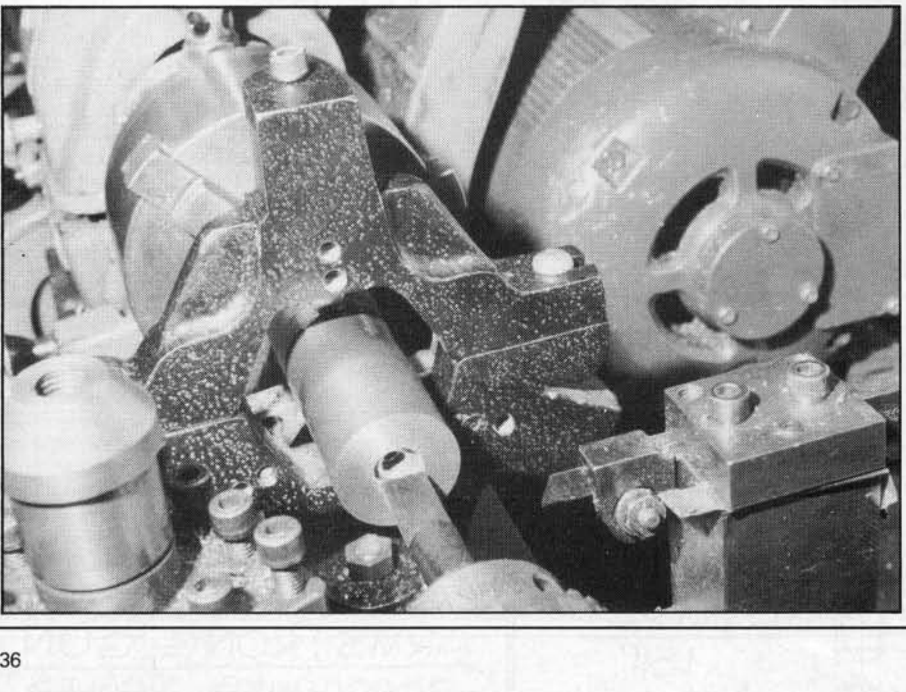
The woodwork can, at this point, be finished. It should not be varnished as this gives a cheap-looking effect. It can be stained if so required. A sander sealer is useful for filling the grain and the actual finish can be French polish or shellac which should be smoothed with a fine grade of wire wool. The final finish should be obtained with pure wax. Car waxes are very good, as are good furniture waxes. Beeswax with white spirit is excellent, giving a deep satin finish. Whatever happens do not use any of the modern quick finishes or silicones...

The Armstrong represented a major step forward in gun design improving on the usual method of cast barrels by a method of laminating the barrel by means of a series of rings or sleeves in steel or wrought iron, each one shrunk on to the smaller mating part. This is the reason for the steps in the barrel outer surface. The result was a far stronger and more accurate barrel which was to form the basis for gun design for many years.

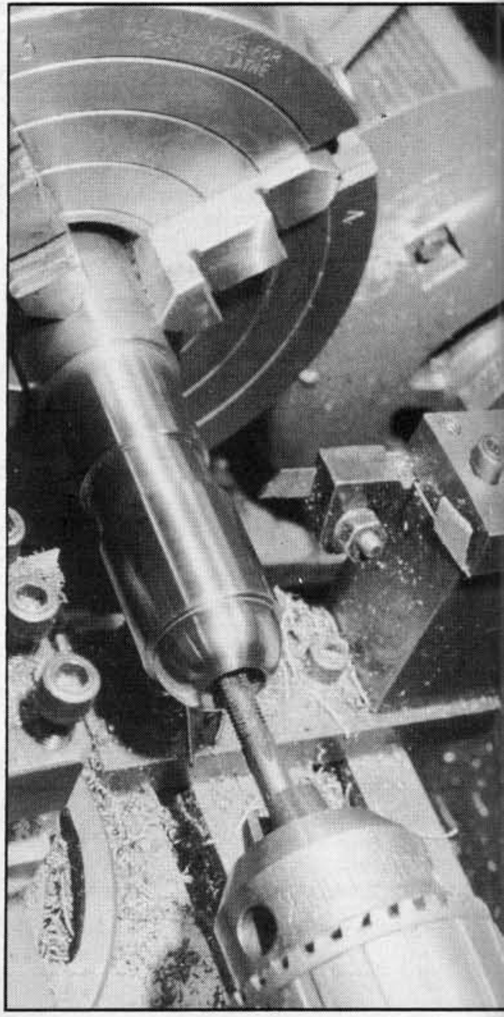
The barrel is a straightforward turning exercise using a bar of mild steel $1\frac{1}{4}$ inches in diameter. The piece of steel should first be turned to length and each end faced. This can be done in a three-jaw chuck if a really accurate one is available, but whilst the facing operation is being carried out, because of the overhang a steady should be used to support the work. One end can be drilled $\frac{5}{16}$ths diameter for a length of about two inches to form the bore.

The work can then be turned round and the other end drilled, tapped and counterbored as shown in the drawings. As some of the turning will take place without removing the work from the lathe, after this operation it may be as well to use a four-jaw independent chuck here and set it up

Counterboring the end of the barrel; everything involved in making the barrel is an enjoyable exercise on the lathe.



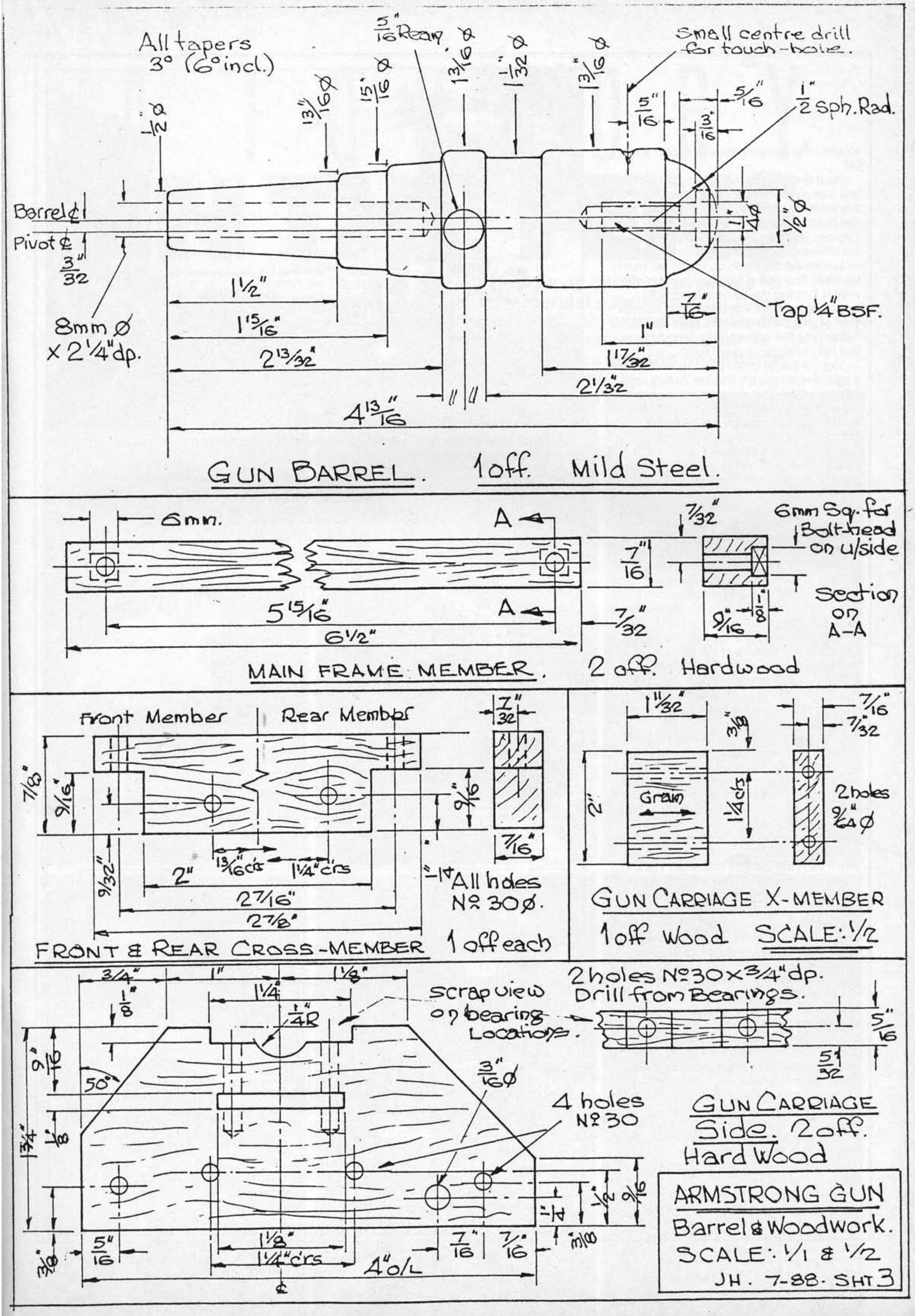
Below, tapping the barrel for the eye-bolt.



with a clock gauge. On most lathes it will not be possible to use a steady for the turning operation and far better gripping can be obtained from the four-jaw chuck than from a three-jaw self-centering one. The end of the work can, however, be supported with a centre. At this setting the rear radius is turned and the two large diameters with the recess in between.

The end radius may be a problem if a radius tool is not available and in this case a hand turning rest and tool will do the trick. If these are not available then it will be necessary to resort to a file. This is not a practice really to be recommended and great care must be taken to keep one's sleeves out of the way of the chuck and to take things easy so the file does not slip. The use of gloves in case of accidents is a good idea.

Whether using a hand graver or a file, turn a series of tiny steps first of all to



All tapers 3° (6° incl.)
5/16" Ream Ø
13/16 Ø
15/16 Ø
13/16" Ø
1 1/32" Ø
13/16" Ø
1/2" Ø
Small centre drill for touch-hole.
5/16"
5/16
3/16
1/2" Sph. Rad.
Barrel ℄
Pivot ℄
3/32"
8mm Ø x 2 1/4" dp.
1 1/2"
1 15/16"
2 13/32"
4 13/16"
1/2" Ø
1/4" Ø
7/16"
Tap 1/4" BSF.
1"
1 17/32"
2 1/32"
GUN BARREL. 1 off. Mild Steel.
6mm.
A
5 15/16"
6 1/2"
7/16"
7/32"
6mm Sq. for Bolt-head on u/side
1/8"
9/16"
Section on A-A
MAIN FRAME MEMBER. 2 off. Hardwood
Front Member
Rear Member
7/8"
9/16"
9/32"
2"
13/16" c'rs
1 1/4" c'rs
2 7/16"
2 7/8"
7/32"
9/16"
7/16"
1/4"
All holes No 30 Ø.
FRONT & REAR CROSS-MEMBER 1 off each
1 1/32"
3/16"
7/16
7/32
2"
Grain
1 1/4" c'rs
2 holes 9/64" Ø
GUN CARRIAGE X-MEMBER
1 off Wood SCALE: 1/2
3/4"
1"
1 1/8"
1 1/4"
1/8"
1/4" R
Scrap view on bearing Locations.
2 holes No 30 x 3/4" dp. Drill from Bearings.
5/16
5/32
9/16"
50°
3/16" Ø
4 holes No 30
1 3/4"
1/8"
5/16"
3/16"
1 1/8"
1 1/4" c'rs
4" o/L
7/16"
7/16
1/4"
1/2
9/16
3/16
GUN CARRIAGE Side. 2 off. Hard Wood
ARMSTRONG GUN
Barrel & Woodwork.
SCALE: 1/1 & 1/2
JH. 7-88. SHT 3

roughly the correct radius and then finish off.

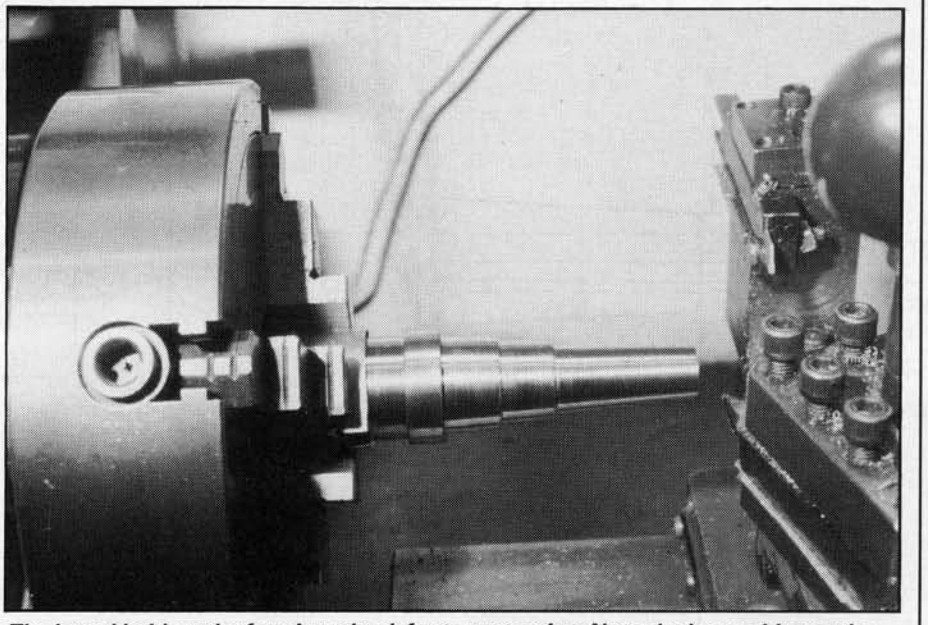
Turn the work round and, again, a four-jaw independent chuck is advised. Protect the work with a brass strip and centre it. Set the top slide to an angle of three degrees and turn the barrel to shape as per the drawing. Whether it is to be left bright or blackened the finish on the barrel must be really fine as it is the focal point of the model. Getting the correct finish will require a carefully sharpened and honed tool, at exact centre height, the final cuts being very fine indeed, A good cutting oil will help to obtain a good finish.

Set the barrel on a vee block and scribe a light line across the muzzle. Rotate until this is vertical, and check that it is, with a square. Gently centre punch the position for the pivot. Protect the barrel with brass shim set it in a machine vice and carefully start one of the holes with a centre drill. Line the tool with the scribed line on the muzzle and drill right through with a reaming sized drill for $^5/_{16}$ths inch. Finish the hole with a reamer.

The pivot pin is a simple piece of turning but ensure that there is sufficient room left for the pin ends to go through the trunnions. The eye at the end of the barrel is formed from a piece of $^9/_{16}$th inch diameter mild steel and is screwed in place. The thread and the $^1/_2$ inch diameter section can be turned and the eye formed by sawing and filing. The part should appear as part of the barrel and blending in by radiusing gives a good effect. There are, however, some examples of barrels of this type with a slightly proud and flattened end so a thin flat section would not necessarily be wrong.

That more or less completes the work, the only decision to take now is whether the barrel and fittings are to be left bright or to be blackened, which is the more correct finish. To blacken the steel parts, heat them to a point where they are just beginning to go a dull red and then drop them in some oil. Old car engine oil will do but take care as it is quite possible to set the oil on fire when carrying out this operation. For this reason the quantity of oil used should be sufficient to thoroughly quench the work which MUST be carried out in the open as unpleasant fumes are given off. Small parts can be threaded on to wire to blacken them in this way. When the parts are cold give them a rinse in white spirit to remove surplus oil and the result should be nicely blackened steel. The process does not cover blemishes in the metal so a good finish is essential.

How much additional detail, if any, is added is entirely up to the reader. There would be eye bolts at each end of the frame about half way up, to which would be tied ropes or chains. These were used to pull the gun into position as well as to restrain it on the recoil. If it is intended to detail the model then reference to books on 18th century armaments is recommended. It is a satisfying little model and looks pretty when finished; it is also most unusual and yet not difficult to make. It can be made on one of the compact type lathes without any real difficulty.



The barrel held on the four-jaw chuck for taper turning. Note the brass shim on the chuck jaws to prevent damage.

19th CENTURY ARMSTRONG MUZZLE-LOADING FORT GUN. General arrangement: not full-size. by John Harman