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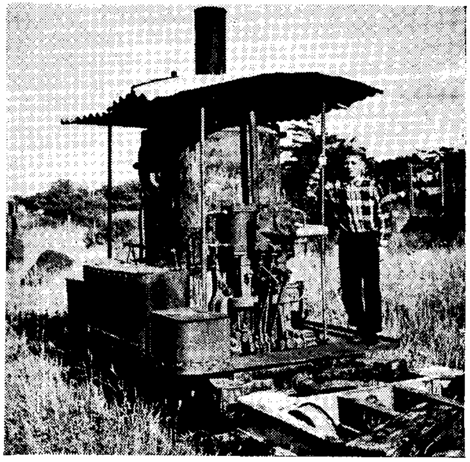

COVER PICTURE

A French vertical-boiler locomotive discovered abandoned near Biarritz by Mr William F. Whitman of Florida. Photograph by Mr Whitman.

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Starting model engineering from scratch: A sensitive test indicator for the lathe.

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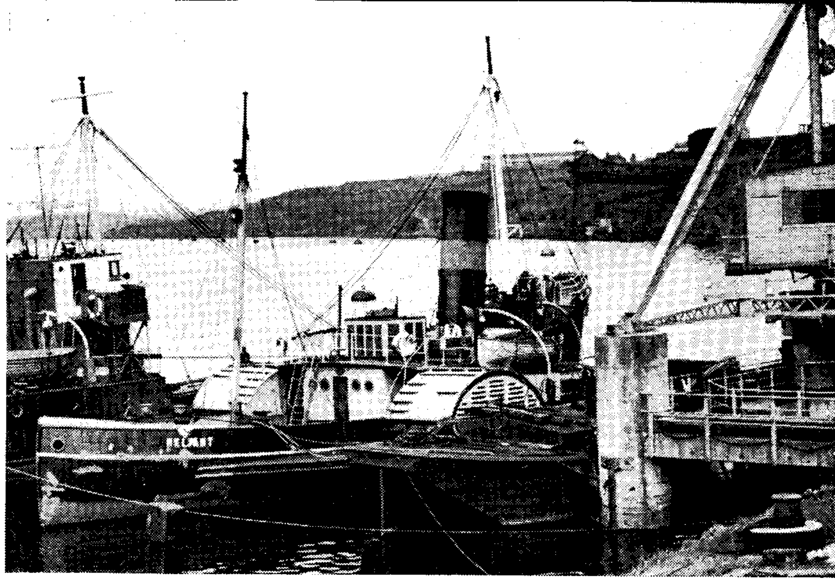
SMOKE RINGS



A commentary by the Editor

Committee for modelling

As many readers will have heard, a National Joint Committee for Recreational Modelling has been formed, for the purpose of co-ordinating and promoting the interests of model engineers, modellers and users of models throughout the United Kingdom.

The committee, which is under the chairmanship of Mr H. S. Weston of the S.M.E.E., includes representatives of the Society of Model Aeronautical Engineers, the Model Yachting Association, the Model Power Boat Association, the Model Rail Car Association and the Electric Car Racing Association.

The work of the committee is at present primarily concerned with the possibility that the newly constituted Lee Valley Regional Park will be able to provide facilities for all branches of recreational modelling. The park will cover a very large area of ground stretching approximately from Hertford to the Thames.

Although the members of this committee represent associations connected with the organised side of modelling, they are conscious of the needs of the many thousands of modellers who are not members of clubs, but who may wish to operate as individuals. They therefore realise that any facilities that can be arranged should be available for these modellers also, and not solely for society meetings.

It is hoped that facilities will be available for model yachts and power boats, live steam locomotives of various gauges, and model aircraft of all types.

The committee will be very glad to hear from anyone—either individual model engineers or clubs—who feels that he can give or may require assistance or information in connection with the proposals of the Lee Valley scheme. Communications should be addressed to Mr T. W. Pinnock, Secretary N.J.C.R.M., 28 Bolton Street, London, W.1.

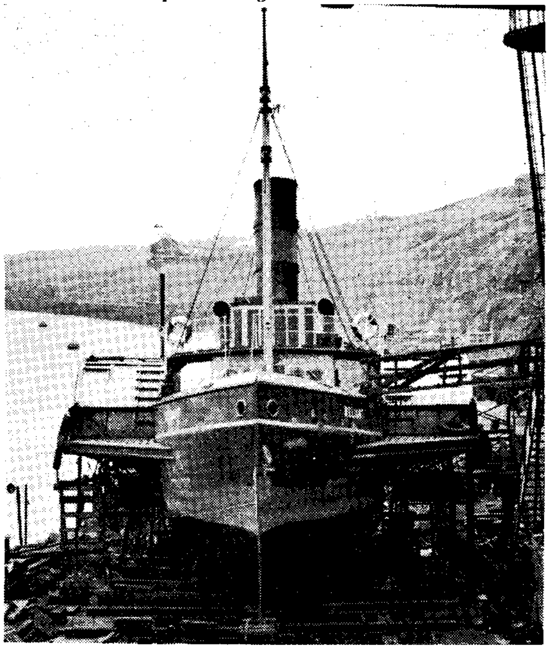
Paddle tug *Reliant*

The paddle tug *Reliant* is the last remaining side lever engined tug on the river Tyne, writes reader W. Featherston. She was sold to Seaham Harbour Dock Company in 1955.

P/T *Reliant* was built by J. T. Rennoldson at South Shields, Co. Durham, in 1907 as the *Old Trafford* to join the tug fleet of the Manchester Ship Canal. Her service on the canal lasted 44 years. She was then sold to the Ridley Steam Tug Company of Newcastle upon Tyne for service on the river Tyne; she was then renamed *Reliant.*

Her opposite number on the Tyne, *Eppleton Hall,* is to be scrapped.

Heading picture and below: Two views of the old paddle tug "Reliant."

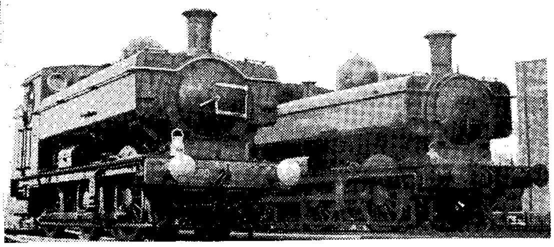


Record of club tracks

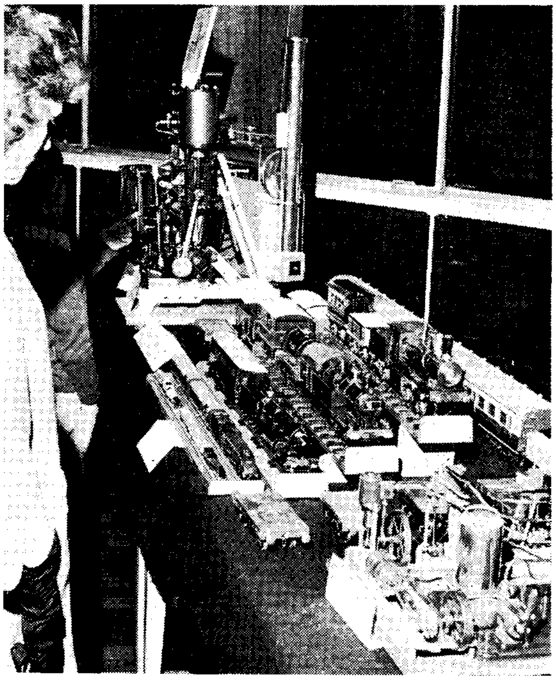
Mr G. R. Heslop, Secretary of the Sunderland Model Engineering Society, asks me to say that he has taken over the preparation of a complete list of locomotive tracks, with information on the various clubs and societies, started by the late Col. R. Horsfield. Mr Heslop asks all secretaries willing to assist him in this useful task to write to him at 57 Crosslea Avenue, Sunderland.

Metropolitan Panniers

My pictures, which were taken by Mr L. J. Green of Ruislip, show Mr E. Allchin's 5 in. gauge Pannier tank locomotive, similar to those described in M.E., on the running board of the prototype; the other picture shows two of the full-size locomotives still in service, note the additional lamp brackets fitted to the smokebox door of the second engine.



Metropolitan Panniers at Neasden.



Some of the smaller exhibits at the Hatfield exhibition. See Club News.

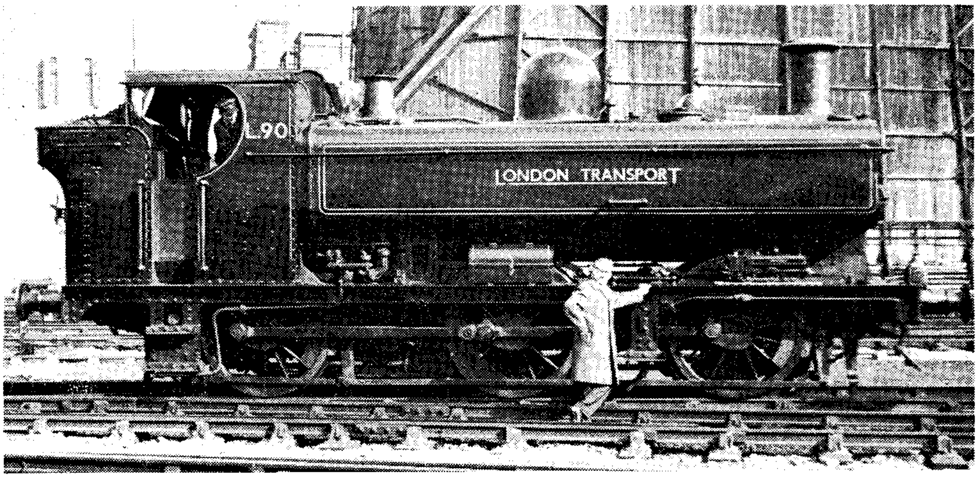
The late Charles Langer

On behalf of the Tonbridge Model Engineering Society I write with sincere regret of the death of the President, Charles Corless Langer, M.A., who passed away recently after a very brief illness.

Charles was a founder member of the Society and will be remembered for his untiring efforts in its early days. He was Secretary for a short period and later became President, an office that he held for about 18 years, always with dignity and distinction.

His unassuming manner at all times won him many friends, not the least amongst them the late LBSC. He was a most versatile engineer, and it is sad to think that his untimely passing left so many of his hopes and aspirations unfulfilled.

He was greatly loved, and will be missed by many.



Mr E. Allchin with his 5 in. gauge Pannier tank locomotive on the running board of the prototype. Photograph by L. G. Green.

MODEL PETROL ENGINES

In a new series, Edgar T. Westbury reviews the development of the small two-stroke

IN A SERIES of articles published in M.E. over a year ago, I reviewed the various aspects of the miniature four-stroke engine and its progress over half a century of development. As a sequel to this series, it will, I trust, be appropriate to deal in a similar way with the two-stroke, which, in the size and form used by model engineers, is at least as popular as its more sophisticated rival. One of my friends, referring to the above articles, said " Very nice for those who like to play with valves and cams and things, but why have you neglected the two-stroke for so many years ? "

True enough, I have not produced a new design for a two-stroke engine for a long time. This is not due to lack of interest, or even ideas for development of design; but the fact that miniature two-strokes have been produced commercially in great numbers and variety, and are readily available to those who want them, makes it more difficult to persuade model engineers to undertake their construction. Let me make it clear that I have nothing against the ready-made engines or those who use them for propulsion of various kinds of models; most of them work very well, and provide a source of power far more efficient than anything previously available. They also enable impatient enthusiasts to buy *time*, to say nothing of the elimination of hard work and skill involved in construction.

I have on many occasions given technical assistance to the manufacturers of engines, and many of the features of design which are now common practice were first applied by amateur designers, among whom I venture to include myself. But I have also tried to encourage individual constructors (when you come to think of it, this is really what model engineering is all about), and this is sometimes interpreted as a private vendetta against commercially made engines. Such an idea is clearly absurd, as the number of engines likely to be made in home workshops, even at the most optimistic estimate, could never be a serious menace to manufacturers. In some respects, any individual enterprise may even be helpful to them, by demonstrating the application and possibilities of miniature engines to the uninitiated more convincingly than the most expensive publicity campaign.

In this review, therefore, I propose to concentrate on the home-produced two-stroke, and trust that I shall not offend any persons or parties by doing so. Of necessity, I propose to indulge freely in reminiscence (or as some may consider, ancient history) about two-strokes in general and miniatures in particular, but I shall also do my best to consider modern problems and to answer some of the innumerable questions which have been put to me by readers.

Mainly historical

I have always found it helpful, in trying to explain the development of an engine or other mechanical device, to give at least a brief review of how it originated, and its early development. There are many who consider this unnecessary and, in support of their opinions, are fond of quoting the famous aphorism " History is bunk ! " ascribed to the great Henry Ford. But nobody can deny that everything in the present and future has its roots in the past, sometimes a long way back. One of my objections to many modern text-books is that they often assume that the reader knows all about the foundations of the subject beforehand—or ought to —before starting to read them.

One of the questions I am very frequently asked is " Who invented the two-stroke ? " This is a very simple question, but, like many such, not really so simple to answer. The early " atmospheric " internal combustion engines, such as the Hugon and Lenoir, were two-strokes, in the sense that combustion took place once per complete revolution of the shaft, i.e., two strokes of the piston. But these engines were completely superseded by the Otto engine, in which the mixture charge was compressed in the cylinder prior to ignition, and nearly all later i.c. engines followed this principle, though not necessarily the identical working cycle. This included two-strokes, in which it became necessary to incorporate some form of air pump, compressor or blower to force the charge into the cylinder as distinct from sucking it in during one complete piston stroke, as in the Otto cycle engine.

Most authorities credit Dugald Clerk with the invention of the precompression type of two-stroke, and it is probable that his engine was the first of such to be employed to any great extent. But Clerk's patent of 1881 was predated by that of James Robson in 1879. Besides individual features of design, the major difference between the two engines was that Clerk employed a separate pump cylinder for charging, while Robson utilised the reverse side of the piston, in a cylinder like that of a double-acting steam engine, for the purpose.

In Fielding's patent of 1881, engine construction was simplified by using an enclosed crankcase as a charging pump. The engine patented by Day in 1891 carried this idea still further, besides eliminating mechanically operated valves and their operating gear. In Fig. 1, based on Day's patent specification, it will be seen that the charge of air/fuel mixture (carburetion and ignition details are not shown) is taken in through a large disc valve in the end plate and, after precompression in the crankcase, is transferred to the cylinder through an automatic valve in the piston crown, while the exhaust is released through a port uncovered by the piston. Both these events take place during the later part of the down stroke and the beginning of the up stroke.

In later development by Day and some other engineers, the automatic valves were eliminated, and all three events controlled by the piston through ports in the cylinder, as shown in Fig. 2. A deflector is fitted to the piston head with the object (only partially achieved) of directing the fresh mixture upwards and preventing it from escaping or mixing with the exhaust gases. In the "three-port" engine, as it is called, the mechanical system is reduced to the minimum of three working parts, and this has been the pattern for the great majority of two-stroke engines ever since. The diagrams are explanatory only, and not complete or exact in detail, but they are approximately correct in proportions and design of the actual engines.

Before the end of the nineteenth century, many individual inventors filed patents for "improvements in or relating to" two-stroke engines, but whatever their merits might have been, manufacturers have not been enthusiastic about any departure which involves complication of design or construction. Much the same applies to the innumerable attempts to improve these engines in more recent years and, apart from engines of quite large size, the simple three-port engine is still predominant, though it has been considerably improved in detail, and its performance has been enhanced by long and patient development by many individual experimenters.

As a rival to the four-stroke engine, however, the two-stroke has many limitations and disadvantages. Although it is sometimes thought that an engine which fires twice as frequently as a four-stroke (other things being equal) *ought* to produce twice as much power, this is rarely, if ever, achieved in prac-

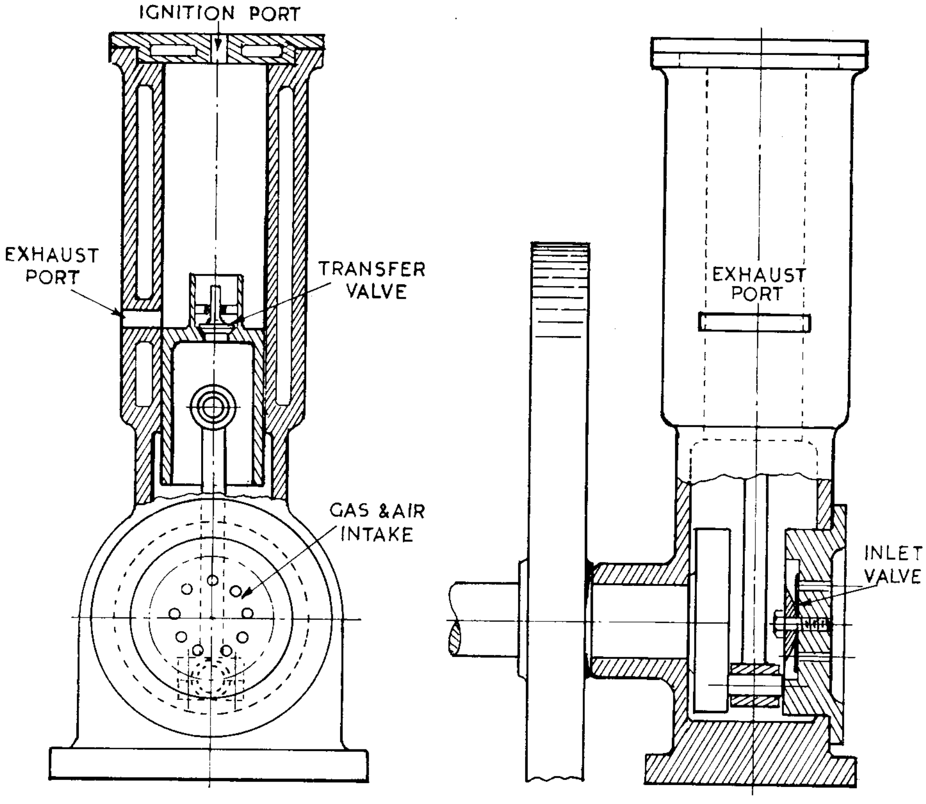


Fig. 1. The basic design of the Day enclosed crankcase engine of 1891

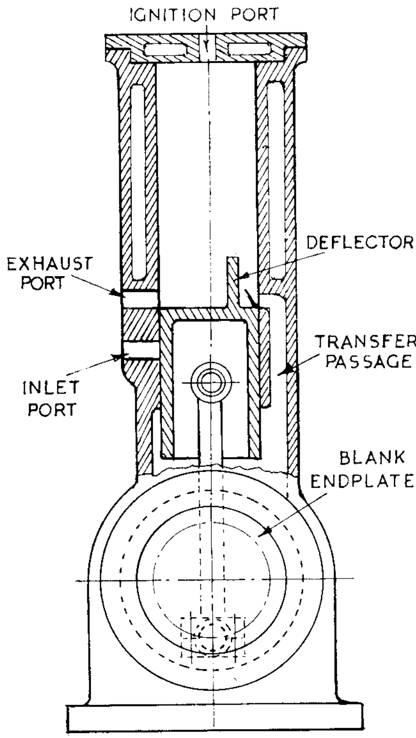


Fig. 2. This drawing shows the three-port variation of the Day engine.

tice, and it is even difficult to attain parity of performance. Two-stroke engines have to answer for many sins; they are usually more noisy, less economical, and more difficult to control than four-strokes; in some cases they are liable to overheating, tricky to start and generally temperamental.

Sophisticated engineers, for the most part, have tended to regard two-strokes as unworthy of serious consideration, and have neglected them in the general scheme of engine research. I have even encountered a rooted opposition to them, and have been told "We wouldn't have anything to do with two-strokes at any price!" This may partly account for the fact that in the development of (full-size) aircraft engines, few attempts have been made to use a two-stroke engine, though some promising designs have been evolved at various times. The late Professor A. M. Low once facetiously remarked "These wretched little (two-stroke) engines have no right to existence; they ought not to work at all, but, surprisingly, they do!" At the time when I became interested in motor cycling, two-stroke machines were considered definitely inferior to four-strokes, and, in fact, their riders were regarded as *declassé*. Things are very different now, and over 90 per cent of two and three wheeled vehicles have two-stroke engines.

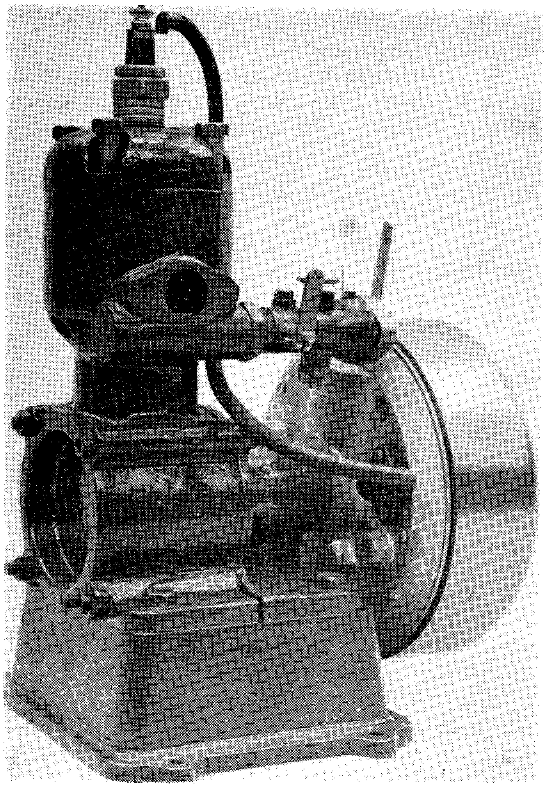
I have always considered that the two-stroke should be given due consideration in technical literature, if only because most mechanically minded youths obtain their first introduction to i.c. engines by way of two-strokes of some kind or other. But many of those who use them have no more than a vague idea of how they work, to judge by some of the very naive questions they ask about them.

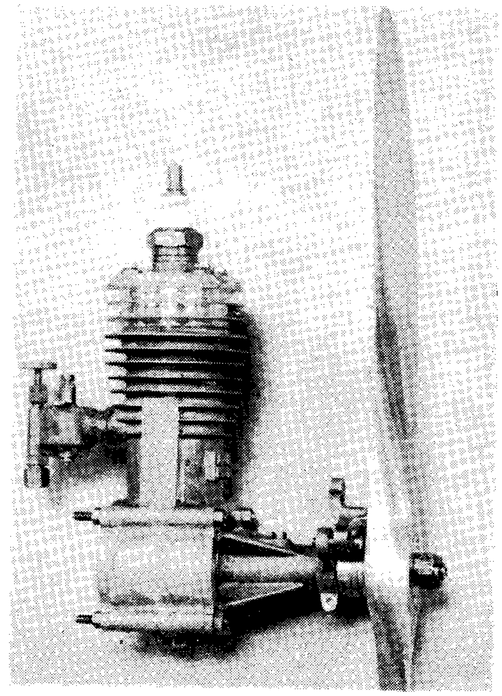
Fifty years of experimental work

I have been personally interested in the design of both four-stroke and two-stroke engines in small sizes almost as long as I can remember, but the first that I actually designed were of the latter type. They included an air-cooled motor-cycle engine, a three-cylinder engine for light aircraft, and a water-cooled stationary (or marine) engine, all of which worked fairly well, but failed to achieve commercial success for reasons unconnected with technical merit. Most of the engines designed since that date have been "models" in the sense that they were intended to drive or propel models of some kind, though it is often contended that such engines are not models in the true sense of the term, as they do not emulate full-size engines in scale proportion. But this applies to nearly all miniature i.c. engines up to the present day; though it is not absolutely impossible to build them more or less accurately to resemble full-size engines of certain types, it is not generally expedient to do so, if they are required to work as efficiently as possible.

In common with four-stroke engines, miniature two-strokes in the early days were not only few and far between, but also of dubious design, and no information on their construction was available. The first of my engines to be described in M.E. was *Atom I*, built in 1925 with the intention of installing it in a half-scale model of the Comper CLA3 light aeroplane constructed by Cranwell RAF Apprentices. The engine ran quite well, except for sparking plug trouble (the miniature plugs then available were not at all satisfactory), but the 'plane never became airborne. As a "guinea pig" for further experiments, however, *Atom I* served a very useful purpose, though it was too large to suit the popular sizes of model aircraft. I tried to stimulate interest in the development of suitable engines, but found it extremely difficult to persuade aeromodellers that anything better than rubber motors could be produced for this kind of work. It was not until the early '30's that I succeeded in obtaining the co-operation of (then) Capt. C. E. Bowden, and was able to prove that engine-powered model aircraft were practicable.

During the 1920's there was a great upsurge of interest in the development of model speed boats, and although flash steam was then regarded as the most efficient means of their propulsion, petrol engines were beginning to challenge their supremacy. From over the channel came that wizard of





The author's "Atom Minor" 15 c.c. engine.

Left : A 75 c.c. water-cooled stationary gas/ petrol engine designed in 1920.

two-strokes, M. Gems Suzor, to astonish the natives with the performance of *Canard* and, later, *Nickie II*. The M.P.B.A. and the Modele Yacht Club de Paris got together to set up an International class of petrol-driven speed boats with engines limited to 30 c.c. capacity, and this was undoubtedly a milestone in the history of model power boats.

This application of small petrol engines offered, at the time, a more promising field for their development, and by taking advantages of lessons learnt by experiments with *Atom I*, I designed an engine of 30 c.c. capacity, having features which I considered suitable for efficient speed boat work. It was named *Atom II*, and gave excellent results on the test bench, but, unfortunately, ended its career in a spectacular breakdown under load, due to a faulty crankcase casting. Its successor *Atom III*, of more robust construction, though similar in its general design, withstood the most stringent tests, and produced speed and power beyond my expectations; I still regard it as one of the most successful of my two-stroke designs.

Most model exponents of petrol-driven speed boats, however, preferred four-stroke engines, and regarded two-strokes with suspicion. I can remember only a very few of them who had any faith in the possibility of achieving high boat performance with a two-stroke engine. Notable among them was that great individualist from the North, Mr A. D. Rankine, whose *Oigh Alba* dynasty of boats put up spectacular performances; another was the late Bill Rowe, of the Victoria M.S.C., whose boats were mostly noted for high speed, long distance endurance runs. My own attempts to produce results in this sphere were handicapped by lack of knowledge of hull design, and usually ended in crashes or capsizes.

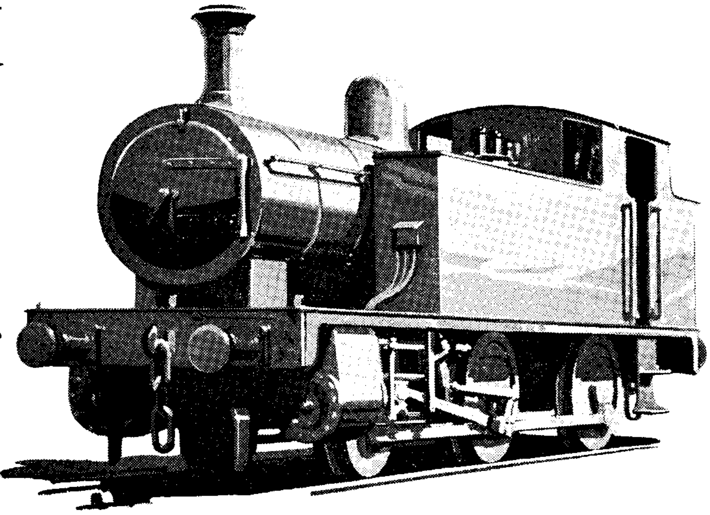
Following up the success of Capt. Bowden's engine-powered aircraft, in demolishing records in their class which had been held for many years, I designed a two-stroke engine of 15 c.c. capacity in 1932, which I called the *Atom Minor*. Its power and reliability, demonstrated in Bowden's *Blue Dragon* and other aircraft, proved beyond all doubt that all existing records in endurance, speed and altitude of model aircraft would become things of the past.

I shall refer later to the particular features of these early engine designs, which, although now becoming antique, are still capable of producing good results and for this reason cannot be dismissed as completely obsolete. While I have never claimed brilliance of design or super-efficiency in any of my

Continued on page 435

SIMPLEX

A simple 0-6-0 tank locomotive for 5 in. gauge



Building the Boiler

by Martin Evans

Continued from page 340

BEFORE WE CARRY on with the building of the boiler, I must apologise for one or two mistakes which have crept into the drawings published in M.E. so far.

The trunnion pins of the valve gear expansion links should be $\frac{3}{16}$ in. dia., not $\frac{7}{32}$ in. as shown on page 19 (January 5). I think any builders who may have reached these parts will have spotted this and either made the trunnion pins $\frac{3}{16}$ in. dia. or drilled out the link bracket accordingly. As the link brackets were dimensioned with a $\frac{1}{4}$ in. radius, there should be plenty of metal around the bush if anyone prefers the larger diameter.

The valve spindle crossheads or forks (page 219, March 1) should, of course, be tapped $\frac{3}{16}$ in. × 40T, not $\frac{7}{32}$ in., as the valve spindles are $\frac{3}{16}$ in. dia.

Finally, the overall length of the weighshaft (also page 219) should be $8\frac{15}{16}$ in., the arrows having been drawn in the wrong position.

Some builders have also had a bit of bother with the delivery union on the top of the boiler feed pump, as this comes rather close to the weighshaft. I have made a small adjustment on the full-size drawing which will sort things out, but to anyone who has reached the point where the weighshaft is being fitted, I would suggest that the shaft be turned down to $\frac{5}{16}$ in. dia. for a length of about $\frac{5}{8}$ in., in the middle. It will still be strong enough for its job by a wide margin.

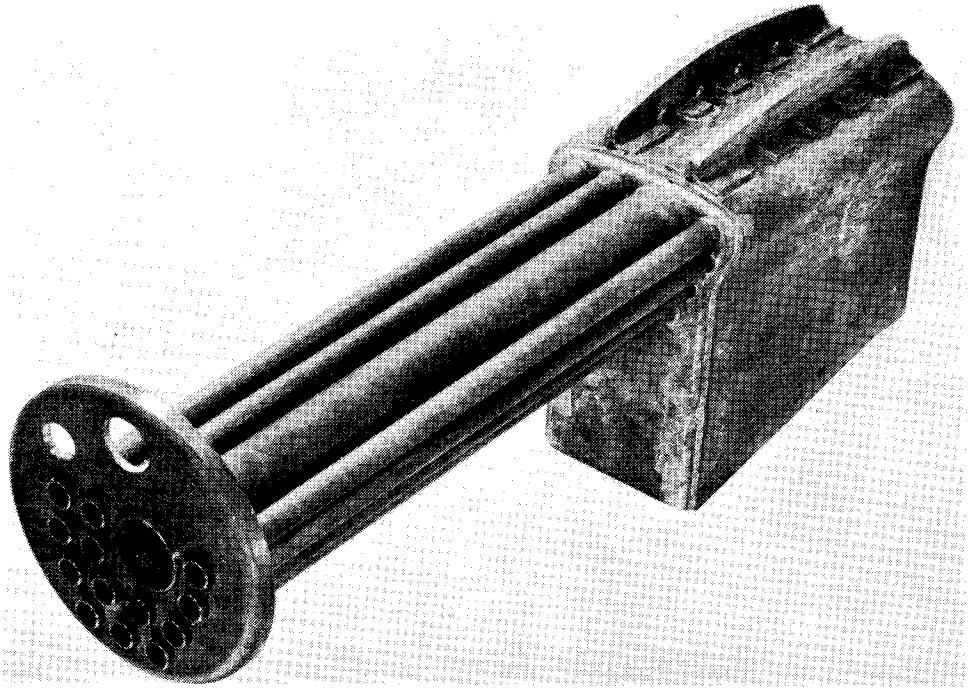
Now to return to the boiler. The next item on this is to braze the throatplate to the barrel and outer wrapper, but before starting operations, a couple of $\frac{3}{32}$ in. copper rivets may be put through the flanges of this plate to hold the outer wrapper in place while the heat is applied. The aim should be, in all such cases, to use only as many rivets as are essential to hold the parts together. As I have remarked on many previous occasions, every hole drilled in a boiler is a potential source of leakage.

Mr D. Young is concurrently describing how to build the boilers for his 5 in. gauge 0-4-0 "push and pull" engines in some detail, so perhaps I may refer beginners who are in doubt about the various processes involved to his articles, which will allow me to go ahead faster. I will however remind those who have had little or no experience of brazing and silver soldering that the first essential for good joints is absolute cleanliness, and as Mr Young suggests, any doubtful parts can with advantage be dipped in the "pickle" tank for ten minutes or so, afterwards rinsing with hot water, before starting to flux the joints.

For the throatplate/barrel joint, Propane and Air/gas blowpipers can use C.4 or Argobond or similar silver brazing alloys, which give a sound joint with a good fillet, and as soon as the builder is satisfied with this operation, a start can be made on the remaining flanged plates—the smokebox tubeplate, firebox tubeplate and backplate, and the backhead.

Making the plates

All the plates are cut from $\frac{1}{8}$ in. copper sheet and should not present any difficulty in flanging, provided that they are frequently annealed. Although hardwood can be used for formers for making flanged plates for a "one-off" boiler, I think a solid steel former makes for a better job. Another possibility is to use half and half—$\frac{1}{8}$ in. steel plate on the "business" side and $\frac{1}{4}$ in. hardwood on the other. I made the formers for my original *Jubilee* boiler that way as I was not keen



A view of the inner firebox and tube assembly of the original "Simplex" boiler showing the unusual but simple crown-stays

on the idea of sawing them from $\frac{5}{16}$ in. or $\frac{3}{8}$ in. steel ! Incidentally, I understand that Mr Farmer of Birmingham can supply ready-made flanged plates for the *Simplex* boiler at a reasonable figure (usual disclaimer).

Tackle the inner firebox next. Mark out the positions for the tubes and the superheater flue in the firebox tubeplate and drill them all $\frac{1}{8}$ in. dia. at this stage. *Do not on any account* drill the stay-holes—this must be done through the holes in the throatplate later on.

Now clamp the firebox tubeplate to the smokebox tubeplate, both flanges outwards, and with the smokebox plate arranged so that the tubes will have a rise towards the front of $\frac{3}{16}$ in., run the $\frac{1}{8}$ in. drill through the smokebox plate for all the tubes *except* the two top inner ones and the flue itself. The position of these two tubes and the single flue in the smokebox tubeplate must be marked out individually as there is only one flue and that lies on the left-hand side of the boiler. (Yes, I was nearly caught napping !)

The tube holes in the firebox tubeplate are next opened out and reamed a shade undersize, accomplished simply by not putting the reamer right through, while the flue hole can be brought up to a few thou under $1\frac{1}{8}$ in. dia. by drilling a row of small holes all around, breaking out the unwanted piece and finishing by careful filing with half-round files.

All the holes in the smokebox tubeplate, however, can be finished to the full diameters, as the tubes can later be lightly expanded at this end. Also at this stage, mark out and drill for the blower tube bush, and cut the $\frac{3}{4}$ in. dia. hole for the main steam pipe bush. These bushes can then be turned up from drawn gunmetal bar, but only partially tap the threads in them at this stage, otherwise they will be damaged by the heat of the brazing torch. Press these bushes in and braze them, using C.4, Argobond or similar.

Returning now to the other two flanged plates, we can cut the firehole at this stage, in both the firebox backplate and the backhead—make sure that they are exactly in line—and also the $1\frac{3}{16}$ in. hole for the regulator bush. If it is intended to silver solder all the firebox stays, which is strongly recommended for those using oxy-acetylene or air/gas blowpipes, the holes for the eight stays between the firebox backplate and the backhead are now drilled $\frac{5}{32}$ in. dia. through both plates.

The firehole ring, which is made from $1\frac{3}{4}$ in. dia. copper tube $\frac{1}{8}$ in. thick, is next turned up, fitted to the firebox backplate, riveted over (it must be annealed first, of course) and brazed. Make sure that the ring fits the hole in the backhead nicely, then the two plates can be put aside while the inner firebox is tackled.

The firebox wrapper is made from $\frac{3}{32}$ in. thick copper sheet. Check the length required by bending a piece of $\frac{3}{32}$ in. soft iron wire around the firebox tubeplate, but add about $\frac{1}{8}$ in. to this just to be on the safe side; any excess can easily be trimmed off afterwards.

Some builders go to the trouble of making a shaped wooden former for bending the wrapper, but I have never found any need for one myself. Having annealed the sheet, lightly mark its longitudinal centre-line, then put in the 6 in. radius in the middle, corresponding with the raised crown of the box, checking it against the flanged plates.

To put in the corners, which are $\frac{3}{8}$ in. radius, a good dodge is to cut two pieces of $\frac{3}{4}$ in. dia. round b.m.s. about 7 in. long, face both ends, drill and tap say $\frac{1}{4}$ in. BSF. Cut two lengths of flat b.m.s. about $\frac{3}{4}$ in. $\times$ $\frac{1}{4}$ in. section and $3\frac{3}{8}$ in. long with squared ends, drill two $\frac{1}{4}$ in. holes in these pieces $2\frac{7}{16}$ in. apart, then bolt them on the ends of the round rods. We now have a nice structure over which we can bend the wrapper, one end being clamped firmly in the vice and the other supported by a strong bar of suitable length.

Having got the wrapper shaped to fit closely around the flanged plates, the bottom edges are trimmed to size and shape. The wrapper is then riveted to the firebox tubeplate, using only as many $\frac{3}{32}$ in. snaphead copper rivets as are really necessary, but do not fit the firebox backplate at this stage, although it may with advantage be put in place just to assist assembly.

Simple crownstays

Next item—crownstays. These are extremely simple, as can be seen from the drawings. Cut them out from $\frac{1}{8}$ in. copper sheet, anneal, bend in the vice, place them in pairs back to back in the vice (upside down) and file away the four half-round "gaps" with a large coarse round file.

Rivet each pair of crownstays together with a couple of $\frac{3}{32}$ in. snaphead rivets and try them on the firebox wrapper. It is important that they run the *full length* of the wrapper, otherwise the firebox will be seriously weakened. Only four rivets should be necessary to hold each crownstay to the crown, but make sure that the stays make good contact for their full length.

The assembly can now be brazed or silver soldered, starting with the wrapper/tubeplate joint, and then turning the assembly through 90 deg. and doing the crownstays. Argobond would be excellent here, as it gives nice fillets.

It is now time to fit the tubes and the flue, so cut these to length, face off the ends that are to be at the smokebox end and very slightly taper them. At the firebox end, the tubes should be given a very light skim in the lathe, for a length of $\frac{3}{16}$ in., just enough to ensure a tight fit in the holes in the firebox tubeplate. There should be no difficulty in chucking the tubes, but the flue, being too large to go through the lathe mandrel, will have to be supported by some kind of steady. With care, it could be taken down with a file.

Fitting the tubes

Put the tubes in the pickle for fifteen minutes, wash thoroughly, then press them home in the firebox tubeplate. Up end the firebox assembly, and wrap around every tube with $\frac{1}{32}$ in. dia Easyflo silver solder in wire form. It is advisable to make two complete loops round every tube in one continuous length, then we can be quite sure of obtaining good sound joints. Flux thoroughly and then push the smokebox tubeplate over the outer ends of the tubes; this will space them properly and also help to hold them firmly while silver soldering.

Before getting busy with the blowpipe, make sure that the tubes are parallel with the sides of the firebox in plan, but have a slight upwards inclination towards the smokebox end.

Play the flame inside the firebox and keep it on the move, so that the thin tubes do not become overheated, and heat until the silver solder "flashes." Don't overdo it, or you will melt the firebox joints, though the rivets used on these should prevent a complete disaster.

It is a good idea to feed in a bit more silver solder, dipping the stick into some dry flux before doing so, until there is a distinct white "pool" of solder all around the tube ends. Allow to cool, pickle and wash thoroughly, and then examine the tube joints carefully. There should be a white line of silver solder all around every tube on the *inside* of the firebox. If any tube joint looks doubtful, don't chance it, but go through the whole procedure again—pickle, wash, flux, solder, heat, cool, pickle, wash, examine !

When satisfied with the tube fixing, anneal the outer ends of the tubes, pickle and wash, then try the whole assembly on the outer shell. Cut the front section of the foundation ring and insert this, clamping it in position with a couple of toolmakers' clamps, push home the smokebox tubeplate, securing it with about four 4 BA screws made from copper or gunmetal, put in from the outside and filed flush (have the threads on the tight side towards the outside so as to avoid leakage), then lightly expand all the tubes and the flue by the use of a tapered drift.

The firebox backplate should now be offered up to the rear of the inner firebox, and if it fits nicely, we can go ahead and cut and fit the two side sections of the foundation ring. If the backplate does *not* fit nicely, a little careful bending will be needed before proceeding further.

The smokebox tubeplate and the ends of the tubes are now silver soldered, and here I would prefer Easyflo No. 2 as it melts at a comparatively low temperature, and then the boiler can be put on its back and the three sections of the foundation ring silver soldered in place.

Having got this far safely, now is the time to tackle the side stays and the six stays in the throatplate. Drill right through both plates with a drill about No. 27 to start with, keeping the drill as square as possible to the plates, then open out with $\frac{5}{32}$ in. drill. The three holes in the throatplate immediately underneath the barrel can be tackled by a long extension, so that the chuck or the drill itself does not foul the barrel—a portable electric drill is useful here, though the job can be done with a hand drill if care is taken.

To be continued.

READERS' QUERIES

Launch gearbox

I have built a 54 in. Radio-controlled model launch, which is propelled by a 34 cc J.A.P. two stroke engine.

I am contemplating fitting a gearbox, which will be operated by the Radio, to allow Forward-Stop-Reverse of the propeller shaft.

Would you kindly provide me, if possible, with a suitable drawing of such a gearbox, utilising dog-clutches, in preference to friction ones ?—P.A.V.

▲ *We regret that we have no working drawings of a reversing gear suitable for a radio-controlled model boat. An article entitled "Reversing by Radio" was published in* Model Engineer *some years ago, but the issue containing this article is no longer available.*

The drawing below shows an arrangement of gearing which can be used in a simple reversing gear. It employs a cluster of bevel gears, one of which is fixed to the input shaft while the others run freely on their shafts. A sliding sleeve, with teeth on each end (shown in the neutral position) can be moved either to right or left to engage similar teeth on either of the axial bevel gears. It must, of course, be keyed or splined to the output shaft. The bevel gears to take the drive from your engine should not be less than 2 in. diameter. Where dog clutches are used for engagement, the engine must be throttled down to idling speed for shifting gear; this may be done by means of a cam on the selector shaft. This is, in any case, advisable to prevent the engine racing when declutched.

Painting and lining

I am building a 3½ in. gauge *Lickham Hall* locomotive and have reached the painting and final stages and would like some help over the following points:

1) Lining. I propose using a draughtsman's pen with which one can adjust the thickness of the line; can you suggest anything better ? Do I use ordinary oil paint thinned before lining, or what ? Coloured Indian Inks?

2) Final Varnishing. Can you suggest the best type of varnishing for finishing coat on metal. Should it be brushed or sprayed ?

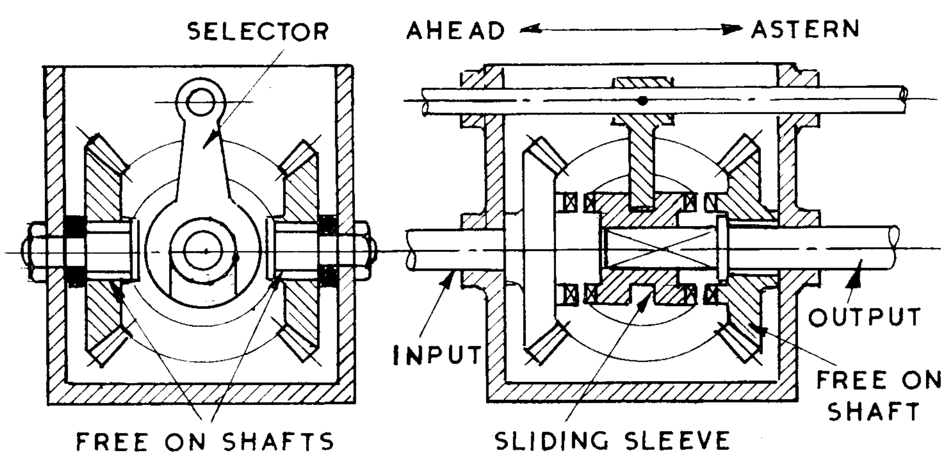
3) What do you recommend to glaze cab windows, mica, perspex or what, from where can it be obtained, and how would you recommend fixing it ?

On the plan it shows $\frac{1}{16}$ in. half-round beading used around the cab windows. I have difficulty in bending this beading; can you suggest the best way of bending, should it be soldered on or pinned with very thin pins riveted over ?—E.T.E.

▲ *A draughtsman's pen is generally used for the lining on small locomotives though one or two builders use a home-made roller tool and we have even heard of very fine sable brushes being used. Indian ink is not recommended and most builders appear to get the best results with poster colours, but it is, of course, essential to spray a final coat of varnish to protect the lettering and lining.*

Clear perspex is probably as good as anything for the glazing of cab windows and this can be obtained from F. J. Bly (Plastics) Ltd., 26 Laycock Street, London, N.1, and also Allmodels Engineering Ltd., 2 Burlington Mews, Acton, London, W.3. It is generally affixed by means of a thin brass frame and a number of very small brass screws.

The cab and window beading is generally made from annealed brass wire and is soft soldered to the sheet; two or three small clamps are useful to hold it in position while soldering.



A Reversing Gearbox design, suitable for a 54 in. launch.

Origin of the Plough

by Colin R. Tyler

THE ORIGIN of the plough has forever been shrouded in the mists of time. We shall never know the genius who first scratched the soil and after sowing his seed covered it, tended the new green shoots and finally harvested his crop, obtaining more food for his family per handful of seeds than his neighbours. Small wonder the new tool was to become universal, although thousands of years were to pass before this came about, culminating in the classic horse-drawn and later mechanical ploughs of the nineteenth and twentieth centuries; the result of milleniums of trial, error and finally science.

A sharpened stick probably formed the first "plough" which fulfilled more of a hoeing than ploughing duty. This became a tool for scratching grooves in the soil prior to receiving the hand broadcast seed, then covered by dragging a branch as a harrow over the soil.

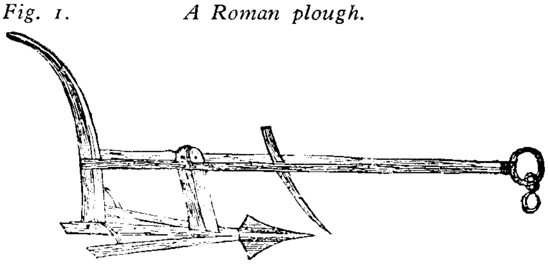
The earliest plough in existence is the Plough of Walle preserved in a peat bog and discovered in Germany. No more than a naturally shaped tree branch, with part of the trunk forming the share, much as the "heel" attached to a rose shoot when grafting, the branch forming the handle.

In Greece this type of plough was used with the branches probably specially trained to form the handles or stilts.

Among the earliest illustrations of ploughs were some made by the Egyptians. Model ploughs complete with ploughmen and oxen have been found in burial chambers, and thus the first authentic information was handed down to us. About 4000 B.C., the Egyptians manufactured wooden ploughs, but these differed from the Grecian type in that the two main parts—the beam and stilts—were made separately and lashed together in the form of a scythe.

Both the Egyptian and Grecian implements were pulled by the ploughman, who walking backwards used the plough with a chopping action. In the Nile Delta the annual deposit of silt from the floods provided an admirably soft soil—regularly renewed and fertile—which could be easily worked in this manner. The wooden tip was eventually replaced with a flint or copper tip and with the coming of the Iron Age this material was used.

Fig. 1. A Roman plough.



The next stage employed men (or women !) to haul the now larger and heavier implement away from the ploughman who instead of supplying the power, only guided the implement in straight furrows by means of the handles now added. A major advance this, and a recognisable picture of a plough as we know it today emerges. Later, of course, oxen replaced man power.

No particular part of the world seems to have been the birth-place of the plough. As Egyptian and Greek implements were developing, so in India, Europe and other parts was the plough being used, although the design was somewhat different in that the beams were longer and of a type used until very recently in the Far and Middle East. Elephants, camels and asses were all used for hauling, though strangely there is no evidence that horses were in service until Norman times, when they can be seen in the Bayeux Tapestry, probably because they were considered to be more a mode of transport and were small animals compared with the mighty ox whose breed was specifically improved for ploughing. When the ox was first employed for ploughing, the rope was simply attached to the beast's horns, yokes appearing when it was appreciated that a better pull could be obtained from the beast's shoulders.

Here, it seems the Egyptian plough reached its limit of development and we must look elsewhere to continue the story—to Rome and Greece, in fact.

The Greeks were probably the first to use wheels for regulating the depth of cut while the Roman plough had one taking two forms, one as shown in Fig. 1 and another shaped like a letter T with one end of the cross used as the share, the leg as the hauling shaft and the other end of the cross as the handle.

If the Greek and Roman implements are combined in the mind's eye we have the type of plough which to all intents and purposes remained the same as long as an animal pulled it. When mech-

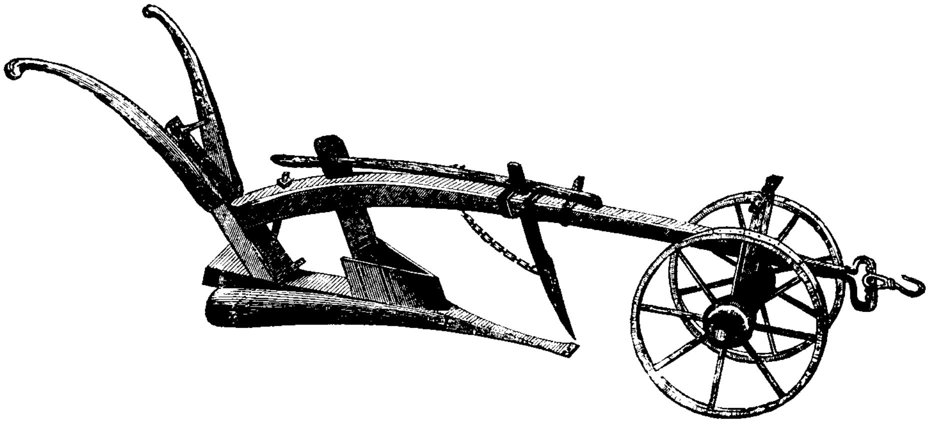


Fig. 2.

Left: A Kentish Turn Wrest plough.

anisation was introduced in the early nineteenth century, the animal and steam-powered ploughs worked side-by-side for 100 years, both finally to be ousted, at any rate in the Western world, by the introduction of the internal combustion engine.

To revert to primitive ploughs, we can now turn our attention to Europe in general and Britain in particular, as for the purposes of this survey they are one as regards development of agriculture.

In Britain over some 700 years prior to 1800 B.C. there developed a system of farming which was to be the basis of all farming for the next 3,000 years and it was the Celts about 750 B.C. who made further improvements on the system. The Celts used harnessed ox-drawn ploughs roughly of the Roman type. The fields they ploughed were small and can be seen in outline in parts of England, Wales and Ireland to this day.

About 75 B.C. the Belgae brought their massive wheeled ploughs drawn by a team of oxen eight strong, two abreast, cutting and turning a furrow slice in modern fashion. Due to the short length of the Celtic Field, the Belgae ploughs with their string of oxen found difficulty in working and gradually the fields changed shape, becoming longer and narrower, thus reducing the number of times the oxen had to turn at the hades or headlands.

By the time the Romans in their turn invaded England, both the Celtic and Belgae systems were in use in Britain and working quite well side-by-side. The Romans, however, would have none of this arrangement and superimposed their own system of large collective type farms manned by slave labour, drawn, of course, from the unfortunate natives of this island. Thus we now have three systems of farming none of which were universal, although the Celtic system was quickly overshadowed by the other two.

The Romans used their light two oxen implements, incidentally thereby partially reverting to the small Celtic type fields, based however on the Roman acre or jugerum 120 ft. × 240 ft., the smaller dimension being the distance a pair of oxen could pull a furrow without a rest, compared with the British acre based on the fields of the Belgae, 220 yds. × 22 yds., this time the longer dimension being the distance eight oxen could pull without a rest.

In A.D. 410 the Romans left our shores, and were replaced by the Anglo-Saxons, who—predictably—did not like the Roman system and therefore adopted the Belgae system incorporating the British acre, establishing by Norman times a semi-manorial system of farming which, while being basically Belgae, nevertheless had not rid itself of Roman influence in that the large co-operative farm with overlordship still existed with the work, land and produce sharing features of the Belgae.

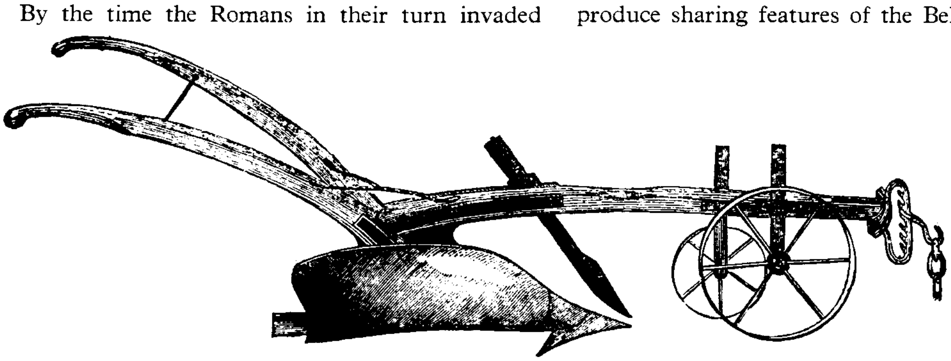
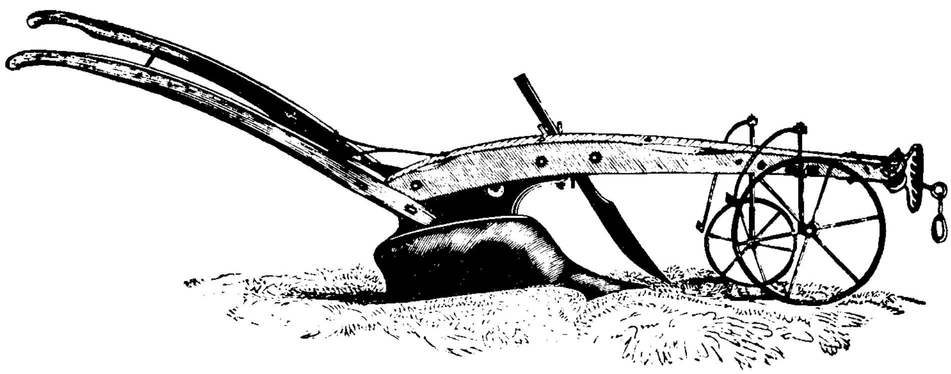


Fig. 3.

Left: A Bedfordshire plough.

Fig. 4.



Right: Ransome's Rutland plough.

Of course, all this took place over many centuries and the picture was never at any one time as clear cut as the preceding paragraphs may indicate. Farms of every system were in existence and for 2,000 years the Celts still worked their little fields in Wales and the West, while Saxon fields covered much of the rest of the country. Implements in general and ploughs in particular were rarely of one particular type, but made locally often by the ploughman himself, who made his plough in the traditional way for that part of the country. This also took into account the various soil types and local conditions. Even today the boundaries of many Parishes are the same as in Saxon times and they are usually found to incorporate a good selection of the various soils, so that adjacent Parishes had their fair share of good ground.

As previously mentioned, the Saxons were probably the first to use horses, in addition to oxen, for ploughing, and their cruel method of attaching the wretched animals to the plough by their tails persisted into the seventeenth century. Saxon and Norman ploughs usually had wheels, the larger clods broken by a hatchet wielded by the ploughman.

Oxen were still used for ploughing when inclosure was made compulsory by Act of Parliament, but horses were beginning to replace them. Magnificent Shire horses, whose lineage could be traced back to the times of the Crusades, were becoming more and more common.

This was the period prior to the hesitant and often unsuccessful experimental era with the new power of steam which, although the first mechanised method of cultivating and one which has many historically fascinating machines associated with it, never really ousted the traditional method of ploughing by ox or horse until the internal combustion engine appeared. The reason for this was, of course, economics. While it was possible to own animals and a plough, it was left to the rich farmer, or hire companies, to invest in costly machinery. Hire companies tended to appear very quickly in the mid-nineteenth century, to fulfil the needs of the less wealthy farmers.

It was not until the late eighteenth century that serious attempts were made to improve animal-drawn ploughs. Until now design was strictly traditional and they were handed down father to son to be repeated without much thought being given to the scientific forming of the various parts, or the application of the implement to the soil.

First efforts to improve the general design were made in Holland and the influence of this work was felt first in Scotland and Northern England. About 1730 the Rotheram plough appeared and was described as the perfect plough, although still made chiefly of wood, and of the swing or wheelless type; 1775 saw the introduction of the all-metal Scotch plough, this model being a modified Rotheram type, but still a swing implement. From now on many variations on the theme appeared, wheels and other modifications being added and it is beyond the scope of this article to deal with them individually. Three typical ploughs are shown in Figs. 2, 3 and 4.

To be continued.

MODEL PETROL ENGINES

Continued from page 428

engines, I think I can justly claim that many of their features, in structural methods and functional working parts, were innovations which have influenced the progress of design even up to the present day, including that of commercially built engines. I have always sought to exploit as fully as possible the *potential* advantages of the two-strokes, including low frictional or other mechanical losses, and low weight, while reducing their inherent disadvantages such as imperfect charging and scavenging.

Up to and during the last war, I made many experiments in the design of two-stroke engines from 50 c.c. down to $2\frac{1}{2}$ c.c., most of which, but by no means all, have been described in M.E., and nine of these designs are still available from the M.E. Plans Dept.; but others, and mutations (or mutilations) of them, have never been recorded, beyond references to them in a series of articles on *Improving the Two-stroke* published during the war years.

To be continued.

FOR THE SCHOOLS

Making a Workshop Camera

by Duplex

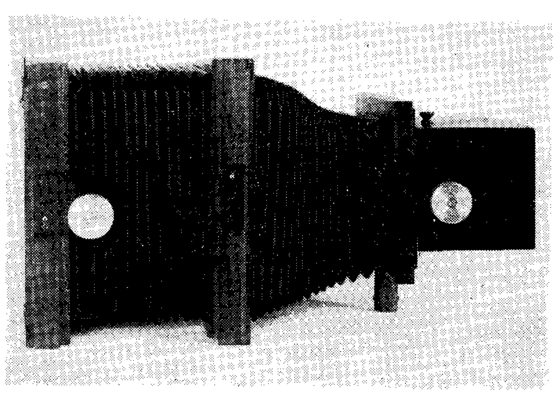
Continued from page 343

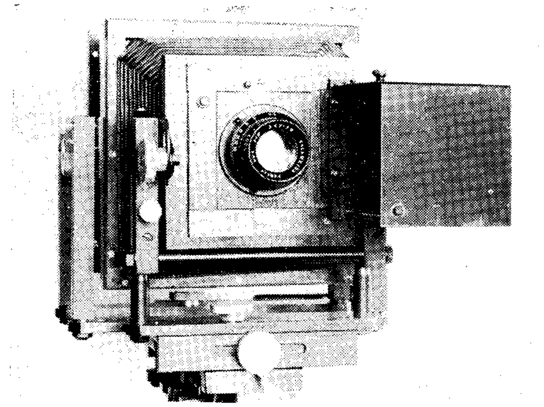
THE CAMERA FRONT comprises the front panel and its fittings which are carried in the fork of the front slide.

As the main part Sa is of stout construction, it can quite well be made from a single piece of seasoned mahogany; but those who are adept at cabinet work will, no doubt, prefer a mitred frame with a rabbet to take the lens panel. However, where the part is made from the solid, the housing for the lens panel is made by attaching a light framing to the face of the frame itself.

The central hole, which is made of a diameter to suit the lens fitted, was cut out in the jig-saw that was described in a previous series of articles. This machine is fitted with a coned guide centre that can be set to any required radius relative to the saw blade. This centre engages in the marked-out centre of the circle being cut, and the work is slowly rotated by hand against the moving saw blade. A pivot plate is attached to either side of the frame, Sb and Sc, Fig. 42, but the latter is extended to carry a stud and clamp-nut for locking the tilting movement of the camera front. The lens panel is not illustrated, since it is made to suit the particular lens fitted. Single-piece construction should serve, but a built-up frame is preferable if there is any danger of the wood warping.

Top right: Fig. 41. Bottom right: Fig. 42. Below: Fig. 40.

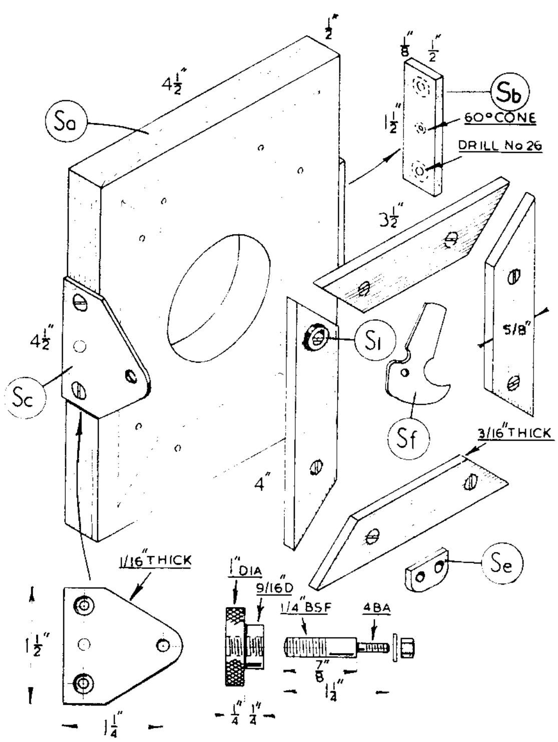


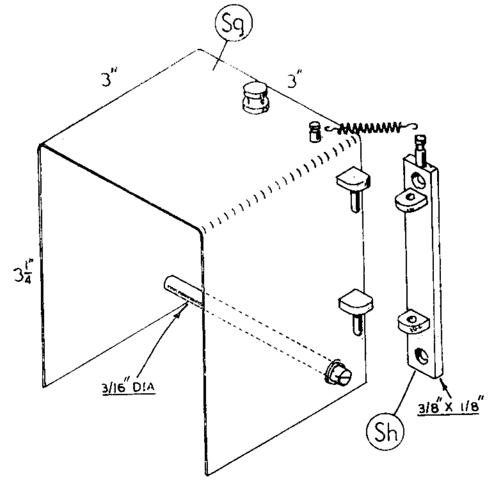


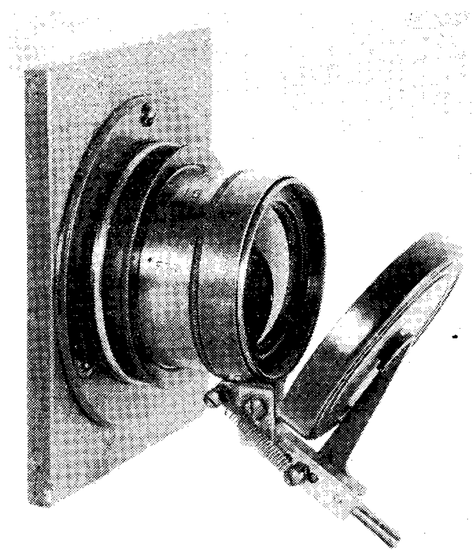
To make a light-tight joint, strips of narrow velvet ribbon are glued to the back of the lens panel. The bottom edge of the panel is held in place by a small brass plate Se and at the top an L-shaped latch Sf is pivoted to the woodwork.

To give a well-finished appearance, the brass fittings should be polished and then lacquered, and the wooden parts are French polished.

Although the lens hood (Sg, Fig. 43) may be regarded as an optional fitting, it should not be omitted if, in practice, there is any possibility of extraneous light reaching the front of the lens and causing unwanted reflections which might adversely affect the quality of the negative. The hood is







Above: Fig. 43. Right: Fig. 45.
Below, left: Fig. 44. Below, right: Fig. 46.

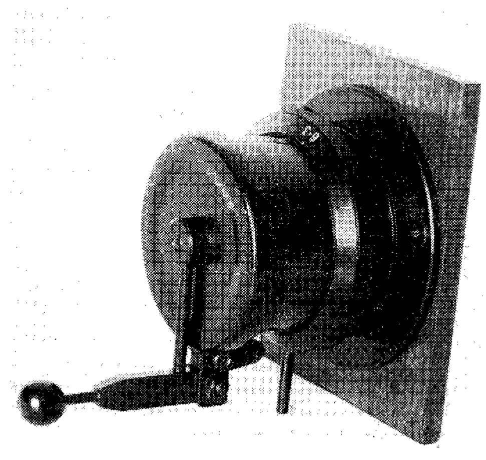
opened for setting the lens iris diaphragm, and it has the advantage that it cannot then be moved into the working position until the lens shutter has been closed, thus preventing inadvertent exposure of the plate.

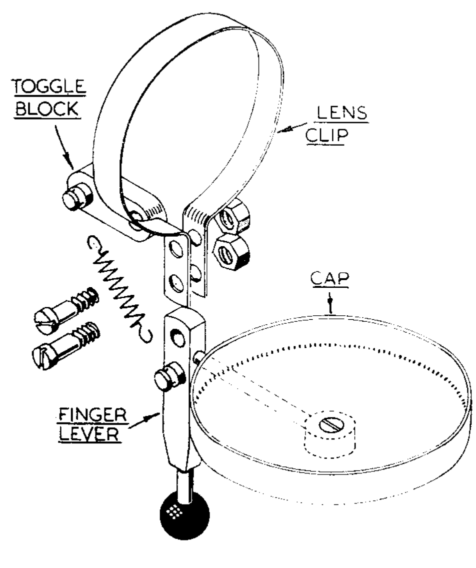
The hinged form of hood was adopted to enable a simple capping shutter to be fitted, but where a between-lens type of shutter is incorporated in the lens mount a conventional form of tubular lens hood may be preferred. The hood was cut out from aluminium sheet and then bent to shape on a wooden former.

To give additional stiffness, a tie-bar is fitted, as shown in the drawing; this is located so as just to clear the lever of the lens shutter when the cap is closed. Any simple type of hinge can be used, but that illustrated consists of a pair of pintles attached to the hood and fitting into the two eyes carried by the hinge-plate Sh which, in turn, is attached to the wooden frame. As represented in the drawing, a small tension spring is anchored to both the hinge-plate and the hood. This provides a toggle action and serves to retain the hood in either the open or closed position, even if the camera is pointed downwards.

In addition, a small finger-knob is fitted on its upper surface for opening and closing the hood. The inner surface of the hood should be treated with dead-black paint to guard against reflections, and the outside is finished with optical black. The small collar Si, which is attached to the front frame, acts as a stop against which the hood closes.

As previously mentioned, an anastigmatic lens of





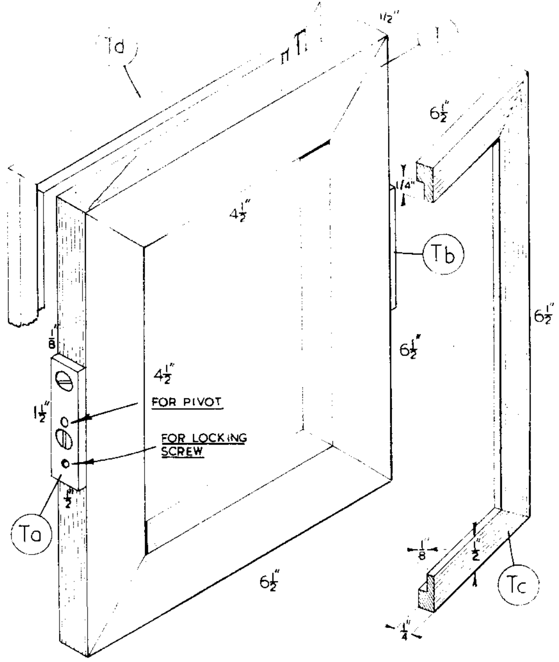


Fig. 47.

6.3/f aperture and 6 in. focal length is suitable for fitting to the camera. Lenses of this description are used in cameras with focal-plane shutters and, therefore, have no shutter incorporated in the lens mount. These can often be bought second-hand comparatively cheaply.

A coated lens has some advantage in giving a brighter image and also helps to cut down the flare that may arise from using a brightly illuminated, white photographic background.

The accompanying illustrations, showing shutters fitted to two different lenses, represent a simple form of construction that enables the shutter to be operated when the lens hood is closed. A more rapid type of shutter is not required, for in indoor photography and with the lens stopped-down the exposure time will necessarily amount to several seconds. A clip of spring steel is shaped to encircle the lens rim, and to this is secured, by means of a cross-bolt, a small rectangular block that anchors the toggle spring which serves to maintain the cap in either the open or shut position. The limbs of the clip are extended to provide a bearing for the finger-lever that carries the lens cap.

When the clip is tightened, it should grip the rim of the lens mount only sufficiently firmly to hold the shutter in place, for excessive pressure may distort the lens mount and its fittings. If necessary, a packing strip of soft card should be inserted under the clip to distribute the clamping pressure more evenly.

The cap of the shutter can be made from sheet metal and pressed to shape on a wooden former, or it may be machined from the solid. On the other hand, the metal cover of a domestic, small glass food jar will be found suitable for this purpose. The cap is attached at its centre to the arm of the finger-lever with a countersunk screw. To ensure that the cap makes a light-tight and dust-proof closure, it should be lined with velvet. A cardboard disc is cut out to fit loosely into the cap and the edges of the velvet, after being trimmed to shape, are turned over and glued to the back of the disc. When dry, the finished disc is pressed lightly into the cap. There are, of course, other ways of making a capping shutter, but the one illustrated was easily made and is also of small size, so that it can be accommodated within the lens hood described.

After the shutter has been assembled, it is advisable to make a final check to ascertain that the lens hood will close when the shutter is capping the lens, but is prevented from closing if the shutter is in the open position.

The bellows frame (Fig. 47), which is pivoted in the bellows fork, P Fig. 4, serves the double purpose of connecting the two separate sections of the bellows and preventing them from sagging, as would otherwise happen if they were in the fully extended position for doing close-up work.

Well-seasoned wood, preferably mahogany, should be used for making the frame. The mitred joints were cut to shape in the jig-saw by making use of its 45 deg. fence and length stop. The metal plates, Ta and Tb, are attached to the two side members of the frame, and each is drilled with a centre-drill to afford a bearing for the pivot screws which are carried in the uprights of metal bellows fork.

After the plates have been fixed to the woodwork, the frame is stood on the surface plate and the pivot centres are marked off, in turn, with the scriber of the surface gauge. This ensures that the frame, when mounted in place, will stand upright and with its centre line at the correct height above the bar bed.

As represented in Fig. 47, the right-hand plate, Ta, has an additional drilled centre to receive the point of the knurled finger-screw which is fitted to the bellows fork for fixing the frame in the upright position. As is also shown in the drawing, a light, mitred frame is attached to both the front and back faces of the main frame. The purpose of these frames is to secure the two sections of the bellows to the frame so as to make a light-tight joint.

To ensure making a satisfactory joint, the members of the frames, Tc and Td, are formed with a rabbet to enclose the folds of the bellows. This operation was carried out in the shaping machine with a tool specially made for the purpose from silver steel which was afterwards hardened and tempered. By this means, all the rabbets were readily cut to equal width and depth. The details for fitting the bellows will be given later when the camera back has been completed.

To be continued.

ELECTRIC TIME TRANSMITTER AND DIAL MECHANISM

Part Three

by Charles Blazdell

Continued from page 384

THE CASE, Fig. 10, consists of two parts, a backboard firmly fixed to the wall and a light detachable cover. The dimensions given suit the transmitter described but if a dial mechanism is to be accommodated in the same case a little more depth from front to back will be required. Also if cast iron is used for the pendulum bob instead of lead some 1½ in. of extra length will be necessary.

The case as made allows the whole of the mechanism to be visible with the cover on and completely accessible with it off.

The backboard

This was a plank of wood—Parana pine in my case—purchased planed all over and finishing to 8⅝ in. wide by ⅝ in. To avoid as much carpentry as possible, use was made of the large variety of strip wood and mouldings stocked by the local "do it yourself" shop. These are of hard wood accurately finished and require little more than cutting to length. The two strips of ½ in. × ⅜ in. (2) are attached by a few panel pins and one of the modern quick-setting glues. 3 and 4 are seatings for the movement glued and screwed to the backboard, the former ⅜ in. thick and the latter ⅝ in. Both are 1¾ in. wide. The 4⅛ in. dimension locates a stout roundhead wood screw taking the weight of the movement shown dotted.

The cover

For the top and bottom of the cover any hardwood approximately ⅝ in. thick is suitable. Cutting the mortises is the only "skilled" carpentry on the job. Four strips of wood are tenoned to glue tightly

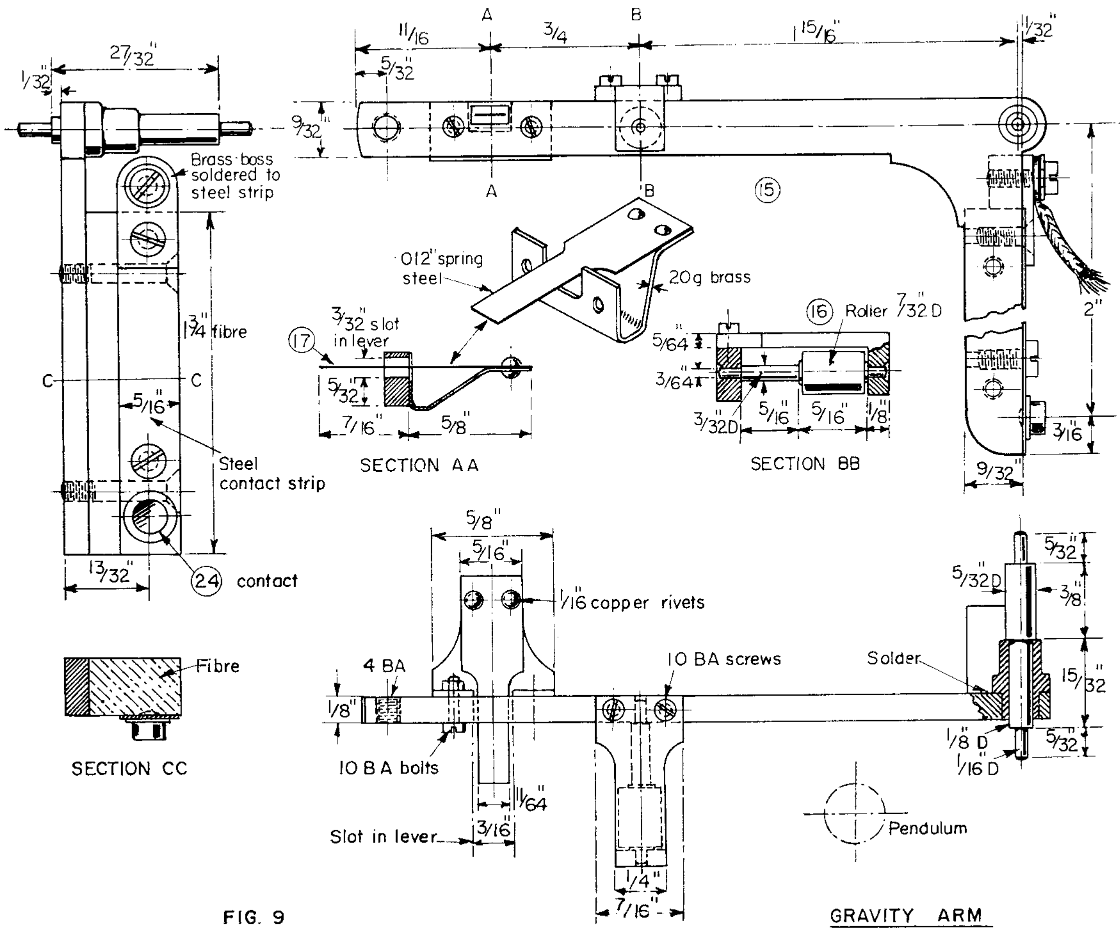


FIG. 9

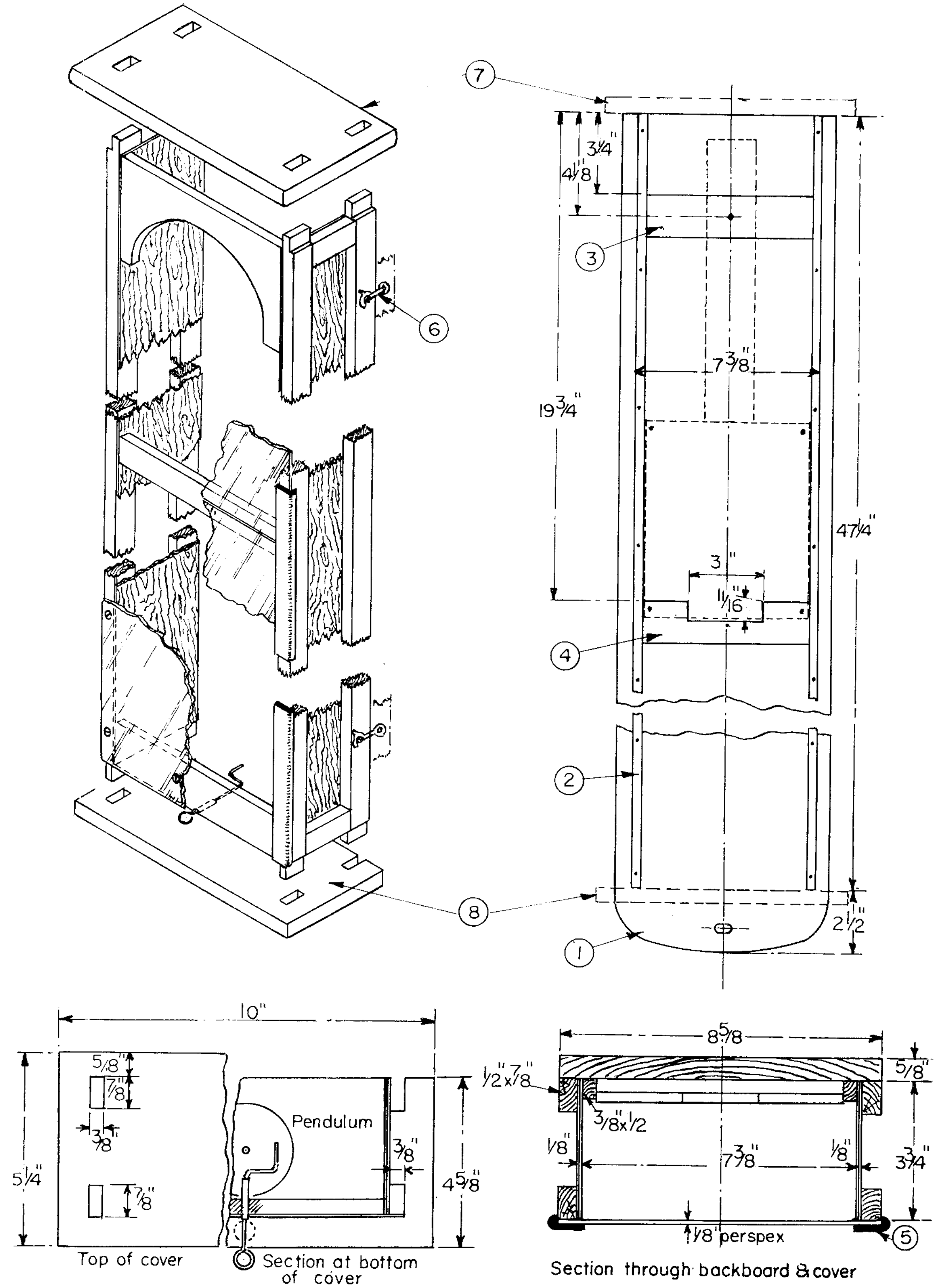
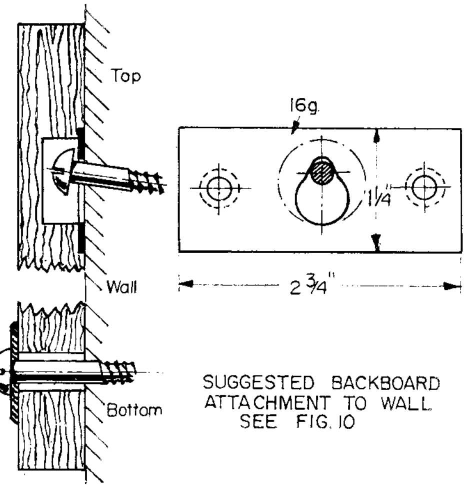


FIG. 10 CASE FOR MASTER CLOCK



SUGGESTED BACKBOARD ATTACHMENT TO WALL SEE FIG. 10

in and ⅛ in. three-ply glued on the inside with stiffening pieces 2 in. long top and bottom. The top overlaps the backboard so supporting the weight. The arch across the front is not needed for strength but was included for appearance. The corresponding member at the bottom is 1¾ in. wide and has a brass ferrule driven through its centre as close to the base as possible. A length of stainless steel rod 1/16 in. dia. is passed through the ferrule and cranked so that when turned through 90 deg. it will contact the pendulum rod just below the regulating nut. This allows starting or stopping the pendulum without removing the cover. Normally it is pushed through to the position shown dotted and lies flat on top of the baseboard.

Perspex was used instead of glass, because in addition to its lightness and clarity it can be drilled and made to act as a stress-bearing part of the structure like the skin of the modern car.

It extends the full width and length of the cover in two pieces butting on the centre-line of the wooden member provided to support it. A cover strip not shown on the sketch conceals the joint. Four csk brass screws per side drilled through the perspex into the ½ in. × ⅞ in. members are sufficient to keep the whole cover rigid and square. Strips of moulding 5 attached by five slender brass round-head screws per side also drilled through perspex provide a finish. One-eighth perspex was the only thickness available at the time but possibly 1/16 in. would be suitable. The whole of the inside of the case was painted flat white to contrast with the movement and the exterior stained and varnished. The fasteners 6 on the backboard hook over round-head screws on the cover and draw both tightly together. When once set going, any disturbance of the case from the vertical is likely to stop the clock. A suggested way of hanging the case is shown in the sketch. The steel plate is recessed into the backboard to which it is screwed. The top fixing is plugged into the wall at an angle down which the backboard slides into close contact with the wall, while the plate becomes wedged on the neck of the screw so making the top secure against movement. The lower fixing passes through a clearance hole in the board.

On trial it may be found that the pendulum appears to swing more contentedly with the case a little off true vertical. The clearance hole will accommodate this and the fixing screw with a big brass washer under the head can be tightened up. If the tilt is noticeable it can be corrected by adjusting the backstop or possibly the length of the gathering jewel wire, but if the dimensions given for the clock details have been followed this is unlikely to be necessary. ▣

Early aircraft engines

SIR,—Thank you for publishing in your January 19 issue my letter regarding Mr Westbury's series of articles, but I have to admit to being mildly disappointed that although four months have elapsed since I composed it, its effect is so inconspicuous as to completely escape my notice ! Mr Westbury's latest contribution (Part IV) is perhaps even more liberally besprinkled with errors of commission and omission than his earlier efforts. I have already emphasised my ardent admiration for the author's other work and I am now concerned that he is writing on a subject that seems to take him right out of his depth.

Despite my well-intentioned comments, we are greeted on page 164 with an excellent photograph of an 11-cylinder *Clerget* rotary engine bearing an incorrect caption, while reading of the article itself, reveals that a certain confusion (and I am being kind !) exists in E.T.W.'s mind about *Clerget* engines in general. I have found out the hard way that it would be impossible to enumerate and comment upon all the errors in the article without producing something of similar or even greater length, the preparation of which might well involve some independent research. The latter I feel is a duty which is incumbent upon Mr Westbury to perform, since it is he who sets out to be our informant.

After conjuring with engine and aircraft names, horse-powers, etc., in gay abandon, the author has rather startlingly arranged for *Argus Motoren Fabrik* and *Oberursel Motoren Gesellschaft* to exchange identities. In the same breath, as it were, he credits Mr Bentley's aero-engine design genius with having begotten a second child without apparently having produced a first !

The gem of the piece however, indeed a real classic, is his translation of *Canton-Unné* as " single crank-pin." I am not sure off hand whether both *Monsieur G. H. M. Canton* and *Monsieur P. G. Unné* have passed on, but if they have, and since they were the designers and patentees of the *Salmson* built engine, they must be positively *revolving* in their graves. If, as one hopes, they are still with us, please send them

Continued on page 454

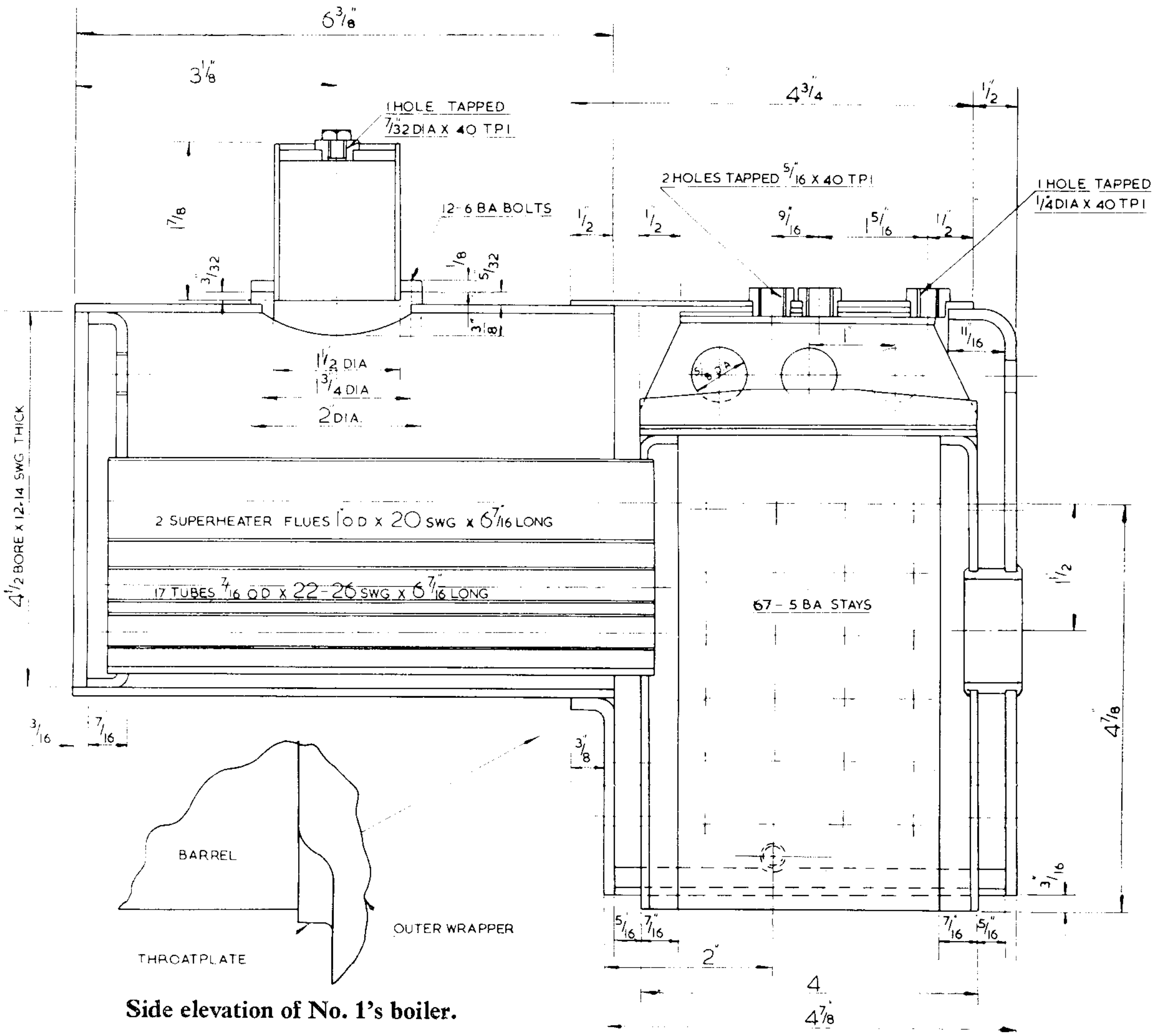
RAIL-MOTOR LOCOMOTIVES

The boiler for No. 1 by D. Young

Continued from page 393

IT IS TIME for No. 1 to take her bow. Unlike No. 2 she is not a self-contained locomotive, as from the description in *The Engineer* it will be remembered that water was carried under the coach body, only coal being available from the "scuttles" at each side of the firebox. It has not proved feasible to provide a well tank between the frames. Several solutions to this problem are available, namely to build a 10-ton capacity truck incorporating a water tank or fit the tank to the front of the driver's truck. The method I favour in this instance is provision of a small four-wheeled tender, which I hope to provide a few details for later on; buffers and drawhook will not be required on the engine, which will be close coupled to the tender.

It is hoped that readers will be as impressed by



Side elevation of No. 1's boiler.

her looks as I was, and still am, but as Mr E. S. Cox so aptly put it: "What makes an attractive locomotive design is very much in the eye of the beholder, and when we get down to rail-motor engines then the margin becomes very narrow indeed"; Mr Cox's preference as stated in "Chronicles of Steam" is for the L. & Y. design. A further point is that the chimney shape is shown differently on my drawing for the side and front views, the reason being that I could not decipher from the photograph whether the top curve was concave or convex due to light reflection. My first impression was that it was concave as shown on the side view but further reference to information about Hudswell Clarke designs of this period indicated that if the chimney was to their specification the curve would be as for the front view; photographs of other Rhymney locomotives, not all of Hudswell Clarke origin, again indicated a convex shape somewhat as Mr Robinson's on Great Central locomotives. Unless someone can positively establish the correct shape before this detail is reached, my suggestion is that the pattern be made to suit the heavier convex ring and then those who, like myself, prefer the concave shape, can easily machine this flange from the casting.

The outer wrapper is a piece of copper sheet either 12 or 13 s.w.g. thick, size $15\frac{5}{8}$ in. × $4\frac{3}{8}$ in. Take care in marking out and cutting that these dimensions are adhered to. A few words about the thicknesses of boiler material that I shall specify will probably save correspondence as even our worthy Editor has rightly queried some of those specified previously. My case for the defence is as follows:

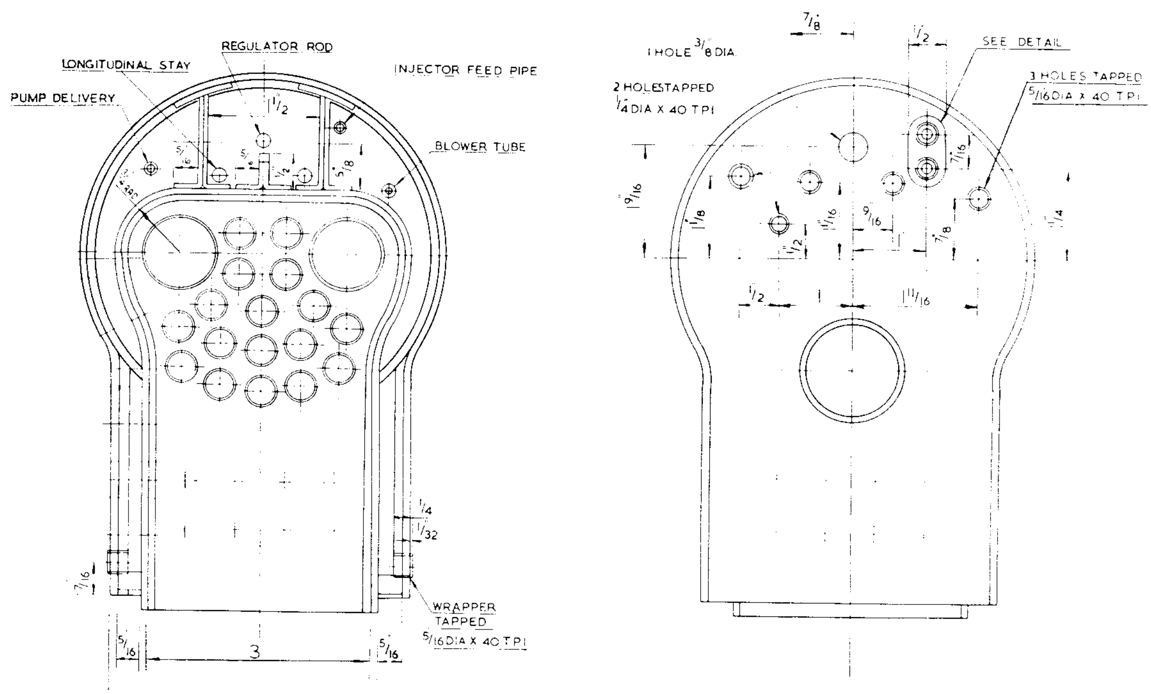
(i) Most of our locomotives run on elevated tracks which are not always in perfect alignment and unfortunate derailments do occur; my boiler designs take into account this possibility so are externally robust as well as internally.

(ii) The outer wrapper is one of the plates which require staying later on in construction; for those competent in this operation 14 s.w.g. plate is ample, but as a first effort when some of the holes will have torn threads, the extra thickness allowing more threads is an additional safety factor.

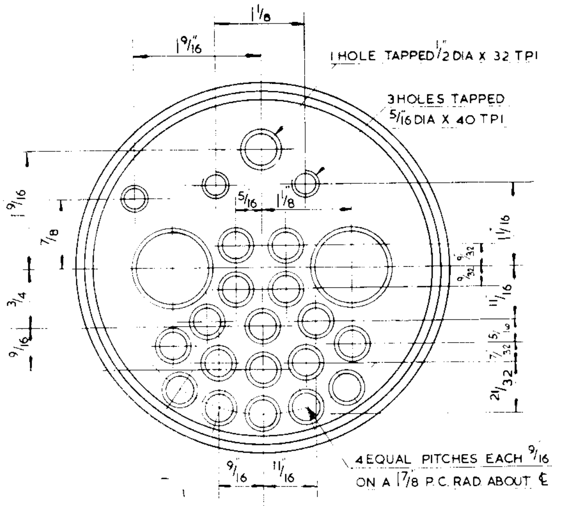
(iii) Two gauge thicknesses are specified, as in industry odd gauges such as 13 are gradually being dropped and in the future 12 s.w.g. will probably be more readily available.

(iv) The above remarks mean that in first cost this boiler will be more expensive than if designed solely to meet internal pressure conditions only. I can assure beginners, and others, that a virtually indestructible boiler will result, having an extended life, also that no detriment to steaming ability is incurred.

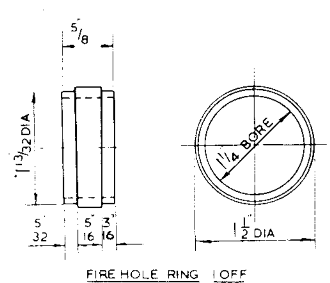
Equally divide the $15\frac{5}{8}$ in. length of wrapper and



Cross-section and backhead details.



Section through smokebox tubeplate.



scribe a centre line across; now constructors will begin to appreciate the usefulness of these centre lines on all boiler plates.

Take the boiler barrel and lay the wrapper plate across it with centre lines coinciding; cramp the wrapper to the barrel at each end. "Record" Junior cramps are very suitable, usual disclaimer. Pull each wing of the wrapper plate round the barrel until it resembles a ∩ shape. Make sure that each leg is vertical and parallel to each other. On releasing hand pressure a gap will appear between barrel and wrapper; this is quite satisfactory. I have always found it better to pull the wrapper round without annealing as there is less likelihood of dents, etc.; the wrapper then being laid aside we can proceed to the backhead.

This is a little out of sequence but the backhead is the easiest bit of "copper bashing," also if the throatplate was flanged first on the backhead former it would probably spoil it. Lay the former, sharp edge down, on a piece of 10 s.w.g. copper sheet; scribe around the profile. The allowance for flanging is approx. $\frac{9}{16}$ in. distant from this scribed profile so mark out, then saw, finishing to line with a coarse file. To conserve paraffin I anneal plates in the living room fire, keeping domestic bliss by fetching more coal from the bunker whilst the plate is getting hot. The fire should have burnt through to a bright red to do this properly. When the plate is the same bright red colour and before green-tinged flames appear, grip with an old pair of pliers and retreat outside to dip into cold water. Lay the former, radiused side downwards, on the copper, adjust to give an even flange width, then grip in the vice, using soft jaws to avoid marking the soft copper; mine are scrap ends of paxolin angle section.

With a wooden or soft-faced mallet, start flanging the copper round the profile; do not try to complete flanging at one go, as soon as the copper begins to harden, repeat the annealing process. It is surprising the ease with which this generously radiused flange can be produced. It is in line with full-size practice and, more important, allows a longer firebox without fouling the horncheeks on the frames. The edge of the flange will be slightly ragged and uneven; file this smooth to give a total depth of $1\frac{3}{8}$ in. Transfer the centre-line from the former and we can proceed to the throatplate. A piece of 10 s.w.g. sheet 5 in. × $4\frac{1}{2}$ in. can be cut, annealed, then placed on the bottom half of the backhead former which is reversed from the side used for flanging the backhead. As there are only two straight edges to flange a bend radius is an unnecessary complication; proceed to flange these two sides as before. The flat surface against the former will be slightly distorted during flanging. Lay it on a flat surface and tap out the ridge, checking that the flanges have not opened out.

Square off the bottom edge of the plate then transfer the centre-line; at $4\frac{5}{16}$ in. above the bottom edge and on the centre line, centre pop and scribe an arc of a circle of $3\frac{13}{16}$ in. dia., i.e., the bore size of the barrel. Cut out this scallop and file until it coincides closely with the barrel bore; cut off the two ears so that they are $4\frac{1}{8}$ in. above the bottom edge and see that they blend nicely into the barrel. The next requirement is a $3\frac{1}{2}$ in. length of 16 swg copper strip, 1 in. wide, anneal and make saw cuts $\frac{1}{8}$ in. deep at $\frac{1}{2}$ in. spacings along one edge. Bend this strip, finger pressure will suffice, until it fits neatly into the boiler barrel with the sawn portion protruding, clean up both contact faces with emery cloth to assist silver soldering, then clamp in position.

On the bottom centre-line of the barrel $\frac{1}{4}$ in. from the back edge, drill a No. 41 hole through barrel and strip; countersink to approx. $\frac{1}{16}$ in. depth × 60 deg. on the outside and remove all ragged edges from both sides of the hole. Grip a length of 1 in. square or $1\frac{1}{2}$ in. × $\frac{3}{4}$ in. steel bar in the vice with approx. 1 in. protruding horizontally, put a $\frac{3}{32}$ in. dia. × $\frac{1}{4}$ in. long snaphead rivet through the hole from the inside and sit the rivet head on the "dolly" bar. Use a rivet set to ensure the strip and barrel are in close contact and knock down the protruding rivet shank into the countersunk hole. Repeat the above procedure at approx. ½ in. pitch until the strip is completely riveted to the barrel. Hold the throatplate in position and bend over each tab, tapping down to give good contact; roughen up the flanges of the throatplate with a coarse file to give the silver solder a good key, clean up the surfaces in contact with the barrel and tabs then clamp into position, on the outer tabs. In the centre of the middle tag drill No. 41, continuing through the throatplate, countersink the outside; then with the dolly held vertical in the vice, again about 1 in. projecting, insert a 3/32 in. dia. rivet, hold the boiler barrel vertical over the dolly and rivet; repeat for the remaining tabs. At this stage the joint is very fragile so take care not to distort it.

At the front end of the outer wrapper 3/16 in. in from the edge on the centre-line drill a No. 41 hole, place the wrapper on the barrel with ⅜ in. overlap and drill through. Clean up a 1 in. strip of the wrapper all round the inside and fix to the barrel with a 7 BA bolt. At ½ in. pitch on either side of this bolt drill further No. 41 holes and fit bolts; remove the first bolt, countersink the wrapper and rivet; this time the dolly is held horizontally with approx. 5 in. protruding from the vice and the wrapper is laid over the dolly.

Take care not to damage the temporary bolt heads also make sure that the rivet head is in good contact with the dolly. Repeat the process at ½ in. pitch until the join with the throatplate is met, keeping the front edge of the wrapper against the machined spigot on the barrel. If trouble is experienced with the 7 BA bolts breaking (I have had this problem), use a No. 30 drill, 5 BA bolts and ⅛ in. dia. rivets.

Clamp the bottom of the throatplate to the wrapper and check positions of the next rivet pitches in order that they will locate nicely into the throatplate flanges; the dimension will be approx. 15/16 in. from the wrapper edge and in the other direction must not be too close to the throatplate ears. Carry on the bolt and rivet technique until the last rivets are not less than ⅝ in. above the bottom edge of the throatplate, if they are much lower trouble will be experienced in fitting the foundation ring; tap down the wrapper onto the throatplate below the last rivets if necessary.

All is now ready for the first brazing operation, so perhaps a few remarks on my own meagre equipment would not be amiss. The brazing hearth is a sheet of ½ in. thick asbestos millboard placed on top of an old dustbin, nothing more elaborate, heat being provided by my old friend the five-pint blowlamp. The pickling tank is discarded porcelain sink with the plug hole blocked up. Regarding the sulphuric acid pickle, I can only suggest one acquaints a local chemist with one's needs. My source of supply has been a local garage, the correct dilution of this acid being 8 : 1, but on my last visit I was informed that all batteries were now delivered charged and acid would no longer be held in stock; the proprietor did however find just sufficient for my needs at that time. One point to be remembered when diluting is that acid must be added to water *not water to acid.*

Incidentally my aforementioned friend uses a small tin trunk filled with coke as a hearth and a plastic container for a pickling tank. My plastic bucket got too close to the blowlamp one evening, hence the sink.

Silver solders

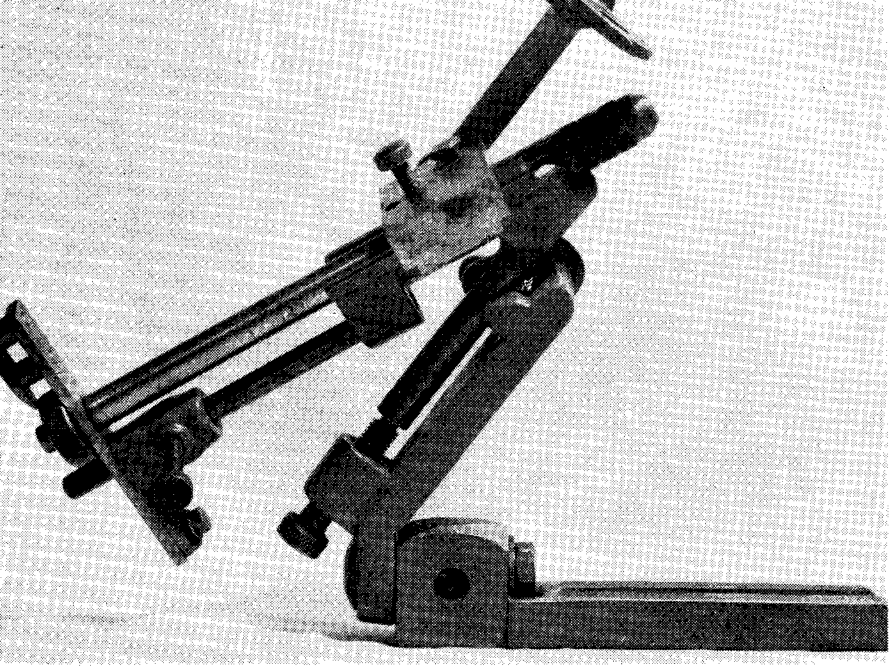
For silver solder I would recommend Easyflo throughout for beginners, with the appropriate flux; mention of flux, this can now be mixed up into a fairly watery paste, just sufficiently stiff so as not to run all over the place when smeared liberally around the barrel and throatplate joints, inside and out. At the same time the dome bush can be refitted, fluxing liberally but not on the top surface of the bush or Easyflo will do as its name suggests and spread onto this jointing face.

For a first attempt at brazing, it is best to choose a calm dark evening. Stand the boiler, barrel upwards, in the brazing hearth and light the blowlamp. When the flame has turned blue with a yellowish periphery, not before or a sooty deposit will form and ruin our chances of success, play the flame all round the barrel and throatplate joint until the copper begins to glow a dull red. Hold a stick of solder momentarily in the blowlamp flame, dip into some flux powder, then direct the flame onto a bottom corner of the throatplate. Move the flame along the joint, feeding in the solder; if the copper is clean and at the correct temperature the solder will run easily around and through the joints. Take special care between the throatplate and barrel to get a little fillet of solder to build up in the corner.

Transfer the flame to the dome bush and surrounding copper; when heated to a dullish red, the solder should run right round the joint in one go. Up-end the boiler with an old pair of pliers or tongs and check that the solder has penetrated right through the joints including around the tabs, if not, reheat and feed more solder into the offending spots. Finally return the boiler to its original position and recheck.

The boiler is now pickled; grip with the pliers or tongs and lower carefully into the pickling tank.

To be continued.



SHARPENING SMALL DRILLS

by S. U. Belsey

CONSIDERABLE quantities of learning have been expended on the mathematical differences between "small" and "very small," but anyone who has drilled a $\frac{1}{16}$ in. hole and then proceeded to try a No. 80 could supply all the practical details that a mathematician would require.

It may seem rather illogical to discuss sharpening small drills without dealing with a drilling set-up, but keeping tiny drills in good condition is far more difficult than drilling, so I will describe my own sharpening methods.

Several types of drill-grinding jig use a V section pivoted trough in which the drill is secured and presented to the grinding-wheel. The trough rotates about an axis which passes slightly to the left of, and at an acute angle to, the drill axis. This arrangement produces two cone-shaped faces at the drill point which intersect at the axis, and have the desired included angle and backing-off angle. The consequence of this arrangement is that the longer the drill being sharpened the further out from the tip of the trough is the point of the near-intersection of the pivot and drill axes. It follows from this that if a method could be found of keeping all sizes of drills at the same distance from the bottom of the trough, satisfactory sharpening would be

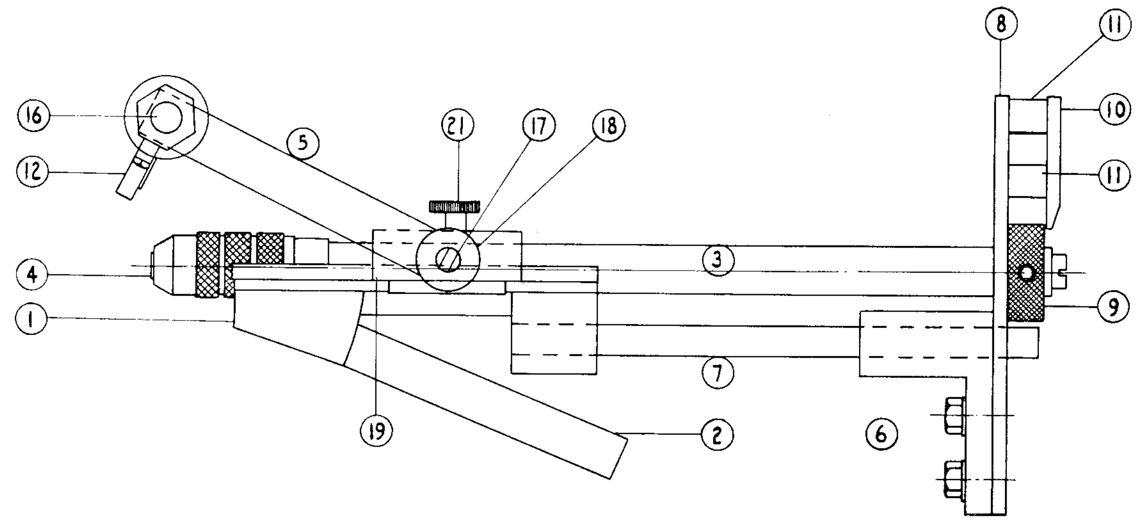


Fig. 1
DRILL GRINDING JIG

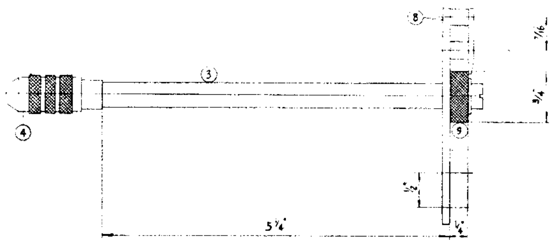


Fig. 2

secured by fixing their points at the same distance from the end of the trough.

In my modified jig, the small drills are secured in an Eclipse pin chuck, the shank of which is fixed in a $\frac{1}{4}$ in. diameter hole accurately drilled down the centre of a piece of $\frac{3}{8}$ in. dia. silver steel rod. The trough unit came from a "Reliance" No. 1 drill grinding jig. The pin chuck is secured so that the tip of the drill occupies the exact point which would be occupied by the tip of a $\frac{3}{8}$ in. drill if this was being sharpened. The angular position of the drill is exactly parallel to that of a correctly-aligned $\frac{3}{8}$ in. drill. The means of setting the small drill correctly into position will be described later.

The general arrangement of the device is shown in Fig. 1. The trough is shown at 1 and the pivot spindle at 2. The drill-holding device is shown at 3 in this drawing and separately in Fig. 2. The Eclipse pin chuck is shown at 4. It is fixed by drilling an axial hole in the end of a piece of $\frac{3}{8}$ in. round silver steel, $\frac{1}{4}$ in. dia. and $1\frac{1}{2}$ in. deep. The hole and chuck shank are well tinned with solder, and the chuck shank is sweated into the hole. It will be necessary to use Baker's Fluid for this job, so the completed unit will have to be boiled afterwards. The piece of silver steel is parted-off $5\frac{1}{2}$ in. long and the free end is turned down to $\frac{1}{4}$ in. for a

Fig. 4

length of exactly $\frac{3}{8}$ in. This end is drilled axially No. 26 and tapped out 2 BA using a high-speed steel tap.

The axial setting of the drills in the original device is done by a back-stop 16 which slides upon a rod 7. This back-stop is used for axial setting of the complete drill-holding device by inverting it and bolting to it a 3 in. length of $\frac{1}{2}$ in. $\times$ $\frac{1}{8}$ in b.m.s. strip, as shown at 8 in Figs. 1 and 2. A clearance hole is drilled in the strip to allow it and the back-stop to pass freely along the rod 7. A hole is now required in the strip to take the reduced end of the holder-unit 3. This hole must be exactly aligned upon the end of the holder-unit. Therefore, the assembled back-stop and strip are moved up the rod 7 as close as possible to the trough. A $\frac{3}{8}$ in. drill is laid in the trough, point touching the strip, and given a sharp tap on the end of its shank. The point of the drill neatly marks the spot for the hole, which is drilled $\frac{1}{4}$ in. If the holder unit is now placed in the trough in its operating position, it can be located axially by putting the back-stop onto the rod 7 and slipping the reduced end of the rod

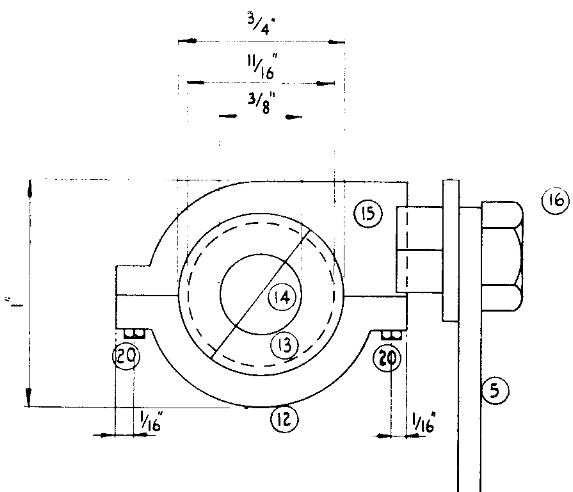


Fig. 3

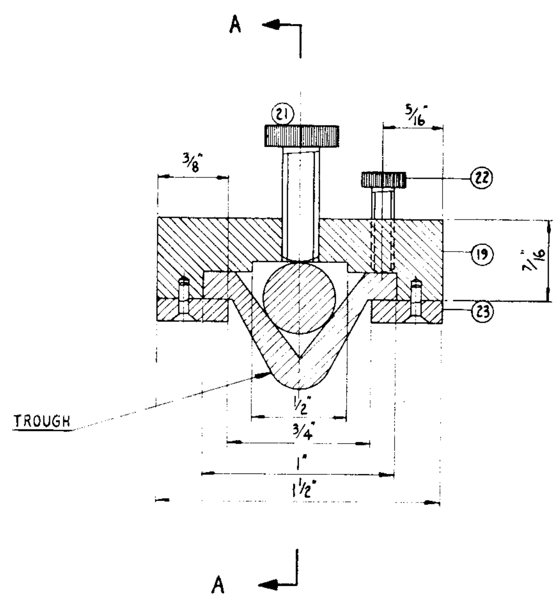


Fig. 5

SECTION B.B.

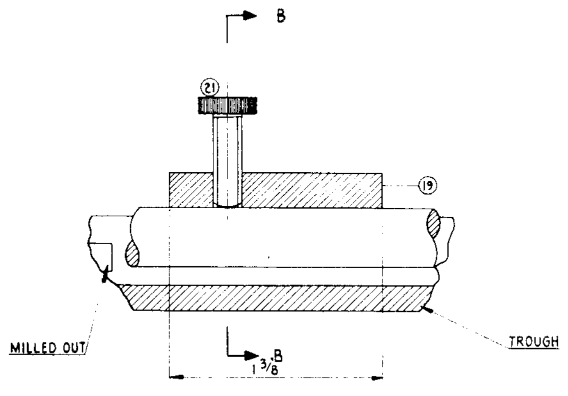


Fig. 6

SECTION A.A

into the hole in the strip. The means of keeping the full-diameter part of the rod in contact with the strip will now be described.

A disc of steel 9, ¼ in. thick × ¾ in. dia., is turned up, knurled and drilled centrally ¼ in. dia. While it is in the lathe a line is scribed right across its diameter. The purpose of this scribed line will be explained later.

With the end of the rod fully inserted into the hole in the strip 8, the disc is slipped over the protruding length of the holder unit. It is important that the disc should rotate freely on the rod, but with complete absence of end-shake. For this reason a 7/16 in. washer 10 is secured by means of a 2 BA bolt 11 in close contact with the end of the rod 3. If this action locks the disc against the strip, the thickness of the disc must be reduced until it just turns freely. Conversely, if end-shake is present between the disc, washer 10 and strip 8, the end of the rod 3 must be faced-off until the end-shake just vanishes.

When the disc has been satisfactorily fitted, a No. 26 hole is drilled diametrically into the disc and tapped out 2 BA to take an Allen grub-screw. Incidentally, a small pad of brass inserted into the hole beneath the grub-screw will prevent indentation in the rod.

A pointer 10 is screwed to the strip 8, through two distance pieces 11, the thickness of the distance pieces being such that the tip of the pointer 10 just clears the face of the disc 9. A scribed line is made down the centre of the pointer. It will be seen that locking the back-stop 6 upon the rod 7 locates the drill-holder unit axially, but allows it to turn freely.

The initial position of the drills for sharpening is fixed by using the "peep-sight" shown at 12 in Fig. 1 and enlarged in Figs. 4 and 5. Before giving full dimensions the device and its operations will be described. The "sight" itself consists of a brass ring 13, diametrically across which is fixed a thin steel wire 14. The edge of the ring is knurled and has a circumferential groove which fits over a ridge in the split clamp 15. The enlarged views in Figs. 3 and 4 will make this arrangement clearer.

The ring and its clamp are soldered to a 0 BA bolt 16 which passes through a hole in the arm 5. The arm 5 is pivoted on a stub 17 which is threaded to take a knurled clamp-nut 18. If the stub is made 3/16 in. dia. the clamp-nut 18 can be made 2 BA and it will be found that a double-loop spring washer between the clamp-nut and strip will provide an excellent friction hold for the complete peep-sight and strip. The stud is screwed into the sliding block 19 which can be slid into any desired position on the slide-ways at the top of the trough and fixed by the brass 4 BA set-screw 21.

Setting the sight

The first rather paradoxical job to do in setting the peep-sight is to remove the arm and its sliding block from the trough, together with the drill-holding unit. Next, a ⅜ in. drill is secured in the trough according to the maker's instructions. As a check it is sharpened as usual and left clamped in place. The point is inspected for satisfactory backing-off and symmetry, and if it is in order, the sliding block and sight are slid onto the trough side-ways. The sight is aligned with the tip of the drill and the block is moved until the steel wire 14 just touches the tip of the drill. The sliding block is now locked in place by means of the set-screw 21. The split clamp gripping screws 20 and the setting up of the peep-sight is now complete.

It will be clear now that any size of drill held in the pin chuck 4 of the drill-holder unit, with its tip touching the wire 14 and its lips parallel with it, will be in the correct position for grinding over half the tip. It is necessary to produce an exactly symmetrical point, and this is where the scribed disc 9 does its job. The drill-holder unit is clamped in place by means of the set-screw 22, and one side of the drill tip is ground. To make sure that the drill and holder are turned through exactly 180 deg. for the second tip to receive attention, the Allen screw in the disc 9 is slacked off, and the disc is rotated until the scribed line lines up with the line on the pointer 10. The Allen screw is locked up and the set-screw 22 is eased off. Axial alignment is preserved by locking the back-stop 6 by its own set-screw. Now, turning the disc 9 until the other half of the scribed diametral line aligns with the line on the pointer 10 will turn the holder-unit and drill through 180 deg., and the drill will be ready for grinding the second face.

It may be mentioned at this stage that it will be necessary to run the grinding wheel in the opposite direction to the usual when sharpening very small drills as the point of the little drill will probably catch on the wheel and snap off if the wheel runs " against " the drill.

Peep-sight unit

It is now necessary to describe the dimensions of the peep-sight unit. The foundation of the device is the sliding block as shown in Fig. 1 and enlarged in Figs. 4, 5 and 6. This block started as a block of steel 1½ in. wide × 1⅜ in. long × 7/16 in. deep. The trough in the jig for which this device was constructed was 1 in. wide with slides ⅛ in. deep. Therefore, a groove 1 in. wide × ⅛ in. deep was milled down the centre of what was to be the underside of the block from one of the 1½ in × 7/16 in. faces to the other. To leave a space for the ⅜ in. rod of the holder unit the centre of the block was milled out 1/16 in. deeper over a width of ½ in.

Retaining strips 21 were cut from steel strips 1⅜ in. × ⅜ in. × ⅛ in. thick, and bolted into position as shown in Figs. 1, 4, 5 and 6. The dimensions given apply particularly to a Reliance jig, and may have to be altered to suit other makes. The groove may be milled slightly narrower and deeper than specified, and then the meeting faces A and B, Fig. 5, can be filed away until a close but easy sliding fit is obtained between the block and trough.

The hole for the brass clamping screw 22 was drilled No. 34 and tapped 4 BA 5/16 in. from the side face of the block, so that the clamping screw bears upon the trough slide. The hole for the holder unit clamping screw 23 was drilled No. 26 on the block centre-line and was tapped 2 BA. The holder unit clamping screw was 1½ in. long, 2 BA with a knurled head. The holder unit clamping screw 22 was ¾ in. long and also had a knurled head. The screws were staggered as in Fig. 6 for easier manipulation.

The arm 5 in Figs. 1, 3 and 4 was a 2¾ in. length of ⅜ in. × 1/16 in. b.m.s. strip, with holes 3/16 in. and ¼ in. dia. at 2⅜ in. centres. (The dimensions were not critical.)

The split clamp

The split clamp was made from a piece of ⅛ in. thick brass strip, 1¼ in. long × 1 in. wide. A centre-punch mark was made at the centre of the face of the strip, the strip was fixed in a four-jaw chuck and the punch mark was central. A hole was drilled in the strip and bored out 11/16 in. dia. Next, a " sink " 1/16 in. deep was turned ¾ in. dia. in the face of the strip. The strip was then mounted in a machine vice on the vertical-slide and split in halves lengthwise with a very thin slitting saw.

The two halves of the strip were filed up to the shape shown in Fig. 3 which can be simply described as a three-quarter circle with lugs ⅜ in. long. The clamping pressure was applied by means of two 12 BA set-screws 20, and to locate these screws the two halves of the clamp were soldered back together and the screw-hole positions were centre-punched 1/16 in. and drilled No. 42. The holes in part A, Fig. 3, were opened out No. 55, and three in part B were tapped out 12 BA.

To make the peep-sight itself a piece of 1 in. b.m.s. was clamped in a 3-jaw chuck and turned down to ¾ in. It was knurled for a length of ⅜ in. At 3/32 in. from the outer end a 1/16 in. wide groove 1/32 in. deep was turned with a parting tool, leaving a reduced diameter of 11/16 in. A hole ⅝ in. dia. was drilled into the rod and a ring ⅛ in. thick was made by parting off a length ⅛ in. long.

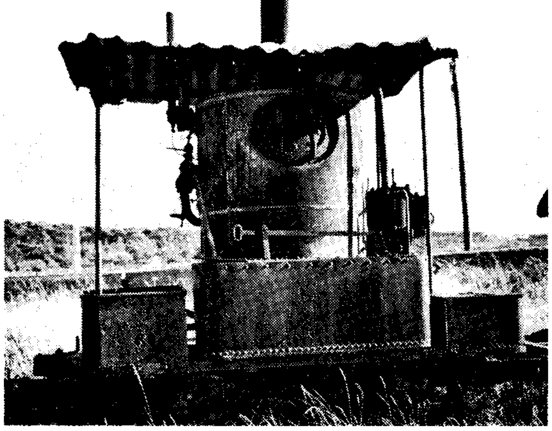
It will be appreciated that the operation of sawing the split clamp in halves had reduced the diameter of the centre hole by the thickness of the saw blade. Therefore, the clamp was assembled and the centre hole was filed out carefully until the sight ring was just firmly held in place in the clamp with the 12 BA screws 20 screwed up tightly. The clamp was fixed to the head of the OBA bolt 16 so a shallow groove ⅛ in. wide was made in the bolt-head and the part B of the clamp was soldered into place.

The aligning wire

The aligning wire 14 had to be made of hard steel so a piece of Bowden cable was unstranded and a piece of one strand was cut off. Bowden wire is made with the individual strands prespiralled, so to soften and straighten the strand it was connected across a six-volt battery until it glowed a dull red. A slight pull straightened it out. The connection was made by fixing one end in the vice. A piece of heavy flex with alligator clips was connected, one clip to the vice and the other to the free end of the wire. It was found that the simplest arrangement was to connect the flex to the battery first, and leave the free end of the wire connection last. As soon as this connection was made, the wire smoked due to surface oiliness, and then began to glow dull red. A gentle tug at the alligator clip straightened the wire and it was at once disconnected.

The strand was hardened and tempered blue. To fix the strand across the sight-ring 13 a diametrical groove was sawn across the face of the ring with a piercing saw, and the wire was soldered into it.

The chuck is slightly over ½ in. dia. and it must be accommodated inside the trough for part of its length so the end of the trough was milled out to 9/16 in. dia. about the axis of the holder-unit rod, to a depth of ¾ in. ■



A French Vertical-boiler Locomotive

discovered abondoned near Biarritz by William Whitman from Florida

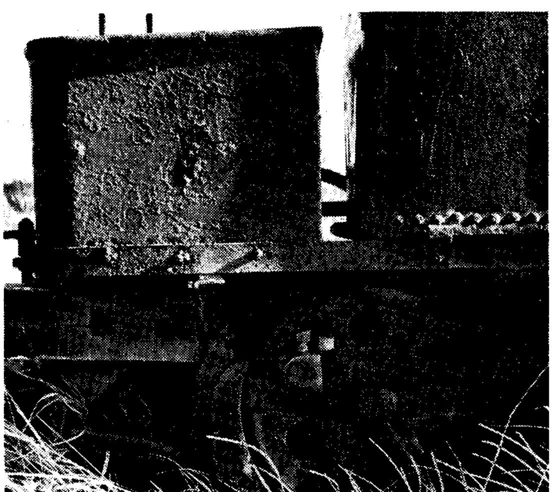
TWO YEARS AGO during a stay in France I happened to visit an inlet known as " La Barre," which is located six kilometers north of Biarritz. Here on the south side of the river, where the jetties end, I noticed what I thought to be the chimney of a boiler, the top of which just protruded above a vertical wall. Closer inspection proved this to be correct, the chimney being a part of an 0-4-0 vertical boiler locomotive that had been used to build the original jetties.

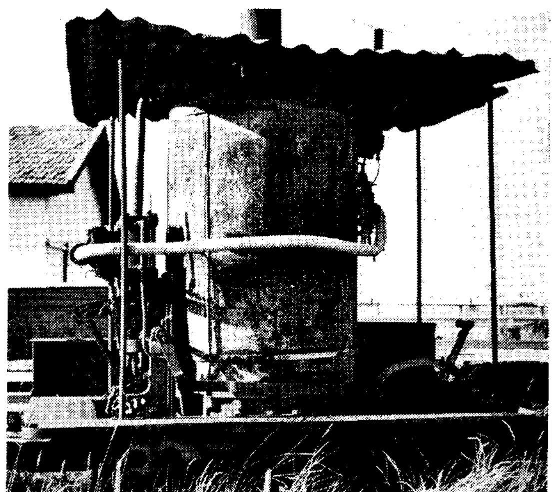
My next move was to obtain permission to photograph this quaint and simple engine, a request that was granted by the government employees living on the grounds adjacent to the engine. This picture taking having been accomplished, I returned to Biarritz with my exposed film and tried unsuccessfully to locate an English or American steel tape reading in inches and feet. As a last resort I purchased a French metric tape and spent an afternoon taking the locomotive's measurements. To be certain of not misplacing and losing these I mailed the paper with the dimensions back to my U.S.A. address, but kept the exposed film. Much to my surprise and consternation the 0-4-0 dimensions were never seen again, apparently having gone astray in the international post.

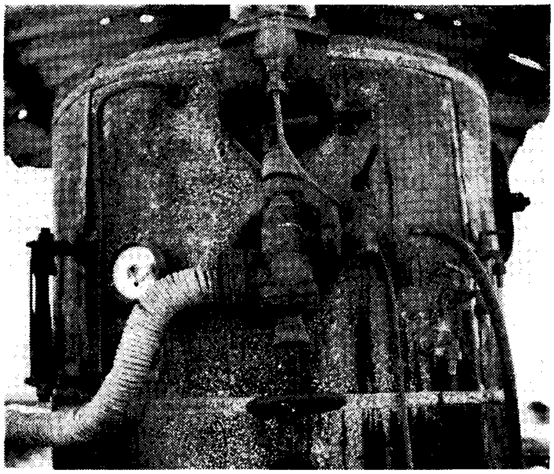
This past summer I was fortunate in being in France again and took the opportunity to visit the inlet of " La Barre " a second time. I soon found my old friend, the little 0-4-0 contractor's engine but alas, with the rising price of copper and brass, people had stripped the boiler of valve fittings as well as disassembled the motion and rods to obtain other nonferrous items. While this enabled more exact dimensions to be taken, it detracted greatly from the engine's appearance. Armed with a tape reading in inches and feet, that I had brought from the U.S.A., I soon retook all the measurements I had recorded two years before. Taking no chances this time I locked the paper bearing the measurements in my suitcase and successfully got it home upon my return to America.

I think this little 0-4-0 contractor's locomotive would be a quick and easy one to model. In the smaller gauges the Stuart Double 10 engine should work reasonably well. The photographs were taken as the locomotive appeared two years ago, prior to being stripped for brass and copper. Fairly complete dimensions are submitted below for those who may be interested in modelling this simple engine.

Track gauge:
3 ft. $6\frac{1}{2}$ in.







Pressure gauge, main steam valve and whistle.
Right: The reversing lever.

Overall Dimensions:

Overall length not including buffers 7 ft. $6\frac{3}{4}$ in. Overall width 5 ft. 3 in. Overall height to top of chimney 9 ft. $8\frac{1}{4}$ in.

Platform:

Non-skid diamond pattern. 3 in radius on rounded corners. Raised $1\frac{1}{4}$ in. lip around most of its perimeter. Distance from rail head to top of platform 1 ft. $8\frac{3}{4}$ in. (Not including raised lip.)

Sunken floor opposite firehole door:

1 ft. $3\frac{1}{2}$ in. below non-skid diamond platform.

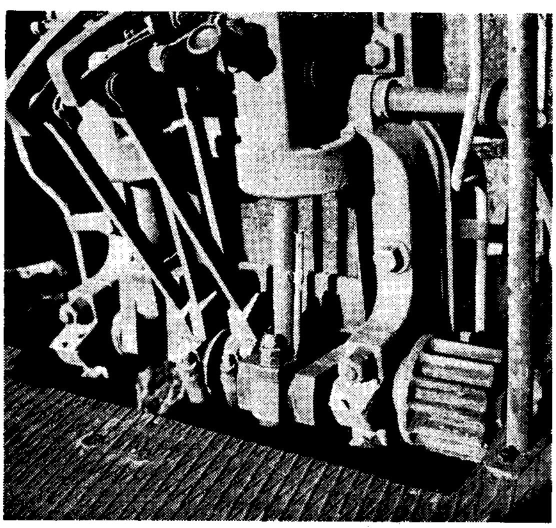
Wood buffers:

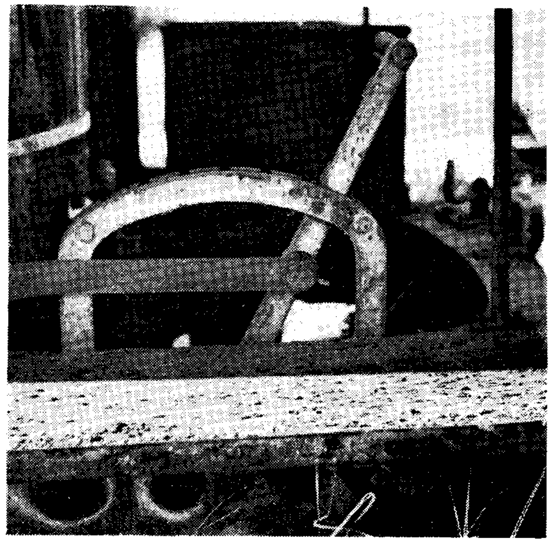
5 in. square.

Boiler:

Outer shell diameter $38\frac{1}{2}$ in. plus $1\frac{1}{2}$ in. lagging. Sides 6 ft. $7\frac{1}{2}$ in. (This includes firebox.) Straight

Below: Close-up of the motion.





sides of boiler extend 5 ft. 1 in. above platform. Boiler extends 1 ft. $6\frac{1}{2}$ in. below platform. Top of firebox located 4 ft. 5 in. down from top of boiler. Firebox has "hanging tubes" design. Top of firehole (9 in. wide × $8\frac{1}{2}$ in. high) 4 ft. 5 in. from top of boiler. Inspection plate oval 1 ft. 2 in. × 10 in. with 2 in. wide reinforcing ring.

Curved smokebox dome:

Extends $3\frac{1}{2}$ in. above straight sides of boiler.

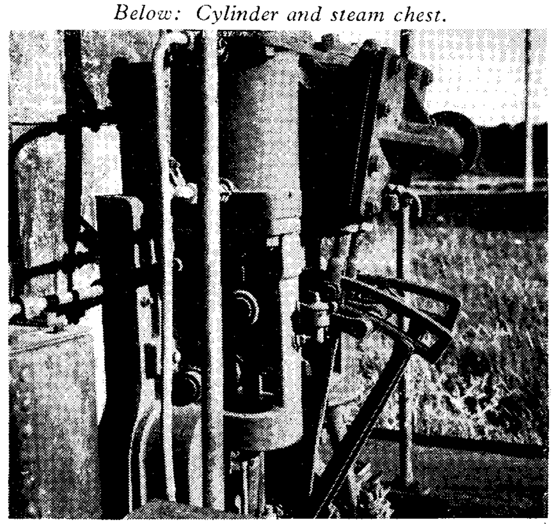
Chimney:

9 in. dia. × 2 ft. 7 in. overall length.

Engine:

Twin cylinder simple. Fitted with reversing gear. Bore $5\frac{5}{8}$ in. with $3\frac{1}{2}$ in. stroke. Cranks at 90 deg. Small drive pinion 12 teeth. Large drive pinion (on leading axle) 40 teeth.

Below: Cylinder and steam chest.



CHINGFORD CHANGE

K. S. Lane describes the rebuilding of a well-known track

FOR MANY YEARS the Chingford Club had debated whether to repair or replace their multi-gauge track at Ridgeway Park which has stood some 20 years.

Before a decision could be made, several club tracks were visited and with their assistance different types of construction were noted. Armed with this information the following points could be discussed to reach a verdict which the whole club would accept.

The first point was whether the old track was worth repairing, and on this the club was unanimous. The track had given good service but due to its construction it was virtually impossible to repair. The second point considered was whether the club could afford a new track. This was to take a good 12 months of club effort to augment the financial reserves of the club, so that cost did not restrict the scope of design.

The third point was to become a gamble on the weather, and a gamble as to whether we could complete a specific section within the allowable time. This was important, because the track has to operate every Sunday afternoon between Easter and the end of September and as none of our club members were professional hole diggers it was difficult to put a time limit on the project.

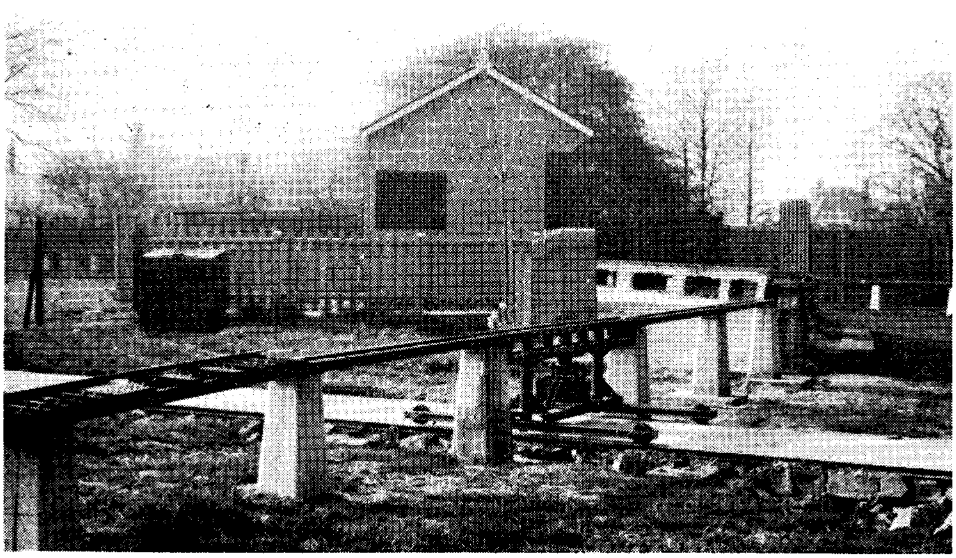
It was found that at approximately one-third of the way round the old track, the new and old levels matched and that this was the point which had to be reached so that public running could commence Easter Sunday. We were, in fact, to be some two weeks late in opening due to an unforeseen delay caused by replacement of the old club workshop by the local authority, which involved removal from the old building of all the club equipment and its dispersal for about eight weeks.

The work was split into two groups, that to be carried out in the workshop and the outdoor work. All welding, drilling, tapping, sawing and painting, etc., was carried out by members who were not able to have a go at the heavy work. The outdoor work consisted of mainly digging, demolishing the old track, removing many tons of rubble and earth and concrete mixing.

With a design now decided upon, we purchased seven tons of British Rail point rodding and a 240 volt portable generator. Two club members loaned a concrete mixer and electric arc welder which have been in constant use since the start of the project. Jigs and moulds were made to the selected design and all was now ready to put our plans into operation.

The track was surveyed to determine all levels, using the station section as the datum.

Work started some 18 months ago whilst the old track was still in operation. This was accomplished by taking a slightly larger radius out of the

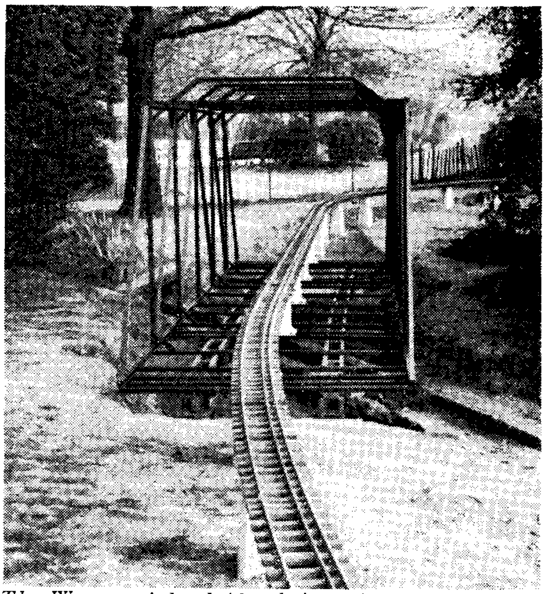


This picture shows the start of the new track and the station section which will be the last to be completed. Note the transporter, the sidings for which were completed last summer.

station. The construction decided upon is shown in the accompanying drawing.

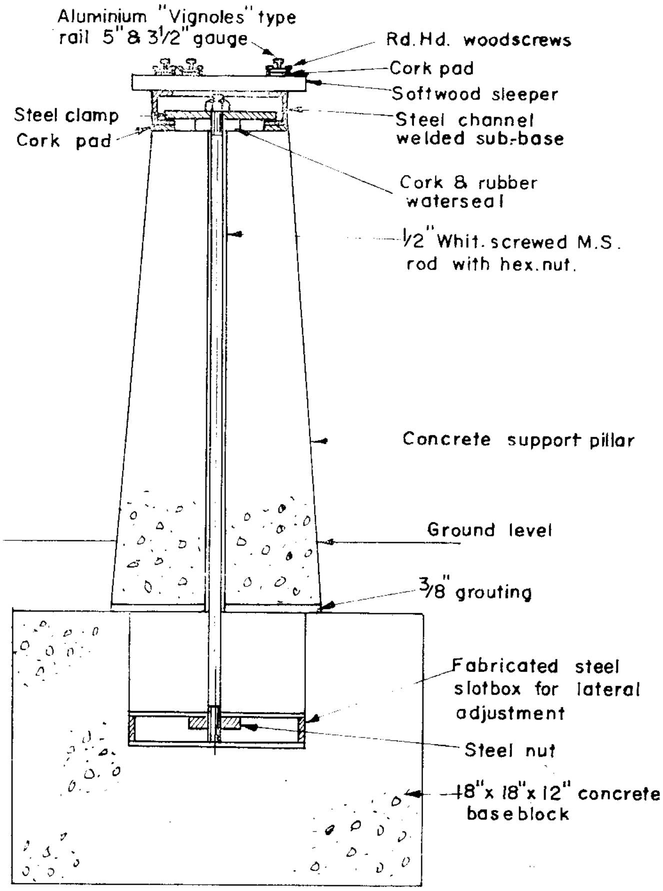
The slot box set in the concrete is constructed from the point rodding with part of the old track forming the ends and 16 gauge strip steel welded in position to prevent concrete penetrating the centre. The nut which slides on the inside is made from ½ in. × 2½ in. x 3 in. mild steel and has a ½ in. Whit. hole tapped in the centre.

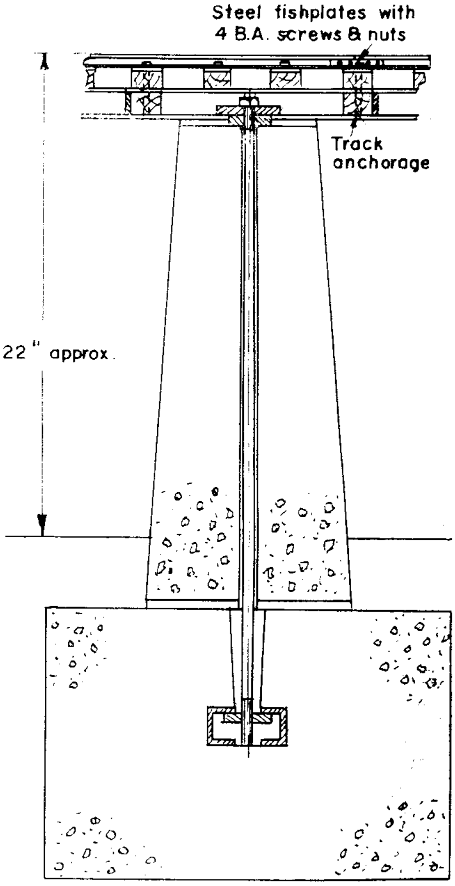
After casting, a ½ in. dia. rod is screwed into this nut and set into position. Having set the position, the slot left in the concrete was filled with sand so that in years to come it will be possible to get to the unit by simply removing the sand. The top of the concrete base was now ready to receive a layer of grouting which was adjusted to give the required height. The pillars which were to be set on the grouting were previously cast in steel moulds. These were cast in batches of eight and have a steel tube cast in so as to allow the ½ in. dia. rod to pass through. These moulds were cast well



The Warren girder bridge before the temporary floor was laid.

Below: These drawings show how the new track was constructed.





in advance and were left in the mould for at least two days before being withdrawn. During the period when these moulds were being cast one mould was altered temporarily to cast the modified pillars used in conjunction with the transporter. Some weeks after the pillars had been set, the pre-welded beams which support the sleepers were set on the pillars with a layer of cork between the pillar and steel beam and clamped by means of a ½ in. thick plate using the ½ in. dia rod projecting through the pillar.

The running track was laid in one concerted effort, to 3½ in. and 5 in. gauges. This is an aluminium alloy Vignole section and has a layer of cork betwen the rail and sleeper to minimise electrolytic corrosion. This is held in position by means of two screws per rail per sleeper. The track sections are joined by plated steel fishplates. It was found that by having all the sleepers jig drilled, when the master sleepers were laid in position the rail took a natural radius and did not require any preforming.

To ensure that as many errors as possible were eliminated, the following procedure was adopted. Holes approximately 18 in. cube were dug at 5 ft. intervals on the premarked alignment. Into this was set a frame supporting the slot box with the adjustable sliding nut. It was decided that a maximum of four would be set each week, weather permitting, so that any error in these bases could be eliminated within the movement allowed within the slot box. After the first four bases had been set we always grouted in the pillars for the previous week's bases first so that the alignment did not acquire an accumulative error.

Whilst all this work was going on, there were two other projects concerned with the track that were beginning to take shape. One was the transporter and sidings and the other was a 24 ft. Warren girder bridge.

The transporter is the four-wheel type with a hydraulic jack to raise the track from the resting position. Upon leaving the main line this gives access to three 6 ft., four 10 ft. and one 100 ft. sidings. The 100 ft. siding is mainly for use as a test track so that any engine can be adjusted or tried out without interfering with the main line when in use. At a later stage it is possible that one of the other 10 ft. sidings will be taken through the station to give double line effect.

The Warren girder bridge was quite an interesting project. Two 24 ft. box girder beams were made out of point rodding. The design was worked out to see if they would take the load, and in actual working conditions deflect $\frac{1}{16}$ in. at the centre with a 5 in. gauge Atlantic and train fully loaded with adults. With the design mathematically correct the beams were welded as designed. The beams were to rest on two concrete blocks 4 ft. x 2 ft. × 5 ft. deep and clamped with ⅛ in. thick plates. The superstructure was made at one of the club member's homes and this was completely fabricated, this arrived at the track in a van and was assembled during the Easter holiday. A temporary floor was laid and together with the pond underneath are to be completed at a later date.

Work has been carried out through the summer and into the winter, at times after nightfall, under arc lights from the generator, so as to be ready for Easter running. Although there is still a lot of hard work ahead we should be able to commence running on time, although we have not yet had time to make our enclosure as pleasing to the eye as we would like. We will again have to run on part of the old track for about 200 ft. which will have to be replaced next winter.

Even with all this work going on, the club members found time to overhaul the club engine and build a new boiler for it and make another passenger trolley to add to the set already in operation.

The whole operation of replacing our track has meant a lot of hard work for a lot of people. The track will be finished next winter, which will leave the tidying up of the enclosure, automatic signalling and safety rails for the passenger trolleys to be fitted. ▣

Early Aircraft Engines

Continued from page 441

the article; it should enliven their declining years !

As Mr Westbury implies, the early *Système Canton-Unné* involved the use of a ball-bearing ring or drum embracing the crankpin, to which all the equal sized connecting rods were jointed. An added arrangement aimed at imparting to this central member a motion that would ensure " true geometric movement of all connecting rods around the crankpin." One would have been happier however, to see these comments followed by a statement that, while this was one expedient used in an attempt to produce the geometrically ideal radial or rotary engine, it is the early compromise arrangement of master and articulated rods adopted by the brothers *Seguin* and others, which, despite certain drawbacks, has survived the test of time.

Although students of aeronautical history may not form a very large part of your readership, I think you owe it to them, to Mr Westbury and to your own magazine, to insist that the series does not continue unless it is based upon careful research (preferably from sources in addition to the Chalais-Meudon catalogue), an exercise which may well eliminate the necessity for such expressions as " possibly," " probably " and " believed to be " in qualification of statements which, to the best of my knowledge, are relatively easy to verify.

Wimbledon, S.W.19. M. P. Sayer.

A TALE OF TWO PANNIERS

by G. Marden

Continued from page 388

CONTINUING with my description of how I modified the rocker shaft arrangement . . . the jig lever was adjusted until equal port opening was obtained, after which it was securely clamped to blank C by two small toolmaker's clamps. Blank C and the jig lever were now dismantled from the rocker shaft, still clamped together, and hole F in the jig lever was used as a guide to drill blank C. Next, the outline of the lower rocking lever was marked out on blank C and was sawn and filed to shape, relative to the square and round holes. Finally, the 4 BA thread on the rocking shaft was continued to the square shoulder and $\frac{1}{8}$ in. was cut from the outer end of the thread. Thus, it was now possible to assemble the lower rocking lever on its square with certainty that the relative angular position of both levers was correct.

The steam brake works well and locking of the driving wheels can be avoided by working the brake lever to and fro like a pump handle. One engine has an "O" ring on the steam brake piston and the other piston is packed with $\frac{3}{16}$ in. square graphited yarn. There is no noticeable difference in the performance and presumably the useful life will determine which is the better. "O" rings are also used in the water gauges and they are satisfactory. An auto-drain valve (Fig. 8) is fitted close to each brake cylinder at the lowest point in the steam pipe. It consists of a ball valve, the ball of which drops off its seat by gravity, allowing any accumulated water to drain away but when a brake application is made, the flow of steam through the drain orifice carries the ball upwards on to its seat and permits steam pressure to build up within the brake cylinder.

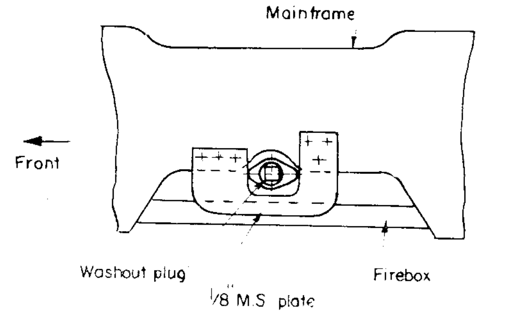


FIG. 9

The boilers differ from the "words and music" in two respects. The throatplate is double flanged to receive the barrel and the firebox stay size is increased from 4 BA to 2 BA. Full size welded steel boilers usually have unflanged plates butted together and it is not implied that there is anything wrong with LBSC's design. However, if there should be a local lack of penetration on the bronze welding (joints are not X-rayed in 1 in. scale), the greater total area of a flanged joint must provide a worthwhile margin of safety. Cases have been known of wastage occurring with 4 BA and 5 BA firebox stays and it was thought that the larger 2 BA stays would mitigate the seriousness of this trouble. Nevertheless, the larger threads are more difficult to seal against leakage. The *Pansy* design necessitates cutting away of the frames to clear the boiler washout plugs. Considerable loss of rigidity results, so these engines have been fitted with bracing plates (Fig. 9). If this point had been foreseen,

Continued on page 457

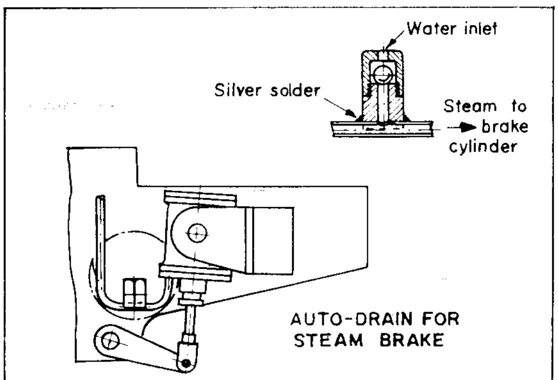


FIG. 8

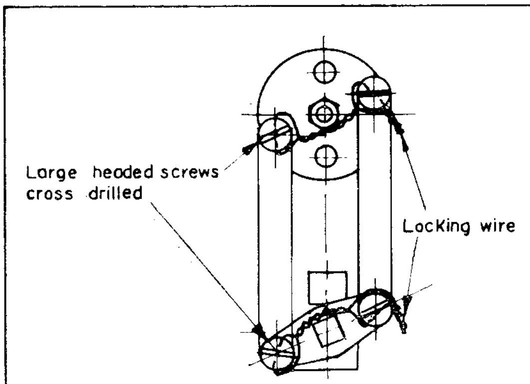


FIG. 10

JEYNES' CORNER

E. H. Jeynes makes some research into the origin of Thermic Syphons

THE NICHOLSON thermic syphon has been fitted in model locomotive fireboxes only in the last couple of years or so, Martin Evans saying in Smoke Rings, April 7, 1967, that *Firefly*, which was being finished off by Norman Spink, was probably the first 5 in. gauge locomotive boiler to be fitted with a Nicholson thermic syphon. The late LBSC had tried it without being impressed with its aid to circulation.

Many full-size locomotive boilers were fitted with this device in the United States, it having been introduced, I believe, in the 1930's; but it was practically ignored by the conservative Britain Main Line companies; with the exception of the Southern Railway with their Bulleid Pacific (Gresley fitted one engine only with the syphon as an experiment).

I was particularly interested in the late LBSC's remarks, page 332, April 7, 1967, where he described the fitting work. He says—" Instead of the usual central girder stay on the firebox crown, I cut a narrow slot into which the top of the syphon was fitted and brazed." These words have a particular significance relating to the invention of the original idea, designed and fitted by J. G. Bodmer over 120 years ago to a full-size locomotive on the Dover Railway.

An editorial description in 1845 remarks on the substitution of tapering channels inserted in slots, in the firebox crown, to increase the heating surface, and render the fitting of girder stays to the firebox crown unnecessary. Bodmer, however, did not stop at one syphon, he fitted five, having a shallow one in the centre with deeper ones on each side, his idea being not only to increase the steaming quality of the boiler, but also to prevent the collapse of the crown through carrying the water accidentally at too low a level, which was the cause of so many boiler failures in the early days.

Here is what that editor of long ago had to say: " Actually, the extra water spaces in the new crown-corrugations are fitted in slots cut in the firebox crown and end, and enriveted with angle bar, they are also stayed. These extra water spaces taper slightly in width so as to allow easy escape of steam, and, of course, are open at the end and upper surface. This arrangement is found to answer a double purpose, namely, the getting up steam in a much shorter time, also rendering the heavy girder stays on the crown of the box unnecessary; also the staying of the top of the box to the shell.

" The great depth of the water spaces in Mr Bodmer's firebox offers additional security against accidents, with little if any additional weight. We may add that this is not a mere speculative idea, as a very powerful engine fitted with this improvement has been running on the Dover Railway for some time with success."

Rapid circulation

It appears that Bodmer was in complete agreement with Bourne on the subject of rapid boiler circulation, but carried his ideas of economy further; the well-known " Meyer " expansion valve gear was founded on Bodmer's right and left-hand screw thread adjustment. One of Bodmer's inventions in this line was a piston-valve, having a concentric cut-off valve; this could be adjusted while working, from outside.

In conclusion, I would say that the advantage of even this crude syphon had been grasped by

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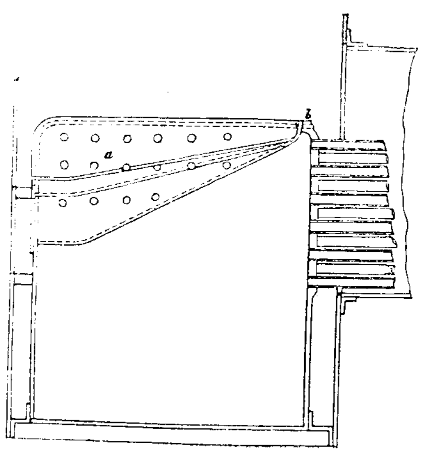
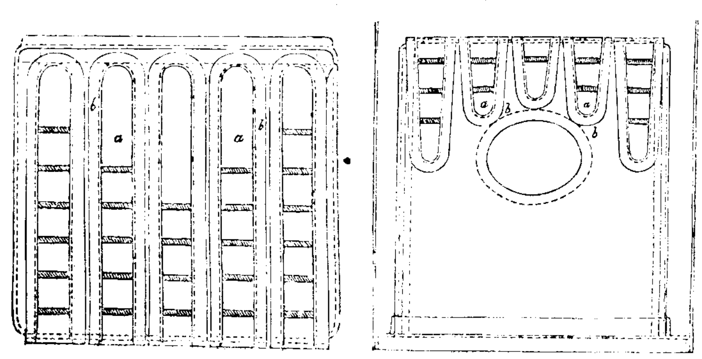


Below: J. G. Bodmer's improved firebox.



TWO PANNIERS

Continued from page 455

the shape of the frames would have been modified to allow access to the washouts through holes. The pivot screws for the regulator, which is sealed inside the boiler, have been turned with large heads and are cross drilled to permit wire locking (Fig. 10). A screw slackening off and dropping into the boiler would be awkward, to say the least!

Sub-assemblies such as cylinders, wheels on axles, die blocks in links, etc., were put together and stored until nearly all the parts were ready for final erection. This avoided cluttering restricted workshop space with large half-built locomotives for years on end. Atmospheric corrosion was reduced because each sub-assembly was painted (where appropriate) prior to storage. Continuous assembly, as components are manufactured, often results in many pieces, which should have been painted, remaining bare metal—this happened with *Purley Grange*. The disadvantage is that current progress cannot be inspected with the sobering thought that: "This much has been achieved but there is still a long way to go!" The engines were finished with six heavy coats of Humbrol G.W.R. green enamel, each coat being stoved for 20 minutes at approximately 120 deg. C, after which it was rubbed down with fine emery cloth. The final coat was scoured with chrome cleaner and then treated with a high grade wax polish. The result is surprisingly good. M.E. "Great Western" transfers were applied to the pannier tanks and proved most successful. These transfers must be positioned correctly first time and this was readily accomplished as follows: The transfers were trimmed to $\frac{1}{16}$ in. all round the lettering of each word, then "boxes," having the same dimensions as the trimmed transfers, were drawn on the tank sides with a soft pencil, so that the transfer could be aligned against its appropriate pencil box before being pressed down. After setting, a surface protection was given to each letter with Humbrol clear varnish; the pencil lines were removed later with a damp cloth.

During construction, LBSC was consulted from time to time and he was kept informed of progress, including steaming of the locomotives in an unfinished state, but before the job was completed his sad demise from our ranks occurred.

So much for building two identical engines simultaneously. There is much to be said for it on a basis of the result accomplished compared with the effort expended, but, to the real steam man, perhaps the greatest satisfaction is contemplating and driving not just one but *two* live steamers. The current interest in trading passenger hauling railways may suggest the possibility of keeping one engine and selling the other, but thinking back on the amount of effort and skilled work involved in their construction (and the low hourly rate of pay yielded by present market values) I could not bring myself to do this—besides, with two equally good locomotives how could it be decided which one should go? ■

The late LBSC

SIR,—My copy of M.E. with the announcement of the death of LBSC has just come to hand, having been held up some weeks on account of a postal strike here.

On behalf of the Surrey Hills Steam Locomotive Society may I say how sorry we are to learn of his passing. There are over 80 of us who owe him a great debt of gratitude for showing us that the difficulties of turning, fitting, etc., are not insurmountable. To quote Prof. Sylvanus Thompson in his preface to "Calculus made easy"—"What one fool can do another can."

With an uncanny clarity and a bewitching persuasiveness of style of writing he has tempted the timid beginner to attempt what is—when all is said and done—a perfectly easy task. His lucid descriptions and unorthodox methods have brought many hours of happiness to untold numbers of enthusiasts.

He was another example of "one who disobeys all the accepted rules of orthodoxy and produces a result as good as or better than the accepted method." It is only a near genius who is aware of the short cuts he may legitimately take, and can explain these in simple terms to take the terror away for the tyro.

Though he had critics here, many ultimately came round to adopting ideas and dimensions recommended by LBSC, because, perhaps annoyingly, they worked. His lobby chats were a delight, and it was his inspiration that caused so many clubs, our own included, to be founded.

A number of good writers luckily remain, but the magic touch of LBSC's articles will be missed by many. Our club will long have him in memory. Vale.

Victoria, Australia. R. GRAEME ORR.

JEYNES' CORNER—*from preceding page*

Bodmer (which may not be apparent to those casually looking at a drawing), in that should the water level drop below the crown of the firebox for a short time, no damage would be caused, as water would still pass up the inclined water spaces and spread out over the crown of the box, keeping it from serious overheating. ■

POSTBAG

The Editor welcomes letters for these columns. He will give a Book Voucher for thirty shillings for the letter which, in his opinion, is the most interesting published in each issue. Pictures, especially of models are also welcomed. Letters may be condensed or edited.

Metric system

SIR,—I read with interest your notes on Smoke Rings, March 15, on the forthcoming changeover to the metric system.

It would appear to me that *Model Engineer* has only one choice, and that is to make the changeover to metric. It is important that M.E. keeps up to date with all the new developments in engineering. Not to change over would soon lead to M.E. being considered out of date; not to mention the difficulty for new model engineers in obtaining the old size tools and materials.

Nevertheless, I would like to join with the Editor in wondering if the changeover is really desirable and if it will ever be complete. As for the way in which the changeover will affect the model engineer himself one can only say that it will certainly be expensive.

One important thing that the Editor did not mention is the graduation of the handwheel on the lathe cross-slide. Would it be possible for *Model Engineer* to publish a design for converting lathes to have two graduated rings reading in both 1000th of an inch and in metric.

Perhaps also dimensions in M.E. articles could be published in both old and new forms of measurements, this would be a help to all the United Kingdom during the transition period, and would I expect be appreciated by readers in the U.S.A. who will still be using the old system.

I would suggest to all new model engineers that when purchasing a vernier, one reading in both metric and inch scales would help when following old designs and for conversion of scales.

I would like to add how much I enjoy *Model Engineer*, especially the articles on steam locomotives.

London, S.E.17 A. MOUNT.

SIR,—I read with cynicism your remarks in Smoke Rings, March 15, about the changeover to the metric system.

I would like to point out that here in Germany, a country which has been metric for many years, the terms ein pfund (one pound) and ein zoll (one inch) are both still in common use. A German pound is half a kilogramme. I should also like to say that the common number of items bought at a time is also a dozen (or two). Crates of beer, for example, are sold containing 24 bottles and wine is bought in boxes of 12. The metric and decimal systems are synonymous, and both in my mind are impractical. How many times can you halve ten and still get a whole number ? In practice, when working from a centre line, division by two to all practical limits is endless. For example, half a half is a quarter, half a quarter is an eighth and half an eighth is a sixteenth and so on. Now try it with the metric system and see when you get stuck. Starting with .5 it is easy enough to .125 and then what ? I know, out comes the paper and pencil. The only reason for a measure of ten is that we have ten digits on our hands. There is nothing else to recommend it. Eight would be a better unit of measure and 16 even better. These we have in practice in our present system of measurement. (In sixteenths of an inch, etc.)

The introduction of the metric system will result in one thing, another set of measurements to contend with, superimposed on the old one. How many types of thread are already in existence in British Industry ? Each new system was to replace the former one. I believe it is 32, but heaven knows what they all are, some come easily to mind, Whitworth, BSF, BSP, BA, SBS, and so on and on.

Being a gunner I have to work in angular measurement; I was once working with American equipment some of which used degrees and minutes and some Mils and we were working with a German Survey troop who worked in Grads. Incidentally, the American capacities for fuel were shown in the handbooks in American gallons (8 pints each of 16 fluid ounces) and in any case over here we work in litres for the purpose of accounting for fuel.

There is an overriding advantage in not going metric which is often forgotten. It teaches our children to be good at sums where they have to calculate in pounds, shillings, pence, inches, feet, yards, to keep up with the shop assistant adding up my purchases. In Germany I find that I can always add up my bills in a decimal system quicker than even the quickest shop assistant. I attribute this to my practice in what everyone calls the impossible system we are fortunate to have at the moment.

I do not think the introduction of the metric system will make a ha'porth of difference. It certainly won't to me and I believe that in 30 or 40 years' time many of us will still be working in feet and inches. I certainly shall.

B.F.P.O. 16. G. W. BOOTH.

SIR,—I found your comments on the metric system in *Model Engineer*, March 15, interesting. As a hobby, model engineering seems to thrive mainly in the English-speaking countries which use the inch standard. Elsewhere it is regarded at best as an extreme form of eccentricity.

I am not aware of the existence of any generally accepted M.E. standards in the metric system and if the changeover is to be made, these would have to be developed. As an example of the difficulties one encounters in this regard, I have not been able to obtain in Geneva taps and dies for the metric fine thread, since these are not used, it seems, in industry, which has its own standard.

Maybe there are some export possibilities for Britain here !

May I take this occasion to say how much pleasure I get from your magazine. As my first model I have completed E. T. Westbury's Trevithick overcrank engine and am now building your *Boxhill* with my son's assistance.

Geneva. FRANK GUTTERIDGE.

Lathe lead screws

SIR,—The letters of Martin Cleeve and R. G. Shepard have been read with great interest and both are to be congratulated on the research they have applied to the subject of screw cutting. It is an operation on a centre lathe which needs great care and attention and a sound knowledge of tool grinding. Every apprentice who has passed through his turning tests knows how complex the manufacture of a first-class thread can be.

It is difficult for the writer to remember exactly the facts and figures appertaining to the screw which Martin Cleeve cut from his piece of 50 ton tensile steel as many lathe users submit to us samples of screw cutting in various materials of unknown specifications from which they have experienced trouble with surface finish.

It is quite true to say that the finish we obtained on Martin Cleeve's threaded portion could possibly have been lost a little if we had machined the threads down to a sized effective, but we would doubt very much whether we would have taken a chance on finally finishing the thread to a definite size without ensuring that the screw cutting tool was reground with a keen cutting edge.

One of the greatest troubles with machinists is that they often work too long with a tool that has lost its cutting edge perfection. With screw cutting it is more than important that the flank of the tool is absolutely sharp, more especially if the top-slide is not set at half the included angle where the tool can have a top rake, as the accuracy of the V-form is assisted by the angle of the side and not just by the angle of the veeing tool which is normally ground without top rake.

Such a tool is inclined to scrape rather than shave during the final sizing cuts where a few tenths of a thou of material is being removed, and if any work hardness has taken place, there would be a tendency for the tool to "dig in" when the free material is contacted. Martin Cleeve takes care of this possibility by giving a positive bias towards the left thread flank. R. G. Shepard avoids this by setting his top-slide to 27½ deg. and feeding with the top-slide. Both methods avoid the wedge action of the tool which can cause trouble.

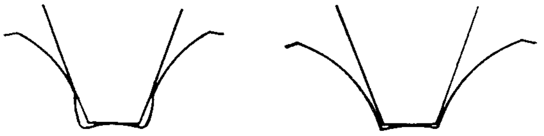
Super finishing is often dependent upon what form of coolant is used and it is advisable always to screw-cut with an effective fluid such as a soluble oil of known quality. A ratio of 20 to 1 water/oil is an ideal solution. It is not general practice to use the swan neck type of tooling; the new techniques are for absolute rigidity.

The amount of care and attention which Martin Cleeve has given to his ML.7 lathe in his anxiety to ensure that any trouble which he has experienced is not due to mechanical defects is only to be admired, and the introduction of the stop to the closure variation possibilities of the half nuts is one feature which does assist in obtaining screw-cutting perfection and such a feature is necessary with Acme threads. The combination of material in the die cast half nuts and the lead screw is ideal and the life of both is protected by such material harmony.

We have noted that Martin Cleeve, in an article covering components for his quick-change backgear, refers to his "Myford's bull-gears which are presumably of No. 20 diamentral pitch with 65 teeth" which have been found to vary in outside diameter from .038 in. to .042 in. under the calculated whole diameter for such a gear, and as he mentions that the reason is not wholely clear, we thought it right that we should answer the query.

The Myford 20DP gears as arranged in the back-gear drive are of 14½ deg. pressure angle and the pinion was corrected to prevent the under-cutting which occurs in such gears below 32 teeth. This under-cutting is illustrated above right.

Whilst all Super 7 gears have a 20 deg. pressure angle, gears on the ML.7 lathes were designed with a pressure angle of 14½ deg. and such a pressure angle has been maintained on the ML.7 lathe gears because



of the spare position. The large number of these machines in use throughout the world made a possible change from 14½ deg. pressure angle to 20 deg. a dangerous business from a spare aspect.

Difficulties in parting off

D.G.T.'s difficulties, more especially when parting off on small lathes where the problem of obtaining adequate depth of parting tool, are often met.

Another problem of parting off is the inherent nervousness of lathe users with this operation. It is essential to maintian a steady rate of feed throughout the whole movement of the tool and it is important that a good coolant is used on steel.

A safeguard to the "digging in" problem is to slightly hollow the top of the parting tool by grinding on the periphery of a 6 in. or 8 in. dia. wheel and to grind the front clearance to an angle of not more than 5 deg. The tool should be very slightly above centre height if the material is of a reasonable diameter and brought down to centre height if rubbing takes place as the diameter becomes smaller.

The Myford quick setting lathe tool is sensibly proportioned and has the advantage of a form of cushion between the tool and the top-slide created by the use of the boat which enables the tool to rock to obtain the dead centre height. The boat is manufactured from a zinc base alloy and this assists in the damping out of vibrations.

On the subject of poor chuck jaws, this would naturally be a liability and although the packing of the front of the jaws by a wrapping of paper is frowned upon, it is far better to carry out this procedure than to risk a serious "dig in" which could possibly do more harm to the inaccurate jaws than the fear of increasing the bell mouthing by pressure at the bell mouth end through the medium of the packing.

The majority of machinists today have the great advantage of being able to perform their operations with first-class equipment and accessories, but there is no doubt whatsoever that a great number of lathe users in the amateur field cannot afford to be continuously buying perfection in the way of chuck accuracy, and operations such as parting off have to be carried out with the gripping means at their disposal, hence the necessity to give greater study to this subject.

Nottingham. E. Barrs,
Director, Myford Ltd.

Thank you Mr Barrs for your most helpful letter—Editor.

South Bend lathe

Sir,—I was very pleased to read the welcome comments of our sound engineering friend, R. V. Hutchinson of Michigan, about my "mods to a South Bend lathe." None of my catalogue matter shows a boring table for the South Bend.

I agree that centre lathes, particularly of American manufacture, are made solely for turning and are not readily adaptable for the many other operations which model or professional engineers wish to carry out on their lathes. Some of the older English lathes made provision for boring by means of T-slots in the "wings" of the slide rest. These "wings" considerably increased the lengthwise spread of the slide rest (the South Bend has these wing extensions), and the infed top faces could carry a substantial slotted plate to which the work could be bolted for boring.

As my new table is rather narrow for some jobs I have a hardened and ground plate 7.5 in. sq. × .437 thick drilled and tapped with a useful pattern of $\frac{3}{8}$ in. BSF holes, and bolt this to the table. If any job arises too large for this set up I will have to call in the assistance of my engineering friends.

I have felt the saddle "bucking" under adverse conditions, but have not carried out any mods to eliminate this disability, just reduced the cut and put a slight "drag" on with the locking screw.

I was unaware of any other type of cross-slide nut as the new spare screw and nut is of the same pattern as the original. Strangely enough I have done very little taper turning other than with the top-slide.

I have removed the indexing pawl on my four-way toolpost and never use more than two tools at any given time, mainly because I do not make any long runs of a particular component. I find two screws on a short tool bit adequate for a sure grip, three for $\frac{1}{2}$ in.—$\frac{5}{8}$ in. shanks. Yes, square head screws every time, also I find the square box key finds the square head more readily than the socket head key finds its chip-choked socket.

Your congratulatory remarks are much appreciated.
Derby. "LITTLE EATONIAN."

Round-bed lathes

SIR,—I was sorry to learn of the death of Mr J. J. Pike, Hackney. I never actually met Mr Pike, and corresponded with him on one occasion only, six or seven years ago, to enquire about a second-hand lathe. I do recall, however, that 35 years ago Mr Pike put on the market castings and parts for an orthodox pattern back-gear for fitting to the 4 in. round-bed Drummond lathe.

In Mr Pike's arrangement, the back-gear shaft was located in the orthodox position, behind and parallel with the lathe's work-spindle, and ran in a bearing at each end in the orthodox manner. This was accomplished as follows: the headstock of the 4 in. Drummond lathe was, like most lathe headstocks, a roughly U-shaped casting, the legs of the U being the pedestals carrying the mandrel bearings. The components which Mr Pike supplied included a pair of cast-iron brackets and a pair of gunmetal bearings for the back-gear shaft. One of the brackets was bolted to each leg of the U, and one of the bearings for the back-gear shaft was mounted on each bracket. Thus Mr Pike's back-gear was entirely different in design and construction from either of the other two back-gears designed for fitting to the 4 in. Drummond lathe, the Bowyer-Lowe and the Walram.

The Bowyer-Lowe arrangement was an epicyclic back-gear, contained within the headstock cone-pulley. It was designed by Mr A. E. Bowyer-Lowe and fitted to his own lathe, and was described by him in M.E.; in a letter in M.E., April 12, 1962, Mr Bowyer-Lowe mentioned that his description originally appeared in M.E. April 1 and 22, 1915. A reprint of the drawings for the Bowyer-Lowe back-gear appeared, however, in M.E. March 1, 1962 (page 279), together with a short article on the subject by Mr L. R. East of Melbourne, Australia. The Walram was a mandrel-tail back-gear. On the 4 in. Drummond lathe, projecting from the tail-end mandrel bearing, there was a lug intended by the makers to take a stud upon which could be run an "idle" wheel to reverse the direction of the screw-cutting train. The Walram back-gear was arranged for mounting on this lug in place of the stud.

An orthodox back-gear requires two gear wheels on the lathe mandrel, the bullwheel and a smaller wheel integral with (or attached to) the cone-pulley. As the 4 in. Drummond was designed as a plain lathe, the maker's headstock pulley fitted nicely between the mandrel bearings, completely filling the available space. Drummond's headstock pulley therefore could not be used when Mr Pike's back-gear was fitted and the castings and parts Mr Pike supplied offered the choice either of replacing Drummond's three-step pulley with a two-step pulley and retaining the 1 in. wide belt *or* of retaining a three-step pulley and changing to a $\frac{3}{4}$ in. belt. The latter choice would, of course, require the countershaft step-pulley in the case of a power lathe or the flywheel in the case of a treadle lathe, also to be changed for one taking a $\frac{3}{4}$ in. belt. In Mr Pike's back-gear, the spur wheel attached to the headstock cone-pulley had 30 teeth and drove a wheel of 85 teeth on the back-gear shaft. The wheel at the other end of the back-gear shaft again had 30 teeth, and the bull wheel on the mandrel which meshed with it had 85 teeth. The reduction was therefore $85^2/30^2=8.028$ to 1.

A back-gear made up from Mr Pike's castings and parts and fitted to the headstock of a 4 in. round-bed Drummond lathe was shown in the Trade Section of the M.E. Exhibition in 1932, and a photograph and brief description appeared in the report on the Exhibition—M.E., October 6, 1932, page 320. In view of today's prices it is interesting to note that in 1932 the complete set of castings and parts for Mr. Pike's back-gear cost £1 with cast wheels or 35s. with cut wheels.

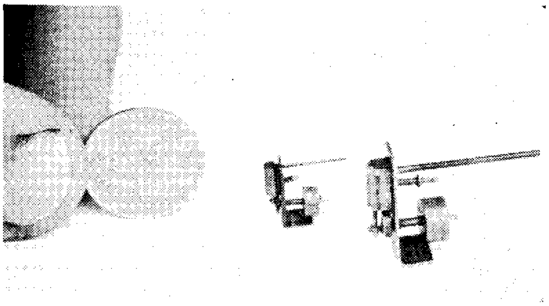
Birmingham, 11. NORMAN GARDNER.

Miniature engines

SIR,—My picture shows two small, single acting oscillating engines. I am now 15, but I made the bigger engine when I was 13 and the smaller one when I was 14.

The smaller one has a $\frac{1}{32}$ in. bore. Both were made without the help of a lathe except for the flywheels (turned on a 5 in. lathe), the rest being made on an electric drill. The ports on the smaller one were made with a ground-down dental burr; they are about 7 thou too large for the engine, but I had no means of making smaller ones. Both engines run perfectly on air but I have not tried them on steam. The feed pipe in both cases is a hypodermic needle.

Rotorua, New Zealand. DONALD HISCOCK.



Ploughing engine

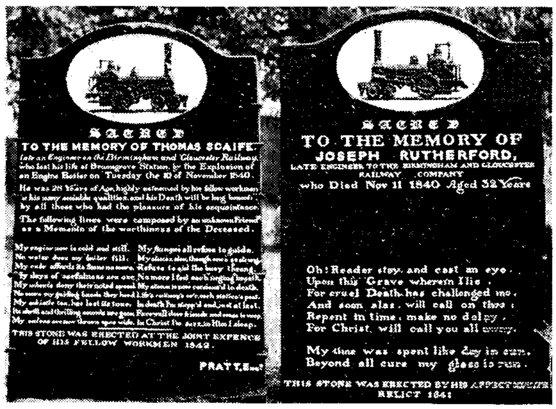
SIR,—I refer to Mr W. J. Hughes' article on Road Vehicles at the M.E. Exhibition in which he criticises Mr Tyler's Fowler ploughing engine. I understand that it was a regular practice to paint the strakes of full-size traction engines white when exhibited at such places as the Royal Shows. Surely then it is equally correct to paint model strakes white at the M.E. Exhibition.

Secondly, the chimney cap. Whilst Mr Hughes is undoubtedly correct on the shape of true Fowler chimneys, that well-known contractor, the late Mr John Patten, always had caps fitted to his ploughing engines similar in shape to Mr Tyler's model. This is well shown on the excellent photographs appearing in the same issue on pages 228/9. I must, however, admit that my personal preference is for the true Fowler cap.

Rugby. J. H. DALTRY.

2-6-0 locomotives

SIR,—Mr K. N. Harris, in his article on "British 2-6-0 Moguls," repeats the old rumour that one of the American Norris 4-2-0 engines, imported by the Birmingham & Gloucester Railway for working the Lickey (not Sidney !) Incline, blew up. This prevalent misconception has been brought about, mainly, by the fact that reproductions of Norris engines figure on the headstones of the two graves in Bromsgrove churchyard (as in my picture) of the men killed in the accident



on November 10, 1840, when the boiler of a remarkable locomotive, designed by Dr Church of Birmingham, exploded. Another reason for this rumour is that one of the Norris engines was involved in a boiler accident, when descending the Licky Incline on April 7, 1841. The engine concerned was *Boston* and a plug in the firebox tubeplate which had been fitted in a tube hole, in order that the corresponding hole at the smokebox end could be utilised as a mud hole, blew out, causing the death of one person and injuries to others. As a matter of interest, there was a similar incident concerning another Norris locomotive *William Gwynne*.

When writing of American built locomotives which worked in this country before the Second World War, Mr Harris overlooks the five 0-6-2 tank engines, bought by the Barry Railway from the Cooke Locomotive & Machine Co. of Paterson, New Jersey, in 1899 and the two Port Talbot Railway 0-8-2 tanks built by the same firm in that year. In 1882, an American "single" express locomotive ran a few trips on the Lancashire & Yorkshire and Great Northern Railways. This machine was shipped to this country by the Eames Vacuum Brake Company, as a travelling advertisement and practical demonstration of their form of brake. Excluding narrow gauge, there were others, too (an American locomotive worked at Chilwell Depot near Nottingham about 50 years ago) and, if we include Ireland, one thinks of the two 0-6-2 saddle tanks of the Cork, Bandon & South Coast Railway supplied by Baldwin Works in 1900. Regarding the American "Moguls" of the Midland Railway, I have always understood that the 30 Baldwin built locomotives had bogie tenders and the 10 Schenectady engines had six wheeled tenders from the start.

As to the Midland & South Western Junction Railway 2-6-0's Nos. 14 and 16, added to stock in 1895 and 1896 respectively, the first engine was withdrawn about 1914, the boiler put to stationary use and the frames and wheels sold to J. F. Wake of Darlington in 1918. In due course, with a different boiler and cab, the engine became Cramlington Coal Co. No. 15 and later, on the formation of the Hartley Main Colliery Company, that company's No. 16. It lasted in colliery service until 1943. No. 16 became G.W.R. No. 24 at the grouping and in February, 1925, was rebuilt with a Swindon style cab and standard No. 9 boiler. It was withdrawn in July, 1930.

Your author omits to mention the "Krugers," built at Swindon between 1899 and 1903. Of these 10 engines, the first one was turned out as a 4-6-0 but the other nine were built as 2-6-0's. The whole class had an extremely short life and were withdrawn between 1904 and 1906. Another surprising omission by Mr Harris was any reference to the L.M.S. Ivatt Class 4 2-6-0's introduced in 1947 and built until 1952 when the class totalled 162 engines, although he illustrates a member of the class, wrongly captioned. It is an interesting point that 337 "Moguls" of pre-nationalisation design were built by British Railways in addition to the 200 of B.R. design.

Finally, *David* Joy of the famed radial valve gear, please !

New Romney. GEORGE BARLOW.

SIR,—I have just seen your issue of March 15. The article by K. N. Harris is poor; on its evidence the author has little or no qualifications to write on this subject, having little knowledge and an unwillingness to do more than the skimpiest research.

Two points will serve to demonstrate this. No mention is made in the text of the L.M.S. Class 4 2-6-0 although they were unique in being built with double chimneys. Yet a photograph is included of 43050, which, if I remember correctly, was the first of this type to be built with a single chimney, although it is described as a light branch line engine; obviously complete confusion about the two post-war 2-6-0 types of the L.M.S.

The M.S.W.J.R. pair had a much more interesting life than Mr Harris indicates. Reference to the RCTS's standard work on G.W.R. locomotives would have dispelled his ignorance on this score.

Moving onto ground where I cannot claim certainty, I feel that the story that the Norris 4-2-0's were used as bankers has been shown to be a myth. Where, may I ask, is Sidney Bank ?

Bristol. W. A. RICHARDS.

Model Engineer *editorial staff must plead guilty of the mistake in the caption to the Class 4, but not to the other errors !*—Editor.

Other letters on pages 441 and 454.