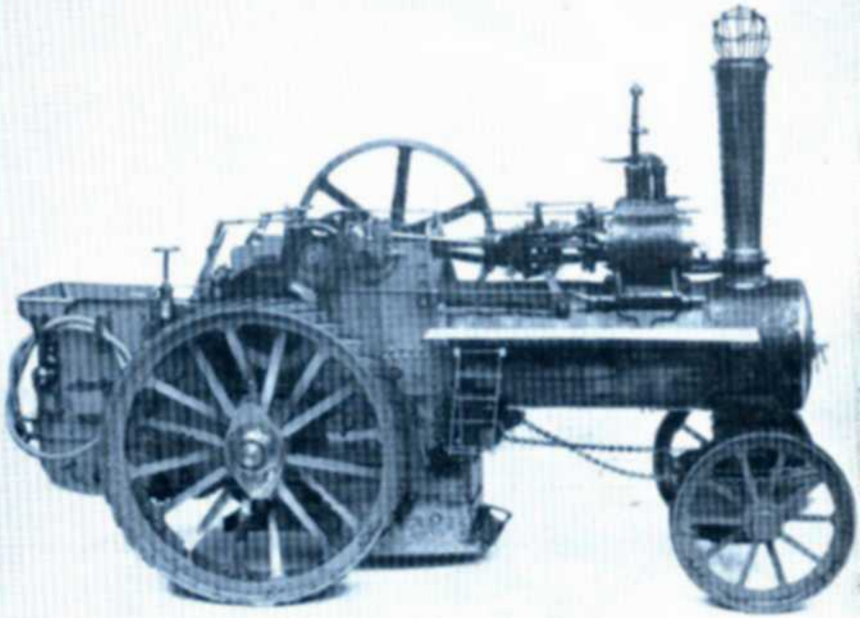
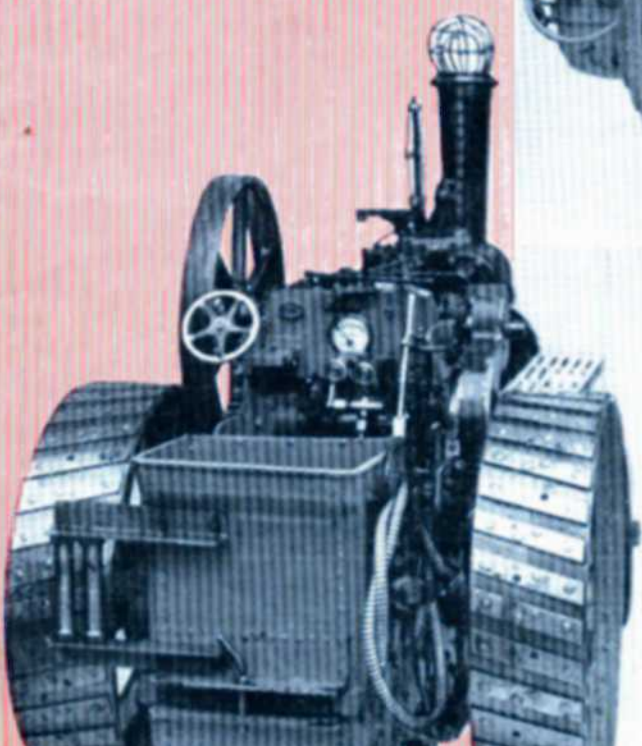
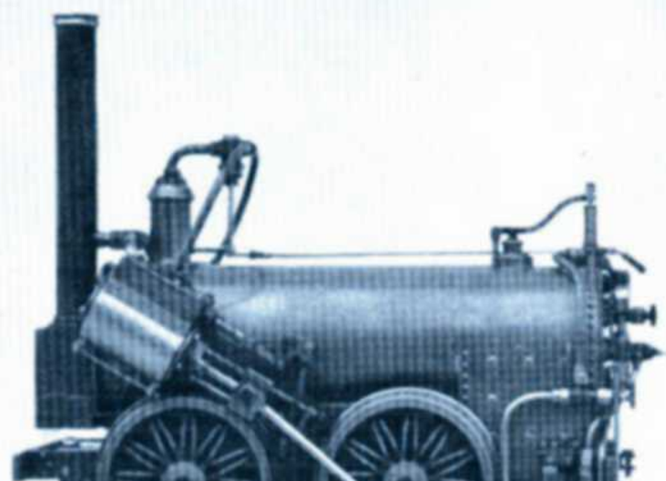
Model Engineer

THE MAGAZINE FOR THE MECHANICALLY MINDED

TWO SUPERB MODELS BUILT BY READERS







ONE SHILLING 21 FEBRUARY 1957 VOL 116 NO 2909

Model Engineer

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Subscription 58s. 6d. (U.S.A. and Canada $8.50) post free

Published every Thursday

Incorporating SHIPS AND SHIP MODELS

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Light milling spindle

M.E. musical clock: C. B. Reeve concludes his description of this superb clock

All correspondence shou'd be addressed to the Editor, Model Engineer, 19-20 Noel Street, London, W.1.

SMOKE RINGS

A WEEKLY COMMENTARY BY VULCAN

IN these days of petrol restrictions there is a great deal of attention focused on possible alternative fuels.

Among the ideas put forward is the suggestion of producing fuel from water, a hardy annual which was revived recently by a contemporary magazine.

Modern researches in the atomic structure of matter have upset many established theories in chemistry and many feel that hitherto impossible things *can* happen, but I am very sceptical about the idea of obtaining fuel from water *on an economical scale* that would make a practical contribution to the fuel problem.

On the face of it, the theory seems feasible enough: water is the result of a chemical combination of two gases, oxygen and hydrogen, and these can be recovered in gaseous form by electrolysis. Hydrogen is an ideal fuel for internal combustion engines, while oxygen, as a supporter of combustion, would enable an engine to develop its maximum power.

Engines working on oxygen-hydrogen fuel have been used effectively to drive naval torpedoes. Where, then, does the snag arise? Simply in the amount of electrical energy required for the electrolytic process.

Not practicable

It is suggested that sufficient energy could be obtained from wind-driven generators, but anyone who has attempted to generate electricity on a commercial scale by this method will be aware of the difficulties, not to mention the initial cost of the machinery involved.

According to accepted physical and chemical principles, water is the result of a reaction which releases a great deal of energy, usually in the form of heat; and to restore the original state of the elemental gases a similar amount of energy would have to be expended, not counting losses involved in conversion.

The practical problem of making fuel from water, therefore, seems to be almost equivalent to collecting the exhaust gases from a car and turning them back into petrol—but perhaps my scientific knowledge is out of date!

Keep it clean?

HOW will the Clean Air Act, 1956, the provisions of which came into force on January 1, affect outdoor miniature steam railways?

The Act gives local authorities the power to establish smoke control areas in which the emission of injurious smoke can be severely curtailed or prohibited altogether.

Will this mean that little *Tich* puffing round the park with a train-load of youthful enthusiasts will have to perform on smokeless fuel? Or are the operators of these fascinating railways such superb firemen that the Act will not be infringed?

Another point comes to mind. Suppose some vital alteration has to be made because a locomotive's grate

SMOKE RINGS . . .

will not satisfactorily burn smokeless fuel will the owner be able to claim a percentage of the cost of adapting the grate, as most householders will be able to.

Of one thing we can be certain; in these days of Government economies any request of financial help from local authorities to alter model steam-engine grates will itself go up in smoke !.

"Merchant Navy" haste

AN exciting run by the up Atlantic Coast Express, hauled by rebuilt Merchant Navy 4-6-2 No 35013, *Blue Funnel*, is briefly reported in *The Railway Observer*.

Starting from Salisbury with a load of 12 bogies—about 430 tons—the train took 39 min. 25 sec. for the 33 miles to Worting summit, against 36 min. allowed. Then matters livened up considerably; speed rose to 73 m.p.h. at Hook, 77 at Fleet, 76 at Milepost 31, 81 at Brookwood, 87 at Woking, 90 at West Byfleet, and 92 at West Weybridge. Then it fell to 84 at Walton, 80 at Hampton Court Junction, 72 at Malden and 66 at Earlsfield.

The train was well on the right side of time when Clapham Junction was passed at 40 m.p.h. Obviously, the rebuilding has not affected the well-known liveliness of these engines.

Bigger tankers

JUST as we are becoming used to the modern super-tankers of 40,000 and 50,000 tons deadweight comes the announcement of a tanker of 106,500 tons !

This has been ordered by A. S. Onassis, the Greek-Argentine shipowner, from the Bethlehem Company's yard at Quincy, Mass., U.S.A. The new ship, although not quite so long as *Queen Elizabeth*, will be nearly 20,000 tons bigger and has a beam of 134 ft. She is intended to trade between the Persian Gulf and California, as she is far too big to negotiate the Suez Canal. When fully loaded she will have a draught exceeding that of *Queen Elizabeth* and will carry more than 34½ million gallons of oil.

It is expected that her keel will be laid shortly and that she will be in service within two years. In view of the competition between the Ludwig, Niarchos and Onassis interests to own the biggest tanker and the biggest tanker fleet, the next move is awaited with interest.

The tanker EVGENIA NIARCHOS, 47,112 *deadweight tons, in dry dock at Southampton. With* SPYROS NIARCHOS, *her sister ship, she is the largest tanker built in Britain*

H. P. Jackson

MANY of our locomotive enthusiasts will be very sorry to learn of the death of Mr H. P. Jackson on January 19, after a short illness; he was 73.

For many years Mr Jackson supplied castings and drawings for locomotives, mainly for 3½ in. gauge, and the models which he built for many customers had a character of their own. He was, first, a keen locomotive enthusiast and secondly, a very strong advocate of the really true-to-scale model.

As a result, he strove to ensure that, while his locomotives always worked well when in steam, they were, as nearly as could be, exact scale replicas of their prototypes in outward appearance. In short, his name became synonymous with a really good-looking and satisfactorily-working model, whatever its type or class.

Mr W. E. Jackson, son of H.P., will endeavour to continue the supply of Jackson castings and drawings, for the time being.

Cover picture

The handsome traction engine, to the Allchin design, was built by Capt. J. C. Davis, of Crowborough Sussex, a very successful model engineer. The sturdy little period engine was constructed by Oscar M. Hueter, of California. Constructional details of the Allchin traction engine, by W. J. Hughes, appear from time to time in MODEL ENGINEER. *Plans are available from the Plans Service Department.*

Diesels in tunnels

CAN too high a concentration of diesel-hauled traffic through railway tunnels produce a toxic air pollution ?

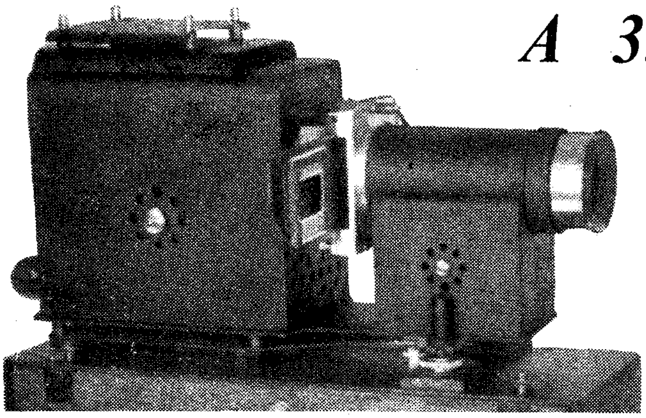
A. T. Gandell, general manager of the New Zealand Government Railways, has just carried out some research on this subject in the five mile single-track Rimutaka Tunnel, where natural movement of the air is relied on to ventilate the tunnel, and periods of calms and wind velocities of up to 17 m.p.h. are encountered.

Gandell, according to a report in *The Railway Gazette*, says that the number of trains passing through daily is eight diesel-hauled goods and seven railcars, the maximum interval between them being four hours and the minimum three or four minutes. No pollution has so far been noticed.

But, as the *Gazette* points out, would the result of tests still be negative if the tunnel chosen was a heavily worked double-track one in a situation where a calm, humid atmosphere prevailed ?

INDEX FOR VOLUME 115

The index for Volume 115 of MODEL ENGINEER is now ready. It may be obtained from the Sales Department, Percival Marshall & Co. Ltd, 19-20, Noel Street, London, W.1, price 1s. post free. It includes a title page and it will be sent out in an envelope with cardboard stiffener. Overseas readers should send an International Money Order for 1s. Please do not send stamps.



A 35mm transparency projector . .

H. J. TURPIN gives constructional details of a transparency projector that will stand comparison with any commercial instrument of similar wattage

AFTER MANY YEARS of making and running small locomotives I decided to turn to something more static but equally satisfying—a 250 watt projector for 2 in. × 2 in. transparencies which will bear critical comparison with any trade instrument of similar wattage.

On first examining this problem in detail it becomes obvious that there are several items which the ordinary engineer cannot make, such as the objective lens, condenser, lamp and reflector. Therefore, they will have to be purchased. Armed with these items the job then resolves itself, first, in determining the precise arrangement that will produce the maximum uniform illumination on the screen; and secondly, in constructing a convenient housing that will provide ample natural ventilation and contain the extraneous light.

As all lenses, even similar ones, differ in characteristics it is impossible for the amateur to lay down or even determine their precise relative position in any other way than by the practical one of constructing a mock-up. The main problem is to use as much light as possible from the light source.

In the diagram, Fig. 1, it will be seen that this is measured by the cone of light whose apex angle is *A*. This in turn is governed by the diameter of the condenser, *B*, and its distance from the light source. Structurally, it is an easy matter to make *A* a maximum by placing it against the glass of the lamp.

One has to make a choice, however, of one of two arrangements; namely either a small-diameter condenser close against the light source, in which case the lens will have to be made from special heat-resisting glass with probably a catathermic screen in between; or a large-diameter condenser of less quality glass placed at a safer distance.

The latter is the easier and cheaper but necessitates a condenser system of greater bulk. This is no real handicap.

Having decided on the cone of light, *A*, then the next problem is to arrange as much of this light as possible to be transmitted so that it converges at a point within the objective lens. In order to bend the outer rays of light to this convenient point it will be found necessary to provide two further condenser lenses, *C* and *D*. These are, for convenience, all 3 in. dia. and sold as 5 in. focal length by Messrs Brunnings, of Holborn, London, W.C.2.

The cone of light leaving the third condenser, *D*, has a base diameter of about 2¾ in. at the lens, and along that cone at a distance, *E* (about 1½ in.), and where the cone decreases to 2 in. dia. the slide should be positioned.

The distance of 1½ in. is essential in order that the slide is sufficiently remote from the heat transmitted through the condenser system. In any event, transparencies should not be projected unless they are mounted between glass in proper 2 in. × 2 in. frames.

The objective lens is the heart of the projector and I have used a Kershaw bloomed f. 2.8, 4 in. focal length anastigmat. The price is £7 7s. new. It is possible to make up a lens cheaply in various ways but I think it is false economy. The definition of this Kershaw gives the same crisp definition at the corners as it does at the centre and to use any lens which does not do this is just waste of time and money spent in making the rest of the projector.

This objective lens should be placed in position in the mock-up so that with its adjustable extension tube in the mean position a properly focused picture is seen on the screen.

Having got all the above positions fixed, the next step is to add the reflecting mirror, *F*, to supplement the cone of light from angle, *A*. This adds considerably to the screen illumination when adjusted properly.

The check for correct position of reflector is obtained by the use of a low power magnifier, *G*, such as a reading glass, temporarily held in the light beam in order that an image of the filament may appear on the screen. It should look like Fig. 2. The clear

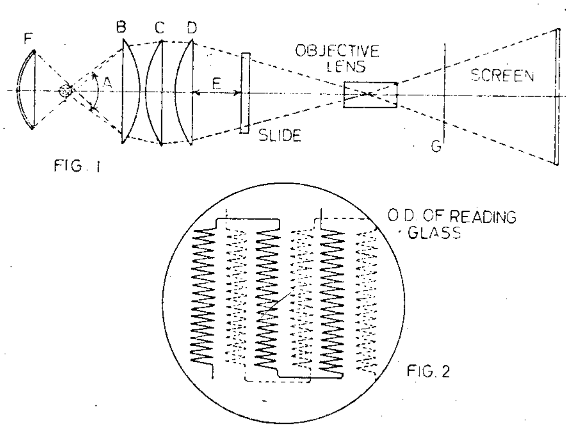


Fig. 1: Diagrammatic lens system; Fig. 2: Images of the filament on the screen

and distinct image comes direct from the lamp. The diffused one is the image coming from the reflector.

An important point to watch here is that the two images must not coincide. If they do so it means that the filament image from the reflector is passing through the actual filament of the lamp and damage to this will occur because heat as well as light is reflected by the mirror.

CONSTRUCTION

Every part (Fig. 3) is within the capabilities of the average model engineer. It is made essentially from mild-steel plate, the thicknesses of which are stated on the drawing. The projector is divided into three parts: the lamphouse, lamphouse cover and support for objective lens and slide carrier; and it will be seen that the last named is completely isolated from the first two. This is to ensure that minimum heat is conducted to the slide through the metal parts.

There is, however, always heat as well as light passing through the optical system from the 250 W lamp. The heat could be reduced at the slide by the insertion of a catathermic screen between condensers, *C* and *D*, but it would be rather large and expensive. I have never found this necessary.

Base. The main plate, *J*, is 12-gauge (0.10 in.) thick upon which everything is mounted. Coupled to this and below it is a second plate, *K*, shown dotted in the plan view. This does three things, it stiffens plate, *J*, allows ample flow of air upwards through the openings, *L*, in plate, *J*, and prevents the heat radiated downwards by the lamp from burning the table.

Plate, *J*, also carries three feet, the rear one fixed and the front two adjustable, and have inserted in them rubber pads usually sold for small cabinets.

The lamp holder, *M*, is turned from bakelite and first attached to a fixing plate, *N*. This holder is fitted with an internal brass sleeve 16-gauge thick with a bayonent joint cut to fit the lamp and to which is attached a terminal, *O*. The centre electrode is a coil-spring loaded flat piece of brass with a terminal at its rear end.

Terminal block, *P*, is also made from bakelite and is held to the base by three 4 B.A. screws, the centre one extending downwards to fix the rear foot. To the block is attached a small toggle switch and two brass plugs whose diameter and centres are those of the standard electric fittings. The plugs are $\frac{5}{16}$ in. dia. through the block and each one is about 0.005 in. slack in its hole so that they may be accommodated in the lead sockets. They are each retained by a 4 B.A. screw. Permanent 18-gauge wiring is made to the lamp holder.

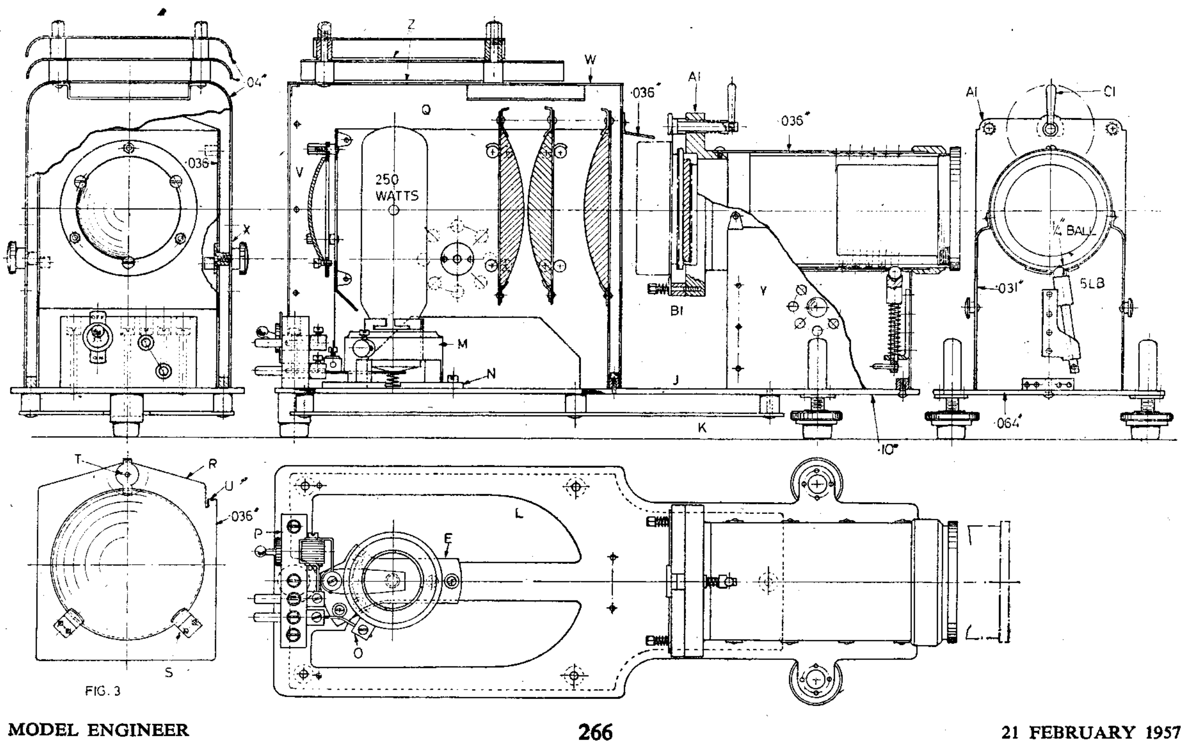
Condenser housing, *Q*, carries the three condensers, positions the reflector and takes the brunt of the heat given out by the lamp. Mild steel, $\frac{3}{16}$ in. square, is riveted ($\frac{1}{16}$ in. rivets) to the front edge and two sides, and provides means of fixing the housing by four 8 B.A. screws to the baseplate. Normally this member is considered a fixture. In the sides, two bushes are provided to receive the outer casing by chromium plated knurled thumb screws.

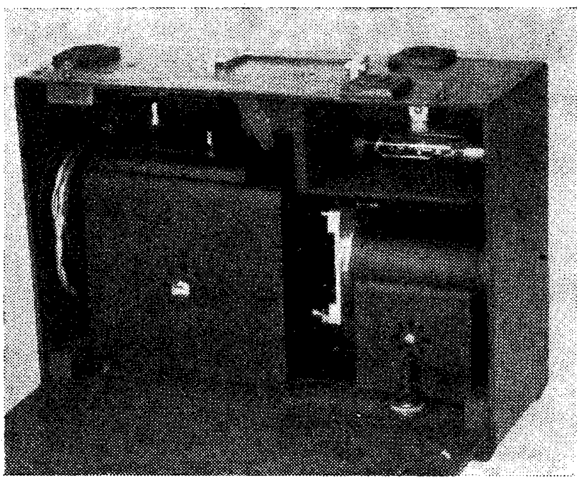
The first two condensers, *B* and *C*, are held in plates, *R*. The condensers themselves rest in two hook-shaped brackets, *S*, and are retained by a rotating catch, *T*. It is essential that the condensers are just freely held in the carrier.

These two units are lowered into the housing between pairs of mild steel studs $\frac{1}{4}$ in. dia. × $\frac{1}{4}$ in. long and positioned by the hook piece, *U*, over the upper studs. By this construction it is possible to remove the condenser units readily for cleaning. The third condenser, *D*, is attached to the front of housing just as *B* and *C* are to the plates, *R*.

Reflector, *V* can also be purchased

Fig. 3: The general arrangement of the projector





The projector and lamp in their case

from Brunnings. It is mounted on a 16-gauge mild steel ring merely by being held just freely under the heads of three 6 B.A. screws. This ring in turn is held to the housing, *Q*, over three 6 B.A. special studs and fixed under finger pressure only by three 6 B.A. nuts made from $\frac{1}{4}$ in. mild steel hexagon, $\frac{3}{8}$ in. long. By these nuts the reflector unit is easily removed.

The lamp is a mains voltage type specially made for this kind of projector. A wattage of 250 will be found ample for any room demonstration, and it is inadvisable to exceed this owing to the heat developed. Besides, do not forget that the greater the illumination the more the faults in the slides will be disclosed.

The outer casing, *W*, is merely a cover for all the things that have been previously described. It is assembled vertically downwards and is located by the $\frac{3}{16}$ in. square strips fixed to the base of the inner housing. There is a gap cut in the rear end to fit over the terminal block, while the front end has a $2\frac{3}{4}$ in. dia. hole; and a light shield 3 in. long protruding $\frac{5}{8}$ in. is fixed with four $\frac{1}{16}$ in. dia. rivets. This is positioned at the top of the $2\frac{3}{4}$ in. hole.

Chromium plated thumbscrews, *X*, retain the outer casing, and each is at the centre of eight $\frac{1}{4}$ in. dia. ventilating holes.

Objective support, *Y*, is an entirely separate unit from the lamphouse. It carries the objective lens, spring-loaded ball for lens adjusting sleeve, and support for slide holder. The lens sleeve is $2\frac{1}{4}$ in. dia. and a tube of 20-gauge mild steel is rolled such as to form a sliding fit for the sleeve. To give the end of the tube some support the front end is finished with a mild steel ring and secured by three $\frac{1}{16}$ in. mild steel countersunk rivets.

The rear end of the tube holds the support for the slide holder, *A*1. This is made from aluminium alloy which is turned down to $2\frac{1}{4}$ in. dia. for insertion into the mild steel tube and held by three 6 B.A. screws.

The slide holder rests at the bottom on a $\frac{1}{4}$ in. square bar, *B*1, and is retained by a spring-loaded 20-gauge strip. The thickness of the lower end of the slide holder is about 0.003 in. wider than the gap made by *B*2 in order to ensure a firm grip.

The top end of the slide holder is secured by a turnover cam, *C*1, and assembled when the handle is vertical. Lowering the handle one side or the other draws the slide holder in tightly under pressure of the coil spring.

To support the 20-gauge tube a box-shaped member is provided, having four lugs projecting upwards from the sides and to which the lens tube is fixed with $\frac{1}{16}$ in. rivets. The tube must be countersunk on the inside for these rivets and this will have to be done with nimble fingers using a small piece of $\frac{1}{4}$ in. drill sharpened for the purpose.

There is a spiral groove around the lens adjusting sleeve and provision for engaging this is by a spring-loaded ball. Pressure is applied by a 5 lb. spring supported by a 16-gauge bracket riveted to the front end of the objective support. The last mentioned has two pieces of $\frac{1}{4}$ in. square mild steel, 1 in. long, riveted to the front and rear ends, and they are tapped for 4 B.A. screws which secure the whole unit to the baseplate.

Slide holder details

Slide holder, Fig. 4, is made from mild steel plate. The moving part, *D*1, has attached to it two brackets to hold the slides, each one carrying two leaf springs 0.01 in. thick to spring load the slide so that it is always positioned correctly. It should be noted that the distance, *E*1, between the openings is long enough to prevent parts of two pictures appearing on the screen as the slides are moved across.

The fixed part as a whole is held in the support, *A*1 (Fig. 3), the dimension, *F*1, fitting into gap, *B*1. The upper end, *G*1, is held by the turnover cam, *C*1. *D*1 is 0.08 in. thick and runs in the slideway 0.125 in. wide, but it is spring loaded by the two springs,

Fig. 4: Details of the projector's slide holder

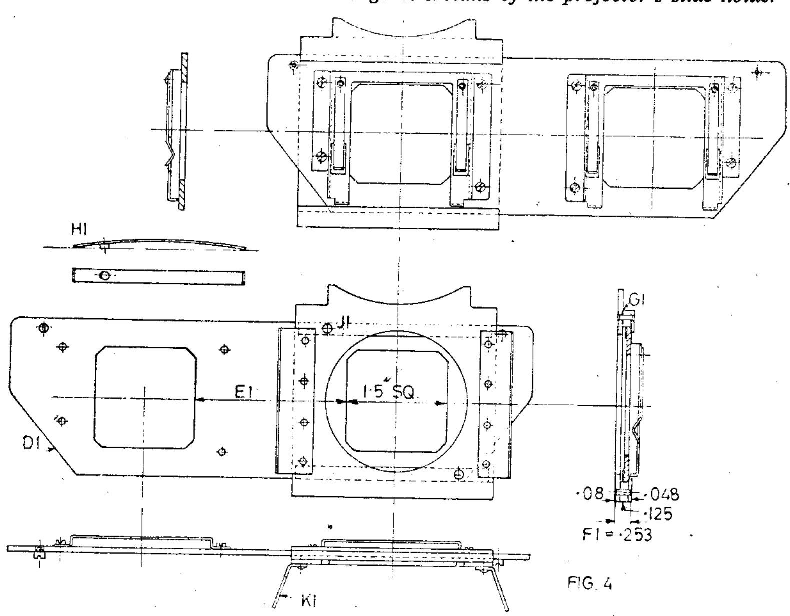


FIG. 4

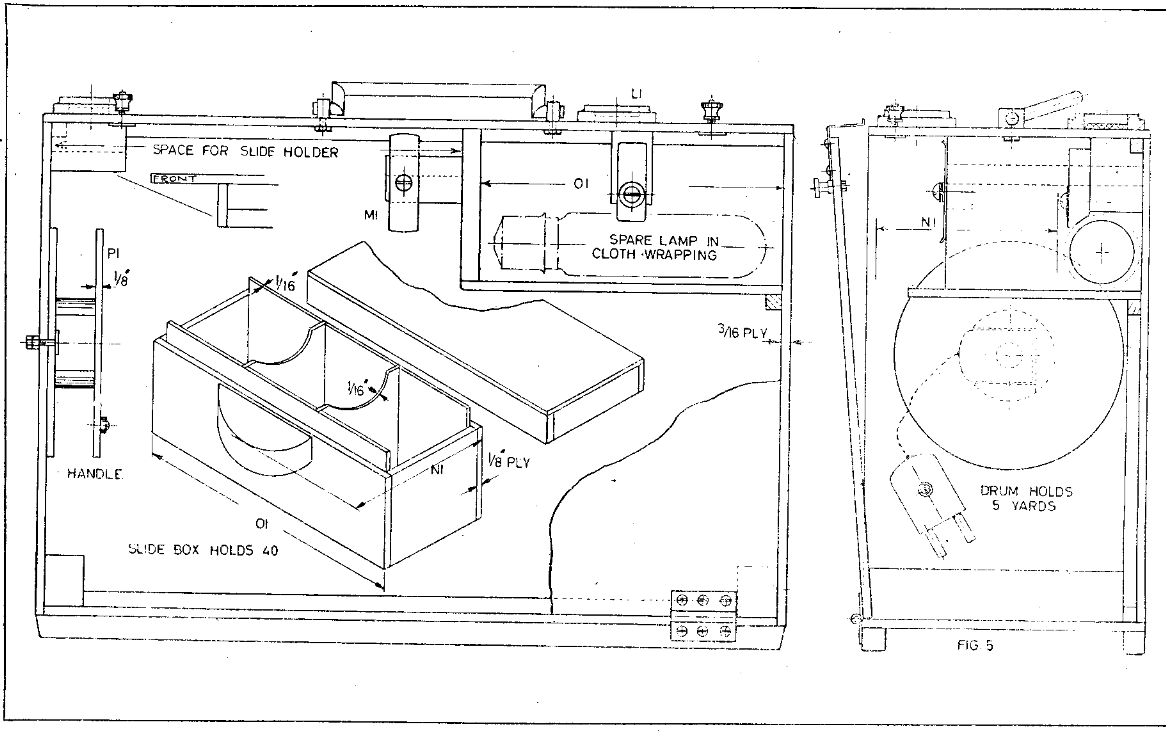


Fig. 5: Side and end elevations of the case

*H*1, which are $\frac{3}{16}$ in. wide × 0.012 in. thick.

A stud, $\frac{1}{8}$ in. dia., at one end drops into a hole in the fixed member at *J*1 and thus *D*1 is made to slide across with a smooth action and is always correctly positioned.

The two inclined members, *K*1, 0.04 in. thick are light-shields to prevent light straying sideways into the room.

Making the case

The case, Fig. 5, enables everything to be carried conveniently to a showing of transparencies. It holds the projector, slide holder, spare lamp, winding drum for five yards of flex and connections and a box to hold 40 slides. The case itself is used as a stand for the projector when in use and has three wooden sockets, *L*1, to register its feet.

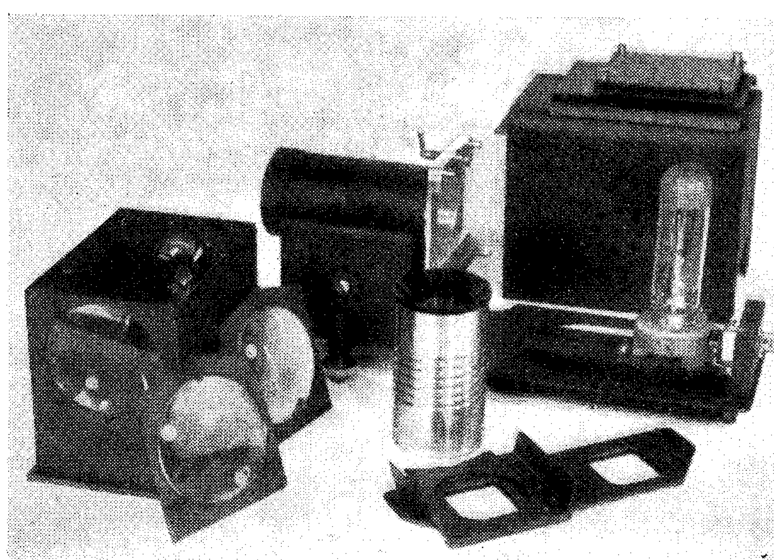
On the top also is the handle which is made from $\frac{1}{4}$ in. round brass, cut nearly through in four places, and bent and silver soldered to the shape shown.

Space for slide holder is inside at the top and is retained by an 18-gauge turnover button, *M*1. Spare lamp and slide box are kept on the right-hand side, the limits of space for the latter being indicated by dimensions, *N*1 and *O*1.

Something that is really worth while doing is the drum, *P*1, the hub of which has a slot to receive the socket end of the flex. It is just pushed in and the wire wound on. There is nothing more annoying than flex that knots and kinks when one wants to use it.

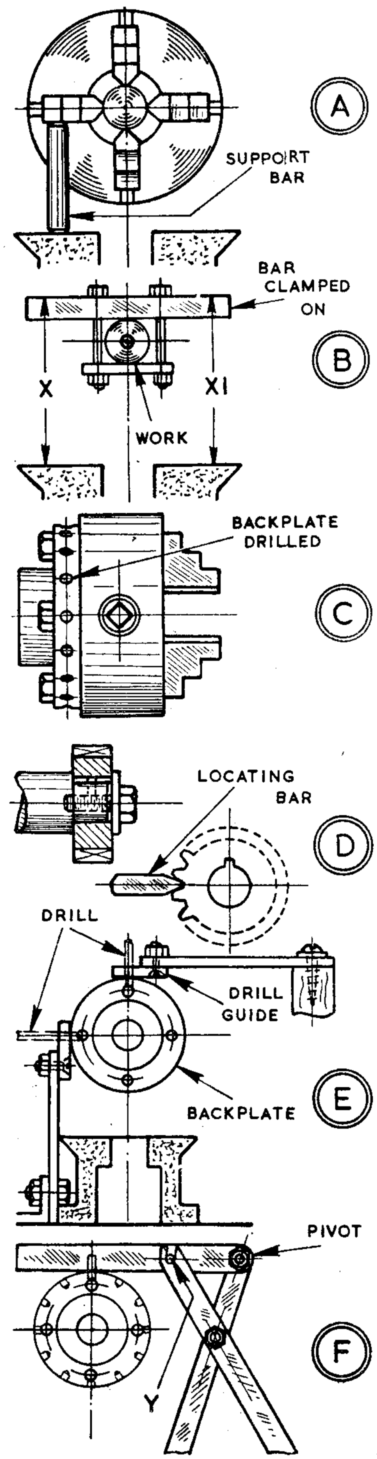
The inside dimensions of the case shown are $14\frac{1}{4}$ in. long, $9\frac{1}{2}$ in. high and $5\frac{3}{8}$ in. deep, but of course everything depends upon how the projector is constructed. ■

The various components of transparency projector



By GEOMETER | *Beginner's Workshop*

DIVIDING IN THE LATHE



It is a great convenience, even on a simple lathe, to be able to mark round components with the commonly-required numbers of divisions, such as four or six, as are necessary when making squares and hexagons; and to make other numbers of equal spacings in a neat and regular manner, such as to provide serrations on the edges of small bosses and knobs by which a finger grip can be obtained on fittings.

It is true, square and hexagon material can be obtained in ranges of standard sizes; but these do not cover all requirements—such as an exceptionally large size, or if a fitting is needed with a circular flange larger than the hexagon, or if a square or hexagon is required on the end of a shaft for key or spanner manipulation.

To make squares or hexagons to a high degree of precision, milling is, of course, necessary; but for general purposes careful filing—checking by micrometer if desired—is quite satisfactory. When the lathe has means of dividing, the material is machined slightly larger than the size over the corners, a pointed tool being mounted sideways in the toolholder and set touching the work.

Using four-jaw chuck

At each located position the tool is traversed by saddle or topslide, leaving a scribed line. To produce the flats, the material between the lines is filed away, the job being removed from the chuck and held in the vice, still on the bar or in soft jaws to avoid damage.

When equipment includes a four-jaw chuck and the jaws overlap the flat surface of a bed, squares can be marked by holding each jaw to a support bar, as at *A*. Such a bar can be from round mild steel, say about ⅝ in. dia., its length having been obtained by checking with inside calipers from the bed to the undersides of a pair of jaws when these are horizontal. The bar should be reasonably to length, and it can be used either side of the bed, but on one side only for one job.

Another method, applicable in the absence of a four-jaw chuck and also to work between centres is to clamp a straight bar to the work, as at *B*. Distances *X*-*X*1 can be equalised with a surface gauge or scribing block and a mark made on the work with the tool; then the bar can be set horizontal again, after rotating half a turn, for making the second mark.

Quarter markings are made with the bar set vertically with a square from the bed. Pressure can be kept on the work from the tailstock to prevent movement.

Quicker method

Much more speedy and wider in scope, however, are drilled backplates, as at *C*, in conjunction with a simple plunger device for holding. Indexing for drilling can be done from a change gear which can be mounted on a mandrel in the chuck, key-pinned and held by a setscrew. A locating bar in the toolholder fits between the gear teeth, as at *D*.

When there are two chucks, 12 spacings on one backplate and 40 on the other will give the following divisions most commonly needed: on the first, 2, 3, 4, 6, 12; on the second, 2, 4, 5, 8, 10, 20, 40. The first can be obtained from a 48 or 60 tooth gear; the second from a 40 or 80 tooth gear.

The guide for a drill about ⅛ in. dia. should be from silver steel, and hardened. A countersunk screw fixes it to a mild-steel bar which is mounted from the back on a block or wall, or from the bench or stand at the front of the bed, as at *E*.

For a bench lathe, indexing can be as at *F*, a cross-bracket fixed behind the lathe carrying a pivoted bar with a silver steel pin. Normally, the bar holds by its own weight, or a wing-nut and screw can be fitted at *Y* for tightening. ▣

The MUNCASTER steam-engine models

EDGAR T. WESTBURY glances back with a modern eye to some classic models of the past

IN THE COURSE of the long history of MODEL ENGINEER—now, incidentally, approaching 60 years—many notable designs and descriptive articles have been published which have established traditions or marked milestones of progress in model engineering.

Not only are these remembered by old readers but they are often the subject of considerable discussion, and requests for further information about them are constantly encountered. A few of the authors of these features are still with us, and in one or two cases continue to contribute articles; but most of them have passed on and are no longer available to provide either new designs or guidance on their earlier ones.

Many readers have suggested that the M.E. should reprint some of these earlier features, but while this might be a good idea from certain aspects there are several reasons why the policy has not been adopted by this journal. In the first place, although the designs for models do not necessarily become outdated the mode of treatment, including methods of construction, is subject to certain changes as workshop equipment and technique improve.

In modern setting

To many modern readers, reprinting of old articles or designs may seem to be a policy of retrogression, or at least stagnation; it may even give the impression that there is a dearth of new ideas in model engineering—which is far from being the case. Therefore the idea of verbatim reprints of articles is not considered desirable, but there is much to be said for the revival of old designs in a modern setting.

There can be few model engineers who have not heard of such pioneers as Henry Greenly, C. S. Lake, Fred Westmoreland, H. H. Groves, George Gentry, or the traction engine specialist "Frost-spike," who have been acknowledged masters in a very wide and versatile field of design. Last but not least, the name of H. Muncaster is well remembered as a specialist in the design of all types of steam engines, whose excellent drawings of many types of stationary and marine engines in early volumes of the M.E., and also in the handbook *Model Stationary Engines*, published nearly half a century ago, provided scope for the talents of innumerable constructors.

H. Muncaster was a practical draughtsman who not only had a wide experience of steam-engine design but also obviously had a love and devotion to his craft, and to all things mechanical. In the introduction to his book he pays due homage

1—A simple oscillating engine

to the many early engineers and inventors who contributed to the development of the steam-engine, and also gives a complete answer to those who would condemn model engineers for "living in the past."

"For the purposes of the model engineer," he states, "it does not follow that the most recent and perfect engines are most suitable; on the other hand, some of the older engines form subjects better adapted and more fitted as prototypes for models, being more picturesque and providing better object lessons."

With which precepts I wholeheartedly agree, and also with his further comments that many of the most popular so-called models "have no prototype in reality, but nevertheless may be useful in illustrating some of the points of the steam-engine, as well as providing a simple motor, where only a small amount of power is required." No model engineer, therefore, need despise the crude and primitive types of models produced by beginners, so long as they lead on to the more realistic types which were Muncaster's speciality.

The simplest form of engine described by Muncaster is one having a single-acting oscillating cylinder (Fig. 1) and this will commend itself to many readers, not only on account of its simple construction, but also because it can be built without castings. It is of the type which would now be classed as "inverted" vertical, having the cylinder below the crankshaft, though in the early days the practice of locating the cylinder at a low level—firmly bolted to the floor if possible—was considered normal and orthodox.

THE PILLAR

The main structural component of this engine is the pillar, shown in Fig. 2, the lower portion of which is of rectangular section, with extended feet at the sides for mounting on the flat square baseplate. At the top end, the section is also rectangular and is cross bored to form a housing for the single main crankshaft bearing. In the centre, it is turned to circular tapered form, with simple ornamentation in the form of a beading near the lower end.

To save material in making this part, the foot at the base may be made separate and silver-soldered on; or screwing and sweating would probably be satisfactory. This should be done before machining and I suggest that the front and rear sides should then be faced quite flat and true by filing, or any other convenient method, after which the two ends may be marked out, exactly central both ways, and centre-drilled so that the part can be mounted between centres for turning.

The cross holes for the main bearing and the cylinder trunnion may now be drilled, and it is essential that these should be exactly square with the pillar face, so it will be advisable, after marking out their positions, to set the pillar up on the faceplate of the lathe for these operations.

An alternative to the pillar as the

support for the crankshaft bearing is given in Fig. 3. This consists of an A-frame cut from sheet metal, with the bearing housing at the apex, either bushed or otherwise reinforced to provide extra bearing surface. It does not, however, incorporate the port block or other cylinder mounting and it is not explained how this should be fitted. For this particular type of engine, I do not consider it so elegant in appearance as the pillar, neither does it simplify construction.

CYLINDER

The designer suggests that the cylinder (Fig. 4) may be made from a piece of brass tube, with the flange, end cap and portface soldered on, but in practice it will usually be found just as easy to machine it from the solid, as the manipulation of small pieces, which have to be accurately located and soldered simultaneously, is not as simple as it looks. In either case, however, it is essential that the bore of the cylinder should be exactly circular and parallel, the flange faced square with it, and the portface dead flat and parallel to the axis.

These conditions can be assured by machining, as the bore and flange can be dealt with at one setting; a D-bit is recommended for taking the final cut in a blind bore, after which it should be finished by lapping with aluminium oxide or brick dust on a *short* copper or aluminium lap—not one which extends the full length of the bore, as this will tend to make it tapered or bell-mouthed.

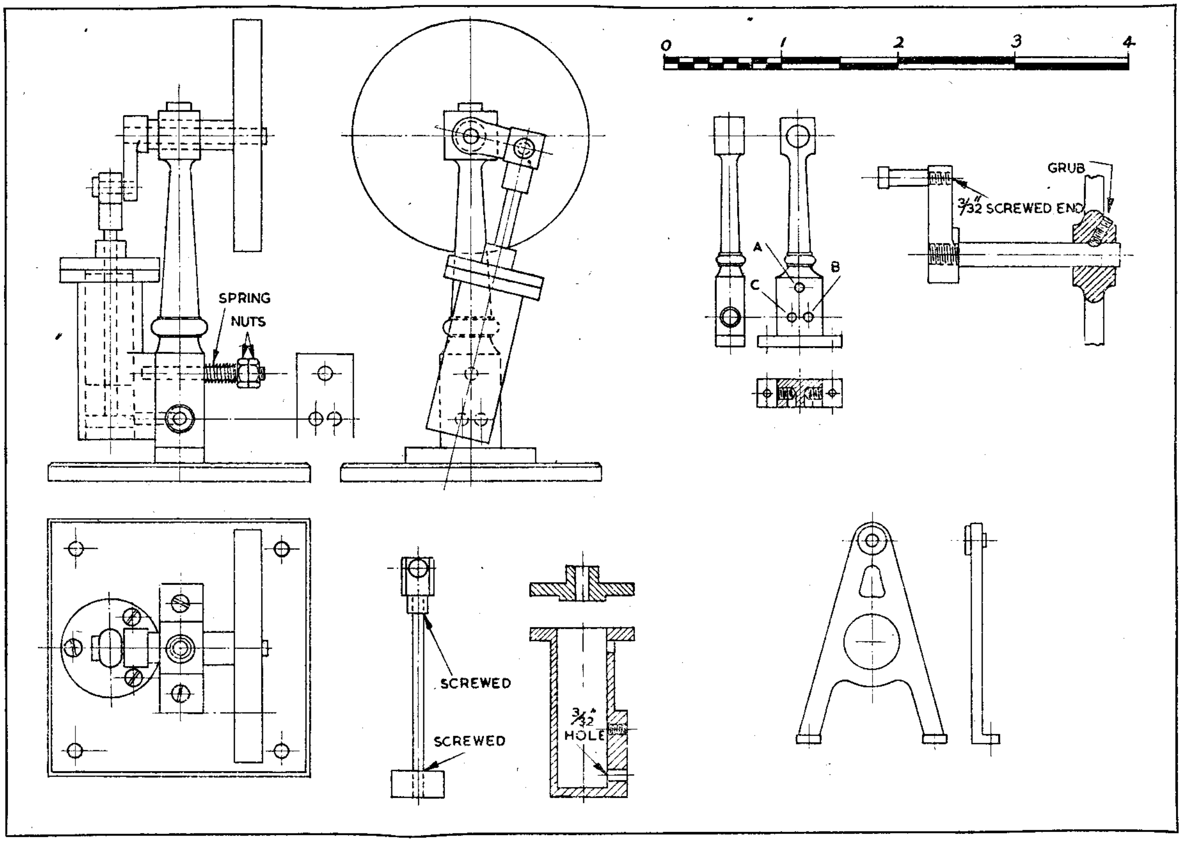
If the cylinder is machined from the solid the smallest diameter of bar which can be used is 1 in. A good deal of material will be left around the base, after turning as much as possible of the outside, and this will have to be filed or machined away, leaving the portface to be faced flat. A very efficient way of doing this is to make a short mandrel, of a size to fit neatly in the cylinder, and fix this in an angle-plate or a short piece of angle iron, on the lathe faceplate.

Clamp the cylinder endwise on this, checking it first to see that it is parallel with the faceplate; it can then be turned into any position to machine the portface or " nibble " away the rest of the surplus material. By working to the same index reading on the topslide for each cut, the shape may be made practically circular and flush with the upper turned part, needing only a clean-up with a smooth file to take off the sub-angular corners, and a final polish with emery cloth.

The trunnion is fitted to a tapped hole in the face of the portblock, and it is most essential that this should be dead square with the cylinder axis. It could well be drilled and tapped while the cylinder is set up on the faceplate, to ensure this; the hole should not go right through into the bore, though some constructors may find difficulty in tapping a short blind hole.

If it does go through, however, make certain that the trunnion stud does not project into the bore when tightly screwed in and that there are no burrs left on the inside to interfere with the free movement of the piston. It is an advantage to machine a shallow recess around the tapped hole to relieve the centre of the face; alternatively, this may be done on the corresponding face of the pillar.

Little need be said about the cylinder



The components of the engine

Muncaster steam-engine models . . .

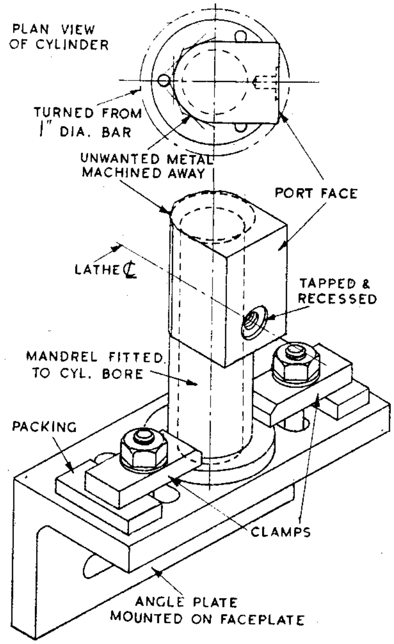
cover (also shown in Fig. 4), as this is a simple job which can be turned at one setting. The spigot should fit neatly in the cylinder bore, and the hole drilled centrally to a working fit for the piston rod. It is attached to the cylinder flange by three 3/32 in. or 8 B.A. screws. The piston assembly (Fig. 5) is built up in three pieces, the rod, of 3/32 in. dia. bright mild-steel, being screwed on each end to take the solid piston at one end and the crankhead bearing on the other, both these pieces being of brass or gunmetal.

In the drawing, the piston is shown as a plain parallel disc, machined to fit closely in the cylinder, but I strongly recommend, at least to those with little experience in these matters, that a groove should be machined in it for packing with graphited asbestos or cotton yarn. The advice I have given in articles on other engines, that the final machining of the piston should be done after it has been screwed tightly on the rod, still holds good. Final adjustment of the length of the rod, so that the piston just stops clear of the end of the bore at the extremity of its stroke, can best be done on assembly.

CRANKSHAFT

The crankshaft is built up with a web made from rectangular brass bar, into which the main journal and crank-pin are screwed. As an alternative form of construction a disc can be used, and this would not only improve the appearance but could also be balanced if desired. In either case, however, it is essential that both the tapped holes should be square with the web and parallel with each other. No details are given of the flywheel, which is shown as a solid disc, but I recommend that a spoked flywheel with a heavy rim should be fitted.

The main bearing is in the form of a plain bush, made to press tightly in the cross hole at the top of the pillar, and the centre hole in the end of the latter is drilled through into the bush to serve as an oil hole. It is now in order to assemble the parts temporarily, to ascertain that everything works freely and smoothly, without binding or tight spots, and that the piston clears at both ends of the cylinder.



Set up for machining the cylinder block

PORT LOCATION AND TIMING

The entire success of an oscillating cylinder engine depends on the accurate location of the steam-ports, and this is where many constructors fail to get the best results, as it is by no means easy to mark out and drill holes exactly in the right place. Both the size and position of the two holes in the stationary portblock are dependent on their radius from the trunnion centre, in conjunction with the maximum distance of swing at extreme cylinder angularity—which, incidentally, is *not* the same thing as half the piston stroke.

In this engine, the maximum distance of swing under these conditions at $\frac{3}{8}$ in. radius is $\frac{3}{16}$ in., so the ports should be drilled at $\frac{3}{16}$ in. centre distance apart, and as the blank space between them should be exactly the same as the port diameter, this dimension should be 3/32 in.; on no account drill larger holes as this would only result in steam wastage between the ports.

Even with the utmost care in locating the holes in the portblock, however, there is still a possibility of error in the position of the single hole in the cylinder face, which may completely nullify all efforts to produce a correctly timed engine. I suggest, therefore, adopting an unconventional method of drilling these holes, which not only kills two birds with one stone, as it were, but also ensures positively that they are correctly located in relation to each other.

First of all, the hole in the cylinder is marked out as correctly as possible and drilled undersize, say 5/64 in. or No 48 drill, the hole being continued right through the opposite wall of the cylinder. The engine is then assembled and the crankshaft turned to swing the cylinder to maximum angle in one direction, where it is clamped in place by the nut on the trunnion stud with a suitable distance piece.

LAPPING

By running the drill through the hole in the cylinder the position of the hole in the block may be spotted or drilled to full depth, after which the cylinder is shifted to the other extreme position by turning the crank, and the operation repeated. The ports are then opened out to 3/32 in. or No 42, and the hole in the outer cylinder wall closed by a plug screwed or soldered in.

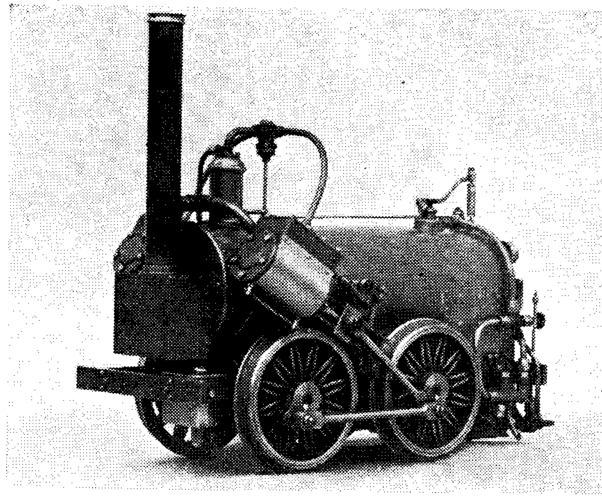
Finally the two side holes in the portblock, forming steam and admission connections, are drilled to meet the ports and tapped to take screwed pipes, the faces of both cylinder and portblock then being lapped on a piece of plate glass to produce a truly flat and smooth finish.

When finally assembled, a light spring is fitted to the trunnion and the locknuts are adjusted to hold the cylinder against the block, but with no more tension than is necessary to keep it in steamtight contact against the working steam pressure. The engine will run in either direction, according to which of the two connecting pipes is connected to the steam line, so that it could readily be made reversible by fitting a change-over cock.

If made according to directions and carefully finished, this should not only be a satisfactory working model, but also a handsome and dignified one.

● *To be continued.*

Some readers' models



A review of some of the work undertaken by M.E. readers

SUCH interest was aroused by the picture of my model of *Invicta* [Readers' models, 17 January 1957] that I am sending two more photographs; these give different angles.

As I previously mentioned it has pulled as much as 440 lb. on a continuous track with grades—and 400 lb. up a two per cent. grade from a standing start on a slightly lesser grade. It burns domestic coal—which gives off a realistic smoke—and it has run for as long as five hours !

OSCAR M. HEUTER.

UNICORN AND PUMP

MY Unicorn engine was built to M.E. design with some additions. The cylinder studs are 8 B.A. and the ratio of the governor belt drive gives it a speed of approximately 300 r.p.m. The return spring prevents " hunting."

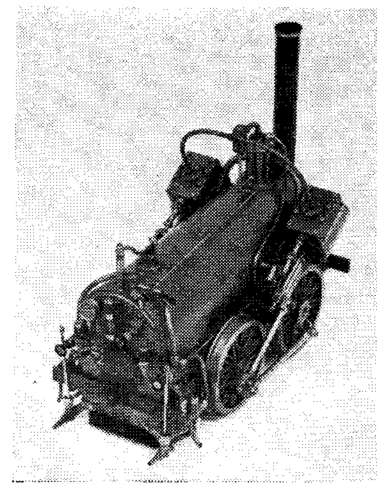
The centrifugal pump (below, left) which is driven by the Unicorn engine has a six-bladed impeller with a 1 1/32 in. dia. shaft relieved of side thrust by a $\frac{3}{16}$ in. dia. pulley shaft running in the ball races. The flat belt was made by grinding down plastic belt from $\frac{1}{8}$ in. thick.

A. BEAUMONT.

STANLEY STEAMER

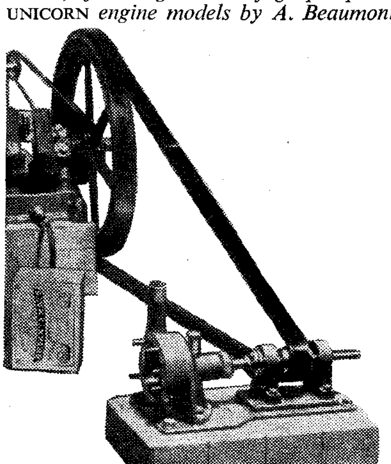
ALTHOUGH I did not keep a timesheet for my model of L.B.S.C.'s *Stanleyette* I estimated that the job occupied me for 400 hours.

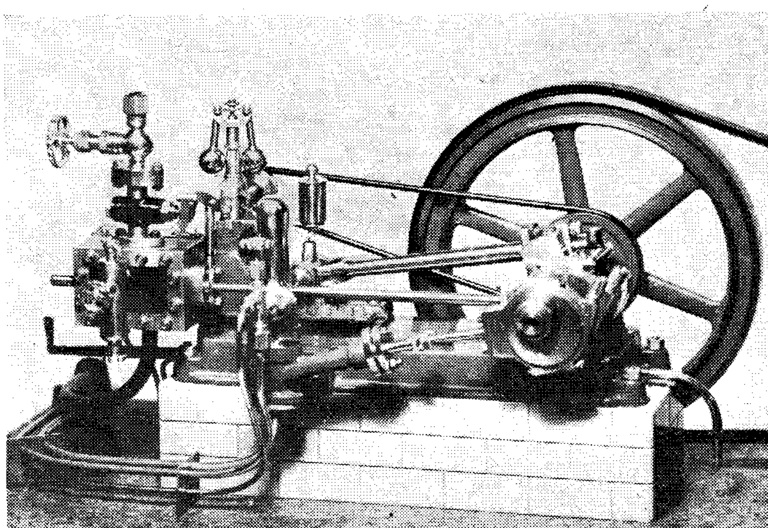
The wheels and tyres gave me my biggest headache. At one period I hoped someone would produce light alloy castings, but having acquired a chunk of much weather-beaten wood—it was washed up by the sea, incidentally—I turned up the wheels and bushed them.



Above and right: *Oscar M. Heuter's model* INVICTA

Below, left and right: *Centrifugal pump and* UNICORN *engine models by A. Beaumont*





Readers' models . . .

The tyres were made from gas tubing set with Bostick and joined up with a rubber plug, and I touched the tread with a chaser to form the ribs.

The leaf springs were taken from the main spring of and old clock, and having some ball bearings, I utilised them in the back-axle bearings and in the crankshaft—which meant only setting out the crosshead a fraction.

The rear weight was taken by the torque rods and the exhaust-pipe support, which put the leaf springs and ball bearings out of action; so I pivoted the cylinder block with a shouldered screw in the front holes of the frame brackets.

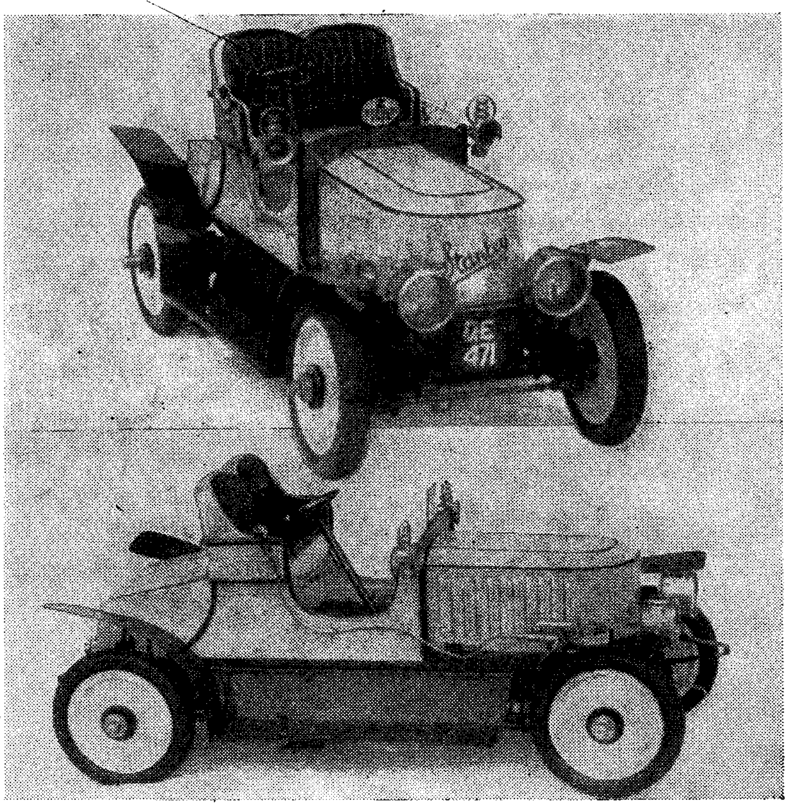
I drilled a 5 in. length of $\frac{3}{16}$ in. brass rod right through No 30 for the steering column ($\frac{1}{8}$ in. rod) halfway from each end.

The sheet metal parts, bonnet, wings, etc. were from bits left from a Redex oil drum.

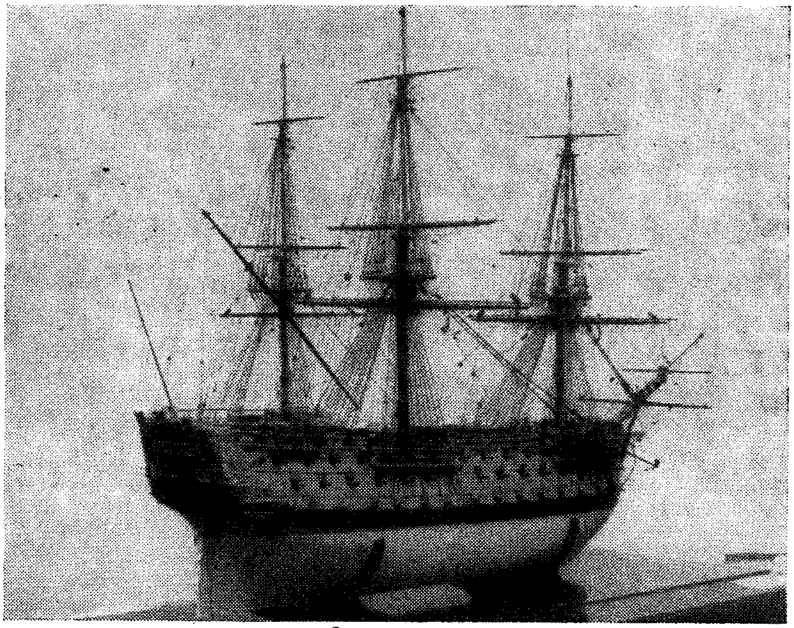
The body is of 3-ply from bottoms of cheese boxes. The seat was carved from the same wood as the wheels. The upholstery was made from an old bank wallet—matt side up for mats. The piping was mending cotton stuck on—an optical illustion for curved bucket seats !

As for signwriting; I find that if the letters are put on with a children's paint brush and are gone over with an empty ball-point before the paint is dry, it trims them up.

The fuel tank was from a piece of square brass tubing cut down from scrapped brass bedstead, with the sides integral with lugs inserted. It has a needle valve inside to cut off the methylated spirits, otherwise it would burn dry. An air vent/overflow pipe comes out under the running boards. The other pipes under the driver are from safety valve and test valve. This saves a mess on the floor.



Above: S. Reeves' STANLEYETTE *model with visible—and invisible—additions*



Below: Model of H.M.S. VICTORY *(circa 1780) by W. McMather*

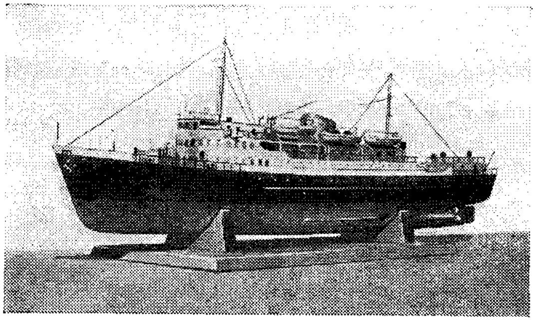
There was a spare face on the block on the backhead which I used for a steam-gauge and I used it to provide a spare fitting with a cycle valve stem which can be connected to an air supply at will. The domed boiler end was dished out with a ballpein hammer on a sandbag and flanged after. The job done in less time than making a former.

Lamp glasses are Perspex; a file cut made divided glass and reflectors were cigarette silver paper—the dimpled sort. The rear lamp had a bit of red cellophane toffee wrapping stuck behind it.

The horn body was two Cs dowelled and silver soldered together off set—reed and trumpet ends, ditto.

I have not had it in steam yet *in situ* as I only finished it at Christmas and wanted a photograph while it was clean.

S. REEVES.



A WORKING MODEL OF
ST NINIAN

By EDWARD BOWNESS

This instalment sees the plating of the hull completed and the propeller shaft bearings and the bilge keels positioned

Continued from 7 February 1957, pages 201—203

WHEN the outer strake (No 3) is finished on each side of the former we can proceed with the inner strake (No 6). This strake calls for a considerable amount of care as it lies almost horizontally amidships and vertically at each end.

Also it has to curve outward on each side amidships, as at this point it lies at the turn of the bilge. However, there should be no real difficulty if the lines on the former are followed closely when cutting out the plates and care is taken in fitting them to the former. Shorter plates may be used to make it easier to get the necessary twist.

The overlap must not be overlooked; this makes the normal width of the plates $1\frac{3}{16}$ in. The forward and after ends of this strake will at a later stage be soldered direct on to the brass stem piece and stern frame respectively, so that the length of the end plates should be left a little full and the ends trimmed off flush after soldering.

This applies also to the forward end of strake 4 as it makes contact at its lower corner with the stem piece and may not be entirely concealed by the cover plate which goes on later.

The upper edge of strake 6 almost coincides at station 2 with the centre of the propeller tubes where they enter the hull. A brass or bronze bush 2 in. long × $\frac{1}{4}$ in. bore and $\frac{7}{16}$ in. external dia. must be sweated in on either side at this point to form the forward bearing for the propeller shafts.

Their position fore-and-aft is with the forward face 1 in. forward of station 2 (Fig. 14) and their transverse position is controlled by the holes in the former and the drilling jig shown in Fig. 10. Clearance for these bushes should be cut away in the former, not forgetting that later the hull must be lifted off it.

Location for the bushes when fitting the plates, and later when soldering them in position, is provided by pushing $\frac{1}{4}$ in. dia. rods through the drilling jig, the bushes, and into the holes in the former. With the bush in position the upper edge of the adjacent plate in strake 6 should be cut away to fit around it on the underside.

The plates for strake 5 should now be cut and fitted to the shape of the former. The lower edge must be cut to the line on the former and the upper edge cut to give 3/32 in. overlap on strake 4, with a fair curve to harmonise with the line of the other strakes. The line on the former between strakes 4 and 5 is covered by the plates of strake 4 which are already in position.

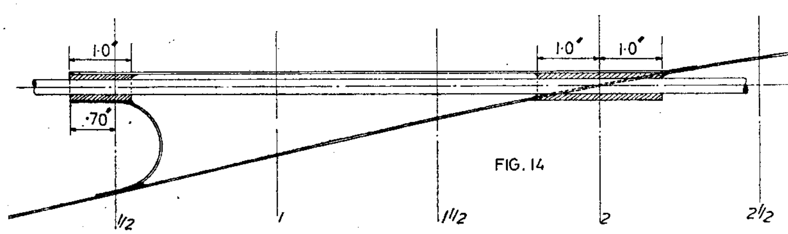
The plates under the quarters where the propeller bosses come through will require cutting away and fitting on top of the brass bushes, as for strake 6. The forward and after ends of strake 5 will be soldered direct on to the stem piece and stern frame respectively, and extra allowance must be made for this as already explained in connection with strake 6.

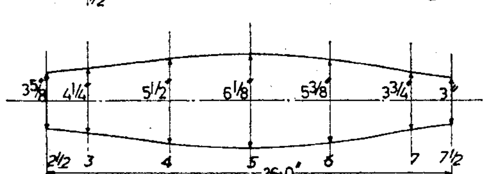
The plates for strake 6 should now be secured to the former, after which the plates for strake 5 must be soldered in position, commencing amidships and working towards each end. When dealing with the after end of the hull the plates which fit around the propeller bushes should first be soldered to the bushes with a good fillet of solder after which the soldering together of the plates may be proceeded with, the reason being that soldering the bushes in position will require a little more heat than merely soldering the plates together.

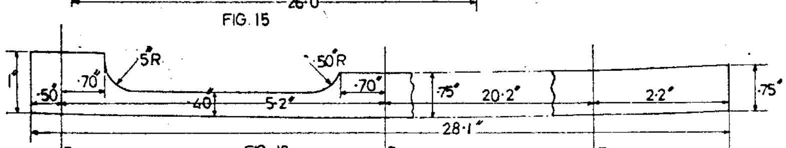
A corresponding fillet of solder will have to be run around the bushes on the inside after removing the hull from the former.

The ends of strakes 5 and 6 must now be firmly soldered to the stem and the stern frame and the surplus metal trimmed off flush.

The bottom strake 7 is a wide plate tapering toward each end and is virtually the keel plate of the ship. It should be made in three pieces, small pieces for the bow and stern and a larger piece amidships. The large central piece is 26 in. long and







Showing the details of the propeller shafts, the large central piece, and the amidships bulwarks

ST NINIAN . .

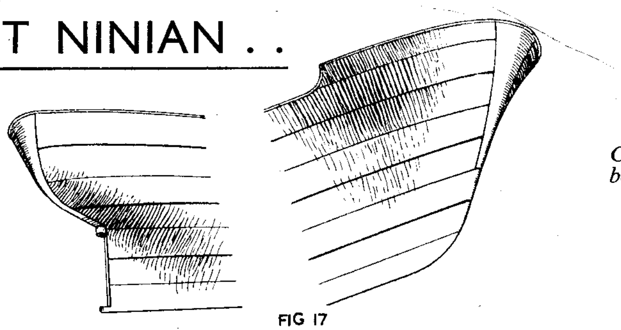


FIG 17

Cover plates at bow and stern

extends from station $2\frac{1}{2}$ to station $7\frac{1}{2}$, these lying midway between stations 2 and 3, and 7 and 8.

The sheets are butt jointed at these points and later will have butt straps $\frac{1}{8}$ in. wide soldered on the inside. The central piece is symmetrical about the centre line of the ship as shown in Fig. 15, from which also its dimensions may be obtained.

A template should be made to these dimensions in stiff paper and applied to the former to see if adjustment is necessary. If it is all right the plate should be cut out allowing about $\frac{1}{4}$ in. all round for working it to shape.

A somewhat thicker gauge of metal could be used for this plate to obviate damage when setting it down at the pondside. The additional weight would be no disadvantage, situated as it is at the lowest point of the ship. The plate should then be shaped carefully until it is a good fit on the former, using the rounded piece of boxwood to stretch and mould it where necessary after the edges have been trimmed to give the correct overlap on strake 6. It should be soldered in position.

The two end pieces are a little more difficult as they lie almost flat where they meet the central piece and have to be folded up till they are vertical at the ends of the keel. It might be easier to make them in two halves, joined together along the edge of the keel, but if, as with the larger plate, a heavier gauge of metal is used, they can be formed to the correct shape by stretching the edge with the boxwood or by a little judicious peening with the hammer.

A stiff paper template should be made in each case to get the approximate shape of the metal before cutting them out. The piece at the bow should be divided on the centre line to a point 1 in. forward of station 9 as from this point it is soldered on each side of the stem piece. The piece at the stern is wrapped around the stern piece at its after end, and soldered to it.

We should now prepare strake 1 which is an outer. This is the sheer strake and in view of its prominent position on the model extra care should be taken to have its upper and lower edges lying with a smooth, true curve throughout the length of the hull.

A smoothly curved line should be drawn on strake 2, 3/32 in. below its upper edge, as a guide for fitting the plates of strake 1. These should be cut as already described and fitted to the former. The curvature for the flare in the plates near the bow will require special care and patience. There is also considerable curvature in the plates at the stern, especially aft of station 1.

It should be noted that, approaching deck level, the side of the hull is vertical to match up with the railings above it. At the bow stations $8\frac{1}{2}$ and 9 the pillars for the railings slope outwards, in keeping with the flare.

Before fixing strake 1 prepare the short bulwarks at the bows and the bulwarks amidships, up to the level of the rail. The bulwarks amidships are merely strips of tinplate $\frac{3}{4}$ in. wide, cut to the curve of the sheer of the ship (see Fig. 16). If these are too long for the material available, a butt joint should be made at any convenient point in the $\frac{3}{4}$ in. wide parallel portion.

It will be seen that, at the after end, a short portion projects $\frac{1}{4}$ in. above the former. To prevent these getting damaged, a strip of wood $\frac{3}{8}$ in. or $\frac{1}{2}$ in. thick should be nailed across the former between them.

The bulwark at the bows will require care in shaping, but as it is in three pieces (Fig. 17) the centre-piece being the cover plate which continues down the stem, it will not be too difficult.

Two rectangular holes will be required to clear the mooring ropes at the fairleads leading to the bollards, but these can be cut later when their position can be more easily determined. With the bulwarks firmly fixed to the former, strake 1 should now be soldered in position.

To complete the outer shell of the hull all that remains is to fit the cover plates at the stem and the stern. With the older straight stem, the stem bar finished off the hull forward, the strakes of plating being riveted to it; with the modern soft-nosed bow the stem bar, as an external feature, is lost and is replaced by a wide cover plate.

In the model this will be $1\frac{1}{2}$ in. wide at its upper edge and will continue down to cover strake 4, at which point it should be $\frac{1}{2}$ in. wide. It requires folding over along its centre line with an almost sharp corner at its lower edge, opening out to $1\frac{1}{2}$ in. radius at its upper edge, the actual shape being obtained from the former on which it must be a good fit. It can then be soldered in position, giving a clean, firm finish to the forward ends of the strakes of plating.

The cover plate at the stern is not quite so tapered, its width being 1 in. at the upper edge and $\frac{3}{8}$ in. at the lower. It extends from the top of strake 1 and around the stern until it meets the tube for the rudder stock, against which it should fit neatly.

Its radius decreases from $1\frac{1}{2}$ in. at the top until at the turn of the stern outline it is quite small, after which it flattens out as it approaches the rudder tube. The actual shape may be seen on the former, against which it should fit closely.

A punch with rounded edge, $\frac{1}{8}$ in. thick and $\frac{1}{2}$ in. wide and of $\frac{3}{8}$ in. or $\frac{1}{2}$ in. radius, will be required for the curved portion, and this should be used with a light peening hammer. The peening should be done on a reasonably soft surface.

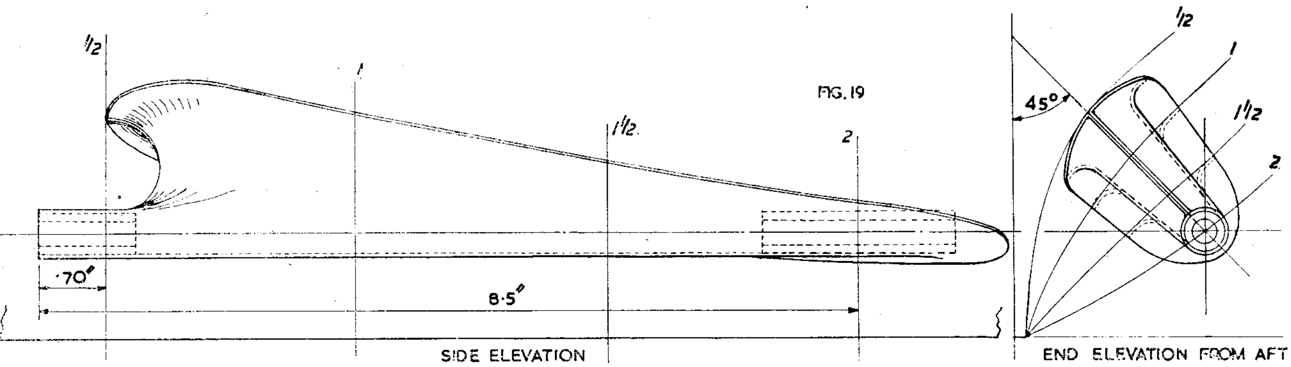
I find the square of hard black rubber, $\frac{3}{16}$ in. or $\frac{1}{4}$ in. thick, obtainable at Woolworths or similar stores, very suitable. When the plate fits snugly on the former it should be soldered into position. Care and neatness in fitting these two cover plates is essential, as they are very conspicuous in the finished model.

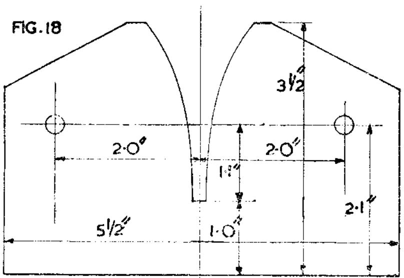
PROPELLER SHAFT BEARINGS

The actual plating of the hull is now complete, but there are one or two items to be attended to before we remove the hull from the former. The most important are the propeller bosses.

Before commencing these we require a jig or template to hold the ends of the shafts which locate the bushes immediately forward of the propellers. These bushes are $\frac{1}{4}$ in. bore, $\frac{7}{16}$ in. external diameter by 1 in. long, and should be made from brass or bronze bar. The jig should be made from a piece of hardwood $5\frac{1}{2}$ in. long, $3\frac{1}{2}$ in. wide and about $\frac{1}{2}$ in. thick (Fig. 18).

A V-shaped notch should be made as shown, so that when the forward face of the jig is 0.7 in. aft of station $\frac{1}{2}$ the deadwood at the stern will fit tightly into it. Two holes, $\frac{1}{4}$ in. dia., should be drilled where shown, great care being taken to locate them accurately.





Left: *Jig for supporting prop shafts*

Above: *Details of the web which supports the after bearing of the starboard propeller*

When using the jig its forward face should be 8.5 in. aft of station 2, and this should be checked on each side of the hull to ensure that the jig is square with the centre line of the ship and that the bushes are in their correct fore-and-aft position.

Straight steel rods 1/4 in. dia.—the propeller shafts themselves, if they are available—should then be pushed through the jig, and the bushes threaded on them, after which they should be pushed through the bushes in the hull and into the holes in the former.

As will be seen from Fig. 14, the bushes are supported by a stream-lined web from the body of the ship, and not by A-brackets as in older fine-lined vessels. These are set as nearly as possible at right angles to the form of the hull, and can be made out of single sheets folded around the propeller shaft bearings and flanged to fit the surface of the hull.

The sheets should be of soft brass about 1/32 in. or 20 s.w.g. in thickness, to ensure rigidity. Before cutting them out it is advisable to try out the shape in brown paper, allowing plenty of margin for subsequent working.

Fig. 19 shows the web for the starboard propeller shaft bearing. From the end view it will be seen that the web is set at an angle of 45 deg. to the base line, and that from its internal radius of 7/32 in. around the bushes it opens out to about 3/4 in. wide where it meets the hull at station 1/2.

Maintaining the same angle the width decreases as its depth is reduced owing to the form of the hull, and it has a flange approximately 5/16 in. wide which lies flat on the hull surface. The forward end of the plate fits around the outer part of the shaft bearing where it protrudes from the hull, and the flange must be carried forward until it lies flat on the hull.

At its after end the two sides of the web must be brought together, between the bearing and the hull, and soldered to form a rather sharp stream-lined edge. This should receive a fillet of solder on the inside to add stiffness and to fill the angle between the bush and the plate.

The bush is of course tinned and sweated to the plate to form a rigid structure. The inside of the web should also be tinned where it comes into contact with the bushes and with the hull.

These propeller bushes call for a considerable amount of skill and care in the making, but when finished they form a very satisfying feature of the model.

BILGE KEELS

The bilge keels should now be fitted. They will add strength to the hull and will help to preserve its shape when the plated shell is removed from the former. On the actual ship they seem to be unusually short, extending only from a little aft of station 4 to a little aft of station 6, or less than one fifth the length of the vessel. This, I believe, is becoming the practice with ships of reasonably high speed.

I find that, so far, I have made no mention of the speed of *St Ninian*, or of her engines.

The prototype is fitted with two British Polar two-stroke, direct-reversing diesel engines, built by British Polar Engines Ltd, of Glasgow. Each engine has eight cylinders, 340 mm. bore by 570 mm. stroke, and they each develop 1,310 b.h.p. at 250 r.p.m. The propellers are 8 ft dia. The designed speed of the ship is 15 knots, which is fairly high for such a comparatively small ship.

To return to the bilge keels—for the model I think it would be advisable to lengthen them somewhat, so I propose we add 3 in. at each end making them extend from 3 1/2 in. aft of station 4 to 2 1/2 in. forward of station 6, making them 16.4 in. long overall.

This takes in a little more of the curvature of the hull and will make them more useful in stiffening the hull, and more effective as stabilisers when sailing the model. As will be seen in Fig. 11, they are placed immediately above the turn of the bilge amidships, which brings them a little below it toward each end.

The bilge keels on the ship are horizontal, but in lengthening them for the model they can be curved upward a little so that they follow the curve of the hull a little more closely.

They should be made from 1/4 in. brass angle, or could be bent to a right angle from 1/2 in. wide annealed brass strip about 20 s.w.g. thick. They can be bent to the curve of the hull by peening along the edge of the horizontal web. This web should be rounded off at each end with an easy curve.

When soldering them in position the heat should be directed chiefly on the outer edge of the angle to avoid distortion, due to the soldering together of metals of unequal thickness. Thorough tinning is essential. Pressure to keep them together until the solder sets can be applied by means of a piece of wood, as already suggested for soldering the plates.

We can now remove the hull from the former. It should be a fairly tight fit, so care must be exercised in taking it off. Find out just where it is tight and tap it slightly along the upper edge to free it. It will probably be binding at the stern frame and the stem piece as these were a tight fit for the grooves in the former.

● *To be continued.*

SCREW CUTTING

By H. J. TAPLIN

In order to work out the necessary change wheels for setting up for screwcutting a thread of a given pitch, the principle of screwcutting must be understood.

A thread is, of course, a continual spiral. This is achieved by rotating a bar and moving a cutting tool along its axis at a uniform speed, thus cutting a spiral or thread.

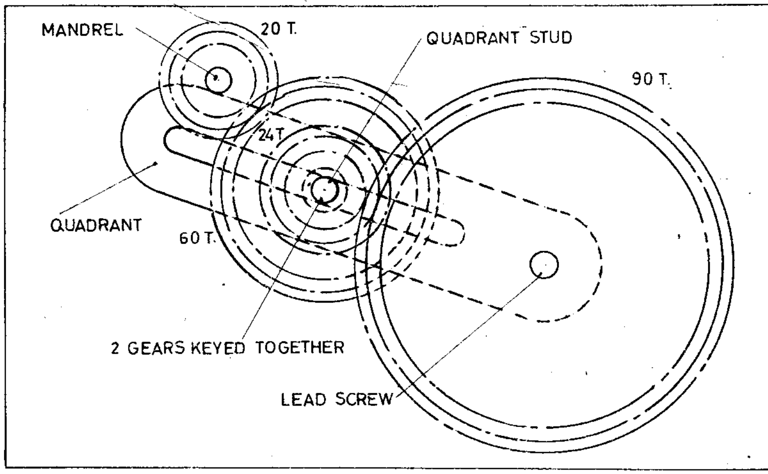
In the case of a lathe the movement of the cutting tool is produced by the "leadscrew" which can be engaged at will with a split nut on the saddle so that when the leadscrew is rotated the saddle is driven along, carrying the cutting tool.

Now the distance the saddle is thus moved along for each revolution of the leadscrew is governed by the "pitch" of the leadscrew or, in other words, the number of t.p.i.

Thus for example if the leadscrew is four t.p.i. and is rotated four times, the cutting tool will have moved along 1 in. And if the mandrel (carrying the work piece) is geared to the leadscrew with gears of equal numbers of teeth, the leadscrew will rotate at the same speed as the mandrel. But as the pitch of the screw in this example is four t.p.i. the cutting tool will travel 1 in. while the work is rotating four times, thus cutting four t.p.i.

Now to the ratio between the leadscrew and the mandrel which, in this case, is 1/1. If instead of gearing the leadscrew and mandrel with gearwheels of equal teeth, I gear them with gears in which the leadscrew gear has twice as many teeth as the mandrel gearwheel, the mandrel will rotate twice to once on the leadscrew. Thus, while the mandrel is rotating eight times the leadscrew will only rotate four times. However, as I have shown that the saddle moves 1 in. while the leadscrew is rotating four times, the mandrel in this instance rotates eight times while the cutting tool moves 1 in.—thus making eight threads to the inch.

In this second example the ratio is 2 to 1. It is immaterial as to what number of teeth is used in these two examples, providing that in the first example the number of teeth on each gear is the same, and, in the second, twice as many teeth are on the leadscrew gear as on the mandrel gear. The formula in this instance for the gear ratio is:



$$\text{Ratio} = \frac{\text{Number t.p.i.}}{\text{Pitch of leadscrew}}$$

$$\text{Ratio} = \frac{4}{4} = 1:1$$

$$\text{or } \frac{8}{4} = 2:1$$

In some lathes the change wheels are in steps of two, e.g., 20, 22, 24, 26, etc., and in others perhaps in steps of five, e.g., 20, 25, 30, 35, etc.

Obviously the gears chosen in these examples must be large enough to engage, or an idler gear must be used on the quadrant between them. This reverses the rotation of the leadscrew.

Having established the formula I will take a more complicated example. Assuming a leadscrew of eight t.p.i. and I want to cut a thread of 36 t.p.i. I have, therefore, this formula:

$$\text{Ratio} = \frac{36}{8} = 4.5$$

Now if I select a 20 t. gear for the mandrel I must have 4.5 times this number of teeth on the gear for the leadscrew, namely 90 t. Supposing, however, I want to cut 90 t.p.i., the formular is then:

$$\text{Ratio} = \frac{90}{8} = 11.25$$

This ratio is too big to do a straight reduction with two gears only. Therefore, I must use a "compound train" utilising the quadrant.

The first thing to do is to split this 11.25 : 1 ratio into two multiples—and to accomplish this I can take a ratio of, say, 3 : 1. Now if I divide 11.25 by three (the selected ratio) I get the other multiple, which is 3.75.

I next select two gearwheels giving a ratio of 3 : 1, say 20 t. and 60 t.; the 20 t. goes on the mandrel and the 60 t. on to the stud on the quadrant. I now need a pair of gears which will give me a ratio of 3.75 : 1.

In order that my big gear is not *too* big I choose the smallest gear I can, a 24 t. gear. To arrive at the correct number of teeth on its mating gear I must multiply the number of teeth on the small wheel, i.e., 24 t. by 3.75. The answer to this is 90.

The 24 t. gear is fitted on the quadrant shaft and is keyed to the 60 t. gear which I have already put there; the 90 t. gear wheel is mounted on the leadscrew. The quadrant arm and its adjustable axle are then arranged so that the 20 t. gear wheel on the mandrel engages with the 60 t., and the 24 t. engages with the 90 t. I thus have a ratio:

$$\text{Ratio} = \frac{60}{20} \times \frac{90}{24} = 11.25$$

(The diagram illustrates this set-up.)

The foregoing is true for any lathe with change wheels and for any pitch of leadscrew.

While in the examples which have been given the gears work out conveniently, this will not always be the case. It may, therefore, be necessary to change the multiples to suit the gear wheels available.

Further, it may not always be possible to get the exact ratio required with existing gear wheels. But in such cases it is usually possible to get within a decimal or so, which could mean no more than perhaps 1/1000 of the required pitch error, which, in the majority of cases, would be acceptable.

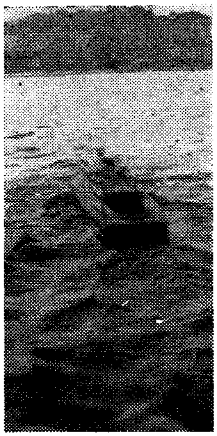
In order to get these variations either in a single or a compound train, it does not necessarily mean that a lower or higher number of teeth should be deducted or added from one gear wheel only, as this may possibly alter the ratio too much. But by adding or deducting the same number of teeth from each of a pair of gear wheels the ratio is not altered to the same extent.

For example if I take two gear

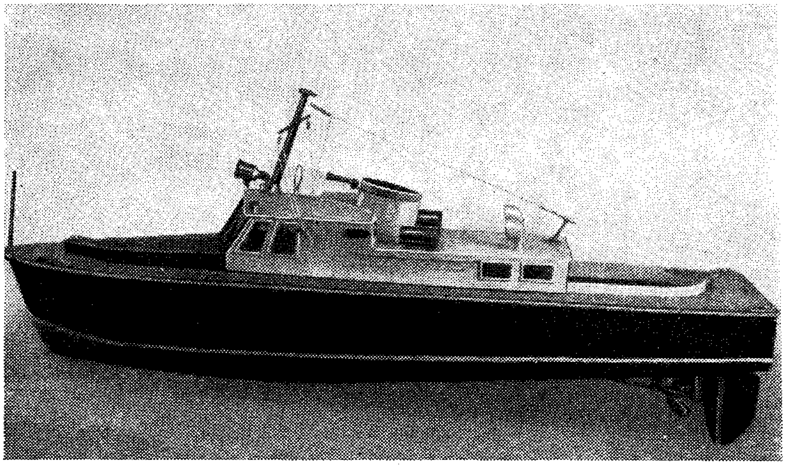
Continued on page 296

FIRST ATTEMPTS AT MODEL BOAT BUILDING

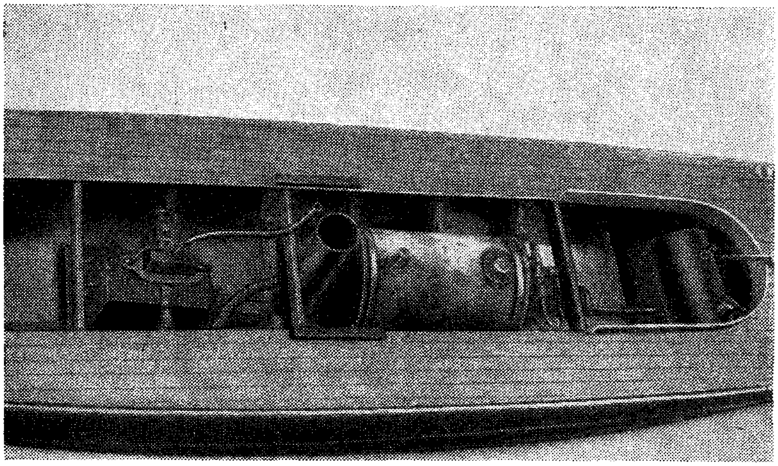
Shortage of equipment did not deter STUART A. GALLIENNE. He invoked the aid of his wife and the kitchen sink to build his first model ship



LILY *under way*



Side view of the author's model steam launch



Quayside view of the power plant

THE pictures on this page show my first serious attempt at model boat building. The boat, of mahogany construction throughout, was built from M.E. plans P.B.6, all instructions being carefully followed.

The planking is ⅛ in. (an old table top cut up), only four planks being used, two on the bottom and one on either side. Some difficulty was experienced in steaming the bow ends but with the co-operation of the kitchen staff, the sink and the water heater, the desired result was achieved.

The ends to be curved were thoroughly soaked and boiling water was poured on while gradually clamping down. This was repeated six times and the planks were ready for screwing into position.

The water-line is painted white and below this is dark green. Seven coats of green paint were applied, each one being rubbed down. Above the water line is natural mahogany. The entire hull is finished with Valspar varnish.

The deck is $\frac{3}{16}$ in. deal, pencil marked every ⅜ in. and then varnished.

The power plant is a Stuart Sun twin-cylinder engine which I machined from castings and fitted with a displacement lubricator. A 3 in. two-bladed propeller is fitted to a ¼ in. stainless steel shaft. The boiler is 7 in. long and 4½ in. dia. with a 2 in. centre flue and six cross tubes ⅜ in. dia.

The blowlamp was built up from 2½ in. brass tube and a primus type burner, pressure being supplied with a cycle pump. The superstructure is made of sheet brass on mahogany frames. The fore hatch is mahogany and detachable separate from the superstructure which is also detachable in one piece.

Hand rails are $\frac{1}{16}$ in. stainless steel and the knobs were machined from ⅛ in. round stainless steel. The searchlight and navigation lights are lit from a battery in the cabin. The blocks on the mast are fitted with working sheaves. The fairleads also have working rollers.

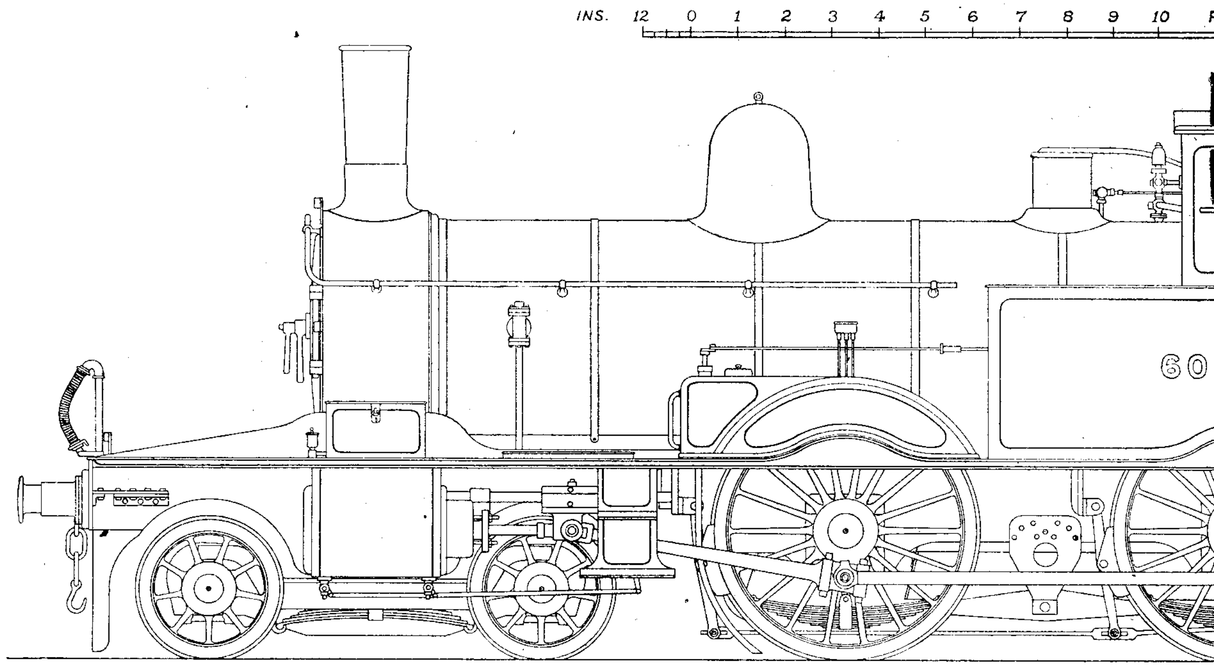
The power plant was installed as near as possible as shown on the plans and when launched the water-line was found to be perfect.

The name *Lily* is not very clear in the photographs as it is gold lettering on oak and varnished, but the name-plate can be seen on the cabin side near the handrail. The name is a tribute to my wife for her help and co-operation in cleaning up the kitchen after fitting the planks!

The boat took 12 months of spare time to complete and while it is not an exhibition model, which it was not intended to be, it exceeded my expectations in performance. ■

LOCOMOTIVES I HAVE KNOWN

NUMBER 27 By J. N. MASKELYNE



LONDON AND SOUTH WESTERN 4-4-2 TANK ENGINES

IN THE 1880s, when the suburban passenger traffic on most railways was being worked by 6-wheeled or 8-wheeled tank engines, the London and South Western Railway went one better and introduced 10-wheelers.

They were designed by William Adams, but they were all built by private builders such as Beyer Peacock & Co., Neilson & Co., Dübs & Co. and Robert Stephenson & Co. The class eventually numbered 71 engines —officially styled the " 415 " class— built between March 1882 and December 1885.

My drawing shows No 60, which was originally No 78, built by Stephensons in 1885 and renumbered in 1890; she is depicted in her original condition, except for the number, because that is how she was when I first came to know her and many of her sisters in 1899 and 1900.

They were handsome engines and wonderful workers on many of the London suburban services operated by the L.S.W.R. I remember seeing many of this class at work on trains to Epsom, Leatherhead, Guildford, Hampton Court, Shepperton, Windsor and Reading.

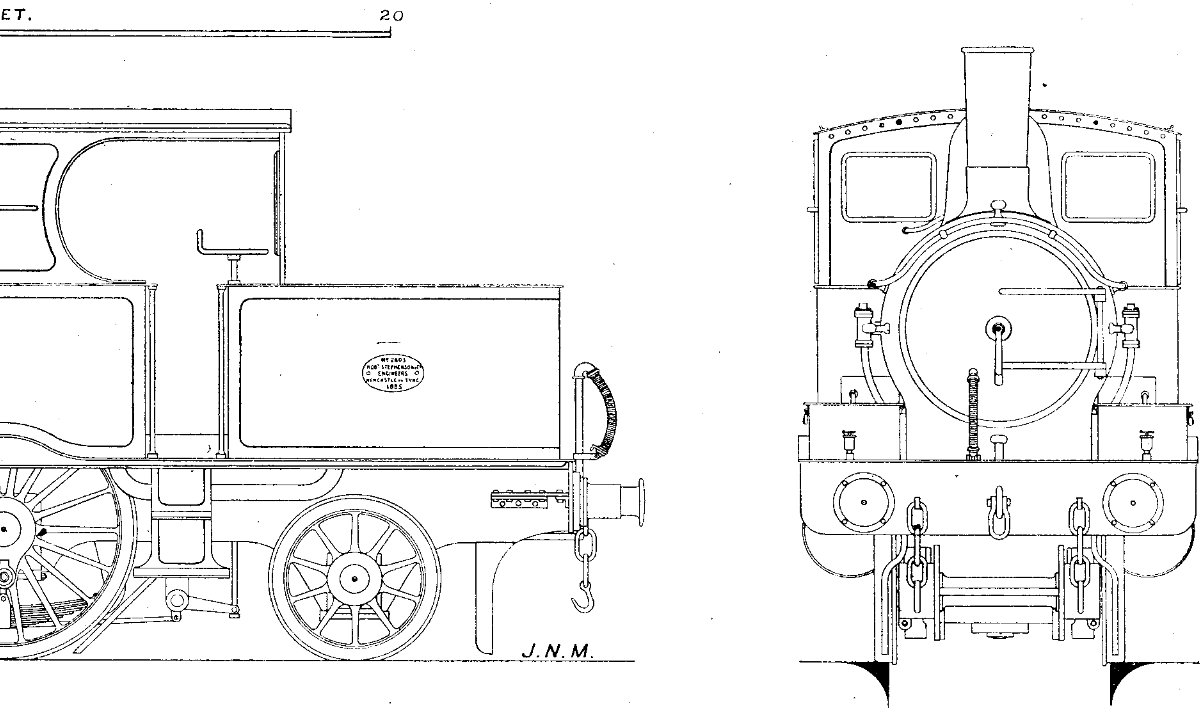
Not every train stopped at all stations—and the engines had opportunities of showing their paces on non-stop sprints to such places as Richmond, Surbiton and even Guildford.

There were some differences of detail between the various batches built, but there now seems to be no information available as to the precise reasons for the changes.

For example, the 12 engines built by Beyer Peacock in 1882, and the 18 by Stephensons in 1883, had a water capacity of 1,000 gallons whereas in all the others the capacity was 1,200 gallons. Again, in 10 engines by Stephensons and 10 by Dübs in 1885, the trailing wheels were 3 ft 6 in. dia., while in 10 built by Neilsons in the same year this diameter was 3 ft, as in all the earlier engines of the class.

Apart from these variations, the general dimensions of this class were: Cylinders, 17½ in. dia. 24 in. stroke; coupled wheels 5 ft 7½ in. dia. when new; bogie wheels, 3 ft dia.; wheelbase 29 ft 5 in., divided into 7 ft plus 6 ft 5 in. plus 8 ft 6 in. plus 7 ft 6 in.

The boiler was 4 ft 2 in. dia. and 10 ft long, pitched 7 ft above rail level. There were 201 tubes of 1¾ in. dia., the firebox was 6 ft 2 in. long, and the grate area was 18.14 sq. ft. The heating surface was 944.7 sq. ft for the tubes and 111.2 sq. ft for the firebox, totalling 1,055.9 sq. ft. The original working pressure was 140 p.s.i., later increased to 160 p.s.i.—rather a big jump!



The total weight in working order was 54 tons 2 cwt, of which 30 tons 16 cwt was imposed upon the coupled wheels and therefore available for adhesion. The tractive effort was 14,920 lb., quite a respectable amount for such engines.

The withdrawal of this class began in 1921, but was halted in 1928 when only two of the engines remained in service; these were originally Nos 125 and 520, and they were kept specially for working the Axminster-Lyme Regis branch where they are still at work.

In 1946, there were joined by a third engine, old No 488, which had had an interesting history: She was sold to the Government in September 1917, for working at the General Salvage Depot near Sittingbourne, Kent, and two years later she was sold to the East Kent Railway. In 1946 she was resold to the Southern Railway by whom she was numbered 3488. She was taken into Eastleigh Works where, like her two sisters, she was provided with new frames made to the original drawings, and her bogie was altered to give extra side play. After this she was sent to Exmouth Junction motive power depot as a spare engine for the Axminster branch.

So, here we have another instance of old engines being renovated and kept in good repair specially for working a particular service simply because no other engines have proved so satisfactory on the same service.

In the British Railways books these engines are numbered 30582, 30583 and 30584, respectively, and I for one hope they may be kept at work for some years to come.

A further point of interest is that during the 1914-18 war—for about 18 months—four of this class, Nos 480, 481, 485 and 487, were lent to the Highland Railway for working light-passenger traffic. In this way the engines became familiar far from their native haunts.

My last trip behind one of these engines occurred in the summer of 1921, when I had gone down to Staines one day. For my return to London I chose to travel by an up fast train from Windsor, rather than by a local stopping at all stations. When my train came in I was surprised to see that the engine was No 0490.

At that time very few of these fine old engines were left in service, especially in the London district; those that did remain were used on empty-carriage working between Waterloo and Clapham Junction, and it was rare indeed to see one on a regular passenger service.

I believe that No 0490 was then stationed at Strawberry Hill (Twickenham) and was probably the last one of the class to work London suburban trains; she was withdrawn for scrap in 1926.

Another interesting detail is that the trailing wheels of these engines were mounted in radial axleboxes, and in this respect were unique on the L.S.W.R. After 1885, however, Adams abandoned the 4-4-2 type in favour of the 0-4-4, of which he designed two different classes between 1888 and 1896; but for many years his 4-4-2 tanks continued in full force to give very satisfactory service. ■

VIRGINIA

This week L.B.S.C. begins instructions for building the tender of this old-time American locomotive

NOW THAT the little reminder of days gone by has reached the stage at which she can run, most builders will be anxious to reap some of the reward that sweetens labour; they certainly will if they are anything like your humble servant !

To enable this to be done, I thought it would be as well if I described how to build the tender before giving details of the trimmings, such as bell, headlight, boiler cleading and bands, which can be added at any convenient time.

The tenders of most of *Virginia's* full-size relations were weird and wonderful boxes of tricks. Though a few of them ran on six wheels, following British practice, the vast majority were furnished with two four-wheeled trucks, with built-up bar frames, disc wheels made from chilled cast-iron, with no separate tyres, and equalised springing.

The main frames were built up either from channel-section girders, or bars of rectangular section, with no separate beams, the side members being rounded at the corners and joined to two separate stiffening girders which ran down the middle of the frame, and to which the draw-gear was bolted. Instead of a sole-plate, the top of the frame was covered with wooden planks, like the floor of a room, placed transversely and attached to the frame girders. The tender body was entirely separate and was erected " on the floor."

The tender body followed contemporary British practice, inasmuch as it had straight sides with a flared coping at the top and rounded rear ends. The front ends were also rounded, and the coal was carried in a recess between them. This recess extended about halfway into the tender tank and was wider at the front than at the back.

Needed stamina

The fireman had the backbreaking job of shovelling all the coal from floor-level. This might not seem a very arduous job but when you consider that this involved lifting several tons of black diamonds to a height of three or four feet and throwing them into the firebox during a single journey, on an engine that was anything but a steady rider, it will be realised that the fireman needed both physcial strength and good stamina.

However, nobody in those days seemed afraid of a spot of hard work ! The toolbox was usually placed at the back of the tank, over the drawbar, as on many British engines.

The brake gear was at first operated by hand, and the blocks were placed between the wheels, the beams being of wood. A compensating device was fitted and the pull-rods were connected to a vertical brake-shaft on the fireman's side of the tender; this had a cross-handle with both ends turned up like a cow's horns and a ratchet gear underneath like that used on the brake shafts of street tramway-cars.

This also provided the unfortunate " tallowpot " with additional exercise, until the advent of the Westinghouse automatic air-brake. When water-troughs, or track-pans as they are called in America, came into vogue the tenders were fitted with water-scoops and the internal pipe was turned over at its upper end to discharge downwards.

The tanks were long and shallow and were well stayed with sheet-metal stays which also acted as anti-surge plates.

The 3½ in. gauge tender

In designing the tender for the 3½ in. gauge locomotive I tried—as with the engine—to simplify matters for ease of construction, while keeping the outward appearance as correct as possible.

The main frame is made from two pieces of flat steel, the ends being bent around to form one sill and half the beam, the two being joined by a plate which carries the drawgear. No central members are needed. The truck bolsters are made from two wider strips of steel, bent to shape, riveted to the side sills and furnished with pins on which the trucks are mounted, a circular rubbing-plate being fitted between the bolster and the truck frame.

The trucks themselves can either be cast or built up. If the latter, the pieces are very simple to make and can be temporarily pinned or screwed together, the whole assembly being afterwards brazed at a single heating. The springing is precisely the same as on the engine truck.

The wooden floor is dispensed with and a metal soleplate substituted, to which the tender body is attached; and as the soleplate is fixed to the frame by angles and screws, removal of the screws, which are accessible at the sides of the frame, allows the whole tender body to be instantly taken off the frame if this should be required. Accidents happen even on small railroads !

The sides and the coal recess can be bent up from a single sheet of brass, if a piece long enough is available the joint being made at the back of the recess; otherwise it can be made in two pieces with the second joint in the middle of the tender back. This allows for the rounded ends both front and back.

The top can be made from one single sheet and the coping can be made from a strip attached to it. The big rectangular casing which houses the upper end of the pipe from the water-scoop on the full-size article comes in just right for a filler, as it is big enough to allow the handle of our emergency hand pump to be operated through it for the full stroke.

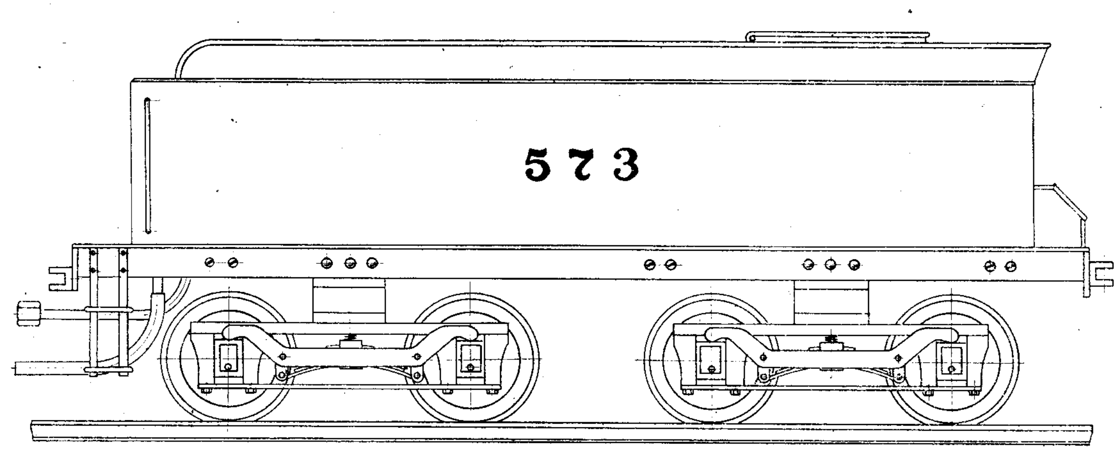
The detachable handle can be carried in the toolbox at the back, nice and handy when somebody lets both fire and water down and there isn't enough steam to operate the injector. The fittings inside the tank are to the usual L.B.S.C. standards.

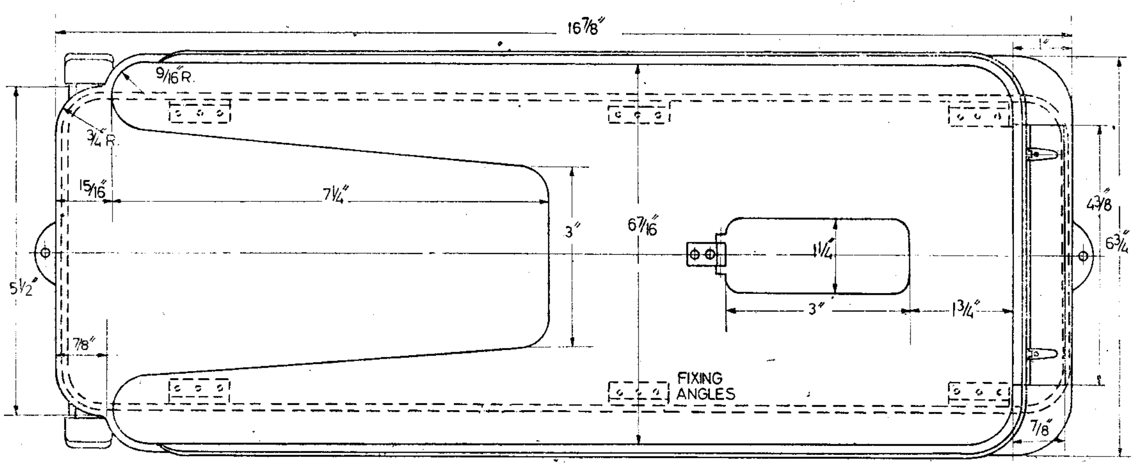
Frame construction

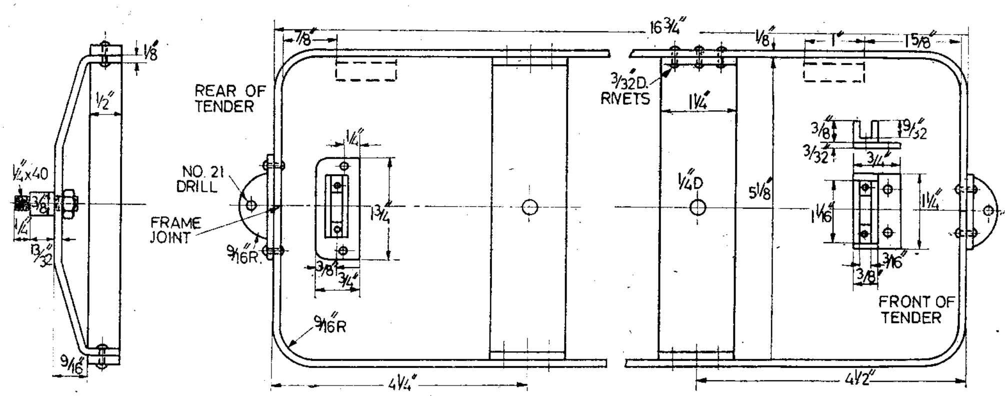
Two pieces of soft mild steel, ½ in. wide, ⅛ in. thick, and approximately 22½ in. long, are required for the frame. These are bent around at each end to form right angles with a $\frac{9}{16}$ in. radius, as shown in the plan drawing, so that the overall length is 16¾ in.

The easiest way to do this is to put a piece of ½ in. round bar in the bench vice, with about 1½ in. projecting from the side of the jaws. Mark the piece of steel, then put a piece of gas-pipe or something similar, over the end of the steel to give extra leverage. Place the steel with the marked spot on the bar in the vice jaws, then a good hearty press down on both ends will form the desired bend.

Although the piece of bar is ½ in. dia. the slight spring in the strip will form the bend to the given radius. Before I had a bending machine I made all my bends in the above manner and had no trouble. Anybody of average strength will find the bending easy.







Check off the ends with a try-square to make certain that they are exactly at right angles with the sides, then lay them on the bench with the ends touching and measure across from side to side. Note how much needs taking off the ends to bring the sides 5⅛ in. apart and reduce them.

Now cut two pieces of 3/32 in. steel to ¾ in. width, one 1¼ in. long and the other 1¾ in. Round off the edges of the longer one as shown. The semi-circular sockets for the coupling-pins can easily be milled up from a piece of $\frac{7}{16}$ in. × ⅜ in. steel bar, about 2¼ in. long; $\frac{7}{16}$ in. square will do at a pinch. Mill a groove in this, $\frac{3}{16}$ in. wide and $\frac{5}{16}$ in. deep.

If a regular miller is available it is only a few minutes' work with the steel in the machine-vice on the table and a $\frac{3}{16}$ in. slotting cutter on the arbor. It can be done in the lathe with a similar cutter on an arbor between centres and the steel in a machine-vice (regular or improvised) on the saddle, setting the steel in the vice at such a height that the full depth is taken out at one cut.

Any Myford or similar lathe will do this quite well with the backgear in and plenty of cutting oil applied by drip-can or brush. Feed very slowly with the cross-slide handle. Alternatively, clamp the piece of metal under the slide-rest tool-holder and endmill the groove, as I have described for other similar jobs.

After the groove is formed cut the piece in half and round off the grooved side to the shape shown in plan. Next cut away the metal at the bottom of the groove for about $\frac{1}{2}$ in. width to clear the end of the drawbar or coupling-link when coupled up; this can be done by drilling and filing. Then drill the hole for the pin.

Finally drill a No 41 hole at each side of the clearance and rivet the socket to the plate in the position shown. The front one is fitted level with the bottom of the plate to line up with the drawbar or link on the engine; the back one is fitted in the middle of the plate to bring the slot to the correct height to couple on to a passenger car.

Against-the-clock method

Put the two halves of the frame together on the bench (which must be level), clamp the coupler assemblies at each end over the joints, drill No 41 holes through plates and frames and rivet up with 3/32 in. charcoal-iron rivets. To make the job extra strong, I advise brazing or silver-soldering the lot; and if this is done only $\frac{1}{16}$ in. rivets need be used to hold the parts togehter.

Incidentally, as I'm always running against the clock, I shall make both my sockets from a $\frac{3}{8}$ in. slice parted off a $1\frac{1}{8}$ in. offcut of steel shafting, milling a groove $\frac{5}{16}$ in. deep and $\frac{3}{8}$ in. wide on opposite sides of it. This will be sawn across the middle, the sawn parts run under a $\frac{1}{2}$ in. cutter on the miller to true them up and the clearances at the bottom of the groove formed with a Woodruff key-seat cutter. Drill the pinholes, and there we are !

Truck bolsters

The truck bolsters may be cast, or bent up from $1\frac{1}{4}$ in. $\times$ $\frac{1}{8}$ in. steel. If they are cast, the pin for attachment of the truck and the rubbing plate will be cast integral, and there should also be a chucking-piece cast on opposite the pin. If this is held in the three-jaw the pin can be turned and screwed and the contact surface faced off at the same setting. All that then remains will be to smooth off both ends with a file, set the bolsters between the frames at the positions indicated and rivet up.

For the bent-up bolsters, two pieces of steel, of section as mentioned above, and $6\frac{1}{4}$ in. long, will be required. Mark off the centre and at 1 in. each side of it make a slight bend to the angle shown in the cross-section. Place this across the frame and mark off where the vertical bends will have to be made to bring the overall width to $5\frac{1}{8}$ in. which is the correct distance between the sides of the frame.

The bends can be made in the bench vice. Should the steel be hard. make it redhot at the bends, otherwise it will crack on the outside of them. Check for correct width then set each bolster in position shown and make sure that the bottom is exactly $\frac{9}{16}$ in. below the bottom of the frame. Fix temporarily in position with toolmakers' cramps then drill three No 41 holes through frame and bolster and rivet up. File off any of the bolster side which projects above the top edge of the frame.

On the centre line of the bolster, and exactly midway between the sides of frame, drill a $\frac{1}{4}$ in. clearing hole. For the pins, chuck a piece of $\frac{3}{8}$ in. round mild steel in the three-jaw, face the end, turn down $\frac{1}{4}$ in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. $\times$ 40. Part off at $\frac{13}{16}$ in. from the shoulder, reverse in chuck and turn down the other end to $\frac{1}{4}$ in. dia. sufficient to leave 13/32 in. length the full $\frac{3}{8}$ in. dia.

Test for accuracy

Screw $\frac{1}{4}$ in. $\times$ 40. Put this end through the hole in the bolster and secure with a nut made from $\frac{3}{8}$ in. hexagon rod; either steel or brass will do. The complete frame assembly should then be laid on something flat and true, such as the lathe bed, to test it for accuracy. If both sides do not touch the flat surface for their full length, carefully twist the frame until they do; a little careful manipulation will do the trick.

Warning to beginners—when setting the bolsters in the frame do not get mixed as to which is front and back of the frame. The front is the end with the low coupler socket and the centre line of the bolster should be $4\frac{1}{2}$ in. behind this. The other one is set only $4\frac{1}{4}$ in. from the back end, the distance between the truck pins being 8 in. Not that it matters a great deal if they are reversed, but we might as well have things right !

Soleplate

The soleplate on which the tender body is mounted can be cut from a piece of hard-rolled sheet brass of 16-gauge, $6\frac{3}{4}$ in. wide and $16\frac{7}{8}$ in. long after the ends have been cut square. The back corners shoud be rounded off with a file to $\frac{3}{4}$ in. radius. Nick a piece $\frac{5}{8}$ in. square out of each front corner and then file the resulting double corners to similar radii, as shown in the plan of the tender body.

Lay the finished soleplate on the bench and put the frame on top of it, upside down—naturally !—adjusting same until the soleplate projects an even distance all around the frame. Hold it there firmly and then run your scriber all around the inside of the frame, making a deep scratch on the soleplate. Now remove the frame and at the places indicated on the frame drawing by dotted lines rivet four pieces of $\frac{3}{8}$ in. $\times$ 3/32 in. angle. Either commercial brass angle can be used, or the pieces can be bent up from sheet brass of 13-gauge in the bench vice.

Making it watertight

Two similar pieces can also be riveted on, midway between the others. They should all be set close to the scribed line indicating the frame outline; and after riveting, sweat them over with solder so that no water can leak through from the tank.

After the tender body is mounted on the soleplate and the whole bag of tricks erected on the frame these angles will project down inside the frame and will be attached to it by two 3/32 in. or 3/48 in. screws passing through clearing holes in the frame into tapped holes in the angle. Removal of the screws will allow the complete tender body to be lifted off the frame if required.

● *To be continued.*

USEFUL BOOKS

FITTING BEARINGS

Plain, ball and roller bearings are described fully in *Bearings and How to Fit Them* by Ian Bradley and Norman Hallows.

The authors give details of the best materials and methods for constructing bearings, and describe their various applications, particularly with regard to the small workshop.

The book is obtainable from Percival Marshall and Co. Ltd, 19-20, Noel Street, W.1, price 3s. 9d. post paid (U.S.A. and Canada $1.00).

GEAR CUTTING

Gear Wheels and Gear Cutting, by Alfred W. Marshall, explains the principles which govern the formation and numbers of the teeth for a given mechanism and describes the types of gears in general use.

There are numerous illustrations in this 92 page book, price 3s. 9d. post paid, which can be obtained from Percival Marshall and Co. Ltd, 19-20, Noel Street, London, W.1. Rate in U.S.A. and Canada is $1.00.

The ALLCHIN

M.E. TRACTION ENGINE

(Continued from 13 December 1956, pages 850 to 852)

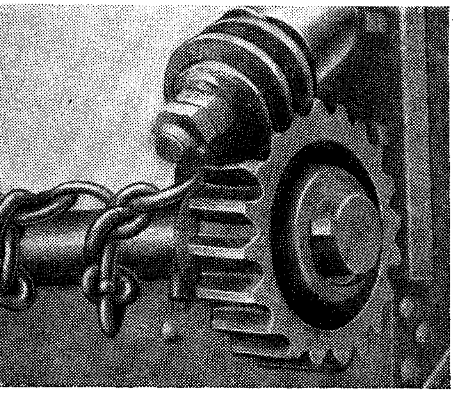


Fig. 3: Close-up of the steering. Note also the ashpan damper rod

THE STEERAGE of *Royal Chester* comes next, and the arrangement is shown in Figs 1, 2, and 3. Each chain is wrapped round the drum, and secured to shackles bolted through the drum. In the drawing the chain is shown wrapped $2\frac{1}{2}$ times round the drum; the shackles should be shown bolted the other way, to give two complete turns only.

At the front end, of course, the shackles are fastened to the brackets bolted to the spud-pan, using nuts and locknuts.

A steel two-start worm of 5/32 in. pitch and $\frac{5}{16}$ in. lead works on a bronze wormwheel of 20 teeth, which is keyed to the drum. When screw-cutting the worm, make the blank at least $1\frac{1}{4}$ in. long on the end of the bar.

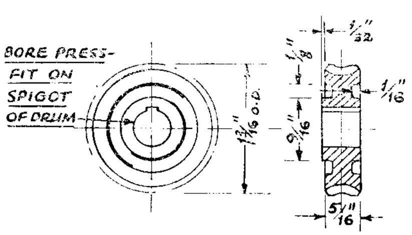
Centre the end and drill $\frac{1}{8}$ in. dia. $\frac{5}{8}$ in. deep. Enlarge the hole to 5/32 in. dia. for a depth of 15/32 in. Part off the worm at a full $\frac{9}{16}$ in. long. Face up the parted-off end and turn away the worm for a length of $\frac{1}{16}$ in. to a diameter of $\frac{5}{16}$ in. The $\frac{1}{8}$ in. hole will subsequently be filed out square to fit the corresponding square on the steerage spindle.

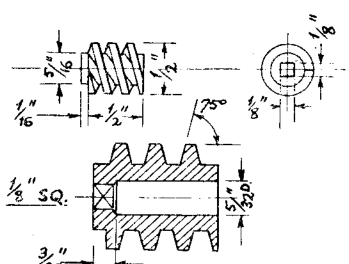
The remaining part of the worm, turned on the blank, should have three flutes filed or milled along its length. It is then case-hardened, and used as a hob in cutting the wormwheel.

Before turning the blank for the latter, the steerage-chain drum should be turned from $\frac{5}{8}$ in. dia. mild steel. The journals should be a running fit in the bearing brackets, and the spigot for the wheel is $\frac{5}{16}$ in. dia. with a 3/32 in. keyway end-milled in.

The blank for the wormwheel may be turned on the end of a stub of $1\frac{1}{4}$ in. dia. bronze rod about 1 in. long. It is bored out a tight press fit on the drum spigot, and has a 3/32 in. keyway "planed" in. The 1/32 in. extension of the boss should face outwards in turning. After parting off at a full 11/32 in., the blank may be finish-faced and the outer recess turned on a stub-mandrel. It is then hobbed to cut the teeth.

Either rustless or mild steel may be used for making the steering-wheel; a circular blank $2\frac{1}{4}$ in. dia. × $\frac{1}{4}$ in. thick will do nicely. Grip it in the outside jaws of the three-jaw chuck, face, centre, and drill 3/32 in. Turn the profile of the face and edge of the wheel, as in Fig. 9, not forgetting to leave a "ridge" where the boss for the handle will come.



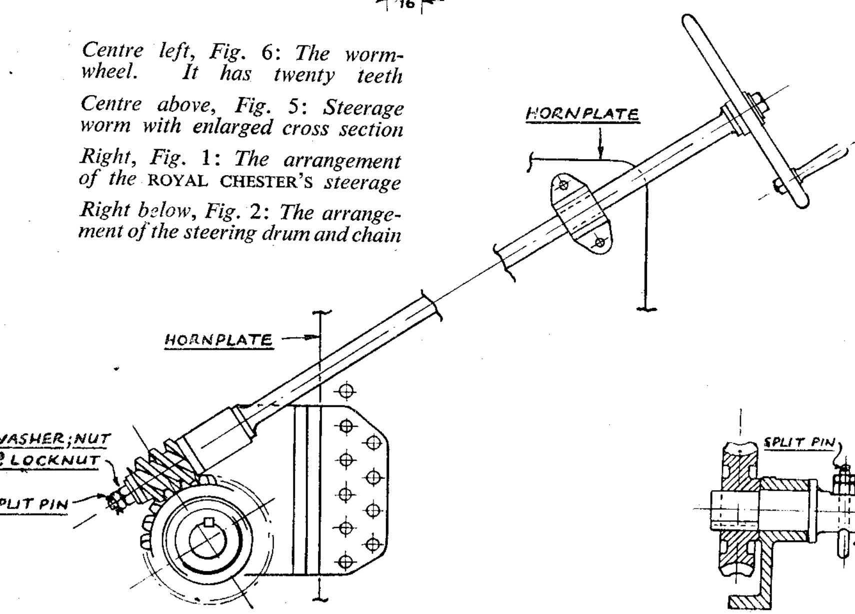


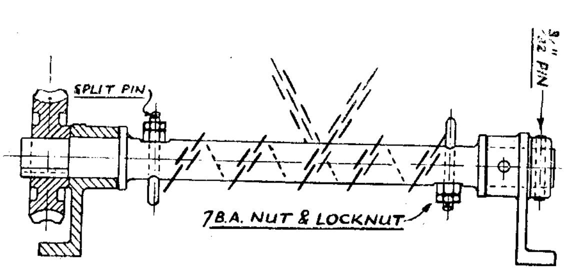
Centre left, Fig. 6: The wormwheel. It has twenty teeth

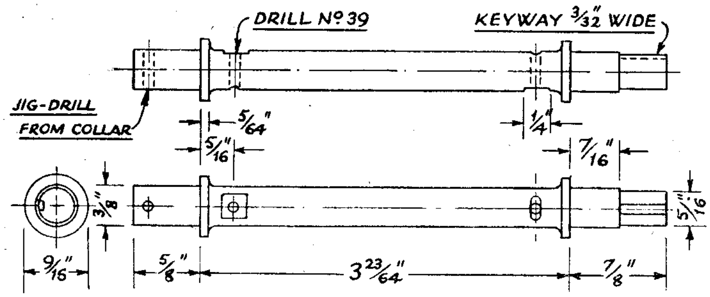
Centre above, Fig. 5: Steerage worm with enlarged cross section

Right, Fig. 1: The arrangement of the ROYAL CHESTER'S *steerage*

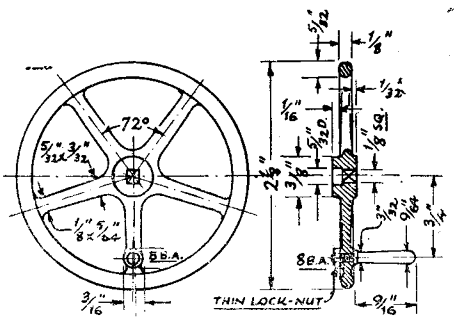
Right below, Fig. 2: The arrangement of the steering drum and chain







Above, Fig. 7: The steering chain drum



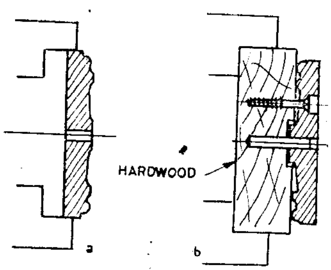
Above, Fig. 8: The steering-wheel and handle

Remove from the chuck and turn up a disc of hardwood about 2½ in. dia. by ⅜ in. thick. Centre the face, drill 3/32 in. to a depth of ½ in., and press in a stub of 3/32 in. rod ⅝ in. long. In the steering-wheel blank drill three holes in the places which will be cut away when the spokes are sawn out. Deeply countersink them, slip the centre hole on to the peg sticking out from the hardwood disc, and insert woodscrews through the holes into the disc (Fig. 9b).

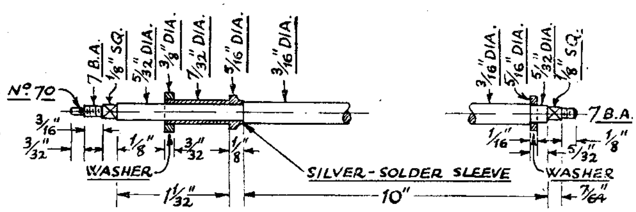
The under face of the wheel may now be profiled, again leaving the ridge for the handle boss. Enlarge the centre hole to 5/32 in. dia. for a depth of 3/32 in. Remove the screws, set out the spokes and handle boss, and remove the waste by fretsawing or drilling. Finish by careful filing, drill and tap the handle boss 8 B.A.

In order to avoid having to turn down the diameter of the long slender steerage spindle over most of its length, it may be made as shown (Fig. 10) with a separate sleeve and boss silver-soldered on at the lower end.

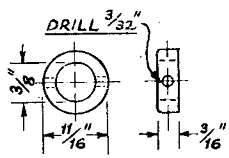
The shaft itself is turned from mild or rustless steel of 3/16 in. dia., set to run truly. Reduce to 5/32 in. dia. for a length of 1 9/16 in., and then at the end turn down to 3/32 in. × 9/32 in. long. Screw this 7 B.A., and turn away the threads for a length of 3/32 in. File the ⅛ in. square section ⅛ in. long. Similarly turn and square the other end, to the dimensions given.



Left, Fig. 9: Two stages in turning the steering-wheel blank



Above, Fig. 10: Details of the steering spindle



Above, Fig. 11: The collar for the steerage drum

CHAIN MAKING

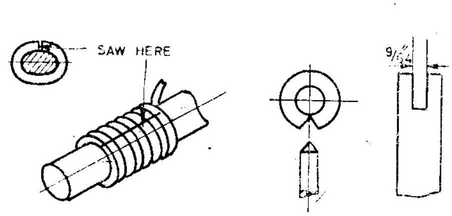
Turn the sleeve from ⅜ in. rod, and silver-solder it in position with Easy-flo. Turn the two washers. File out square the holes in worm and steering-wheel to be a good fit on their respective squares on the spindle. Before assembly, file the small flats and grooves on the chain drum and turn the collar for the latter (Fig. 11).

First file up a former of oval section, a bare 7/32 in. × 3/32 in., but make one side "humped" along its length as sketched (Fig. 12). Wrap 18-gauge iron wire (which is malleable enough) round and round the oval rod in closely packed turns.

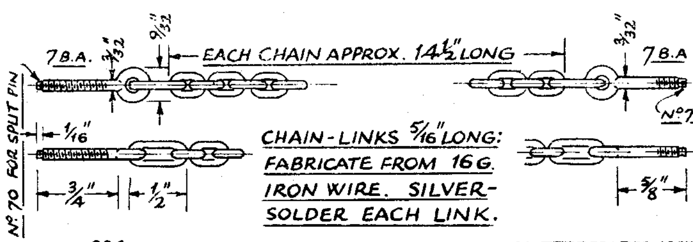
To separate the links saw through the turns, parallel with the length of the rod and in the centre of the "hump," with a very fine saw. The hump allows for the thickness of the sawcut, so that when a link is eventually straightened and the gap closed by squeezing with pliers the shape is properly oval.

It is now an easy matter to open the gaps slightly, string the links together, and close the gaps. A touch of Easy-flo "paint" may be applied in each joint before closing, or alternatively a touch of Easy-flo flux, but keep to a minimum in either case. See that the joints in alternate links all face the same way.

Below, Figs 12, 14 and 19: Simple method of chain making; making the shackles; notch in the tinplate



Below, Fig. 13: Details of the steerage chain with shackles



Lay the chain on a piece of asbestos millboard, and with a small flame heat each link in turn. As it comes dull red, touch the joint lightly with the end of a piece of Easy-flo wire, which will flash into it. Here again a minimum is desirable.

The shackles are made as sketched (Fig. 14). Bend rings of 13-gauge wire and file out a notch at the joint. File the end of the screwed part to fit, then braze together. The shackles are split-pinned (No 70 hole) at the ends so that in the event of nuts coming loose, they could not come off entirely.

FIREGRATE AND ASHPAN

We have stolen a march on big sister in having a firegrate which can be dropped to dump the fire, though this is entirely unobtrusive. As seen in Fig. 15, a trapdoor is fitted in the bottom of the ashpan, normally being held closed by a latch. The firegrate is supported at its front end on a stirrup riveted to the pan, and at the back by two links loosely pivoted to a small stirrup attached to the trap.

When the latch is pulled (which can be done with the fire-pricker) down drop the trap and grate.

The firebars are cut $3\frac{3}{8}$ in. long from $\frac{5}{16}$ in. × $\frac{1}{8}$ in. mild-steel bar, with a slight bevel at the front, as drawn (Fig. 16), to allow for the pivoting. Set out and drill one outer bar, and jig-drill three others from it. Then jig the others with the two middle holes only. Countersink the holes in the outer bars.

Drill and part off the spacers from $\frac{1}{4}$ in. rod, four at 9/64 in. long and 14 at 5/32 in. Bend up and drill the grate support (Fig. 17) from $\frac{1}{4}$ in. × $\frac{1}{8}$ in. mild steel, and make the grate links (Fig. 18) from the same material.

In assembly (which should *not* be done until the ashpan has been made and jig-drilled from the support !) bolt the two pairs of outer bars together with 5 B.A. screws, with the 9/64 in. spacers in place, through the middle holes. Put the links in place and slip a $\frac{1}{8}$ in. round-headed iron or mild steel rivet through the bars and link. Cut a notch (Fig. 19) in a piece of tinplate, and wedge this between link and bars to fill the 1/64 in. gap temporarily.

Rivet over into the countersink, and file flush. Similarly assemble the bars on to the grate support. Remove the screws and the tinplate packing, which should leave the joints free. Assemble bars and spacers on to two lengths of 10-gauge iron wire, as drawn, and rivet the ends over, filing flush to finish.

The ashpan (Fig. 20) is bent up from 18-gauge mild-steel or iron sheet, and it will pay dividends to make up a dummy from thin card, of one half at least. This will enable you to see just how much to nick out at the front to allow for the slight turn-up, and also how to fit the back corners at the bottom.

It is better to leave the back flap a little large on the edges—the surplus

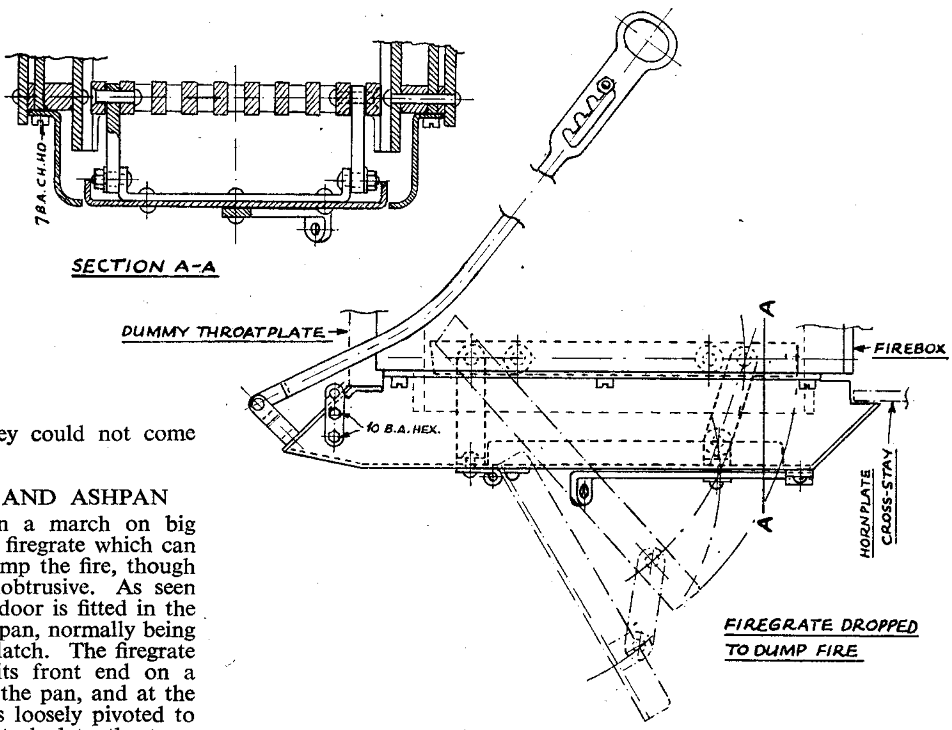
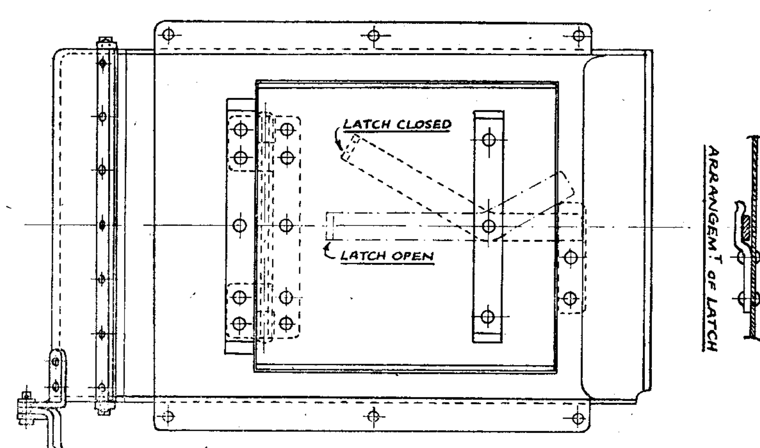
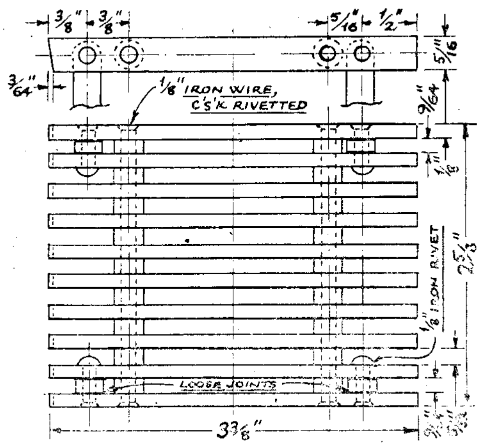
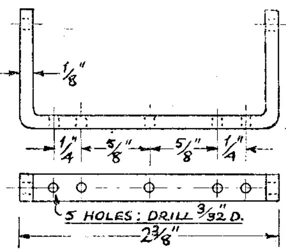
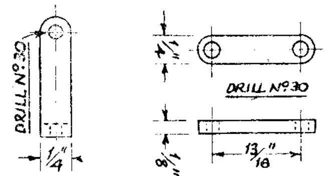


Fig. 15: Arrangement of the firegrate and ashpan









Left, Fig. 16: The construction of the firegrate

Centre, Fig. 17: Grate support Right, Fig. 18: The grate links

can be filed off after brazing. It will also help to have a block of hardwood cut to shape to bend the radii round, and on which to hammer the front to shape, after cutting the nicks out. The upper flanges may be bent in folding-bars, as usual.

Make and fit the front stretcher, leaving this a little longer than necessary. Braze all the joints and clean up, mark out and cut out the opening for the trap. The latter (Fig. 21) is an easy job to bend up from sheet, and the grate stirrup is equally easily made from $\frac{1}{4}$ in. × 14-gauge strip. Turn up the stirrup pivots from $\frac{1}{8}$ in. rod, and rivet to the stirrup.

On the hinge-pieces (Fig. 23) make the lugs which are to be bent round the wire 7/32 in. long. To bend the lugs, grip the end in the vice with a length of 16-gauge wire (Fig. 24a) and bend downwards. When bent round as far as possible, take a fresh grip, as at (b), and so on. To assemble the hinge, slip a length of wire through the pieces and lightly rivet the ends. The hinge should be perfectly free when made.

After making the latch and catch for the trap, all the necessary holes are drilled. Make a trial assembly first, using screws and nuts instead of rivets, then offer up the assembly to the firebox, to make sure that there is correct clearance all round the grate.

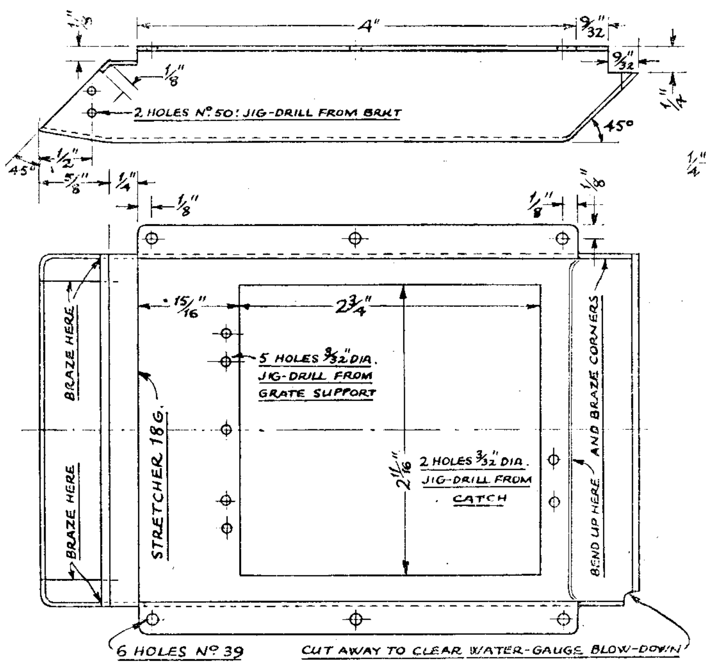
Replace the screws with 3/32 in. round-head iron rivets, but when riveting the latch, slip a thin copper washer over the rivet between latch and trap. Do not tighten this joint, but it must not be slack.

The assembly is held in place by six $\frac{1}{4}$ in. × 7 B.A. *bronze* screws tapped into the bottom of the firebox, previously jigged from the ashpan flanges. The holes will probably penetrate into the water space, and so the screws must be coated with jointing compound before insertion. Do *not* use steel or brass screws.

ASHPAN DAMPER

The damper (Fig. 25) is filed up from 18-gauge steel sheet, and the hinge-bar is made from $\frac{3}{16}$ in. × $\frac{1}{16}$ in. steel strip. Centre the strip very carefully in the four-jaw chuck for turning the tiny spigots. The two are riveted together with 3/64 in. round-head rivets.

Make the hinge brackets (Fig. 26) from $\frac{3}{16}$ in. × $\frac{1}{16}$ in. strip, and bolt



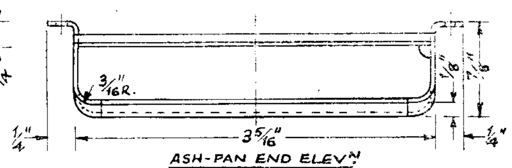


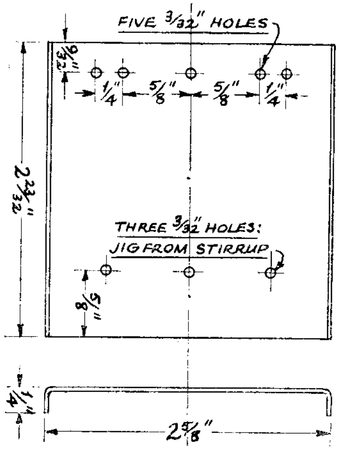
Fig. 20: Details of the ashpan

them to the ashpan with 10 B.A. hexagon headed screws. It will be necessary in assembly to file a small notch in the sloping edges of the pan, behind each bracket, to allow the damper to swing on its hinges.

The fork of the stirrup (Fig. 27) is made in the same way as previous ones; the stirrup is then bent at right angles and riveted to the damper with 3/64 in. round-head rivets. The pin is another simple turning job, and is drilled No 70 for a tiny split pin.

Damper control rod

Set out the handle first (Fig. 28) on a strip of 16-gauge bright mild steel, $\frac{5}{8}$ in. × $1\frac{11}{16}$ in., and in the positions



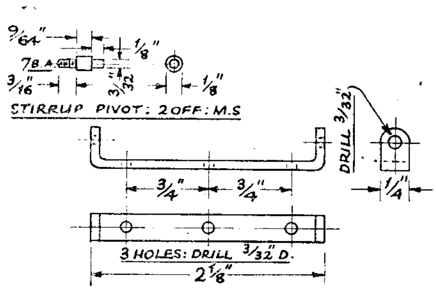


Fig. 22: The stirrup and pivots for the firegrate links

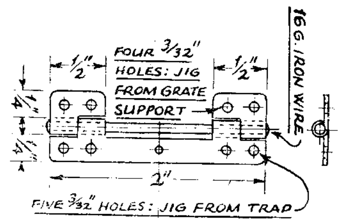
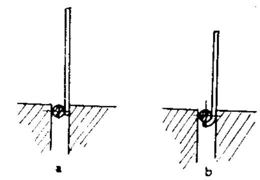


Fig. 23: The hinge for the ashpan trap

Left, Fig. 21: Trap for ashpan



Right, Fig. 24: Bending the lugs for the hinge

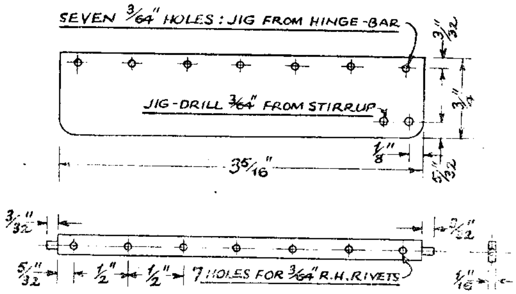
indicated drill 1/16 in. holes. Enlarge these to 3/32 in., and file out the lower row to form the slot. Trim the corners off to form the notches and drill and file out the hand-hole.

Make the rod from 1/8 in. × 16-gauge bright mild steel, allowing not only for the double right-angle bend at the bottom and for the "set" or curve which is necessary to clear the steerage, but also 1/4 in. or so extra. Put the eye of the rod in its stirrup, with pin in position, and put the uppermost notch of the handle on its stud in the hornplate.

Now with damper closed, clamp rod and handle together and mark off the correct length of the rod with a scriber (Fig. 30).

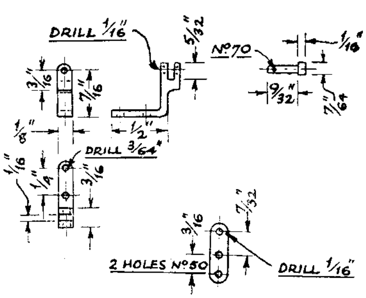
Remove the clamp, cut away the surplus, and silver solder the joint. Finish the handle to shape and clean up the joint.

● *To be continued.*



Above, Fig. 25: Ashpan damper and hinge-bar

Right above, Fig. 27: Stirrup and pin for the damper rod

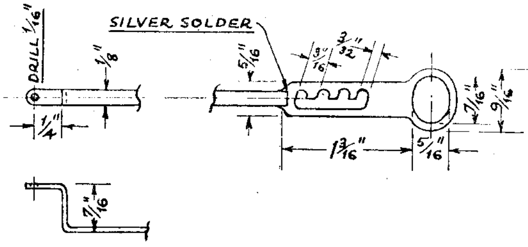


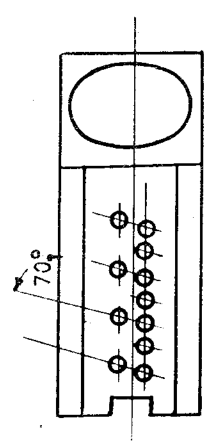
Right, Fig. 26: Brackets for the hinge-bar

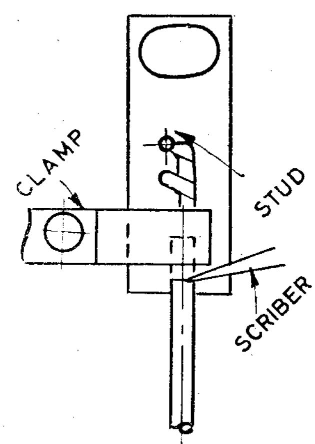
Right, Fig. 30: Marking the rod to length

Centre, Fig. 29: How to form the notched slot

Below, Fig. 28: Damper control rod







Expert's Workshop

By DUPLEX

MECHANICAL DRAWING AIDS

SCREW THREADS are represented in mechanical drawings in various ways and for the most part in accordance with established conventions, although differences may be found in drawings published abroad.

The simplest way, and one that requires no special drawing appliances, is that illustrated in Fig. 6 *A*, where the actual threads both male and female are indicated by continuous or broken lines. This method has the merit of saving time and is adequate for ordinary workshop drawing as long as the diameter and pitch of the thread are also added to the drawing.

In the second method, illustrated in Fig. 6 *B*, the convention adopted is rather more elaborate and in consequence occupies more time. Here the crests and roots of the male thread are indicated by thin and thick lines respectively and the female threads are represented by broken lines which are drawn right-handed, but where the part is shown in section the back of the thread is drawn and will then appear to be left-handed.

As with this method the threads are drawn diagrammatically the correct pitching of the individual threads is not observed, although they should be drawn at an approximately correct angle.

As the helix angle will vary in relation to the pitch of the thread and the diameter of the screw, a means of setting out the appropriate angle in the drawing is needed if the thread is to be given a realistic appearance.

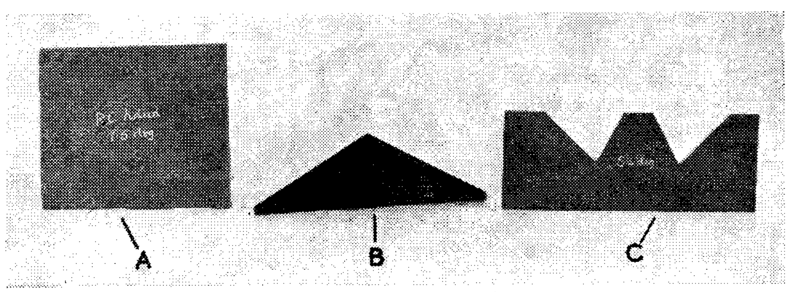
With the pantograph drawing board described this angle can be readily reproduced by referring to the protractor scale when adjusting the angularity of the combination set-square.

On the other hand, it will usually be found more convenient and time-saving to keep the set-square in its original position and use instead a small set-square specially cut to the appropriate angle; in this way the small square alone is moved along the arm of the main square and there is no need to keep altering the setting of the protractor head of the pantograph.

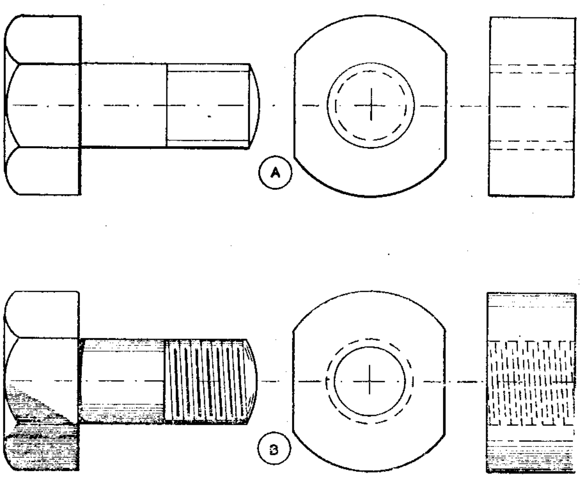
Examination of the helix angles of screw threads of various types shows that in the medium sizes the standard Whitworth thread has a helix angle of approximately $3\frac{1}{2}$ deg. which in the B.S.F. thread becomes $2\frac{1}{2}$ deg. and in the larger sizes of the standard brass thread of 26 t.p.i. this angle is reduced to some $1\frac{1}{2}$ deg.

Consequently a fair diagrammatic representation of any thread in common use can be obtained by employing set-squares cut to angles of 3 deg. and $1\frac{1}{2}$ deg. for reproducing both right- and left-hand threads.

The special square illustrated in Fig. 7 *A* was cut to shape from plastic sheet of $\frac{1}{16}$ in. in thickness. The angles at the two diagonally opposite corners of this square are formed to $1\frac{1}{2}$ deg. so that it can be conveniently used for drawing threads lying in either the vertical or horizontal positions. To avoid the danger of smudging when inking-in, the under side of the square should be heavily chamfered along the edges subtending the $1\frac{1}{2}$ deg. angles.



Above, Fig. 7: Special set-squares. (a) for setting out the thread helix angle; (b) square for chamfering; (c) square for drawing thread flanks

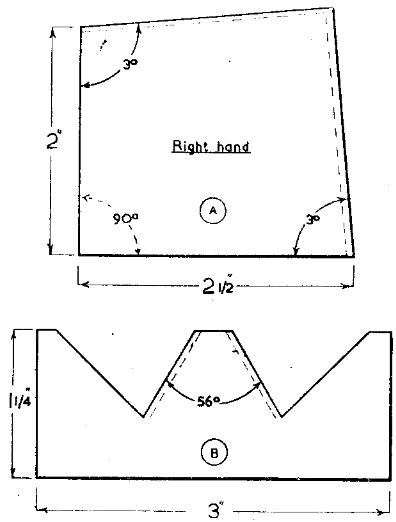


Left, Fig. 6: Two conventional ways of drawing screw threads

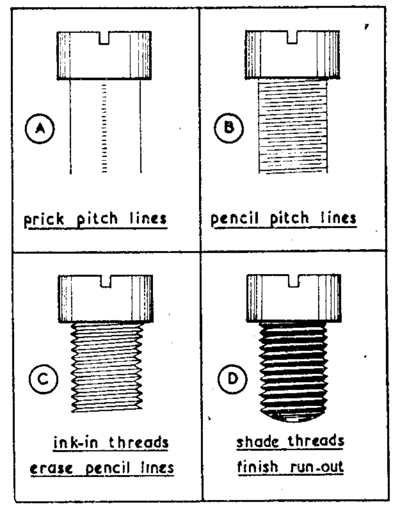
With the aid of right- and left-handed squares of each of the two helix angles specified there should be no difficulty in drawing a fair representation of a male and female thread both in plan and in section in accordance with the convention adopted in Figs 6 *B* where shading has been added to give the drawing a more finished appearance.

Although the above methods of depicting screw threads are largely used in both working drawings and those made for reproduction, the appearance will be greatly enhanced if the threads are drawn to the correct contour at their roots and crests and appropriate shading is added to bring the threads into relief.

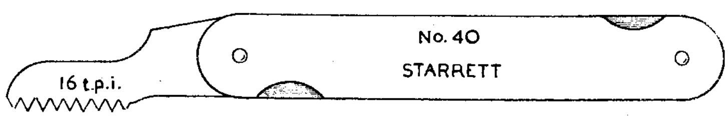
As detailed drawings of this kind



Above, Fig. 8: Dimensions of screw-thread set-squares



Above, Fig. 9: Representing stages in drawing screw thread



Above, Fig. 10: Screw thread gauge for marking thread pitches

take more time to execute and are unsightly unless accurately made, any aids that help to overcome these difficulties will hardly be unwelcome. The successive stages that have been found practicable as one means of drawing screw threads are set out in Fig. 9.

To obtain the correct appearance it is essential to space the crests and roots of the threads at regular intervals, and accuracy in this respect is sometimes ensured by pricking these points with a toothed tool such as a hacksaw blade. But a blade of this kind is rather too thick and the set of the teeth gives a staggered effect to the marking produced; moreover the pitch of the teeth is too limited.

These drawbacks can be largely overcome by making use of a screw-thread gauge of the kind illustrated in Fig. 10, for this tool has a range of from 9 to 40 t.p.i. and the teeth formed in the thin blades are sharp enough to leave a clear impression when pressed down on the drawing paper.

An alternative way of spacing the threads and one that does not involve permanently marking the paper is to lay the leaf of the thread gauge as nearly as possible horizontally on the paper and then to mark the apices of the Vs with a sharp pencil.

The results obtained by adopting either of these methods is represented in Fig. 9 *A*.

The realistic appearance of the finished drawing will be enhanced by reproducing as nearly as possible the correct pitching of the screw thread. For example, Fig. 9 is intended to represent a 3/8 in. B.S.F. screw of 20 t.p.i. drawn twice full size, so that the pitch becomes 10 t.p.i. and the intervals between the crests and roots of the thread are now equivalent to 20 t.p.i.

All that is now required is to select the 20 t.p.i. blade of the thread gauge and press it against the drawing paper so as to leave a clear impression of the points of the teeth; alternatively the roots of the teeth are marked with a pencil. Where the line of markings needed is longer than the blade itself, no difficulty will be found in meshing the teeth again to prolong the line of indentations as represented in Fig. 9 *A*.

With the aid of the small 3 deg. set-square alternate long and short pencil lines are drawn through these marked points to the pencilled side lines of the screw in accordance with Fig. 9 *B*. The exact length of the short lines is immaterial as they serve only as guide lines and will be later erased. The 3 deg. set-square is used because the helix angle of the standard screw thread is only slightly less than 3 deg.

Next the flanks of the threads are inked-in with the aid of the small square illustrated in Fig. 8 *B*, which is also cut from 1/16 in. plastic material and is shaped so that it can be used either side up to facilitate drawing the thread contours. The 56 deg. included angle is an approximation of the standard Whitworth thread angle; but this is unimportant, for the 30 deg. set-square is often used for this purpose.

As shown in Fig. 9 *D* the under sides of the threads are blocked in with the inking pen to form areas of shading and throw the threads up in relief, but sometimes a highlight is simulated by leaving a gap in the centre of the shading.

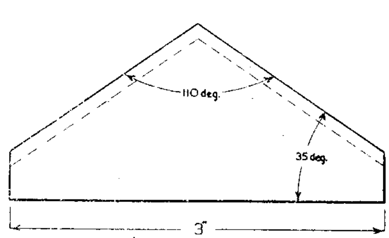


Fig. 11: A square for chamfering the ends of screws

Block shading with the drawing pen can be carried out by ruling two or more contiguous lines so as to avoid depositing an excess of ink with the blades of the pen too widely set.

The tip of the screw is best drawn after the threads have been finished and for this purpose either an arc is struck with the compass or the end of the screw is finished with a chamfer.

The commonly used angle of this chamfer varies from 30 deg. to 45 deg., but a chamfer of 35 deg. drawn with the small set-square illustrated in Fig. 11 gives a neat finish. In this connection commercial washers are usually chamfered to 40 deg. and the ends of shafts and machine spindles have a good appearance when chamfered to 30 deg.

● *To be continued.*

WHY AND HOW OF SOLDERING

Soldering and Brazing by A. R. Turpin deals comprehensively with three categories—soft soldering with alloys of low melting point, hard soldering with higher melting points, and using brasses for brazing with melting points of 800 deg. C. and over. Each category is discussed from the point of view of melting point, plastic range, viscosity, strength, cost and electrical conductivity. Price 5s., postage 3d., from Percival Marshall, 19, Noel Street, London, W.1 (U.S.A. and Canada $1.00).

READERS' QUERIES

Do not forget the query coupon on the last page of this issue

This free advice service is open to all readers. Queries must be on subjects within the scope of this journal. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling, cannot be given: stamped addressed envelope and query coupon with each query. Mark envelope "Query," Model Engineer, 19-20, Noel Street, London, W.1.

Water feed pump

I am building a vertical boiler and would be obliged if you could advise me on the size of the water feed pump required. The boiler is 8 in. dia. and 16 in. high with nineteen $\frac{3}{4}$ in. tubes. The information I require is: bore and stroke of pump, and size of suction and delivery pipes.

The engine is $1\frac{1}{2}$ in. bore × 2 in. stroke double acting, and I intend to work the pump from an eccentric on the engine shaft. I shall fit an injector eventually, but would like the pump to be capable of supplying the full needs of the boiler, using a bypass as a means of control.—G.R.T., Brampton, Cumberland.

▲ *A pump of $\frac{1}{2}$ in. bore × $\frac{3}{4}$ in. stroke, driven direct from an eccentric on the engine shaft, would be suitable. The suction and delivery pipes should be not less than $\frac{3}{16}$ in. dia.—that is not less than $\frac{1}{8}$ in. bore, and ball valves may be used for suction and delivery, but not less than $\frac{1}{4}$ in. dia.*

There is no definite relationship between the size of the engine and the size of the pump as a great deal depends on the load and speed of the engine. But this size of pump should give adequate output for most purposes and is suitable for control on a bypass on the delivery side of the pump.

Fitting flat bar

I have purchased 250 ft of $\frac{1}{2}$ in. × $\frac{1}{4}$ in. flat bar mild-steel to make a track for my 5 in. gauge passenger-hauling locomotive.

This will be fixed to seven boards each 15 ft in length, giving a total of 105 ft.

My problem is how to fix the bar steel to make a suitable track. I have written to Bassett-Lowke, but they cannot advise me or sell anything suitable.

I could have pieces welded every 1 ft but this means 210 separate weldings—and the price quoted was £6.

Can you tell me how to overcome this problem and where I could buy suitable material for the securing of bar steel to wooden boards ?—T.A.H., St Columb, Cornwall.

▲ *It is always a problem to decide what is the best method of fixing flat bar for use as a passenger-carrying track for a model locomotive. The chief requirement is, of course, that the track should be exactly to gauge throughout its length and that there should be no possibility of the rails moving sideways. In the circumstances the best method is to have cross pieces welded at every foot, as you state.*

Possibly a cheaper method, though it would require very carefully doing, is to have hardwood sleepers made with grooves cut in them exactly to gauge. These should not be less than inch by inch and about eight inches long. These could be placed at every foot and screwed down to the wooden baseboard which you have. The screws should preferably not be wood screws, but would be better in the form of long bolts, which could be passed through the holes in the sleepers and nutted up from underneath.

Sealing and caulking

I have built a wooden boat hull—4 ft 6 in. × 12 in. beam—and have covered the framework with two-ply. Can you advise me of a good product for sealing and caulking joints, the main ones being two at the keel and two chine line joints? I would like to use something which would " run " and then harden and become waterproof and shrink-proof if possible.—G.E.T., London, W.2.

▲ *The material generally used for this purpose is known as marine glue and is applied hot and in a liquid condition and hardens on cooling. This is manufactured by Alfred Jeffery and Co., Marshgate Lane, Stratford, London, E.15.*

There are, however, several marine sealing compositions of a plastic nature which might be more suitable for use on the type of hull having a plywood covering.

Marine engine

I am constructing a two-cylinder single expansion double acting marine engine of $2\frac{3}{8}$ in. bore and $2\frac{1}{4}$ in. stroke. It is to be used for serious work and I hope to use a boiler pressure of about 100 p.s.i. and steam with a moderate degree of superheat. Maximum r.p.m. is to be 200.

a. How accurate is the P.L.A.N. formula in estimating the horse power of an engine of this size ? (Assuming that design and workmanship are sound.)

b. I wish to use a vertical solid-fuel boiler of either the fire tube or central flue type to steam this engine under these conditions. What should be the overall dimensions (approximately) to ensure an ample supply of steam ?

Referring to question *a*, my calculation runs thus:

Assume M.E.P. on pistons of 60 p.s.i.

Area of pistons $= 3.14 \times \frac{19^2}{16^2} = \frac{3.14 \times 361}{256} = 4.4$ sq. in.

$\therefore$ Thrust on pistons $= 60 \times 4.4 =$ 264 lb. wt.

$\therefore$ Work done per revolution of engine =

$$\frac{2 \times 2\frac{1}{4} \times 2 \times 264}{12} = 198 \text{ ft. lb.}$$

$\therefore$ Work done per minute at 200 r.p.m. =

$200 \times 198 = 39{,}600$ ft. lb.

$\therefore$ Horse power = 1 (perhaps plus a little).—J.G.L., Reading, Berks.

▲ a. *The P.L.A.N. formula for calculating the horse power of an engine refers to the internal or indicated horse power without allowing for mechanical or steam transfer losses. It is perfectly accurate if all factors are properly known, but your method of calculation is not correct, as the factors involved are:*

P—mean effective pressure which can only be obtained accurately by means of indicator cards, but would probably not be much more than one third of the working pressure.

L—the length of stroke in feet.

A—the area of the piston in square inches.

N—the number of working strokes of the engine, which in a twin double-acting engine would be four per revolution.

b. *For a vertical multi-tubular boiler of fairly normal design, the size of the actual boiler, excluding firebox, should be approximately 3 ft dia. × 4 ft in height with at least another foot for the firebox, preferably with water walls, and a grate area of not less than $1\frac{1}{2}$ sq. ft.*

Dividing problem

I have a dividing head, geared 40-1, and plates with holes: 49, 41, 40, 39, 31, 28, 27, 23, 21, 17, 15, 13, 12. Can I drill a blank with 53 holes in it from the existing plates ? If not can you tell me of a method to follow ?—C.H.B., Twickenham, Middx.

▲ *It is not possible to obtain* 53 *divisions from any of the plates you have available as it is absolutely necessary to be able to obtain—by one of the plates in conjunction with the worm of the dividing head—some multiple of the required number.*

With the geared type of dividing head slight inaccuracies in the plate are relatively unimportant since they are reduced to the ratio of the gearing. Therefore it would be practicable to make up a temporary division plate by dividing the plate as accurately as possible, using dividers or by one of the methods that have been described in MODEL ENGINEER *at various times; the best known is the use of a perforated strip as described in the Percival Marshall handbook "Milling in the Lathe."*

If, however, it is required to carry out a number of jobs having 53 *divisions it would be desirable to make a stock division plate by using the worm-geared head as this would improve the accuracy; it would also probably be more suitable for permanent use.*

Lord of the Isles

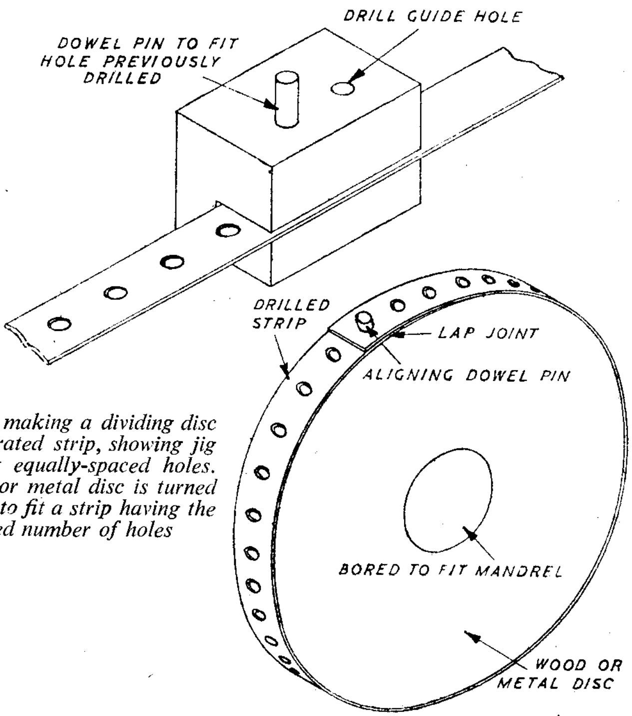
I intend making a $3\frac{1}{2}$ in. gauge model of an old Great Western locomotive *Lord of the Isles* which is dated about 1851. I have seen a photograph in a library book, and the wheel arrangement was 4-2-2. But I think this engine may have originally been of a 2-2-2 arrangement; with the boiler covered with what looks like strips of timber.

If you are unable to help with this particular engine, perhaps you can recommend an engine of the same class.—C.F.C., Manchester.

▲ *This engine was one of the G.W.R's celebrated broad gauge 8 ft singles—and she was always a 4-2-2. The only one of the class that was ever a 2-2-2 was the first one,* GREAT WESTERN, *build in April, 1846, and it was because the leading axle of this engine broke soon after she went into service that the 4-2-2 arrangement was adopted.*

The only drawings of these engines that are of any use to modellers are those which were reproduced in a massive publication in two volumes entitled "Locomotive and Stationary Engines" by Tredgold, and published about 1854. These two books are now regarded as collectors' pieces, and can only be obtained in the secondhand market. But there is just the possibility that the municipal library in Manchester may possess copies and would be prepared to obtain photostat copies of the drawings for you.

However, these celebrated engines are fully described and illustrated in McDermott's "History of the Great Western Railway" published in the 1920s by the old G.W.R.



Method of making a dividing disc from perforated strip, showing jig for drilling equally-spaced holes. The wood or metal disc is turned to the size to fit a strip having the required number of holes

Brazing firebox tubes

I have got a *Juliet* boiler well under way. The firebox is brazed and tubes are fitted. I have now to braze the tubes to the firebox tubeplate with Easy-flo, but I want to be sure of what I am doing.

I have plenty of heat, but can the burners heat the inner tubes without burning the outer ? I thought of putting one burner to blow on the top and one on the bottom row. Will the heat travel into the middle of the tube pack and melt the Easy-flo ?—G.E.C., Renfrewshire.

▲ *The arrangement of burners which you propose for the brazing of the tubes for your* JULIET *boiler should be quite satisfactory provided that you take due care. It is all a question of getting sufficient heat to melt the Easy-flo quickly so as to avoid the risk of burning any other parts of the boiler at that particular spot.*

Pump for cutting oil

I shall be grateful if you will advise me on a suitable type of pump to supply cutting oil to my ML7 lathe. The pump is required to pump a head of about 4 ft. At present I am using a gear type pump driven from a 1/10th h.p. motor at 1,425 r.p.m. nominal. This is perfectly satisfactory, but is unfortunately rather noisy.

I have made up a vane-type pump, the vanes being $1\frac{7}{8}$ in. o.d. by $\frac{3}{4}$ in. square, which was monumentally unsuccessful when used with the same motor since it provided a head of some 15 in. Incidentally, I am using Shell Makron 21 cutting oil, which has a considerably higher viscosity than ordinary soluble oil.

Specifically, can you make any suggestions on obtaining quieter running of the gear pump or for an alternative type of pump ?—T.W.C., Hailsham, Sussex.

▲ *The centrifugal type of pump is recommended, and such pumps are obtainable in a variety of sizes from Stuart Turner Ltd, Henley-on-Thames, Oxon.*

A pump having an impeller about 2 *in. diameter would be suitable and it should preferably be installed below the level of the liquid in the tank. Most commercial pumps for this purpose are arranged vertically and actually immersed in the liquid.*

A series of articles on rotary pumps and motors has been published in MODEL ENGINEER *and would be very helpful to you if you are proposing to construct a pump of this type. Basically, any type of pump could be used for this purpose, but a rotary type and one in which no actual contact of the moving parts with the casing takes place, is preferable.*

POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

IDENTICAL

SIR,—May I draw attention to an article which appeared in MODEL ENGINEER in 1909 [May 27, page 488, June 3, page 515, and June 10, page 537, vol. 20] on the Venice (California, U.S.A.) Miniature Railway, the engines of which are identical to the *Billy Jones* locomotive of the Wildcat Railway featured in the January 17 issue.

The Venice Railway article is most copiously illustrated with good photographs and diagrams, and many dimensions of the locos, etc., are given, together with good, descriptive matter.

Bromsgrove, Worcs. M. RIGG.

SPECIAL SOLDER

SIR,—Further to your reply to the query " Soldering Problem " [December 27], the silver rings are fused to the ceramic tubes and soldering must be done with silver-bearing resin core solder, which is a trade article, obtainable from radio supply houses. If ordinary solder is used, the rings will dissolve on repeated soldering.

Terminal blocks in high-quality electronic equipment are sometimes made in the form of ceramic slabs or wafers with fused-in silver patches for soldered connection points, and users are warned that silver-bearing solder must be used to avoid the trouble reported by your querist.

Windsor, Ont., Canada. H. S. GOWAN.

IS OUR FACE RED?

SIR,—As a reader of and subscriber to the MODEL ENGINEER for over half a century, except for breaks during war years, I have duly noted its many changes, one of which distresses me: it is the constantly increasing use of the highly Communist-coloured cover.

I feel there must be very many others who feel as I do about this and I am *ashamed to be seen with these coloured pages in my possession* lest I be mistaken for a *pro-Communist.*

Windsor. W. H. WHEELER.

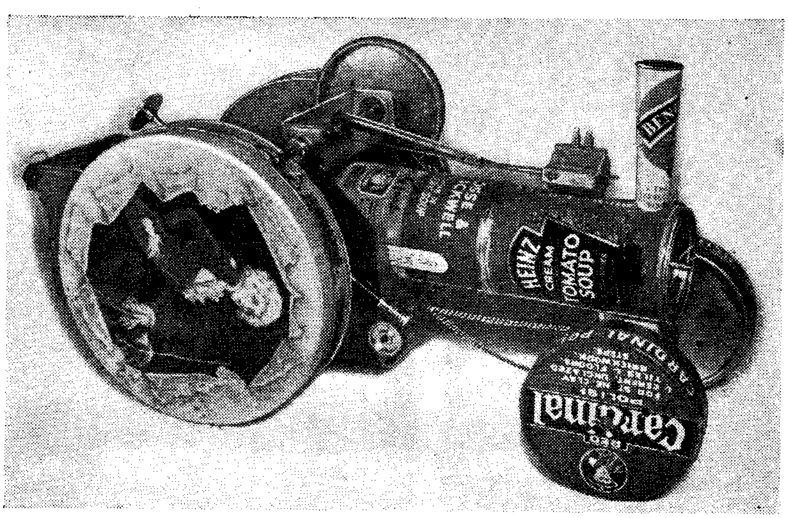
TINCANNERY

SIR,—At the 1956 Model Engineer Exhibition I was very interested in Mr J. B. Hool's tincannery; so much so that I started collecting tins.

I am enclosing a photograph of the result of my efforts, as it might be of interest to readers contemplating a tin-can traction engine. I have taken time off from a Marshall type portable but I have not regretted one minute of it.

Didcot, Berks. EDWIN F. CHANDLER.

All my own work! Mr Chandler's tin-can traction engine



CLOCK MATERIALS

SIR,—As a potential builder of the M.E. clock, might I say how pleased I was to see, on a number of ocassions, the publication of helpful information about obtaining materials; also the names and addresses of suppliers.

Might I make a contribution to the common pool of information? I decided to use Invar rod for the pendulum.. Many phone calls and inquiries produced no results until I was give the name of the makers, but there was a snag. The minimum value of metal they will sell was £2, plus postage.

This constitutes five rods 45 in. long of $\frac{5}{16}$ in. dia. Nilo 36, which is virtually non-expandable at normal range of temperatures. The makers are: Henry Wiggin and Co. Ltd, of Wiggin Street, Birmingham 16.

I have four spare rods which I am willing to let builders have at cost, i.e., 8s. 6d. each, plus post. Clock wheel cutters as specified are 25s. each from Messrs Pringle.

214, Folly Lane,
Swinton, Lancs. E. YOUNGHUSBAND.

● *We still have a few* $\frac{1}{2}$ *in.* × 0.008 *in. springs left which we can supply free to readers, vide Smoke Rings, January* 24.—EDITOR.

DIELECTRICAL

SIR,—Regarding electrical vibrations, I have been aware of this phenomenon since a child but as none of my relations could feel it I was always told I was imagining it.

Recently I have come across several friends who can feel these vibrations and it appears from my inquiries that sensitivity varies considerably from person to person. Evidently I am a " super sensitive " for I can feel vibrations on practically any piece of a.c. equipment, whether earthed or not, also on bakelite switches, electric lamps, radio cabinets, etc.

I do not consider this effect to be due to an electro-magnetic field, as one of your correspondents suggests; my own explanation is that it is due to dielectric vibration, the dielectric being the insulating material.

In my own case I can feel the effect on touching a live conductor (this is not to be confused with a shock!) I imagine the dielectric in this case to be the natural oil on the skin since the sensation is greatly reduced if the finger is washed with petrol.

The effect can be very useful, as I can tell if a piece of equipment is live or not simply by touching an associated piece of insulation, whether connections are reversed or not.

Glasgow, W.2. M. J. ABBOTT.

MODEL BEAM ENGINE

SIR,—I enclose a photograph of a model of the Vulcan beam engine described in your journal during, I think, 1954.

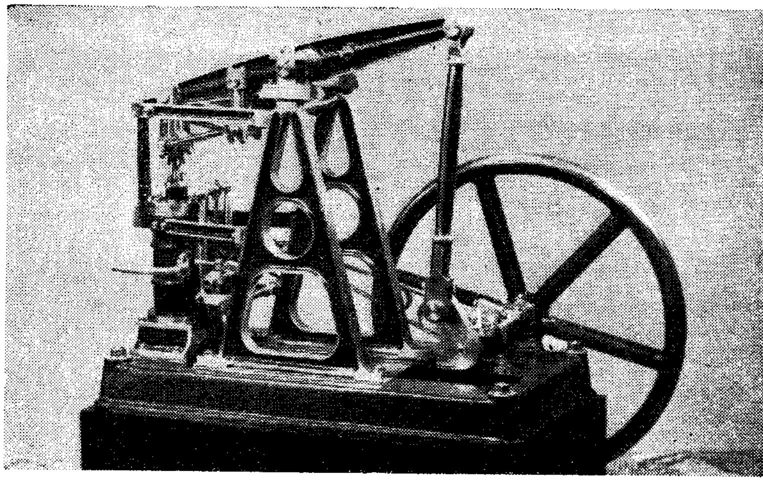
The model was constructed from your sheet of details and the series of articles. A set of very fine castings were obtained from Messrs H. Haselgrove, as recommended by Mr Westbury, the only exception to this being the cast aluminium bedplate which was supplied by Messrs A. J. Reeves.

It took 12 weeks of spare time work to construct and the tools available were a Zyto 3⅜ in. lathe, hand bench drill and the usual hand tools.

The engine runs extremely well on compressed air and I am at present constructing a boiler to run it on live steam. Since the photograph was taken I have mounted the pump on a suitable bracket between the A-frames and this, although not conforming to practice as it was in those days, looks and works very well.

The block on which the engine is mounted is wood stained and polished black, the name and date being patternmakers' lead figures pinned on and painted silver. The engine is painted a dark green which contrasts very nicely with the polished cast iron of the A-frames.

Manchester. N. SAVAGE.



The model Vulcan beam engine built by Mr Savage

AT BRADFORD MUSEUM

SIR,—My attention has been drawn to the article by J. N. Maskelyne in "Locomotives I Have Known" about two 4-4-0 engines built specially for racing. [M.E., December 27]. In his final paragraph he states: "I seem to remember that there was a fine 1 in. scale example in the 1925 Railway Centenary Exhibition at Darlington."

He may be interested to know that there is a 2 in. scale model, built at Queensbury, near Bradford, in the museum at the Cartwright Memorial Hall.

City of Bradford
Art Gallery
and Museums WILFRID ROBERTSHAW (Director).

PICKLING BATH

SIR,—In reply to Lieut-Col Theyer's letter on a pickling bath [Postbag, January 10], the vinegar and salt solution is ideal for use after brazing. If the solution is brought to the boil and the article immersed in this the result is better than sulphuric acid.

If parts of the article have been previously polished they come out with original shine. I can assure your reader of this as I have used it for years in the normal course of my business as a watchmaker and jeweller. I find it applies to all copper alloys, such as brass, gold, bronze, etc.

Bradford, Yorks. A. LAMBERT.

KITSON-STILL LOCO

SIR,—I was delighted to read W. E. Carlisle's article about this engine. [M.E., January 24].

In his presidential address to the Institution of Mechanical Engineers, Mr Crowe of the North British Locomotive Co. said that it "came very near to being a success." The Kitson-Still locomotive was killed by the depression of 1928-32,

Admittedly the problem of getting 1,200 b.h.p. into the space available was a big one, as compression ignition engines of that power were in the very early stages but the idea should have been developed.

I was working on high-pressure steam and compression ignition locomotives at the time and I was intensely interested in the engine. In discussing it, however, the steam men asked, "Why not have a 100 per cent. steam-engine ?" The diesel men declared, "Why in Heaven's name mix steam with diesel ?"

Never from that day to this have I come across a locomotive man who appreciated that by combining a high-pressure steam power unit with a compression ignition engine, change speed gears can be eliminated; the steam portion of the job supplying the features that even the best supercharged c.i. engine lacks.

I wonder what these islands have lost by the dogmatic assertion that no improvement of existing ideas is possible because, if it were, someone would have done it.

Devizes, Wilts. KYRLE W. WILLANS.

GRINDING A MOWER

SIR,—I have used a grinder made by Atkinson and Ellis for about 30 years and I can assure Mr Stocker that if the axis of the cylinder is kept above that of the grinding wheel there will be ample back off. In the grinder the cylinder and wheel revolve in the opposite direction to that of the lathe. It is quite as important to grind the bottom blade as the cylinder.

From the dust on the grinder bed I wouldn't insult my lathe by asking it to do the job and still expect it to be accurate. If I couldn't find a professional to do it I would revert to the old blacksmith's trick of turning the machine backwards and feeding with oil and carborundum powder, tightening down until sharp.

Bletchley, Bucks. F. C. ATKINSON.

HOT-AIR ENGINE

SIR,—Mr Woodforde quotes [M.E. January 24] Professor Rankine in 1885 as stating that a Stirling hot-air engine could work up to an average of 5.6 p.s.i.

But compare Professor Goodeve's account of hot-air motors in his *Textbook on the Steam-Engine with a Supplement on Gas Engines*; London, Crosby Lockwood 1889.

We find this statement on page 97: "Stirling's engine is supplied with compressed air; that is an essential

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condition, for otherwise the power developed would be insufficient to move the working parts."

And on page 98: "that we have air at, say, 260 lb. pressure on one side of the piston, but at 150 lb. pressure on the other side, and that there is an ample amount of working power."

Back to page 97: "An engine of 45 h.p. was set up at Dundee Foundry and drove all the machinery of the works for a period of three years." But "the heating vessels, however, caused so much difficulty that the method was given up."

Further: "There is a compressing pump for supplying any waste of air by leakage, the usual pressure of the enclosed cold air being ten atmospheres"
or, $9 \times 14.7 = 132$ p.s.i.

From this it appears that the hot-air engine ceased to be regarded as a practical machine because the materials available for furnaces and air chambers could not stand the combined heat and pressure.

Therefore, now that we have improved cast iron, heat-resisting steels of many types, and the alloys which would carry the exhaust gases of aircraft engines under the most extreme conditions of vibration and heat, the subject might with profit be re-examined, for there are many places where power could be secured with advantage from fuels derived from waste, now thrown away, and coal saved.

If someone with the necessary tools were to experiment with an engine having a force pump to keep up the air pressure, and a heating chamber which could utilise a very high temperature without going out of shape, an interesting small power unit might result.

Goodeve gives the number of Stirling's patent as AD 1827 No 5456, and a subsequent one AD 1840 No 8652.

Mill Hill, N.W.7. H. H. NICHOLLS.

BACK TO STEAM ?

SIR,—Frank Woodall, who criticised the lack of steam car builders [Postbag, January 24], appears to be a man who has little interest in general engineering and it's a wonder he reads the MODEL ENGINEER at all.

His sarcasm towards that beautiful piece of engineering, the traction engine, on its Sunday afternoon's outing, is absurd. Even if the gentleman who is enjoying a Sunday drive on his engine should have a permanent "slow-down" signal bolted to his stern, he is, at least, able to enjoy the scenery while attending to his fire and steam, which is far more entertaining than simply looking for the next filling station.

He is more than a driver; he is an engineer and, as such, we are interested in him. Inventions are, in nearly all cases, improvements of what has been accepted in the past and perhaps we have taken the wrong road by considering the internal combustion engine the only answer.

What would our machinery departments in the museums look like with only models of today's popular production ? Who would read the MODEL ENGINEER if it were not crammed with information of the ingenuity and beauty of the productions of yesterday's inventors ?

A reader recently described a locomotive as "something having its guts hanging out." He probably considers a balloon a better finished article.

Colonel Nasser and the Texas Oil Kings have passed us a hint and it may well be that the designers of tomorrow will be searching for the knowledge of readers who have never lost interest.

Fleetwood. S. MCGREGOR.

DEAN SINGLES

SIR,—I was very pleased to see the Dean Single appear at last in the "Locomotives I Have Known" series [MODEL ENGINEER January 10] and it reminds me of one small point on when I should like Mr Maskelyne's opinion.

Some time ago Mr D. G. Webster suggested that my driving axlebox covers were wrong and that the raised part should be as in Mr Maskelyne's drawing, i.e., a rectangle with radiused corners. In my collection of photographs some three dozen are clear enough to show the shape of this cover and all of them show it to be an elongated octagon with radiused corners. What is the explanation of this discrepancy ?

I should also like to know the function of the lubricator cup between the sandbox and the splasher. Was it for the ram of the vacuum pump ?

I have not yet seen the Paddington Majestic but I am surprised that it could be over decorated. Photographs show that almost everything on the prototypes which could be lined was lined—even brake rods, spring buckles and guard irons.

Birmingham. J. H. BALLENY.

SIR,—I was interested to read Mr Balleny's letter regarding the shape of the raised portion of the driving axleboxes on the G.W.R. Dean Singles. This was definitely four-sided with radiused corners.

Many years ago when I first made a drawing of one of these engines, I was perplexed over the problem of how to represent that raised surface because it was radiused all round its edges with quite a large radius; therefore, there was, strictly speaking, no outline to be shown.

The drawing, however, looked so strangely blank without any representation of the raised front that I decided to put in the outline as a rectangle with the scale equivalent of about $1\frac{1}{2}$ in. radius at each corner, which much improved the appearance of the drawing.

Some years later I acquired copies of the six Weight diagrams issued for these engines and I was pleased to see that the Swindon draughtsmen had used the same method as I had done, the only difference being that they had indicated a larger radius than mine.

I think the octagonal effect Mr Balleny mentions is due to some trick of lighting, influenced perhaps by reflections of the four dome-headed nuts at the four corners.

The little lubricator referred to was for the ram of the vacuum pump.

London, W.1. J. N. MASKELYNE.

SCREWCUTTING . .

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wheels of 60 and 20 I have a ratio of 3 : 1 while if I take a gear wheel of 60 t. and 18 t. the ratio is then 3.33. But if I deduct two teeth from both the original gears, making them 58 t. and 18 t., I have a ratio of 3.22.

In the case of a compound gear this can be worked with both separate pairs of gears. For example, if I take the ratio I have previously referred to:

$$\frac{60}{20} \times \frac{90}{42} = \text{a ratio of } 11.25$$

By reducing the first pair of gears by 2 t. each I get:

$$\frac{58}{18} \times \frac{90}{24} = \text{a ratio of } 12.08$$

Then leaving the first pair of gears the same and adding 2 t. to each of the second pair I get:

$$\frac{58}{18} \times \frac{92}{26} = \text{a ratio of } 11.15$$

It will, therefore, be seen that by this method it is possible to cut almost any thread within very close limits with practically any pitch of leadscrew and gear wheels.

While there are a number of methods by which the leadscrew may be re-engaged, the novice would be best advised to keep the leadscrew engaged *all* the time, either winding it back by hand or reversing—if, in the latter case, the lathe is fitted with a reversing switch. ■