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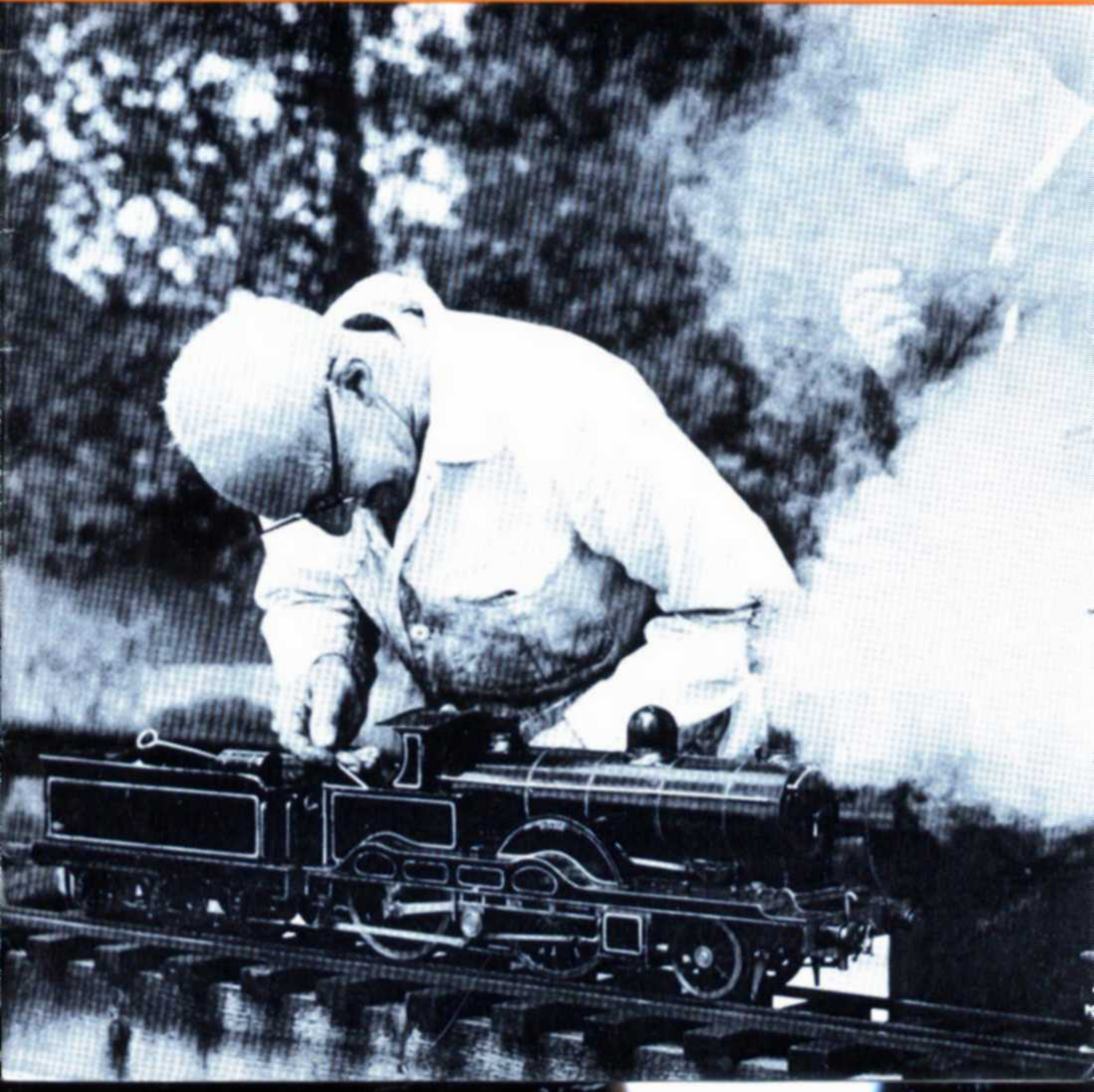

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October 20 1967

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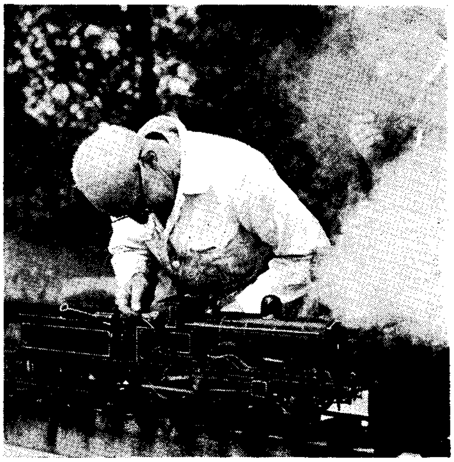

COVER PICTURE

A $\frac{3}{4}$ in. scale L.N.W.R. Compound locomotive "Ionic," built by Mr R. H. Procter of the Southampton M.E.S., who is seen here raising steam. Photograph by Lorna M. Minton.

NEXT ISSUE

Model engineers and their work: A simple four-cylinder steam engine.

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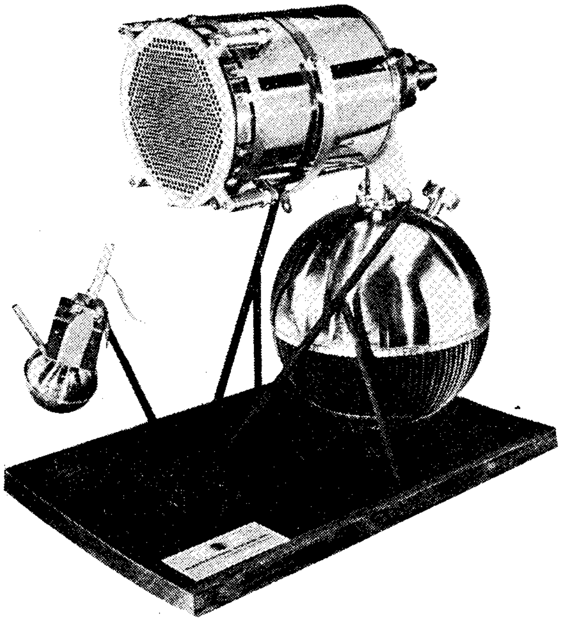
SMOKE RINGS

A Commentary by the Editor

My recent comment on the steam tug *Racia* has brought forth several letters from readers who point out that she is not the last of the steam tugs, but only the last of the coal-fired tugs. Reader John Cornwell points out that in the Ship Towage fleet there are still seven steam tugs, the *Cervia, Nadia, Tanga, Challenge, Atlantic Cock, Crested Cock* and *Ocean Cock.*

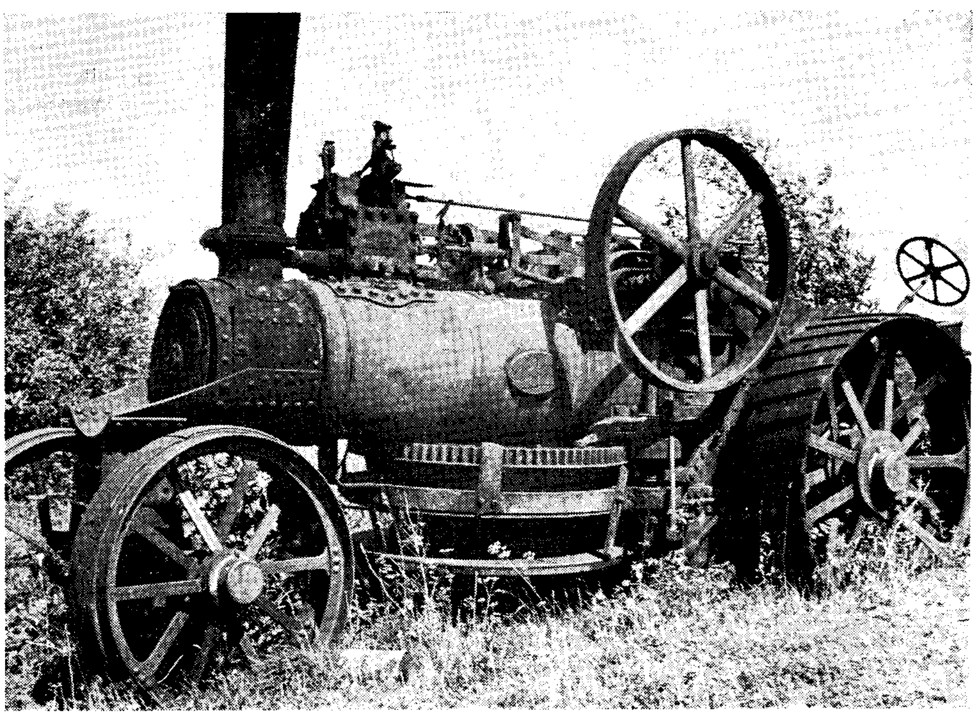


An Ion engine. The sphere contains the feed system and the fuel. Photograph courtesy Bell Aerosystems Co.

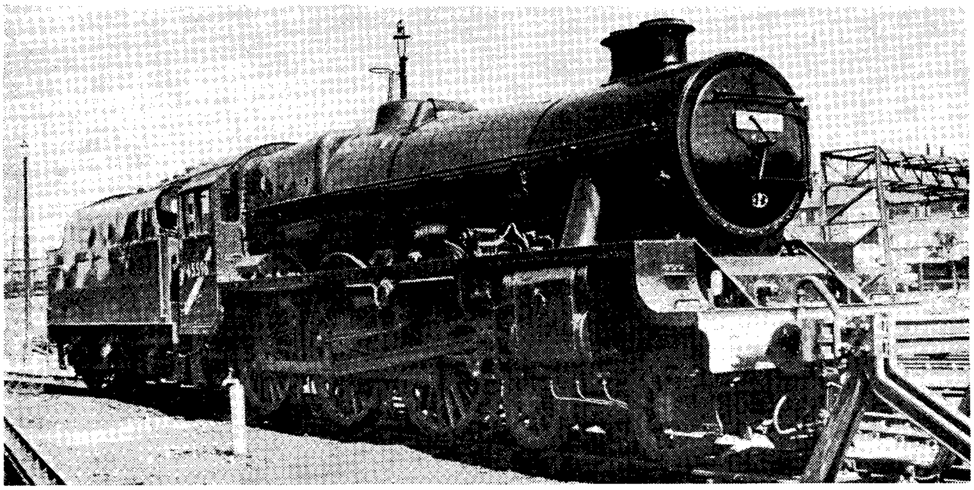
New engine

An ion engine operated successfully in space for the first time on July 20, 1964. It is believed that such an engine will eventually be capable of powering a space probe outside the solar system. The operation of an ion engine requires two resources: electric power and a propellant. So far the propellants used have been mercury and, more recently, cesium. First the propellant is ionised—broken up into electrified particles—by a flow of electrons emitted from a cathode. The ions are then accelerated by high voltage to speeds exceeding 100,000 m.p.h. The thrust is produced by ejecting the electrified particles from the engine at this speed.

The engine shown in my illustration was built by the Lewis Research Center, U.S.A., and has run continuously for 341 days. As a next step, two engines designed and built by the Center will be flown in a satellite, to find out their performance over a period of six months or longer, and to investigate their effect on other components used in the satellites.



A Fowler double-drum ploughing engine photographed in West Suffolk in 1952 by reader G. W. Cox.



The three-cylinder Stanier 4-6-0 locomotive "Bahamas" which it is hoped to preserve in working order.

Steam paddleboats

Visitors to Switzerland this year may still travel on steam-driven paddleboats on Lake Geneva. A reader tells me that there are four such vessels in service on the lake. The boats are virtually as when they were built, although the boilers are now oil-fired. Travellers showing interest in these vessels are usually made welcome in the engine rooms. The *Suisse*, the largest of the fleet, is powered by a two-cylinder diagonal engine of 1,500 h.p. The oldest boat, the *Major Davel*, was built in 1892, and is still steamed occasionally. She is powered by a triple-expansion diagonal engine constructed by Escher Wyss of Zurich and has Joy valve gear. This vessel is now in poor condition and is expected to be broken up in the near future. Unfortunately the fate of the whole fleet is in the balance, as manning the vessels is proving difficult and expensive.

Locomotive "Bahamas"

I hear that attempts are being made to preserve the Stanier 4-6-0 three-cylinder locomotive *Bahamas*, ex-L.M.S. No. 5596. This would be one of the few Stanier express engines preserved in working order, and readers willing to help towards raising the necessary funds should contact Mr F. Barnes of Woodlea, High Bents Lane, Bredbury, Cheshire. Mr Barnes is a member of the Stockport *Bahamas* Locomotive Society, which has been formed to preserve this engine.

Syphons and superheaters

I hope that LBSC's comments on firebox superheaters in our last issue (page 960) will not discourage locomotive builders from trying out these useful fittings. Those who have fitted firebox superheaters in place of the more usual spearhead flue-tube type have undoubtedly obtained a higher superheat, but even if a higher temperature is not thought desirable, the firebox type has the advantage that the flues are much less likely to become blocked up in service. The fact that such superheaters are not used in full-size locomotives is not really a very good argument against them. Many of the fittings on our small engines have to be quite different from those on the full-size locomotive. The size and arrangement of the tubes in model boilers, also, have to be vastly different from the big engine, if success is to be achieved.

Ample superheat can be obtained in most full-size locomotive boilers using the conventional spearheads, and anything further in this direction might result in overheating and lubrication troubles at the front end. The argument about flue blockage too does not apply to full-size practice.

As for thermic syphons, I don't think anyone would suggest that these are desirable in a small $3\frac{1}{2}$ in. gauge round-top boiler such as that specified for *Mabel*. Thermic syphons are more suited to the larger wide-firebox types of boilers, though that fitted to my 5 in. gauge 2-6-2 tank engine, which has the typical Swindon narrow-firebox boiler, has proved completely successful. When driving this on the Birmingham track recently, I was struck by the *absence* of too-violent circulation. The water gauge was very easy to read, the level keeping steadier than on many locomotives with conventional boilers which I have driven.

Christmas cards

It is a little early in the year to be thinking about Christmas cards and calendars, but I have just received rather a nice card from the Talyllyn Railway Preservation Society. This depicts locomotive No. 2 *Dolgoch* passing No. 1 *Talyllyn* on a train at Pendre. Cards are available from the T.R.P.S., Towyn, Merioneth, at 1s. 3d. each, or 12s. 6d. per dozen, post free. Calendars are 4s. each, post free.

Martin Evans.

MODEL STEAM FIRE ENGINES

by Edgar T. Westbury

Part VII

Continued from page 948

On full-size fire engine boilers, the major fittings were attached by studded flange joints, but in view of the difficulty of making them secure and readily accessible in a small scale, it is considered more practical to screw all the fittings into the tapped bushes, which have already been described. Screwed fittings, when fully tightened, have a nasty habit of finishing up in anything but the most suitable position, except in the case of plain unions, in which this problem does not arise. It is therefore necessary in many cases to interpose shims or washers in the joint in order to ensure that the fitting is properly orientated, and at the same time secure and steam-tight. The thickness of the shim can only be determined by trial, and is nearly always some odd dimensions; this complicates matters when two fittings have to be in true alignment, such as those for gauge glasses.

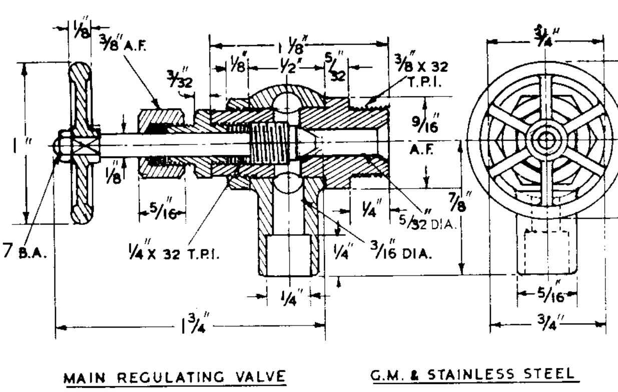
Valves and stopcocks on small boilers often tend to be unshapely, with only a sketchy attempt at scale fidelity, and of a size disproportionate to that of the steam or water passage which they control. In model locomotive construction, fittings which serve their practical purpose have been evolved, and the problems associated with them are rarely mentioned nowadays, but they call for consideration when the fittings have to be adapted to other steam engines, and their shape and size need to conform as closely as possible to scale.

Main regulating valve

This is a highly important fitting, which needs to be both sturdy and accurate to maintain steam-tightness in frequent repeated use. In full-size, the body of the valve is in the form of a casting with flanges for attachment to the boiler and also for the cover which carries the spindle gland. A different method of construction is employed in the regulating valve shown in Fig. 21, in which the "banjo" principle, similar to that of the two-way connector in Fig. 20, is retained in order to enable the outlet to be disposed at the most suitable angle. The body of the valve is in the form of a hollow stud, screwed both internally and externally to locate the spindle, gland and seating in concentric alignment.

The body of the valve should be made from gunmetal rod or cast hard bronze, and may with advantage be turned and threaded at the boiler end first, for fitting to a tapped chucking bush for further machining operations in the reverse position. It is then carefully centre drilled, and drilled right through $\frac{5}{32}$ in. dia., then opened out concentrically to $\frac{7}{32}$ in. for a depth of $\frac{9}{16}$ in., and tapped $\frac{1}{4}$ in. $\times$ 32 t.p.i. The outside is turned $\frac{3}{8}$ in. dia. for a length of $\frac{3}{4}$ in., threaded $\frac{3}{8}$ in. $\times$ 32 t.p.i. for a length of $\frac{3}{4}$ in., and a half-round groove $\frac{3}{16}$ in. wide is turned in it at $\frac{1}{2}$ in. from the end. It is then cross-drilled $\frac{5}{32}$ in. dia. in the centre of the groove. The valve seating is best formed by means of a D-bit made from $\frac{7}{32}$ in. silver steel rod, tapered to 60 deg. on the cutting end. It is entered just deep enough to form a clean, narrow seating just clear of the cross hole.

The banjo is first machined on the outside, stalk end outwards, and drilled and counterbored to take the steam pipe. This is intended to be silver



Right: Fig. 21. Details of the main regulating valve for the model Shand Mason fire engine.

soldered in, thus avoiding the need for a union joint of the conventional type, which would indeed be superfluous, only taking up more space, and difficult of access in the particular circumstances. It is not absolutely essential to turn the banjo to a spherical contour, but it will be just as easy to do so, and it will take up less space than in any other shape. The cross drilling is also facilitated by holding the spherical part in the three-jaw chuck with the stalk between two of the jaws. It should be truly faced and concentrically drilled $\frac{3}{8}$ in. dia., then internally grooved with a small half-round boring tool $\frac{1}{4}$ in. from the face. The other side can be faced by wringing the banjo on to a stub mandrel, then turning it in position in the lathe chuck to ensure true running.

The valve pintle should be made from stainless steel or monel metal; it can be turned at one setting from a rod held in the chuck and supported at the end by the back centre, after drilling with a fine centre-drill. It is turned down on the end for threading **7 BA**, for a length of $\frac{1}{8}$ in., and $\frac{5}{32}$ in. dia., $\frac{3}{16}$ in. long, to be finished $\frac{1}{8}$ in. square, and $\frac{1}{8}$ in. dia. as smooth and parallel as possible for the main stem. The screwed portion should preferably be screwcut, $\frac{1}{4}$ in. $\times$ 32 t.p.i., to fit closely in the tapped hole in the body. Finally the relieved back end of the pintle, and the pointed end, which has a taper of 60 deg. inclusive, can be turned, prior to parting off at a diameter well below that of the $\frac{5}{32}$ in. steam passage. It is, of course, unnecessary to carry the taper to a fine point.

A casting should be used for the handwheel if it can be obtained; otherwise it can be made by turning the rim and face contours, then fretting out the spokes and rounding them off by filing. At one time it was possible to obtain handwheel castings of fair accuracy in a range of sizes down to 1 in. dia., but I have not seen any for several years, and can only conclude that they have now gone the way of all the castings which are too small and fiddly for moulders to bother about. Some constructors may be prepared to fabricate such components, with separate rim and round-section spokes, by silver soldering, which makes a very neat job if properly carried out. A handwheel of this size is not convenient to manipulate when hot, and a modified form with insulated rim may be considered an improvement, but I would prefer to retain the correct handwheel and open or close it by means of a wheel-spanner, as commonly done in full-size practice.

The fitting of the wheel to the pintle may be considered a delicate operation and simplified methods are commonly employed, but there is little doubt that a squared spindle and hub socket, as shown, are worth while on the grounds of security and reliability. I have described in previous articles how an accurate square hole can be produced while the work is set up in the lathe, by means of a slotting tool; a square on a small shaft can also be shaped quite easily with the aid of a filing rest, as described in the *Lathe Accessories* handbook.

Other parts of the regulating valve, including the gland body, gland nut, and locking nut, are quite straightforward, and call only for reasonable care in preserving accuracy. The gland nut, while set up for drilling and tapping, can be used as a chucking piece for facing, threading and drilling the gland body from the inner end.

A similar form of construction, but of reduced dimensions, may be employed for the blower valve, which is connected to one side of the two-way connector, to control steam to the front end of the blast nozzle by way of a cone union joint. The other end of the connector, as already explained, leads to the pressure gauge syphon pipe, which incidentally is not a syphon, but a water trap. It is recommended that this should be longer than normal in the model, to ensure that condensation is not prevented by too close proximity to the heated end. These features are shown in the general arrangement drawing (Fig. 1, in the August 4 issue). Valves and other fittings of the type described will work reliably and maintain steam-tightness if the parts are carefully machined with keen tools, including drills, taps and dies.

Boiler casing

The fitting of a brightly polished casing to the boiler is essential to faithful and characteristic resemblance to the prototype. In the Southgate engine, despite a few battle scars, the brass casing is still in very good condition, and bears evidence of the loving care and skill in making and fitting it over 70 years ago. No joints are visible between the cylindrical jacket and the cap, though it seems unlikely that these could have been made in one piece, in the days when pressing, deep drawing, and spinning techniques were very much in the embryo stage. In the casing for the model boiler, I have attempted to adapt the casing construction to methods most readily available to constructors, and avoid difficult operations.

The jacket is intended to fit over the upper part of the boiler, with an annular clearance of $\frac{1}{8}$ in. to be filled with insulating material or "lagging." I believe that for locomotive boilers, asbestos millboard is generally favoured for this purpose, and it is convenient to use, especially where surfaces are irregular or projecting fittings are present, as it can be moulded to shape while in a damp condition and is firm when dry. But it is inferior in heat insulating properties to a loose-texture material such as hair felt, which is adequate to withstand the heat of the outside of a boiler. Whether this is of any practical importance or not, the lagging should be wrapped around the boiler to build up a thickness of $\frac{1}{8}$ in. when compressed, and cut out where necessary for the various bosses to take the fittings.

The jacket can be made from half hard sheet brass of a thickness which can be manipulated by hand, without the use of special bending tools. Hammering should be avoided if possible, as any dents or bruises in the surface are very difficult to get out. A mandrel of some kind, such as a piece of heavy gauge tubing, about 3 in. dia., will be useful for bending the sheet metal smoothly into a circle. The circumference of the jacket is very slightly less than 11 in., and it will be in order to cut the sheet to this width, to allow for any trimming that may be necessary; all edges should be straight and square with each other.

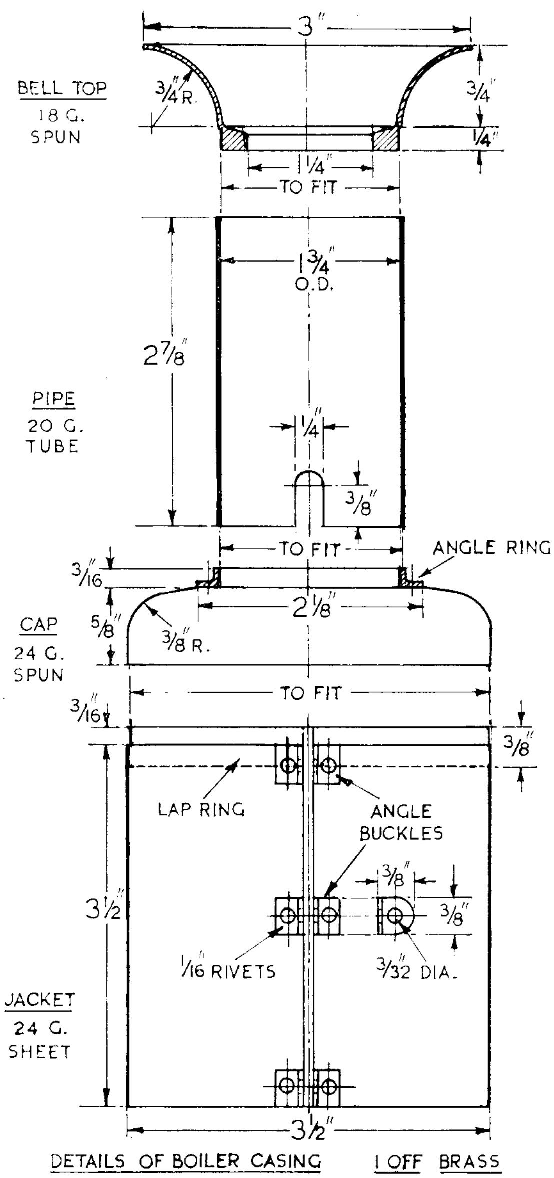
As will be seen from the boiler assembly drawings, the jacket covers only the upper part of the shell, and does not appear to be fixed in the full-size engine as no fastenings are visible. It has been considered advisable to clamp the jacket over the lagging in the model, leaving an open joint, with buckles for bolts to pull the edges together. These buckles can be made from short pieces of angle brass secured by $\frac{1}{16}$ in. rivets at the edges of the sheet, after its circumference has been determined by trial. The joint can be located at the back of the boiler, where it is not conspicuous. Other methods of fixing the jacket are practicable, but this is simple and allows for some variation in the thickness of the lagging. A lap ring is attached inside the top of the jacket, preferably by a few small rivets. Its purpose is to locate the cap concentrically and flush with the outside of the jacket. It should be fitted after the jacket is bent to shape, and soldering is best avoided, as brass is very liable to distortion when locally heated.

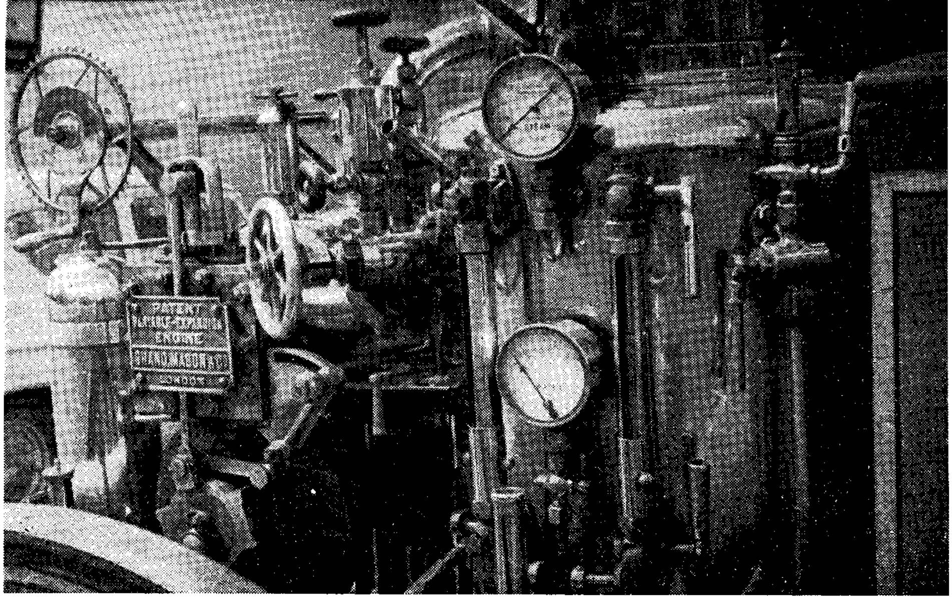
The metal employed for the cap must be ductile, and the quality known as "cartridge brass," which is specially produced for deep drawing operations, is recommended. It can be beaten to shape over a former, if kept well annealed, but the most accurate and simplest method is by spinning, which not only produces a high finish, but also enables the size to be adjusted so that it fits tightly over the lap ring. The former for this process may be of hardwood, plastic material or metal, chucked truly in the lathe. A set screw and large washer may be used to clamp the metal disc, which should be about $4\frac{1}{4}$ in. dia., and a wooden tool, lubricated with tallow or soap, may be used for preliminary shaping, followed by a hardened steel burnisher for finishing. One or more movable pegs are fitted to the tool rest, to enable sufficient leverage to be applied to the tool. The lathe should be run at a moderate speed, and the metal re-annealed at any signs of hardening up under the tool.

It is, of course, possible to machine the cap, and also the bell top of the chimney, from solid metal or a casting, but thin sections are difficult to machine because of the liability to excessive spring and chattering.

The holes in the jacket and cap to clear the bushes in the boiler should be located as closely as possible by measurement, and drilled well under size at first so that the casing parts can be offered up, and any errors of position corrected by filing as required. They should not be larger than is necessary to avoid fouling the fittings

Below: Fig. 22.





Left: A Shand Mason Engine showing some of the boiler and main pump details, including the patent variable expansion valve operated by an eccentric outside the flywheel.

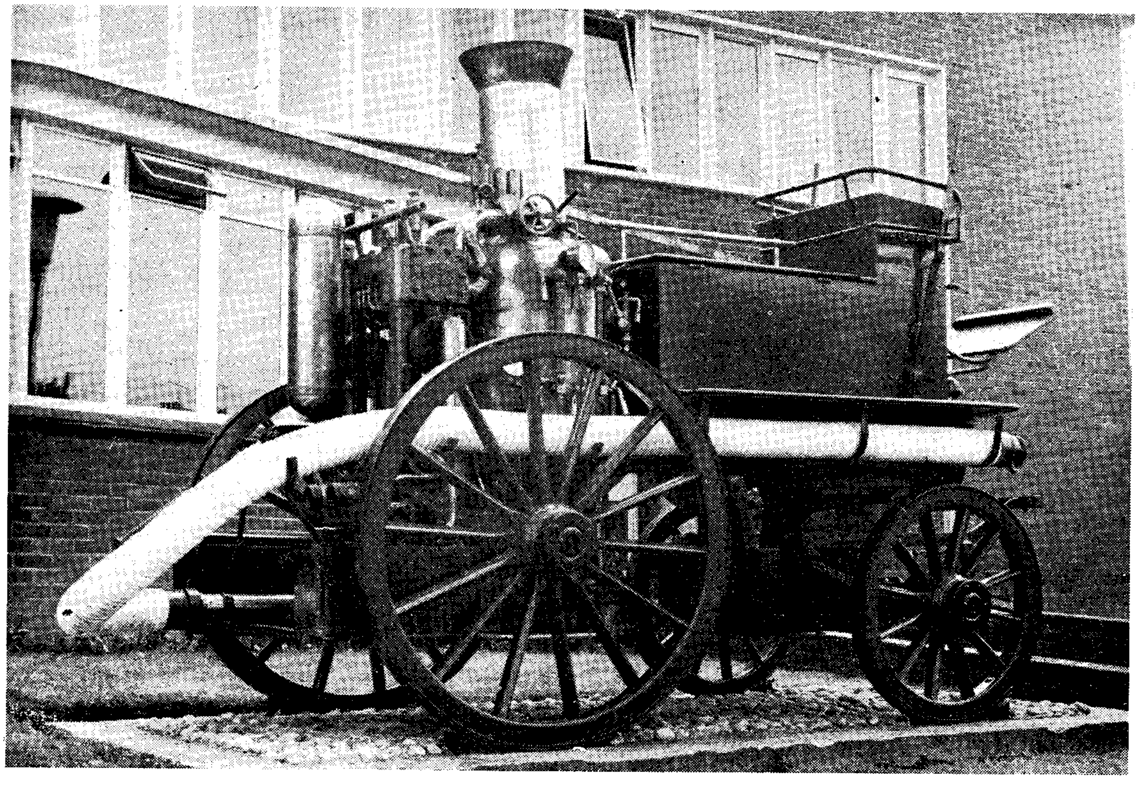
Below: A Shand Mason at Gillingham.

screwed into the bushes.

An angle section ring, machined from a casting or solid material, is fixed to the top of the cap by half a dozen (or more) $\frac{1}{16}$ in. rivets. It is bored to fit the $1\frac{3}{4}$ in. dia. chimney pipe, which is slotted at the bottom to clear the blast nozzle fittings, and should not require any positive fixing. The wide bell top is another part which can best be produced by spinning, though with sufficient coppersmithing skill, it could be made in one piece with the pipe. Otherwise, a register spigot must be provided at the base of the bell top to fit tightly inside the pipe, also an internal rim to centralise it on the boiler flue. This may be silver soldered or pinned in position if the component is made from sheet or tube.

The photograph of a Shand Mason engine seen on the A2 at Gillingham, Kent, shows a chimney with a much narrower, and I think less elegant, flare than that of the Southgate engine, also several other differences of detail. Its date is not stated.

To be continued



More oil
in small doses

by
F. Cottam

A complete Great Western type hydrostatic lubrication system for locomotives

THE cylinder lubricator to be described is used on three of my locomotives, one $3\frac{1}{2}$ and two 5 in. gauge and was first fitted to my $3\frac{1}{2}$ in. gauge "King" in 1947; it was at that time described in *Model Engineer*.

A simple displacement lubricator has two big disadvantages. It has poor regulation of oil feed, and when steam is shut off to the cylinders, pressure in the oil container causes "gulping," which means a rush of oil to the cylinders.

With the lubricator to be described, oil supply is regulated and is visible, also it is shut off when the regulator handle is in the closed position.

Many locomotives running on Club tracks may be seen with oil around the top of the chimney and running down the outside—probably a small percentage of that which is being sprayed over driver and passengers. This is wasteful and undesirable.

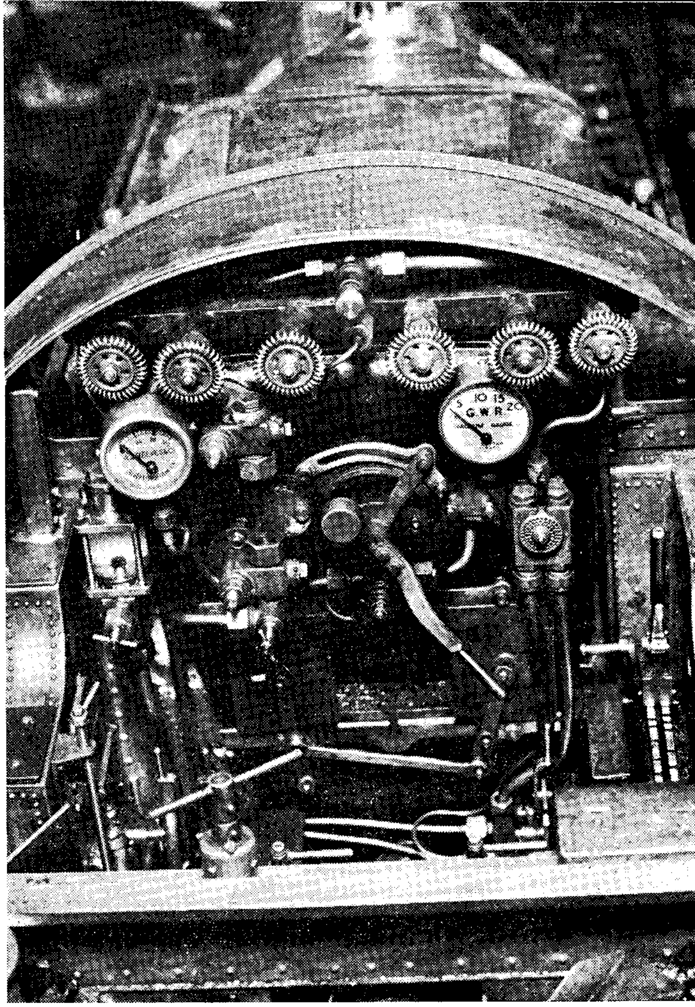
My lubricator bears some resemblance to that fitted to Great Western engines. It consists of a pressure-tight oil container, either in the cab or under the cab floor, a sight feed fitting on the cab side and a jockey valve on the backhead, which is operated by an upward extension of the regulator handle, moving through a slotted quadrant above the regulator.

The action of the lubricator is as follows:—

The oil container is filled by first turning off the steam valve and the oil regulator on the sight feed fitting. The drain valve is then opened after any pressure has been released. Close drain and fill with cylinder oil.

The sight feed glass should be filled with salt water. Only a pinch of salt is needed; the amount determines the size of the oil drops which will float up through the glass. This should only need to be done at the beginning of the season and drained out when the engine is stored for the winter.

Having filled the oil container and attended to the sight feed glass, open the steam valve to the



Cab view of one of Fred Cottam's locomotives, showing the sight feed fittings.

oil container. Steam will pass into the oil container and condense, displacing oil which passes up through the non-return valve and regulating valve on the sight feed fitting, then through the nipple at the bottom of the glass and floating up in small beads through the water in the sight glass.

From the top of the sight feed fitting, oil passes to the jockey valve. When the regulator is moved from "closed" position, oil passes through the jockey valve in which it is combined with a jet of steam, after which steam and oil combined pass to the cylinders either by way of a hollow stay or an external pipe.

For oil delivery into the cylinders, should there be a single steam pipe in the smokebox on the dry side of the superheater, oil may be fed into this.

On my latest engine, a 5 in. gauge G.W. 2-8-0 tank, the oil delivery pipe divides in the smokebox, the two branches feed into outside steam chests from between the frames. If this arrangement is used, both branch pipes must be of the same length and curvature. Also they should enter the cylinders at the same level. Oil will go the easiest way and if the branch pipes are not identical one cylinder will get the lot.

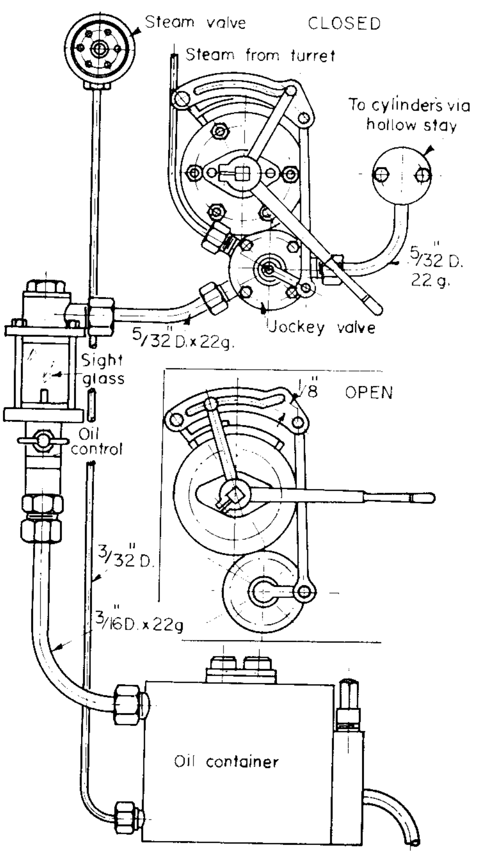
My drawing shows the layout of the fittings, also suggested pipe sizes. The 1/16 in. tube from the turret to the jockey valve is not fitted with a shut-down valve. Should it not be convenient to feed the oil through a hollow stay to the front end, 3/16 in. × 20 or 22 s.w.g. external delivery pipe should be used. Avoid any " uphill " stretches.

The action of the lubricator is automatic and only works when the regulator handle is in " drifting " or " open " position.

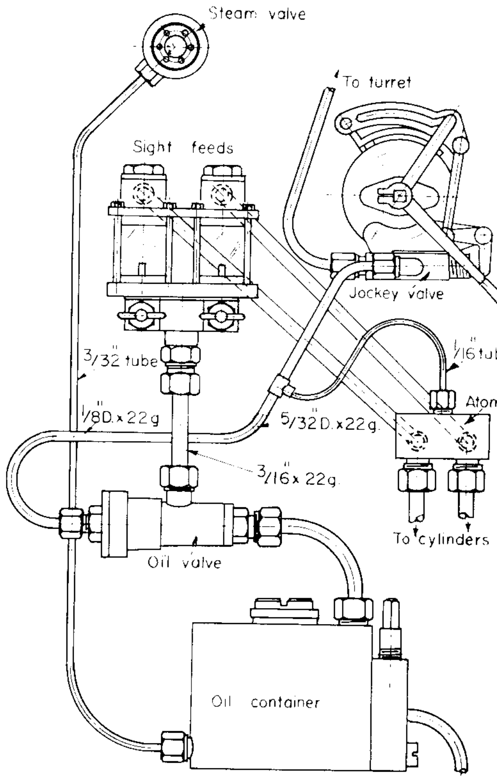
On G.W. locomotives, the first movement of the regulator was to " drifting " position, which brought the jockey valve and lubricator into operation. Further movement of the regulator handle opened the regulator. This was necessary to maintain cylinder lubrication while running down grades with steam " off."

This feature is useful on our engines to get a good dose of oil into the cylinders before dropping the fire at the end of a run, although be sure that the cocks are open and the brakes on.

Regulator handles on the full-size locomotives were in later days fitted with a balance weight, as



GENERAL ARRANGEMENT

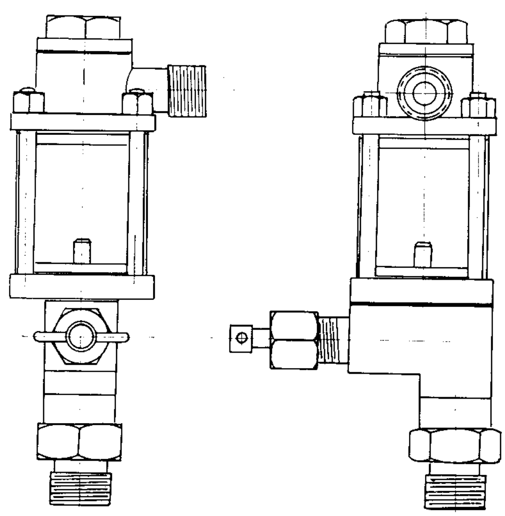


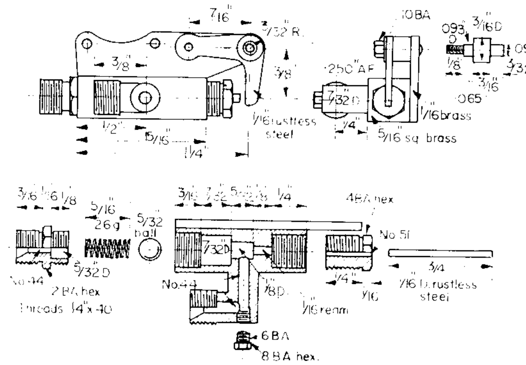
GENERAL ARRANGEMENT TWIN SIGHT FEED

they tended to move into the closed position when the engine was " drifting."

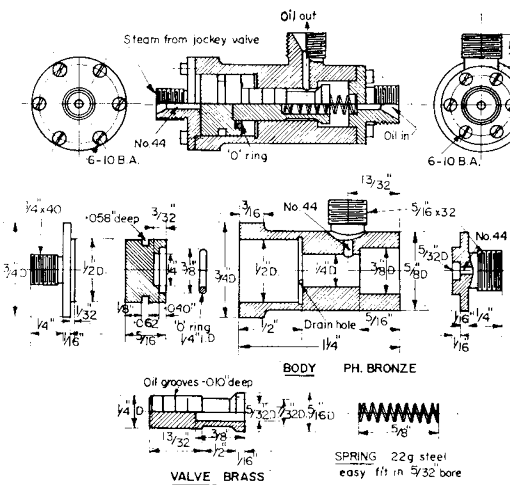
In service, on a 5 in. gauge two-cylinder engine, one drop of oil through the sight glass per minute should be ample—a full-size locomotive used to get about two drops a minute per cylinder.

When running, piston and valve rods should

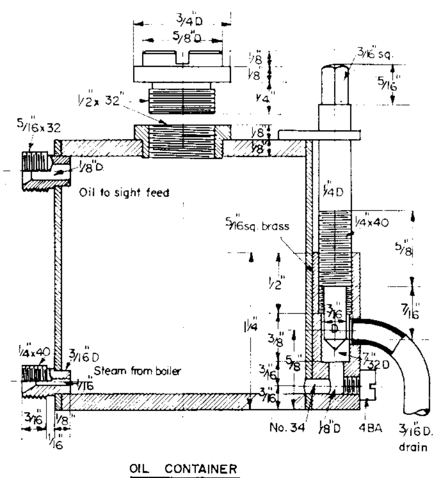

SIGHT FEED FITTING



JOCKEY VALVE
For twin glass lubricator



OIL VALVE



OIL CONTAINER
18 OR 20G. ENDS 1/8" BRASS OR COPPER
FITTINGS BRASS SILVER SOLDERED
SPINDLE RUSTLESS STEEL. CONTAINER
DIMENSIONS TO SUIT LOCOMOTIVE

feel " oily " with, maybe, a trace of oil inside the chimney. The picture of the backhead shows the sight feed fitting with a bead of oil showing in the glass.

The jockey valve is of the taper plug type, not shown in the drawings. This has the two oil ways and steam passage around the diameter of the plug. The oil inlet from the sight glass is on the left. The $\frac{1}{16}$ in. steam pipe which can be seen just below the whistle valve on the turret goes to the underside of the jockey valve while the oil delivery on the right goes to the hollow stay.

Although this type is more compact than the disc valve type, with three ports around the outside diameter of a taper plug, it is not easy to make it oil tight. It will be replaced with a disc type when trials are over and the engine is stripped down for painting.

The other picture is of the cab floor with two sections of floor board removed. The floor, by the way, is from $\frac{1}{8}$ in. paxolin, lined and grained to represent wood. Paxolin does not warp or burn and is very suitable. Under the floor and on the right is the oil container with filler and squared end of drain valve. On the left is the vacuum chamber which is a part of the brake system. Separate drawings are given for the components.

The oil container is of brass or copper and must withstand boiler pressure. Make this as large as is convenient. On my 5 in. gauge engine, this is made from a 4 in. length of 2 in. dia. $\times$ 20 s.w.g. copper tube with $\frac{1}{8}$ in. end plates. These and the fittings are silver soldered. Steam connection from a valve on the boiler turret is taken to the bottom of the oil container. It may be more convenient to take this pipe into the top, in which case an internal pipe should be fitted.

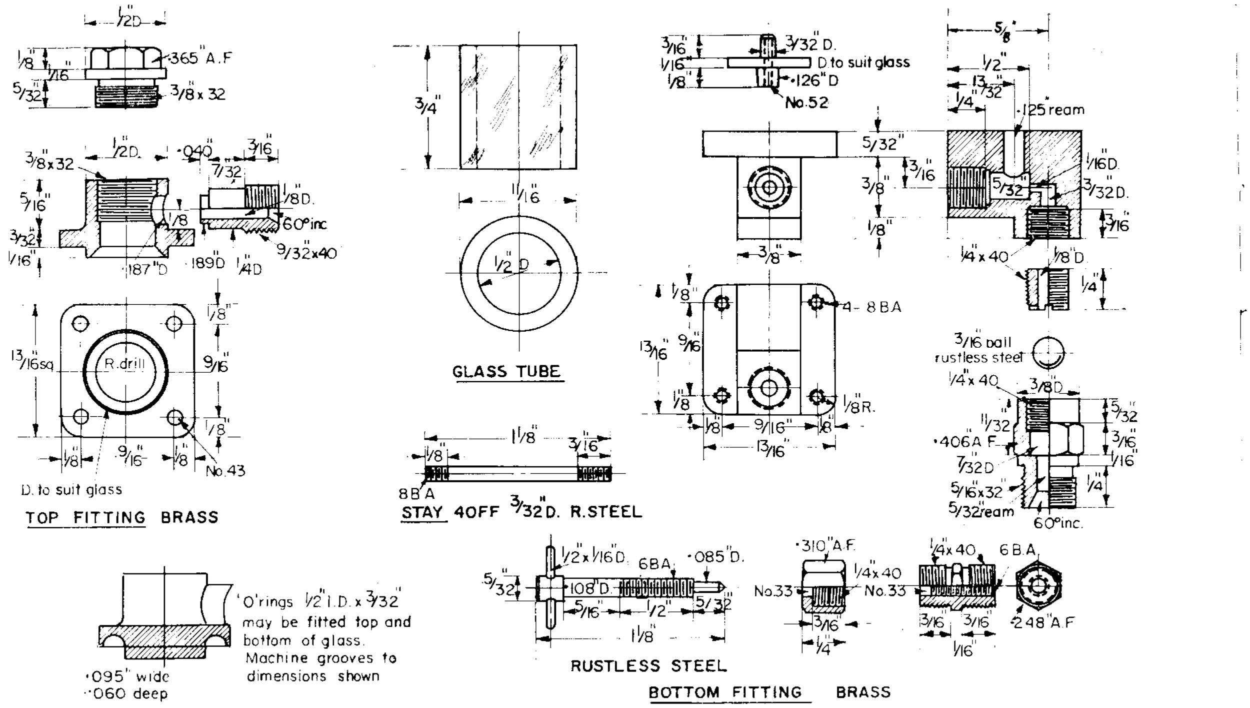
This pipe on G.W. locomotives was duplicated and incorporated two condenser coils under the cab roof. Either condenser could be used, the selection was made with a Y valve on turret and a three-way cock on lubricator. There was always plenty of vibration in a locomotive cab and having two condensers could save a lubricator failure from a broken pipe.

On our small engines, the lubricator works well without a condenser but the steam pipe should be of reasonable length—not too short.

To continue with the oil container: the oil outlet connection is taken from the top. Other fittings are the filler, which should have a lead or aluminium washer under the screw cap and the drain valve.

A clock key is a useful tool for operating the filler cap and drain valve but be ready for the inevitable question—how far does it go on one winding !

The drain pipe can be taken away from any of the three sides of the $\frac{5}{16}$ in. sq. brass block, soft soldered in and bent to clear brake rigging. If yours is a 5 in. gauge engine it is wise to set this pipe to clear the $3\frac{1}{2}$ in. gauge rails on the club track. On my engine one of the floor boards lifts out to uncover filler and drain valve.



SIGHT FEED FITTING

In the event of a sudden drop in boiler pressure there is a possibility that some oil may pass up the steam pipe into the boiler turret. This can be avoided by taking the steam pipe to the bottom of the container and always having a little water in it.

With the 4 in. × 2 in. dia. oil container arranged vertically on my engine, it is filled to $\frac{1}{4}$ in. from the top with oil, then topped up with water. The engine will then run for a full day without a refill. The overall dimensions of the oil container are not given as this item must be made to suit the engine. If made from tube it can be fitted vertically or horizontally, under the cab floor, in the cab or on the running plate alongside the firebox.

Oil passes from the oil container to the sight feed fitting which can be located on the backhead, or (the best position) on the cab side alongside the backhead.

The bottom fitting contains a non-return valve and an oil control valve. The non-return valve was not originally used, but I found that if the oil container was drained while the oil control valve was still open, water in the sight glass would disappear, which was rather a nuisance. The diameter of the oil nipple at the bottom of the glass is not critical as the size of the oil drops is determined by the amount of salt in the water. The gland on the oil control valve is packed with graphited yarn.

Glass tube is not always easily obtainable, but I hope that one of our advertisers will be able to supply it. To encourage our advertisers, this sight feed fitting can also be used with a mechanical lubricator but the oil control valve should not be fitted. The glass tube should not be less than $\frac{1}{2}$ in. bore × $\frac{11}{16}$ in. dia. In the past I experimented with full-size gauge glass; this was well under $\frac{1}{2}$ in. bore and very difficult to cut.

Some pieces of glass tube were obtained cut roughly to length. Ends were squared by gripping tightly in the three-jaw chuck with some thick paper around the tube. A rough carborundum slip was supported by the tailstock drill pad. It was kept wet and fed up to the glass with the tailstock screw. I use a piece of $\frac{1}{8}$ in. thick carborundum cutting wheel.

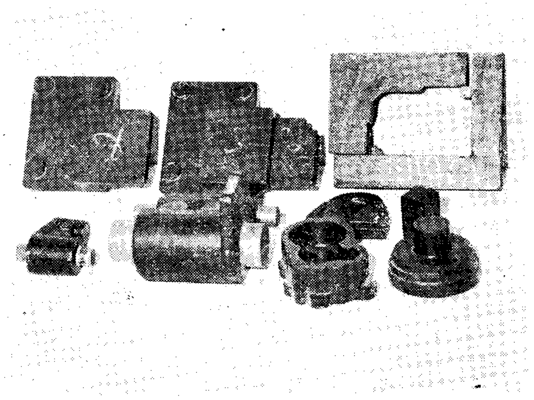
The top fitting has a filler cap which should have a lead or aluminium washer on its face. The oil outlet is silver soldered. A $\frac{1}{4}$ in. dia. counterbore is used for seating the outlet into the top fitting before silver soldering. Details of the counterbore are given later.

The $\frac{1}{16}$ in. registers which project into the top and bottom of the glass are not dimensioned on the drawing but they should be at least .010 in. smaller than the bore of the glass. As in gauge glasses it is fatal for metal to touch the sides or bores of the tube.

To be continued

A MILLING ATTACHMENT
FOR THE LATHE

By J. A. Radford



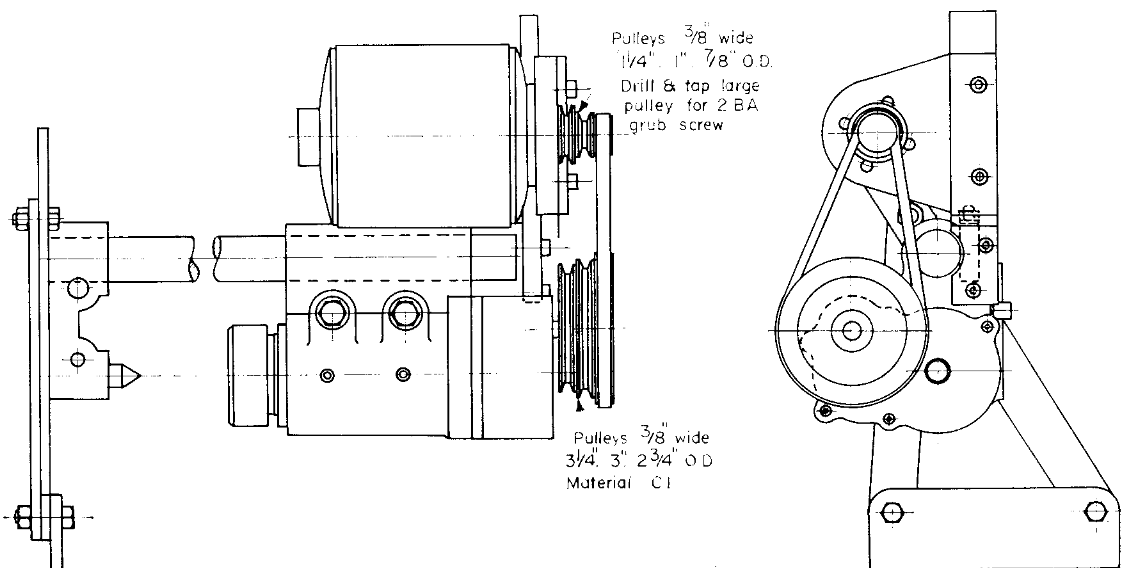
A view of the patterns.

I BOUGHT the Myford milling fixture with the universal vertical-slide for my Super 7 and set it up according to recommendations. But when the vertical-slide was swung completely down and parallel to the indexing head and at an angle to the cross slide, it soon became apparent that this was not very satisfactory. In setting up with the slide in a vertical position, there was insufficient room to mill a gear of any size and also the amount of cross-slide traverse left in front of the milling head was very small.

It seemed to me to be necessary to bring the base of the vertical-slide much higher and right back towards the operator to the end of the cross-slide and also to bring the base beyond the right-hand side of the cross-slide to reduce the overhang. As there is only one tee slot in the end of the Super 7 cross-slide and then the large hole to take the top-slide, the means for securing the vertical-slide to the cross-slide seemed to me to be inadequate.

Accordingly I designed and made two bases to fit the cross-slide and also both the universal and the fixed vertical-slides, bringing the bases of the vertical-slides to the best positions, and providing very sound and strong means of support. At the same time I discarded the screwed mandrel provided in the milling attachment and made a collet type which protruded only half an inch from the end of the bearing, and I made several collets and mandrels to fit. Also I tapped the end of the bar support for a $\frac{5}{16}$ in. Whit. screw and made the bar support bracket shown in my drawing and in one of the photographs.

This arrangement, especially when using the fixed vertical-slide, enabled much useful gear cutting and some keyways in small shafts to be done. However, although I could now mill the full length of the cross-slide travel, which was 6 in., and accurately determine the proper depth of the cutter in a vertical direction, I was still very limited in the lengths which it was possible to mill



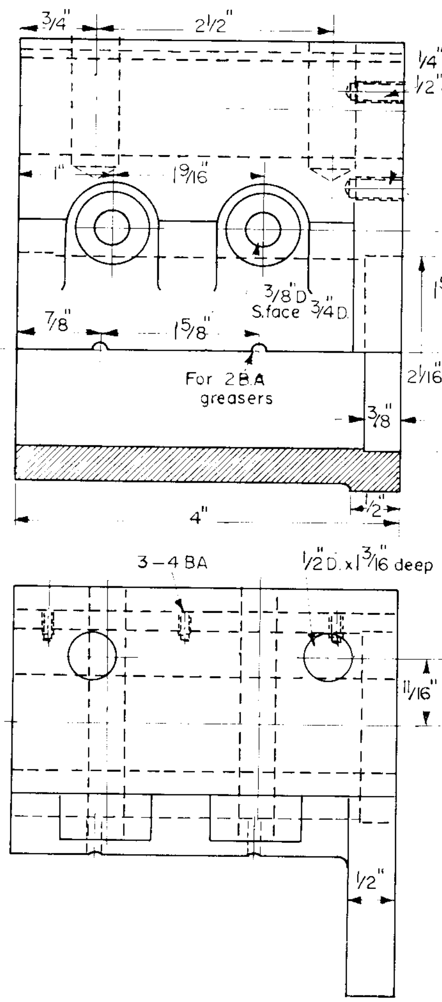
G.A. MOTORISED MILLING ATTACHMENT FOR THE LATHE and also as the cutter was underneath the work, it was impossible to see what was going on; a mistake in indexing did not become apparent until the work had progressed some distance around the blank.

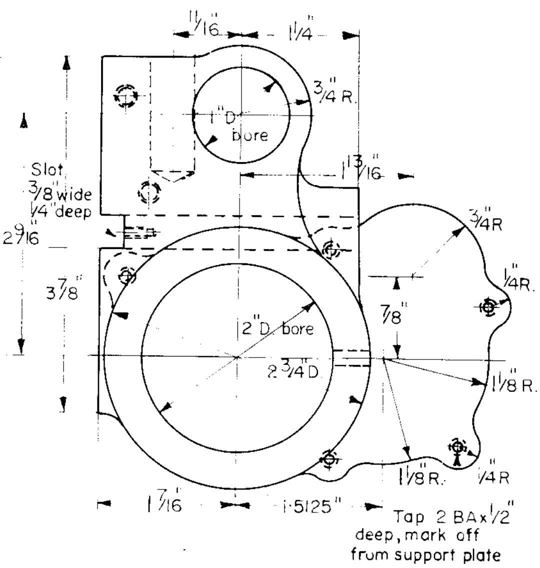
The ideal milling attachment, it seemed to me, was one that had a cutter which moved with the saddle and cross-slide, so that a blank could be turned, milled in place, finished and parted off, saving all the trouble of making mandrels, etc., and where a long shaft could be turned, all keyways milled in place, whether of the slotted type or end-milled feather type, before being shifted in the lathe. Such keyways would be true and parallel in both planes. Also such things as dog clutches should be simple to mill, the making of my own milling cutters should be possible and also it seemed to me that if a long casting could be set up parallel to the rear edge of the bed and in a vertical position, it should be possible to mill such things as machine slides to the full length of the saddle travel and perhaps with automatic feed.

I considered many different types of drive for a long time. Overhead shafts, overhead motors on swinging brackets, flexible shaft drive, even air drive, but none seemed to be very satisfactory. A motor drive seemed to be the only solution but how could a small enough motor that could be accommodated on the lathe provide sufficient power to do a useful amount of work?

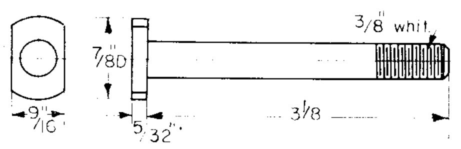
Investigating my $\frac{5}{16}$ in. Desoutter 800 rev. electric drill with a 9-1 speed reducer, I thought I had a sufficient amount of torque to do a great deal of milling. This was too awkward to set up as a drive, but I investigated several series-wound motors. I found one with a current consumption of 1 amp. (the drill takes .75 amp.) so with $33\frac{1}{3}$ per cent more power and at a cutter speed of around 100 r.p.m. I felt that I had sufficient torque, provided that the speed reduction from 4,500 to 100 r.p.m. could be done efficiently. Worm gear seemed the obvious solution but I ruled it out because of friction losses.

Spur gearing running in ball races (as in the

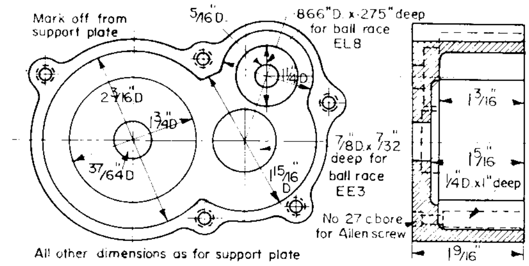




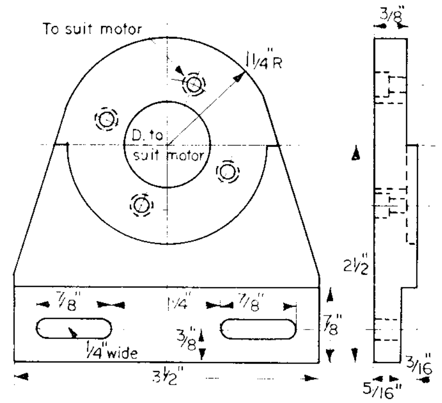
BODY C I



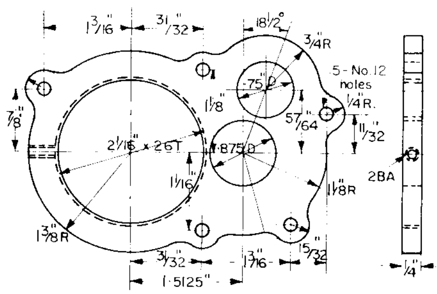
TEE BOLT MS 2 OFF



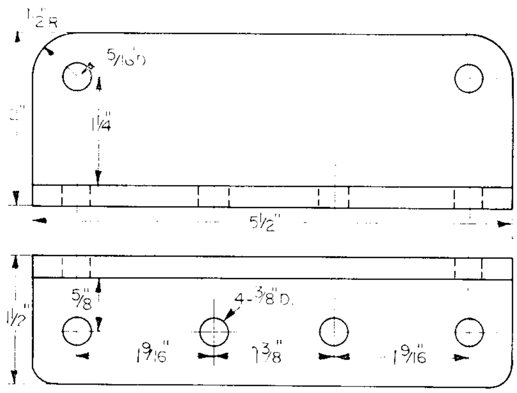
GEAR BOX L.ALLOY CASTING



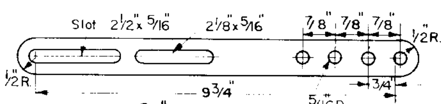
MOTOR SUPPORT BRACKET C1



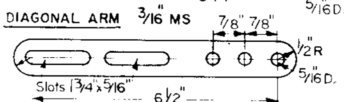
GEAR BOX BEARING SUPPORT PLATE BMS



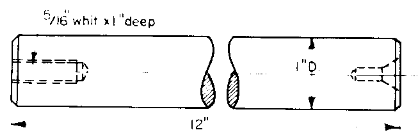
BASE ANGLE 1/4" MS ANGLE



DIAGONAL ARM 3/16" MS



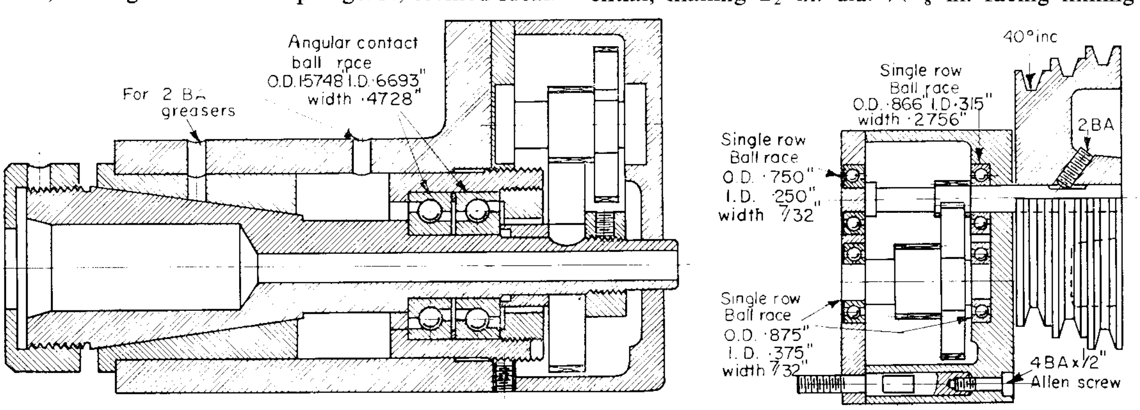
VERTICAL ARM 3/16" MS



SUPPORT BAR GROUND M S BAR

electric drill) with an initial reduction of approx. 3-1 through three step cone pulleys and a $\frac{1}{4}$ in. vee belt, leaving 15-1 for the spur gears, seemed ideal.

I had sufficient confidence to go ahead and make patterns and complete the whole attachment, using the existing baseplate and vertical-slide and bar support bracket and I have been fully justified. I had not the slightest trouble milling the 16 D.P. drive gears for the Allchin traction engine, making the bevel gears for the differential, making $2\frac{1}{2}$ in. dia. $\times$ $\frac{5}{8}$ in. facing milling



GEAR BOX ASSEMBLY

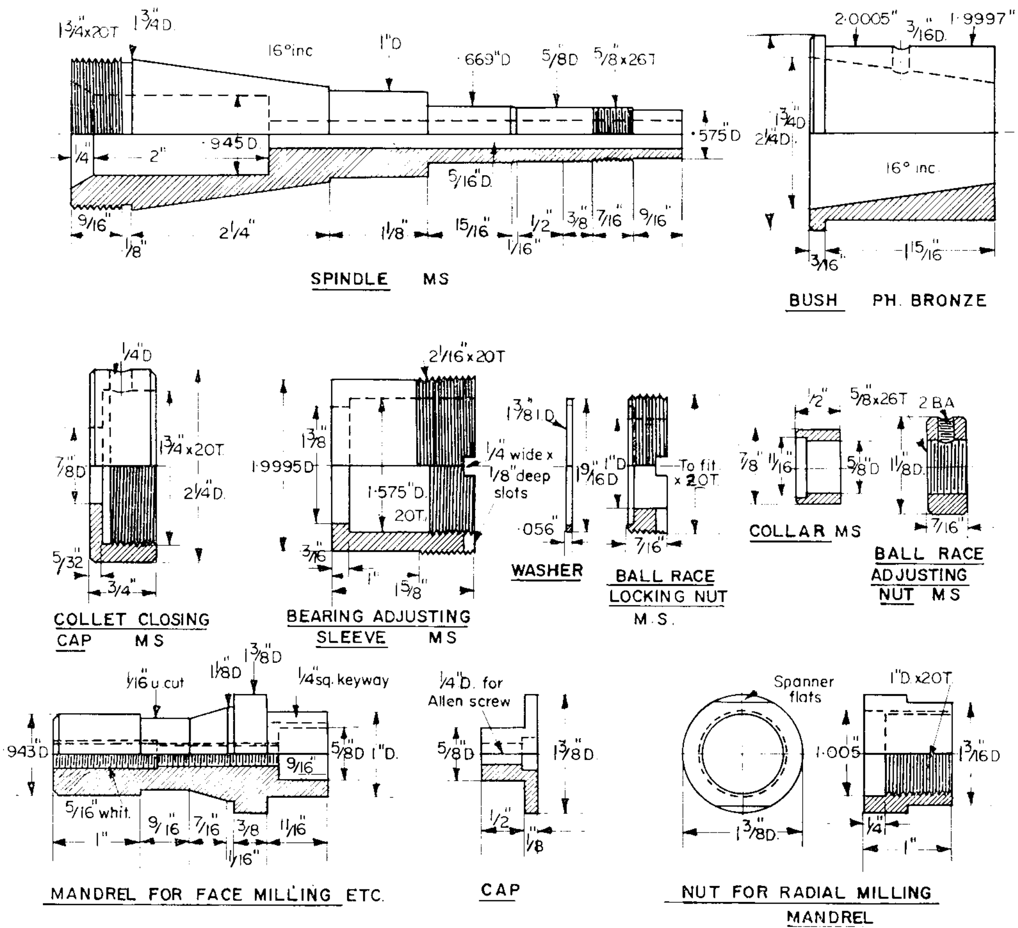
cutters in H.S. steel and many other cutters, and the final justification was milling the slides complete for a " Bormilathe " type of attachment illustrated in one of the photographs. (I have since made a quartering table $6\frac{1}{4}$ in. square to fit the cross-slide) so I now have a useful horizontal borer all made possible by this milling attachment.

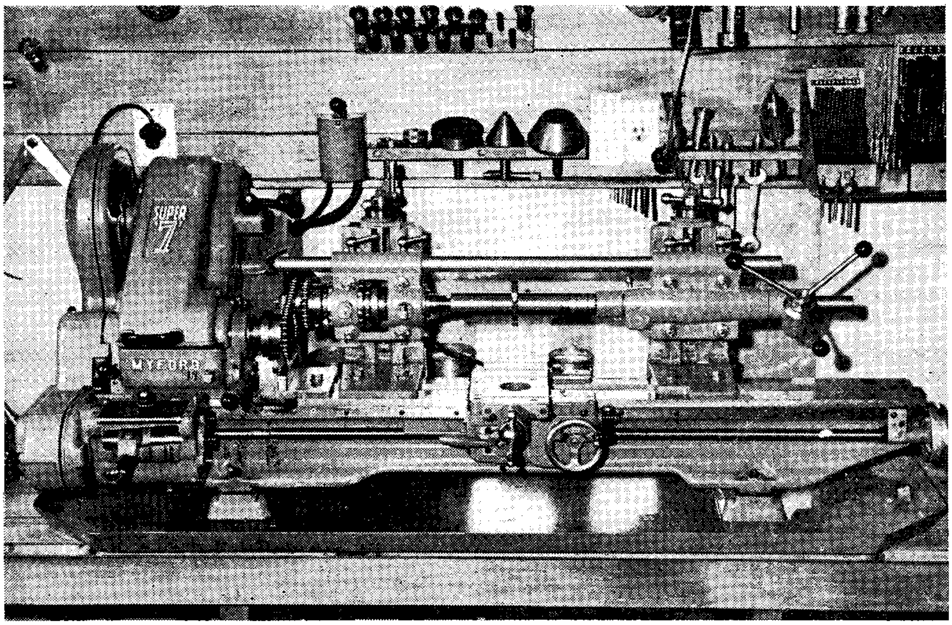
I will now describe the construction of the various parts, knowing that those readers who have the ability and desire to construct this milling attachment will find that it broadens the scope of their work enormously.

The patterns illustrated in one of the photographs show the two baseplates with the core box for the fixed vertical-slide base, the back centre support arm, the main body casting, the gearbox pattern with the motor support bracket behind, and the pulley pattern behind which is the distance block. The core box shown (the only one required) is made of two pieces of wood $\frac{7}{8}$ in. thick. The shape is the shape of the core print on the pattern, plus the desired internal shape. The moulder merely lays the two pieces clamped together on a flat piece of iron, fills with sand, wipes off the top with a straight edge and puts the sand, after opening and removing the core box, in the oven to bake.

Allow $\frac{1}{16}$ in. on all surfaces for machining ($\frac{1}{8}$ in. radius on round cored holes) and finish the patterns with several coats of a thin mixture of french polish (bought in tins) and lamp black sanded between each coat, with a final coat of french polish only and the core prints with a thin mixture of red lead and french polish. The gearbox is made up on the bread and butter principle, the end cover going on after the internal faces are finished—taper the inside well. You will notice that several lugs are made on the end cover before being glued and dowelled in place. These are for holding in various positions for machining as will be described later. The fillets are made by running bees' wax into the corners with a small electric soldering iron, after which the fillets are scraped to shape with a scraper made from a piece of broken hacksaw blade. Sand smoothly all patterns with very fine glass paper before varnishing.

The baseplates are faced in the lathe on the





The "Bormilathe" type of elevating heads completed.

9 in. faceplate. I marked out and drilled the tee bolt holes before turning, as the holes are useful for holding down. The top was turned first, it will clear the bed all right, and was then drilled and tapped $\frac{3}{8}$ in. Whit. in the correct places and this face set against the faceplate for turning the base, this also will clear the bed. A counterweight which also acts as a driving lug was used. A third hole you will notice was tapped for a third screw for the fixed steady and two dowel holes in each base. The final adjustment, to bring the vertical slide dead parallel to the faceplate after the surfaces had been hand scraped to surface plate, was accomplished by some filing and fitting of the $\frac{5}{16}$ in. grooves into which are set the short pieces of $\frac{5}{16}$ in. key steel. These bear against the right-hand edge of the cross-slide and ensure that the vertical-slide is always at right angles to the bed. The undersides of the bases are recessed to make for less machining and scraping and the tee bolt holes are rather deeply spot faced. The universal slide base has a $\frac{7}{16}$ in. drilled hole and the bolt with 1 in. dia. head is held in place and from turning with a 2 BA grub screw drilled and tapped in place after the $\frac{7}{16}$ in. bolt has been pulled up tightly by means of a collar and nut. No core is required for this base but the webs should be tapered downwards as shown.

When drilling the hole in the fixed vertical-slide for the third holding down bolt, make it $\frac{7}{16}$ in. instead of $\frac{3}{8}$ in. (but not in the base) as this slide can then be used on the top-slide of the lathe for such things as bevel gears, facing cutters, etc., as it has considerably less overhang than the universal type.

Now the main body casting can be machined. The base and keyway should be machined in one setting. I carefully marked out for the two holding down bolts, working from the outer diameters of the main cored hole, not from the actual cored hole, and instead of drilling these holes $\frac{3}{8}$ in., I drilled $\frac{5}{16}$ in. and tapped $\frac{3}{8}$ in. and bolted through with the distance pieces on my 6 in. hand shaper with additional clamps in the edges of the main cored hole. The face was planed and the $\frac{3}{8}$ in. keyway cut through the centre of these two holes to a depth of $\frac{1}{4}$ in. The holes were then drilled $\frac{3}{8}$ in. and spot faced.

The boring was done in the lathe by bolting on the cross-slide. Two pieces of $\frac{5}{8}$ in. key steel were required for packing to centre height and two pieces of $\frac{3}{4}$ in. $\times$ $\frac{3}{8}$ in. bright steel were tightly fitted into the keyway at each end and into one of the cross-slide tee slots to align the casting for boring true to the keyway. Two long tee bolts were made and an additional clamp or two was used. The casting was set up so that both holes could be bored at one setting at $2\frac{9}{16}$ in. centres using the cross-slide index. The large hole was bored 2 in. using a boring bar with a 2 in. long end turned to 1 in. dia.; the centre part was $1\frac{1}{2}$ in. dia. with the $\frac{1}{4}$ in. dia. H.S. tool in the centre of the length of $9\frac{1}{2}$ in. and the end was about 1 in. long, turned to a large radius down to .590 in. to fit a ball race held in a split steel collar clamped on the end of the tailstock barrel.

I prefer this method for all boring bars and milling arbors in preference to using a centre. The fitting is similar to that shown as the "alternate arbor support," but has a split hole to fit the tailstock barrel clamped with an Allen screw instead of the straight shank shown. *To be continued*

FOR THE SCHOOLS

CROSS DRILLING

by Duplex

Part II

Continued from page 959

COMMERCIAL cross-drilling jigs are necessarily of rather elaborate construction since they have to accommodate a wide range of work, often on a production basis where parts in large numbers are dealt with. Moreover, the construction must ensure that accuracy is maintained in addition to quick and easy loading of the jig.

The Bridson precision jig shown in Fig. 10 will serve to illustrate the essential features of construction in an appliance of this kind, but its relatively high cost would militate against its inclusion in the equipment of the small workshop. A short description of the device will, however, indicate what is required when making a jig of this kind for the workshop. The large V-block (1), which is reversible on the extension bar (2) to accommodate either large or small diameter work, carries the angle bracket (3).

The latter part is mounted in a slide, actuated by a feedscrew, so that the work can be securely clamped in the V-block and, at the same time, aligned horizontally.

This bracket also carries the guide collet (4). Hardened guides are supplied in sets to cover the ordinary range of drills, up to ½ in. in diameter, used in the jig. A graduated stop-bar (5) for end-locating the work, and ensuring uniformity of machining, is fitted to the V-block in which it is locked, after adjustment, with a clamp screw. The slotted bar (2) also carries a second V-block which is capable of adjustment when drilling spindles of various lengths.

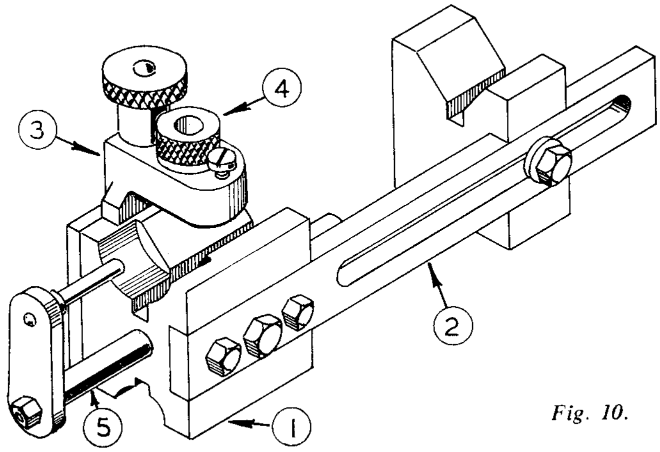


Fig. 10.

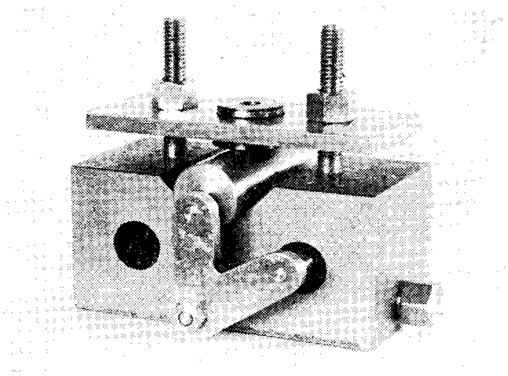


Fig. 11.

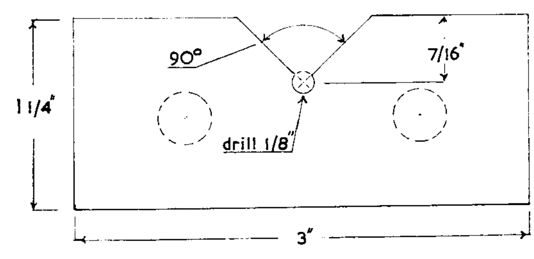
The second V-block also increases the stability of the jig when resting on the drilling machine table. No dimensions of this jig are included, since its capacity, ranging from ½ in. to 2½ in. dia. work, is unnecessarily large to be of use for the usual run of drilling operations encountered in the small machine shop. Nevertheless, the essential features of this jig are embodied in the following cross-drilling jigs made in the workshop; namely: a V-block to locate the work; a clamping device to secure it; an accurately centred drilling guide; and an adjustable work stop for end-location and to ensure uniformity in repetition work.

The V-block

This is the first part needed for the construction of the jig, and it can be either a commercial V-block or one specially made for the purpose. In any case, the fittings that are described later to complete the jig are identical and suitable for fitting to either type of V-block.

The cross-drilling jig shown in Fig. 11 has given reliable service for many years past and has only recently been supplemented by an improved type of jig which will be described later in this article. The original jig was built from the tailstock accessory designed for cross-drilling in the lathe and described in the previous article. There is, however, no great difficulty in making a V-block suitable for the purpose, such as that illustrated in Fig. 12. It is not necessary to use cast iron for

Below: Fig. 12.



THE MACHINED V-BLOCK

making this part, and $1\frac{1}{4}$ in. square mild steel bar will serve equally well when cut off to a length of 3 in.

When the material has been trued on all surfaces by filing, milling or shaping, the recess is marked out with a protractor to an included angle of 90 deg. and to a depth of $\frac{7}{16}$ in. An $\frac{1}{8}$ in. dia. hole is drilled right through the block at the marked apex of the V, and the surplus metal is removed with the hacksaw. As finishing the V by filing is a rather tedious job to carry out accurately, recourse may be had to a machining operation. As shown in Fig. 13, the block is secured at an angle of 45 deg. to an angle plate which, in turn, is bolted to the lathe boring table and set parallel with the lathe axis by means of a try-square held against the lathe faceplate. The work can be fixed to the angle plate with a strap or bridge piece held by two bolts or, better still, a $\frac{5}{16}$ in. dia. hole is drilled at either end to take service bolts, as represented in the drawing.

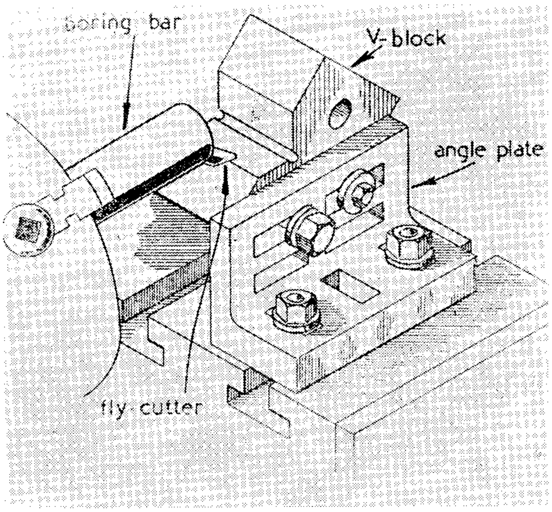
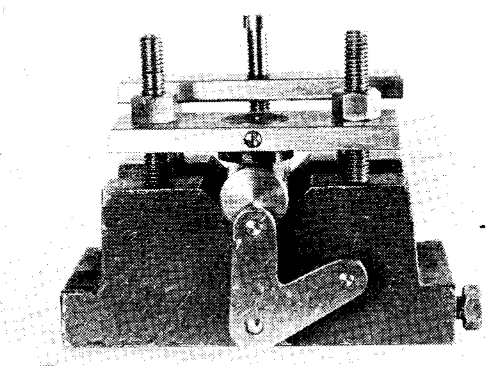


Fig. 13.

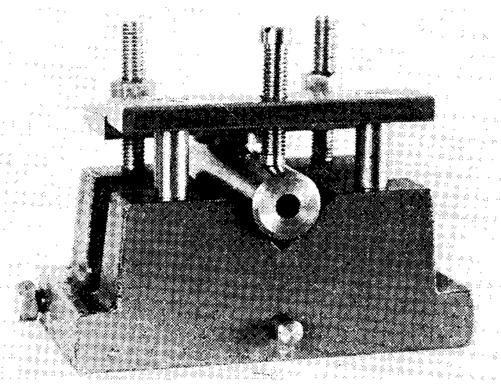
Locating the work on the angle plate can be readily carried out by bringing its base surface into contact with a 45 deg. set square resting on the lathe cross-slide. The faces of the V are machined in succession by fly-cutting with a short boring bar carrying an inset cutter-bit.

A series of light cuts is taken over the vertical face of the V, and the lathe saddle is advanced until the scribed dimension line is reached. The part is then reversed and reset to bring the second face of the V into position for finishing the slot to size. The lathe saddle should be locked after each fresh cut has been put on.

As an alternative, the V can be formed in the milling machine, or in the shaping machine by setting its toolslide to an angle of 45 deg. on either side of the vertical zero graduation. This finishes for the present the work on the V-block. The drilling operations for mounting the additional fittings will be described later, since these are located in accordance with the improved type of jig, and the fittings themselves are also of similar dimensions.



Above: Fig. 14. Below: Fig. 15.



Any difficulty or reluctance as to machining a V-block can be overcome by adapting a commercial product of suitable design. The improved type of drilling jig shown in the accompanying illustrations, Figs. 14 and 15, can be made in this way from the smaller of the two Myford standard V-blocks. This accessory is accurately machined on the base and upper surfaces, as well as on those forming the V-groove. The base, measuring 3 in. × $1\frac{1}{2}$ in., affords increased stability, and the double-V construction enables an additional clamping plate to be fitted for securing the work during drilling. The capacity of the finished jig extends to mounting spindles and round rod of from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. dia. Setting up such parts for drilling can be quickly and accurately carried out, with uniformity maintained by means of the work stop.

If required, the capacity of the jig can be increased by using the larger Myford V-block, which has a base measuring 4 in. × 2 in. At the same time, the scale of the additional fittings is also stepped up to suit.

The guide plate is cut to length from $\frac{3}{4}$ in. ×

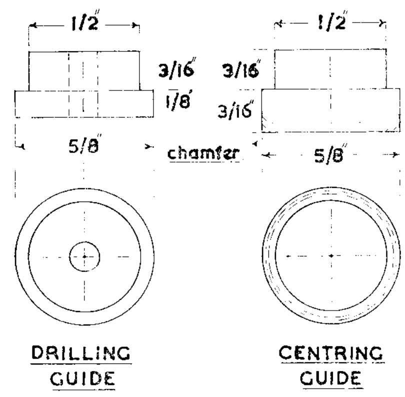
$\frac{3}{16}$ in. mild steel strip, which is afterwards filed and scraped flat with reference to the surface plate. Its appearance will be improved if it is given a frosted finish with a flat scraper in the way described in previous articles.

After it has been painted with marking fluid, the plate is marked out in accordance with the drawing, and the drilling centres are marked with a centre punch at the intersections of the cross lines. The marked centres are then enlarged with a centre drill to afford guidance for the drills that follow.

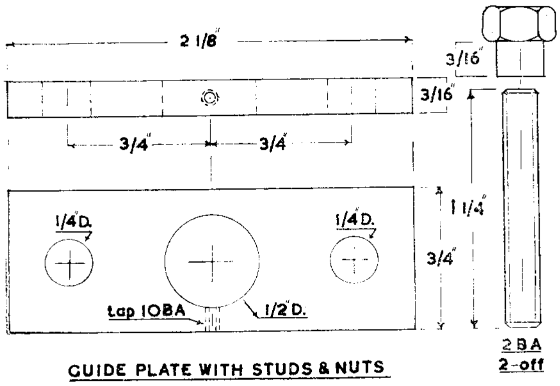
To avoid the risk of damaging the fingers during the drilling operations, the work should be securely gripped in the machine vice. After all the holes have been drilled with a pilot drill, those of $\frac{1}{4}$ in. nominal diameter are enlarged with a letter D drill, which is 4 thou. under the finished size. The $\frac{1}{2}$ in. dia. hole is finally enlarged with a $12\frac{1}{2}$ mm. drill to the reaming size. All these holes can be accurately machined to the finished size with the corresponding reamers. For this purpose, the reamer is mounted in the drilling machine and the work is steadied by hand so that it can align itself correctly with the reamer. With the drilling machine running at a slow speed, the reamer, lubricated with cutting oil, is carefully fed into the work so as to avoid grabbing, or hogging as the Americans term it. This method of reaming is adopted since it is difficult to feed a reamer accurately by hand into thin material and maintain accurate alignment without bell-mouthing the hole.

Moreover, it is essential to finish these holes accurately, because they furnish guide surfaces for locating the mating components that centre the drill when cross-drilling the work.

Reaming operations of this kind have been accurately carried out in the tapping machine with power drive made in the workshop. Here, the work is held in a machine vice that is mounted on a so-called jelly plate which allows the vice to move freely in a horizontal plane on the machine table, so that no side-thrust is imposed on the reamer and the work is maintained in correct alignment. The machine runs at a very low speed and a sensitive feed is provided for the reamer.



Right: Fig. 17.



Bottom left: Fig. 16.

Any burrs set up by the drilling and reaming operations should be removed with the scraper. A reliable method of machining the $\frac{1}{2}$ in. dia. hole to exact size is to mount the plate in the four-jaw chuck, and centre it with the wobbler which is engaged in the centre-drilled hole and supported by the tailstock.

After the hole has been drilled under-size, it is finished with a small boring tool. As the work proceeds, the diameter of the bore can be checked by inserting a standard taper mandrel, which is measured with the micrometer at the point of maximum entry. To finish the plate, it is drilled and tapped 10 BA to take a brass set screw that retains the $\frac{1}{2}$ in. dia. skirt of the guide bush in place Finally, mark the underside of the plate and the upper surface of the V-block to indicate the correct position of assembly when drilling the block for the two 2 BA locating studs.

Where a set of threading guides, such as those supplied with the Card dieholders, is available, they can be used in the cross-drilling jig. To make the guides, the machining is carried out in the lathe by first deeply centre-drilling the bore centre and finishing it with a drill of the appropriate size held in the tailstock drill chuck. The skirt is then turned to a close push fit in the guide plate, before the flange is reduced to size with a surfacing cut and the guide is parted off to length. Finally, the part is reversed in the chuck, then faced and chamfered.

The centring guide shown on the right of Fig. 17 is machined with its flange over-length. Adjustment is then made by chamfering the end face until the guide, when in place in the guide plate, makes contact with both faces of the V-slot at the same time as the guide plate itself bears on the upper surface of the V-block. The guide plate, with the centring guide in place, is secured on the V-block with a pair of toolmaker's clamps for drilling the holes into which the two 2 BA locating studs are screwed.

GREEN GODDESS

Frank Holland, in South Africa, describes his 5 in. gauge 2-8-4 tank locomotive

WAY BACK in 1956, while I was a member of the Rand Society of Model Engineers, and driving the club locomotive *Sir Alfred* at the Rand Easter Shows to earn money for club funds, it became obvious that the locomotive was taking a hammering, and that we really needed a larger and more powerful engine to assist with the work. At weekends and sometimes during the week, we had other members' locomotives to assist, but the bulk of the work was being done by the club engine, which, incidentally, was a 5 in. gauge 0-6-0 *Pioneer* tank.

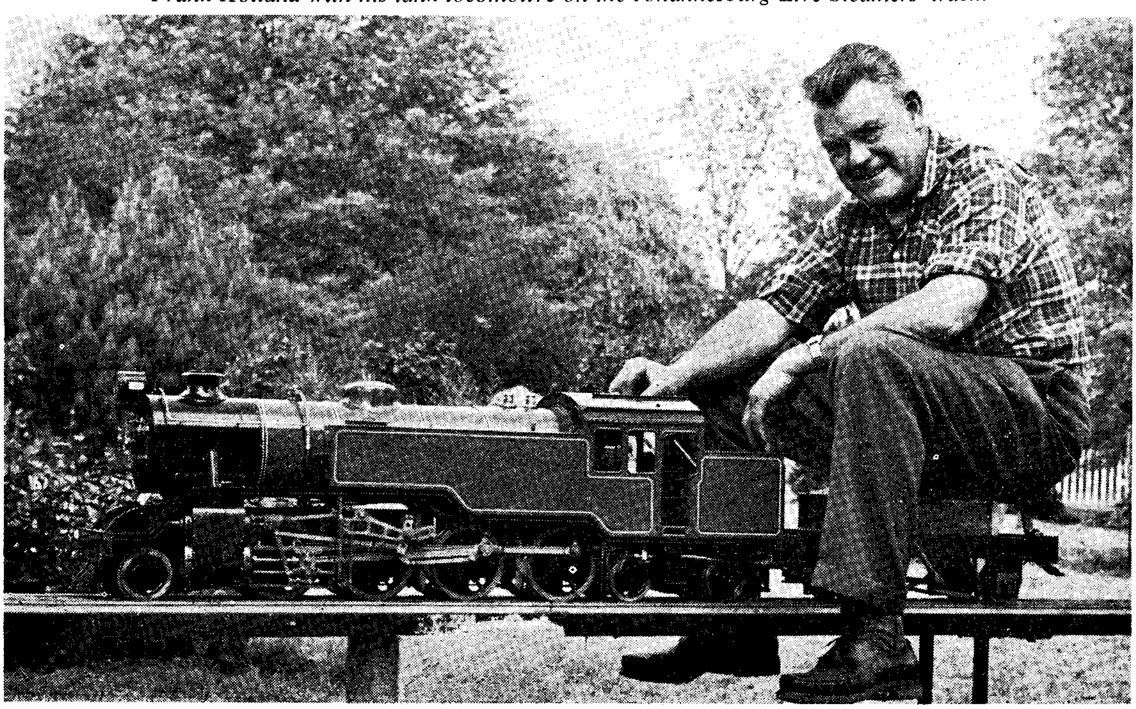
I decided that the most suitable locomotive for the job would be a 5 in. gauge version of *Netta*, but did not care for the English outline, so redrew it with typical South African Railways boiler mountings and cab. Still not satisfied, it was redrawn about eight more times, and eventually emerged as a 2-8-4 tank locomotive of an entirely new design, and the only remaining *Netta* dimensions were the coupled wheel spacings.

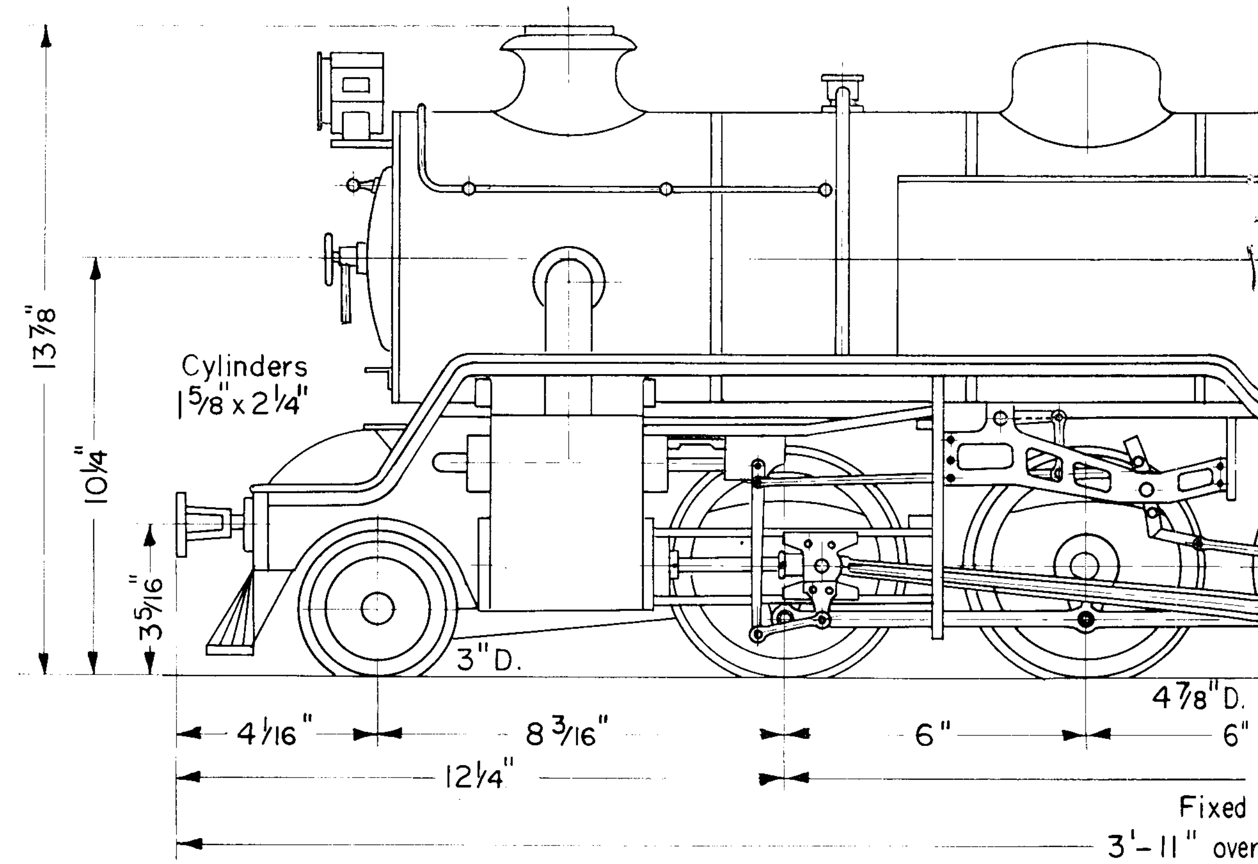
While redesigning, it was decided to incorporate all the things I liked on different engines with the result that it has turned out to be truly cosmopolitan. The smokebox, dome and front end are typical S.A.R. of about 40 years ago and the chimney has a Great Central Railway outline. The curved running boards are L.N.E.R., as is the cab, but with larger windows, and the coal bunker is L.M.S. The valve gear and motion is a mixture of S.A.R. and American practice, while the bissel truck wheels and bogie wheels are S.A.R. The livery is North Eastern Railway and the engine was named *Green Goddess* after the first Pacific type locomotive designed by Henry Greenly for the Romney, Hythe and Dymchurch Railway.

In designing the engine, full-size practice was followed as far as possible. It was originally decided to make complete detailed drawings in case anybody wanted to build a similar locomotive, but construction progressed faster than the drawing board work and the drawings eventually ended up as sketches on odd pieces of paper. It was not possible to work continuously on the engine, for various reasons, and as a result it has taken about ten years to complete.

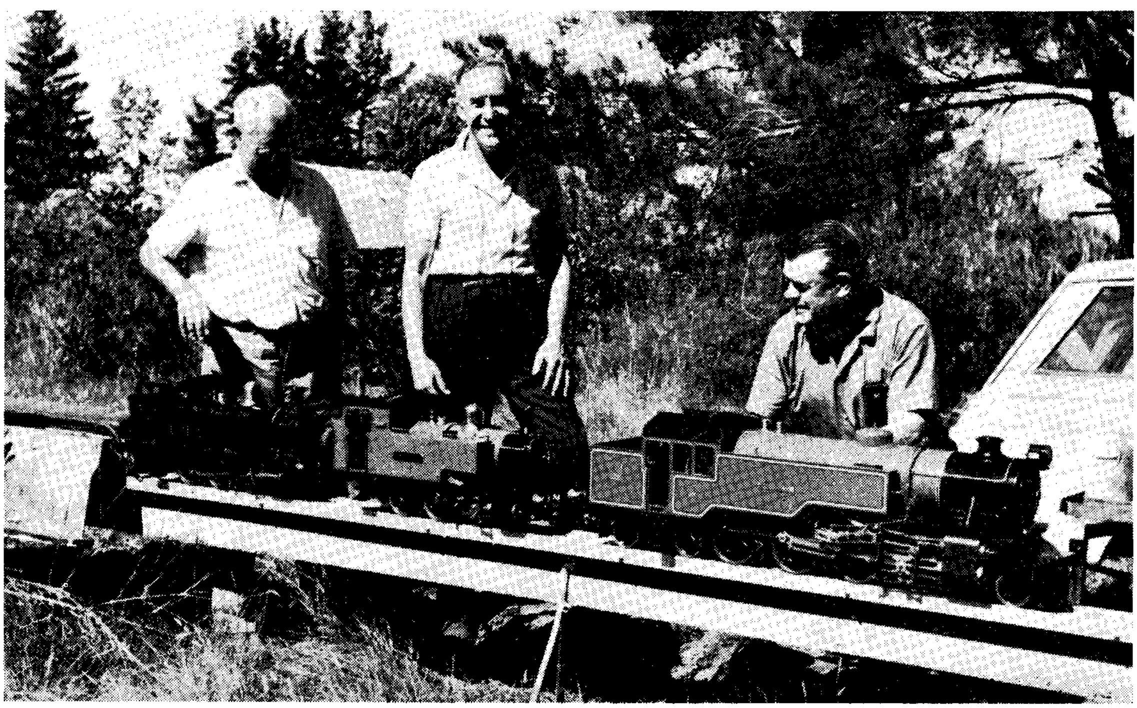
The main steam pipe from the regulator, which

Frank Holland with his tank locomotive on the Johannesburg Live Steamers' track.



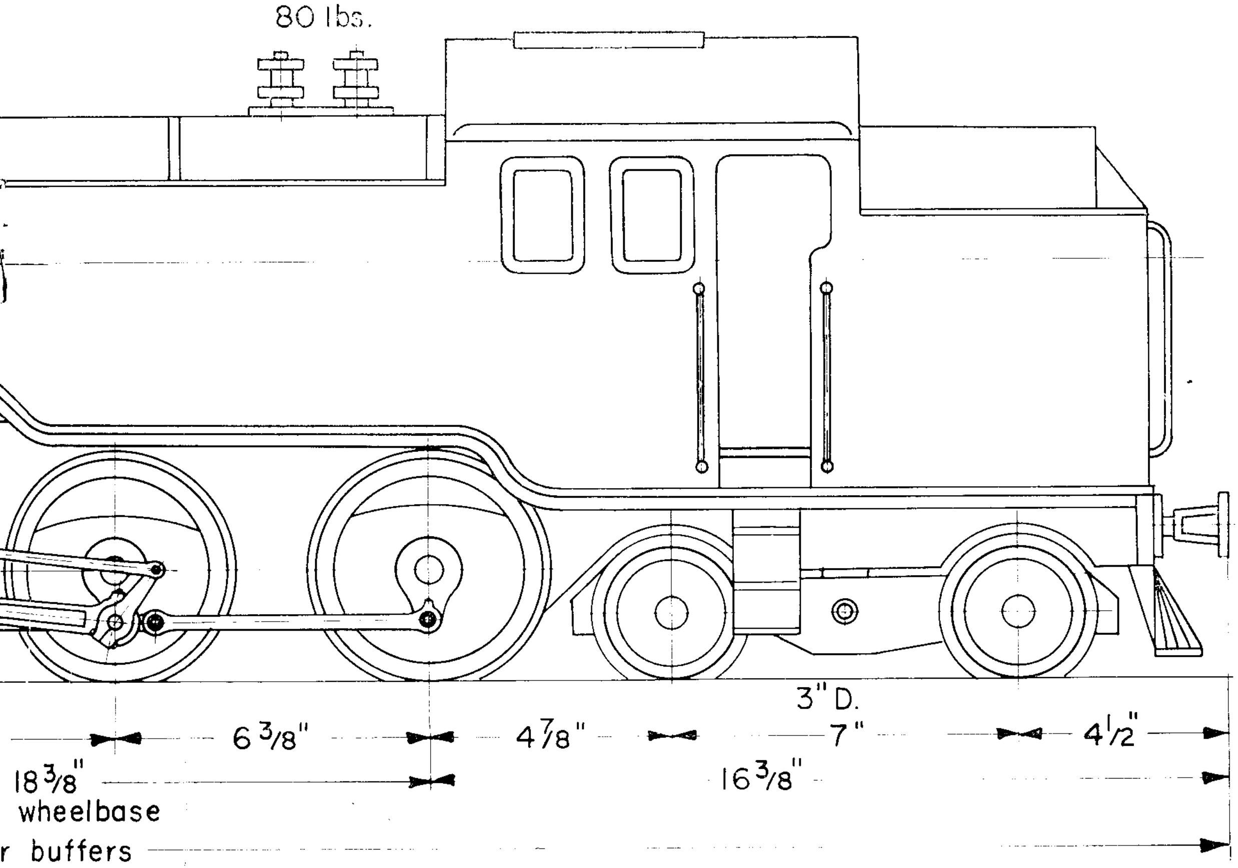


Above: G… arrangeme… 2-8-4T.



Left: Jac… (left) and … both with … 0-6-0 tank… author is … right.

Right: A … of the val…



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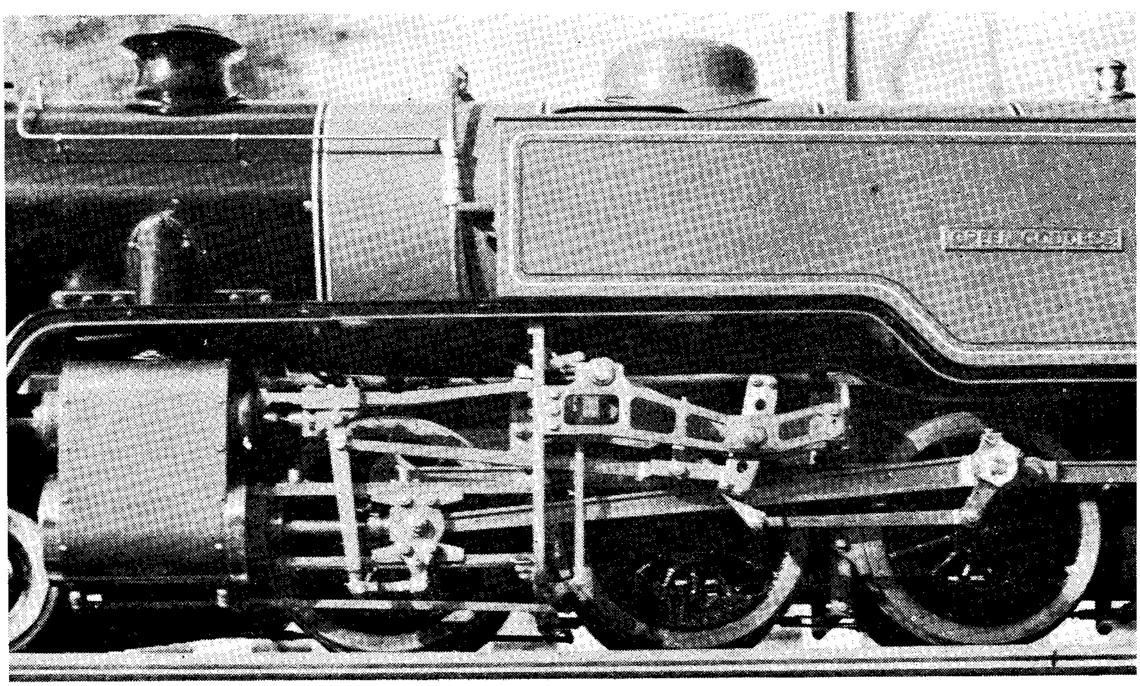

r. Dutton
Doc. Saks
"Butch"
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is of the Stroudley pattern, is $\frac{3}{8}$ in. bore and there are three $\frac{1}{4}$ in. dia. superheater elements in $\frac{7}{8}$ in. dia. flue tubes. From the header, two $\frac{3}{16}$ in dia. pipes feed the slide valve cylinders, which are $1\frac{5}{8}$ in. dia. by $2\frac{1}{4}$ in. stroke. Maybe friend Harris will have something to say about these proportions, but the engine goes like a bomb with more power than can ever be used.

The steam ports are $\frac{3}{16}$ in. × 1 in. and the exhaust ports $\frac{1}{2}$ in. × 1 in. The valve gear, which is designed on the "all square" principle, cuts off at 75 per cent, with a 1/64 in. lead. The valve setting in both fore and back gear was checked most carefully and the extra time taken over this has certainly paid off.

According to the pundits, $\frac{1}{2}$ in. tubes should have been used to suit the distance between tubeplates, but this was cut down to $\frac{7}{16}$ in. to get in more tubes and increase the heating surface. There is no combustion chamber, as I did not think it necessary ,apart from the extra work, and the way the boiler steams bears this out. All plates and the boiler barrel are $\frac{1}{8}$ in. copper, brazed up with Eutectic 1804. This is a fine brazing material. It does not require any flux so it is not necessary to have an acid bath, and the copper only needs to be cleaned with a wire brush before brazing.

The tubes are expanded and silver soldered into the tubeplates. The longitudinal stays are $\frac{1}{4}$ in. dia. copper rod, with the usual hollow stay for the blower. The firebox stays are 4 BA copper suitably spaced to give a factor of safety of seven, and they are riveted both inside and out. They were nutted inside the firebox, but it looked like a hedgehog turned inside out, so the nuts were removed and the stays riveted over. The firebox is caulked inside and out with Eutectic "Tinweld," which is a solder in paste form.

The entire inside of the firebox was coated with this "Tinweld" as it was found by Johnny Armstrong, one of our members and a well-known small locomotive builder in South Africa, that it inhibited the deposits of soot and carbon on the walls of the firebox ,and experience has found this to be correct. Perhaps one of your more knowledgeable readers can explain why.

On completion, the boiler was hydraulically tested to 250 lb. and there wasn't a leak anywhere, or any plate movement. The working pressure is 80 lb., but it was tested to such a high pressure more out of curiosity than anything else, to see if anything would happen.

The motion parts and valve gear are made of gauge plate or ground stock, really a tool steel, and they were finished by draw-filing and rubbing down with a fine emery stick using plenty of paraffin.

The frames are $\frac{1}{8}$ in. black mild steel plate suitably cross stayed, and the tanks, cab and bunker are $\frac{1}{16}$ in. plate. The smokebox saddle was fabricated out of similar material. The tanks are not made to hold water as they would not have a big enough capacity, and they can be removed, along with the cab and bunker, as a single unit by removing six 2BA nuts. This is a big advantage as it makes it easy to get at the cab and other fittings for cleaning or making any adjustments.

To supply water to the boiler, a driving truck is being built which will be a bogie well-wagon type, having seats on the raised platforms at either end and a large water tank as the "load." Provision has been made at the rear of the engine for coupling up the flexible water pipes.

The two injectors were made by Eric Rowbottom, who is an acknowledged expert on these little squirts, and they work well. I have found, however, that they can be temperamental, so it is intended to fit a crosshead pump to Eric's specifications. The pressure gauge is worthy of mention as it was donated to the engine by Harry Dixon, Secretary of the Pacific Region of the Brotherhood of Live Steam, U.S.A., and is a real gem. It reads to 200 lb. per sq. in.

The boiler mountings were made to the specifications of our esteemed editor, Martin Evans, with such modifications as were required to suit the engine, and the lubricator, which is a twin cylinder oscillating type, was donated by Bill Schutz of Cape Town. Bill is another well-known small locomotive builder whose $1\frac{1}{2}$ in. scale S.A.R. class 16 DA is an outstanding example.

The nameplates, as well as the other plates on the cab and bunker, were obtained for me by Dick Marshall Smith, President of the Bloemfontein, S.M.E., and are brass with the letters and border raised and polished on red background.

Steam and hand brakes are fitted, which work on the intermediate, driving and trailing coupled wheels. One day, I hope to fit a turbo-generator to supply current to the headlamp and lights in the cab, but that is a future project. The engine has not been built to any particular scale, but was designed around a set of driving wheels which were available. The aim was to obtain pleasing proportions (to me) without being confined to any particular loading gauge. The overall width over the footplates is 10 in.

As I resigned from the R.S.M.E. in 1960 to start the Johannesburg Live Steam Club, the engine will never fulfil the purpose for which she was designed and built, but I think she is a worthy addition to the J.L.S. roster. In service she has more than proved herself. The designing and building has given me many happy and interesting hours, and it was a thrill to open the throttle for the first time on the club track. We certainly have a great and rewarding hobby.

M.P.B.A. INTERNATIONAL REGATTA

Reported by Artificer

Above: Monsieur and Madame Suzor with Peter and Miss V. Lambert.

EVERY type and class of model power boat was well represented in the three-day regatta held at St. Albans during the Bank Holiday weekend, and the number of boats entered in various competitions reached an all-time record.

The first day was devoted to circular-course hydroplane events, in which the major award was the St. Albans Speed Trophy. As usual the C class (10 c.c.) boats were the most popular, but the most notable feature was the success of many of the D class (5 c.c.) boats, which proved capable of performances equalling or even surpassing those of boats with larger engines. These ultra-light craft, though requiring skilful handling, were favoured by the calm weather which prevailed throughout most of the regatta.

The only overseas competitor this year was Gems Suzor, of the Model Yacht Club de Paris, who was warmly welcomed after his absence for the last two or three years. His C class boat put up a good performance at just a mile a minute. Stan Clifford had rather better luck than last year with his A class boat, with a speed nearly approaching the 70s, but damage in later runs prevented a repeat performance. Clean and consistent runs were put up by several veteran competitors, but the highest speeds were achieved by comparative newcomers to hydroplane racing.

Results (1st day): St. Albans Speed Trophy

1, A. Wall (Coventry), C class, 72.52 m.p.h.
2, S. Clifford (St. Albans), A class, 68.63 m.p.h.
3, P. Lambert (St. Albans), C class, 66.83 m.p.h.

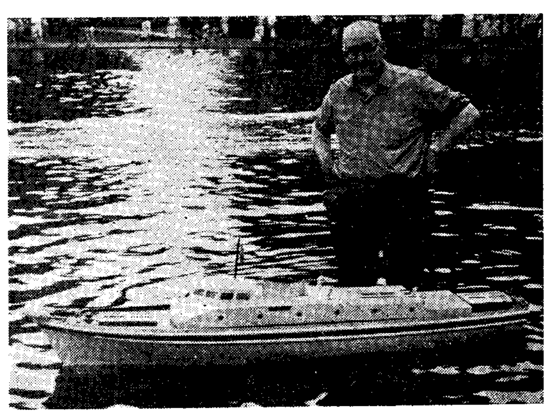
Apart from the above, the highest speeds in the various classes were:

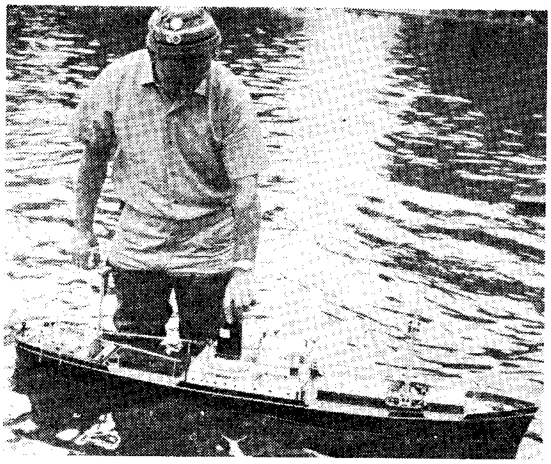
A class, J. Benson (Blackheath), 59.43 m.p.h.
B class, T. Dalziel (Birmingham), 45.45 m.p.h.
C class, G. Suzor (M.Y.C. de Paris), 60.16 m.p.h.
D class, Mr Fairbourne (Coventry), 57.78 m.p.h.

On the second day, the events were devoted to radio controlled and free running prototype craft, in which the total number of boats competing approached 100, including over 20 in. r.c. steering contests. The variety in type and size of boats, and the design of power plants, was very wide, and it was encouraging to see that steamers were well represented; several of them were new, or had not been seen previous to this season. They included a 6 ft. 8 in. Fairmile type cruiser *Sea Mist* by W. Halligan (Wallasey), a smaller sister of the tug *Smoky* by R. Perman (West London), and a tiny flash steamer, only 16 in. long, *Skippy*, by W. Caverhill (Heaton). The latter has a single-cylinder piston valve engine, and positive pump fuel feed to the blowlamp. *Sea Mist* is fitted with an enclosed single-cylinder engine and a horizontal water-tube boiler, while Mr Perman still favours solid fuel, in this case with a vertical boiler, and a single-cylinder link reversing slide valve engine.

Other steam craft included some from northern clubs which had characteristic features of design and performed well. In the Watford club, Mr Disney's diagonal-engined paddle tug *Anglia*, and Mr Nicholls' model of Brunel's *Great Eastern*, were of special interest though the latter is not yet fitted with its second set of engines and their side paddles. An excellent model of the cargo liner *Auk*, by Mr Coleman (St. Albans) made its

Below: Mr Halligan (Wallasey) with "Sea Mist."





Above: Mr Coleman (St. Albans) with his new cargo liner "Auk."

Above right: Mr Jones (Maghull) with his latest C class Hydroplane.

maiden voyage; this is at present electrically propelled, but it is understood that a steam plant will eventually be installed.

A special trophy for the best power-driven ship model, awarded jointly by Gems Suzor and R. O. Porter, was won by R. Johnson (West London) with an electrically driven paddle tug. The trophy consists of a silver plaque, to be presented annually in the future. The boats were judged while in action by Lt. Comdr. Greenhalgh and A. Raymon to qualify for this award.

Results (2nd day): Nomination Contest

1, E. Carty (Tynemouth), Error—Nil.
2, P. Lambert (St. Albans), Error—0.554%.
3, P. Kelf (Heaton), Error—0.606%.

Steering Competition

1, Mrs. P. Husband (St. Albans), 11 + 5 points.
2, S. Davidson (Tynemouth), 11 + 1 + 5 points.
3, J. Bracknell (St. Albans), 11 + 1 + 3 points.

Robin Hood Trophy for Ladies

Mrs. P. Husband.

Radio Control Steering

1, C. Mitchell (Buccaneers).
2, F. Staines (Mortlake).
3, R. Riches (Mayesbrook).

Radio Control Pairs Steering

1, R. Boskett and R. Saunders (St. Albans).
2, R. Walker (Victoria) and Mr Clay (Mayesbrook).

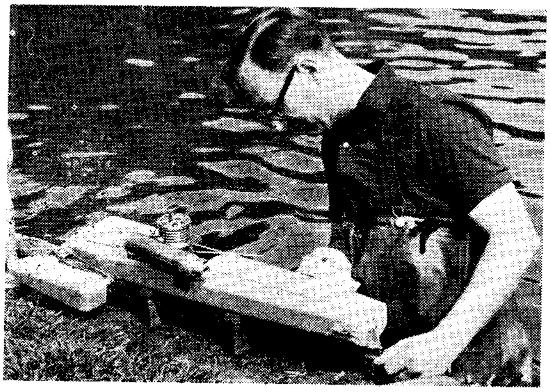
The third day's events comprised both prototype and speed events, which occupied both the small and large lakes simultaneously. A further influx of competitors in all classes swelled the list of entrants, and in the free running events, another steering competition was run, in addition to a knock-out steering and a Ladies' steering contest. These were all well represented and provided a brisk round of activity all through the day.

The International Speed competition, which took place on the large lake, perpetuated a classic event.

Continued on page 1029

Below right: Mrs Pauline Husband with "Cha Cha 4" (C class hydroplane).

Below: Alan Rayman (Blackheath) with his new B class Hydroplane.



ECCENTRICS

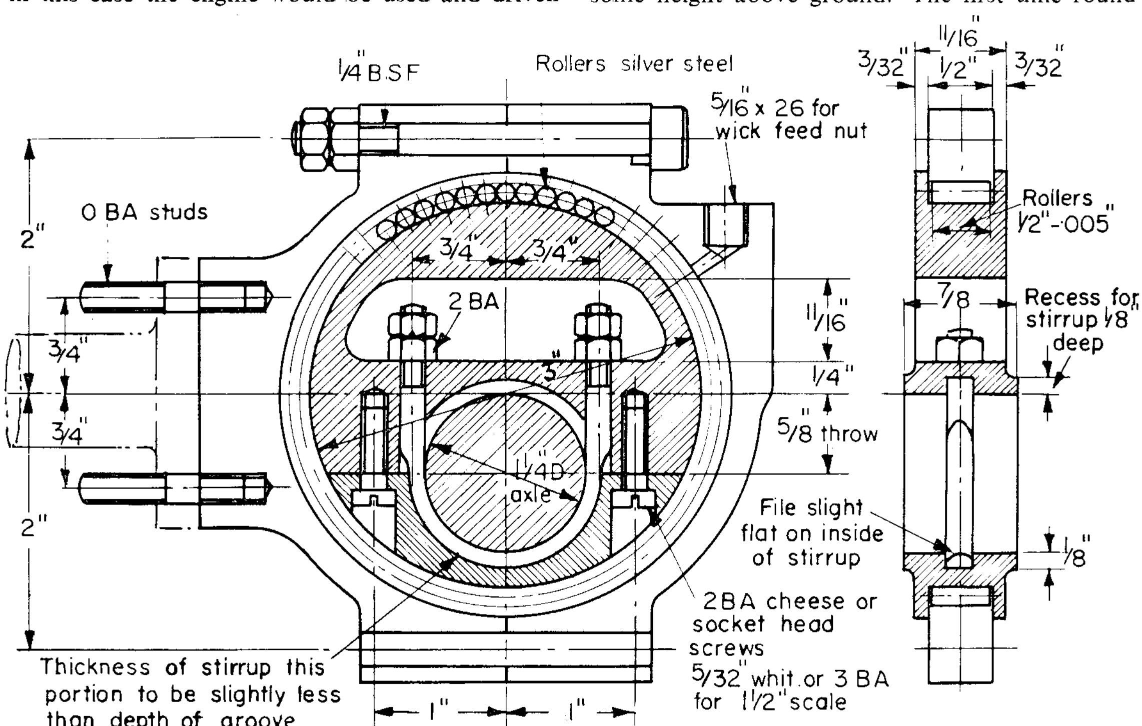
by J. N. Liversage

Valve gear eccentrics can cause a great deal of friction. Here is an ingenious way of overcoming the problem.

In 1955 I visited a large library in London in order to browse through back issues of the *Railway Engineer* for drawings and diagrams of a Great Northern Atlantic locomotive which I had been asked to build for an old friend. My researches were, at the time, unsuccessful, but I did find in the volume for 1899 a double plate diagram and a description of the original Atlantic *Henry Oakley*. These gave all the necessary information regarding the motion etc. below footplate level which I needed, and together with the line diagrams of main line locomotives published in the *Railway Gazette* and later issued in book form completed the picture.

As most model engineers will know, these engines were fitted with Stephenson's valve gear, driven from the rear coupled axle and therefore necessitating four eccentrics, and as an axle-driven pump was required, this meant five eccentrics. Incidentally I do not like axle-driven pumps, but in this case the engine would be used and driven by all and sundry; some who had never been near either a full-size or a model locomotive before, and who could not be expected to work an injector. The pump could therefore be left working and all that was necessary was to open the by-pass when the boiler level got too high.

I do not have much faith in the usual type of eccentric and strap, that is with the usual bronze or gunmetal liner, and a split eccentric fitted to the axle by a simple grub screw would not be a proposition, since the tightening of the grub screw tends to open out the two halves of the eccentric. In any case, in these larger sizes, grub screws can work loose or move relative to the axle. There is also the difficulty of adjustment in the first place. Another objection to rubbing faces is the grinding action of dirt which could possibly be far less with the type of eccentric suggested here. On a ground level track, dirt can be troublesome, more so than a track on timber or other supports at some height above ground. The first time round



SPLIT ECCENTRIC FOR 2" SCALE LOCOMOTIVE

MILD STEEL THROUGHOUT EXCEPT ROLLERS

the track after disuse for some little time, and especially after the winter, the amount of rust dust which an engine can pick up has to be seen to be believed.

After pondering over these eccentrics for some months whilst work proceeded, I thought that a type of roller bearing might be suitable, and, as a coincidence, about the same time I had been going through all the back issues of the *Railway Engineer* right from the commencement of the magazine, and in one issue came across the answer to all eccentrics in the form of a drawing of a patent invented by a master mechanic of one of the American railroads. I don't recollect the date but it would be over 100 years ago. The arrangement and method of fitting eccentric to the axle in this really elegant manner has many advantages and so far as miniature locomotives are concerned is a far better arrangement than that used for the L.M.S. Pacifics, which could turn out to be rather clumsy and on the big side.

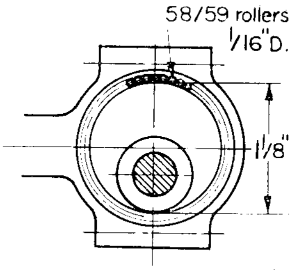
The method of clamping the eccentric to the axle ensures that it seats and runs truly with no side-to-side wobble, which can be caused by grub screw fixing, and I can think of nothing more certain in its holding power than that strap.

There are no tapped holes through or into the axle, just the plain shaft; it can be tightened up just sufficiently to allow the eccentric to be adjusted precisely and then pulled up tight, while tightening will not alter the setting. Tighten up the strap nuts more or less equally each side and the eccentric will never move in use.

The strap, which is of normal design, needs to be bored out with about 0.003 in. or 0.004 in. clearance over and above the diameter over the rollers, and the rollers themselves, of silver steel, should be of a length about 0.005 in. less than the distance between the eccentric cheeks; excessive clearance here may cause the rollers to angle and cause jamming in use. Part off each to length and just touch the ends on a fine grinding wheel to remove all tool marks from parting off, chamfer very slightly at the same time and make absolutely sure that there are no burrs left on the rolling surface.

So far as the actual making of the eccentric is concerned, it is quite straightforward and made from ordinary bright mild steel flat or round, as is also the strap. The gap for access to the stirrup nuts should be made as large as possible, especially with inside cylindered engines as you have to tighten the nuts between the side cheeks of the crank axle, but with a cranked ring spanner of suitable size I doubt if any difficulty will be experienced.

As an example of the dimensions, those I originally made with a 3 in. dia. eccentric, and 0.146 in. silver steel rollers—this No. 26 Stubs wire gauge material happened to be in stock, but any inch size, say $\frac{1}{8}$ in. or round about, will be quite satisfactory.



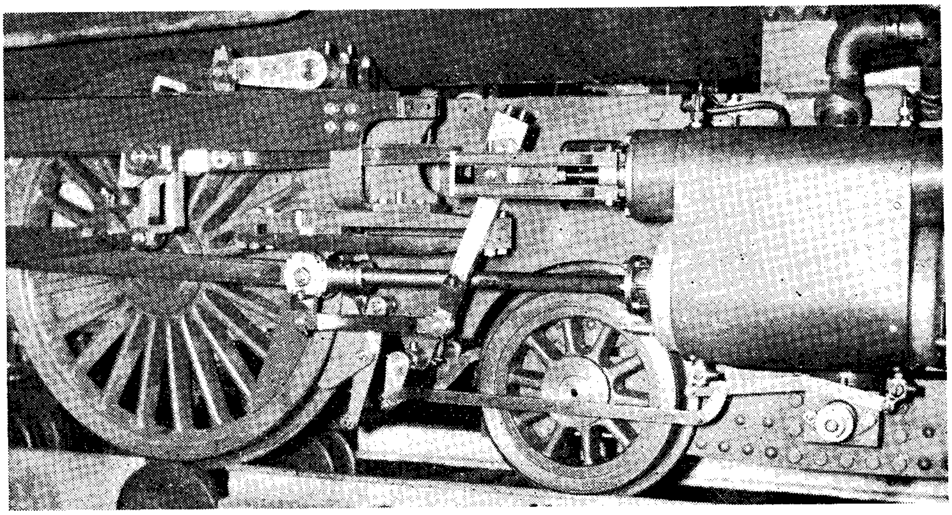
ECCENTRIC FOR 3/4" SCALE LOCO. (SOLID)
Eccentric MS Strap MS

Dia. of eccentric: 3.0 in.
Dia. of rollers: 0.146 in.
Circumference of eccentric: $3.0 \times 3.14 = 9.420$ in.
Circumference of C/L of rollers: $(3.0 + 0.146) \times 3.14 = 9.878$ in.
Number of rollers required: $9.878/0.146 = 67$.
Length of 67 rollers: $67 \times 0.146 = 9.782$ in.
Clearance in rollers: $9.878 - 9.782 = 0.096$ in.
Outside diameter over rollers: $3.0 + 2(0.146) = 3.292$ in.
Bore of eccentric strap: 3.292 in. + 0.003 in. + 0.005 in.

Another example for, say, a $\frac{3}{4}$ in. scale engine.
Dia. of eccentric: $1\frac{1}{8}$ in.
Dia. of rollers: $\frac{1}{16}$ in.
Circumference of eccentric: $1.125 \times 3.14 = 3.533$ in.
Circumference of C/L of rollers: $(1.125 + 0.0625) \times 3.14 = 3.729$ in.
Number of rollers required: $3.729/0.0625 = 59$.
Length of 59 rollers: $59 \times 0.0625 = 3.688$ in.
Clearance in rollers: $3.729 - 3.688 = 0.041$ in.
Outside diameter over rollers: $1.125 + 2(0.0625) = 1.25$ in.
Bore of eccentric strap: 1.125 in. + 0.003 in. + 0.005 in.

Before complete assembly make sure that all the pieces, eccentric, strap and all the rollers are perfectly clean, then for final putting together daub the eccentric groove with grease with a brush and feed in all the rollers round the circumference. See that all are straight and parallel and gently fit the two halves of the strap and bolt up tight. If the eccentric won't turn nicely you have either not left enough clearance between the eccentric and strap or allowed some dirt to enter among the rollers. With the first, correction can be made by fitting a thin shim between the two halves of the strap, and with the second the only way is to have a fresh start after cleaning away all the old grease. Previously I should have said

Though not directly connected with this article, this picture shows some of the fine locomotive work of Mr. Liversage—the motion of a 10¼ in. gauge "Lord Nelson" class locomotive.



that you should clean the brush and also have a good look at the grease that you use, as in all workshops if the lid is left off the tin it will have probably collected some swarf from one of your machines.

One lesson that I have learned from my perusal of all these old journals is that if you are in any kind of trouble with the design or arrangement of anything you are making, whether it be a model or tool or even a machine tool, there is no doubt that if you refer back to old information you will find what you want. Going back 100 years to more or less the beginning of the machine age you will find that what is described is well within your capacity, or the capacity of your machines or tools, since in those days they made the things with exactly the same tackle as you have now, i.e. lathe, hand tools, a drilling machine of sorts, and maybe a milling machine. They had no computors, numerically controlled machines and such like and neither have we as model engineers.

Provided you know where to look, and this may be the difficulty, you will certainly find that "it's been done before" in a far simpler way, from valve gears to calculating machines.

Finally one word as to whether this roller bearing eccentric is satisfactory. The engine mentioned first ran in August 1956, and at the moment 10 years and roughly 8,000 miles later these eccentrics are still in excellent condition. The last time I examined them, early this year, I could feel no play whatever between the eccentric and strap on any of them, not even the one for the pump, which generally gets more sudden thumping than the rest.

My next engine, a Great Western "King," also had these eccentrics working two 1¼ in. dia. piston valves with inside admission, via the "Southern" valve gear and has also run some hundreds of miles and to date has given no trouble. ▣

SIMPLE DRILLING MACHINE

Continued from page 1033

A 1½ in. length of ⅝ in. round was then turned down and threaded ⅜ in. by ⅜ in. long, the other end was deeply slotted by drilling and sawing and a ¼ in. hole drilled for the lever. This piece screwed into the ball-race housing completed the spindle.

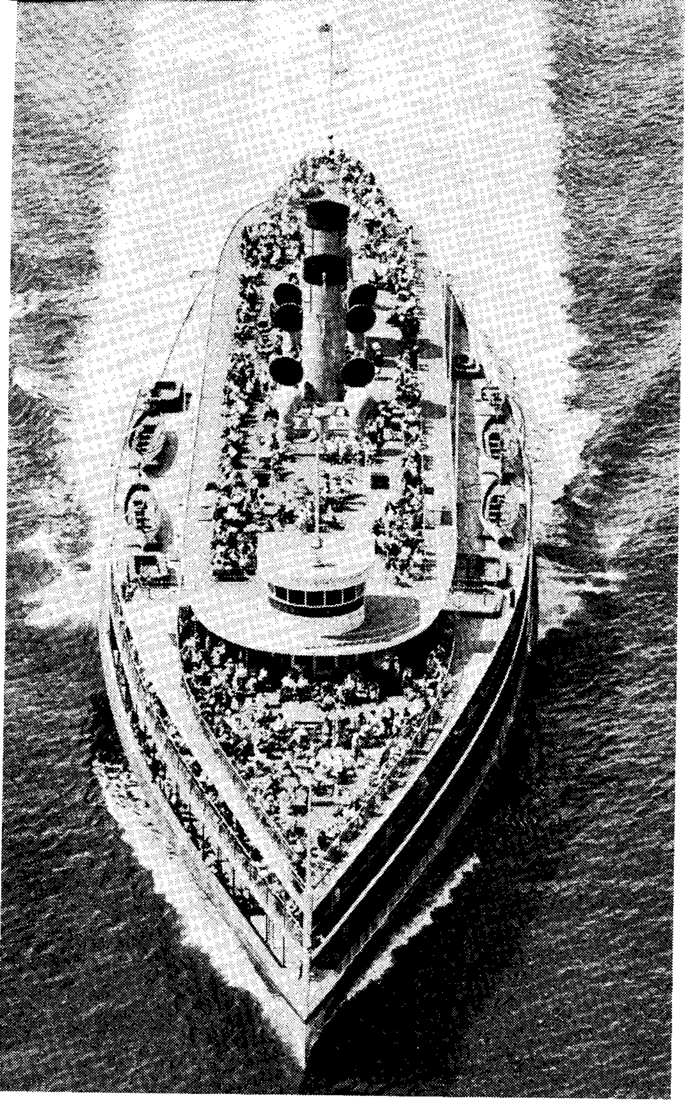
The lever weight is of lead, cast in a tin lid and secured by drilling a hole in the end of lever, and casting it on the lever. (I prefer a weight to a spring whenever possible!)

The motor bracket is of 2 in. × ⅛ in. steel with curved pieces of ½ in. × ⅛ in. welded on, drilled at the ends to take $\frac{3}{16}$ in. U bolts and taking advantage of the original rubber mountings. The motor is a ⅙ h.p. BTH which powered a washing machine at one time.

The machine has proved most successful, having drilled thousands of holes in a period of five years It is equally happy at its maximum capacity, or with a small Eclipse pin chuck with No. 70 drills. It also gets a spot of counterboring and end milling on occasions. It is dead quiet and almost vibration-free. The belt is run fairly slack; that, combined with the motor rubber mounting and light holding bracket, makes speed changing very easy. Good fitting pivot pins are a necessity: it is then possible to feel tiny drills on their break through.

A flat steel drilling table encourages the use of clamps, which with a ribbed C.I. base is almost impossible. The pulleys are die cast type metal; it was necessary to turn these to reduce vibration.

The photograph was taken by Mr. S. Desborough.



The clean lines of " Alexander Hamilton " are apparent in this view of the ship passing under the George Washington Bridge.

K. M. Brown

talks about one of the last of the American sidewheelers, the "Alexander Hamilton"

As these words are being written, the Hudson River paddle steamer *Alexander Hamilton* is nearing the end of her winter lay-up in New York Harbour, and will soon be ready for the 1967 summer season. It may well be her last.

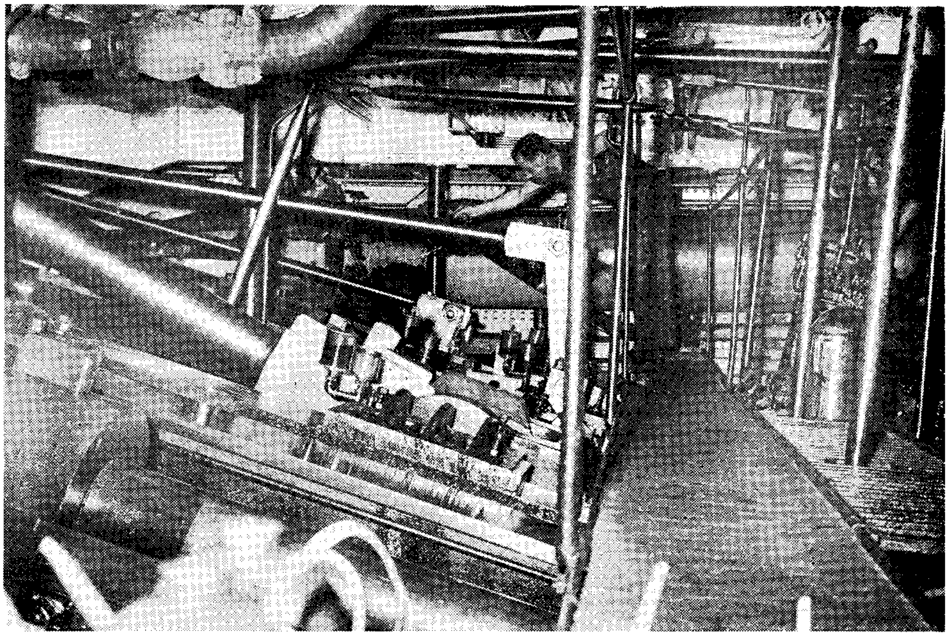
History will remember her, for she is the last paddle steamer on the eastern seaboard of North America. Any reader with a love of steam-propelled excursion vessels visiting the U.S.A. should try to make a pilgrimage aboard her—it will be an experience to remember !

P.S. *Alexander Hamilton* is what the Americans call a sidewheeler to distinguish her from the sternwheel variety of which there are still a few afloat. Ship-lovers more used to English and Continental paddle steamers with their characteristically sleek lines may be forgiven for thinking *Alexander Hamilton* looks more like a gigantic layer cake than a pleasure vessel! Her passenger accommodation is arranged on the main deck and three upper decks, all but the topmost deck covering the full area of the ship. The uppermost deck is completely open and stops just short of a characteristically curvaceous wheelhouse. Perhaps the ship's cake-like appearance is enhanced by the vertical lines of her stem and stern, flat " skyline " and all-white colour scheme for the hull and upperworks. By any standards, *Alexander Hamilton* is a most impressive vessel, like a super enlarged version of the well-known P. & A. Campbell paddler, *Bristol Queen.*

Now for some technical particulars. Her registered tonnage is 2,367 tons; she measures 350 ft. from stem to stern and she is no less than 72 ft. wide over the paddle boxes and 77 ft. over the guards. The paddle boxes do not protrude outside the main deck but are included within its width. In other words, the main deck as well as the paddle boxes are cantilevered outside the hull to give a gently curved but unbroken side line. Below the main deck, the hull width is 42 ft. and draught between 9 ft. and 9 ft. 6 in.

Concealing the paddle boxes within the superstructure was common practice in American excursion steamer design. Broadside on, screw and paddle steamers looked much alike, but in *Alexander Hamilton*'s case, there are no longer any large screw steamers operating around New York that she might be confused with. Her triple expansion diagonal engines develop 3,400 indicated horsepower when the paddles are turning at 36-38 r.p.m. This corresponds roughly with a speed of 19 knots, though she could do 21 or more when new. Even this horsepower rating is not large as American river steamers go, since one of her predecessors on the Hudson River had engines of 5,500 horsepower and could manage 24 knots !

Alexander Hamilton is operated by the Hudson River Day Line and sails from New York regularly during the season from Easter to late September. At one time, she and her companions used to run as far as Albany; but times have changed, she no longer has any companions and normally turns round at Poughkeepsie, 75 miles

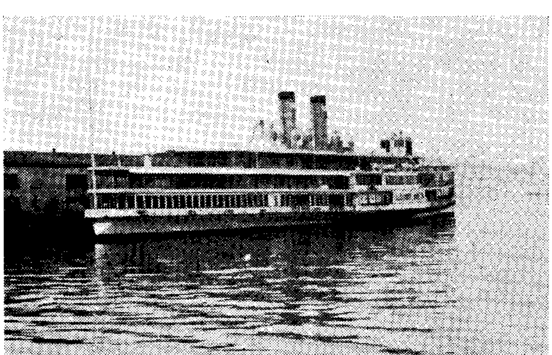


The lower engine-room. The three-cylinder triple-expansion diagonal engine develops 3,400 i.h.p. The high pressure connecting rod is seen raised, on the left.
Photographs Conrad Milster.

up-river from New York. As she is the only vessel on the service and has only a short turn-round, however, most passengers alight at Bear Mountain, 43 miles from New York, where there is enough time to see the sights before picking the paddler up on her return journey. That *Alexander Hamilton* has no companions is perhaps not strictly true because there is another surviving Day Line steamer, the screw vessel *Peter Stuyvesant*. But she hasn't left New York Harbour since 1962. When I went aboard both vessels last October, *Peter Stuyvesant* was being prepared to be disposed of. She, too, is of impressive size and has a four-cylinder triple-expansion surface condensing marine engine driving a single screw. But this article is confined to *Alexander Hamilton*.

It was 1924 when the Hudson Day Line took delivery of *Alexander Hamilton*. Her builders were the Bethlehem Shipbuilding Corporation of Sparrows Point, Maryland, a neighbouring State. *Peter Stuyvesant* is actually her junior by two years. To the technically inclined the engine room is the heart of any vessel and it was here that a tour of the ship commenced. What a scene of activity below decks ! She was not long out of service and in America winter lay-ups are treated very seriously under Coast Guard's regulations. Every bit of gland packing has to be removed, every cylinder head lifted and every bearing, stud and moving part examined. Not only does this keep several of the crew busily employed during the " dead " months, it also costs a lot of money and is a major factor in the economic difficulties facing excursion vessel operators today.

The Hudson River paddle steamer berthed in New York Harbour for her winter lay-up, October 1966.
(Photograph by the author).



Due to the popularity of the single cylinder " walking beam " engine for American side-wheel paddlers—not a single example of which survives, alas—the diagonal engine arrived late and never multiplied to anything like the extent it did in Europe. In consequence, great interest attaches to *Alexander Hamilton*'s machinery. Her surface condensing triple expansion diagonal engines are similar to those of *Bristol Queen* at first glance, only much larger. The cylinder diameters are 36½ in., 56 in. and 85 in. by 6 ft. stroke, as compared with *Bristol Queen*'s 27 in., 42 in. and 66 in. by 5 ft. 6 in. One obvious departure from British practice is that the engines revolve the opposite way as the cylinders are arranged forward of the crankshaft. As the starting platform ostensibly occupies the customary position over the cylinders, when the chief engineer is at the control stand facing the engines while going ahead, he has his back to the direction of travel. Communication from the bridge is by telegraph and gongs.

What characterises the diagonal arrangement is that the crankshaft is at a higher level than the cylinders. The plain oval cranks are unbalanced and arranged, conventionally, at 120 deg. to one another. The framing, too, is conventional. There are four leaf-type castings each carrying a main bearing so each crank has a bearing on each side of it. Integral with the framing are long tie bars inclined downwards and forward and bolted to the front cylinder faces. These ties incorporate the two-bar crosshead guides, and between each pair of cylinders the slippers share a common guide. Long brass drip trays are hung beneath the guides. Grease lubrication is used for all bearings, so the grease cup handles have to be given a turn down periodically while the engines are in motion, always a fascinating spectacle for passengers.

A departure from British practice is the absence of a resilient coupling joining the crankshaft end-on with the paddle shafts. Instead, hull strains are taken up by making the two outboard crank webs integral with the paddle shafts and giving the crankpins a limited amount of movement where they enter them. This is accomplished by a series of brass needles set in tapered slots around the pin. Stephenson's link motion is used to operate the valves and the surface condenser occupies the usual athwartships position beneath the motion. Low down beneath the condenser is the steam reversing engine for raising and lowering the expansion links.

The cylinders are arranged with the high pressure occupying the mid-position and a piston valve above it. Drive from the die block to the valve spindle is via a rocker-shaft. The intermediate pressure cylinder is to starboard of the high pressure and the low pressure cylinder to port, the steam receivers being incorporated in the interconnecting pipework. I.p. and l.p. cylinders have side-mounted slide valves with the spindles driven direct from the die blocks. This makes the valve chests readily accessible. The main pistons have no tailrods.

Apart from a small bilge pump worked off an eccentric on the crankshaft, all *Alexander Hamilton*'s auxiliaries are driven independently from the main engines. Use of an independent air pump is of great value in getting away from stops, as full vacuum is maintained in the condenser while standing and the engines develop full power as soon as the steam reaches the low pressure receiver. Other auxiliaries, all steam driven, include the condenser circulating water pump, and smaller pumps for boiler feedwater, fresh water, fire-fighting, sanitation and oil fuel. To correct the ship's trim when passengers make for one side, such as when preparing to disembark, there is a small turbine-driven ballast pump connected via changeover valves to ballast tanks either side of the engine room. Indication of trim is provided by a hanging brass pointer. There are also two steam-driven induced-draught fans and a pair of 25 kW generators at main deck level aft of the engines. The steering engine is below decks.

The engines take steam at 180 lb. per sq. in. from no less than four oil-fired Scotch boilers. There are two double-enders and two singles arranged in pairs just aft of the engine room bulkhead, with the main " fire room " (what we would call the stokehold) in between. All the boilers are 12 ft. dia., the double-enders being 22 ft. long and disposed forward of the 10 ft. 3 in. long single-enders. Fuel oil tanks are arranged both sides of the fire room. The main boiler stop valves are hand-operated through small trapdoors in the main deck immediately overhead.

The feathering paddle wheels are 24 ft. 6 in. dia. and have nine steel floats 11 ft. 10 in. long and 3 ft. 9 in. deep. The paddle shaft diameter is 16 in. and due to the level of the main deck being somewhat high above water, the hump in the main deck where it passes over the paddle shaft each side of the engine room is almost imperceptible. On some British paddlers, one has to climb steps to get over it !

Windows each side of the engine room afford passengers an excellent view of the engines, which are extremely well kept, the predominant colour being green with much polished brightwork. A mass of gleaming brass piping attached to the framing above the crankshaft is a reminder of the tribulations the engine-room staff have to endure should a main bearing or big-end run hot—a nozzle can be directed over the offending bearing and cold water continuously pumped over it to get the ship back into port. The principal paddle shaft bearings are located outside the hull just inside the wheel where they are kept cool by the cascade of water therefrom. Anchorage for the feathering gear is inside the sponson.

The interior " decor " of *Alexander Hamilton* is fully in keeping with her period, with not too much of the dark polished woodwork that characterised the older American steamboats, but enough to please the connoisseur. There are large open spaces on the main deck, one of which is large enough for dancing to a band. Stairways fore and aft communicate with the upper decks. Above the main deck is the so-called parlour deck, where may still be seen a series of oil paintings adorning funnel casings and bulkheads. As the paddle boxes extend up to this level, the spaces adjacent to them are used for the crew's quarters. There are eight private parlours arranged aft of the parlour deck, and a large windowed saloon forward.

Continued on page 1026

A SMOOTH FOUR-CLYINDER ENGINE SCHEME

by Roland V. Hutchinson

IN Edgar T. Westbury's recent series on single-acting steam engines he left out the four-cylinder-at-90 deg. single plane single crank radial engine; I wonder why ?

To anyone who has flown light planes behind three-cylinder radials, Anzani or Szekely for instance, and has watched the lovely little tri-angular blurs their rear mounted accessories become as viewed, the notion of a smooth running, few-cylinder radial engine has had strong appeal, especially when conscious of, and experienced with, fatigue failures of engine mounts. Three-cylinder radials in light mounts are really " rough babies."

The scheme here described does not suit four cycle i.c. engines, although by putting two together, as a two-bank engine, even firing and good balance may be had. It does, however, adapt to single acting steam-operation and, while by no means new, has had so little practical application that the model engineer may find it attractive. Maybe Mr. Westbury could be coaxed into bringing forth a " Super Cygnet " along these lines.

The whole trick in the scheme lies in contriving its balancing. I am treating this in three stages; first, taking care of the connecting rods, second, the pistons and pins, and third the crankshaft itself.

First—connecting rods—refer to Fig. 1 and note that the cylinders are radial to the crank axis and *not* desaxé. The centres of gravity of opposite *pairs* of rods, will, by inspection, always lie on lines $W'\ W'''$ and $W'\ W''''$ joining their centres of gravity, and the centre of gravity of the *group* of four rods will be on their intersection at G. For *any* crank angle G *always* falls on the crank radius at a constant distance, OG, from the shaft centre.

Hence the *connecting rods* may be balanced by a crankshaft counterweight opposite the crank having a weight-moment $4W \times \overline{OG}$, where W is the whole weight of one rod.

Second—pistons and pins—refer to Fig. 2. Consider opposite pairs of pistons and pins, all alike dimensionally and of the same weight. Again, by inspection, their centres of gravity must always lie on the cylinder centre-lines at points located by the projections of the crankpin thereon, and the centre of gravity of the *four* pistons will come at mid-length of a straight line joining these projected points. This midpoint *always* lies on, *and bisects*, the crank radius, regardless of crank position, hence the four pistons may be counterbalanced by a weight angularly opposite the crankpin, having a moment about the shaft axis of $4Wp \times \frac{1}{2}r$ or $2Wpr$, where Wp is the weight of a single piston and pin assembly.

Thus the combination, so far, requires a weight-moment $2\,(Wpr + 2W \times \overline{OG})$ about the shaft axis, had by weight or weights angularly opposite the pin. Now $\overline{OG}$ depends upon the weight, and its lengthwise distribution, of the connecting rod, but is independent of the crank/rod-length ratio.

Let O be the crankshaft centre.

OR = crankarm = r

AR = rod length = l

$W'R$ = distance, crankpin to c.g. of rod = a

Weigh the connecting rod and call this weight W as before. Support the rod at its small end and weight the big end, with rod horizontal, calling this W. The centre of gravity of the rod is at W', distant a from the crankpin, and $a = \left(\frac{W - W_r}{W}\right) \times 1$.

In Fig. 1, triangles ARO and $W'\ RG$ are similar, hence $AR : RO :: W'R : RG$, whence $RG = ar/1$, and further $\overline{OG} = r - ar/1$ or $\frac{r(1-a)}{1}$.

Substituting this value, we find the counter-weight moment for rods and pistons is

$$2r\left[Wp + \frac{2W(1-a)}{1}\right].$$

Third—the crankshaft itself. This depends to some extent upon the type of rod used, which may just as well be of the " shoe " type, *a la* Brotherhood, Anzani, or General Motors " Pancake " diesel,

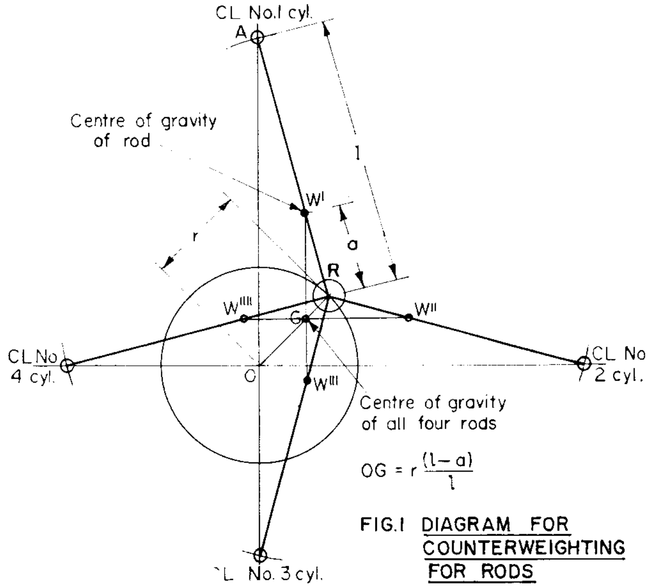


FIG.I DIAGRAM FOR COUNTERWEIGHTING FOR RODS

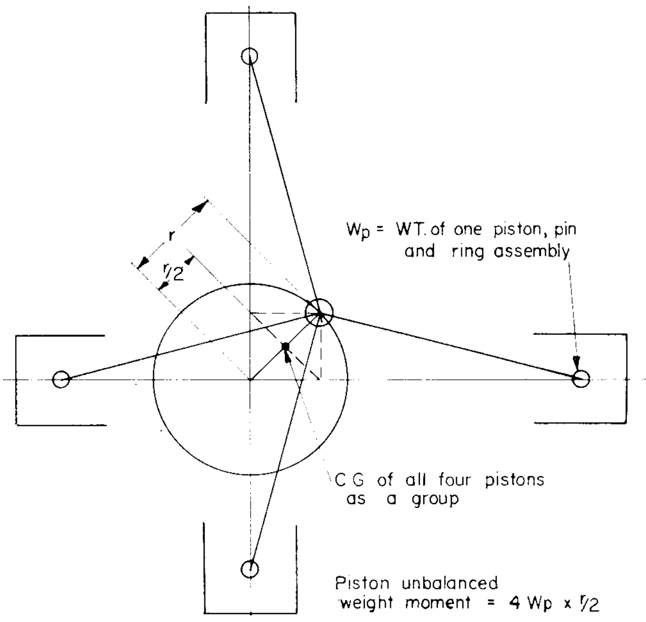


FIG. 2 DIAGRAM FOR COUNTERWEIGHTING FOR PISTONS

with retainer rings surrounding the big-end shoes. These rings are considered concentric with, and effectively a part of, the crankpin, when figuring crank arm and pin unbalanced weight-moment.

So the *whole* counterweight moment is the sum of

$$2r\left[Wp + \frac{2W(1-a)}{1}\right]$$

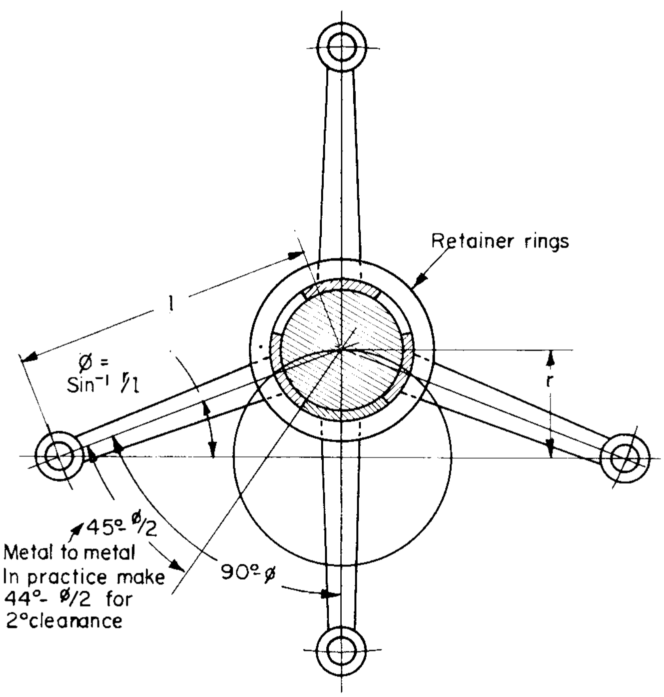


FIG. 3 SKETCH ILLUSTRATING SHOE-WRAP ON CRANKPIN

plus the unbalanced weight-moment of crank arms, pin and retainer rings figured conventionally, and the counterweight is angularly opposite the crank-pin.

In Fig. 3, the angular extent of the rod-shoes, measured from rod centre-lines will, allowing 2 deg. clearance, be $44° - \frac{1}{2} \sin^{-1} r/l$. For example if $r/l = \frac{1}{4}$, $\sin^{-1} r/l = 14\frac{1}{2}°$ very nearly, and the shoe wraps round the pin $44° - 7\frac{1}{4}° = 36\frac{3}{4}°$ each side of the rod centre-line, or a total of $73\frac{1}{2}$ deg.

If sensitive scales are not available, the c.g. locations of the rods, their weights and those of the keeper rings may quite easily be figured, their elemental shapes being quite simple—specific weights per cubic inch of steel, brass or bronze being taken as .283, .31 and .32 lb. respectively.

If an alternative master and three link rods be used, with big end parted at 45 deg. to the centre-line of the master rod, the balance obtained is not quite so good as with the simple " shoe " big ends, but will still be quite good.

It seems obvious that the best balance will be had using a two-armed rather than an overhung crank, and the counterweights divided between them equally.

This is another instance, like the Holcroft conjugated four-cylinder valve gear, where one decides definitely and accurately in advance what to do—does it—and comes up with a proper result. It is no place to try " muddling through."

ALEXANDER HAMILTON

Continued from page 1024

Apart from the unfavourable economic climate for steam boat operation, what is most likely to sound the death knell of *Alexander Hamilton* is an impending Coast Guard's regulation that no passenger-carrying vessel should contain any timber in her structure. And *Alexander Hamilton* has a great deal of wood in her, as a little sagging here and there reveals. It looks as though 1967 will be the last year for the U.S.A.'s remaining old-style riverboats, unless some way can be found of exempting vessels of " antique " value. Fortunately the sternwheeler *Huron* and a handful of interesting ferry vessels on the Canadian Great Lakes escape—but for how long? The owners of a privately preserved river steamer elsewhere in the U.S.A. plan to rebuild her superstructure in aluminium in order to conform to the new regulation, but that is an expensive process no commercial operator could possibly contemplate. I consider myself fortunate to have seen a traditional American sidewheeler at first hand. While unable to take a trip on *Alexander Hamilton*, at least I had the good fortune to travel on some of the even older steam ferry vessels operating around New York, though they, too, are doomed. ■

Models at a Crafts Exhibition

Reported by Northerner

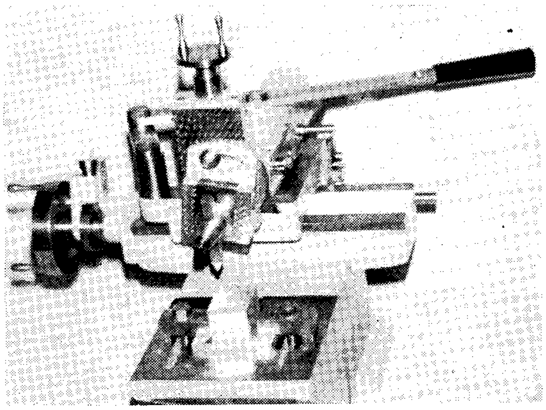
THE North Western Electricity Board recently held their biennial Art and Crafts Exhibition in Manchester for employees and their families, and there were several items of interest to model engineers. The first was an excellent free-lance 0-6-0 locomotive in 3½ in. gauge by our old friend Eddie Hinchcliffe of Rochdale. It was finished in the former Great Eastern colours, and generally speaking was up to his usual competent standards. However, he may have hurried a little towards the end in order to have it assembled in time, as there were a few file marks here and there which normally would have been draw-filed out.

P. L. Westry of the West Lancs Area had three delightful little 4 mm. scale narrow-gauge locomotives: *Maid Marian* and *Britomart* (Hunslet 822 and 707 of 1903 and 1899 respectively) and *Rarawai No. 3*, a John Fowler locomotive No. 7063 of 1893 built for a sugar plantation in Fiji. These models all had excellent detail and the atmosphere was right.

From the Peak area K. G. Nelson had sent a 24 in. R.A.F. Fire Tender which was quite well finished. The hull was from the W. J. Hughes design named *Chiquita*, but Mr. Nelson had used his own design for the upper works. The boat was electrically driven.

In the competition for apprentices, several of the exhibits were group work, including from the Manchester area, a *Model Engineer* beam engine to 1 in. scale. But on close examination this proved disappointing; not only was there some wobble in the rims of the flywheel and main gear wheel, but there was side play in the main beam journals, and slop in the links of the parallel motion.

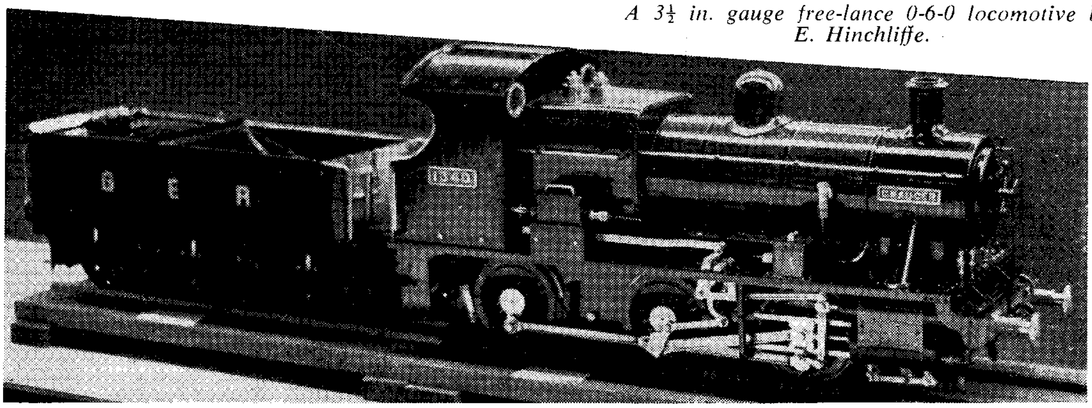
24 in. electrically driven Fire Tender by K. G. Nelson. Below: A Hand Shaper from South Lakeland.



South Lakeland had sent a hand shaper which was good in general, but there was some side play in the main slide and the vertical feed screw had tight spots. From West Lancashire came a 6 in. circular saw bench, motorised and well guarded, with attachments, and also a woodworker's vice.

On balance, however, for excellent craftsmanship West Lakeland came first, with a surface plate and straight edge, a machine vice and a pair of toolmakers' clamps. These may be rather hackneyed subjects, but there is little merit in tackling a "different" subject unless it is meritorious in craftsmanship too.

A 3½ in. gauge free-lance 0-6-0 locomotive by E. Hinchliffe.



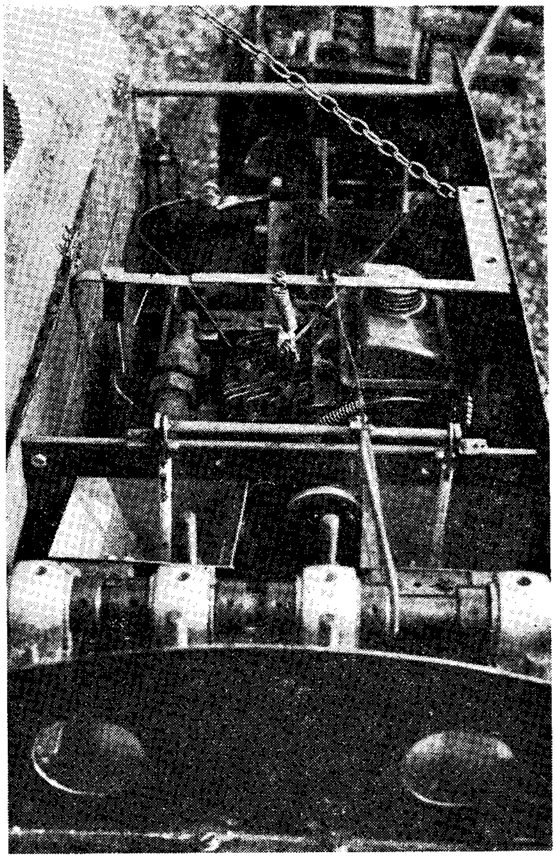
From Tender to Locomotive

R. M. Tyrrell tells how he converted a spare $7\frac{1}{4}$ in. gauge tender to a "Diesel" locomotive.

ALTHOUGH I AM a Live-Steam enthusiast, there is no doubt that on a garden railway there are many times when "instant locomotion" in the form of a petrol or electric engine is very useful. I had previously made a four-wheeled locomotive using two starter-motors and a hefty 12 volt accumulator with a simple resistance-controller. At full charge the performance was electric all right, but a starting current of some 80 amp. proved very hard on the battery.

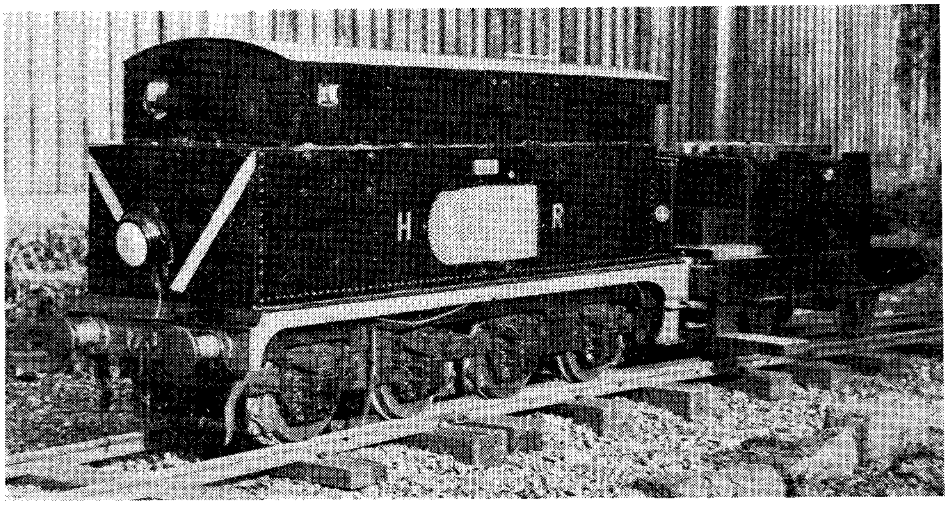
So I resolved to build a "diesel" as quickly and cheaply as possible. For a start, an advertisement in M.E. enabled me to buy second-hand an excellent bogie tender of very heavy construction with working brakes and a strong body of 16g. steel sheet. (Curiously enough, the vendor was unable to tell me what had become of the tender's engine and this remains a mystery!)

The first job was to remove the separate water tank which was of heavy gauge copper sheet, and which incidentally came in most useful for the extra water supply on the driving truck of my 0-4-0 tank engine. The next task was very hard on both my temper and my hacksaw blades as it was necessary to cut away, in situ, some 80 in. run of 16g. sheet comprising the top flared-out sides of the tender. It was vital to do this so as to be able to add pieces which would increase the vehicle's height by 4 in. thus giving a correct scale look and also allowing enough headroom for clearing the power unit and the reversing gear.



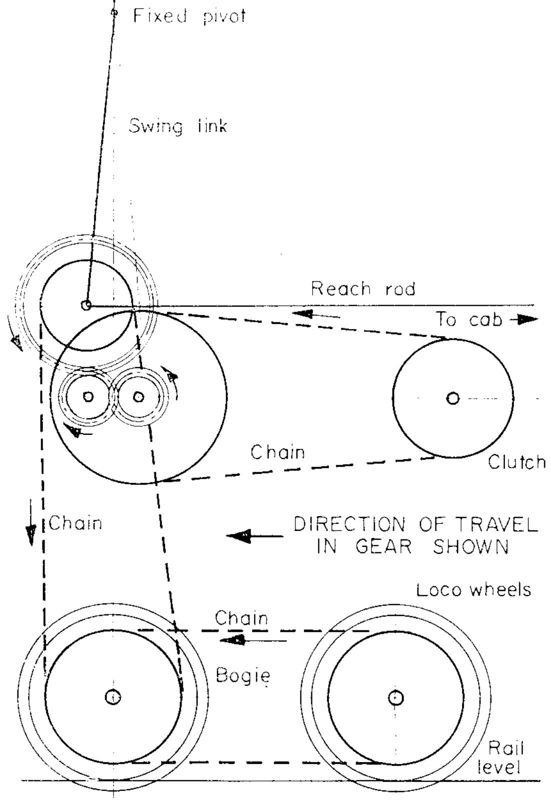
Lack of time (and skill) prevented the motive power from being home-built and so a 50 c.c. four-stroke B.S.A. engine was purchased together with a centrifugal clutch off a Go-Kart.

As the track is not continuous, some form of reversing gear was a must. I gave this much thought and one day it suddenly hit me that the simplest was one I had known since childhood,



Above: The roof opens to reveal the works. The power unit is a 50 c.c. four-stroke B.S.A. engine.

Left: The converted tender with driving truck containing a 12 volt car battery to provide current for the headlight.



namely, the " swing " type used on Hornby clockwork locomotives. In fact, my design is slightly modified, but the principle is the same. Just to make sure of the geometry I drew the gear full-size on the drawing-board and then made a mock-up in Meccano.

Simplicity is the keynote and it works thus: The centrifugal clutch is mounted direct on the motor's crankshaft and has an integral sprocket whose chain drives a lay-shaft. This has a 2 in. dia. pinion which meshes with another on a second lay-shaft driving it at the same speed, but, of course, in the opposite direction. A 5 in. dia. gear wheel on the secondary drive shaft can swing radially above the two lay-shafts and can engage with either pinion; depending upon which pinion is in engagement, the direction of travel is determined. The final drive to the traction bogie is by sprocket and chain from the secondary drive shaft and, lastly, a third chain transmits power to the other axle of the bogie.

The reverse is operated from the cab by two long reach-rods, and a trigger which falls into a deep slot ensures that gear cannot accidentally be changed while the locomotive is running. There is no neutral position because the clutch (which engages at about 500 r.p.m.) makes it unnecessary. The only other controls are throttle, choke, ignition stop-switch and hand brake. Overall reduction ratio from crankshaft to rail wheels is 12 : 1, giving a top speed of about 10 m.p.h., and

Continued on page 1032

INTERNATIONAL REGATTA

Continued from page 1018

The International competition has been held annually for over 40 years except for interruptions during the war. In addition to the major award (which was first won by Gems Suzor's *Canard* in 1924), several challenge trophies for boats in the various classes are provided, and under present-day conditions, the comparable speeds attained in all classes makes it possible to group them together in a single continuous race. The only difference in running boats of classes varying in size, weight, and engine power is in the strength and weight of the tethering. All boats are required to cover a timed distance of 440 yards (four laps of 110 yards each), from ½ lap to 5 laps being allowed for warming up to obtain a flying start.

As usual, a number of boats failed to start within the allotted time of three minutes from coming under Starter's orders, or to complete the four laps after starting the clock. Several others attained their best speed after completing their timed run. The D class boats again distinguished themselves, and in one case achieved a new British record. In general, the performance of other boats was largely a repetition of that of the first day's events.

Results (3rd day): M.P.B.A. International Speed Regatta

1. T. Everitt (Victoria), 73.75 m.p.h. (Wico-Pacy Trophy).
2, C. Everitt (Victoria), 73.47 m.p.h.
3, S. Robinson (St. Albans), 70.30 m.p.h.
4, J. Hampton (Portsmouth), 68.15 m.p.h.

Other awards

A class: J. Benson (Blackheath), International Trophy, 64.27 m.p.h.

B class: D. Innes (Altrincham), Miniature Speed Trophy, 58.44 m.p.h.

C class: A. Wall (Coventry), 66.66 m.p.h.

D class: M. Fairbourne (Victoria), Victoria Cup, 60.00 m.p.h.

Prototype Events, Steering Competition

1, P. Kelf (Heaton), 23 points.
2, K. Ison (Hemel Hempstead), 18 points.
3, J. Borton (Buccaneers), 16 points.

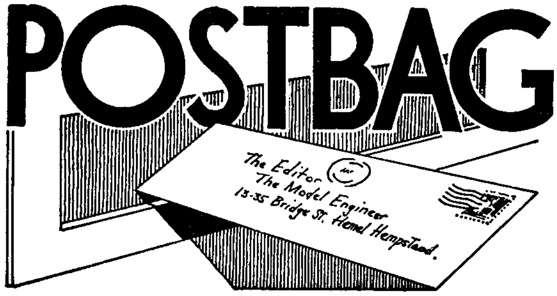
Knock-out Steering Competition

1, J. Borton (Buccaneers).
2, E. Carty (Tynemouth).

Ladies' Steering Competition

1, J. Mullaby, 11 + 3 + 1 points.
2, Mrs. Curtis (St. Albans), 11 + 3 points.
3, Mrs. Drayson (N. London), 11 + 1 points.

A further attraction on the third day was the pond-side live steam locomotive track, which provided additional interest and was kept busy giving children rides behind 3½ in. gauge engines built and driven by members of the St. Albans Model Engineering Society.



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

Standards

SIR,—I was interested to see under the heading of "Smoke Rings" your comments concerning proposals for a unified method of boiler testing and the issue of boiler certificates.

This commentary stirred thoughts of other cases for standardisation in the same sphere of model engineering. Namely, tyre profiles in association with basic trackage dimensions, braking systems and brake hose couplings.

Obviously these latter subjects for consideration most usefully align themselves with the larger gauges, perhaps operating over undulating gradient profiles with large train weights and where ground level track involves the negotiation of turnouts.

Of late my own model engineering interests have been centred around $7\frac{1}{4}$ in. gauge. In this gauge it is actually possible to find a manual recommending a wheel back to back dimension of $6\frac{13}{16}$ in., a recent constructional article in *Model Engineer* with the same dimension at $6\frac{5}{8}$ in., and commercially available wheels on axles for rolling stock at $6\frac{3}{4}$ in. A sure case, you must agree, for a wheel profile and track standard if the finer points of track design are to be taken advantage of to enable comfortable running on "foreign" tracks to take place in complete confidence.

The case in the larger gauges for adequate braking systems not only on locomotives but on rolling stock also has been stated many times before, but no standard appears to exist to define the principal parameters of, say, a vacuum brake system working at x in. Hg or a system working at y p.s.i. It goes almost without saying that a standard for hose sizes and connections would be useful to say the least.

I feel that my foregoing remarks are of particular note in these days of increased private transport facilities for the carriage of locomotives and the increasing interest and enthusiasm for the larger gauges.

May I suggest then, that perhaps *Model Engineer* could be of great service to its readership and their future work by publishing recommended standards, say in the form of pull-out supplements.

East Barnet. P. R. MEAKIN.

Boiler testing

SIR,—I have read with interest your remarks upon the subject of boiler testing in the current *Model Engineer*.

Everyone will, I am sure, agree with you upon the need to test a new boiler thoroughly before it is put into operation in order to make perfectly certain that it is free from structural defects and safe to operate. A hydraulic test to twice the working pressure has been almost universally accepted in the model world as a satisfactory criterion in this respect. Such a test presents no difficulty, if carried out before the boiler is mounted and before too many fittings are installed upon it, as the fewer holes that have to be temporarily plugged the better. Ideally, all bushes intended to take fittings should be left blind at this stage, thus reducing the number of points at which leakage can take place and making the maintenance of a steady pressure that much easier.

When it comes to annual re-testing of a boiler which is installed on a locomotive, the position is very different. Then so many points of potential minor leakage have been introduced that to maintain even $1\frac{1}{2}$ times working pressure without constant pumping may be impossible.

Granted that some loss of pressure will take place in the annual test, what criterion will be used for acceptance and what will it mean? As a matter of interest I have just checked up upon the possible sources of leakage from fittings on one of my boilers and have come up with the surprising total of 40.

Although there is no evidence when the locomotive is under steam that there is any leakage at any of these points, I would not like to guarantee that the whole thing is as tight as a drum, as it would need to be if the usual criteria of hydraulic tests are to be applied. I suspect, for instance, that my Stroudley type regulator would prove a source of some slight leakage and there may be others sufficient in toto, to be significant.

The annual re-testing of installed boilers may, therefore, be impracticable and I would prefer to see a time limit of, say, five years put on the validity of the original test after which re-testing to twice working pressure should again be required. By that time the locomotive would probably be due for a complete overhaul so that removal and stripping down of the boiler would be an accepted proposition.

Finally we should not forget that we are dealing with model boilers which are not used very frequently or under very exacting conditions and should not take too much notice of what is done in full-size boiler insurance circles.

I hope this does not sound too incautious but we have to be realistic about what is practicable and necessary.

Orpington. R. S. GARLICK.

L.N.W.R. locomotive

SIR,—That photograph of *Dreadnought* on the cover of the last issue of M.E. is the best illustration printed for a long time; how fortunate it survived the "blitz" and other risks so often fatal to photographs.

There is no excuse now for over-size handrail knobs, huge buffer heads, and other errors so often made, while the way the rivets are disposed round the smokebox should be carefully noted—use a magnifying glass.

Note also that the coupling rods are only very slightly swelled towards the middle; this feature of many locomotives was often exaggerated on models, with very ugly results.

Many locomotive engineers thought that if they swelled the coupling rods towards the middle, the rods were better proportioned to resist the stresses involved, and their weight reduced for a given strength, but the extra cost involved must have been considerable.

Note the base of the chimney, not a clumsy casting as so often used, but a steel fitting which seems to have been pressed up from a plate only about ⅛ in. thick; it is probable that one of the hydraulic presses at Crewe would have taken only a minute or so to produce these, when the tools for piercing and stretching the red-hot blanks of steel plate had been made, in building a whole class of locomotives.

In that wonderful work, "A Text-Book of Mechanical Engineering," by Lineham, will be found drawings of the hydraulic plant installed at Crewe by Mr Webb to the design of Mr Tweddell, so that when Mr Whale built his engines he had a wonderful mass production plant at hand; there was also a little riveter with a specially shaped frame, to rivet the domes—British industry even now can learn a lot from the methods Mr Webb used.

It is much to be hoped that equally good photographs of the later Whale engines are in existence, so that those who never saw the Crewe products in their prime can examine them.

Mill Hill. H. H. NICHOLLS.

Bulleid Pacifics

SIR,—In reply to Mr B. Manning's letter, M.E. August 18, regarding the Bulleid Pacifics, he will be pleased to note that to date three Pacifics are to be preserved, two of which are unmodified.

They are "Battle of Britain" No. 34051 *Winston Churchill*, preserved by British Rail and destined for the transport museum at Clapham; secondly, "West Country" No. 34023 *Blackmore Vale*, preserved privately by the Bulleid Pacific Preservation Society, 52 Ruskin Drive, Worcester Park, Surrey; and, finally, modified "Merchant Navy" No. 35028 *Clan Line*, by the Merchant Navy Preservation Society, 9 Haslebury Road, Totton, Southampton.

Nos. 34023 and 35028 are, I believe, to be used occasionally for hauling special trains for railway enthusiasts. More details about this would be available from the addresses given above.

The month of July saw the withdrawal of all remaining examples of the Bulleid Pacifics from British Rail, due to the electrification of the Waterloo-Weymouth section. To commemorate their passing, British Rail ran five special trains, four from Waterloo and one from Bournemouth, on July 2, but at the time of writing I have no details of the specials, other than that No. 35028 hauled the 12.20 Waterloo-Bournemouth.

Wigan. B. R. WOODWARD.

Tank engine

SIR,—I hope, in due course, you will publish drawings and details of the tank engine outlined by K. N. Harris.

It will be a welcome addition to those small locomotives described by LBSC, Martin Evans and others, all of whose work has been appreciated.

Devon. E. W. THOMAS.

Limited cut-off

SIR,—When interest in "Limited cut-off with auxiliary ports" was sweeping the U.S.A., the Denver & Rio Grande Western Railway announced that they had put into service a number of big engines so fitted.

Wondering whether this was to enable use of longer laps with standard valve travel, I wrote to the Chief of Motive Power of the line and enquired. In his reply, he said that laps and cylinder dimensions were as normally fitted to the class, but maximum valve travel was reduced to provide full-gear cut-off at main ports of 60 per cent, instead of the usual 88 per cent. He also said that the object was to counteract the tendency of enginemen to run in full gear at all times, regardless of gradient, to the detriment of fuel consumption on that mountainous line.

Windsor, Ont. H. S. GOWAN.

Diagonal engines

SIR,—I would like to comment on Mr H. H. Nicholls' letter in *Model Engineer* September 1, under the heading "Diagonal engines," in which he refers to the peculiar features of this type of marine engine.

Apart from the cylinders being below the crankshaft, and at an angle of about 25 deg. to the horizontal, there are no features on it which differ from the vertical type of marine engine. The general arrangement is different, but I do not think that it is at all peculiar.

In the past ten years, I have made many enquiries from marine engine builders, regarding drawings of a diagonal engine, and I think I am right in saying that no drawings of this type of engine are available from Messrs. John Brown, British Railways or Cornwall Laird ! The names of Laird and William Henderson, as marine engine builders, are unknown to me, so I can say nothing about them. It may still be possible to obtain drawings from the Fairchild Engine Co. or Heming & Ferguson.

The only components of a diagonal engine below the starting platform are the cylinders and valve chests; but as both the fronts and backs are visible, their modelling should not present any problem to a determined builder. The row of levers referred to on the starting platform are for operating the (1) regulating valve, (2) reversing engine, (3) impulse valve, and one lever for each drain cock on the cylinders.

The legitimate function of the impulse (or starting) valve is to move the crankshaft, so as to get the H.P. crank off the top or bottom centre, if it happens to be there when the engine is to be started; it is not for running the engines. It is, or perhaps I should now say it was, the practice for engineers to stop the engines, with the H.P. crank off centre: or to use the reversing engine momentarily to get the H.P. crank off centre.

Both Mr Nicholls and Mr R. R. May, whose letter on stationary engines appeared in the same issue, echo my own sentiments in their plea for fuller authentic details (and I emphasise details) of full-size engines. The second paragraph of Mr May's letter expresses my own view much better than I could express it myself.

I would like to say that, for everyone interested, the model of a compound diagonal paddle engine in the Edinburgh Museum is superb, the paddle boxes alone are worth a visit, and while you are there, take a look at the other models, which are all to the same incredibly high standard.

Hayle, Cornwall. A. G. HANN.

Compound engines

SIR,—I quote from a letter by H. T. Ellis in M.E. February 3, 1967, referring to Messrs. Haining and Tyler's model Fowler ploughing engines. "Surely 75 pounds per square inch is too low for successful compound working."

I quote again from a booklet dated 1916 issued by C. Burrell & Sons Ltd., giving their instructions for working their compound traction engines. (Incidentally this booklet is a reproduction of the original Burrell instruction book and republished jointly by the East Anglian Traction Engine Club and the Fairground Society). "The proper working pressure for a compound traction engine is from 180 to 200 lb. per square inch, and it is important that the pressure be kept well up. When working with 180 lb. the exhaust from the larger cylinder will only be about 25 lb., and if the boiler pressure is dropped to 115 lb., there will be insufficient exhaust to cause the necessary draught up the chimney, so that the boiler will cease to do its duty, etc., etc. With a working pressure of 75 lb. in the model engines the exhaust from the larger cylinder must be below atmospheric pressure (14.7 lb.) so how is the fire kept burning ?

Kenilworth, Warwicks. "COMPOUND."

Mill engine

SIR,—Re Mr Kershaw's letter and the Glasgow Mill Engine. This, as he suggests, is a pure Wood Bros. engine, although undoubtedly built by Marsdens. The Corliss valve gear is Wood's type for all cylinders.

Bristol. G. WATKINS.

The late Rev. Shores' models

SIR,—I was most interested to read the letter of Mr T. W. Waterhouse in *Model Engineer*, August 18; also to see the photograph of the model undertype engine in question, which was once owned by the late Rev. J. Shores.

This model is now the property of Bingley Urban District Council, together with 23 other models, which form the W. H. Smith collection, which is permanently housed in a special room at the Bingley Central Library.

This collection of models was presented to Bingley by Mr W. H. Smith, a well-known local townsman, in 1944. He was in business and head of the engineering firm of B. Smith & Son Ltd. He was also an enthusiastic model engineer, having a very well equipped workshop at his home, and maintaining an interest until his death in 1963. Mr Smith, like so many people interested in the steam engine, had a great love of music, his main interest being the organ, a fine example of which he had built into his Bingley home.

A great friend of the Rev. J. Shores, Mr Smith often spent the weekend with him at his home at Wellbury near Darlington in the nineteen-twenties.

Any reader wishing to view these models should get in touch with me, the custodian, as follows, by letter: W. Hubert Foster, Riversdale, Holyoake Avenue, Bingley, Yorkshire. Or by telephone between 9 p.m. and 10 p.m. at Bingley 3847, when I will make arrangements to view.

Bingley. W. HUBERT FOSTER.

Turning stainless steel

SIR,—I can confirm Mr Shepard's experience that brush application of coolant is unsuitable for turning stainless steel. I haven't tried "Dromus F" for I very rarely turn stainless steel, but recently a friend asked me to part off a quantity of 2 in. washers in this material, and after experimenting with various mixtures got excellent results from a continuous stream of diluted "Wow," this being an industrial detergent which cost me 6s. for a gallon at a market, and resembles liquid soap. In truth I was using "suds"!

For general work on stainless, I can recommend Sandvik S6 grade tipped tools running at 800 ft./min. if possible, but plenty of power is needed at this speed, and small lathes are usually under-powered.

Dudley, Worcs. R. F. WILLETTS.

Froment clock

SIR,—I would like to congratulate Mr J. R. L. Orange on his beautiful Froment clock. I do not, however, agree with his remarks about Frank Hope-Jones. The brilliant combination with W. H. Shortt which produced the Synchronome-Shortt clock, the only mechanical clock to produce accuracy with extreme reliability, cannot be dismissed as being blinkered by preconceived ideas.

Hope-Jones said that Froment, with or without the adaptations after Froment, was, like Hipp, good—but not good enough. This, I feel, is fair comment and taken with Hope's statement that every now and again the contact will fail has been amply demonstrated. As far as I know, the Sychronome gravity switch holds an unrivalled position for reliability and when the date of its introduction is considered (1895) this must be admitted to be an achievement.

My ½ sec. Hipp built to the design in Hope-Jones' book "Electric Clocks and How to Make Them" has a steady rate and an accuracy of ±2 sec. over 90 days, this error being probably due to temperature errors in pendulum compensation and suspension spring. However, the point here is that the contact has failed twice in 12 months.

It may be that Mr Orange's further articles will show us how to avoid contact unreliability. I hope so.

Generally, clockmakers make statements like "Very accurate." I look forward to the day when they will give us the figures. In the meantime let us allow Hope-Jones to be remembered as the man who showed us the way.

Ruislip. L. F. J. KIRKBY.

Electronic gauge

SIR,—Mr J. W. Porteous' article "Electronic Lathe Setting Gauge" published in the August 4th issue is interesting, but seemingly a bit illogical. He builds his capacity-coupled grid dipper to be sensitive to 1/1,000 in., yet he says its main design purpose is to gauge material too rough for an ordinary dial indicator. If also the other condition existed where the object were of irregular shape, wouldn't it be difficult to ascertain much from the meter fluctuations as to when the object was properly centred ?

The device is also impossible to set-up to read directly in any unit because the sensitivity must vary with the mass, the type of material and the general surroundings. Perhaps Mr Porteous would be willing to comment on these statements.

San Francisco, U.S.A. F. L. REYNOLDS.

TENDER TO LOCOMOTIVE

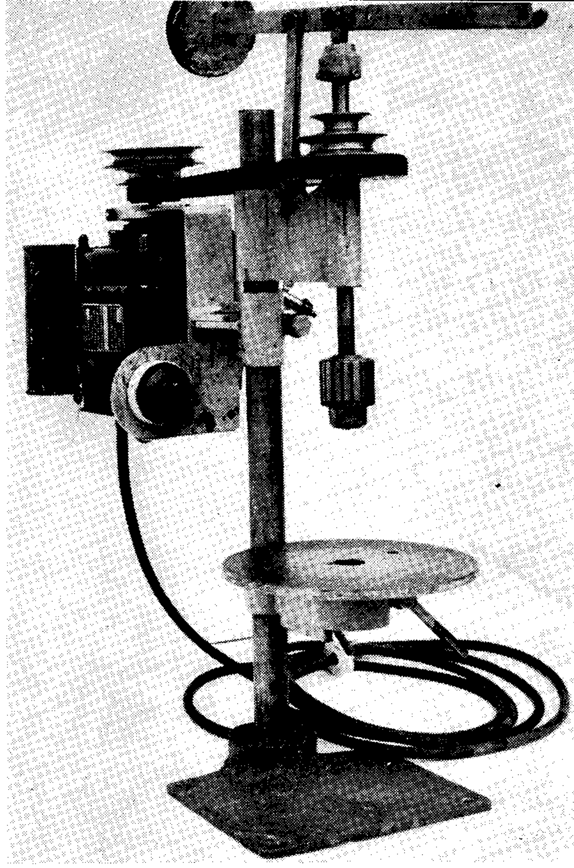
Continued from page 1029

although the traction bogie is locked in the straight position on account of the chain drive, the swivel of the rear one is sufficient for curves of 25 ft. radius to be taken with comfort and safety.

The roof of the locomotive is hinged for easy access to all working parts and to the recoil starter. I am currently fitting sanding gear because although *Daisy* will haul four adults up a gradient of 1 in 17 (which my track unfortunately includes) on a dry rail, any wet or frost on aluminium alloy rail produces furious wheelspin.

A SIMPLE DRILLING MACHINE

by W. E. Smith



THIS DRILLING machine was made largely from odds and ends. The only parts purchased new were: one $\frac{3}{8}$ in. capacity chuck, two matching 3-step pulleys, one used $\frac{1}{6}$ H.P. BTH motor.

The column is round b.m.s. $1\frac{1}{4}$ in. dia. and stands in a gas cut circle of $\frac{7}{8}$ in. plate, bored out to suit, and welded to a piece of $\frac{1}{4}$ in. plate, roughly $8\frac{1}{2}$ in. square, secured at the rear by a $\frac{3}{8}$ in. Whit. set screw.

A hole in each corner enables it to be screwed to the extreme corner of the bench. The whole can be swivelled round, greatly increasing its capacity. Two bronze bushes, originally purchased for a now defunct car, were bored and reamed to $\frac{9}{16}$ in. dia. That fixed the spindle size. Neither of my two drills were more than 3 in. long so that determined the drilling depth.

A $3\frac{1}{2}$ in. length of $1\frac{1}{8}$ in. dia. b.m.s. was bored to take the bushes and a 3 in. length of $1\frac{3}{4}$ in. bored to fit the column. A piece of $\frac{5}{16}$ in. plate was carefully squared and welded in between, giving a centre length of $4\frac{3}{4}$ in. This was then checked with the aid of long rods and corrected in both directions, one direction needed a slight twist, and the other a few taps with a heavy hammer. Slight distortion is bound to take place when welding but can be corrected by twisting or stretching.

Four pieces of $\frac{3}{4}$ in. dia. round b.m.s. 1 in. long were drilled through $\frac{3}{8}$ in. dia. then tapped half-way $\frac{7}{16}$ in. B.S.F. One was welded to the column sleeve in the centre at right angles to its axis. The bushes were then pressed in and carefully reamed to a tight fit. The $\frac{9}{16}$ in. spindle was fixed in the 3-jaw and the bushes lapped or mated together with the aid of some thin oil, moving it over the whole of the surface to be used. Then the column sleeve was sawn through the middle of the welded-on $\frac{3}{4}$ in. piece; a 1 in. long $\frac{7}{16}$ in. B.S.F. bolt and plain washer was screwed in and that part completed. The same clamping arrangement is used to carry the motor bracket and drilling table, so two more were made. The drilling table, I considered, needed a big hole to accommodate such things as connecting rods when drilling the big end bolts clamped firmly in Martin Cleeve's excellent vice.

A short piece of 2 in. dia. round material was chucked, faced and turned down to $1\frac{3}{4}$ in. by $\frac{3}{8}$ in. deep (the plate thickness). The plate was bored to suit, the edges of both deeply chamfered, pressed together and welded. The stub was then mounted truly in the 4-jaw, bored to 1 in. and faced right across removing the surplus weld at the same time. The same clamping device idea was used for the table, the two sleeves being connected together with a piece of $\frac{3}{8}$ in. plate. Each of the clamping bolt heads were fitted, marked, removed and tapped $\frac{1}{4}$ in. B.S.F. and short levers of $\frac{5}{16}$ in. round material made and screwed in.

The $\frac{9}{16}$ in. S.S. spindle was now turned down to $\frac{1}{2}$ in. dia. for a few thou less than the thickness of the ball-race then secured by tapping the end 2 BA with the help of a plain washer and cheesehead setscrew. A keyway was then cut, and the bottom end screw-cut to take a $\frac{3}{8}$ in. drill chuck, $\frac{1}{2}$ in. × 20 T.P.I.

I considered a new chuck a sound investment in the interests of accuracy and have been very satisfied with the results.

Next, a piece of $1\frac{1}{2}$ in. b.m.s. $1\frac{1}{8}$ in. long was bored out to $1\frac{1}{8}$ in. (the outside diameter of ball-race) after drilling right through $\frac{5}{16}$ in. The depth of the bore for the ballrace was $\frac{5}{16}$ in. and a further $\frac{1}{8}$ in. at 1 in. dia. was allowed to clear the securing washer, and also room for a dab of grease. The remainder of the $\frac{5}{16}$ in. hole was tapped $\frac{3}{8}$ in. This was then reversed in chuck, faced and the top edge heavily relieved chiefly for appearance. A flat washer, turned to $1\frac{1}{8}$ in. O.D. and $\frac{9}{16}$ in. I.D., was assembled with the ball-race in the housing. Three pointed 2 BA screws were used to force the flat washer against the ball-race.

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