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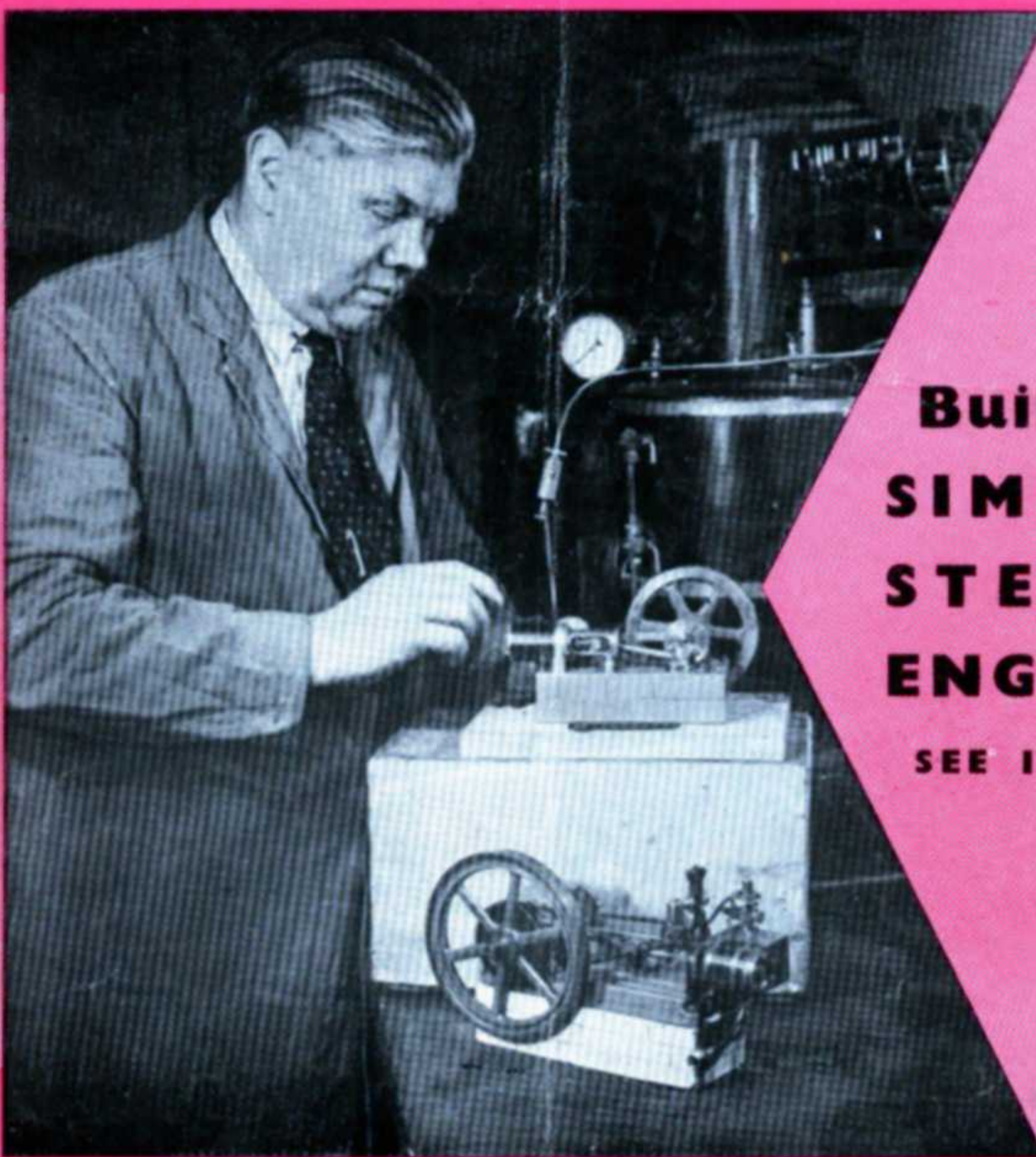

Build a SIMPLE STEAM ENGINE

SEE INSIDE

ONE SHILLING

Model Engineer

11 OCTOBER 1956 VOLUME 115 No 2890

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IN THIS ISSUE

NEXT WEEK

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

SMOKE RINGS

A WEEKLY COMMENTARY BY VULCAN

I AM PLEASED to see a welcome step forward in the system of educating technical students. My own view on education, for what it is worth, is that insufficient attention is paid to practice; there is too much concentration on theory and academic study.

I would like to see school-leavers more fitted to grapple with commercial and industrial life; too often their education begins in earnest only when they have hung up their satchels.

Huddersfield Technical College, however, has adopted a plan after my own heart. They have instituted a four-year "sandwich" course for the Higher National Diploma in Mechanical Engineering which entails spending alternate periods of six months at the college and at an engineering works. I wish the scheme every success.

Deadly diesels?

ARE DIESELS more destructive of the fauna of a country than their dignified predecessors, steam locomotives?

According to "Peterborough," writing in the *Daily Telegraph*, there has been some comment on the number of birds and animals which the new diesels have slaughtered in the Norfolk and Suffolk areas. One correspondent, he says, saw two pheasants killed on a short journey despite warning blasts on the hooter. There were, also, several near misses.

It is thought that the quietness of the trains may be deceiving the local animal inhabitants, as game birds in particular select the dry gravel ballast as a convenient resting site.

But "Peterborough" believes there may be another answer. He observes that in the modern diesel-car passengers can sit near the driver and watch the track ahead. He maintains that just as many animals are killed by steam engines but their destruction is seen only by the engine crew.

Letters for lamps

A NOTICEABLE FEATURE of British Railways' new multiple-unit interurban diesel trains is that they carry no headlights. The time-honoured headcodes which identified the types and, in some areas, the routes or destinations of trains, are to go.

On the new trains, the headcodes have been superseded by the large train code letters (at least in two cases) A for express passenger and B for ordinary stopping passenger trains. These letters can be illuminated from the back for night use; otherwise, there is no provision for power head-lamps, but there are brackets for carrying oil lamps which, presumably, will be used as tail lamps only.

It seems, therefore, that when diesel locomotives are in use for all kinds of trains, passenger and freight,

SMOKE RINGS . . .

the identification will be made by letters alone. This seems slightly ironical, in view of the fact that there already exists a system of letters whereby the present various lamp codes can be learnt visually by imagining the letters to be entwined round the lamps !

They die hard

HOW often we see either the names, or the appropriate initials of the old pre-grouping railway companies used in unexpected circumstances.

For example, at some of the London termini, when overseas mails are expected off a boat train, the initials G.W., L.N.W., G.N.R., S.E.C.R., L.B.S.C., L.S.W., etc., will be found chalked on the platform at spots where the mails for the respective destinations will be deposited as they are unloaded.

A Manchester enthusiast who recently spent a holiday in the southern counties, reports that one day he was sitting on Newbury station and saw a local train depart for Reading. At the rear of the train was a Southern Region horsebox painted in the present British Railway's standard red livery, but in the bottom left-hand corner, in yellow paint, appeared the following wording:

"NOT TO RUN ON S.E. SECTION OF L.B.S.C. RLY."

It is now 33 years since the old London, Brighton and South Coast Railway lost its identity !

Bus problems

THE ubiquitous bus which has driven the tram from the streets of the big cities had always to play second fiddle to the railed-vehicle in one important respect. Unless its body was based on an unwieldy six-wheel chassis its capacity was considerably below that of the tram. In London the average ratio was 56 to 70.

But since the restriction limiting buses on four-wheel chassis to 27 ft has been modified—vehicles of 30 ft now being permitted—the bus has been growing apace.

When I visited this year's Commercial Motor Show at Earls Court I was struck by the number of four-wheel buses which could accommodate more than 70 seated passengers—a capacity in excess of the mammoth trams which ran in London.

But is this a desirable development ? London Transport do not think so. Their latest prototype, the Routemaster, which has been running experimentally in London for several months, seats only 64, which is regarded by them as the optimum number.

Economics

Beyond that capacity, they say, the collection of fares during congested working and the operation of the bus during off-peak hours presents difficult economic problems.

I know that in one London district experiments were made on 70-seater trolleybuses with an additional conductor collecting fares on the upper deck over some of the short, highly-congested sections of long trolleybus routes. The idea, however, finally proved impracticable.

The problem seems to me to be aggravated by the operators' insistence on a universal vehicle that will fulfil all needs. This attitude has been dictated by the savings afforded in maintenance, but are more serious problems created by its adoption ?

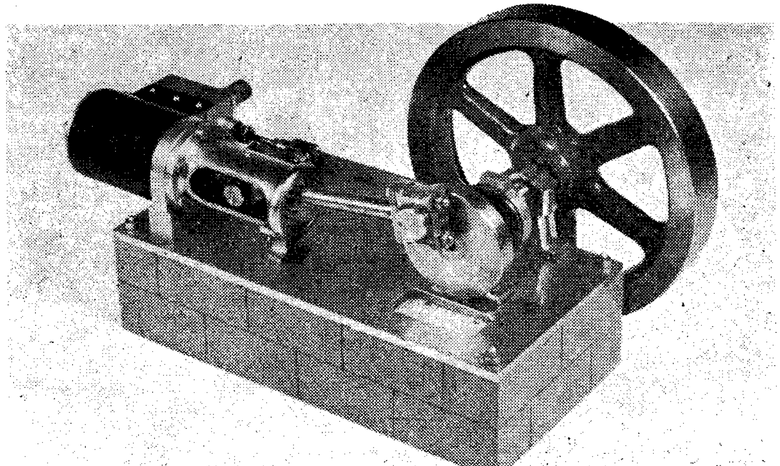
Could not this whole question of bus operation be solved by segregating the different classes of working and designing buses to meet these specific needs ? After all, that is the basis of railway operation.

Venerable junior

"SENIOR JUNIOR" is a description which fits Edward George Dickinson of Bexhill-on-Sea. Mr Dickinson joined the Junior Institution of Engineers when the Institution, like himself, was young. It had in fact existed for just two years and three months and was trying out its fourth new name—the Junior Engineering Society. One of its rules declared that "no gentleman above 26 years of age be eligible for membership."

All this was 70 years ago; and Edward George Dickinson is still a member of the J.I.E. He also has the distinction of being the senior honorary officer. During the Seventh Session, from October of 1887 to September of 1888, he served as honorary auditor.

"The duties of that year," observes the Journal of the J.I.E. for October 1956, "appear to have been comparatively light and free from complications; the receipts for the year were £25 18s. 11½d. and the expenditure £20 1s. 9½d."



A picture of the stationary steam engine designed by E. T. Westbury. First part of the short serial dealing with its construction starts next week

Cover picture

Our technical adviser, Edgar T. Westbury, is testing Theseus, the simple steam engine, the construction of which he is describing in a series of articles in this journal. Also in the same series he will give details of the building of Perseus, which is basically the same engine and can readily be built from castings which will be available.

UNUSUAL LOCOMOTIVES

Part four — By Ernest F. Carter

Steam trams and tramway locos

TODAY THE DISTINCTION between railways and tramways is a very definite one. But it has not always been so—tramways being often worked as light railways and *vice versa*. Thus the steam tram and steam tramway locomotive represent something of a transitional phase in the history of railway transport engineering in which they took their place between the age of horsedrawn tramcars and those propelled by electricity.

In 1858, long before the advent of the first steam tramcar, a certain Mr Curtis inaugurated a horse-drawn tramway system in Liverpool —and within two years the American, G. Francis Train, opened the famous Birkenhead tramway. But it was not until the year 1870 that John Grantham propounded his pioneer scheme for a steam-propelled tram-car to the old-established firm of Merryweather, which had already fought and overcome untold official prejudice against the use of their steam fire engines.

The Grantham steam tramcar, as finally built by Merryweathers in association with the Oldbury Carriage and Wagon Co., weighed 6½ tons empty, and was a double-deck vehicle (30 ft in length overall) seating 20 passengers inside and 24 on a knife-board seat on the top deck.

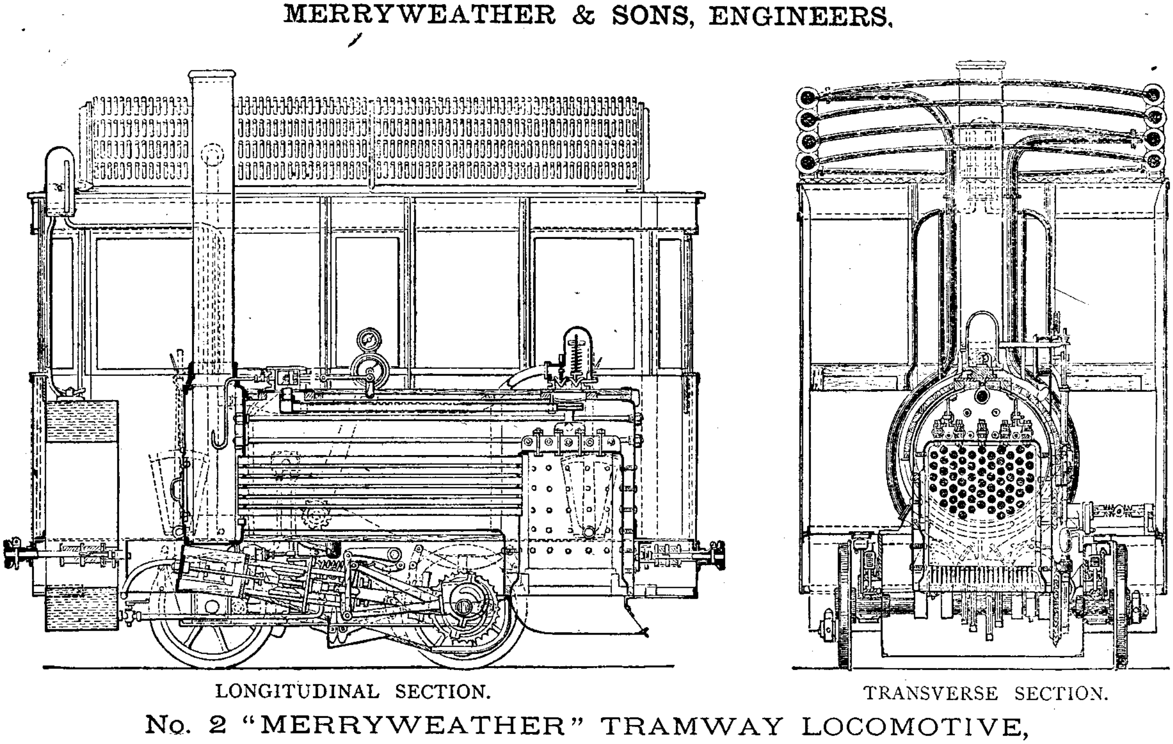
Amidships, on either side of the car, was a boiler chamber—each chamber housing a small vertical boiler 1 ft 6 in. in dia. and 4 ft 4 in. in height, fitted with the then popular Edward Field patent blind water tubes, which, with their inner circulating tubes, depended into a 15 in. dia. firebox. The two boiler compartments were separated from each other × a passageway, opening to the interior of the car at either end to provide for communication between driver, conductor and passengers.

The two-cylinder simple engine, with its 4 in. × 10 in. cylinders, was placed below the car floor and drove directly on to a single pair of 2 ft 6 in. dia. track wheels, one wheel of the second pair of wheels (set at a 10 ft wheel base) being loosely mounted on the axle to allow for short radius curve working.

Additional features, patented in 1872, are shown on the one-eighth scale model in the Science Museum at South Kensington. It incorporated flangeless driving wheels and swivelling axles for the other wheels, rendering the tram dirigible for use on

The condenser was so efficient on this locomotive that the engine could be worked all day on 50 gallons of water

MERRYWEATHER & SONS, ENGINEERS.



LONGITUDINAL SECTION. TRANSVERSE SECTION.

No. 2 "MERRYWEATHER" TRAMWAY LOCOMOTIVE, the highway. The latter wheels are loose on their axles. There are also two axles with flanged wheels which can be lowered by levers until they bear on the rails.

Early in 1873, the full-size Grantham Merryweather steam tram was completed. It was worked experimentally on a 350-yard length of railway track at West Brompton, where it averaged 11 m.p.h. with 90 p.s.i. of steam in the boilers. Then later in the year—at midnight on November 26—further trials took place on the horse-tramway track in Vauxhall Bridge Road, between Victoria and Vauxhall; but deficiency in boiler power, difficulties in firing and dirt in the groove rails of the tramway ruined the engine's performance.

Nevertheless three years later, after being modified by Edward Woods, the tram was taken to the then newly-opened Wantage Tramroad, upon which it became the first power-driven vehicle to be put into service. There it continued working until 1881, though in the meantime a Merryweather unit-type tram engine had been supplied to assist with the increasing traffic of the line.

Public opinion was very discouraging in those far-off days and the Board of Trade regulations, imposed under the Tramways Act of 1870, restricted the use of steam-driven vehicles—on or off rails—on the highway to such an extent as to render the design and building of a power-driven steam tramway locomotive an extremely difficult problem. The Act demanded that no visible smoke or steam should be emitted, that there should be no noise produced—either by the exhaust beat or by the machinery—and that all working parts should be concealed from the public gaze at all points above four inches from rail level.

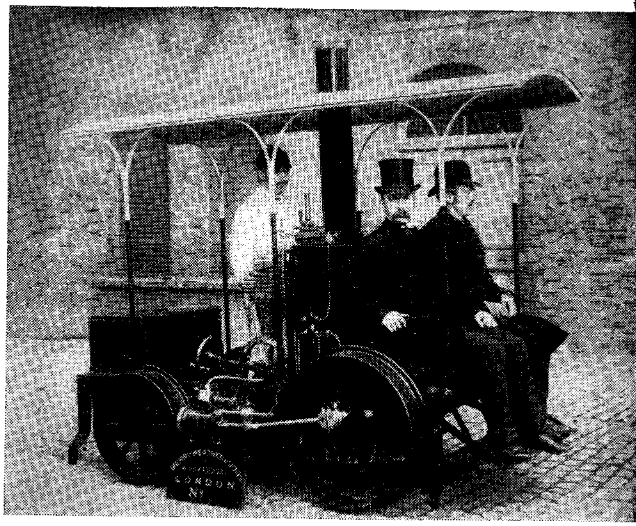
Admittedly the Act did over-ride the 4 m.p.h. speed limit imposed by the Acts of 1861-65, but none-the-less it insisted on the fitting of a positive governor to shut off steam at a vehicle speed of 10 m.p.h.!

But though progress in this country was hindered and hamstrung by Parliament, the year 1875 brought an Englishman, Palmer Harding, to Merryweathers to discuss a concession he had obtained to work the Southern Tramways of Paris by steam—though unlike Grantham, he had decided upon the use of separate engines to haul the passenger-carrying cars.

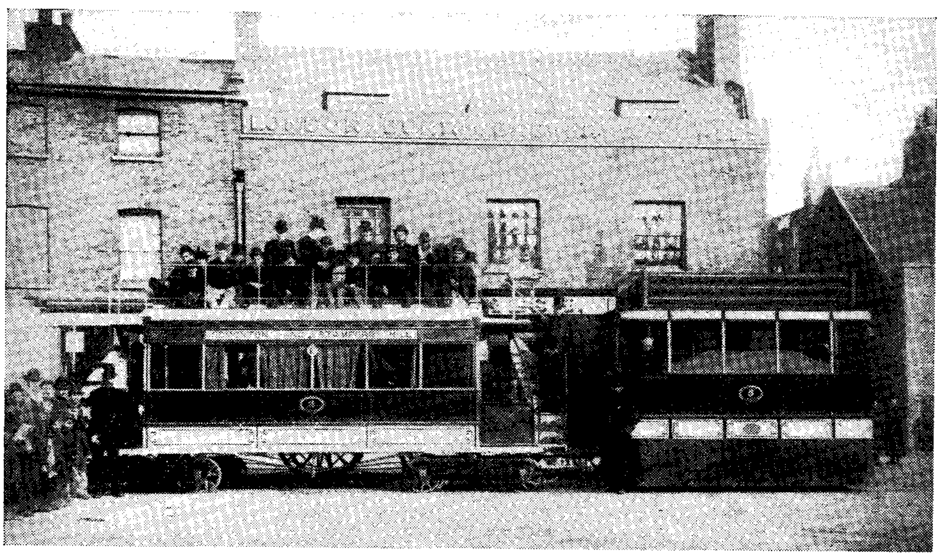
Merryweathers delivered the pioneer tram engine in Paris in November 1875. This little engine weighed only two tons and measured but 5 ft 3 in. over headstocks. It had one small Field-tubed boiler and two inside cylinders 5 in. × 9 in. which drove directly on to the running wheels, which were rod coupled.

Early the following year a similar engine with 6 in. bore cylinders was delivered, but the remaining 44 Merryweather locomotives supplied in 1876 and 1877 were fitted with ordinary horizontal loco-type boilers.

In 1876 a demonstration trial took place at Dewsbury, on the $3\frac{1}{4}$-mile Dewsbury, Batley and Birstal Tramway, when a man on horseback rode

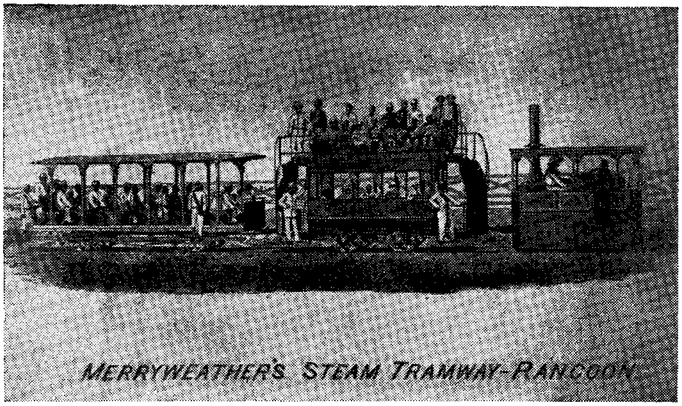


Merryweather inspection car, 1886



Top right: This line was opened in 1883

Left: A car on the North London Tramway, 1885



on ahead of the tram! Three years later the Merryweather tram engine was at work on the tramway, and was so successful that it was followed by four more in 1880 and a further four the following year. The double journey was performed 25 times each day at an average speed of 6 m.p.h. including all stops, or 32 minutes for the single journey.

The following is the specification of Merryweather's Dewsbury type tram engines:

Cylinders: Two 6½ in. × 10 in. mounted inside frames with central valve chest and two separate saddles for support of boiler at the smokebox end. Guide bars of steel with cast steel crossheads and slippers of cast iron. Stephenson link valve motion with oil cups either forged or cast solid on moving parts.

Boiler: Locomotive type of Lowmoor iron fed by eccentric-driven pump and Gifford injector. Working pressure 140 p.s.i. Two safety valves, one "lock-up."

Tank: 100 gallon fitted in front of smokebox.

Condensers: 240 1 in. o.d. 26 s.w.g. copper tubes arranged in four horizontal layers on the roof. Tubes coated with brown varnish to improve radiation. Condensed water and remaining exhaust steam fed to a separator and thence to feed tank. Condenser so efficient that engine can be worked all day on 50 gallons of water.

Casing: Whole locomotive enclosed by sheet-iron casing 12 ft long by 6 ft 4 in. wide up to 8 ft 6 in. above rail level.

A pedal-operated steam brake fitted to all wheels and a ball governor mounted at one side of footplate to shut off steam and apply the steam brake at 10 m.p.h. All operating levers duplicated at either end of engine. Speed indicator fitted driven by a band from the governor shaft, which is driven by pitch chain direct from the crankshaft. Consumption of coke in one day's working of 72 miles costing 5s. 2½d. Driver's wage for the day: 5s. Total cost of running: 1.09d. per mile.

In the meantime Merryweathers had been selling tram engines all over the world, for the successful operation of the Paris tramways by their use had not passed un-noticed by the engineering fraternity. Steam tram engines were supplied in 1877 and 1878 to work 13 miles of metre-gauge tramway at Rouen; also for use on the Dutch-Rhenish Railway between La Hague and Schiveningen, between Wageningen and Ede, and for 5½ miles between Leyden and Katwyk-on-Sea. In Spain, on the Barcelona and San Andres Tramway, where, owing to the climate non-condensing machines were required, the engines were fitted with 7 in. bore cylinders.

The Guernsey line

The three miles of 4 ft 8½ in. between Guernsey, Peter Port, and St Sampson, on the island of Guernsey when opened on 3 May 1879, were worked over a ruling gradient of 1 in 32 by six Merryweather engines with 7 in. bore cylinders; while the Cassel Tramway, from Cassel to Wilhelmshone, a distance of 3½ miles, was worked by 8-ton engines with 7¼ in. × 12 in. cylinders over a maximum gradient of no less than 1 in 16.

May 1879, saw 2¼ miles of 5 ft 3 in. gauge line opened in the antipodes—at Adelaide. Another steam-operated tramway was opened at Wellington. Then in 1883, a similar line was opened at Rangoon, while other Merryweather locomotives found their way to Buenos Aires and Brazil—on the Dom Pedro tramway. So popular did the steam-hauled tram become that between 1875 and 1892 Merryweathers constructed no less that 174 steam tramway locomotives of various gauge and cylinder capacity.

In this country the North Staffordshire Tramway, with its 10 miles of 4 ft gauge line from Stoke to Hanley, commenced to be worked by Dewsbury type engines in April 1891—one of which with 10 in. × 14 in. cylinders comfortably doing its strenuous job over portions of 1 in 14 gradient between Hanley and Longton. Similarly, on the 2 ft 6 in. gauge Alford and Sutton Tramway in Lincolnshire, which was opened on 2 April 1884, the little Merryweather steam giants gave a brilliant performance.

But it was not until 1885 that the steam-worked tramway finally—reluctantly, it seems to us today—came to London, and the North London Tramways Company began operating the first of 15 Merryweather tram engines on April 1, on their line between Finsbury Park and Edmonton via Ponders End and Tottenham, a route of nearly 10 miles. The steamers ran alternately with horse trams, and were, therefore, governed at eight miles per hour!

Development of the steam-hauled tram in London, however, went no further than the North London system, which eventually had 15 engines running. It seems that the cause of the lack of interest was largely due to the locomotives being too heavy for the light horse-tram road, which would have required considerable modification to take their continued running.

Heyday of the horse

It must be remembered, too, that at the time there were no less than 42 miles of horse tramways in London, and that the General Omnibus Company alone owned over 8,000 horses, 11 of which were needed for every tramcar—five pairs working in shifts, with one spare horse in the stables. A tram horse's working life was only four years, some 1,600 being completely broken down every year and sent for slaughter. But despite humanitarian objections to horse-drawn trams, steam was never really popular on the tramways of England—the public being always secretly afraid of disastrous boiler explosions, of which there were many in those days.

By 1891 it was becoming clear that the days of the steam tram were numbered. Electrical engineers were beginning to propound schemes even more grandiose than the earlier dreams of the steam engineers; Edison was even talking of an electric tramway upon which cars would cruise at 100 m.p.h. and "200 m.p.h. when time is an object."

But electric traction was impersonal and thus did not appeal to James Compton Merryweather, who loved steam and all that went with it; so he quietly returned again to his steam fire engines, and the exciting interlude of the steam tramcar was over. ■

PLASTICS in model engineering — 8

Catalin and Nylon

Continued from 27 September 1956, pages 446—448

By E. T. WESTBURY

CERTAIN TYPES of thermosetting resins can be cast, moulded or extruded in the raw or "uncured" condition, without reinforcement by fillers or laminated fabrics, but their properties are not always satisfactory, due to such faults as dimensional instability, brittleness or internal stresses, and only one or two have been found entirely successful in commercial production when produced in this way.

The cast resin known as Panilax, made by the Micanite Co., has already been mentioned; this is opaque, with the characteristic brown colour which often causes it to be confused with its associated product Paxolin, though its mechanical properties are very different. This material has very good machining qualities, and I have used it successfully in electrical work and patternmaking, but in some cases I found it liable to crack without apparent reason.

Cast resins can be produced in very light colours, either opaque or transparent. They often darken on prolonged exposure to light, or have instability in colour—a very good reason for producing them only in brown or black. This does not apply, however, to Catalin, which is produced either in clear transparent form or in a wide range of stable colours, either opaque, translucent or transparent.

In its original state, this material is a liquid, and can be coloured by means of dyes, or mottled, veined or variegated by partial admixture of opaque pigments immediately before casting. Lead moulds are commonly employed for stock rods or sections, and while still in the moulds, the materials are subjected to a slow curing process at moderate temperature. The final product is non-inflammable, non-absorbent, and resistant to oil, petrol and most chemicals encountered in domestic or industrial use. Standard sections include round rods and tubes, rectangular and hexagonal bars, and a wide variety of both ornamental or utilitarian shapes.

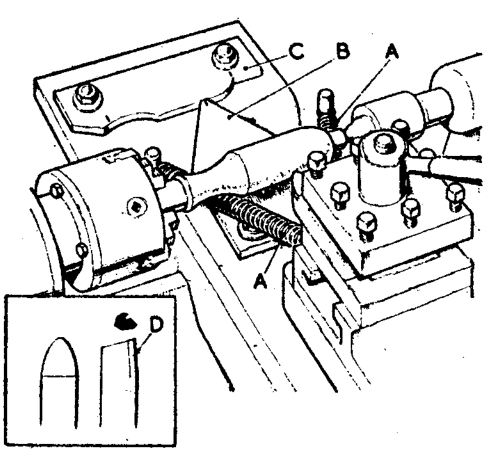
Catalin can be turned readily either by hand or slide-rest tools, using tool forms and speeds similar to those for other plastics which have been described. For production work, Stellite or tungsten-carbide tipped tools are recommended, with zero top rake or negative rake up to 7 deg., and 10 to 20 deg. front or side clearance. For some classes of work, the tool may be set slightly above centre level.

Form tools can be used quite successfully even on light lathes, provided that they are kept keen and properly set, but for many kinds of contour turning a traversing tool controlled by a profile template will reduce cutting load and enable better finish and accuracy to be obtained. The method employed is fairly well known in lathe practice, but for those not familiar with it, the explanatory sketch will be helpful.

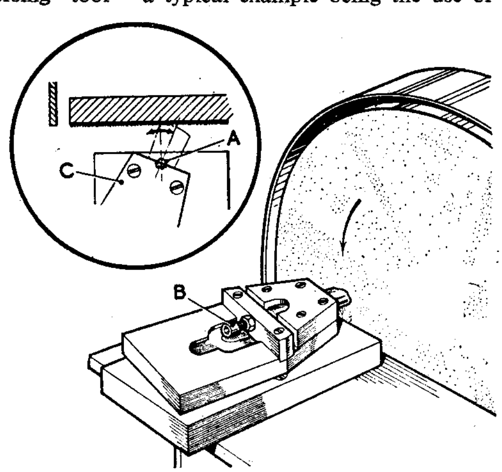
A copying fixture to carry the template, *C*, (Fig. 1) is attached to the back of the lathe bed, and a contact finger or follower plate, *B*, is attached to the rear of the cross-slide. By removing the cross-feed screw and fitting one or more springs, *A*, to press the finger, *B*, against the template, *C*, the tool will automatically copy the contour as the saddle is traversed.

For dimensional adjustment, the topslide may be turned at right angles to the bed to provide means of cross feeding, but if it is practicable to machine the work at a single pass, this will not be necessary. A round-nosed tool of exactly the same radius as the tip of the contact finger should be used; the method is, of course, only suitable for work with relatively gradual changes of contour, and not for stepped or deeply grooved work.

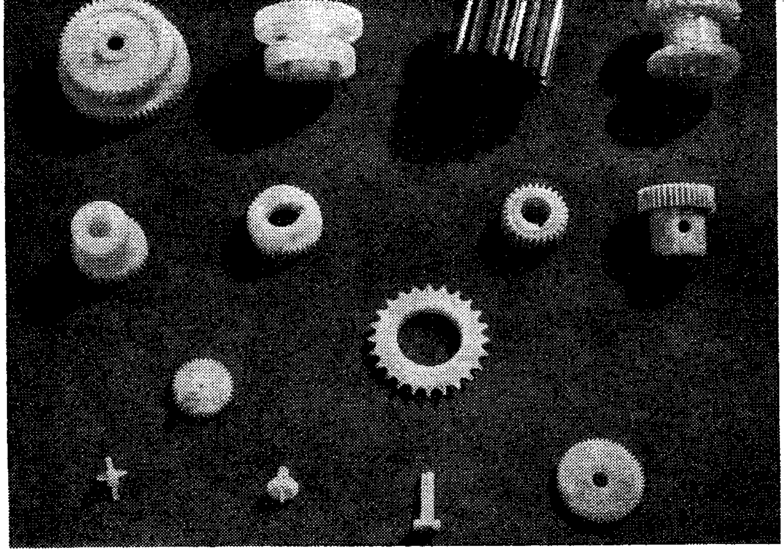
Routing, milling or spindle moulding may be carried out as described for other plastics, and the use of contour guides or jigs enables shape and dimensions to be closely controlled in repetition work. Abrasive methods are also extensively employed both in shaping and finishing work, a typical example being the use of a



Left, Fig. 1: Profile turning of Catalin with the aid of a guide template



Right, Fig. 3: An example of a simple jig for use in radius grinding



A selection of nylon gears, both machine cut and moulded

resilient felt backing, *B*, (Fig. 2) on a wooden disc, *A*, to support the sanding disc the edges of which are serrated so that they can be folded back over the wooden mount at *C* and secured by sealing wax or other cement.

This method is suitable for shaping rounded handles and similar work, but control depends entirely on skill of hand, and where positive accuracy of radius is required, a rigid sanding disc in conjunction with some form of jig is preferable. In the example shown (Fig. 3), the work holder, *C*, is pivoted at *A* to produce an exact radius on the end face, and length adjustment or feed can be produced by a screw, *B*.

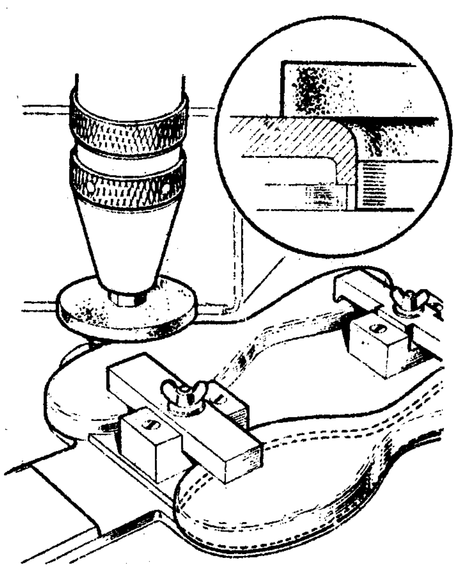
To control rounding-off contours on work already shaped by routing or spindle moulding, the use of a formed abrasive wheel, with a control wheel or roller, is illustrated (Fig. 4). It will be seen that the removal of material by the grinding wheel is limited by contact of the side contour of the work against the non-abrasive roller and the exact contour is thus preserved. In certain cases this arrangement may be inverted, with the control roller located above the grinding wheel. Work of this nature can be carried out quite satisfactorily in a drilling machine, by running the spindle at appropriate speed and locking the height adjustment.

For polishing, the same general methods as used for other plastics are suitable, and Catalin is capable of taking an extremely high lustre. After machining or grinding to as high a finish as possible, the process known as "asking" is recommended to remove all tool marks and scratching. This is a wet process, using pumice paste on a calico mop at moderate speed up to about 2,800 r.p.m. for a 6 in. mop; this may possibly be found somewhat messy if carried out in a general-purpose workshop, but the obvious precaution of using a partially-enclosed spindle head will be found helpful.

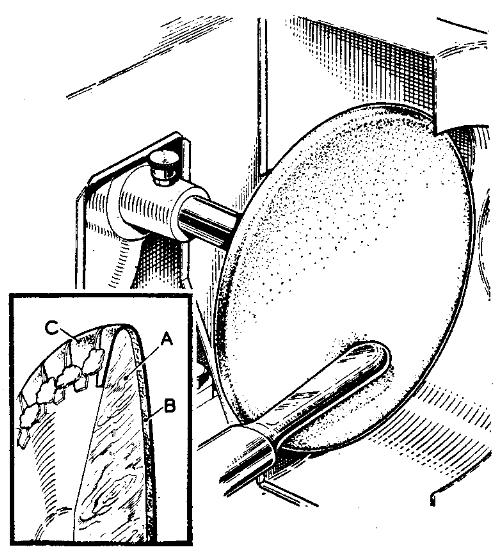
Subsequent polishing may be carried out by soft mops with dry compounds, and for final glossing, non-abrasive wax polishes on chamois leather or deerskin may be used. In commercial practice, tumbling barrels with hardwood pegs or leather clippings are commonly employed.

Normal twist drills can be used for drilling, but special drills with a large helix angle and deep flutes are available, and should be ground with a negative rake angle at the tip, as shown at *D* (Fig. 5). A tip angle of 120 deg. included angle, as at *A*, is suitable for blind drilling, but where the drill breaks through the material it is better to use a more acute angle up to 60 deg. inclusive as at *B*. For deep drilling, it is advantageous to grind away the lands of the drill as at *C* to facilitate escape of swarf, but the end portion must be left untouched to prevent binding in the hole.

Catalin may be fabricated and built up by cementing, and special "curing" cement may be used to form amalgamated joints practically equivalent to welding. These consist of liquid Catalin, which must be mixed with a curing agent or "accelerator" immediately prior to use, setting time depending on the pro-



Left, Fig. 4: Controlled rounding-off of profiled parts, using vertical-spindle abrasive wheel and a control disc



Right, Fig. 2: Using a resilient sanding disc for shaping work by freehand method portion of this which is added. It is, possible, however, to obtain very satisfactory joints with less trouble by using a one-solution cement or adhesive with a nitro-cellulose base. Catalin can also be used in the raw state to produce castings in the home workshop, and further information on this process will be given later.

Nylon

To the man in the street the word nylon may be associated rather with anatomy than with engineering, but its first commercial application was not in connection with feminine adornments, but with the much more prosaic process of producing a substitute for natural bristles in brushes. It is a coal-tar derivative, obtained by the action of adipic acid on synthetic phenol.

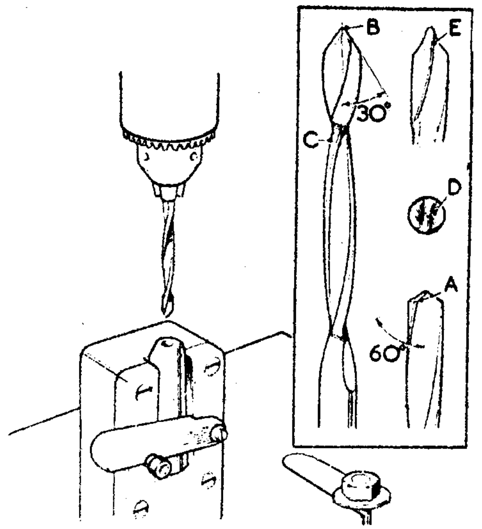
This form of nylon is marketed in this country by the British Rawhide Belting Co. Ltd, and is available in round rods and tubes, square and hexagonal sections, sheets of various thicknesses, and flexible tapes; also in certain moulded forms. It has a high tensile strength and resilience, and the same properties which have made it so valuable for the production of tough and elastic filaments for bristles or textiles can be applied to mechanical components with equal advantage.

Nylon bearings

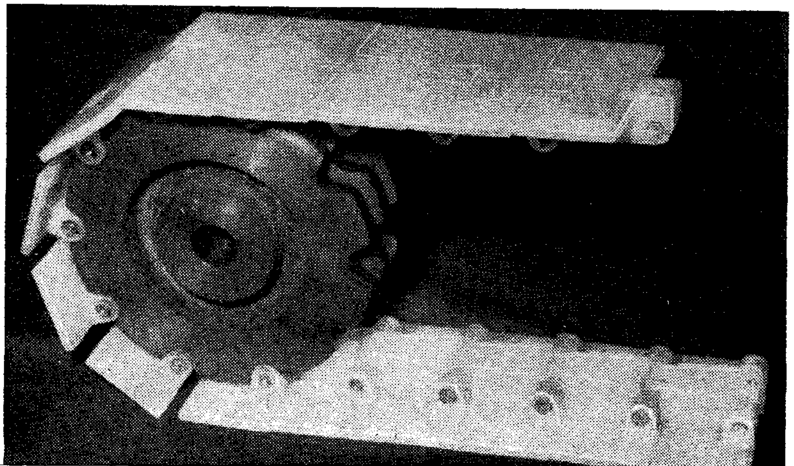
One of the most important applications of solid nylon is for making bearings, the main factors which commend it for this purpose being its resistance to wear, low coefficient of friction, and its ability to withstand heavy impact shock load and vibration. The limiting factors in the use of nylon for bearings, on the other hand, are its non-conducting properties, which retard heat conduction and dispersion, destructibility at high temperature, and high coefficient of expansion. Where these factors can be kept under control, however, it has many practical advantages over metal, not the least of which is its ability to run with very little or no lubrication.

If a running temperature of over 150 deg. C. is encountered, nylon bearings are liable to seizure through surface disintegration. They should be kept fairly thin—not more than $\frac{1}{8}$ in. wall thickness per 1 in. of diameter—to assist conductivity, and running speed should not exceed five to six hundred feet per minute if any appreciable load must be carried. Running clearance should be sufficient for very free running, but not excessive, and while running in, ample lubrication should be supplied until the bearings are thoroughly bedded down, after which it may be considerably reduced, so long as the bearings show no tendency to undue rise of temperature. Water lubrication is recommended for many purposes, and often shows advantages over oil.

In common with most other high-class plastics, solid nylon is relatively expensive, as expressed in terms of weight, but the figure is much less alarming in terms of volume, owing to its low weight compared with metals. For instance, nylon bearings work out slightly less costly than phosphor-bronze for a given size.



Right, Fig. 5: The type of twist drill recommended for Catalin, showing a typical jig for deep drilling



Bottom of page: Nylon conveyor 'belt,' with sprockets

(Illustrations by courtesy of Catalin Products and the British Rawhide Belting Co.)

Moulded bushes or half-bearings are obviously more economical than machined components, owing to the wastage of material in the latter case. Machining can readily be carried out by methods and tools described for other plastic materials.

Recent industrial use

In addition to bearings, nylon is an excellent material for gears and other mechanical components. It has an ultimate tensile strength of 37,000 p.s.i. and a bending stress of 9,950 p.s.i. A comparatively recent industrial application of nylon is for moulded links in slat-type conveyor chains. The links can be obtained in standard sizes, together with sprockets in cast iron with machine-cut teeth and link pins in stainless steel, so that conveyors of any type and size can readily be assembled; and entirely non-metallic conveyors, essential in certain processes, can be made by using nylon link pins and plastic sprockets.

The variety of nylon known as Akulon is used mainly for extrusion and injection moulding of products such as bushes and gears, also for wire coating for both electrical insulation and mechanical protection. Flexible grades of nylon are used for machine belting and belt conveyors.

Manufacturers

Panilax: Micanite and Insulators; Catalin: Catalin Products, Ltd, Waltham Abbey, Essex.

Retail Suppliers

Nylon and Akulon: British Rawhide Belting Co. Ltd, 246-8, Great Portland Street, London, W.1. and at 15, Paradise Street, Liverpool, 1.

● *To be continued.*

NUTS and SPANNERS

Beginner's Workshop

GEOMETER comes forward with some useful ideas for those beyond-finger-reach situations

THOUGH there may be sound reasons—design or commercial—for the extraordinary locations of some nuts, bolts, setscrews and small detachable components, one may in moments of impatience attribute a certain lack of foresight to manufacturers. They have seen to it, of course, that assembly was a logical sequence, slick and straightforward—and in reverse dismantling would probably be equally simple, though it may be quite different when a component has to be detached on its own.

Apart from a natural tendency to inaccessibility in complicated assemblies, the main cause of most difficulties seems to be the reduction to minimum dimensions of such features as flanges, bosses, lugs and pitch circles of bolts and studs. Of course, it makes for compactness and adds to strength. But often one could wish for just that little extra space—for example, round bolts on spot-faced seatings close to the adjoining mass of components.

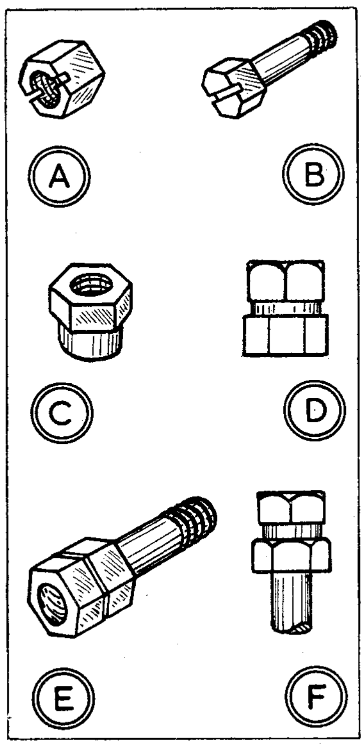
There are situations in which it is sufficiently easy to perform the initial loosening or final tightening of a nut or bolt with an open spanner, the removing or fitting proving tedious. Then a screwdriver slot cut with hacksaw or slotting saw across the end of nut or bolt, *A* and *B*, may prove helpful—for a screwdriver can often be used, particularly at an angle where a tubular box spanner cannot.

In other awkward situations, tubular box spanners may permit nuts to be fitted easily. If the corners of such a spanner foul the component they should be reduced just to clear by careful grinding or filing.

Given a lathe, hexagon bar, drills and taps, the type of nut at *C* can be substituted for ordinary ones too deeply sunken on spot-faced seatings—and much subsequent trouble will be avoided.

The nut at *D* is a "double-hexagon off-set" type intended to permit assembly with open spanners where because of space restriction, angular movement is very limited and in situations in which ring spanners cannot be used—and where even the jaws of open spanners will not pass properly from one flat to another.

Round bar of over-the-corners diameter is used, drilled, tapped, reduced centrally with a parting tool. The corners of the hexagons are marked out of line (a flat to a corner) then the hexagons are carefully filed and, finally, the nut is parted off. In tightening or loosening, the spanner is shifted from one hexagon to the other, required angular movement thus being reduced by half.



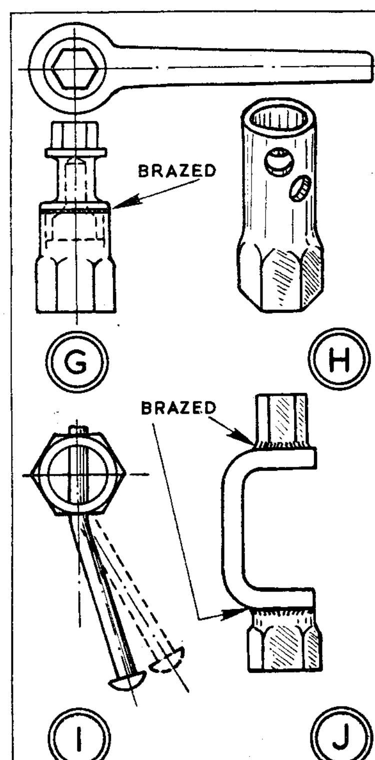
A deep bolt head, like a deep nut, is often all that is required to facilitate assembly and dismantling. Special bolts can be turned from hexagon bar, a somewhat lengthy and deterring process, and another method, quicker and generally equally effective, is to braze an ordinary nut on top, *E*. If the double-hexagon principle is required a nut as *C* can be used on the bolt somewhat shortened, *F*.

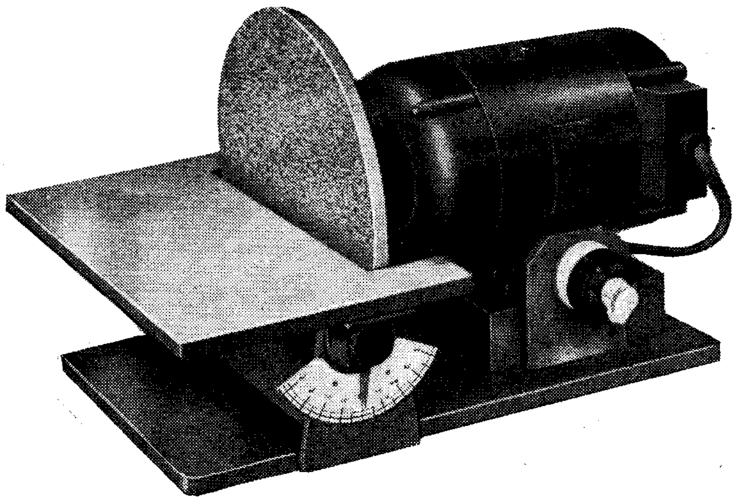
For sparking plugs of car engines which demand a tubular box spanner the modification at *G* to the standard spanner is very useful. This permits an open or ring spanner or the ratchet jack handle to be used—with the advantages of small angular movement and working at the most convenient position.

From round mild steel, a stem or neck piece is machined to push into the tubular spanner. It is then drilled for lightness and given a filed hexagon on top to take whatever spanner is used. The piece is brazed in.

Half the normal angular movement on tubular box spanners can be obtained by drilling another cross hole, as *H*, in line with the corners of the hexagon when the original is across flats. Another method, to the same effect, is to bend the tommy bar slightly, *I*—and the two can, of course, be combined.

An "avoiding" spanner for projections can be made as *J* from a tubular box spanner. A piece of stout rectangular bar is turned U-shape deep enough for clearance, then the cut-off spanner is brazed on one end and a piece of hexagon bar on the other. Thus any suitable spanner can be used. ■





Constructing a 10-inch Disc sander

By F. SURGEY

An accessory which can be a valuable asset in the workshop

THE NEED for a sander of some description arose from the making of patterns for the various machines I have constructed and the machine illustrated here, though built with very simple materials, has proved a valuable asset to the workshop.

I had previously used a similar type of machine for metal finishing. In this instance the glasspaper or sand paper was replaced by emery discs and the capacity of this machine to true up squarely the edges of a small assembly of aluminium and plate was remarkable.

The cost of this particular unit was in the region of £25—as compared with about £7 for my machine. The larger portion of this sum was made up by the cost of the motor. But the unit when built (less motor) was only £1, so if any reader wishes to construct a useful machine for the workshop he is invited to study the following details. Instructions for a belt drive if the motor is too expensive an item are also given.

Variety of materials

The machine is constructed largely of $\frac{1}{2}$ in. thick plywood, but it can be made from metal, using plate or castings. Before making a similar machine it is advisable to discover what diameter of discs are available in your area. I was rather unfortunate in not being able to obtain 10 in. dia. discs without ordering them especially.

There are many smaller sizes of, say, 5 in. dia. in the shops for use with the small portable power tools and my design could easily be scaled down to make a smaller machine. I like the disc to be of fairly large diameter though, for this, with the heavier type of motor necessary, makes for greater operational efficiency.

First, then in the motorised version the first piece cut was the baseplate. This was 17 in. × 10 in. and the holes for the screws or bolts were drilled into it to secure the completed machine to the bench. They were four in number—one at each corner and $\frac{1}{4}$ in. dia.

If a 10 in. dia. disc is used, the motor has to be packed up off the baseplate and so two hardwood blocks 6 in. long and of 2 in. × 2 in. section were cut and tacked to the baseplate. The motor was then set in position on top of these two blocks and the holes for the motor were marked off and drilled right through both block and baseplate. The bolts were $\frac{5}{16}$ in. and the heads were let flush into the underside of the baseplate.

Mounting the disc

In my case the motor was a Brooks Cub of 1/3 h.p. 250 v., single phase, running at 1,425 r.p.m. with a $\frac{5}{8}$ in. shaft diameter. A steel-flanged collar, to which the 10 in. disc is screwed, was next turned; it is important that the face of the flange is perfectly true in relation to the $\frac{5}{8}$ in. bore which must be carefully reamed. A $\frac{5}{8}$ in. Whit. Allen grubscrew secured the flanged collar to the motor shaft. The disc was then bolted to the flanged collar by three $\frac{3}{16}$ in. countersunk headbolts and nuts. The disc was turned on a wood lathe and recessed to fit the flanged collar tightly. This ensures a true running disc.

If a reader finds the disc does not run true when assembled it can, if made of wood, be trued up by running the machine with the table in position and by using a wood-turning chisel as one would on an ordinary wood lathe. There is, of course, a completely-turned aluminium disc on the market ready for fitting to the motor if you do not wish to make one from wood.

The abrasive disc is glued to this—and the best quality cloth backed disc is the best for the job. It is obtainable in various grades. Ordinary sandpaper will do, as a 10 in. disc can usually be cut from a standard sheet but this type of sheet does not last as long as the other. The table supporting plates were next fitted, being cut from ⅜ in. thick ply. They are not only screwed to the baseboard but are rigidly fixed by screws to either end of a length of 2 in. × 1½ in. wood which runs across the baseboard.

These supporting plates were drilled for the table pivot bolts which are 5/16 in. Whit. before assembly to the baseboard.

The pivot brackets

Two pieces of 1½ in. angle iron are drilled for the table pivot brackets, and the table bolts to these. As the table will be required to tilt to various angles it would be better for the pivot brackets to be slotted where attached to the table so that the table itself can be set close to the disc at all times.

From the photograph it will be noted that a protractor scale is fitted for easy setting of the table to any angle. It would be preferable, too, to use small plastic handles or wheels on the pivot bolts to save searching for a spanner whenever the table angle needs setting.

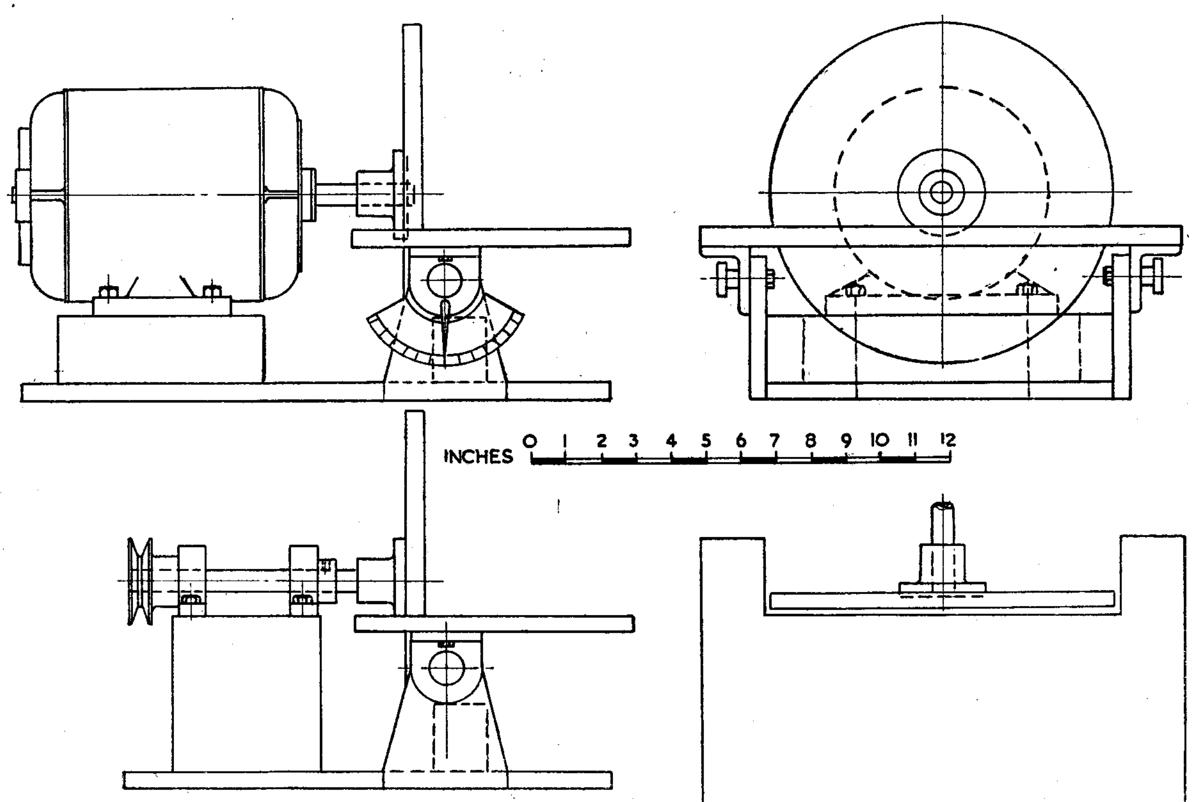
The table is also a piece of ½ in. ply. The wings on either side of the disc are optional, but I think look better. The surface of the table could be faced with 3/32 in. or ⅛ in. steel plate if desired and another useful addition would be a die-cast protractor head which is easily obtainable. This would run along the front edge of the table and be handy for 45 deg. joints. It is preferable to have the switch controlling the motor secured in a handy position on the machine so that current can be switched off quickly, for the discs do tear off at times and create an awful clatter.

Countershaft drive

For the reader who does not want to fit a motor but wishes to drive the unit from a countershaft the alterations are quite simple. In place of the motor there are screwed two wooden blocks, to the top of which are bolted the bearings for the shaft. These bearings or plummer-blocks may be of the type with Oilite bushes or ball-bearings, preferably the latter.

The shaft, of ⅝ in. or ¾ in. dia., is fitted with a flanged collar and disc at the front, and passes through the two bearings. It is fitted with a standard ½ in. V-pulley at the back. The diameter of the pulley depends on the r.p.m. and the size of the pulley on the countershaft. Any two convenient pulleys will do so long as the disc speed is about 1,500 r.p.m. ▣

Constructional details of the 10 in. disc sander



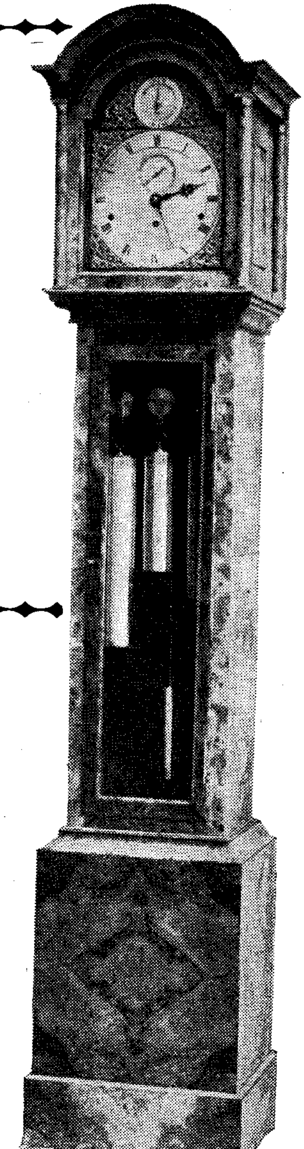
The M.E.

MUSICAL CLOCK - 2

By C. B. Reeve

The pillars, wheel cutting and the three driving barrels are among the items discussed in this instalment

Continued from 27 September 1956, pages 435—438



THE PILLARS are constructed next. They should be made from a length of hard-drawn brass rod of $\frac{1}{2}$ in. dia. (Fig. 5). Commence by cutting each pillar to a length of, say, $2\frac{11}{16}$ in., chuck each in turn in the self-centring chuck and face both ends off true and square and, at the same time, centre-drill both ends with the slocombe drill.

Now turn a spigot at each end of the rod $\frac{3}{16}$ in. in diameter to leave the unturned rod to measure $2\frac{5}{16}$ in. in length as shown in the drawing. One spigot of each pillar has to be threaded with a $\frac{3}{16}$ in. × 40 thread die (or any other size fine thread will do). To get the thread right up to the shoulder, reverse the die in the die holder. Before finishing off these threads it is as well to drill a suitable size hole and then tap it in a spare piece of plate and try the fit of the threaded spigots of the pillars.

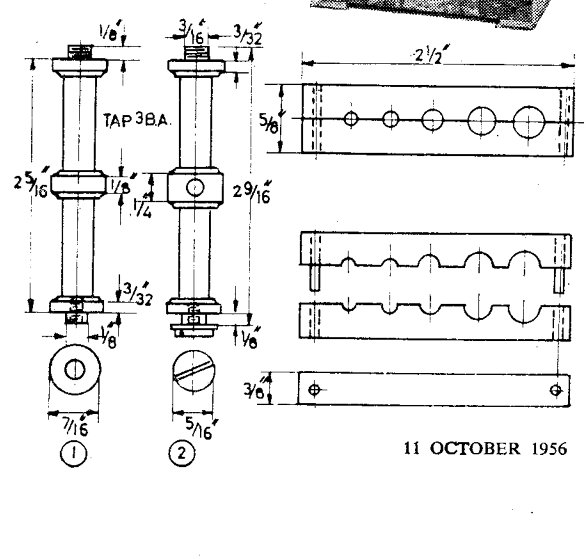
Now reverse the pillars in the chuck and drill a short hole 3/32 in. dia. and thread up with a $\frac{1}{8}$ in. Whitworth tap. The pillars can be turned to the shape shown in the drawing. Ten pillars will be required as No 1 and two pillars as No 2 (Fig. 5).

These two pillars have a broader central boss for the reception of the set screws that hold the movement to the wooden seat board. They should be drilled and tapped 3 B.A. but this drilling and tapping should be left until the pillars have been finally fitted to the back plate to ensure that the tapped holes are quite vertical when the pillars are tightened up.

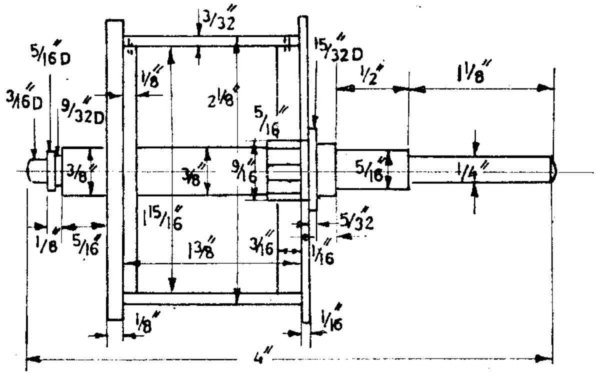
To ensure a good finish on the pillars, they should be planished with a hand tool and I have found that an ordinary carpenter's wood chisel is excellent for the purpose, provided it is well whetted on an oil stone. The small radius shown on the edges of the bosses can be produced by a hand form tool made from a bradawl. Finally each pillar should be finished off with fine emery sticks.

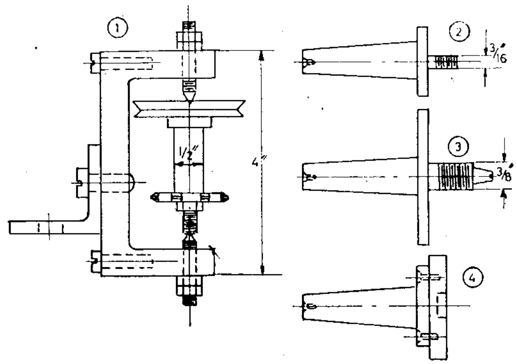
The 12 steel screws and brass washers for holding the three front plates to the pillars should next be made. The screws should be made from a short length of $\frac{3}{8}$ in. mild steel round rod; a spigot of $\frac{1}{8}$ in. dia. and $\frac{1}{4}$ in. length should be turned.

Above right: How the clock will look on completion

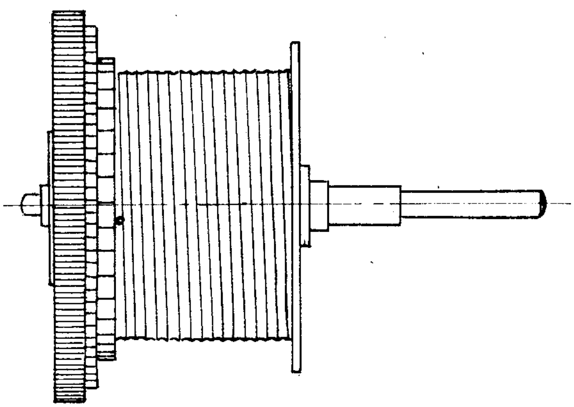


Right, Fig. 5: Ten pillars as No 1 required and two pillars as No 2 required; riveting stake for wheel mounting on collets

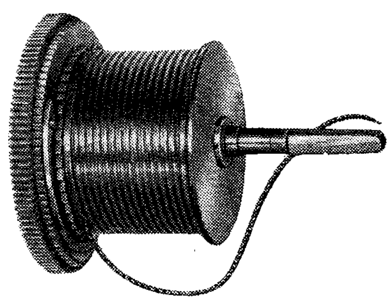




Above, Fig. 8: Cutter frame and wheel mandrels



Left, Fig. 6: Detail of arbor and barrel construction: barrel completed with ratchet wheel and great wheel keyed on with a slip washer



After cutting the thread, the end of the screw should be rounded off followed by polishing with an emery stick. This applies to all the screws used in the construction of the clock.

Next part off each screw in the lathe. If you are not very successful in using the parting tool, cut them through with a miniature hacksaw with the mandrel turning slowly. Next grip gently each screw by the threaded portion with the jaws of the chuck and, with the underside of the screw head butting against the face of the chuck jaws.

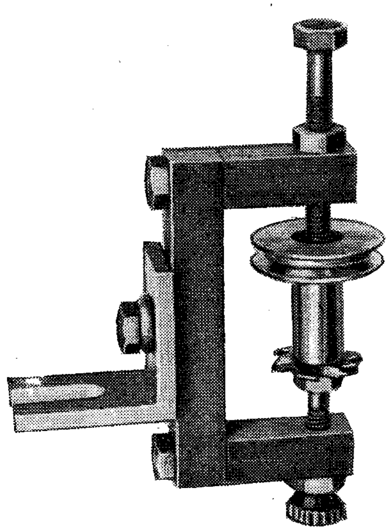
Now, with a sharp round-nose tool, face off the head of the screw smoothly. The screw should be transferred to the vice and the slot cut with a fine hacksaw. Take out the turning marks by holding the head of the screw well down a No 2 emery stick held in the vice. Continue with finer emery sticks and for a final finish a No 000 will produce a mirror-like finish.

The brass washers are turned from a length of brass rod held in the self-centring chuck and require holding in the fingers and smoothing and finishing off the same way as the screws.

The plates can be drilled to receive the pillars at the positions shown in

Above right: Great wheel, barrel and maintaining ratchet

Below: The cutter frame



the drawings. Commence the drilling by using a $\frac{1}{16}$ in. drill. Drill all the holes in the front plate first and remove all burrs. Now asemble the front and back plates together and, using the holes previously drilled in the front plate as a guide, drill the holes in the back plate. Only the minimum amount of drilling should be done—just sufficient to mark the position for the pillar. Remove the front plates and finish the drilling.

The reason for not drilling through both plates at once is that the swarf collects between the plates, causing them to lift and bring them out of correct register with one another. This rule applies to all drilling operations in regard to the plates.

All the holes in the front plates should be enlarged to $\frac{3}{16}$ in. dia.; the holes in the back plate, however, should be finally drilled with a No 21 gauge drill and tapped with a $\frac{3}{16}$ in. $\times$ 40 thread tap, afterwards slightly countersinking the holes so that the pillars screw home flush with the plate. The spigots of the pillars that fit the holes in the front plates should be of such a length as to be just below the level of the height of the washers. Then, when the screws are inserted, the plates will tighten up perfectly.

The complete frame can now be

THE M.E. MUSICAL CLOCK . . .

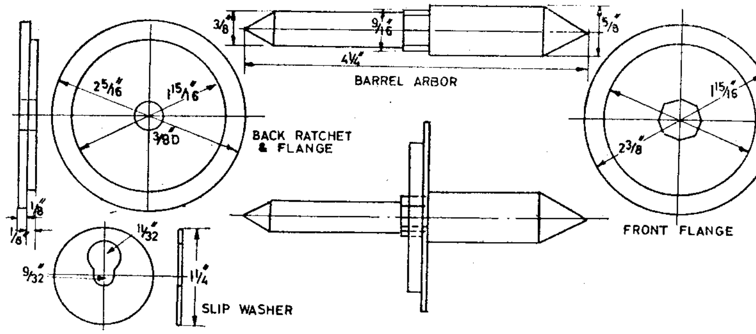


Fig. 7: Parts of the barrel assembly

assembled, but it is as well to make each pillar to its respective position on the plates. A glance at Fig. 4 will show that certain sections of the plates have been cut away. Do nothing about this at the moment.

Figs 6 and 7 show the construction of the three driving barrels. These are all of the same dimensions so far as the drum portion is concerned. There is a slight difference from one another in the pivoted portion of their arbors which can be disregarded for the present.

Commence by cutting to a length of $4\frac{1}{4}$ in., a piece of $\frac{5}{8}$ in. dia. silver steel, chuck and turn each end to a 60 deg. cone. File a fine nick at about 1 31/32 in. from one end to serve as a datum line which should be further marked by turning a groove on the rod in the lathe with a fine knife tool. The remainder of the rod, approximately 2 9/32 in., should now be turned down to, say, a diameter of a full $\frac{1}{2}$ in.

At a distance of $\frac{3}{8}$ in., taken from the shoulder just formed, make another nick; the remainder of the rod from this nick should now be turned down to a diameter somewhat over $\frac{3}{8}$ in. Next the $\frac{1}{2}$ in. portion is filed eight-sided, taking care to avoid filing into the $\frac{5}{8}$ in. shoulder. Then take a $2\frac{1}{2}$ in. $\times$ $\frac{1}{4}$ in. thick circular brass blank and centrally drill a hole of such a size that it can be filed eight-sided to be drive-on fit on the arbor.

To drive on the circular blank on arbor, grip the arbor in the bench vice by the unturned portion of the rod. Place the circular blank in position and drive home with a hammer and a hollow punch improvised from a tube spanner. Place in lathe between the centres and test for truth. It may be a little out, but this can be disregarded as it will require turning anyway.

Before mounting the circular blank it is prudent to turn a minute recess between the eight-sided portion and $\frac{5}{8}$ in. dia. shoulder. This will ensure the blank going right home and making an invisible join with the shoulder on the arbor. Next cut a $4\frac{1}{2}$ in. length of brass tube into three equal lengths. The outside diameter of the tube should be $2\frac{1}{8}$ in. and the thickness of the walls of the tube should be 3/32 in.

Chuck each length in turn in the self-centring chuck and true both ends of the tube so that the length is $1\frac{3}{8}$ in., taking particular care to remove all burrs. Now, with the arbor mounted between the hollow centres in the lathe, turn the seating for the brass tube which should be a tight fit on the step just turned. The step should be $\frac{3}{16}$ in. wide. This will leave about $\frac{1}{16}$ in. thickness for the flange.

Now skim down the $\frac{3}{8}$ in. dia. portion of the arbor and leave it with a smooth finish. Prepare another $\frac{1}{4}$ in. thick $\times$ $2\frac{1}{2}$ in. dia. brass blank to form the other face to the barrel. The hole in the blank should be bored a good fit to the $\frac{3}{8}$ in. dia. of the barrel arbor. If the blank is chucked in the self-centring chuck with the lathe jaws in position, so arranged that slightly more than half the thickness of the blank protrudes from the chuck jaws, it will be found that the boring of the hole and the turning of the step can be done at the same setting; approximately half the thickness of the blank is turned away in this case to form the step which is also made a close fit to the tube. With all three parts of the winding drum or barrel prepared it should now be assembled.

See that all is well pressed firmly home. Drill three small holes, say, No 55 gauge drill size, equidistant from each other near both ends of the tube into the thickness of the steps formed on the circular blanks. Tap each hole with a 10 B.A. tap and screw in short lengths of prepared 10 B.A. brass rod quite tightly and cut off flush with the outside wall of the tube. The barrel should be returned to the lathe and turned true all over; for the time being do nothing further with either end of its arbor.

The question now arises as to the screwcutting of the barrel for the groove to guide the driving line. It will make no difference to the going of the clock whether the groove is cut or not, provided the movement is mounted level in its going position, neither leaning backwards or forwards. If it is decided to screwcut the barrel, set the screwcutting gear to give 12 threads per inch and the cutting tool should have a half round-nosed tip and be slightly over $\frac{1}{16}$ in. in width.

The other two barrels should be made to the same dimensions stated, but the final finishing of all three had better be left until the wheels have been cut, which will next be described.

Some readers may wish to purchase their sets of wheels with the teeth already cut. They can be obtained from Messrs Osbourne and Son,

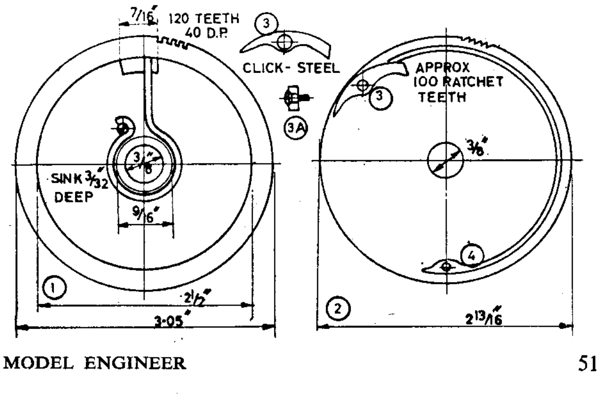
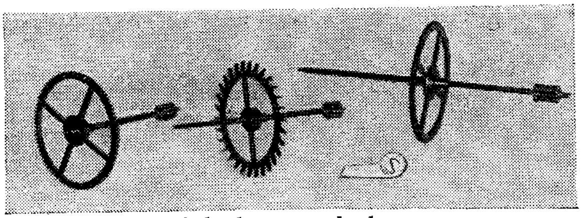
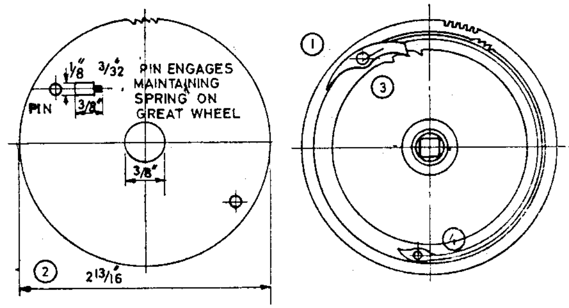


Fig. 9: Front views of great and ratchet wheels





Above: *Centre and third escape wheel of time train with maintaining click*
Right, Fig. 10: *Back view of ratchet wheel and plan view of great wheel ratchet maintaining wheel and barrel ratchet*

61, St John Street, Clerkenwell, London, E.C., or Philip Thornton, Great Haywood, Stafford. To do the wheelcutting oneself is not so very difficult provided there are suitable means of dividing for the numbers of the teeth required.

Fig. 8 (No 1) shows a simple piece of apparatus that will do the cutting part of the job very well. It should be mounted on the slide rest in place of the tool post and the pulley on the cutter arbor should be belted to a small fractional electric motor, mounted in a vertical position and screwed to a hinged board fixed on the wall at the back of the lathe, so arranged that by swinging the hinged board backwards or forwards an even tension of the belt is maintained between pulley on the electric motor and the pulley on the cutter frame arbor as different diameters of the wheels are being cut. The drawing is self-explanatory, as to how the cutter frame is constructed.

The cone bearings

It is difficult to give dimensions as this to some extent depends on the centre height of the lathe on which it is to be used. My lathe has a centre height of 2¾ in., so I made my frame about 4 in. high and built the frame from ½ in. square mild steel rod. As will be seen in the drawing the frame is held together with ¼ in. dia. bolts. The cone bearings were also made from ½ in. dia. bolts and there is provision for height adjustment. This is important and will be explained later.

The cutter arbor was made from a short length of round steel rod; a portion of the rod was turned down to ¼ in. dia. to fit the hole in the clock wheel cutter. The cone bearings are better for being case-hardened and should be run in a little before being put to definite use.

Referring to Fig. 8 again, the three fitments, Nos 2, 3 and 4, are for holding blank wheels that require turning and having the teeth cut. No 2 should have its spigot turned to a diameter of 3/16 in. and threaded to take a nut. No 3 has a spigot of ⅜ in. dia. and will also need threading and a nut fitted. No 4 is a fitment from which it will be seen that a wood disc is secured to its face plate by two or three wood screws put in from the back. The face of the wood disc is turned true and its diameter turned down a little less than the diameter of the blank wheel. The blank wheel is next centre popped and two small holes are drilled through the blank at any convenient position.

Now hold the blank against the wood disc, bring up the tailstock and hold the blank in position by entering the point of the tailstcck centre into the centre-popped sink in the blank. While held thus, two small screws are put through the blank into the wood disc. The blank can be turned to size and have its centre hole bored true to the run of the wheel and also at the same setting the teeth of the wheel can be cut.

A suggested way to make a division plate appeared in MODEL ENGINEER many years ago. Mount a disc of wood on the tail end of the mandrel which should be turned to a diameter of 22½ in. and around its periphery fasten an ordinary 5 ft tape measure. Arrange a stiff spring and pointer that can register each ⅛ in. division—this will give 360 divisions and multiples of this number.

Drilling through the disc

Now mount a brass disc on the lathe faceplate and a drilling spindle on the slide rest. Drill each hole through the brass disc with a 1/16 in. drill. It is as well to have a very small amount of drill protruding from the drill chuck. To obtain other divisions the tape measure can be cut and the wooden disc turned down to suit the reduced length of the tape measure.

The time train wheels consist of the great wheel, 120 teeth × 40 d.p., the full diameter of blank being 3.05 in.; the centre wheel 1/16 in. thick, 96 teeth × 52 d.p., the full diameter being 1.88 in.; the third wheel 1/16 in. thick, 90 teeth × 52 d.p., the full diameter being 1.76 in.; the escape-wheel (dead beat) 30 teeth, full diameter 1 13/16 in.

Circular milling cutters for cutting teeth cf clock wheels can be obtained quite reasonably from Messrs Pringle and Son, Clerkenwell Road, London, E.C. One each of the following cutters will be required: 34 d.p., 40 d.p., 42 d.p., 52 d.p., 44 d.p. and 48 d.p. This range will cut all the wheels contained in the movement.

A brass circular blank 3⅛ in. dia. × ¼ in. thick will be required for the great wheel; this should be chucked in the self centring or four jaw chuck and have both faces skimmed true. It will be found that very little machining will be necessary to obtain this. Next machine out the recess or sink of which the outer wall is 2½ in. dia. and the inner wall a full 9/16 in. dia. The depth of the sink should be 3/32 in.

Drilling the centre hole

Next drill and bore out the centre hole carefully to ⅜ in. dia. It must be made a good fit to the ⅜ in. spigot of the wheel mandrel chuck (Fig. 8, No 3) and the latter fitted to the lathe mandrel very firmly. Now place the circular blank on the wheel mandrel with the sink side facing outwards (not forgetting to put a washer between the nut and the blank wheel).

Fit the cutter to the cutter arbor so that the cutting edges of its teeth will revolve anti-clockwise and see that the cutter is adjusted to cut dead on centre with the lathe centres—otherwise staggered teeth will be the result. Assuming that the division plate is fixed on the tail end of the mandrel and that the spring pointer is also fixed with its point in a hole of the 120 hole circle, the cross-slide should now be adjusted to cut approximately three-quarters of the depth of space between two teeth and locked in this position. All other slides that are not being used should also be locked.

Either by using the top slide feed-screw or the leadscrew, take the first cut through the blank wheel. With a thick wheel it is necessary to stop the rotation of the cutter before backing out in readiness for the next cut. For thinner blank wheels of, say, 1/16 in.

THE M.E. MUSICAL CLOCK...

thickness this is unnecessary if the cutter is withdrawn quickly with the aid of the lathe rack hand wheel.

Having gone round the wheel once, the final cut can now be done. The cross-slide should be unlocked and carefully advanced and a trial cut taken on two adjacent tooth spaces. To ensure a well formed tooth, it is better to leave a minute flat on the top of the tooth rather than advance the cutter too close to the wheel. Should this occur, it seems to produce a lopsided-looking tooth and, of course, the wheel will be undersized.

The next wheel to be cut is the large maintaining ratchet wheel which is approximately $2\frac{13}{16}$ in. dia. × 3/32 in. thickness. This ratchet wheel and the great wheel are seen in Fig. 9 (Nos 1 and 2) and again in Fig. 10 (Nos 1 and 2). The blank ratchet wheel should be chucked on the same wheel mandrel as was used for the great wheel. It requires no sinks on either of its faces.

More teeth the better

A small fly-cutter should be made to cut the ratchet teeth and the number of teeth the wheel should contain is optional. The greater the number of teeth, the more effectually will the ratchet wheel do its job. It is important that the fronts of the teeth are radical and not undercut.

The ratchet on the back flange of the barrel should now be cut. They should, of course, be considerably larger than the teeth of the maintaining ratchet but an exact number of teeth does not matter. Fifty teeth is a convenient number and this number will give a nice size of tooth for this component. The fronts of these teeth are cut just undercut a few degrees. It is important that the fronts of the teeth point the right way (which is to the left or anti-clockwise when viewing the barrel from the front flange side). The great wheel and maintaining ratchet wheel can now be fitted to the barrel arbor and it is better to turn the arbor to size to fit the former rather than the other way about. Just a running fit without shake is required.

The maintaining spring is shown in Fig. 9 (No 1) in position within the sink of the great wheel. This spring is bent up from a length of $\frac{1}{16}$ in. square silver steel. It should be just an easy fit around the hub of the inside of the great wheel. Its shorter (or eye end) holds itself against the head of a $\frac{1}{8}$ in. dia. small screw. The height of the screw head should be just below the level of the great wheel hub. The free end of the spring should be made of such length to be just clear of the inside wall of the wheel.

It will be seen in the drawing that a small window is cut right through the wheel thickness. Referring to Fig. 10 (No 2) it will be noted that there is a pin $\frac{1}{8}$ in. dia. × $\frac{5}{16}$ in. total length including the threaded portion. This pin protrudes from the back of the maintaining ratchet wheel into the window of the great wheel and it contacts the right hand side of the free end of maintaining spring.

Winding the spring

The effect of this is that, when there is motive power on the driving barrel, the maintaining spring is automatically wound up and the winding up is limited to the extent of about three or four of the great wheel by the action of the pin reaching the left hand side of the window. As the great wheel rotates there is a click pivoted in the movement frame whose nose drops into the teeth of the maintaining ratchet wheel which is rotating with the great wheel.

In the process of winding up the driving barrel, the pivoted click will lock the maintaining ratchet wheel and at the same time the maintaining spring will expand and thus keep the great wheel rotating in an anti-clockwise direction. The drive of the maintaining spring has, of course, to be weaker than the drive of the clock weight. After the maintaining spring has been made and fitted, it should be heated up to cherry red and hardened in oil; after it has been cleaned with emery paper its temper should be let down to a deep purple blue.

Making the slip washer

The next item to be made is the slip washer which is shown in the bottom left hand of Fig. 7. It should be made from a piece of 1/32 in. thick brass plate and its function is to hold the great wheel and maintaining ratchet closely to the ratchet flange of the driving barrel. A small annular groove is turned on the barrel arbor into which the sides of the slot of the slip washer will fit. When correctly positioned the slip washer has a small screw put through it into the thickness of the great wheel hub.

The barrel ratchet click, which can be of mild steel, should next be made. The plan view is shown in Fig. 9 (No 3) and Fig. 10 (No 3). Note it should be $\frac{1}{8}$ in. thick and can easily be cut to shape with a metal-cutting fretsaw. Before any cutting is done, it should be drilled for its screw fixing hole with a No 36 or 37 gauge drill, and the upper side of the hole counterbored, say, 1/32 in. deep to accommodate the head of the fixing screw whose threaded portion should be a No 6 or 7 B.A. screw.

Locating the click

This screw will have to be made with a small shoulder between the head of the screw and its threaded portion. The click pivots on this shoulder after the screw has been tightened up. Fig. 9 (No 3a) shows what is required. An easy way to locate the position of the click in relation to the barrel ratchet is to engage its tip in a ratchet tooth and place a No 36 or 37 gauge drill upside down in the hole of the click and give a light blow with the wooden handle of the hammer to the cutting end of the drill. This is a very handy way of marking out parts that have to be fitted together. Most small drills are cone-pointed at their non-cutting ends.

Now the click spring should be made. It is seen in Figs 9 and 10 (No 4). It is made from a piece of stiff brass plate 3/32 in. thick and it should be carefully cut to shape with a metal-cutting fretsaw at the spoon fixed end and for a short distance beyond it, but the remainder should be cut in a straight line and bent afterwards to the curved shape as shown by the fingers, and not with pliers, as these will cause kinks to take place.

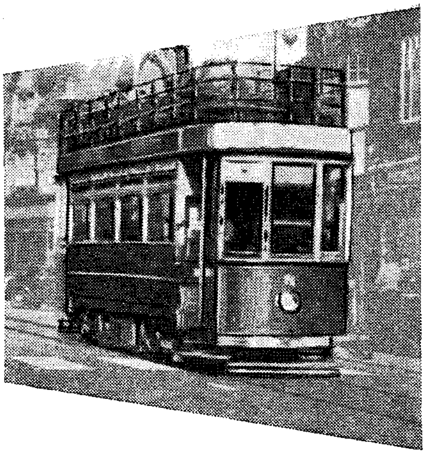
Finish of the great wheel

Before shaping, it should be nicely filed up and smoothed off with emery sticks. Its position on the maintaining ratchet can be found and marked off in a similar way as was used for the click. The fixing screw for the spring is a No 10 B.A. and it has a brass steady pin fitted at the pointed end of the spoon.

This concludes the making of the great wheel, maintaining ratchet and barrel of the time train, with the exception of the pivoting of the arbor, but this should be left until the rest of the train has been made. The other two barrels are made to exactly the same dimensions but their arbors are just left rough turned for the time being.

A point worth mentioning is that the pointed centres of all three barrel arbors must be carefully preserved from damage and must not be cut off until the clock is finished.

● *To be continued*



The Colwyn Bay trams

One of the open-top double deckers seen just before the line was closed

P. B. CARRIER tells the story of the tram-cars at a North Wales holiday resort—which have now given way to the ubiquitous bus

THOUSANDS of holidaymakers to North Wales will remember the smart green and cream trams which ran from Colwyn Bay to Llandudno. These, like so many of our older transport systems, have now been superseded by buses.

For nearly 50 years the famous "toast-racks" and trams plied over the shoulder of the Little Orme, for the line was opened for passenger traffic in 1907. Although proposed in 1894, to shorten the railway route to Llandudno, the resources of the companies formed were inadequate and the first section, between West Shore Parade and Rhos, was commenced in 1906. This was laid with tramway rail, with ballasted track and sleepers, as for most of its distance of five miles it ran independently of the road. The line was operated by 14 single-decker bogie cars, in the original livery of dark red and cream. Quite a large depot was built at Rhos with accommodation for 20 cars on its eight tracks.

It was originally intended to extend the line through Colwyn Bay to Rhyl and Prestatyn, but the farthest point reached was Old Colwyn, just over eight miles away. The extension to Colwyn Bay was opened on 30 September 1907. This was a successful venture and in 1912 another $1\frac{3}{4}$ miles of track brought the line to the Queens Hotel, Old Colwyn.

In 1910, four single-deck four-wheel radial truck cars were bought, the first to have semi-convertible bodies. Trailer cars were authorised in 1914 but were never operated. A further extension was started from West Shore to Deganwy but was scrapped later. Most of the track, except for interlacing sections and bridges, was doubled eventually. This was particularly difficult on Penrhyn Hill which has a gradient of 1 in $11\frac{1}{2}$, as the mountain shelf had to be cut for the two tracks.

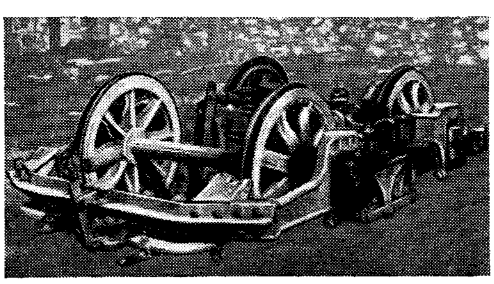
The Old Colwyn extension was closed in 1929 due to bus competition and 1930 saw the first Sunday service, which till then had not been allowed. In 1931 the livery was changed to the familiar green and cream. The first double-deck trams made their appearance in 1936 when 10 open-top bogie cars, already 10 years old, were purchased from Bournemouth Corporation. These proved valuable assets, but a rule was made that if the wind on the exposed section of line at Penrhyn exceeded 50 m.p.h., all upper deck passengers had to descend to the lower saloon. To enforce this, a wind gauge was installed.

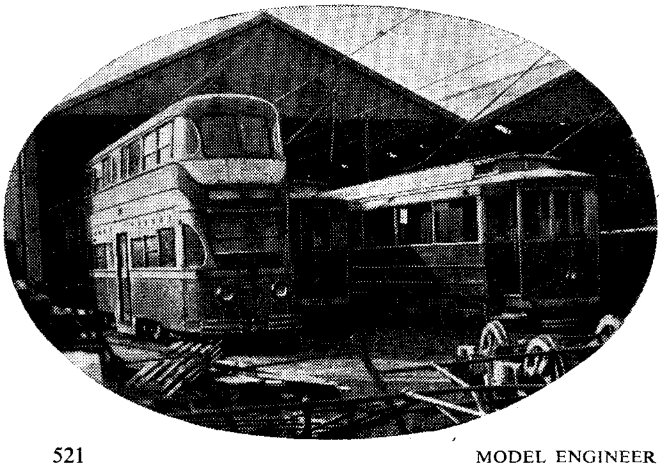
Business was brisk for the line during the war years, when many Ministry departments were moved to the area. In 1946, two double-decker streamlined trams were purchased from Darwen Corporation, but when inspected by the Ministry of Transport in 1948 they were only allowed to operate at each end of the line and not over Penrhyn Hill or along the shores of Penrhyn Bay.

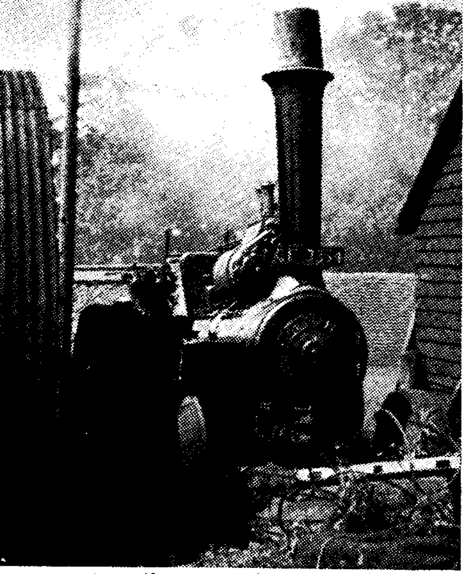
One constant worry was the sea erosion along this latter stretch which added to the financial problems of the company. After much argument for and against the retention of the trams, this picturesque line ran its last tram on Saturday, 24 March 1956 ■

Below: An old four-wheel bogie rusting away in the scrap-yard of the depot

Right: A trio of trams in the depot. The streamlined version on the left is an ex-Darwen Corporation vehicle







Above: *No 2505 up to her axles in farmyard debris*

A traction engine for sale? Then buy it, advised Peter in Australia. His father, A. L. FROST, tells of

Bringing home the Burrell

WHEN MY SON PETER set off on a long trip abroad he asked me to look out for a traction engine for him—preferably a Burrell. So I contacted our local steam man, Ron. Now Ron is a man of parts, a member of the rapidly disappearing clan of steam ploughing-engine drivers.

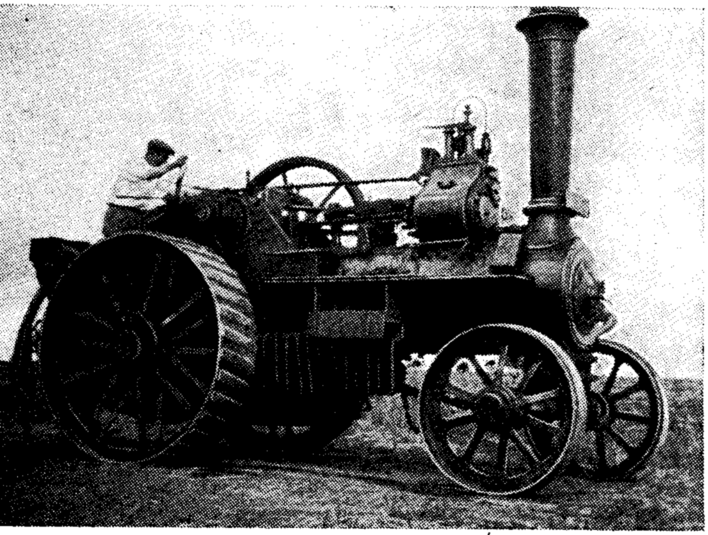
He gets about the country and picks up all the steam news for miles around. So it was no surprise when one Saturday night in the local he called me into a corner and confided that he had found the very thing. It was a Burrell single-crank compound of uncertain age but in working order. It had, in fact, been recently re-tubed and fitted with a new smoke-box, and lay at a farm only nine miles away.

As nowadays fathers take orders from their sons a cheque was posted and pending Peter's return from Sydney I became the somewhat abashed owner of a Burrell 7 h.p., No 2505, built—so we discovered from Clark's great book—in 1902. And there for months the matter rested and I put the whole thing out of my mind.

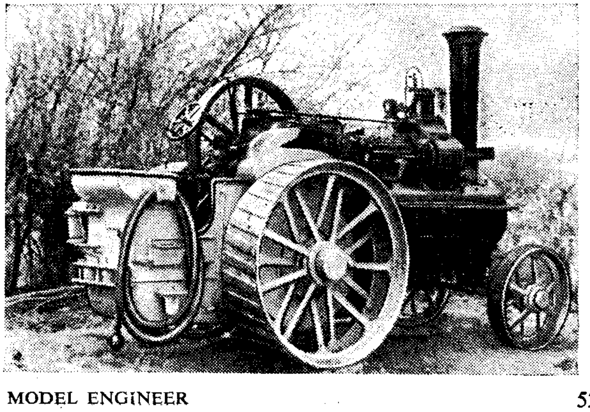
But the inevitable happened—a phone message from the farmer asking when we proposed to move the engine. I went to look for Ron and found him a few miles away driving his shining 16 h.p. Fowler pulling seven gleaming furrows through the stiff Essex clay. Yes, he could manage the following Sunday and would call round about nine. So I laid in some coal, cylinder and engine oil, and collected my meagre stock of tools.

Promptly at nine on a fine June morning we set off in the van. A long gravel drive led us to a beautiful old Tudor farmhouse, and there tucked away between a toolshed and a bull's pen we found her. But she was axle-deep in a jungle of live and dead debris of nettles, rusty wire, and wood and old oil drums. This cleared we got the sound sheet off and found the motion well greased and only rusty here and there.

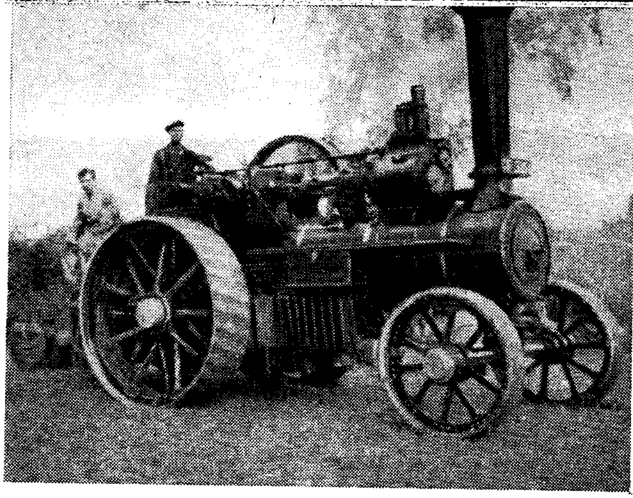
Two pairs of hands on the flywheel and she turned over without a protesting squeak. So after examining firebox, smokebox and tubes and checking the water-gauge Ron decided to light her up. An armful of straw from the barn and soon for the first time in years smoke ascended her handsome chimney—at least some did, but most blew back through the firehole. But Ron, the professional, knew the answer to that. He cut the ends from an old oil drum and perched the cylindrical part on top of the chimney.



Above: *The proud owner tries his hand*
Below: *Cleaned up and partly repainted*



Left: The owner gives the famous name a spot of metal polish



Right: At the East Anglian rally. Ron is at the regulator, Peter enjoys a rest on the coal bunker

This improved the draught and soon the fire was burning merrily.

So we got on with checking trimmings, oiling up, filling the lubricator and all the hundred and one jobs necessary for her resurrection, only breaking off now and again to put a bit on the fire. After an hour or so she began to sing, but the needle of the steam gauge still stuck obstinately on the peg. Twelve o'clock came and still no steam. So Ron said: " She's like an ode kittle. She'll never steam while you're a-watching her. Let's nip up the Shoes and have a pint."

Now The Three Horseshoes, a typical rural tavern, was strategically placed at the head of the drive and in a few moments we were in the public bar where the locals in their Sunday best viewed our entry with some suspicion. But quite suddenly Ron was recognised and our purpose known. So we ate our sandwiches and drank our beer to the accompaniment of nostalgic reminiscences of engines and men.

An hour quickly passed and I began to get anxious lest the Burrell blew up. I had visions of stuck safety valves and of the rustic calm of the country Sabbath being suddenly shattered. But Ron re-assured me and after another drink we departed. Fifty pounds on the clock and not a blow anywhere. Ron opened the regulator. With a heavy sigh she moved and was soon ticking over, steam hissing from open cylinder cocks. Encouraged by the exhaust, the fire began to burn more brightly and soon 100 lb. showed up.

And now her weaknesses were revealed. The injector steamcock was blowing through and the injector wouldn't work. Nor would the feed pump. Water-gauge packing was blowing and so were the glands of pistons and valve rods. But the vital thing was to get some water into the boiler. Injector cones were taken out and cleaned but still no response. We turned our attention to the pump and by wangling and priming got it to lift and to our relief the water climbed the glass. The injector was more obstinate and its failure was put down to overheating caused by the steam continually blowing through. It was impossible to remedy this while in steam so we had to rely on the pump. And now to move her out into the yard. We cleared the obstructions and Ron put her into low gear. He opened the regulator. She hesitated, being sunk quite a bit into the ground. A touch of the simpling valve and she heaved herself out, her exhaust beating a lovely staccato bark.

But we decided not to take her home that day in view of the failure of the injector and of the blows that needed attention. We drove her on to a piece of hard ground by the barn and arranged to pick her up the following weekend. This we did. Her various weaknesses having been attended to we lit her up once more and found her quite roadworthy.

When we were setting off the farmer appeared and asked if we would oblige by doing a job for him before we went. He had a baler bogged down in a low meadow and none of his tractors could move it. So we set off and did our good deed for the day, the Burrell heaving the heavy baler out without a murmur.

The journey home was uneventful except for one or two incidents. She climbed the short sharp hills of the Essex byeways like a bird and although our coal was not of the best she steamed well.

Treat for the G.I.'s

Our way lead past an American airfield and when our approach was noted, G.I.'s came from all directions and trained their cameras and cine-cameras on us. The drive into our yard is just 8 ft wide and the engine is 7 ft 8½ in. overall width. So you see what a tricky piece of driving was needed to avoid damaging the boarded fence on one side and the herbaceous border on the other. But Ron put her in low and with just a breath of steam he steered her home without damage. So now there's a Burrell at the bottom of our garden.

Peter, the engineer of the family, having returned from his globe-trotting, has cleaned, de-rusted where necessary and repainted her in the original colours of maroon and black. The boiler has been given an hydraulic test and all mechanical parts overhauled. She ticks over beautifully and has recently given pleasure to young and old at the local village fete, besides appearing at the East Anglian Rally held recently near Braintree in Essex where she came second in the competition for mechanical condition. ■

VIRGINIA

Continuing the instructions for a $3\frac{1}{2}$ in. gauge old-time American loco, L.B.S.C. specifies, this week, an up-to-date lubricating device

Continued from 27 September 1956, pages 452—454

THE use of separate cylinders instead of combined cylinder and smokebox saddle castings with steam and exhaust ways cored in—a difficult job in $3\frac{1}{2}$ in. gauge—calls for separate steam and exhaust pipe connections.

The simple arrangement illustrated is the same as I use on my own outside cylinder engines. It has proved easy to make and fit and perfectly satisfactory in service. The layout is the same both for steam and exhaust, the only differences being dimensions, the addition of an oil check valve to the steam pipes and the fittings at the tops of the vertical pipes.

The exhaust should be fitted first. Chuck a piece of $\frac{1}{2}$ in. square brass rod in the four-jaw and set to run truly. Face the end, centre, and drill to 1 in. depth with 7/32 in. drill, and part off at $\frac{7}{8}$ in. from the end. Rechuck, and run a $\frac{1}{4}$ in. × 40 tap right through. In the middle of one of the facets drill a 19/64 hole and ease it with the "lead" end of a $\frac{5}{16}$ in. parallel reamer until the end of a $\frac{5}{16}$ in. tube will fit tightly. Cut a piece 3 in. long, put about $\frac{3}{16}$ in. of $\frac{5}{16}$ in. × 32 thread on the end, and fit it in the hole, silver soldering the joint.

Cut two pieces of $\frac{1}{4}$ in. copper tube of about 20-gauge, about $1\frac{5}{8}$ in. long, face off to a dead length of $1\frac{9}{16}$ in. in the chuck, screwing one end for $\frac{5}{8}$ in. length and the other for $\frac{3}{16}$ in. length, with $\frac{1}{4}$ in. × 40 thread. Make two locknuts to fit from $\frac{1}{2}$ in. hexagon brass rod, and two more from $\frac{3}{8}$ in. rod, with a plain hole; all about $\frac{1}{8}$ in. wide. The plain ones are silver soldered to the pipes at $\frac{5}{8}$ in. from the short-screwed ends. The tapped nuts are screwed on the longer-screwed ends to the end of the threads and the pipes and then screwed into the centrepiece until they touch in the middle.

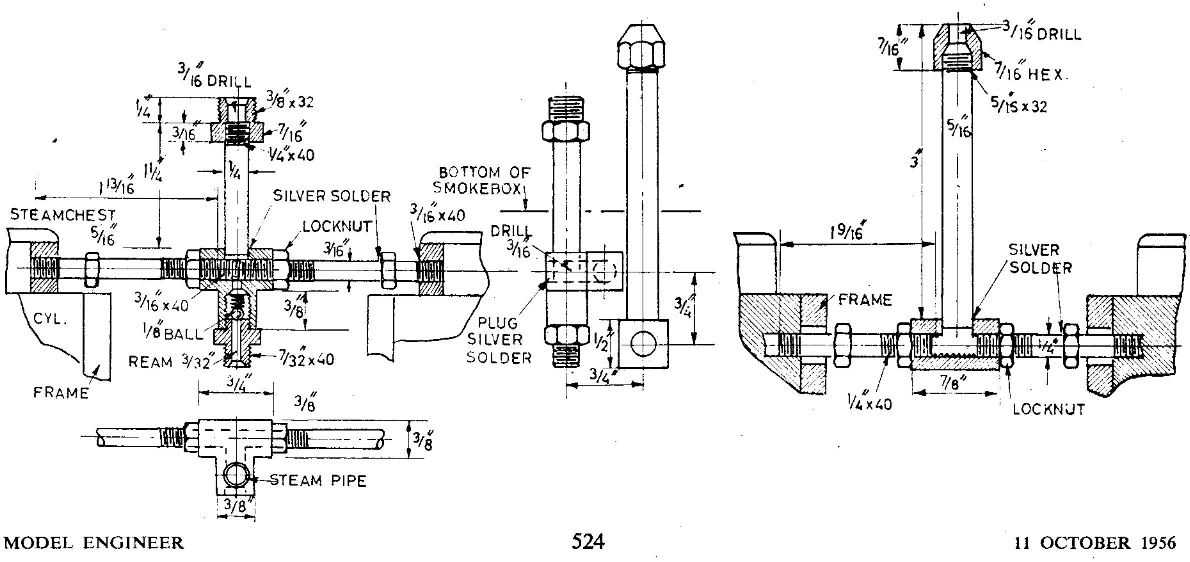
Smear a little plumber's jointing (Boss White or similar) on the threads at the shorter ends, hold the assembly with the $\frac{5}{16}$ in. pipe vertical between the cylinders opposite the exhaust holes, and screw the pipes out of the centrepiece into the cylinders, using a spanner on the smaller nuts. Put another taste of plumbers' jointing on the threads between the locknuts and centrepiece, then screw both locknuts tightly up against it.

The blast nozzle is made exactly the same as a union nut, but the end is tapered off as shown to allow the blower ring (to be described later) to fit over it.

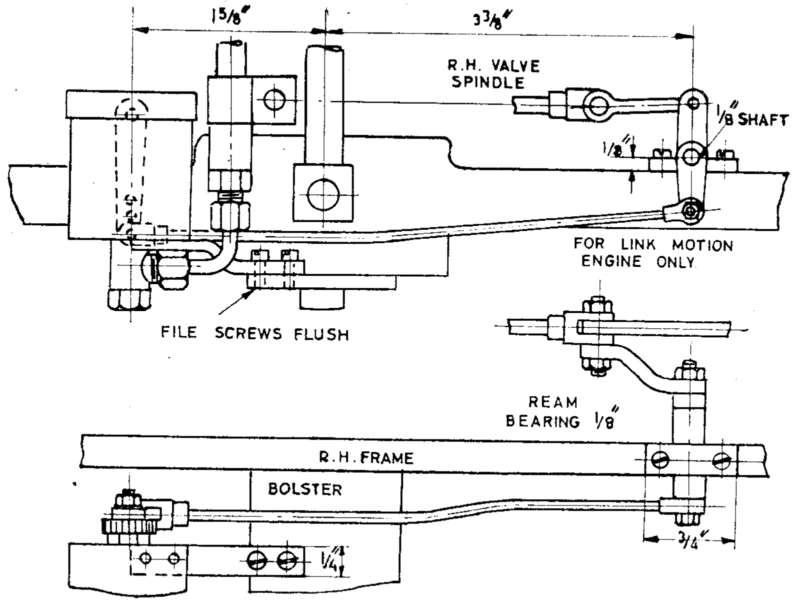
Steam pipe assembly

The centre may be built up, or a casting, in which case a chucking piece will be cast on opposite the boss for the oil check valve. To build up, saw the tee shown in the plan from a piece of $\frac{3}{8}$ in. × $\frac{3}{4}$ in. brass bar. Chuck in the four jaw with the head of the tee running truly, centre, drill right through with 5/32 in. drill and tap $\frac{3}{16}$ in. × 40. Then drill a 15/64 in. hole right across the stem of the tee (see plan) and drill a $\frac{3}{16}$ in. hole up the stem, breaking into the tapped hole as shown by the dotted lines. Plug the end of this with a slice of brass rod about $\frac{1}{4}$ in. thick, driving in tightly. Open out one side of the cross hole to take a $\frac{5}{16}$ in. pipe and fit a piece $1\frac{3}{8}$ in. long in it; this should have a few $\frac{1}{4}$ in. × 40 threads on the end.

Chuck a piece of $\frac{3}{8}$ in. round brass rod in the three jaw, turn a $\frac{1}{16}$ in. pip on the end—a tight fit for the hole opposite the pipe—and part off $\frac{3}{8}$ in. from the shoulder. This will form the body of the oil check valve Squeeze it into the hole, then silver



Steam pipes and oil check valve; side view of steam and exhaust pipes; exhaust pipe assembly



How the lubricator is erected and driven

solder the pipe, boss and plug at one heating. Pickle, wash off and clean up, then chuck the assembly by holding the pipe in the three jaw. The boss opposite it should run truly. Centre this, drill it 1/16 in. until the drill breaks through into the communicating hole, open out to 3/8 in. depth with 3/16 in. drill and tap 7/32 in. × 40.

For the valve seating chuck a piece of 3/8 in. hexagon rod in the three jaw. Face off, turn 3/16 in. length to 7/32 in. dia. and screw 7/32 in. × 40. Centre deeply and drill to 5/8 in. depth with a No 44 drill; part off at 9/16 in. from the end. Reverse in the chuck, turn and screw as above for 5/32 in. length, put a 3/32 in. parallel reamer through the hole and face off about 1/32 in. to form a true seat for the ball, which should be 1/8 in. dia. rustless steel. Seat it with a tap as described for the pump balls and assemble as shown with a light spring made from 28 or 30-gauge wire (hard bronze for preference) to keep the ball seated on the suction stroke of the pump. Uninitiated folk would hardly credit that these little balls would float, but they will—in the thick cylinder oil—if given half a chance.

To make the steam pipe union chuck a piece of 7/16 in. hexagon rod in the three jaw, face, centre deeply, and drill to 1/2 in. depth with a 3/16 in. drill. Turn down 1/4 in. length to 3/8 in. dia. and screw 3/8 in. × 32. Part off at 7/16 in. from end, reverse in the chuck, open out the centre hole for 3/16 in. depth with 7/32 in. drill and tap 1/4 in. × 40. Chamfer the corners of the hexagon. This fitting is not permanently attached until the smokebox is fitted.

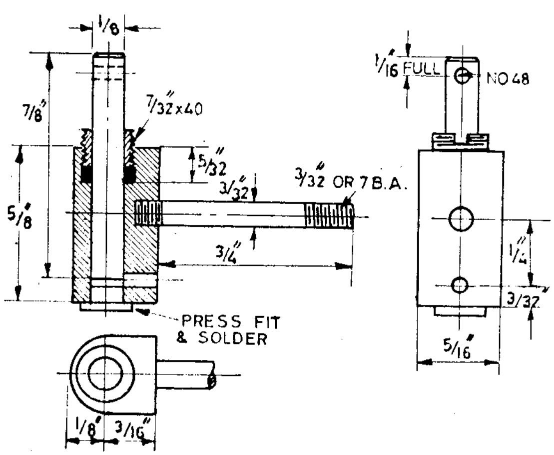
The cross-steam pipes are made from 3/16 in. copper tube and fitted up in exactly the same way as described for the exhaust pipes. All dimensions are shown on the drawing.

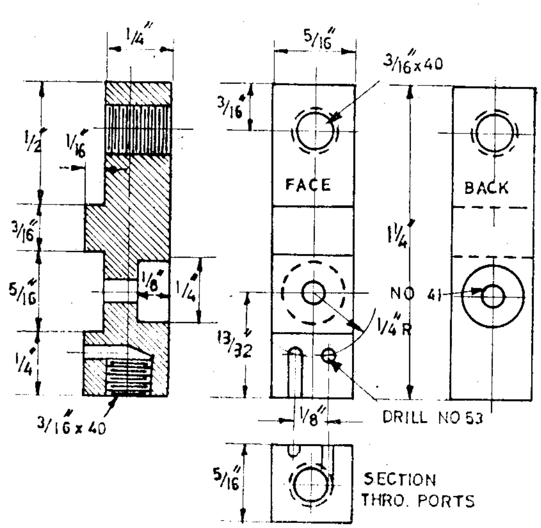
Mechanical lubricator

Old-time American enginemen would have been mighty glad if their tea kettles had been provided with this gadget, especially the firemen. Part of their duties when running on a down grade or other place where the engine was coasting with steam off was to go along the runningboard with a can of melted tallow and pour a quantity into the tallow cups on the steamchests. A pleasant job on a dark night with half-a-gale blowing and raining or snowing! This was how the nickname of "tallowpot" came to be applied to American firemen. Drivers rejoiced in the nickname of "hoggers."

To make the oil tank cut a piece of 18-gauge sheet brass 4½ in. long and 1¼ in. wide, bend to a rectangle measuring 1¼ in. × 1 in. and stand it in the brazing pan on a piece of 16-gauge brass about 1⅜ in. × 1⅛ in. Silver solder all around the bottom and along the joint, which should be in one corner. Pickle, wash and clean up, file the projecting parts of the bottom flush with the sides, drill a 3/16 in. hole in the middle of the bottom and another at 3/16 in. from the top on the centreline of one of the shorter sides. The lid can either be flanged over a formerplate of the

Right: Oil pump stand
Below: Pump cylinder





VIRGINIA . . .

same size as the tank top, or made from a piece of 18-gauge brass $1\frac{1}{2}$ in. × $1\frac{3}{4}$ in. with a $\frac{1}{4}$ in. nick taken out of each corner and $\frac{1}{4}$ in. of each edge bent up to form a tray. The corners can be silver soldered, but use very little, otherwise there will be a blob in each corner and the lid will not go on to its full depth.

The pump stand is made from a piece of $\frac{5}{16}$ in. square brass rod faced off at each end to a dead length of $1\frac{1}{4}$ in. Chuck truly in four jaw, centre, drill 5/32 in. for $\frac{3}{16}$ in. depth and tap $\frac{3}{16}$ in. × 40. File or mill the $\frac{1}{16}$ in. rebates shown in the drawing, then in the middle of the lower recess, at 13/32 in. from the bottom of the stand, drill a No 41 hole. At $\frac{3}{16}$ in. from the top drill a 5/32 in. hole and tap it $\frac{3}{16}$ in. × 40. Both these must go through dead square with the face, so use either a drilling machine or the lathe—not a hand brace.

Pin-drill out the back of the smaller hole to $\frac{1}{4}$ in. dia. for $\frac{1}{8}$ in. depth. The ports are set out at $\frac{1}{4}$ in. from the pivot hole at $\frac{1}{8}$ in. centres. The right-hand port is drilled right through into the tapped hole in the bottom of the stand. The left-hand port is drilled in to $\frac{1}{16}$ in. depth only and a groove is milled or chipped with a little half-round chisel (easily made from a bit of $\frac{1}{16}$ in. silver steel ground away to half its diameter, or diagonally, and hardened and tempered) from the port to the bottom of the stand.

For the pump cylinder square off a piece of $\frac{3}{16}$ in. rod to $\frac{5}{8}$ in. length, make a deep centrepop on it at $\frac{3}{16}$ in. from one of the facets, chuck in the four jaw with the pop running truly and drill right through with a No 34 drill. Open out to 5/32 in. depth with a $\frac{3}{16}$ in. drill and tap 7/32 in. × 40. Put a $\frac{1}{8}$ in. parallel reamer through the remains of the hole. For the gland chuck a piece of $\frac{1}{4}$ in. brass rod, face, centre and drill No 34 for $\frac{1}{4}$ in. depth. Turn down $\frac{1}{4}$ in. of the outside to 7/32 in. dia. and screw 7/32 in. × 40. Part off a slice a bare $\frac{3}{16}$ in. wide, cross-slot it with a hacksaw and put the $\frac{1}{8}$ in. reamer through. It can be held in the chuck by the threads for this purpose.

The plug at the bottom is turned from $\frac{3}{16}$ in. rod to a drive fit and soldered over. The port and trunnion holes must be dead square with the face otherwise oil will leak between the rubbing surfaces; the 3/32 in. trunnion, made from silver steel screwed as shown, must be exactly at right angles to the port face. True this up—also the rubbing face of the cylinder—by the same method described for cylinder port face and slide valves. The cylinder can be rounded off as shown, or left rectangular as desired.

The ram or plunger is a $\frac{7}{8}$ in. length of $\frac{1}{8}$ in. rustless steel or drawn bronze with a No 48 cross hole drilled at $\frac{1}{16}$ in. from the top. The gland is packed with a strand of graphited yarn. The spring is wound up from 22-gauge tinned steel wire and secured by a commercial nut.

To make the crank, chuck a piece of $\frac{3}{8}$ in. round rod in the three jaw, face, centre, drill No 48 for $\frac{3}{16}$ in. depth and tap 3/32 in. or 3/48; part off a $\frac{1}{8}$ in. slice and, at $\frac{1}{8}$ in. from centre, drill a No 53 hole, tap 9 B.A. or 2/56 and screw in a piece of 15-gauge spoke wire threaded to suit. The shaft is a $1\frac{5}{16}$ in. length of 3/32 in. silver steel threaded each end to suit.

At the end opposite the crank, fit a ratchet wheel about $\frac{7}{16}$ in. dia. with 35 or 40 teeth. If drilled No 43 it can be pressed on, but be sure to fit it the right way—buttress side of the teeth to your left when looking at it from the opposite end to the crank. About $\frac{3}{16}$ in. of the shaft should project.

For the bearing chuck a piece of $\frac{5}{16}$ in. hexagon rod, face, centre and drill to 1 in. depth with No 41 drill. Turn down a bare 13/16 in. of the outside to $\frac{3}{16}$ in. dia. and screw $\frac{3}{16}$ in. × 40. Part off at 3/32 in. from the shoulder, reverse and chamfer the corners and make a $\frac{1}{8}$ in. locknut to suit from the same size rod.

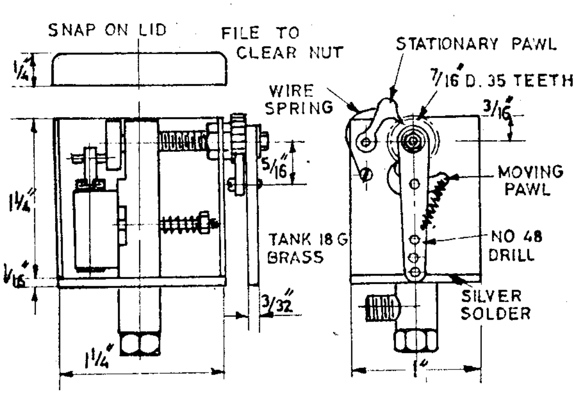
To make the check valve chuck a piece of $\frac{5}{16}$ in round rod, face the end, turn down $\frac{3}{16}$ in. length to $\frac{3}{16}$ in. dia. and screw $\frac{3}{16}$ in. × 40. Part off at $\frac{3}{8}$ in. from the shoulder Reverse in the chuck, centre, and drill right through with a No 43 drill, open out and bottom to $\frac{5}{16}$ in. depth with $\frac{3}{16}$ in. drill and D-bit and tap 7/32 in. × 40. Put a 3/32 in. reamer through remains of hole. Drill a 5/32 in. hole in the side and silver solder a 7/32 in. × 40 union nipple in it.

For the cap chuck a bit of $\frac{5}{16}$ in. hexagon rod, face, centre and drill $\frac{1}{4}$ in. depth with a No 30 drill; turn down a full $\frac{1}{8}$ in. of the end to 7/32 in. dia. and screw 7/32 in. × 40. Part off at $\frac{3}{16}$ in. from the shoulder. Seat a $\frac{1}{8}$ in. ball in the recess and assemble with a spring similar to the one in the upper valve.

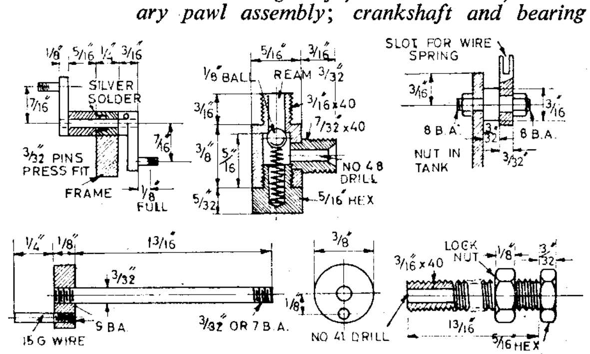
See that the port and cylinder faces are perfectly clean and attach the cylinder to the stand; place the assembly in the tank and screw the check valve loosely into the stand through the hole in the bottom of the tank. Put the bearing through the hole in the tank side, put on the locknut, enter the bearing in the tapped hole at the top of the stand and screw in until the head of the bearing touches the side of the tank; then run the locknut back and tighten it against the inside of the tank. Tighten up the check valve under the tank. Enter the crankpin into the hole at the top of the pump ram, hold the crank at the opposite end of the bearing between the pump ram and the stand, enter the crankshaft into the bearing and screw home into the crank.

The ratchet lever is filed up from 3/32 in. × $\frac{1}{4}$ in. steel and drilled as shown. The pawls are filed up either from cast steel and hardened or from mild steel and case hardened. The

(Continued on page 538)



Left: *Mechanical lubricator*
Below: *Rocking shaft*; *oil check valve*; *stationary pawl assembly*; *crankshaft and bearing*



WORKSHOP TOPICS

Hacksaw blades, high-speed steel and the construction of a cheap lathe centre are some of the subjects discussed

By MARTIN CLEEVE

I WONDER if any reader can tell me why it is that hacksaw blades, both power and hand, have a tooth cutting clearance of about 45 deg. (Fig. 1A) whereas the clearance for lathe or planer and shaper tools seldom exceeds 10 deg.? The standard sharpening seems to be more suitable for cutting wood than metal.

While there is little that can be done about it on hand blades, where the teeth are very close together, power saw blades can be re-sharpened and the teeth given a more reasonable clearance with very advantageous results.

This may easily be done by hand upon the periphery of a fine grinding wheel, the blade being held flat upon the workrest at approximately the angle required to alter the original clearance to one of from five to ten deg., as at Fig. 1B, each tooth being just a little more than "sparked." I have been prolonging the life of my blades by this means for many years.

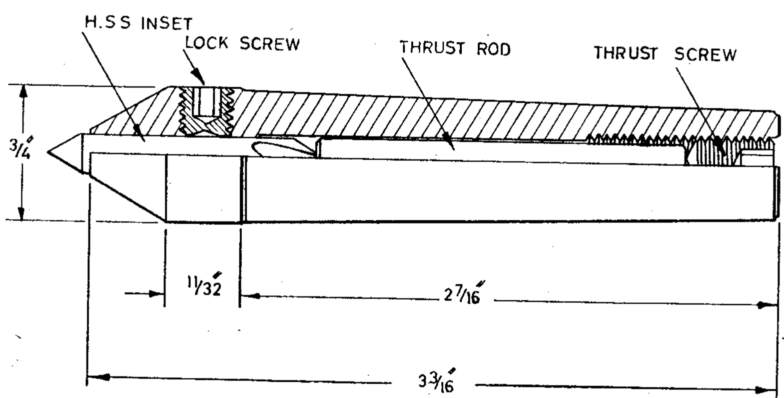
Little difference

I found that very little noticeable advantage resulted from sharpening under controlled conditions, in an attempt to have all the teeth at exactly the same height, (unlike milling cutter teeth, where this is of the utmost importance) neither does it seem to make much difference when the set of the teeth is carefully followed, the 80 or so teeth on a 12 in. blade can, therefore, be treated in a matter of two or three minutes; moreover, the sharpening can be repeated two or three times. A blade, freshly sharpened, cuts at a very satisfactory rate and also has a good "life."

Some years ago, when tools were very difficult to get, I made excellent use of worn out or scrap blades from a local firm who cheerfully gave me a dozen at a time. They were 14 in. blades and of excellent high-speed steel. I used to grind a groove and snap off the odd two inches, and then "blast" a hole by the expedient of striking an electric carbon arc at the required point and poking out the molten metal with a piece of rod. For each dozen blades received, I returned six re-sharps. I should explain that in those days I was working on a commercial basis, my blade consumption is now very low.

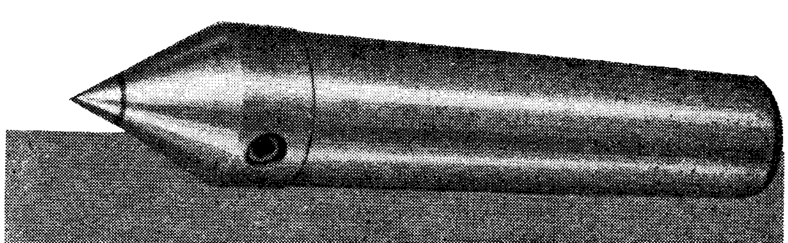
As I am in a questioning mood, I may as well add another. Why has the carbon-steel tool become almost obsolete? I agree that some firms, apparently with some reluctance, still turn out carbon-steel twist drills, but if one tries to obtain other tools in carbon steel there is often, by way of discouragement, an almost intolerable delay, while h.s.s. is quoted at a higher price.

Now what, for instance, could be more ridiculous than a high-speed steel hand reamer? Indeed, my experience of reaming, mostly in mild steel, has indicated that it is one of the slowest, as well as the most unsatisfactory and unreliable machining operations, and I should be very interested to know how reamers are put to such apparently successful use in, for example, the motor car industry



Above, Fig. 3: Details of the high-speed lathe centre

Below, Fig. 2: A No 2 Morse taper lathe centre with high-speed steel point. The illustration is full size



Workshop topics . . .

where, I am sure, if they experienced the same trouble with choked flutes, siezure and chatter as I sometimes do, producing one car would cost a million pounds!

Conversely, it is interesting to note that most small lathes are supplied with a hardened carbon-steel centre for the tailstock, and it has been my experience that carbon steel, for this particular duty, is not so very satisfactory. Wear soon takes place and if it becomes unduly heated during a prolonged machining operation in the course of which interest in the work in hand has taken the mind from the question of oil, the point will sometimes just melt away!

War-time prize!

During the war I used to do a little production work for a local firm.

While I was visiting there one day I noticed a broken 15/32 in. h.s.s. twist drill with a No 1 Morse taper shank. Upon request, this prize was readily given me, whereupon I hurried home, set up my then somewhat crude toolpost grinder, and made a very serviceable lathe centre which received exclusive use until quite recently when the ML7 was installed. It is not used on the new lathe as I have an aversion towards taper adapters. I have, however, a No 2 Morse taper centre with a tungsten-carbide tip—which I am in constant fear of breaking—and I have managed until now with this for high-speed turning, using the carbon-steel one for heavy work.

Nevertheless, I missed the use of a high-speed centre which is favoured for the majority of work, but not being so extravagantly minded as I used to be I did not fancy paying the price for the tailor-made job; moreover, I have yet to find a h.s.s. centre without that idiotic refinement "with spanner flats to facilitate removal"—a feature which adds expense and unnecessary, as well as undesirable, overhang.

H.S.S. insert

In view of all the foregoing, it was thought a good idea to test a fancy idea of mine and to make up a centre with a high-speed steel insert and a mild steel body.

The result proved most gratifying. The h.s.s. insert consists of a broken centre drill, while the body is drilled and tapped to take a thrust rod and screw, and a locking screw for the inserted point; thus, as wear (or accident) takes place the centre may be pushed out and re-sharpened like a propelling pencil. The photograph, Fig. 2, will give an idea as to what it looks like, and for the benefit of those who may like to make one I have included a drawing, Fig. 3, and a few necessary notes upon machining the body as well as grinding and fitting the insert.

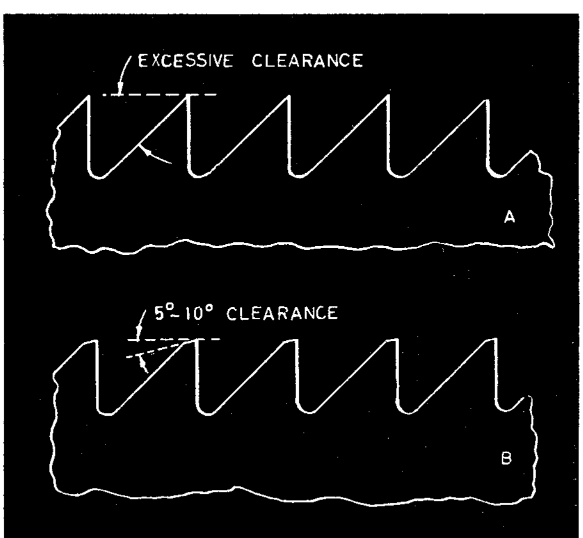
I think the job is best tackled by first machining the No 2 Morse taper upon a $4\frac{1}{8}$ in. length of $\frac{3}{4}$ in. dia. bright mild steel. This may then be inserted in the headstock taper and drilled for the broken centre drill which, in my case, had a body diameter of $\frac{3}{16}$ in.

Centre drill bodies are not usually made to close limits so, as the fit must be almost of the interference type, reaming would not be good enough, but I found that after opening out the hole in stages, with ordinary twist drills, until it was about five to seven thou undersize, the balance of the metal could be removed by utilising the remaining cutting edges on the centre drill itself.

Very frequent withdrawals are necessary to clear the chips and, as the resulting hole is quite tight, lubricating oil must be used. Before machining the cone it is as well to re-chuck and drill and tap for the push rod and screw; machine the cone, fit the lock screw, insert the broken centre drill, lock and grind the point.

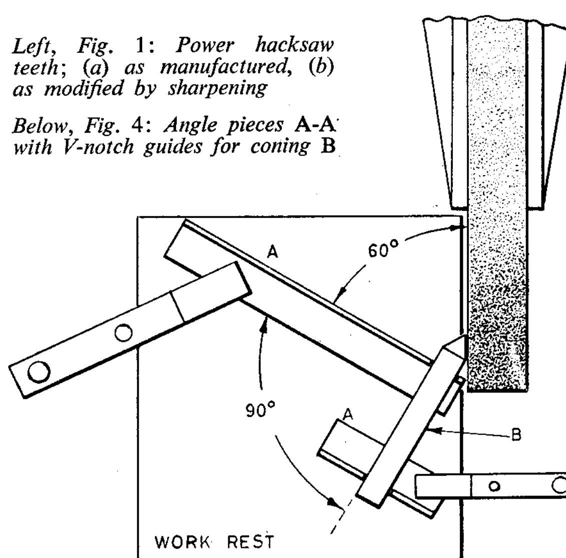
For the point grinding I used a toolpost grinder driven from overhead, as this undoubtedly gives the most accurate and concentric results. For those able to adopt this method it is a good idea to screw a catch or backplate over the mandrel nose and to smear the surface of the plate with grease.

The grease will help to trap some of the grinding dust, but do not worry unduly about a small job which creates hardly any more dust than the operation of polishing rotating work with emery or carborundum cloth; moreover, the point may be initially shaped by inserting the bit in a hand-brace



Left, Fig. 1: Power hacksaw teeth; (a) as manufactured, (b) as modified by sharpening

Below, Fig. 4: Angle pieces **A-A** *with V-notch guides for coning* **B**



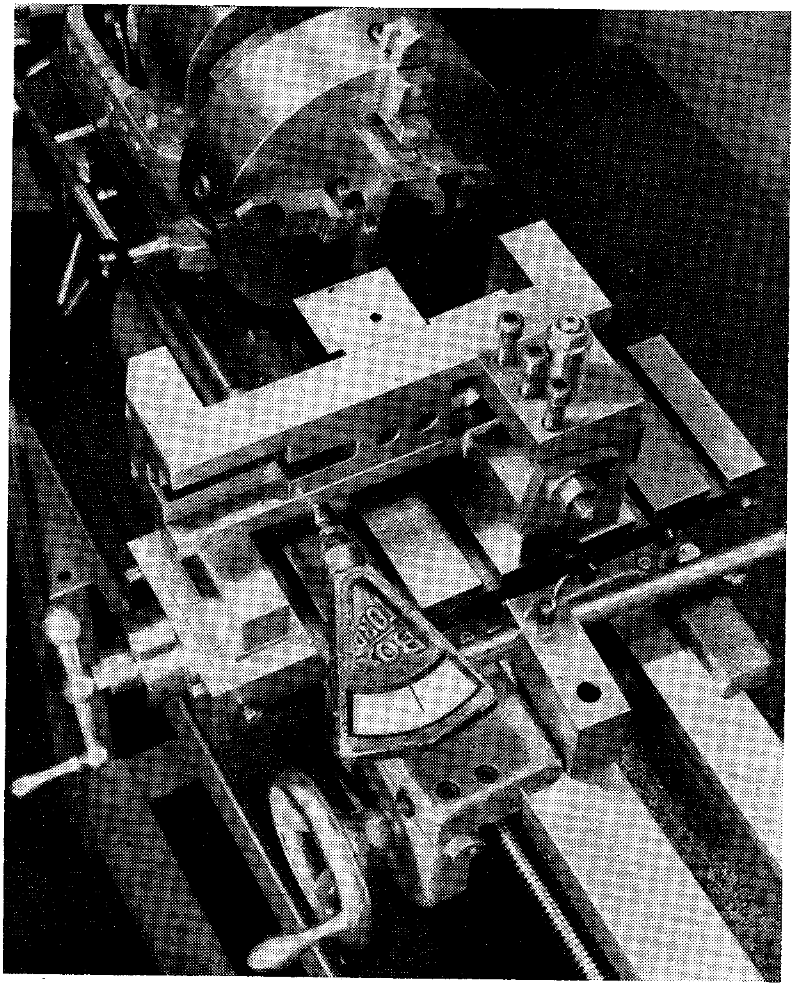


Fig. 5: Set-up for facing the upper surfaces of a machine vice. The " block " in the chuck was not made especially to hold the facing tool

chuck and presenting it to the side of the offhand grinding wheel.

By rotating the bit while in contact with the wheel an almost finished cone is soon produced. Do not try to grind the mild steel portion of the centre body as this will clog the grinding wheel; and do not take the finished job to pieces to show your friends !

For the benefit of those who may have to resort to hand grniding the lathe centre point, I have made a few experiments. I find that it is possible to grind an accurate 60 deg. included angle cone, concentric to within one thou, by means of the simple set-up illustrated by Fig. 4.

Here, the offhand grinding wheel is provided with a somewhat larger workrest upon which is clamped two odd pieces of $\frac{1}{2}$ in. × $\frac{1}{2}$ in. × $\frac{1}{16}$ in. angle, each having a filed vee notch to position the bit to be ground, but leaving it free to be rotated by " stroking " with the forefinger while applying very gentle pressure towards the wheel. Again, the point is best roughed out by the hand-brace method, using only one vee notch as a rest.

Readers who adopt the hand method would find it advantageous to bore the hole for the centre-insert, using a very small boring tool. This would ensure maximum concentricity on final assembly. I advise beginners to have a rehearsal bore with an odd piece of stock so as to get the feel of the job, and to minimise the risk of spoiling the No 2 Morse taper piece.

By the way, before spending time upon a broken centre drill, check that it is h.s.s. by sparking it upon the grinder. H.S.S. emits dull red sparks. If more convenient, use a length of Eclipse $\frac{3}{16}$ in. dia. h.s.s. toolbit—you will still have a very cheap lathe centre !

Truing a vice

From experience gained during the designing and making of the built-up type of machine vice which was recently described, it was thought a good idea to incorporate some of the improvements in my original and somewhat larger vice which was commercially made by the more orthodox process of machining from the solid. In the course of checking over it with the clock gauge, I was somewhat surprised to find that hardly any two surfaces were in agreement—it seemed to be about 10 thou " out " all over.

However, it is not proposed to go into minute details as to how it was trued up, but I have included a photograph, Fig. 5, which illustrates how the vice was mounted on the lathe cross-slide for facing the top surfaces, so as to get them parallel with the base. Beginners will find this of interest as it shows a method of facing a piece of work which is too large to be mounted on the faceplate and revolved in the usual manner.

In this case the facing tool is held in a four-jaw chuck so as to revolve at a radius of about $1\frac{1}{4}$ in. Thus, by feeding the work past the cutter by means of the cross-slide, the surface is very nicely trued.

The tool was revolved at 465 r.p.m. and it was found to behave quite nicely when taking light cuts of about three to five thou in depth, these being applied by advancing the saddle.

" Keep plate "

The dial indicator was used to check that the vice base was parallel with the cross-slide—a job involving the somewhat tedious winding back and forth of the cross-slide.

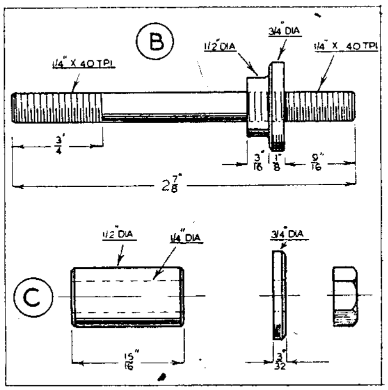
The vice is now fitted with a new sliding keep plate of my improved design. I am not sure that " keep plate " is the proper name for it, but it is the piece which prevents the moving jaw from falling out—which is about all the original little square of metal did. The new plate may be seen in position just to the right of the dial indicator. It is of greatly increased length, and it slides on the sideways as well as the underbase. The U is cut to clear drills, etc., when the vice is in use.

The original plate was held by two cheese-headed screws. They defied proper tightening, so $\frac{5}{16}$ in. high-tensile hexagon socket-head screws were substituted. ■

concluding—

Workshop grinding machines

By DUPLEX



IN LAST WEEK'S ARTICLE the machining of the grinder body was described, but it should be pointed out that one important advantage of making the body as illustrated in the drawings is that the bearings are then fully enclosed and dust is excluded from the working parts.

The next step is to make the machine spindle, *B*. This part may either be of built-up construction, as in Fig. 12, or it can be machined from a length of $\frac{3}{4}$ in. dia. mild-steel rod. After the flange has been firmly screwed home on the spindle it is cross pinned with a well-fitting taper pin, and the work is again mounted between centres for taking a light facing cut over the abutment surface of the wheel flange. The loose flange is then machined to the same diameter as the fixed flange and is accurately surfaced on both faces.

The spacing collar, *C*, must have its abutment faces machined parallel in order to align the ball races correctly. To complete the spindle it is fitted with the driving pulley, *D*, which screws on to the spindle so as to clamp the inner races of the ball bearings, and the pulley is afterwards secured with a lock nut. The diameter of the pulley depends on the size of the driving pulley fitted to the spindle of the large grinder, but a speed of from 8,000 to 10,000 r.p.m. should be aimed at for running the miniature grinding head. When ball bearings are run at these high speeds, they are best lubricated with machine oil rather than grease.

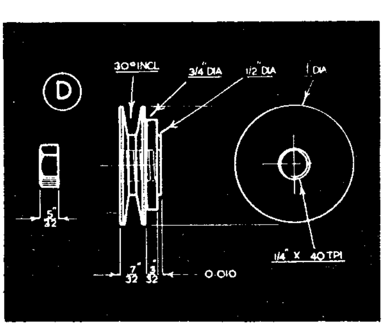
The flanged ring, *E*, which serves to clamp the outer race of the right-hand ball bearing, can if required be turned from brass or duralumin. This part fits closely in the bearing housing and should be given only a few thou. in. clearance over the base of the wheel flange in order to exclude dust. After the ring has been secured in place with three 6 B.A. screws, a reference line should be scribed across both parts, or two corresponding dots punched, as an aid to reassembly.

Assembling the spindle

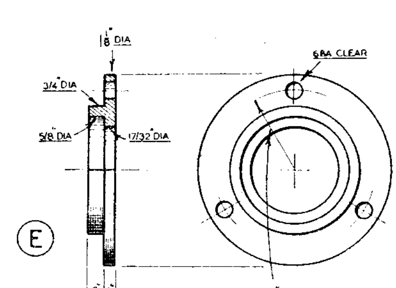
To avoid damaging the ball bearings or their housings, the necessary pressure should be applied by means of the clamping nuts rather than by using a hammer. The right-hand bearing is first entered in its housing and seated against the abutment shoulder by tightening the flanged ring, *E*. The spindle is next placed in position and, after the sleeve, *C*, has been slipped on, the left-hand ball bearing is put in place and pressed home against the distance sleeve by tightening the pulley lock nut.

After the parts have been assembled in this way, it will probably be found that the end pressure has put an axial load on the bearings, resulting in rough running. This should be corrected by lightly tapping the ends of the spindle until it will spin freely. The pulley can now be screwed on to the spindle and locked in place. Finally, the grinding wheel is mounted

Above left. Fig. 12: *B—the grinder spindle*; *C—bearing distance sleeve*



Left, Fig. 13: *The spindle pulley*



Right, Fig. 14: *The bearing clamp ring*

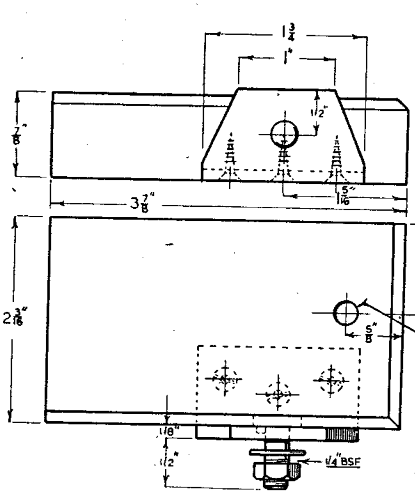


Fig. 15: *The wooden base with the grinding rest mounting and the fixing screw*

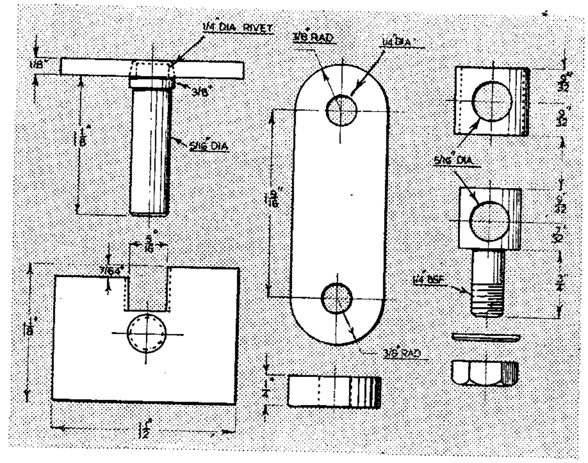


Fig. 16: *Components of the grinding rest*

on the spindle and secured by means of its loose flange and clamp nut. To ensure even pressure on the wheel the two flanges are lined with washers made of thin card or blotting paper, and the clamping nut is then tightened sufficiently to provide for driving the wheel.

The grinding rest

So that the grinder can be readily detached from the sliding baseboard it is mounted on a small wooden base, which also provides a means of attachment for the grinding rest.

The base is held in place by the fingerscrew (Fig. 15) and is located by the slotted clamping plate attached to the upper surface of the sliding baseboard. The pillar of the grinding rest is pivoted at its lower end on a stud, which is fixed in a short length of brass angle. At its upper end the pillar is fitted with a sleeve clamp for gripping the spindle that is attached to the underside of the work table.

With this arrangement the table can be set to any required grinding angle, and its height can also be adjusted to accommodate tools of various sizes.

With a small wheel of the width used there should be no danger of breakage as a result of centrifugal force or from excessive pressure being applied against the side faces of the wheel. The chief duty of the guard is, therefore, to prevent surface oil and abrassive dust being flung about the bench. The guard illustrated was beaten to shape on a wooden former from 20-gauge sheet copper and it is secured to the wooden base with five screws.

To transmit the drive a 5/32 in. dia. round, plastic belt is used in conjunction with V-pulleys machined to an included angle of 30 deg. This plastic material is of light weight and has little tendency to rise from the pulleys because of centrifugal force, but the drive is best kept short in order to reduce belt stretch.

By adopting the following method, secure joints can be readily made in plastic belting. A length of mild-steel bar, say, $\frac{3}{8}$ in. × $\frac{3}{4}$ in., is gripped in the vice and the projecting end is heated with a Bunsen burner until the surface of the steel becomes blued. The two ends of the belt material are then pressed against opposite sides of the heated bar until they become mushroomed. Following this the ends of the belt are immediately pressed firmly together in correct alignment and, at the same time, care is taken to avoid including air in the joint.

When the joint has cooled the surplus material is trimmed off with a sharp knife and the belt is afterwards rolled on the hot bar until the joint becomes quite even and almost invisible. Joints made in this way show no tendency to pull out and, in fact, they seem to be quite as strong as the rest of the belt. ■

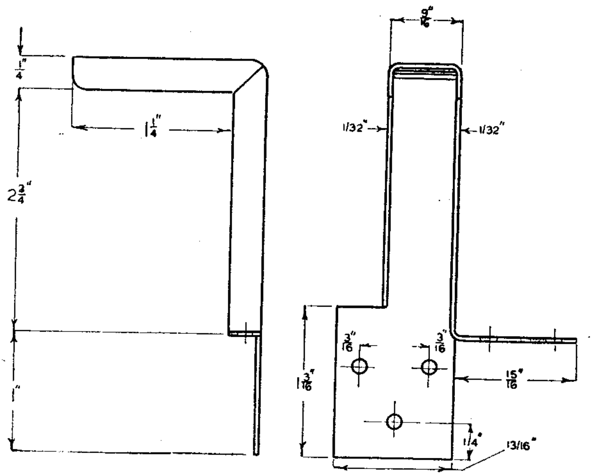
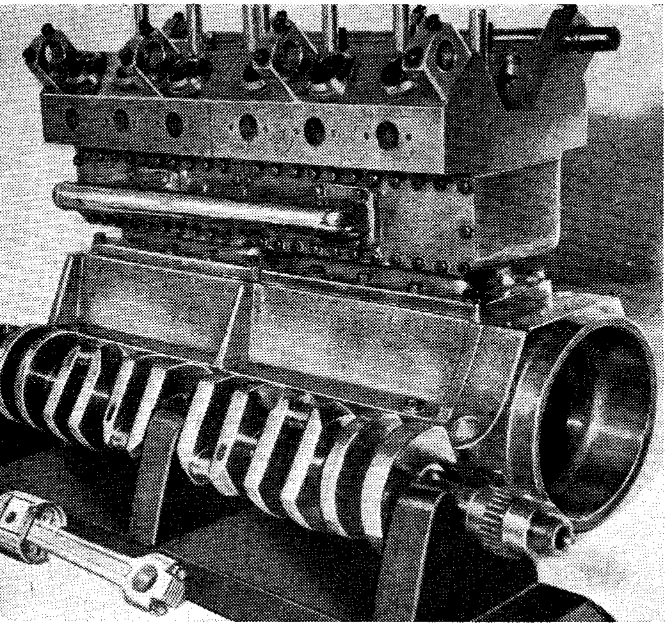


Fig. 17: *The wheel guard*

HOBBIES HANDBOOK

Fathers with Christmas gift problems on their hands will welcome the 1957 edition of *Hobbies Handbook*. A feature is a design for making a model trawler, *Anglian*. There will be many trawlers in Christmas stockings this year. Also in the handbook are hundreds of ideas for toys and novelties; in every case there is a kit available, together with design and working instructions. It is a full 152 pages. *Hobbies* 1957 *Handbook*, price 2s., published by Hobbies Ltd., of Dereham, Norfolk. ■



Some models at MANSFIELD

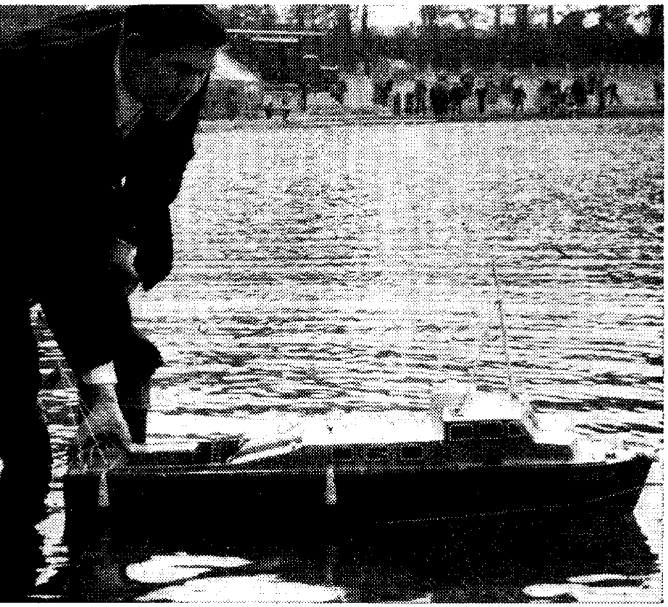
By NORTHERNER

A variety of subjects and some excellent craftsmanship characterised the display at this Nottinghamshire models exhibition

Above: Unfinished Maserati racing engine by A. V. Lowe. Connecting rod and piston are to left

Below: C. Jenkinson launching his R.A.F. launch

Right: The two-cylinder side-valve petrol engine built for J. S. Penny's model coastal tanker

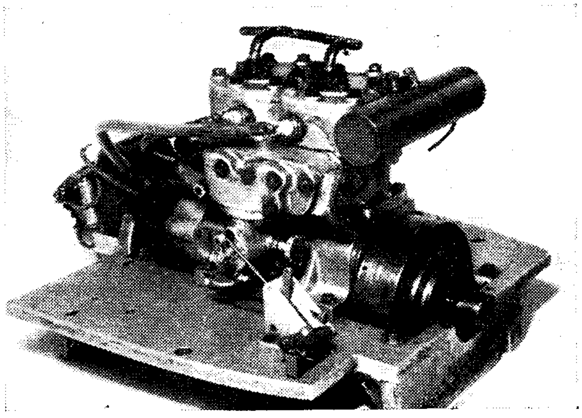


In connection with the recent Miners' Welfare Festival held at Mansfield, Notts, an exhibition of model engineering was held at which models from the surrounding area were to be seen.

Competition was held for the trophy set up to perpetuate the memory of the late Fred Smith, that great model builder of Pinxton. Many readers will recall his models of mining subjects—steam winding engines, horse winding gear, and other historical subjects—and it was very pleasant to see several of these superb exhibits again.

The trophy was awarded for an excellent piece of craftsmanship—the model was unfinished. It was of a six-cylinder Maserati racing engine, and it was being built by the late A. Victor Lowe of Hucknall at the time of his death. The engine was 30 mm. bore × 35 mm. stroke, and was made to a very high standard. As an example, the crankshaft, with six throws and seven bearings, was turned from solid nickel-chrome bar.

Another example of Mr Lowe's work was seen complete, and gave some indication of what the Maserati engine would have been like. This was an o.h.c. Norton motorcycle engine of 23 c.c., with aluminium cylinder, cast-iron liner, and dural connecting rod.



A first prize was awarded to J. S. Penny of Winthorpe for his ⅜ in. scale coastal tanker. The hull was planked on formers, with superlative finish, and the vessel was driven by a vertical twin side-valve engine of 10 c.c. which was also built by Mr Penny. A centrifugal water pump for cooling purposes was gear driven from the crankshaft; the ignition was by magneto.

The craft is radio controlled, and I was told that it is actually classified and insured as a petrol-carrier by Lloyds !

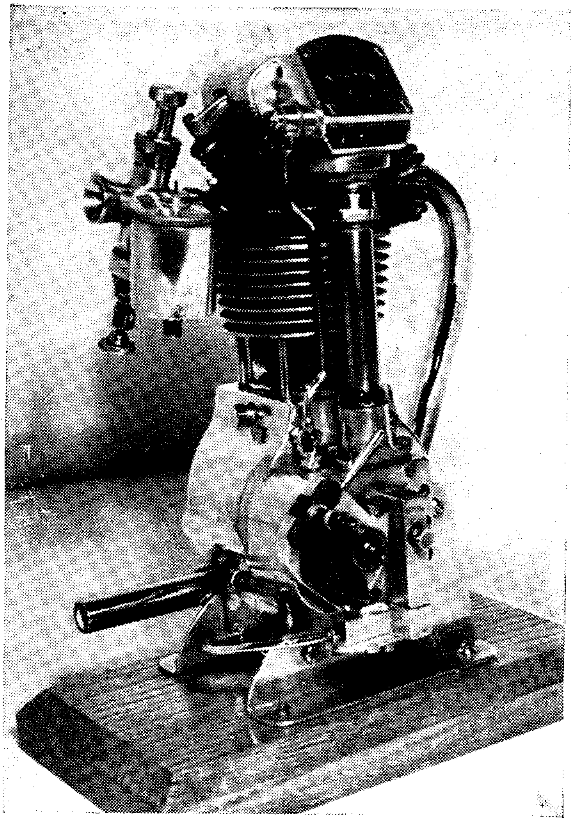
Second prize was won by the Allchin M.E. traction engine which is being built by R. Hancock of Kirkby-in-Ashfield. Finish was very good on the whole, and when complete the model should be worthy of high honours.

An austerity 2-8-0 locomotive built to ½ in. scale from L.B.S.C.'s instructions, secured the third prize for A. Walters of South Normanton. With rather more attention to finish this could well have secured a higher award, but bad file-scratches on the links and rods certainly detracted from the model's appearance.

The name of Frank Surgey of Somercotes, Derbyshire, is not unfamiliar to MODEL ENGINEER readers, since from time to time he has described models of his in these pages. Several of them were on loan, including such diverse objects as machine tools and a 1 in. scale A.E.C. bus, "glass-case" Sunbeam and Triumph motorcycles, and a 2 in. scale Huwood-Hudswell 100 h.p. diesel mine locomotive. There was also a 1 in. scale Hunslet diesel mine locomotive, the model being powered by electricity.

A number of model power boats were demonstrated from time to time, running on the lake in the park and controlled by radio. One of these, by C. Jenkinson of Bilsthorpe, was a 1 in. scale model of a 45 ft R.A.F. safety launch. Fitted with a water-cooled diesel engine, the boat was of the usual plywood construction of hard-chine boats, and had occupied 400 hours of building time.

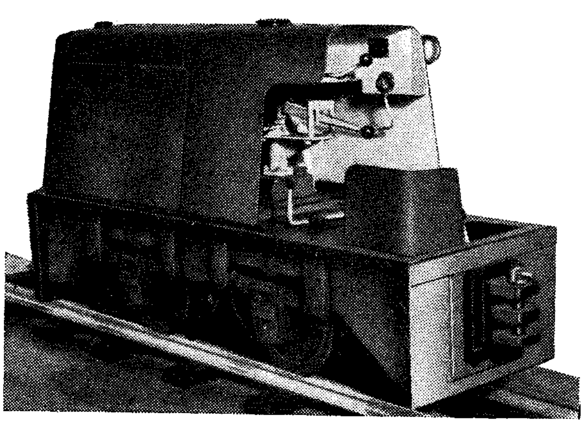
Also impressive on the water was the 52 in. cabin cruiser *Barbara* built by M. A. Bull of Mansfield. The diesel engine of this boat was fitted with two fans, one for cooling, and the other to induce passage of the exhaust gases up the funnel with quite realistic results. ■

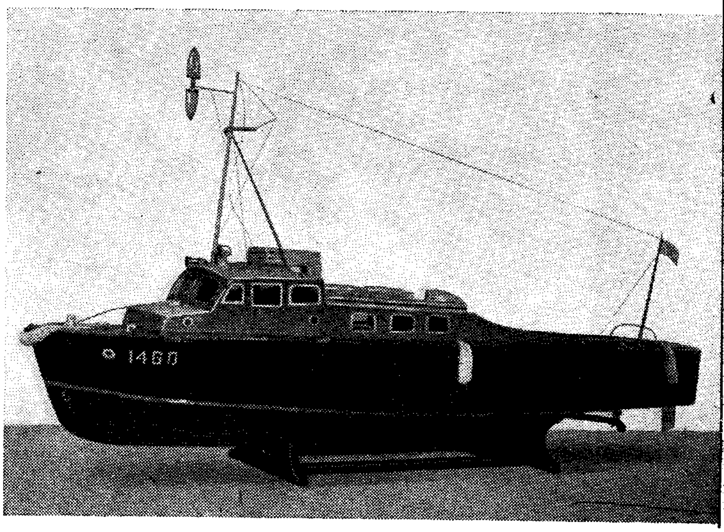


Above: *A camshaft Norton engine of 23 c.c. built by the late A. Victor Lowe of Hucknall*

Below, left: *F. Surgey of Somercotes built this 1 in. scale model Hunslet diesel mine locomotive*

Below: *A 1 in. scale safety launch by C. Jenkinson*





REVERSING small single-phase A. C. MOTORS

J. F. O. VAUGHAN describes a simple reversing unit

IT IS OFTEN very useful to be able to reverse the rotation of motors in the workshop—a typical example is when screwcutting on a lathe with a solid nut. The arrangement described here is not in any way novel, but it has the advantage of using standard switches available in the surplus market, and it prevents accidental starting of the motor in reverse.

In the present case, the motor is $\frac{1}{4}$ h.p. It is probable that larger motors take a starting current in excess of that which the usual run of switches can handle. Motors of $\frac{1}{4}$ h.p. take about 2.6 to 2.9 amp on 230 v. a.c. to run them, and about 10 amp to start. It is, of course, the starting current which determines the switch rating. However, very neat toggle switches rated at 10 amp 250 v. a.c. are available.

Small single-phase a.c. motors have two separate windings—a starting winding and a running winding. To reverse the direction of rotation it is necessary to reverse the connections to one winding. If the motor is of the capacitor-start type, it will have a capacitor in series with the starting winding. Provided this arrangement is not disturbed, the difference can be ignored.

Spring bias

The circuit diagram shows that two separate switches are required, a double pole on-off switch and a two-pole change-over switch for reversing. The latter is a three-position switch with a centre off position and it is biased by a spring so that it holds in the centre and in one extreme position, but not in the other extreme position. This latter position is used for reverse.

One thing the diagram does not show is that these motors have a built-in centrifugal switch which disengages the starting winding as soon as the motor has attained normal running speed. The result is that when the motor is running, the reversing switch is out of action. It is only necessary for this switch to be in the right position at the actual moment of starting.

For normal use, the reversing switch is left in the forward position and the motor is controlled by the on-off switch. If the reversing switch is accidentally left in the centre position the motor simply will not start. The reversing switch cannot be accidentally left in the reverse position because of the spring.

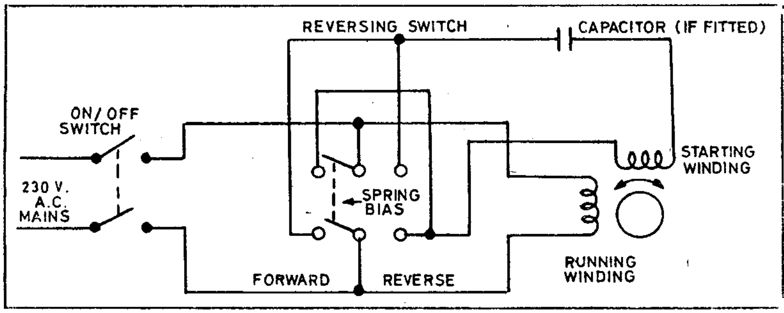
To start the motor in reverse, the reversing switch is put in the centre position and the on-off switch moved to on. The reversing switch is then moved to reverse for about a second and released. The motor will continue to run in reverse until the main switch is put to off. The operation takes less time to do than to describe.

Using two-position switch

This is the preferred arrangement. If the reversing switch has no spring bias, this can be arranged externally. If, however, a three-position switch is not available, a two-position one can be used, with certain disadvantages. If a spring-biased two-position switch is used it will have to be held in reverse while the on-off switch is switched on. This may need two hands.

The fact that the switch promptly flies to the forward position does not matter, because the starting winding is out of circuit when the motor is running. If the switch has no spring bias, this can be arranged externally, or a mechanical latch can be provided to prevent accidental reversing. If the two directions are used equally, it may be better to have no safety device in reverse.

Be careful that the reversing switch does go to the starting winding, so that there is current in the running winding whenever there is current in the starting winding. A reversal of connections could result in a ruined starting capacitor, or burnt out starting winding. If the motor connections are not obvious, a word with the local dealer or the manufacturer will pay dividends. ▣



The diagram showing the layout of the circuit. It does not illustrate the centrifugal switch which disengages the starting winding when the motor reaches running speed

POSTBAG

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

THE "INFERNAL" ENGINE

SIR,—I was rather amused at Vulcan's comments regarding the lovely clean efficient diesel engine, known to some folk as the infernal combustion engine.

It is clear to me that our good friend has never had to work on these machines with their black slime and stink of crude oil. When I served in motor ships my hands were always ingrained with dirt and a pair of boots lasted me about three months.

Steam reciprocating engines were alway clean to work on; in fact the emulsified lubricating oil kept one's hands clean. However, I must agree with Vulcan that the steam engine is about the most wasteful prime mover made and a modern ship's engine only gives about 8 per cent. efficiency.

Chippenham, Wilts. M. SPEAREY.

INEXPLICABLE EXPLAINED

SIR,—"Where did that chimney come from?" Mr J. N. Maskelyne asks in his criticism of my L.N.W.R. G2 0-8-0, and he goes on to say that it certainly was not taken from official drawings.

Well I am sorry to flatly contradict such a knowledgeable person as J.N.M. but I do assure him, most emphatically, that it is an exact copy of the official Crewe drawing and it was carefully built up piece by piece and conforms with all outside dimensions and profile. The only departure from official dimensions is the inside diameter.

Perhaps J.N.M. could be persuaded to include a *George the Fifth*, *Precursor* or *Prince of Wales* in his excellent series Locomotives I Have Known, as these were all fitted with this type of chimney.

With regard to that "curious and inexplainable fault" appertaining to the rear axle "apparently made in two parts and joined by a clumsy bit of pipe," if Mr Maskelyne had examined this he would have noted that it was the leading axle and not the rear.

Further contemplation may have revealed "the inexplicable," for it would then have been obvious that the clearance between the full diameter axle and the undersides of the slidebars is very small (it is so on the prototype), but whereas the full-size locomotive can afford to have stiff springing, the small version cannot, due to the more uneven roads upon which it is often run.

It is very necessary, as most of us know, to have a resilient springing to avoid derailments and it was found that under these conditions the axle fouled the slidebars on occasions.

Therefore, the two sections of the axle directly beneath the slidebars were turned down to a slightly less diameter and the "clumsy bit of pipe" is nothing other than the original axle diameter.

Mr Maskelyne's remaining criticism with reference to heavy wheel spokes is quite justified; they are a little too thick, but did he notice that the balance weights were all in their odd but correct places?

Chester. E. E. HOBSON.

IMPROVISED BUILDING

SIR,—The locomotive in my picture is a slightly modified version of *Ajax* by Dick Simmonds. I built it in Malaya in 1952/3 the whole job taking about 18 months. She was christened *Curry Puff* and any readers familiar with that part of the world will at once recognise the aptness of this name!

The photograph shows myself driving with my wife and a friend, all seated on one very makeshift passenger truck. The track also was makeshift, being some scrap channel section as used for some types of folding steel doors with ties made of ⅜ in. square bar shouldered down at each end and nutted into the channel at about one-foot intervals. This was simply laid over some small ballast on the ground, providing a rather precarious 400 ft run round the house.

The only tools used on the job were an old type 3 in. Myford, a hand bench-drill press and the usual hand tools. The boiler was built from a battered old sheet of ⅛ in. copper, the barrel being formed round a drainpipe of the house after annealing over a charcoal fire in the garden. Brazing was carried out with a 5-pint blowlamp and a charcoal fire. I estimate I lost enough perspiration on this job to provide the boiler with its first fill—and that over the top nut too. The Malayan climate is not the best in which to braze 5 in. gauge boilers.

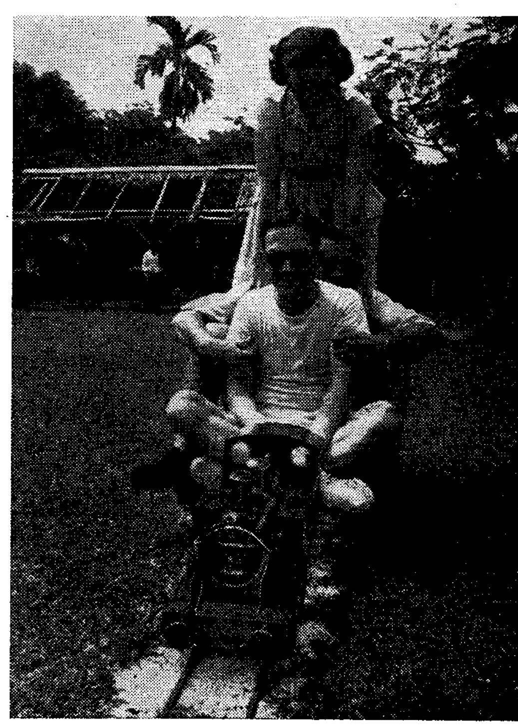
Curry Puff was not quite complete when the photograph was taken but she is more or less finished now. Next job? I have a yen to build something really big in 5 in. gauge—an American type and I *do* know what I am letting myself in for too!

Old Windsor, Berks. ALAN BRADBURY.

THE HOOKE JOINT

SIR,—Congratulations to Mr Couddas on the design of his milling attachment shown at the recent M.E. Exhibition. This would appear to have many points of superiority over the usual type of set-up used for milling in the lathe.

Mr Bradbury takes his wife and friend for a trip on the 400 ft model railway he built in Malaya



POSTBAG . . .

There is, however, one detail in which it is capable of improvement. Where two Hooke-type universal joints are used to transmit power between two parallel shafts, the forks of the intermediate shaft should be in the same plane. In this way the variation in angular velocity produced by a Hooke joint when working at an angle is cancelled out by the joint at the other end of the intermediate shaft, thereby ensuring that the two parallel shafts rotate in step.

As shown at the exhibition and illustrated in MODEL ENGINEER for September 13 the errors are cumulative and irregularity of angular velocity will become worse as the displacement between the parallel shafts is increased.

Harrow Weald, Middx. W. H. RIDER.

SAVING WHEEL WEAR

SIR,—I've been thinking! What the heck's the use of these thrupple-nut things?

For your information—I'm building a 5 in. narrow gauge free-lance locomotive, and I'm not going to fit sanding boxes: I will glue glasspaper to the treads and save wear on the wheels!

London, E.17. DAVE CAPENER.

ASPINALL ATLANTICS

SIR,—I was very interested in the article in the above series [MODEL ENGINEER, September 6] dealing with the Aspinall Atlantics of the late L. and Y. Railway, since it reminded me of a small matter in connection with these engines that has been a source of puzzlement for a good many years now.

In a boyhood book, *The Wonder Book of Railways*, that I still possess and which I have dipped into over the years when in reminiscent mood, there is an illustration of one of these locomotives involved in an accident. It is lying to one side at about a 45 deg. angle, not much damaged, against a high wall over which many heads are peering, and it is being righted by two breakdown cranes.

The point of the matter is that the illustration is captioned "Breakdown cranes at work after an accident to the Scotch express," which in later years is something that I have never been able to reconcile, for surely these engines were never so used?

Perhaps the caption is inaccurate, although I should be surprised if this is indeed the case, for although a boys' book, *The Wonder Book of Railways* has stood up wonderfully well in the light of the acquired knowledge of things connected with railways of later years.

Hanwell, Middx. F. SEWARD.

WHY THE DIFFERENCE?

SIR,—One reason I like your magazine is because you quite often include something pertaining to model boats. Our club is only interested in racing boats, so we look forward to any item on engines, hulls, or racing results.

One thing we notice is that all racing boats in England are run with mufflers which, of course, are not used here. We also notice that the speeds are much lower on the average than speeds run in this country. We have wondered whether this is due to the muffler, or different engines. We do not wish to give the impression that we can do so much better; we are sure that there is a good reason for the difference.

Here, for example, is the result of a race run in St Louis on September 1 1956:

First place for class B went to Howard Scott of Chicago with a four-cycle engine; his speed was 64.28 m.p.h. D and E classes were troubled by rough water, but two runs were made giving a first to myself in class E, using a McCoy engine; the speed was 83.33 m.p.h. First place in class D went to Roy Ruggeri of St Louis using a Hornet engine; his speed was 62.06 m.p.h. Trophies were awarded for the three firsts.

St Louis. PETER F. YANCZER.

COAL ESCORT

SIR,—I was interested to read Mr Barker's letter "Submerged locos" [MODEL ENGINEER, September 27] and his reference to traction engines in the Boer War.

I have a recollection of the Sussex Regiment's mobile column, operating in the Riddlersbury District, O.F.S. in 1901, escorting a wagon-load of coal to a traction-engine convoy which had run short of fuel.

After the war I was stationed at Bloemfontein when an experimental goods service using Fowler engines was run between that town and Ladybrand. I think the old ox-wagons were still necessary to stock the coal and water stations en route.

The railway was then in course of construction so the success of the venture in any case would be shortlived.

Welwyn Garden City, Herts. A. FORD.

STEAM AND DIESEL

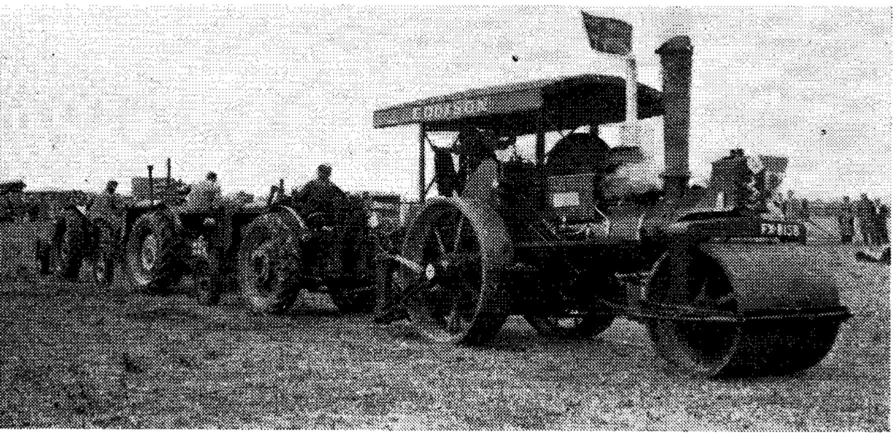
SIR,—From my point of view Vulcan's Smoke Ring [MODEL ENGINEER, September 20] was somewhat distorted. How does a model engineer look "dispassionately and objectively" at a steam locomotive?

Do you really expect speeds of over 100 m.p.h. to be exceeded to any great extent and to become a common service by the introduction of diesel and diesel-electric trains? Will not any diesel unit of outstanding performance be really only a big brother to one of its forerunners?

If there has been no progress in the performance of the steam locomotive in 50 years may it not be largely because of track restrictions and conditions and economy reasons generally?

If the steam locomotive is messy it need not be—they were kept clean and smart at one time—and though their smoke may be dirty the exhaust of the diesel is just as deadly though it may be almost invisible. The compression ignition engine may have improved beyond all recognition in the last 25 years but how old is it, and was not the steam engine making progress at the same stage of its life? As to the extreme power of the diesel,

The supremity of steam power at low speed. Three modern tractors fail to hold this stalwart roller



most steamers can develop wheel-spin in spite of their weight.

Let us forget the marine-type which can tick over at 20 r.p.m. When such an engine is installed in a locomotive we shall need an entirely new railroad complete with outsize bridges! If we are to lose interest in the steam locomotive because it is outdated let us also forget the sailing ship, the traction engine, the roundabout, the pendulum clock, etc., etc.

No, sir, I suggest Vulcan revives his interest by going to one of the main termini to watch one of the classics get under way with a long, heavy train of coaches behind the tender.

Lincs. P. R. BARLOW.

FOR MUSEUM

SIR,—The enclosed photograph is of a Tasker 7 h.p. engine, No 382, built in 1896 and recently bought back by Messrs Tasker for their museum.

The late owner was Mr C. Enkel, of Collier Row, near Romford, Essex who is shown in the background.

Enfield, Middx. J. MYALL.

This traction engine was rescued from limbo by Messrs Tasker, the original makers

RAILWAY DATA

SIR,—Our club here in Australia, Carillion City Model Railroad Club, is very desirous to contact other model railway clubs in all parts of the world. In this way we can learn new ideas and obtain photographs and information regarding the railways of every country.

We are proud to say that our club holds bigger model railway exhibitions in Australia than any other club, and the more photographs we can obtain the better will be our display. Also we want to help tourists with information about train travelling, and we intend to open an information desk as soon as we can receive sufficient data from other countries.

15, Fish Parade, Gorman's Hill, Bathurst, N.S.W., Australia. B. DAVIS (President).

SENTINEL ON DUTY

SIR,—Steam enthusiasts may be interested to know that at time of writing there is a Super-Sentinel undertype steam tractor at work in this district. It is owned by the well-known firm of road contractors, W. and J. Glossop Ltd, and forms the tractor unit of an articulated assembly carrying road surface planing plant. The makers number is 8768, the road registration number T.E. 9861, and the owner's number, R.B.6. I enclose a snapshot of the engine at work in London Road, Sevenoaks.

Recently, while passing a yard at Beddington, Surrey. I noticed a Sentinel under-type tar sprayer bearing the name of the above firm. This appeared to be in reasonable condition, but whether or not it is actually in use I cannot say. There were also three Aveling and Porter steam-rollers here owned by the Rowley Plant Hire Co.

Sevenoaks, Kent. D. A. JOHNSON.

"VIRGINIA'S" PUMP

SIR,—The "Anti-air-lock pin" has bobbed up again in the axle-driven feed pump for *Virginia.*

The pin is $\frac{1}{8}$ in. dia. and $\frac{5}{16}$ in. long in a port or passage 5/32 in. dia. and the stroke of the pump is $\frac{5}{8}$ in., so that somewhere about halfway of the delivery stroke, the pump proceeds to bung up its own delivery passage—the original area of 0.019 sq. in. being reduced to 0.0069.

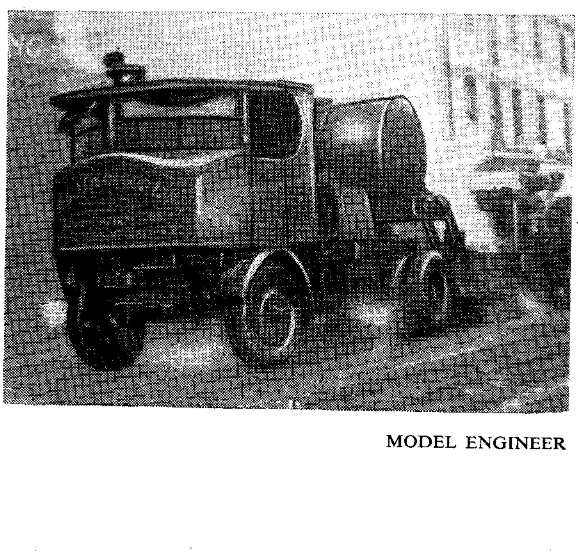
In the case of the pump specified for the largest *Netta* the proportions were even worse—a $\frac{1}{8}$ in. dia. pin, $\frac{1}{4}$ in. long in a No 30 drill size port, the stroke of the pump being $\frac{3}{8}$ in., so that for some two-thirds of the delivery stroke the port was reduced to the equivalent of a No 69 drill size hole.

And this Heath Robinson remedy is intended to counteract an air-lock which need never exist; it can be eliminated by lifting the passage from barrel to valve chamber off centre so that the top of the inside of the passage and of the barrel are in line; or better still by increasing the size of the passage to that of the barrel, in other words carrying the barrel right through into the valve chamber and lengthening the ram and letting it do its own dirty work of "anti-air-locking."

The pump specified for *Virginia* is of a very poor design, in that the thrust is tending to move the flange of the pump away from the guide-yoke instead of towards it, and it is only prevented from so doing by four No 6 B.A. screws.

I suggest that the pump flange should be re-positioned so as to come on the axle side of the guide-yoke and that the barrel should be screwed into the valve chamber, instead of silver-soldered, to facilitate assembly.

Braintree, Essex. W. B. HART.



A Super-Sentinel engaged on road work in Sevenoaks. See "Sentinel on duty"

READERS' QUERIES ★ ★ ★

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

Making a crankshaft

Q I have rough turned a four throw crankshaft for an obsolete i.c. engine (all journal diameters 1¾ in.) Material used: flame cut mild steel billet. I intended having the rough turned shaft case hardened—finally ground, but have been advised that case hardening is unnecessary. The suggested finish is normalising and grinding. I am aware that motor crankshafts are normally produced from hard specification steel and are *not* hardened, but I feel rather doubtful as to a soft ground finish being adequate on mild steel.—H.R.P., Enfield, Middx.

A *If this is a relatively low-efficiency engine for which neither the speed or the bearing load has to be extremely high, a mild steel crankshaft, unhardened and running in white metal or soft bronze bearings, would be fairly satisfactory—though an alloy steel having greater resistance to wear would, of course, be an advantage. It would be very risky to attempt case-hardening a mild steel crankshaft, owing to the great danger of distortion and possibly cracking as well. For normalising mild steel, it should be uniformly heated to a red heat and allowed to cool naturally.*

Working by hot air

Q I fail to see how a hot air engine works and would be obliged if you could enlighten me on the subject. —R.E., Birmingham.

A *Several types have been made, working on different principles. But the most common type is the closed circuit engine as originally invented by Stirling. In this type of engine the air is alternately heated and cooled, causing it to expand and contract. This is done by using a closed chamber, one end of which is heated and the other end kept as cool as possible. Inside the chamber is a moving piston, or, strictly speaking, a displacer which does not touch the sides, but it is used to displace the air from one end of the chamber to the other. A communicating pipe from this chamber leads to the working cylinder, which has a piston alternately forced out and drawn in by the changing pressures. The displacer piston is usually timed about 90 deg. out of phase with the power piston. Numerous articles on the hot air engine have been published in* MODEL ENGINEER, *with diagrams showing working principles.*

Inside-cylinder castings

Q I am proposing to build an 0-6-0 tender locomotive in 2½ in. gauge with inside cylinders. Can you inform me where I can obtain castings for the inside cylinders?—P.M.J., Horsforth.

A *Drawings and all necessary castings and materials should be obtainable from Kennion Bros (Hertford) Ltd, 7, Greenways, Hertford, Herts.*

VIRGINIA

Continued from page 526

moving pawl is pivoted on a 3/32 in. screw in the ratchet lever and held in contact with the wheel by a light spring, one end of which is hooked into a hole in the tail of the pawl and the other in a hole in the lever.

The stationary pawl is mounted on a stud turned from a scrap of $\frac{3}{16}$ in. round steel, one end of which goes through a hole in the tank and is nutted inside. This pawl is kept in contact with the wheel by a spring of 16-gauge steel wire, bent as shown, and attached to the tank by a screw nutted inside. The action is exactly the same as the winding ratchet on an alarm clock. The lever is prevented from coming off the shaft by a commercial nut and washer. When the nut is tight home the lever should swing freely without side shake.

The complete lubricator is erected on the bolster carrying the engine truck, as illustrated. A bracket, bent up from 3/32 in. × ¼ in. steel strip, is attached to the underside of the tank at each side. First solder them to the tank in position, then put a screw through each from the inside of the tank with nuts underneath. The screws attaching the brackets to bolster must be filed flush to avoid interference with the movement of the truck. The union under the tank is connected to the upper check valve by a piece of 3/32 in. copper pipe with a 7/32 in. union nut and a cone at each end.

The driving arrangement for the engine with link motion can be arranged by employing a small rocking shaft screwed to the top of the frame a little behind the valve spindle fork. The bearing consists of a little plummer block filed up from ¼ in. square brass rod, into the side of which is silver soldered a bush made from ¼ in. round rod, the hole being reamed ⅛ in. The spindle is made from ⅛ in. silver steel and the rocker arms from ⅛ in. × ¼ in. steel. Each carries a crankpin made from 3/32 in. silver steel or drill rod screwed at one end for a nut, 8 B.A. or 2/56, and pressed into the arms. The outer arm is brazed to the spindle; the inner one is pinned directly opposite. The complete assembly is attached to the top of the right-hand frame by two screws in the position shown.

The outer rocker is connected to the side of the valve-spindle fork, the pin of which is made long enough for this by a short connecting rod bent to the angle shown in the plan. The inner rocker is connected direct to the ratchet arm by a 3/32 in. rod screwed at both ends. The rocker end carries a brass boss filed up from ⅛ in. × ¼ in. brass rod and screwed on. The other end carries a fork made from ¼ in. square steel—made in the same way as the valve-spindle forks—and attached to the ratchet lever by a 9 B.A. or 2/56 screw. The exact length of this rod is easily obtained from the actual job with lever and rocker arm hanging straight down.

The pawl should ratchet one tooth at each revolution of the driving wheels when the valve gear is in the notched-up position. If it does not do this when the fork is connected to the bottom hole of the ratchet lever try one higher up. In the case of the Walschaerts gear the back end of the driving rod is connected to the wrist pin of the feed pump, the pin being extended sufficiently to allow this to be done without the rod fouling the side of the pump barrel. It shoud be bent to clear the underside of the guide yoke.

● *To be continued.*