# Model Engineer

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## EXHIBITION PREVIEW

ONE SHILLING

# Model Engineer

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


# SMOKE RINGS

## A WEEKLY COMMENTARY BY VULCAN

MANY REQUESTS for information on models which have been described in past volumes of the M.E., including some which appeared up to 50 years ago, are submitted by readers who wish to build these models and often we are unable to assist them directly in these matters.

Occasionally, however, full sets of issues containing the articles on particular models are kept on file by constructors, who are usually willing to loan them or otherwise dispose of them to readers who may be interested.

I have recently heard from a reader who has built the Aveling type DX road roller model from the description published in the M.E. during 1938, and he has all the articles dealing with its construction in folio, for which, he states, he "would like to find a good home." If any readers are seeking this information, I shall be pleased to put them in touch with this correspondent.

Incidentally, I must point out that the Aveling DX is not a *steam* roller; its power unit is a single-cylinder diesel engine and in the model this is copied as faithfully as possible to work on petrol with spark ignition. It makes a very handsome and efficient working model, and it has been constructed successfully by many readers; a special prize offered by Messrs. Aveling and Barford for the best model to this design was won by C. Nicholls, of Gloucester.

### That brazing job

IF you have a small brazing job to be done on your model wrap up the relevant parts and bring the work to the demonstration area at the Model Engineer Exhibition, New Horticultural Hall (August 22-September 1).

Hand it to Charles Kennion, the well-known Hertford model engineer, who will be pleased to do the brazing for you free of charge.

During the exhibition Mr. Kennion will be conducting regular demonstrations of small brazing jobs on models brought along by visitors.

### Modified Merchant Navy

ONE of the recently modified Merchant Navy engines of the Southern Region has lately been tested on the *Atlantic Coast Express* with the dynamometer car attached. The engine, No. 35020, *Bibby Line*, had no difficulty in timing the train of 363 tons tare load over the $171\frac{3}{4}$ miles from Exeter to Waterloo in the scheduled 190 minutes.

The reduction of boiler pressure from 280 lb. to 250 lb. does not seem to have had any noticeable effect on either the performance or the steaming capacity, and when working hard the

# SMOKE RINGS . . .

ratio between boiler pressure and steamchest pressure was satisfactorily close and constant. But slipping of the driving wheels, so apparent in the original engines when running as well as when starting, is still present to an undesirable extent.

It is interesting to recall that when the results of performance and efficiency tests of these engines were published in 1954, this slipping tendency was attributed to leakage of oil from the oil-bath that enclosed the valve gear. Presumably some other cause must now be formed, since the modified engines have ordinary Walschaerts gear and no oil-bath.

One suggestion is that some overbalance in the reciprocating weights may have something to do with it and the remedy is therefore to be found in rebalancing the reciprocating masses.

## Model seaplane

VISITORS to the Model Engineer Exhibition, to be held at the New Horticultural Hall from August 22 to September 1, will see a model seaplane take off and land.

This demonstration will be held on the 25 ft. square water tank which will once again be a prominent feature of this popular exhibition. The seaplane has been built by the Epsom District Model Flying Club.

Further exciting demonstrations will be provided by the Model Power Boat Association and the International Radio Controlled Models Society, both of which have promised to supply models and demonstrators.

It is by no means certain, however, that there will be enough to keep up a round-the-clock display and there is a great opportunity for individual and club modellers, who have boats in these two categories, to show their skill and craftsmanship.

Those who would like to demonstrate should be prepared to spend some time at the Exhibition.

## "Big Emma" memento

SINCE my previous note about the Lickey banking engine was written, some further information has come in. *Big Emma* was fitted with a powerful electric headlight and carried the equipment for lighting it; all this apparatus has been transferred to B.R. Class 9 2-10-0 engine No. 92079, which has replaced *Big Emma* on the Lickey incline.

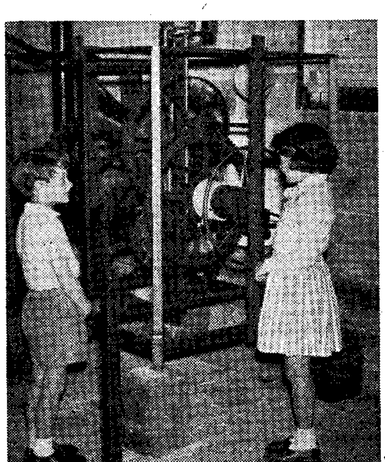
An item of special interest, however, is being preserved as a tangible memento of *Big Emma*; it is her set of four cylinders which, so far as I know, were unique for a British locomotive. They incorporate cross ports, making it possible for one piston valve to supply steam to both cylinders on one side of the engine.

The arrangement, which appeared to work quite well, requires that the two adjacent cranks on each side of the engine must be at 180 deg. to one another, as on Western Region 4-cylinder engines; but whether it possessed any particular advantage, as compared with the more normal separate valve for each cylinder, is open to doubt. The saving of material is, of course, obvious but seems to have been of little value in itself.

## Calling all cars!

MODEL cars will be racing on the track of the North London Society of Model Engineers which will be on display at the Model Engineer Exhibition. Demonstrations are to be held during the day on Wednesdays and Saturdays, and on every evening.

*Christopher* (5) *and Philippa Lamb* (6) *looking at the time-worn timepiece. See* " 570-*year-old clock* " *paragraph in last week's issue*



To fill the vacant periods on other days the Exhibition Manager would be glad to hear from individuals who have cars of up to 1 c.c. engine capacity and who can spare the time to demonstrate their models, even if it is only for a few hours.

As is well known to those who operate model cars on rails, a patent has been granted in respect of track attachments and steering mechanism. It would be necessary, therefore, to eliminate any steering feature or have the steering effectively locked.

A modification will be made to the track in respect of the notching of the rails which is sometimes used. Further details can be had from the Exhibition Manager, 19-20 Noel Street, London, W.1. Telephone Gerrard 8811.

## Roses and names

THERE are many examples of standardisation these days, particularly in the car, motorcycle, radio and gramophone record industries. Many items of equipment are identical.

Is there any point in this, I wonder? Those folk who cherish memories of a particular car, for example, will not think that the DEF model is quite different from the XYZ product just because the name-plates are different. They know that the same engines and body components are used in both cars, so there is no real difference.

Those not in the know probably do not care what name their car bears, so long as it works well.

## Atom photographed

THE atom has been photographed! What is reckoned to be the first picture ever taken showing atoms as separate entities has been achieved by Dr. E. Muller, professor of physics at Pennsylvania State University. His picture was taken, according to a report in *Engineering*, by a field ion microscope and it shows pearl-like atomic clusters magnified 2,750,000 times.

The object of the picture was the tip of a tungsten wire which was so fine as to be invisible. It was sharpened to a point, inserted in the microscope and reduced to a temperature of −300 deg. F.

The photograph, which was reproduced in the *Engineer*, shows an area of black and white dots forming a compact cluster-like pattern.

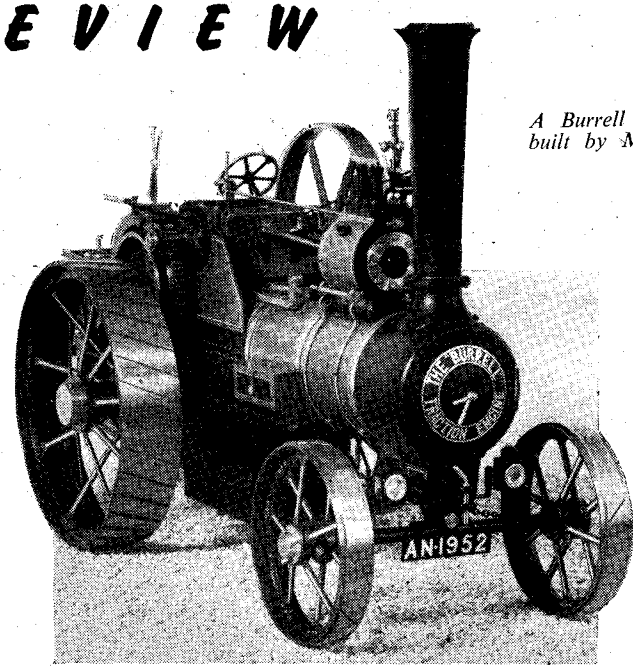
## Cover picture

*A general view of last year's* MODEL ENGINEER *Exhibition at the New Horticultural Hall.*

# EXHIBITION PREVIEW

By E. T. WESTBURY and J. N. MASKELYNE

***A report on some of the models you will be able to see at the Model Engineer Exhibition from August 22 to September 1***



*A Burrell traction engine built by Mr. A. Newman*

THE ORIGINALITY in respect of both the subjects for modelling and also their treatment, evinced by the models in the mechanical section, completely refutes the common allegation that model engineers have one-track minds.

For instance, nearly all the models in Class J (General Engineering) are of an unusual type and made by ingenious methods. J. S. Bodell, a draughtsman, of Sale, Cheshire, has entered a working model carbonating machine, capable of making five gallons of mineral water per hour. It is driven by a 10 v. motor supplied by a step-down transformer, which also feeds a 30 v. water level control relay.

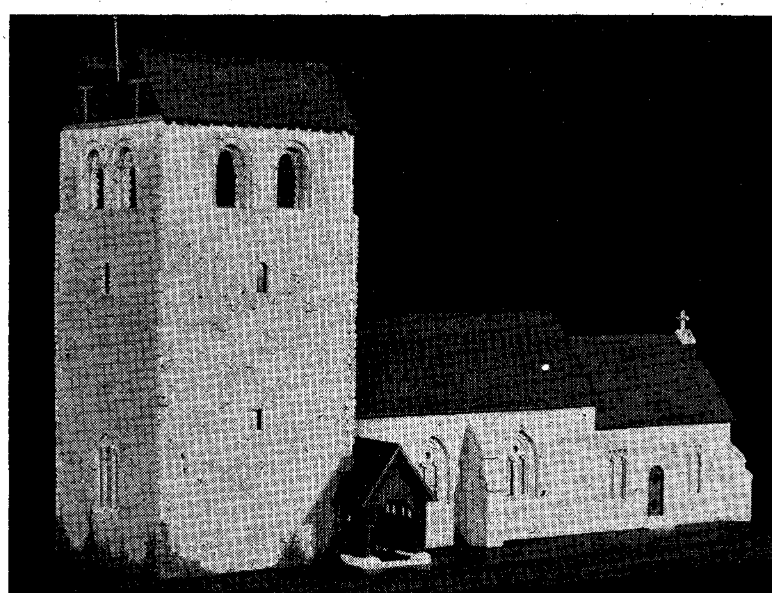
G. H. Landon, a retired electrical engineer, exhibits a case of model firearms, ranging from the "handgonne" as used at Crecy to the 20th century Lee-Enfield rifle. The model of a steam trawler's winch, by A. B. King of Aberdeen, was assembled in a garden shed from parts machined while fire-watching during the war. L. J. Roe, a retired motor mechanic of Twickenham, has produced a 1/3 scale model of the Myford ML7 lathe, all machining for which, including the hobbing of the changegears, was done on the full-size prototype.

### Road vehicles

Among the mechanically propelled road vehicles (Class L) there are as usual some interesting traction engine models, including a 2 in. scale freelance showman's engine, based on the articles by Frost Spike published many years ago in M.E., constructed by W. Paxton, a printers' maintenance engineer, of Morden Park, Surrey.

Two examples of Fowler engines are entered, one being a 2 in. scale model of the 8 h.p. agricultural type,

*This model of a parish church is by L. Seymour*



by H. G. Winton, an aircraft engineer of Acton, London, W.3, and the other a $1\frac{1}{2}$ in. scale Supreme showman's engine, complete with working dynamo which generates efficiently at 500 r.p.m.

Steam-rollers, for some unknown reason, do not appear to be so attractive as their near relatives, traction engines, as a subject for modelling, but this year there is at least one example of a very familiar type, the 10-ton Aveling and Porter single-cylinder, built by R. Forster, a retired boilersmith of Dorchester.

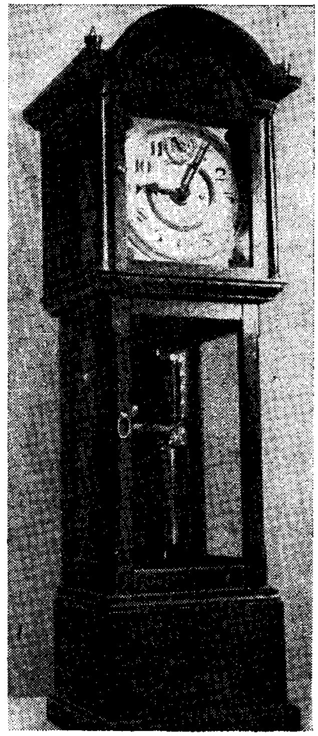
Non-working engineering models include several modern road vehicles, from motorcycles to coaches. The favourite of motorcycle modellers appears to be the Norton. H. W. Hooper, depatch foreman of Birmingham, has produced a 2 in. scale model of the Dominator; G. D. Kemp, engineering student, a 1/22 scale model of the 1955 works type, mainly in balsa wood; and H. Sykes, a miner, of Leicester a 1 in. scale model of the Manx racing type.

A 1931 Grand Prix Bugatti in $\frac{3}{4}$ in. scale is entered by W. R. Finch, draughtsman, of Potters Bar, and a Lotus Mk IX Sports racing car by S. Pemberton, a studio executive of Tufnell Park. A very fully detailed $\frac{3}{4}$ in. scale model of a London Transport private hire coach, with correct steering, suspension, brakes, and other mechanical parts, all to true scale, has been produced by E. A. Allchin, coach builder, of Greenford.

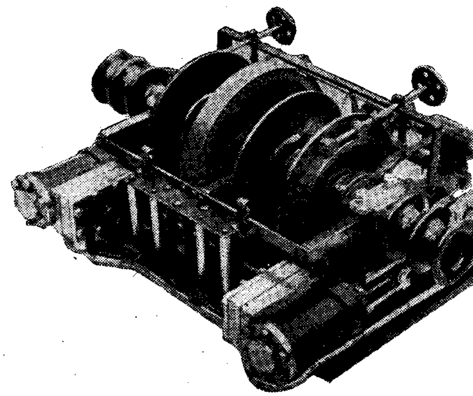
Among unusual models in this class are the scale model of a cinema projection room by R. W. Platten, a projectionist from Finsbury Park, who intends to use it in the training of student projectionists in the future, and a model of one of Trevithick's locomotives by C. H. Toogood of Sudbury, Suffolk, a regular exhibitor who has entered many unusual types of models in the past.

Architectural and scenic models include a $\frac{3}{16}$ in. model of St. Bartholomew Church, Fingest, Bucks, by L. G. Seymour, of Barnsbury, London, N.1; a 4 mm. scale model of Burnock Ford, including a Norman church and several other buildings, by A. McIntosh, a storekeeper, of Bromley, Kent, and a sectional part of a bungalow by H. Lynch, a bricklayer from Finchley, London, N.2.

One can always expect to see some good examples of clockmaking at the M.E. Exhibition and this year is no exception. J. C. Stevens, a teacher, of Ealing, who has entered some interesting clocks in the past, has produced an eight-day bracket clock with striking gear, calendar work, fusees and verge escapement, following traditional design, with case copied from an eighteenth century specimen.—E.T.W.



*Left: T. B. Voase's $\frac{1}{2}$ sec. pendulum clock which has Hipp escapement*



*Below: Andrew King's model of a trawler's winch gear*

ONCE AGAIN, the entry forms reveal a nice variety in the locomotives and the railway exhibits. With the threatened demise of the steam locomotive, its miniature counterpart seems to be more popular than ever.

Yet, when this fact is carefully thought over, there seems to be, as yet, nothing that can quite take the place of the steam locomotive as the prototype for a model. Hot on its tail, so to speak, railway modelling in general seems to come second.

C. G. East of East Molesey has built a $3\frac{1}{2}$ in. gauge version of the popular L.M.S. 4-6-2 locomotive *Duchess of Buccleugh*, with the idea of producing a reasonably accurate replica, particular attention being given to such items as working sanding gear, a completely fitted cab layout and paired brake shoes on the wheels. Details like these do not often have special attention given to them.

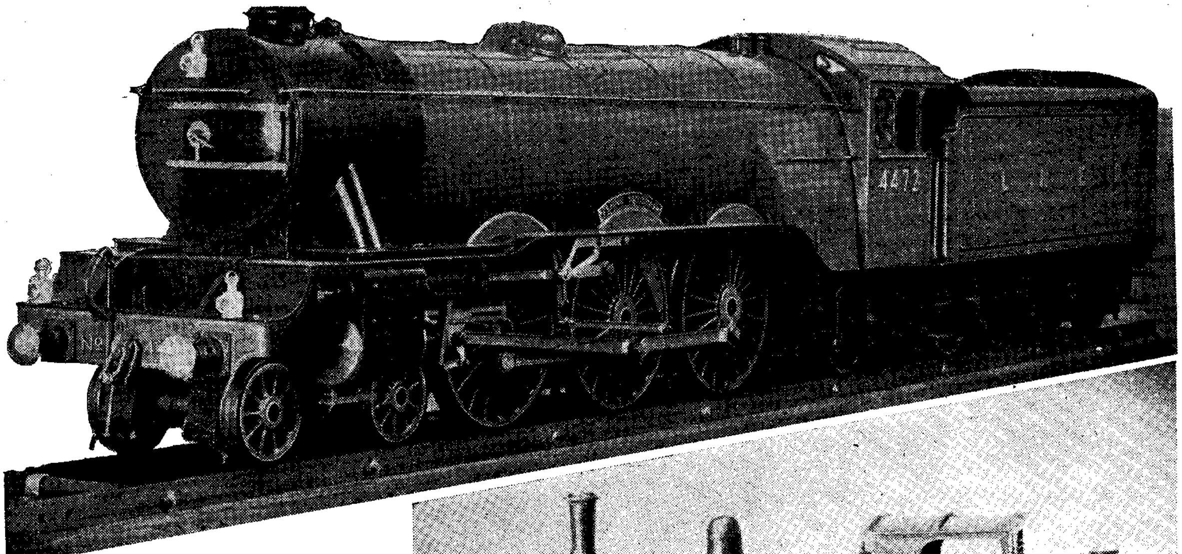
An example of L.B.S.C.'s $3\frac{1}{2}$ in. gauge 0-6-0 tank locomotive *P. V. Baker* made by L. Griffin of Hornchurch required three years for its construction. This may seem to be rather a long time for such an engine, but it is explained by the fact that the only purchased items are the wheel castings and the pressure gauge; everything else on this interesting little engine has been made by the builder.

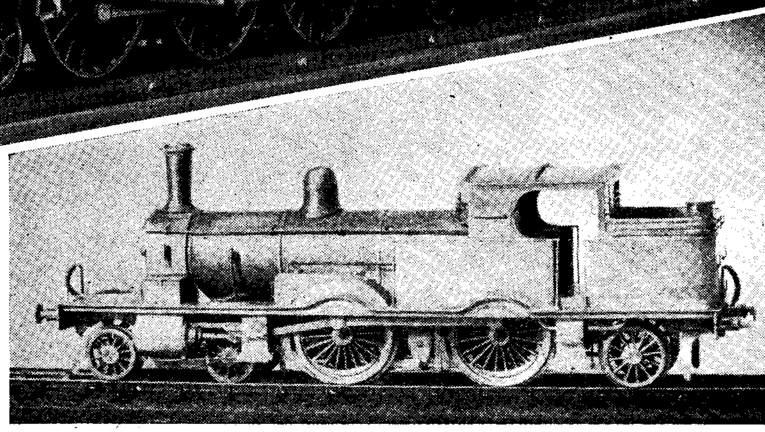
Another $3\frac{1}{2}$ in. gauge engine that seems to have called for a considerable amount of homework is a London and North Western G Class 0-8-0 coal engine built by E. E. Hobson of Chester. The wheels and dome are the only castings on the engine.

There are several points of interest about this model. Not only is it of a most unusual class of engine—in fact, I believe it to be the first steam example of its class ever seen at the M.E. Exhibition—but it is fitted with fabricated piston-valve cylinders; a lubricator of the builder's own design, in which the normal ball valve is dispensed with, and there is a proper working sanding gear. All these items and this construction involve no little technical knowledge and skill; yet Mr. Hobson is a carpet manufacturers' representative by profession.

The old-time locomotive always appeals very strongly to model makers, and one of the strongest favourites among an almost limitless choice of prototypes is the Stirling 8 ft. singlewheeler of the old Great Northern Railway. Quite a number of examples in different sizes have been seen at the exhibition during recent years and yet another is to be seen this year.

It is the work of Mr. C. G. S. Buist of Alnmouth, who is a retired engineer. The model is $\frac{3}{4}$ in. scale, is coal-fired and follows the prototype fairly closely, externally. Certain modifica-





*Above: F. G. Poynter's beautiful 5 in. gauge model of the famous L.N.E.R. locomotive No.* 4472 FLYING SCOTSMAN

*Right: Bernard Wright of New Malden built this model Adams 4-4-2 tank while he was serving with the forces*

tions have been made internally, of course, particularly with regard to the boiler, in order to make a successful working model.

C. H. Horner of Darlington is a British Railways engine driver who has built a $3\frac{1}{2}$ in.gauge 0-4-0 shunting engine named *Florence*. She is a slightly modified edition of L.B.S.C.'s *Tich*, but is fitted with working cylinder cocks, compensated hand brake, for which the wheelbase has had to be shortened, footsteps, gland oil cups, injector and dummy sandboxes. Evidently, Mr. Horner is a firm believer not only in taking a " busmans' holiday " whenever the opportunity presents itself but also in having everything just right on the little engine.

F. G. Poynter of Walthamstow has gone in for something rather larger than any of the foregoing, and has built a 5 in. gauge version of one of Britain's best-known and best-loved of modern locomotives, the late Sir Nigel Gresley's *Flying Scotsman*.

The model is a correct 3-cylinder job, and its photograph shows that it is, externally, very nicely to scale. The building of it occupied spare time over a period of five years; the only castings are the wheels, all other parts being fabricated. It has a five-piece crankshaft, press-fitted together without pins or brazing.

A fine locomotive model in the Loan section should arouse a great deal of interest and command much attention from visitors. It is an official $\frac{3}{4}$ in. scale model of a Rhodesian Railways 15th Class 4-6-4 + 4-6-4 Beyer-Garratt engine and it has been lent by Beyer Peacock and Co. Ltd., the builders of the prototype. It is a sizeable exhibit for $\frac{3}{4}$ in. scale, being just 7 ft. long; but it is bound to present some ideas to model locomotive builders, quite apart from displaying the principal features of the design.

Another locomotive model in the Loan section is probably one that many visitors will wish to see. It is the $\frac{3}{4}$ in. scale model of British Railways Class 7 4-6-2 engine, being made by Tony Appleby of Westcliff-on-Sea, whose $1\frac{1}{4}$ in. scale showman's traction engine was, *the* sensation of last year's Exhibition.

The model Class 7 is not yet finished, but visitors can see for themselves the result of one year's work by this very remarkable youth. The work has reached a sufficiently advanced stage to enable the model to be " bench tested " for several hours.

Among the smaller railway models, in Class B and C, there are some that claim attention by reason of some unusual point of interest. For example, F. W. Murray of Heston, Middlesex, has built, to published drawings, a 7 mm. scale model of a Taff Vale Railway U1 class engine. Mr. Murray is a bus demonstrator by profession, but with his son he owns and operates a garden railway, for which this engine has been built.

Two enthusiasts, A. S. Taylor of Birmingham and E. Longbottom of Bournemouth have joined forces in building and exhibiting two 4 mm. scale G.W.R. Bulldog Class 4-4-0 engines. The two models are exhibited together in a home-made Perspex case and represent a joint undertaking over a period of three years. The models are very fully detailed externally, even to the correct representation of the rather plentiful prototype riveting.

F. A. Fry of Newbury shows a 4 mm. scale model of British Railways, Western Region, twin-set diesel buffet railcar. The model represents the prototype as it was when first introduced, that is without the corridor coach coupled between the two diesel units.

Another interesting duet of models exhibited together in a glass case consists of two S gauge $\frac{3}{16}$ in. scale models of Southern Railway locomotives of decidedly contrasting type; one is an Adams 4-4-2 tank engine, and the other an N Class 2-6-0 tender engine. Both are the work of Bernard Wright of New Malden, who built them while on national service in Germany in 1952-4, using only such small tools as could be carried in a kitbag. The completion of external detail work was done after Mr. Wright had been demobolised.—J.N.M. ■

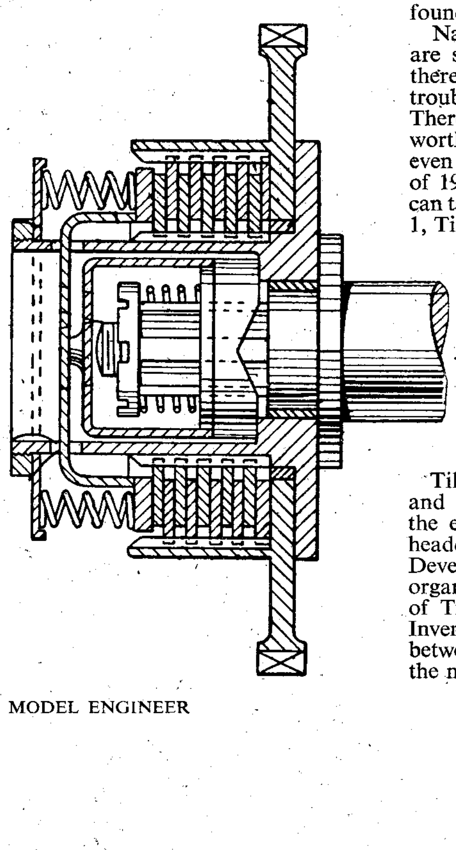
# INVENTIONS UNLIMITED

**No invention of merit need moulder in a corner of the workshop. The National Research Development Corporation exists to help industry and commerce exploit the inventive genius of today.**

**JOSEPH MARTIN presents the facts**

EVERYONE IS FAMILIAR with the tradition of the desperate inventor who tramps the streets of London day after day in a vain attempt to convince someone of wealth or influence that his battered suitcase holds the means to a fortune.

This tradition will never pass completely into myth. There is always somebody with a perpetual motion machine in his attic, and on the positive side our society is bound to produce an occasional Frank Whittle with an idea so revolutionary that the experts look at it askance.



*Sectional view of J. Bearn's torque limiting friction clutch. The cam faced elements are wedged together when under pressure of the springs (By courtesy of the N.R.D.C.)*

But on the whole—allowing for the shaft of genius that soars, like Whittle's jet, high above all accepted formulas—the genuine inventor of today has little or no need to wear out his shoe-leather and his spirit in a search for recognition.

Every year the British Industries Fair reveals the eagerness of the best in modern industry to seize upon any notion that has a practical value even if it is concerned—to take an actual example from this year's Birmingham B.I.F.—with nothing more world-shaking than an improved door-knob. The industrialist wants to make money; offer him an idea that is likely to be profitable and he will be glad to share a fortune with you. He has found that imagination pays.

Naturally, I generalise. Exceptions are sure to be found, and here and there a James Watt will still have trouble in discovering his Boulton. There are, too, many ideas whose worth is not immediately obvious even to the most alert industrialists of 1956. It is here that the inventor can take note of an address in London: 1, Tilney Street, W.1.

Tilney Street lies off Park Lane, and the corner house not far from the elegant Grosvenor Chapel is the headquarters of the National Research Development Corporation. This organisation was set up by the Board of Trade under the Development of Inventions Act of 1948 to form a link between the men who have ideas and the men who can use them. Broadly, its purpose is to secure the development and exploitation of inventions with a public value.

**Aim of the Corporation**

As the Corporation's first concern is the national interest, every kind of invention comes within its scope. Its primary task is, however, to act as a liaison between industry and public research so as to ensure that public inventions are introduced to industry.

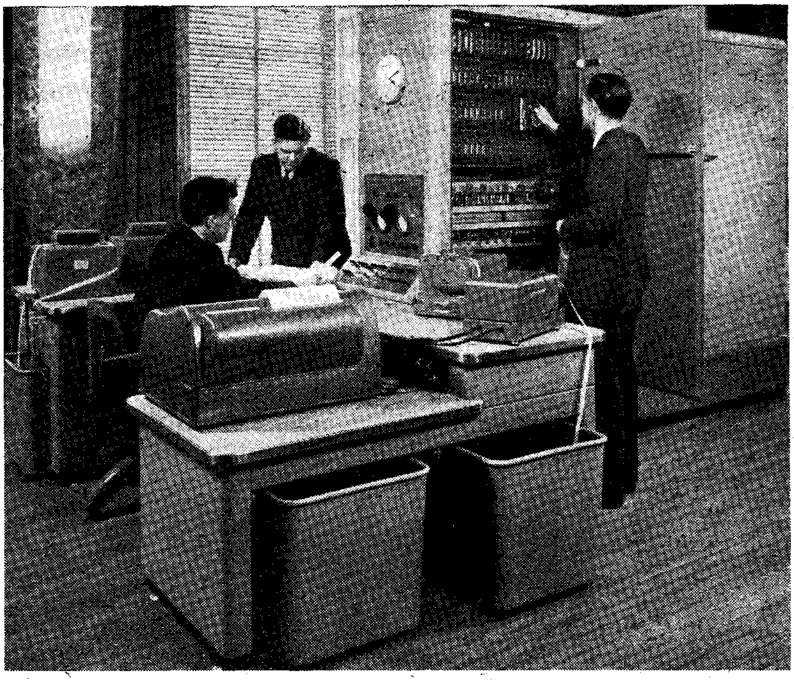
In this we have a sign of the times. During the 19th century when steam and electricity were opening up enormous possibilities, every apprentice dreamed of becoming a Watt or an Edison; Samuel Smiles' *Lives of the Engineers* formed a kind of supplement to his *Self-Help*. But in the 1950s, invention is largely a result of research in the laboratory—which does not necessarily imply a room equipped with retorts and test-tubes, or even a room at all.

The would-be inventor of today may feel, with some reason, that he hardly stands a fair chance as almost everything has been invented already and only in highly specialised fields is there much hope of discovering anything of great importance. In an age dominated by advanced physics, the laboratory has replaced the traditional garret.

Consider the amount of scientific research that is being done day by day and year by year in our universities. At Cambridge the study of the sciences is said, without prejudice, to have reached a point when the balance of the university is threatened. In the younger universities the emphasis on science may well be even greater.

**Not enough scientists**

The red-brick foundations have grown up with modern science. Their pioneers drew their inspiration from the spirit expressed by H. G. Wells in his own youth, and to this impulse the needs of the last war and the



*The Ferranti Pegasus computer—a project of the N.D.R.C. (By courtesy of Ferranti Ltd.)*

Atomic Age have added a further huge thrust.

Outside our seats of learning, industry is absorbing so many scientists that there are not enough to teach the succeeding generations. Before the war, the scientist was an apologetic intruder in the business world. Here and there a company needed him; but on the whole, apart from the chemical industries and similar obvious exceptions, he was out of place in a factory. To the average industrialist the young man with a university degree was branded as an an academic theorist whose bright ideas could best be left on paper.

For immediate evidence of the change that has occurred we need only run our eyes down the situations vacant column of a national newspaper. I saw in a fairly recent issue of *The Times*, for instance, that physicists are wanted by a company manufacturing plaster board. The advertisement asks for men with Ph.D., M.Sc. or B.Sc.(Hons.) and mentions research work in rheology and crystal physics.

Some of the liveliest new industries are themselves test-tube babies. They were born from urgent wartime research or from post-war work in a new field such as plastics. Others are perpetually nourished from the laboratory. Even old and conservative companies which had been engaged for many years in a fairly simple process of manufacturing and selling are finding that only ceaseless experiment can keep them ahead or abreast of their competitors.

The chemical industries, of course, are directly dependent upon their laboratories. Costly though the research may be, a single discovery after years of apparent pottering about may yield tremendous profits. The scientific staffs of these companies can be likened to prospectors; at any time their patient sifting of compounds may disclose a handsome nugget.

In addition, industry has its own research associations founded by particular trades for their common benefit. I have in front of me a list of forty such organisations. It begins with baking, ends with wool, and includes lace and British whiting; not to mention iron, coal and steel. The Medical Research Council and the Agricultural Research Council, which may be regarded as separate from the general category, are bodies of great public importance ministering directly to the common need.

**Research goes on**

Finally, there are the research centres controlled by Government Departments, such as the Ministry of Supply and the Department of Scientific and Industrial Research. The Chemical Research Laboratory, the National Physics Laboratory and the Chemical Engineering Organisation, which are three of the twelve bodies operating under the D.S.I.R., cover in themselves very wide territories of investigation.

Thus, in numerous fields, research continues. No-one will suppose that all these back-room boys are engaged in feverishly trying to invent something. An invention often takes shape as the result of a discovery (if any sharp distinction can be admitted) in the course of a research process, and it may even be a kind of by-product unrelated to the aim of the inquiry.

**Range of ideas**

Not uncommonly, for instance, an apparatus designed for an experiment proves to have permanent value and becomes an invention more important perhaps than the experiment which it was built to serve. Sometimes, too, a discovery made in one field of research may have an important bearing upon another. Instances of this were provided by top-secret research during the war—as when certain developments in poison-gas were converted to the purpose of killing insects instead of human beings.

Post-war research is so complex and so highly specialised in most of its aspects that it is impossible to comprehend the whole or to do more than hint at the innumerable interlockings which make every part dependent, however indirectly, upon the others, so that a man working in plastics may be indebted to an electronics researcher, who in turn has profited from a discovery made through a collaboration of radio engineers and astrophysicists.

Suffice it to say that with all this activity continuously in process, the need has existed for a central organisation which could collect the most promising results, assess their value, submit them to industry, encourage their development, and in general make sure that nothing of value was lost. This need is efficiently fulfilled by the N.R.D.C.

**Ideas channel**

The Corporation acts as a channel for ideas—in the main, as I have indicated, for those ideas which are evolved in research establishments supported wholly or partly by public money. Promising inventions are directed to "where they may find good use," and longer term projects, if in need of nursing, are given proper supervision.

To attract the Corporation, the invention must be clearly of public importance, capable of development, and not yet receiving the attention that it deserves.

None of this lies in the abstract. The Corporation has functioned as a

# INVENTIONS UNLIMITED

strictly practical and immensely active organisation since the first days of its existence. A single big invention of national value would amply justify its creation by Act of Parliament, but in fact there is such a busy traffic of ideas at the corner of Tilney Street that a score of useful inventions, all available for licensing, may be published in a single issue of the N.R.D.C. Bulletin.

### Electronics to eggshells

A recent issue describes twenty-six selected inventions ranging from a multi-state electronic circuit to a container for fragile articles. Eight of them belong to electrical engineering and electronics, six to mechanical engineering, three to civil engineering, three more to aero and auto engineering, and four to the category of scientific instruments. The last two are classified as miscellaneous—the group most likely, perhaps, to accommodate the private inventor.

From the Ministry of Supply comes a torque-limiting friction clutch designed by J. Bearn. Although most torque-limiting clutches can be set to slip at a pre-determined torque value, a considerable reduction in torque is called for before a solid drive is re-established, and in addition the performance varies through the effect of temperature changes on the co-efficient of friction.

With Mr. Bearn's invention this lag in re-establishing the drive is avoided. The drive to the clutch is through a coupling which consists of a pair of cam-faced elements wedged together by spring pressure. At the limiting torque value the cammed faces ride upon each other, thus permitting a limited angle of lost motion. The resulting axial thrust is transmitted to a plate interposed between the clutch loading springs and clutch plates. In this manner the load on the clutch itself is relieved and slipping occurs.

I have picked Mr. Bearn's patent because it stands between the simplest invention on the one hand and the more complex type, such as a microwave attenuator, on the other. The most important projects to be initiated by the N.R.D.C. are machines designed for fantastically complicated operations; electronic digital computers capable, for example, of developing numerical techniques for showing the pre-disposition of an aircraft to aerodynamic flutter.

As industry was reluctant to accept the risk of constructing these computers, the Corporation saw a clear duty to act. Besides putting money into the project (and incidentally making a profit) it offered grants to Manchester and Cambridge Universities for the training of computer engineers.

All this has a much closer bearing upon our daily lives than we realised even a year ago, for computers and computer-operated tools—another of the Corporation's interests—are leading us swiftly towards our second Industrial Revolution. The first revolution gave us efficient tools; the second is giving us tools to operate the tools. This, in a sentence, is what distinguishes automation from the long process of labour-saving which began in earnest when man invented the wheel.

Another project of which the Corporation is rightly proud—the pre-fabrication of electrical circuits—provides an illustration of a fundamentally simple idea which has been developed for extremely elaborate purposes. The circuits are printed on foil or other conductive material so that, in effect, the plan of the layout becomes the actual wiring system, and one need only drop in the components at the relevant points.

### Automation circle

On this basis, Technograph Printed Circuits Ltd. have evolved flat and foldable circuits whose use in Britain and overseas, and particularly in the United States, is having a profound effect upon the manufacture of electrical and electronic apparatus, with the possibility in the near future of automatic assembly processes.

Thus we come back to automation—that word which confronts us with increasing frequency at the breakfast-table. The circuits are already being applied—and here we have an example of one important new development fitting in with another—to the construction of electronic computers.

More easily understood than some of these inventions is the little engine designed for the Corporation by Sir Harry Ricardo. Strange as it seems, the peoples of Asia have been sent all kinds of things from Bibles to tractors but until quite recently nobody realised that what they would find most generally useful in the daily tasks of living was a handy, hardy all-purpose machine, a prime mover suitable for a dozen different kinds of work in the village communities. The obvious answer seemed to be an internal combustion engine.

Neither petrol nor oil, however, was the choice of Sir Harry Ricardo. He preferred steam. The N.R.D.C.-Ricardo power unit built at Shoreham-on-Sea is a two-cylinder Uniflow type engine capable of developing 2.5 b.h.p. continuously at 1,250 r.p.m. with steam at 150 p.s.i. Its main components can be die cast and are therefore easily standardised. The working parts are encased, the lubrication is automatic, and the entire unit weighs only about 250 lb.

It may be that the Ricardo engine will prove the precursor of a great age of steam in the underdeveloped countries where the 19th century still lies ahead. At any rate Sir Harry's invention is perhaps the best kind of encouragement for the average inventor.

There is much more that could be said about the big winners spotted by this ever-alert Corporation. But I must not forget the private inventor. I asked Mr. R. A. E. Walker, the secretary, about him when I called at Tilney Street.

"Yes," he said, "the private inventor has a place within the scope of the Act, and we deal with as many as 300 private inventions in a year."

I had a vision of hopeful applicants sitting side by side in a reception room, each holding a suitcase, a mysterious brown-paper parcel, or an uncovered, alarming construction with wires sticking out of it.

"We used to have something like that at the beginning," said Mr. Walker. "But we devised a procedure which we want the inventor to follow. Before doing anything else, he must apply to the Patents Office for a patent. If he then writes to us we will send him a form to complete."

### Simple procedure

Nobody likes filling in forms, but this document from the N.R.D.C. is simple and sensible, and the average inventor will be delighted to supply the few basic facts that the Corporation requires. After all, most interviews are by appointment, and one dreads to think what the day's work would be like at No. 1 Tilney Street if wild-haired geniuses were continually bursting in with perpetual motion machines and non-drip umbrellas.

Yes, there are still plenty of crazy inventors at large and Mr. Walker meets some of them—"the type who have written to Churchill." But if you have a really sound invention which could be perfected and exploited in the public interest, the National Research Development Corporation will be glad to consider it, providing that you use the correct procedure and first apply to the Patents Office.

I doubt if any Frank Whittle of the Fifties will be turned away unsatisfied from the corner house in Tilney Street. ■

 By Geometer

# Radii — *functions and checking*

FOR THE REASON that it is so easily specified, a radius is generally chosen in mechanical design as the junction between converging lines or surfaces as an alternative to a sharp corner—or a more complicated curve as may be employed in special circumstances. Specification of a radius is always as *A*, where it is only necessary to substitute a dimension for *R*.

A radius, however, is more than a simple academic contrivance, a feature of basic geometry, for the curve it specifies is often essential for efficient functioning of the machine or component. Generally, it is indispensable for changing the direction of flow of gases or fluids in passages, for conduction of heat from surfaces and for strength in areas of stress in components.

Thus, as at *B*, a right-angle curve in a pipe introduces little more resistance than a continuous straight flow; whereas if the bend is a sharp corner, the edges set up minor contrary flows or eddies.

Where the flow is of heat from a part —as from a cylinder to its cooling fins—the rate of flow is generally best where the fins, as at *C*, join the barrel with a root radius and are tapered out to their tips. This is apart from the necessity for radiused and tapered fins for moulding and casting the cylinder.

The flow being of stress, as when a component is strained under load, strength is always improved by employing a radius rather than a sharp corner where there is a sudden change of shape or section. Consequently, shafts terminating at flanges, as at *D*, and joining to webs in the case of crankshafts, as at *E*, always carry radii.

Rough radii are fairly easily formed, as on the square end of a piece of metal such as a clip, when a file is used to round it. Working more precisely, dividers can be used to scribe the radii, leaving lines to file. A single clip will thus gain in appearance, and should there be several they will be reasonably alike. Filing can be more accurate still, if a steel disc (diameter twice the required radius and preferably hardened) is clamped to the metal or held with it in the vice.

Small radii as left in machining processes are provided by suitably rounding the turning tools—as on shafts *D* and *E*. Then it is necessary for the tools to be ground to the required radii for reproduction on the shafts.

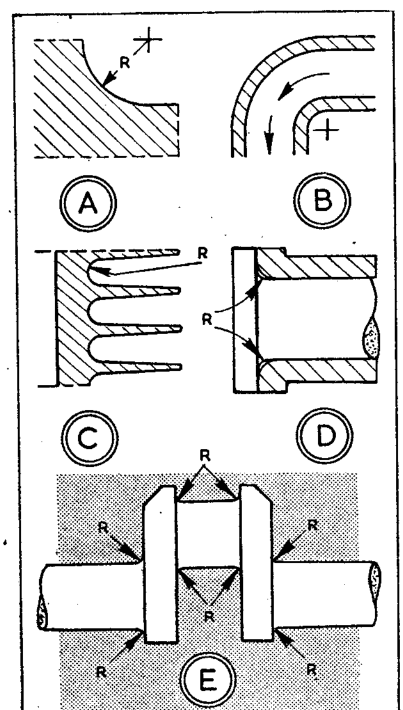
Checking of such small radii is done with gauges as at *F*—a holder containing a range of sizes from about 1/32 in. to $\frac{1}{4}$ in. The appropriate one is presented for comparison to the tool or to the work when, if necessary, holding up to a light will better reveal the fit. An incorrect turning tool may then be rectified by using a hand abrasive stone.

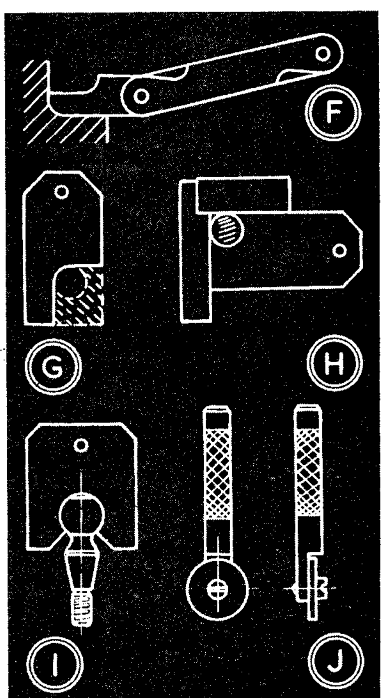
Particular care is necessary when, as at *D*, a shaft has a radius fitting in a bearing. Either the end of the bearing must carry a larger radius or be chamfered or counter-bored clear of the shaft, otherwise there will be to some extent the condition of " riding " on the radius. In fitting in such a case, the shaft radius would be checked with the gauge at *F*, and a larger one selected for the bearing as it is scraped to clear.

Radius gauges similar to but larger than the standard type, *F*, can be produced by drilling and filing from plate material ($\frac{1}{16}$ in. to $\frac{1}{8}$ in. thick). For the internal radius a hole can be drilled or drilled and reamed, and the surplus material sawn and carefully filed away, *G*. For the external radius, *H*, a hardened disc can be used as a filing guide. If the material is square the disc can be aligned, holding a straight-edge along each edge in turn or using a small square.

For checking ball components, a hole in a plate gauge need only be relieved clear of the shanks, *I*; and in production gauges of this type there may be two holes, one " Go," the other " Not Go."

Attaching a handle with a central screw facilitates use of the radius gauge at *J*, a disc parted or sawn from steel bar previously machined to size. ■



# A MODEL of 1888

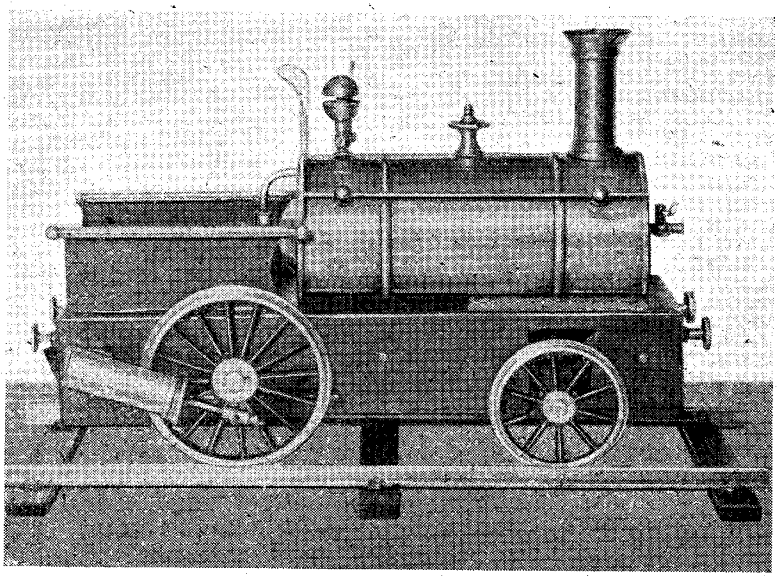
**By REX WAILES**

**A family removal over 40 years ago resurrected a 19th century model**

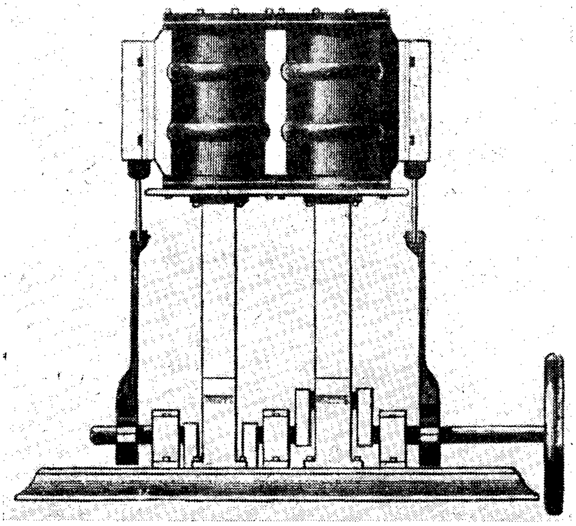
WHEN WE MOVED INTO a much larger house in 1913, my father brought to light many possessions that had been packed away when he had been married fifteen years before. Among them was a model oscillating cylinder steam locomotive which he had made while still at school. At Christmas, she was put under steam and had her weekends of glory.

At the end of the holidays she was packed away and did not see the light of day until the death of her maker nearly 40 years later. Then she was rediscovered, cleaned, steamed and provided with a travelling case, for by this time there was another generation to take an interest in her.

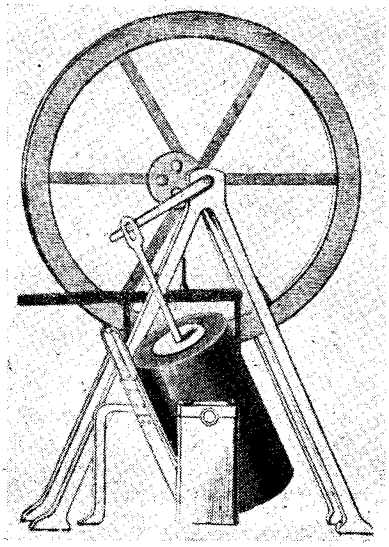
The inevitable question as to where the design came from was unexpectedly answered by the disinterment from among her maker's books of a well-printed cloth-bound volume. In 1888 this book was published by Swan Sonnenschein and Co. of Paternoster Square, London, whose motto



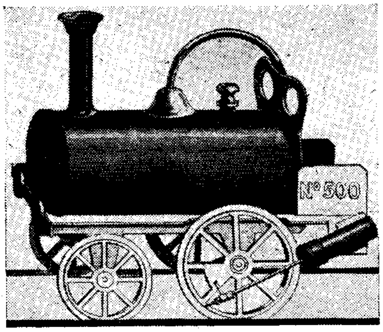
*Above: The model Mr. Wailes' father built while at school*



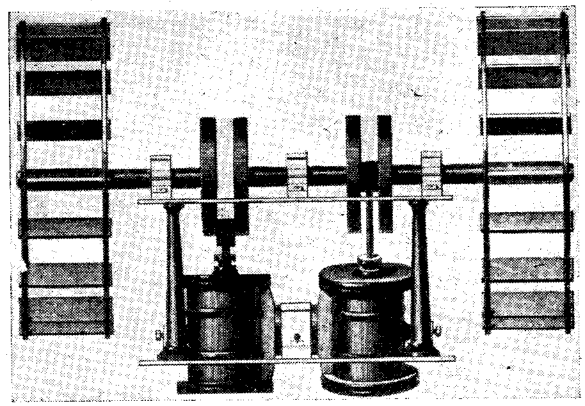
*Left: Two-cylinder launch-type engine*



*Right: Single-action oscillating cylinder engine with flywheel*




*Left*: *Single-action oscillating cylinder locomotive*



*Right*: *Oscillating cylinder marine engine*

on the title page is "Ardua quae Pulchra." It is called *Model Engine Making In Theory and Practice* and it has over 100 illustrations.

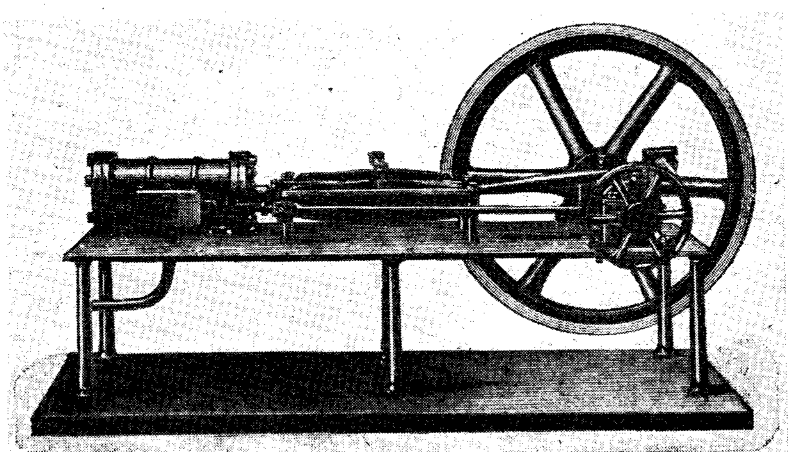
Not the least interesting features of the book are the four pages of advertisements. The first is that of John Bateman and Co. (Museum of Models), High Holborn. Also at the "Original" Model Dockyard, 53, Fleet Street and 104, Strand. Among other things they advertised were:

"Vertical Steam Engine Model (works beautifully). Complete with Boiler, Furnace, Brass Cylinder, etc., etc., two shillings, post free, two shillings and threepence. Locomotive Railway Engine (works perfectly) 7½ in. long, 2 Brass Cylinders, etc. etc. five shillings and sixpence complete. Postage fivepence extra."

Robert A. Lee, Engineer, of 76, 77 and 78, High Holborn, advertised model steam engines, engine castings, and the Excellens photographic lenses, as well as "Lee's Patent Electro-Motor and Battery for Driving Lathes, etc. Half h.p. for one-third the price of a Gas Engine."

The publishers advertised the fourth edition of *The Dynamo, How Made And How Used*, by S. R. Bottone, at 2s. 6d. Stevens' Model Dockyard, 22, Aldgate, Established 1843, offered model yachts and steam boats and fittings for model ships for sale, while Lucas and Davies, 21, Charles Street, Hatton Garden, advertised "Brass and Iron Castings, Sets or Parts (As Supplied to the Author of this work)."

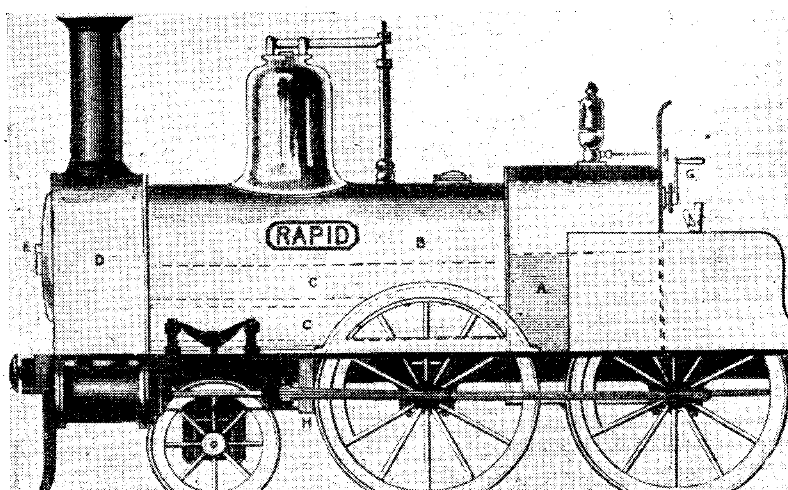
*Horizontal slide-valve engine*



The author describes in detail how to build seven engines and includes illustrations of six of them. (They are reproduced here.) In his introduction, he recommends the reader to purchase screws of Whitworth Standard thread of Messrs. Davies and Timmins, 24, Charles Street, Hatton Garden; a screw plate with 20 screw holes and with it a set of taps for 7s. from Messrs. Buck and Hickman, 28, Whitechapel Road, and copper tube, sheet and rivets from Messrs. Stanton Bros. of 73, Shoe Lane. The castings for the oscillating engine he obtained from R. H. Lee, and those for the launch engine, marine engine and locomotive engine and boiler described in the book from Lucas and Davies.

It is this book, given to him in the year of publication, which evidently inspired my father to make his model, although as the engine is not of the same design as any of those illustrated it is anybody's guess as to where he bought the castings. ■

*Locomotive with slide-valve engine*



# A SUGAR MILL ENGINE with CORLISS VALVE GEAR

○ ○ ○ ○ ○

**R. J. BROOME tells how he built an unusual steam engine**

BEFORE DESCRIBING this engine it would perhaps be in order to give a picture, in brief, of the reason which lies behind the construction of such a conglomeration of bits and pieces which eventually combined to give me a pleasant memory of thousands of hours of pleasure.

It really started when I became chief engineer of several cotton mills and a sugar mill. There were engines of all types and sizes—steam, oil and gas. Some were a perpetual headache—being both old and decrepit: some were real beauties and of these I would cite a 600 h.p., 60 r.p.m. Corliss compound built in 1913 named Juanita; a somewhat smaller Uniflow engine built, I think, by Robey of Lincoln in the 1920s; and a 400 h.p. Corliss sugar mill engine built by Henri Mariolle.

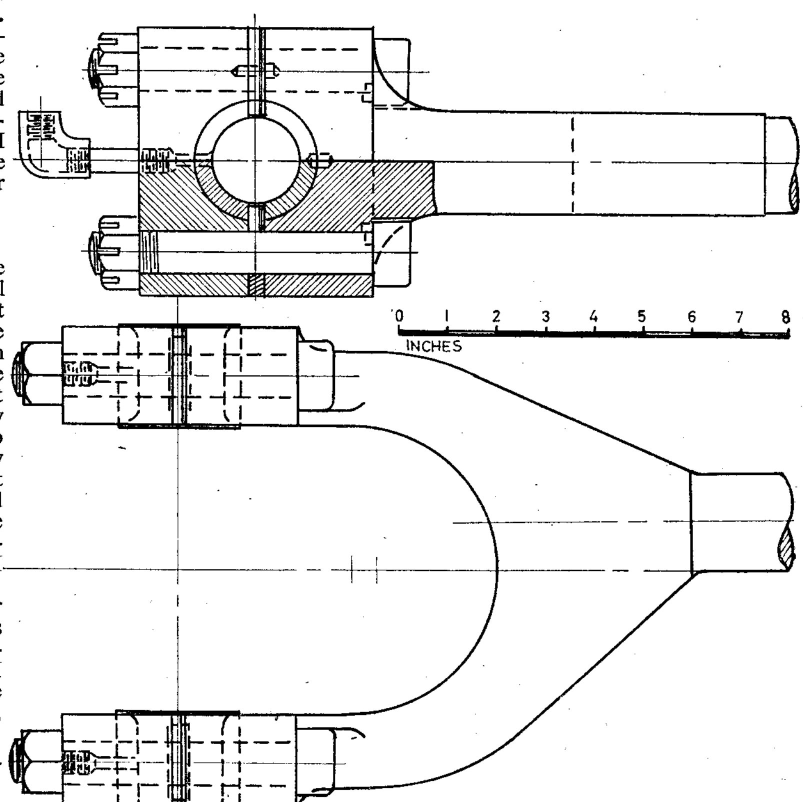
**Long working hours**

These engines gave good service and as far as I know they are still likely to be at work. They could not fail to fire the imagination of anyone mechanically minded, so I soon made up my mind that I must have one of my own. In those days, not so long ago either, it was customary for Englishmen in South America to work twelve to fourteen hours a day and it was only during the war that it became common to have weekend breaks, so there was not a lot of spare time for indulging in model engineering. When I returned to Britain I bought a Zyto and got cracking.

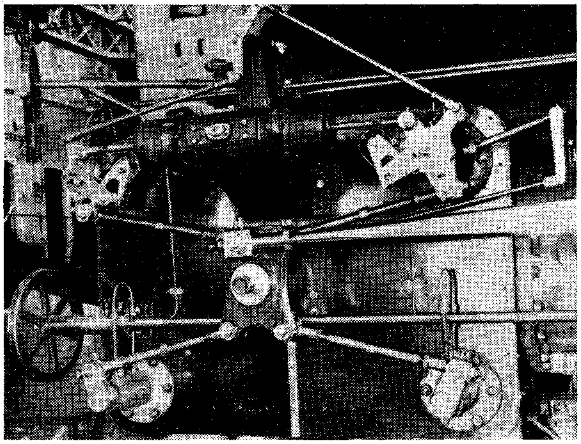
Having some friends in the sugar industry, it was not long before I was pestering them for a general arrangement of one of their engines and I began to size up the job. Since the engine was to be made in the house, the lathe was enclosed in a cabinet in the dining-room, reasonably close to a slow-combustion stove so that my tropic-tainted blood would not be unduly thickened by the winter blasts while getting on with the works.

The drawing was examined first with an eye to size. The dimensions of the finished engine were important. The work was to be done in the dining-room remember, and there had to be room to feed the family and for the " One who must be obeyed " to move around with the vacuum cleaner and pick up the stray bits for return to the cabinet, to say nothing of the unwanted and usually very oily ones !

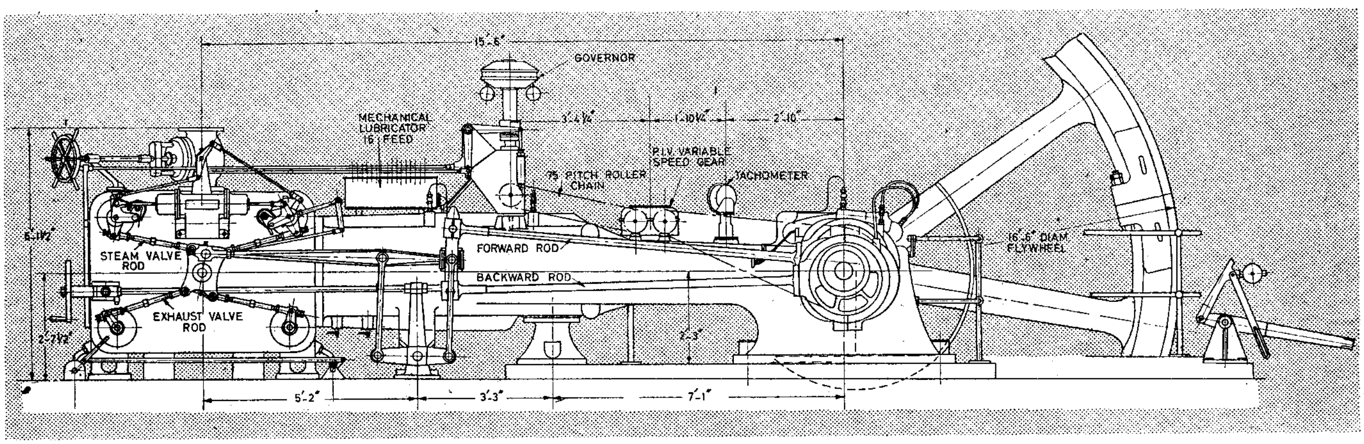
It was decided that ½ in. to the foot would be about right. It would be large enough to work, it would require a flywheel of 8½ in.—which is the




*The fork end of the valve rod*



*Left*: *Valve gear of the prototype engine*




*Below*: *Side elevation of the engine*

absolute maximum I could turn in the lathe gap—it would need a cylinder 1 in. × 1¾ in. and I would have to take some liberties with the valve gear with regard to pin sizes, etc. I decided that where the gear turned out too small to be dependable I would try to thicken things up, but only where necessary and as little as possible.

Construction was accordingly carried out. Castings were the obvious means of making the bedplate and cylinder and I had to set to and make the patterns. I heartily dislike woodwork and have no real skill in it, wherefore, after making the above patterns, I became a fabrication addict. I discovered I had no skill in that either, but it was at any rate more interesting and a certain amount of craftsmanship was eventually acquired as the various brackets took shape.

A very large number of details and assemblies were made twice and three times, but this was inevitable when one started with little more than "know-how" and enthusiasm. How I do agree with our friend and mentor, L.B.S.C.—to whom I owe so very much—in his "Nature cannot be scaled." Neither can my fingers!

**Pride of my life**

The castings were made by a local foundry. They were cleaned up and the cylinder bored, valve chests milled and piston, rod, bearings, etc., were eventually all fitted up to my satisfaction. The rod, which has small-end brasses adjustable with a wedge and 12 B.A. screw, was my pride and joy for about a week and I carried it around to show my friends! The governor started as a rusty bar end about 2 in. × 2 in. × 1 in. and it was drilled, sawn, filed and fitted with its various accessories and a pair of bought bevel wheels. The pulley bracket was silver soldered and put in place with four 12 B.A. screws.

The valves were some offcuts of ¼ in. stainless steel. They were slotted and drilled and the stems fitted. Since on the original engine the valve stems are prevented from leaking by a spherical gland seating, other arrangements had to be made for sealing on the model as I doubted my ability to copy these in such a small size. The arrangement used appears to work satisfactorily and the packing is renewable by removing the valve bonnets.

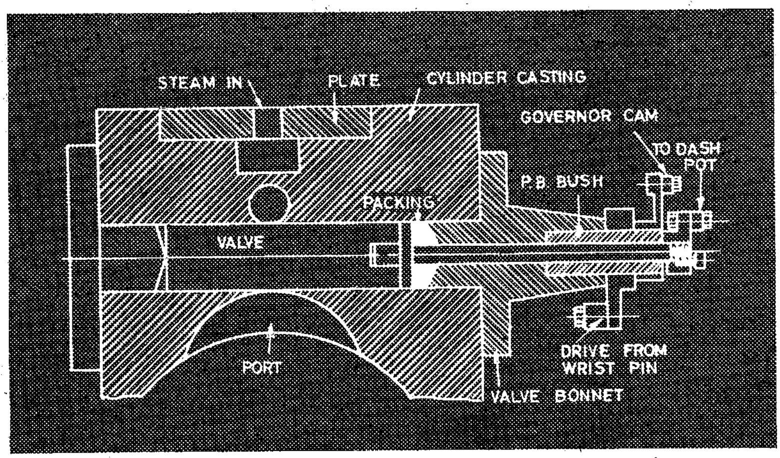
The flywheel exercised my mind for a long time. I did not want to make a pattern—I considered that the time spent so doing could be better spent making the wheel—so taking my courage in both hands, and a fortnight's holiday, I bought a circular piece of ½ in. iron plate 9 in. dia. A hole was put through the centre, it was mounted in the lathe and each side recessed under the rim and tapered to give the taper on the spokes, i.e. thickest near to the hub gradually thinning out to ¼ in. just under the rim.

The spokes were marked out and a ¾ in. hole drilled at each of the corners to give the correct radius where they blended into the rim and hub. A hacksaw cut away the unwanted material and I was left with the rough spokes which were then filed to shape. The hole in the centre was opened out to 1¼ in. and the wheel was sawn in half.

The next process was to make the centre of the wheel. This was made from two blocks of m.s. sweated together, drilled for the four bolts which held the wheel together, bored for the main shaft and finally a channel was turned out of the centre to a diameter of 1¼ in. so that the two halves of the wheel were a tight fit. The wheel was silver soldered in place and the four bolts removed to separate the two halves.

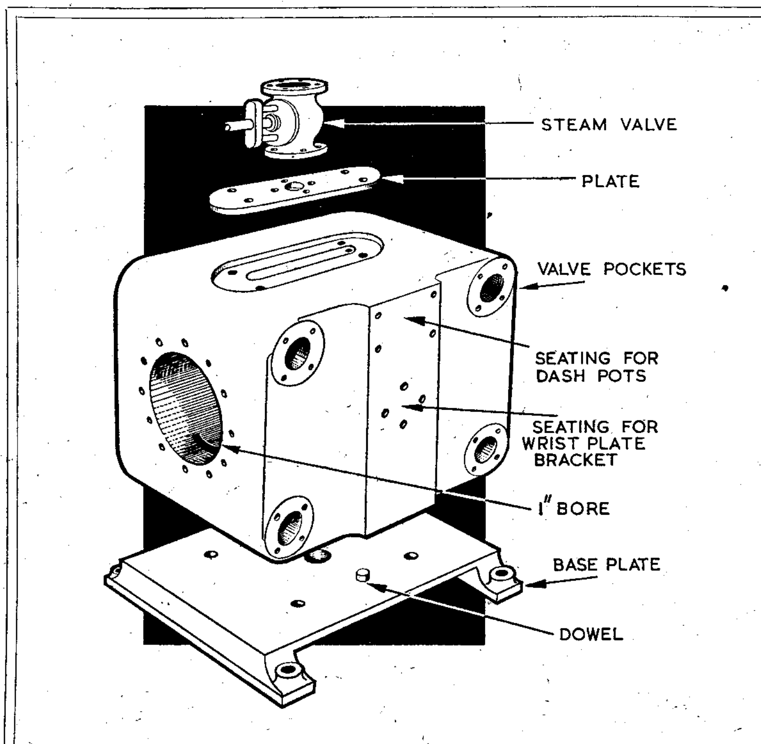
Blocks were prepared for the two outer ends of the joint, each having two 3/32 in. bolts, and the four wheel surfaces were cut back to allow these blocks to be silver soldered to the ends where they were also held in

# SUGAR MILL ENGINE . . .




*Above: The inlet valve arrangement*

*Below: A pictorial view showing the bedplate, cylinder casting, cover plate and steam valve*




place by ⅛ in. csk. screws. The wheel was now returned to the lathe and the rim finished with the two central ⅛ in. × ⅛ in. slots for the barring rack.

The rack was made from ⅛ in. sq. b.m.s. bar. The teeth (120 on each) were filed and the strip was bent round the wheel and soft soldered into place, after dividing at the wheel joints. There is no doubt that a cast wheel would have been better but I am satisfied that the above method makes a quicker and less costly job than would have been necessary for this particular design.

**Reversing troubles**

With the eccentrics and bearings being straightforward pieces of work, the next difficulty was the reversing gear. The difficulty was occasioned by the small sizes involved and my determination that the bearings, which have brasses on the original, should have them on the model. There was quite a lot of scheming before the eccentric rod ends were tackled and even then they had to be made three times before I finally found a pair that looked right and did not bind somewhere.

A huge number of bearing rods had to be made before I learned how to drill them in the lathe so that the end holes were parallel and the same distance apart. The four on the engine now are not much to look at but they are made with the holes in the right places !

The wrist plate and valve rods were quite simple. The adjusting rods, of right and left hand 12 B.A. threads, were made from spoke wire which is amply strong.

The actual cut-off gear is similar to the prototype in construction and action except for the pawl springs, which I found impossible to fit so I had to think up another way of doing it.

**Delicate aroma**

The trimmings include an L.B.S.C. type oil pump supplying oil to the cylinders. This is fitted at the back and stands behind the cylinder owing to its being too big to occupy its proper place on the top of the crosshead, which is occupied by an oil box with pipes to the various bearings, slides, etc.

While this model was not intended in any way for exhibition, a great deal of time and trouble was taken with the painting in an attempt to emulate the prototype finish with, I think, good results.

Finally, having started to make the boiler, I am looking forward to filling the house with the smell of hot steam and oil. There just ain't nothin' like it. ■

# CONVERTING A TELESCOPE

## An ex-service instrument starts life anew as a handy prismatic monocular

**By L. S. King**

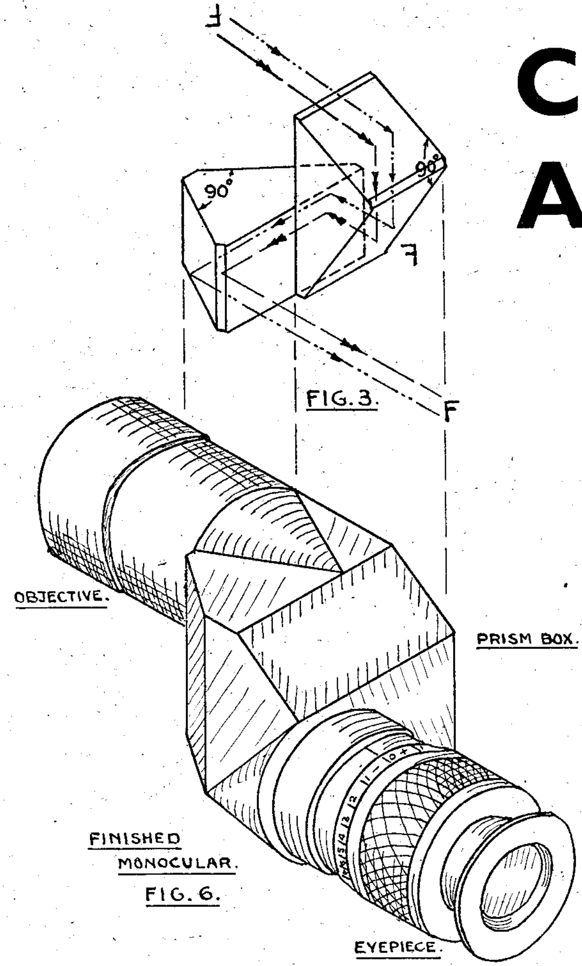



*Fig. 3: The path of light through the prisms*

*Fig. 6: The rectangular prism box of the monocular*

WHATEVER SIGHTING this ex-service telescope did, I shall never know because this story starts from a casual walk into a surplus disposal shop with a request to "look through the telescope in the window, please."

The telescope was marked, 7 × 44 mm. Ross lenses 17s. 6d. and the outstanding thing as I remember it was the astounding brilliance it gave, quite apart from its good magnification. Being more accustomed to smaller glasses of the order of 24 mm. or 30 mm. dia. objective lens, the realism given by this telescope of movement across the street was remarkable.

It had one serious drawback, however—everything was upside down and, of course, left to right.

This brilliance was in fact due to the light-gathering powers of the relatively large 44 mm. objective lens. As area increases as the square of the diameter, a 44 mm. dia. lens is better than a 30 mm. dia. in the ratio of 2.15 to 1, or better than a 24 mm. dia. lens as 3.36 to 1; that is from twice to well over three times as much light.

Another feature was the uncanny ability with which the telescope could pick up objects at night—and objects, so feebly illuminated that they could not be picked out by the naked eye, could be seen through the telescope with ease. This was because a parallel beam of light reaching the objective becomes a considerably narrower beam of light as it emerges from the eyepiece and, consequently, by a concentration of the light energy the intensity of illumination is increased and, with it, the discernibility of the object sighted on.

The arrangement of the lenses of the telescope as purchased is shown diagrammatically in Fig. 1. Both the object glass and the eyepiece are depicted as simple lenses, but they were in fact forms of compound lenses.

An image of a distant object is formed by the objective lens and this image is observed by the eyepiece acting as a simple magnifying glass. Thus the rays passing through the objective form a real inverted image *AB* but, continuing through the eyepiece lens, appear to have come from *IM*, so that *IM* is the final image virtual and inverted as seen by the observer.

Magnification results as the angle subtended at the eye has been increased.

Actually the magnifying power numerically, which in this case was given as 7, can be shown to be equal to the ratio

$$\frac{\text{diameter of objective}}{\text{diameter of eyepiece lens}} = \frac{\text{focal length of objective}}{\text{focal length of eyepiece lens}}$$

To invert the image the right way up either of two methods might have been adopted. One method is to use an erecting eyepiece as employed in straight-through Galileo type binoculars, and the other is to use what is known as the Porro prism system as incorporated in prism binoculars.

The use of the erecting eyepiece is seen in Fig. 2, *E* being the erecting lens. The inverted image *AB* of the objective is this time viewed by the erecting lens to form a second real image *CD* of the same size as *AB*, but now upright. It is this second image *CD* which is observed through the eyepiece lens and the final image as seen by the observer is now both virtual and upright and right to right and left to left.

The distance between *AB* and *CD* is four times the focal length of the erecting lens and even if this had been short with a strong lens, it was not possible to avoid increasing the original 10 in. length of the sighting telescope by at least another 2 in.—and this seemed to be in the wrong direction. This method is used usually on relatively low-power glasses of the opera-glass type.

On the other hand the use of prisms

# CONVERTING A TELESCOPE . . .

by "folding" the light ray (and for reasons to be explained later) would reduce the overall length and *not* increase it, and so a pair of prisms was sought. Here, however, was something of an uncertainty—to obtain prisms that would cover the coned light beam in the position in which the prisms would be placed and large enough to cover the light cone at the objective lens end, which is the large end.

With one eye for guidance on the probable size used in commercial binoculars by an inspection of shop windows this matter was, however, conditioned by the availability of government surplus stock. It resolved itself in a pair of prisms—price 15s.—with a $2\frac{1}{2}$ in. × $1\frac{1}{4}$ in. face across the hypotenuse. The prisms were not silvered, but as the reflection from the internal prism surfaces is by total reflection, this was not considered a vital point.

The Porro prism system is a combination of two right-angled prisms arranged as in Fig. 3 and functions by total reflection at two interior surfaces in each prism mutually at 90 deg., so that a light beam incident normally on the hypotenuse face is bent twice—once at each reflecting surface—and emerges from the same hypotenuse face but inverted relative to the incident beam. One prism of the pair therefore inverts the image top for bottom and the other changes right to left.

This combination of two prisms when placed in the light path between the objective and the eyepiece lenses will then correct the characteristics of the original telescope, so that the image is the right way up and right and left are correctly disposed. The light beam has been folded up, but in point of fact the prisms will do more than just fold up the beam as shown in Fig. 3.

In Fig. 4, $L$ is the length of the original telescope between the objective lens and the inverted image of Fig. 1 which has to be viewed by the eyepiece. As this length has to be converted into the bent shape when the prisms are interposed I will call $L$ the total equivalent air path. At Fig. 5 it will be seen that the length of the light path within each prism is always equal to the length $H$ of the hypotenuse.

Now a light path of length $H$ in glass is equal to a light path in air of length $\frac{H}{\mu}$, when $\mu$ is the refractive index of glass. As $\mu$ for glass is about 1.5 to 1.58, it is now possible to visualise an actual shortening of the light path so that for Fig. 4:

$L$, the total equivilent air path

$$= D_1 + \frac{H}{\mu} + D_2 + \frac{H}{\mu} + D_3$$

$$= \frac{2H}{\mu} + D_1 + D_2 + D_3$$

$$= \frac{2H}{\mu} + D_1 + D_3 \text{ if } D_2 \text{ is reduced}$$

to zero by butting the prisms together.

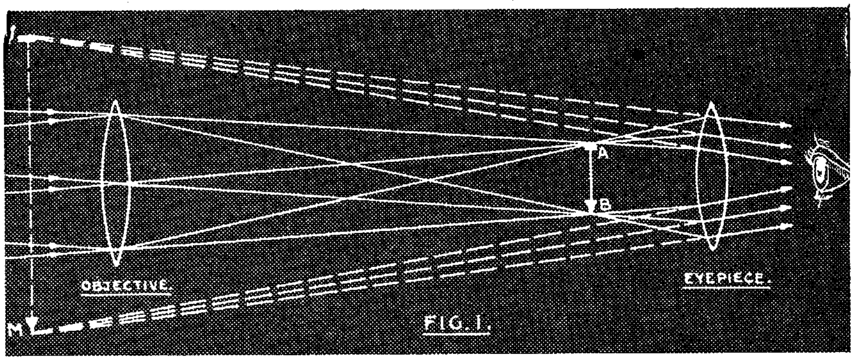
The refractive index of the prism glass was measured as 1.5 and $H$, as already stated, was $2\frac{1}{2}$ in., and the equivalent air path within the two prisms was

$$\frac{2 \times 2\frac{1}{2}}{1.5} = 3.3 \text{ in.}$$

The prisms were held together in contact (Fig. 3) by a cradle constructed in sheet brass and the whole assembly built into a rectangular prism box with as many of the corners removed (see Fig. 6), as was practicable in order to reduce size. There was, of course, an actual air path within the prism box when the light path met the hypotenuse faces. This amounted to a total of 2.5 in. and the total equivalent air path within the prism box was 3.3 in. + 2.5 in. = 5.8 in.

The total end-to-end length of the sighting telescope was 10 in. before modification, and the total length of both ends projecting from the prism box had to be 10 in. — 5.8 in. = 4.2 in.

With regard to the actual positioning of the cradle with its prisms relative to the two lenses, the system was brought as close to the eyepiece lens as was mechanically possible and as great as possible from the objective lens. This was done because the effective area of the prism surfaces was considerably smaller than the area of




*Above, Fig.* 1: *Arrangement of the telescope lenses*

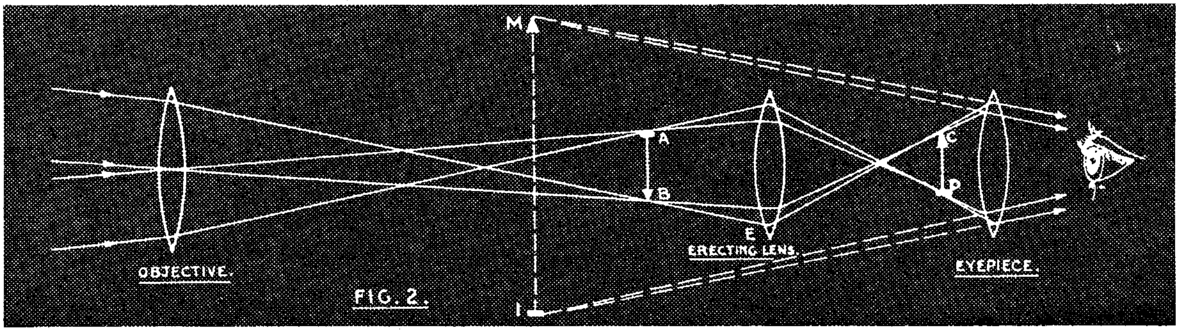



*Fig.* 2: *Use of the erecting eyepiece*

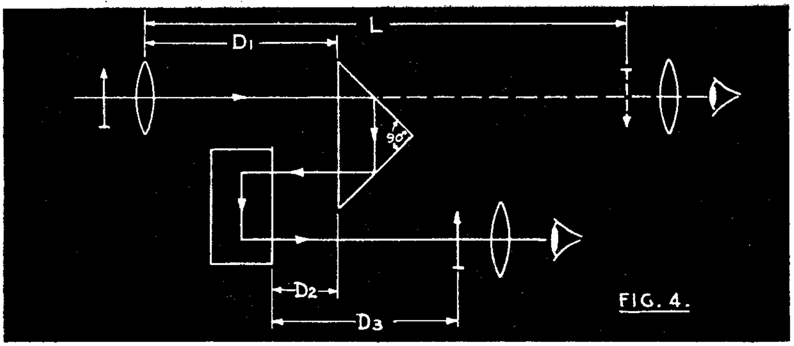



FIG. 4.

*Fig.* 4: *How the line of vision is changed when it passes through the prism*

the objective lens. It was feared that if the prisms were close to the object lens they would impose a cut off on the effective area of the object lens.

Having positioned the prism system as close to the eyepiece mounting as possible a mock-up was made to position the objective lens mounting, using the total length of 4.2 in. as guidance but noting that the objective lens must focus for all focusing positions of the eyepiece lens. A position for the objective was found that focused comparable to the focusing of the original telescope.

But with the prism system positioned as far from the objective lens as imposed by the dimensions of the prisms themselves nothing more could be done in relation to whether in that position the effective area of the prisms was in fact large enough for the job or not—or whether, by virtue of those very dimensions which brought the prisms in such close proximity to the objective, the prisms might even be too big for the job.

This was an interesting point and tests were attempted by masking round the largest diameter the prism faces could carry and then looking through the monocular to discover whether the mask edge could be seen. Alternatively, circles of paper were stuck on the prism faces to see anything outside the circles. These tests were not effective and it would appear that the mask acted in a similar way to the aperture stop on a camera.

The criterion of judgment was apparently not whether the field of vision was being obscured or cut off but whether light was being lost and the light-gathering powers of the 44 mm. objective being degraded. As far as could be ascertained the finished monocular is as brilliant as the original telescope. This was verified by night tests.

Even so, the prisms might be larger than would suffice for the light passing through the object lens. But though the finished monocular does suffer somewhat from the size of its prisms and their square corners, the overall length has been reduced from the original 10 in. of the telescope to 8 in., which gives a worth-while saving.

Two other points to note are that the field of view is 140 yards at 1,000 yards, which is comparable with a good commercial product and better than a number, and that the prism box is covered with rexine to exclude any possibility of dust entry.

Although the finished monocular is as good optically as was the telescope, one gets the impression that there is a lot more in the optical design of binoculars—and monoculars—than is apparent in one amateur construction.

Perhaps this construction merely opens the door, but it could form the basis of a much more rigorous optical set-up. ▣

*Fig.* 5: *The length of the light path within each prism, which is always equal to the length* H *of the hypotenuse*

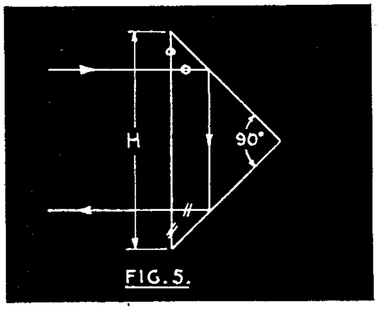



FIG. 5.

# SPEED TESTER and VIBRATION DETECTOR

TO DETECT accurately the rate of rotation of a lathe shaft or, alternatively, to set it to a prescribed speed, is a problem which often faces the engineer. A small tool marketed by Dowty Nucleonics, of Cheltenham, solves this difficulty.

Known as the Anson Vibrometer, it will not only give accurate readings of shaft speeds but, among other manifold duties, it will search out hidden sources of vibration and also measure the pulsation of A.C. mains.

This pocket-size machine utilises the principle of the vibrating reed. A thin, high-quality steel band—the reed—can be wound in and out of the instrument through an orifice known as the "node-gate," rather like the retractable steel rule in its circular case. The reed, of a springy nature, is easily set in vibration, its frequency depending on the amount which is projected through the node-gate. Thus, a short reed oscillates at a high frequency; a long reed at a low frequency.

When placed against a vibrating body an oscillation similar to that in the object is imparted to the extended reed. This frequency reaches its maximum amplitude when the natural vibration of the cantilevered reed matches that in the object against which the instrument has been placed. This critical stage is found by the simple trial and error method of winding the reed, which is anchored to a finely calibrated dial, in or out.

By applying the Vibrometer to various points of the vibrating object and "tuning-in" with the reed the actual source of the vibration can be detected readily. Segregating one frequency from another is a simple matter, for the machine is very sensitive.

Determining speeds of rotation is achieved by means of an eccentric. A small spindle with an off-set collar is supplied with the machine. One end of this spindle is inserted in a hole below the instrument face and the other end, which is cone-shaped, is pressed against the revolving shaft to be tested, the spindle and shaft forming a common axis. The unbalanced collar immediately sets up a period which in turn agitates the reed and by tuning-in the shaft speed can be read.

With small motors, where there is not sufficient power to operate the off-set collar, the unbalancing effect can be introduced by fixing a piece of plasticine, or similar substance, to the shaft. The spindle is not needed, the shaft speed being detected by placing the Vibrometer against the motor.

Among its many industrial applications it can be used to discover the speeds of air compressors, road drills and i.c. engines. Merely holding the reed in the exhaust flow of these machines produces the necessary reading. ▣

# No. 13 L.S.W.R. 2-4-0 TANK ENGINE No. 0298

THIS FASCINATING little engine is as old as it looks, but it has a most interesting history. I use the present tense deliberately because the engine is still in service in the Southern Region of British Railways—and for a special reason that will be apparent later in this article.

Between 1863 and 1875 Joseph Beattie ordered eighty-five engines of this type for working suburban passenger traffic, chiefly in the London area but also around Exeter, Salisbury, Bournemouth and other important centres on the London and South Western Railway.

In their original condition these engines must have been very pleasing, judging by pictures of them. They were not only nicely finished but were decorated with plenty of polished brass, copper and other bright metal work.

In later years, however, their appearance was considerably modified by William Adams, who re-boilered most of the engines and drastically toned down the former decoration, though a smart finish was retained in keeping with the Adams tradition. The withdrawal of these engines began as far back as 1890 and was completed by 1900, with the exception of three engines—L.S.W. Nos. 0298, 0314 and 0329.

**Still in service !**

Believe it or not these three survivors are still in active service as British Railways' Nos. 30585, 30586 and 30587, respectively. They are employed in the Bodmin area of Cornwall, where they work exclusively on the short branch line to Wenford quarries, off the Bodmin and Wadebridge branch.

Odd as it may seem, those three aged little sisters are the only engines—out of all the Southern Region's considerable locomotive stock—that can work the Wenford quarry traffic without giving trouble, either to the track or to themselves ! So it comes about that for more than fifty years after all the other engines of their class had been scrapped the three old maids have been carefully maintained specially for working on the Wenford line.

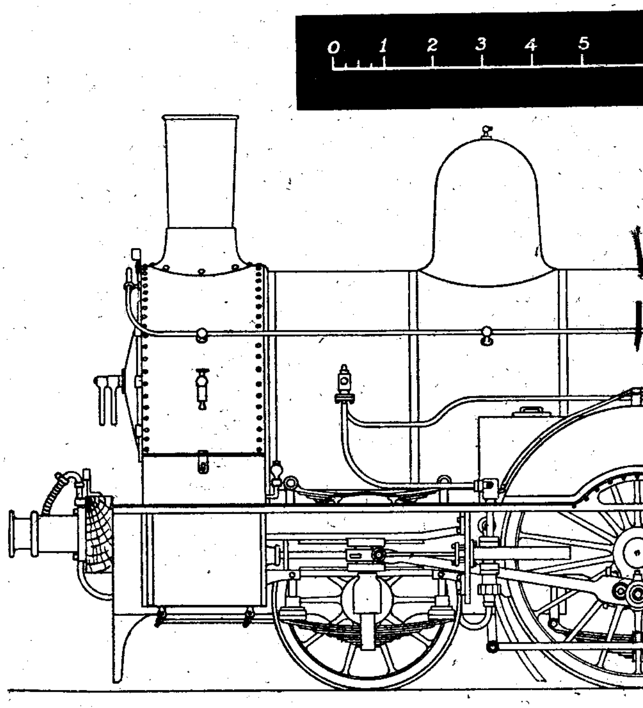
It was in 1913, I believe, that I first met No. 0298 at Eastleigh, where she had just undergone a periodical overhaul, and my drawing shows her as she was then. She had an Adams boiler and an unusually short stove-pipe chimney, giving her a rather stocky look that cannot be described as typical of her class.

Since then further detail changes have taken place, with the result that the general appearance of these engines has been very considerably modified.

There have been a few other instances of old locomotives being kept specially for working certain duties. But none, I think, covering so long a period as that of these three Beattie tank engines. In practically all cases where this has happened the reason has been that the flexibility of the wheelbase and the light axle-loading of the engines concerned have been particularly suitable for the particular lines over which the engines have had to run.

Until 1871 the cylinder diameter was $15\frac{1}{2}$ in., but later it was increased to 16 in. and then to $16\frac{1}{2}$ in. The stroke remained unaltered at 20 in. The diameter of the leading wheels was 3 ft. $7\frac{3}{4}$ in., and of the coupled wheels 5 ft. 6 in. The wheelbase was 5 ft. 6 in. plus 7 ft.

The boiler had a maximum diameter of 3 ft. 10 in.



# HAVE KNOWN

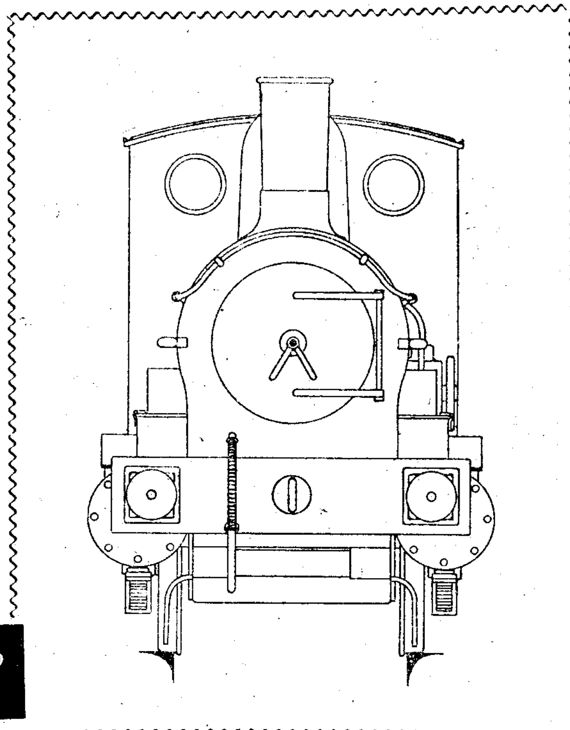
## By J. N. Maskelyne

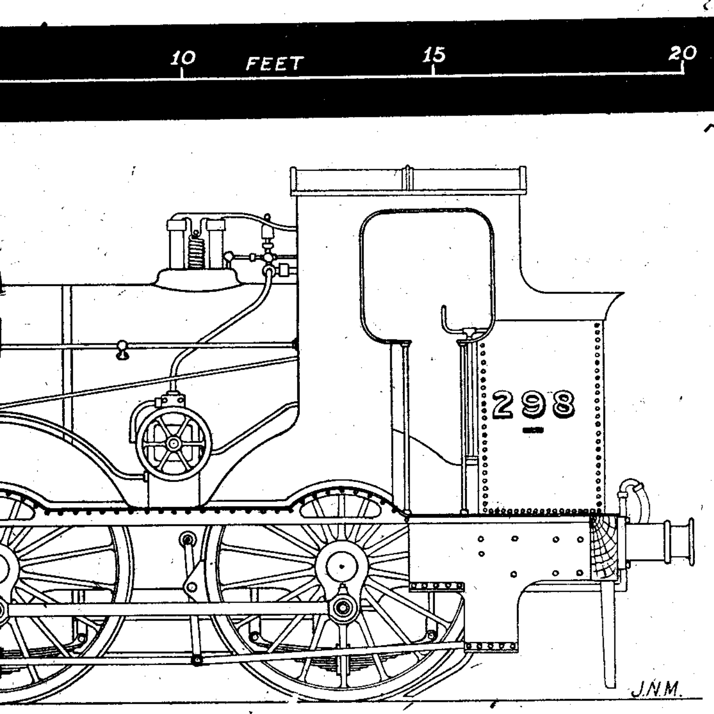
and contained no fewer than 224 tubes of $1\frac{5}{8}$ in. dia. The grate area was 14.8 sq. ft., and the working pressure was 130 p.s.i. In full trim, ready for traffic, the weight was $34\frac{1}{2}$ tons.

An interesting feature of these engines is that they were fitted with Alexander Allen's straight-link valve gear while No. 0298 at least was still equipped with Beattie's steam-driven boiler feed pump (see drawing) as late as 1930.

How much longer the three survivors of this interesting class will remain at work seems to depend entirely on how long the Wenford quarries remain productive. But it must be one of the curiosities of British railway history that these three engines have, in their particular field, withstood the onslaughts of more modern forms of motive power unit for over half a century.

I cannot recall anything to compare with it; and into the bargain these engines date from 1874 and 1875, so they are now more than eighty years old. ■






***IN my next article I shall be dealing with two special locomotives which were not very widely known, though I saw one or other, and often both of them almost daily for about six years: Steam locomotives on the "Tuppenny Tube"!***

# VIRGINIA

***American locomotives make extensive use of equalised springing. Alternative methods of fitting this are described by L.B.S.C.***

A LITTLE American locomotive without the familiar equalising bars would certainly appear to have something missing, so I have included two alternative methods of equalised springing for this engine.

The first is very simple, it employs cast dummy springs and equalising bars with spiral springs concealed in the spring hoops. The second has working leaf springs and a working equalising bar between them. Both give the correct appearance and both are O.K. as far as working properties are concerned, but the second is more tricky to make and erect. However, it is worth the trouble where the builder wants the "real McCoy" as our cousins would say.

The arrangement is clearly shown in the drawing. The equalising bar is carried on a bracket midway between the coupled wheels and a spring is located over each axlebox, one end of this being attached to the frames by a long hanger and the other end to the equalising bar by a short one. A slotted block is fitted to the top of each axlebox, straddling the frame bar, and the weight is transmitted by this from the spring to the axlebox.

**The two methods**

Taking the simple type first, two pieces of $\frac{1}{2}$ in. × $\frac{3}{8}$ in. steel bar will be needed, each about 2 in. long. Square off the ends in the four-jaw chuck and cut a slot in each end, longways, $\frac{1}{4}$ in. wide and $\frac{7}{16}$ in. deep. Builders who own a milling machine can do this job with the bits of rod held in a machine vice on the table, using a $\frac{1}{4}$ in. side-and-face cutter on the arbor.

To do the job in the lathe, proceed exactly as described for axleboxes, clamping the bar under the slide-rest tool-holder at centre height, or holding it in a machine vice on a vertical slide, then traversing across a $\frac{1}{4}$ in. endmill or slot drill held in the three-jaw. When all four ends are slotted, cut the pieces in half. Clean up the spring castings with a file, drill the lugs at the ends with a No. 34 drill and drill up the hoops or buckles with a 9/32 in. drill, taking care to avoid breaking through the top.

Chuck each slotted piece in the four-jaw, setting it to run truly; turn down the solid end—to within $\frac{1}{16}$ in. of the slot—to a diameter which will just slide in the hole in the spring hoop. Face this off to $\frac{5}{16}$ in. length, centre, and drill to a bare $\frac{5}{16}$ in. depth with a 7/32 in. drill. The spring can be wound up from 20-gauge tinned steel wire around a piece of $\frac{1}{8}$ in. rod held in the three-jaw. Bend an inch or so of the spring wire at right angles and push it between the chuck jaws, then pull the lathe belt by hand and guide the spring wire on to the mandrel rod with the other hand. Cut off four $\frac{1}{2}$ in. lengths and touch the ends on a fast-running emery-wheel. The springs should just start to compress when the plunger enters the hole in the spring hoop.

The equalisers can be cast or built up, the bar being made from $\frac{1}{8}$ in. × $\frac{3}{8}$ in. mild steel and the stand from 1 in. × $\frac{1}{4}$ in. bar. The top of the stand can be slotted in the manner described above and the bar may be silver soldered into the slot or secured by a rivet through the middle. Two No. 34 bolt holes are drilled in the foot.

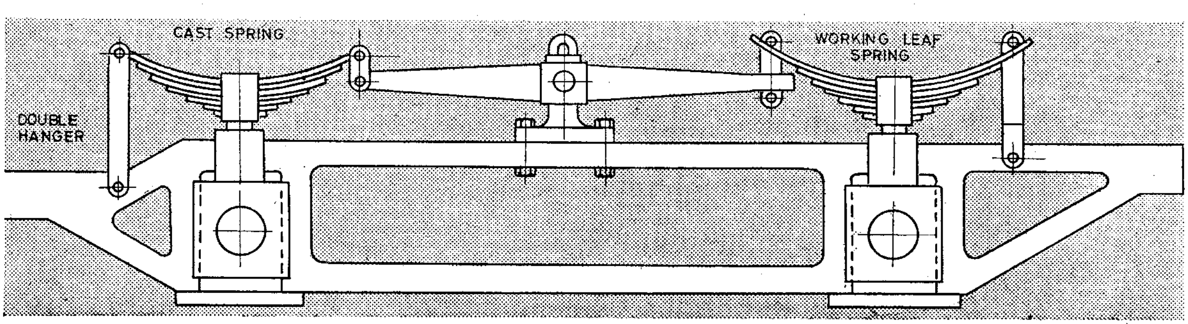
Cut the four short hangers from 7/32 in. × $\frac{1}{16}$ in. steel, or from 16-gauge sheet steel, drill them and the ends of the equaliser bar as shown and rivet the hangers at each end of the bar, putting $\frac{1}{16}$ in. washers at each side of the bar so as to spread the hangers far enough apart to fit over the end of the spring. The springs can then be attached, a short bit of 7/64 in. steel rod being put through hanger and spring eye and riveted over at both ends.

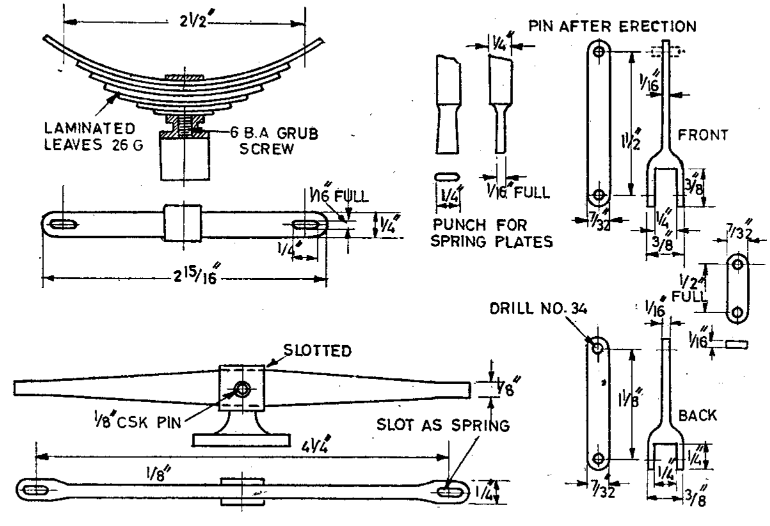
**Attaching longer hangers**

The longer hangers can be cut as shown and attached to the outer ends of the springs in similar fashion. At $1\frac{1}{4}$ in. ahead of the centre of the driving axle drill a No. 34 hole from the side through the top bar of the frame; at $1\frac{1}{4}$ in. behind the centre of the trailing axle, drill another. Midway between the axleboxes drill two vertical holes $\frac{3}{4}$ in. apart in the top bar to correspond with those in the foot of the equaliser.

The whole bag of tricks can then be erected as shown, using 6 B.A. bolts to attach the equaliser foot and spring hangers to the frame bar. The cast dummy springs and equaliser will

*Arrangement of the springing*






*Alternative types of springs and equalisers*

be held rigid, the rise-and-fall movement of the axleboxes being controlled by the coil springs in the hoops.

If working leaf springs are used, which I recommend, the slotted part that fits over the frame bar and bears on the axlebox can be made in one piece with the spring hoop. Saw off four pieces of ½ in. × ⅜ in. mild steel and face the ends in the four-jaw to a dead length of 1⅛ in. One end of each is slotted ¼ in. wide and 7/16 in. deep by the method previously given; ⅛ in. of the other end is milled or filed ⅜ in. square, the little neck in between being turned to ¼ in. dia. with the piece chucked truly in the four-jaw, slotted end outwards.

Before removing from the chuck, centre the bottom of the slot with a thin centre-drill, drill down about ⅜ in. depth with a No. 44 drill and tap 6 B.A. Drill a ¼ in. hole through the squared end, in line with the slot, and file it to a ¼ in. × ⅜ in. rectangular shape to accommodate the spring plates.

**Building up springs**

The springs are made on the Glazebrook principle, each leaf being built up from three or four laminations which are merely strips of the thin steel used for gramophone governor springs and similar purposes. The hangers pass through slots cut in the top plate, just as they do on some of the latest British Railways locomotives; so some of the old-time locomotive engineers designed details which have stood the test of time !

The top plates should be cut to an overall length of 3 in. and the slots can be cut by aid of a punch. This is made from a piece of ¼ in. round silver steel about 2½ in. long. Square off the ends in the lathe, then file one end to a " screwdriver edge " a full 1/16 in. across. Round off the ends as shown and back off the metal slightly from the cutting edge. Harden and temper to dark yellow—or use Mr. Procter's tip as given in these notes in the June 28 issue.

To use, lay the spring plate on a block of lead, hold the punch vertically on it in correct location, then give the shank one good hearty crack with a fairly heavy hammer. A series of light taps will merely split the steel. The punch will cut a clean slot if it is properly made and used as stated.

The bottom plates of the spring should be approximately ⅝ in. long, and the others in proportion, as shown in the illustrations. The completed spring should fit tightly in the rectangular hole in the hoop. Clamp it tightly by a grub-screw in the tapped hole, the Allen type of screw being best for this purpose.

The threads should fit tightly to avoid any chance of coming loose on the road. If you have any doubt about the thread's tightness fill the end of the tapped hole with solder and file flush with the end of the slot, which will certainly teach it good manners. In my time, the eccentric setscrews on the Brighton engines were sealed in by filling up the hole with white metal, and I never heard of one coming loose.

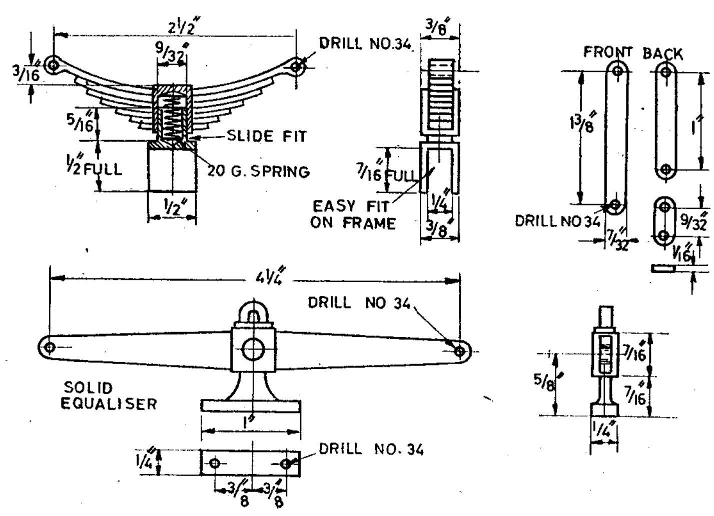
**Working equaliser**

The stand for the working equaliser can be made from 1 in. × ½ in. steel bar, as before, to the same cross section as shown in the detail drawing, but the centre part is slotted out ⅜ in. deep and ⅛ in. wide. The little top piece, which carries an oval cotter bearing on the bar in the full-size job but is merely ornamental in the small one, can be made separately and just soldered on when the equaliser is assembled.

The bar itself is filed or milled from a piece of ¼ in. × ⅜ in. mild steel to the dimensions shown. Each end has a slot in it, similar to that in the ends of the spring. You can't very well punch these through ¼ in. of mild steel, but they can easily be formed by aid of a dental burr. A dental burr is used to clean out the cavity of a hollow tooth before filling it; your dentist would probably give you a few for the asking as they are only thrown away after use.

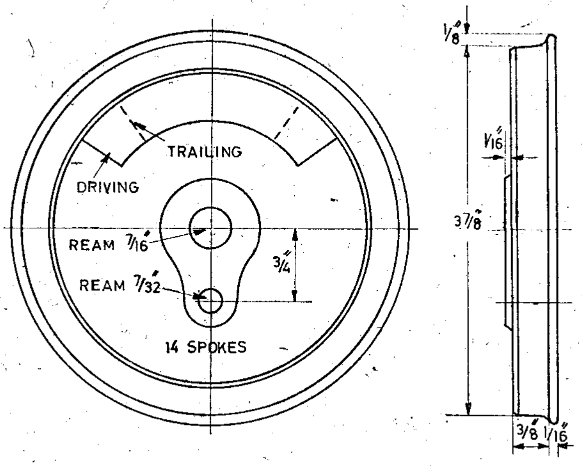
Mark out the location of the slots on the ends of the equaliser bars and

*Spring and equaliser details*

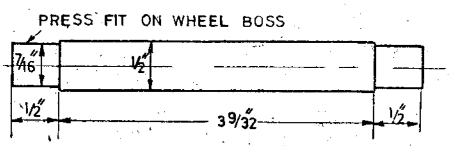


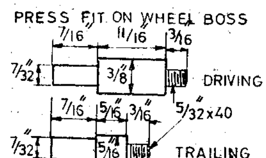
drill a No. 50 hole at each end. Clamp the bar on its side under the lathe tool-holder, level with centres; put a $\frac{1}{16}$ in. burr in the three-jaw and cut away the metal between the two holes by using the burr as an endmill, the same as if slotting axleboxes or similar jobs. Take fine cuts, naturally, and use plenty of cutting oil applied with a brush and you will get a perfect slot; incidentally, the way the little burr cuts steel will explain why you get sundry twinges in the dentist's chair! I use them for all sorts of jobs, cutting steam and exhaust ports, and so on.

*Right*: *Details of the coupled wheels*




*Below*: *Running gear details*




Drill a No. 30 hole through the middle of the slotted part of the stand and countersink slightly both sides. Drill another through the middle of the equaliser bar, insert the bar into the slot and pin it with a short piece of $\frac{1}{8}$ in. silver-steel slightly riveted over both sides and filed flush. The bar should tip easily without being slack.

Only one short hanger is required at the end of each bar, and this is a plain strip as shown. The hangers on the outer ends of the springs must be forked at the bottom to straddle the frame bar; the upper ends pass through the slots in the spring plates. They are made from $\frac{3}{8}$ in. × $\frac{1}{4}$ in. mild steel. The quickest way to form the forks is to mount a small saw-type milling-cutter, $\frac{1}{4}$ in. wide, on a stub arbor held in the three-jaw. Clamp the piece of steel under the slide-rest tool-holder at centre height and at right angles to the lathe centres. Feed it straight on to the cutter with the cross-slide, applying some cutting oil with a brush, then cut off the steel to the full length of the hanger and file or mill away the surplus above the fork so as to fit the slot in spring.

To assemble, put a short hanger through the slots in one end of the spring and equaliser bar and squeeze a short pin in each hole in the hanger to prevent the parts coming adrift. Push the thin end of each of the forked hangers through the other ends of the springs and pin similarly. The forks are then fitted over the frame bar and secured by 6 B.A. bolts, the stand of the equaliser being bolted to frame as shown.

The four coupled wheels are $3\frac{7}{8}$ in. dia. on tread, with $\frac{1}{8}$ in. flanges. The easiest way to machine the castings is as follows. Chuck each casting by the tread, back outwards, in the three-jaw, setting to run as truly as possible with the flange just clear of the chuck jaws. Use a roundnose tool with the end bent at about 45 deg. to the shank so that it will both turn and face without being shifted in the rest. Face off the boss, centre, drill through with a 27/64 in. drill, ream $\frac{7}{16}$ in., then face off the back of the rim, taking a final cut right across and bringing the rim and boss flush. Take a small roughing cut off the flange to true it up.

Reverse the wheel in the chuck, gripping by the flange, and face off the rim and boss, leaving the boss standing out $\frac{1}{16}$ in. above the rim. Note the position of the handles, or reading of micrometer collars, so that all four wheels can be finished to the same thickness. With a parting-tool set crosswise in the rest cut a $\frac{1}{16}$ in. rebate where the spokes join the rim; this shows the joint between the tyre and wheel-centre in full size.

**Finishing tread and flange**

To finish the tread and flange, chuck an odd casting or disc of metal a little smaller than the back of the wheel. Face it off, recessing at the middle for about 1/32 in. depth and 1 in. or so dia. Centre, drill 15/32 in. and tap $\frac{1}{2}$ in. any fine thread; screw in, very tightly, a short piece of $\frac{1}{2}$ in. rod threaded to suit. About 1 in. of the rod should project. Turn this to $\frac{7}{16}$ in. dia. so that the wheels will just slide on it, then turn the end to $\frac{3}{8}$ in. dia. to within $\frac{7}{16}$ in. of the plate. Screw it any fine thread and fit a nut to suit.

Mount a wheel on the stub and tighten the nut sufficiently to hold the wheel without straining anything. Using an ordinary roundnose tool, turn the tread and flange to within 1/64 in. of the finished size. Serve the other three similarly then, when the last one is on, touch up the cutting edge of the tool with an oilstone slip without taking it out of the rest; finish-turn the last one to size.

Remove it, and finish-turn the other three with the cross-slide handle at the same setting; they will then be exactly the same diameter, which is essential with coupled wheels. The edges of the flanges can be rounded off with a file while the lathe is running. Tip for beginners: a speed of about 60 r.p.m. is plenty for this size wheel; if the tool chatters, the lathe is running too fast.

Mark off the position of the crank-pin hole on one wheel. Drill it 13/64 in., either on the drilling-machine or lathe (*not* by hand) and it can be used as a jig to drill the rest. Put it on top of the wheel to be drilled, put a short piece of $\frac{7}{16}$ in. rod through the axle holes in the bosses to line them up, set the wheel so that the pear-shaped bosses are in line, then put the drill through the hole in the boss in the upper wheel and drill through the lower. Repeat this process with the other two wheels and no separate jig will be needed. All four crankpin holes can then be reamed 7/32 in. on the drilling machine or lathe.

The crankpins are turned from silver steel (" drill-rod " to our friends in U.S.A.) as the finished surface of this is very resistant to wear. If the three-jaw chuck is reasonably true the stock may be held direct in same; but if not, use either a split bush or a collet. The spigots should be a press fit in the wheel bosses but they should

● *Continued on page 214*

# TEE BOLTS and NUTS

*MARTIN CLEEVE describes his method for making these components, with notes on the care of tee slots*

MANY SMALL LATHES, built for amateur use, are now provided with a tee-slotted cross slide—an extremely handy feature enabling all kinds of work not normally associated with centre lathes to be carried out.

In order that the permissible swing over the saddle shall be as great as possible, it is customary to make the tee slots somewhat smaller than those standard to the larger machine tables: therefore in addition to the lips of the slots being scaled down, the depth available for the bolt head is considerably reduced. However, provided certain factors are taken into account and there is not an actual flaw in the casting in which the slots have been milled, these cross slides, or boring tables as they are sometimes called, will give excellent service and remain free from damage.

Of course, for an occasional job where only very light clamping is called for, it would be quite in order to merely thin the bolt heads to the required thickness to suit the slot. But it is a fact that such clamping is usually in connection with a milling operation, for which everything possible should be done to obtain the maximum rigidity with the minimum risk of the job slipping—especially under the intermittent blows which the work receives from the milling cutter teeth at the start of a cut.

**Dangers of thinning**

Experience has shown that for the average run of work, merely thinning the head of an ordinary hexagon headed mild steel bolt can be most unsatisfactory. Apart from the strength of mild steel being insufficient to withstand the bending strain, the head must be made even thinner than the actual slot dimension, so that when bending has taken place it will still be possible to slide out the bolt after use! Anyhow, such bending damages the under corners of the slot lips and, if of frequent occurrence, the lips will be reduced in strength by the metal breaking away or chipping: Fig. 1 illustrates how the trouble starts.

A compromise can be made by modifying the head of a mild steel bolt, so as to leave more supporting metal where it is needed—as shown by Fig. 2—but it has been found that these still suffer from the defect shown in Fig. 1, only to a slightly less extent.

A fully satisfactory tee bolt results from modifying the head of a $\frac{1}{2}$ in. B.S.F. high tensile steel bolt as in Fig. 2—also reducing the stem to $\frac{3}{8}$ in. dia. and re-threading. But this is a somewhat extravagant method of approach and though I still have a number in use, these were made in moments of desperation. Moreover, for setting up work on the cross slide, a 6 or 7 in. tee bolt is sometimes called for and apart from the question of expense such lengthy H.T. bolts are not easily obtained in small quantities.

**Preparing the tee bar**

Very occasionally a tee nut is called for. These are used in conjunction with a hexagon socket head capscrew to meet those cases where a nut on an upper surface would interfere with the placing of a milling cutter arbor or other fixture, etc. Figs. 3 and 4 illustrate these.

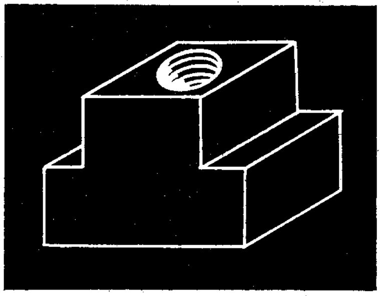
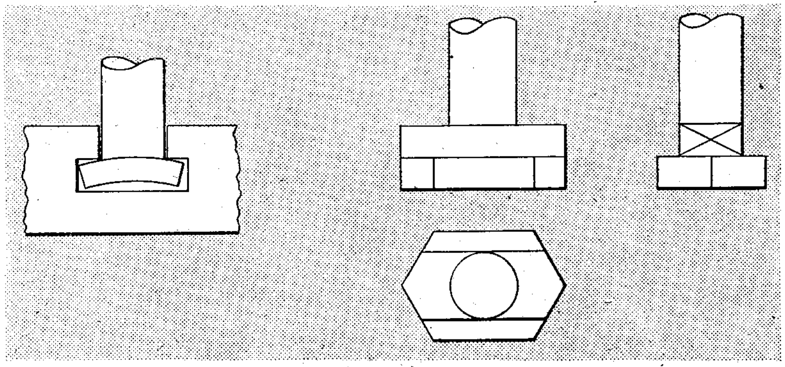


*Fig. 3: The tee nut*

To some, my method may appear somewhat circuitous, but I think that when all factors are taken into consideration there is not a very wide choice.

The dimensions of the tee slots, standard to the Myford ML7 lathe, are given in Fig. 5. The nearest commercially rolled bar to suit this purpose is $\frac{3}{4}$ in. × $\frac{3}{8}$ in. section. Four 5 in. lengths were cut and all gripped in the four-jaw chuck and faced down to a width of $\frac{9}{16}$ in., to suit the wide portion of the slots. Following this

*Figs. 1 and 2: Thin head bent with strain and modified $\frac{1}{2}$ in. B.S.F. head*



# TEE BOLTS and NUTS . . .

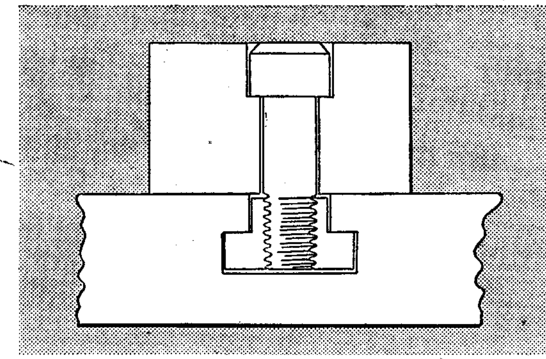


*Fig. 4: Tee nut and socket head screw locking block to the cross slide*

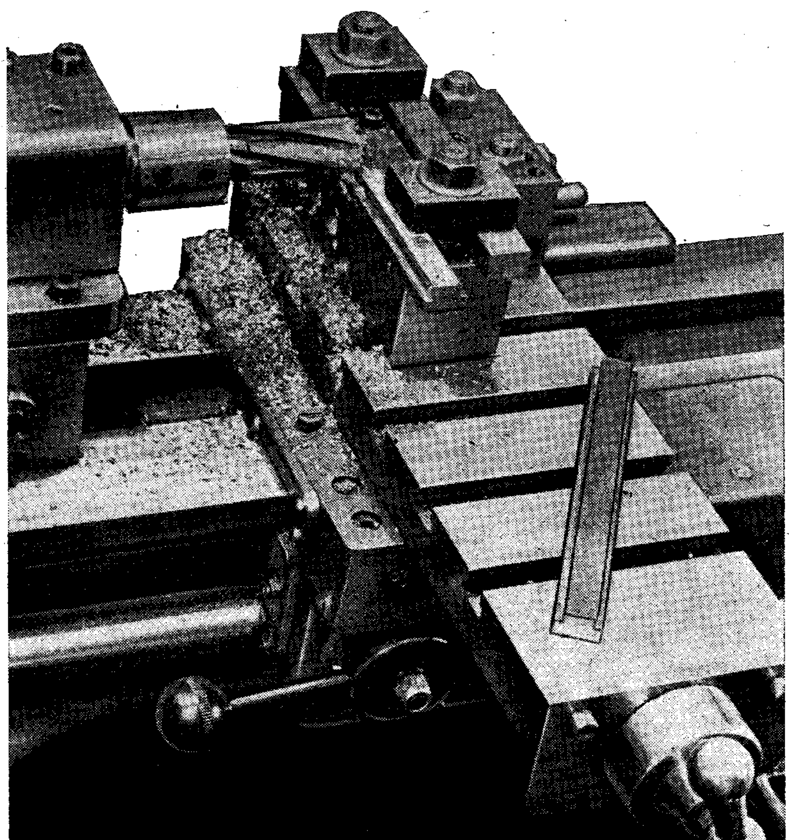
the lathe was set up as shown in Fig. 6, where the strips are being end milled into a tee section, the central stem having a final dimension of from five to ten thou. under $\frac{3}{8}$ in.

As with quite a number of my lathe-milling jobs, the set-up centres around a length of $1\frac{1}{2}$ in. square bright steel, this being firmly secured to the cross slide and packed up by an additional strip of $1\frac{1}{2}$ in. × $\frac{1}{8}$ in. m.s. to obtain the desired height. The strips were then milled abut against a locating member, but as the clamps hold the block in addition to the work—to maintain alignment when changing pieces—the main "jig block" was fixed to a further smaller block which may be seen at the right.

Having milled all four strips on both sides, they were cut into $\frac{3}{4}$ in. lengths with the slitting saw and thus made ready for the bolt stems. It was decided that the most convenient method would be to tap the heads $\frac{5}{16}$ in. B.S.F. and to screw in the correspondingly reduced and threaded stems. Although it does not appear so on the drawing—Fig. 7—the $\frac{5}{16}$ in. size still leaves a reasonable amount of metal upon either side of the head and a considerably greater length of thread than that given by a standard $\frac{5}{16}$ in. B.S.F. hexagon nut.

When drilling and tapping the blanks it was necessary to take extra care to see that they were drilled on the centre line, vertically tapped and slightly counterbored or counter-drilled $\frac{5}{16}$ in. dia. to ensure a good seating for the stem and for the fact that a die will not thread right up to a shoulder.

*Fig. 6: Milling mild steel strips to form tee bolt heads and tee nut blanks*



**Making the stems**

The stems were made from ordinary $\frac{3}{8}$ in. dia. bright mild steel, cut to length as required, one end being turned down and threaded $\frac{5}{16}$ in. B.S.F. Caution was taken to see that the die did not run into the shoulder to form three or four skive marks. After tightly screwing on the tee heads, each was finally faced down to the dimensions shown in Fig. 7, a slight chamfer on all corners facilitating subsequent entry into the slots.

When making use of the tee slots for setting up a job for milling, drilling, etc., it should be remembered that they have nowhere near the strength of those on "full size" machines. And in addition to the risk of breaking away the lips, the whole table may very easily be distorted—sometimes to such an extent that it cannot be moved without slackening off the jib adjusting screws.

**Distortion prevention**

To guard against such possibilities, I make a point of never clamping a job to the cross slide in the manner approved for heavier tables—Fig. 8, which shows a piece of work "clipped" to the table for drilling. In this case the tee slot lips are thick enough to withstand easily the pressure from the underside only. The clipping of a job to the cross slide of a small lathe is therefore one such practise which will certainly distort the table and possibly break the slot lips.

Although work is shown clipped in Fig. 6, the interposed block is giving a pressure equal but opposite to that of the tee bolt head in a manner similar to that shown in Fig. 9. Thus though the work is held securely and has be-

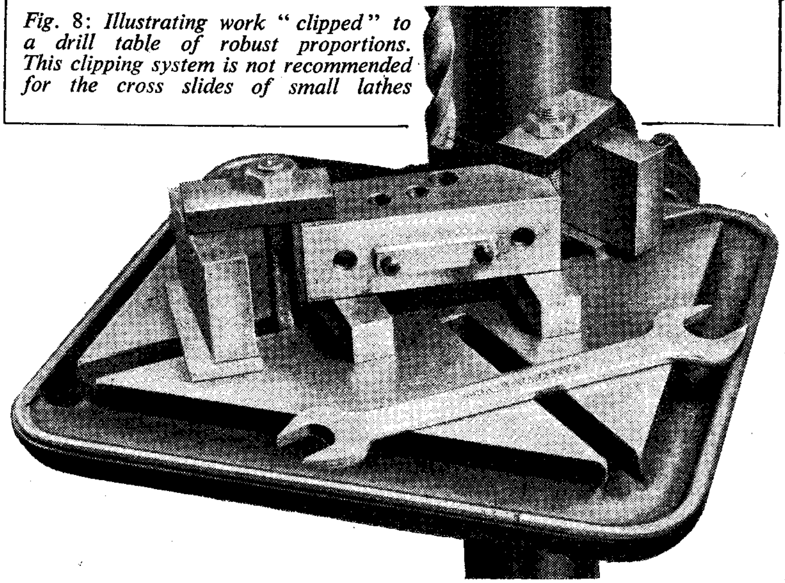


*Fig. 8: Illustrating work "clipped" to a drill table of robust proportions. This clipping system is not recommended for the cross slides of small lathes*

come almost part of the slide, this locking is obtained from a crushing or compressive force upon the cast-iron slot lips.

As one further striking example of the kind of forces which the tee slots will withstand when work is properly mounted upon what may be termed the "lip compression principle," examine the picture captioned Fig. 10.

**Practical example**

Here a 1½ in. square "jig block" is fixed to the cross slide by two tee bolts with the interposition of a piece of card to act as a further insurance against slipping. The work to be milled —a piece of 2 in. square mild steel in which a slot ⅝ in. wide and ½ in. deep is formed—is bolted to the block by means of a long ⅜ in. bolt and nut with the interposition of a piece of card. This is very important, as the work is held only by one bolt, which must resist a tendency for the job to rotate when the milling cutter teeth strike the corner.

At the start of the cut the jig block may be held to the cross slide by tightening the two tee nuts with considerable force and the nut and bolt holding the work to the block may be tightened up to the thread-stripping point if desired without distortion or damage to the cross slide.

**Tee nuts: a caution**

To round off this demonstration the slot was formed in three passes of the ¼ in. wide cutter at full depth, the central piece being removed last. The cutter is 2 in. in diameter, speed, 123 r.p.m., and feed about two thou. per revolution.

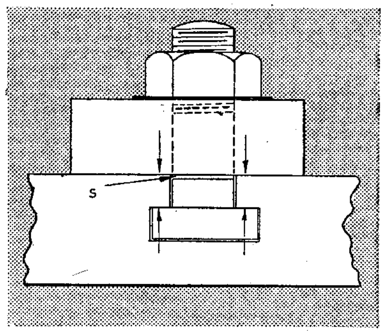
When using tee nuts in the manner shown in Fig. 4, experience has shown that a ¼ in. B.S.F. thread size is quite satisfactory, but the greatest care must be taken to ensure that the screw is only of just sufficient length. If it is too long screwing it up will result in lifting the nut and bursting out the tee-slot lips.

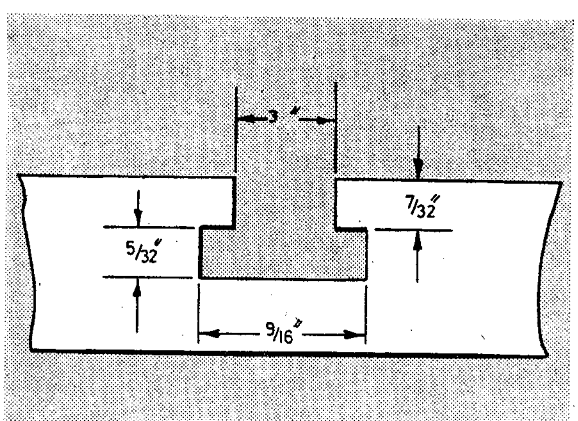
**Tee stem position**

Similarly, with both tee bolts and nuts the tee stem should always be about 1/32 in. below the surface of the table, so that when drawn up it is still able to grip under the lips and not merely attach itself to the component being fixed (see "S," Fig. 9).

Finally, in so far as it is practicable each side of the tee-bolt head should take its share of the load. A rough check can be made by rocking the bolt until the neutral point is reached —when both sides of the tee are touching and checking for the vertical. Of course, if the lathe is an old one and the undersides of the slots have worn uneven with repeated

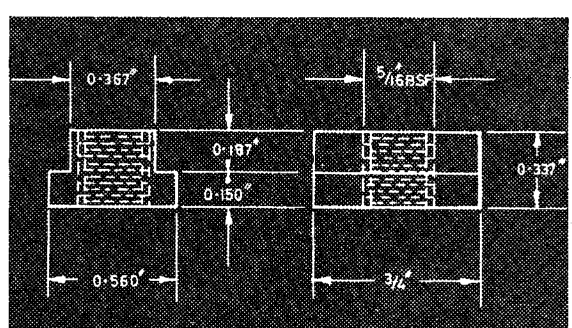
*Below, Fig. 9: Showing the direction of compressive or crushing forces upon slot lips. "S" shows where space must be provided*



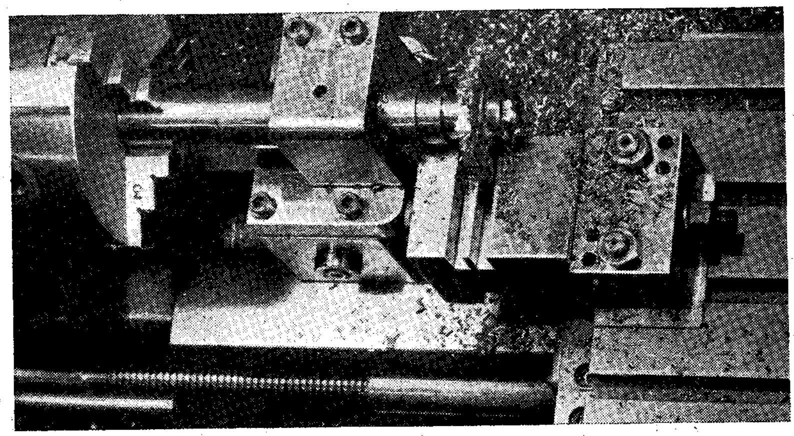

*Left, Fig. 5: Slot dimensions: ML7 lathe*

*Below, Fig. 7: Actual dimensions of a finished tee head*



## TEE BOLTS and NUTS continued . . .

*Right, Fig. 10: Heavy but safe going for a 3½ in. lathe: milling ¼ in. wide, ½ in. deep slots at one pass in mild steel. The work is mounted so as not to strain the tee slots or distort the table*



use—or misuse—one can only hope for the best !

In my earlier article (MODEL ENGINEER, July 26, "The skew-rack tailstock mechanism," Part 2) Fig. 15 at page 122 erroneously shows the machining limits for the spindle diameters as being plus 0, minus 0.005 in.

These limits should be plus 0 minus 0.0005, being one half thousandth of an inch instead of five thousandths. ■

# Life span of a diesel engine

**300,000 miles of town work is nothing to a diesel bus engine—in fact fuel consumption is lower at the end of this period !**

HOW LONG will a diesel engine run without overhaul ? With an eye on economy Mr. E. V. Dyson, the general manager and chief engineer of Warrington Corporation transport department, has made a serious attempt to answer this question.

The problem appears to hinge upon post-war engine development together with improved fuel and lubricating oils. Bearing these factors in mind, it was felt as long ago as 1949 that pre-war preventive maintenance methods might be more than adequate under these improved circumstances and therefore in need of revision.

Consequently, it was decided to concentrate maintenance methods on routine servicing only and to base the overhaul period not on mileage as had formally been the practice, but on the condition of the engine and engine performance as indicated by consumption records and exhaust gases.

Mr. Dyson followed out this procedure and has just had an examination made of a Leyland 0/600 125 h.p. diesel engine which has completed 300,000 miles without overhaul, neither the sump nor cylinder heads having been removed.

The engine is one of 20 originally fitted to 20 double-deck buses supplied to the Corporation by Leyland Motors Ltd. over six years ago.

The test vehicle, during its first six months in service, averaged 9.39 m.p.g., and has shown an even better fuel consumption during its last six months' running with an average of 9.73 m.p.g. Fuel consumption for the whole 300,000 miles averaged 9.57 m.p.g. operating on internal town services over mostly flat country in well built-up areas where stops are frequent and much gear changing is experienced.

A further disadvantage to economical running is the abnormal amount of low gear work and engine idling because of heavy traffic congestion and long periods of waiting and slow moving caused by railway level crossings and canal swing bridges.

After riding in a bus which had covered over 295,000 miles with the original engine untouched—to demonstrate its pulling power and smoke-free exhaust gases, officials watched the dismantling of the engine in bus No. 3. When the cylinder heads were removed, they found the pistons and combustion chambers were free from carbon. In fact the part numbers stamped on the piston heads were clearly visible ! All the piston rings were free, but the oil transfer holes in the grooves for the scraper rings were choked up.

Maximum wear on the cylinder bores, which have replaceable dry-type liners, was 0.008 in. on the thrust side. No. 1 piston and connecting rod was removed to reveal a big-end bearing in excellent condition with practically no wear and the centre main bearing, which is normally expected to show more wear than the other main bearings, was in good condition with the fine flashing of indium coating just worn sufficiently to allow the copper in the strip bearing to be seen.

Generally, the condition of the engine was such that if it had been left alone it could have efficiently completed a much higher mileage. ■

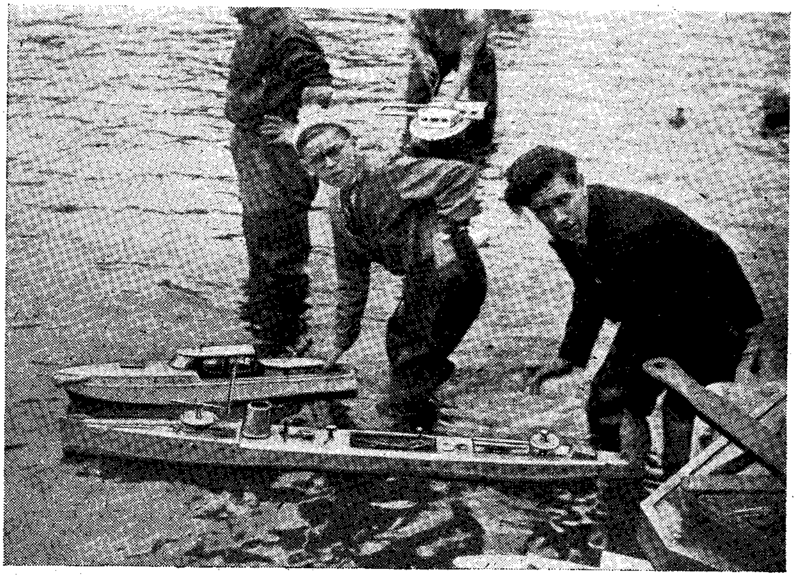
# SOUTH LONDON and KING'S LYNN REGATTAS

**By Meridian**

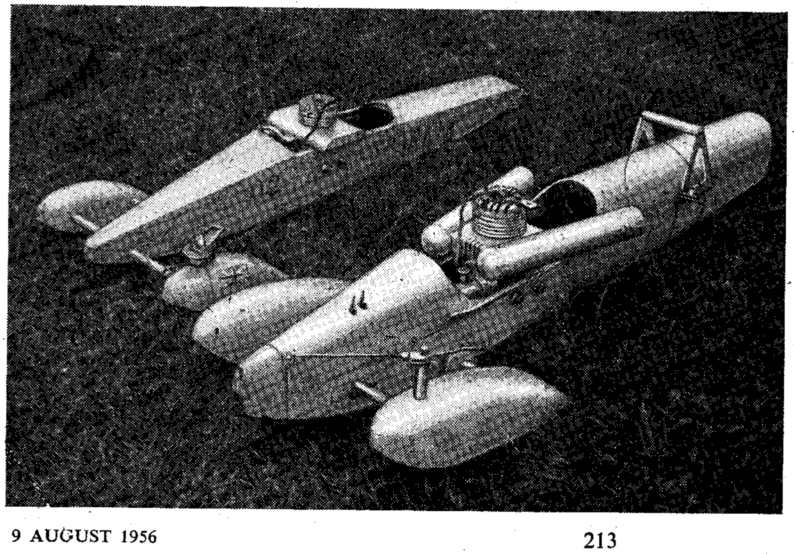
THE EARLY REGATTAS of the M.P.B.A. calendar have not, so far, been blessed by really good weather. There is no doubt that a bad day must affect the attendance of any outdoor event and honour is due to those stalwart enthusiasts who turn out and enable a regatta to be carried to a successful conclusion.

Two such regattas affected by adverse conditions were the South London and King's Lynn events held on successive Sundays during June. At the South London regatta, however, a good attendance resulted despite a cold and gloomy day.

Due to local regulations speed events are always first on the programme at Brockwell Park and some good speeds were attained running on a course of about 105 yards per lap. The 10 c.c. boats were in particularly good form, with R. Phillips (St. Albans) recording 69.47 m.p.h. with *Foz* 2 in the Class C race and W. Everitt winning the C Restricted event at 65.93 m.p.h. with *Nan* 2.



*Waiting for the "go ahead" signal in the Victoria M.S.C. steering event*

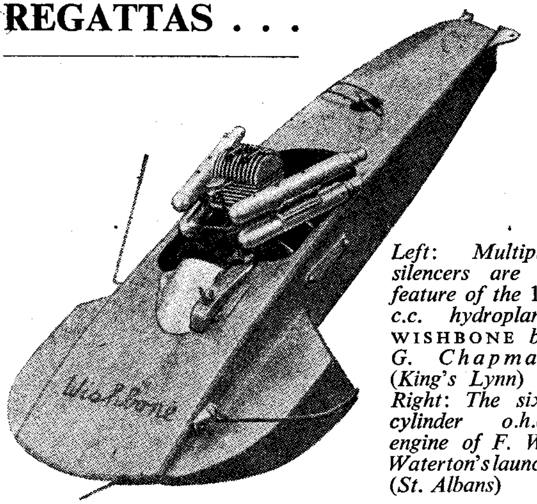


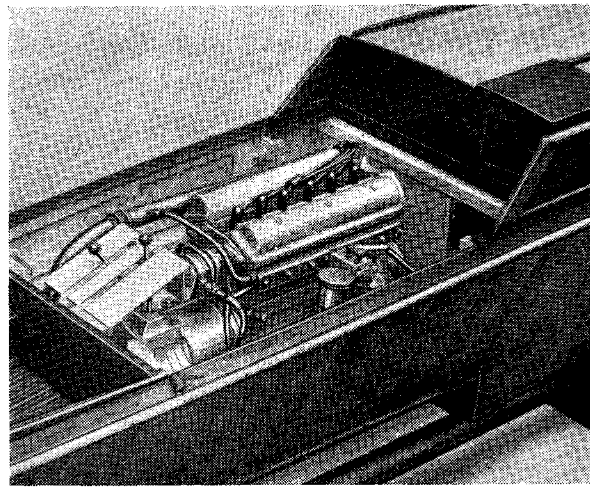
*Two fillies from the George Lines stable, 15 c.c. and 30 c.c. Sparkies*

Colin Stanworth (Bournville) spent most of the morning with his home-built 10 c.c.. engine in pieces as he tried to remedy a tight gudgeon pin. Eventually, perseverance was rewarded with a run of over 59 m.p.h. to take second place to Dick Phillips.

There were no entries in Class B on this occasion, but some 30 c.c. boats were present to take part in the Class A race. The winning speed again topped the sixty mark with J. Benson's

# REGATTAS . . .





*Left: Multiple silencers are a feature of the 15 c.c. hydroplane* WISHBONE *by G. Chapman (King's Lynn) Right: The six-cylinder o.h.c. engine of F. W. Waterton's launch (St. Albans)*

*Orthon* (Blackheath) attaining 61.25 m.p.h.

About thirty craft contested the straight events—comprising the usual nomination and steering—and some excitement was created by the capsizing of several of the faster boats by the new steering markers. These markers consist of iron rods mounted on a heavy base and fitted with a round float which is free to move up and down the rod according to the water level. When a fast boat hit one of the floats, however, its round shape allowed the boat to ride up it, and several craft were overturned.

The steering at first resulted in a tie between J. Clay (Blackheath) and J. Clarke (Welling) but following a re-run the verdict went to the latter, whose petrol-engined launch was running very reliably.

**RESULTS**

C RESTRICTED RACE

| | |
|---|---|
| 1. W. Everitt (Victoria) *Nan* 2 | 65.93 m.p.h. |
| 2. K. Hyder (St. Albans) *Slipper* 4 | 65.08 „ |

CLASS C RACE

| | |
|---|---|
| 1. R. Phillips (St. Albans) *Foz* 2 | 69.47 m.p.h. |
| 2. C. Stanworth (Bournville) *Cocotoo* ... ... ... | 59.39 „ |

CLASS A RACE

| | |
|---|---|
| 1. J. Benson (Blackheath) *Orthon* | 61.25 m.p.h. |
| 2. W. Everitt (Victoria) *Melody* | 57.83 „ |

STEERING COMPETITION

| | | |
|---|---|---|
| 1. J. Clarke (Welling) | 9 points | 3 |
| 2. J. Clay (Blackheath) *Elizabeth* | 9 „ | 0 |

NOMINATION RACE

| | |
|---|---|
| 1. J. Clay (Blackheath) *Elizabeth* | Error .3 sec. |
| 2. J. Cleary (Blackheath) *Via Media* ... ... ... | „ .5 sec. |

### King's Lynn speed regatta

The King's Lynn event is an informal regatta for speed only. The venue is attractive, being a farm pond in the village of Watlington near King's Lynn.

There was one event only open to all classes of racing hydroplanes irrespective of size, but provided a very interesting race. Dick Phillips repeated his fine performance by topping the list with a run of 66.19 m.p.h. with *Foz* 2. This boat is running really well and must be regarded as favourite for the Hispano-Suiza race to be run at St. Albans on August Bank Holiday week-end.

The home club was represented by B. Stalham with *Tha* 3 and G. Chapman with *Wishbone*, both Class B boats. The former boat is still fitted with the supercharged 15 c.c. vee-twin engine and looked as though it would reach really high speed. A slowing on the later laps, however, reduced the average speed to the forties.

G. Chapman had the misfortune to damage the bottom of his boat when the starting cord became entangled with the flywheel. But the hole was promptly repaired with a motor tyre patch and a good run was obtained.

Of the larger boats G. Lines' *Big Sparky* (Victoria) displayed remarkable speed, but it registered its best time after the official laps had been completed !

**RESULTS**

| | |
|---|---|
| 1. R. Phillips (St. Albans) *Foz* 2 | 66.19 m.p.h. |
| 2. K. Hyder (St. Albans) *Slipper* 4 | 63.92 „ |
| 3. G. Lines (Victoria) *Big Sparky* | 61.6 „ |
| 4. J. Benson (Blackheath) *Orthon* | 58.78 „ |

## VIRGINIA . . . *continued from page 208*

not be tight enough to split the bosses when pressing in. It is easy enough to turn a correct press fit. Just ease the end of the hole in the wheel boss with a taper broach; only a scrape, for about $\frac{1}{8}$ in. depth. If the spigot is turned so that it will just enter the enlargement very tightly it will be the exact size for a correct press fit.

After turning the spigots part off the pins to the overall length shown in the drawing; reverse in chuck and turn the ends to 5/32 in. dia. for $\frac{3}{16}$ in. length, screwing 5/32 in. $\times$ 40, or A.S.M.E. equivalent. Before pressing into the wheel bosses put a brass nut on the thread to prevent damage. The bench vice can be used for the squeezing operation. Don't forget that the bigger pins are pressed into the wheels with the bigger balance-weights !

Each axle needs a piece of $\frac{1}{2}$ in. round mild steel (our American friends call it "cold-rolled") the ends of which are turned to a press fit in the big holes in the wheel bosses by the same method described for crankpin spigots. If the chuck is not true, and a collet is not available, turn the axle between centres, using steel slightly larger. This will ensure that the wheel seats are concentric with the axle.

Have the steel long enough to allow for a carrier at the headstock end, so that the full length of the axle can be turned without removing it from the lathe. The surplus can be parted off with the axle held in the chuck, for which job a true chuck is not essential. Press one wheel on each axle only; the other must be left until the eccentrics for the valve gear are made and fitted.

● *To be continued*

★ ★ ★ **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.**

## Refitting lathe tailstock

Q I would be grateful for your advice on the following:

The tenon of the sandwich plate of the tailstock of my lathe shows a side-to-side movement between the ways of from 3 thou. to about 8. My measurements make the wear to be chiefly in the tenon, there being a difference between the ways of about 2-3 thou. only. My plan is to assume wear equal on both sides of ways and abrade or scrape equally off each side to restore parallelism, then build up one side of the sandwich plate and machine off (or else a strip).

I constantly come up against the problem of " restoring dimensions " e.g. damaged spot to otherwise perfect lathe bed or ruined keyway. Can metal be deposited by spraying, and if so does it create great heat and distortion ?—T.M.A., Dungannon, Co. Tyrone.

A *In many cases the easiest way to restore correct fitting and alignment is to machine away the tenon altogether and make a new one, which can then be correctly fitted to the ways of the bed and then fastened to the inside of the tailstock by screws. The holes for the screws may be slotted to allow adjustment for exact alignment. Afterwards this can be positively ensured by means of dowels. It is assumed that the ways in the bed are parallel and in correct alignment and this, of course, should be ascertained and any necessary correction made before fitting the tenon.*

*Other methods of taking up wear on the tenon would be by fitting gib strips with adjustment screws and, in some cases, tapered gibs have been used. It is possible to build up iron or steel surfaces by metal spraying; this method is used extensively in restoration of shafts and similar purposes, so it would appear quite suitable for machine tool slots.*

## Working pressure

Q I have built a single-acting uniflow engine, ⅞ in. bore × ⅞ in. stroke. Could you tell me what working pressure would be best for this engine ? I have tried it on a 100 p.s.i. air line and have obtained about 3,000 r.p.m.—W.G.W., Dawley, Salop.

A *The most suitable working pressure for a single-acting uniflow engine will depend very largely on the details of design, but generally speaking engines of this type will run fairly well on a pressure of about 100 p.s.i. The optimum results for a given working pressure will depend largely on the admission valve, exhaust port timing and the clearance space above the piston at top dead centre. This assumes that the engine exhausts to atmosphere, but higher efficiency can be obtained by using a condenser to obtain a vacuum at the exhaust port.*

## Direction and speed indicator

Q I would like to build a wind direction and wind speed indicator capable of being read from dials indoors. But I have been unable to discover the principles involved.—D.G., Southmoor, Berks.

A *The wind speed could be measured by a form of Pitot head as used on aircraft in conjunction with the indicating dial instrument, suitably calibrated. The standard aircraft instrument is designed only to work at high speeds, but it might be possible to adapt and recalibrate an instrument to suit. For indicating wind direction the type of instrument known as a Selsyn could be employed to transmit the readings of an ordinary rotating head, such as employed with an ordinary wind vane to a repeater dial instrument. Selsyn indicators are also used extensively on aircraft and can be obtained from dealers in ex-aircraft equipment.*

## Lubrication and boiler

Q My first serious attempt at model building—Edgar T. Westbury's Unicorn mill engine—is nearing completion. Could you tell me what method of cylinder librication is required and where I can obtain details of a suitable boiler ?—W.W.C., Glasgow.

A *The most suitable type of lubricator for the cylinder and steam chest is a small displacement lubricator of the type which can be obtained ready made from Messrs. Stuart Turner, Henley-on-Thames, Oxon, or other firms dealing in model supplies. In cases where steam is not superheated very little internal lubrication is necessary and for runs of up to 10 or 15 minutes it will probably be found quite satisfactory to give an injection of oil both before and after running the engine. The internal flue boiler, Ref. No. M.10 price 5s. 6d., would be suitable for driving this engine. But in cases where only light running is required, a small boiler would suffice and the reduced size of boiler described in* MODEL ENGINEER *of 13 May 1954, classified as the Trident Mark II, would be quite suitable. The particular form of design is one which is quite easy to construct and very satisfactory in use.*

## Constructing Seagull

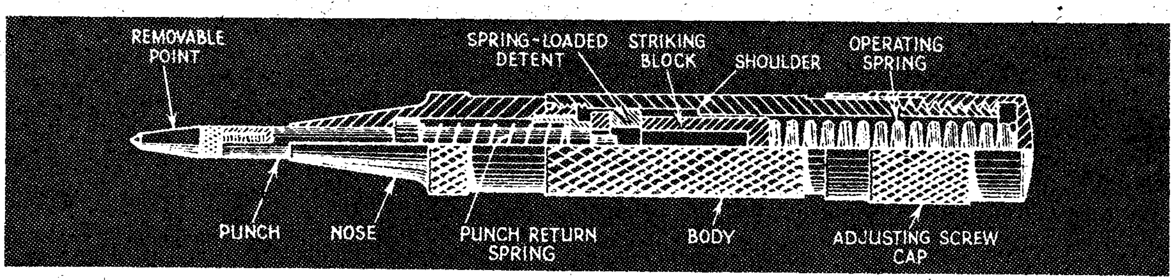
Q I am constructing a Seagull engine, as described in MODEL ENGINEER. Your advice on the following would be appreciated: The method of forming the chamfer for the valve seatings; the gauge of wire recommended for the valve springs and the suitability of mild-steel valves.

I find that there is a very slight leakage past the valves at t.d.c. on the compression stroke when testing the engine by rotating the flywheel by hand. But with a little thin oil on the valve face they are completely air-tight.—J.V., Bournemouth.

A *The best method of forming the chamfer for the valve seatings is to make up a seating cutter having guides to fit both the valve port and the stem guide. The actual cutter may be in the form of a D-bit and it can be used simply by turning it with the fingers. A tool of this kind is very easily made from silver steel.*

*The gauge of wire recommended for the valve springs is 19 gauge and they should have not less than six complete turns not counting the end turns which should be ground flat.*

*Mild steel valves will work satisfactorily, but are liable to pitting if they become overheated. It is therefore better to use steel having a higher heat resistance, such as nickel or nickel chrome steel. It should not be necessary to rely on oil on the valve face to make the valves completely air tight as the slightest leakage past the valves cannot be tolerated in so small an engine.*




# Making an
# AUTOMATIC CENTRE PUNCH

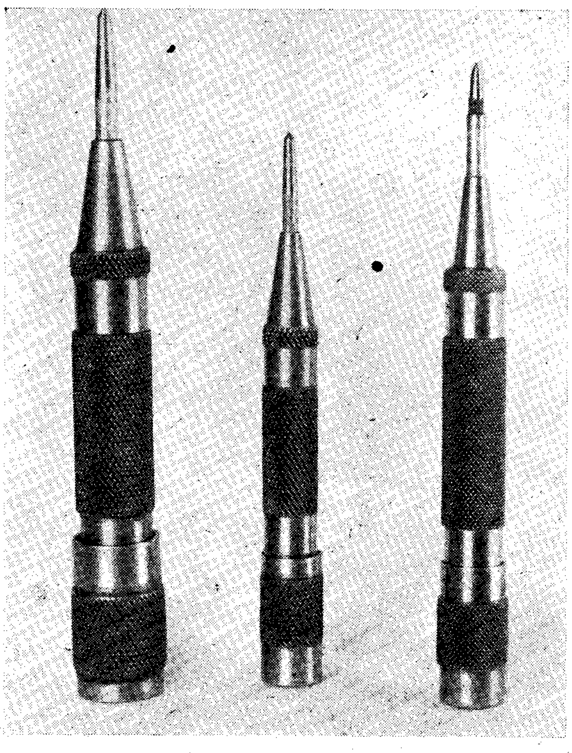
## By DUPLEX

THE AUTOMATIC centre punch is furnished with a self-contained mechanism that enables the punch point to strike a blow and indent the work surface when the operator applies downward pressure.

This type of punch has the advantage that, unlike the ordinary centre punch, it can be operated with one hand. In addition, the force of the blow struck is uniform, but can be readily adjusted by turning a knurled cap. In the original Starrett punch the hardened punch point is removable and easily replaced.

Before the actual construction is dealt with, the internal mechanism calls for description (Fig. 2). In the resting position the punch spindle is protruded to the full extent by the action of its return spring. But when the body of the punch is pressed downwards by the hand—with the punch point resting on the work—the punch spindle is forced upwards, carrying with it the striking block and at the same time compressing the operating spring. As the automatic striking action of the tool depends on the accurate fitting and correct working of the detent, this component is illustrated in greater detail in Fig. 3.

*Above, Fig. 2: Sectional view of an automatic centre punch*

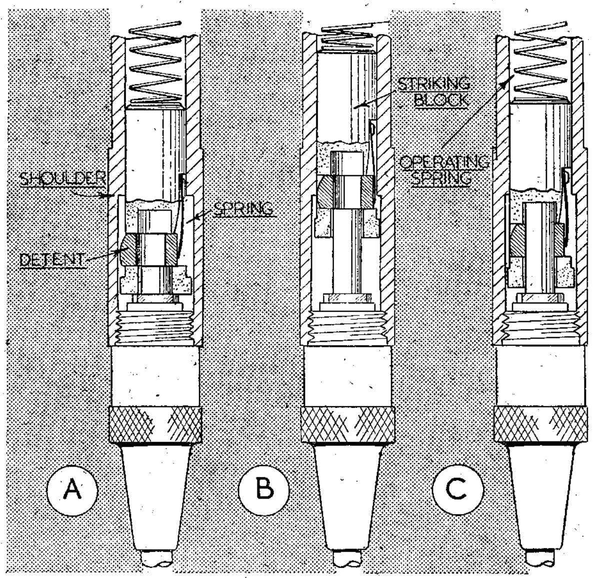


*Left, Fig. 1: Two automatic centre punches made in the workshop (left) and the original Starrett punch (right)*

The lower end of the striking block is cross-drilled to accommodate the detent, which is made a free sliding fit. In addition, the detent is pushed off-centre by means of a small leaf spring attached to the striking block. When the parts are in the resting position, with the punch ready for action (Fig. 3A) the shoulder formed on the upper end of the punch spindle is in contact with the lower side of the detent and, because of the eccentric position of the detent, the spindle is trapped and cannot pass through the bore in the detent.

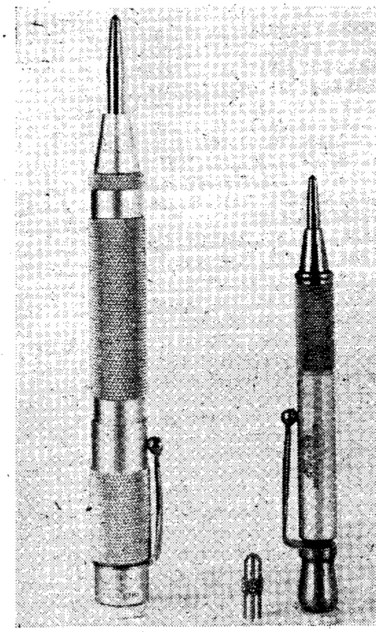
On pressing the punch point against the work surface, the punch spindle (Fig. 3B) rises and carries with it the detent and the striking block. In the fully raised position, the curved face of the detent comes into contact with a shoulder formed within the body of the tool and this presses the detent inwards until its bore becomes concentric with that of the striking block.

By the action of this mechanism (Fig. 3C) the striking block is released on reaching the end of its upward travel. The block then slides down the punch spindle and strikes its upper end a sharp blow. When the tool is again lifted from the work, the return spring resets the punch spindle in the fully extended position and the leaf spring returns the detent to the off-centre setting in which it again engages




*Left, Fig. 3: The action of the detent in controlling the working of the punch*

*Right, Fig. 4: The Moore and Wright automatic centre punch (left); the spring-dotting punch (right). This tool is particularly useful for marking out small work and, in addition to a pocket clip, it is fitted with a small cap to cover the punch point*



the shoulder formed on the upper end of the punch spindle. The upper end of the punch body is fitted with a screw-cap that is turned downwards to compress the operating spring and so regulate the force of the blow. For punch marking dimension lines and guide circles with a series of dots, the tool should deliver a light blow, but when marking out drilling centres a deeper indentation is required and the operating spring is more heavily compressed.

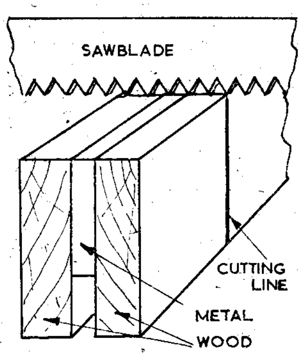
The Moore and Wright automatic punch (Fig. 4) is constructed in the same way; but the cap for adjusting the spring tension is made captive so that it cannot become fully unscrewed.

The punch as a whole is chromium plated to prevent rusting, and the pocket clip fitted is a useful addition. The punch point is not made detachable as in the Starrett tool.

The punch, after being placed in contact with the work, is operated by lifting and then releasing the bulbous finger grip fitted at the top of the tool. The internal plunger rod is furnished with a compression spring that can be dismantled by removing the end-cap in which the punch spindle is carried. ■

# Hints from Readers

**on making model parts**

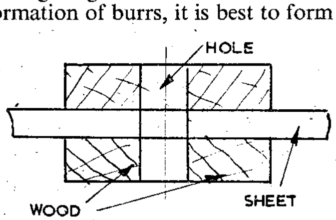



### How to saw thin metals

THE drawing shows a simple and efficient method for cutting thin metal sheets with a hacksaw. Make a " sandwich " with two adequate pieces of wood and, after having laid out the cutting lines on these pieces, put the whole sandwich in the vice and proceed with the cutting operation.

### Drilling thin sheets

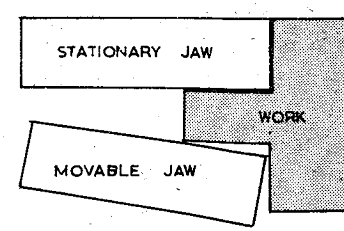
IT is extremely dangerous to drill very thin stock. In order to avoid cutting fingers and to eliminate the formation of burrs, it is best to form a



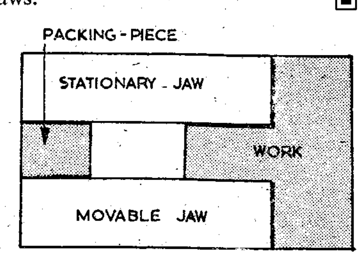

sort of " sandwich," putting the metal sheet between two layers of thin wood.

### Holding odd parts in parallel vice

WHEN a piece of work, because of its odd shape, cannot be held in the parallel vice of a shaping or milling machine, i.e. in the centre of the jaws, there is always the danger that the movable jaw—putting itself in an




oblique position—will only hold the piece at its edge. In order to eliminate such trouble put a small counter piece or packing piece (of approximately the same width as the item of work) at the other end of the jaws, thus ensuring a good parallelism between the vice jaws. ■



# 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

## COMPRESSION PRESSURES

SIR,—I am afraid that your reply to a query about compression pressures (Readers' Queries, June 28) was based on a wrong assumption and is, in consequence, misleading.

Boyle's Law is only applicable to isothermal changes, i.e. the temperature of the gas remaining constant which, in practice, it never does. The general law of expansion (and compression) is $PV^n$ = constant, where n is an index whose value, for air and other so-called "perfect" gases, generally lies between 1.0 and approximately 1.4.

In all practical cases of air compressors and i.c. engines, where the volume changes rapidly, the upper limit for n is closely approached and can safely be assumed in calculations. An elementary knowledge of logarithms is all that is required to obtain a solution.

The final temperature can also be obtained by applying the characteristic equation, $PV = RT$, where R is the "gas constant" and T the absolute temperature (obtained by adding 460 deg. F. or 273 deg. C. to the thermometer value). The actual value of R need not concern us here, and the equation can be rewritten, $\frac{PV}{T}$ = constant.

I append specimen calculations. Supposing: initial pressure, $P_1 = 14.7$ p.s.i. abs; initial volume, $V_1 = 10$ cu. in.; final volume, $V_2 = 5$ cu. in.; and initial temperature, $t_1 = 60$ deg. F.

Then, to find the final pressure: $P_1V_1^{1.4} = P_2V_2^{1.4}$,

so that $P_2 = P_1 \cdot \frac{V_1^{1.4}}{V_2^{1.4}} = P_1\left\{\frac{V_1}{V_2}\right\}^{1.4}$

Since $\frac{V_1}{V_2} = r$, the compression ratio, this can be written, $P_2 = P_1r^{1.4}$. Substituting for $P^1$ and r, the final pressure will be $P_2 = 14.7 \times 2^{1.4} = 14.7 \times 2.64 = 38.8$ p.s.i.

To obtain final temperature: initial absolute temp. $T_1 = t_1 + 460 = 520$ deg. F. abs. Then, $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$, therefore $T_2 = \frac{T_1P_2V_2}{P_1V_1}$. Hence, $T_2 = \frac{520 \times 38.8 \times 5}{14.7 \times 10} = 686$ deg. F. abs., from which the final temperature $t_2 = 686 - 460 = 226$ deg. F.

Obviously, the greater the compression ratio, the bigger will be the departure from isothermal conditions.

The above is only a very bare outline of the relevant facts; if your querist requires a fuller explanation he should refer to any good modern textbook on heat engines or thermodynamics.

Stoneleigh, Epsom. G. SPENCER HARRY.

## COMMON PHENOMENA

SIR,—Vulcan's recent comments on the various phenomena one encounters in everyday life are always of interest, and it may be said with truth that most of them are accepted without question as being commonplace.

Except to those of an academic turn of mind many of these phenomena, intensely interesting as they may be as material for discussion, pass unnoticed

The waves lapping in on either beach (Smoke Rings, July 5) may be explained by the fact that the waters are tidal and thus possess a powerful directive force. On the other hand, it is a well-known fact that the water's edge of promontories reaching for some distance into fresh-water lochs always has the appearance of incoming waves, no matter where one looks. And so it goes on!

I wonder if I am alone in what I experience, when a particularly loud back-fire occurs? It seems I am made aware of it a split second before it occurs, but despite this, there is no lessening of the sudden fright I get. Indeed, it would appear to accentuate it!

Another thing, can anyone explain why drops of water are nearly always identical in size?

Glasgow, S.4. R.J.

## DROVE FLOUR MILL

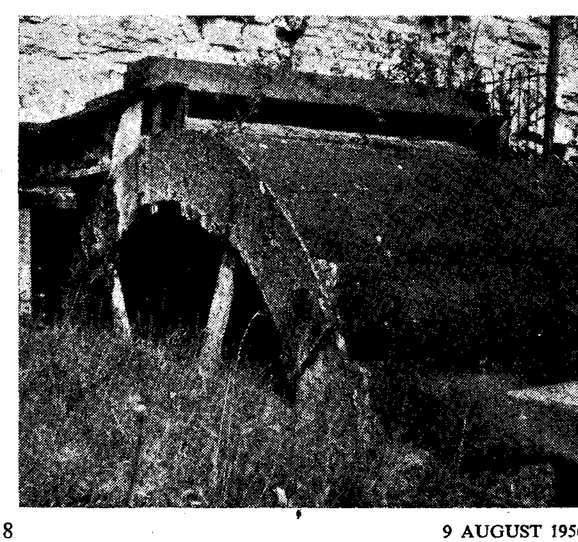
SIR,—My picture shows an overshot water wheel, approximately 15 ft. × 5 ft. which drove a flour mill at Painswick, near Stroud, Glos, about 30 years ago. The mill has long since been demolished, but the wheel is preserved as a link with the past.

Smethwick, Staffs. M. H. CRITCHLEY.

## O.H.C. ENGINES

SIR,—Many eyebrows will doubtless be raised by Mr. Sproson's letter (Postbag, July 12) containing his startling assertions re o.h.c. engines. With one exception he appears to have in mind the early pre-war types, which were prone to lubrication and noise problems. The modern o.h.c. engine is quieter than its pushrod counterpart and needs far less attention between overhauls.

It is interesting to note that one reason for Jaguar's choice of o.h.c. was on account of its liveliness, one other reason being its ability to maintain its tune over long periods.



*An overshot water wheel which is now derelict. See letter "Drove a Flour Mill"*

As for performance, an o.h.c. engine can be developed to a far higher specific output than a pushrod unit, and it will be more reliable at that. The 1,500 c.c. M.G. unit was pushed up to 85 b.h.p. by constant development, but the new twin-cam head is already giving over 100 b.h.p., as is the Coventry Climax single-cam 1,500.

Few, if any, of the fastest cars on the road today employ pushrod valve operation; perhaps the most successful of those that do is the Bristol, which in any case owes its success to the head shape as did the Riley; the Bristol is successful despite, rather than because of, its complicated pushrod valve gear.

Valve bounce is governed by the relation between valve spring pressure and the weight of the reciprocating valve gear, high r.p.m. on pushrod engines being obtainable only by very heavy spring pressures to counteract the excessive loading imposed by the weight of the machinery chattering up and down. All this overloads the camshaft drive too.

No, the o.h.c. engine is definitely on the way *in*, both on the Continent and in the U.S.A.

North Anston, Sheffield. S. D. WOOLASS.

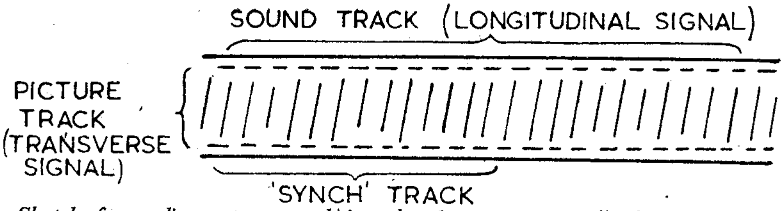
## TELEVISION ON TAPE

SIR,—I have watched with interest the letters of Ray Dar and W. A. Wakes in your columns on the subject of recording television on magnetic tape.

The main drawback to the recording of TV on tape is the insufficient bandwidth available at standard tape speeds ($3\frac{3}{4}$, $7\frac{1}{2}$, 15 in./sec.). In America the problem is increased due to the higher definition system used which requires a bandwidth of 4 mcs. as opposed to the British 405 line transmissions requiring 3 mcs.

I would draw the attention of anyone interested to the American Ampex TV tape recorder which was announced and described in the June and July issues of *Radio Electronics*. This system is to be put into use by the Columbia Broadcasting System this coming August.

The recorder overcomes the bandwidth problem in a novel way, and here I quote from the above periodical: "The new TV tape recorder . . . looks much like an Ampex sound recorder except for wider tape (2 in.) and more controls. Tape speed is 15 i.p.s., recording 64 minutes of programme on a 14 in. reel. The 4 mc. bandwidth is made possible by recording across the tape. Four rotating heads, so mounted on a drum that one is always in contact with the tape, record the video as shown in exaggerated form in the drawing. Sound is recorded on a single track in the ordinary way . . . "



*Sketch of recording system recently introduced in America. See "Television on Tape"*

Interested readers may see that although recording TV on tape is a practical proposition, it is well out of reach of the average model engineer and radio fan's capabilities.

Blackpool. JOHH C. PRIEST.

## INSURING MODELS

SIR,—In your issue dated 5 July 1956, P. S. Hall writes about insuring models to be shown at the M.E. Exhibition and you comment upon the subject. Are you not both wide of the mark?

Surely the purpose of insuring a model against loss is to enable the insurer to replace it, if lost; and on this basis the value of a model is the amount that would be charged by a suitable commercial manufacturer to provide a replica.

Last year I had a model in the exhibition—a model which I have made practically from scrap many years before and which I would have been inclined to value at a few shillings. Before I entered it I showed it—in pieces—to two professional engineers who specialise in costing. To my astonishment one valued it at £80 and the other independently estimated that it would cost about £100 to make one off, including the necessary drawings.

In accepting the lower figure for insurance value I am under no illusions as to its market value.

Ashton-on-Mersey, Cheshire. W. V. HANCOCK.

## SOCIETY NEEDED

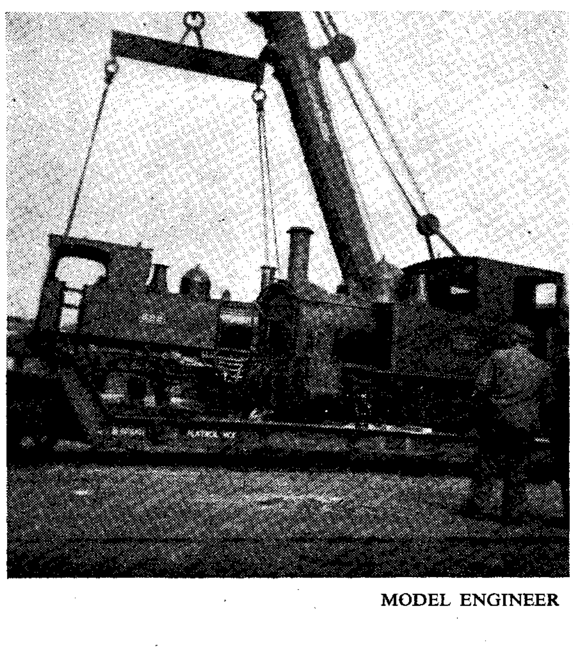
SIR,—Would people interested in forming a society to save The Welshpool & Llanfair Light Railway, please contact the Clerk to the Parish of Llanfair Caereinion. For those who are unfamiliar with it, here are a few details.

There are two engines No. 822, *The Earl*, and No. 823, *The Countess*. They are 2 ft. $6\frac{1}{2}$ in. gauge, built by Beyer Peacock in 1902. The weight is about 20 tons each, pressure 150 p.s.i., outside cylinders $11\frac{1}{2}$ in. × 16 in. and the driving wheels are 2 ft. 9 in. dia. The line is 9 miles 4 chains long.

I enclose a photograph which I took at Welshpool during the loading and unloading of the two engines in February and March this year when No. 822 had a thorough overhaul in Oswestry shops.

Oswestry. ALLAN PARKE.

*Two engines of the Welshpool and Llanfair Light Railway at Oswestry for an overhaul. See letter "Society Needed"*



# POSTBAG . . .

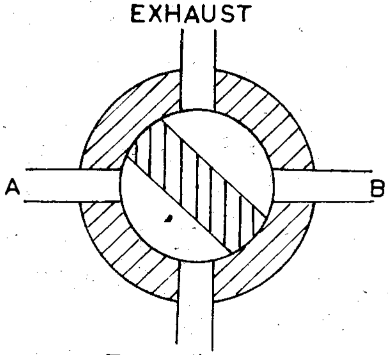
## OSCILLATING ENGINE

SIR,—Despite your many changes, I still think the M.E. a good fourpence worth (1s. 6d. in the debased currency). However, when I read your answer to K.C.P. (Readers' Queries, May 31), I almost cancelled my subscription!

By all means make an oscillating cylinder locomotive, K.C.P. Construct two outside cylinders, they look fine; they should be double acting though to be self-starting, otherwise a third cylinder is necessary.

Reversing them is the easiest thing in the world. A four-way cock is needed; it can be made from an ordinary gas tap. The centre plug is removed and the hole plugged solid. Two flats are then filed on each side. The outer casing is drilled at right angles to the original openings, converting the two-way into a four-way cock.

Referring to the sketch, *A* and *B* are connected to the steam ports on




the engine. A movement of 90 deg. of the cock reverses the engine.

A water tube boiler is not necessary, just solder as many brake-lining rivets to the bottom of the boiler as will fit into the firebox. I think L.B.S.C. once described a methylated spirits fire (made in an open Oxo tin and asbestos yarn) which would last a quarter of an hour or so. Incidentally, his fire engine plans should be quite a help.

Johannesburg, S.A. W. H. R. TUTTON.

## S.A. HEAVYWEIGHT

SIR,—I wish to refer to the articles appearing on the South African Heavyweight (May 17 and 24); the 15F Class 4-8-2 locomotive.

Mr. J. Perrier refers to an animal guard. It is correctly known as a cow-catcher, and the so-called buck-eye coupling is the Alliance Automatic Coupling or the Patent Buffer, and I have the scale pattern for this coupler and its buffer beam cover.

I am also constructing this locomotive with working steam and vacuum brakes to the design of H. Greenly and E. A. Steel. It will have a steam turbine for headlight and tender lights.

Referring to the smokebox, the rivets as shown on the drawings should be hexagon bolts with nuts screwed to smokebox ring.

I will gladly answer letters and information sought on this subject.

Bulawayo, S. Rhodesia. M. E. WHITELAW.

*Mr. Whitelaw beside a Class* 15F 4-8-2 *loco at Braamfontein shops. See letter "S.A. Heavyweight"*

## STEAM TRACTORS

SIR,—The letter of Mr. Geoffrey B. King (Postbag, July 12) must have aroused memories of the early days of the farm tractor for direct ploughing.

I remember, during the 1914-1918 war, seeing light steam tractors pulling four-furrow ploughs near Boston, Lincs. The Mann light steam agriculture tractor was specially built for ploughing, having rear wheels 20 in. broad and the two front wheels were placed close together so as not to track with the rear wheels.

The weight, however, was too heavy. Most light steam tractors weighed at least six tons and packed the soil too much for good cultivation. A farm tractor has to develop maximum power at minimum weight. This is an opportunity for an experimental engineer to design a light steam tractor for ploughing and cultivating. A water-tube or flash-steam boiler with a compact light-weight engine and transmission would have a chance of success.

I often wonder why some of our model engineers do not design an improved type of traction engine, lighter in weight, with a boiler which is easy to clean and open up for insurance purposes, and simple and easy to operate and overhaul. I have just had my Maclaren steam tractor passed for insurance. I had to remove all the lagging, water tank and connections; a lot of work for the necessary testing by hydraulic pressure to 50 per cent. over the working pressure.

The steam engine has faded into the background because so many of our makers followed grandfather so faithfully in their designs.

The latest type Aveling Barford steam rollers seemed to be an improvement in the right direction with an improved type of locomotive boiler, a clutch, gearbox, piston valves, water ballasted wheels and rolls, and some other new ideas. Now I hope we will have some suggestions for new ideas from some of our "steam men."

Linlithgow. ANGUS MACKAY.