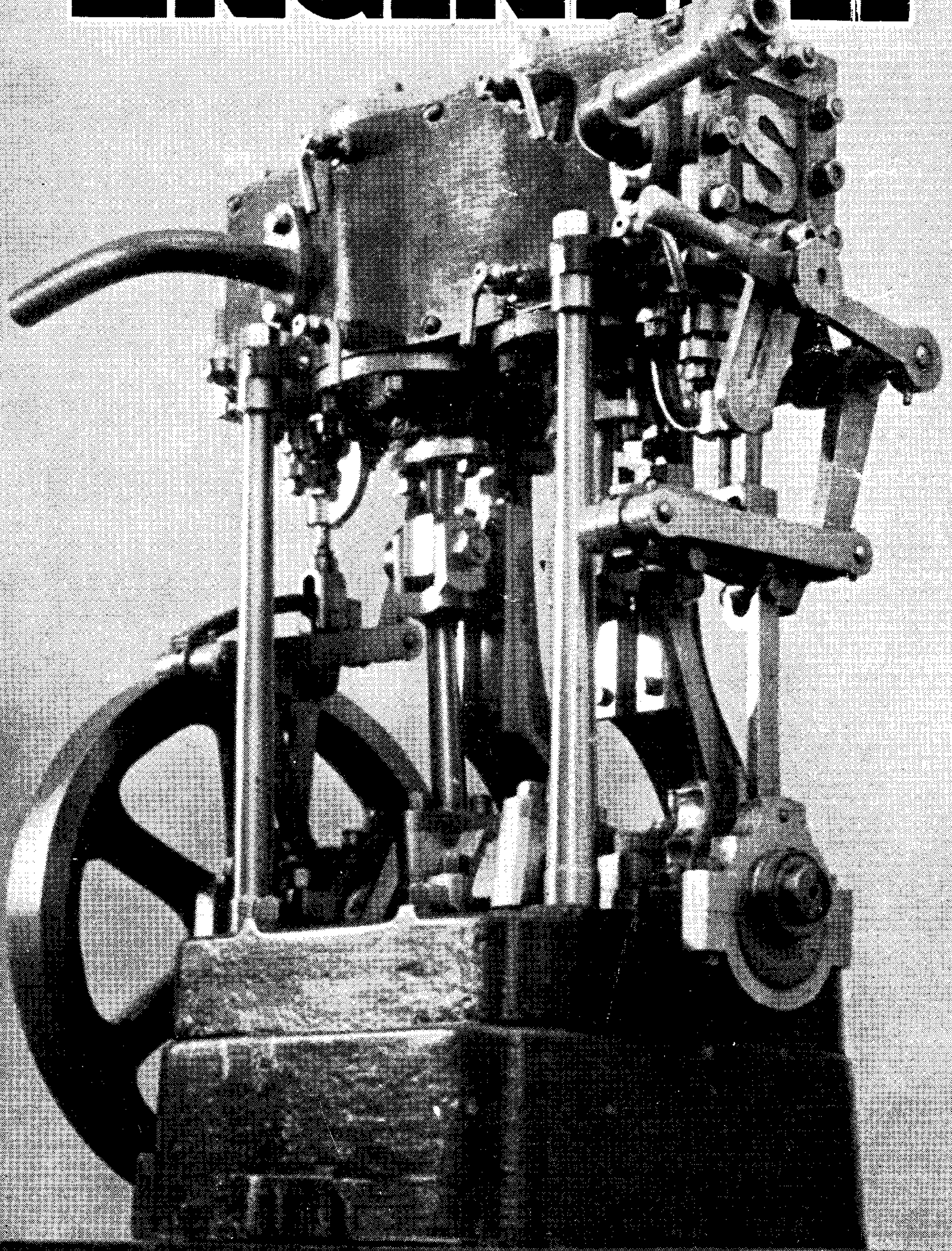
THE MODEL ENGINEER



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The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

19TH MAY 1949 VOL. 100 NO. 2504

SMOKE RINGS

Our Cover Picture

● MODEL STEAM engines of various types have, from the very earliest days of model engineering, been one of the most interesting outlets for the skill of the amateur constructor, and despite the attractions of more modern types of motive power, they are still as popular as ever. The Stuart Turner range of castings for the construction of favourite types of steam engines has always enjoyed a well merited popularity, and though the supply of castings and parts for their construction was temporarily cut off during the war, their return to the market last year was welcomed by many model steam engine enthusiasts. This photograph, submitted by Mr. A. R. Turpin, shows an excellent example of a Stuart Turner compound launch engine, built by Mr. George Bagster, of the Sutton Model Engineering Club.

Whitsun Fete at Malden

● A LARGE fete has been planned for the Whitsun holidays on the Malden and District Society's grounds at Claygate Lane, Thames Ditton, Surrey, and all model engineers will be made welcome.

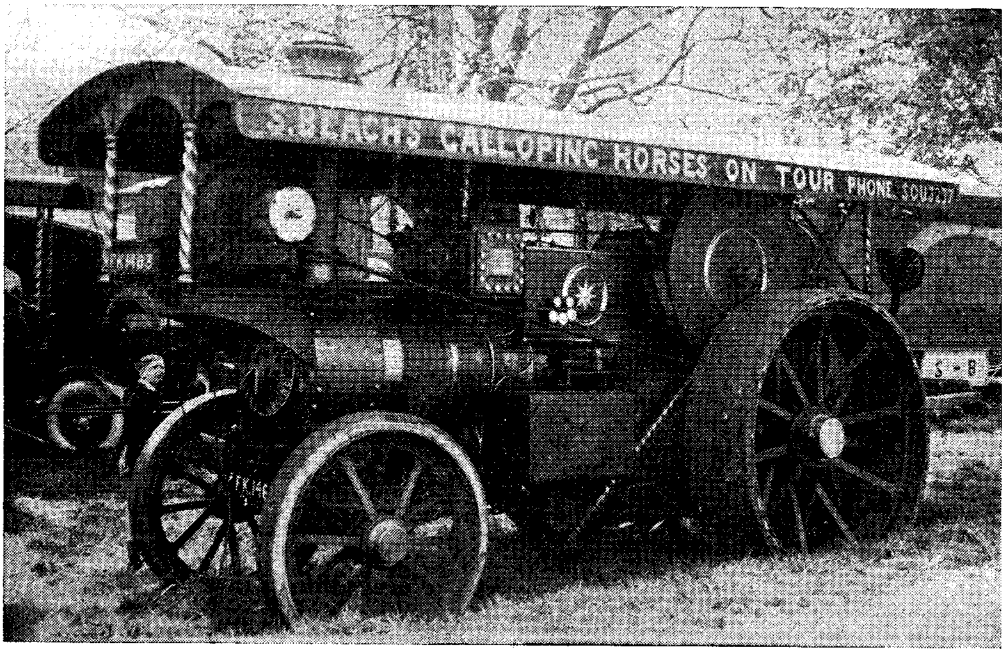
On Whit Saturday, Whit Sunday and Whit Monday, June 4th, 5th and 6th, the society's 880-ft. continuous railway track will be in full use from early morning to dusk (sorry, no available period for "free" or "general" running during these three days). An exhibition of models will be staged in the Scout Hall (adjacent to, and included in the fete area) and will include, among other features, many famous prize-winning exhibits from THE MODEL ENGINEER Exhibitions of the past few years.

On Whit Saturday, and Whit Monday there will be the usual form of fete in addition, with all the best side-shows and further attractions. Teas, light refreshments, ice cream, etc., will be available on all three days of the show.

The society's grounds are delightfully situated very close to the famous Thames Ditton Green (Giggs Hill Green) with its cricket associations, old-world houses, celebrated inns, etc. Buses run every few minutes from Kingston Bus Station direct to Claygate Lane. Thames Ditton and Hinchley Wood Stations (S.R. from Waterloo) and the Kingston by-pass road are about one mile from the grounds, whilst from Surbiton Station (fast trains from Waterloo) a trolley-bus to "The Dittons" terminus, plus a short walk along the Portsmouth Road, makes a convenient route. Further details and sketch-map may be had from either the Hon. Social Secretary, S. W. Stevens-Stratten, 3, Coombe Gardens, New Malden, or from Hon. Secretary, G. F. Tonnstein, 7, Thetford Road, New Malden, to whom all other enquiries should be made in the first instance.

Burrell Engine No. 2984

● OUR PREVIOUS references to Miss Sally Beach's fine Burrell engine No. 2984 (see our issues for March 17th and April 14th) created quite a stir among our readers, especially in the Southern counties; but Mr. P. E. Brown, of Mortlake, is the first and, so far, the only reader to report having found this engine at work after its recent overhaul. He found it at the Easter fair in Old Deer Park, Richmond, Surrey, and we lost no time in paying it a visit and photographing it. We understand that it will be at Richmond again at Whitsun.



The engine has been renamed *Lord Fisher*, and it seems to be in very good mechanical condition, though there is little evidence of the recently-reported redecoration; we would have liked to have spent an hour or two cleaning it!

At the same fair, there was a nice little Burrell tractor, No. 3497, *Conqueror*, which was so placed that a photograph was impossible. We intend to have another try, if possible, at Whitsun, when we hope to find the same equipment at the same place.

There was one feature of *Lord Fisher* which interested and mildly amused us; it was the collection of licences, all nicely framed, mounted on the near side of the engine and clearly seen in our photograph. They all expired in May, 1947; no licence for either last year or this year was anywhere to be found!

"At Home" Day in Barnsley

● MESSRS. T. GARNER & SONS LTD., held another very successful exhibition of tools, workshop equipment and model engineering supplies at Barnsley on April 2nd, and the event was well attended both by the trade and the general public. The widespread interest in the products marketed and advertised by Messrs. Garner was proved by the fact that trade representatives from as far north as Stirling, and interested visitors from as far south as Bristol, forgathered in Barnsley for this friendly and informal show, which provided an excellent opportunity for the discussion of workshop problems and requirements, and the demonstration of new tools and appliances. In the latter category, special interest was displayed in the new Garner light horizontal milling-machine, recently described in THE MODEL ENGINEER, an entirely new motorised vertical milling machine, hand and power shapers, Delapena honing appliances, the highly ingenious and versatile Scope lathe, and the Myford "ML7" and "ML8" lathes for metal work and woodwork respectively. The surprising capacity of the "ML8" lathe, with its various attachments, was convincingly demonstrated by carrying out ripping, rebating, dovetailing, planing and turning operations on the spot. Messrs. Garner are to be congratulated on their enterprise in staging this intimate but comprehensive exhibition, which provided plenty of interest to amateur and professional engineers.

An Awkward Scale

● WE SOMETIMES receive complaints that such scales as $1\frac{1}{16}$ in. to the foot, 17/32 in. to the foot, 7 mm. to the foot and the like are very awkward to work to, and some people would like to see them abolished! We wonder what these good folk will have to say about the scale to which Bassett-Lowke's magnificent $\frac{1}{4}$-in. scale (*nominal*) *Queen Elizabeth* was built. This model, for special reasons, had to be 21 ft. 7 in. long, and this works out to 0.2194 in. to the foot!

"Hielan' Lassie" Wins the Cup!

by "L.B.S.C."

SOME two years ago, or thereabouts, Mr. Arthur J. Webb, a follower of these notes living in Birmingham, decided that it was about time he realised his ambition and started to build a locomotive. He says he didn't know anything at all about the job, and had only the vaguest idea of how to operate a lathe; but as my instructions and drawings made the work seem straightforward and easy, he took his courage in both hands, and decided to have a go at a "Hielan' Lassie." Castings were obtained from Dick Simmonds, and work was commenced. Our friend carefully followed the "words and music," which he says went as merrily as marriage bells; and a total of 2,058 hours, spread over 20½ months of spare time, produced the result you see in the reproduced photographs. These were taken by Mr. G. R. Alcock, of Harborne. The time stated, includes stripping the engine down for painting, and reassembling it; the average was 100 hours per month. Mr. Webb adds that his own lassie was not neglected for the steam one, as he managed to take her out at least one and sometimes two evenings per week—married readers take heed! Incidentally, some readers, when writing to me, say that their wives do not take much interest in their work; well, make them "first priority" and see what a difference it makes—'nuff sed!

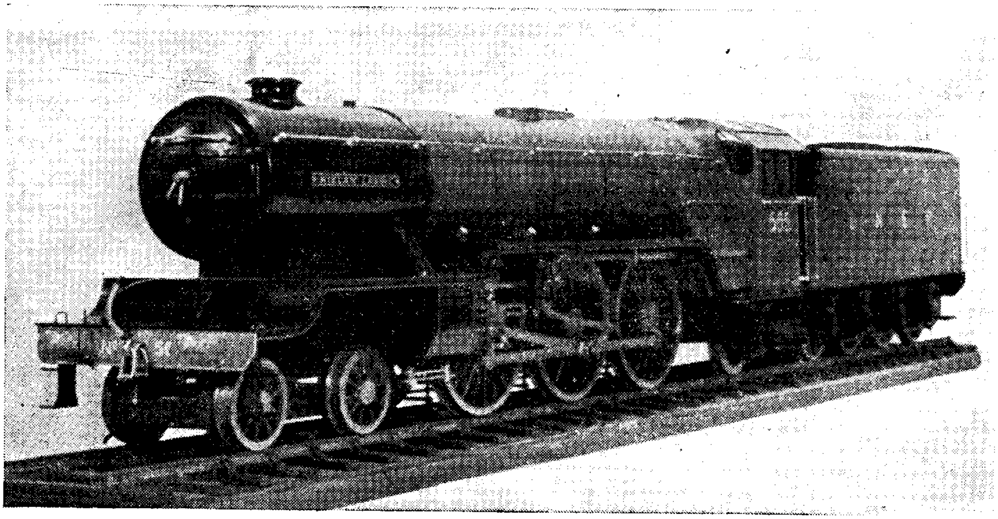


Photo by] [*G. R. Alcock*

First attempt—and she won the Cup!

There is no need to describe the engine at length, as she is built according to instructions and drawings; Mr. Webb says that in this respect he is unlike his namesake of the old L.N.W.R., who had no use for anyone's ideas but his own. Our friend preferred the single chimney to the double one, so fitted it, but it has not affected the steaming in any way, as the boiler persists in blowing off all the time, even when fired with ordinary house-coal, the wretched kind that the Coal Board sees fit to dole out to long-suffering domestic consumers.

The engine has not yet had a prolonged track test; but working on a roller test stand, she can be made just to tick over at a slow crawl or roar away like an aeroplane engine, whilst she notches up very nearly to middle before reaching the kicking-point. Our friend is looking forward to some first-class performances on the Birmingham club track at Sheldon, when it is reopened, and is anxious to see if his engine can beat the performance of another "Lassie" (the first one finished in the B.S.M.E.). This one made a non-stop run of 5¼ miles, hauling seven adults and five children, with plenty of power to spare. He hopes that the pictures of an inexperienced worker's first attempt at locomotive building, will be of some encouragement to other beginners. His own patience and perseverance have already received one reward, as his engine was exhibited at the recent Birmingham club show, and was awarded the Douglas Picknell Memorial Cup. Hearty congratulations!

Friend Webb, like myself, favours the old-timers; and as he wants to build one of these for his next effort, he proposes to go in for 5-in. gauge, as a 3½-in. engine of that type would be very weeny compared to the " Lassie," and he does not wish the actual engine to be any smaller. He has in mind either a 5-in. gauge L.N.W.R. 2-4-0 " Jumbo," or a G.W.R. 4-4-0 " City," using as many of the " Maid of Kent " castings and parts as possible, and adapting the instructions. This seems to me to be a good wheeze. Although the " Jumbos " had the Allan straight link motion, the " Joy " gear as specified for the " Maid " could be used, as Joy gear and the L.N.W.R. are inseparable, in a manner of speaking. If he decides on the " City," he can use the link motion; and in either case, the coupled wheel castings can be used, as the pear-shaped bosses would not show under the outside frame of the G.W.R. engine.

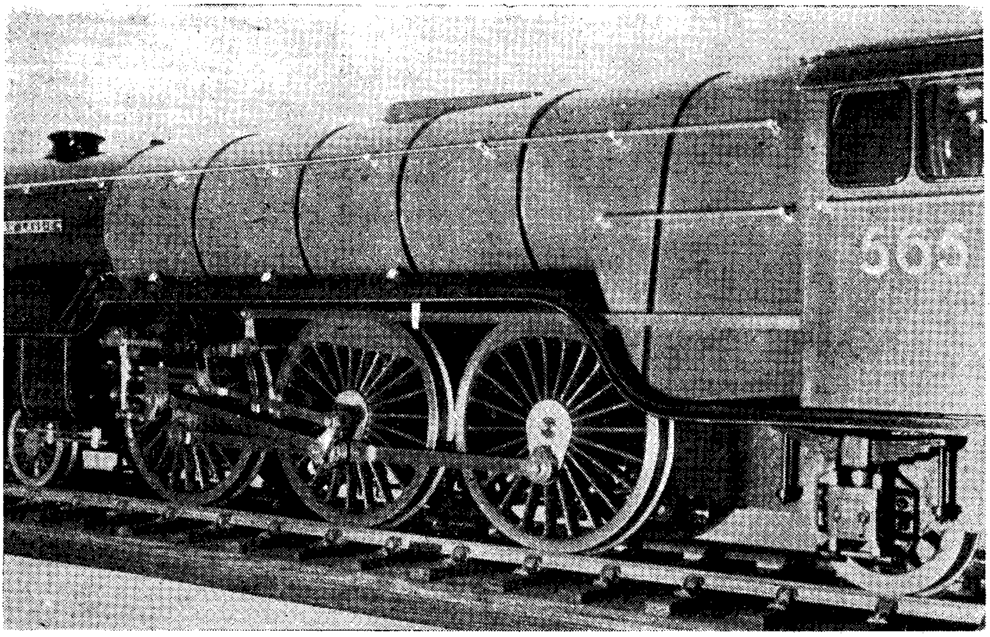


Photo by] [*G. R. Alcock*

" The little bits that are of great importance "

Never Too Late to Start!

Mention of the " Maid of Kent " reminds me of a letter recently to hand from a Sheffield reader, Mr. J. Redfearn, who started to build a " Maid " at an age when, by the good rights, he should be retired, and enjoying a well-earned rest. Our Yorkshire friend evidently believes in the saying that " a change of work is the best rest," for he has now completed the chassis, and although it is the first locomotive he has ever attempted to build, the whole of it is his own work, with the sole exception of the slides for the reversing shaft; she has the Joy valve-gear. On a short track, with air supplied from a tyre pump, it ran perfectly in either direction. He says the boiler is causing a little apprehension, but he is going to do it, if it takes a year; and is so pleased with his work up to date, that he has started building " Doris " as a parallel job. A splendid example, that, to some of our younger readers who suffer from impatience. Incidentally, the kind words he said about the instructions, made me feel that it really is worth while trying to make the job easy. I sincerely hope our worthy friend is as successful with his boiler as with the chassis, and look forward with great interest to hearing the result of the first steam trial.

Is a Brick Arch Necessary?

One thing leads to another! A correspondent who is building a " Minx " writes as follows: " I have just completed the chassis of a ' Minx ' to the 'words and music,' and it has come out very well indeed, giving a fine ' brake-horse-power ' when tested from a stationary boiler; and I am just commencing to build the locomotive boiler. We have in our club a ' one-man-brains-trust ' who knows all the answers on the strength of building one locomotive, and he did not make all of that himself. He says that the long firebox of the ' Minx ' needs a brick arch, and it will not steam without it. I am content to follow your instructions, but perhaps you would put a few words in, as to why full-size engines use brick arches, yet you do not specify them for the little ones, which I suspect is for some good reason."

Certainly, anything to oblige. I have referred to this subject before, but it was a long time ago; and as many readers who are newcomers to our craft may not have seen the previous notes, I will briefly expound here. The reason why I do not specify brick arches in small fireboxes, is simply because they are not necessary; indeed, they are just the reverse! It can readily be seen

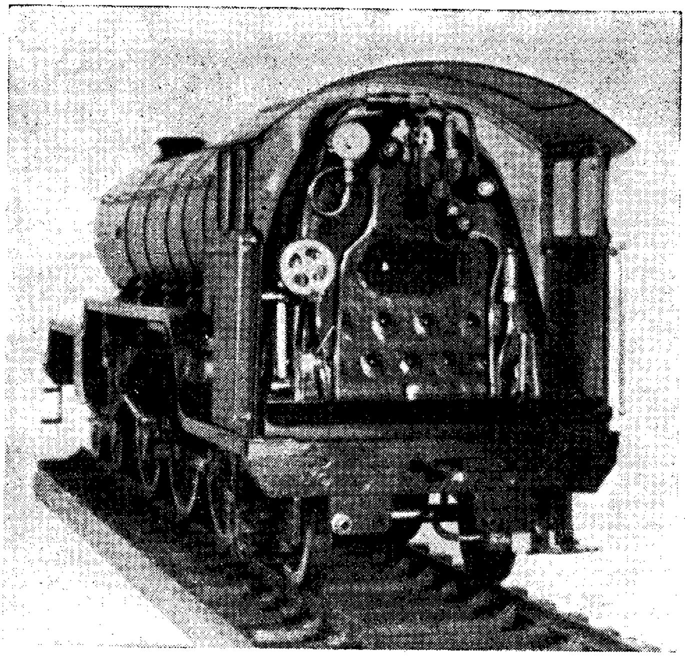


Photo by] [*G. R. Alcock*

The sort of controls that we don't want to see abolished!

chimney, and nothing would stop it; so, to get over the trouble, and comply with the provisions of the Act of Parliament, coke was used as fuel. If it was anything like the stuff we are getting for our Ideal domestic boiler, the poor firemen had my sincere sympathy; with a grate area of one square foot, I have to clear out the clinkers four times per day, and get nearly a pailful, all told! On top of that, the wretched stuff costs nearly £5 per ton and I have to beg for a licence to get it, whereas before Adolf started his antics, I could get all the best Welsh coal the boiler needed, for less than half the price—yet some folk say we are better off! However, to return to the story, engines got bigger, trains became heavier, and up went the cost of the coke, until the fuel bill became alarming, and something had to be done about it. In the late 'fifties, therefore, locomotive engineers began experimenting with a view to burning ordi-

how this comes about, by considering the function of a brick arch in a full-size engine. In the very early days of steam traction, when the only railways were those owned by the North Country collieries, the crude locomotives of Blenkinsop, Hedley, Stephenson, Hackworth and other designers, naturally burnt the coal produced on the spot; and they usually threw out dense clouds of black smoke when at work, putting up a sort of smoke barrage all over the landscape. When the Liverpool and Manchester Railway Bill was passed, it was pretty obvious that this sort of antic couldn't be tolerated on a passenger-carrying railway; and a clause was inserted in the Bill, which required the locomotives to be so constructed, that they consumed their own smoke.

So far, so good—but the wasp in the jampot was, that as long as the fireman baled ordinary black diamonds into the firebox, smoke of the same colour came out of the

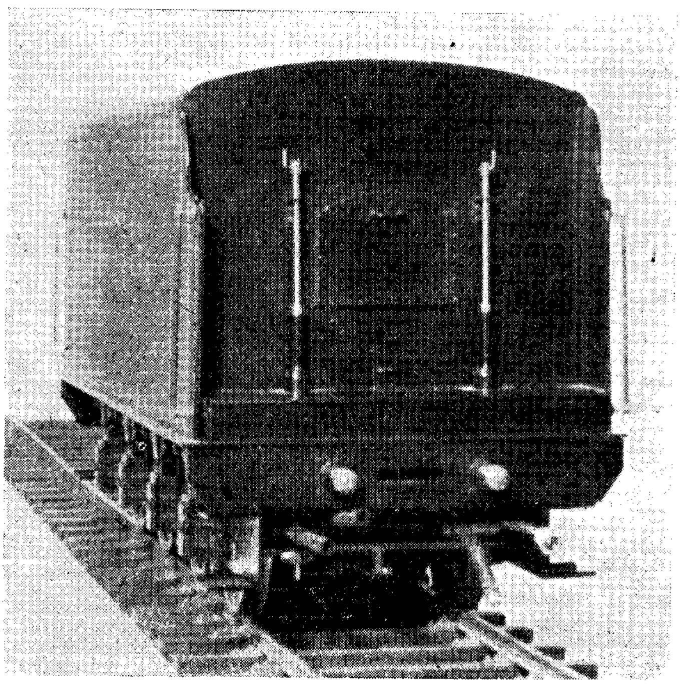


Photo by] [*G. R. Alcock*

Simple, but effective

nary raw coal without making smoke ; and many weird and wonderful boilers and fireboxes were schemed out and constructed. Some of them did the job, and some didn't, but unfortunately, the most efficient of the freak boilers were so complicated that their maintenance gave the running-shed staff a perpetual headache. Joe Beatty, for example, on the L.S.W.R. used a firebox divided into two, front half and back half, with two firehole doors one above the other, a firebrick partition stopping coal put in the upper door from falling straight down. Ahead of this was a big combustion chamber with a gadget something like the great grand-daddy of a Nicholson syphon in it ; and beyond that were a lot of very small tubes. The boiler steamed all right, was economical of coal, and didn't make a lot of smoke, but if leakage started in the combustion chamber, or in the part of the firebox nearest to it, the foreman boiler-maker at the running-shed looked like becoming a fit and proper candidate for the loonies' home.

Jim Cudworth, on the South Eastern, used a very long and steeply sloped grate, in a firebox divided longitudinally by a water partition which was also a remote ancestor of the Nicholson syphon. Each side of the firebox had its own firehole door. History doesn't say whether the driver and fireman had to keep changing sides when the engine was running ; but anyhow, the boiler didn't do so badly. Dan Clark, on the Great North of Scotland, used a series of hollow staybolts, with steam jets to blow air in above the fire, and so burn up the smoke. J. McConnell, on the L.N.W.R. used a very long combustion chamber (great-great-grand-nanny of "Hielan' Lassie") but instead of water-tube struts, he also used an ancestor of Mr. Nicholson. This boiler steamed like a witch, but the tubes were so short that the smokebox became nearly red hot.

Many other wangles were tried out, but it was Matt Kirtley and Charley Markham, on the Midland, who finally solved the problem. They didn't bother about any complications, believing (like your humble servant) that the simpler the job the better. They knew, like all the other locomotive engineers, that what was required, was to get some air in over the top of the fire, to mix with smoke coming off the coal and burn it up. Now this couldn't be done by simply opening the door of the ordinary firebox a little, because the blast would have pulled the cold air straight over the top of the fire against the tube ends, and made them leak like old boots ; so they built an arch of firebricks just below the tubes, and fitted a deflector plate over the firehole door, like an inverted scoop, to deflect the air on to the fire underneath the arch. The latter naturally became red hot, and this in combination with the incoming air, burnt up the smoke all right, whilst the arch protected the tube ends in addition, and no cold air could get to them ; so at long last, everything was Sir Garnet.

Now this is the rub : all the above experiments were carried out with a view to burning ordinary bituminous coal. Down in South Wales it was a different tale altogether ; Joe Tomlinson, on the Taff Vale Railway, found that his engines would burn Welsh coal perfectly, without making any smoke whatever, in their ordinary fireboxes *without either brick arch or deflector plate*. They didn't even need a blower when standing. His only trouble was, that the intense heat played Old Harry with the firebars ; and he got over that by sprinkling the bars with bits of broken firebricks (we used to do that on the "Brighton," to prevent clinker sticking to the bars) reducing the air space between the bars, and making holes in the firehole door, just as I still specify. Over in U.S.A. and Canada, where there weren't any smoke restrictions, they never bothered about brick arches and deflector plates until a few longitudinal circulating tubes were fitted in some of the larger fireboxes, and a brick arch built on top of them. I have not yet seen a drawing of an American boiler with the usual form of deflector plate over the firehole, nor seen one "in the flesh."

Experience Still the Best Teacher

Now let us consider the case of the little engine, in view of the above. It is, unfortunately, only too true, as my correspondent remarked in his letter, that certain good folk are prone to "lay down the law" by virtue of building, or partly building, one engine. This is a colossal mistake, and I defy anybody to "learn all the answers" by building even half-a-dozen engines. I have personally built scores, having now reached the "diamond jubilee" of my first successful effort, *and I am still learning* ; if I did not discover something fresh in each job, I should consider the time wasted. Incidentally, the building of "Jeanie Deans" proved a veritable mine of information, as I broke entirely new ground there. All followers of these notes know full well, that I always endeavour to apply my knowledge and experience of full-size practice to the "little girls," wherever it can possibly be of benefit ; and it is, therefore, unlikely that I should neglect this question of brick arches. I have tried them in small fireboxes, not, of course, built of bricks, but made up from fireproof material, such as asbestos sheeting of suitable thickness ; and can confidently assert that even in $7\frac{1}{4}$-in. gauge, no benefit can be obtained by fitting them, whilst in sizes below, they may become just a nuisance.

From the notes above, relating to full-size practice, it will be seen that the reason for a brick arch and deflector plate in a full-size firebox, is to deflect air downwards on the fire, to burn up the smoke from bituminous coal. If Welsh coal, anthracite, or coke is used exclusively, there is no actual need for either brick arch or deflector plate. I found, *by actual experiment*, that on a little engine, burning bituminous coal, sufficient air to ensure complete combustion can be admitted over the fire, simply by drilling a few holes in the firehole door, and fitting a baffle plate on it ; so that the air drawn in, does not go straight across the fire to the tubeplate. Confirmation that the combustion is complete, is provided by the fact that not a particle of smoke is emitted from the chimney when the engine is running, and the boiler has no difficulty in maintaining full pressure. I also found that the holes and baffle were beneficial with both Welsh and anthracite coal, same as Joe Tomlinson did on the old Taff Vale Railway, as these fuels give off an inflammable gas under the blast action; and air going in through the holes causes it to burn with a blue lambent flame, the intense heat of which, helps to keep the safety valves from forgetting their special mission in life.

The length of the "Minx's" firebox has nothing to do with the matter at all. The only thing about a long firebox is that the fire should be of uniform thickness all over the bars, as near as the fireman can manage it, so that the rush of air induced by the blast, doesn't find a hole or a thin spot, and all go through it. With an ultra-long firebox like "Helen Long's," an even draught all over the grate can be obtained by fitting a sloping ashpan, and having the blast nozzle the exact size needed to create the necessary vacuum in the smokebox, for maintaining an even "pull" on the fire.

"The Proof of the Pudding ..."

Followers of these notes may recall the pictures and description of the 2½-in. gauge super-detail "King Arthur" built by Mr. H. Murray Taylor, and brought for a trial on my road. Well, I didn't say anything at the time, because I knew the fault was only temporary, and could be remedied; but the first time she came here, she had an asbestos "brick" arch, equivalent in size to that on her big sister. She wouldn't steam for toffee-apples; conked out in less than one lap of my road. Friend Taylor was very downhearted at the failure of his magnificent job, but I told him it was only the "brick" arch cluttering up his firebox, and if he scrapped it, all would be well. He took my advice, and on his next visit—"oh, what a difference in the morning," as the old song says (only it happened to be the afternoon!). The little "King Arthur" was as different as chalk from cheese; went as well as she looked, steamed like a witch, and did 22 laps of my road on one tenderful of water.

A well-known professional "model maker" built a 2½-in. gauge four-cylinder "Princess Royal" for another friend, Mr. Charles Haller, the well-known importer of the delicious brand of coffee that bears his name. On the advice of another member of the "locomotive brains trust"—that tickles me no end!—the builder fitted a "brick arch" composed of a piece of sheet iron with a lot of holes drilled in it, and plastered over with asbestos, which filled up the holes and was thus held to the iron plate. When this engine was first tried on my road, she was also a most abject failure, taking about 20 minutes to get up steam, and losing the lot in a lap, stopping for a blow-up before doing another lap. She went back to the builder three times, with no better result, and he gave it up as a bad job. Out of friendship for Mr. Haller (to whom I owe a debt of gratitude) and to save what was probably the most expensive 2½-in. gauge locomotive ever built, from being relegated to the scrap-heap, I took her in hand; and the first thing I did was to yank out the "brick arch," throw it in the domestic ash bin, and alter grate and ashpan to my usual specification for an engine of this type. For curiosity's sake I then tried the engine on the road, to see what difference this made; and although the cylinders and motion wasted twice the amount of steam necessary for hauling my weight, the boiler now not only supplied it, but maintained it against the pump or injector. All the "brick arch" did, was to clutter up the firebox and choke the draught.

Sometimes, in full size, an engine will be better off without a brick arch than with it; I have already mentioned that many transatlantic engines do not have them. On the old L.B. & S.C.R. it was no uncommon thing for a brick arch to fall down, and I can give an instance from my own experience. The heroine of the play was 456 "Aldingbourne," one of the worst of Bob Billinton's 0-6-2 "clink-bang watercarts" that ever tried to break the hearts—and backs—of long-suffering enginemen. We started out one morning on a pick-up goods turn; one of the "slow boat to China" stunts where you potter around the suburbs, and stop at all the goods yards, picking up a wagon or two here, dropping one there, and doing any odd spots of shunting that may be called for by the depot foreman. The engine was in a shocking condition, nearly falling to bits, and the tubes and stays leaking badly; and the arch looked a bit rocky before we had even started. However, on these jobs, the longest non-stop run was not more than three miles, and the load seldom exceeded 20 wagons, so an engine had to be in the last stages of decrepitude if she couldn't manage a job like that. Anyway, the engine lost water so badly that one of the injectors had to be going practically all the time, and some of it must have sprayed out on to the arch whilst we were standing, for I noticed at East Dulwich that a couple of bricks had come out. I said to my mate, "I reckon the arch is going to collapse"; and sure enough, the heavy blast on the long pull up the viaduct to Knight's Hill Tunnel (1 in 90) must have loosened the bricks, for when we set back into the sidings at Tulse Hill, the whole blessed lot fell down. It didn't take long to get them out with the clinker shovel, whilst the engine was standing still. Luckily, we had some excellent Welsh coal in the bunker (I wish I could get a few tons of similar grade for our Ideal boiler!) and by careful manipulation of the firehole door, which opened inwards on the Brighton engines, forming its own deflector plate, it was possible to keep the cold air from blowing on the tubeplate, and so we got along fine.

However, the funny part about it was, that after we passed Streatham Junction South, and were plodding around the curve towards Tooting, our next port of call, I noticed that the water had gone up out of sight in the top nut, and shut off the injector. It wasn't wise to open the fire-hole door to take a look whilst the engine was puffing, on account of the cold air going in; and when we stopped, and did have a look, we both nearly fainted. The intense heat of the Welsh coal fire, playing direct on the tube ends without the intervention of the brick arch, had evidently expanded them enough to stop the leakage, for the firebox was as dry as a bone! That incident was, I submit, full vindication of Joe Tomlinson of the Taff Vale's idea that with Welsh coal, brick arches and deflector plates were unnecessary. They certainly are not needed on little engines!

Binding a "Model Engineer" Volume

by A. R. Turpin

THE correct term here is "casing," because the covers can be obtained already made up from the offices of THE MODEL ENGINEER, price 3s. 6d. The job is not a difficult one, and a beginner should not take more than two man-hours on it, using nothing but the tools he is likely to find in his own workshop, or his lady's workbox.

first copy. Place the marked card strip along the centre fold and, with a pricker, make a hole right through the section at each mark. This, by the way, is not the orthodox method, but the beginner will find it easier this way.

Now fix your tapes to the sewing stand as shown in the photograph, looping them over the top bar and fixing with a pin, taking the other

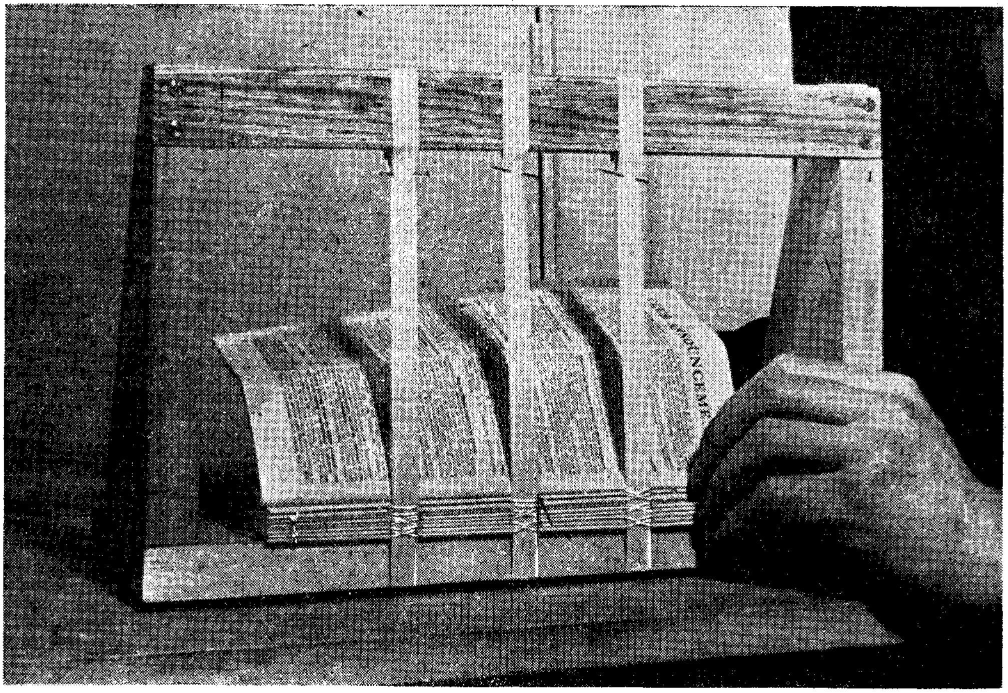


Photo No. 1. The sewing stand

These consist of two pieces of planed wood 12 in. × 6 in. × ⅞ in. thick, one long edge of each board planed dead square, and the other bevelled to an angle of 45 deg. A couple of carpenter's 4-in. cramps, some two-ply twine, a yard or two of ½-in. tape, and some Scotch glue with a third more water added than you would use for carpentry. A sewing frame as shown in Photograph No. 1 will mean a quicker and neater job, and only takes about 30 minutes to knock up, but this is optional.

First, remove the wire stitches, and then all surplus advertising matter from each copy; but I think the pictorial covers are worth binding in. Next, mark out a piece of card to the dimensions shown in *A*, Fig. 1, and having put the sections in numerical order, open out the

end under the base, and after straightening, fasten them with drawing pins so that there is a distance of 2⅛ in. between centres. If you haven't made up the stand, just cut 6 in. lengths of tape and put them aside for the time being.

Now take the first, or last copy—it doesn't matter which, so long as you lay it on the base-board the right way up—and place the fold against the tapes. Now thread a suitable darning needle with a length of thread and start sewing, as shown in *B*, Fig. 1. Starting from the left-hand pricked hole, push your needle through from the outside, then along the inside of the section and out of the next hole, round the tape and in again, and so on until you come to the right-hand hole. Draw the thread taut by pulling in the direction of the stitch—if you pull the thread towards you, you will cut the paper—then mark the next section with the pricker and lay it on top of the first. Push your needle through the right-hand hole of this section and repeat the procedure as before, but moving from right to left, draw the thread taut. Now you should have left about three inches of thread hanging out loose at the starting mark, and to this end tie the main thread. Add another section, and sew as before from left to right, but this time when you go round the tapes, loop in the other two stitches as shown in *E*, Fig. 1, and when you reach the end, pass the needle behind the stitch connecting the two sections below, and form a loop as shown in *D*, Fig. 1; this is a "kettle" stitch. Now go on adding sections, sewing in the same way, and making "kettle"

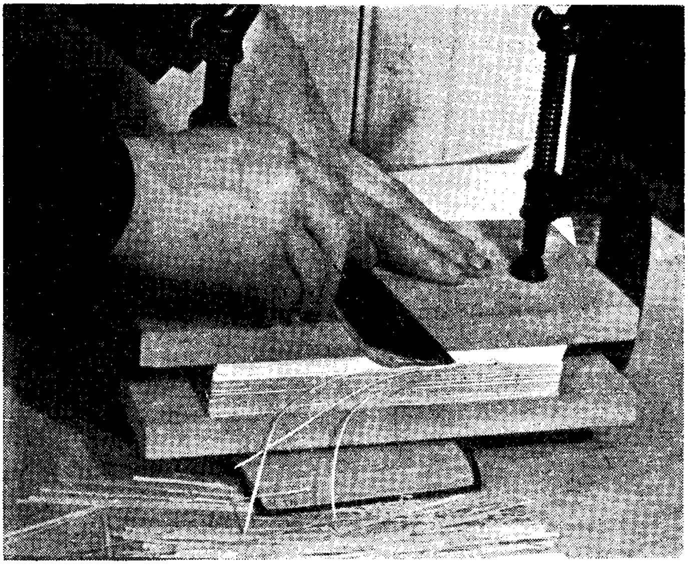


Photo No. 3. Trimming the edges

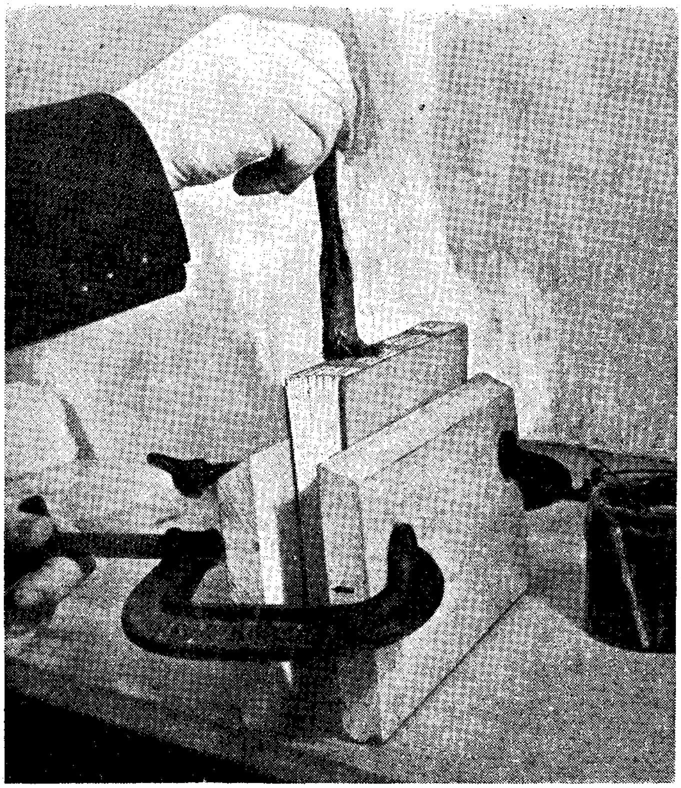


Photo No. 2. Gluing the back

stitches at each end and looping in the tape stitches every third section until all are sewn on.

Finish off by making a number of "kettle" stitches.

From time to time you will require more thread, join the new length with any reliable knot on the *inside* of the section.

If you did not make up the sewing stand, start by sewing the first section without tapes and then thread the tapes through the tape stitches, after which proceed as with the stand.

By the way, don't forget to sew in the index where you want it, either at the front or back, treating it in the same way as a section.

Now cut your tapes, leaving about two inches loose on either side of the back. It will be seen that the back is somewhat swollen because of threads passing through it, and this swelling must be reduced as much as possible. So lay book on the bench and hammer along the back edge (for terminology, see *C*, Fig. 1), with a flat-faced hammer or mallet, place the left hand flat on the book and pull hard on each tape

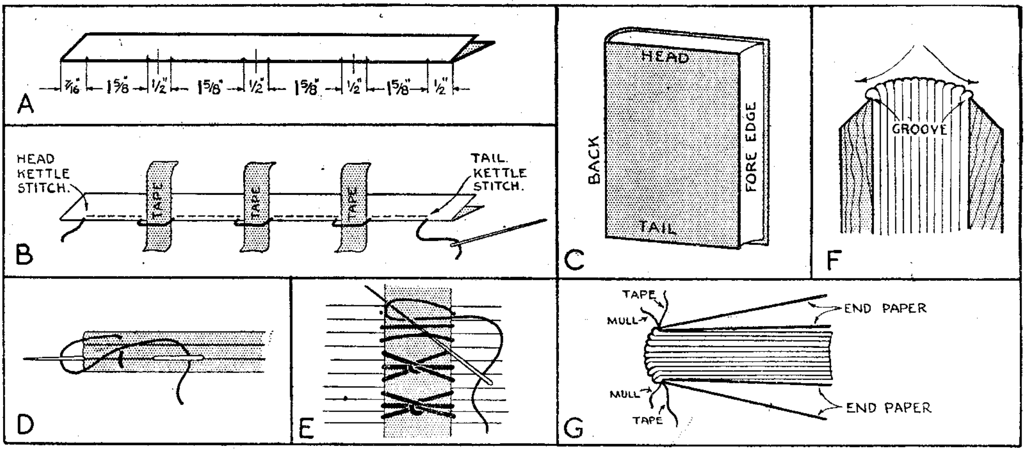


Fig. 1 illustrates various steps to be taken when binding a volume

in turn to take up any slack, turn the book over and repeat.

Next, put a piece of strawboard on either side of the book and nip between the boards with tapes inside, as shown in Photograph No. 2. The back should project an inch or so above the boards, and be thinly but well glued, getting the glue well down into the tapes and stitches.

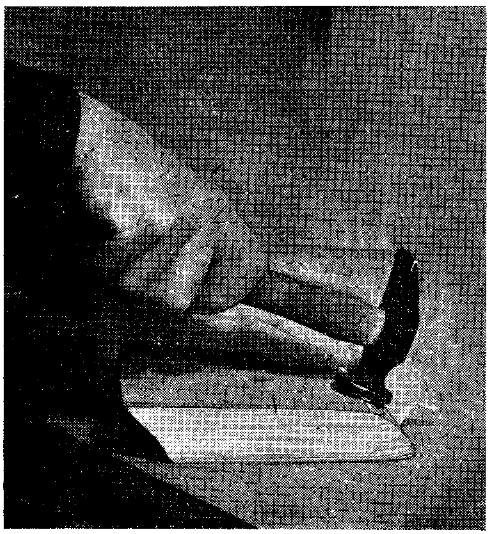


Photo No. 4. Rounding the back

Trimming

Allow the glue to set, but not harden, and we are ready to trim. Clamp the book up between the boards with the bottom board projecting beyond the fore edge, and the top board level with the margin that is to be trimmed off. See that the back is straight and square and start trimming. I use a "skiving" knife for this, but any knife with a broad, stiff, and sharp blade will do; a broad chisel or even a plane iron. Use the edge of the board as a guide to keep the knife upright and don't press too hard (see **Photograph No. 3**). If the result is a bit rough, and it most likely will be the first time, finish off with sandpaper. Repeat with the head and tail edges.

Rounding the Back

The next job is to round the back. Lay the book flat on the bench with a piece of strawboard on top, and with the left-hand thumb press the centre sections of the fore edge towards the back, and with the fingers pull the outside sections of the back towards the fore edge, at

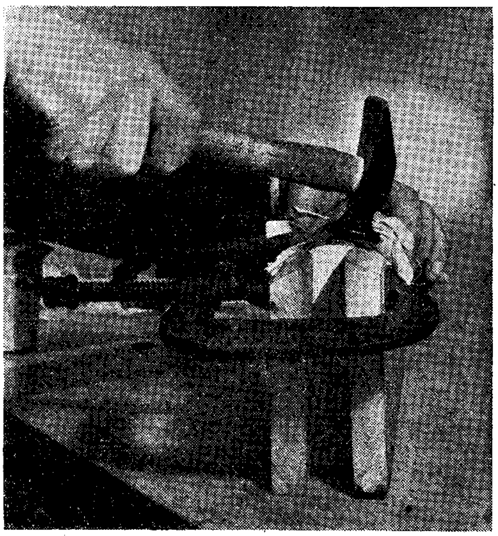


Photo No. 5. Making the grooves

the same time hammer along the edge of the back towards the fore edge, moving the left hand as necessary. See Photograph No. 4.

Turn the book over and repeat. Stand the book on its tail, and, using both hands round the back, mould it into a smooth curve. Now comes the difficult part and you will feel you want four hands. Without losing the curve on the back, place the book between the boards so that the back projects about ⅛ in. above the bevelled edges of the boards. Clamp up tightly with the clamps as close to the back as possible, and then with the hammer, strike the back glancing blows from the centre sections outwards all along it; first to one side, and then to the other. See *F*, Fig. 1, and Photograph No. 5. This procedure will bend the backs of the sections over and form a groove in which the cover boards will eventually lie.

Remove the book from the press. Cut a piece of mull or similar material 1 in. shorter than the back and 2 in. wider, glue the back, and rub down the mull on to it with a "folder," or the handle of a spoon, see Photograph No. 6. Cut a piece of cartridge paper the same size as the back, glue it and rub this down on top of the mull. These are the first and second linings.

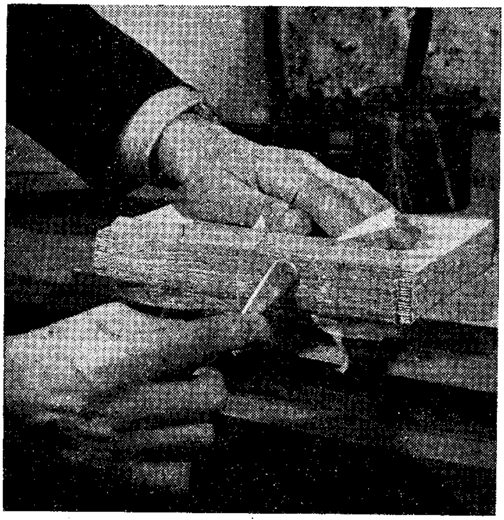


Photo No. 6. Gluing the linings

Next come the end papers. Cut two sheets of cartridge paper so that when folded in half they are slightly larger than the book, glue an eighth-inch strip along the folded edge of these papers and rub the glued edge down into the groove formed in the back—see *G*, Fig. 1—one on the front of the book, and one on the back. Clamp between boards with the back just clear of them, and leave for 24 hours.

Finishing the Cover

Remove book from press, and trim the end papers to size of the pages. Put a piece of waste paper between the end papers, and glue the front one. Rub down the loose end of the tapes on to the glued paper, and then the surplus mull; dab on some more glue, remove waste paper. Fold the cover inside out, and lower the front board on to the glued end paper, butting the edge of the board up against the back groove, and rub well down; make certain the cover is the right way up. Carefully turn the book over, and repeat with the back end paper. Open the covers to see everything is as it should be inside, then clamp between boards with the back clear, and leave for 48 hours. Photograph No. 7 shows a completed volume standing on one ready for casing.

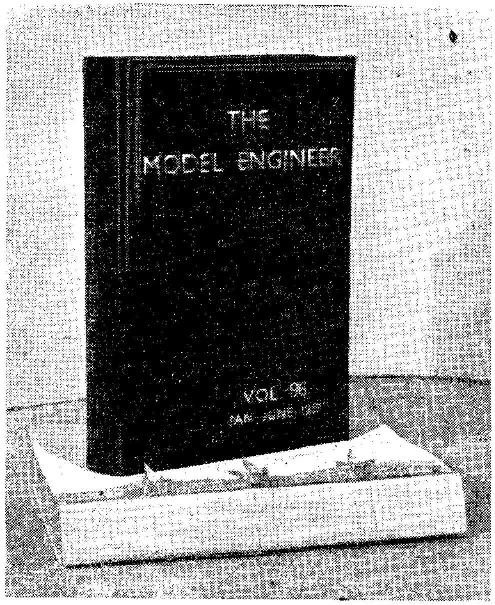


Photo No. 7. The finished volume and one ready for casing

Alternatives

By the way, a simple alternative to trimming the volume yourself, which is not too easy to do nicely, is to take the uncased volume to the local printer, who is almost certain to have a power guillotine, and on such a machine the book can be trimmed in a few minutes and much neater than you can hope to do it yourself.

It is also an easy matter to colour, marble, or splatter the edges. To marble, mix the special colours in a bowl, clamp the edge between and level with the edge of the boards, just touch the surface of the water with it, and repeat with the head and tail. To splatter, dip an old tooth-brush in water colour and draw a knife across the bristles away from the work.

It is as well to practise these processes on an old book you do not want.

If the work is carefully carried out, this method of binding will give you a better and stronger job than 90 per cent. of the books sold today.

*In Search of Speed

Further Developments of " Faro "

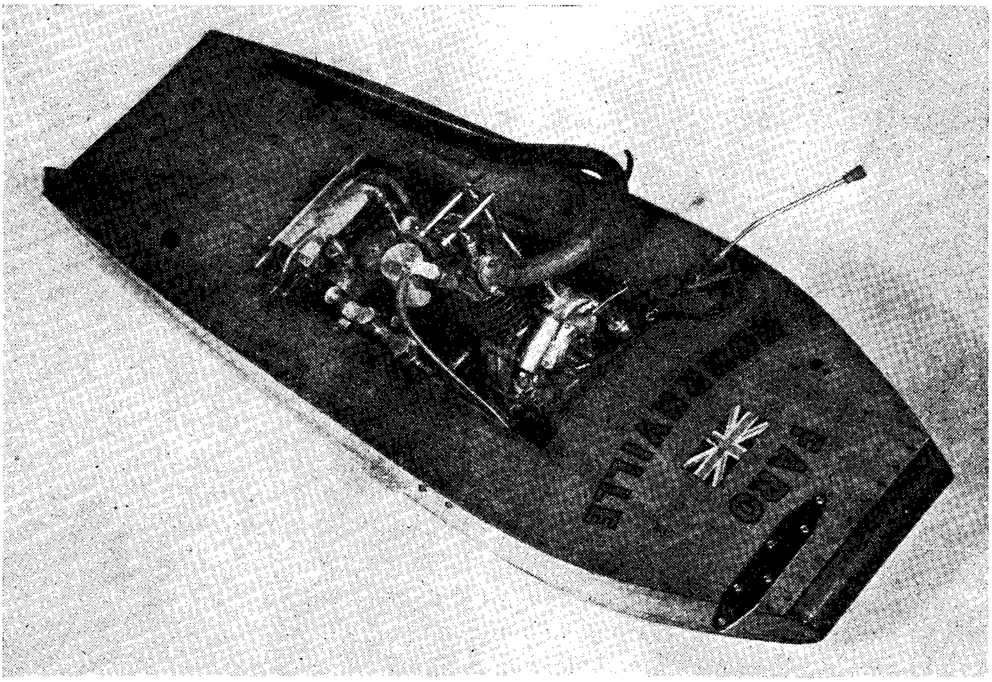
by Kenneth G. Williams

THE camshaft tunnel, being open to the crankcase, receives a copious supply of lubricating oil thrown by the inside flywheels, and the crankcase air pressure release-valve formerly connected directly to the tunnel allowed large quantities of oil to be blown out through the vent pipe to waste. This was prevented in the revised design by drilling the vent from the timing-wheel case, thus forming an oil baffle and having the advantage of circulating a good flow of oil mist to the timing gears which had formerly run rather dry.

The valve springs were renewed, as the old ones appeared to have lost some of their original strength, and new cast-iron valve guides were also fitted, the exhaust guide now having full length contact with the valve stem.

The drawings are mostly self-explanatory; parts 1, 2 and 3 are magnesium alloy castings, and the camshaft tunnel end-cap, 4, is turned from aluminium bar. The cylinder, 5, is cast-iron, the fins being machined from the solid; after rough machining, the bore was ground to size and lapped to a high finish with a spring brass lap and metal polish. The cylinder-head, 6, was also an iron casting.

Mild-steel was used for the various studs and bolts, and the same material was used for the main shafts and flywheels, 12 and 13, and spacing washer, 14, the thickness of the latter being suited to adjust endplay of the main crankshaft assembly. The timing gears, 15, 16 and 17, were cut from nickel chrome steel and left normal. The crankpin and nut, 18 and 19, were made of a carbon chrome steel (R. T. Chrome, British and Saar) and the lock washer 20, mild-steel sheet.



General view, showing engine mounting, ignition switch and accessories

The ball-bearings used were all of Hoffman make, the sizes being mainshaft, drive side ½ in. S5 caged, timing side ⅜ in. S3 caged, big-end of 'con-rod ⅜ in. S3B. deep groove full of balls. Both ends of the camshaft run in ¼ in. S1 caged.

The only plain rotating bearings in the engine, 21 and 23, on the intermediate timing shaft which carries the ignition contact-breaker cam were made of chill cast phosphor bronze. The

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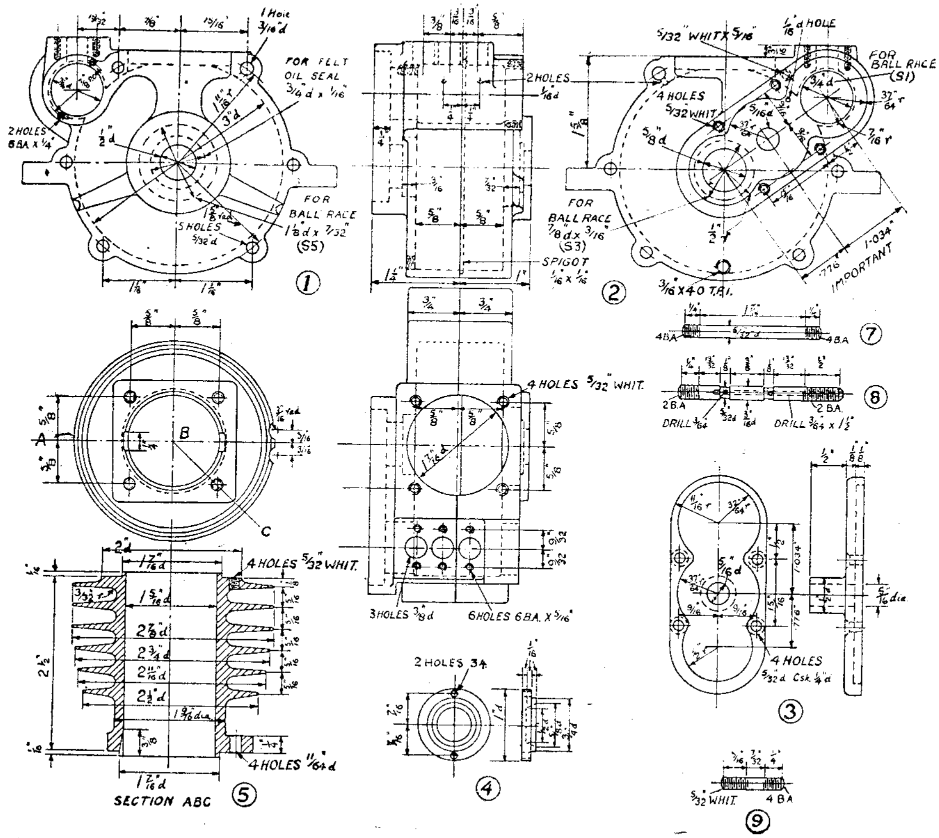
*Continued from page 566, " M.E.," May 12, 1949.



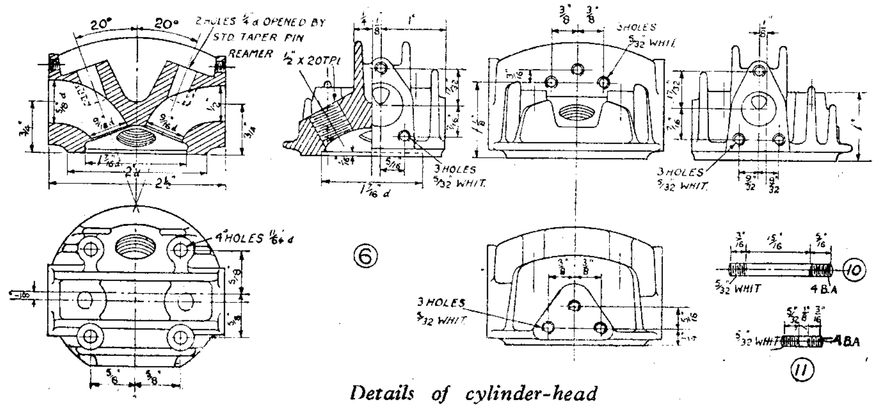
Details of crankcase and cylinder

shaft itself, 22, and the cam were of silver-steel.

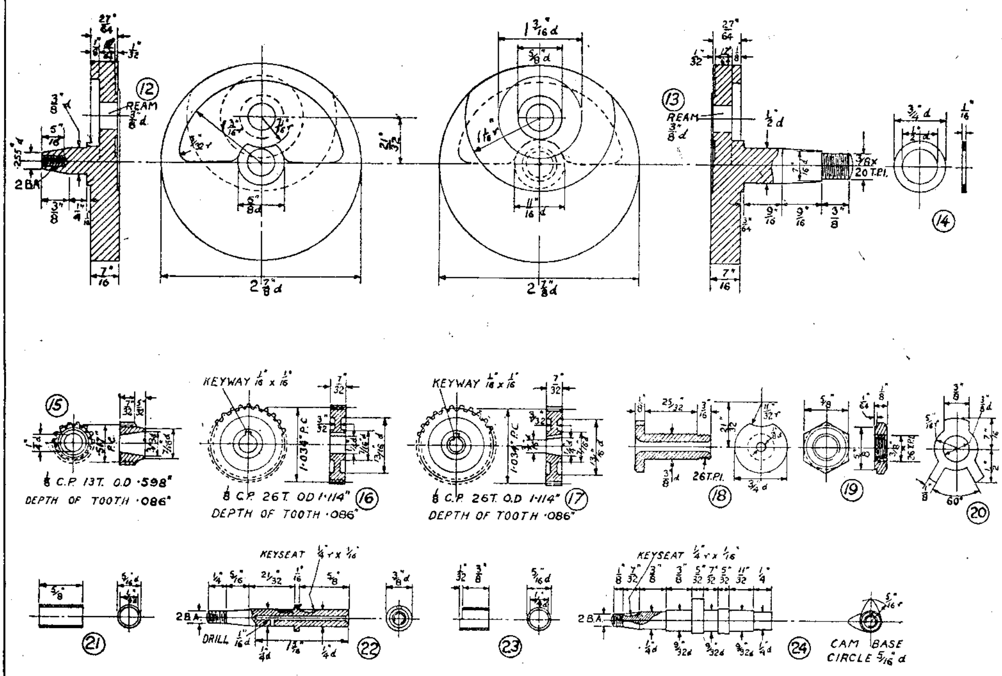
The camshaft, 24, was produced by turning, the cams first being made as full circles, and finished to size by hacksawing, filing and circular shaping the base circles in the lathe by hand.

Forming the cams is a very tedious job, involving assembling the engine with a timing disc marked in crankshaft degrees secured to the mainshaft, then marking the positions of both cams on the full circles through the tappet guides and removing the unwanted metal, the final contours being determined by cut and try methods, checking the valve lift against the timing disc each time.

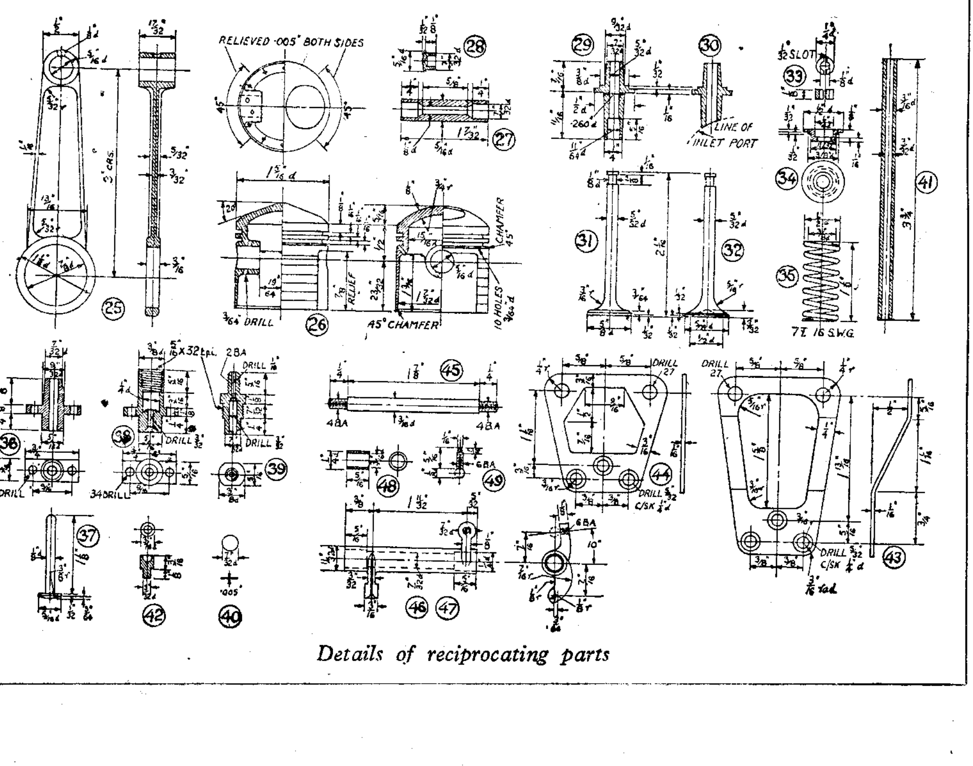
A very simple method of hardening the camshaft was evolved; first the whole shaft was hardened right out by heating to a uniform cherry red and quenching in cold water, then,



Details of cylinder-head

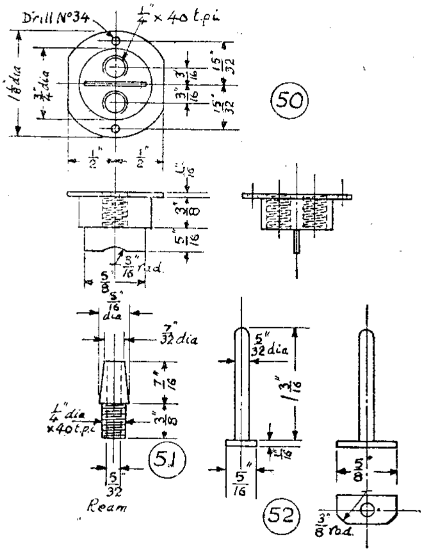


Details of rotating parts



Details of reciprocating parts

after polishing all over with fine emery cloth, tempering was carried out by heating the shaft from the ends until a dark straw to purple colour appeared in the shaft portion ; when the temper colour of a light straw appeared at the cam tips, the shaft was again quenched in cold water.



Details of new tappet gear

This produced an extremely hard cam face to resist wear, while the shaft is left tough to resist torsion. R. T. Chrome is a non-shrink tool steel and ball-race fits on the journals remain unaltered after hardening and tempering.

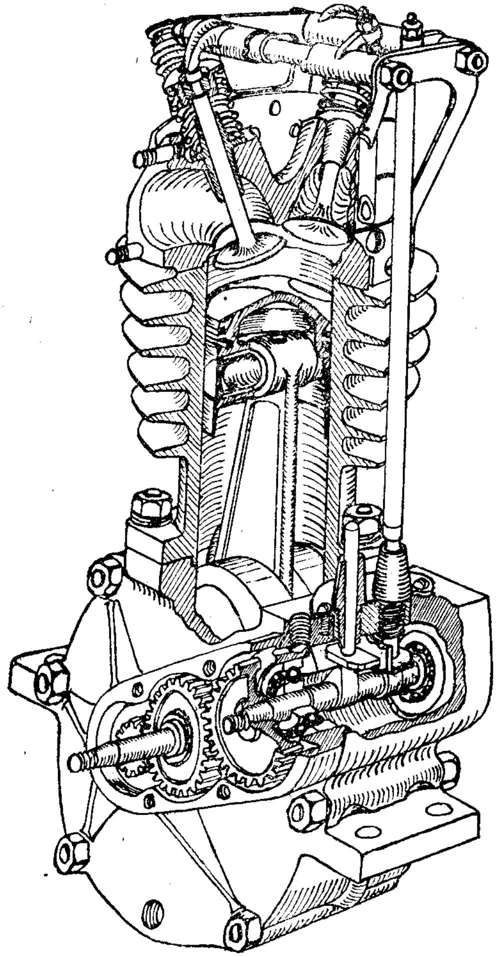
The connecting-rod, 25, is in duralumin "B" and the present one for a 3/8-in. diameter gudgeon-pin is bronze bushed at the small-end, which is increased to 9/16 in. diameter outside.

A magnesium alloy casting (Electron) is used for the piston, 26, also made to fit the 3/8-in. gudgeon-pin, 27, which is in R. T. Chrome steel left normal and having dural end pads, 28, pressed in. Piston rings 1/16 in wide made by Wellworthy are used. Valve guides, 29 and 30, are in close grained cast-iron, while the valves themselves, 31 and 32, are in K-E 965 steel, being motor-cycle valves turned down, this steel is distinguished by being non-magnetic and has a tensile strength of about 17 tons per sq. in. at red heat.

Silver-steel is employed for the split collets, 33, and spring collars, 34. Valve springs, 35, were purchased and are motor-cycle clutch springs (Burman pattern 280 × Mk. 1). Tappet guides, 36, were in chill cast phosphor bronze and the tappets themselves, 37, silver-steel, hardened and tempered dark straw. The modified tappet gear is shown as parts 50, 51 and 52, the guides being in phosphor bronze and the block mild-steel. The new crankcases were, of course, machined to suit.

A word of explanation is needed to make the crankcase pressure release-valve quite clear. The valve disc itself, 40, is in 0.005 in. thick shim steel and rests on the top face of the 3/32 in. diameter hole in the bronze body, 38, the seat is formed by a hollow ground drill. The lift of the disc is limited to 1/32 in. by part 39, also bronze, and three slots in the lower end allow the escape of oil vapour and crankcase fumes.

The valve rocker gear comprises mild-steel endplates, 43 and 44, silver-steel spindles, 45, and rockers, 46 and 47, made of a common hardening carbon steel cut from solid, hardened on the radiused heels and fitted with bronze bushes, 48, and ball-ended adjusting screws of



Cut-away view

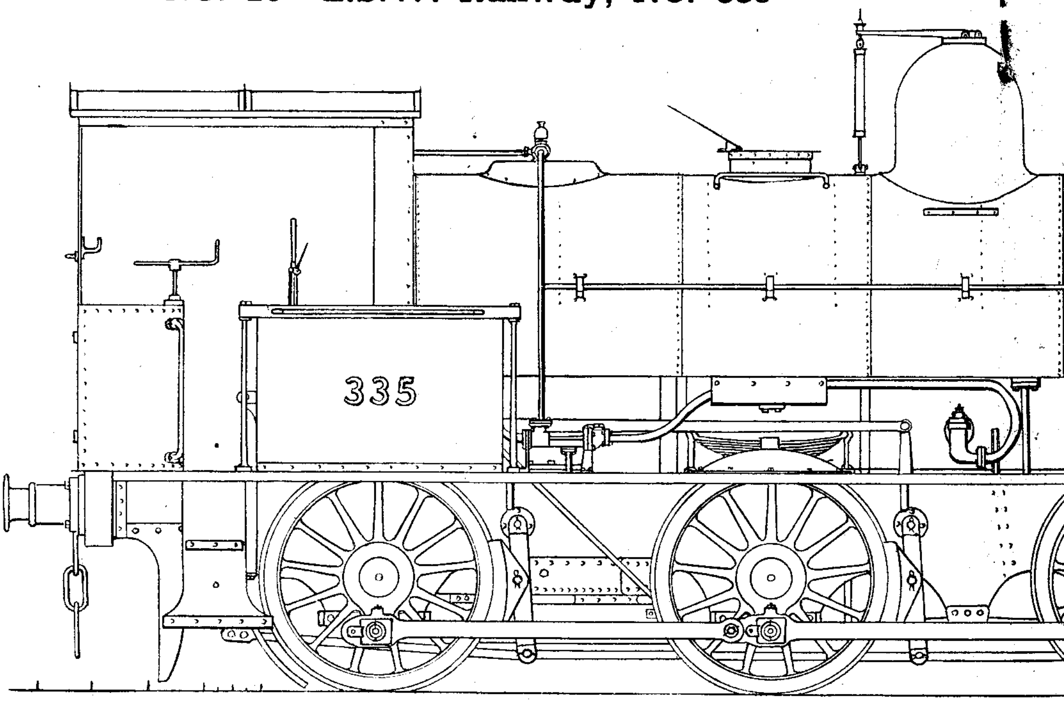
mild-steel, 49, case-hardened. Push-rods, 41, are of duralumin tube having inserted hardened ends, 42, of silver-steel.

When assembling the engine, paper washers are used to make oil-tight joints to the timing gear cover, cylinder base flange and tappet block, while the cylinder-to-head joint has ground in metal-to-metal surfaces.

(*To be continued*)

LOCOMOTIVES WORTH MOD

No. 29—L.S.W. Railway, No. 335

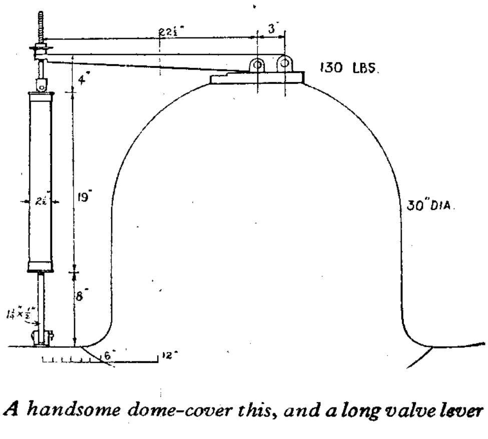


Side and half end elevations of No. 335. In the end views she carries her original c

WHEN this sturdy little saddletank engine emerged in the year 1876 from the celebrated Manchester works of Messrs. Beyer Peacock & Co., did those who had built her ever imagine that over 70 years hence she would still be going strong? Indeed, No. 335 survived until March, 1948—having given a total of 72 years of faithful service.

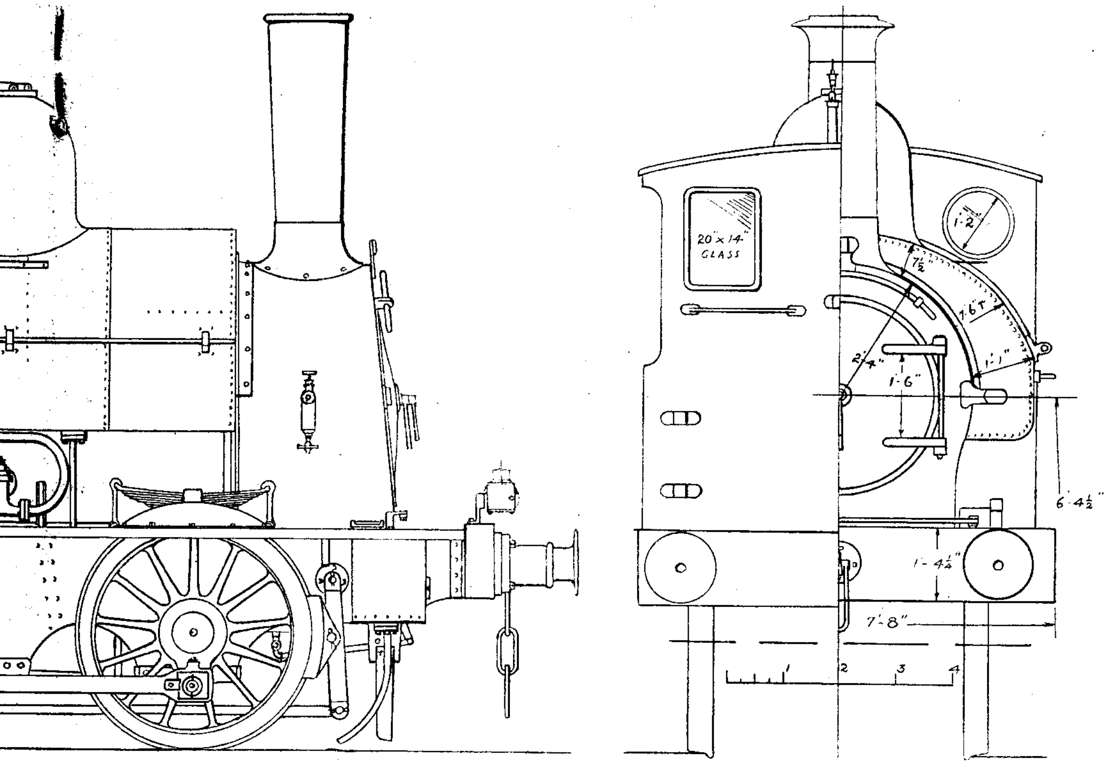
What, one wonders, was the secret of such longevity? Stout construction? Undoubtedly, she had been well built—but so were most locomotives, come to that. Had she been always well looked after? Ah! yes, that must have had much to do with it—no machine, however good, will run without adequate attention. Was it that the policy of her railway company happened to favour the retention in service of that particular class of six sisters? Well, policy does have a great deal to do, also, with length of service.

Curiously, No. 335 hardly ever altered in outward appearance during her long career, and what was changed was changed early on. She exchanged her handsome polished-top Beyer chimney for the Adam's stovepipe type (which, it must be granted, became her well), wooden brake-blocks gave place to iron ones, and the cabside windows vanished (leaving only the funny little vertical side sheets, giving but little protection, albeit a clear view for shunting operations). But that was all, really, and for years and years these little engines, Nos. 330-335 were the familiar friends of generations of lovers of South Western locomotives. How familiar



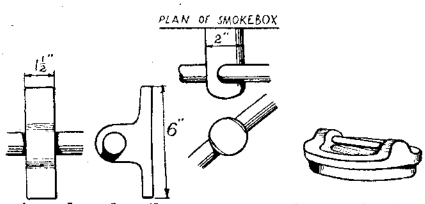
A handsome dome-cover this, and a long valve lever

MODELLING by F. C. Hambleton



r original chimney. Note the difference in shape of leading and rear cab windows

they became! Old Nine Elms Yard would have appeared strangely empty without a "saddle" or two tugging away at a long string of wagons, moving slowly along those numerous curved roads. And what loads they could shift! They

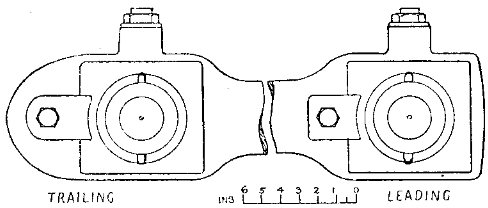


Curious hand-rail supports, and a typical Beyer-Peacock sandbox lid

did well with their 17 in. by 24 in. cylinders, 4 ft. 3 in. wheels and 130 lb. pressure. The wheelbase was 6 ft. 10 in., plus 6 ft. 11 in., from front buffer-head to leading axle was 6 ft. 9½ in., and rear axle to rear buffer-head 6 ft. 7 in. The boiler centre was pitched 6 ft. 4½ in. above rail level. The stovepipe chimney had a total height of 4 ft. 6 in., and an inside diameter at the top of 16 in. The throw of the coupling-rods was 11 in.

Width over bunker 6 ft. 10½ in. and over the buffer-beams 7 ft. 8 in.

No. 335 was painted dark olive green, and displayed many touches of polished work: whistle, brass window frames, numerals, injector



An old-world pattern of coupling-rod ends

pipework, steel reversing-rod, and shining Salter spring-balance valves. In later life she was sold to the Kent & East Sussex Railway, replacing the 8-coupled tank engine *Hecate* on that line, and survived until March of last year!

So, at long last, passed No. 4 of the K. & E.S. Rly., a locomotive link with the days of W. G. Beattie, of William Adams, and the fine old London & South Western Railway.

LIMITS—and Limitations!

by Edgar T. Westbury

SEVERAL correspondents, in the Practical Letters columns of THE MODEL ENGINEER, have recently raised the subject of exact limits, and their importance in the design of models; and as my name has been mentioned in connection with this matter, it is, perhaps, desirable that I should express my views thereon.

Everyone, I think, agrees on the necessity for a high degree of accuracy in the production of efficient working models of all types, and although this is more important in some kinds of mechanism than in others, it is quite certain that it cannot be neglected in any branch of model engineering. It is also generally agreed that it would be desirable to adopt definite standards of accuracy, and to state, wherever possible, just what limits, or "tolerances" in the degree of accuracy are permissible in specific cases. In production work, where mating components are often produced by different operators, or even in different factories, such measures are more than desirable—they become absolutely imperative; and working drawings of accurate machined or fitted components now almost invariably carry, in addition to full dimensions, the plus and minus limits allowable in each case.

Many readers have concluded that a statement of limits, in similar terms, is equally desirable or even necessary in model practice. I do not for one instant question their views on the score of desirability, but I would like to raise the question as to whether the universal adoption of these excellent principles is practicable, under the conditions of working which generally apply in model engineering.

In the first place, the mere marking of a drawing to show limits signifies nothing in itself; it cannot directly produce accuracy, and those who infer that such measures would immediately improve the quality of model work are just as fallacious in their ideas as the man who puts the hands of the clock to five-thirty and complacently says, "there we are, now—time for tea!"

Although I am just as desirous as anyone to assist readers to improve accuracy, and have often made either stipulations or suggestions as to the limits of accuracy which should be observed in special cases, I have generally avoided specifying limits on drawings, for very definite, and as I believe, sound reasons. I will illustrate the most important of these with a little parable: Suppose one designed a more or less elaborate article of woodwork, say, a bureau or a sideboard, and put the work of constructing it in the hands of a competent craftsman in this class of work. In order to show exactly what had to be done, it would be necessary to prepare more or less complete drawings; but it would not be at all necessary to inform the craftsman of the exact limits to be observed in the dimensions of important mating parts such as mortices, tenons, tongues and grooves. Indeed, if limits were put on the drawings, the craftsman would immediately say: "These thousandths of an inch mean nothing to me—my only measuring instrument is a foot rule." Yet he would be quite capable of fitting the parts with a very high *comparative* (as distinct from *dimensional*) precision, and this is much the more important aspect of accuracy as it concerns the individual craftsman. And the moral of this story is that no craftsman can work to a higher dimensional standard of accuracy than that of the measuring instruments which he possesses, though he can obtain higher comparative accuracy by the exercise of manual skill, aided by the senses of touch and vision.

In many small i.c. engines, the fit of the piston in the cylinder, if actually measured, is often within limits of 1/10,000 in., and in many cases an error of not more than twice this amount would be quite sufficient to make all the difference between success and failure of the engine. (I.C. engine constructors, please confirm!) But the limits very rarely are measured, or are even measurable with available equipment, the necessary precision being obtained by "fit and feel," and the only limit being "as close as you know how to make it!" Although most model engineers who undertake precision work nowadays own a micrometer, and know how to use it, this suffices only for the outside measurement of work, and accurate internal measurement of small bores, to the limits referred to, involves problems which can only be solved by the use of equipment not usually available to the amateur craftsman.

In measuring to very fine limits, the problem is further involved by considerations of surface finish; it is not sufficient to observe a superficial accuracy if the surface is not regular—i.e., grooved, scored or tool-marked. Therefore, to be consistent in such matters, it is apparently necessary to mark drawings also in terms of finish as well as limits of dimensional accuracy.

Even more important still, to the maker of small machines, are the limits of geometrical accuracy, that is, angle, parallelism, alignment, roundness, etc.—which, strangely enough, are rarely marked on drawings so far as I am aware. Yet I find that many workers who can attain good proficiency in working to a scale reading on a micrometer or vernier, commit some awful blunders in geometrical accuracy.

It follows, therefore, that if we insist on all these limits being shown on the drawings of models, they will be pretty well cluttered up by the time we have finished—not only that, but many intending constructors will be scared of tackling the job by the formidable complication of instructions; and to those who do see it through, their observance may wellnigh approach

(*Continued on page* 617)

IN THE WORKSHOP

by "Duplex"

37—Gear-cutting in the Lathe

ALTHOUGH the involute form of gear tooth has not, perhaps, in every instance the geometric accuracy of the cycloidal gear, it is nevertheless, now used almost entirely in high quality engineering products such as motor-car gears and the geared mechanisms applied to machine tools ; moreover, gears of this type are more easily produced to a high standard of accuracy, and the latitude permissible with regard to accuracy of machining is less exacting for satisfactory working.

In view of these observations, it is proposed to deal only with the cutting of involute gears, and later with the making of cutters of this form ; however, many of the principles involved can also be applied to other tooth forms should the need arise.

In the subject matter that follows, practical description will, as far as possible, displace mathematical references ; but some of the latter are unavoidable, and, for those so minded, manuals such as Messrs. Brown & Sharpe's *Practical Treatise on Gearing* will prove interesting reading.

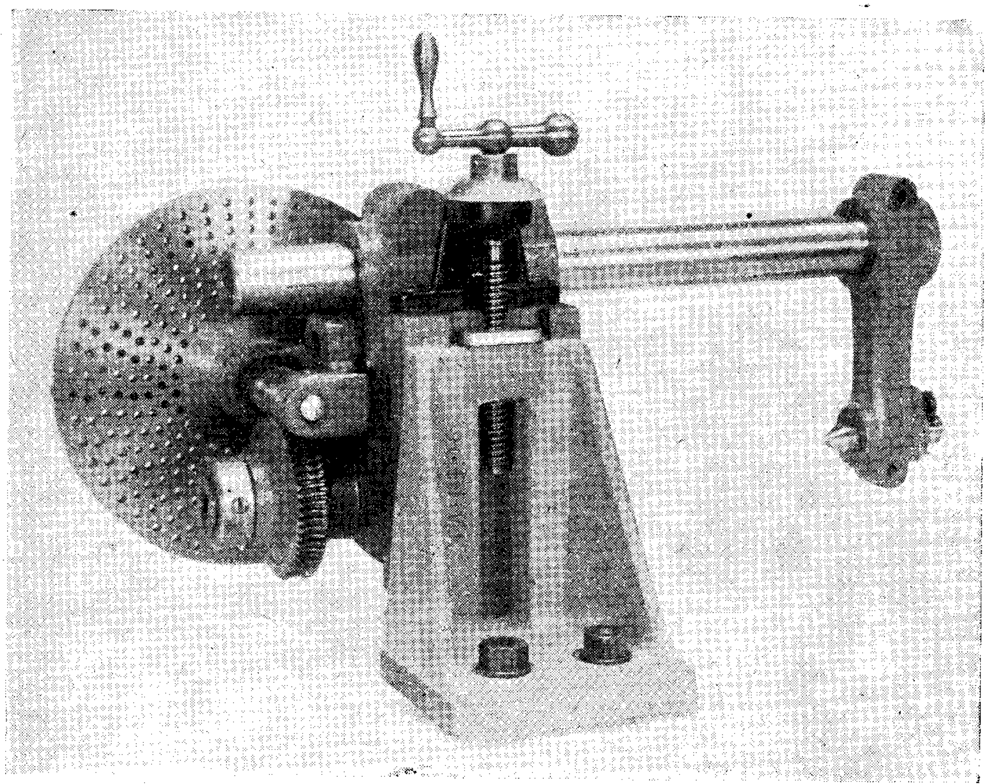


Fig. 1. The Myford attachment, showing details of dividing gear

At the outset, it may be pointed out that, given suitable equipment, there is no great difficulty in cutting straight-tooth gear wheels such as those, for example, that form part of workshop appliances, internal combustion engines, and some types of steam engines. There are, no doubt, many who are deterred from doing this work by the high initial cost of the actual cutters, for if a variety of work is undertaken it is quite possible that a number of these expensive tools will be required.

To overcome this difficulty, a method will be later described in detail for making these cutters which should enable highly satisfactory results to be obtained.

Gear-cutting Appliances

There are two main methods used for gear-cutting in the lathe : either the gear blank is attached to the arbor of a gear indexing device secured to the lathe saddle, and the cutter, mounted on a mandrel between the lathe centres, is driven from the lathe headstock ; or this procedure is reversed so that the work is mounted on the lathe mandrel, which is controlled by an indexing device, and the cutter is driven by an attachment fixed to the saddle.

The first method has the outstanding advantages that the full power of the lathe drive can be applied to the cutter, all the lathe mandrel speeds, including the back gear, are available, and in addition the cutter mounting is very rigid.

In the second method a subsidiary drive is required for the gear-cutting attachment, but, here, the automatic saddle traverse can be employed for the actual machining operation.

An advantage gained when using this method is that, in some instances, the gear-cutting operation can be carried out without having to remove the work from the chuck after the gear blank has been turned and bored to size.

Driving the Cutter from the Lathe Mandrel

This method of driving the gear cutter has gained in popularity since the general adoption of a self-contained drive for the lathe, thus replacing the older and usually less efficient form of drive from an overhead countershaft, which entails fitting a device to maintain a constant belt tension when the cutter undergoes a considerable change of position during the machining operation.

With the application of ample power to the rigidly supported cutter, the machining can be more quickly carried out and with less fear of inaccuracy arising, provided that the work, too, is properly mounted.

The gear blank, in this case, is mounted on an arbor carried in the gear-cutting attachment, which is secured to a vertical milling slide bolted to the cross slide of the lathe.

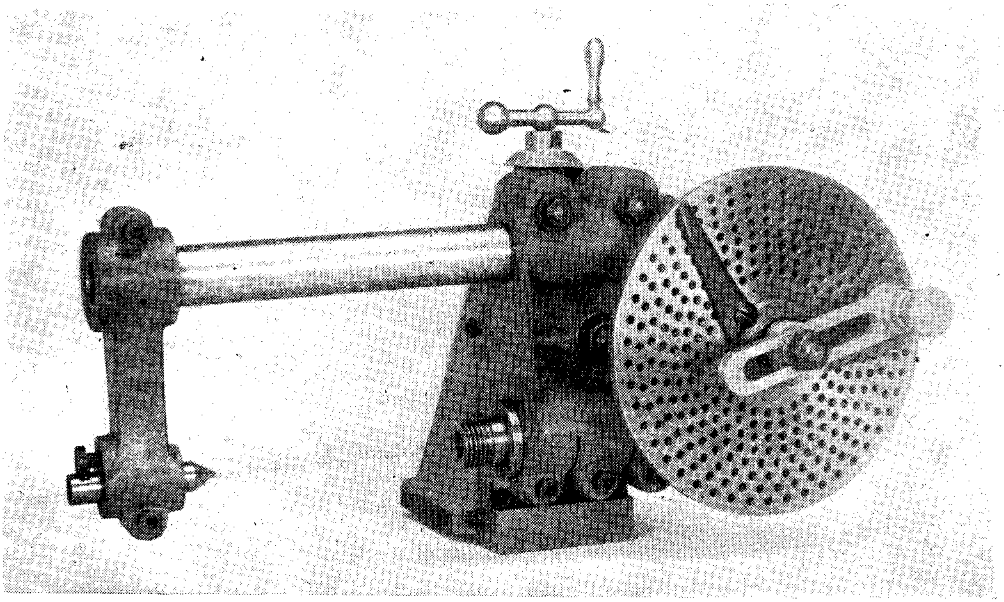


Fig. 2. Opposite side of the Myford gear-cutting attachment

Three views of the Myford gear-cutting attachment are shown in Figs. 1, 2 and 3, and it will be seen that additional support is provided for the arbor carrying the work by means of an adjustable over-arm fitted with a supporting centre.

The spindle nose is, here, made a facsimile of the lathe mandrel to enable chucks and other fittings to be used as required. The rotation of this spindle is controlled by the indexing device which, as will be seen in the illustrations, consists of a worm shaft meshing with a worm wheel secured to the main spindle. The two division plates supplied for attachment to the worm shaft provide for a dividing range of from 1 to 360 deg. and nearly all the numerical divisions from 1 to 100.

Although the fixed form of vertical slide may be used when cutting straight-tooth or spur gears, the swivelling slide can be employed, as shown in Fig. 3, to set the device at an angle suitable for machining bevel gears.

The Southbend gear-cutting attachment, illustrated in Fig. 4, is similar in principle, but the vertical slide forms part of the appliance,

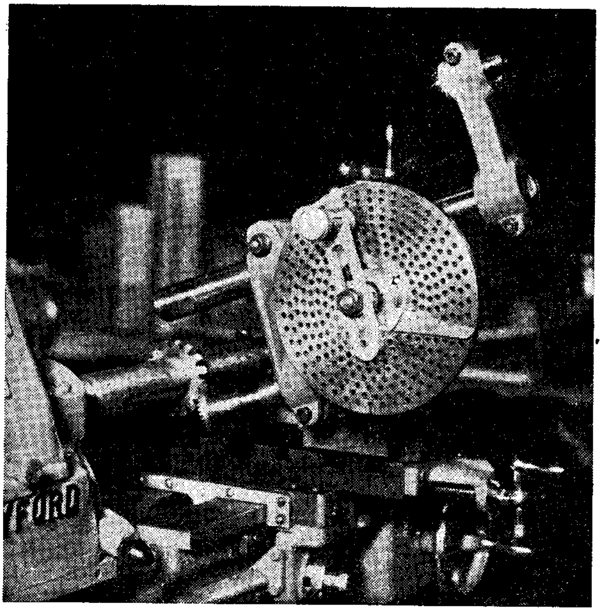


Fig. 3. The Myford attachment used for cutting a bevel gear

driving pulley is provided with a ball-thrust bearing at either end.

The cutter spindle is driven by means of a pair of spiral gears designed to give a speed reduction of 5 to 1.

The dividing-head is attached to the headstock casting in place of the forward wheel guard, and its worm wheel meshes with the 66-tooth back gear wheel which is keyed to the lathe mandrel.

An Improvised Gear-cutting Attachment

The attachment illustrated in Fig. 7 is bolted to the vertical milling slide, which can in turn be secured either to the lathe bed for milling work mounted on the boring table, or it can be attached to the cross-slide for gear-cutting operations. The gear-cutters are mounted on the spindle of a Potts drilling and milling attachment, and, in order to reduce the speed of the drive, a back gear having a 4 to 1 reduction has been fitted in addition to the bevel wheel drive with its 3 to 1 reduction ratio.

The bevel pinions were obtained from a discarded drilling machine, but the pinions for the back gear were cut with the aid of the actual attachment here described.

As it may be necessary to mount the cutter with considerable overhang beyond the spindle bearing, it is advisable to support the lower projecting end of the spindle in an outboard bearing.

This has been accomplished as shown in Fig. 8, where it will be seen that the bearing bush is carried in a bar attached to the lathe cross-slide;

and its feedscrew is furnished with an adjustable type of index.

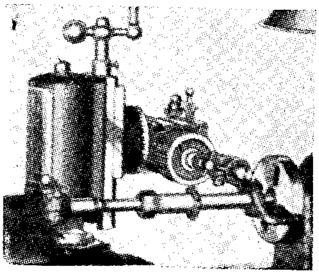
As will be seen in Fig. 5, the Atlas gear-cutting attachment is secured to the standard pattern vertical milling slide, but for indexing the work, a change wheel, controlled by an adjustable detent, is mounted on the end of the spindle farther from the work.

Driving the Gear-cutter from a Saddle Milling Attachment

As has already been pointed out, when the milling attachment is used for driving the cutter, an additional drive of some form becomes necessary.

The original Drummond gear-cutting attachment illustrated in Fig. 6 is driven from an overhead countershaft which is provided with a keyway to allow the driving pulley to slide along it and so keep in step with the driven pulley fitted to the attachment; in addition, a belt-tensioning device, controlled by a weight-arm, is fitted in order to maintain the correct tension in accordance with the movements of the lathe cross-slide and the vertical milling slide.

The vertical slide which forms part of the attachment has an adjustable index collar fitted to its feedscrew, and the spindle carrying the



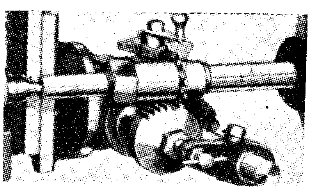


Fig. 4. The Southbend gear-cutting attachment

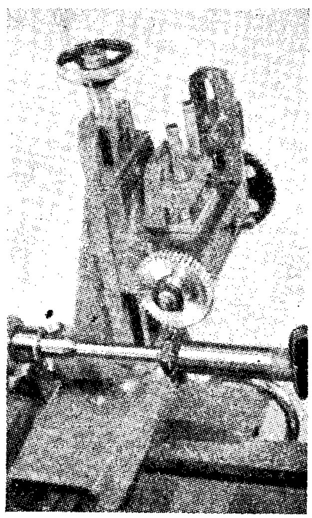


Fig. 5. The Atlas gear-cutting attachment

in addition, an umbrella-shaped shroud is fitted to the spindle to prevent the ingress of chips into the bearing.

The belt drive to the attachment is taken from a pulley mounted on an overhead shaft, and to adjust the belt tension a pair of jockey pulleys are carried on a sliding bracket. As the belt tension in a drive of this length will vary but little with the small amount of saddle traverse required for ordinary gear-cutting, it is hardly necessary to fit a device for automatically maintaining a constant belt tension.

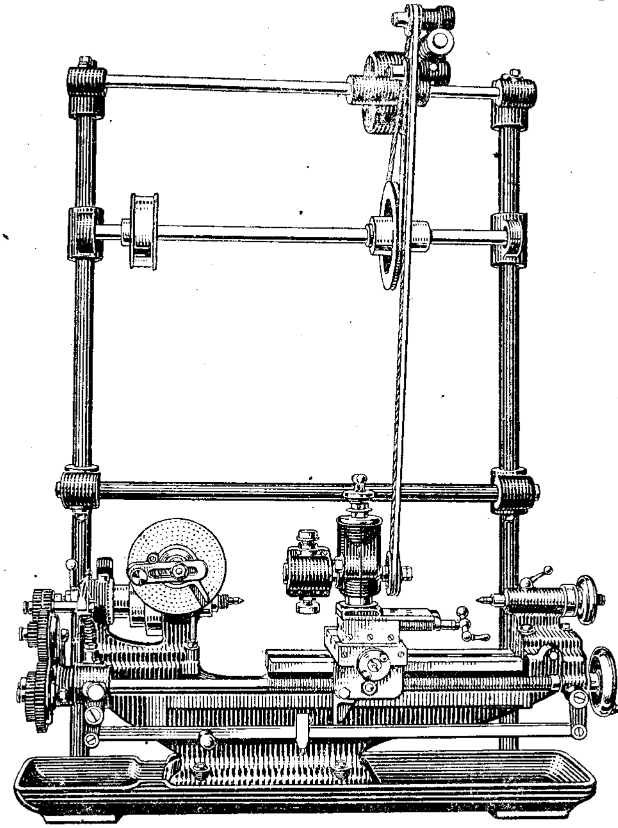


Fig. 6. The Drummond gear-cutting and indexing attachment

When this method of gear-cutting is adopted, the work can be bored and turned to size while secured in the lathe chuck; there is then no necessity to remove the part from the chuck for the gear-cutting operation. This is certainly an advantage, as the concentricity of the bore and the gear teeth is thus assured.

The gear blank can, however, if required, be secured to a mandrel mounted between the lathe centres.

The gear teeth are indexed either by means of a dividing-head controlling the rotation of the lathe mandrel, as illustrated in Fig. 9, or a change wheel secured to the tail of the mandrel can be used for this purpose, in conjunction with a suitable detent.

In the event of a train of change wheels being employed, inaccuracies in dividing will be reduced if the backlash in the gears is taken up by a weight, suspended from a cord attached to the chuck so that a constant rotational pull is exerted. The mass of the weight must, however, be sufficient to overcome any tendency for the gear-cutter to rotate the work under the machining stress imposed.

Where a change wheel is available with the same number of teeth as the wheel to be cut, the indexing is simple and direct, for the wheel is then secured to the mandrel and a rigid detent is used; likewise, intermediate divisions can be obtained by utilising the appropriate tooth spaces.

When these conditions do not apply and a wheel having, say, 24 teeth has to be cut, then $24 = 6 \times 4$, and 6 is multiplied by 5 to represent the standard 30-tooth wheel which is mounted on the mandrel. To reduce the number 30 to 24 it is multiplied by 4/5, and the wheel train is accordingly arranged as shown in Fig. 10.

A 50-tooth and a 40-tooth wheel are keyed together and mounted on the stud; the 50-tooth wheel is then meshed with the 30-tooth mandrel wheel, and the detent is used to index the tooth spaces of the 40-tooth wheel.

To prove the train, the driven wheels are multiplied together and then divided by the driving wheel :—

$$\frac{40 \times 30}{50} = \frac{1200}{50} = 24$$

Arranging the Feed

Where the cutter is driven from the lathe mandrel, the gear-cutting attachment carrying the work is traversed across the line of the cutter teeth by means of the cross-slide feedscrew. If the lathe has an automatic cross feed, the gear-cutting operation is facilitated and the regularity of the feed helps to impart a good finish to the work. Usually the rate of automatic cross feed is less than the corresponding longitudinal feed, so that, for example, in the small Southbend lathe fitted with a gearbox, the minimum rates obtainable are a half and one-and-a-half thousandths of an inch respectively for each turn of the mandrel.

On the other hand, when the work is mounted on the stationary lathe mandrel, the cutter is traversed along the work either by hand feeding, or by means of the power feed obtained from the leadscrew. The simplest way, perhaps, of arranging a drive for the leadscrew, independent of the lathe mandrel, is to disengage the mandrel driving belt, and then to fit a light round belt to transmit a drive from a small pulley on the lathe countershaft to a large pulley carried on the first quadrant stud. The latter pulley is keyed to a small

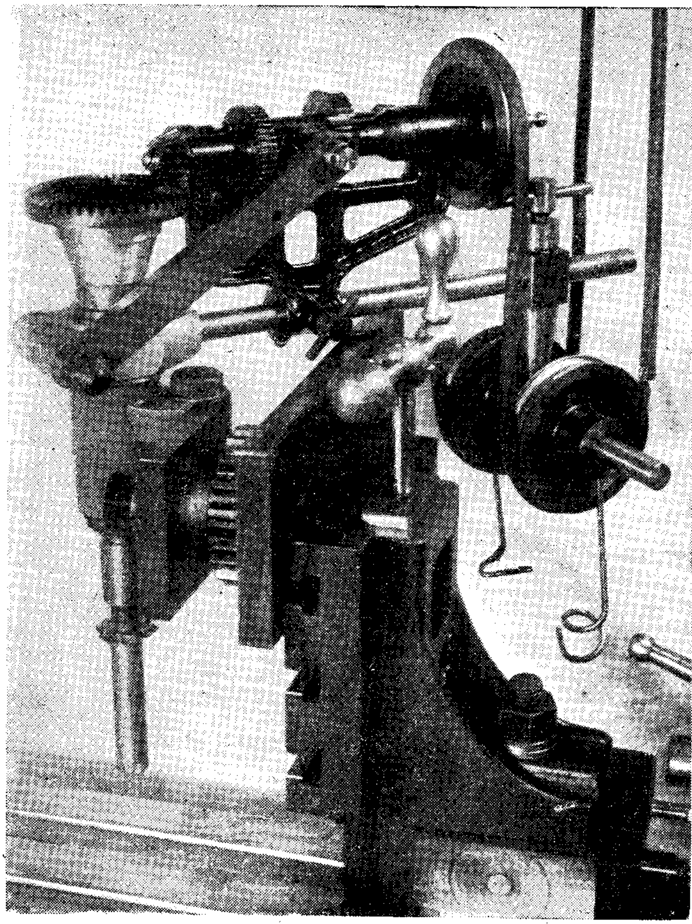


Fig. 7. A back-geared bevel-driven attachment mounted on the vertical slide

change wheel which in turn drives the leadscrew through a train of gears. By an arrangement of this sort, a saddle feed is usually obtainable sufficiently slow for ordinary gear-cutting.

An alternative and convenient method of providing an independent feed for the saddle is illustrated in Fig. 9. Here, the reduction of the countershaft or overhead shaft speed is obtained by means of a worm drive having a reduction ratio of some 80 to 1. As will be seen, this unit is built in the form of a closed gearbox and is attached to an adjustable arm bolted to the lathe quadrant. The worm wheel shaft is designed to carry a change wheel of any size that may be required to actuate the leadscrew in accordance with the rate of feed desired, and for the sake of convenience an idler wheel is interposed, but this does not, of course, affect the overall gear ratio of the drive. As the power transmitted is very small, the mechanism of the worm drive can be of quite light construction.

In passing, it may be noted that the worm consists merely of a portion of ½-in. Whitworth thread finished by lapping, and the worm wheel was machined by using a corresponding tap as a hob; the gears are supported in bushes fitted to the oil-tight gearbox. If the oil in the box is maintained at a level to allow the worm wheel to dip, adequate lubrication will be assured and little wear will take place under the light loading imposed.

Gear-cutters

There are many, no doubt, who will prefer to buy the cutters required for any particular gear-cutting operation; but as these tools are expensive, and as many workers are interested in making their own equipment, a detailed description of the production of these cutters by simple but effective machining methods will be given in a subsequent article.

The most widely known form of circular involute gear-cutter is, perhaps, that manufactured by Messrs. Brown & Sharpe and illustrated in the catalogues of leading tool merchants.

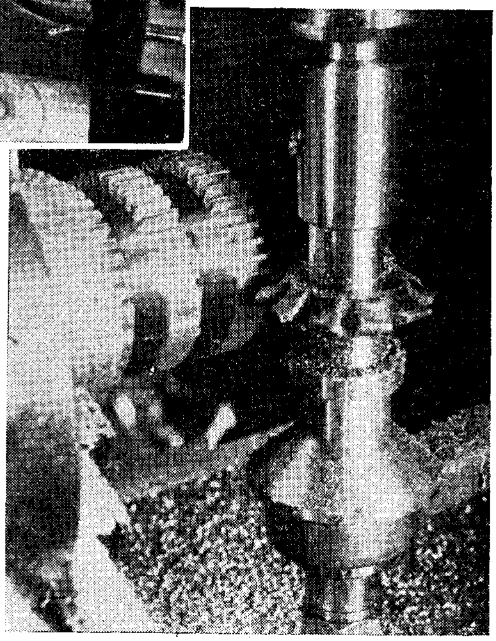


Fig. 8. The outboard bearing and chip deflector fitted to the spindle

These cutters are also made in this country, notably by the B.S.A. Company; besides these, small cutters of Swiss manufacture designed for clockmaking and instrument work are at times procurable.

As the radius of the curvature of an involute tooth varies with the number of teeth on the pinion, cutters of the correct diametral pitch must also correspond with the number of teeth cut on the gear blank. For each diametral pitch, therefore, a series of cutters is manufactured to cover the whole range of wheels from the smallest with 12 teeth to the largest having 135 teeth or more.

The following Table shows that, in accordance with the Brown & Sharpe system, eight cutters are required to cut the full range of wheels of any particular pitch, and it should be noted that all gears cut to the same pitch with these cutters will work together.

No. 1 will cut wheels from	135 teeth	to a rack.
2	55	134 teeth
3	35	54
4	26	34
No. 5 will cut wheels from	21 teeth	to 25 teeth
6	17	20
7	14	16
8	12	13

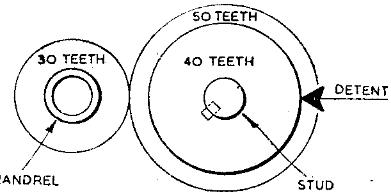


Fig. 10. A gear train used for indexing a 24-tooth wheel

It will be seen that the smaller the number of teeth on the wheel the more critical is the form of the cutter, and so the less its range. The provision of a single cutter to machine gears, having different numbers of teeth over a small range, has been planned to produce gears giving a satisfactory performance under ordinary working conditions; but an intermediate series of gear-cutters, designated by half numbers, is also available when greater accuracy is required. To obtain a tooth form of still greater accuracy, a separate cutter for each tooth number should be employed. Accurately cut involute gears have the advantage that the angular velocity of the individual members of a gear train remains constant, even if the depth of meshing is not exactly correct; this fact is of importance where a gear train is employed for indexing operations.

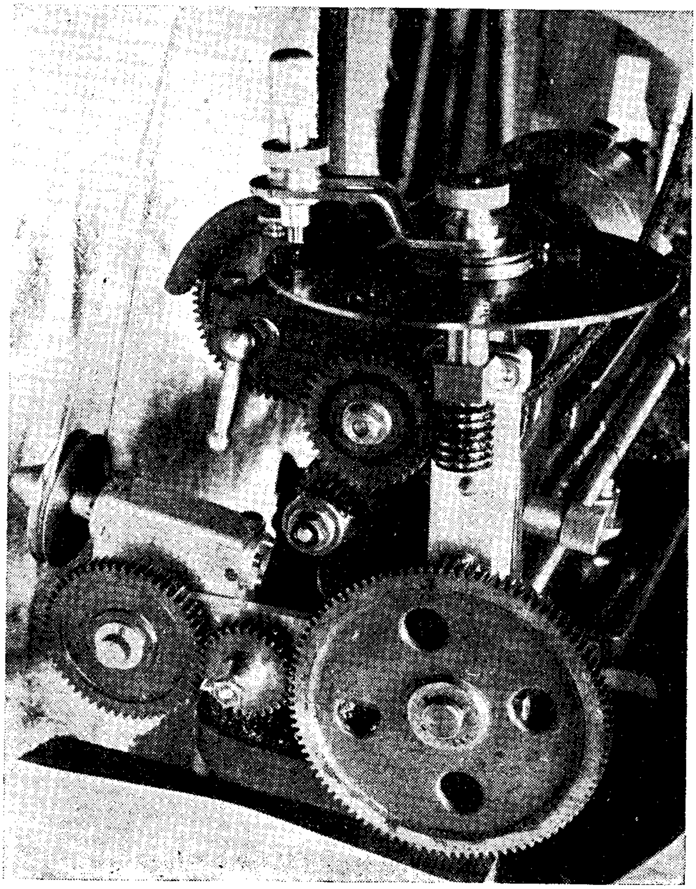


Fig. 9. The mandrel dividing-head and the worm-drive attachment for driving the leadscrew

A further factor to be taken into account when selecting an appropriate gear-cutter is the pitch of the gear teeth. This can be reckoned either as circular pitch, denoted by the distance between the centres of two adjacent teeth measured on the pitch circle, or as diametral pitch represented by the number of teeth to each inch of the pitch circle diameter.

Diametral pitch is in general use for the gears fitted to machine tools and other engineering products of this quality; moreover, this system simplifies the calculations required in gear-cutting and in laying out the correct working centres for the assembled gears.

As an example, a

32-tooth gear wheel of 16 diametral pitch will have a pitch circle diameter of $\frac{32}{16}$ in. = 2 in.; further the diameter of the gear blank is obtained by increasing the number of the teeth by 2 and again dividing by the diametral pitch, so that this diameter equals $\frac{32+2}{16} = 2\frac{1}{8}$ in.

The working centre distance between any two wheels is determined by adding together the radii of their pitch circles.

Thus, to mesh correctly two wheels of 16 diametral pitch and having 64 and 32 teeth respectively; the diameters of the two pitch circles are $\frac{64}{16} = 4$ in. and $\frac{32}{16} = 2$ in.; the sum, therefore, of the radii, $2 + 1 = 3$ in., represents the distance between the working centres of the two gears.

To obtain the best results with machine-cut gears, and at the same time to promote quiet running and good wearing qualities, especially where high speeds are used, a fine, rather than a coarse pitch, should be employed; the strength of the individual teeth to withstand the load imposed is then ensured by making the wheel face of adequate width. A narrow tooth of coarse pitch will be less able to withstand shocks and will be noisier in operation than a broad tooth of fine pitch.

Materials for Gear Wheels

The gears made in the small workshop will usually be of ample strength to serve the purpose for which they are designed, and attention will be directed more to ensuring quiet running and long working life.

Cast-iron gears, such as lathe change wheels, work well together at low or moderate speeds and under light loading, but better operation at higher speeds and greater tooth strength will be obtained if the smaller wheels are made of steel.

Cast-iron gears have the advantage that with use, and if not overloaded, the teeth assume a glazed, hard-wearing surface requiring but a minimum of lubrication.

Where the teeth are more highly stressed and subjected to shock, as in the gearboxes fitted to lathes, the gears are preferably made of hardened alloy-steel of high tensile strength.

To correct any distortion that may result from the hardening process, these gears have their teeth accurately form-ground as a finishing operation. Case-hardened mild-steel gears have excellent wearing properties, but if they are brought into mesh while running, the edges of the teeth may become chipped.

Soft steel gears should not as a rule be run together, as with this combination wear may be rapid if light loading is exceeded.

To distribute tooth wear more evenly between the wheels, the pinion, or smaller gear, should be hardened; in the small workshop it is advisable to restrict the hardening or case-hardening process to small gears, for it is not usually possible to correct the distortion that is apt to arise in large gears and those of slender form.

Where a bronze gear wheel is used, the smaller wheel or pinion should be made of steel and preferably hardened in order to resist wear. For light drives at moderate speeds a gear wheel machined from duralumin can be employed to run with a bronze or steel pinion.

Gear wheels made of plastic material such as Tufnol are excellent for quiet running and have good wearing properties, but it should be borne in mind that some plastics cause rapid wear of steel cutting tools, and a gear-cutter may in this way be subjected to abnormal wear.

Gears made from plastics or plasticised fabrics must be backed by a brass plate when being cut, or they will become ragged at the point where the cutter emerges from the blank at the end of the cut.

(*To be continued*)

LIMITS—and Limitations !

(*Continued from page* 610)

drudgery instead of being, as it should be, a pleasure. The conditions under which the model engineer works approach more nearly to those of the old-time craftsman than the modern works operative, and I believe most readers will agree with me that this is how it should be.

The outlook of the model engineer, who regards his work as a recreation and a pleasure, not to mention an outlet for his creative urge, cannot be compared to that of the professional engineer, whose incentive is entirely different, and in many cases must produce accurate work in the minimum time, and cope with other economic factors which are not encountered in the amateur workshop.

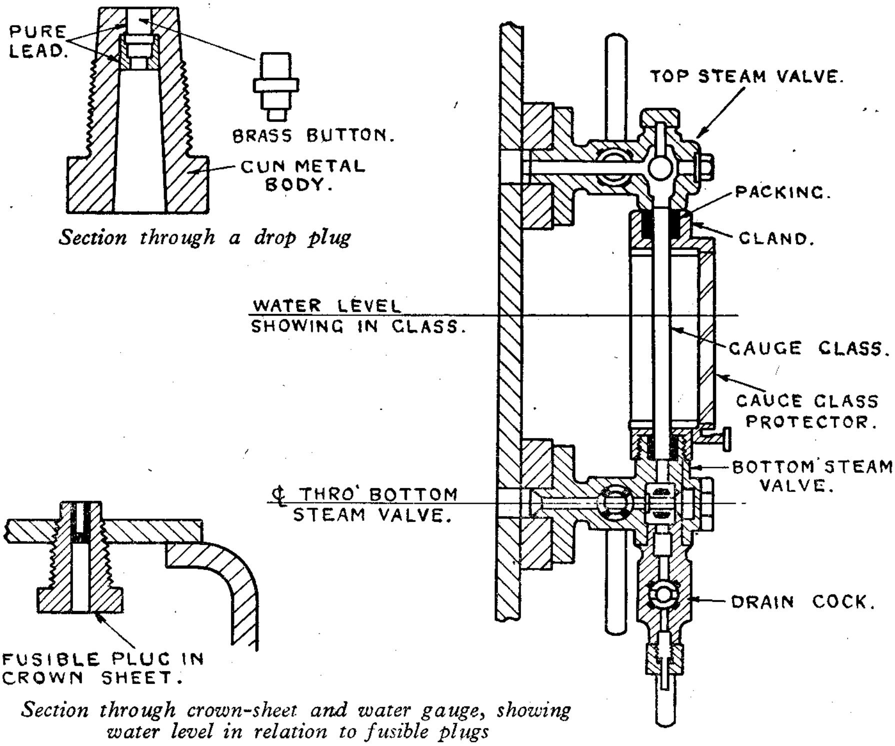
With regard to the comparison between fractional and metric systems of measurement, I think there is very little difference or difficulty in working to either, but I believe the alleged advantages of the metric system are largely fallacious. Many competent workmen, when measuring either in metric terms or decimal-inches, will either consciously or unconsciously translate them in progressive fractional divisions of an inch "plus or minus a sixty-fourth," and if one seriously thinks it over, it will often be found that this is a more "natural" method of subdividing small dimensions than the use of any decimal system. However, to those who dislike either system, there are always conversion tables available, and in cases where odd or inconvenient figures emerge, it is usually possible to work to the nearest round figure, and use "comparative" methods of measurement to ensure accurate fitting of essential parts.

Miniature Fusible Plugs

by H. Andrews

IT was with more than ordinary interest I read Mr. Cottam's article in the November 11th, 1948, issue on "Fusible plugs for $\frac{3}{4}$-in. scale locomotives," especially as I intend to fit fusible plugs to a 5-in. gauge L.B.S.C.R. "Terrier."

With regard to full-size practice, I would like to supplement Mr. Cottam's remarks, particularly as he mentions that a straight brass core sweated in a fusible plug was not used so far as he was aware in locomotive work. On the contrary, this type of plug, known as the "drop type" is used exclusively on Southern Region locomotives. I give a sketch of one of these drop-type plugs.



Section through a drop plug

Section through crown-sheet and water gauge, showing water level in relation to fusible plugs

I believe I am correct when I say that insurance companies insist on the use of drop-type plugs for boilers they have on risk. The reason for this is that the solid fusible metal can reseal itself when water and steam start to blow through a plug which has commenced to fuse, for fusing is not always a rapid process.

Partial fusing can happen when the water level has been allowed to fall too low and a change in gradient causes the crown-sheet to become uncovered for a short period, especially when it is optimistically hoped to recover the normal water level with the regulator closed on a downhill stretch.

Mr. Cottam mentions that it is not always low water that will cause failure of the plugs ; excessive scale is another reason. A boiler should never be allowed to get into such a state which would permit scale to cause local overheating of areas of the crown-sheet. It should be remembered that it has been computed that scale $\frac{1}{8}$ in. thick can reduce the effectiveness of the heating surface by as much as 25 per cent., which means the heat absorbed by the crown-sheet, stays and plugs, normally dissipated to the water will cause burning of the metal even though a full "pot" of water is present. Long before the plugs fused under these conditions, there would be other signs of trouble, i.e.,poor steaming, foaming, and leaky stays and tubes. Even so, should this condition arise, it is fully taken care of by the use of the drop-type plug, as it would "let go" completely and not allow itself to be cooled by the passage of water and steam, thereby assisting the resealing process when local overheating occurs. The conditions under which a solid fusible metal plug can reseal itself have been the subject of much testing and research.

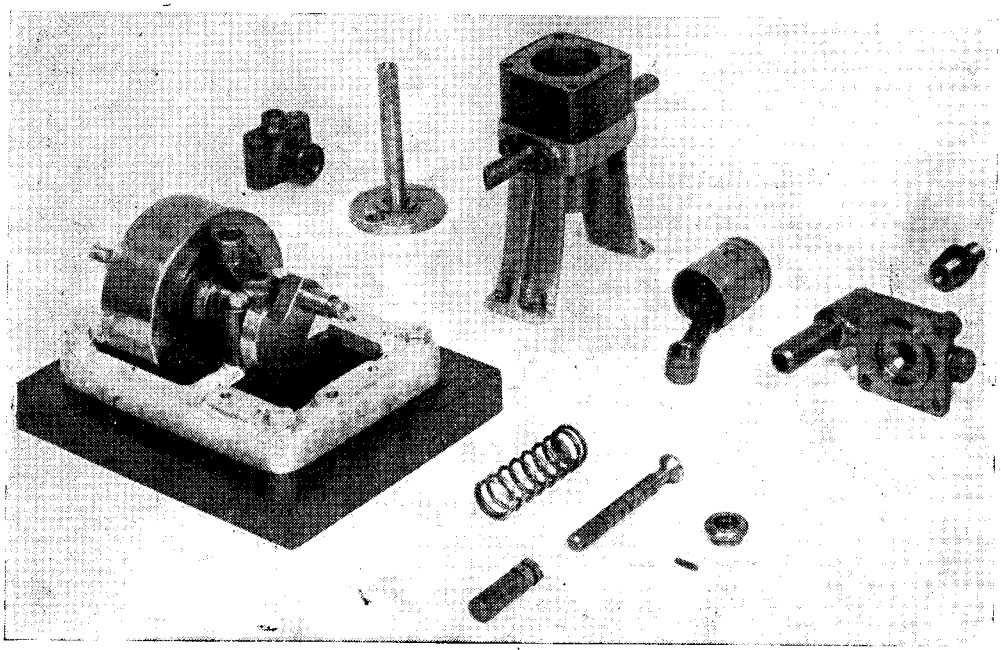
The size of the plug, too, is important, for the core hole must be sufficiently large to lower the

(*Continued on page* 621)

*UTILITY STEAM ENGINES

by Edgar T. Westbury

THE gudgeon pin is turned from mild-steel, finished to a tight fit in the piston bosses and case-hardened. In most cases, the lubrication will have to be obtained from the cylinder walls, owing to the difficulty of getting it by any other means, and for this reason the end pads of the gudgeon pin are made hollow, and a small cross hole is drilled in the pin, which should be assembled with the hole upwards, so that the oil is fed in at the point of lowest pressure. To those readers who prefer to make gudgeon pins of silver steel, it may be observed that this may be used in the annealed state, or low-tempered, but in such condition it is neither so tough nor hard-surfaced as case-hardened mild-steel.



The " Spartan " engine partially dismantled to show its major working components

Poppet Valve

A hard-wearing high-tensile steel is best for this component, and corrosion resistance is also an advantage, so an excellent material for the purpose may be found in a stainless steel air-craft bolt. It may be turned between centres if desired, but the indentations should not be too large at either end, especially the lower end, where a good area of bearing surface is desirable. All parts of the surface must, of course, be truly concentric and highly finished. The stem should be turned about 0.001 in. oversize and lapped with a ring lap until it will just push stiffly into the guide, when it is run in to a free working fit with thin oil, or a trace of paste metal polish or plate powder and oil.

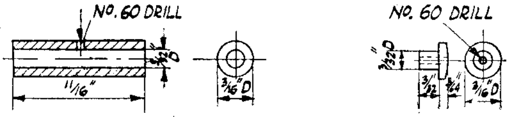
The valve retaining collar is turned from mild-steel and recessed at the lower end to take a short cross pin about 3/64 in. or 0.048 in. diameter, a cross hole of this size (No. 56 drill) being drilled through the end of the valve stem. A piece of 18-gauge steel wire is used for the pin, and should be filed on the ends to fit exactly in the recess of the collar. For the valve spring, 18-gauge piano wire may be used, wound on a $\frac{5}{16}$-in. mandrel, the free length being $1\frac{1}{4}$ in. and the number of complete turns not less than six, with allowance for squaring off the end turns by grinding. It is desirable to machine the shoulder of the valve guide on the cylinder head to provide a true bearing surface for the spring; this may be done by fitting the casting on a pin mandrel, and at the same time a skim can be taken over the skirt of the guide for the sake of neatness.

No grinding-in of the valve should be necessary if the valve is accurately turned and the seating cut by a hand tool as recommended, but the fit of the valve should be tested with marking blue before final assembly of the engine.

*Continued from page 542, " M.E.," May 5, 1949.

Steam Inlet

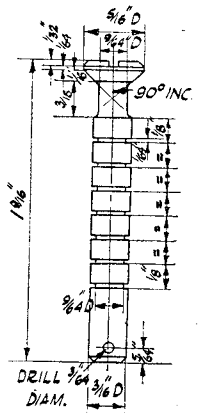
The details of this may be varied to suit the arrangement or mode of installation of the engine; some constructors may prefer to fit an elbow or a banjo union, to save vertical height as compared with a bent steam pipe. The inlet fitting might be combined with a control valve if desired. As shown, it is simply a double-ended nipple turned from hexagonal brass rod, the lower end fitting the mouth of the valve pocket, and the upper end forming the female end of a ¼-in. union joint.

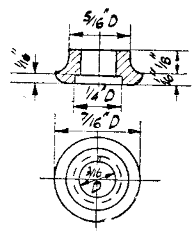


Gudgeon pin and end pads

Drain Tap

An ordinary steam cock or a pin valve, as obtainable ready made from most model dealers (I saw some very good and inexpensive ones recently on Kennion Bros. stand at a provincial exhibition) may be used as an alternative to the fitting shown. The latter is, however, simple to make, and will be very satisfactory if accurately machined; the body is made from hexagonal brass rod and the pintle (for preference) from





Poppet-valve and spring retaining collar

free-cutting stainless steel. Concentricity of the point with the screw thread is essential, and may be ensured by turning them at the same setting and using a tailstock die-holder to cut the thread. The handle may be bent cold by holding the screwed portion throughout its full length in a tapped hole in a piece of steel bar and tapping with a wooden or rawhide mallet, or levering with the aid of a piece of brass tube.

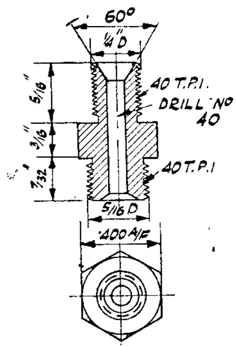
Exhaust Pipes

The short stub pipes fitted to the engine shown are obviously only "rudimentary organs," and it is, of course, practicable and indeed desirable to carry the pipes well away from the engine to discharge the exhaust as efficiently as possible to atmosphere, or to a condenser. In the case of an engine fitted to a hydroplane, the pipes may run out under the step, and will act as an ejector condenser to improve efficiency, but it might be found desirable to fit branch outlet pipes with light valves to relieve back pressure for running the engine when the boat is under static conditions. Alternatively, the pipes may be run into the funnel or uptake of the boiler to assist draught, if the method of firing is such as to benefit from the use of a blast ejector.

Short, straight exhaust pipes can be machined entirely from the solid, but longer, bent pipes will need to have the flanges brazed on. In the case of pipes machined from solid, it is possible to machine the edges of the flanges to a close approximation of the shape shown by eccentric turning, thereby leaving very little to be finished by filing. The shank of the pipe can be held in an eccentric chucking device, such as an ordinary vee block mounted in the four-jaw chuck, a solid plug being fitted to the bore of the pipe to prevent crushing, and set over the required amount to machine one side of the flange. It is then loosened and turned through 180 deg. to deal in a similar way with the other side. If separate flanges, brazed to the pipes, are used, this operation may be carried out before parting them off from the bar.

Assembly

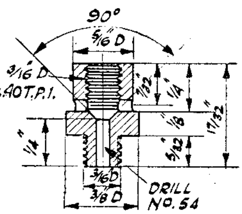
This calls for little comment, the methods being similar to those which have previously been described, but generally simpler, as there

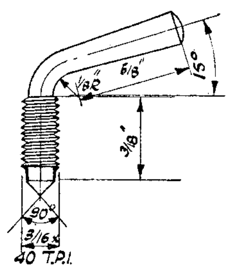


Steam admission nipple

is very little to do in the alignment of working parts. The three main bearings can be lined up by mounting them, at the appropriate spacing, on the mandrel used when facing the undersides, and the latter clamped down to the bedplate while spotting the positions of the setscrew holes. Next the trunk column is clamped in position, and similarly used to spot the holes for its holding-down screws. When bolting the cylinder and head on the trunk column, the location of the head should be so adjusted that the valve stem comes as centrally as possible over the tappet. Exact alignment is not necessary, but the nearer it is, the more direct will be the thrust of the tappet.

For timing the admission cam, a tentative arrangement will be to set it about 30 deg. behind the crank, in the direction of rotation. This setting will give fairly good working results, but final setting for maximum efficiency will depend upon working conditions, including steam pressure and angle of lead and cut-off. The amount of tappet clearance allowed will affect the angular period of valve opening, and it is quite legitimate in an engine of this type to use it for such a purpose, though the practice would

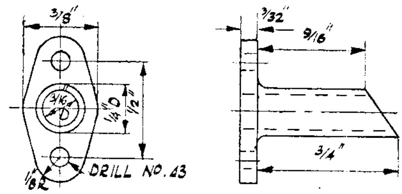




Details of drain-valve body and pintle

be quite rightly open to criticism if applied to i.c. engines. When the best possible timing, under the particular conditions, has been attained, the cam may be positively located, if desired, by drilling the crankshaft and fitting a snug key, as already explained. Note that this key is not required to take a heavy strain, as the friction grip of the collet is quite adequate to drive the cam if properly fitted, but just to ensure against inadvertent slipping in emergency, and ensure that the cam is always timed correctly in subsequent reassembly after the engine has been dismantled for any reason.

Lagging of the cylinder is strongly recommended, even if for no other reason than to cover up the cylinder studs, which do not enhance the appearance of the engine if left exposed. As in the case of the "Warrior" engine, thin shim steel, about 0.005 in. thick, may be used for lagging, and it may be bent quite easily to fit closely around the flanges of the cylinder (which should preferably be smaller in outside dimensions than that of the cylinder head, by an amount equal to the thickness of the lagging



Exhaust pipes

plate), and lap riveted, using a couple of domestic brass pins cut down for rivets. The sheath thus formed is slipped bodily over the cylinder, after packing the space between the flanges loosely with lagging material, but before fitting the cylinder head. Take care that the edge of the lagging plate does not stand proud of the top cylinder surface so as to prevent making a tight joint.

So much for the construction of the "Spartan" engine, which I feel sure will fill a demand for a simple lightweight high-efficiency engine for racing or moderately fast boats, running either on flash steam or superheated steam from water-tube or centre-flue boilers, though the latter type are out of keeping with the general policy of high power/weight ratio of plant, with which the engine is intended to conform. I shall have something more to say on the subject of suitable feed and oil pumps for the engine later. Incidentally, the name I have selected for this engine implies a combination of austere simplicity with robust physique, and I am confident that the engine will live up to it. Castings for the engine can be obtained from Precision Accessories Ltd., 12, Ogle Street, London, W.1.

(*To be continued*)

Miniature Fusible Plugs

(*Continued from page* 618)

boiler pressure as well as damp down the fire. In this connection the regular inspection and cleaning of fusible plugs is very necessary, as the core-hole under the fusible metal can become choked by the products of combustion, thus preventing the fusible metal running out or the brass button being blown out.

Practical experience has taught me that it is futile to try to knock down a brick arch, neither have I heard it advocated when plugs have fused. The best thing to do after turning on both injectors is to withdraw the fire with the clinker shovel or knock it through the grates if the engine is fitted with a drop grate and self-dumping ash-pan. Failing this, subdue the fire with earth and ballast.

A point sometimes not always appreciated by our younger brethren is that the water-gauges only register the water above the crown-sheet. To illustrate my point I have also sketched the fusible plugs in the crown-sheet in relation to the water-gauges.

In conclusion, I need hardly stress the fact that the traditional care of drivers, firemen, and boilermakers in working and examining the expensive equipment in their charge is of such a high order that fused plugs are rare, and a collapsed crown-sheet is practically unknown on our railways.

PRACTICAL LETTERS

"Eureka" Clocks

DEAR SIR,—I have a catalogue of these clocks which I believe were put on the market about 1909. They had a fine appearance but were rather expensive, being from £4 4s. od. to about £8 os. od. or £9 os. od., and never seemed to sell well. One very rarely sees a specimen nowadays.

From the design it might be thought that a close rate of timekeeping could be expected; I had one for some weeks to regulate for a friend about 1919, but could *not* get it to go to time. After getting it close to time it would vary quite irregularly, fast or slow. It may have been difficult to compensate the long and rather stiff hairspring, and it would be interesting to see if modern alloys like Elinvar would improve this.

Yours faithfully,
Stourbridge. J. H. McDOWELL.

The "Eureka" Electric Clock

DEAR SIR,—I have constructed one of these clocks, and encountered the short-circuiting of the magnet poles as mentioned by "Artificer," but I have counterbored the steel part of the rim as suggested, and the result is quite satisfactory.

I have made certain modifications to the contact mechanism of the clock and the details which follow may, perhaps, be of interest.

The contact pin on the balance wheel is made of solid metal instead of in two halves, thus greatly simplifying this rather tricky detail and providing a more robust pin.

In order to prevent contact on the return swing, the L-shaped contact spring is provided with a very thin plate of hard insulating material riveted to one side of the tip.

By providing two such springs the clock becomes "double acting," i.e., with an impulse in each direction of swing.

I have used this method in the clock, and find that the additional impulse gives a much steadier action to the balance, besides giving a greater swing. The "double acting" arrangement could, of course, be used with the solid contact spring and insulated pin, but I think the insulated springs are easier to construct.

I feel that I cannot pass Mr. G. R. Wallace's letter (March 24th, 1949) without comment. I fully realise that the magnetic circuit is closed if a steel rim is fitted, but the splitting of the rim will not rectify this condition, the magnetic circuit will still be closed whether a split or solid rim is used.

The remedy (as "Artificer" has already stated) is to provide magnetic clearance for the central pole-piece at one end only, at the point where it passes through the rim. If this is done, then a solid rim may be used if desired.

Incidentally, with my own clock, I must admit that I have departed from the "words and music" a good deal.

I have fitted standard $\frac{1}{2}$-in. × $\frac{3}{16}$-in. ball-races in place of the extremely complicated bearing fitted to the original clock. The races were "run in" before fitting and the housings were left on the loose side. So far, they appear to be quite satisfactory and the clock is keeping time to within two or three minutes per week, which, though capable of improvement later, is reasonably satisfactory, I think.

A rheostat in the battery circuit has been found to be a more effective means of adjusting the rate of the clock than the mechanical device fitted to the hairspring. I am using a 60-ohm rheostat in conjunction with a 3-volt battery and find that this gives means of adjustment either on the fast or slow side. It is a pity the clock (perhaps I should say my particular clock!) is so "touchy" so far as voltage is concerned, but assuming a fairly large battery, the discharge is so small that, once adjusted, the voltage should be constant for some considerable time.

In conclusion, I should like to say that many entertaining hours have been spent in the construction of this clock and in its finished state, complete with "Perspex" dial and case, it was well worth doing.

Yours faithfully,
Birmingham. F. A. A. PARISER.

Amateur Car Construction

DEAR SIR,—In reply to Mr. P. Roffe's letter of April 14th, I have built up two small cars, one in 1939 and one last year. Both used Austin 7 chassis with two-seater bodies. The second one is fitted with a Ford 8 engine, gearbox, front axle, and Austin rear-axle and chassis; the chassis was lengthened and lowered. The body was built of light angle-iron and alloy sheets screwed on with $\frac{1}{8}$-in. Whit. screws and covered with beading over joints.

Though I am a motor engineer by trade, all the work can be done by anyone with the usual tools, small lathe, drill, and using usual hand tools. Any welding can be done at most garages.

If anyone is interested, the car could be seen, or maybe a reader in this district who is good at drawing could make some sketches which could be reproduced in THE MODEL ENGINEER, as I am afraid I don't get much time, but would give all the help I could. I hope to be able to send some photographs of the car in the near future.

Yours faithfully,
Royston, Herts. H. A. PEPPER.

Steam Ploughs

DEAR SIR,—With reference to your query in THE MODEL ENGINEER of March 17th, I have to report that at 09.45 on April 5th, whilst on a cross-country flight from Lee-on-Solent to Donibristle, I observed two mighty steam engines busily engaged in steam-ploughing a field 160 deg. 4 miles from Andover.

Yours faithfully,
F. E. SARGENT,
Dunfermline. Lieut.-Com., R.N.

Why not the Professional Touch?

DEAR SIR, — I have read your interesting account of the large model *Queen Elizabeth* built by Messrs. Bassett-Lowke, and would like to bring up one or two points on what is commonly known as "professional finish."

In the first place, a modelmaker must be able to differentiate between the realistic and the idealistic type of model, for these are poles apart; there is a place for both in the scheme of things, and I have a theory that the idealistic type of model should be employed as a means of advertising a product, or for ornament, whereas the realistic model serves the purpose of providing a permanent record to show what an actual product was really like. By "idealistic" and "realistic" models I mean, respectively, models which incorporate the highest possible degree of finish, possibly to the exclusion of certain details; and, models which allow every part of the parent machine as it actually appeared, both in appropriateness of material and degree of finish.

To the layman, "professional finish" almost always brings to mind the idealistic or showcase type of model; what, in fact, is often termed the museum model. The Bassett-Lowke *Queen Elizabeth* is definitely in this class; being built for a purpose, namely, the advertisement of the actual vessel. Where so many people, not always only laymen, trip up is, that they imagine that all good models ought to be in this class: very highly finished, and bearing in this respect no resemblance to the finish of the real thing. They do not realise that for some purposes a truer representation of the prototype would, in fact, serve the purpose far better; for instance, the Bassett-Lowke style of ship model is ideal for exhibition in an office window, but would be better as a record of the prototype ship, as in a museum collection, if some of the fine finish were omitted, and details such as hull plating, etc., inserted instead.

When building any type of model with the idea in mind of representing the real thing in miniature, a very close watch must be kept on one's work, so as to capture the spirit as well as the dimensions of the parent machine: in other words, not to be led astray by this war-cry of "professional finish." As a matter of fact, I can say quite truthfully that it is frequently even more difficult accurately to produce a model having the exact authentic "rough" appearance of some piece of functional machinery in miniature, than it is to make the same model or component with an idealised and superb finish. In other words the desire for realism cannot be regarded as a cloak to excuse poor workmanship.

Some types of model offer scope for super-finish and authenticity at the same time: for example, high-grade cars, especially the new American style of coachwork; racing yachts; sailplanes and certain racing and expensive private-owner aircraft. However, machines such as lorries, locomotives, industrial machinery, farm implements, and R.A.F. aircraft, are comparatively rough in actual fact, and must be modelled with care and sympathy if the feeling of the prototype is to merge in the model. Anyone building truly representative models of the realistic type must, however, be prepared to be misunderstood by the bulk of the general public. At the last National Model Aircraft Exhibition held in London, my 1-in. scale model Messerschmitt rocket fighter, built as a realistic type of model, was set beside a truly magnificently finished model which included such details as chromium-plated undercarriage, buffed alloy parts, and a high gloss finish. This model was far from true to scale and incorporated many incorrect details, whereas the Messerschmitt, built from drawings I made from real aircraft is, I can truthfully say, correct down to nuts and bolts and chipped paintwork.

To test out my theory, I spent about two hours listening-in to comments on these two models; invariably onlookers stated that it was ridiculous to have given my model the first prize, the other one being "so much better made." The moral seems to be: if anyone wants the applause of the crowd, build an exhibition type of model with high finish, and disregard truth. But do not go on from there and describe it as an accurate portrayal of the prototype. If, on the other hand, you are sufficiently skilful as a modeller to hope that your products may, in museums or private collections, be shown to posterity, then for goodness sake forget this fetish of "professional finish," and set out to give other people an idea of how your prototype really did look.

Please realise that this is in no way condemnatory of Messrs. Bassett-Lowke or any other firm or individual who build exhibition models: it is only an attempt to show how different types of model and finish should be built, according to the purpose for which they will be used. My letter is directed against those who use terrific finish as a bluff to mask inaccuracy of scale and detail, at the same time presenting the results as "an accurate detailed model of so-and-so."

Yours faithfully,

Colchester. L. GEORGE TEMPLE.

[We are in the fullest agreement with the views expressed in this letter and hasten to correct any impression to the contrary. The point we wished to make was that this finish is possible for the amateur, not that it should be applied indiscriminately. The model of the cruiser *Dorsetshire* recently completed by Mr. Norman Ough, and now to be seen in the Imperial War Museum at Lambeth, is a case in point. The ship is shown in dry dock undergoing repairs, and with its paintwork streaked with red lead and the usual litter of the graving dock lying all around, is a wonderful example of realistic modelling, and is well worth close study. In the case of the *Queen Elizabeth*, however, since she has been painted in her proper Cunard colours, we consider that the smartness and brightness of the model in no way exaggerates the impression given by the actual ship. One often sees the reflections of the water on the side of a smartly painted ship. Also, when one reduces the irregularities on the surface of the plating by 1/50th, which is approximately the scale of the model, the result is actually a polished surface. The strakes of the plating might have been shown, and in a more realistic model ought to be shown, but they would be little more than paper thickness at this scale.—MARITIME EDITOR, "M.E."]