IN THE WORKSHOP

by "Duplex"

*43—Gear-cutting in the Lathe

THE description of the methods employed for machining, hardening and marking the gear-cutters was concluded in the previous article, and it now remains to sharpen the teeth to render the cutter ready for use.

Sharpening the Cutter

The ordinary method of sharpening circular, multi-tooth cutters is to use a grinding machine furnished with an indexing device, in the form of an adjustable stop, which makes contact with the faces of all the teeth in turn; and as the teeth were, in the first instance, accurately spaced by a machining operation, the tooth faces will by this method also be correctly ground.

Those who have no qualms about using their lathes for grinding operations will be able to grind the cutters without difficulty, by using a grinding spindle attached to the saddle, and a device for indexing the teeth of the cutter when the latter is mounted on an arbor carried between the lathe centres.

It will be remembered that, at an earlier stage, the flat faces of the teeth were finished with a fine file, following the sawing operation for cutting out the tooth gaps. This filing process should leave the teeth quite sharp, but as it is a free-hand operation it is advisable to finish the cutting edges by using a more exact method, and one which can be readily repeated should resharpening of the cutter become necessary at some future time.

Accordingly, we have designed a simple form of honing jig for use in the small workshop where a proper cutter grinder is not available.

A Cutter Honing Jig

Although this appliance will sharpen the teeth symmetrically and to a high finish, it is not, of course, capable of removing a large amount of metal; when, therefore, the cutter teeth have become chipped, it may be found necessary either to grind their faces, or to soften the whole cutter and remachine the leading faces of the teeth.

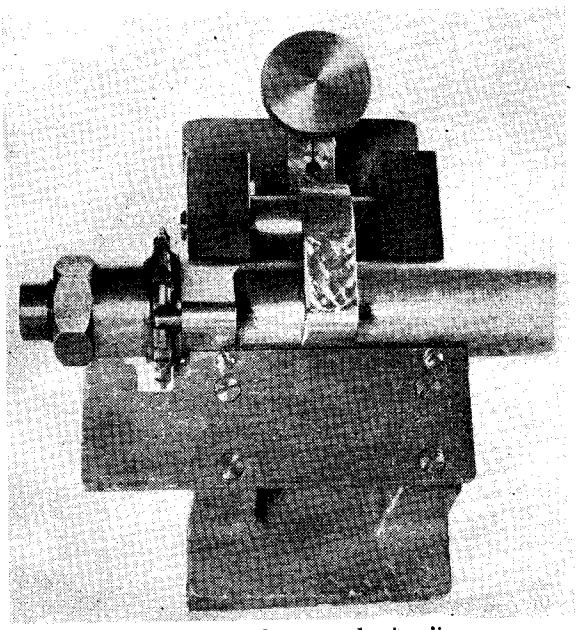

Fig. 36. *The cutter honing jig*

From the view of the jig shown in the photograph, Fig. 36, it will be seen that the cutter is secured in place on its arbor so that the teeth can be indexed by means of the index pin fitted to the arbor web as previously described. The arbor with the cutter in place is clamped in the V-groove in the jig by means of a pivoted arm controlled by a knurled finger-bolt.

The flat table seen in the foreground guides the hone, and is fitted with a fence secured in place by the two round-headed screws seen lying close to the arbor. This fence prevents the edge of the hone coming into contact with the curved surfaces at the base of the teeth, which serve to index the teeth against the register pin; by this means, any damage to these important register surfaces is prevented.

The work of constructing the jig is quite straightforward, and the dimensions and relationship of the parts are shown in the working drawings given in Fig. 37. For the casting forming the base of the jig a Myford saddle V-block was used, as it was found to be of exactly the right construction and very little additional machining was required. The V-block in this case is the larger of the two patterns made by Messrs. Myford.

The dog-legged clamping lever was cut out from a piece of mild-steel bar and then fitted with its knurled setting-screw.

Although the clamping lever is shown in the drawing with a long head, there is no need for it to project more than a short distance beyond the centre-line of the arbor, otherwise it may

*Continued from page 121, "M.E.," July 28, 1949.

interfere with the free manipulation of the stone during the honing operation. The pivot pin for the lever is threaded ¼ in. B.S.F. at one end, and screwed into the casting, and in addition, spacing collars are fitted on either side of the lever to locate it centrally between the bearing lugs. When fitting these collars, the inner faces of the lugs may be filed flat or machined with a spot-facing cutter, but this refinement of workmanship is in no way essential for the proper working of the clamping lever.

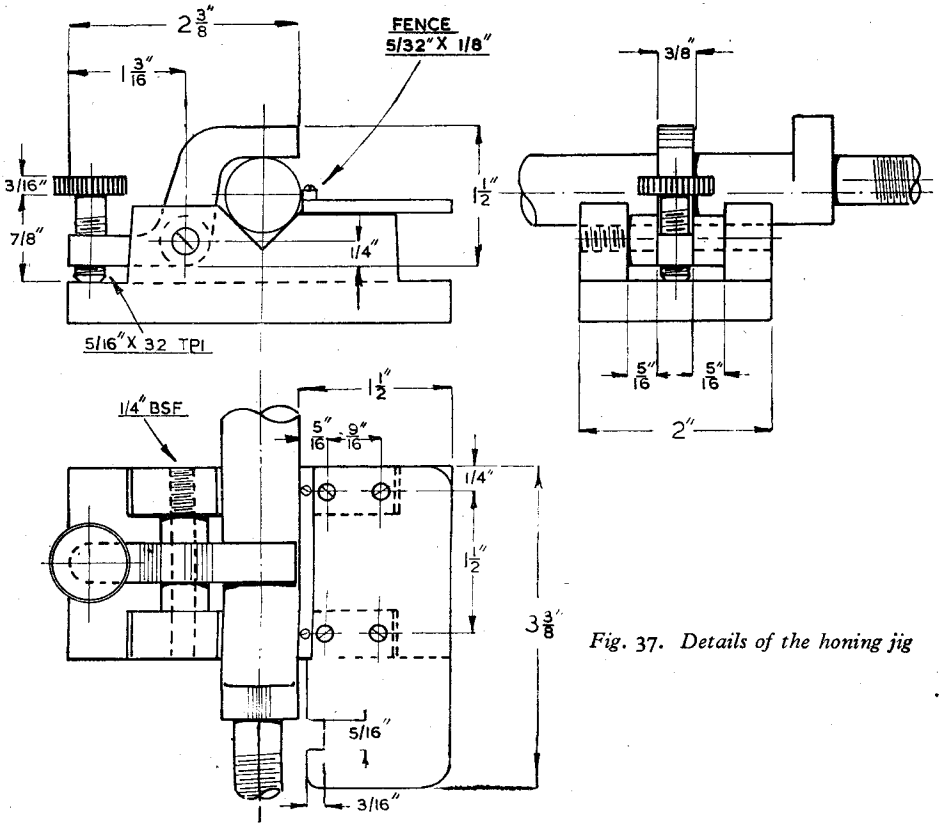

Fig. 37. Details of the honing jig

The table should next be fitted and secured in place with four cheese-headed screws, of ⅛ in. diameter or so, fitted to lie flush with the table surface. It should be noted that, in order to maintain the radial angle of the cutter teeth at the honing operation, the upper surface of the table is made to lie $\frac{1}{16}$ in. below the centre-line of the cutter when mounted in place on its arbor. This may entail reducing the height of the two lugs supporting the table, either by filing or by a machining operation. To machine the lugs, the V-block is clamped to the lathe surface plate and the surplus metal is turned off with a facing tool.

To prevent the hone rocking, as it is moved to and fro across the faces of the teeth, it is important that the surface of the table should be made truly flat.

Nowadays, there appears to be a growing tendency among amateur workers to invoke the aid of a machine to produce flat surfaces wherever they may be required, and although this is often the easiest and quickest way, there are occasions, particularly in the case of thin material, when this is hardly feasible with the ordinary machine equipment found in the small workshop.

It is said that adversity brings out the best in human nature, and certainly financial stringency promotes skill in using hand tools, notably the ability to ply a file correctly and thereby produce flat surfaces.

It will be observed that an ordinary hand or flat file varies in thickness from toe to heel as the flat surfaces belly-out towards the centre of the length of the blade. This property enables the surface of the work to be filed slightly concave, not only in respect of its width, but also in the direction of its long axis, corresponding with the direction of the filing stroke.

When gripping the material for the table, which in this instance is only $\frac{3}{16}$ in. thick, a metal block is placed between the vice jaws to rest on the upper surface of the slide portion of the movable jaw. The height of the block should be such that it supports the work from tipping and, at the same time, allows the material to stand a little above the vice jaws to enable the

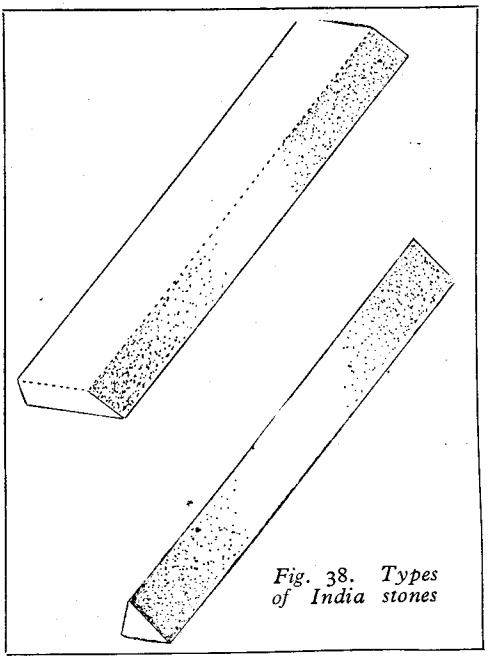

Fig. 38. Types of India stones

file to be used without endangering the surface of the vice.

When the surface of the table has been filed true and its flatness checked with a straight-edge, the centres for the fixing screws are marked-out and drilled; the holes in the lugs to receive the screws are then drilled with the table clamped in place.

The contour of the gap in the table should next be marked-out and filed to shape, so that, when the cutter is placed in the gap, the arbor can be slid into position and the cutter clamped in place with its securing-nut, as shown in Fig. 36.

It will be observed that the gap is continued towards the left of the table; this is to allow the cutter to be disengaged from the register peg when the clamp-nut is slackened to bring a fresh tooth into position for honing.

Finally, the fence is fixed in position to confine the contact of the hone to the flat portion of the faces of the cutter teeth.

It will be seen in the drawing that the width of the table is represented as 1½ in., but it will be found that, as only a narrow stone is generally used for the honing operation, a table width of 1 in. will be sufficient.

Using the Honing Jig

To operate the jig, the arbor is rotated to bring the point of one of the cutter teeth close to the edge of the gap cut in the table, and until, with the aid of a rule or straight-edge, the upper face of the tooth is set just proud of the table surface. The arbor is then firmly secured in this position by tightening the knurled finger-screw, and it remains clamped, as set, throughout the honing operation.

When locating the cutter against the register pin, the tooth to be honed is always turned downwards as far as it will go, in order to eliminate the

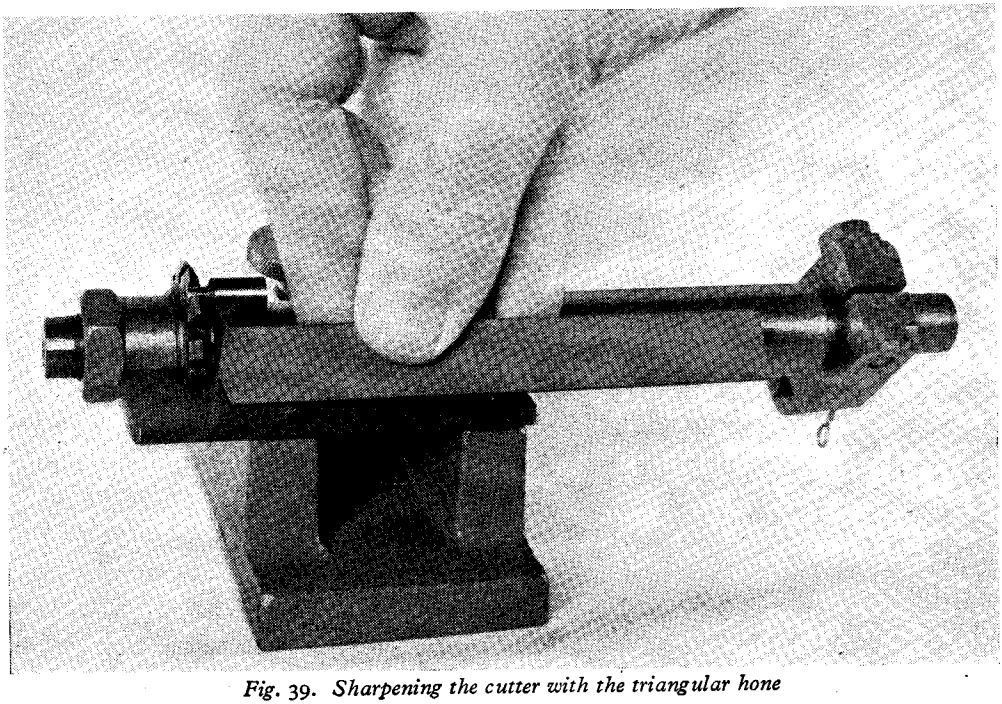

Fig. 39. Sharpening the cutter with the triangular hone

backlash constantly in one direction and so ensure uniformity of setting and sharpening the cutter teeth.

For the actual honing, an India stone will be found to cut quickly and leave a well-finished surface. These artificial stones are made in three grades: coarse, medium and fine; a coarse stone can be used for renovating a damaged cutting edge and a fine stone for finishing, but a single, medium-grade hone will be found satisfactory for ordinary sharpening.

It should be noted that, in order to preserve the correct profile of the cutter teeth, the face of the tooth alone is honed and never the flanks of the teeth.

Driving the Cutter

Where the cutter is mounted on the arbor of the lathe gear-cutting attachment, it is secured in place by means of spacing collars and a clamping-nut, but when the cutter is driven by the lathe mandrel, it is mounted on an arbor carried either between the lathe centres or in a chuck. In the latter case, a special arbor of the type depicted in Fig. 40 is used.

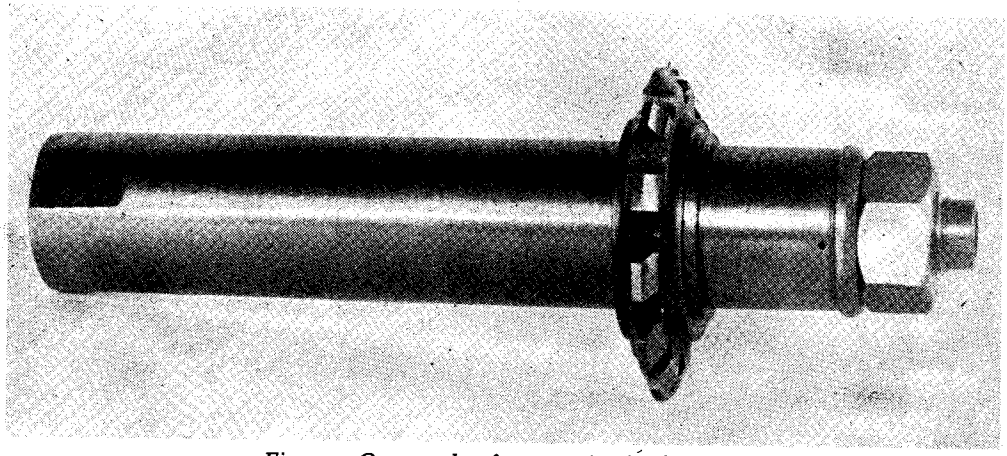

Fig. 40. Cutter arbor for mounting in the chuck

The shapes best adapted for the present purpose are those illustrated in Fig. 38, as the bevelled edge allows the stone to enter as far as the base of the cutter tooth and, at the same time, to keep clear of the tooth above. On the whole, a triangular stone with a ½ in. width of face is preferable, as it affords a good grip for the fingers in the somewhat limited operating space available.

The stone should be treated with thin oil before use to float off the metal dust and prevent it adhering to the abrasive surface; after use, the stone should be wiped clean before being put away.

To carry out the honing, the stone is worked to and fro across the face of the cutter tooth while maintaining light contact with both the guide fence and the table surface.

It will generally be found that, as illustrated in Fig. 39, the stone can be held most conveniently, and operated to the best advantage, if it is held with the tips of the fingers applied to the rear face, and the thumb to the front of the hone.

If the stone is allowed to project rather further to the left than is shown in the photograph, the length of the cutting stroke can be increased accordingly. To reduce wear of the table surface, the cutting pressure should be directed primarily to the vicinity of the cutter tooth rather than against the fence or table. The honing is continued until it is felt that the level of the tooth has been reduced to that of the table; each tooth is then dealt with in succession until all have been correctly sharpened.

This is most readily made by turning a length of round, mild-steel mounted between the lathe centres, and both the shank and the seating for the cutter are machined at the same setting to ensure concentricity; the threaded portion can be either screw-cut or formed with a die, and if a thread of 40 t.p.i. is used, the nut previously made for the eccentric cutter arbor will serve as a clamping-nut. After the arbor has been turned and threaded, a flat should be filed at the far end of the shank to afford a secure grip when the arbor is held in the vice to tighten the cutter clamping-nut.

When this short arbor is used to drive the cutter for the gear-cutting operation, it is gripped in the four-jaw chuck, and the cutter is centred by means of the dial test indicator.

For this purpose, the lathe mandrel is turned slowly by hand in the reverse direction and the chuck is adjusted until the reading on the indicator dial becomes constant.

To increase the rigidity when gear-cutting, the tailstock centre should be engaged with the arbor to afford additional support.

It may be found that the gear-cutting operation can be carried out more conveniently if the cutter is positioned further from the lathe headstock than the short arbor permits. In this event, a long arbor of the pattern illustrated in Fig. 41 may be used.

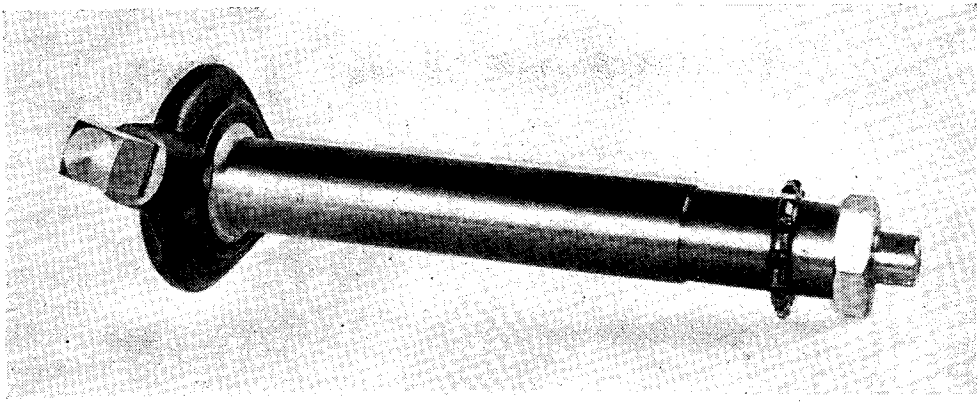

Fig. 41. Cutter arbor for use between centres

As before, the arbor is machined when mounted between the lathe centres, and its end is also threaded to take the clamp-nut belonging to the eccentric cutter arbor. The flat afterwards filed at the further end provides a seating for a lathe carrier, as well as a gripping surface for the vice jaws.

(To be continued)

Jubilee of Bassett-Lowke Ltd.

THIS year marks the fiftieth anniversary of the firm which bears a name that is known in every corner of the world where model engineering is practised.

After a somewhat inconspicuous beginning, the firm introduced the " Black Prince " type of low-pressure model steam locomotive, and from then the progress was steadily maintained. The engine mentioned was a great advance upon anything of the kind then available on the ordinary market, and it may be said to have been the first attempt to produce, commercially, a model locomotive that was not expensive but had some resemblance to its prototype. From this point, progress was very rapid and the range of models of this kind was widened. Castings and parts, small steam fittings of many different sorts and sizes became a speciality, and considerable attention was given to the production of a most comprehensive selection of small ships' fittings. All these things achieved much popularity and helped to establish a reputation that has scarcely been equalled by any manufacturer of model parts.

During two wars, Bassett-Lowke's factory at Northampton applied its utmost capacity to the making of important instruments and models for the Government, the Admiralty and the War Office. With the cessation of hostilities, each time, the firm reverted as quickly as possible to its normal productions, and added still more to the range of their goods. High-class exhibition models for the railways, shipping companies, engineering firms, municipal authorities and the like, were built in large numbers, and are to be found in many parts of Britain and abroad.

As is fitting for a jubilee year, Bassett-Lowke Ltd. have, this year, completed and sent to the Cunard Steamship Company's offices in New York, what is probably the finest commercially-produced ship model ever built, the 1/48-scale replica of the liner *Queen Elizabeth*, which was the subject of a special illustrated article in our issue of April 21st, last. The accuracy and finish of this beautiful model have not only set a standard that will be very hard to improve upon, but are a credit to the British modelmaking industry and cannot fail to create a profound impression abroad.

Right from the beginning, the name Bassett-Lowke has figured almost consistently in the advertisement pages of THE MODEL ENGINEER, and the most cordial relations have been steadily maintained between the firm and ourselves. We learn that negotiations are in hand for the building of a fine modern factory in Northampton, and in offering our sincere congratulations upon the attainment of fifty years' service to the model engineering hobby, we extend our best wishes that the negotiations for the new factory will be successful and will lead, eventually, to fresh prosperity to be enjoyed through many years to come.