Milling attachment

with three functions

WHILE the slide movements provided on a metal turning lathe for sliding, surfacing and angular work on a horizontal plane are normally sufficient, the scope of the lathe can'be extended to include many kinds of work beyond ordinary turning by the fitting of attachments which provide a vertical movement. Many of these devices, varying in complexity and utility, have been described in ME, and have been put on the market by makers of lathes and their accessory equipment.

The most popular attachment is the vertical slide, which was first used by instrument makers and horologists and was later adapted to larger lathes up to 3 1/2 in. or more in centre height. Many model engineers consider the vertical slide indispensable. One form has a perpendicular slideway, integral with the base or rigidly fixed to it, so that the sliding table can move only in a vertical plane, and the other has a slideway which can be swivelled about a horizontal axis to provide for oblique sliding.

Attachments to carry a milling spindle or a dividing head are often mounted on the vertical slide table, or are made with a self-contained elevating movement. It occurred to me that the three functions of the vertical work table, milling spindle and dividing head could quite easily be combined in one compact unit; this idea is not new, but it has seldom been carried out as neatly or thoroughly as it might be.

One of the most important requirements of any fixture used for milling in the lathe is that it should be as rigid as possible to avoid deflection, which is liable to destroy accuracy, and cause digging-in or chattering of the cutting tool. At the very best, there are limits to the usefulness of a light lathe for milling operations, as its slides are not designed for this work, and it is often necessary to mount the work (or the cutting tool) at some distance from its point of support. Most vertical slides nowadays are of very sturdy design, but this is of little use if the entire fixture is liable to deflection. The number of separate parts or articulated joints must necessarily affect rigidity, and the non-swivelling vertical slide is generally to be preferred. But the weakest feature, indeed the Achilles heel, of the orthodox vertical slide is its attachment by a single bolt to the cross-slide. No matter how broad the base of the slide, or the strength of the fixing bolt, there is a limit to the security which can be obtained by its anchorage to a T-slot in the cross-slide or boring table of the lathe. A practical improvement, though one not easy to carry out without an effect on the adaptability of the fixture, would be to provide the base with a broad foot to take two or more well-separated fixing bolts.

The overhang of the sliding work table from the base of its vertical support is another factor which affects rigidity. Many fixtures, especially those which swivel, do not provide the support to withstand the levering action caused by rotating cutters-generally much greater than the continuous action of a comparable single-point tool.

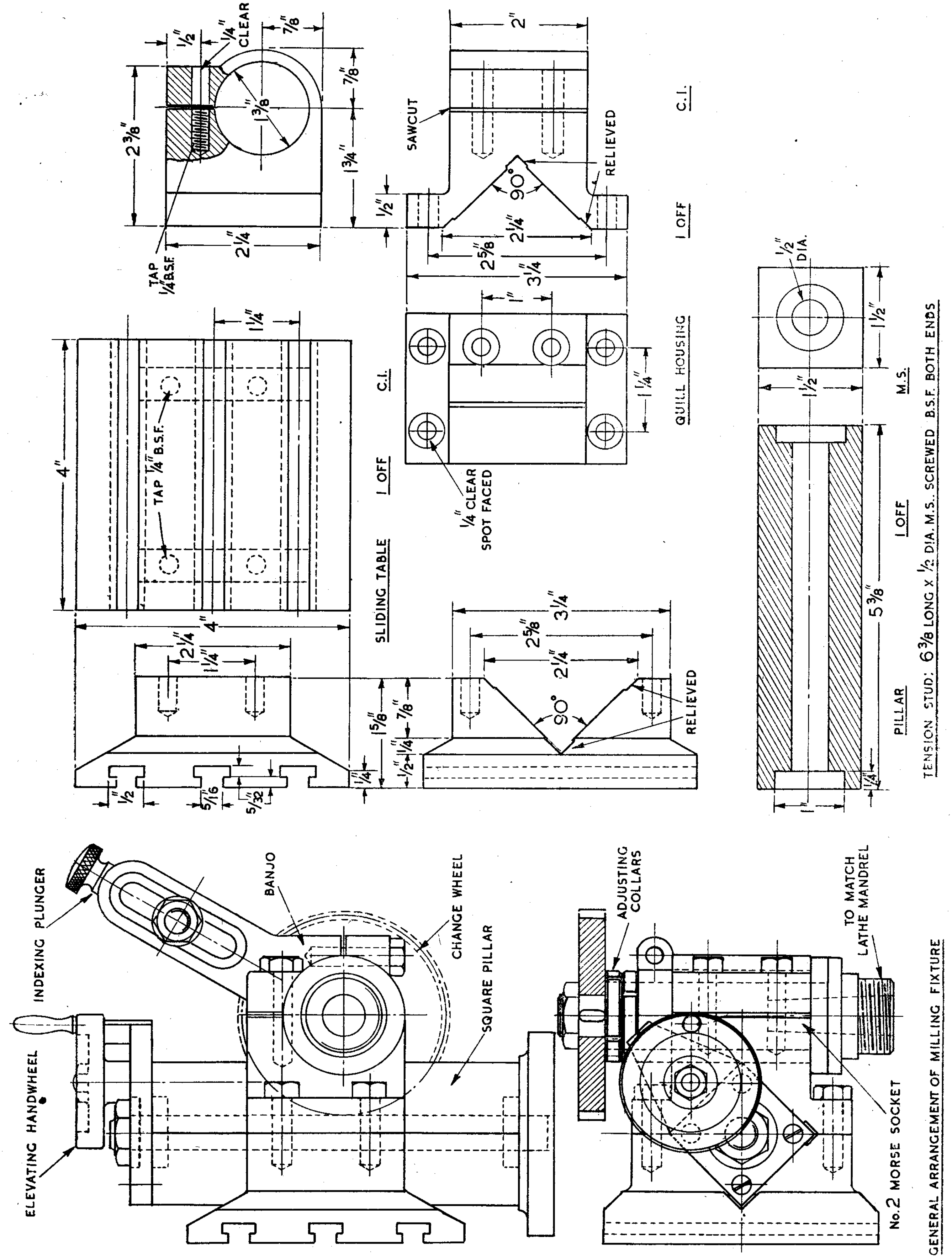
In the appliance shown, the form of vertical support is unusual. It is intended to provide rigidity with the minimum overhang of the work table or milling spindle. Its principle is logical, and by no means without precedent in machine tool design, as the prismatic form of slideway or lathe bed. has been used in some of the best machine tools. But the major reason for the use of a square pillar is ease of production in the home workshop. The pillar itself can be made from stock mild steel bar, which is obtainable in. sufficiently accurate shape to need no more than a little filng and scraping, with the normal checking. Exactness of angle on the four sides is not highly important so long as the sliding parts are fitted to the bar; this also can be done by filing and scraping.

The pillar is mounted on a part-circular baseplate with flats on the sides to bring it within the width of a normal cross-slide-there is no advantage in any overlap-but of an adequate diameter that will provide adequately stable mounting. Slots in the base give a latitude which will accommodate variations in the spacing of the T-slots in the cross-slide, and also the angular position of the base. A 1/2 in. hole is drilled through the centre of the pillar and counterbored at both ends to provide! a register recess. It is secured to the base by a long tension stud, which can be tightened much more securely than is possible with the central anchorage bolt usually fitted on a vertical slide. Alternatively, the pillar could be permanently attached to the base by brazing or welding, but this might restrict the rotation of the pillar for setting the table at angles other than 90 degrees to the lathe axis, unless the baseplate is modified.

On the side of the pillar opposite to the vertical table, a housing is provided for either a milling spindle or a simple form of dividing head. The bearing for both fittings is of the self-contained quill type; you can remove or replace it without upsetting adjustments. In the general arrangement drawings, the dividing spindle is shown in position; it is designed to take the same nose and socket fittings as the lathe itself, so that work can be transferred from one to the other. The tail end of the spindle takes any of the lathe change wheels, which can be indexed by a spring plunger mounted on a banjo clamped to the quill. This gives a range of divisions which will cope with many-perhaps most-workshop requirements. The range can easily be extended by the addition of a worm gear or other multiple indexing device.

If milling or indexing is never likely to be required, the spindle housing may be replaced by a V-grooved saddle, similarly fitted to slide on the pillar with the vertical table. But the housing takes up so little room, and is so unlikely to get in the way or affect operation of the slide, that it is worth fitting even if its use is not at first envisaged. Only vertical movement of the slide is provided, in the interests of simple construction and rigidity. In my experience, angular movement of the slide is rarely needed; you can generally obtain the essential object by mounting the work obliquely on the table. The spindle housing, in the form shown, is also restricted to the horizontal position. For some kinds of work, provision for swivelling the housing about the horizontal axis, and also for fitting an overarm support bar would be an advantage, but these refinements have already been anticipated in the design and will be incorporated in a modified version.

The elevating movement of the slide is provided by a screw, the bearing of which is in an overhanging plate attached to the top of the pillar. It engages a tapped hole in the housing or saddle casting, and is operated by a disc handwheel grad-


SLIDING TABLE
1 OFF
C.I.
QUILL HOUSING
1 OFF
C.I.
PILLAR
1 OFF
M.S.
TENSION STUD: 6 3/8 LONG X 1/2 DIA. M.S. SCREWED B.S.F. BOTH ENDS
GENERAL ARRANGEMENT OF MILLING FIXTURE
TAP 1/4" B.S.F.
1/4" CLEAR
SAWCUT
RELIEVED
90°
1/4" CLEAR SPOT FACED
1/2" DIA.
ELEVATING HANDWHEEL
INDEXING PLUNGER
BANJO
CHANGE WHEEL
SQUARE PILLAR
ADJUSTING COLLARS
TO MATCH LATHE MANDREL
MORSE SOCKET
No. 2 MORSE SOCKET

uated to serve as an index. This is, in my opinion, much better than the popular ball handle with a separate index disc; it gives a more open spacing of divisions owing to its larger diameter and is therefore easy to read. But this is, of course, an optional fitting, and may be modified to suit your preference. The screw is intended to be 3/8 in. BSF 120 **t.p.i.,** so that if 50 divisions are engraved on the disc, each will represent a vertical movement of 1/1,000 in. Although feed-screws for machine slides generally have square or Acme threads, and are coarser than most standard V forms, the Vs together with their corresponding internal threads, are quite serviceable and provide finer adjustment. They are likely to be at a disadvantage only when frequent and rapid traverse is required.

In making this appliance, you should begin with the square pillar. Having obtained a suitable piece of square steel bar, ***or*** machined it from the solid, you check it for general truth, and mark it out carefully for central drilling. It is then set up in the four-jaw chuck, and its true running is checked over the four flats-not over the corners, which may vary in sharpness. As you cannot steady the projecting end of the bar (except by making a special fitting) the overhang may cause some lack of rigidity, tending to affect the accuracy of drilling. It will therefore be worth while for you to allow an extra 1/2 in. or so of length, which, after the centre-drilling and supporting on the back centre, you can turn circular and run in the three-point steady; this extension will of course have to be parted off afterwards, but it can be retained until you have machined the register recess.

The pillar need not be made to the specified length (though this will give a convenient range of vertical movement for most purposes on lathes of about 3 1/2 in. centres). Neither is it essential that the hole should be exactly central. But it must be at least parallel to the axis, so that when the ends are faced at the same setting as the drilling operation the pillar will stand exactly vertical on a level surface. Take all possible pains to be accurate. Though errors in machining can be corrected in fitting, it is much better if they do not occur in the first place.

Your most suitable tool for forming the recess at each end of the pillar is a counterbore. You can make one by fitting a double-ended high-speed or silver steel bit in a mild steel bar 1/2 in. diameter, to suit the drilled hole. The exact size of the recesses is not critical, as the spigots of the baseplate and cap can be fitted to them.

The baseplate can be made from an iron casting or a piece of steel plate. In the machining, the important points are flatness and parallelism of the underside and pillar seating, and the fit of the spigot. The position of the slots for bolting it to the cross-slide may be modified to suit the spacing of the T-slots in the lathe on which it is to be used. For the tension stud, a suitable length of 1/2 in. mild steel bar is screwed at each end to fit the tapped hole in the baseplate, and to take a standard nut at the top. Screwed rod or studding may be used, but it is not so strong as a properly made double-ended stud.

I recommend simple iron castings for both the sliding table and the quill housing. You can cast in the T-slots in the table by providing a corebox and putting core prints on the pattern, but unless they are cast smooth and accurate they may be more trouble than they are worth. It is quite possible to machine the slots from the solid, or from rudimentary grooves cast directly from the pattern, when the table is fitted to the pillar and mounted on the cross-slide.

The table casting is first machined on the front surface. After it has been mounted in the four-jaw chuck, and reversed for similar treatment on the joint face, you can machine the four edges square by mounting the casting face down on an angle plate. To make sure that these edges are in reasonably true angular relation to the V groove, clamp a round bar in the groove and use it as a location gauge.

If you do not have a shaping or milling machine you can file and scrape the V surfaces to fit the pillar. Use an accurate flat bar, or a slip of plate glass, to test the individual side surfaces, with the aid of marking colour or " mechanics' blue." You can again use the round bar as a gauge to check both the squareness of the groove with the edges of the table, and its parallel truth with the face. Lay the table on a surface plate with the bar in the groove, and measure its underside distance from the plate at each end with inside calipers, or over the bar with a dial test indicator.

After the quill housing has been machined on the joint face, you can deal with it in the way that you fitted the V groove. When offered up to the pillar, the joint faces may not make contact, and there is a choice between increasing the depth of the grooves or of fitting shims between the faces.

To machine the bore of the quill clamp, the casting may be mounted on an angle plate and squared off carefully from the V groove. The bore should be dead parallel and both ends faced to provide a true seating for the quill when fitted either way round. Before splitting the clamp, the holes for the clamp screws should be drilled, tapped and spot faced.

NED.

To be continued