TECHNOLOGY

TOOLING OF BUILDING-BLOCK MACHINE TOOLS FOR CLAMPING DRILLS WITH CT-PROFILE SHANKS

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To drill holes on “building-block” (standard-unit) machine tools and automatic lines, cylindric drills, which are much cheaper, are used in place of drills having tapered shanks. It is even more effective to use drills having CT-3-profile shanks (CT means constant thickness and 3 is the number of profile faces). Such shanks ensure more reliable clamping of drills, greater resistance of drills to torsion, and better machining conditions.

Various types of collet chucks and mandrels, which are connected with the spindles of the multi-spindle head or of the building-block (standard-unit) machine tools by keys, are used as accessory tools for clamping drills on the referred machine tools. But key joints do not make for adequate torsional rigidity and increase the number of setup elements. So, it is more effective to use CT-3-profile connection (polygon shaft joint) of the mandrel with the spindle.

If the building-block machine tools are sufficiently steady, it is desirable to drill holes by maximally short drills (without jig bushings); because of short length of the drill, its rigidity increases, which, combined with use of a CT-3-profile shank, increases cutting speeds.

The setups for clamping drills with CT-3-profile shanks may be of various designs (Fig. 1). The mandrel 6 of the setup with a two-sided six-tab collet 5 (Fig. 1a) has a CT-profile shank with a CT-3-profile thread, on which the nuts 8 and 9 are screwed (tightened). The mandrel is joined with the spindle 10 through a CT-3-profile hole. The nuts 8 and 9 perform the function of regulating the throat clearance of the mandrel, which is axially fixed in the spindle by the screws 11 in contact with the surface of the groove in the shank of the mandrel. The axes of the screws are shifted relative to the axis of the mandrel by a distance h. Turning of each screw produces a torque \( M_{\text{tor}} = Q_l h \), where \( Q_l \) is the axial screw tightening force, under the action of which selection of the clearance (gap) in the CT-3-profile joint (connection) and automatic centering of the mandrel take place. In this case, the connection passes from the clearance area to the interference (tension) area. It is desirable that the direction of the torque \( M_{\text{tor}} \) developed on cutting matched the direction of action of the torque of the screw \( M_{\text{tor}} \). In the hole with the chamfer of the mandrel is fitted the two-sided six-tab collet 5, which is tightened by a nut that can be screwed through a cylindric thread on to the mandrel 6. A bronze bushing 3 in contact with the collet chamfer is fitted on the body 2 of the nut with the help of a collar spring (spring lock) 4. The hole in the shank is of a CT-3 profile shape. As the nut is screwed down (tightened), the tabs on two sides of the collet contract and securely clamp the CT-3-profile shank of the drill 1. In the shank of the mandrel a long thread is cut under the screw 7, by which the throat clearance of the drill is regulated.

In the setup (Fig. 1b), a one-sided six-tab shank 5 having a conicity (taper angle) of 1/10 and a groove, into which enters the collar of the bronze bushing 4 secured in the nut 3 by the screws 2, is securely attached to the mandrel 6 having a CT-3-profile shank. The hole in the collet has a CT-3 profile. Upon tightening of the nut 3, the tabs of the collet contract and secures the CT-3-profile shank of the drill 1. Upon unscrewing of the nut, the collet moves out from the groove and disengages (releases) the drill (positions 7–11 are the same as in Fig. 1a).

The mandrel 3 in the setup (Fig. 1d) is shaped like a CT-3 profile with a thread on the shank, on which the nuts 6 and 7 are screwed for regulating its throat clearance relative to the spindle 8. Rigid axial fitting of the mandrel in the spindle is done with the help of the screws 9. A six-tab collet 2 with a conicity of 1/10, which is controlled by the spring-controlled spring 4, is inserted into the conical (tapered) hole of the mandrel. To prevent turning, the collet shank and the mandrel hole to be con-
Fig. 1. Setups for clamping drills with CT-3-profile shanks.

connected are shaped like CT-3 profiles. The hole in the collet is also shaped like a CT-3 profile. The end of the collet shank has a round shape (with a diameter \( d \) of the inscribed circumference of the CT-3 profile of the shank). A thread is cut at the end of the shank for tightening the nut 10, upon screwing of which the collet 2 which, by overcoming the force of the spring 4, fits into the tapered mandrel hole and clamps the CT-3-profile shank of the drill 1. The setup is adjusted outside the machine tool (lathe). The throat clearance of the drill is regulated by the screw 5. Upon unscrewing of the nut 10, the spring 4 ejects the collet 2 and the collet releases the drill.

In the setup (Fig. 1e) the mandrel 4 is shaped like a CT-3 profile. The design of the connection of the mandrel with the spindle 9 of the machine tool by the screws 8 and regulation of the throat clearance of the mandrel by the nuts 5 and 6 are the same as described above. A CT-3 profile hole with a notch is made at the end of the knee part of the mandrel 4. Into this hole is mounted a split CT-3-profile reducing bushing 3, into which the drill 1 having a CT-3-profile shank is fitted. Upon screwing of the bolts 2, the knee of the mandrel and the bushing are elastically deformed. The throat clearance of the drill is regulated by the screw 7. By replacing the bushing 3, drills of various diameters (within a fixed range) can be mounted. The mandrels are connected with the spindle by the fit H6/h6 or H6/g6.

A CT-3-profile thread is cut on the shank of the collet 3 of the setup for building-block machine tools (Fig. 1c); on this thread are screwed the nuts 8 and 9 for regulating the throat clearance of the mandrel relative to the spindle 10 of the machine.