

The present invention concerns a clamping device in accordance with the introductory part of patent claim 1 for workpieces to be processed on a machine tool.

If a workpiece has to be processed by means of a machine tool, the latter has to be secured somehow on the working table or in the operating zone of the machine tool. It is known for the working table to be provided with undercut grooves, wherein clamping bolts are carried for displacement. By means of the latter and clamp-type retaining elements, a workpiece can be clamped on the working table. This method is cumbersome, time consuming and often unsuitable for small workpieces.

Moreover, clamping devices are known which have a frame that is provided with clamping elements. In a design known from the CH-A-467 647, a frame side is designed as a fixed clamping jaw and inside the frame, a displaceable clamping jaw is carried which is subject to the action of one or more clamping screw spindles or the like. Thereby it is possible to clamp the workpiece between the fixed and displaceable clamping jaw. The drawback of such a clamping device is that only a single workpiece, or several identical workpieces that are of exactly the same size, can be clamped. A further drawback is that such a frame, if it is to be used for the clamping of large, or a plurality of small workpieces, is either too yielding because it is subject to elastic deformation during the clamping, or that it becomes extraordinarily heavy and unwieldy if it is to be designed with sufficient rigidity. In many applications, in particular in the processing of a workpiece by wire electroerosion, it is absolutely essential to design the frame to be open. This requirement constitutes an additional difficulty in designing the frame to be sufficiently stable with an acceptable weight.

It is the object of the present invention to develop a generic clamping device in such a way that it can be kept relatively light and manipulable, but that it nevertheless has an extraordinarily high resistance to elastic deformation during the clamping process, and that it is possible to selectively clamp therewith individual larger workpieces, even those of an irregular shape, or a plurality of smaller workpieces also with varying dimensions, in a secure and precise manner.

In accordance with the invention, this is achieved with the features of claim 1.

This design allows workpieces to be clamped between two clamping bars which are roughly adjusted to the desired distance, that is to say, to the width or length of the workpiece to be clamped, and which are provisionally mounted at both ends on the frame sides. The actual clamping of the workpiece or workpieces is, in this arrangement, effected in the auxiliary frame at the point that is most suitable for

this purpose, so that the supporting frame is freed of any clamping forces.

The clamping bars intended for use in such a clamping device have a plurality of through threaded bores widened to a pre-determined nominal size and extending at right angles to the direction of reach of the clamping bars.

In this arrangement, the threaded holes can assume three functions:

1. To prevent bending of the clamping bars, it is possible to provide the two bores of each clamping bar extending directly next to the workpiece with a through screw-bolt, which is loosely inserted into the aligned bores and is secured by a nut.
2. Some of the bores can be provided with grub screws which are then tightened towards the workpiece. This makes it possible in particular to clamp irregularly shaped workpieces or those not true to size.
3. Some of the bores can be provided with cylindrical stop rods towards or on which the workpiece is disposed; this is advantageous, in particular when it is necessary to successively clamp a plurality of identical workpieces in the same position in the frame.

Further developments of the object of the invention, as well as preferred modes of embodiment emerge from the dependent claims 2 to 12.

Two examples of embodiments of a clamping device in accordance with the invention will be explained below in greater detail with reference to the attached drawings. In the drawings, there are shown in

Fig. 1 a top view of a first example of the embodiment of a clamping frame in which several workpieces have been clamped;

Fig. 2 a side view of a clamping bar in accordance with a first mode of embodiment;

Fig. 3 a bottom view of the clamping bar according to Figure 2;

Fig. 4 a part section through the clamping bar along line IV-IV in Figure 2;

Fig. 5 a top view of a second example of the embodiment of a clamping frame wherein several workpieces have been clamped;

Fig. 6 a side view of a clamping bar according to a second mode of embodiment;

Fig. 7 a bottom view of the clamping bar according to Figure 6 and

Fig. 8 a part section through the clamping bar according to Figure 6 along line VIII-VIII in Figure 7.

According to the schematic representation of Figure 1, provision is made for a supporting frame generally designated by 1, which can be secured by means, not designated in detail, on the working table (not shown) of a machine tool. The frame 1 has two crossbars 2 and 3 as well as two longitudinal members 4 and 5 which are assembled into a rectangular rigid structure. The two longitudinal members 4 and 5 are provided with threaded bores 6 extending at right angles to the plane of the frame which are arranged in one row each in the longitudinal reach of the longitudinal members 4 and 5 at a uniform mutual interspacing.

In the case of the example, the frame 1 is provided with four clamping bars 7, 8, 9 and 10 of an identical form. Their design clearly emerges from Figures 2-4 where the clamping bar 7 is represented in a side view, in a bottom view and in a part section. The clamping bar 7 is formed by an elongate steel element with a rectangular cross-section. At both ends, the clamping bar 7 has one flattened extension 11 each. The length of the clamping bar 7 without the extensions 11 corresponds to the clear width of the frame 1 measured between the two longitudinal members 4 and 5. The dimensions of the extensions 11 are designed in such a way that they at least partly cover the tops of the longitudinal members 4 and 5 which are provided with the threaded bores 6 and bear thereon.

The extensions 11 are provided with elongate slots 12 which are arranged in such a way that when the clamping bar 7 is inserted into the frame 1, they lie above the threaded bores 6 and leave them free. The length of the slots 12 amounts to slightly more than the mutual interspacing of the threaded bores 6, so that each clamping bar 7-10 can be inserted at any desired point inside the frame 1, extending parallel to the cross members 2 and 3. As may be seen in Figure 1, provision is made for screws 13 which pass through the slots 12 and which are screwed into the threaded bores 6 so as to retain the clamping bars in their position.

One longitudinal end edge of the clamping bar 7 is provided with a plurality of uniformly interspaced prismatic recesses 14. Between the recesses 14, provision is made for a narrow flat zone of the longitudinal end edge. The clamping bar 7 is, moreover, provided with a plurality of bores 15 extending in the plane of the frame and transversely to the longitudinal direction of reach of the clamping bar 7. These bores lie on

each occasion in the narrow flat zone of the longitudinal end edge of the clamping bar 7 between the prismatic recesses. In addition, further bores 15a may be provided in the zone of the ends of the clamping bars.

The design of the bores 15 and 15a respectively is shown in section in Figure 4. As such, these are threaded bores which are, however, widened to a certain nominal size n. This size preferably lies approximately between the core hole diameter k and the nominal thread diameter g. In the case of the example, the threaded bore 15 and 15a respectively are provided with a metric M10 thread whose nominal thread diameter amounts to 10 mm. The core hole diameter of an M10 screw amounts to approximately 8.2 mm. Thus the nominal diameter n to which the threaded bores 15 and 15a are widened, amounts to 9 mm.

This design makes it possible to use the bores 15 and 15a respectively in three ways: firstly, M10 screws or threaded bolts can be screwed in, secondly, round rods with a diameter of 9 mm can be passed through and they are securely carried largely without play in the bores 15 and 15a respectively and thirdly, M8 screws or screw-bolts can be passed through.

Reverting to Figure 1, the advantage of this design will be explained below. In a first example, six cylindrical workpieces are to be clamped in the frame with their axis extending transversely to the plane of the frame. For this purpose, the two clamping bars 7 and 8 are used in the orientation shown. In this arrangement, the workpieces 16 lie respectively in the prismatic recesses 14 and are therefore uniformly interspaced. The clamping bar 7 can be screwed fast in a desired position on the frame 1 by means of the screws 13. Then the clamping bar 8 is inserted into the frame 1 and is pushed forward towards the workpieces 16 until it bears on them and is lightly secured on the two longitudinal members 4 and 5 by means of the screws 13.

Now M8 screw-bolts 17 are passed through all the respective aligned bore pairs 15 of the two bars 7 and 8 and are each provided with a nut 18. The latter are now successively and uniformly tightened, so that the clamping bar 8 which, after all is only lightly secured on the frame sides 4 and 5, is drawn towards the workpieces 16 and clamps the latter fast. Finally, the two screws 13 of the clamping bar 8 can also be tightened.

Because of the fact that a screw-bolt 17 is provided on both sides directly next to each workpiece 16, any elastic deformation of the clamping bars 7 and 8 is avoided during the clamping process and all the workpieces 16 are securely clamped.

By way of a second example, a cube-shaped workpiece 19 is to be clamped, one surface 20 whereof is uneven or of an indeterminate shape. For this purpose, the clamping bar 9 is in-

serted at a suitable point into the frame 1 and is screwed tight by means of the two screws 13 on the two longitudinal members 4 and 5. Then a second clamping bar 10 is loosely inserted at a distance from the clamping bar 9, which distance is somewhat greater than the relevant width of the workpiece 19. Subsequently one stop rod 21 each with a diameter of 9 mm is inserted into two aligned pairs of bores 15 of the two clamping bars 9 and 10, so that each of the two rods 21 extends between the bars 9 and 10.

The workpiece 19 can now be placed on the stop rods 21 between the two bars 9 and 10, whereby its height and the parallel orientation to the plane of the frame is defined. Subsequently, the clamping bar 10 is displaced the surface 20 of the workpiece 19, leaving a small space free and is lightly secured by means of the two screws 13 on the longitudinal members 4 and 5 of the frame 1. Thereupon, M8 screw-bolts 17 are passed through the pairs of bores 15 and 15a respectively of the two bars 9 and 10 which lie nearest to the ends of the workpiece 19 and one nut 18 each is tightened by hand so far that it just bears on the side face of the clamping bar 9. Now M10 grub screws 22 are screwed into the three remaining bores 15 of the clamping bar 10 issuing in the zone of the workpiece surface 20 and are drawn tight so that the workpiece is clamped between the grub screws 22 and the clamping bar 9. Finally, the fastening screws 13 of the clamping bar 10 can also be tightened.

Here too, the advantage is obtained that the screw-bolts 17 can be arranged very close next to the ends of the workpiece so that any possible elastic deformation of the clamping bars 9 and 10 remains very small in the clamping process.

In accordance with the schematic representation of Figure 5, provision is made for a supporting frame generally designated by 101, which can be secured on the working table (not shown) of a machine tool by means of means not designated in detail. The frame 101 has two cross members 102 and 103, as well as two longitudinal members 104 and 105 which are assembled into a rectangular rigid structure. The two longitudinal members 104 and 105 are provided with threaded bores 106 extending at right angles to the plane of the frame, which bores are each arranged in a row in the longitudinal reach of the longitudinal members 104 and 105 and are uniformly interspaced from each other.

In the case of the example, the frame 101 is provided with two identically formed clamping bars 107 and 108. Their design clearly emerges from Figures 6-8 where the clamping bar 107 is represented in a side view, in a bottom view and in a cross-section. The clamping bar 107 is formed by an elongate steel element with a rectangular cross-section. At both ends, the clamping bar 107 has one flattened extension 111 each. The length of the clamping bar 107 without the extensions 111

corresponds to the clear width of the frame 101, measured between the two longitudinal members 104 and 105. The dimensions of the extensions 111 are designed in such a way that they at least partly cover the tops of the longitudinal members 104 and 105 provided with the threaded bores 6 and bear thereon.

The extensions 111 are provided with elongate slots 112 extending transversely to the clamping bar 107, which extensions are arranged in such a way that when the clamping bar 107 is inserted into the frame 101, they lie above the threaded bores 106 and leave them free. The length of the slots 112 amounts to slightly more than the mutual interspacing of the threaded bores 106, so that each clamping bar 107 and 108 can be inserted at any desired point inside the frame 101, extending parallel to the cross members 102 and 103. As may be seen in Figure 5, provision is made for screws 113 which pass through the slots 112 and which are screwed into the threaded bores 106 so as to retain the clamping bars in their position.

The clamping bar 107 is provided with a plurality of bores 115 extending in the plane of the frame transversely to the longitudinal direction of reach of the clamping bar 107. These bores lie on each occasion in the narrow flat zone of the longitudinal end edge of the clamping bar 107 and are uniformly interspaced from each other. In addition, further bores 123 are provided which are arranged transversely to the bores 115 and are arranged so as to extend between them in planes extending at right angles to the frame. The bores 123, whose exact form may be seen in section in Figure 8, have a normal thread and serve to accommodate U-bolts (not shown). Finally, the clamping bar 107 is provided with bearing bars 124 extending along adjoining longitudinal edges.

With respect to the form of the bores 115, the same applies as in the case of the bores 15 in the clamping bar 7; reference is made in this connection to the explanations in conjunction with Figure 4 which are valid as applicable.

Reverting to Figure 5, the advantage of this second embodiment will be explained below. By way of example, four cube-shaped workpieces 116 are to be clamped in the frame 101. For this purpose, the clamping bar 107 is inserted at a suitable point into the frame 101 and is screwed tight by means of the two screws 113 on the two longitudinal members 104 and 105. Then a second clamping bar 108 is loosely inserted at a distance from the clamping bar 107, which distance is approximately the same as the relevant width of the workpieces 116. Subsequently, stop rods 121 with a diameter of 9 mm are inserted into suitably located bores 115 of the clamping bar 107, so that they extend slightly into the space between the two bars 107 and 108.

The workpieces 116 can now be placed on the bars 124 between the two bars 107 and 108 and between the stop rods 121, whereby their height and their mutual interspacing are defined. Subsequently, the clamping bar 108 is displaced towards the side face of the workpiece 116, leaving a small space free, and is lightly secured by means of the two screws 113 on the longitudinal members 104 and 105 of the frame 101. Thereupon, M8 screw-bolts 117 are passed through the pairs of bores 115 of the two bars 107 and 108 which lie nearest to the ends of the workpieces 116, and one nut 118 each is tightened by hand so far that it just bears on the side face of the clamping bar 108. Now M10 grub screws 122 are screwed into four suitable bores 115 of the clamping bar 108 issuing in the zone of the workpiece surface 20 and are tightened, so that each workpiece 116 is clamped between the grub screws 122 and the clamping bar 107. Finally, the fastening screws 13 of the clamping bar 108 can also be tightened.

Here too, the advantage is obtained that the screw-bolts 117 can be arranged very close next to the ends of the workpieces, so that any possible elastic deformation of the clamping bars 107 and 108 remains very small in the clamping process.

It goes without saying that correspondingly, several smaller workpieces which have different widths can be clamped next to each other. The difference in dimensions can be easily compensated by screwing the grub screws 122 in to a greater or lesser extent.

When the clamping frame 1 or 101 in accordance with the invention is provided with the workpieces, it is extraordinarily stable with a comparatively light weight because of the fact that the clamping elements (screw-bolts 17 or 117, grub screws 22 or 122) can always be arranged directly next to, or very close to the workpiece or workpieces. Because of this, the clamping bars 7 can be kept comparatively narrow and light. The same applies in particular also to the frame members 2, 3, 4 and 5 or 102, 103, 104 and 105, since they no longer have to absorb any clamping forces at all, but only have the function of keeping the clamping bars 7-10 or 107 and 108, and hence the workpieces 16 and 19 or 116 in position. The clamping device in accordance with the invention can also be used in a very versatile manner for clamping large and small, individual or several workpieces of different shapes, in which arrangement, only a few basic elements that are identical with each other (clamping bars, screw-bolts, grub screws, stop rods) are used.



PATENT CLAIMS

- 5 1. A clamping device for workpieces for their processing on
a machine tool, with a rectangular frame (1; 101) with two
longitudinal members (4, 5; 104, 105) and two cross members
10 (2, 3; 102, 103), as well as with clamping elements for secur-
ing the workpieces to the frame, which comprise a displaceable
bar-shaped clamping member extending parallel to the cross
members, characterized in that the clamping elements consist
of at least one auxiliary frame (7, 8, 17; 9, 10, 17; 107,
108, 117) detachably inserted into the rectangular frame (1;
101), which auxiliary frame comprises two clamping bars (7, 8,
15 9, 10; 107, 108) that can be adjustably connected to each
other by connecting means (17, 18; 117, 118), which clamping
bars (7, 8, 17; 9, 10, 17; 107, 108, 117) can be respectively
secured with both their ends (11; 11) to the longitudinal
members (4, 5; 104, 105) with the facility of displacement in
20 the longitudinal direction of the latter, and which have bores
(15, 15a; 115) respectively opposite each other and extending
in the installed state of the clamping bars (7, 8, 9, 10; 107,
10) parallel to the longitudinal members (4, 5; 104, 105) for
the selective insertion of clamping screws (17, 22; 117, 122).
- 25 2. A clamping device according to claim 1, characterized in
that the clamping bars (7, 8, 9, 10; 107, 108) have a plura-
lity of through threaded bores (15, 15a; 115) widened to a
predetermined nominal size and extending at right angles to
30 the direction of reach of the clamping bars.
3. A clamping device according to claim 1 or 2, charac-
terized in that two opposite sides (4, 5; 104, 105) of the
frame (1; 101) are each provided with a row of uniformly in-
35 terspaced threaded bores (6; 106) extending at right angles to
the plane of the frame.
4. A clamping device according to one of claims 1 - 3,
characterized in that the clamping bars (7, 8, 9, 10; 107,
40 108) have flattened end zones (11; 111) which are intended to
lie on the frame sides (4, 5; 104, 105) provided with the
threaded bores (6; 106) and which are provided with one slot
(12; 112) each extending in the direction of reach of the
frame sides and coinciding with the threaded bores (6; 106).
- 45 5. A clamping device according to one of the preceding
claims, characterized in that the threaded bores (15, 15a;
115) in the clamping bars (7, 8, 9, 10; 107, 108) are widened
to a size (n) which in value corresponds approximately to the
50 mean of the nominal thread diameter (g) and core hole diameter
(k).



6. A clamping device according to one of the preceding claims, characterized in that a longitudinal end face of the clamping bars (7, 8, 9, 10) is provided with a plurality of prismatic indentations (14).

7. A clamping device according to claims 2 or 5 and 6, characterized in that some threaded bores (15) of the clamping bar are always arranged between two adjoining prismatic indentations (14).

8. A clamping device according to one of the preceding claims, characterized in that the clamping bars (107, 108) are provided with a plurality of uniformly interspaced threaded bores (123) extending perpendicularly to the plane of the frame.

9. A clamping device according to one of the preceding claims, characterized in that the clamping bars (107, 108) are provided on two adjoining edges extending parallel to the plane of the frame with bearing surfaces (124).

10. A clamping device according to one of the preceding claims, with two clamping bars (9, 10; 107, 108) extending parallel and next to each other, characterized in that some of the threaded bores (15; 115) of the clamping bars (9, 10; 107, 108) are provided with grub screws (22; 122) for clamping a workpiece (19; 116) between the two clamping bars (9, 10; 107, 108).

11. A clamping device according to claim 10, characterized in that some of the threaded bores (15; 115) are provided with stop rods (21; 121) projecting from the threaded bore.

12. A clamping device according to claim 10 or 11, characterized in that through screw-bolts (17; 117) extend through selected aligned threaded bores (15, 15a; 115) of the two clamping bars (7, 8, 9, 10; 107, 108).