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(54) CONNECTION ARRANGEMENTS FOR TOOL HOLDERS

(71) We, KENNAMETAL INC., a corporation of the Commonwealth of Pennsylvania, United States of America, of One Lloyd Avenue, Latrobe, Pennsylvania 15650, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to connection arrangements for connecting a tool holder to a support.

In respect of machine tools which are employed in production processes, it is important to be able to maintain the tool in proper workpiece operating condition at all times. What this involves is the maintaining of the cutting tools in the machine in sharp cutting condition, and this is best accomplished by replacing a cutting tool as soon as it has dulled a predetermined amount.

A great many cutting tool arrangements, at the present time, involve small inserts of extremely hard wear resistant material, such as cemented hard metal carbides, for example. These inserts are mounted, usually detachably, on tool holders which are, in turn, detachably mounted in the machine tool in which they are to be used.

Thus, it becomes possible quickly to renew a cutting tool either by replacing the insert in a respective tool holder, or by replacing the tool holder having the worn insert therein with another tool holder having a fresh insert therein. The last-mentioned procedure is often preferred because an insert can be exactly positioned in a tool holder externally of the machine tool and then, when the tool holder is placed in the machine tool, the insert will be precisely positioned and no other adjustments of the machine tool are required to continue producing workpieces having the proper dimensions.

In a prior United States Patent No. 3,498,563, issued to James F. McGreery, a novel arrangement is illustrated for connecting tool holders to supporting members therefor, such as turrets, in which a tool holder has radially movable clamping elements thereon actuated by an axially movable actuating member in the tool holder which, in turn, is moved toward and away from the clamping elements by a screw also carried by the tool holder.

This arrangement has proved to be highly satisfactory in respect of locating and clamping tool holders in place, but requires the use of a wrench for turning the screw and is, therefore, somewhat slow in operation and somewhat laborious to use.

According to the invention, there is provided a connection arrangement for connecting a tool holder to a support, in which said tool holder has a hollow, cylindrical shank portion receivable in a bore in a support with an abutment of said tool holder engaging a further abutment of said support, said support having a cylindrical member coaxially mounted in said bore and receivable in said shonk portion, and there being provided locking elements in said cylindrical member which elements are movable radially of said bore by an actuating element into and out of engagement with an internal shoulder provided on said shank portion.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example to the accompanying drawings, in which:—

Figure 1 is a plan view, somewhat schematic, showing one way in which a turret could be provided with tool holders and showing tool holders in two of the several positions of the turret;

Figure 2 is a fragmentary view showing the mounting of a key in the support member which engages a tool holder to prevent rotation thereof in the support member;

Figure 3 is a fragmentary sectional view showing the provision of a sensor on the support member or turret for determining when a tool holder is properly mounted therein;

Figures 4 and 5 show clamp elements and an actuating element carried by a turret;

Figure 6 shows a fragmentary sectional view of an actuating mechanism; and

Figure 7 is a schematic plan view showing a modification in which the support member is other than a multiple position turret.

The following describes a connection arrangement having a tool support, for example, a turret rotatably mounted in a machine tool. Such arrangements are, of course, well known in the machine tool art. Each work station of the turret is provided with a bore for receiving one end of the shank portion of a tool holder, with the tool holder having an insert supporting portion at the other end of the shank which projects outwardly from the outer periphery of the turret when the tool holder is mounted therein.

The shank has an axial bore extending therein from the rearward end and internal shoulders in said axial bore. Locking elements, which may be in the form of balls, are disposed for cooperation with the shoulders and an actuating element therefor, which may be in the form of another ball, is mounted in the axial bore at the rearward side of the locking elements.

The support member, or turret, has mounted therein an actuator for engagement with the actuating element in the tool holder and which actuator is spring urged in a direction to drive the actuating element in an actuating direction when the respective tool holder is in position in the respective bore in the turret. The actuator is movable in a direction to release the actuating element from the actuating position by power means, or by manual means. At least the power means is constructed and arranged so as to be operable in respect of each work station of the turret or work member in a respective position thereof so that a single power means can be provided for releasinig any tool holder from the turret when the tool holder is moved away from its working position.

There is also provided a sensor which will interrupt operation of the machine or provide for an alarm signal in the event that any tool holder is improperly mounted in the support member or turret at the time the particular tool support is changed.

Referring to the drawings somewhat more in detail, Figure 1 shows in plan view a turret 10 having a plurality of work station positions 12 circumferentially distributed thereabout and each comprising a generally radial bore 14 formed in the turret with each bore adapted for receiving a tool assembly 16 which consists of a holder 18 and a cutting insert or cutting element 20 mounted thereon. In Figure 1, only one tool assembly 16 is illustrated, but it will be understood that a tool assembly would be provided for each of the work stations 12.

Furthermore, the individual tool assemblies need not necessarily be oriented in the position illustrated, but could be positioned in different rotated positions on the respective axes of the tool units. In the arrangement shown in Figure 1, each work station of the turret is provided with a key element 22 for engagement with a recess in the respective tool holder to hold the tool holder against rotation when mounted in the turret.

As will be seen in Figure 2, each key element 22 may be in the form of a pin press fitted in an accurately located hole adjacent the work station with each holder 18 having a notch for closely receiving the pin 22 pertaining to the respective work station.

The machine may be provided with a sensor in the form of a limit switch 130, as shown in Figure 3, which has an actuating finger 132 engageable by flange 46 of the respective tool assembly 16. If a tool assembly is clamped in the turret without being completely inserted therein, limit switch 130 will provide for the shutting down of the machine before the improperly mounted tool reaches the working position, or the sounding of an alarm, or both.

Figures 4 and 5 show how the locking elements and an actuating ball therefor are carried by the turret or support member. In Figure 4, the turret or support member 150 has a bore 152 formed therein which, at the bottom, is intersected by a threaded hole 154 in which a cylindrical element 156 is threadedly mounted. Cylindrical element 156 extends axially along bore 152 and defines an annular recess with the said bore.

In Figure 4, the cutting insert supporting member is indicated at 158 and at the axially outer end has a pocket for receiving insert 160 while at the other end it is formed with an annular shank 162 receivable in the annular recess formed by bore 152 and member 156. Shank 162 is provided internally with an annular groove 164 which forms a shoulder 166 engageable by locking elements 168 which are mounted in radial holes formed in member 156.

Locking elements 168 are movable radially by an actuating ball 170 in member 156 and adapted for abutment by a screw 172 that is actuable by a suitable wrench introduced into bore 174 of the insert supporting member 158.

The support member 150 and insert support member 158 have respective elements of abutment means 176, 178 formed thereon so that when the insert supporting member, or tool holder, is inserted into the support member 150, which may be a turret, and screw 172 is actuated, the abutment surfaces 176, 178 will be firmly held together thereby to locate the tool holder axially in the support member and to lock it therein.

Rotation of the tool holder can be prevented by a key in the form of a pin 180

mounted in support member 150 and engaging a notch in the tool holder.

Figure 5 is similar to Figure 4 and employs the same reference numerals except that, in Figure 5, actuating ball 170 is disposed on the rearward side of elements 168 and is adapted for actuation to and from clamping position by a plunger 182 extending through the rearward or inner end of member 156 and adapted for actuation either hydraulically or manually or by a cam arrangement e.g. as shown in Figure 6 described below. In respect of Figure 5, it will be understood that plunger 182 is preferably biased toward the right as it is viewed in Figure 5 so that the tool holder is normally locked in support member 150.

Figure 5 shows how an actuating plunger 110, which is biased by spring 112 toward actuating element 66, could be provided with means to withdraw the plunger, which means is manually operable. In Figure 6, the plunger 110 has a transverse slot 114 in one side and, likewise, has an axial slot 116 extending therethrough.

A rod 118 extends through slot 116 and is rotatable in turret 10 and has a manually operable actuating lever 120 thereon and, furthermore, has an eccentric cam 122 located in slot 114. Rotation of lever 120 in any position of the turret will either release the respective tool holder from the pertaining work station or clamp a work holder in the respective work station.

Figure 7 shows a modification in which a block 250 is provided which may be fixed to a machine slide and which is bored to receive a tool unit 252 to be retained in the block 250 by any of the mechanisms which have been described above. Block 250 could be employed with an automatic tool changer mechanism, in which case no indexing of the block would be necessary and tool units would be automatically removed therefrom and placed therein during operation of the machine.

It is also possible for block 250 to be indexable, for example, about a central axis extending through the point marked 254 in Figure 7. In this case, a tool unit could be inserted into the central bore in the block from each end with each tool having a respective actuating mechanism pertaining thereto for locking the tool unit to the block. An arrangement of this nature is also adapted for use in connection with automatic tool changing units but has the advantage that one tool unit could be working while the other tool unit was being replaced.

When a tool holder presents an insert thereon to working position, it is desirable for the insert to be supplied with cooling fluid.

Referring again to Figure 1, a supply of cooling fluid is provided at 275 and is connected by a pump 277 with a stationary nozzle 279. As the turret indexes, nozzle 279 slides on the upper surface thereof and successively communicates with ports 281, each of which is connected by a respective passage means 283 with a port 285 which is engaged by the flange portion 46 of the respective tool holder.

The tool holder, in turn, has a passage 287 formed therein and communicating at one end with port 285 while the other end portion is directed so that coolant fluid emerging therefrom will be directed to the working region of an inert mounted in the respective tool holder.

As is known, the particular inserts in several tool holders will vary in configuration and the arrangement provides for an adequate supply of coolant fluid to each insert as it brought into working position. The arrangement provides for economical use of the coolant fluid and relieves the operator from the necessity of making certain that each insert is properly supplied with cooling fluid.

It should be apparent that the connection arrangement described above provides an extremely rapid system for interchanging tools in a tool support such as a turret.

Tools or tool holders in a support member, such as a turret, can be replaced quickly with a minimum of effort and even during operation of the machine of which the support member or turret forms a part.

WHAT WE CLAIM IS:—

1. A connection arrangement for connecting a tool holder to a support, in which said tool holder has a hollow, cylindrical shank portion receivable in a bore in a support with an abutment of said tool holder engaging a further abutment of said support, said support having a cylindrical member coaxially mounted in said bore and receivable in said shank portion, and there being provided locking elements in said cylindrical member which elements are movable radially of said bore by an actuating element into and out of engagement with an internal shoulder provided on said shank portion.

2. An arrangement according to claim 1 wherein said actuating element is movable by a screw threaded in said cylindrical member.

3. An arrangement according to claim 1 wherein said actuating element is movable by a plunger in said support.

4. An arrangement according to claim 1 wherein said actuating element is spring-biased in the locking direction.

5. An arrangement according to any one of claims 1, 3 and 4 wherein there is provided an actuator device in said support for actuating said actuating element.

6. An arrangement according to claim 5 in which said actuator device is a cam engageable with said actuating element.

7. An arrangement according to claim 5 or 6 in which said actuator device is operable hydraulically.

8. An arrangement according to any one of claims 1 to 7 in which the cylindrical member is threaded into the bore in said support.

9. An arrangement according to any one of claims 1 to 8 in which the tool holder and support have cooperating elements of a key thereon to prevent rotation of the holder in the support.

10. An arrangement according to any one of claims 1 to 9 in which said support is a turret.

11. An arrangement according to claim 10 in which said turret supports a plurality of said holders in circumferentially distributed relation, and each tool holder having a respective actuating element in the turret.

12. An arrangement according to any one of claims 1 to 11 in which a switch on the support is actuated by the tool holder when the latter is in the correct position in the support.

13. An arrangement according to any one of claims 1 to 12 in which said support is rotatable and the or each tool holder is releasable therefrom only in one or a respective rotated position of the support.

14. An arrangement according to claim 13 where said support is a rotatable turret having a plurality of said tool holders therein in circumferentially distributed relation, and a coolant passage is provided for each tool holder to supply coolant to a cutting insert on the holder.

15. An arrangement according to claim 14 in which said coolant passage includes a first portion formed in the turret and a second portion formed in the tool holder, said second portion directing the coolant in the desired direction.

16. An arrangement according to claim 15 in which a coolant supply is provided which communicates with said coolant passages only when the respective tool holder is in working position.

17. A connection arrangement substantially as hereinbefore described with reference to Figure 4 or Figure 5 of the accompanying drawings.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1

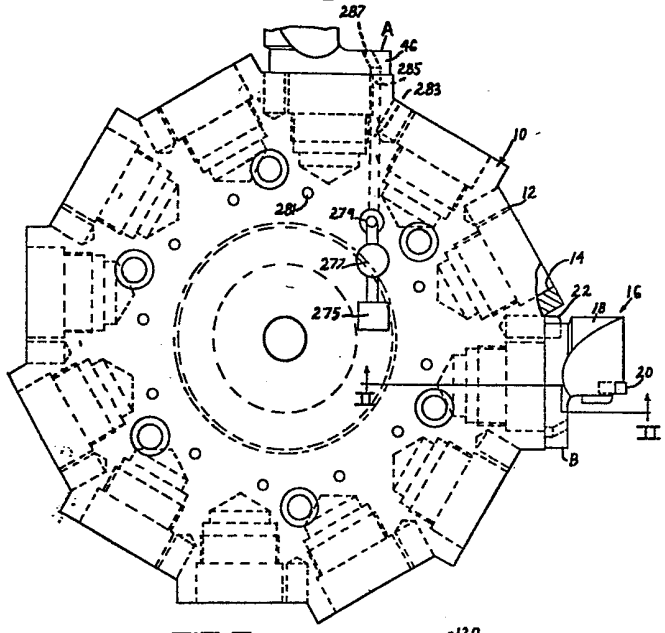
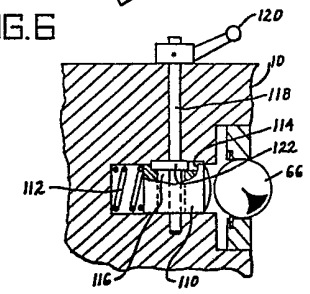


FIG. 6



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Sheet 2

FIG. 2

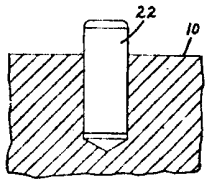

FIG. 3

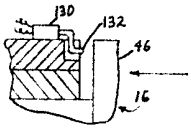

FIG. 4

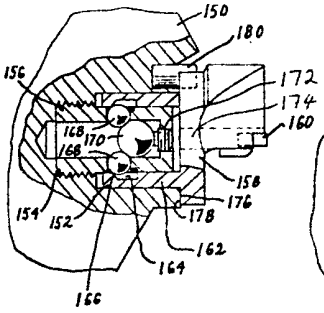

FIG. 5

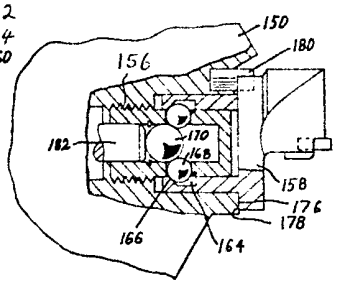

FIG. 7