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FLOATING TOOLHOLDER

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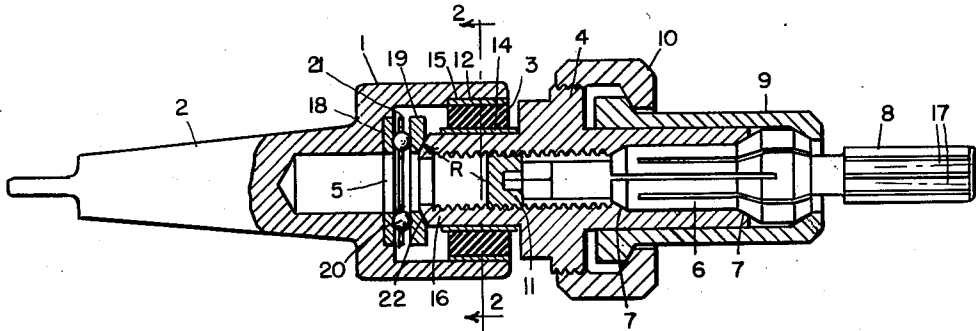


Fig. 1

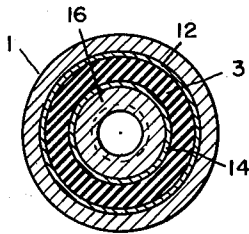


Fig. 2

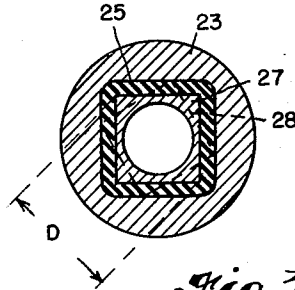


Fig. 3

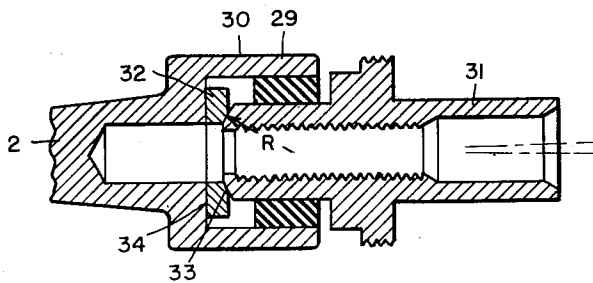


Fig. 4

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FLOATING TOOLHOLDER

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The present improvements in floating tool holders are especially concerned with holders in which the shank and tool holding members thereof are so connected to one another that the tool held in the latter can align itself with a workpiece on which it is performing a cutting operation.

Holders of the character referred have their greatest utility in conjunction with the machining of workpieces which require successive operations by different tools, viz. drilling followed by reaming, tapping or the like, such holders enabling production of high quality work and prolonging tool life in spite of inaccuracies in the co-axial disposition of the second operation tools relative to the axes of the drilled holes or the like in the workpieces.

Among the primary objects of this invention are to provide a floating tool holder in which the tool holding member and thus the tool held therein can fully partake of angular and transverse movement relative to the shank member; in which an axial thrust bearing means interposed between said members is formed so as not to impede such angular and transverse movement; in which a resilient element is the sole means employed to provide for the aforesaid movements but yet the thrust bearing means employed to preclude relative axial movement of said members in one direction does not impede the first-mentioned movements; and in which such resilient element is so formed that even abnormally severe torsional strains imposed on said members are not detrimental to the connections of such element with said members.

Other objects and advantages will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing—

Fig. 1 is a central longitudinal cross-section view diametrically through one embodiment of our invention;

Fig. 2 is a cross-section view of the holder of Fig. 1 taken substantially along the line 2—2 thereof;

Fig. 3 is a cross-section view taken along a plane normal to the axis thereof of a resilient element

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different from that illustrated in Figs. 1 and 2; and

Fig. 4 is a cross-section view similar to Fig. 1 except illustrating a modified form of holder.

In the embodiment of the invention illustrated in Figs. 1 and 2, numeral 1 represents a shank member provided with an end 2 of the usual form adapted for mounting into an appropriate machine, said shank having resiliently connected thereto by means of a resilient element 3, a tool gripping member 4. A thrust bearing 5 is interposed between said members to preclude relative axial movement thereof in one direction.

Associated with said member 4 is a contractible collet 6 formed with conical cam surfaces 7 which are adapted to engage like surfaces in said member whereby inward movement of said collet into said member effects radial contraction of the former into firm gripping engagement with the shank of a tool 8 which is herein illustrated as being a reamer. Such movement of the collet is effected as by a nose piece 9 engageable with the outer end thereof under the influence of a lock nut 10 having threaded engagement with said member 4.

Threaded in said member 4 is a set screw 11 operating as an adjustable positive stop for the end of the shank of the tool 8 whereby thrust loads on said tool are not effective to induce relative axial movement of said tool in said member 4. Thus, in instances where it is desired that the tool enter the work a predetermined distance in accordance with the adjustment of set screw 11 and the length of the tool 8 taken in conjunction with the relative movements of the work carrying and holder carrying devices of the machine, the tool cannot thereafter slip axially in member 4 to disturb this adjusted relationship.

The resilient element 3 referred to above preferably comprises an annulus of rubber or rubber-like material bonded or otherwise secured to metal sleeve members 12 and 14 respectively thereabout and therein. Said sleeve members 12 and 14 are in turn respectively fixed against both axial and rotative movement in shank member 1 and on tool holding member 4 as by forming the outer diameter of sleeve member 12 so as to have a drive or press fit in a counterbore 15 in said shank member and by forming the inside diameter of sleeve member 14 so as to have a similar fit over the cylindrical projection 16 of said tool gripping member. Obviously other well known expedients may be used for securing said resilient element in place between said members, as, for

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example, threaded connections, screws, broaching, swaging, etc.

It is now evident that with the structure thus far disclosed the tool holding member 4 including the tool 8 held thereby may partake of angular movement as indicated by the dot-dash lines 17 as well as movement parallel to the axis of said shank member 1 whereby as the tool and work are brought together, any misalignment thereof will be corrected as the tool performs its cutting operation on the work. This arrangement reduces bending strains on the tool to a minimum, enables the tool to take an even "bite" to thus prolong the life of the tool and eliminates the chatter or vibration of the machine which would otherwise result if a rigid tool holder were employed.

Now in order that axial movement of said tool relative to said shank member be prevented during the cutting operation to enable accurate control of the depth to which said tool enters the work, we have provided, in addition to the set screw 11 which prevents axial slipping of said tool in said holding member, a thrust bearing 5 for preventing axial movement of the holding member relative to the shank member. As illustrated, said thrust bearing 5 comprises a stationary race 18 (fixed in shank 1 by press fitting or otherwise), a movable race 19, and a row of balls 20 or like bearing elements carried in a retainer 21 between said races. The inner end of member 4 and said movable race 19 are formed with inter-engaging spherical faces 22 of radius "R." With such construction it can be seen that any angular, parallel, or rotative movement or combinations thereof of the shank and holding members relative to one another as permitted by said resilient element will not disrupt inter-engagement of such spherical faces. Thus, the thrust bearing 5 will at all times be operative to prevent relative axial movement of said members but such prevention of relative axial movement is not at the expense of hindering the finding by the tool 8 of a co-axial relationship to the drilled hole or other portion of the work inasmuch as the race 19 will always be freely movable in a plane normal to the axis of said shank member and when so moved is yet engaged by the spherical end of said gripping member.

In the resilient element illustrated in Fig. 3 the outer sleeve member 23 is formed with a non-circular cross-section aperture therethrough to which the outer surface of the rubber or rubber-like annulus 25 is bonded and the inner sleeve member 27 is likewise formed with a non-circular cross-section outer surface bonded to the inner surface of said annulus, the diagonal dimension "D" being such that under severe torsional strains, relative rotation of the sleeve members 23 and 27 and thus members 1 and 4 to which said element is connected, is positively arrested when the sleeve member 27 assumes the position illustrated by the dotted line 28, such arresting of relative rotation occurring before the aforesaid bonds of said annulus with said sleeve members are sheared. Such arrangement greatly enhances the life of the holder as a whole and requires less frequent replacement of the resilient element.

The modification illustrated in Fig. 4 is essentially the same as that of Figs. 1 and 2 except that the resilient element simply comprises a rubber or rubber-like annulus 29 having its outer and inner axially extending surfaces (circular or non-circular cross-section) respectively bonded

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directly to the shank member 30 and to the tool holding member 31. Another distinguishing feature is that the thrust bearing only comprises a movable ring 32 formed with a spherical face 33 engaged by a corresponding face on the end of gripping member 31. Said ring 32 is movable in a plane normal to the axis of shank member 30, as is the race 19 previously described, but because the balls 20 have been omitted such movement entails the overcoming of some friction between the ring 32 and the wall 34 of the shank member engaged thereby. However this friction is not sufficient to objectionably impede proper adjustment of the shank and holding members relative to one another with the tool held by the latter assuming a proper alignment with the work.

Having thus described several specific embodiments of our invention and the advantages accruing from the use thereof, it will be apparent to those skilled in the art that various modifications, in addition to those mentioned, may be made without departing from the spirit of the invention. Therefore, the disclosed structures are to be regarded as merely exemplary or typical especially with regard to the particular collets, shanks, and resilient elements that are shown, such parts of the combination being modifiable in many particulars to suit individual desires or requirements.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

We therefore particularly point out and distinctly claim as our invention:

1. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members, a resilient element between said members connecting them together for movement to relative positions with the axes thereof misaligned or parallel to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction.

2. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members, a resilient element between said members connecting them together for movement to relative positions with the axes thereof misaligned or parallel to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction, said thrust bearing comprising a ring constantly engaged by one of said members and movable therewith in response to relative angular or parallel movement of said members.

3. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members, a resilient element between said members connecting them together for movement to relative positions with the axes thereof misaligned or parallel to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction, said thrust bearing comprising a first ring fixed in one of said members, a second ring engaged by the other of said members and movable transversely therewith, and thrust bearing elements engaged between said rings.

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4. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members, a resilient element between said members connecting them together for movement to relative positions with the axes thereof misaligned or parallel to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction, said thrust bearing comprising a ring constantly engaged by one of said members and movable therewith in response to relative angular or parallel movement of said members, the inter-engaged surfaces of said ring and said one of said members being spherical with the centers thereof coinciding with one another and lying along the axis of said one of said members.

5. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members loosely fitted one with the other whereby to define an annular space therebetween, a resilient element in such space connected to said members to thus connect said members for angular and parallel movement relative to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction.

6. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members loosely fitted one with the other whereby to define an annular space therebetween, a resilient element in such space connected to said members to thus connect said members for angular and parallel movement relative to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction, said bearing and one of said members being formed with inter-engaged spherical surfaces whose centers coincide with one another and lie along the axis of the latter.

7. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members loosely fitted one with the other whereby to define an annular space therebetween, a resilient element in such space connected to said members to thus connect said members for angular and parallel movement relative to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction, said bearing and one of said members being formed with inter-engaged spherical surfaces whose centers coincide with one another and lie

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along the axis of the latter at a point generally corresponding with the point of intersection of a central transverse plane through said resilient element with the axis of said one of said members.

8. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members loosely fitted one with the other whereby to define an annular space therebetween, a resilient element in such space connected to said members to thus connect said members for angular and parallel movement relative to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction, the walls of such space being respectively of non-circular cross-section and of such relative size that upon predetermined relative rotation of said members such walls engage one another to arrest further relative rotation.

9. In a floating tool holder, the combination of substantially co-axially disposed tool holding and shank members loosely fitted one with the other whereby to define an annular space therebetween, a resilient element in such space connected to said members to thus connect said members for angular and parallel movement relative to one another, and a transversely movable thrust bearing engaged between said members limiting relative axial movement of said members in one direction, the walls of such space being respectively of non-circular cross-section and of such relative size that upon predetermined relative rotation of said members such walls engage one another to arrest further relative rotation, said resilient element being respectively bonded to said members, such arresting of relative rotation occurring prior to shearing of such bonds.

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