United States Patent [19]

Cellini

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[45] **May 1, 1973**

[54] **TOOL HOLDER LOCKING DEVICE FOR ROTATING SPINDLES**

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[22] Filed: **Oct. 30, 1970**

[21] Appl. No.: **85,439**

[52] **U.S. Cl.** .....**408/239,** 90/11 A
[51] **Int. Cl.** **B23b 39/00**
[58] **Field of Search** .....90/11 A, 11 D; 408/234, 239, 239 A, 240

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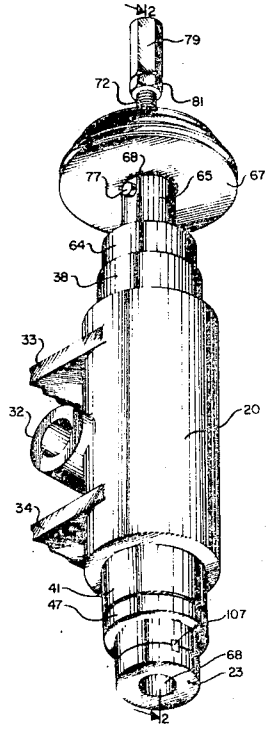
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Primary Examiner—Gerald A. Dost
Attorney—Polachek, Saulsbury & Hough

[57] **ABSTRACT**

A locking device for releasably securing a work tool holder to a rotating spindle. This locking device is centrally mounted within the rotating spindle to rotate therewith and includes a bushing with a lock shank extending downwardly with radially extending projection adapted to engage with projections on the inner end of the tool holder. Cam slot means are provided upon the lock member to effect a turning of the lock member for engagement of the projections of the lock member with the projections of the tool holder, an operating rod extends upwardly from the lock member within the spindle and spring biasing means urging the upward movement of the operating member, the operating member is confined against rotation while being depressed and has pin projections entering the dog-leg slots of the lock member so that as the rod is depressed the lock member will be rotated to engage the lock projections with or disengage them from the tool holder. The rotating spindle is carried in a spindle support which is in turn supported upon an arbor arm of a drill press. The tool holders are easily released by a mere use of a tool for depressing the operating rod at the upper end of the spindle. Centering means is provided for locating the tool holder in the proper angular relationship and alignment with the locking projections of the locking member. The spindles and the lock devices are self contained and can be mounted singularly or in multiple numbers in a supporting frame.

9 Claims, 19 Drawing Figures



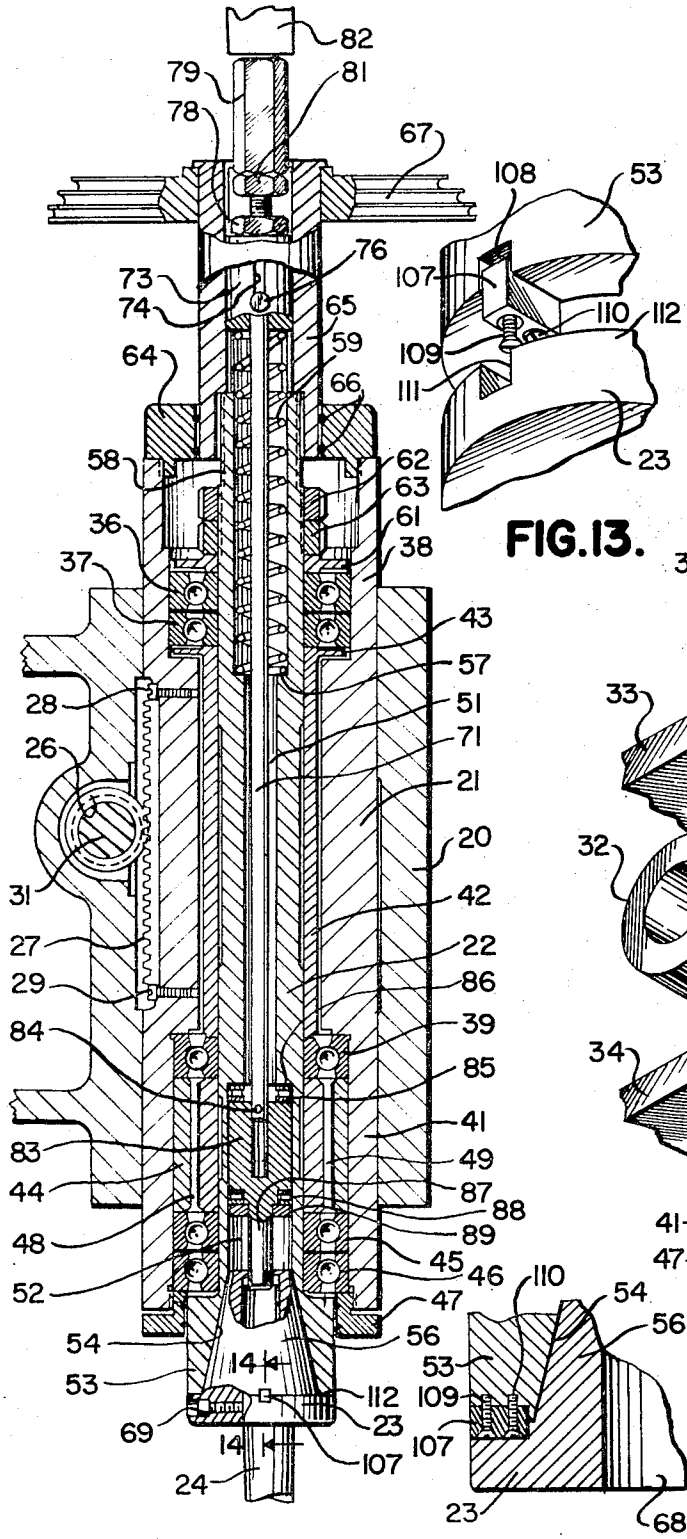


FIG.2.

FIG.13.

FIG.14.

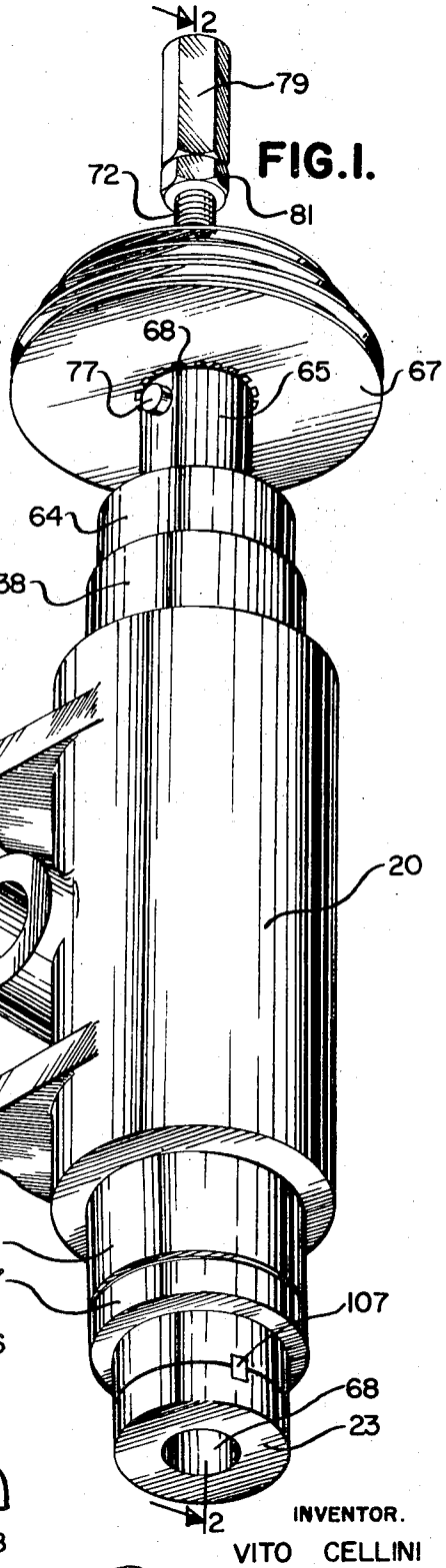


FIG.1.

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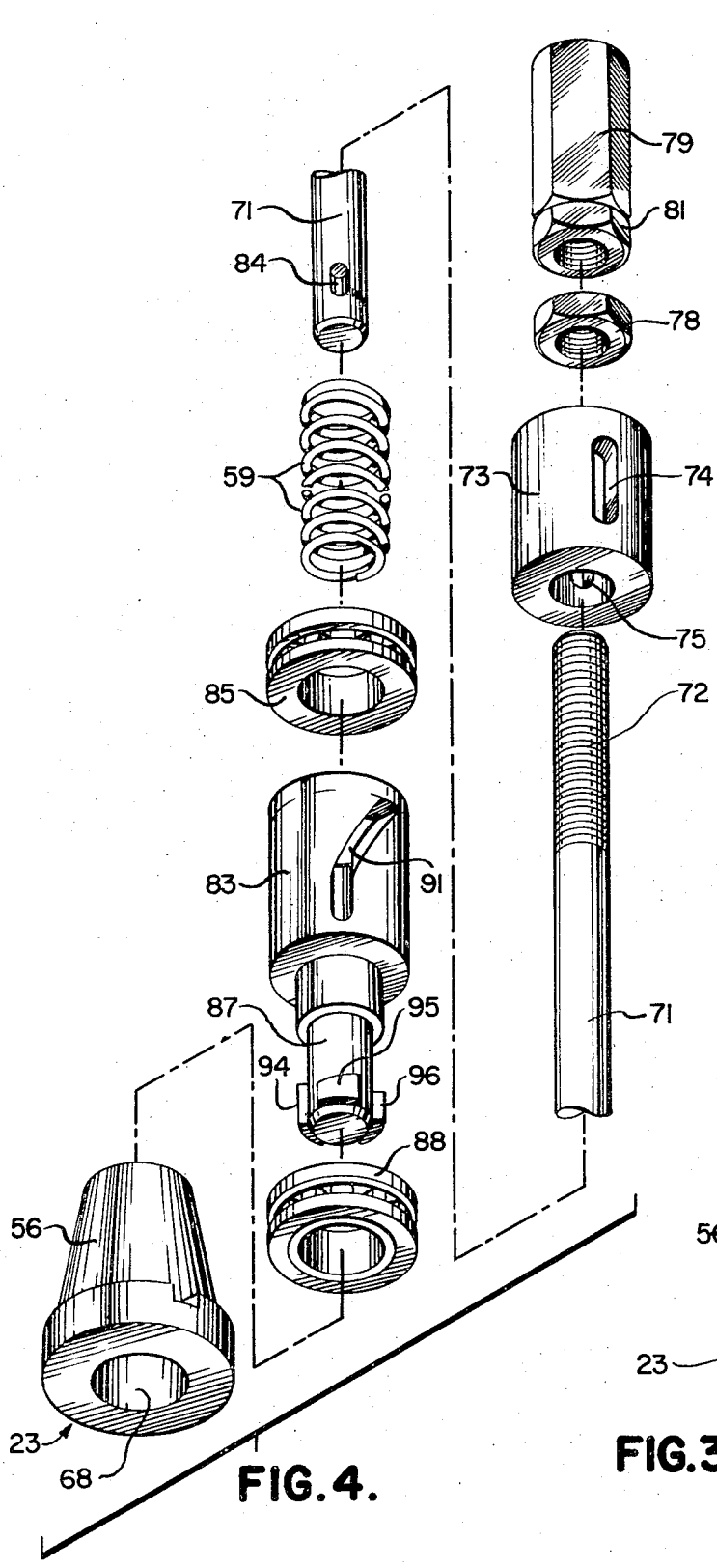


FIG. 4.

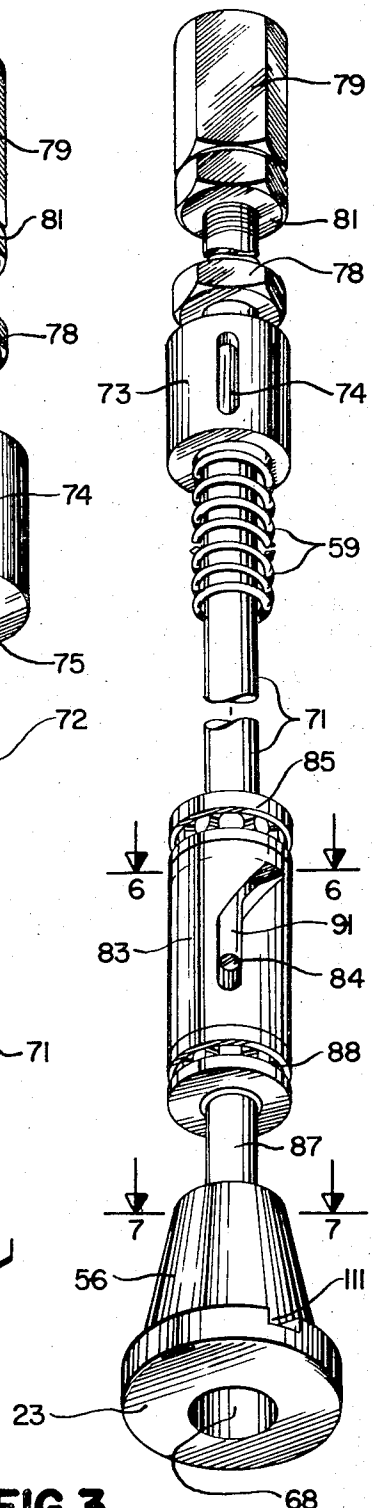


FIG. 3.

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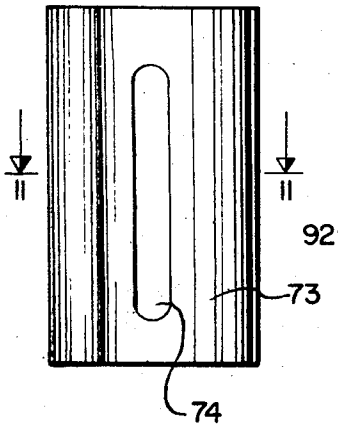


FIG. 10.

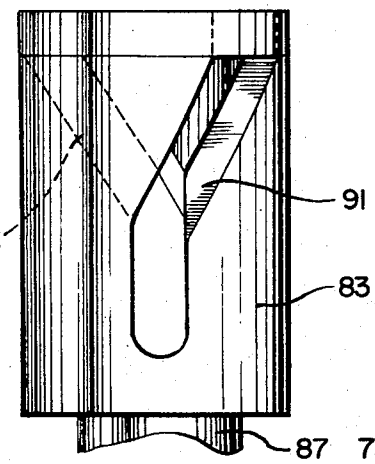


FIG. 12.

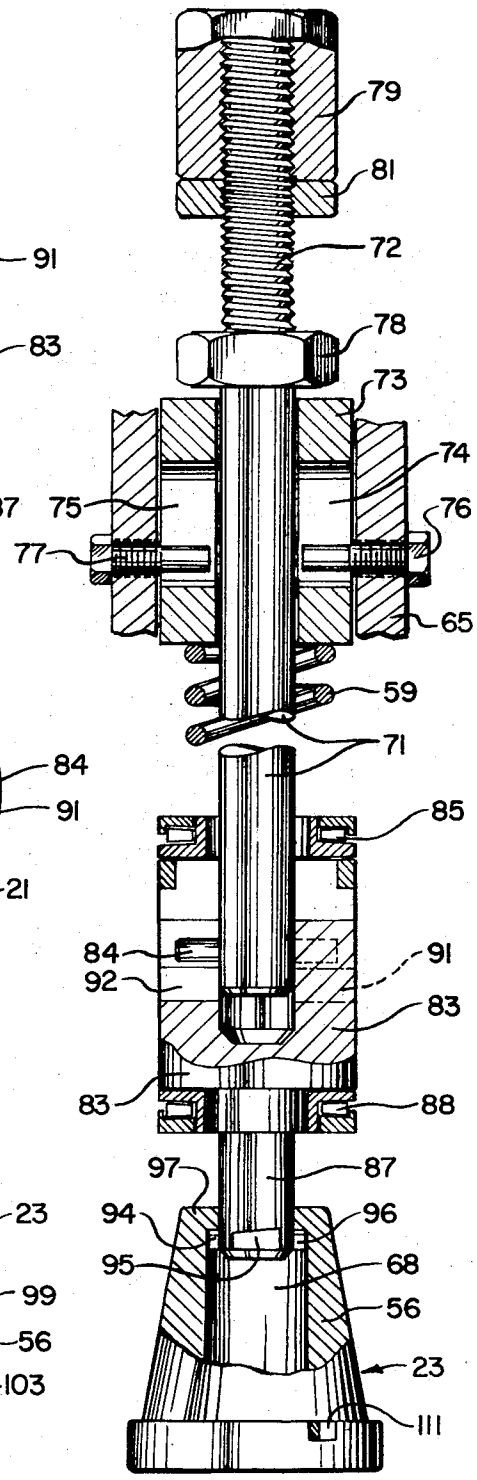


FIG. 5.

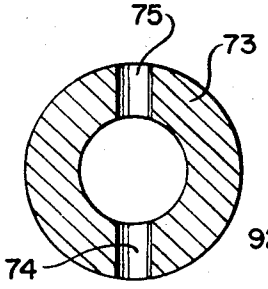


FIG. 11.

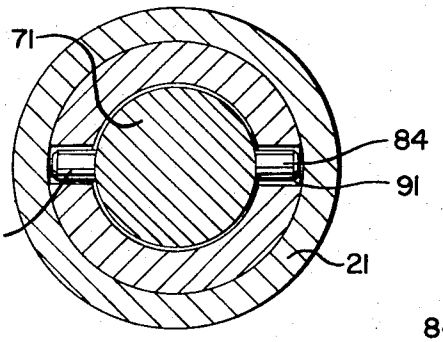


FIG. 6.

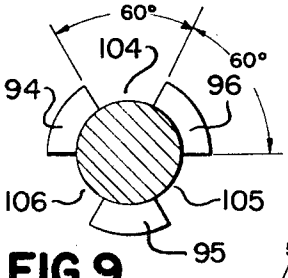


FIG. 9.

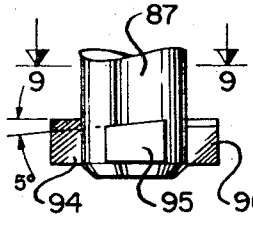


FIG. 8.

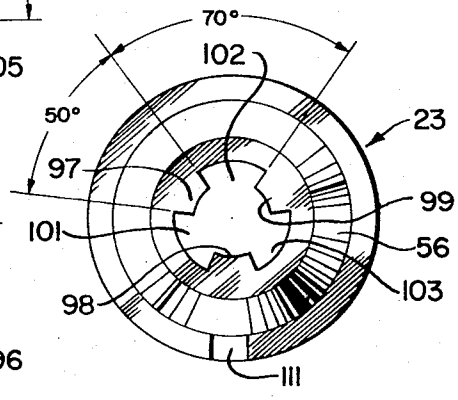


FIG. 7.

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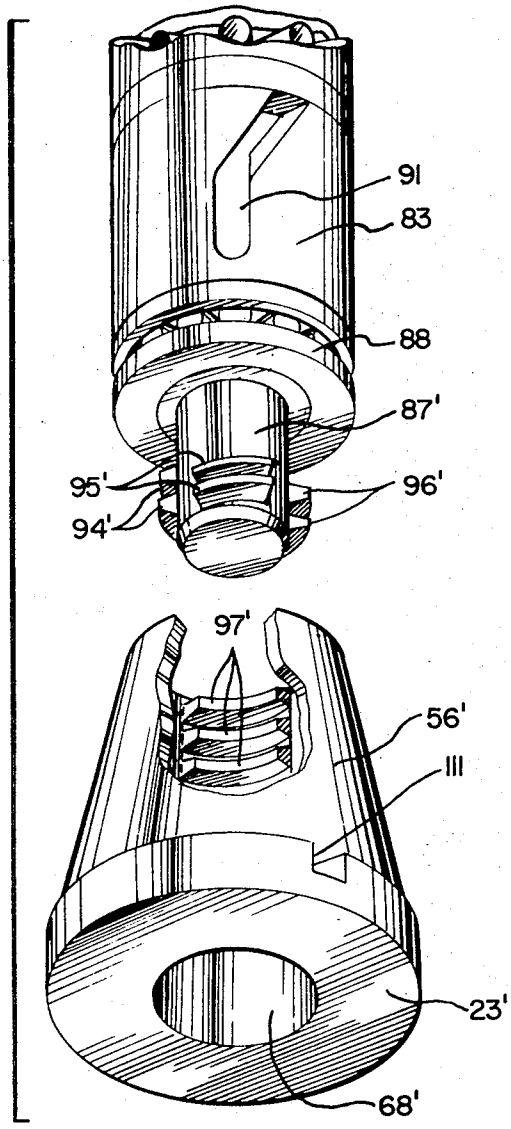


FIG. 15.

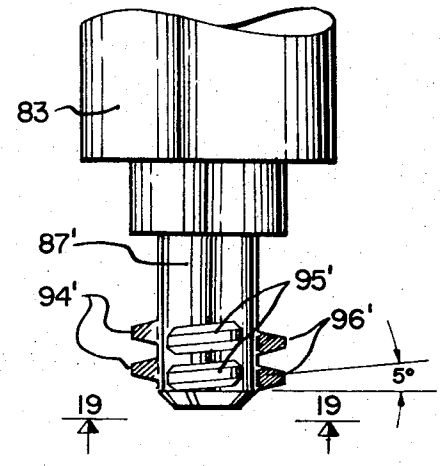


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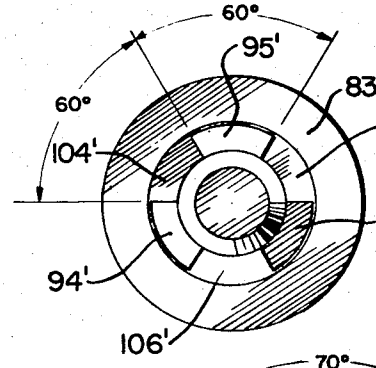


FIG. 19.

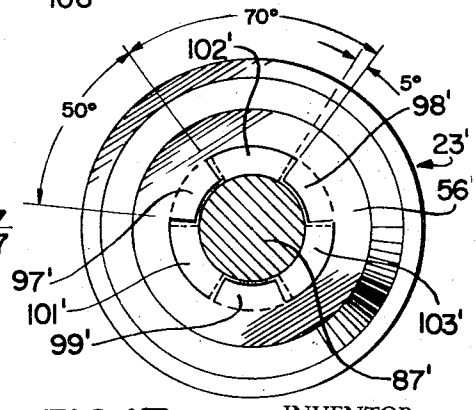


FIG. 17.

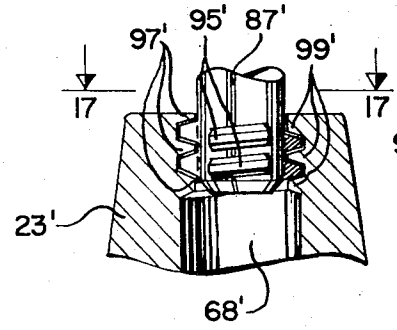


FIG. 16.

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TOOL HOLDER LOCKING DEVICE FOR ROTATING SPINDLES

This invention relates to a locking device for releasably connecting a tool holder to the open lower end of a spindle.

It is an object of the present invention to provide a simple locking device in which the tool holder can be released by a vertical thrust upon an upwardly extending operating rod to automatically effect the turning of a locking member into and out of the upward end of a tool holder, the upper end of the operating rod merely being bumped for the release of the tool holder from the spindle or the attachment of the same to the spindle.

It is another object of the invention to provide a tool holder adapted for use in a spindle which is of a solid type in which the drill rotating tool element is rigidly centered in the tool holder so that wobbling of the cutting end of the rotating tool element is minimized and the working of the tool element providing work within close tolerances.

It is still another object of the invention to provide in a spindle having a locking device centering means so that the tool holder will be easily aligned for effecting the locking connections of the tool holder with the lock member.

It is a further object of the invention to provide the locking device for a rotating spindle or the securement of the tool holder thereinto in which the projections are provided with inclined faces to effect wedging action of the locking member as it is turned and of the projections of the locking member with the projections on the tool holder.

Other objects of the invention are to provide a locking device for engagement of a tool holder in a rotating spindle, which is of simple construction, has a minimum number of parts, self contained in the spindle, automatic in operation, effective and efficient in use.

Reference may be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a bottom perspective view of a rotating spindle head and spindle employing the releasable tool holder and spring biased and releasable holder lock of the present invention.

FIG. 2 is a vertical sectional view of the rotating tool spindle and lock as viewed on line 2—2 of FIG. 1.

FIG. 3 is a bottom perspective view of the tool holder and tool holder lock mechanism, enlarged and removed from the spindle and its head.

FIG. 4 is a collective view, in bottom perspective, of the several parts of the tool holder and tool holder locking device, some parts being of fragmentary showings and the holder other parts being of the assembly of FIG. 3.

FIG. 5 is a fragmentary elevational view of the tool holder and its axial lock mechanism, with most of the operating parts being shown in section as well as in fragments.

FIG. 6 is an enlarged transverse sectional view taken on line 6—6 of FIG. 3.

FIG. 7 is a top plan view of the tool element holder and looking in plan upon the inwardly extending locking shoulders.

FIG. 8 is an enlarged fragmentary elevational view of the latch engaging end of the lock rod bearing the angularly spaced projections adapted to be interfitted through the slotted upper end of the holder of FIG. 7 and be turned into locking engagement with the inwardly extending projections thereof.

FIG. 9 is a transverse section of the lock rod and looking in plan upon the inclined upper faces of the radially extending lock projections, this view being taken on line 9—9 of FIG. 8.

FIG. 10 is a front elevational view of a slide bushing through which the vertically adjustable lock rod is fixed to be carried in the upper end of the spindle.

FIG. 11 is a transverse sectional view of the upper lock rod bushing as viewed on line 11—11 of FIG. 10.

FIG. 12 is a vertical elevational view of a lower bushing having a bayonet type slot into which extensions of the lock operating rod extend to effect the turning of the lock pin that engages through its projections with the inward projections in the rotating tool bit holder.

FIG. 13 is a fragmentary perspective view of the holder and spindle alignment lug used to effect the alignment of the spaces between the inward projections of the upper end of the holder with the lock pin projections upon effecting the assembly of the holder for engagement with the lock pin.

FIG. 14 is a fragmentary vertical sectional view of the tool holder with the lower end of the spindle and of the device as shown in FIG. 13 and as viewed on line 14—14 of FIG. 2.

FIG. 15 is an enlarged fragmentary perspective view of a modified tool holder lock device in which the lock pin are provided with multiple lock projections conforming in section to threads and wherein the holder as seen through the broken away open end thereof has cooperating threads for lock grip with the threads of the lock pin, the tool head being disengaged from the lock pin and being shown therewith in collective arrangement therewith.

FIG. 16 is a fragmentary elevational view of the tool holder in locking engagement with the lower end of the lock pin, with certain of the lock pin projection being shown in section and the upper end of the tool element holder being in section.

FIG. 17 is a transverse sectional view taken on line 17—17 of FIG. 16 and looking in top plan upon the drill bit holder.

FIG. 18 is a fragmentary elevational view of the multiple lock projection lock pin.

FIG. 19 is a bottom plan view looking upwardly upon the multiple, thread like projection lock pin, and as viewed on line 19—19 of FIG. 18.

Referring now particularly to FIGS. 1 to 5, showing the general construction of the spindle and its connection with the head and of the tool holder locking assembly for use in the rotating spindle and its parts removed from the general assembly of FIGS. 1 and 2, 20 represents generally a drill tool arbor in which a vertically extending spindle sleeve or quill 21, which is vertically adjustable with an internal spindle assembly indicated generally at 22, FIG. 2 and rotatable therein, to rotate a rotating tool holder adapter 23 of a type having a central hole and receiving an exact fitting tool bit 24. The vertically adjustable spindle holding sleeve 21 may be adjusted by a work feed pinion 26 journaled in the

arbor 20 and in mesh with a vertically extending rack gear 27 secured to the side of the spindle supporting sleeve 21 by fastening screws 28 and 29, FIG. 1. The pinion 26 is secured to a shaft 31 that has a handle, not shown, and which can be turned to effect the feeding of the quill 21 and its spindle 22 and the drill bit 24 toward or away from the work. The arbor 20 not only has the sleeve formation for the spindle supporting part 21, but has a laterally extending sleeve formation 32 for the pinion gear 26 and the shaft 31, and radially extending upper and lower portions 33 and 34 which connect with the vertically extending table support, not shown, but providing a bed for the work pieces being worked upon by the drill bit 24. While the description is being made with reference to a single drill spindle and more particularly to the locking of the drill tool holder upon the spindle, will it have equal adaptation with multiple spindles wherein multiple drilling or other similar operations are being performed. The spindle 22 is secured within the spindle supporting member 21 for free rotation by tight fitting ball bearing units 36 and 37 in an enlarged internal diameter portion 38 at the upper end of the spindle supporting member 21 and by a single ball bearing unit 39 tight fitted upon the spindle 22 in an enlarged internal diameter lower end portion 41 of the spindle support sleeve or quill 21. A spacing sleeve 42 extends about the spindle 22 and extends vertically between the ball bearings units 37 and 39 and is flanged at its upper end at 43 to keep lubricating oil in the upper bearings and limit the flow thereof into the lower bearing 39.

A bushing 44 is disposed within the internally enlarged diameter bottom portion 41 of the spindle support 21 and supported by two lower ball bearing units 45 and 46 and the ball bearing unit 39, the spacing sleeve 44 and the ball bearing units 45 and 46 are held in place against downward displacement from the lower portion 41 of the spindle support 21 by threaded engagement therewith of a flanged retaining ring 47, the spacing sleeve 44 has vertically extending oil holes 48 to permit the flow of lubricating oil between the ball bearing units 39 and 45.

The spindle 22 has an opening 51 extending axially therethrough and this opening is enlarged at its lower end at 52 to house a locking part for the tool holder 23 and is enlarged therebelow to provide a bottom head portion 53 that has a tapered opening 54 which will tightly receive an upwardly extending conical portion or shank 56 of the tool holder 23, the lower end of the tool holder being in the form of a flange adapted to abut the lower end of the enlarged spindle portion 53 when the conical shank portion 56 is forced home into the tapered opening 54 of the spindle bottom portion 53.

The central hole 51 in the spindle 22 is enlarged at its upper end to provide a shoulder 57 and a top open portion 58 for curtailing a coil spring 59.

The upper open end portion 38 of the spindle support 21 has a retaining washer for the ball bearing units 36 and 37 indicated at 61 and lock nuts 62 and 63 threaded upon the upper end portion 58 of the spindle 22. Also threaded upon the upper end portion 58 is an upwardly extending work sleeve 65 that is mounted on the upper end portion 38 of the spindle support 21 by a retaining ring 64 having sealing means 66 permitting rotation of the sleeves extension 65 therein, the sleeve extension 65 being threaded or splined to the spindle 22. The drive of the spindle 22 is effected through the extension 65 by a triple pulley 67 splined at 68 to and shouldered over the upper end of the sleeve extension 65. It should now be apparent that the complete spindle assembly joined to one another so that by the application of power to the pulley 67, the enlarged lower end portion 53 and the holder 23 fitted tightly therein will be rotated to effect a drilling operation by the tool bit 24. While this spindle assembly seems quite ordinary, it can be made of different size and shape, the invention is not limited thereto but is directed to the tool holder locking device associated therewith that insures a good grip of the tool holder 23 in the lower end of the spindle and permits easy release of the tool holder for connection with the spindle of another tool holder having another bit of a different variety and possibly of another size. Bit 24 is secured by its shank in a hole 68, which is straight and which is of the same diameter as the shank of the drill bit and it is made secure against axial outward displacement by a set screw 69 that is threaded from one side of the tool holder bottom flange and engages with the side of the bit shank within the opening 68. The drill tool element 24 by being in a holder having a tight fit opening for the drill shank provides for good central alignment of the tool element or drill bit so that its cutting point does not readily waiver from its central cutting axis or wobble upon being rotated and extended into the workpiece. With firm union of the drill tool holder by its conical shank with the tapered internal wall of the lower end of the spindle 22, the tool holder will be relatively vibration free and thus little wear will be created upon the tool holder and with the tool holder being rigidly retained and the drill tool element rigidly retained and centrally aligned therein, a most favorable drilling operation will be effected. The flange of the drill holder at the bottom of the same is well shouldered against the end of the spindle portion 53 so that the tool holder is further steadied within the spindle portion 53.

The holder locking device, forming the important feature of this invention, is wholly contained within the spindle 22 and its extension 65. This locking device comprises generally a long operating rod 71 that extends upwardly through the major length of the spindle and its extension, and is threaded at its upper end as indicated at 72 and has a tight fitted slide bushing 73 supported on the upper end of the spring 59 lying in the upper portion 58 of the spindle 22 and reacting against the shoulder 57 at the bottom of the spring chamber. This guide bushing 73 is vertically slidable in the sleeve extension 65 and has vertically elongated slots 74 and 75 on the opposite sides of the slide bushing 73 into which stop pins or bolts 76 and 77 that are threaded from opposite sides of the extension 65 will extend and which serve to limit the upward and downward movement of the bushing 73. The upper end of the bushing 73 is engaged by an adjustable nut 78 on the threaded end portion 72 of the rod 71 so as to vary the spring tension that will react between the upper end of the rod and the bottom end of the bushing 73 and the shoulder 57 within the spindle 22.

Upon the upper end of the threaded portion 72 is an adjustable and vertically elongated nut 79 which is held

in its adjusted position by engagement with its lower end of a lock nut **81**. The top nut **79** is adjustable to be accommodated by a tool or a fixed abutment or stop **82** which will overlie the spindle or even a stationary member that will serve to abut the upper end of the nut **79** when a releasing or securement of the tool holder **23** is to be affected. This abutment is indicated at **82** in FIG. **2** and it can be understood that by rotating the shaft **31** by a handle that the spindle support can be elevated against a fixed abutment or stop **82** overlying the spindle and that the lock operating rod **71** will be depressed. The effect of this operation will be understood as the description sets forth the locking head construction secured to the lower end of the operating rod **71**.

This locking head construction includes a bushing **83** having central opening into which is extended the lower end of the operating rod **71** and which is secured therein by a transversely extending pin connection **84**. This bushing **83** has a roller bearing unit **85** overlying its upper end and is drawn upwardly by the spring **59** against shoulder **86**.

The lower end of the lock bushing **83** has a depending shank **87** and surrounding this shank is a bottom roller bearing **88** that is held upwardly upon the shank by a retaining ring **89**.

The lower end of the lock head shank **87** depends into opening **68** in the conical tool holder **23**.

In the side wall of the lock head bushing **83** and on the opposite sides thereof are bayonet like or dog-leg shaped opposing slots **91** and **92**, each of which have an inclined top portions which join with straight bottom portions and the pin **84** on the bottom of the operating rod **71** extends laterally outwardly from the opposite sides of the rod so that its ends enter the slots **92** and **92**. The inwardly extending stop pins or bolts **76** and **77** from the sides of the spindle extension **65** projecting into the slots **74** and **75** of the bushing **73** permits vertical adjustment of the rod **71** and bushing **75** fixed thereto without rotation, the lock bushing **83** will accordingly by the transverse pin **84** acting in the dog-leg slots **91** and **92** will orient three projections **94, 95** and **96** on the lower end of its depending lock head shank **87** from inwardly extending projections **97, 98** and **99** on the upper end of the conical shank portion **56** of the tool holder **23** and within the tool holder opening **68** and into arcuate openings **101, 102** and **103** on the upper end of the arcuate shank **56** of the holder **23** and between the respective projections thereof so that the lock head radially extending projections **94 95** and **96** will be made free so that the tool holder **23** can be dropped from the lower portion **53** of the spindle. In other words upon depressing the operating rod **71**, the lock head bushing **83** is rotated and the shank **87** thereof rotated to make it possible for the tool holder **23** to be dropped from the tapered opening **54** in the bottom portion **53** of the spindle **22**.

The radially extending projections **94, 95** and **96** are each provided with a five degree inclined top face extending to the left as shown in FIG. **8** so that as turning of the lock shank **87** is effected, a lifting action will result by the engagement with the inwardly extending projections **97, 98** and **99** on the upper end of the tool holder and their respective bottom faces are oppositely inclined to cooperate with the inclinations of the radially extending projections **94, 95** and **96** so that in effect there is a threading action of the lock shank **87** into the tool holder **23**.

In FIG. **9** it will be noted that the projections **94, 95** and **96** extend circumferentially and respectively through 60° and that there are spaces as indicated respectively at **104, 105** and **106** that extend similarly to 60° from one side edge of the radially extending projection to the other side edge of the next radially extending projection.

In order that the 60° projections on the lock shank **87** can readily fit and loosely pass through the respective spaces **101, 102** and **103**, the angular spacing between the projections **97, 98** and **99** of the tool holder extend through **70** degrees thereby leaving a clearance of **5** degrees on the opposite side edges of each of the projections **94, 95** and **96** and the inwardly extending projections **97, 98** and **99** of the tool holder, as best viewed in FIG. **7** extend circumferentially only through 50°. This makes for an easy fitting of the lock shank **87** and its projections into the upper end of the tool holder **23**.

In order to have the tool holder **23** when placed into the tapered opening of the bottom portion **53** of the spindle in proper alignment for reception of the lower end of the lock shank **87** with the radially extending projections a centering lug **107** is secured upwardly into a notch **108** in the lower end of the bottom portion **53** of the spindle **22** by two screws **109** and **110** as best seen in FIGS. **13** and **14** and which has to be aligned and dropped into a cooperating notch **111** in the top face of the flanged bottom end of the tool holder **23** and in shoulder surface **112** thereof. The shouldered face **112** will thus have when the tool holder **23** is properly oriented flush engagement with the lower bottom end face of the bottom portion **53** of the spindle **22**.

Referring now to the other form of the invention shown in FIGS. **15** to **16**, it will be apparent that the only change in the construction has been in the arrangement of the radially extending projections on the lower end of the lock shank **87** and in the upper end of the tool holder. To the general parts, which are the same as in the first form of the invention, the numerals which have been applied to the first form of the invention will be applied in the description of this other form of the invention. In this other form of the invention there is provided a depending shank **87** upon the lock bushing **83** having the dog-leg slots **91** and **92** and adapted to be rotated to provide for the alignment of double and vertically spaced projections arranged in pairs and circumferentially spaced from one another about the lower end of the lock pin shank **87'**. There are three pairs of projections angularly spaced about the lower end of the lock shank **87'** as indicated at **94'**, **95'** and **96'**, each of the projections are beveled on both upper and lower faces and have a thread shape section with the threads of one pair being an extension of the other pair about the lower end of the lock shank and spaces between the pairs of the projections permit the assembly of the lock shank and of the projections to be passed downwardly into the upper end of a conical top portion **56'** of a tool bit holder **23**, having a bottom flange and a central opening **68'** the upper end of the opening having three sets of inwardly extending mating thread projections **97'**, **98'** and **99'** for respectively

receiving the threaded engagement of the respective lock shank pairs 95', 96' and 97'.

The pairs of projections 94', 95' and 96' extend throughout an arc of 60° about the lower end of the lock shank 87' to provide respectively spaces 104', 105' and 106' therebetween, likewise extending throughout angles of 60° the sets of triple inwardly projections 97', 98' and 99' in the upper open end of the tool holder 23' extend as with the first form of the invention throughout an angle of 50° and the spaces 101', 102' and 103' for receiving respectively the pairs of projections 94', 95' and 96' axially as the lock shank 87' is thrust downwardly into the holder 23' to effect locking engagement therewith. All projections on both the lock shank and on the tool holder are of thread section and inclined to the vertical axis of the lock shank 87' so that a tight threading engagement of the lock shank with the tool holder 23' will be effected. The same centering means comprising the lug 107 and located in a slot 111 in the flange of the tool holder is used to effect the alignment of the spaces in the work tool holder between its projections with the projections on the lock shank 87'.

It should now be apparent that there has been provided a tool holder lock and an aligning arrangement for a rotating spindle which can be released by depressing the upper end of the locking device against the action of the spring 59 and by which upon the alignment of the lock shank projections with the projections in the tool holder an automatic rotation of the lock shank is affected through the use of the dog-leg slots in the lock head bushing 83 to effect a final coupling of the projections of the lock shank with the projections in the tool holder. Simply by the use of pressure applied to the top nut 79 the engagement and release of the tool holder is affected.

While various changes may be made in the detailed construction it shall be understood that such changes shall be within the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. In combination, a vertically extending spindle support, a spindle assembly journaled for rotation in the vertically extending spindle support, said spindle having an open bottom end portion, a tool holder conforming to the opening in the bottom end portion and engagable with the bottom end face of the spindle, said tool holder having a central opening adapted to receive a rotating tool element, and a locking device releaseably engagable with the upper end of the spindle tool holder and extending centrally upwardly through the rotating spindle, said lock device including the vertically extending operable rod and means at the upper end of the spindle for holding the operating rod against rotation while effecting a downward thrust of the operating rod and said locking member having dog-leg shaped slot therein and means on the operating rod engaging the dog-leg slot to cause rotation of the lock member with the operating rod being vertically depressed to affect engagement of the locking member with the upper end of the tool holder.

2. The combination, as defined in claim 1, and said locking member comprising a bushing journaled in said spindle and a depending shank, radially extending projections on the lower end of the depending shank and said tool holder having inwardly extending projections circumferentially spaced about the opening therein and said lock member projections upon being turned will provide locking engagement with the inwardly extending projections of the tool holder.

3. The combination, as defined in claim 2, and said spindle support having an open upper end, said spindle assembly including an extension connected to the spindle for rotation therewith and the supporting ring for the extension extended over the open end of the spindle support, a bushing connected to the operating rod and guide means provided between the bushing and the spindle extension to confine the movement of the operating rod in an axial direction, and drive gear means drivingly secured to the upper end of the extension to effect the rotation of the spindle.

4. The combination, as defined in claim 3, and said operating rod extending upwardly through said bushing, said operating rod being threaded on its upper end and an adjusting nut on the threaded end of the rod for adjusting the operating position of the rod and guide means relative to the extension, a top nut threadedly engaging the upper end of the rod and adjustable thereupon and a lock nut for holding the top nut in its adjusted position upon the threaded upper end of the rod.

5. The combination, as defined in claim 4, and a compression spring surrounding the operating rod, said spindle having a spring chamber shouldered at its bottom end and receiving one end of the spring and the upper end of the spring engaging said guide bushing in the spindle extension.

6. The combination, as defined in claim 1, and said bottom portion of the spindle having a tapered opening and said tool holder having a conical portion adapted to fit the tapered opening of the spindle bottom portion and a flange having flush engagement with the bottom end face of the spindle when the tool holder is secured in locked engagement with the bottom portion of the spindle.

7. The combination, as defined in claim 1, and a centering lug depending from the bottom end face of the spindle and the flange of the tool holder having a cooperating recess for receiving the depending lug, said centering lug on the spindle being in vertical alignment with lock projections on the lock member to align the tool holder inwardly extending projections so that the spaces between the projections will be automatically aligned with the radial projections on the lock member upon the tool holder being inserted in the bottom portion of the spindle.

8. The combination, as defined in claim 2, and said radially extending locking projections having an incline top faces and said inwardly extending projections on the tool holder having cooperating under faces whereby the projections of the lock member and the tool holder will be effected with wedging action.

9. The combination, as defined in claim 1, and said lock member having pairs of radially extending thread like projections circumferentially spaced around the lower end of the lock member and said tool holder having cooperating sets of triple thread like projections for wedgingly receiving the pairs of thread like projections on the lower end of the lock member.

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