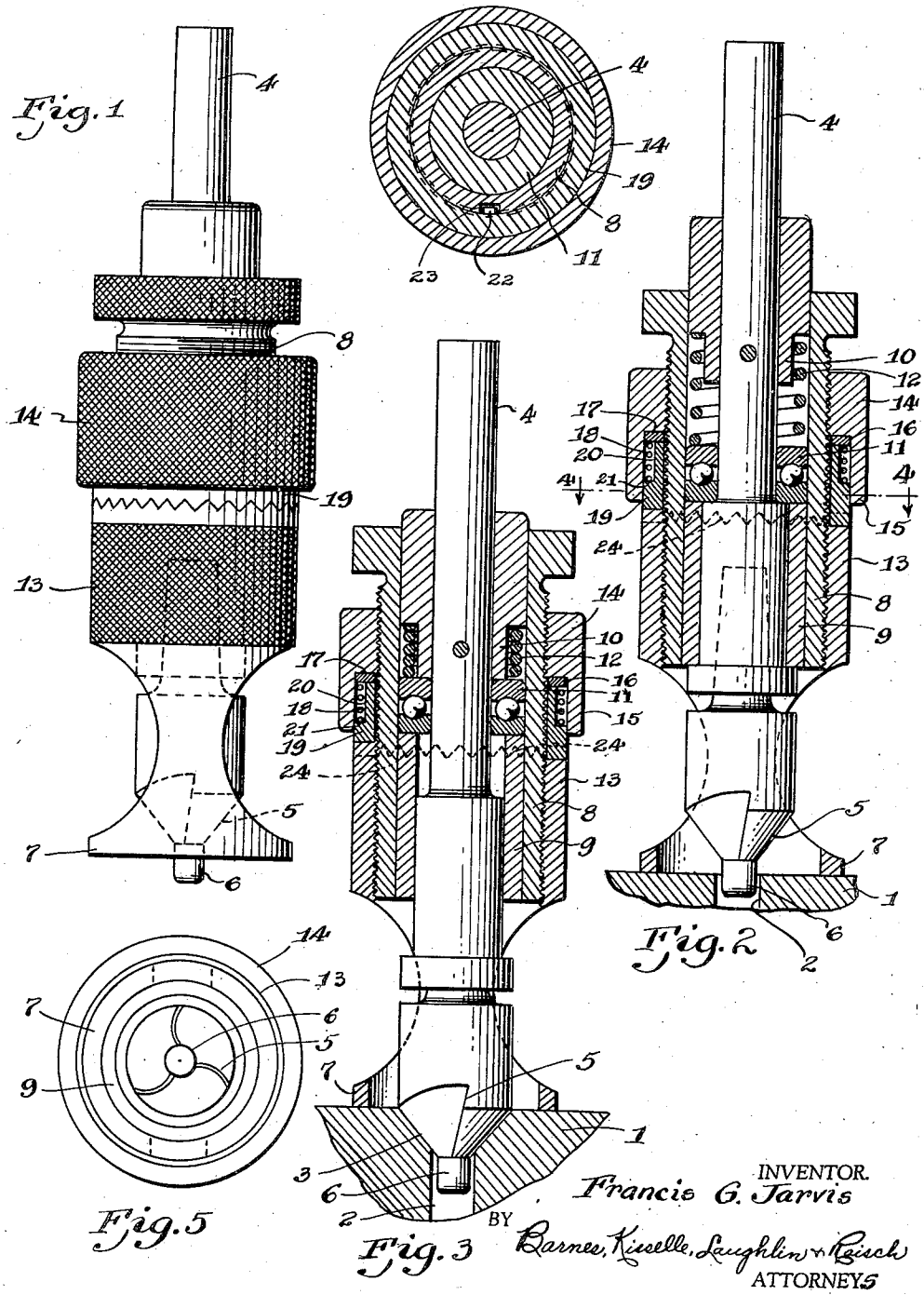
Oct. 10, 1944. F. G. JARVIS 2,359,859

COUNTERSINKING TOOL

Filed Sept. 28, 1940 2 Sheets-Sheet 1

Fig. 4



INVENTOR.
Francis G. Jarvis
BY
Barnes, Kisselle, Laughlin & Risch
ATTORNEYS

Oct. 10, 1944. F. G. JARVIS 2,359,859

COUNTERSINKING TOOL

Filed Sept. 28, 1940 2 Sheets-Sheet 2

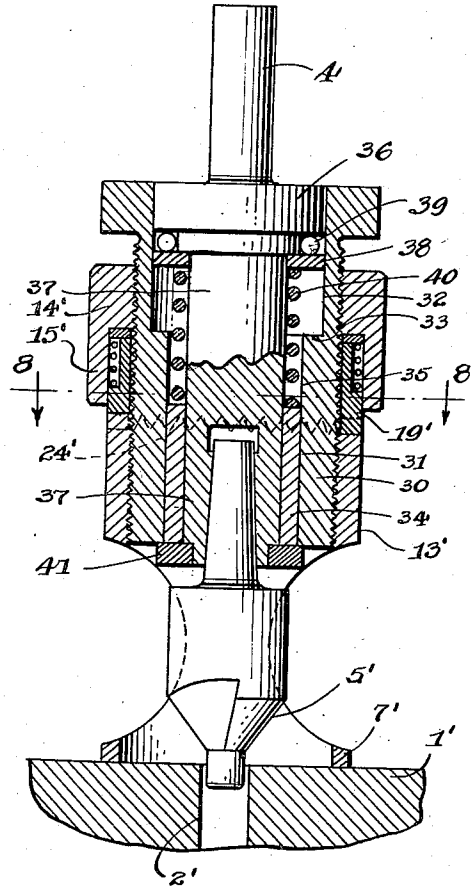


Fig. 6

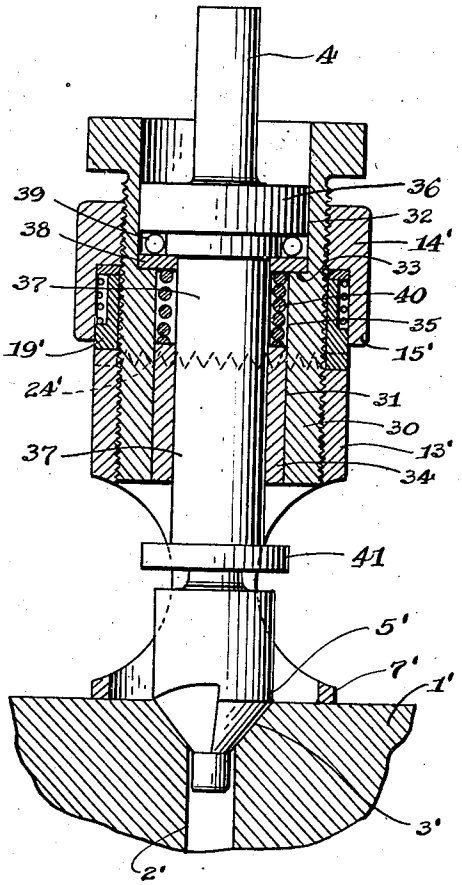


Fig. 7

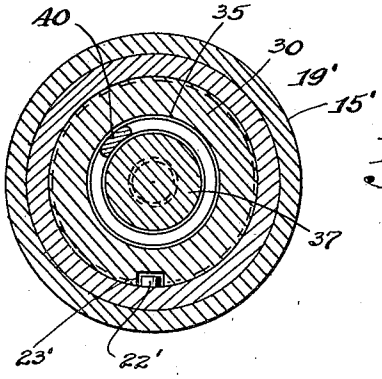


Fig. 8

INVENTOR.
Francis G. Jarvis

BY
Barnes, Kisselle, Laughlin & Raisch
ATTORNEYS

Patented Oct. 10, 1944

2,359,859

UNITED STATES PATENT OFFICE

2,359,859

COUNTERSINKING TOOL

Francis G. Jarvis, Los Angeles, Calif., assignor, by mesne assignments, to Lockheed Aircraft Corporation, Burbank, Calif., a corporation of California

Application September 28, 1940, Serial No. 358,816

18 Claims. (Cl. 77—73.5)

This invention relates to improved means to control the depth of penetration of cutting tools.

It is often desirable to accurately limit the penetration of tools into the work to a predetermined depth. Common examples of this are in the drilling of blind holes or the countersinking of predrilled holes. It is also desirable to be able to quickly and accurately change to a different predetermined depth. It is old to provide stops which will limit the depth of penetration of such tools. However, to vary the depth has heretofore required that the tool be removed from the chuck, placed in a vise, adjusted and gauged, and then locked in a correct position. This is an annoying and time consuming operation.

Airplane manufacture is an industry wherein the use of this invention is particularly advantageous. The construction of an airplane fuselage, wings, rudder and elevators requires that a very large number of rivets be used in their assembly from their component parts. For aerodynamic reasons these rivets must be flush with the surface, and extreme accuracy is demanded in the industry. They must therefore be accurately countersunk so as to neither project nor leave a recess. All of these rivets are not, of course, of the same size, or countersunk to the same depth. It is therefore extremely advantageous to have a tool capable of being quickly adjusted to accommodate varying depths of countersinking. It will be noted that my invention is particularly adapted to satisfy this need.

It is an object of this invention to provide a means which will permit a wide selection of accurate settings of the tool whereby a plurality of choices may be had as to depth of penetration. It is a further object to provide a means whereby the operator may instantly change the setting which will limit penetration of the countersink cutter to a desired depth. Another object is to provide accurate means to control the depth of penetration whereby the operator will at all times know exactly the depth to which his countersink cutter is penetrating. Another object is to provide means to accomplish the above objects quickly without removing the countersink unit from its chuck. A further object is to provide means to accomplish the above objects which may be easily operated merely by the fingers of the operator.

Illustrated in the accompanying drawings is a countersinking tool provided with the invention and adapted to countersink predrilled holes for the head of a flush type aviation rivet such as is used in airplane fuselage, wing, rudder and elevator construction. It is to be understood, however, that the invention can be applied to various types of tools where control of the depth of penetration is important.

In the drawings:

Fig. 1 is a side view of a countersink tool provided with the invention.

Fig. 2 is a vertical section showing the countersinking tool in inoperative position.

Fig. 3 is a vertical section similar to Fig. 2 but showing the countersink cutter at its greatest depth of penetration in the work.

Fig. 4 is a section on the lines 4—4 of Fig. 2.

Fig. 5 is an end view of the countersink cutter and limit member.

Fig. 6 is a vertical section of a modified form of the invention.

Fig. 7 is a vertical section similar to Fig. 6, but showing the countersink cutter at its greatest depth of penetration.

Fig. 8 is a section on the line 8—8 of Fig. 6.

Shown in Fig. 2 is work 1 containing a predrilled hole 2. Fig. 3 shows the same work 1 and predrilled hole 2 at the end of an operation and with the hole countersunk to a predetermined depth as at 3. The tool adapted to perform this operation will now be described.

The tool or countersink unit may be attached to and powered by a drill motor or a drill press (not shown) or other suitable power means.

A rotatable spindle or shaft 4 is provided with a countersink cutter or cutting tool on its end. This countersink cutter may be integral with the shaft or fastened thereto, or it may even consist of a combined drill and countersink cutter. The preferred form, and the one illustrated, shows a countersink cutter 5 provided with a tapered shank which fits within a tapered recess in the end of the shaft. A pilot 6 comprising a small cylindrical longitudinal projection at the end of the cutter flutes is provided to fit within the predrilled hole and align the countersink cutter. This provides an assurance that the predrilled hole and the countersunk hole will be concentric. A stop member adapted to rest on the surface of the work to be countersunk is shown at 7. Shaft 4 is mounted by means herein to be described so that the longitudinal movement of the shaft relative to the stop member is limited. It is therefore apparent that the relation of this relatively stationary stop member and the longitudinally movable countersink cutter determines the depth of the countersink cut or chamfer which will be made.

A spindle housing 8 is provided with a cylin-

drical bushing 9 which is press fitted within one end of the housing. This bushing is adapted to receive the rotatable shaft previously referred to. The shaft 4 is provided with a lateral projection or attachment 10 spaced from the bushing 9. A thrust bearing 11 is fitted within the spindle housing and circumscribes the shaft. A helical spring 12 surrounds the shaft and has its ends abutting the projection 10 and the thrust bearing 11.

As shown in Fig. 3, the shaft 4 may be longitudinally extended until spring 12 is compressed and projection 10 rides upon the thrust bearing 11. The spindle housing 8 is provided with a threaded exterior surface. Stop member 7 is provided with a stop sleeve 13 which is internally threaded and adapted to screw on spindle housing 8. It will be seen that to screw stop sleeve 13 up or down the surface of spindle housing 8 will change the depth of penetration of the countersink cutter 5 at the time it has reached the limit of its longitudinal axial movement.

Means are provided to lock stop sleeve 13 from further movement. Means are also provided to permit an accurate control of the screw movement of stop sleeve 13 on spindle housing 8. To this end a lock nut 14 is provided with an interiorly threaded surface adapted to screw on the spindle housing 8. Lock nut 14 is provided with a longitudinal cylindrical extension 15. A ring washer 16 is adapted to fit within the extension 15 and abut the shoulder 17 formed thereby. A helical spring 18 is adapted to rest upon washer 16. A loose engagement sleeve or lock ring 19 provided with a cylindrical recess 20 on its exterior surface is adapted to fit within the extension 15. Spring 18 is received by a shoulder 21 formed by the recess 20. It will readily be seen that the lock ring 19 is yieldable on its mounting in an axial direction. The interior surface of the engagement sleeve or lock ring 19 is provided with a key 22 adapted to engage a longitudinal groove 23 shown in Fig. 4 and provided on the surface of the spindle housing 8 to prevent rotation of the engagement sleeve. Engagement sleeve 19 is adapted to engage the surface of the stop sleeve 13 when they are screwed together. Provided on the contacting surfaces of these members are a plurality of serrations 24. The combination of these serrations and the axially yieldable mounting of the engagement sleeve permits an accurate control of the amount the stop sleeve 13 is screwed upwards or downwards upon the spindle housing 8, for there will be a click as the serrations engage. The size of these serrations may be chosen as desired. It will be apparent that the pitch of the thread on the surface of the spindle housing and the number of serrations will determine the increments of adjustment. However, in a desirable form serrations have been provided such that the relative movement over one serration causes an axial movement of one thousandth of an inch of the stop sleeve 13.

It will be readily seen that when the lock nut 14 is screwed away from the stop sleeve 13 and the parts are loose on the spindle housing 8, the stop sleeve may be freely screwed on the spindle housing. However, when lock nut 14 is screwed towards the stop sleeve 13 and the adjacent serrations engage, the lock nut may be screwed tightly down upon the stop sleeve and lock it against movement.

A modified form of the invention is illustrated in Figs. 6, 7 and 8. The design of the spindle housing 30 and the parts contained within it to limit axial movement of the countersink cutter embody the main differences from the form described above. The countersinking cutter, stop member, stop sleeve, lock nut and engagement sleeve are all substantially identical in form and operation with the analogous parts described in connection with Figs. 1, 2, 3, 4 and 5. In this modified form, however, the spindle housing 30 is provided with two concentric cylindrical axial openings 31 and 32 which together make the entire length of the spindle housing hollow. The upper opening 32 is of greater diameter than the opening 31 and there is therefore formed a shoulder 33 within the spindle housing 30 where these two openings abut. The spindle housing 30 is provided with a cylindrical bushing 34 which is press fitted within the lower end of opening 31 as illustrated. The bushing 34 is, however, of less axial length than opening 31 and a recess 35 is formed.

Spindle 4 carries a cylindrical collar 36 adapted to rotatably and slidably fit within opening 32. Spindle 4 is provided with a portion 37, one end of which is adapted to rotate in bushing 34 and adapted to retain the countersink cutter 5'. A race member 38 circumscribes portion 37 of journal 4 and is spaced slightly below collar 36. Roller bearings 39 are retained between collar 36 and race member 38. A helical spring 40 surrounding journal portion 37 and abutting against bushing 34 and race member 38 resiliently holds the race member and roller bearings against collar 36 and maintains the entire spindle and countersink cutter normally in the elevated position shown in Fig. 6. A collar 41 on spindle portion 37 engages the spindle housing 30 to limit the upward movement caused by spring 40. It is clear that as the stop member 7' abuts work 1' and the operator applies axial force to journal 4 the spring 40 will compress and allow the countersink cutter 5' to enter the work. Engagement of race member 38 on shoulder 33 limits the penetration of the countersink cutter into the work. Adjustment of the relative axial position of stop member 7' may be made in identically the same way as heretofore described. The spindle housing is exteriorly threaded and the serrated stop sleeve 13', serrated engagement sleeve 19', and lock nut 14' act in the manner heretofore described. Some parts of the device in Figs. 6, 7 and 8 have been labelled with the prime of the corresponding numbers used in Figs. 1, 2, 3, 4 and 5.

In the operation of this device the operator inserts the pilot 6 into the predrilled hole to a depth which will rest the stop member 7 upon the surface of the work. As the shaft is rotated by suitable power means (not shown), the operator will force the countersink cutter 5 into the work surface surrounding the predrilled hole. However, this forcing of the countersink cutter will be stopped by the engagement of projection 10 upon thrust bearing 11 (Fig. 3) and further penetration of the countersink cutter will be impossible. As shown in Fig. 3 any downward force applied by the operator will be transmitted to the work through the stop member 7 and the countersink cutter 5 will not receive the force. The force will be transmitted from shaft 4 to projection 10 to thrust bearing 11 to bushing 9 to spindle housing 8 and through the lock sleeve 13 and member 7 to the work. The operator having completed the countersinking of the first hole will then remove the tool and proceed to the next hole to be countersunk.

If the operator wishes to change the depth of penetration he will screw lock nut 14 in an upward direction as shown in Figs. 1, 2 and 3. Spring 18 will keep the serrations in engagement but permit movement of stop sleeve 13. The operator may rotate stop sleeve 13 in either direction as many serrations as is desired. Such thread movement will cause stop sleeve 13 to go up or down on the spindle housing as shown in Figs. 2 and 3. Lock nut 14 may then be screwed down as shown in Fig. 2 until ring washer 17 contacts engagement sleeve 19 and forces the engagement sleeve against the stop sleeve 13, thereby locking the stop sleeve 13 against further movement. The form illustrated in Figs. 6, 7 and 8 operates in substantially the same manner. Engagement of race 38 on shoulder 33 there limits the penetration of the countersink cutter into the work. The adjustment may be made on this form in the manner just described with reference to Figs. 1, 2, 3, 4 and 5.

I claim:

1. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably and slidably mounted, a stop member screw-threaded on said housing for adjustment relative thereto, said stop member being adapted to engage the work piece, cooperating stop means on the tool and housing for limiting relative sliding movement and in turn to limit movement of the tool into the work to an amount determined by the adjustment of said stop member relative to said housing, means slidably mounted on the housing and having a toothed engagement with the stop member for effecting adjustment of the stop member relative to the housing with step by step movement.

2. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably and slidably mounted, an adjustable stop member screw-threaded on said housing and adapted to engage the work piece, cooperating stop means on the tool and housing for limiting relative sliding movement and in turn to limit movement of the tool into the work to an amount determined by the adjustment of said stop member relative to said housing and indicating means to measure the adjustment of the stop member relative to the housing.

3. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably and slidably mounted, a stop member screw-threaded on said housing for adjustment relative thereto, said stop member being adapted to engage the work piece, cooperating stop means on the tool and housing for limiting relative sliding movement and in turn to limit movement of the tool into the work to an amount determined by the adjustment of said stop member relative to said housing, means slidably mounted on the housing and adapted to have a toothed engagement with the stop member for effecting adjustment of the stop member relative to the housing with step by step movement and spring means adapted to urge said last mentioned means to resiliently engage with the stop member.

4. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably and slidably mounted, an adjustable stop member screw-threaded on said housing and adapted to engage the work piece, cooperating stop means on the tool and housing for limiting relative sliding movement and in turn to limit movement of the tool into the work to an amount determined by the adjustment of said stop member on said housing, means slidably mounted on the housing and having a toothed engagement with the stop member for effecting adjustment of the stop member relative to the housing with step by step movement, and a lock nut screw-threaded on said housing whereby said lock nut may be screwed down to force said last mentioned means to tightly engage and lock said stop member.

5. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably and slidably mounted, a stop member screw-threaded on said housing for adjustment relative thereto, said stop member being adapted to engage the work piece, cooperating stop means on the tool and housing for limiting relative sliding movement and in turn to limit movement of the tool into the work to an amount determined by the adjustment of said stop member on said housing, said cooperating stop means comprising a thrust bearing in said housing, a projection on said tool whereby contact of said projection on said thrust bearing limits relative sliding movement of said tool and said housing.

6. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably and slidably mounted, an adjustable stop member screw-threaded on said housing and adapted to engage the work piece, cooperating stop means on the tool and housing for limiting relative sliding movement and in turn to limit movement of the tool into the work to an amount determined by the adjustment of said stop member relative to said housing and spring means acting on said cooperating stop means to resiliently resist said relative sliding movement.

7. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably and slidably mounted, a stop member screw-threaded on said housing for adjustment relative to said housing, said stop member being adapted to engage the work piece, cooperating stop means on the tool and housing for limiting relative sliding movement and in turn to limit movement of the tool into the work to an amount determined by the adjustment of said stop member relative to said housing, said cooperating stop means comprising two elements, one of said elements being a shoulder in said housing, the other of said elements being a collar on said tool, a race element, and rollers resiliently retained between said collar and said race element whereby contact of said race element on said shoulder limits relative sliding movement of said tool in said housing.

8. In a tool for cutting into a work piece, a rotary cutting tool element, a housing in which the tool element is mounted, a stop member element paralleling said tool, said stop member element being adapted to engage the work piece, said housing being screw-threaded to one of said elements for adjustment of the latter relative to the housing, a slidable mounting between said housing and the other of said elements, cooperating stop means on said housing and said other element for limiting relative sliding movement and in turn to limit movement of the tool into the work to an amount determined by the adjustment of said housing and said adjustable element, and means associated with said housing, said means being provided with serrations for cooperation with serrations on said adjustable element for effecting adjustment of said

element relative to said housing with step by step movement.

9. In a tool for cutting into a work piece, a rotary cutting tool element, a housing in which the tool element is mounted, a stop member element paralleling said tool, said stop member element being adapted to engage the work piece, said housing being screw-threaded to one of said elements for adjustment of the latter relative to the housing, said housing engaging the other of said elements to limit movement of the tool into the work to an amount determined by the adjustment of said housing and said adjustable element and means associated with said housing, said means being provided with serrations for cooperation with serrations on said adjustable element for effecting adjustment of said element relative to said housing with step by step movement.

10. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably mounted, means to limit relative axial movement between said tool and said housing, an adjustable stop member screw-threaded on said housing and adapted to engage the work piece to limit movement of the tool into the work to an amount determined by the adjustment of said stop member on said housing, means slidably mounted on the housing and having a toothed engagement with the stop member for effecting adjustment of the stop member relative to the housing with step by step movement and a lock nut screw-threaded on said housing whereby said lock nut may be screwed down to force said means to tightly engage and lock said stop member.

11. A stop countersink unit, comprising in combination, a tool spindle having an outer tool retaining portion and an inner extending shank adapted to be gripped for rotation in a prime mover chuck, a spindle housing rotatably and reciprocatably mounted upon said spindle, a coaxial stop sleeve adjustably threaded upon said spindle housing and normally extending forward beyond the outer end of said spindle when said spindle housing is in a fully extended position, a spring carried by said spindle and adapted to urge and normally maintain said spindle housing in a fully extended position with respect to said spindle, and adjustable means to lock said stop sleeve at a predetermined position upon said spindle housing.

12. A stop countersink unit, comprising in combination, a tool spindle having an outer tool retaining portion and an inner extending shank adapted to be gripped for rotation in a prime mover chuck, a spindle housing rotatably and reciprocatably mounted upon said spindle, a coaxial stop sleeve adjustably threaded upon said spindle housing and normally extending forward beyond the outer end of said spindle when said spindle housing is in a fully extended position, a spring carried by said spindle and adapted to urge and normally maintain said spindle housing in a fully extended position with respect to said spindle, a lock-nut adjustably threaded upon said spindle housing and adapted to lock said stop sleeve at a predetermined position upon said spindle housing.

13. A stop countersink unit, comprising in combination, a tool spindle having an outer tool retaining portion and an inner extending shank adapted to be gripped for rotation in a prime mover chuck, a spindle housing rotatably and reciprocatably mounted upon said spindle, a coaxial stop sleeve adjustably threaded upon said spindle housing and normally extending forward beyond the outer end of said spindle when said spindle housing is in a fully extended position, a spring carried by said spindle and adapted to urge and normally maintain said spindle housing in a fully extended position with respect to said spindle, a lock nut adjustably threaded upon said spindle housing, a lock ring axially movable but rotationally fixed on said spindle housing intermediate said stop sleeve and said lock nut, said lock ring being adapted to be forced into locking engagement with said stop sleeve by said lock nut whereby said stop sleeve may be retained at a predetermined position upon said spindle housing.

14. A stop countersink unit, comprising in combination, a tool spindle having an outer tool retaining portion and an inner extending shank adapted to be gripped for rotation in a prime mover chuck, a spindle housing rotatably and reciprocatably mounted upon said spindle, a coaxial stop sleeve adjustably threaded upon said spindle housing and normally extending forward beyond the outer end of said spindle when said spindle housing is in a fully extended position, a ball thrust bearing associated with said spindle housing, a spring carried by said spindle and adapted to bear upon said thrust bearing to urge and normally maintain said spindle housing in a fully extended position with respect to said spindle, a lock nut adjustably threaded upon said spindle housing, and a lock ring axially movable but rotationally fixed on said spindle housing intermediate said stop sleeve and said lock nut, said lock ring being adapted to be forced into locking engagement with said stop sleeve by said lock nut whereby said stop sleeve may be retained at a predetermined position upon said spindle housing.

15. In a tool for cutting into a work piece, a rotary cutting tool, a housing in which the tool is rotatably and slidably mounted, a stop member screw-threaded on said housing for adjustment relative to said housing, said stop member being adapted to engage the work piece, cooperating stop means on the tool and housing for limiting relative sliding movement and in turn to limit movement of the tool into the work, said cooperating stop means comprising two elements, one of said elements being a shoulder in said housing, the other of said elements being a collar on said tool, and a thrust bearing retained between said collar and said shoulder whereby contact of said thrust bearing by said collar and said shoulder limits relative sliding movement of said tool in said housing.

16. A stop countersink unit, comprising in combination, a tool spindle having an outer tool retaining portion and an inner extending shank adapted to be gripped for rotation in a prime mover chuck, a retractable stop sleeve rotatably and reciprocably mounted upon said spindle and adapted substantially to house a rotatable cutting tool retained in the outer end of said spindle, and means associated with said stop sleeve and rotatable with respect to said spindle to limit adjustably the retractability of said stop sleeve with respect to said spindle whereby a predetermined limited length of cutting tool may be exposed from said sleeve.

17. A stop countersink unit, comprising in combination, a tool spindle having an outer tool retaining portion and an inner extending shank adapted to be gripped for rotation in a prime

mover chuck, a retractable stop sleeve rotatably and reciprocably mounted upon said spindle and adapted substantially to house a rotatable cutting tool retained in the outer end of said spindle when said stop sleeve is in a fully extended position, a spring carried by said spindle and adapted to urge and normally maintain said sleeve in a fully extended position with respect to said spindle, and means associated with said stop sleeve and rotatable with respect to said spindle to limit adjustably the retractability of said sleeve with respect to said tool spindle upon application of retractive force to the outer end of said sleeve and against said spring whereby a predetermined limited length of cutting tool may be exposed from said sleeve.

18. A stop countersink unit according to claim 14 in which the said lock ring is provided with serrations adapted to register with similar serrations on the stop sleeve, and resilient means to urge said serrated lock rings into engagement with said stop sleeve serrations whereby upon loosening said lock nut the said lock ring may have limited freedom to reciprocate upon said spindle housing as the said serrations pass over one another, and whereby said stop sleeve may be rotated upon the spindle housing threads a predetermined angle as determined by the angle subtended by the width of each serration passed over on said lock ring.

FRANCIS G. JARVIS.