P. P. BALDWIN.

COLLAPSIBLE TOOL.

APPLICATION FILED MAR. 26, 1919.

1,331,138.

Patented Feb. 17, 1920.

2 SHEETS—SHEET 1.

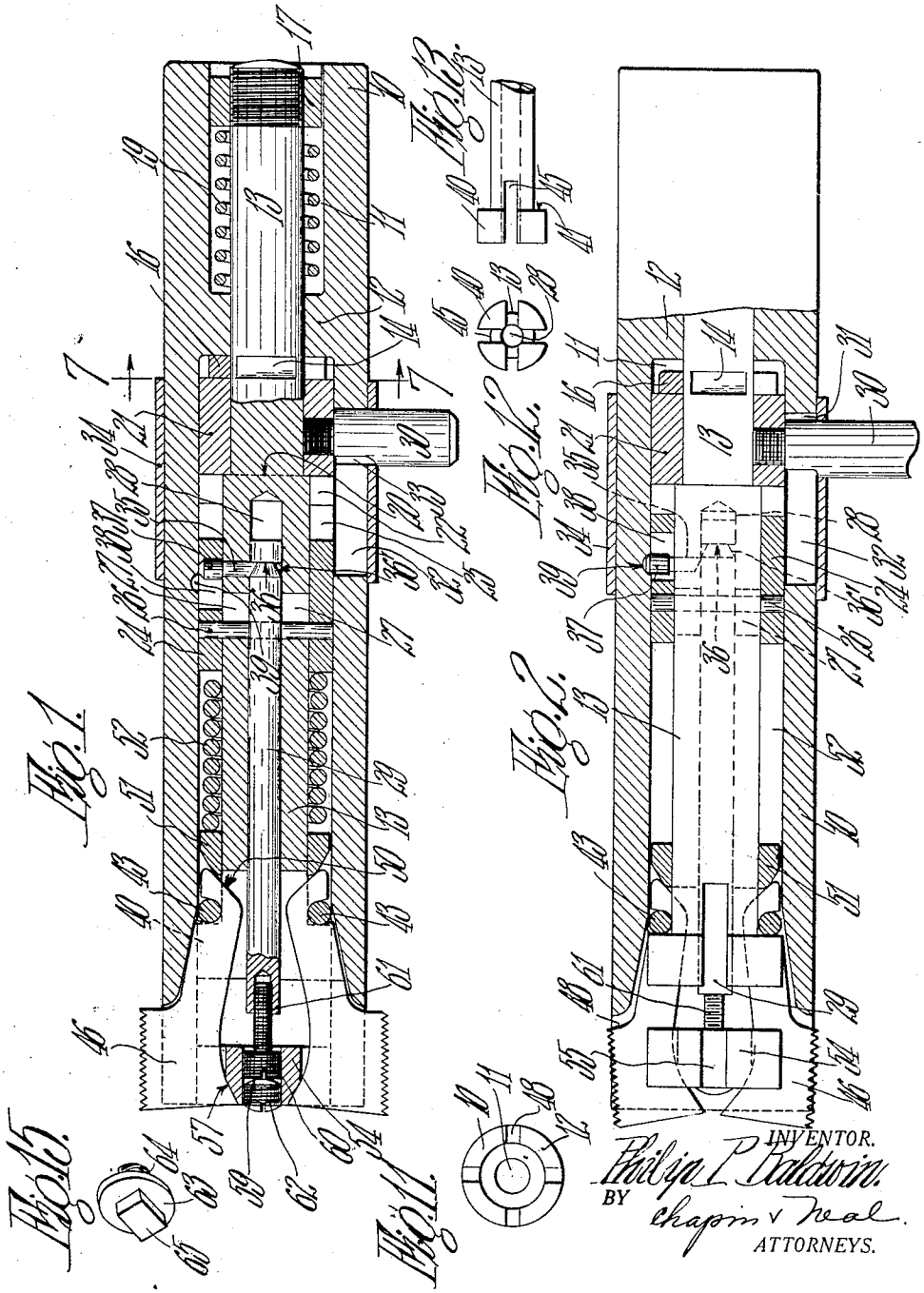


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

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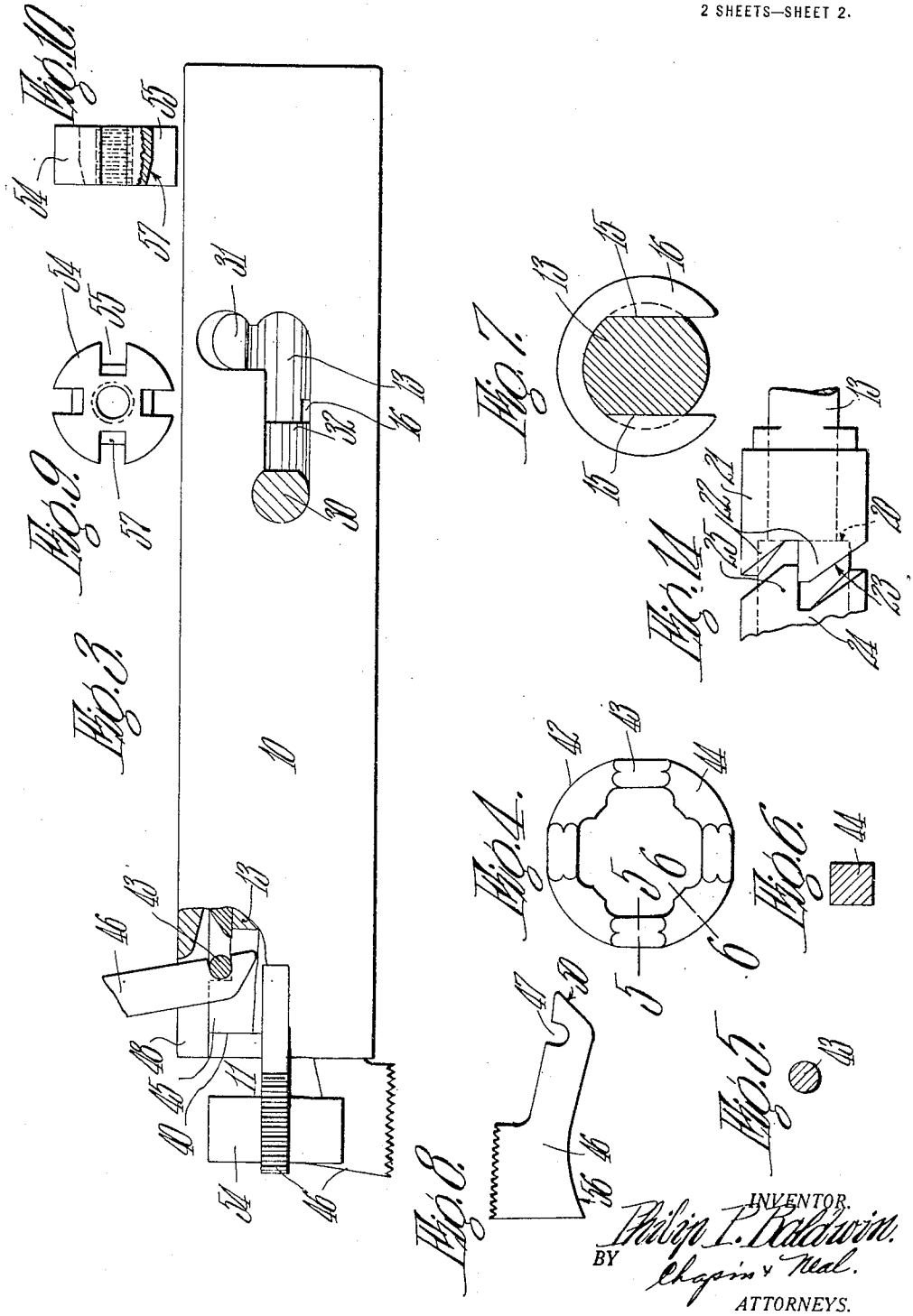
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UNITED STATES PATENT OFFICE.

PHILIP P. BALDWIN, OF GREENFIELD, MASSACHUSETTS.

COLLAPSIBLE TOOL.

1,331,138. Specification of Letters Patent. Patented Feb. 17, 1920.

Application filed March 26, 1919. Serial No. 285,158.

To all whom it may concern:

Be it known that I, PHILIP P. BALDWIN, a citizen of the United States of America, residing at Greenfield, in the county of Franklin and State of Massachusetts, have invented certain new and useful Improvements in Collapsible Tools, of which the following is a specification.

This invention relates to collapsible tools, of the character wherein the cutting elements thereof may be automatically moved away and disengaged from the work on the completion of the cutting operation. The invention, while capable of general application, finds one advantageous use as a collapsible tap and will be described herein in connection with such use for the purposes of illustration.

Collapsible cutting tools have been provided heretofore in many and various forms, as I am aware. The tools of the prior art, so far as I am aware, do however possess certain disadvantages, which I seek to overcome by this invention. Among these disadvantages, may be enumerated,—the lack of provision for a floating movement of the cutting elements relatively to that part of the tool which is automatically fed to the work. This is desirable especially in collapsible taps, which are used for precise thread cutting, where it is desired to have the cutters follow their own lead. The lack of provision for the floating movement has made necessary the use of separate attachments for this purpose. Other disadvantages of the prior tools are that they are often needlessly complex, expensive to manufacture, and difficult to assemble or take apart.

One object of this invention is to provide in a collapsible tool, a part suitable for attachment to the turret of a turret lathe or to other similar means, and a support for the cutting elements of the tool connected to said part for floating movement, together with mechanism, whereby said elements may be held in expanded position and automatically moved to collapsing position when desired.

A further object of the invention is to provide, in a collapsible tool, a solid outer shell within which is housed supports for the cutting elements and mechanism to automatically collapse such elements, the cutting elements extending through the wall of said shell and arranged to transmit their torsional strains directly to the shell rather than to the interior mechanism.

Another object of the invention is to provide in a collapsible tool a generally simplified and improved disposition and arrangement of parts to the end that assembly of the tool is rendered simple and convenient, as is also the dissociation of parts, when desired.

Another object of the invention is to provide in a collapsible tool, means whereby the cutting elements may be readily removed without removing the tool from the turret of the machine and without removal of other parts and more particularly without any disturbance of the various adjustments of the tool.

Another object of the invention is to provide a collapsible tool wherein all the mechanism, except the cutting elements, are completely housed in an outer cylindrical casing or shell, which is of a substantially uniform diameter less than that of the root of the cutting elements, so that the tool may be readily used for cutting in deep holes.

Another object of the invention is to provide improved means for holding the cutting elements in expanded position, such means being in the nature of a one piece catch which is positively moved into and out of its holding position.

A further object of the invention is to provide, in a collapsible tool, two relatively movable members to support the cutting elements and an improved adjusting means to move the one member relatively to the other for the purpose of varying the diameter of said elements, such means being in the nature of a differential screw and adapted for adjusting the cutting elements with close accuracy.

A further object of the invention is to provide, in a tool of the character described, generally simplified and improved mechanical structure.

Other objects and advantages will appear in the following description and in the illustrative embodiment of the invention in the accompanying drawings, in which:

Figure 1 is a sectional elevational view of a collapsible tool embodying the invention;

Fig. 2 is a similar view showing the cutting elements of the tool in collapsed position;

Fig. 3 is an exterior view, partly in section, showing the manner of removing the cutting elements from the tool;

Fig. 4 is an elevational view showing the ring upon which the cutting elements are pivoted;

Figs. 5 and 6 are cross sectional views taken on the lines 5—5 and 6—6 respectively of Fig. 4;

Fig. 7 is a partial cross sectional view taken on the line 7—7 of Fig. 1;

Fig. 8 is a detail view of one of the cutting elements;

Figs. 9 and 10 are end and side elevational views, respectively, of the wedge ring for supporting the cutting elements;

Fig. 11 is an end elevational view of the shell or outer casing of the tool;

Figs. 12 and 13 are end and side elevational views respectively of the float bar of the tool;

Fig. 14 is a fragmentary elevational view showing part of the mechanism for expanding the cutting elements; and

Fig. 15 is a perspective view of a device to hold such elements in expanded position during the removal of the internal mechanism from the outer shell.

Referring to these drawings, the tool includes a suitable outer shell 10, within which is housed all of the working parts. As shown, the outer shell comprises a straight, cylindrical member, having a smooth and substantially unbroken outer surface of substantially uniform diameter. The shell 10 is of hollow, tubular form and has a bore 11 extending from end to end thereof to receive the various elements to be hereinafter described.

Intermediate the ends of shell 10, the bore 11 is restricted by an interior flange 12 (Figs. 1 and 11). Slidable in the shell 10, and guided by the walls of such restricted portion, is a cylindrical bar 13, hereinafter called the float bar. Such bar has two grooves 14 (Fig. 1) formed on opposite sides of its periphery and the bases of these grooves afford flat, parallel surfaces 15, which are engaged by corresponding surfaces on a substantially U-shaped collar 16 (Fig. 7). The latter snugly fits in the grooves 14 and forms a flange to abut the flange 12 described. The collar 16 is thus fixed to the float bar 13, but may readily be removed therefrom, when desired. A second collar 17, is likewise removably secured to the float bar 13 by suitable means, as by the screw threads shown, for example. The collar 17 is applied near one end of bar 13 and is disposed on the opposite side of flange 12 from the collar 16. A coil spring 19 is disposed between the collar 17 and flange 12 and tends to hold the float bar 13 in the position illustrated in Fig. 1, wherein the collars 16 abuts the flange 12 of the shell 10.

Slightly to the left of the collar 16 (as viewed in Fig. 1), there is provided a shoulder 20 on the float bar 13. Between this shoulder and collar 16, and held against axial movement thereby, is a sleeve 21, which is oscillatable on the float bar. The sleeve 21 is provided with a plurality of angularly spaced projections 22, which overlie the enlarged portion of the float bar and such projections have inclined cam surfaces 23. A second sleeve 24, having like projections 25 and similar cam surfaces to coact with the surfaces 23, is also applied to the float bar 13. Sleeve 24 is slidable but not rotatable relatively to the latter. Thus, a pin 26 is applied diametrically through sleeve 24 and passes through diametrically opposed and longitudinally arranged slots 27 in the float bar. The latter is provided with a central, longitudinally disposed bore 28, which extends from the left hand end of the bar (as viewed in Fig. 1) to a position substantially midway between the ends thereof. In this bore 28, a bar 29 hereinafter called the control bar, is slidably mounted and the described pin 26 is driven through this bar, so that the sleeve 24 and control bar 29 are rigidly connected to move in unison.

The cam sleeve 21 described is adapted for manual operation and has secured thereto a handle 30, which extends radially through and beyond a slot 31 in the shell 10. The slot 31 is best shown in Fig. 3 and, as there shown, a second slot 32 intersects slot 31 at right angles. Slot 32 is of less width than slot 31 and the diameter of handle 30 is greater than the width of slot 32 so that, normally, the handle is movable only transversely of the shell in slot 31. A recess 33 (Fig. 1) is however, provided in handle 30 so that the latter when turned ninety degrees, from the position illustrated in Fig. 1, may traverse the slot 32 for reasons later to be described. If desired, a sleeve 34 may be loosely applied to the outer surface of shell 10, with the handle 30 passing through the sleeve, so that the latter conceals the slots 31. The movement of handle 30 from the upper to the lower end of slot 31 (as viewed in Fig. 3) serves to move the control bar 29 relatively to the float bar 13 and such movement of the control bar sets the lands of the collapsible tool, as will appear.

In order to releasably hold the control bar 29 in the position, to which it is moved by the described actuation of handle 30, and to prevent relative movement between the control bar and the float bar 13, a latch 35 is mounted to slide radially in the latter (Fig. 1). The inner end of the control bar 29 is grooved circumferentially to afford a shoul-

der 36, with which the latch 35 may engage to hold the control bar and float bar in the relative positions illustrated. The grooving of the control bar 29 also affords a conical surface 36′ and the lower end of latch 35 is suitably beveled to coact with this surface. The latch 35 has a head 37, which is equal in height to the thickness of sleeve 24 and therefore adapted to engage the internal surface of shell 10. Such engagement serves to hold the latch in its inner position, wherein the control bar 29 is held against movement to the right (Fig. 1) relatively to the float bar. The latch 35, being fixed relatively to the float bar, while the sleeve 24 is movable axially relatively to the latter, a longitudinal slot 38 is provided in sleeve 24 to receive the head 37 of latch 35 and permit the relative movement of the sleeve 24 and float bar 13. The engagement of the latch 35 with the surface 36′ in the control bar 29 is such as to permit the latter to move to the right (Fig. 1) with respect to the float bar 13. That is the control bar might be pushed into the bore 28 of the float bar 13 to thereby cam latch 35 radially outwardly and, of course, if the float bar is pulled to the left (Fig. 1) while the control bar is held relatively stationary, the same result would be accomplished. This outward camming of the latch 35 is normally prevented by the engagement of the head 37 with the interior wall of shell 10. In such wall, and to the left of head 38 (Fig. 1), there is provided a recess 39, which, when the float bar 13 is pulled forwardly (to the left as viewed in Fig. 1) against the tension of spring 19, will overlie head 37 and permit it to be moved radially outward by the camming action described. Such movement of the latch releases the lands of the collapsible tool and permits the collapsing action. The recess 33 in handle 30 permits a sufficient movement of the float bar 13 relatively to shell 10 to bring the head 38 in line with the recess 39 and to cam the former outwardly into the latter.

The lands of the tool are pivotally attached to the float bar 13 and are also supported by means carried by the control bar 29. The outer (left as viewed in Fig. 1) end of the float bar 13 is provided with an enlargement or head 40 (see also Figs. 12 and 13), which closely fits the interior wall of shell 10 and functions, together with sleeves 21 and 24, collar 17, and flange 12, to guide the bar in its floating movements. The intersection of head 40 and bar 13 affords a shoulder 41 against which a ring 42 may seat. The ring 42, shown separately in Figs. 4, 5, and 6, has four portions 43 of rounded cross-section, arranged in quadrature, and intermediate such portions, other portions 44 of square cross section. The head 40 is provided with four radial slots 45, which also extend a short distance into the body of bar 13, to receive the lands 46 of the tool. These slots 45 are arranged at right angles to one another, and the described ring 42 is so applied against the shoulder 41 of head 40 that the rounded portions 43 of the ring overlie the slots. The lands 46 have U-shaped slots 47 (Fig. 8), which partially encompass the portions 43 (as shown in Fig. 1), so that the latter function as pivots for the lands. The outer end of casing 10 is likewise provided with four, right-angularly arranged, radial slots 48 through which the cutting portions of lands 46 may protrude. The lands 46 closely fit the slots 48, and desirably so, in order that the torsional strains imposed upon the lands be taken by, and transmitted to, the solid, heavy, outer shell 10, rather than by the more delicate mechanism within the shell.

The lands 46 have, at their inner ends, cam surfaces 50, and these several surfaces are all engaged simultaneously by a single wedge ring 51, which is slidably mounted upon the float bar 13 and disposed in the rear of head 40. A spring 52, coiled about the float bar 13, acts between the wedge ring 51 and the outer end of sleeve 24 with a constant tendency to separate the wedge ring axially from the sleeve. The wedge ring 51 acts against the cam surfaces 50 on the lands 46 with a tendency to move the cutting portions thereof inwardly or toward collapsed position. The spring 52 will hereinafter be called the closing spring, since it functions to collapse the lands of the tool.

The lands 46, however, are normally prevented from collapsing, under the action of the closing spring, by a block 54 which is carried by the control bar 29. The block 54 is of generally cylindrical form and closely fits the otherwise open, outer end of shell 10. The block 54 has four angularly spaced slots 55 in its periphery for the purpose of receiving the several lands 46. The latter have appropriately formed inclined surfaces 56 which rest upon similarly inclined surfaces 57 formed in the wedge block 54 at the base of slots 55. The surfaces 57 support the lands 46 at their outer ends and limit the extent of the inward movement of the lands under the action of the closing spring.

The wedge block 54 has been described as carried by the outer end of the control bar, and it may, as far as some features of the invention are concerned, be rigidly fixed to the control bar. Usually, however, it is desired to provide means for adjusting the lands 46 radially inwardly or outwardly to suit the particular work in hand. Therefore, the wedge block 54 is desirably connected to the control bar so as to permit the one to be moved, within limits, relatively to the other for the purpose of shifting the wedge block relatively to the lands. This relative

shifting movement operates, by coaction of the surfaces 56 and 57, to spread the lands or to permit them to be drawn together under the action of the closing spring according to the direction of the movement. Preferably, the adjustable connection, between the wedge block 54 and the control bar 29, takes the form of a differential screw, such as is shown in Fig. 1 at 59. Screw 59 has two threaded portions 60 and 61, which are of different pitch, and one portion, as 60, is threaded axially into the wedge block 54 while the other, as 61, is threaded axially into the end of the control bar 29. Thus the two latter elements are securely, yet adjustably connected and the particular adjusting means chosen is advantageous in that it lends itself readily to adjustments of very fine character. This follows, since the axial movement of the block with relation to the control bar is proportional to the difference between the pitch of the portions 60 and 61. That is, if the latter, on one revolution of screw 59, would move axially, say, twenty-five thousandths of an inch and the former, on the same revolution of the screw, would move axially, say, twenty thousandths of an inch, the effective movement of the block 54 relatively to the control bar 29 would be five thousandths of an inch. It will thus be seen that the cutting elements of the lands 46 may be adjusted with very close accuracy, by the means described, so that the collapsible tool is suitable for precision work.

In practice, the outer end of screw 59 is protected by a set-screw 62. This screw 62, when removed, permits the use of a convenient means for preventing the lands from collapsing, which means is used more particularly during the assembly of the mechanism in, or removal of the mechanism from, shell 10. This means may consist simply of a washer 63, having a threaded stud 64 on one side to engage in the open, threaded, outer end of wedge block 54, and a squared head 65 on the other side to permit the stud 65 to be conveniently threaded into the block. The washer 63 is intended to overlie the outer end faces of the several lands 46 and clamp them firmly to the wedge block.

In operation, the shell 10 is usually held stationarily in a chuck while the work to be threaded is revolved. For example, the shell 10 may be held in the turret of a turret lathe. The shall 10 is generally fed axially forward to the work, whereupon the revolving work will be threaded. For precise thread cutting, it is generally desired to have the cutters follow their own lead, and this is permitted, according to my invention, by the incorporation into the tool of the float spring 19, which permits the cutters, together with the entire mechanism within the shell, to float back and forth therein, as required. The axial feed imparted to the shell would, of course, be approximately correct, but such differences between this feed and the correct one (obtained by allowing the cutters to follow their own lead) are compensated for by the provision for the floating movement. Without this provision, the cutters would, from time to time, tend to drag the heavy turret forwardly to compensate for its inaccurate feed, and this is undesirable when accurate work is required.

As shown in Fig. 1, the lands 46 are in expanded position ready for the cutting operation, which is performed as above described, in a manner requiring no further description. The automatic collapsing of the lands 46 may be accomplished as follows: If the automatic axial feed imparted to shell 10 is stopped, the lands 46 continue to progress axially into the work being threaded, and thus a relative axial movement is obtained between the shell 10 and the float bar 13, to which the lands 46 are attached. This relative movement may obviously be produced in other ways and the one described is purely illustrative. Having, however, such a relative movement produced in any way, the float bar 13 moves forwardly in the shell 10 to the extent permitted by handle 30, and this, as described, is sufficient to carry head 37 in under recess 39. As the latch 35 is carried forward with the float bar, while the control bar 29 remains stationary, the surface 36′ on the latter cams the latch upwardly into recess 39. This allows the closing spring 52 to come into play and such spring moves sleeve 24 and thus the attached control bar 29 to the right, as viewed in Fig. 1. As the bar 29 is thus moved, it carries with it the wedge block 54 and an inward movement of the latter permits the collapsing of the lands 46 under the action of the closing spring 52.

The parts then occupy the relative positions shown in Fig. 2. It will be seen from this figure that the beveled end of latch 35 engages the smooth outer periphery of bar 29 and that the head 37 of the latch lies in recess 39. Such engagement of head 38 in the latter temporarily prevents the complete return of the float bar 13 under the action of the float spring 19. However, as handle 30 is moved from the upper to the lower end of slot 31 (Fig. 3), the coacting cam sleeves 21 and 24 are axially separated, and the control bar 29 is thus forced forwardly. As soon as the grooved portion of the bar 29 comes in under the end of latch 35, the float spring 19 can then return the float bar into the position illustrated in Fig. 1 and, in so doing, the head 38 is cammed downwardly to force latch 35 into engagement with shoulder 36. The latch is

then held from outward movement by the shell 10 until such time as the float bar is again pulled forwardly.

The arrangement of the latch 35 for action in the described manner is thought to be important and novel. The latch is of the simplest construction and does not depend on spring action to directly force it into locking position. The action of the latch is positive in each direction by reason of its cam actuation under the movement of the float bar 13 and its impelling spring 19. The utilization of the latter to return the latch into locking position, in addition to its floating function, is also thought to be important.

The provision for accurate adjustment of the lands, as above described, is also important, as well as the provision for preventing the imposition of torsional strains on the internal mechanism of the tool. The shell 10 is purposely made strong and sturdy to safely take such strains. The shell 10 is also of cylindrical form and of substantially uniform diameter, no portion thereof being greater than the diameter of the root of the threads of the lands, when the latter are in expanded position. Thus, long threads may be cut or threads located far within a cylinder and at a distance from the entrance end of the hole therein. Furthermore, there are no obstructions on the forward end face of the tool so that it can readily be used as a bottoming top, when desired. The arrangement of the wedge block is important, inasmuch as it provides a firm support for the lands by its disposition directly in under the cutting portions thereof.

It is also to be noted that the tool is characterized by the absence of the usual large number of springs employed in tools of this character. Only two springs are provided. One, the closing spring, acts simultaneously on all four (or more, if desired) lands and, aside from the feature of making one spring do the work of four, this arrangement is important since the one spring may readily be made of ample strength to effectively accomplish its purpose and yet, withal, is simple and inexpensive. The incorporation of the float spring with the mechanism of the collapsible tool itself is particularly important. Heretofore, separate attachments have had to be used to supply the desirable floating movement. This is eliminated, according to my invention, and a tool is provided which has, inherently therein, all the floating qualities desired for precision work.

Other important features of the invention relate to the provision for the convenient assembling or removal of parts. To remove the lands 46, as is frequently necessary, all that is necessary is to give handle 30 a quarter turn so that it can slide forwardly in slot 32 (Fig. 3). Then, by pushing on the handle, the entire mechanism may be shifted forwardly so that the lands 46 are completely extruded from the shell. By turning handle 30 to prevent its return in slot 32, the lands may be held in their extruded position. Then, as clearly shown in Fig. 3, the lands may be swung sufficiently on their pivots to permit their removal and the insertion of new lands, if desired. To remove the lands, it is obviously unnecessary to remove the shell 10 from the turret and, furthermore, it is unnecessary to disturb any of the carefully made adjustments. The removal of the lands is thus a very simple matter and may be accomplished conveniently and expeditiously.

The entire internal mechanism of the tool may likewise be readily removed. This, as well as the removal of the lands, is accomplished while the latter are in their expanded positions, and the device shown in Fig. 15 is used to hold the lands against collapsing. The collar 17 and handle 30 are unscrewed, whereupon the float bar 13, with all its associated parts still held in correctly adjusted working relation, may be completely removed as a unit from the shell. The removal of collar 16 permits the cam sleeve 21 to be slipped off the float bar and by driving out a single pin (26) the other cam sleeve 24, the spring 52, wedge ring 51, and pivot ring 42 may be successively slipped off the bar 13 in the order named. The removal of parts is, thus, rendered as convenient as possible, and it will be obvious that the assembly of parts may be made with equal convenience and as expeditiously as possible.

The invention has been disclosed herein, in an embodiment at present preferred, for illustrative purposes. It is recognized, however, that many modifications may be made in the one structure herein disclosed, having for their object the use of the invention in a form differing from the specific one disclosed. It is, therefore, desired to have the scope of the invention defined by the appended claims interpreted by the spirit of the present disclosure rather than by the letter of the one form disclosed.

What I claim is—

1. In a collapsible tool, a member by which the tool may be supported and fed to the work, cutting elements, supports therefor capable of relative movement to permit said elements to be spread and drawn together and mounted to move relatively to said member, and means yieldingly connecting one of said supports and member so that the one may float within limits relatively to the other.

2. In a collapsible tool, a member by which the tool is supported and fed to the work, cutting elements, supports therefor

connected for relative movement, releasable means to hold said supports against relative movement to maintain said elements in one position, means operable on release of said means to move said supports the one relatively to the other to move said elements to another position, and means connecting one of said supports to said member to permit floating movements of the former relatively to the latter.

3. A collapsible tool, comprising, an outer shell, cutting elements protruding outwardly from the shell, a member slidable within the shell for supporting said elements, a second member slidable within the shell for supporting said elements at a distance from the first-named member, means to move one member relatively to the other, means to releasably hold said members against relative movement, an abutment provided in the shell for engagement with one of said members to limit its movement relatively to the shell, and means to yieldingly hold the last-named member against said abutment.

4. A collapsible tool, comprising, an outer shell, cutting elements protruding outwardly from the shell, a member slidable within the shell for supporting said elements, a second member slidable within the shell for supporting said elements at a distance from the first-named member, means to move one member relatively to the other, means to releasably hold said member against relative movement, an abutment provided in the shell for engagement with one of said members to limit its movement relatively to the shell, and means operable after the last-named member has been moved a predetermined distance away from said abutment to release said holding means and permit said members to move the one relatively to the other.

5. A collapsible tool, comprising cutting elements, a cylindrical outer shell having in one end a series of radial slots through which said elements protrude, means within the shell to support and position said elements radially of the shell, said means including relatively movable parts normally held against movement to hold said elements in one position, and means operable on release of said parts to move the one relatively to the other to move said elements to another position, the radial walls of said slots arranged to take the torsional strains imposed on said elements in cutting and prevent the transmission of such strains to the interior mechansim.

6. A collapsible tool, comprising cutting elements, a cylindrical outer shell having in one end a series of radial slots through which said elements protrude, means within the shell to support and position said elements radially of the shell, said means including relative movable parts normally held against movement to hold said elements in one position, the radial walls of said slots arranged to take the torsional strains imposed on said elements in cutting and prevent the transmission of such strains to the interior mechanism, and the end face of said shell having no part protruding beyond the end faces of said elements, whereby the tool may be used for bottoming.

7. In a collapsible tool, cutting elements, two members each acting to radially support said elements and arranged for axial movement the one relatively to the other, means releasably holding said members against relative movement to hold said elements in one radial position, and means operable on release of said members to automatically move them relatively to one another to move said elements to another radial position, an adjusting device to separate the supporting part of one member from the like part of the other member for the purpose of radially adjusting said elements, the supporting part of one member being separable axially from the body thereof, and said device comprising a screw having a portion threaded into the last-named part and a second portion threaded into said body, said portions having threads of different pitch.

8. The combination in a collapsible tool, having cutting elements, and two relatively movable members each engageable with said elements and adapted on such relative movement to cause a radial movement of said elements, of means to radially adjust said members, one thereof being constructed in two parts which are connected together by said means, the latter comprising a differential screw.

9. In a collapsible tool, cutting elements, two members movable axially the one relatively to the other to cause radial movement of said elements, a shell within which said elements are mounted for floating movement, a one-piece device slidable transversely in one member and adapted to engage the second member to hold the members against relative movement, a cam provided on the second member, and a cam provided on said shell, one of said cams arranged on a forward floating movement of said members to positively force said device outwardly to release said members, and the other cam arranged on a reverse movement of said members relatively to the shell to positively force said device into holding engagement with said members.

10. In a collapsible tool, cutting elements, two members mounted for relative axial movement and arranged on such movement to cause radial movement of said elements, a shell within which said members are mounted for floating movement, releasable means to hold said members against relative movement, and means to move said members the one relatively to the other upon release of

the last-named means, the latter comprising a device mounted in one member for radial movement and engaging the shell at one end and the second member at the other end to hold said members against relative movement, the second member having an axially inclined surface with which said device engages, and a recess provided in the shell in the axial path of said device and adapted to permit the latter to be forced radially outward by said cam on a floating movement of said member relatively to the shell to release the members for relative axial movement.

11. A collapsible tool comprising an outer shell, cutting elements, a member slidable in the shell and connected to said elements to be moved axially thereby, a second member acting to radially support said elements and mounted to move relatively to the other member, releasable means to hold said members against relative movement, means to effect the last-named movement on release of the last-named means, coacting cams one on each member and one of which is oscillatable relatively to the other to reset said members after such relative movement, the first-named member having a shoulder to engage an abutment provided in said shell, a collar removably secured to said first-named member, and a spring between said collar and abutment to yieldingly hold the first-named member against the latter, all constructed and arranged so that on removal of said collar the entire mechanism within said shell may be removed as a unit with all its parts in properly adjusted coöperative relation.

12. In a collapsible tool, an outer shell, a member mounted therein for floating movement, cutting elements pivotally supported from said member and protruding radially from said shell, a second member engageable with said elements and mounted for axial movement relatively to the first member, a spring tending to move said members relatively to one another in one direction to move said elements radially to one position, resetting means operable from without the shell to move said members relatively to one another in the opposite direction to move said elements radially to another position, means to releasably hold said elements in the last-named position, and means permitting the first-named member and associated parts to be moved axially relatively to the shell by said resetting means a sufficient distance to permit complete access to said elements, the latter being connected to the first-named member for convenient removal when thus exposed from the shell.

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