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L. VAN DALEN
MULTI-STEP DRILL
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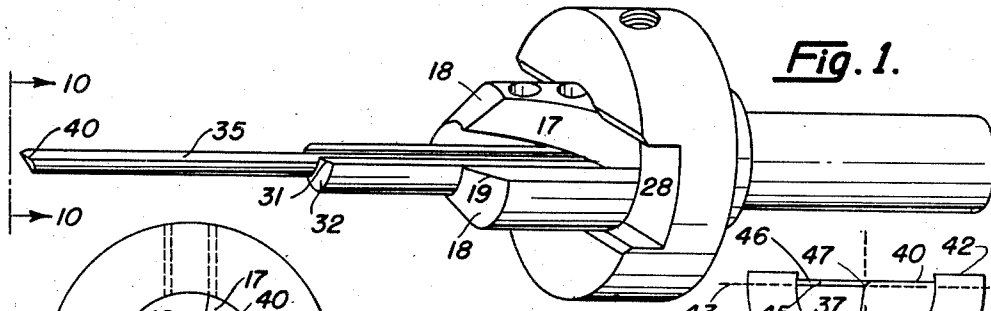


Fig. 1.

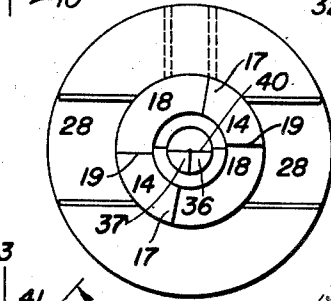


Fig. 4.

Fig. 10.

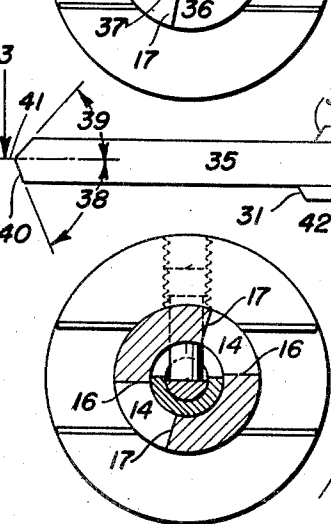


Fig. 5.

Fig. 2.

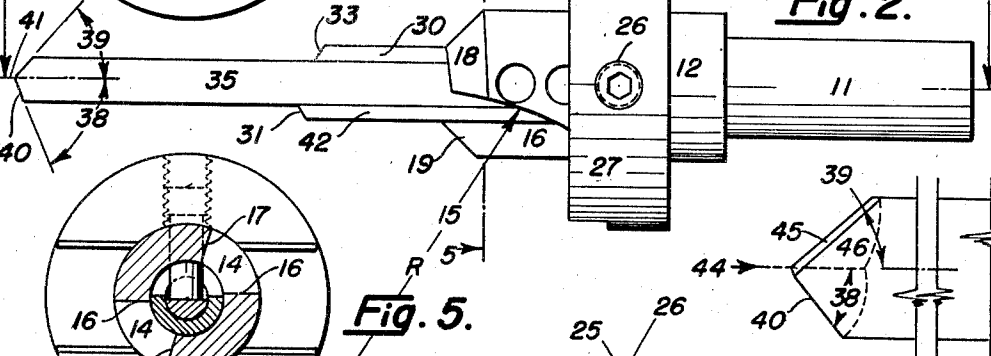


Fig. 3.

Fig. 11.

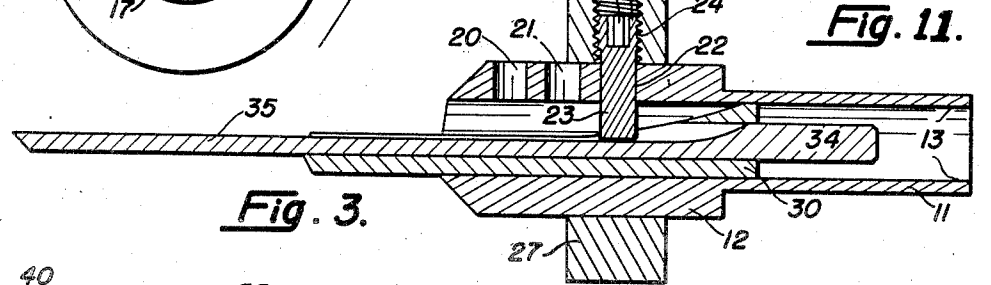


Fig. 6.

Fig. 7.

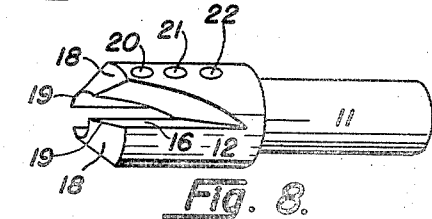


Fig. 8.

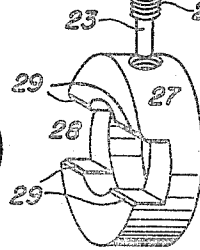


Fig. 9.

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MULTI-STEP DRILL

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3 Claims. (Cl. 145—125)

The present invention relates to a multi-step drill, the lengths of whose steps are adjustable.

One of the objects of the present invention is a multi-step drill for drilling woods of various degrees of hardness and also for drilling metals.

In drilling wood for the reception of wood screws, especially woods of the harder types, it is desirable to drill the wood for the screw-root diameter, for the length of the threaded portion, and to drill the wood at a somewhat larger diameter for the reception of the unthreaded body or stem portion of the screw and also to countersink the wood for the head either flush with the outer surface of the wood or to countersink it for the head at a greater depth, so that the screw can be covered over with a wooden plug or the like.

The same "size" screw comes in many lengths, as, for instance, a No. 10 flat head wood screw may be $\frac{3}{4}$ inch long, an inch long, $1\frac{1}{2}$ inches, 2 inches etc. in length. Therefore, the length or depth to which the various diameters, particularly the thread-root-diameter and the shank-diameter should be drilled, varies according to the length of the screw. Likewise, the depth of the countersinking varies according to whether the screw is to be flush or countersunk just enough for an overlay of putty or to be countersunk for a wooden plug.

The object of the present invention is to provide a multi-step drill whereby screw-receiving holes may be drilled with the length of the thread-root-diameter drilling as well as the length of the shank-diameter drilling adjustable to any desired depths, and whereby the depth of the countersink-drilling may be varied in three steps, namely, one for flush countersinking, one for a shallow overlay or for otherwise placing the head below the surface of the wood and a third depth for the reception of the wooden plug.

A further object of the present invention is a multi-step drill of this type which will not clog with the drillings or chips, and which will be secure against loss of adjustment, while in operation, and in which all three drilling-depths may be fixed by a single set screw.

A further object of the present invention is to provide a drill of this character, one or several cutting edges of which may be formed of low carbon steel which has been case-hardened to a comparatively small depth, and yet one which may be sharpened and dressed, from time to time, without loss of the effectiveness of the case-hardened portion thereof, at the cutting edge.

In the accompanying drawings in which like reference characters indicate like parts.

Figure 1 represents a perspective view of a step drill embodying my present invention.

Figure 2 represents a side elevational view of the same.

Figure 3 represents a section on line 3—3 of Figure 2.

Figure 4 represents an end elevational view of the same.

Figure 5 represents a section on line 5—5 of Figure 2.

Figure 6 represents a perspective view of the centermost portion of the step drill, showing one embodiment of such centermost portion.

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Figure 7 represents a perspective view of the intermediate portion of the drill, representing one embodiment of this portion.

Figure 8 represents a perspective view of the countersink portion of my drill, showing one embodiment thereof.

Figure 9 represents a perspective view of the lock collar and countersink-stop forming a part of the multi-step drill of the present invention.

Figure 10 represents an enlarged end-elevational view of the center drill and of the intermediate drill.

Figure 11 represents a top plan view of the same on a similarly enlarged scale.

In the embodiment of my invention as shown in the accompanying drawings, I provide a tubular shank 11 which is adapted to be grasped within the drill chuck, lathe chuck or the like. A tubular locking head 12 is formed integrally with the tubular shank 11, and coaxial therewith, and with the same internal bore 13. The outer diameter of the locking head 12 is preferably slightly greater than the maximum diameter of the head of the screw, namely, the head of the "screw size" for which the multi-step-drill is intended. Thus, for instance, if the multi-step-drill is intended for No. 10 wood screws, the outer diameter of the head 12 will be somewhat larger than the head of No. 10 wood screws.

The front end of the tubular head 12 is cut away at diametrically opposed zones 14 preferably by a milling cutter operating on the radius 15 to provide generally radial flat surfaces 16, which lie in a plane or planes passing through the axis of the head 12, and cylindrical surfaces 17 whose axes are generally at a right angle to the axis of the head 12 but lying in a plane spaced a substantial distance from the plane in which the axis of the head lies, as indicated for instance in Figure 2.

The free end of the head-member 12 is then turned or preferably ground to form a pair of similar spiral conical surfaces 18 to form a slight relief back of the cutting edges 19 thereof, which edges are formed between the surfaces 18 and the surfaces 16.

The bevel of the surfaces 18 and of the cutting edges 19 is such as to correspond generally to the bevel of the underside of the flat head of the wood screw or the like.

The clearances 14 serve not only to provide the cutting edges 19, but also to provide ample clearance for the aggress of the wood shavings or chips during the drilling operation.

Three similar radial holes 20, 21 and 22 are extended radially through the head 12, spaced about an $\frac{1}{8}$ inch apart (for a No. 8 or a No. 10 wood screw, for instance). The diameters of these holes 20, 21 and 22 are such as snugly or neatly to receive the threadless stem-portion 23 of a set-screw 24 having an Allen head 25 whose outer threaded portion 24 is screw-threaded into the radial threaded-hole 26 of the locking-collar and stop-collar 27; the collar 27 being neatly fitted to and slidably telescoped over the outer diameter of the head 12.

The collar 27 is provided with a pair of radial recesses 28, channeled across the front face thereof, preferably at a right angle to the direction of the radial threaded hole 26. The edges 29 of the channels 28 are preferably beveled off or rounded off, so that they will not cut the surface of the wood against which they bear in the stopping position when the drill has reached its desired depth for which it is set.

As will be seen from Figures 1, 2, 5, 8 and 9, the channels 28 are so disposed as to be in operative juxtaposition to the chip-clearances 14 formed in the head 12, so that the chips emerging through the clearances 14 may make their exit through the channels 28; the centrifugal force imparted to the chips (by the rotation of the multi-step

drill) serving to eject the chips through the two opposite ends of the channels 28.

The intermediate drill portion 30 is preferably formed tubular, with its outermost diameter neatly fitting and slidably telescoped within the inner bore 13 of the shank 11 and head 12. The tubular intermediate member 30 is then cut away from its front end towards its rear end to a depth slightly less than one-half of its diameter, so that slightly more than one-half of the circumference of the inner bore thereof is left intact as indicated for instance in Figures 4, 5 and 10.

The outer end of the intermediate member 30 is then ground to a spiral bevel, to form the cutting edge 31, with a spiral surface 32 forming a relief in back of the cutting edge 31 and terminating in the low-side 33 indicated in Figure 2.

The center-drill-member 34 is made of a cylindrical rod (preferably drill-rod) which is milled and/or ground away either to leave behind approximately one-half of its diameter or to leave behind slightly more than one-half of its diameter. Preferably, it is ground away to somewhat more than one-half its diameter at the front end thereof and to half its diameter towards the rear portion thereof, but all in one continuous plane surface 35.

Thus, for instance, with a 0.100" diameter inner drill or center-drill 34, the drill-rod is preferably milled or ground down until the flat surface 35 thereof is about 0.010" above the center-line or center-plane 43 shown in Figure 10.

The front end or cutting end of the center-drill-member 34 is cut or ground to two different flat surfaces 36 and 37, respectively, which intersect each other at somewhat more than 90°, possibly 105° or 110°, more or less, but whose line of intersection intersects the plane flat surface 35 of the drill approximately in the center-plane thereof as indicated in Figures 2, 4 and 10. The line of intersection between the plane 36 and the flat surface 35 of the drill is at the angle 38 to the axis of the drill while the line of intersection between the surface 37 and the flat surface 35 of the drill is at an angle 39 to the axis of the drill; the angle 38 being slightly greater than the angle 39, thereby forming a relief behind the cutting edge 40 of the center-drill-member 34, and thereby also forming a point 41 which will be substantially in the axis of the drill.

In order better to balance the center-drill-member 34, a slight bevel 45 is preferably ground on the relieved edge 46 of the drill, where the surface 37 intersects the surface 35, so as to produce what may be called a slight pivot-edge 47 and thus bring the pivot-point 41 approximately on the dead-center of the drill, as indicated more particularly in Figures 10 and 11. In this manner any tendency which the drill might otherwise have to wobble slightly, off-center, at its drilling end, is obviated or minimized.

The intermediate-drill-portion 30 is also preferably milled or ground away so that the amount by which it is in excess of a half-tube will be slightly greater than the amount by which the center-drill 34 is in excess of a half-cylinder. This is indicated particularly in Figure 10, which shows these approximate relationships, that is, the intermediate-drill 30 being approximately 0.017" in excess¹ of a half-tube, while the center-drill 34 is approximately 0.010" in excess² of a half-cylinder. In this manner the center-drill 34 is more securely locked or retained within the intermediate-drill-member 30 and is thereby prevented from springing or bending away from the intermediate-drill-member while rotatably applied to the work. This tends better to prevent the ingress of fine wood-chips between the outer cylindrical

surface of the center-drill 34 and the inner cylindrical surface of the intermediate-drill 30.

By telescoping the four members 12, 27, 30 and 34 in relation to each other, as shown in Figures 1 to 5, inclusive, and then setting the flat end of the screw (23 and 24) against the generally flat surface 35 of the center-drill 34, as such surface is exposed within the intermediate-drill-member 30, the entire multi-step drill is securely locked with its various parts in any desired predetermined setting.

It will thus be seen that the inner drill 34 as well as the intermediate drill 30 are each provided with a single cutting edge (40 and 31, respectively) while the countersink is provided with two cutting edges (19).

The chips produced by the cutting edges 40 and 31 will flow into one of the two clearances 14 in the head 12, and from there will be discharged into the cross-channels 28, and thus expelled.

There being no clearance between the outer cylindrical surface of the intermediate-drill-member 30 and the inner bore 13 of the head 12, no wood chips or the like can get between these two surfaces. Likewise no chips can get between the outer cylindrical surface of the center-drill 34 and the contiguous inner cylindrical surface of the intermediate-drill 30. Thus, for instance, if an ordinary spiral drill were used (in place of the drill 34), a spiral clearance is formed between such center-drill and the intermediate-drill 30, which can become packed with wood-chips or the like, thus tending to spring such center-drill out of axial alignment with the intermediate-drill 30.

The shank 11 and head 12 as well as the intermediate drill member 30 may be formed of cold-rolled steel, and then case-hardened or cyanide-hardened to the depth which may be achieved by this type of hardening.

By dressing or grinding the cutting edges 31 and 19 only on one face thereof, the case-hardened surface is maintained on the other face of the cutting edge and hence maintained on the cutting edge itself. Preferably, the spiral conical surfaces 32 and 18 are ground when it is desired to sharpen the cutting edges 31 and 19, respectively; thus leaving the flat surfaces 16 on the head 12 and the corresponding flat surface 42 on the intermediate-drill intact with their case-hardened skins which will at all times present case-hardened cutting edges.

If desired the center-drill 34, instead of being a flat drill as indicated, may be a spirally-fluted drill of the more or less conventional type; still permitting the assembly-locking and setting of the multi-stepped drill by the single set-screw (23 and 24), or, preferably the front-end or drilling-end of the center-drill 34 may be spirally fluted for just a short distance from its front or cutting end, with the balance of its length unfluted and cut away to the approximately half-round form shown in Figures 3, 5 and 6. In this alternative form of construction (not shown in the drawings) the spiral flutes are so spiraled at their rear ends as to "open up" onto or terminate in the cut-away portion of the approximately half-round stem of the center-drill 34, so that the wood-chips propelled outwardly by the spirally-fluted front end of the center-drill will be conveyed to the cut-away or clearance portion of the stem so that they can freely move outwardly in the approximately half-round clearance-space between the stem and the hole drilled by the center-drill. This spirally-fluted portion of the center-drill 34 may be a third or a quarter of the over-all length thereof, more or less. In this modified embodiment of my invention the center-drill 34 will have two cutting edges as is generally the practice with fluted or "twist" drills (although the major length of the drill is nevertheless provided with the "flat" 35).

While in the drawings the center-drill 34 is shown as being provided with a "flat" 35 up to a point just somewhat short of the rear end thereof, it is to be understood that the "flat" 35 may extend fully to the rear end of the center-drill 34 so as to leave no cylindrical portion

¹ In a radial direction at a right angle to the plane of the surface 42 thereof.

² In a radial direction at a right angle to the plane of the surface 35 thereof.

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at the rear end as shown for instance in Figure 6. The extension of this "flat" to the rear end permits a wider range of lengthwise adjustment of the center-drill 34 in relation to the intermediate-drill 30. If the front end of the drill is spirally fluted, as indicated, hereinabove, then the "flat" 35 will stop short of the front end of the drill 34, namely, it will stop at the rear end of the spirally-fluted drilling-end of the center-drill 34.

By the single radial force exerted by the set-screw upon the innermost or center drill 34 not only is the innermost drill 34 clamped, but the drill 34 in turn presses the intermediate-drill 30 against the bore 13 of the head 12, thus clamping the three members (34, 30 and 12) together, and in turn, clamping the collar 27 to the outer surface of the head 12; all in adjustable relation to each other.

Having described my invention, I claim:

1. A multi-step drill comprising a center-drill-member, an intermediate-drill-member which is cut away to approximately half its diameter through a substantial portion of its length including the front end thereof, a generally tubular countersink-member and a locking collar telescoped over the countersink-member, and a set-screw extending through said collar and lockingly engaging at least one of the other members.

2. A multi-step drill comprising a center-drill-member, a semi-tubular intermediate-drill-member cut away so as to leave behind somewhat more than a half-tube, a generally tubular countersink-member having a chip-clearance adjoining its cutting edge, and a locking collar telescoped over the countersink-member and having a chip-clearance-channel in registration with the chip-clearance of said countersink-member, and means extending through said collar for locking said members together in predetermined adjustable positions in relation to each other.

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3. A multi-step drill comprising a center-drill-member, a semi-tubular intermediate-drill-member cut away to form approximately a half-tube through a substantial portion of its length including its front end, a generally tubular countersink-member, and a locking collar, said drill-members and countersink-member and locking collar being all telescoped in relation to each other and disposed coaxially in relation to each other, and a set screw extending through said collar and through said countersink-member and bearing directly against the center-drill-member, thereby to lock said drill-members and said countersink in pre-determined adjustable relationship to each other.

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