(No Model.) 2 Sheets—Sheet 1.

A. LATHAM.

COUNTERBORE, REAMER, OR COUNTERSINK.

No. 370,484. Patented Sept. 27, 1887.

Fig. 1.

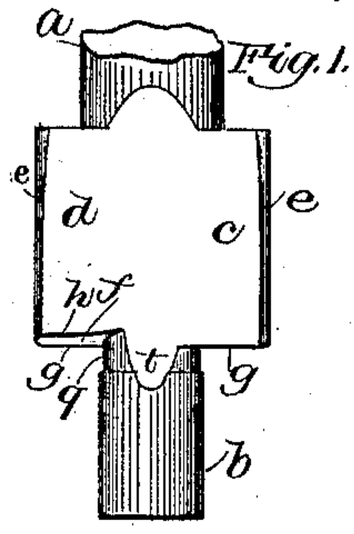


Fig. 2.

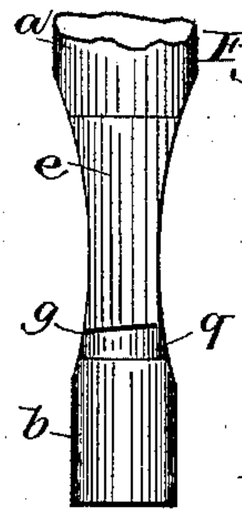


Fig. 17.

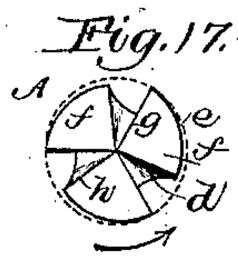


Fig. 16.

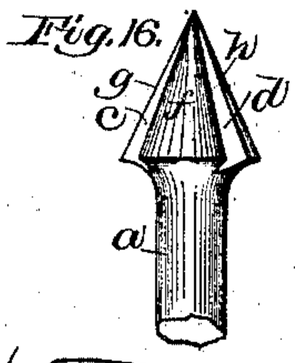


Fig. 4.

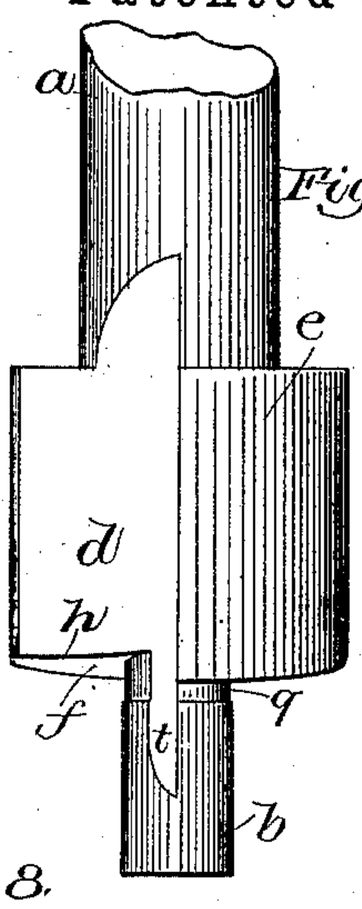


Fig. 5.

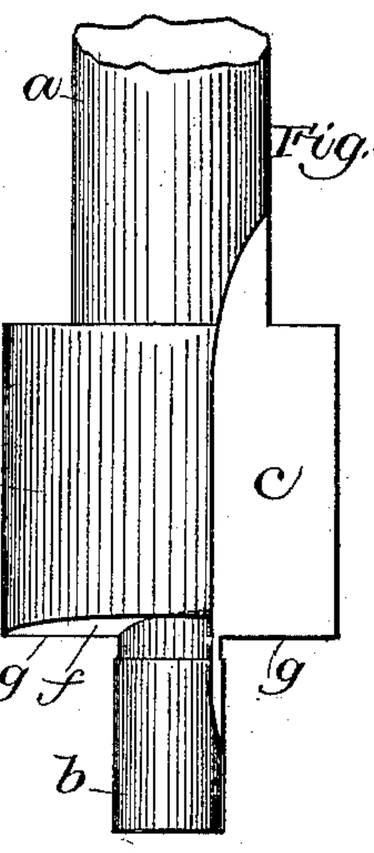


Fig. 3.

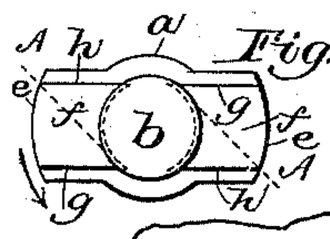


Fig. 7.

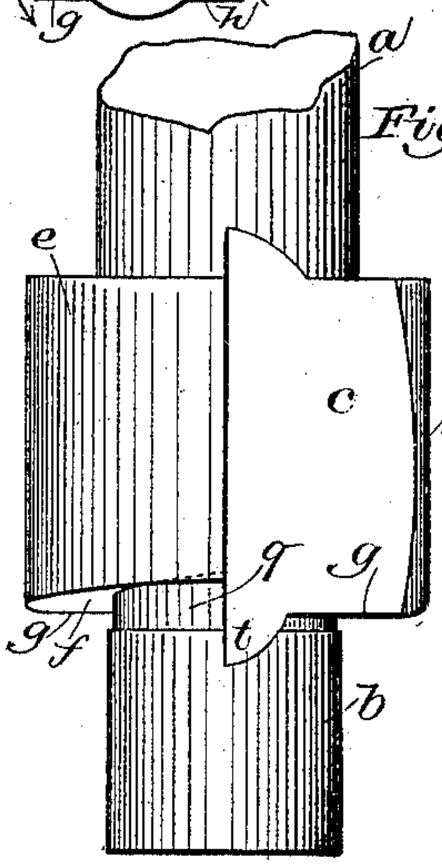


Fig. 8.

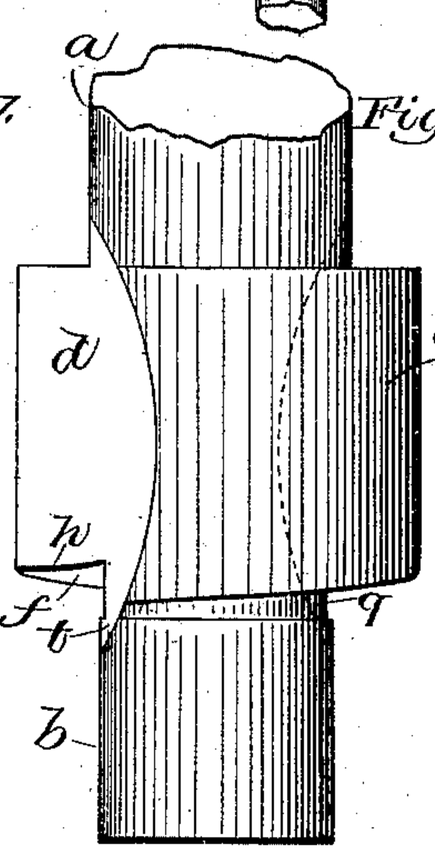


Fig. 12.

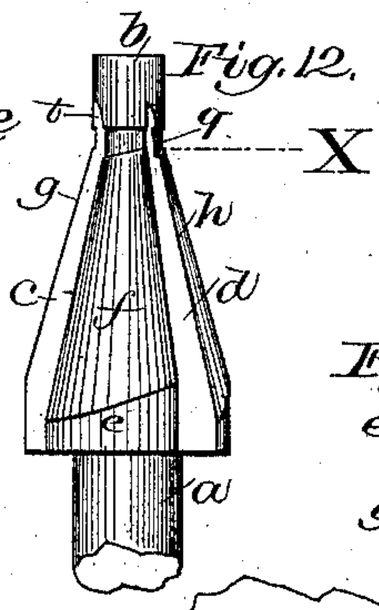


Fig. 6.

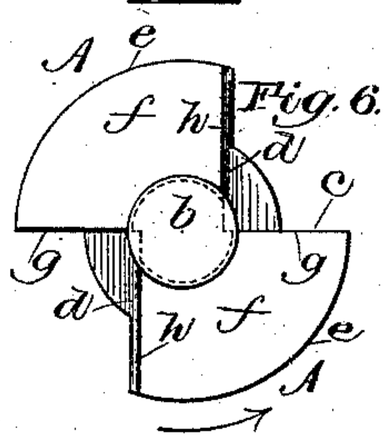


Fig. 13.

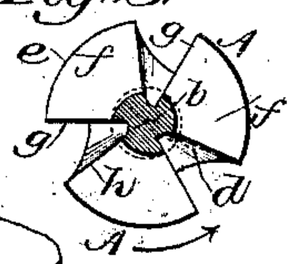


Fig. 14.

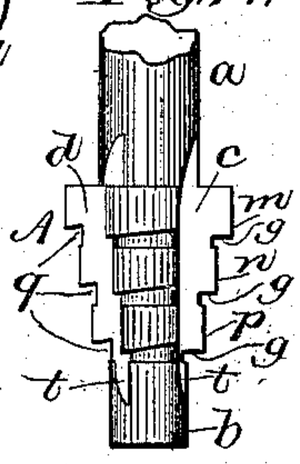


Fig. 9.

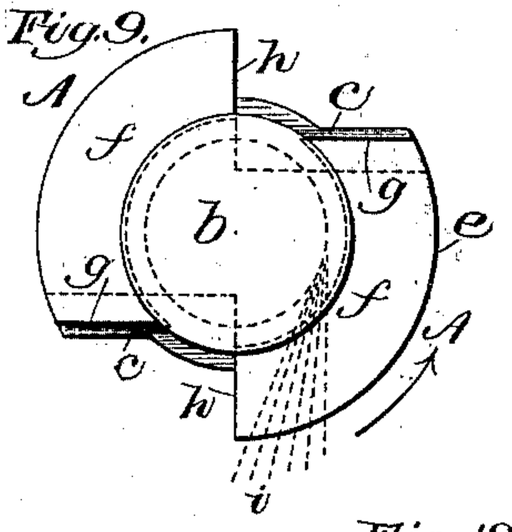


Fig. 10.

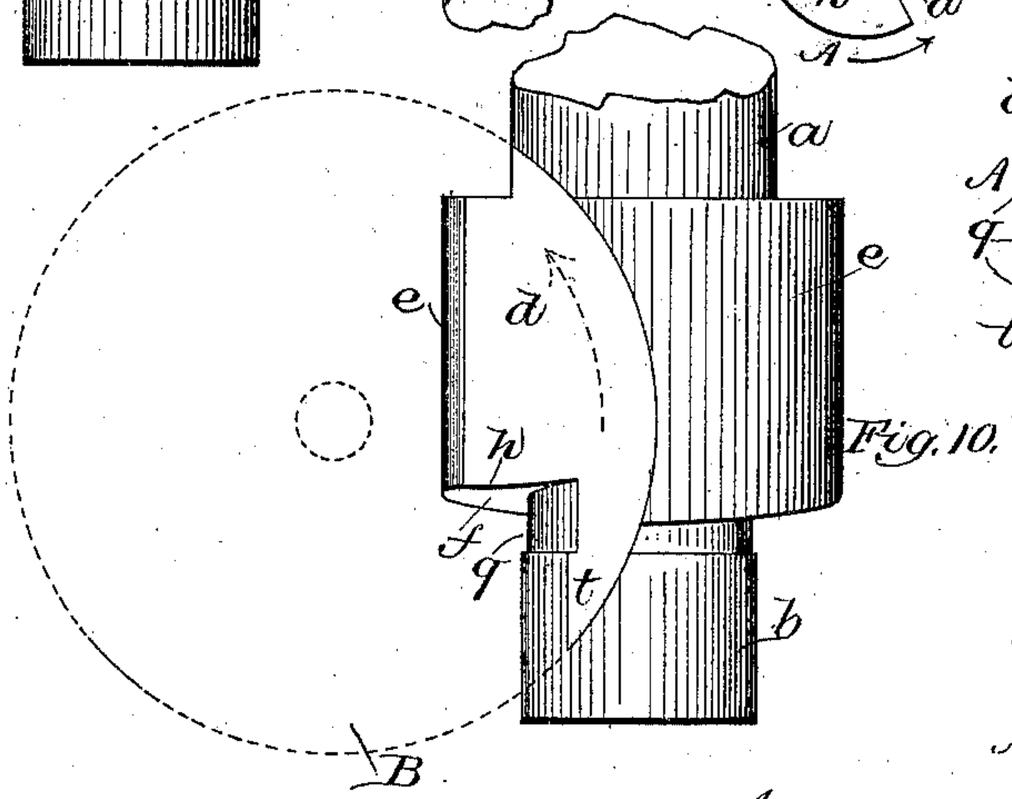


Fig. 15.

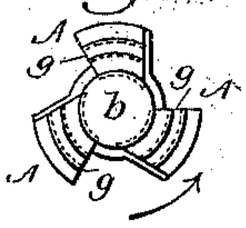


Fig. 18.

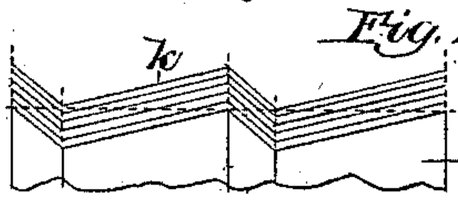


Fig. 19.

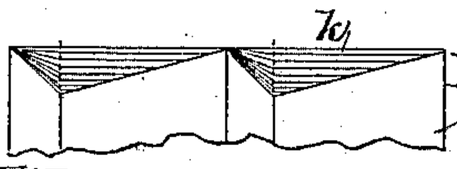
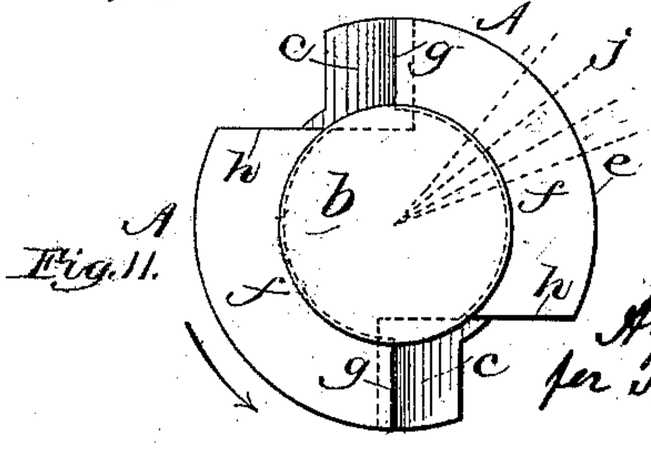


Fig. 11.



WITNESSES.

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Albert Latham

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N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

A. LATHAM.

COUNTERBORE, REAMER, OR COUNTERSINK.

No. 370,484. Patented Sept. 27, 1887.

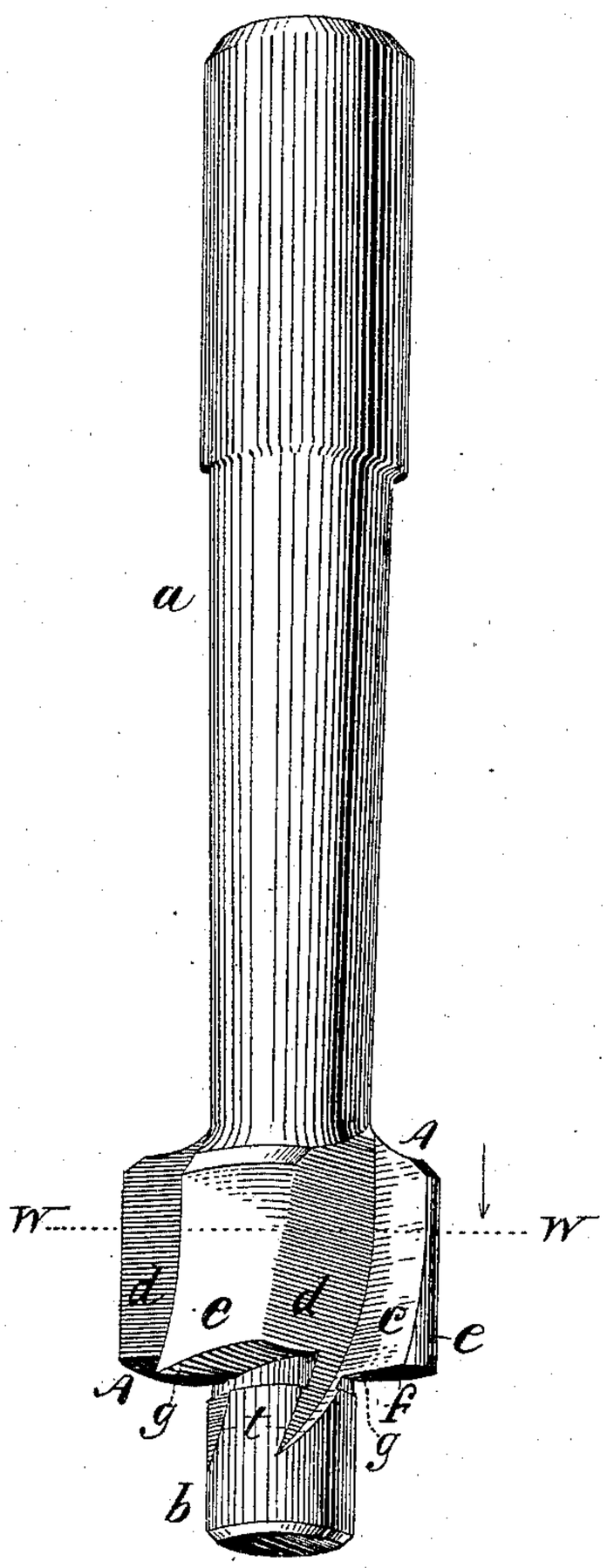

Fig. 20.

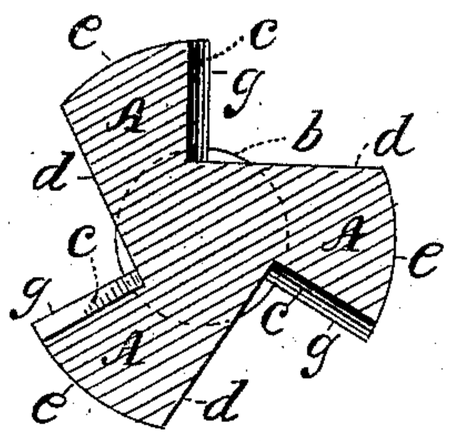

Fig. 21.

Witnesses.
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S. E. Tuckerman

Inventor.
Albert Latham
per F. W. Porter, Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

ALBERT LATHAM, OF WALTHAM, MASSACHUSETTS.

COUNTERBORE, REAMER, OR COUNTERSINK.

SPECIFICATION forming part of Letters Patent No. 370,484, dated September 27, 1887.

Application filed August 31, 1885. Serial No. 175,818. (No model.)

To all whom it may concern:

Be it known that I, ALBERT LATHAM, of Waltham, in the county of Middlesex and State of Massachusetts, have invented a new and useful Improvement in Counterbores, Reamers, or Countersinks, which will, in connection with the accompanying drawings, be hereinafter fully described, and specifically defined in the appended claims.

This invention relates to counterbores, reamers, or countersinks which are employed in working metals; and it consists in features of novelty, hereinafter fully described, and pointed out in the claims.

In said drawings, Figure 1 is a side elevation of a tangential counterbore. Fig. 2 is an edge elevation of the same. Fig. 3 is an inverted or under side plan view of the counterbore shown in Figs. 1, 2. Fig. 4 is a side elevation of a radial counterbore, viewed as from the right in Fig. 5. Fig. 5 is an elevation of the counterbore shown in Fig. 4 and as viewed from the left in that figure. Fig. 6 is an inverted or under side plan view of the counterbore shown in Figs. 4, 5. Fig. 7 is a side elevation of a concave-lip tangential counterbore, taken as from the left in Fig. 8. Fig. 8 is a side elevation taken as from the right in Fig. 7. Fig. 9 is an inverted or under side plan view of Figs. 7, 8. Fig. 10 is a view similar to Fig. 8, showing by dotted lines the operation of an emery-wheel in sharpening the teeth of the counterbore, and the teeth being radial, instead of tangential, as in Fig. 8. Fig. 11 is an inverted or under side plan view of the counterbore shown in Fig. 10. Fig. 12 is a side elevation of a taper reamer embodying my invention. Fig. 13 is a sectional plan view, the section being taken on line *x*, Fig. 12, and the plan showing the portion below that line. Fig. 14 is a side elevation of a stair-step counterbore embodying my invention. Fig. 15 is an inverted or under side plan view of Fig. 14. Fig. 16 is a side elevation of a countersink embodying the essential feature of my invention. Fig. 17 is a plan view of the same, viewed as from the top of the sheet in Fig. 16. Fig. 18 is a diagrammatic view showing the end of a two-lip counterbore as enrolled or extended in a right line, and showing in parallel lines the paths of the cutter when imparting the freeing to the ends of the lips. Fig. 19 is a view like Fig. 18, with the exception that the paths of the cutter, when imparting the freeing to the ends of the lips, are shown in oblique instead of parallel lines. Fig. 20 is a perspective view of a counterbore having three radial lips formed with an arc-like front face, *c*, the same as the corresponding face in Figs. 7, 8, 9, 10, 11. Fig. 21 is a sectional plan view, the section being taken on line W W, Fig. 20, and the view being as from above that line.

I deem it proper to state as matter of introduction that the three essential parts of counterbores are the shank *a*, by which they are secured in the arbor of the lathe or other tool by which they are actuated; the stem *b*, which enters the already-formed hole in the body to be counterbored, which stem holds the counterbore in proper axial relation to said hole, and the lips A, which perform the cutting, and whose several characteristics will be hereinafter described in connection with my improvement. Reamers are also formed with a shank, *a*, and with a series of cutting-lips, A, as shown in Figs. 12, 13, and with a stem, *b*, in case the taper of the cutting portion of the reamer is considerable; but the stem is often omitted, especially so if the taper be but slightly more than the chip to be cut and the cylindrical portion be of considerable length. Countersinks are also formed with a shank, *a*, and a conical head or body having a series of cutting-lips, A. This tool is formed with its lips converging to a point, and hence stem *b* is omitted, the object being that holes having various diameters may be tapered or countersunk with the same tool; but all said tools have a common purpose—namely, to enlarge a hole already formed—and the only difference in them is in the form of such enlargement, as with counterbores the enlargement of the hole is of uniform diameter, and usually with the flow of such enlargement at right angles to the axis of the hole. With reamers the hole may be enlarged in part or all its length in taper form, as with the reamer shown in Fig. 12; or, if the cylindrical portion be of sufficient length and the taper but slight, the reamer may be passed entirely through the hole, thereby leaving it enlarged but of uniform diameter, while countersinks are usually formed with their lips on the oppo-

site sides at an angle of sixty degrees, in order that the enlargement which they produce shall correspond with and receive the usual conical screw-head or for other purposes.

In my application Serial No. 144,005, filed September 25, 1884, for counterbores, reamers, or countersinks, and manufacture thereof, and from which the subject-matter of this application has been eliminated under the ruling of the Office requiring division of the application, is shown machinery especially adapted and designed for the manufacture of the tools which constitute the subject-matter of this application, and this specification will be prepared with due reference to said former application and the subject-matter thereof.

For convenience of description the same parts will in all the illustrations, whether of counterbores, reamers, or countersinks, have the same indicating letters or figures.

Referring again to the drawings, *c* represents the front lineal face of the lips A. *d* is the rear lineal face of the lips. *e* is the outer or circumferential face of the lips, and *f* is the spiral end face of the same. The cutting-edge *g* is the acute angle resulting from the intersection of the front lineal face, *c*, and spiral end face, *f*, while the retired angle *h* results from the intersection of the rear lineal face, *d*, and spiral face *f*.

In order to give the proper "freeing" or "clearance," as it is termed, to cutting-edge *g*, the face *f* is cut away rearward from face *c* by a spiral path, as is shown in various figures; and one of the essential features of my invention consists in cutting said spiral face of each tooth with precisely the same pitch, in order that as the teeth are sharpened by grinding upon the front lineal face, *c*, they will each remain of the same length and with their edge *g* at the same angle to the axis of the body of the tool. If the lips of the counterbore be radial and the faces *c d* be in the same plane, as shown in Figs. 1, 2, and the cutting-edges *g* are, when the tool is first made, at right angles (or otherwise) to the axis of shank *a* and stem *b*, and the faces *f* are identical spirals, then as faces *c* are ground away to sharpen edges *g* the edge *g* will always remain at the same angle to the axis, if face *c* be kept tangential, as at first formed; or, if the face *c* be radial from the axis and the edge *g* be at right angles (or otherwise) to the axis, then if as face *c* is ground away to sharpen the cutting-edge said face is kept radial the angle of edge *g* to the axis will remain unchanged; and the same is equally true in relation to the reamers and countersinks whose front edge, *c*, is radial, and which is ground away to maintain the cutting-edge *g*, as with faces *f* each the same spiral, and with faces *c* uniformly ground away and kept radial, the edge of every tooth will have the same inclination to the axis and each the same projection from the axis.

The means and method of forming faces *f*, an identical spiral in all the teeth, are fully shown and described in my said earlier specification.

In Fig. 9 the dotted lines *i* indicate both the changing positions of the cutting-tool by which spirality is imparted to faces *f*, the cutting commencing on each lip at line *g*, with the counterbore revolving in the direction indicated by the arrow, the path of the cutting-tool by which such spirality is imparted being indicated in Figs. 18, 19, in the former of which the cutter moves in parallel paths *k*, in the lineal direction of the counterbore, but gradually encroaches thereon after arriving at its end face, (indicated at *l*,) until the spiral face of each tooth is completed; but instead of moving in parallel paths the cutter may move as shown in Fig. 19, where at each cut the tool moves in a spiral path till the required chip is acquired, when it moves, as in Fig. 18, across the face of the lip, all as described in said former application. When the front face, *c*, of the teeth is radial, then the cutting-tool, by which the face *f* is rendered spiral, is arranged as indicated by dotted lines *j*, as the counterbore revolves, as indicated by the arrow in Fig. 11, and the reduction of the lips by grinding away face *c*, as stated, will proceed, as indicated by said lines *j*.

In Figs. 7 to 11 the front face, *c*, is formed as an arc of a circle, the lips in Figs. 7, 8, 9 being tangential, while in Figs. 10, 11 they are radial. This form of lip is sharpened by means of a small emery-wheel arranged as indicated at B, Fig. 10, and it gives a free cutting-edge of any desired acuteness, according as faces *c f* are arranged relatively to each other.

As a result of forming each face *f* of the several lips in a tool with identical spirals, the angle of cutting-edge *g* will not be changed in relation to the axis of the tool, as the lips are gradually worn away by grinding said faces *f*; and hence whether the enlargement to be produced by the tool be conical or cylindrical, it will at all stages in the life of the tool have the same identical angles relatively to the axis of the hole previously formed and which is being thus enlarged.

When the counterbore is formed with a series of steps, as at *m n p*, Figs. 14, 15, the tool may be used in connection with different-sized holes, or it may be employed to form a seat for a screw or bolt having a multiple-shouldered head corresponding therewith.

In order that in tangential counterbores, like or similar to those shown in Figs. 1, 2, the cutting-tool which shapes the spiral face of the lips may have time after moving across the end face of one lip and arriving at rear face, *d*, thereof, to be moved to the proper position to commence at line *c* on the next lip, a slight depression or reduction, *t*, is formed in stem *b* next the lips when milling faces *c d*, thus affording room to move the cutter in the lineal direction of the counterbore, after the rear of one lip has passed the cutter and before it is encountered by the next, such distance that the

cutter will be at the end face of the lip at the moment that face *c* of the next lip arrives at the edge of the cutting-tool; and to facilitate the grinding of stem *b*, after it has been hardened, in order to bring it to standard size, a concentric groove, *q*, is formed therein next the ends of lips A. By forming tangential counterbores with the faces *c d* at or near a right angle to each other, as shown in Figs. 7, 8, 9, the counterbore possesses at least three times the amount of life or endurance as when formed in the usual manner, as shown in Figs. 1, 2, as is easily demonstrated by measurement of the peripheral extent or distance between lines *c d* of each lip, the extent of such distance being the measure of endurance or service of the counterbore. Besides this, at every grinding of face *c* the angle of intersection between faces *c* and *e* is in its entire length sharpened, as well as cutting-edge *g*, thus restoring the desired sharp angle between faces *c e*.

By reason of my method of producing the backing off or clearance of the end faces, *f*, the several seats or shoulders formed by a stair-step counterbore, like that shown in Figs. 14, 15, will be always the same lineal distance each from the other, if the lips are all equally reduced by sharpening, and hence the several shoulders of duplicate multiple-headed bolts will bear equally upon the several seats or steps cut by the counterbore.

When the front face, *c*, is to be formed as an arc of a circle, as in Figs. 7 to 11, both faces *c* and *d* will be formed by a rotary cutter or mill, which B may indicate, both in form and mode of operation.

It will, from the above description, be obvious that not only has the front face, *c*, of every lip in a counterbore the same relation to radial lines, and the end faces, *f*, each the same spirality or pitch, and also the same angle relatively to the axis of the counterbore, but that the edge *g* of every lip will have the same relation to a plane which is at right angles to said axis, so that each edge *g* will in use cut a chip of the same thickness as every other, which result could not be accomplished if the several foregoing conditions did not each exist in the tool, as described and shown.

I claim as my invention—

1. As a new article of manufacture, a counterbore, reamer, or countersink having a plurality of lips, each of which is formed upon its end face, *f*, in a spiral path identical in pitch with every other lip, and having said end face of each lip at the same angle relatively to the axis as every other lip, and having the front lineal face, *c*, of each lip in the same relation to radial lines as every other lip, and also having the cutting-edge *g* of every lip in the same plane, whereby each lip will cut the same depth of chip, all as specified.

2. A counterbore having the lips A formed with the front lineal face, *c*, as an arc of a circle, and with the rear face, *d*, in a right line and at a right angle, or nearly so, to face *c*, as specified.

3. A stair step counterbore having its several series or sets of lips arranged one above the other, as specified, and with each tooth cleared or backed off in a spiral path identical in pitch with each and every other tooth thereof, and with the front lineal face of each tooth in the same relation to a radial line as every other tooth thereof, substantially as specified.

ALBERT LATHAM.

Witnesses:
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ROBERT ASHE.