United States Patent

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[54] **CARBIDE THREAD CHASER SET**
9 Claims, 11 Drawing Figs.

[52] U.S. Cl. **10/120,** 408/217, 408/219
[51] Int. Cl. **B23g 1/26,** B23g 5/04
[50] Field of Search 10/89, 101, 102, 111, 120, 120.5, 141, 142, 143, 146; 408/217, 219, 221

[56] **References Cited**

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2,067,593	1/1937	Benninghoff	10/111
2,744,269	5/1956	Kerr et al.	10/120
3,159,858	12/1964	Appleby	10/111
3,176,331	4/1965	Appleby	10/120
3,177,508	4/1965	Scott et al.	10/120
3,093,850	6/1963	Kelso	10/120

Primary Examiner—Charles W. Lanham
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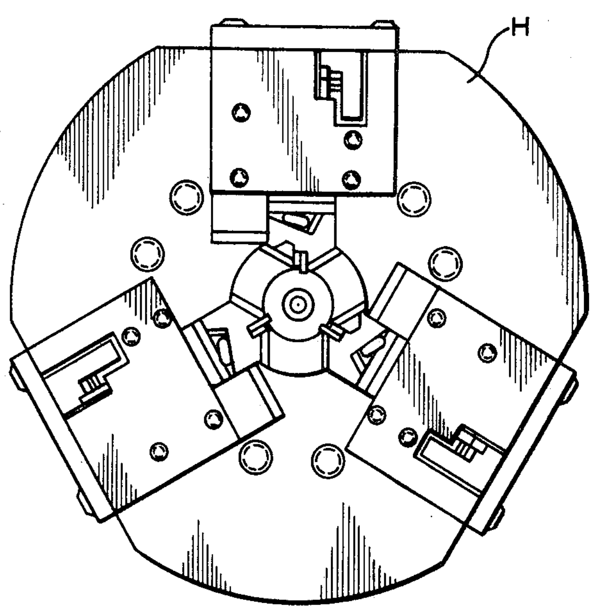
ABSTRACT: A set of multitooth thread chasers with their teeth shaped and arranged to perform a succession of central roughing cuts of approximately trapezoidal cross section, respectively, and of successively decrescent areas. The chasers are free from any portions which can cause flanking cuts which result in lateral flanges on the resultant chips. The cut produced by each tooth extends close to, but terminates a few thousandths of an inch short of, the flanks of two adjacent threads so that, in the final rough-cut thread, a very thin layer of metal remains between the rough-cut thread surface and the thread finish lines, and this layer is continuous and uninterrupted along the entire final rough-cut thread surface.

This layer is removed by a single finishing tooth which makes a single finish cut concurrently cutting a portion of one crest, along the thread trough and flanks and a portion of the adjacent crest, thus cutting over a length of thread cross section equivalent to one complete thread.



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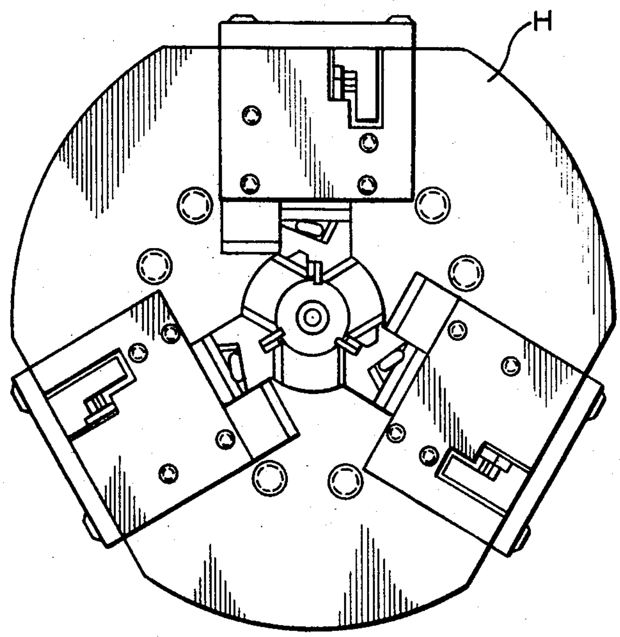

Fig. 1.

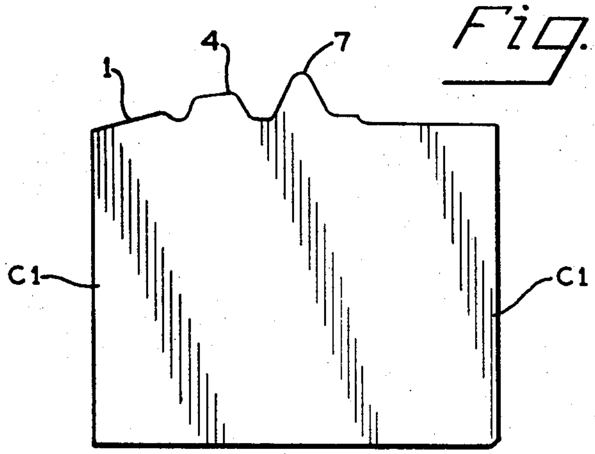

Fig. 2.

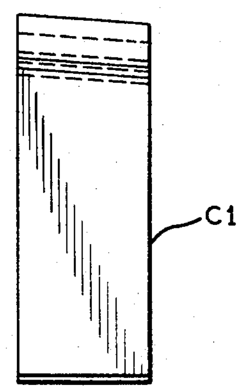

Fig. 3.

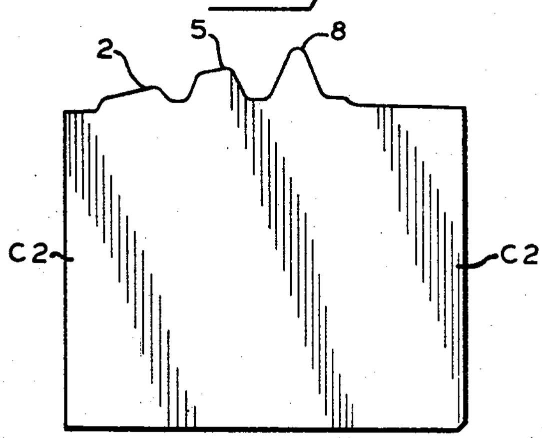

Fig 4.

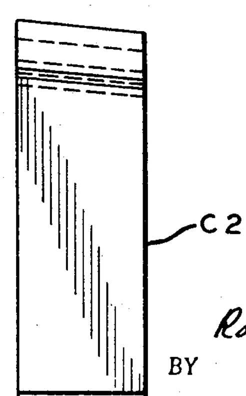

Fig. 5.

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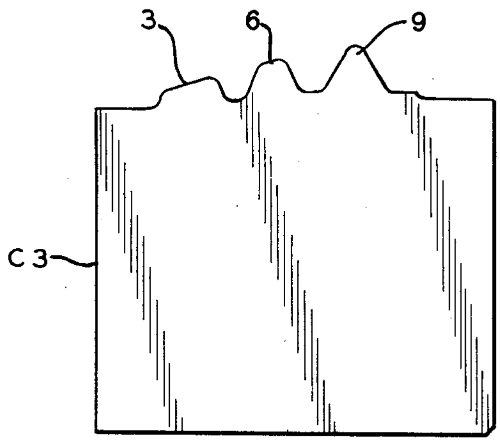

Fig. 6.

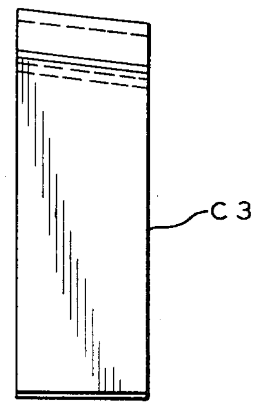

Fig. 7.

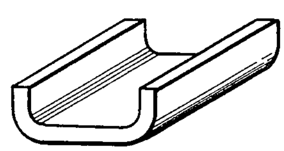

Fig. 9.

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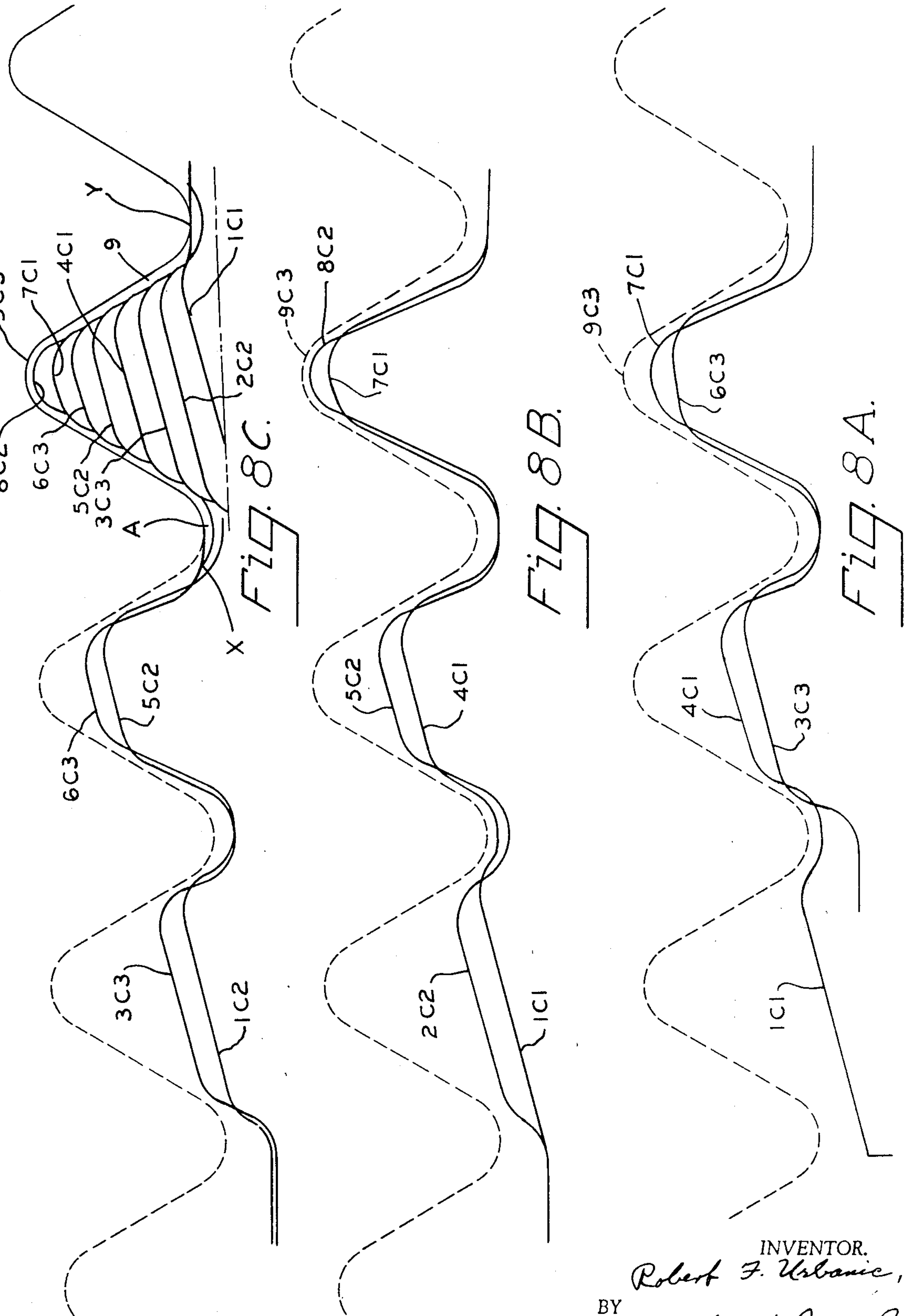

Fig. 8C.

Fig. 8B.

Fig. 8A.

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CARBIDE THREAD CHASER SET

This invention relates to a carbide chaser set for high-speed thread cutting. For purposes of illustration, the set of die chasers is shown and is adapted for use in a rotary spindle head of a thread-cutting machine, such as disclosed in U.S. Pat. No. 3,082,446 issued to William L. Benninghoff on Mar. 26, 1963, and entitled Taper Thread Cutting Die Head With Radially Removable Wedge Elements for Controlling the Chasers, U.S. Pat. No. 3,159,858 of Donald O. Appleby, issued Dec. 8, 1964, and entitled Set of High-Speed Thread Cutting Carbide Chasers, and U.S. Pat. No. 3,176,331 of Donald O. Appleby, issued Apr. 6, 1965, entitled High-Speed Carbide Chaser Set. The application of the invention to tap chasers and other chasers will be apparent from the illustrative example.

In U.S. Pat. No. 3,364,544, of the present applicant, issued Jan. 23, 1968, entitled Cutoff Tool and Chip Reforming Breaker, the desirability of forming chips which can be readily broken and removed from the cutting throat is described, as also are the difficulties resulting from packing of the chips in the cutting throat.

Various attempts have been made in cutting threads with carbide chasers, to pattern the cuts of the chaser teeth with a view to assuring a resultant chip which reduces the difficulties of packing and binding in the cutting throat. Examples of the type of cuts which have been employed are disclosed in the two Appleby patents above identified, in U.S. Pat. No. 3,177,508 of James A. Scott and Donald O. Appleby, issued Apr. 13, 1965, entitled Set of High-Speed Carbide Chasers, and in U.S. Pat. No. 3,093,850 to John W. Kelso, issued June 18, 1963, and entitled Thread Chasers Having the Last Tooth Free of Flank Contact Rearwardly of the Thread Crest Cut Thereby.

As is apparent from these prior patents, the practice has been to form the thread by cuts which extend from flank to flank of the adjacent flanks of the adjacent threads, each cut removing a portion of the metal extending from one flank entirely to the adjacent flank across the trough of the thread. Later, this was superseded by a plurality of plunging roughing cuts which, in general, extend in curvilinear fashion from a deep central cut upwardly laterally along the adjacent flanks, the removed chip being generally an open channel shape with a curvilinear base and relatively lineal diverging sides.

These patterns were followed by cuts in which a series of central roughing cuts of generally rectangular or trapezoidal cross sections were interspersed with, or followed by, flanking cuts on one or both of the adjacent flanks. A difficulty presented in the latter cases, aside from that of assuring that the teeth of the chasers would cut to a perfect match and form a continuous uninterrupted and smooth finished thread surface on the flanks, is the fact that the chips cut out from the central cuts, which extend along the flanks to any substantial degree, produce chips which in cross section have flanges at their lateral edges projecting abruptly away from the cutting tool. Such chips are very difficult to break, and resist curling due to the stiffening and reinforcing effects of the flanges. Again, in those instances in which central cuts are interspersed with flanking cuts, the flanking cuts, even when totally separated from the central cuts, usually produce chips which are disposed with their edgewise dimensions extending forwardly from the cutting tool. These chips can be bent or broken only by flexure edgewise and, due to their substantial edgewise dimension, are highly resistant to bending and breaking. Furthermore, bending such chips edgewise instead of flatwise, and the bending of flanged chips, causes high frictional resistance and interferes with the removal of the chips from the throat and introduction of coolant to cutting site. As a result, the chips tend to pile up and bind in the cutting throat, obstructing the flow of coolant, developing high frictional heat, and dulling the cutting edges.

In accordance with the present invention, a set of chasers is designed so as to present to the work concurrently a succession of roughing teeth followed, in the cutting order by one single finishing tooth. The chasers are free from any roughing

teeth or portions which could cause flank cuts of a type which produce lateral flanges on the roughing cuts or produce chips which require edgewise bending.

Only one flank cut is provided and that is by the finishing tooth, and its cut extends entirely from a point on the crest of one tooth, down its flank, around and across the trough between it and the next adjacent tooth, and along the flank of the next adjacent tooth to a corresponding point on the crest of the adjacent. Thus the single finish cut is concurrent along the cross section of the thread equivalent to a complete finished tooth. The central roughing cuts approach so closely to the finish line of the thread that only a very few thousandths, for example, 0.003 to 0.005 of an inch thickness of metal remains between the surface of the final rough-cut thread and the finished thread. This layer of material is removed concurrently over the cross section equivalent to that of a complete thread cross section by the finishing tooth. The chip produced by this cut is coextensive in width with such finished cross section and so very thin that it easily bends and breaks, and presents no problem in curling, bending, breaking, and removal from the throat. It does not cause high frictional resistance and heating.

Since it is continuous for the equivalent of one complete thread profile, the problem of producing matching cuts of separate teeth along the flanks and troughs of the thread, which must be very carefully matched to produce continuous smooth surfaces, is eliminated.

The rough-cut chips are trapezoidal or rectangular in cross sections, and free from lateral flanges, and thus break up readily and bend flatwise offering little opposition to the chaser and chip breaker, much less tendency to pack in the cut throat, and more free and efficient coolant application. Furthermore, prior channel-shaped chips or chips having generally angular or trapezoidal cross sections with flanges at the edges have relatively rigid corners which tend to dig into the chip breaker and clog the coolant passages therein, whereas the flat and trapezoidal chips free from lateral flanges do not present this problem.

In the present structure, the only channel-shaped chip is the final chip which is so extremely thin it imposes no problem and takes up very little space and passes readily out of the cutting throat.

The cuts produced by the present chasers are bounded at the front and rear by surfaces which are generally parallel to each other, though the cuts, at their lateral margins, are not necessarily parallel to the flanks of the thread.

By eliminating chips which tend to bind, the tendency of chips to weld to the carbide chip breaker when jammed thereagainst is eliminated.

Another feature of the present invention is that by the arrangement of the teeth, the roughing cuts are all progressively less in area from the first roughing cut to the last roughing cut so that the size of the roughing cut is in inverse proportion to the overhang of the cutting edge of each tooth relative to its base. Thus, the successive roughing cuts are progressively less heavy and tend toward balance with the reduced effective strength of teeth having greater overhang.

Various specific objects and advantages of the invention will become apparent from the following description wherein reference is made to the drawings, in which:

FIG. 1 is a diagrammatic front elevation of a rotary spindle chaser head with the set of chasers of the present invention installed therein;

FIG. 2 is a front elevation of the leading chaser of a set of three chasers;

FIG. 3 is a right side elevation of the chaser illustrated in FIG. 2;

FIG. 4 is a front elevation of the second of a set of three chasers;

FIG. 5 is a right side elevation of the chaser of FIG. 4;

FIG. 6 is a front elevation of the third and final chaser of the set of three chasers;

FIG. 7 is a right end elevation of the chaser illustrated in FIG. 5;

FIGS. 8A, 8B, and 8C are developed views showing the cuts made by the successive teeth of the set of chasers, FIG. 8C including also the superposition of the successive cuts on a finished thread; and

FIG. 9 is a fragmentary, perspective view of a chip of the prior art, showing lateral flanges thereon.

Referring to the drawings, each of the chasers is made of sintered carbide. The chasers are precisely shaped and are used in conjunction with a breaker, preferably such a breaker as illustrated in U.S. Pat. No. 3,126,560 issued Mar. 31, 1964, to E. E. Jennings, entitled Thread Chaser and Chip Breaker and Deflector Combination, or a breaker with coolant grooves, such, for example, as disclosed in U.S. Pat. No. 3,176,330, issued Apr. 6, 1965, to E. E. Jennings and entitled Coolant Discharge Device for Cutting Tool.

Each chaser is mounted in the rotary spindle head H, in the manner described in the foregoing patent, with a chip breaker juxtaposed against each chaser at the leading or cutting face of the chaser.

Referring to FIGS. 2 and 3, a chaser C1 is illustrated, this chaser being approximately a rectangular parallelepiped, except for the toothed edge.

In FIGS. 4 and 5 is illustrated a chaser C2 similar to the chaser heretofore described except for the tooth arrangement. In FIGS. 6 and 7 is illustrated a chaser C3 of the set.

The teeth of the chasers are numbered, for convenience, 1 through 9, respectively, in their cutting order. The chaser C1 is provided with roughing teeth 1, 4 and 7 in the cutting order. The chaser C12 has roughing teeth 2, 5, and 8. Chaser C3 has roughing teeth 3, 6, and the only finishing tooth of the set, 9. Thus all the teeth 1 through 8 are roughing teeth and, except for the finishing tooth 9 on chaser C3, neither the teeth 1 through 8, nor any portion of any chaser can cut on the flanks of the thread in any manner to cause flanges on the lateral edges of the rough cuts, or flank chips which are thicker edgewise in the direction of rotation than crosswise. As is apparent from the drawings, in the cutting succession or order, the broadest roughing cut is by tooth 1 and, progressing in the cutting succession, from tooth 1 to tooth 8, each roughing tooth has a shorter cutting edge and cuts a roughing cut of smaller area than that of the preceding roughing tooth. The overhang of the cutting edges increases in the cutting order. Thus the smaller area of cut tends to balance the stress due to increased overhang.

These cuts are arranged, as best illustrated in FIGS. 8A through 8C wherein metal being removed by the cut of each tooth is shown from the base of the cut of the preceding tooth to the cutting edge of the particular tooth.

Except for the first cut and the finishing cut, the cuts are generally trapezoidal with slight curvilinear lateral edges. These edges do not curve back far enough to cause the resultant chips to have any substantial abrupt flanges which could interfere with their curling and breaking. Instead the roughing chips are substantially rectangular except the chips produced by the finishing tooth 9 which extends partly across the crests of two adjacent threads. The succeeding finishing cut removes the remainder of the material from the one of two adjacent crests which is trailing in the direction of advance of the chaser, as indicated at A, at the right-hand portion of FIG. 8C.

It is to be noted that the bases of the cuts are generally linear and parallel throughout most of the lateral extent of the cuts, but are somewhat curvilinear at the lateral edges of the cut. The bases of the rough cuts are preferably parallel to each other, as near as practicable, though the lateral edges of the various cuts are not necessarily parallel to the flanks.

A distinguishing feature is that no one of the teeth 1 through 8 forms any portion of the finished flank surface of the thread. All of this is done by the single finishing tooth 9. Since the lateral edges of the roughing cuts approach to within 0.003 to 0.005 of an inch of the finish line along the flanks and at the bottom of the trough, and at the crests of the thread, the finishing cut produces a very thin compound curvilinear uninterrupted cut extending from the point X in the upper right-hand portion of FIG. 8A to the point Y. The portion of the threading between the points X and Y is equivalent to the cross section of the finished surface of one complete thread.

The improved shape of roughing cut chips over the channel-shaped chips of FIG. 9 is apparent from comparison of the cuts illustrated in FIG. 8C and FIG. 9. The chip shape assures the proper finished surface in high-speed cutting without the difficulties heretofore encountered.

Having thus described my invention, I claim:

1. A set of multitooth carbide chasers for cutting a finished thread having a plurality of roughing teeth and only one finishing tooth, said teeth being arranged in a cutting sequence such that the roughing teeth make a succession of central roughing cuts and the finishing tooth makes a single finishing cut;

the depths of the roughing teeth, measured radially from a theoretical cylinder which is coaxial with the thread to be cut by the chasers and which is spaced from the teeth of each chaser in a direction toward the chaser edge opposite from the cutting edges of the teeth, being successively increscent in an order of succession from the first roughing tooth to the last roughing tooth;

the included flank angle of each roughing tooth being less than the included flank angle of the finishing tooth;

The cutting edges of the roughing teeth, in said order of succession, being successively decrescent in length from the first cutting tooth to the last cutting tooth;

the ends of the cutting edge of each roughing tooth being positioned very close to, but short of, two adjacent flank lines, which are convergent toward an included trough, of the theoretical finished thread the chasers are designed to cut, so that the chip producible by each roughing tooth is substantially free from flanges at its lateral edges; and

the single finishing tooth having a continuous cutting edge the shape of which is that of the profile of the cross section of said two adjacent flank lines and their included trough.

2. The structure according to claim 1 wherein the cutting edges of the roughing teeth, for the major portions of their lengths, respectively, are approximately parallel with each other and the end portions of said edges are slightly curvilinear and divergent from each other toward the bases of the associated teeth, respectively.

3. The structure according to claim 1 wherein the areas of the forward faces of the roughing teeth, each measured between the ends of its cutting edges and from its deepest portion toward said theoretical cylinder a distance equal to its maximum depth less the maximum depth, measured in like manner, of the roughing tooth immediately preceding it, are successively decrescent in said order, are shallow radially relative to the length of their cutting edges, respectively, and are substantially free from flange portions at their ends.

4. The structure according to claim 1 wherein the end portions of the cutting edges of the roughing teeth approach sufficiently close to said flank lines of said theoretical finished thread that the cross section of the space between the ends of all of the roughing teeth and said flank lines, in an axial plane through the axis of said theoretical thread, is concavo-convex and is continuous along the entire extent of said flank lines and trough and so thin that a chip of like shape would have negligible resistance to bending transversely of its length.

5. The structure according to claim 4 wherein said ends of the cutting edges of the roughing teeth are from about 0.003 to about 0.005 inches from said convergent theoretical flank lines.

6. The structure according to claim 3 wherein the roughing teeth are shaped so that the depths of said areas are approximately equal to each other.

7. The structure according to claim 3 wherein the roughing teeth are shaped so that said areas are approximately trapezoidal.

8. The structure according to claim 1 wherein the roughing teeth are shaped so that the crests of the majority of them are lineal for the major portions of their lengths, respectively.

9. The structure according to claim 8 wherein the crests of the majority of the roughing teeth are lineal and parallel to each other.

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