United States Patent [19]

Urbanic

[11] **3,776,655**

[45] **Dec. 4, 1973**

[54] **CARBIDE THREAD CHASER SET AND METHOD OF CUTTING THREADS THEREWITH**

[75] Inventor: **Robert F. Urbanic,** Willowick, Ohio

[73] Assignee: **The Pipe Machinery Company,** Willowick, Ohio

[22] Filed: **Sept. 7, 1971**

[21] Appl. No.: **178,388**

Related U.S. Application Data

[62] Division of Ser. No. 887,457, Dec. 22, 1969, Pat. No. 3,629,887.

[52] **U.S. Cl.** **408/1,** 10/111, 10/120, 408/218

[51] **Int. Cl.** **B23g 1/00,** B23g 5/04

[58] **Field of Search** ..... 10/1 R11 A, 89, 101, 10/102, 111, 120, 120.5; 82/5; 90/11.42; 408/1, 217, 218, 219, 221

[56] **References Cited**

UNITED STATES PATENTS

1,656,595	1/1928	Merrifield	408/1
2,067,593	1/1937	Benninghoff	10/111
3,093,850	6/1963	Kelso	10/120
3,159,858	12/1964	Appleby	10/111
3,176,331	4/1965	Appleby	408/218
3,177,508	4/1965	Scott et al	408/218
1,770,585	7/1930	Steinruck	408/218

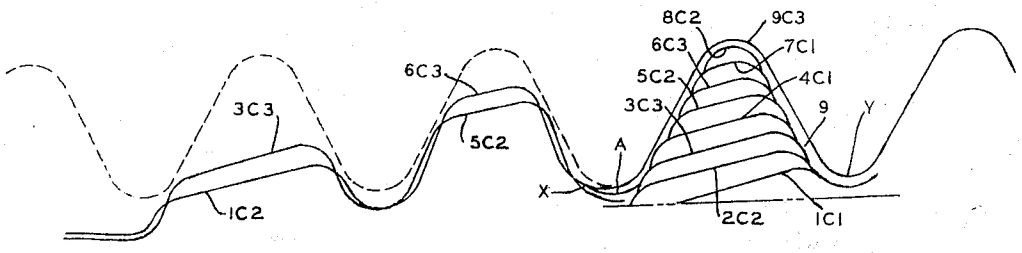
Primary Examiner—Charles W. Lanham
Assistant Examiner—E. M. Combs
Attorney—John H. Leonard

[57] **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.

2 Claims, 11 Drawing Figures



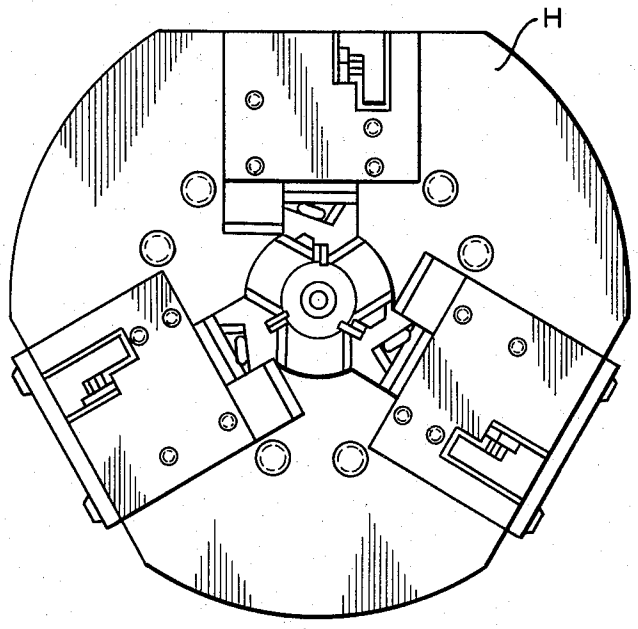


Fig. 1.

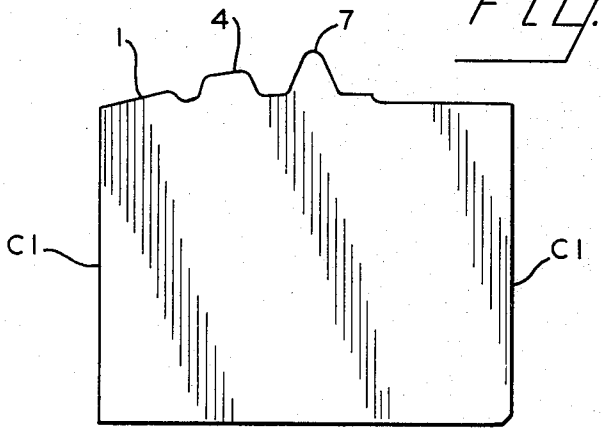


Fig. 2.

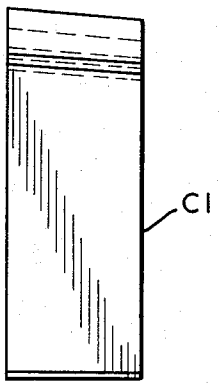


Fig. 3.

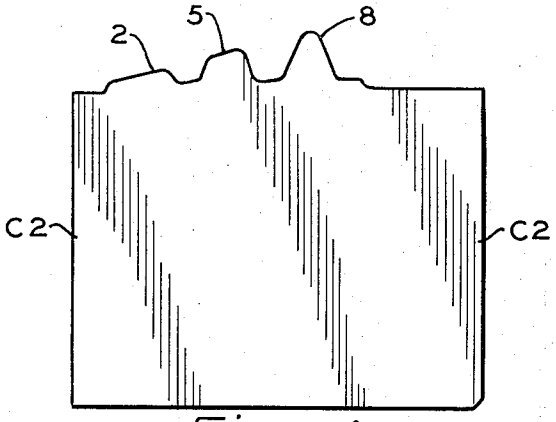


Fig. 4.

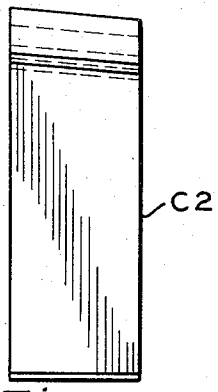


Fig. 5.

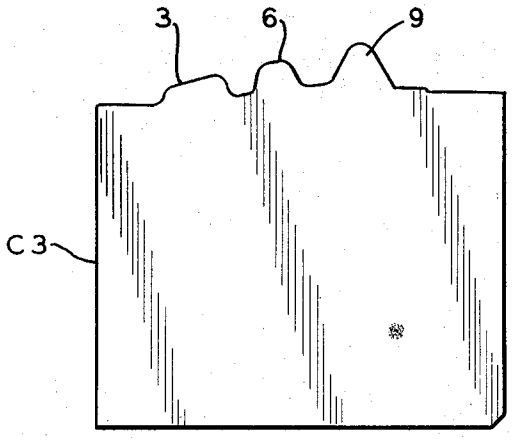


Fig. 6.

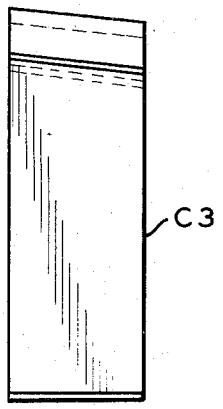


Fig. 7.

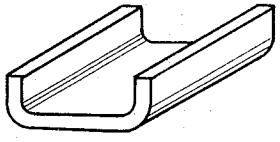


Fig. 9.

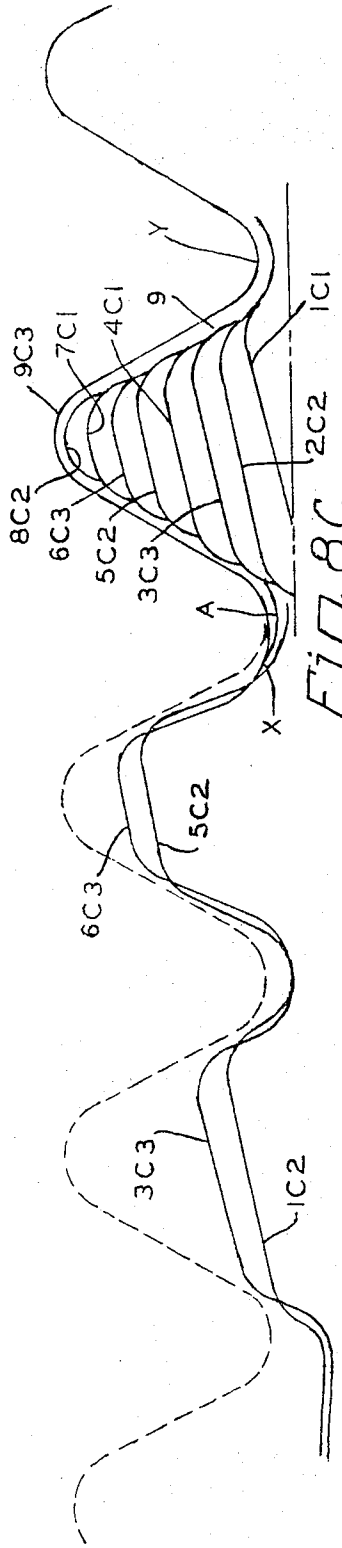


Fig. 8C.

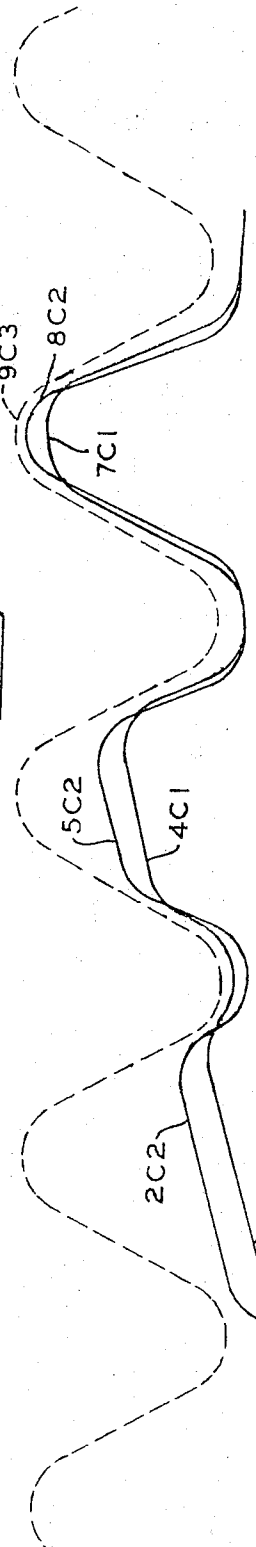


Fig. 8B.

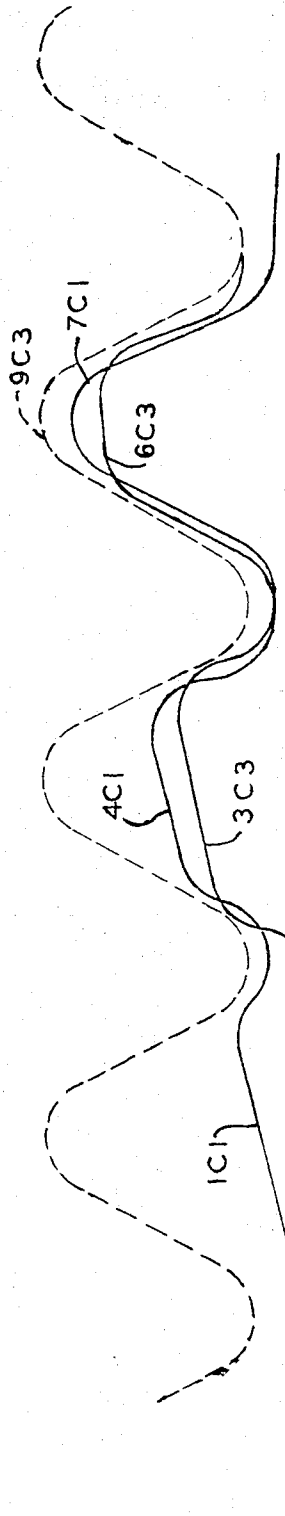


Fig. 8A.

CARBIDE THREAD CHASER SET AND METHOD OF CUTTING THREADS THEREWITH

This is a division of application Ser. No. 887,457, filed Dec. 22, 1969, now U.S. Pat. No. 3,629,887.

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 Cut-off 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 of assuring a resultant chip which reduces the difficulties or 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 case, 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, must 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 C-1 is illustrated, this chaser being approximately a rectangular parallelapiped, except for the toothed edge.

In FIGS. 4 and 5 is illustrated a chaser C-2 similar to the chaser heretofore described except for the tooth arrangement. In FIGS. 6 and 7 is illustrated a chaser C-3 of the set.

The teeth of the chasers are numbered, for convenience, 1 through 9, respectively, in their cutting order. The chaser C-1 is provided with roughing teeth 1, 4 and 7 in the cutting order. The chaser C-2 has roughing teeth 2, 5, and 8. Chaser C-3 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 C-3, 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 method od cutting finished screw threads comprising:

concurrently cutting at high speed in a single pass a succession of roughing cuts each of which extends close to, but terminates short of, two adjacent finish flank lines of the finished thread to be cut, which flank lines, in section in a radial plane including the axis of the thread, are convergent in a

direction such that their juncture is a thread trough common to said finish flank lines of the finished thread to be cut;

each of said roughing cuts being of generally trapezoidal section in said plane, and being of progressively less cross section, in order, from the crest to the trough to each thread, being free from lateral flanges, and being continuous along its flanks and an instantaneous base therebetween;

the instantaneous bottoms of said sections of the roughing cuts, preceding the last roughing cut, being approximately parallel to each other for the major portion of their lengths, and the ends of each roughing cut being slightly curvilinear and divergent from each other in a direction away from the trough of the finished thread, and each of said roughing cuts having an included flank angle less than the included flank angle of said finished thread to be cut, and the last of said roughing cuts extending close to, but terminating short of, said finish flank lines and finish line of said trough and contiguous crests so that only a very thin thickness of metal remains after the roughing cuts between the resultant rough cut flank lines of the rough cut thread and the rough cut trough therebetween, and portions of the adjacent crests, respectively, on the one hand, and the finish flank lines of the finished thread and their finished trough and crests, on the other hand, which thickness of metal is continuous along the entire finish cut of the convergent flank lines and their trough and so thin that it offers substantially no resistance to bending and breaking and removal from the cutting site, said single pass being free from flank cuts prior to a single finishing cut, and the section of said thickness of metal remaining after the rough cuts being coextensive with the profile of a complete convolution of said thread from crest to crest; and

during said single pass, finishing the thread by a single finishing cut which is coextensive in section in said plane with said two adjacent convergent finish flank lines and their common finished trough and said crest portions, and which removes said thickness of metal concurrently along said entire section, and the thickness of metal removed by the single finish cut being substantially uniform throughout its length.

2. The method according to claim **1** wherein the thickness of the metal removed in the first cut is from about 0.003 to 0.005 inches.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,776,655 Dated December 4, 1973

Inventor(s) Robert F. Urbanic

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 4, line 61, for "od" read --of--.
Col. 5, line 7, for "to" read --of--.
Col. 6, line 24, for "first" read --finish--.

Signed and sealed this 20th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334