

SPECIFICATION

Drilling and thread forming screws

This invention relates to drilling and thread forming screws, and more particularly to such a screw which causes the chips formed thereby to break into small discrete pieces.

In British Patent Specification 1195246 there is shown a drilling and thread forming screw comprising a trailing threaded shank and a pilot end designed to drill through a workpiece of material such as sheet metal. Fasteners of this type have generally met with acceptance in the automotive, building, and appliance fields due to the simplicity of assembly or fabrication as a consequence of their use which results in savings in both time and money in the assembly operation.

One of the problems by which one is often confronted in using fasteners of this type, is the creation of a metal chip which takes the form of a continuous thread of metal formed during the drilling operation of the fastener. These chips may become lodged under the head of the fastener, and are subject to rusting, resulting in an unsightly appearance and an undesirable projection on the surface fastened. It has therefore, been suggested that means be provided on the pilot end of a drilling screw to cause breakage of the metal chip and eliminate the creation of a continuous ribbon-like chip such as may be formed by application of the screw in materials such as sheet metal. Such an arrangement is shown in British Patent Specification 1403787.

It is an object of the present invention to provide a drilling and thread forming screw with improved means for breaking a chip formed thereby into small discrete particles.

The invention provides, in one of its several aspects, a drilling and thread forming screw comprising at its drilling end portion two flutes extending longitudinally in opposite quadrants, each flute presenting a concave cutting surface terminating in a substantially straight cutting edge extending in a direction inclined to the axis of the screw, which cutting edges are disposed substantially parallel to a common central axial plane of the screw, a chip breaking element projecting from each cutting surface and providing a ramp surface steeply inclined to the cutting surface and extending parallel to, and spaced from, the cutting edge.

The invention also provides, in another aspect, a drilling and thread forming screw comprising a threaded shank and a pilot end portion disposed on a common axis, a pair of flutes extending longitudinally of said pilot end portion to provide a pair of cutting surfaces terminating at cutting edges disposed substantially parallel to a common plane, each said cutting edge forming an angle with said common axis, and a truncated cylindrical element disposed on each of said cutting surfaces, each said element having its axis lying in a direction substantially perpendicular to the cutting edge of the surface from which it projects and a flat end surface disposed at an angle greater than

90° with said cutting surface to thereby direct a continuous chip formed by said cutting surface away from said surface to form a small radius of curvature and thereby cause breakage of the chip.

Preferably, each said element of a screw in accordance with the invention is provided by a truncated cylinder of which the axis lies in a direction substantially at 30° with respect to said common plane, the flat end face of the cylinder intersecting the cutting surface along a line substantially parallel to the cutting edge and spaced therefrom a distance of at least 1/32 inch. Preferably, also, the cutting edges are inclined to the axis of the screw at an angle of substantially 50°.

There now follows a detailed description to be read with reference to the accompanying drawings, of a drilling and thread forming screw embodying the invention and selected to illustrate the invention by way of example and not of limitation in the accompanying drawings:

Figure 1 is an elevational view of the illustrative drilling and thread forming screw.

Figure 2 is a bottom plan view of the screw of Figure 1;

Figure 3 is a fragmentary sectional view taken along the line III—III of Figure 1;

Figure 4 is a fragmentary sectional view taken along the line IV—IV of Figure 1;

Figure 5 is a side elevational view of the screw of Figure 1;

Figure 6 is an elevational front view of a screw forming die for manufacturing the illustrative screw;

Figure 7 is a side elevational view showing the die of Figure 6;

Figure 8 is a fragmentary view of the die of Figure 6 and 7 showing the screw pilot end forming upper portion of the die, taken on an enlarged scale for clarity;

Figure 9 is a fragmentary sectional view taken along the line IX—IX of Figure 8; and

Figure 10 is a fragmentary sectional view taken along the line X—X of Figure 8.

Referring to Figures 1—5, there is shown the illustrative drilling and thread forming screw 10 having a head 12 at one end with an elongated shank 14 extending therefrom. The head 12 may be of any type suitable for accepting a tool for turning the screw to effect insertion into or withdrawal from the workpiece. The shank 14 is further provided with a plurality of helical thread convolutions 16 formed on the trailing portion thereof, and a pilot end 18 is disposed at the end opposite the head 12.

The pilot end 18 of the illustrative screw as best shown in Figures 1 and 2 is provided with a pair of slots or flutes 20, each formed by a concave cutting surface 22 and a drag surface 24. The cutting surface 22 terminates at its leading end in a cutting edge 26 disposed at an angle of substantially 50° with the axis of the head 12 and shank 14.

Each of the cutting surfaces 22 of the illustrative screw is provided with a chip breaker

element 28 in the form of a partially cylindrical element which can be produced by passing a cutting plane through a flat ended cylinder from a line on the flat end through the cylindrical wall.

- 5 The element will therefore be referred to, and is best described as, a truncated cylinder positioned on the surface 22. Referring to Figures 1—5, the chip breaker 28 comprises a flat ramp surface 30 formed by the end portion of the truncated
- 10 cylinder, and a sloping curved surface 32 formed by the side of the truncated cylinder and disposed substantially at right angles to the ramp surface 30. It will be noted that the ramp surface 30 intersects the cutting surface 22 at a distance
- 15 spaced from the cutting edge 26 and that the intersection of the two surfaces forms a line substantially parallel to the cutting edge. In the case of the illustrative screw, for instance a number 8 screw, the intersection of the cutting
- 20 surface 22 and the ramp surface 30 is spaced a distance of 1/32 of an inch from the cutting edge 26.

- The chip breaker element 28 of the illustrative screw is oriented with regard to the fastener such
- 25 that a complete cylinder of which the element 28 is a portion thereof would lie with its axis at an angle of 30° with a plane P (Figure 2) which bisects the fastener and is equidistant from the pair of cutting edges 26.
- 30 Referring now to Figure 6, there is shown a typical die structure for manufacturing the fastener shown in Figures 1—5. The die is very similar to that shown in the aforementioned British Patent Specification 1195246 in that a
- 35 pair of such dies is employed to form the pilot end 18 of the fastener through a forging, or pinch pointing operation. As will be understood by those familiar with the art, a pair of such dies are employed in a machine in facing relation and the
- 40 unformed pilot end of the fastener blank is inserted between the two dies which are then impacted to create the configuration shown in Figures 1—5. As shown in Figure 6, the die 34 is provided with an outwardly projecting convex
- 45 surface 36 which forms the cutting surface 22 of the fastener when the forging operation takes place. In order to produce the illustrative screw, the surface 36 is interrupted by a pocket 38 formed in the surface, to produce a female die
- 50 surface conforming to the chip breaker element 28 shown in Figures 1—5.

As shown in Figure 7, the plane P as described with regard to Figures 1—5 is actually that at which the mating dies 34 meet and the 30° angle

55 of the chip breaker element 28, as described hereinbefore, relates to the surface lying along the plane P, or the mating surface of the die 34.

Referring now to Figures 8—10, the method of forming the pocket 38 in the die 34 will be

60 described. As shown in those Figures, a substantially flat ended milling cutter 40 is moved into the surface 36 of the die 34 such that its axis is at right angles to the edge 42 of the die which forms the cutting edge 26 of the fastener formed

65 thereby. Additionally, the milling cutter 40 is

oriented by presenting it at an angle of 30° to the face of the die which results in the angle of the ramp surface 30 of the screw 10 being at an angle of 30° to the plane P as shown in Figure 2.

- 70 In operation the screw 10 is turned into the workpiece to form a pilot hole for introduction of the threads into the workpiece. As the screw 10 is turned, spiral chips are formed at the cutting edge 26 and ride upwardly along the cutting surface 22 until they contact the surface 30. The surface 30
- 75 being substantially flat and parallel to the edge 22 and steeply inclined at less than 90° to the plane P, it therefore acts as an inclined ramp. The chips are thus rolled backwardly upon themselves at a
- 80 small angle produced by the angle of the ramp surface and the small radius into which a chip is formed tends to break the chip into small pieces.

The novel chip breaker element 28 is therefore effective to break a metallic chip into small

85 discrete segments, which are easily carried away along the flute, and do not interfere with the thread convolution 16 when introduced into the opening formed by the pilot end.

CLAIMS

- 90 1. A drilling and thread forming screw comprising at its drilling end portion two flutes extending longitudinally in opposite quadrants, each flute presenting a concave cutting surface terminating in a substantially straight cutting edge
- 95 extending in a direction inclined to the axis of the screw, which cutting edges are disposed substantially parallel to a common central axial plane of the screw, a chip breaking element projecting from each cutting surface and providing
- 100 a ramp surface steeply inclined to the cutting surface and extending parallel to, and spaced from, the cutting edge.
2. A drilling and thread forming screw comprising a threaded shank and a pilot end
- 105 portion disposed on a common axis, a pair of flutes extending longitudinally of said pilot end portion to provide a pair of cutting surfaces terminating at cutting edges disposed substantially parallel to a common plane, each
- 110 said cutting edge forming an angle with said common axis, and a truncated cylindrical element disposed on each of said cutting surfaces, each said element having its axis lying in a direction substantially perpendicular to the cutting edge of
- 115 the surface from which it projects and a flat end surface disposed at an angle greater than 90° with said cutting surface to thereby direct a continuous chip formed by said cutting surface away from said surface to form a small radius of
- 120 curvature and thereby cause breakage of the chip.
3. A drilling and thread forming screw as set forth in claim 2 wherein the axis of each truncated cylindrical element lies in a direction substantially at 30° with respect to said common plane.
- 125 4. A drilling and thread forming screw as set forth in either one of claims 2 and 3, wherein the intersection of each cylindrical element with its cutting surface forms a line substantially parallel to the cutting edge.



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3. A drilling and thread forming screw as set forth in claim 2 wherein the axis of each truncated cylindrical element lies in a direction substantially at 30° with respect to said common plane.

- 125 4. A drilling and thread forming screw as set forth in either one of claims 2 and 3, wherein the intersection of each cylindrical element with its cutting surface forms a line substantially parallel to the cutting edge.



5. A drilling and thread forming screw as set forth in any one of the preceding claims wherein said cutting edge lies at an angle of substantially 50° with said common axis.
- 5 6. A drilling and thread forming screw as set forth in any one of the preceding claims wherein the intersection of each element with its cutting surface forms a line substantially parallel with the cutting edge and spaced therefrom a distance of 10 at least $1/32$ inch.
7. A drilling and thread forming screw substantially as hereinbefore described with reference to Figures 1 to 5 of the accompanying drawings.