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PATENT SPECIFICATION

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(54) CHIP BREAKING DRILL SCREWS

(71) We, ILLINOIS TOOL WORKS INC., a corporation organized under the laws of the State of Delaware, United States of America, of 8501 West Higgins Road, Chicago, Illinois 60631, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

Screws, having points enabling drilling and thread cutting operations to be performed in one operation, are becoming increasingly popular. Certain applications of drill screws also require a sealed joint or require a fastening which is resistant to corrosion. The drilling operation performed by such screws may at times produce chips which are deleterious to sealing and/or corrosion resistant functions. For example, relatively large lengths of chips may curl upwards during the drilling operation and become situated beneath the bearing surface of the screw head. Subsequent turning of the screws with the chip beneath the head may mar the finish of the workpiece or harm the sealing integrity of sealant or sealing washers which may be associated with the fastener.

It is accordingly an object of the present invention to provide drilling and cutting screws by which the chips will be broken into small pieces.

According to this invention, a screw comprises a threaded shank, driving tool accommodating means integral with a trailing end of the shank, and a drilling tip at the leading end of the shank; the drilling tip including first and second oppositely disposed flutes extending substantially longitudinally of the shank, and outwardly and axially rearwardly flaring end surfaces between the flutes; each flute being defined by a substantially concave surface intersect-

ing the end surfaces and forming a cutting edge portion and a drag edge associated with that flute, and each of the concave surfaces including at least one obstruction formed thereon to break or bend the chips produced by the cutting edges.

The accompanying drawings show two examples of screws embodying the present invention. In these drawings:—

Figure 1 is an elevation of the screw;

Figure 2 is a view similar to Figure 1 showing the screw turned 90° from the position shown in Figure 1;

Figure 3 is the entering end view of the screw; and

Figure 4 is a partial elevation of a second screw.

The screw shown in Figures 1 and 2 includes a threaded shank portion 12, a driving head 16 having suitable driving tool accommodating means 18, and a drilling tip 14.

The drilling tip may be formed by forging or pinch-pointing techniques, and includes a pair of oppositely disposed flutes 24 and 26, each defined by a generally concave surface 36, 38. The drilling tip has end surfaces 32 and 34 disposed between the flute surfaces. These end surfaces flare outwardly and axially rearwardly from a tip end 40. The intersections of the flute surfaces and these end surfaces form cutting edge portions 20 and 22, and drag edges. The intersections of the flute surfaces with sides of the tip form substantially longitudinally extending cutting edge portions 52 and 56.

In order to increase the effectiveness of the cutting action of the edges 20 and 22, the end surfaces 32 and 34 are relieved behind these edges to avoid interference with the work.

Each of the concave surfaces 36, 38 has obstructions in the form of a plurality of protuberances 28, 30. As shown in Figure 3, these obstructions 28 and 30 extend radially

outwards from the concave surfaces 36, 38. The obstructions 28 and 30 are preferably spaced slightly from the cutting edges, to allow the edges to efficiently cut or drill the material and yet provide a means in the flute to subsequently break the chips due to substantially decreasing the radius of the curled chips to the point where they break and, therefore, are not allowed to eject upwards. While the obstructions 28 and 30 are spaced from the cutting edges, they are still close enough to the edges to break the chips before they become relatively long, or large enough to come beneath the bearing surface of the driving head 16.

As shown in the drawings, each of the obstructions 28 is generally oblong in shape and is positioned in the flute with the longest dimensions of the oblong obstruction extending generally transverse to the flute and to the longitudinal axis of the fastener. It will be apparent that such obstructions can readily be formed in the same forging step that the drilling tip is formed.

The obstructions 28 and 30 are shown to be small relative to the dimensions of the flute surfaces 36, 38. This enables forging or pinch-pointing technology to be utilized without harming or significantly altering the structural and functional characteristics of the flutes 24 and 26. Pursuant to the invention, a plurality of discrete, relatively small obstructions are formed on the flute surface, which will provide a number of obstructing surfaces acting on a chip produced at any portion of the cutting edges 20 or 22. These plurality of obstructing surfaces may be formed at discrete locations in the flute and yet not substantially alter the dies or machinery used in a forging technique.

In use, a chip cut in a workpiece by cutting edge 20 or 22 slides into the concave surface 36 or 38 of the associated flute 24 or 26. The normal gradual curvature of the flute will form the chip into a curl or coil in accordance with the properties of the chip. As the chip contacts the obstructions 28 or 30, the radius of curvature of the chip is substantially decreased and, consequently the obstructions tend to break the chip into small pieces. Thereafter, the small pieces may be discharged or forced downwards, rather than tending to curl upwards beneath the head of the screw or otherwise on top of the workpiece.

It should be noted that the cutting edges 20 and 22 may be formed into a hook to effectively increase the cutting ability of the drill. The hook is shown for illustrative purposes as having an angle A of approximately 15°. The cutting angle may also provide a surface which tends to slightly

decrease the radius of curvature of a chip compared to a cutting edge having zero or a nominal cutting angle.

In Figure 4, there is shown a slightly modified form of the present invention, wherein the obstructions in the flutes 28a and 30a are formed as depressions in the surface rather than protuberances. These depressions 28a and 30a are of the same relative size and location, and have the same general functions, as described above with reference to the protrusions 28, 30 in Figures 1 to 3. The chip formed by cutting edges 20a and 22a may be broken in a manner similar to that described above by substantially decreasing the radius of curvature of a coil as it enters a depression and then attempts to conform to the relatively steep curvature of the depression or as it abuts the peripheral edges of the depressions 28a or 30a.

While the preferred embodiments have shown two obstructions in each of the opposed flutes, it should be understood that one or any larger number of discrete obstructions may be formed in the flute in a variety of combinations and locations and yet come within the scope of this invention.

WHAT WE CLAIM IS:—

1. A drilling and thread cutting screw comprising a threaded shank, driving tool accommodating means integral with a trailing end of the shank, and a drilling tip at the leading end of the shank; the drilling tip including first and second oppositely disposed flutes extending substantially longitudinally of the shank, and outwardly and axially rearwardly flaring end surfaces between the flutes; each flute being defined by a substantially concave surface intersecting the end surfaces and forming a cutting edge portion and drag edge associated with that flute, and each of the concave surfaces including at least one obstruction formed thereon to break or bend the chips produced by the cutting edges.

2. A screw in accordance with claim 1, wherein the obstructions are in the form of a plurality of protuberances extending outwardly from each concave surface.

3. A drilling and thread cutting screw in accordance with claim 1, wherein the obstructions are a plurality of depressions in each concave surface.

4. A screw in accordance with any of claims 1 to 3, wherein the obstructions are spaced from the cutting edge portions.

5. A screw in accordance with claim 4, wherein the drilling tip is forged, there are second cutting edge portions extending substantially longitudinally, and each obstruction has a surface generally oblong in shape with its longest dimension essentially



outwards from the concave surfaces 36, 38. The obstructions 28 and 30 are preferably spaced slightly from the cutting edges, to allow the edges to efficiently cut or drill the material and yet provide a means in the flute to subsequently break the chips due to substantially decreasing the radius of the curled chips to the point where they break and, therefore, are not allowed to eject upwards. While the obstructions 28 and 30 are spaced from the cutting edges, they are still close enough to the edges to break the chips before they become relatively long, or large enough to come beneath the bearing surface of the driving head 16.

As shown in the drawings, each of the obstructions 28 is generally oblong in shape and is positioned in the flute with the longest dimensions of the oblong obstruction extending generally transverse to the flute and to the longitudinal axis of the fastener. It will be apparent that such obstructions can readily be formed in the same forging step that the drilling tip is formed.

The obstructions 28 and 30 are shown to be small relative to the dimensions of the flute surfaces 36, 38. This enables forging or pinch-pointing technology to be utilized without harming or significantly altering the structural and functional characteristics of the flutes 24 and 26. Pursuant to the invention, a plurality of discrete, relatively small obstructions are formed on the flute surface, which will provide a number of obstructing surfaces acting on a chip produced at any portion of the cutting edges 20 or 22. These plurality of obstructing surfaces may be formed at discrete locations in the flute and yet not substantially alter the dies or machinery used in a forging technique.

In use, a chip cut in a workpiece by cutting edge 20 or 22 slides into the concave surface 36 or 38 of the associated flute 24 or 26. The normal gradual curvature of the flute will form the chip into a curl or coil in accordance with the properties of the chip. As the chip contacts the obstructions 28 or 30, the radius of curvature of the chip is substantially decreased and, consequently the obstructions tend to break the chip into small pieces. Thereafter, the small pieces may be discharged or forced downwards, rather than tending to curl upwards beneath the head of the screw or otherwise on top of the workpiece.

It should be noted that the cutting edges 20 and 22 may be formed into a hook to effectively increase the cutting ability of the drill. The hook is shown for illustrative purposes as having an angle A of approximately 15°. The cutting angle may also provide a surface which tends to slightly

decrease the radius of curvature of a chip compared to a cutting edge having zero or a nominal cutting angle.

In Figure 4, there is shown a slightly modified form of the present invention, wherein the obstructions in the flutes 28a and 30a are formed as depressions in the surface rather than protuberances. These depressions 28a and 30a are of the same relative size and location, and have the same general functions, as described above with reference to the protrusions 28, 30 in Figures 1 to 3. The chip formed by cutting edges 20a and 22a may be broken in a manner similar to that described above by substantially decreasing the radius of curvature of a coil as it enters a depression and then attempts to conform to the relatively steep curvature of the depression or as it abuts the peripheral edges of the depressions 28a or 30a.

While the preferred embodiments have shown two obstructions in each of the opposed flutes, it should be understood that one or any larger number of discrete obstructions may be formed in the flute in a variety of combinations and locations and yet come within the scope of this invention.

WHAT WE CLAIM IS:—

1. A drilling and thread cutting screw comprising a threaded shank, driving tool accommodating means integral with a trailing end of the shank, and a drilling tip at the leading end of the shank; the drilling tip including first and second oppositely disposed flutes extending substantially longitudinally of the shank, and outwardly and axially rearwardly flaring end surfaces between the flutes; each flute being defined by a substantially concave surface intersecting the end surfaces and forming a cutting edge portion and drag edge associated with that flute, and each of the concave surfaces including at least one obstruction formed thereon to break or bend the chips produced by the cutting edges.

2. A screw in accordance with claim 1, wherein the obstructions are in the form of a plurality of protuberances extending outwardly from each concave surface.

3. A drilling and thread cutting screw in accordance with claim 1, wherein the obstructions are a plurality of depressions in each concave surface.

4. A screw in accordance with any of claims 1 to 3, wherein the obstructions are spaced from the cutting edge portions.

5. A screw in accordance with claim 4, wherein the drilling tip is forged, there are second cutting edge portions extending substantially longitudinally, and each obstruction has a surface generally oblong in shape with its longest dimension essentially

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extending transverse of the flute.

6. A screw in accordance with claim 1, substantially as described with reference to Figures 1 to 3 or Figure 4 of the accompanying drawings.

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