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A SCREW

This invention relates to a screw for use in wood, particle board, plastics or in metal.

Many different designs of screw point and screw thread configuration are of course well known in the art. In particular, it is known to provide a wood screw wherein the helix angle of the thread is between 14 degrees and 16 degrees and wherein the included angle of the thread profile at its crest is 50 degrees. It is known to provide such a screw with a double thread to give a twin start facilitating its initial insertion into wood.

It is also known from GB-A-1357720 to provide a self-tapping screw having a single or multi-start helical thread wherein the included angle of the thread profile at its crest is 40 degrees but wherein the axis of symmetry of the thread profile is inclined towards the screw head by at least 5 degrees from the perpendicular to the screw axis. Such a type of self-tapping screw is also known to be used in chipboard and is provided with a helix angle of between 10 degrees and 12 degrees.

Furthermore it is known from GB-A-1564904 to provide a self-tapping screw having a thread helix angle of between 17 degrees and 19 degrees and an included angle of the thread profile at its crest of between 45 degrees and 55 degrees. Although such a screw is said to be usable in both metal and plastics materials, it is not said to be usable as a wood screw and the specification of GB-A-1564904 teaches that the above limits on helix and

thread crest angles are critical.

The traditional methods of manufacturing screws by cutting threads have been largely replaced by current production methods involving rolling a thread onto the shank of a headed cylindrical metal blank. Such a rolling operation produces a thread crest diameter greater than the diameter of the original blank so that, in order to achieve a particular thread crest diameter, one starts with a smaller blank diameter. This leaves any unthreaded portion of the shank with a smaller diameter than the thread crest diameter and such screws are known in the art as scant shank screws.

A scant shank wood screw is described in GB-A-2072781 but this specification is especially concerned with the provision of an enlarged location collar immediately under the head of the screw.

It is an object of the present invention to provide an improved screw which, by virtue of its particular thread form, will be capable of advantageous application as a wood screw for use in woods or plastics or as a self-tapping screw for use in metals.

In accordance with the invention there is provided a hardened steel screw having a head at one end, an entry portion at the other end and a threaded shank portion extending from the entry portion towards the head, characterised in that the thread profile is of helical form wherein the helix angle is between 20 degrees and 25 degrees, the included angle of the thread profile at its crest is between 30 degrees and 40 degrees and the thread profile is symmetrical about an axis perpendicular to the longitudinal axis of the screw.

Preferably the said helix angle is substantially equal to 20 degrees and the said included angle is substantially equal to 40 degrees.

5 The threaded shank portion may extend from the entry portion to a position closely adjacent the underside of the head or may terminate short of the head to provide an unthreaded shank portion of a smaller diameter than the thread crest diameter of the threaded portion dependent upon the overall length of the screw and the type of
10 screw required.

The thread preferably comprises a two start thread and is preferably raised rapidly to the full crest diameter from the entry portion of the screw. The entry portion of the screw may comprise a tapered point or may
15 be a blunt end and the threaded portion may extend to a position adjacent the end of the entry portion. A tapered entry portion may comprise a conical unthreaded point wherein the included angle of the unthreaded point is substantially equal to 30 degrees.

20 The diameter of the shank at the base of the thread conveniently lies within the range of 60% to 70% of the crest diameter of the thread.

A raised unthreaded location portion, or collar, may be provided immediately below the screw head having a
25 diameter substantially equal to the crest diameter of the thread.

Other features of the invention will become apparent from the following description given herein solely by way of example with reference to the accompanying drawings
30 wherein:

Figure 1 is a side elevation of a countersunk screw in accordance with the invention, the head being provided with a driving recess;

5 Figure 2 is a side elevation of the head and unthreaded shank portion of a countersunk screw similar to that shown in Figure 1 but having a cross slot in the head;

Figure 3 is an enlarged cross-sectional detail of the thread profile; and

10 Figure 4 is a graph showing the relationship between torsional strength and nominal screw diameter (screw gauge) for hardened and non-hardened screws.

The screw shown in the drawing is manufactured from a cylindrical metal blank, usually of a low carbon steel, 15 which is itself cropped to length from wire stock and then cold headed. The screw comprises an unthreaded shank portion 10 corresponding to the diameter of the headed blank adjacent to which a rolled threaded portion 12 extends towards the entry portion 14 of the screw. At 20 the other end of the screw there is provided a head 16, shown herein as a counter-sunk head and having either a driving recess (Figure 1) or a cross-slot (Figure 2) therein for driving engagement by a driving tool. It will be appreciated that, dependent upon length and 25 application requirement, the threaded portion 12 may extend substantially up to the underside of the head 16 from the entry portion 14.

The entry portion 14 of the screw comprises an unthreaded conical point having an included angle 30 substantially equal to 30 degrees from which a rapidly

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raised two start helical thread extends over the threaded portion 12 to the unthreaded portion 10 of the shank. In this example the thread profile is provided with steeply inclined flanks 20 to define therebetween an included angle to the thread profile at its crest which is substantially equal to 40 degrees with the edge of the thread at the crest having a maximum thickness of 0.008 inches (0.20mm). The helix angle of the helical thread, in this example, is substantially equal to 20 degrees and the thread profile is symmetrical about an axis perpendicular to the longitudinal axis of the screw.

In accordance with the invention the helix angle of the thread is always ~~20 degrees or greater but preferably~~ ~~(lies)~~ within the range 20 degrees to 25 degrees whilst the included angle of the thread profile at its crest is always ~~[40 degrees or less and preferably]~~ within the range 30 degrees to 40 degrees. It is found that, in use, the provision of a low included angle to the crest in combination with the high helix angle of the thread greatly facilitates the insertion of the screw by reducing the insertion torque which has to be applied. Comparative tests have been carried out on 2 inch (50.8mm) screws of Number 10 Screw Gauge driven into beech wood to a depth of 30.5mm using a pilot hole in the wood of 3.2mm diameter. All the screws used in the tests were bright zinc plated and case hardened and were not provided with any low friction coating. The results of the tests are tabulated below which show that the screw according to the invention, which was provided with a two start thread having a 20 degrees helix angle and 40 degrees included crest angle, resulted in a substantially lower insertion torque than that required to drive the known forms of screw:-

	Conventional Wood Screw to BS1210	Conventional Self-Tapping Screw to BS4174	Conventional Two Start Wood Screw	Screw of the Invention
5	Newton Metres insertion torque	Newton Metres insertion torque	Newton Metres insertion torque	Newton Metres insertion torque
10	5.1 - 5.5	4.6 - 4.7	5.3 - 5.5	3.5 - 4.0

Tests have also been carried out on the insertion speed of the screws described above as measured by the number of turns required to fully apply the screw, i.e. to bury the countersunk head in the wood:-

15	<u>No. 10 Screw Gauge 2" (50.8mm) Screw</u>			
	Conventional Wood Screw to BS1210	Conventional Self-Tapping Screw to BS4174	Conventional Two Start Wood Screw	Screw of the Invention
20	26 turns	32 turns	15 turns	11.1 turns

	<u>No. 12 Screw Gauge 3" (76.2mm) Screw</u>			
	Conventional Wood Screw to BS1210	Conventional Self-Tapping Screw to BS4174	Conventional Two Start Wood Screw	Screw of the Invention
25	33 turns	42 turns	19.5 turns	14.3 turns

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A screw may be produced in accordance with the invention by conventional cold heading and thread rolling techniques and it will be appreciated that the screw may have a cross slot or recess in its head and that such head may be of any suitable form. The screw in accordance with the present invention is preferably provided with a two start thread which thread may extend from the unthreaded shank portion 10 either to the end or to the start of the entry portion 14. Thus, although the specific example described hereinbefore is provided with an entry portion comprising a conical unthreaded point, such entry portion may be threaded to the end thereof and may either taper to a point or may comprise a relatively blunt end.

As mentioned hereinbefore, the screw need not be provided with the unthreaded shank portion 10, whereby the threaded portion 12 may extend from the entry portion 14 substantially up to the underside of the head 16. Also, a raised unthreaded location portion in the form of a cylindrical or frusto-conical collar may be provided immediately below the screw head 16, such collar having a maximum diameter substantially equal to the crest diameter of the threaded portion 12.

In the screw of the present invention the diameter of the shank at the base of the thread preferably lies within the range of 60% to 70% of the crest diameter of the thread dependent upon the Screw Gauge number as follows:-

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Screw Gauge Number		Thread Base/Thread Crest Diameter
5	3	64%
	4	62%
	5	62%
	6	68%
	7	68%
10	8	68%
	9	63%
	10	63%
	12	63%
	14	63%

15 Screws produced in accordance with the invention are always hardened, either case hardened or through hardened, in order to give them sufficient torsional strength for use in their various applications i.e. in both hard and soft woods, man-made board materials, plastics or metals. It is of course conventional practice to harden self-tapping screws but wood screws are not usually hardened and reference may be had to Figure 4 which shows the relationship between torsional strength and nominal screw diameter (i.e. screw gauge number) for hardened and non-hardened screws.



CLAIMS

1. A hardened steel screw having a head at one end, an entry portion at the other end and a threaded shank portion extending from the entry portion towards the head, characterised in that the thread profile is of helical form wherein the helix angle is between 20 degrees and 25 degrees, the included angle of the thread profile at its crest is between 30 degrees and 40 degrees and the thread profile is symmetrical about an axis perpendicular to the longitudinal axis of the screw.
2. A screw as claimed in Claim 1 further characterised in that the said helix angle is substantially equal to 20 degrees and the said included angle is substantially equal to 40 degrees.
3. A screw as claimed in any one of the preceding claims further characterised in that the thread comprises a two start thread.
4. A screw as claimed in any one of the preceding claims further characterised in that the threaded shank portion thereof extends to the end of the entry portion.
5. A screw as claimed in any one of Claims 1 to 3 further characterised in that the threaded shank portion thereof extends to the start of the entry portion.
6. A screw as claimed in any one of the preceding claims further characterised in that the entry portion is tapered.
7. A screw as claimed in Claim 6 further characterised in that the thread is raised rapidly from the tapered



entry portion to the full thread crest diameter.

8. A screw as claimed in Claim 7 further characterised in that the tapered entry portion comprises a conical unthreaded point.

5 9. A screw as claimed in Claim 8 further characterised in that the included angle of the conical unthreaded point is substantially equal to 30 degrees.

10 10. A screw as claimed in any one of the preceding claims further characterised in that an unthreaded shank portion is provided between the threaded portion and the head, the diameter of the portion being less than the crest diameter of the threaded portion.

15 11. A screw as claimed in any one of Claims 1 to 9 further characterised in that the threaded portion extends from the entry portion substantially up to the underside of the head.

20 12. A screw as claimed in any one of the preceding claims further characterised in that a raised unthreaded location portion is provided immediately below the head, said portion having a maximum diameter substantially equal to the crest diameter of the threaded portion.

13. A screw constructed and arranged substantially as hereinbefore described with reference to the accompanying drawings.
