

1 Drilling and thread forming fasteners

 The present invention is directed to fasteners represented by the type of screw which drills a pilot
5 hole, and forms threads in a workpiece, without the need for pre-drilling, tapping or the like.

 In United States Patent No. 3,395,603, there is described a drilling and thread forming screw which has been manufactured in large quantities, and has met with
10 great acceptance for use in the fields of automotive manufacturing, metal building construction, appliance fabrication, etc. The fastener comprises a pilot end portion which is generally elliptical in cross section and thus has a transverse major axis and a transverse
15 minor axis. A pair of flutes are formed in the pilot end portion, each of which provides cutting surfaces essentially coterminial with the major axis and drag surfaces essentially coterminial with the minor axis.

 While the invention of the above referenced
20 patent has heretofore been employed in various size ranges of fasteners and for various applications, there has risen a need for a fastener of the type described wherein the length of the pilot end portion is required to be substantially decreased so that the threaded portion of
25 the fastener extends substantially closer to the tip than is necessary the majority of applications in which such a fastener is employed. However, it has been found that by shortening the pilot end portion of the fastener, the drag surface as disclosed in the aforementioned U.S. patent
30 No. 3,395,603, when retained as a substantially flat surface, as there disclosed, is inclined at an angle which greatly inhibits the flow of chips produced by the drilling operation from the opening being formed.

 In view of the above, it is the object of the
35 present invention to provide a drilling and thread forming fastener having a drill point of a configuration which aids

1 in the removal of chips produced by the drilling operation
and which may be employed over a broad range of drill tip
sizes.

5 The invention provides in one of its aspects a
drilling and thread forming fastener comprising a trailing
threaded shank and a pilot end portion, said pilot end
portion having a transverse major axis and a transverse
minor axis, a pair of flutes extending longitudinally in the
pilot end portion whereby to provide a pair of cutting
10 surfaces, each of said cutting surfaces being formed
arcuately in the longitudinal direction to provide proper
rake for drilling, said flutes being oriented such that said
cutting surfaces lie generally close to the plane defined by
the major axis of said pilot end portion, whereby cutting
15 edges associated with said cutting surfaces describe a circle
having a greater diameter than said minor axis when said
fastener is rotated, drag surfaces formed by said flutes,
and lands intermediate said drag and cutting surfaces of
decreasing radius from said cutting edges to said drag
20 surfaces whereby said lands will not engage the sidewall of
a pilot hole formed by said cutting surfaces, each said drag
surface being formed arcuately in the longitudinal direction
of said fastener to provide clearance for chips of material
produced during the drilling process, said arcuate surface
25 having a substantially constant radius throughout its length
and extending from a point adjacent the tip of the pilot end
portion to a point adjacent the threaded shank.

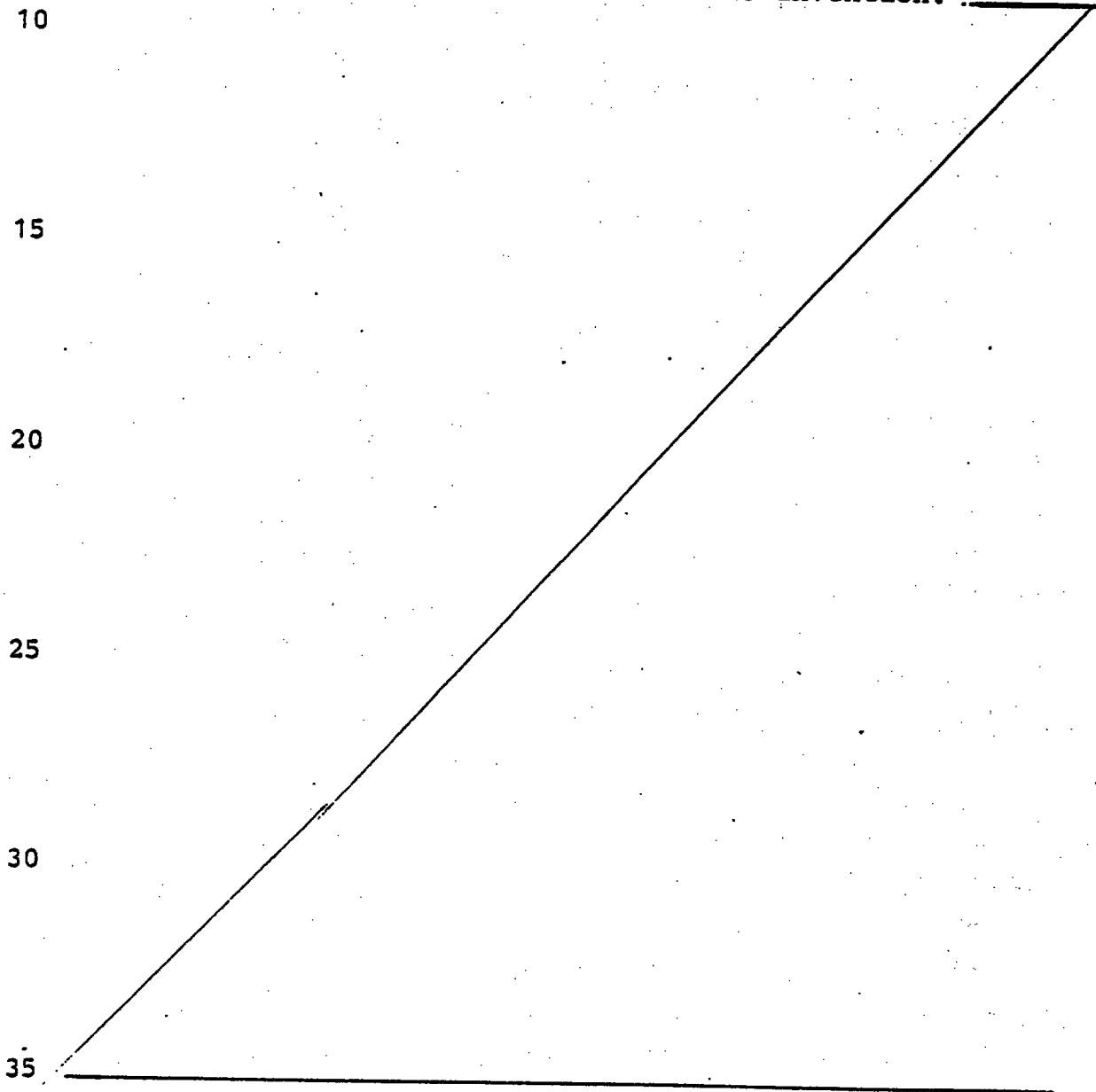
The invention also provides in another of its
aspects a drilling and thread forming screw having a threaded
30 shank and a pilot end portion in which two longitudinally
extending flutes are provided, and which has, in its
transverse cross section, a minor axis and a major axis, said
flutes providing cutting surfaces lying generally close to a
plane defined by the major axis, the pilot end portion also
35 comprising a pair of drag surfaces formed by said flutes each

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1 of which is longitudinally arcuate, has a substantially
constant radius throughout its length, and extends from a
point adjacent the tip of said pilot end portion to a point
adjacent said threaded shank.

5 There now follows a description, to be read with
reference to the accompanying drawings, of a drilling and
thread forming fastener embodying the invention and
selected for description to illustrate the invention by way
of example and not of limitation of the invention.



1 In the accompanying drawings:-

Figure 1 is an elevational view of a drilling and thread forming fastener constructed in accordance with the prior art;

5 Figure 2 is a side elevational view of the prior art fastener of Figure 1 taken at 90° to Figure 1;

Figure 3 is an end view of the prior art fastener of Figures 1 and 2;

10 Figure 4 is an end perspective view of the aforementioned illustrative drilling and thread forming fastener constructed in accordance with the present invention;

Figure 5 is a side elevational view showing the illustrative fastener of Figure 4;

15 Figure 6 is an elevational view of the illustrative fastener of Figures 4 and taken at 90° to the view shown in Figure 5; and

Figure 7 is an end view of the illustrative fastener shown in Figures 4 through 6, showing further details of the invention.

20 Referring now to Figures 1, 2 and 3, there is shown a prior art fastener, of the drilling and thread forming type, substantially as described in the aforementioned U.S. patent No. 3,395,603.

The fastener generally comprises a screw body 10
25 having an elongated shank 12 with a head 14 integral with a trailing end thereof. The screw body 10 further is provided with a pilot end portion 16 of substantially elliptical transverse configuration. As in the prior art structure referred to, the term elliptical is here used for
30 purposes of description of visualization only and is not intended in a strict mathematical sense. Longitudinally extending flutes or slots 18 and 19 of similar construction are formed in opposite quadrants of the pilot end portion 16. The flute 18 is defined by a cutting surface 20
35 having cutting edges 22, 24 and by a drag surface 26. The flute 19 is defined by a cutting surface 28 having cutting

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1 edges 30 and 32, and by a drag surface 34. Each of the
cutting surfaces 20 and 28 is slightly arcuate longitudinally of the portion 16 and lies generally close to a
5 plane which has a small amount of angularity with respect
to the longitudinal axis of the screw to facilitate removal
of material from the cutting edges during the cutting
operation. The contour of the surfaces 20 and 28 as shown
in Figure 3 provides the proper cutting angle and rake at
the cutting edges 22 and 24. The drag surfaces 26 and 34
10 are angularly disposed with respect to the longitudinal axis
of the screw to facilitate discharge of material removed in
the cutting operation.

In Figure 3, the maximum width of the cutting
surfaces 20 or 28 is shown to be greater than the maximum
15 width of the drag surfaces 26 or 34. The cutting surfaces
20 and 28 lie generally offset from and parallel to the
aforementioned plane which defines the transverse major axis
a of the elliptical pilot end portion of the screw. The
drag surfaces 26 and 34 lie in a similar relationship close
20 to a plane which defines the transverse minor axis b. A
pilot hole cut by the cutting edges 22, 24 and 30, 32
therefore will be of greater diameter than the minor axis b
of the pilot end portion. Thus, the drag surfaces 26 and 34
which define the minor axis b will not engage the sidewalls
25 of a pilot hole cut by the cutting edges. Likewise, the
arcuate portions of the pilot end portion intermediate the
cutting and drag surfaces, designated as lands 36 and 38,
will also not engage the sidewalls of a pilot hole.

The fastener shown in Figures 1 to 3 thus far, has
30 the structure shown in the U.S. patent No. 3,395,603, and
further discussion as to the advantages and details of the
structure can be found by referring to that patent.

Referring now to Figures 4 to 7, there is shown a
fastener similar to that described heretofore, but with the
35 incorporation of the teachings of the present invention.

In Figures 4 to 7 there is shown a fastener having

1 a screw body 110 comprising a shank section 112 and a pilot
end portion 116. The fastener is further provided with
longitudinally extending flutes 118 and 119 formed in
opposite quadrants of the pilot end portion 116. The flute
5 118 is partially defined by a cutting surface 120 having
cutting edges 122 and 124. In like manner, flute 119 is
partially defined by cutting surface 128 having cutting
edges 130 and 132. Behind the cutting edges 130, 132 are
arcuate lands 146, 148 of the pilot end portion 116 which
10 are identified in Figure 7 and which decrease in radius from
the cutting edge 130, 132 to the drag surfaces 40, 42.

The fastener thus far described is similar in
construction to the prior art fastener set forth above, and
shown in Figures 1 to 3, like portions being given like
15 reference numerals with addition of the prefix 1.

Referring now to Figure 6, the length L of the
pilot end portion 116 is shown to be measured from the tip
of the pilot end to the first turn of the thread designated
T. As heretofore referred to, in many applications of the
20 fastener it is desirable to have the conventional length L
decreased in order to provide greater penetration of the
threads provided on the fastener shank, while still retaining
the standard length of fastener. In this instance, the
angle that the drag surface 26 or 34 of the prior art
25 fastener assumes with respect to the surface to which the
fastener is applied becomes smaller, providing less space in
which drilling chips may be removed through the flute 18 or
19 in the prior art fastener. This situation leads to a
clogging of the flute with drilled material, and may slow
30 the drilling time of the fastener, producing a less
desirable fastening operation.

In the improved fastener shown in Figures 4 to 7,
the problem has been alleviated by providing drag surfaces
40 and 42 constructed in a manner to produce a greater volume
35 of space in the flutes through which drilling material may
pass, and which guide the drilling material upwardly and away
from the cutting edges of the pilot end _____

1 portion 116 of the screw body 110.

As will be seen from Figures 4 to 7, the drag surfaces 40, 42 are cylindrical, each having a radius R, the axes of the notional cylinders lying in directions at 90° to the axis of the screw body and orientated about the axis of the screw at an angle of 90° plus ϕ from the axial plane in which the cutting surfaces 120 and 128 generally lie (the cutting surfaces 120 and 128 being as those of the fastener described in U.S. patent No. 3,395,603).

5 In practice the angle ϕ is generally in the area of 15° , and the disposition of the drag surfaces 40 and 42 relative to the cutting surfaces 120 and 128 respectively as viewed axially is therefore more than 100° , say 105° . Such an angular relationship has been employed in prior constructions but has not in itself relieved the problems set forth above when the drag surfaces 40 and 42 have been flat and disposed at an extreme acute angle with the work surface to be drilled by the fastener.

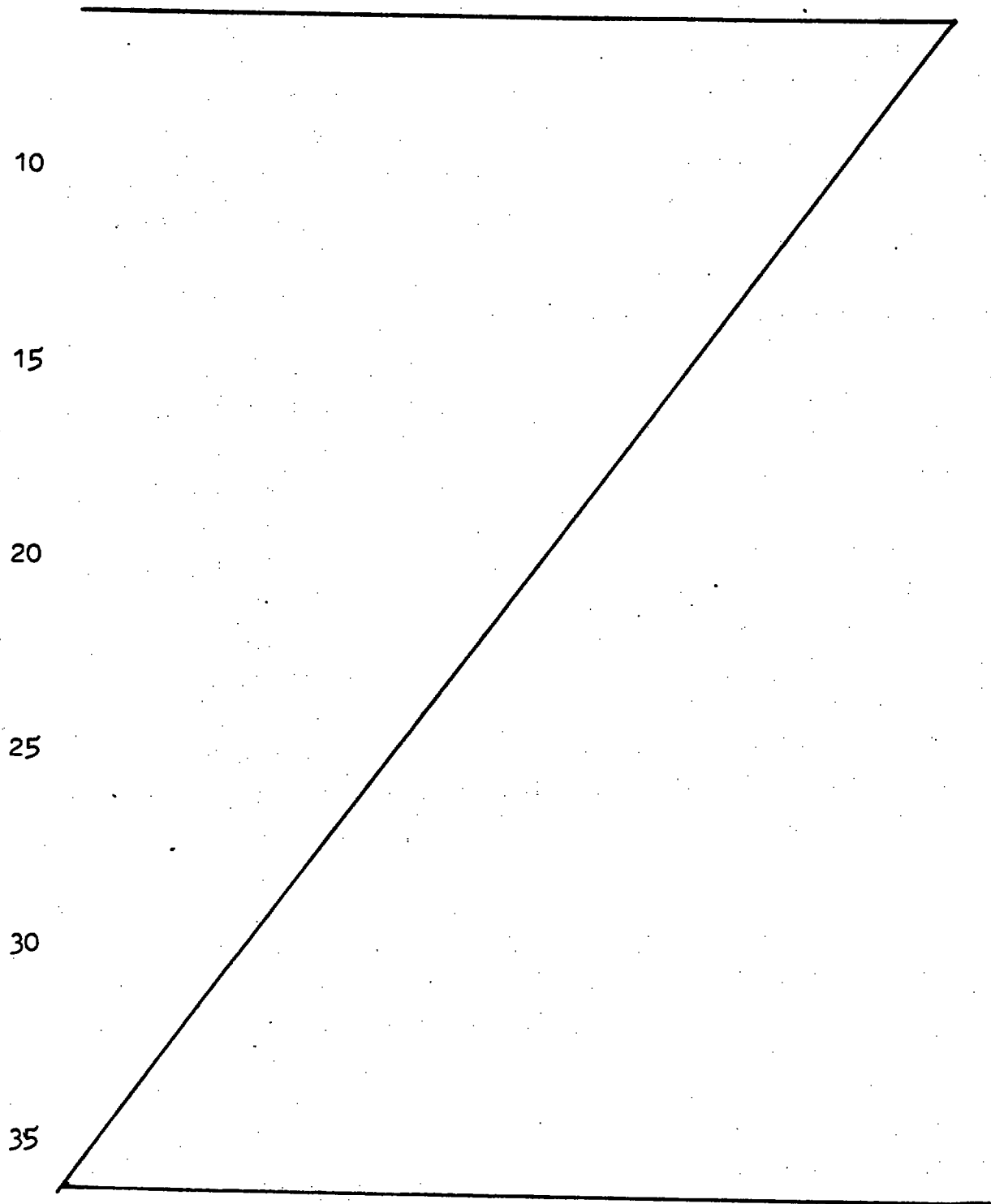
In the present embodiment, each drag surface 40, 42 has a continuous and constant curvature of radius R from the tip of the fastener to a point substantially adjacent the thread T of the fastener. In practice, it has been found that a radius R which is substantially equal to that of the surfaces 120 and 128 to provide the proper cutting angle at the cutting edges, provides the satisfactory relief to allow smooth flow of material through the flutes 118 and 119.

In effect, the continuous arcuate nature of the drag surfaces in the longitudinal direction of the fastener provides a clearance for chips to be removed during the drilling operation and also a surface which is conducive to moving the chips in a continuous manner from the opening being drilled by the fastener 110. Thus, the objective of the invention is achieved by the simple expedient of forming a continuous arcuate surface on the drag surface 40 and 42 of the fastener similar to that of cutting surfaces 120

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- 1 and 128 of the fastener, which serves the purpose of
providing the increased space required to remove chips
during the drilling operation, and a surface which is in
all respects conducive to moving the chips formed by
5 the drilling fastener upwardly and out of the opening.



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Claims:-

1. A drilling and thread forming fastener comprising a trailing threaded shank and a pilot end portion, said pilot end portion having a transverse major axis and a transverse minor axis, a pair of flutes extending longitudinally in the pilot end portion whereby to provide a pair of cutting surfaces, each of said cutting surfaces being formed arcuately in the longitudinal direction to provide proper rake for drilling, said flutes being oriented such that said cutting surfaces lie generally close to the plane defined by the major axis of said pilot end portion whereby cutting edges associated with said cutting surfaces describe a circle having a greater diameter than said minor axis when said fastener is rotated, drag surfaces formed by said flutes, and lands intermediate said drag and cutting surfaces of decreasing radius from said cutting edges to said drag surfaces whereby said lands will not engage the sidewall of a pilot hole formed by said cutting surfaces, each said drag surface being formed arcuately in the longitudinal direction of said fastener to provide clearance for chips of material produced during the drilling process, said arcuate surface having a substantially constant radius throughout its length and extending from a point adjacent the tip of the pilot end portion to a point adjacent the threaded shank.

2. A fastener as set forth in claim 1 wherein said cutting surfaces and said drag surfaces are of substantially the same arcuate configuration.

3. A fastener as set forth in claim 1 wherein the cutting and drag surfaces of each flute generally lie close to radial planes disposed, as viewed axially of the



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1 screw, at an angle greater than 100° to one another.

4. A drilling and thread forming screw having
a threaded shank and a pilot end portion in which two
5 longitudinally extending flutes are provided, and which
has, in its transverse cross section, a minor axis and a
major axis, said flutes providing cutting surfaces lying
generally close to a plane defined by the major axis,
the pilot end portion also comprising a pair of drag
10 surfaces formed by said flutes each of which is longi-
tudinally arcuate, has a substantially constant radius
throughout its length, and extends from a point adjacent
the tip of said pilot end portion to a point adjacent
said threaded shank.

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5. A drilling and thread forming fastener
substantially as hereinbefore described with reference to
Figures 4 to 7 of the accompanying drawings.

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