A screw head is provided with ribs (26) on some of the driver engageable surfaces. The rib (26) is slanted outwardly from the screw axis by a small angle A between 1° and 10°. A punch (150) for making a screw head with ribs (26) on some of the driver surfaces includes a slanted groove (168) for providing a rib (26) which is slanted from the screw axis by a small angle A between 1° and 10°.
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SCREW HEAD WITH SLANT RIB
AND PUNCH FOR MAKING SUCH SCREW HEADS

The present invention relates to screw heads of the type described in U.S. Patent 4,084,478 dated April 18, 1978, as generally shown in Figures 2 and 3 thereof. Such screw heads are provided with ribs on some of the driver-engageable surfaces of the head to interlock with an edge of the driver to reduce the tendency for the driver to slip out of engagement with the screw head during driving and removal.

In producing such ribs with a metal punch, the metal of the screw head tends to flow outwardly from the screw axis as well as axially, and accordingly, may not completely fill in the rib during the head forming operation.

In the present invention, this problem of incomplete filling of the rib is improved by slanting the rib outwardly from the screw axis by a small angle between 1° and 10°, preferably about 1° to 6°, to match the angle of flow of the metal. Another requirement of the invention is that the apex angle of the rib, as measured normal to the slant rib angle, is sufficiently large that the rib will not interfere with the withdrawal of the punch from the formed screw head.

In order to more fully understand the invention, reference should be had to the following non-limiting detailed description together in connection with the following drawings wherein:

Figures 1, 2 and 3 are taken from U.S. Patent No. 4,084,478;

Figure 3A is a view similar to Figure 3 showing the slant applied to the rib in accordance with the present invention;

Figure 3B is like Figure 3 of '478 showing the wing
angle B, which is the angle by which the side wall
deviates from the centerline plane of the wing as well as
the location of section line c---c;
Figure 4 is an enlarged sectional view taken along
line c-c in Figure 3B to show angle D which is referred to
as the base angle;
Figure 5 is an end view of a punch which may be
employed to form the rib shown in Figures 3A and 3B; and
Figure 6 is a side elevation of the punch shown in
Figure 5.
To fully appreciate the present invention, reference
should be had to earlier patent 4,084,478 of April 18,
1978, which is owned by the assignee of the present
application. As mentioned above, Figures 1, 2 and 3 are
directly taken from this '478 patent to avoid unnecessary
repetition of the teachings in the '478 patent. All of
the disclosure of the '478 patent is pertinent to the
present invention.
Referring now to Figure 3A, this is a view similar to
Figure 3 except it shows the slant angle A by which the
apex of the rib deviates from a line parallel to the screw
head axis. In Figure 3A, for purposes of illustration,
this angle A has been exaggerated. It must be, in actual
practice, between 1° and 10° preferably about 1° to 6° to
match the angle of flow of the metal. The exact angle can
readily be determined by appropriate experiments and will
be a function of the size of the wing slots, the depth of
the screw head, flow characteristics of the metal,
temperature of forming, etc.
Since the punch which forms this slant rib must be
withdrawn from the formed screw in a direction parallel to
the axis of the screw, the formed rib must not interfere
with the withdrawal of the punch. To provide this, the
rib is provided with an apex angle which is quite large,
preferably greater than 90°.
To appreciate this relationship, reference should be
had to Figure 4, wherein the surface of the rib, as seen
along a section line c---c which is parallel to the axis,
will have a base angle D with respect to the vertical wing
angle. This base angle D must be equal to or less than
the vertical wing angle B. Thus, any die punch surface
which engages the surface of the rib can pass in a vertical
direction over this cross section without interference.

For convenience in this specification the angle D is
referred to as the base angle and the angle B is referred
to as the wing angle. As can be seen by examining Figure
3B and Figure 4, if the apex angle is small, a sectional
plane parallel to the axis through the rib will show an
increased angle D and the punch will not be able to
release after the screw head has been formed.

In most commercial screws, the wing angle is on the
order of 4° to 5°. With a rib slant angle of 1° to 6°, an
apex angle of 90° or more will result in a base angle D of
less than the wing angle. If the apex angle is on the
order of 70°, and the slant angle is 12°, the base angle
will be 16° which is greater than the wing angle. In this
case, the punch could not be withdrawn. Thus, it will be
clear to one normally skilled in the art that there are
several critical points to the invention.

The slant rib angle should be between 1° and 10°,
preferably between about 1° to 6°, to match the flow angle
of the metal. The apex angle of the rib, as measured
normal to the rib, should be sufficiently large,
preferably greater than about 95° depending upon the
vertical wing angle B of the driver-engageable surface.
As the wing angle B becomes larger, the apex angle can
become smaller. As the wing angle becomes smaller, then
the apex angle must be larger. In any case, the base
angle D created by a section through the rib surface and
measured to the vertical wing surface must be less than
the vertical wing angle.

While one specific embodiment of the invention has
been described above, the basic principles can be applied to all of the ribs (including tapered ribs) in the screw head shown in the '478 patent except where the wing angle is 0° (e.g. Figure 39 of the '478 patent). In this connection, reference should be had to Figure 38 which apparently shows a slight deviation of the rib 76. However this rib lies within a substantially vertical plane. This rib 76 is not a slant rib as defined in the present invention. The rib edge of the present invention is slanted with respect to the screw axis and accordingly lies in a plane that is not parallel to the screw axis.

The rib configurations described above may be formed by conventional techniques in commercially employed heading machines. Figures 5 and 6 illustrate a punch of a configuration which is adapted to form the rib shown in Figures 3A and 3B. These Figures 5 and 6 are similar to Figures 58 and 59 of U.S. Patent 4,151,621 but have been modified to illustrate the present invention. The punch, indicated generally by the reference character 150, may be formed in accordance with conventional punch forming techniques but modified to include the present invention. The punch 150 includes a body portion 152 having a face 154 and an integral nib 156 which protrudes from the face 154. The nib 156 is the complement of the shape of the recess and the face 154 of the punch 150 is of complementary shape to that of the intended screw head, here described for purposes of illustration as a flat head. The nib 156 includes a central core 158 and a plurality of blades 160 which extend generally radially and outwardly from the core. Each of the blades 160 has a pair of side surfaces 162, 164 and an end surface 166 which is inclined upwardly and outwardly from the outer region of the core 158. The blades 160 at their upper ends, merge into the face 154 of the punch to define an integral structure. A number of the surfaces 162 and/or 164 of the blades are provided with grooves 168 which are
defined by groove sidewalls 170. The grooves define a
cross-sectional area and configuration substantially
identical to that of the rib 26 which is to be formed on
the sidewall of the recess groove. Thus, the grooves 168
are of the order of a few thousandths of an inch in depth
or less and their relative dimensions are exaggerated for
clarity in the drawings. The grooves 168 may be formed on
one or more of the surfaces 162 or, on both of the
surfaces 162 and 164 as desired. In the illustrated punch
the grooves 168 are formed on the surfaces 162 of several
of the blades 160 which will define the drive walls. The
grooves 168 extend from the lower edge 172 of the
respective blade sidewalls 160 and/or 162, where the
sidewalls join the end surfaces 166, and extend upwardly
to the extent desired. The grooves may extend fully to
the top of the blades 160, where they meet the face 154 of
the punch or, may terminate below the juncture of the
blade 160 and face 154 depending on the rib configuration
which is to be fabricated. Each of the grooves is formed
so that it has a triangular cross-section, the apex of the
triangle forming the rib edge which is engageable by the
edge of the driver. The axis of groove 168 is tilted
upwardly and outwardly from the punch axis in the
direction of metal flow by an angle A with respect to a
plane parallel to the punch axis. This angle A (see
Figures 3A and 6) is between about 1° and 10°. The
associated side wall 162 of the punch is slanted outwardly
from the punch axis by a small vertical wing angle B (see
Figures 3A and 6) between 1° and 10°. The groove 168 has
an apex angle sufficiently large that a vertical section
through the groove (and the formed rib) will provide a
base angle D (see Figure 4) for the groove (and the rib
surface) which is equal to or less than the vertical wing
angle B, this apex angle being measured in a plane normal
to the groove apex.

Since the punch has a surface exactly complementary to
the final screw head, the preferred ranges for the slant
angle A and the wing angle B are the same as those
specified for the screw head.
1. In a screw head provided with a rib on a driver-
   engageable surface comprising a side wall, the rib having
   a surface which comes to an apex which is engageable by an
   edge of the driver to reduce tendency of the driver to
   slip out of engagement with the side wall, the screw head
   being formed by a metal-deforming punch to cause metal
   flow in a predetermined direction;

   the improvement characterized in that the rib 26 is
   straight and has a triangular cross-section, the apex of
   the triangle forming a rib edge which is engageable by the
   edge of the driver, the rib axis being tilted upwardly and
   outwardly from the screw axis in the direction of metal
   flow by an angle A (the rib angle) with respect to a plane
   parallel to the screw axis, said rib angle A being between
   about 1° and 10°, the associated side wall 22 being
   slanted outwardly from the screw axis by a small vertical
   wing angle B between 1° and 10°, said rib 26 having an
   apex angle sufficiently large that a vertical section
   through said tilted rib will provide an angle D (the base
   angle) for the rib surface which is equal to or less than
   the vertical wing angle B, said apex angle being measured
   in a plane normal to the rib edge.

2. The screw head of claim 1 characterized in that
   the rib angle A is between about 1° and 6°.

3. The screw head of claim 1 characterized in that
   the rib angle A is about 3°.

4. The screw head of claim 1 characterized in that
   the rib angle A is about 5°.

5. The screw head of claim 1 characterized in that
   the rib angle A is between about 3° and 6°.

6. In an impact tool for forming driver-engageable
   surfaces at an end of a rotatable fastener comprising:
       a body portion having an axis and having an end
   region lying along said axis, the end region having
   primary surfaces which define a primary geometrical shape
substantially corresponding to that of the primary driver-
engageable surfaces to be formed; and
means forming at least one elongate groove of
relatively small cross-sectional dimensions in at least
one of said primary surfaces of said end region, said
groove extending generally longitudinally of said axis,
whereby when the end region of said tool is impacted into
the material of the rotatable fastener, the primary
surfaces of the end region will form said geometrically
shaped primary driver-engageable surfaces and said
elongate groove will form a projection of relatively small
cross-sectional dimension extending from said at least one
primary driver-engageable surface;
the improvement characterized in that the
elongate groove 168 has a triangular cross-section, the
apex of the triangle forming a rib edge which is
engageable by the edge of the driver, the groove axis
being tilted upwardly and outwardly from the punch axis in
the direction of metal flow by an angle A with respect to
a plane parallel to the punch axis, said angle A being
between about 1° and 10°, the associated side wall of the
punch being slanted outwardly from the punch axis by a
small vertical wing angle B between 1° and 10°, said
groove having an apex angle sufficiently large that a
vertical section through said formed rib 26 will provide a
base angle D for the rib surface which is equal to or less
than the vertical wing angle B, said apex angle being
measured in a plane normal to the groove.
7. The tool of claim 6 characterized in that the
angle A is between about 1° and 6°.
8. The tool of claim 6 characterized in that the
said angle A is about 3°.
9. The tool of claim 6 characterized in that the
said angle A is about 5°.
10. The tool of claim 6 characterized in that the
said angle A is between about 3° and 6°.
### I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC

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### IV. CERTIFICATION

- **Date of the Actual Completion of the International Search:** 08 SEPTEMBER 1992
- **Date of Mailing of this International Search Report:** 15. 10. 92

**International Searching Authority:** EUROPEAN PATENT OFFICE

**Signature of Authorized Officer:** VAN DER WAL
ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. US 9204459
SA 60800

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