PATENT REQUEST : STANDARD PATENT

I/We, being the person(s) identified below as the Applicant, request the grant of a patent to the person identified below as the Nominated Person, for an invention described in the accompanying standard complete specification.

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Invention Title: RECESSED SCREW AND A DRIVER BIT ENGAGEABLE THEREWITH

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BASIC CONVENTION APPLICATION(S) DETAILS

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by

Fellow Institute of Patent Attorneys of Australia of Carter Smith & Beadle

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NOTICE OF ENTITLEMENT

We, Yugenkaisha Shinjo Seisakusho, of 1–22, Matsu 3-chome, Nishinari-ku, Osaka, Japan, the applicant in respect of Application No. 87825/91, state the following:–

The person nominated for the grant of the patent has entitlement from the actual inventor by assignment.

The person nominated for the grant of the patent is the applicant of the basic application listed on the patent request form.

The basic application listed on the patent request form is the first application made in a Convention country in respect of the invention.

Dated this 12th day of December 1991

Yugenkaisha Shinjo Seisakusho

by Katsumi Shinjo

(Katsumi Shinjo – President)
1. A recessed screw comprising:
   a recess formed in a head of the screw and engageable with a driver bit;
   the recess being defined with a plurality of sticking walls and a plurality of radial grooves;
   each sticking wall being a portion of a conical surface slanted inwardly towards a bottom of the recess;
   and
   each radial groove being disposed between the two adjacent sticking walls, extending outwards from the sticking walls in a radial direction, and defined by a vertical wall lying in parallel with an axis of the recessed screw.

2. A driver bit having protrusions tightly fittable in the recess as defined in claim 1.
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Invention Title: RECESSED SCREW AND A DRIVER
BIT ENGAGEABLE THEREWITH

The following statement is a full description of this invention, including the best
method of performing it known to me/us:

- 1 -
RECESSSED SCREW AND A DRIVER BIT
ENGAGEABLE THEREWITH

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a recessed screw having a recess formed in the head thereof and adapted to receive a driver bit, and more particularly relates to an improved shape of the recess.

The invention further includes a driver bit for use with and engageable with the recessed screw having the improved recess.

2. Description of Prior Art

The most popular recess formed in the screw head for engagement with a driver bit is the so-called Phillips type, in which the recess is of a crossed shape. The crossed recess has in general torque transmitting walls which are slanted inwardly towards a bottom of said recess. These slanted walls of the crossed recess are likely to cause the so-called "come-out" of the driver bit, in other words, the bit tends to disengage from and slip out of the recess when a strong screwing torque is imparted to said bit.

In addition to such a problem, a sufficiently strong torque cannot be applied to the driver bit because it has only four blades or ridges.

It also has been proposed to employ recesses of certain modified shapes including hexagonal recess, in place of
the crossed one, in order that a higher torque can be imparted to the modified recess than in the case of the crossed recess. An example of the modified recesses is shown in Figs. 9 and 10, in which a screw head 1 has a driver bit-engaging recess 2 composed of two holes square in transverse cross section, as indicated by the phantom lines "A" and "B". The square holes are superimposed one upon another and disposed symmetrically and with a phase shift of 45° around an axis of the screw. Eight corner grooves 3 are each defined by a pair of side walls 4 and 4, which are perpendicular to each other and extend towards a bottom 5 of the recess 2 (see for example United States Patents Nos. 3,604,305 and 4,384,812).

It is however noted that the screw having the modified recess 2 as exemplified above has also the side walls 4 which are, similarly to the crossed recess, slanted inwardly towards the bottom 5. Such slanted walls will facilitate the sticking or biting of the driver bit in said recess, but will inevitably cause the so-called "come-out" problem.

It may be possible to form the side walls 4 to extend not slanted but straight in parallel with the screw axis so as to avoid the come-out. This hypothetic shape will be effective to transmit a higher torque giving a stronger screwing force. However, a slight clearance necessary for the recess to smoothly receive the driver bit is disadvantageous in that said bit will be held in the recess 2 in a shaky state. In a case where the screw is the
so-called self-drilling screw which is driven at much higher speeds by the driver bit, it will probably slip out of the hypothetic recess. Further, the initial sticking of the driver bit in said recess will be so poor that the screwing operation is not easy to be performed by an automatic tool.

SUMMARY OF THE INVENTION

An object of the present invention which was made in view of the problems inherent in the prior art recessed screws is therefore to provide an improved recessed screw as well as a driver bit engageable therewith, which recess is of such a shape that smooth and strong initial sticking or biting of the driver bit is ensured and the come-out thereof does not occur even when transmitting a high torque, whereby high speed rotation of the bit can be achieved without any problem.

Provided in the invention is a recessed screw having a recess in the head thereof for engaging with a driver bit, with the recess being defined with a plurality of sticking walls and a plurality of radial grooves, wherein each sticking wall is a portion of a conical surface slanted inwardly towards a bottom of the recess, and each radial groove being disposed between the two adjacent sticking walls, extending outwards from the sticking walls in a radial direction is defined by a vertical wall lying in parallel with an axis of the recessed screw.

In detail, the recess in a preferred mode of the in-
vention is a superimposition of two holes square in their transverse cross sections, the holes being disposed symmetrically with a phase shift of 45° around the recessed screw axis so as to provide eight corner grooves as the radial grooves, wherein a pair of side walls as the vertical wall to form each corner groove lie in parallel with the screw axis, whereas each of the conically curved sticking walls is provided at a place where one of the side walls forming one corner groove intersects one of the other side walls forming the other corner groove adjacent to the one corner groove, and each sticking wall being a portion of a conical surface which is inwardly slanted towards the bottom of the recess.

The driver bit used to tighten the recessed screw into an article must basically comprise protrusions fittable in the recess. However for use with the preferred type of recessed screw just described above, the driver bit may be composed of a shank and a bit portion extending therefrom and having at its extremity a pointed central end. The bit portion is formed with eight V-shaped grooves which extend axially of the driver bit so that eight blades or ridges are defined each between the two adjacent V-shaped grooves. A bottom of each V-shaped groove, that is an extension from feet of adjacent blade, is also a conically curved wall which can come into close contact with the conical surface of any of the sticking walls in the recess of the screw head.
In an alternative mode of the invention, each conically curved sticking wall in the recess may be formed as the radial corner groove's bottom where the pair of vertical side walls of each groove intersect one another. Correspondingly, the blades of the driver bit have at their tops the conically curved walls closely engageable with the curved sticking walls in the recess.

Due to the shapes of the cooperating members as described above, with the driver bit being inserted in the screw's recess, the conically curved walls of the driver bit can closely contact and engage with the sticking walls in the recess so that the tight sticking, i.e., biting, of the driver bit is ensured initially and maintained thereafter without failure.

In use, a torque will be applied to the thus fitted driver bit to thereby cause a friction of certain strength between the tightly contacting surfaces. Then, with a higher torque exceeding the friction, the driver bit will rotate a very small angle so that side surfaces of the eight blades come into contact with the corresponding side walls of the corner grooves in the screw's recess, and thus a sufficient torque is transmitted to forcibly rotate the recessed screw.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a recessed screw provided in a first embodiment of the invention;
Fig. 2 is a vertical cross section in part of the recessed screw;

Fig. 3 is a perspective view showing in part a driver bit engageable with the recessed screw;

Figs. 4 and 5 are enlarged cross sections showing the driver bit fitted in and rotating the recessed screw;

Fig. 6 is a plan view of a recessed screw provided in a second embodiment of the invention;

Fig. 7 is a vertical cross section in part of the recessed screw shown in Fig. 6;

Fig. 8 is a perspective view showing in part a driver bit engageable with the recessed screw shown in Fig. 6;

Fig. 9 is a plan view of a prior art recessed screw; and

Fig. 10 is a vertical cross section in part of the prior art recessed screw.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The embodiments of the present invention will now be described below referring to the drawings.

In Figs. 1 and 2, a principal portion of a recessed screw 10 provided herein is illustrated, while Fig. 3 illustrates a driver bit 20 engageable with a recess 12 formed in the recessed screw.

The bit receiving recess 12 formed in a head of the screw has eight corner grooves 13 which are formed by superimposing two holes "A" and "B" one upon another, which
holes are square in transverse cross section and arranged symmetrical with each other and with a phase shift of 45° around the axis O-O of the recessed screw. Similarly to the prior art recessed screw shown in Figs. 9 and 10, each corner groove 13 is basically defined with a pair of side walls 14a and 14b which are perpendicular to each other and extend to a conical bottom 15 of the recess 12.

It is however to be noted that the pair of side walls 14a and 14b forming each corner groove 13 in the recessed screw 10 in the invention do extend in parallel with the screw axis O-O.

It is another feature of the recessed screw 10 in the invention that the side walls 14a and 14b belonging to two adjacent corner grooves 13 and 13 intersect one another to form a ridge portion therebetween. These ridge portions protruding inwardly of the recess 12 provide curved sticking walls 16, which are slanted inwardly and gradually towards the bottom 15 of the recess 12 at a gentle angle (for example at about 10° or less). The curved sticking walls 16 enhance to the driver bit 20 such a biting function as will be detailed hereinafter. As indicated by the phantom lines in Figs. 1 and 2, each sticking wall 16 is a portion of a conical surface "C" having a center line, which coincides with the screw axis O-O, and slanted inwardly towards the bottom 15 of the recess 12.

Therefore, transverse width of each curved sticking wall 16 gradually decreases from its upper end 17 towards
its lower end 18 where the sticking wall merges into the bottom 15 of the recess. Because the depth of the recess 12 must be designed appropriate in consideration of the thickness of the screw head 11, the lower ends 18 of the curved sticking walls 16 may have a certain width still at the border between each wall 16 and the bottom.

The driver bit 20 must in use tightly engage with the recess 12 in the recessed screw 10 so as to rotate same, and thus must be of a shape similar to the recess 12 as shown in Fig. 3.

The driver bit comprises a shank 21 and a bit portion integrally extending from the shank and having at its extremity a central pointed end 22. The bit portion between the end 22 and the shank 21 is formed with eight V-shaped grooves which extend axially of the driver bit. Thus, eight blades 23 of a reversed V-shape in cross section are formed to be engageable with the corner grooves 13 in the recess 12. Side surfaces 24a and 24b of each blade 23 are perpendicular to each other, similarly to the side walls 14a and 14b of the corner grooves 13 which are perpendicular to each other as described above. Present at each V-shaped groove's bottom, where the side surfaces 24a and 24b belonging to the adjacent blades 23 and 23 are adjoined one to another, is a connecting plane 25. These planes 25 are conically curved walls tightly engageable with the similarly curved sticking walls 16 in the recess 12. In other words, the connecting planes (i.e., curved
walls) 25 are portions of the same conical surface "C" as are the recess's 12 curved sticking walls 16.

In use of the recessed screw 10, it receives the driver bit 20 inserted in the recess 12 in such a state as shown in Fig. 4. The curved sticking walls 16 of the screw 10 come into close contact with the connecting planes (i.e., curved walls) 25 of the bit 20, all of these walls being the portions of the same and common conical surface "C". Consequently, the biting effect is produced between the former walls and the latter walls, and at the same time clearances "e" take place between each side wall 14a or 14b of the corner grooves 13 and each corresponding side surface 24a or 24b. The clearances "e" are for smooth insertion of the driver bit into the recess. In this initial biting state, an initial torque given to the driver bit 20 will be transmitted to the recessed screw 10 due to a friction between the bitten driver bit and the biting recess. When the torque acting on the driver bit 20 exceeds the friction, the bit will rotate only a little relative to the recessed screw 10 and take a position as shown in Fig. 5. In this state of the members, outer edges of the side surfaces 24a of the eight blades 23 contact with the side walls 14a forming the corner grooves 13. Following this step, a propelling torque of desired strength will be applied to the recessed screw 10. Since both the torque transmitting side surface 24a and torque receiving side wall 14a do extend in parallel with the axis
0-0, no component force is produced in axial direction of the driver bit 20. In other words, only the twisting torque will be imparted by the driver bit 20 to the recessed screw 10. It is apparent that the forcible rotation of the driver bit 20 will never cause "come-out" thereof, but effectively transmits the necessary torque. The driver bit 20 is thus prevented from slipping out of the recess 12, even when rotated at high speeds.

Figs. 6 and 7 show a recessed screw 30 provided in a second embodiment of the present invention. Curved sticking walls 31 for producing the biting effect are formed at places where the side walls 14a and 14b of each corner groove 13 intersect one another, that is at the outermost regions of the corner grooves 13. Also, the sticking walls 31 provided here are portions of the conical surface "C" which is slanted inwardly towards the bottom 15 of the recess 12 and has an axis coinciding with the screw axis 0-0, similarly to the recessed screw 10 illustrated in Figs. 1 to 3. Each sticking wall 31 is widest at its lower end 33 adjoined to the bottom 15 of the recess 12, while its upper end merges into two upper and side edges of the adjacent corner grooves 13.

A driver bit 40 for tightening the recessed screw 30 is shown in Fig. 8, in which a top of each blade 23 is formed as a conically curved wall 41 tightly engageable with the curved sticking wall 31. Similarly to the latter walls 31, the former walls 41 are also portions of the conical
surface "C".

The operation for tightening the recessed screw 30 by means of the driver bit 40 is substantially identical with that for the recessed screw 10 and driver bit 20 which are shown in Figs. 1 to 3. The biting effect is also produced by contacting the curvad walls 41 with the respective sticking walls 31. Outermost edges of the side surfaces of eight blades 23 will similarly come into contact with the side walls 14a of eight corner grooves 13 so that a sufficient torque can be applied to the screw 30, without causing the come-out of driver bit 40.

In summary, an improved recessed screw and a driver bit engageable therewith which are formed as described above are effective to ensure a sufficiently strong biting action between the screw and the bit, and at the same time a high torque can be transmitted therebetween not to result in "come-out" of the driver bit. Therefore, high speed rotation thereof is achieved without any problem.

This feature of the recessed screw and mating driver bit is most advantageous for the self-drilling screws which must be driven under a strong torque to rotate at very high speeds.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS

1. A recessed screw comprising:
   a recess formed in a head of the screw and engageable
   with a driver bit;
   the recess being defined with a plurality of sticking
   walls and a plurality of radial grooves;
   each sticking wall being a portion of a conical surface
   slanted inwardly towards a bottom of the recess;
   and
   each radial groove being disposed between the two
   adjacent sticking walls, extending outwards from the
   sticking walls in a radial direction, and defined by a
   vertical wall lying in parallel with an axis of the
   recessed screw.

2. A driver bit having protrusions tightly fittable in
   the recess as defined in claim 1.

3. A recessed screw comprising:
   a recess which is formed as a superimposition of two
   holes square in their transverse cross sections;
   the holes being disposed symmetrically with a phase
   shift of 45° around an axis of the recessed screw; and
the recess having:

- eight corner grooves, each being defined by a pair of side walls and lying in parallel with an axis of the recessed screw; and
- conically curved sticking walls each formed at a place where one of the side walls forming one corner groove intersects one of the other side walls forming the other corner groove adjacent to the one corner groove;

wherein each sticking wall is a portion of a conical surface which is inwardly slanted towards a bottom of the recess.

4. A driver bit tightly fittable in the recess of the recessed screw as defined in claim 3, the driver bit comprising:

- a shank;
- a bit portion extending from the shank and having at an extremity of the portion a pointed central end;
- the bit portion being formed with:
  - eight V-shaped grooves which extend axially of the driver bit;
  - eight blades each defined between the two adjacent V-shaped grooves; and
  - planes which are formed each at a bottom of each V-shaped groove so as to connect feet of the adjacent blades;
wherein each plane is a conically curved wall capable of coming into close contact with a conical surface of any sticking wall in the recess.

5. A recessed screw comprising:
   a recess which is formed as a superimposition of two holes square in their transverse cross sections;
   the holes being disposed symmetrically with a phase shift of $45^\circ$ around an axis of the recessed screw; and
   the recess having:
   eight corner grooves, each being defined by a pair of side walls and lying in parallel with an axis of the recessed screw; and
   conically curved sticking walls each formed at a place where the side walls forming each corner groove intersect one another;
   wherein each sticking wall is a portion of a conical surface which is inwardly slanted towards a bottom of the recess.

6. A driver bit tightly fittable in the recess of the recessed screw as defined in claim 5, the driver bit comprising:
   a shank;
   a bit portion extending from the shank and having at
an extremity of the portion a pointed central end;

the bit portion being formed with:
eight V-shaped grooves which extend axially of the
driver bit;
eight blades each defined between the two
adjacent V-shaped grooves;
wherein a top of each blade is a conically
curved wall capable of coming into close contact with
a conical surface of any sticking wall in the recess.

7. A driver bit substantially as hereinbefore described
with reference to the accompanying drawings.

8. A recessed screw substantially as hereinbefore
described with reference to the accompanying
drawings.

9. The steps, features or integers disclosed in the
accompanying specification or drawings, individually
or in any combination.

DATED this 13th November 1991

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