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Self-Tapping Screw

10 The invention relates to a self-tapping screw as specified in the preamble of claim 1.

In a manner known per se, for example from EP 0 948 719 B1, a screw, adapted in particular to be screwed into plastic material, comprises a drive and a threaded shank. The screw further comprises a main thread, said main thread having a maximum main thread outer diameter. The main thread has a
15 load bearing area and a thread cutting area, with the thread cutting area ending at the point of the thread turn at which the female thread has been completed.

On the shank of the screw, at its end facing away from the drive, the screw has a screw end of a diameter of at least 20% of the maximum main thread outer diameter.

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It is the object of the invention to provide a screw with improved insertion properties.

This object is accomplished by the characterizing features of claim 1 in combination with its preambles.

25 The subclaims contain advantageous embodiments of the invention.

The invention provides for the shank to additionally include, in the area of the screw end, a tap flute, which tap flute comprises at least two tapping thread turns. The outer diameter of these tapping thread turns is no more than 90% of the maximum outer diameter of the main thread. A tap flute region is thus
30 formed on the screw in which the tapping thread turns have the same diameter profile, and wherein, moreover, the diameter of the main thread in the tap flute region is less than or equal to the diameter of the tapping thread turns.

The advantage of this is that the tapping thread turns make for quick and straight initial insertion of the screw in a pilot hole made in a component, in particular of a plastic material, resulting in an as precise as possible alignment of a load bearing area following the thread cutting area. This allows the load bearing area to proceed along the female thread pre-cut by the thread cutting area and thus cause less friction during the screw insertion process.

In an advantageous embodiment of the invention, the main thread in the tap flute region has the same diameter as the tap flute itself. As a result, in this region, the main thread can serve as a tapping thread turn and ensure uniform engagement with the wall of the pilot hole into which the screw is inserted. A main thread having two tapping thread turns can thus in particular be used to ensure that the screw is optimally centered and aligned.

Alternatively, three tapping thread turns can be provided, with the diameter of the main thread in the tap flute region being smaller than the diameter of the tap flute itself. In this embodiment, only the tapping thread turns are used for centering the screw, with the main thread cutting the female thread only afterwards.

Preferably, the tapping thread turns start at the core in the area of the screw end and continuously expand their diameter from the beginning of the core. This ensures even and fast centering of the screw during tapping.

In particular, the thread turns having the same outer diameter are evenly distributed around the circumference of the tap flute region. This also facilitates centering of the screw.

Furthermore, the diameter of the screw end can be at least 30%, at least 40%, at least 50%, at least 60% of the main thread outer diameter. This results in the formation of a blunt screw end, so that after only a short insertion distance, the screw will already be guided by the pilot hole.

It is particularly preferred for all thread turns in the tap flute region to have their beginning in the same cross-sectional plane. This ensures even contact of the thread turns in the tap flute region over the entire tap flute region.

According to another advantageous embodiment, all threads in the tap flute region can have the same thread design, especially the same thread profile.

Preferably, the tap flute starts directly at the end of the screw. This provides a fast centering function.

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Alternatively, the tap flute can start at a distance from the end of the screw. In this way, the area towards the end of the screw can fulfil a locating function.

The tap flute thread and the main thread can be rolled threads, thus permitting their production at low costs.

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The tap flute and the main thread may have a flank angle in the tap flute region that is more obtuse than the flank angle of the main thread outside the tap flute region. This allows the centering function of the tap flute region and the cutting function of the main thread to be specifically taken into account.

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After the tap flute has reached its maximum outer diameter, it can run out abruptly. This reduces friction, especially when the screw is inserted into a narrow pilot hole.

Furthermore, the invention may provide for the tap flute to extend over a maximum of two turns. This ensures sufficient guidance, while still ensuring an effective screw connection.

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According to the invention, there may also be interruptions of the thread turns, with the interpolated course of the thread outer diameter remaining the same.

According to the invention, the insertion torque can be further reduced in that the maximum main thread outer diameter lies in the cutting area, with its outer diameter furthermore also being smaller in the bearing area. As a result, the bearing area turns following the cutting area are screwed into a female thread that has been cut slightly larger, thus reducing the friction experienced by the thread turns. This has an especially positive effect when the screw is screwed into a plastic material.

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Preferably, the thread cross-sectional profile in the area of the maximum main thread outer diameter is larger at least in its radially outer area of the thread cross-sectional profile than the thread cross-

sectional profile in the bearing area in this area. The radially outer area is about 85% of the maximum main thread diameter.

Additional advantages, features and possible applications of the present invention may be gathered
5 from the description which follows in which reference is made to the embodiments illustrated in the drawings.

In the drawings,

10 Fig. 1 is a lateral view of a screw according to the invention;

Fig. 2 is a view of a cross-section through the screw shank of Fig. 1 taken along line B-B in the tap
flute region of the screw;

15 Fig. 3 is a lateral view of a screw according to the invention having three tapping thread turns;

Fig. 4a is a view of a cross-section through the screw shank of Fig. 3 taken along line A-A in the tap
flute region;

20 Fig. 4b is a view of a cross-section through the screw shank of Fig. 3 taken along line B-B in the tap
flute region;

Fig. 5 is a comparative view of the thread profile contour in the cutting area and a thread profile con-
tour in the bearing area of the main thread.

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The view of Fig. 1 shows a self-tapping screw 10 with a screw shank 14 and a screw drive 12. The
threaded shank 14 has a main thread 16, which has a cutting area F and a bearing area T. The cutting
area F ends at the point on the main thread 16 where the female thread has been completed, after
which the bearing area T then follows. This is the case after about two turns of the main thread 16 start-
30 ing from the free end of the screw 18.

In this example, the cutting area F and the bearing area T are parts of the same thread turn, so that
there is no actual transition between the bearing area T and the cutting area F. At the end of the screw

opposite the drive, i.e. at the "tip", a tap flute region AB is provided according to the invention. In this example, the tap flute region AB is formed by two thread turns 20a, 20b extending from the screw core directly at the screw end 18 and continuously increasing their diameter D_{AA} towards the drive 12 up to the end of the tap flute region AB. The tapping thread turns 20a, 20b have their maximum outer diameter D_{AA} at the end of the tap flute region AB. This diameter is less than 90% of the diameter D_{AF} of the main thread 18. As a result, the holding properties of the tap flute 20 are not impaired and a centered and straight initial insertion of the screw 10 is still possible. In the tap flute region AB, the main thread 16 runs in the same way as the tapping thread turns 20a, 20b.

Shown in Fig. 2 is a cross-sectional view taken along line B-B approximately through the middle of the tap flute region AB. This cross-sectional view shows the tapping thread turns 20a, 20b and the main thread 16. At this point all threads have the same diameter D_{AA} . Although diameter D_{AA} increases steadily from the end of the screw towards the drive, this diameter is the same in every cross-sectional plane in the tap flute region AB.

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Fig. 3 is a lateral view of another embodiment of a screw according to the invention, which screw is provided with three tapping threads 20a, 20b, 20c, and its main thread 32 in the tap flute region AB has a smaller diameter than the tapping threads 20a, 20b, 20c.

The main thread 32 thus begins in the tap flute region AB between the tapping thread turns 20a, 20b, 20c and increases in diameter in such a way that at the end of the tap flute region AB it will eventually be the same as the diameter of the tapping thread turns 20a, 20b, 20c. From the end of the tap flute region AB, the tap flute 20 runs out and the main thread 32 extends further along the shank. The thread turn diameters are shown in the cross-sectional view of Fig. 4a, taken along line A-A, of the end of the tap flute region AB, and in the cross-sectional view of Fig. 4b, taken along line B-B, of the shank.

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Furthermore, following the tap flute region AB, the main thread turn 32 has a cutting area F and a bearing area T in the direction of the head.

The maximum main thread outer diameter D_{AF} is in the cutting area F, after which the female thread has been produced after cutting area F. The bearing area T following the cutting area in the direction of the drive has an outer diameter D_{AT} which is smaller than the maximum main thread outer diameter D_{AF} .

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This thus reduces the friction experienced by the bearing area T which follows after the cutting area F during the screw insertion process. This results in a low screw insertion torque.

5 It is to be noted that the invention also relates to screws which have a cutting area F of the design illustrated in Fig. 1 and a main thread 32 of the design illustrated in Fig. 3 having a maximum main thread outer diameter D_{AF} in the cutting area F and a smaller outer diameter D_{AT} in the bearing area.

Fig. 4a is a view of a cross section, taken along line A-A, through the screw shank at the end of the tap flute region AB. All threads have the same outer diameter D_{AA} at this position.

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Fig. 4b is a view of a cross-section, taken along line B-B, approximately in the middle of the tap flute region AB. This view clearly shows that the main thread 32 is within the outer diameter D_{AA} defined by the tapping thread turns 20a, 20b, 20c.

15 Fig. 5 is a comparative view of the thread profile contour in the cutting area and a thread profile contour in the bearing area of the main thread. The view of Fig. 5 further shows that the cross-sectional profile 38 of the thread in the area of the maximum outer diameter D_{AF} of the main thread is larger at least in its radially outer area E of the thread cross-sectional profile than the cross-sectional profile 36 of the thread in the bearing area T in this area E.

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Claims

- 10 1. Self-tapping screw (10, 30) comprising a drive (12) and a shank (14) bearing a thread comprising a main thread (16, 32), said main thread (16, 32) having a maximum main thread outer diameter (D_{AF}) and a cutting area (F) and a bearing area (T) following in the direction of the drive (12), said shank (14) having a screw end (18) at an end thereof opposite the drive (12), said screw end (18) having a diameter (D_E) of at least 20% of the maximum main thread outer diameter (D_{AF}), **characterized in** that the shank further has, in the region of the screw end (18), a
- 15 tap flute (20), said tap flute (20) comprising at least two tapping thread turns (20a, 20b, 20c) which attain, in their outer diameter (D_{AA}), no more than 90% of the maximum main thread outer diameter (D_{AF}) and form a tap region in which the tapping thread turns (20a, 20b, 20c) have the same diameter development, and in addition in that the diameter of the main thread (16, 32) in
- 20 the tap flute region (AB) is less than or equal to the diameter (D_{AA}) of the tapping thread turns (20a, 20b, 20c).
2. Self-tapping screw according to claim 1, **characterized in** that the diameter of the main thread (16, 32) in the tap flute region (AB) is identical to the diameter (D_{AA}) of the tap flute.
- 25 3. Self-tapping screw according to claim 1, **characterized in** that at least three tapping thread turns (20a, 20b, 20c) are provided, with the diameter of the main thread (D) in the tap flute region being smaller than the diameter (D_{AA}) of the tap flute (20).
- 30 4. Self-tapping screw according to any one of the preceding claims, **characterized in** that the tapping thread turns (20a, 20b, 20c) in the area of the screw end (18) start at the core and constantly increase in diameter.

5. Self-tapping screw according to any one of the preceding claims, **characterized in** that the tapping thread turns (20a, 20b, 20c) of the same outer diameter (D_{AA} , D) are equally distributed around the circumference of the tap flute region (AB).
- 5 6. Self-tapping screw according to any one of the preceding claims, **characterized in** that the screw end (18) has a diameter (D_E) of at least 20%, at least 30%, at least 40%, at least 50%, at least 60% of the main thread outer diameter (D_{AF}).
7. Self-tapping screw according to any one of the preceding claims, **characterized in** that all
10 thread turns in the tap flute region (AB) start in the same cross-sectional plane.
8. Self-tapping screw according to claim 7, **characterized in** that all thread turns (20a, 20b, 16) in the tap flute region (AB) are of identical thread design.
- 15 9. Self-tapping screw according to any one of the preceding claims, **characterized in** that the tap flute (20) starts immediately following the end of the screw (18).
10. Self-tapping screw according to one of claims 1 to 9 above, **characterized in** that the tap flute (20) starts at a distance from the screw end (18).
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11. Self-tapping screw according to any one of the preceding claims, **characterized in** that the tap flute (20) and the main thread (16) are rolled threads.
12. Self-tapping screw according to any one of the preceding claims, **characterized in** that the tap
25 flute (20) and the main thread (16) have a more obtuse flank angle in the tap flute region (AB) than the main thread (16) outside the tap flute region.
13. Self-tapping screw according to any one of the preceding claims, **characterized in** that the tap
30 flute (20) runs out abruptly.
14. Self-tapping screw according to any one of the preceding claims, **characterized in** that the tap flute (20) extends over a maximum of two turns.

15. Self-tapping screw according to any one of the preceding claims, **characterized in** that the thread turns are interrupted, with the interpolated course of the outer diameter of the thread remaining the same.
- 5 16. Self-tapping screw according to any one of the preceding claims, **characterized in** that the main thread has its maximum outer diameter (D_{AF}) in the cutting area (F), with its outer diameter (D_{AT}) being smaller in the bearing area (T).
- 10 17. Self-tapping screw according to claim 16, **characterized in** that the cross-sectional profile (38) of the thread in the area of the maximum main thread outer diameter (D_{AF}) is larger at least in its radially outer area (E) of the cross-sectional profile of the thread than the cross-sectional profile (36) of the thread in the bearing area (T) in this area (E).