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(54) **Préscsavar (press-fit) csavar**

Press-Fit Bolt

The invention relates to a press-fit bolt adapted to be pressed into a prepunched sheet metal part, according to the preamble of claim 1.

EP 0 678 679 B1 discloses a press-fit bolt which has segment-like concave recesses provided in an annular surface thereof which faces a sheet metal part. However, the disadvantage of this design is that – although twisting of the bolt is prevented by ribs located between the recesses - the edge of the head portion will still press into the sheet metal part. With a view to improving such anti-twist functionality, additional press-fit structures are provided which extend along the shank portion in a raised manner.

Furthermore, DE 42 03 153 A1 discloses a press-fit bolt having a shank whose head-side end is provided with a conical portion, said cone diverging from the head of the press-fit bolt. In addition, the head comprises an annular surface with press-fit structures mounted thereon that extend outward from the shank. Press-fitting the bolt will cause material to be displaced that will then flow into the conical portion of the shank which thus acts as an undercut and provides pull-out resistance.

DE 10 2011 104 529 A1 discloses a circumferential press-fit rib which is triangular in cross-section. To prevent twisting, blocking ribs are provided which extend radially outward.

Disclosed in WO 2011/033760 is an insert nut having press-fit structures provided on its head end which faces the component, with the surface facing the component extending in a conical manner.

US 8 092 131 B2 discloses an insert nut with raised press-fit structures provided on an annular surface thereof, said press-fit structures having a triangular cross-section which slopes down at a 90° angle right on the edge of the annular surface.

Disclosed in EP 0 667 936 B1 is a press-fit part with a groove provided in the bolt. This creates an undercut which is to accommodate a flow of material for securing the bolt in place. The head surface facing the component has press-fit structures in the form of bulges. Said bulges increase circularly from the underside of the head and decrease again in a symmetrical circular manner. These bulges press into the sheet metal part and thus prevent twisting of the press-fit bolt.

It is the object of the invention to provide an improved press-fit bolt which exhibits increased pull-out resistance and long-term stability in metal sheet joints.

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

The subclaims define advantageous further developments of the invention.

A press-fit bolt of the prior art is known to comprise a head portion having an annular surface which faces the sheet metal part. Once the press-fit bolt has been pressed in, this annular surface will make contact with the sheet metal part and a shank integrally formed on the head portion will extend through the pilot hole of the sheet metal part. Furthermore, at least two press-fit structures are integrally formed on the annular surface, which structures will be urged into the sheet metal part during the press-fitting operation. Press-fit bolts of this kind may have a threaded portion on their shank, or may be provided with a similar structure on their head end which functions as an undercut. It is further known that the press-fit structures integrally formed on the annular surface start radially spaced from the shank and terminate radially spaced via a apex or arch toward the end of the annular surface. This allows the outer portion of the annular surface to directly contact the sheet metal part to be joined, thus considerably improving the grip of the press-fit bolt under dynamic loads.

According to the invention, the contours of these press-fit structures are such that the slope from the structures' radial inner end to their apex is lower than the slope from their radial outer end to their apex. The angle defined between said first slope and the annular surface is smaller than the angle defined between the inclination and the annular surface.

The flatter design of the first slope results in a directed material flow which flows from the press-fit structures toward the shank/thread where the material then compresses on the shank, thus considerably improving the pull-out resistance of the press-fit bolt, in particular if a thread run-out or a similar undercut-forming structure is also provided. The material displaced toward and compressed on the shank as a result of the slope will then flow into the thread run-out or an undercut to be provided in the shank, thus ensuring improved pull-out resistance of the press-fit bolt.

According to an advantageous embodiment of the invention, a plurality of raised portions in the manner of individual press-fit structures may be provided in the peripheral direction. Preferably, such press-fit structures are evenly distributed at the same radial distance. Consequently, the individual press-fit structures are spaced from each other. This spacing of the press-fit structures securely prevents twisting of the press-fit bolt once the latter has been press-fit.

Advantageously, the minimum spacing between two adjacent press-fit structures should be 5° at least - which will not only provide a reliable anti-twist function but also prevent the sheet metal from being punched through.

A segment-like boundary of the press-fit structures in the peripheral direction is considered advantageous here. The segment size may preferably be chosen such that the sum of the radial inner widths of the press-fit structures corresponds to the outer circumference of the shank. This will ensure a uniform flow of material.

Notably, the width to spacing ratio of the press-fit structures is between 1:1 and 8:1, for example an angular relationship of 40° width to 5° spacing of the press-fit structures.

Preferably, the angle defined between the radial outer edge of the press-fit structure and the annular surface is less than 90°, in particular between 45° and 70°. As a result, less force will be required for press-fitting, and this in turn will minimize any adverse effects on the sheet metal material.

Considered particularly advantageous is a contour line of the press-fit structures in a radial direction which – at a distance from the shank – rises in a first flank and then transitions into a second flank which has a smaller gradient than the first flank, and then slopes down at an inclination which is steeper than the gradient of the first flank. Providing a flatter apex which transitions into an arch will result in considerably lower production costs. The radial inner first flank may preferably extend at an angle of approx. 25° to 30° with respect to the annular surface. Notably, an angle of 28° will yield ideal flow behaviour of the material in the direction of the shank.

In their radial extension, the press-fit structures take up to 75%, in particular between 50% and 75%, of the radial extension of the annular surface. In this area, adjustments may be made with a view to the pull-out resistance to be achieved.

In particular, a surface ratio of cam surface to annular surface of 1:1 can be achieved.

Notably, a structure height of about 50% of the sheet metal thickness can be obtained, with the sheet thickness typically varying between 0.5 mm and 4 mm.

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

Throughout the description, the claims and the drawings, those terms and associated reference signs are used as are listed in the List of Reference Signs below. In the drawings,

Fig. 1 is a top view of a press-fit bolt;

Fig. 2 is a lateral view of a press-fit bolt;

Fig. 3 is a partial sectional view of an enlarged detail of Fig. 2; and

Fig. 4 is a perspective view of a press-fit screw.

Fig. 1 is a top view of a press-fit bolt 10 which is pressed into a prepunched sheet metal part. The press-fit bolt 10 which includes a shank 12 and a head portion 14 is pressed into said sheet metal part with its annular surface 16 facing the sheet metal part. Pressed-in raised structures 18 are provided on the annular surface 16. These structures 18 are segment-like projections integrally formed and evenly distributed circumferentially on the annular surface 16. The pressed-in structures 18 are of a width of an angle α, which – in the present embodiment – amounts to approx. 40°, and are evenly disposed circumferentially at a spacing of an angle β, which – in the present embodiment – corresponds to an angle of approx. 5°. In a radial extension r, the pressed-in structures 18 are spaced from the shank 12 and, in a radial direction, they take up approx. 70% of the annular surface 16. As is shown in Fig. 1, the pressed-in structures 18, which are to be pressed into a sheet metal part, are spaced at a distance A from the outer edge of the annular surface 16, and at a distance l from the shank 12. This spacing has been chosen such that the volume displaced by the pressed-in structures 18 can be accommodated between the shank 12 and the pressed-in structures 18.

Fig. 2 is a lateral view of said press-fit bolt 10. The head portion 14, which includes a flat annular surface 16 at plane N, is provided with raised pressed-in structures 18. As is shown in Fig. 2, the shank 12 of the pressed-in bolt 10 has a thread 17, for example an M6 thread.

Fig. 3 is an enlarged view of a detail designated by X in Fig. 2. Fig. 3 is a partial sectional view illustrating a pressed-in structure 18 in cross-section. This view shows that the flank of the radial inner area defines a gradient angle γ with plane N of the annular surface. Gradient angle γ is preferably 28° since this angle results in ideal flow behaviour of the displaced material during the press-fit operation. The downward inclination δ which encloses the radial outer flank with the plane of the annular surface 16, amounts to approx. 50°. Owing to the steeper outer flank angle, the resulting material flow will be directed towards the radial inner area during the forming process. The material will thus flow to the thread run-out 19 where – in the inner area between the inner edge and the shank 12 - the displaced material will be act to stabilize the press-fit bolt 10 in position. This ensures maximum pull-out resistance of the bolt with respect to the component.

Fig. 4 is a perspective view of a press-fit screw 20 according to the invention. The screw 20 comprises a threaded shank 22 and a head portion 24. The head portion 24 furthermore includes an annular surface 26 which faces a sheet metal part. Evenly distributed circumferentially along this annular surface 26 and evenly spaced radially from each other are eight pressed-in structures 28. These press-fit structures 28 are trapezoidal in cross-section, with the angle of the inner leg being smaller than the angle of the outer leg. The radial inner boundary of the pressed-in structure 28 is defined by a secant of the circular segment. The sum of the widths B of the pressed-in structures 28 corresponds to the outer diameter d_A of the threaded shank 22. The end of the threaded shank 22 which faces the head portion 24 terminates in a conical shape, thus forming an undercut which is evenly filled by the material displaced by the pressed-in structures during the press-fit operation.

The geometry of the pressed-in structures illustrated in the description of the drawings yields a pull-out resistance which is considerably improved over that of the prior art.

715071/DO

SZABADALMI IGÉNYPONTOK

PRÉSCSAVAR (PRESS-FIT) CSAVAR

1. Préscsavar (10, 20) egy előlyukasztott lemezrészbe való bepréseléshez, egy fejrésszel (14, 24) és egy szárrésszel (12, 22), amely a fejrész (14, 24) egy a lemezrésszel határos gyűrűfelületet (16, 26) tartalmaz, továbbá van a fejrésznek (14, 24) legalább két kiemelkedő préseleme (18, 28) van, amely préselemek (18, 28) a szártól (12, 22) és a gyűrűfelület (16, 26) sugárirányú külső peremétől egy távolságra van elhelyezve, azzal jellemezve, hogy a préselemnek (18, 28) egy kontúrvonalat határoz meg, amely a gyűrűfelületből (16,26) kiindulóan sugár irányba a szártól (12, 22) távolodva egy első emelkedéssel (γ) emelkedik és egy ereszkedéssel (δ) tovább futva újra a gyűrűfelülethez (16, 26) ér vissza, ahol az első emelkedés (γ) kisebb, mint az ereszkedéssel (δ).

2. Az 1. igénypont szerinti préscsavar (10, 20) azzal jellemezve, hogy az első emelkedés (γ) és az ereszkedés (δ) között egy, az első emelkedésnél kisebb második emelkedés van.

3. Az előző igénypontok szerinti préscsavar (10, 20), azzal jellemezve, hogy a préselemek (18, 28) kerületi irányba szegmensenként körülhatároltak.

4. Az előző igénypontok szerinti préscsavar (10, 20), azzal jellemezve, hogy a préselemek (18, 28) a gyűrűfelület (16, 26) kerületén egyenletesen vannak elosztva.

5. Az előző igénypontok szerinti préscsavar (10, 20), azzal jellemezve, hogy két szomszédos préselem (18, 28) egymás között egy 5°-os szöget zár be.

6. A 3. vagy a 4. igénypont szerinti préscsavar (10, 20), azzal jellemezve, hogy két szomszédos préselem (18, 28) egy 5°-os szöget zár be és a préselemek (18, 28) egy 40°-os szegmenst határoznak meg.

7. Az előző igénypontok szerinti préscsavar (10, 20), azzal jellemezve, hogy a préselemek sugár irányú kiterjedése a gyűrűfelület sugár irányú kiterjedésének 50% -75%-a.

8. Az előző igénypontok szerinti préscsavar (10, 20), azzal jellemezve, hogy az első emelkedés szöge (γ) 25°és 30° közötti tartományban van.

9. Az előző igénypontok szerinti préscsavar (10, 20), azzal jellemezve, hogy az első ereszkedés szöge (δ) 45-70% közötti tartományban van.

10. Az előző igénypontok szerinti préscsavar (10, 20), azzal jellemezve, hogy a préselemek (18, 28) vastagságainak (B) összege kiadja a szár kerületét.

A meghatalmazott:

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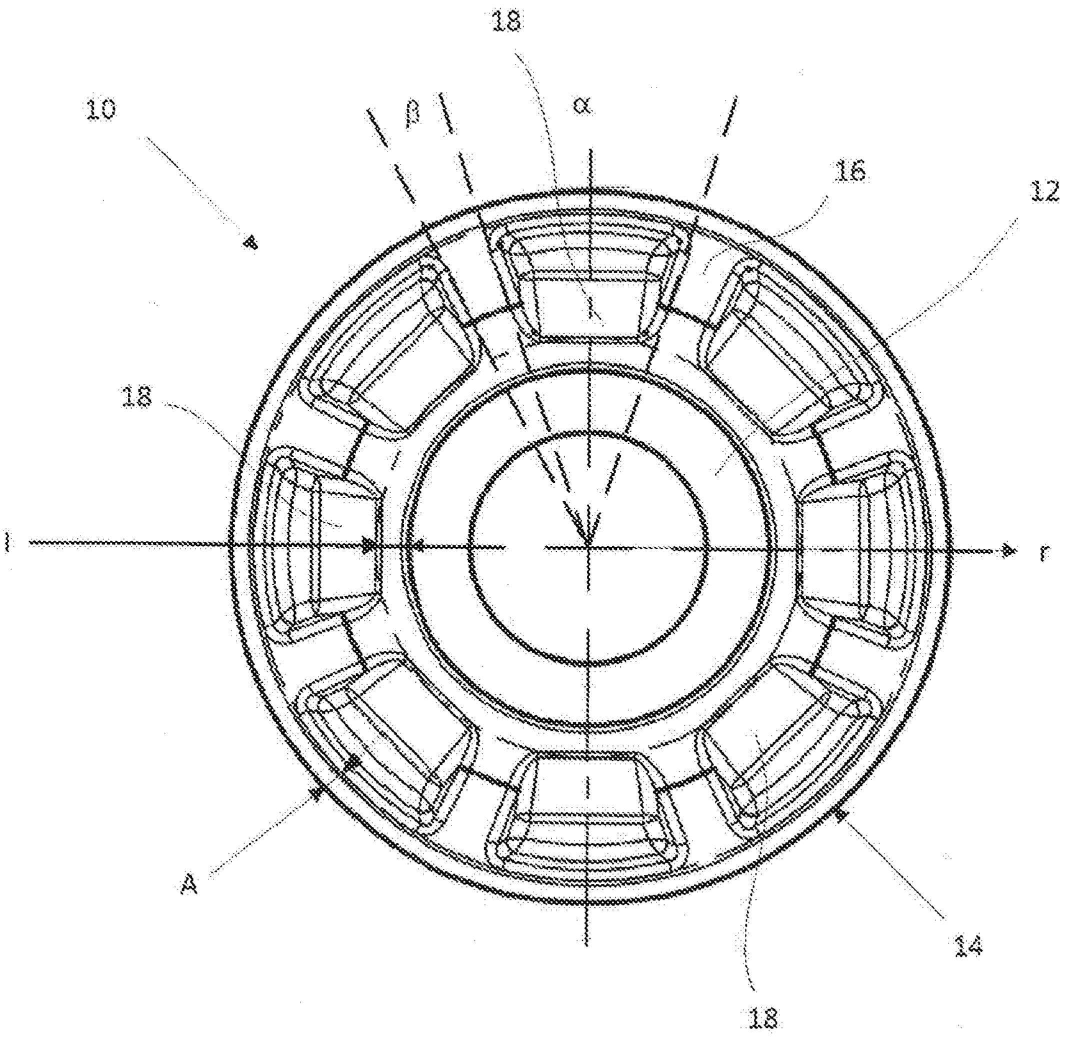

Fig. 1

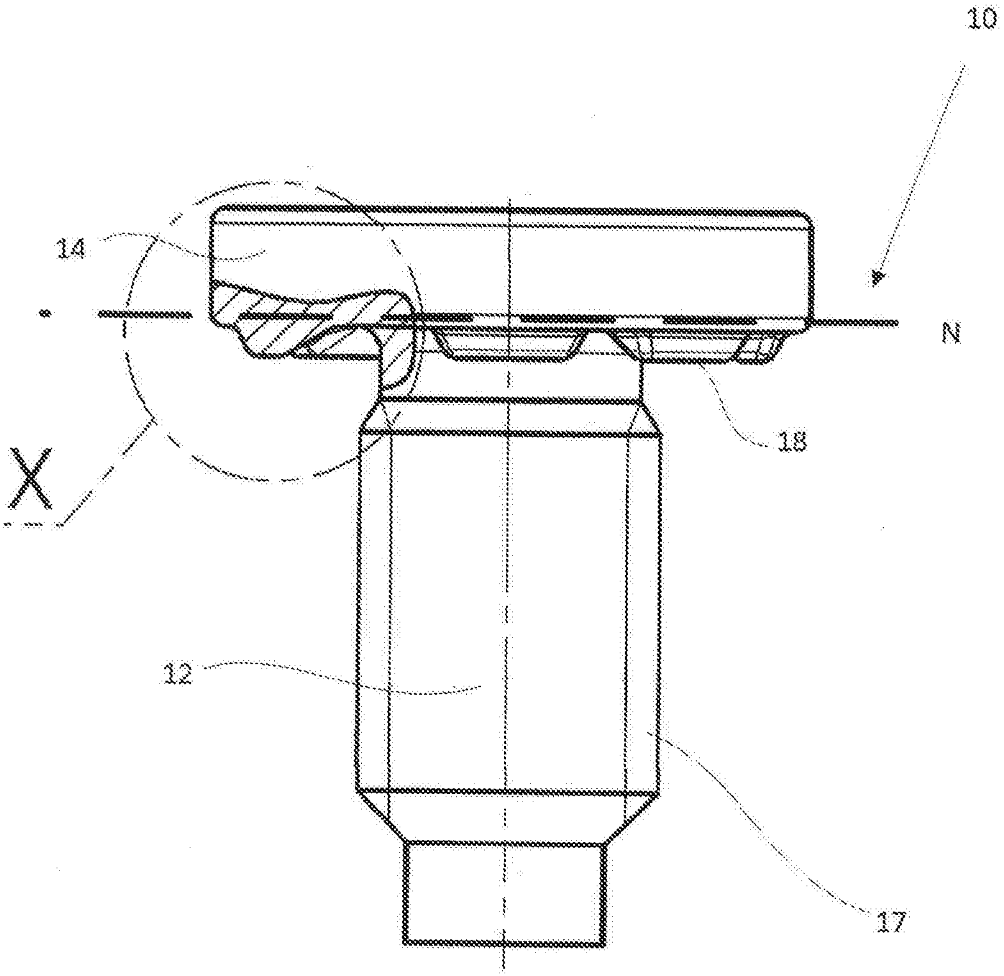

Fig. 2

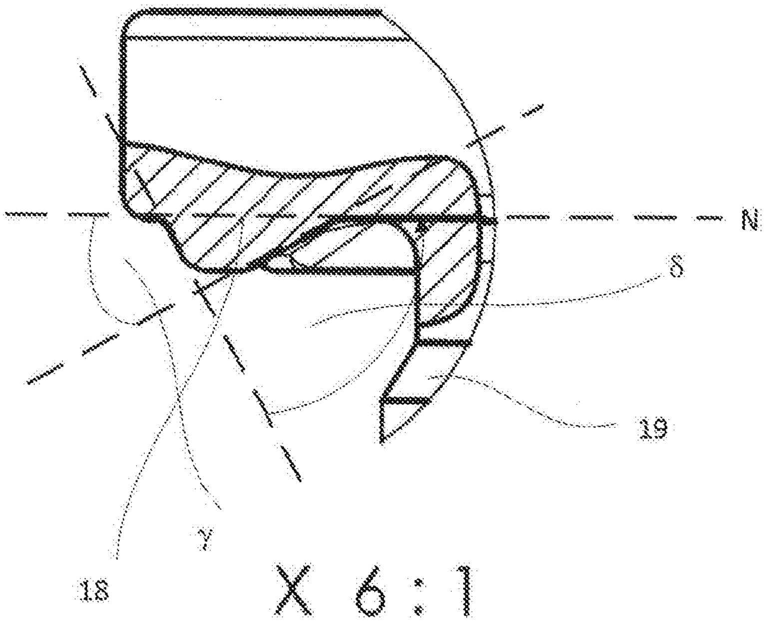

Fig. 3

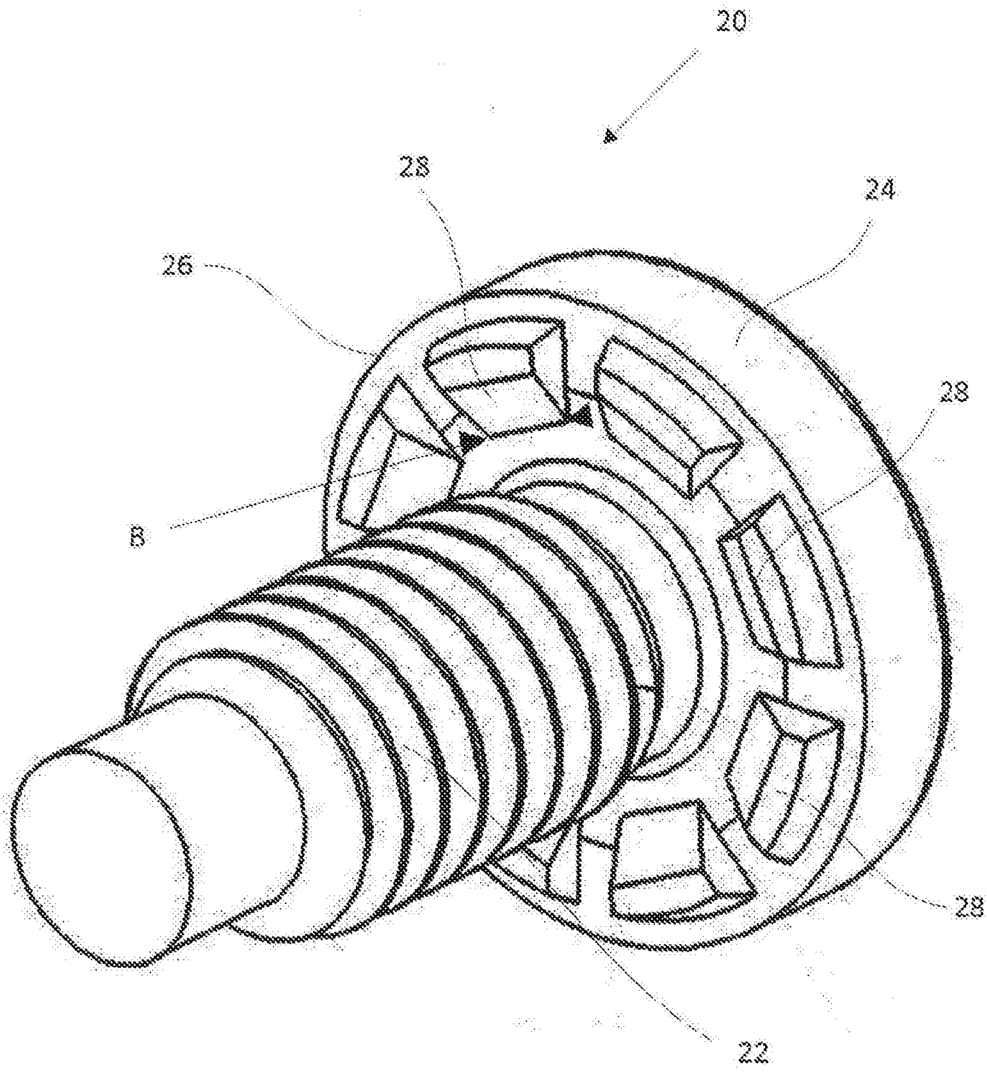

Fig. 4