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(54) **Method for cold forging high strength fastener from austenitic 300 series material**

Verfahren zum Kaltschmieden eines hochfesten Befestigungsteils aus austenitischem Serie-300-Material

Procédé pour le forgeage à froid d'un fixateur grande résistance d'un matériau austénitique de la série 300

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JP-A- 4 219 512 **US-A- 6 017 274**

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a method of forming a metal fastener, in particular a method for cold forging high strength fastener with austenitic 300 series material.

2. Description of the Related Art

[0002] Referring to Fig. 1 and 2, a conventional method 1 of manufacturing a fastener comprises a sequence of procedures, which include a procedure of preparation **11,** a procedure of head formation **12,** a procedure of drill point formation **13,** a procedure of threads formation **14** and a procedure of heat treatment **15;** wherein, a raw shaft **21,** made of the austenitic 302 or 304 stainless steel, is initially arranged in the preparation **11** and provides with a first diameter "**d**" for instance the specification of #12 (approximately of 5.5 mm) and a maximum shearing force approached 2630 pounds. Further, the raw shaft **21** respectively forms a head **23** and a shank **24** extended therefrom and thereafter forms a drilling portion **25** disposed reverse to the head **23** by the formation procedures **12** and **13.** Still, a plurality of threads **26** are sequentially convolved on the shank **24** by a thread roller machine, thus obtaining a preliminary fastener. Ultimately, the fastener is susceptible of carburizing and quenching inside a heat furnace for altering the molecular arrangement thereof and is also coated with a carburized layer 27 thereon for increasing the hardness thereof. The above apparatuses here are omitted in Figures.

[0003] However, the conventional method may have some disadvantages: 1. Higher manufacturing cost and more procedures

[0004] Although the integral fastener includes higher strength than the raw shaft through the concatenating procedures of formations, the fastener still requires the heat treating procedure to enhance its case hardness, so that the fastener can be smoothly drilled into objects. Additionally, the fastener would facilely become rusty and corrosive by the carburized layer and the additional process for corrosion resistance is necessary, whereby the conventional method results of increasing the cost and adding more excess manufacturing procedures.

2. Descending the quality of the fastener

[0005] The procedure of heat treatment may assist the fastener to increase its case hardness but may negatively soften its core hardness susceptible of the high temperature in carburizing and quenching, thus decreasing the elongation of the fastener to result in the broken thereof or difficultly drilling the fastener into objects. Therefore, it would affect the screwing security.

[0006] Document GB-A-2 025 810, which is considered as being the closest prior art, discloses a method for cold forging high strength fastener with austenite 300 series material comprising the steps of:

a head formation for forming a screw head at one end of an austenite 300 series shank;
a drill point formation for forging a drill portion at the other end of said shank, opposite to said screw head; and
a thread formation for continuously rolling a plurality of screw threads between said head and said drilling portion, hence an integral fastener is accomplished.

SUMMARY OF THE INVENTION

[0007] The object of the present invention is to provide a method for cold forging high strength fastener with austenitic 300 series material which facilitates to achieve a high strength and an effective corrosion resistance, simultaneously to obtain a rapid manufacture, a lower manufacturing cost and the using security.

[0008] The method in accordance with the present invention comprises in sequence a procedure of preparation, a procedure of head formation, a procedure of drill point formation, and a procedure of thread formation. That is, preparing an austenitic raw shaft and reducing its diameter by cold forging so as to generate a preliminary shank, which can bear above 1/2 force more than the raw shaft; further passing through the formation procedures in sequence to build an integral fastener. In this manner, the entire cold forging work facilitates to fabricate the integral fastener with high strength and harness without any additional heating procedures, thus decreasing the manufacturing cost and process; moreover, the fastener has a better elongation to avoid being broken while screwing so as to increase the screwing security.

[0009] The advantages of the present invention over the known prior art will become more apparent to those of ordinary skilled in the art upon reading the following descriptions in junction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1	is a flow diagram showing a conventional method of manufacturing a stainless fastener;
Fig. 2	is a schematic view showing the conventional procedures;
Fig. 3	is a flow diagram showing a first preferred embodiment of the present invention;
Fig. 4	is a schematic view for showing the procedures of Fig. 3;
Figs. 5a and 5b	respective indicate the torque range in the experiment relating to the torque value and the angle;
Fig. 6	is a flow diagram showing a second preferred embodiment of the present invention; and
Fig. 7	is a schematic view shown an integral fastener of Fig. 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Before the present invention is described in greater detail, it should be noted that the like elements are denoted by the same reference numerals throughout the disclosure.

[0012] Referring to Fig. **3** and **4,** a method **3** of a first preferred embodiment for cold forging a high strength fastener comprises the steps of a process of preparation **31** for preparing a raw shaft **41** having a first diameter "**d1**" fabricated of austenitic 300 series material, for instance of 302 or 304 stainless steel, and the raw shaft **41** is initially squeezed by cold forging for reducing above 15% of the first diameter "**d1**" and a preliminary shank **42** with a second diameter "**d2**" is hence generated. Assumed that the second diameter "**d2**" is measured of 5.5mm, and the first diameter should be predetermined at least of 6.325mm, so that the second diameter "**d2**" smaller than the first diameter "**d1**" assists the shank **42** to undertake in excess of 1/2 force to the raw shaft **41,** namely the shank **42** is subjected to the maximum shearing force of 4065.25 pounds, extremely larger than the conventional method (2630 pounds).

[0013] Still further, the preliminary shank **42** forms a screw head **43** at one end thereof through a procedure of head formation **32** and the head **43** has a third diameter **"d3"** greater than the second diameter **"d2"** of the shank **42.** In a procedure of drill point formation **33,** a drilling portion **44** is thereafter cold forged at the other end of the shank **42,** reverse to the head **43,** so as to increase the hardness of the drilling portion **44.** Further at a procedure of thread formation **34,** a plurality of screw threads **45** are convolved on the shank **42** by a thread roller machine (not shown), hence an integral fastener **4** is accomplished. The fastener **4** increases its case hardness and strength by passing from the cold forging of the preparation **31,** thence to the head and the drill point formation **32, 33,** and then to the thread forming formation **34** to impart multiple squeezing forces to the shank **42.** Furthermore, the integral fastener **4** can additionally experience a procedure of whitening **35** for cleaning the remnants on the outer surface thereof, thereby retrieving primary colors of the raw austenitic 300 series materials and maintaining a bright appearance.

[0014] Moreover, the fastener **4** has been previously tested in different areas and provides with some experimental statistics as presented in tabled below:

(1) For utilized in construction industry

[0015] 8 random samples of fasteners made by the present invention and providing with the specification of #12×35 are adopted in the experiment and here the table 1 shows the numerals relative to the hardness, torque, shearing force and loading weight while in screwing: (Referring to Fig. 5a and 5b)

TABLE 1

CHARACTERISTICS	RESULTS	REFERENCE
Surface Hardness-Thread	402~423 HV0.3	
Surface Hardness-Drill Point	395~432 HV0.3	
Torsional Strength	124.15~124.28in.lb (Maximum value)	Equating with 143.08~143.20kg.cm (metric system)
Shearing Force	4065.25 pounds	
Loading Weight	6045 pounds	

(2) For utilized in automotive industry

[0016] 8 random samples of fasteners made by the present invention and providing with the specification of M8×1.25×32mm are adopted in the experiment and here the table 2 shows the practical numerals by comparing to the standard level:

Table 2

CHARATERISTICS	RESULTS	STANDARD VALUE
Core Hardness	37-38 HRC	33-39 HRC
Axial Tensile Strength	124-125kg/mm2	110 Min.kg/mm2
Elongation	12-14%	10 MIN.%

[0017] In view of the austenitic 300 series materials devoid of the enough strength, the standard value of TABLE 2 is defined according to the value of the fasteners fabricated of iron materials. From the table 2, the elongation and the axial tensile strength of the present invention obviously exceeds the standard level except for the core hardness being located within the range of the level, which indicates the fastener can be well adapted to the automotive demand. Those numerals of the two charts indicate that the present invention is adapted to the relative fields and provides with high hardness and high strength.

(3) Inspection on Corrosion Test

[0018] Further, the experiment carries out both Salt Spray Test and Kesternich Test procedure per DIN 50018 for corrosion tests, and the results indicate that the fastener does not appear patches of rust and corrosion thereon. Therefore, the fastener of the present invention substantially achieves a better corrosion resistance.

[0019] Referring to Fig. **6,** a second preferred embodiment of the present invention still comprises the same procedures of preparation **31**, the head formation **32,** the drill point formation **33** and threads formation **34.** Particularly, a procedure of corrosion resistance **36** can be carried out after the threads forming procedure **34** depend on the market demand in order to coat with a rust-resistant layer **46** (as shown in Fig. 7) on an outer surface of the integral fastener **4** for achieving superior corrosion protection.

[0020] In view of the above descriptions, the present invention has following advantages:

1. Higher strength without proceeding heat treatment
By means of the procedure of preparation, the raw shaft is initially squeezed by cold forging to generate a preliminary shank with a smaller diameter, which results of the shank providing with higher density and strength for bearing above 1/2 force greater than the raw shaft. The subsequent procedures of formations also experience the conformity forging method with the initially process so as to avoid breaking the molecular arrangements of the austenitic materials and simultaneous reinforce the strength and hardness for the fastener to be firmly drilled into the objects.

2. Effective corrosion resistance and more screwing security
Due to that the fastener is not susceptible of the carburizing and quenching, the present invention is conducive to raise the producing speed and reduce the manufacturing cost. Additionally, the core and case hardness of the fastener would not be influenced while being devoid of the heat treatment procedure and the fastener would increase its corrosion resistance without being carburized, hence the present invention can have better elongation to prevent an unintentional broken, increase the screwing security and achieve better corrosion resisting effect.

[0021] To sum up, the present invention takes advantage of cold forging for initially preparing a preliminary shank with higher core and case hardness and subsequently passing through the head, the drilling portion and threads formations to generate the integral fastener with high strength and hardness. In this manner, the present invention deviates from the conventional heat treatment, which facilitates to decrease the manufacturing cost, improve the corrosion situation and simultaneously enhance the screwing security.

[0022] While we have shown and described the embodiment in accordance with the present invention, it should be clear to those skilled in the art that further embodiments may be made without departing from the scope of the present invention as defined by the appended claims.

Claims

1. A method (3) for cold forging high strength fastener with austenite 300 series material comprising the steps of:

    a preparation (31) for preparing a raw austenite 300 series shaft (41) having a first diameter (d1) which is initially squeezed by cold forging for reducing above 15% of said first diameter (d1) and hence generating a preliminary shank (42) with a second diameter (d2) smaller than said first diameter, thus said shank (42) being provided with higher density and strength for bearing above 1/2 force greater than said raw shaft (41);
    a head formation (32) for forming a screw head (43) at one end of said shank (42);
    a drill point formation (33) for forging a drill portion (44) at the other end of said shank (42), opposite to said screw head (43); and
    a thread formation (34) for continuously rolling a plurality of screw threads (45) between said head (43) and said drilling portion (44), hence an integral fastener (4) is accomplished.

2. The method as claimed in claimed 1, wherein, a procedure of whitening (35) is subsequently proceeded after said procedure of thread formation (34) for retrieving primary color of said raw austenite 300 series materials.

3. The method as claimed in claimed 1, wherein, a procedure of corrosion resistance (36) is subsequently proceeded after said procedure of thread formation (34) in order to coat with a rust-resistant layer (46) on an outer surface of said integral fastener (4) for corrosion protection.

Patentansprüche

1. Eine Methode (3) enthält die Schritte für einen hohen starken Befestiger mit Austenit-300-Serie Material zu kaltschmieden:

    eine Vorbereitung (31), während der ein roher Schaft (41) mit Austenit-300-Serie Material und mit einem ersten Durchmesser (d1) vorbereitet wird; der erste Durchmesser (d1) wird durch der Kaltschmiede ursprünglich gequetscht, um ein Durchmesser über 15% kleiner als der erste Durchmesser zu verringern; deshalb ein einleitender Schaft (42) wird mit einem zweiten Durchmesser (d2) erzeugt, und der zweite Durchmesser (d2) ist kleiner als der erste Durchmesser (d1) ; daher kommt es, dass der Schaft (42) höheren Dichte und Festigkeit besitzt, um 1/2 größere Kraft als die des rohen Schafts (41) zu tragen;
    eine Kopfformation (32), während der ein Schraubenkopf (43) an einem Ende des Schaftes (42) geformt wird;
    eine Spitzeformation (33), während der ein Schraubenspitze (44) am anderen Ende des Schaftes (42) geformt wird, und der Schraubenspitze (44) befindet sich am entgegengesetzten Ende des Schraubenkopf (43), und
    eine Gewindeformation (34), während der viele Gewinde (45) zwischen den Kopf (43) und den Schraubenspitze (44) kontinuierlich und spiralig geformt werden; deshalb ein integraler Befestiger (4) ist erfüllt.

2. Die Methode nach Anspruch 1, **dadurch gekennzeichnet, dass** ein Verfahren des Bleichens (35) nachdem der Gewinderformation (34) genommen wird, da eine primäre Farbe des Austenit-300-Serie Materialen wiedererlangt wird.

3. Die Methode nach Anspruch 1, **dadurch** gezeichnet, dass, ein Verfahren der Korrosionsbeständigkeit (36) nachdem der Gewinderformation (34) genommen wird, da ein äußeres Oberfläche des integralen Befestigers (4) mit einer korrosionsbeständigen Schichte (46) überzieht, um der Korrosionsschutz zu erreichen.

Revendications

1. Procédé (3) pour le forgeage à froid d'un organe de fixation de haute résistance d'un matériau austénitique de la série 300, comprenant les étapes de :

    - préparation (31) pour préparer un arbre à l'état (41) en austénite de la série 300, ayant un premier diamètre (d1), qui est initialement pressé par forgeage à froid pour réduire ledit premier diamètre (d1) de plus de 15% et produire par conséquent une tige préliminaire (42) ayant un second diamètre (d2) plus petit que ledit premier diamètre, une densité et une résistance plus élevées étant ainsi communiquées à ladite tige (42) pour supporter une force supérieure de plus de ½ de celle dudit arbre à l'état brut (41) ;

- formation de tête (32) pour former une tête de vis (43) à une extrémité de ladite tige (42) ;
- formation de pointe de perçage (33) pour forger une partie de perçage (44) à l'autre extrémité de ladite tige (42), opposée à ladite tête de vis (43) ; et
- formation de filets (34) pour laminer en continu une pluralité de filetages de vis (45) entre ladite tête (43) et la partie de perçage (44), un organe de fixation d'un seul tenant (4) étant par conséquent obtenu.

2. Procédé selon la revendication 1, dans lequel une étape de blanchiment (35) est par la suite effectuée après ladite étape de formation de filets (34) pour revenir à la couleur primaire desdits matériaux austénitiques de la série 300 à l'état brut.

3. Procédé selon la revendication 1, dans lequel une étape de résistance à la corrosion (34) est par la suite effectuée après ladite étape de formation de filets (36) afin de déposer une couche résistant à la rouille (46) sur une surface externe dudit organe de fixation d'un seul tenant (4) pour une protection contre la corrosion.

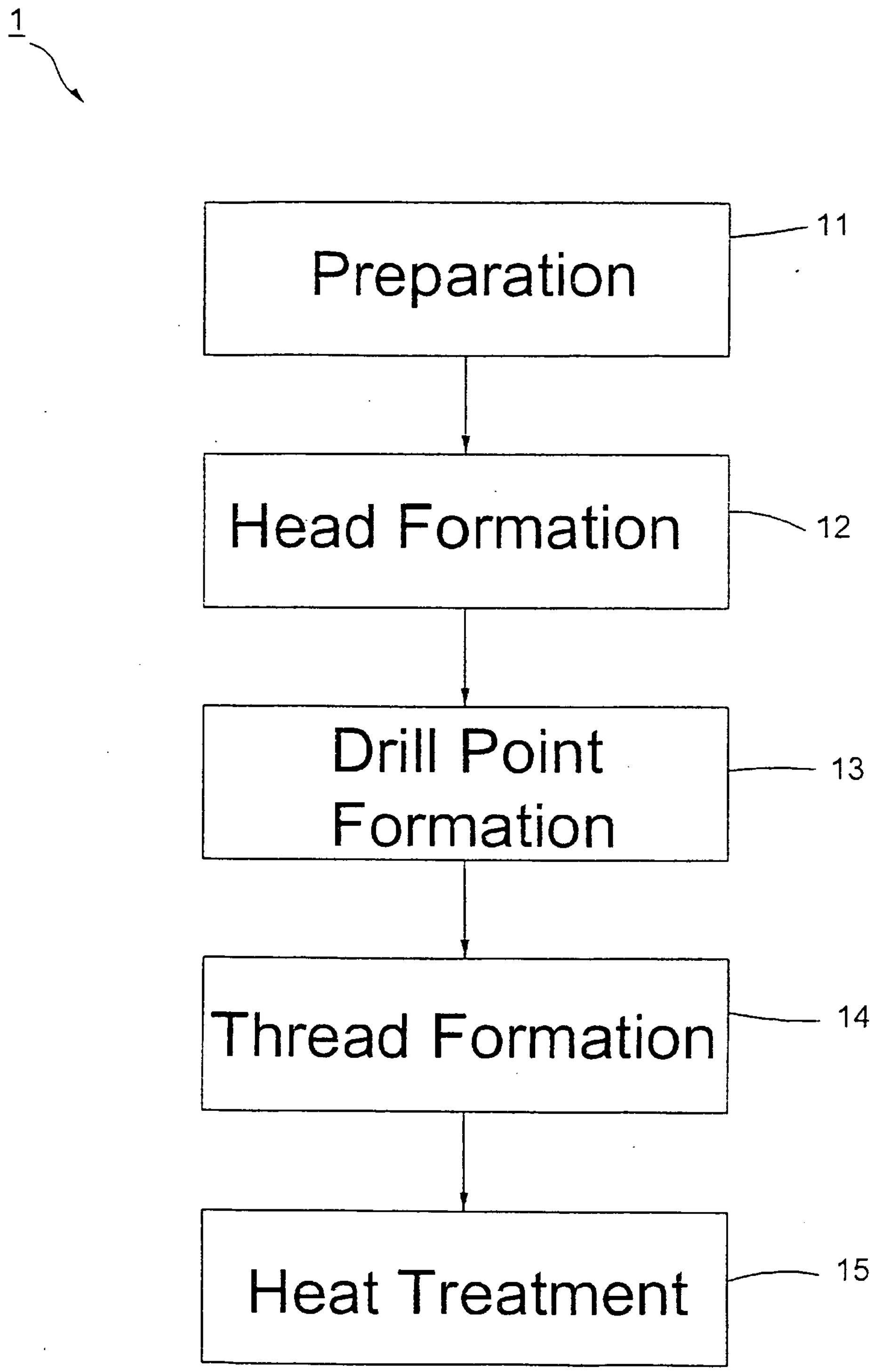

FIG. 1 (PRIOR ART)

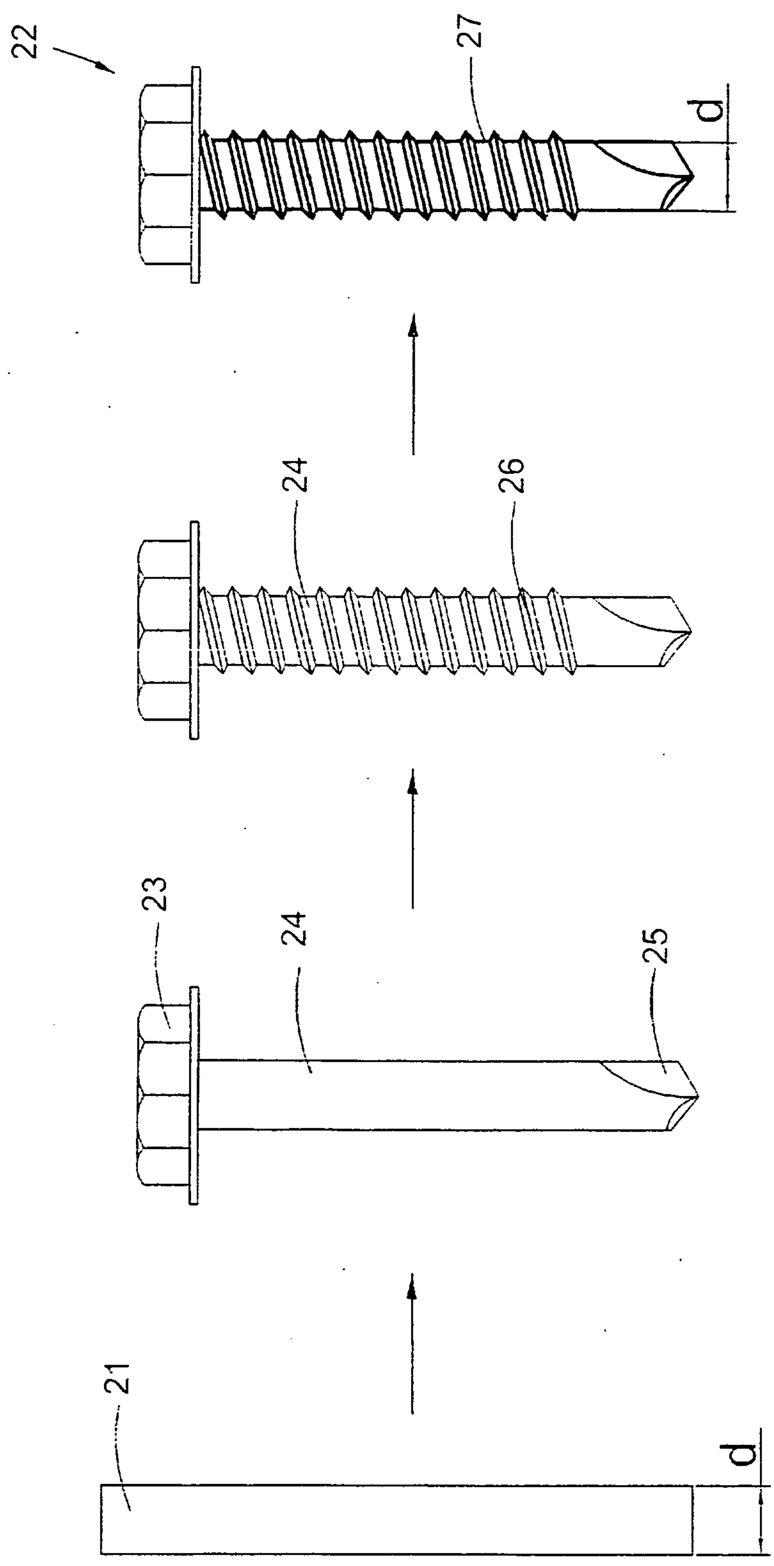

FIG. 2 (PRIOR ART)

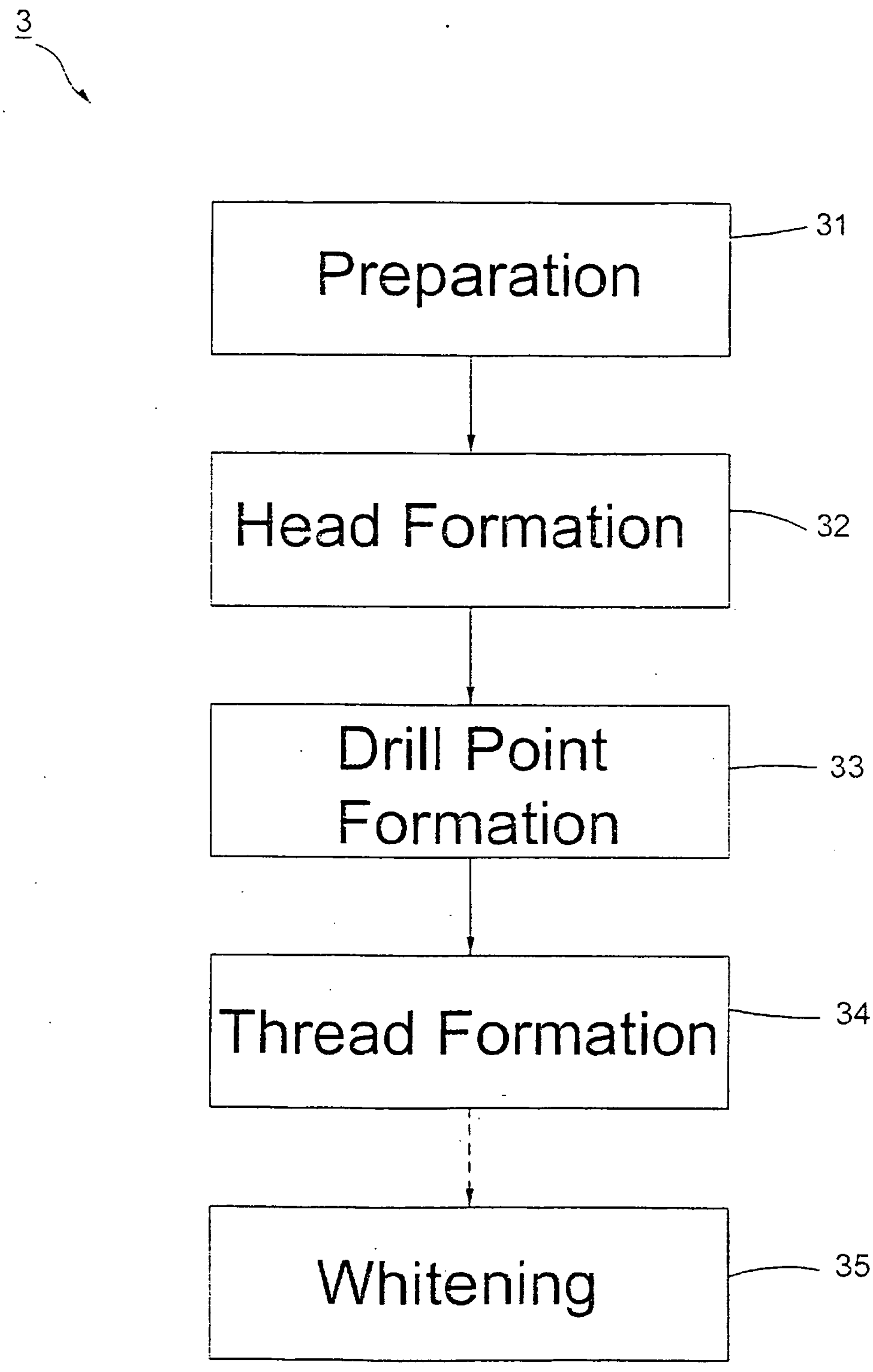
3
Preparation
31
Head Formation
32
Drill Point Formation
33
Thread Formation
34
Whitening
35

FIG. 3

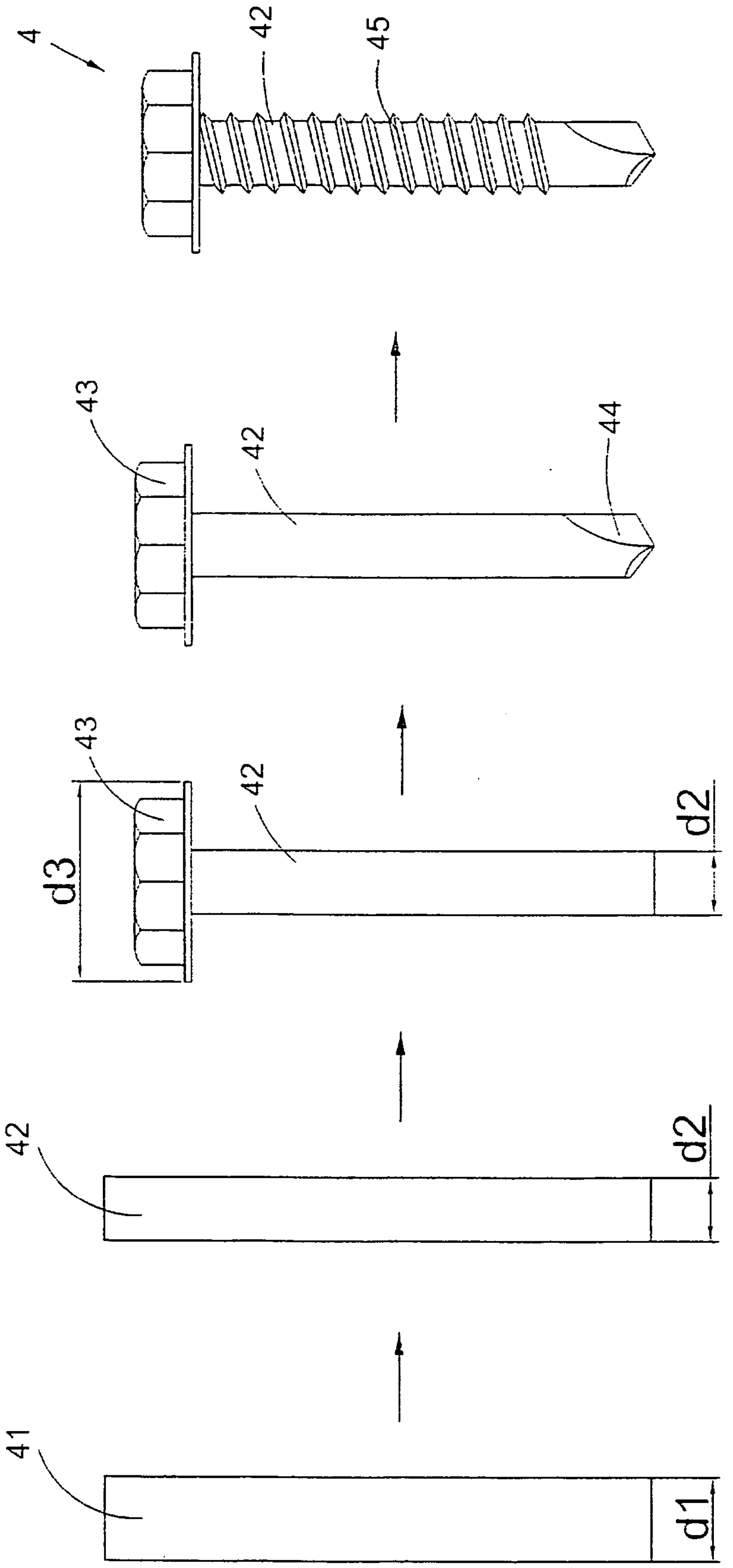

FIG. 4

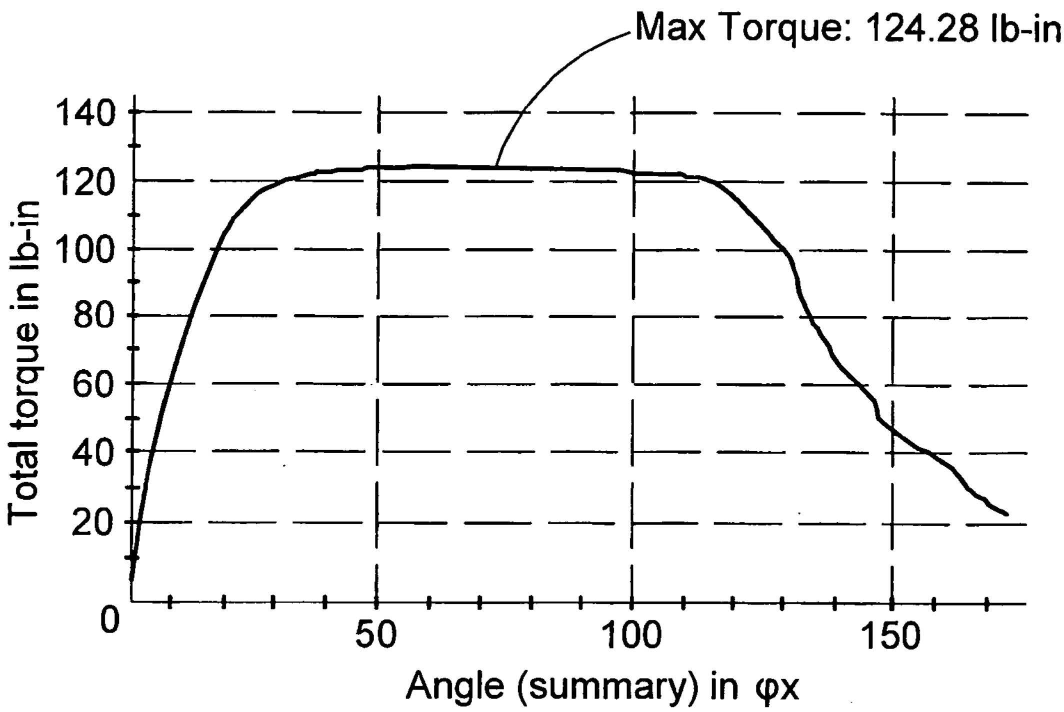
Max Torque: 124.28 lb-in
Total torque in lb-in
140
120
100
80
60
40
20
0
50
100
150
Angle (summary) in φx

FIG. 5a

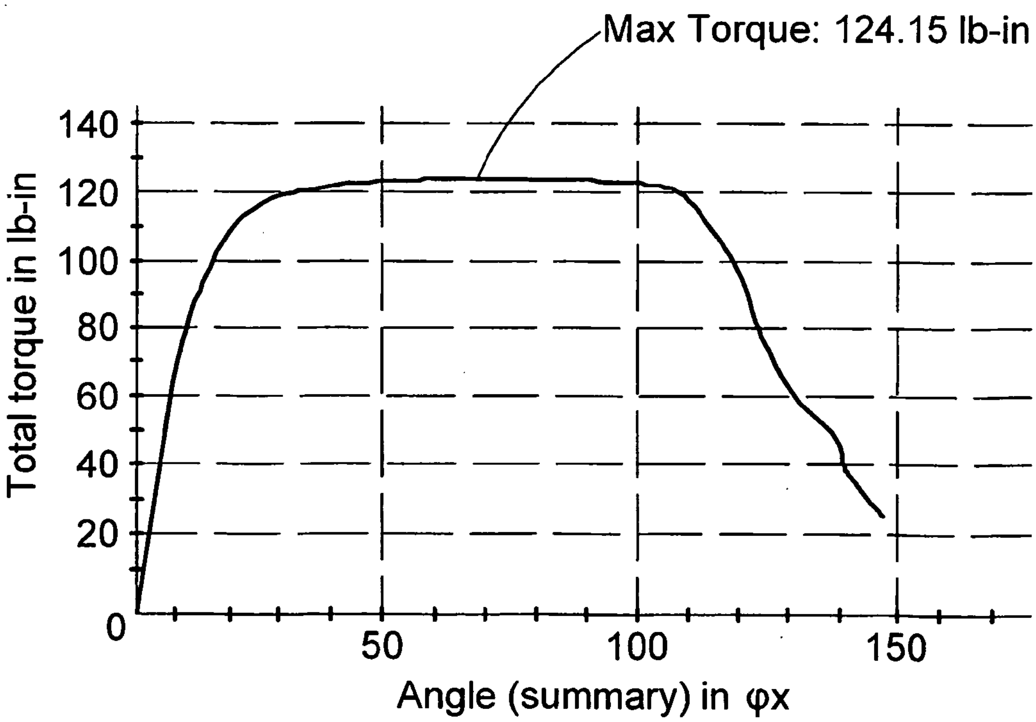
Max Torque: 124.15 lb-in
Total torque in lb-in
140
120
100
80
60
40
20
0
50
100
150
Angle (summary) in φx

FIG. 5b

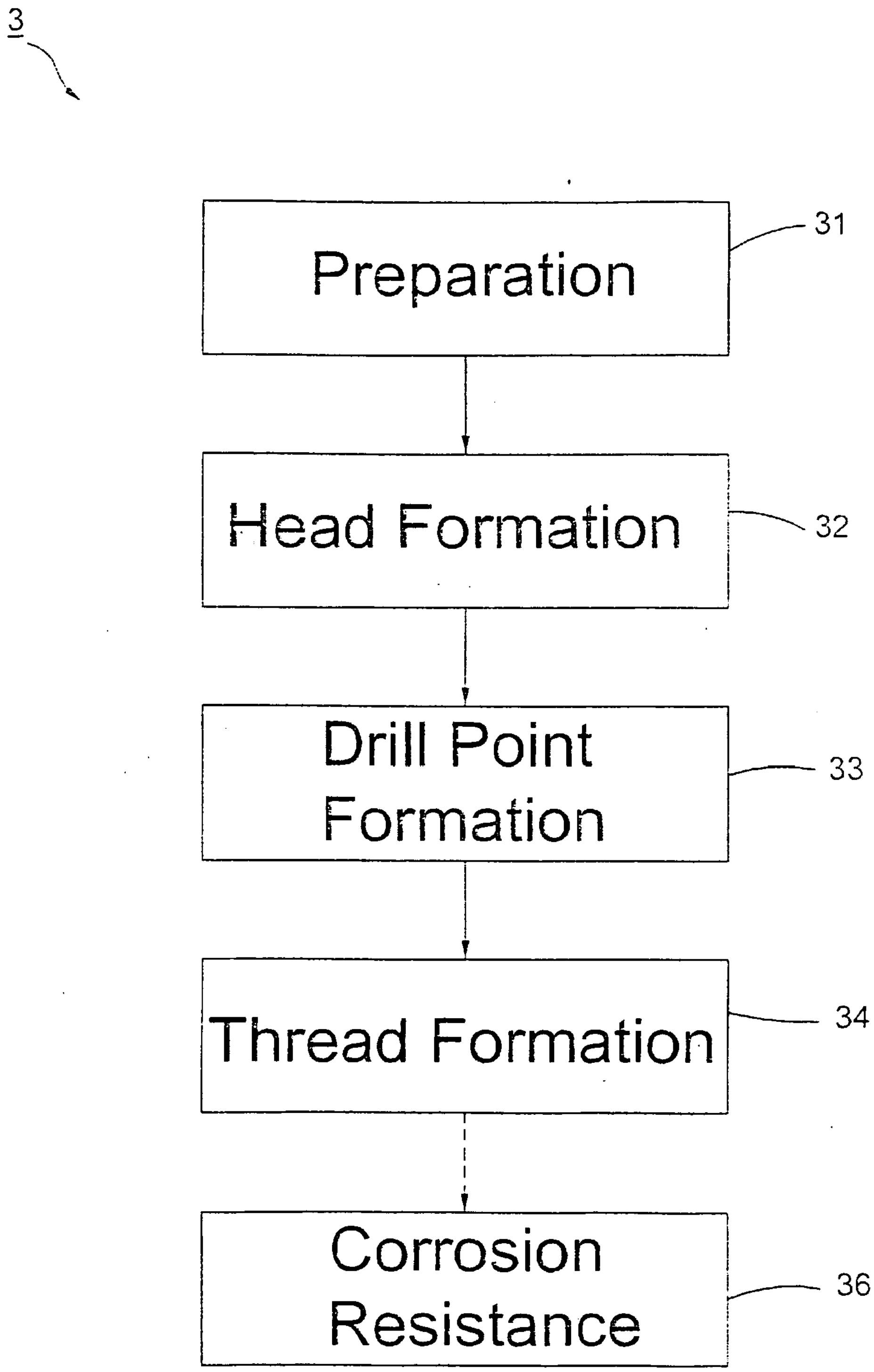
3
Preparation
31
Head Formation
32
Drill Point Formation
33
Thread Formation
34
Corrosion Resistance
36

FIG. 6

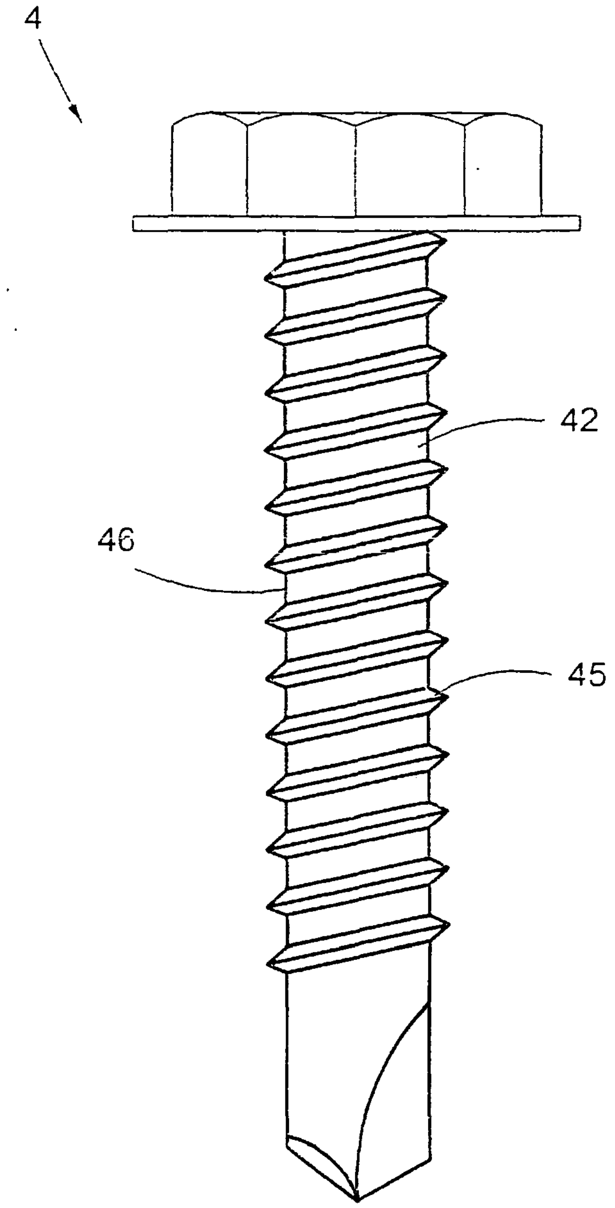

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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