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(56) Fremdragne publikationer:
**JP-A- 2011 021 690**
**US-A- 1 298 015**
**US-A- 3 478 638**

# DESCRIPTION

## BACKGROUND OF THE INVENTION

### <FIELD OF THE INVENTION>

**[0001]** The present invention relates to a fastening pin for a rigid member to be driven and a manufacturing method thereof. More specifically, the present invention relates to a fastening pin capable of fastening a thin steel sheet such as a bracket or a plate into the rigid member such as a concrete or a metal steel.

### <RELATED ART>

**[0002]** In a construction such as a building or in a civil engineering construction such as a bridge or a tunnel, a fastening member is driven by a tool using a driving source such as a compressed air, a combustion gas or a gunpowder, in order to fasten a thin steel sheet such as a bracket or a plate into a rigid member such as a concrete or a metal steel.

**[0003]** Patent Documents 1 to 3 disclose, as the fastening member, a concrete pin in which a head side of a shaft part is formed to have a large diameter and a leading end side thereof is formed to have a small diameter.

Patent Document 1: EP2085624

Patent Document 1: US6171042

Patent Document 1: JP-A-2008-051153

**[0004]** However, since a rigid concrete is utilized in a high strength construction and the conventional concrete pin is provided at its middle part with a large step or a taper angle of its head part side is set too large, a driving resistance increases and thus a portion below the head part is liable to be flexed. As a result, a poor driving is frequently occurred. Further, in the recent, strength of the construction is gradually increased, a rebuilding construction of a concrete building tends to be increased, and the strength of the concrete is increased due to material age thereof. Accordingly, a pin which can be driven into more rigid member is strongly demanded. Of course, when a pin is driven into a rigid member having strength over substantially 60 $N/mm^2$, a tool with sufficient power is necessary. In this case, from the viewpoint of workability due to a size of a driving tool itself, it is necessary to reduce a penetration resistance for the rigid member when being driven and to retain the fastening force

(retaining force of the pin) for the rigid member after being driven.

**[0005]** When the concrete pin is driven into the rigid member, the pin is driven and penetrated substantially perpendicular to the rigid member. However, since the rigid member is used as a member to be driven, the shaft part and the under-head part directly below the head part are required for high strength. If the strength is insufficient, the shaft part is liable to be flexed or the under-head part is liable to be bent, thereby hindering a fastening operation. If a pin with a step is to be employed for corresponding to very rigid concrete such as ultra high strength concrete which is recently developed and practically used, it is necessary to increase a shaft diameter to improve the strength. As a result, the penetration resistance is increased and thus a tool with sufficient power is necessary.

**[0006]** Further, it is not easy to manufacture a concrete pin in which entire shaft part is formed in a taper shape or the under-head part is formed in a rounded shape. Also, a pin having a large shaft diameter can afford a high strength but this pin is expensive. When a fastening pin having a large shaft diameter is used in order to afford high strength, an outer diameter of a metal rod member used as a material also becomes large. Accordingly, there is a problem that the manufacturing cost becomes expensive. US 3 478 638 discloses a fastening pin according to the features of the preamble of claim 1.

## SUMMARY OF THE INVENTION

**[0007]** While the invention is defined in the independent claims, further aspects of the invention are set forth in the dependent claims, the drawings and the following description.

**[0008]** One or more embodiments of the invention relate to a fastening pin capable of being effectively driven into a rigid member to be driven without being flexed when being driven.

**[0009]** In addition, one or more embodiments of the invention relate to a manufacturing method of the fastening pin capable of increasing a diameter of the fastening pin over a diameter of a metal rod member used as a material even without increasing the diameter of the metal rod member.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0010]**

FIG. 1 is a front view illustrating a concrete pin according to an embodiment.

FIG. 2 is a perspective view illustrating the concrete pin in a state where being driven into a rigid concrete.

FIG. 3 is a perspective view illustrating a concrete pin according to another embodiment.

FIGS. 4 (a) to 4(c) are front views illustrating the concrete pins which are formed at its surface with grooves.

FIGS. 5 (a) and 5 (b) are views explaining a manufacturing method for forming an enlarged head part and a large diameter section of the concrete pin.

## DETAILED DESCRIPTION OF THE EMBODIMENTS

**[0011]** Hereinafter, embodiments of the invention will be described with reference to the drawings. The embodiments described herein are not intended to limit the invention but only to exemplify the invention, and all features or combinations of the features of the embodiments are not always essential to the invention.

**[0012]** In FIGS. 1 to 5, reference numeral A refers to a concrete pin. The concrete pin A is an example of a fastening pin and is used to fasten a thin iron plate into a rigid concrete having strength over 60 $N/mm^2$, for example. The concrete pin includes an enlarged head part 1 and a shaft part 2. The shaft part 2 is constituted by a large diameter section 2a below the enlarged head part 1, a middle shaft section 2b below the large diameter section 2a and a small diameter section 2c extending from the middle shaft section 2b to a bullet-shaped leading end thereof. The "bullet shape" is a shape such that a diameter of the shape gradually decreases toward a leading end at which the diameter is zero and a decrease ratio of the diameter gradually increases toward the leading end. Herein, an example of the size of the concrete pin A is dimensioned as follows. Entire length thereof is 19 mm, a diameter d of the enlarged head part 1 is 6.25 mm, an axial length (length from an under-head part to a leading end of the fastening pin) l of the shaft part 2 is 17.5 mm,. a length l1 of the large diameter section 2a is 6.5 mm, a length l2 of the middle shaft section 2b is 3.0 mm, a length l3 of the small diameter section 2c is 8.5 mm, and a diameter d1 of the middle shaft section 2b is 2.96 mm.

**[0013]** An under-head part 3 is provided below the enlarged head part 1 and provided at its outer surface with a round portion (curved portion) 4. The round portion 4 is set so large that the under-head part 3 is not to be flexed when the fastening pin is driven into the rigid member. In a case of the concrete pin A having the dimensions mentioned in the above, the round portion 4 of the under-head part 3 may be set with substantially R 1.5.

**[0014]** Next, the large diameter section 2a has a length greater than 1/3 of the axial length of the shaft part. The large diameter section 2a includes a taper portion 5 formed between the round portion 4 and the middle shaft section 2b so that the diameter of the under-head part 3 is larger than that of the middle shaft section. The taper portion 5 connects the round portion 4 of the under-head part 3 and the middle shaft section 2b and is adapted to cause a penetration

resistance for the rigid member to be reduced and keep a pullout resistance after the fastening pin is driven into the rigid member. And, the taper portion is configured so that the large diameter section 2a is not to be flexed when the fastening pin is driven into the rigid member. The taper portion 5 is tapered at an angle θ1 of 2 to 5 degree.

**[0015]** Herein, the middle shaft section 2b is a straight portion having uniform diameter.

**[0016]** Next, the small diameter section 2c is formed by a lower middle shaft portion 6 having a diameter smaller than that of the middle shaft section 2b, a lower taper portion 7 provided between the lower middle shaft portion 6 and the middle shaft section 2b, and a leading end portion 8 provided below the lower middle shaft portion 6. The lower taper portion 7 is tapered, for example, at an angle θ2 of 10 degree. The length of the leading end portion 8 is, for example, 5 mm and formed in a bullet shape.

**[0017]** In the above configuration, since the round portion 4 of the under-head part 3 of the concrete pin A is set to have a considerably large value of substantially R 1.5, the strength of the under-head part 3 and the large diameter section 2a is large, and a stress concentration on the under-head part 3 is alleviated and thus a bending strength of the under-head part 3 is improved. Further, when an operator hits the enlarged head part 1 while the fastening pin is driven into the rigid member, the enlarged head part 1 is not easily flexed.

**[0018]** Further, the large diameter section 2a has a length greater than 1/3 of the axial length of the shaft part and the large diameter section 2a includes a taper portion 5 with a taper angle of 2 to 5 degree formed between the under-head part 3 and the middle shaft section 2b so that the diameter of the under-head part 3 is larger than that of the middle shaft section. Accordingly, the strength of the under-head part 3 and the large diameter section 2a is increased, and a stress concentration on the large diameter section 2a is alleviated and thus a bending strength of the large diameter section 2a is improved. Further, when an operator hits the large diameter section 2a while the fastening pin is driven into the rigid concrete, the large diameter section 2a is not easily flexed.

**[0019]** Herein, when the taper angle θ1 of the taper portion 5 is smaller than 2 degree, a diameter in an upper area of the concrete pin A is not sufficiently large and a desired strength (bending strength) is not achieved. On the contrary, when the taper angle θ1 is larger than 5 degree, a penetration resistance is increased when the fastening pin is driven into the rigid member and a desired pullout resistance (retaining force) cannot be obtained after the fastening pin is driven into the rigid member. In addition, the taper angle is limited to 5 degree from the viewpoint of production technique (which will be described later).

**[0020]** Since the middle shaft section 2b is a straight portion having uniform diameter, a penetration resistance is not increased when the fastening pin is driven into the rigid member and a large pullout resistance can be obtained after the fastening pin is driven into the rigid member.

**[0021]** Further, the small diameter section 2c is formed by the lower middle shaft portion 6 having uniform diameter smaller than that of the middle shaft section 2b, the lower taper portion 7 provided between the lower middle shaft portion 6 and the middle shaft section 2b, and the leading end portion 8 provided below the lower middle shaft portion 6. Since the leading end portion 8 is formed in a bullet shape, a penetration resistance is reduced. Further, since the lower middle shaft portion 6 has uniform diameter, the penetration resistance is reduced and the pullout resistance is improved. In addition, since a diameter of the lower taper portion 7 provided between the lower middle shaft portion 6 and the middle shaft section 2b is gradually increased, it is possible to increase the strength of a region from an upper portion of the pin to the middle shaft section 2b. Herein, the reason for forming the lower middle shaft portion 6 to have uniform diameter is to achieve a desired pullout resistance after being driven. Further, the reason for setting the taper angle of the lower taper portion 7 in 10 degree is to reduce a diameter of the small diameter section 2c and thus to reduce penetration resistance into the concrete member.

**[0022]** As mentioned in the above, the under-head part 3 is formed with the round portion 5 and the large diameter section 2a includes a taper portion 5 formed between the round portion 4 and the middle shaft section 2b so that the diameter of the under-head part 3 is larger than that of the middle shaft section. Accordingly, the strength of the under-head part 3 and the large diameter section 2a is large, and a stress concentration on the large diameter section 2a or the under-head part 3 is alleviated and thus a bending strength of the large diameter section 2a or the under-head part 3 is improved. Further, when an operator hits the enlarged head part 1 while being driven into the rigid member, the enlarged head part 1 or the large diameter section 2a is not easily flexed.

**[0023]** Since the middle shaft section 2b is a straight portion having uniform diameter, a penetration resistance is not increased when the fastening pin is driven into the rigid member and a large pullout resistance can be obtained after the fastening pin is driven into the rigid member.

**[0024]** By the above configurations, as illustrated in FIG. 2, it is possible to securely fix a thin iron sheet C to the rigid concrete B by the concrete pin A. Herein, since the thin iron sheet C is relatively soft, the round portion 4 of the under-head part can be penetrated through the thin iron sheet. In addition, although not illustrated, the concrete pin A can be constituted as a connecting pin formed by connecting a plurality of pins using synthetic resin coupling material. In this case, when being driven into the rigid member, the concrete pin A is driven together with the coupling material divided from the other concrete pins. In this way, the round portion 4 is penetrated through the thin metal sheet and the coupling material D and thus the penetration resistance of the round portion 4 is increased. Accordingly, the round portion cannot penetrate through the concrete and thus a poor driving is not occurred.

**[0025]** The concrete pin A is not limited to the above embodiment. For example, as illustrated in FIG. 3, the large diameter section 2a may be formed in two stages. That is, the taper portion 5 constitutes a lower part of the large diameter section and a straight portion 9 with uniform

diameter constitutes an upper part thereof. In this case, the large diameter section 2a can secure a bending strength by the taper portion 5 and a retaining force after being driven can be maintained in a high level by the straight potion 9.

**[0026]** Further, the middle shaft section 2b can be made longer and directly connected to the bullet-shaped small diameter section 2c.

**[0027]** Further, in the respective embodiments, as illustrated in FIG.S 4 (a) to 4 (c), in order to increase the retaining force after being driven, knurling grooves 10 or oblique parallel grooves 11 may be formed on the surface of the shaft part. The same is applicable to the concrete pin illustrated in FIG. 3.

**[0028]** Herein, the large diameter section 2a in an upper part of the concrete pin A has a diameter larger than an outer diameter of the metal rod member (carbon steel wire) as a material of the concrete pin A by the taper portion 5. The taper portion thus configured can be processed and formed by two left and right dies 12 and a header punch 13, as illustrated in FIG. 5 (a).

**[0029]** That is, a space 16 consisting of an upper space 14 and a lower space 15 is provided between matching surfaces of the two left and right dies 12. The upper space 14 has an inner diameter larger than an outer diameter of a rod member 21 and is formed with a taper portion 5a and a round portion 4a so that the upper space has a width larger than the lower space. Further, the upper space is provided at its upper end with a circular concave portion 17. The lower space 15 has an inner diameter substantially equal to the outer diameter of the rod member 21. Herein, the upper end of the upper space 14 is open and a lower end of the lower space 15 is closed. In this case, although a lower die 18 can be fixedly provided on a lower side portion of the matching surface of the pair of dies 12 as illustrated in FIG. 4, it is also possible that the lower die 18 is provided on one or both of the two left and right dies 12 and closes the space 16 when the pair of dies 12 are mated to each other. The header punch 13 is arranged over the matching surface of the pair of dies 12 to move in a vertical direction. The header punch 13 is provided at its lower surface with a circular concave portion 20 corresponding to the enlarged head part 1 of the concrete pin A. Thereby, a space for the head part is formed between the circular concave portion 17 of the upper end in the matching surface of the dies 12 and the lower surface of the header punch 13 so as to correspond to the outer shape of the enlarged head part 1.

**[0030]** When the taper portion 5 in the upper part of the concrete pin A is formed by the dies thus configured, first, a metal rod member 21 (carbon steel wire) having a diameter equal to the diameter of the middle shaft section 2b is provided inside the space 16 of the pair of dies 12. At this time, an upper end of the rod member 21 is projected upward from the dies 12. And then, the pair of dies 12 are mated to each other to fix the rod member 21. Next, as illustrated in FIG. 5 (b), the header punch 13 is lowered to urge and crush the projected portion of the rod member. Thereby, the enlarged head part 1 is formed between the lower surface of the header punch 13 and the circular concave portion 17 of the dies 12. Simultaneously, when the upper

part of the rod member 21 is crushed, the rod member 21 is fixed inside of the space 16. At this time, since the upper space 14 has a diameter larger than the outer diameter of the rod member 21, a portion of the upper part of the rod member 21 is projected to correspond to the inner shape of the upper part of the space, thereby filling the round portion 4a and the taper portion 5a. In this way, the round portion 4 and the taper portion 5 are formed.

**[0031]** According to the manufacturing method for forming the taper portion mentioned in the above, the taper portion 5 having a diameter larger than the diameter of the rod member 21 can be rapidly and economically formed in the fastening pin without a specific processing.

**[0032]** When knurling grooves or oblique parallel grooves are formed on the surface of the concrete pin A, a concave and convex part may be formed in the space of the dies to correspond to each of the grooves.

**[0033]** As mentioned in the above, by driving and crushing the projected portion of the rod member 21 using the header punch 13, the upper part of the rod member 21 is projected along the matching surface of the middle shaft section 2b to form the taper portion 5. However, in this manufacturing method, the taper angle of the taper portion 5 is limited within 5 degree.

**[0034]** Herein, after the rod member 21 is processed as mentioned in the above, the small diameter section 2c of the lower part of the rod member 21 can be processed in a conventional way.

**[0035]** As mentioned in the above, the large diameter section 2a of the concrete pin A has a diameter larger than an outer diameter of the metal rod member 21 used as a material by the taper portion 5. However, since the taper portion 5 is formed by axially urging and crushing the upper part of the metal rod member 21 using the header punch 13 to cause the upper part to be projected outward, it is not necessary to use the metal rod member 21 having a diameter equal to a diameter of the upper end of the taper portion 5. Accordingly, it is possible to simplify the manufacturing process and to reduce a manufacturing cost thereof.

**[0036]** Although the above embodiments are directed to the concrete pin, the present invention is not limited to the concrete pin. For example, the present invention is also applicable to a fastening pin which can be driven into another rigid member.

# REFERENCES CITED IN THE DESCRIPTION

Cited references

This list of references cited by the applicant is for the reader's convenience only. It does not

form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

**Patent documents cited in the description**


- EP2085624A [0003]
- US6171042B [0003]
- JP2008051153A [0003]
- US3478638A [0006]

**Patentkrav**

**1.** Fastgørelsesstift som skal drives ind i et stift element, hvilken fastgørelsesstift omfatter:

en forstørret hoveddel (1); og

en skaftdel (2),

hvor skaftdelen (2) inkluderer:

et afsnit (2a) med en stor diameter dannet under den forstørrede hoveddel (1);

et midterste skaftafsnit (2b) dannet under afsnittet (2a) med den store diameter; og

et afsnit (2c) med en lille diameter som strækker sig fra det midterste skaftafsnit (2b) til en forende af fastgørelsesstiften (A),

hvor afsnittet (2a) med den store diameter inkluderer et rundt afsnit (4) dannet under den forstørrede hoveddel (1) og et tilspidset afsnit (5) dannet mellem det runde afsnit (4) og det midterste skaftafsnit (2b), og en diameter af afsnittet (2a) med den store diameter på en side af den forstørrede hoveddel (1) er større end en diameter af afsnittet (2a) med den store diameter på en side af det midterste skaftafsnit (2b),

hvor det midterste skaftafsnit (2b) har en ensartet diameter fra en side af afsnittet (2a) med den store diameter til en side afsnittet (2c) med den lille diameter, og

hvor en side af en forende af afsnittet (2c) med den lille diameter har en projektilform,

**kendetegnet ved, at** afsnittet (2c) med den lille diameter inkluderer:

et nedre midterste skaftafsnit (6) med en ensartet diameter, som er mindre end en diameter af det midterste skaftafsnit (2b);

et nedre tilspidset afsnit (7) tilvejebragt mellem det nedre midterste skaftafsnit (6) og det midterste skaftafsnit (2b); og

et forendeafsnit (8) tilvejebragt under det nedre midterste skaftafsnit (6) og med projektilform, og

hvor en tilspidset vinkel ($\theta 1$) af det tilspidsede afsnit (5) er inden for et område fra 2 til 5 grader.

**2.** Fastgørelsesstiften ifølge krav 1, hvor en nedre ende af afsnittet (2a) med den store diameter er i kontakt med en øvre ende af det midterste skaftafsnit (2b), og den nedre ende af afsnittet (2a) med den store diameter har den samme diameter som en diameter af den øvre ende af det midterste skaftafsnit (2b),

hvor en nedre ende af det midterste skaftafsnit (2b) er i kontakt med en øvre ende af afsnittet (2c) med den lille diameter, og den nedre ende af det midterste skaftafsnit (2b) har den samme diameter som en diameter af den øvre ende af afsnittet (2c) med den lille diameter, og

hvor en nedre ende af det runde afsnit (4) er i kontakt med en øvre ende af det tilspidsede afsnit (5), og den nedre ende af det runde afsnit (4) har den samme diameter som en diameter af den øvre ende af det tilspidsede afsnit (5).

**3.** Fastgørelsesstiften ifølge krav 1 eller 2, hvor en længde (11) af afsnittet (2a) med den store diameter er den samme som eller større end 1/3 af en aksial længde (I) af skaftdelen (2),

hvor den tilspidsede vinkel (θ1) af det tilspidsede afsnit (5) er udført således, at den reducerer en indtrængningsmodstand over for det stive element og bevarer en udtræksmodstand efter fastgørelsesstiften er drevet ind i det stive element, og således at afsnittet (2a) med den store diameter ikke bøjes, når fastgørelses-stiften drives i det stive element.

**4.** Fastgørelsesstiften ifølge et hvilket som helst af kravene 1 til 3, hvor en krumning af det runde afsnit (4) er udført så stor, at et under-hovedafsnit direkte under det forstørrede hovedafsnit (1) ikke bøjes, når fastgørelsesstiften drives ind i det stive element.

**5.** Fastgørelsesstiften ifølge et hvilket som helst af kravene 1 til 4, hvor en nedre ende af det nedre tilspidsede afsnit (7) er i kontakt med en øvre ende af det nedre midterste skaftafsnit (6), og den nedre ende af det nedre tilspidsede afsnit (7) har den samme diameter som en diameter af den øvre ende af det nedre midterste skaftafsnit (6),

hvor en nedre ende af det nedre midterste skaftafsnit (6) er i kontakt med en øvre ende af forendeafsnittet (8), og den nedre ende af det nedre midterste skaftafsnit (6) har den samme diameter som en diameter af den øvre ende af

forendeafsnittet (8).

**6.** Fastgørelsesstiften ifølge et hvilket som helst af kravene 1 til 5, hvor det runde afsnit (4) har den største diameter i skaftdelen (2).

**7.** Fremgangsmåde til fremstilling af en fastgørelsesstift (A) som inkluderer en forstørret hoveddel (1) og en skaftdel (2), hvor skaftdelen (2) har et afsnit (2a) med en stor diameter dannet under den forstørrede hoveddel (1), et midterste skaftafsnit (2b) dannet under afsnittet (2a) med den store diameter og et afsnit (2c) med en lille diameter som strækker sig fra det midterste skaftafsnit (2b) til en forende af fastgørelsesstiften (A), hvor afsnittet (2a) med den store diameter inkluderer et rundt afsnit (4) dannet under den forstørrede hoveddel (1) og et tilspidset afsnit (5) dannet mellem det runde afsnit (4) og det midterste skaftafsnit (2b), hvor en diameter af afsnittet (2a) med den store diameter på en side af den forstørrede hoveddel (2a) er større end en diameter af afsnittet (2a) med den store diameter på en side af det midterste skaftafsnit (2b), hvor det midterste skaftafsnit (2b) har en ensartet diameter fra en side af afsnittet (2a) med den store diameter til en side af afsnittet (2c) med den lille diameter, og hvor en side af en forende af afsnittet (2c) med den lille diameter er projektilformet, hvilken fremgangsmåde omfatter:

at tilvejebringe et par pressestempler (12, 12) og et hovedstempel (13) som er bevægeligt i en vertikal retning over pressestemplerne (12, 12);

at tilvejebringe et øvre rum (14) og et nedre rum (15) på en kontinuerlig måde mellem matchende overflade af parret af pressestempler (12, 12), hvor det øvre rum (14) inkluderer et tilspidset afsnit (5a), som har en indvendig diameter, som er større end en udvendig af et stangelement (21) anvendt som et materiale af fastgørelsesstiften (A), hvor det nedre rum (15) har en indvendig diameter, som i alt væsentligt svarer til den udvendige diameter af stangelementet (21), og hvor en bund af det nedre rum (15) er lukket;

at anbringe stangelementet (21) i det øvre rum (14) og det nedre rum (15) i en tilstand, hvor en øvre del af stangelementet (21) rager opad fra de matchende overflader af parret af pressestempler (12, 12);

at matche parret af pressestempler (12, 12) med hinanden for at fiksere stangelementet (21) deri; og

at forme det tilspidsede afsnit (5) af fastgørelsesstiften (A) ved at trykke og knuse den øvre del af stangelementet (21) med hovedstemplet (13) for at forårsage, at den øvre del af stangelementet (21) rager udad,

hvor en tilspidset vinkel (θ1) af det tilspidsede afsnit (5) er inden for et område fra 2 til 5 grader.

# DRAWINGS

*FIG. 1*

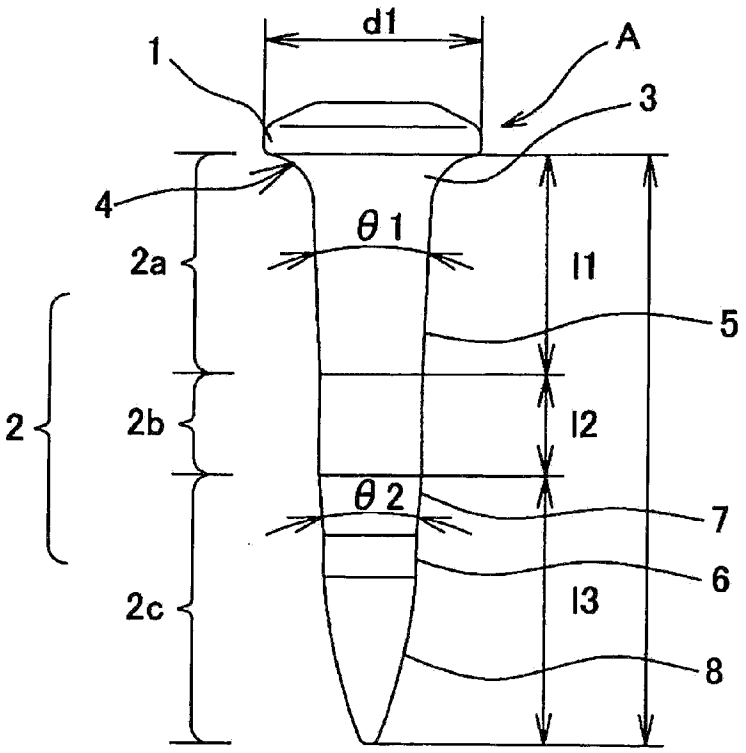

FIG. 2

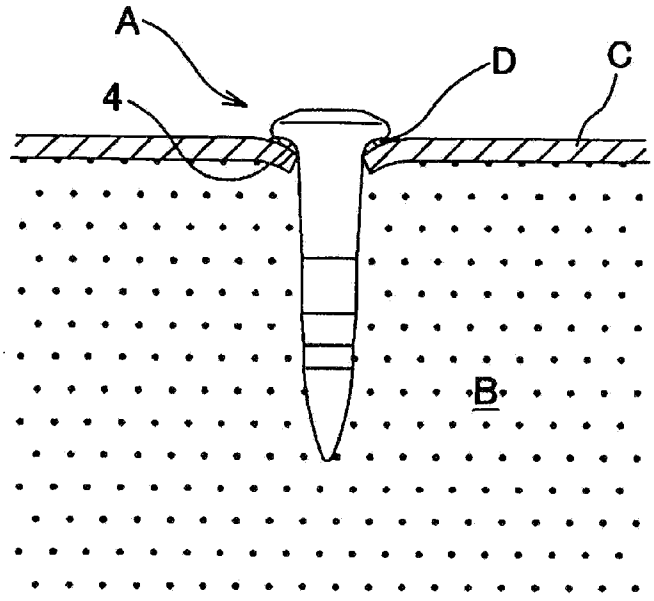

FIG. 3

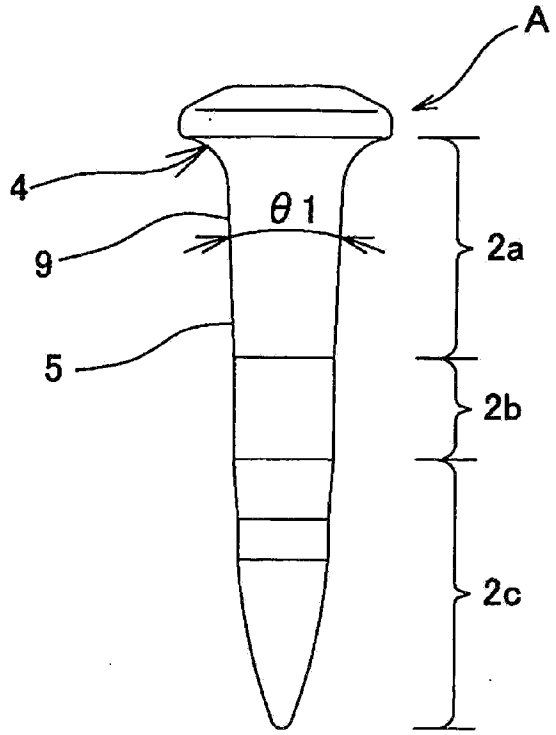


FIG. 4(a)

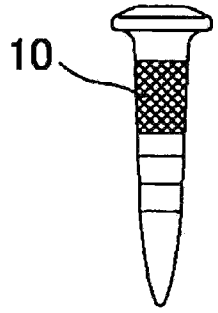


FIG. 4(b)

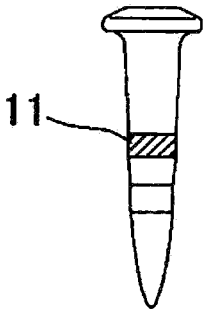


FIG. 4(c)

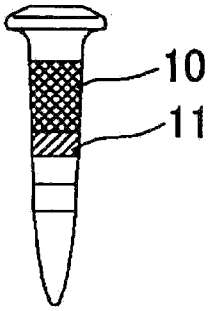

FIG. 5(a)

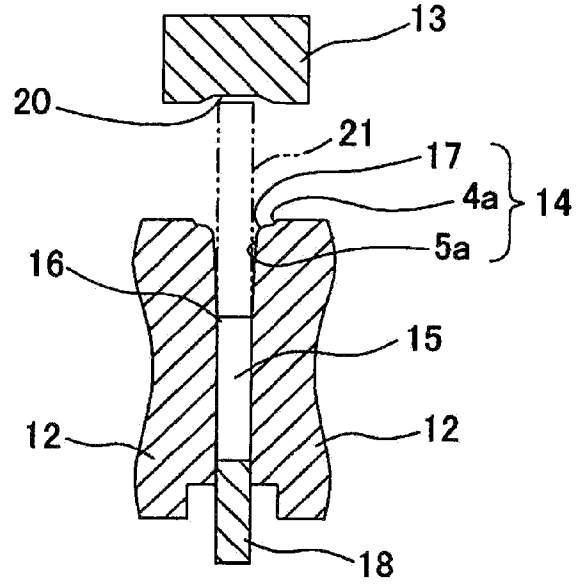


FIG. 5(b)