

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



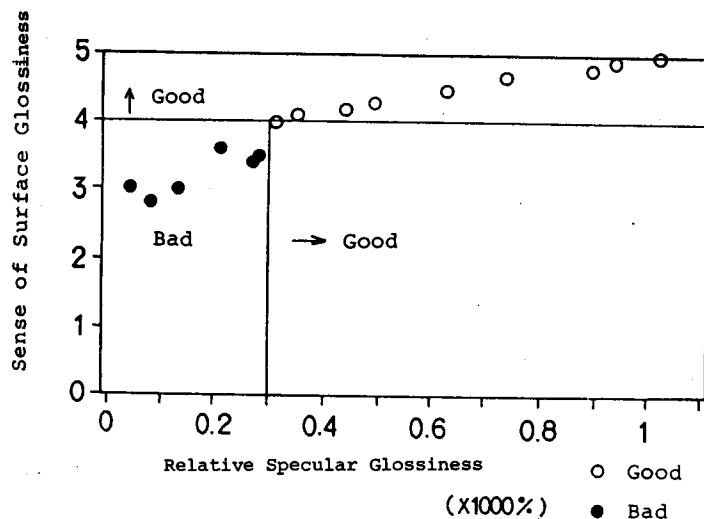
(11) Publication number:

0 581 210 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **93111822.8**(51) Int. Cl.⁵: **C25F 3/24**(22) Date of filing: **23.07.93**(30) Priority: **24.07.92 JP 218386/92**(43) Date of publication of application:
02.02.94 Bulletin 94/05(84) Designated Contracting States:
DE DK FR GB(71) Applicant: **AICHI STEEL WORKS, LIMITED**
1, Wanowari
Arao-cho
Tokai-shi
Aichi 476(JP)(72) Inventor: **Shimizu, Seiji, AICHI STEEL WORKS****LTD.****Wanowari,****Arao-cho****Tokai-shi, Aichi-ken 476(JP)**Inventor: **Kawai, Eikichi, AICHI STEEL WORKS**
LTD.**Wanowari,****Arao-cho****Tokai-shi, Aichi-ken 476(JP)**(74) Representative: **Blumbach Weser Bergen**
Kramer Zwirner Hoffmann Patentanwälte
Radeckestrasse 43
D-81245 München (DE)(54) **Section stainless steel having good image clarity.**

(57) Disclosed is a mirror-finished stainless steel with good image clarity and having mirror-finished surfaces which are characterized in that the relative specular glossiness G_s (45°) is 300 % or more, the degree of the surface flatness (for the reference length of 50 mm) is 50 μm or less and the degree of the surface flatness (for the reference length of 5 mm) is 10 μm or less. The steels are most suitable as interior and exterior material for constructions and as interior decorative material, parts of instruments for nuclear power plants, parts for chemical plants, parts for daily necessities, parts for automobiles, and the like.

FIG.5**EP 0 581 210 A1**

FIELD OF THE INVENTION

The present invention relates to a section stainless steel with a good image clarity section, which is most suitable as an interior and exterior material for constructions and as an interior decorative material.

BACKGROUND OF THE INVENTION

As a mirror-finished section stainless steel there has been known, for example, one manufactured by forming a cold-rolled stainless steel sheet and strip with a strickling board pattern.

The section stainless steel is widely used as interior and exterior material for constructions, interior decorative material, parts for chemical plants, parts of instruments for nuclear power plants, daily necessities and others.

However, since the section stainless steel is manufactured by working a steel strip with a strickling board pattern, thick articles could not be produced and their corner R is large.

In particular, the corners and the summit angles of channel steel, angle steel and the like are finished to be thick by the forming. Therefore, the glossiness and the mechanical strength of the section stainless steel are often insufficient. In addition, the dispersion of the degrees of the surface flatness of the article in the longitudinal direction and in the cross direction is large.

In order to overcome the problems, a method has been employed in which a section stainless steel is manufactured by hot-rolling or cold-rolling and then it is mirror-finished by various mechanical polishing means, for example, by buffing or lapping.

However, the prior art techniques involve the following problems.

Specifically, since the difference in the speed between the working rolls and the material to be rolled therewith is large in the rolling step and additionally the material often sticks to the rolls due to heat in the same step, the surface of the rolled article is often roughened. In addition, since the flow stress of the article to be shaped is large and the shape of the article itself is complicated, the dispersion of the dimension of the section steel is often large.

Therefore, the mirror-finishing by such mechanical polishing is limitative and the relative specular glossiness and the degree of the surface flatness of the section stainless steel are not good. As a result, stainless section steels having poor relative specular glossiness and flatness are produced, taking much labor and time.

Because of these reasons, section stainless steels have often a significant image distortion to detract from their outward appearance so that they are no more suitable to interior decorative materials and to interior and exterior material for constructions.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above-mentioned problems in the prior art, and the object of the present invention is to provide a section stainless steel with a good image clarity, which steel is most suitable as interior and exterior material for constructions, interior decorative material, as parts of instruments for nuclear power plants, parts for chemical plants, parts for daily necessities, parts for automobiles and the like.

Specifically, the present invention provides a mirror-finished section stainless steel with good image clarity, having mirror-finished surfaces which are characterized in that the relative specular glossiness G_s - (45°) is 300 % or more, the degree of the surface flatness for the reference length of 50 mm is 50 μm or less and the degree of the surface flatness for the reference length of 5 mm is 10 μm or less.

BRIEF EXPLANATION OF THE DRAWINGS

- Fig. 1 is a perspective view of showing the mirror-finished part of an angle steel of Example 1;
- Fig. 2 is a perspective view of showing one embodiment of the use of the angle steel of Example 1;
- Fig. 3 is a plan view of the electrode to be used in the electrochemical composite mirror-finished surface working method in Example 1;
- Fig. 4 is an A-A line cross-sectional view of Fig. 3;
- Fig. 5 is a graph of showing the relationship between the sense of the glossiness and the relative specular glossiness in Example 2;
- Fig. 6 is a graph of showing the relationship between the sense of the glossiness and the surface roughness in Example 2;

- Fig. 7 is a graph of showing the relationship between the degree of the image distortion and the degree of the surface flatness in Example 2;
- Fig. 8 is a graph of showing the relationship between the degree of the image distortion and the degree of the surface flatness in Example 2 for a different reference length;
- 5 Fig. 9 is a graph of showing the relationship between the degree of surface flatness when the reference length is 5 mm and 50 mm in Example 2;
- Fig. 10 is a graph of showing the relationship between the degree of the image distortion and the image clarity in Example 2;
- Fig. 11 is a graph of showing the relationship between the degree of the image distortion and the image clarity using a different optical comb;
- 10 Fig. 12 is a graph of showing the relationship between the sense of the glossiness and the sense of the image distortion as a total evaluation in Example 2;
- Fig. 13 is a perspective view of showing the mirror-finished face of the channel steel of Example 3;
- Fig. 14 is a perspective view of showing one embodiment of the use of the channel steel of Example 3;
- 15 Fig. 15 is a perspective view of showing the mirror-finished face of the flat steel of Example 4;
- Fig. 16 is a perspective view of showing one embodiment of the use of the flat steel of Example 4.

DETAILED DESCRIPTION OF THE INVENTION

20 The section stainless steel of the present invention includes a simple section stainless steel and a welded section stainless steel, such as an angle steel, a channel steel, a flat steel, an H-steel having the shape of an H, an I-steel having the shape of an I, and a T-steel having the shape of a T.

At least one surface of the section stainless steel indicates a part of constituting the outward design surface of the same, for example, a major surface or minor side surface of an angle steel, a flat surface of a channel steel, or a front surface or side surface of a flat steel.

The relative specular glossiness is, for example, a 45-relative specular glossiness $G_s(45^\circ)$ to be measured by the "Method of Measuring the Specular Glossiness" as defined by JISZ-8741. The degree of the surface flatness is a value to be determined by JISB-0601, which indicates R_{max} (μm) for the reference length of 50 mm or 5 mm.

30 The relative specular glossiness and the degree of the surface flatness have a close relationship to each other.

In case of the invention the relative specular glossiness is 300 % or more, and the degree of the surface flatness is 50 μm or less for the reference length of 50 mm and is 10 μm or less for the reference length of 5 mm. If the relative specular glossiness is less than 300 %, the surface of the section stainless steel does not have a glossy appearance needed by interior and exterior material for constructions and by interior decorative material.

On the other hand, if the degree of the surface flatness is more than 50 μm , the surface smoothness of the section stainless steel can not be even. In particular, if the steel is long (for example, having a length of from 4 to 6 m) or wide (for example, having a width of from 30 to 200 mm), the surface smoothness would partly be uneven. Such an uneven section stainless steel would reflect a distorted or deformed image on its mirror-finished surface and is therefore unsuitable as interior or exterior material for constructions and as interior decorative material.

45 As a means for mirror-finishing the steel so as to satisfy the above-defined relative specular glossiness and surface flatness, preferred are an electrochemical composite mirror-finished surface working method and combination of the method and a buffing method.

The electrochemical composite mirror-finished surface working method has been developed as a method of efficiently mirror-finishing the surface of a metal material having a relatively large surface area such as a section stainless steel and the like. In accordance with the method, anodic dissolution by an electrochemical reaction and a mechanical grinding and polishing action are combined, whereupon the small hills of a rough surface of the metal material to be worked are selectively removed.

Accordingly, removal of the small hills of the rough film as formed on the rough surface of the metal material by electrolytic dissolution is essentially effected. Therefore, the mirror-finishing may be effected efficiently in a short period of time by the method.

55 Thus, a worked metal surface having a much reduced surface roughness with high accuracy of a submicron unit is obtained, and automation of the mirror-finishing operation becomes easy with promoting the producibility and the corrosion resistance of the finished surface. The mirror-finished surface is free from various influences of stress, heat and vibration.

At least one surface of a section stainless steel is mirror-finished by the above-mentioned electrochemical composite mirror-finished surface working method. Accordingly, a mirror-finished stainless section steel having excellent glossiness and surface smoothness on the designed outward surface is obtained, which is most suitable as interior and exterior material for constructions and as interior decorative material and others.

The other parts except the above-mentioned at least one surface may be mirror-finished by any other polishing method. Two or more different kinds of mirror-finishing may be combined, if desired.

The section stainless steel of the present invention is characterized by having at least one mirror-finished surface which has a relative specular glossiness of 300 % or more, a degree of the surface flatness of 50 μm or less for the reference length of 50 mm and a degree of the surface flatness of 10 μm or less for the reference length of 5 mm.

Accordingly, the section stainless steel of the present invention has a high glossiness and an especially excellent image clarity, which are needed by a section stainless steel to be used as interior and exterior material for constructions and as interior decorative material and others. The image clarity as referred to herein indicates a surface property of a metal which reflects an image of an object on its surface.

The surface of the section stainless steel of the present invention is flat, is free from roughness and has smoothness both in the longitudinal direction and in the cross direction.

Therefore, the section stainless steel of the present invention has a specifically designed outward appearance and especially an excellent surface smoothness with high accuracy to be most suitable as interior and exterior material for constructions such as high buildings and also as interior decorative material.

Regarding the defined relative specular glossiness and surface flatness, at least one surface of the section stainless steel of the present invention may be specifically mirror-finished to satisfy the defined ranges for the two factors, and the steel has a good outward appearance with an excellent design well applicable to interior and exterior material for constructions and interior decorative material.

In accordance with the present invention as mentioned above in detail, there is provided a section stainless steel with a good image clarity which is most suitable as interior and exterior material for constructions and as interior decorative material and the like.

The present invention will be explained in more detail by way of the following examples, which, however, are not intended to restrict the scope of the present invention.

EXAMPLE 1

Fig. 1 to Fig. 4 are referred to in this example, which demonstrates manufacture of an angle stainless steel having a good image clarity.

Specifically, this example demonstrates manufacture of an angle steel 1 which is most suitable as interior and exterior material for constructions, by mirror-finishing a section stainless steel by an electrochemical composite mirror-finished surface working method.

The angle steel 1, as shown in Fig. 1, has equal legs, a length of 6 m and has a flat face 11, a side face 12 and a back face 110.

The two surfaces of the flat face 11 and one side face 12 of the angle steel 1 are mirror-finished by an electrochemical composite mirror-finished surface working method.

The electrochemical composite mirror-finished surface working method is effected in the manner as shown in Fig. 3 and Fig. 4, using a disc tool electrode 4, a rotating device (not shown) for rotating it, an electrolytic solution 41 and an abrasive 43.

The tool electrode 4 has, as shown in Fig. 3 and Fig. 4, a cross electrode 40 (cathode). It has a flow duct 420 for the electrolytic solution 41 in the center of a projecting cylinder part 42. The electrolytic solution 41 may be an aqueous sodium nitrate of an inert condition (passive condition).

The surface of the disc tool electrode 4 has, as shown in Fig. 3, an abrasive 43. The abrasive 42 may be a non-woven fabric having grinding stone particles adhered thereto.

First, a section stainless steel 44 to be mirror-finished is set below the tool electrode 4, as shown in Fig. 4. Next, the tool electrode 4 is brought near to the angle stainless steel while it is rotated by the rotating device. Next, as shown in Fig. 4, an electrolytic solution 41 is applied to the steel 44 by continuously feeding it into the flow duct 420.

Accordingly, a passivated insulating anodic oxide film 45 is formed on the surface of the section stainless steel of the anode.

Under this condition, the small hills 441 and the anodic oxide film 45 of the section stainless steel 44 are removed and dissolved out repeatedly by grinding them with the abrasive 43 and by the electrolytic

action.

The effect and action of the thus mirror-finished steel are mentioned below.

In the angle steel 1 as worked in this example, the two surfaces of the above-mentioned flat face 11 and one side face 12 both have been mirror-finished to have a relative specular glossiness G_s (45°) of 300 % or more and have degrees of the surface flatness of 50 μm or less for the reference length of 50 mm and 10 μm or less for the reference length of 5 mm.

Therefore, the angle steel 1 has a high glossiness and has an especially excellent image clarity which are required for an angle stainless steel of interior or exterior material for constructions, interior decorative material and the like.

In addition, the surface of the angle steel 1 is even and is free from roughness and irregularity both in the longitudinal direction (of, for example, a length from 4 to 6 m) and in the cross direction.

Therefore, the angle steel 1, having a good design property and especially a degree of the surface flatness with high accuracy, is most suitable as interior and exterior material for constructions, such as a corner part of separate rooms of high buildings as shown in Fig. 2.

Since the above-mentioned two surfaces of the angle steel have been mirror-finished by the electrochemical composite mirror-finished surface working method and the relative specular glossiness and surface flatness of the two surfaces satisfy the above-defined ranges, the angle steel has an improved outward design property when it is used as an interior or exterior material for constructions.

The mirror-finishing of the angle steel 1 may be carried out in a relatively short period of time.

EXAMPLE 2

This example illustrates measurement of the relative specular glossiness and surface flatness of the angle steel 1 having a good image clarity, as obtained in the previous Example 1. The results are mentioned below, referring to Fig. 5 to Fig. 12 and Table 1.

The relative specular glossiness of the angle steel 1 was measured in accordance with the "Method of Measuring the for Specular Glossiness" as defined by JISZ-8741. The degree of the surface flatness of the same was measured in accordance with the "Definition and Designation of Surface Roughness" as defined by JISB-0601, which indicates R_{max} (μm) for the reference length of 50 mm and 5 mm, respectively. In addition, the measured data were compared with those measured by the "Test Methods for Image Clarity of Anodic Oxidation Coatings on Aluminium and Aluminium Alloys" as defined by JISH-8686.

The results obtained are shown in Fig. 5 to Fig. 12 and Table 1.

Next, the relative specular glossiness and surface flatness of samples A to I are explained below, referring to Table 1.

The total sensual evaluation point as referred to herein indicates the total of the sense of the glossiness (five-rank evaluation, $n=10$) and the sense of the image distortion (five-rank evaluation, $n=10$). The total point of 8 or more means that the sample is good (see Samples A to E). For sample F, it satisfies the defined relative specular glossiness and the degree of surface flatness for the reference length of 50 mm, but the degree of the surface flatness thereof for the reference length of 5 mm is 12 μm and is large so that the surface has a citron-like skin.

For sample G, since this has a large value of the degree of the surface flatness for the reference length of 50 mm, the outline of the image reflected thereon is gently distorted or deformed.

For sample H, since the relative specular glossiness is low, the sense of its glossiness is insufficient.

For sample I, both the sense of the image distortion and the sense of the glossiness are bad.

The results are explained more in detail referring to Fig. 5 to Fig. 12.

Fig. 5 shows the relationship between the relative specular glossiness and the sense of the glossiness, from which it is understood that the two are in proportion to each other. Namely it indicates that the sense of the glossiness may well be represented by the value of the relative specular glossiness. Regarding the relationship between the sense of the glossiness and the surface roughness, the two could not always be in good proportion to each other (see Fig. 6). The surface roughness can express only a part of the surface condition so that it can not well express the sense of the glossiness. Anyway, since the sense of the glossiness may better be represented by the relative specular glossiness rather than the surface roughness, the claimed range has been defined by the relative specular glossiness G_s (45°) of being 300 % or more.

Table 1 - Results of Measurement at Angle of 75 mm x 9 mm

Sample	Relative Specular Glossiness (Gs 45°) %	Degree of Surface Flatness (μm)		Surface Roughness (Rmax) μm	Point of Total Sensual Evaluation (10-rank evaluation) (8 or more points mean good samples.)	Individual Sensual Evaluations (5-rank evaluation, average of 10 panelists)		
		5 mm	50 mm			Sense of Glossiness	Sense of Image Distortion	
A	1020	1	41	0.2	10.0	5.0	5.0	
B	736	4	33	0.8	9.4	4.7	4.7	
C	893	9	35	0.5	8.8	4.8	4.0	
D	629	3	28	1.1	8.9	4.5	4.4	
E	310	9	30	1.5	8.0	4.0	4.0	
F	392	12	43	2.2	7.7	4.2	3.5	citron-like skin
G	425	3	71	1.2	5.8	4.3	1.5	distorted or deformed
H	283	8	42	2.0	6.7	3.5	3.2	insufficient glossiness
I	271	10	62	17.5	5.7	3.4	2.3	bad

The sense of the image distortion is closely related to the degree of the surface flatness. Good samples of reflecting non-warped or not distorted images fall within the range where the degree of flatness is 50 μm or less for the reference length of 50 mm and the degree of flatness is 10 μm or less for the reference length of 5 mm (see Fig. 9). Fig. 8 simply shows the relationship between the degree of flatness for the reference length of 50 mm and the sense of the image distortion. As can be noted from Fig. 8, the sense of

the image distortion is often not good even in the range of the degree of flatness being 50 μm or less.

Fig. 7 shows the relationship between the degree of flatness for the reference length of 5 mm and the sense of the image distortion. As is noted from Fig. 7, the sense of the image distortion is often not good even in the range of the degree of flatness being 10 μm or less. From the results, it is understood that a satisfactory evaluation for the sense of the reflected image can be obtained only under the condition of having a degree of flatness of 50 μm or less for the reference length of 50 mm and having a degree of flatness of 10 μm or less for the reference length of 5 mm.

Fig. 10 and Fig. 11 each show the results of the "Test Methods for Image Clarity of Anodic Oxidation Coatings on Aluminium and Aluminium Alloys" of JISH-8686. As can be noted from them, those with a good sense are often evaluated to be bad or those with a bad sense are often evaluated to be good by the optical comb method using an optical comb of 0.5 mm or 1.0 mm length. By this method, the sense of the image distortion could not be evaluated correctly and the allowable range of the evaluation points could not be defined.

Fig. 12 shows the relationship between the sense of the glossiness and the sense of the image distortion as the total evaluation, which indicates that the total evaluation is good when the sense of the glossiness and the sense of the image distortion both have 4 points or more.

As mentioned above, the image clarity of a section stainless steel is controlled and defined by the two factors of the sense of the glossiness and the sense of the image distortion. Precisely, the image clarity is decided to be good when both of the two factors have 4 points or more. The sense of the glossiness can not be expressed well by the surface roughness but may be well expressed by the relative specular glossiness. On the other hand, the sense of the image distortion can not be evaluated by the optical comb method but may be evaluated by the degree of the surface flatness. The degree of the surface flatness can not be expressed without using both the reference length of 5 mm and the reference length of 50 mm.

EXAMPLE 3

This example demonstrates mirror-finishing of a channel steel 2 as shown in Fig. 13 and Fig. 14, in place of the angle steel 1 of the previous Example 1, by the same electrochemical composite mirrorfinished surface working method as in Example 1.

The channel steel 2 is composed of a decorative flat face 21, two side faces 22 and 23 standing on the both sides, and a groove face 24.

Of them, two surfaces of the decorative flat face 21 and one side face 22 are mirror-finished by the electrochemical composite mirror-finished surface working method and then buffed, as shown in Fig. 13. The other faces are finished by hair-line finishing.

As shown in Fig. 14 the channel steel 2 is used as an interior decorative material, being sandwiched between construction walls 25 and 26. The other are same as those in Example 1.

Relative specular glossiness and the surface flatness of the channel steel 2 were also measured in accordance with the same methods as those described in Example 2 to obtain results comparable with those of the angle steel.

The present example also provided channel stainless steel samples with a good image clarity which were most suitable as interior decorative materials. The samples of this example had the same data as those of the previous Example 1.

EXAMPLE 4

This example demonstrates mirror-finishing of a flat steel 3 as shown in Fig. 15 and Fig. 16, in place of the angle steel 1 of the previous Example 1, by the same electrochemical composite mirror-finished surface working method as in Example 1.

The flat steel 3 is composed of a decorative flat face 31, the side faces 32 of the both sides, and a back face (not shown).

Of them, two surfaces of the decorative flat face 31 and one side face 32 as shown in Fig. 15 are mirror-finished by the electrochemical composite mirror-finished surface working method and then buffed. The other faces are finished by hairline finishing.

As shown in Fig. 16, the flat steel 3 is used as an interior decorative material, being attached to the side 37 of a support 36 at a corner or edge. The others are same as those in Example 1.

Relative specular glossiness and the surface flatness of the flat steel 3 were also measured in accordance with the same methods as those in Example 2 to give the same results as those of the angle steel.

Accordingly, the present example also provided section stainless steel samples with a good image clarity, which were most suitable as interior decorative material. The samples of this example had the same data as those of the previous Example 1.

The above-mentioned Examples 1 to 4 demonstrate use of the section stainless steel of the present invention as an interior or exterior material for constructions and as an interior decorative material, which use, however, is not limitative. In addition to the demonstrated examples, the section stainless steel of the present invention may also be used in other various fields of parts of instruments for nuclear power plants, parts for chemical plants, daily necessities and others.

While the invention has been described in detail and with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof.

Claims

- 15 1. A section stainless steel with good image clarity, having mirror-finished surfaces which are characterized by a degree of relative specular glossiness G_s (45°) of 300 % or more, a degree of surface flatness of 50 μm or less for the reference length of 50 mm and a degree of surface flatness of 10 μm or less for the reference length of 5 mm.
- 20 2. A section stainless steel according to claim 1, wherein said section stainless steel is of an angle steel and having a flat face, a back face, and side faces, and having mirror-finished at least one of said faces.
- 25 3. A section stainless steel according to claim 1, wherein
said section stainless steel is of a channel shape and having a decorative flat face, two side faces standing on both sides thereof, and a channel face,
at least one of these faces having a mirror-finished surface.
- 30 4. A section stainless steel according to claim 1, wherein
said section stainless steel is of a flat steel and having a decorative flat face, side faces on both sides, and a back face,
at least one of these faces having a mirror-finished surface.
- 35 5. A section stainless steel according to claim 1, wherein
said section stainless steel is of H-shape, having faces of an H-shape,
at least one of these faces having a mirror-finished surface.
- 40 6. A section stainless steel according to claim 1, wherein
said section stainless steel is of I-shape, having faces of an the I-shape,
at least one of these faces having a mirror-finished surface.
- 45 7. A section stainless steel according to claim 1, wherein
said section stainless steel is of T-shape having faces of a T-shape,
at least one of these faces having a mirror-finished surface.
8. A section stainless steel according to claim 1, wherein
said section stainless steel is used as an interior and exterior material for construction.
- 50 9. A section stainless steel according to claim 1, wherein
said section stainless steel is used as an interior decorative material.
10. A section stainless steel with good image clarity according to claim 1, wherein
said section stainless steel is used as a part of instruments for nuclear power plants.
- 55 11. A section stainless steel with good image clarity according to claim 1, wherein
said section stainless steel is used as a part for chemical plants.

12. A section stainless steel with good image clarity according to claim 1, wherein said section stainless steel is used as a part of daily necessities.

5 13. A section stainless steel with good image clarity according to claim 1, wherein said section stainless steel is used as a part of an automobile.

10 14. A section stainless steel according to claim 1, wherein
an electrolytic composite mirror surface working method is used to obtain a mirror-finished surface,
said method comprising an anodic dissolution by electrochemical reaction and a mechanical
grinding with an abrasive.

15 15. A section stainless steel according to claim 13, wherein
a mirror-finished face which is polished by said electrochemical composite mirror surface working
is further polished by a buffing method.

20

25

30

35

40

45

50

55

FIG.1

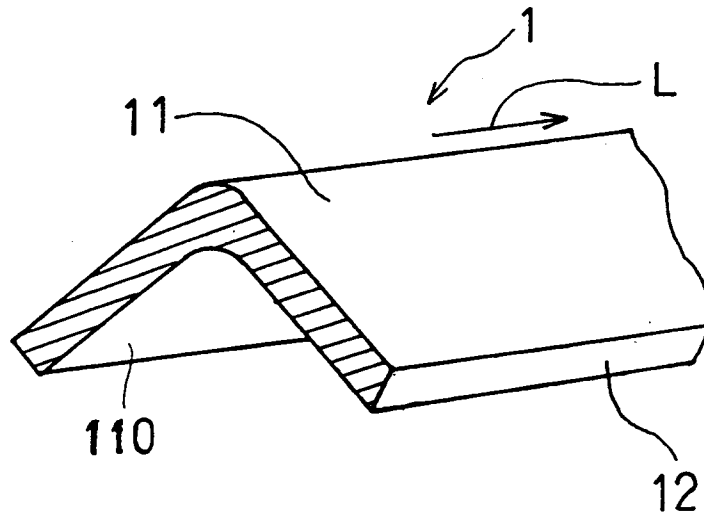


FIG.2

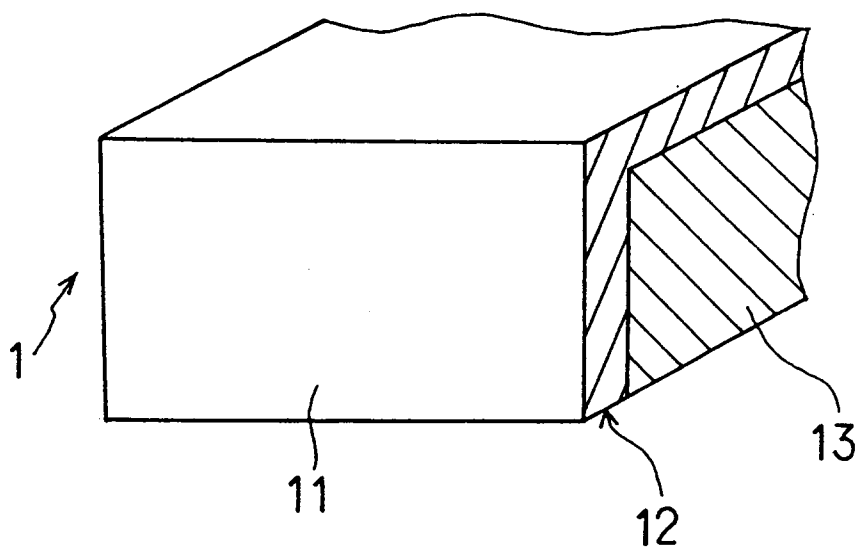


FIG.3

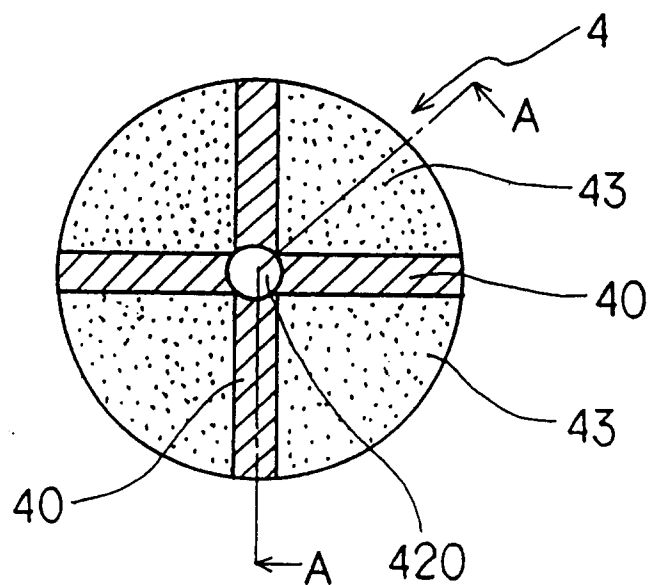


FIG. 4

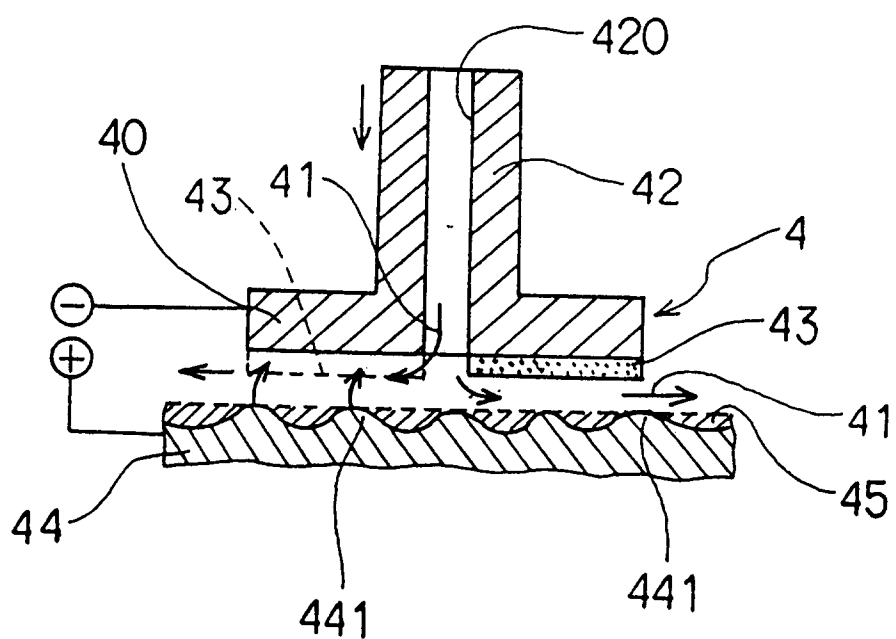


FIG.5

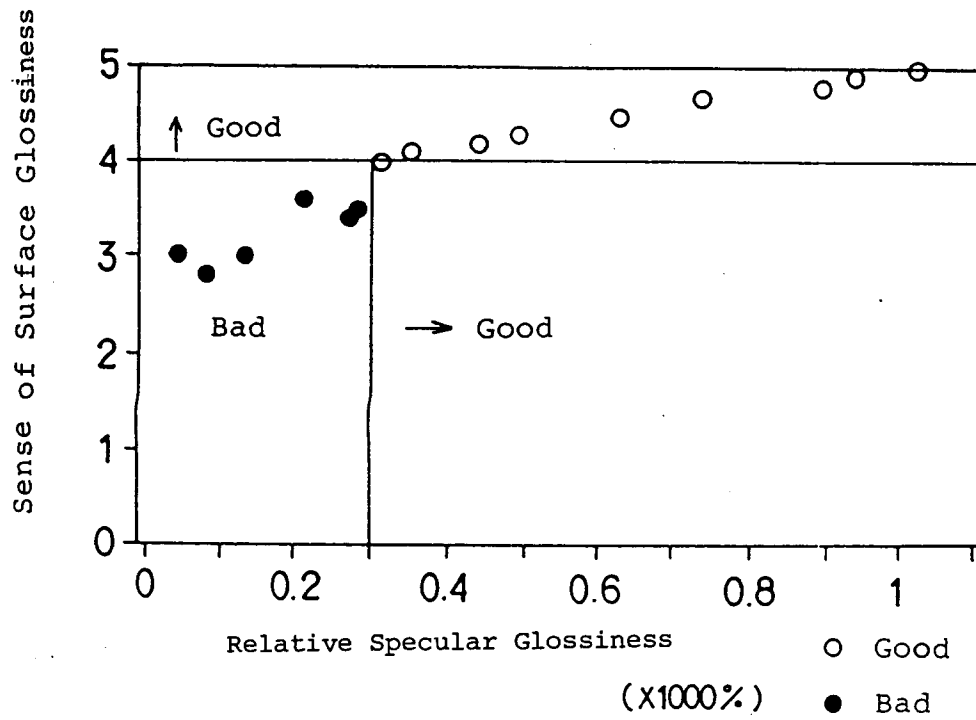


FIG.6

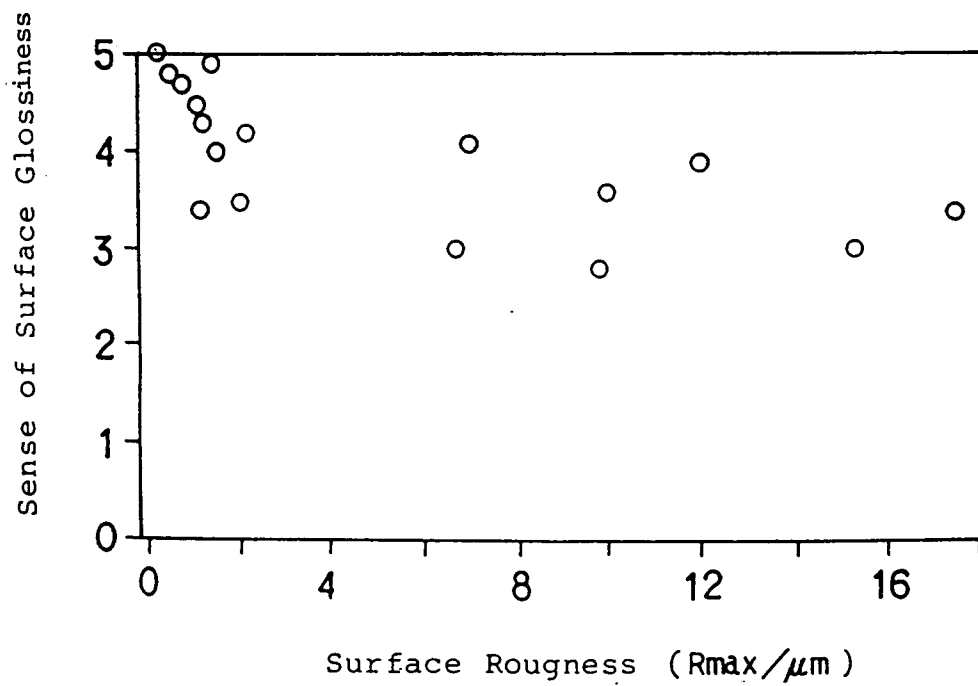


FIG.7

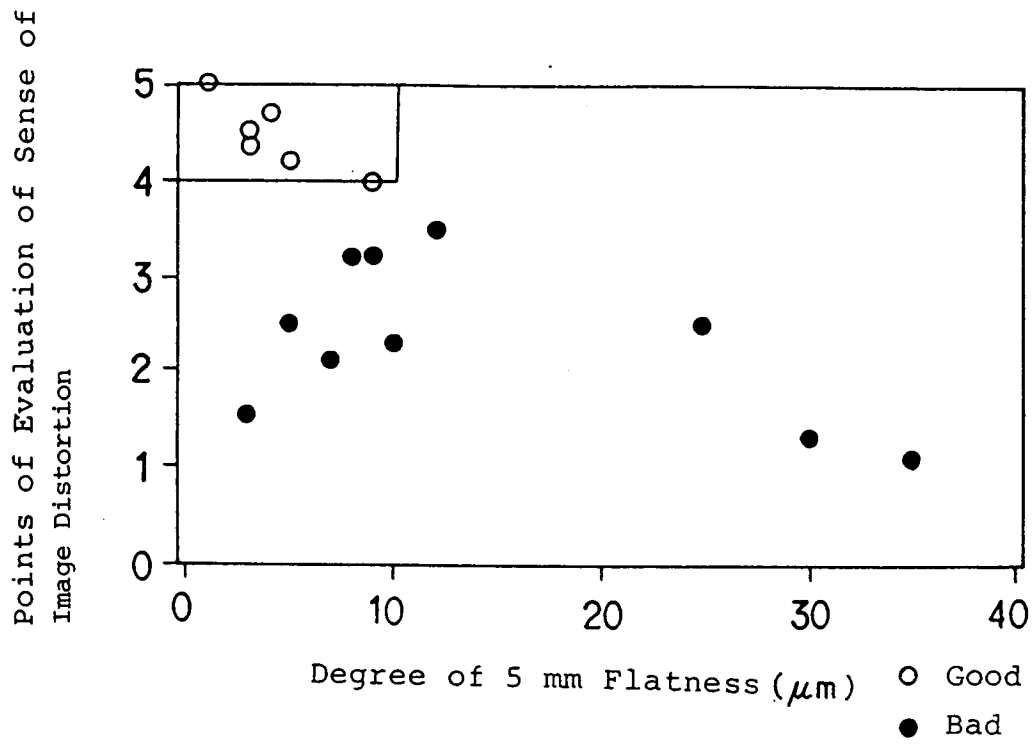


FIG.8

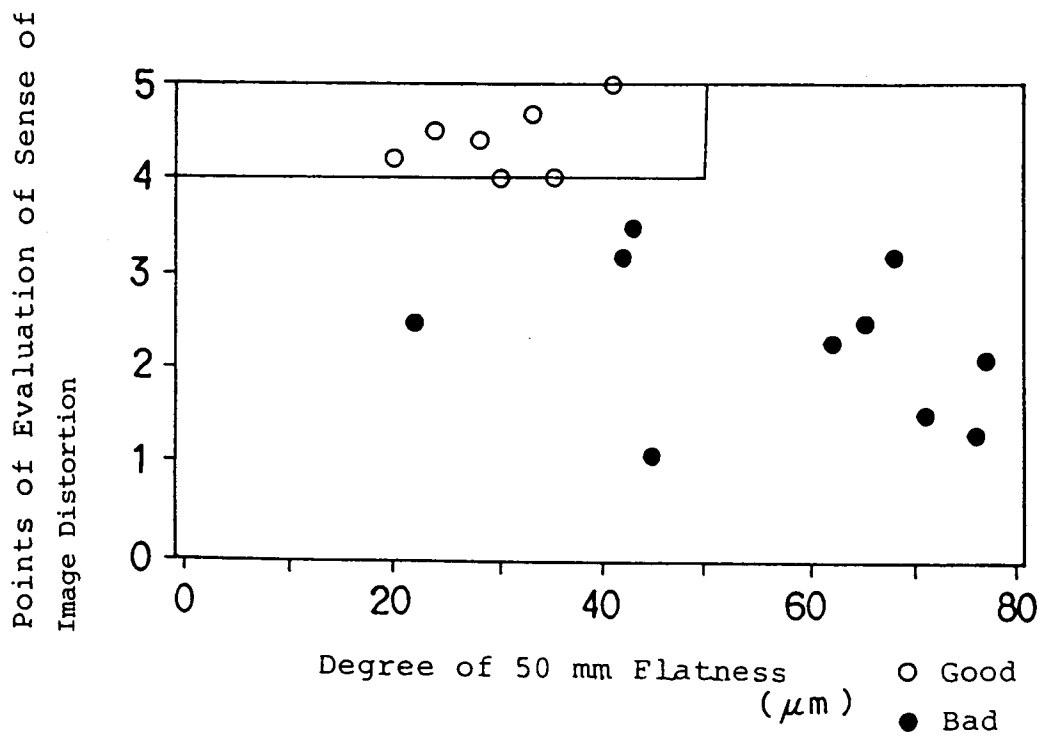


FIG.9

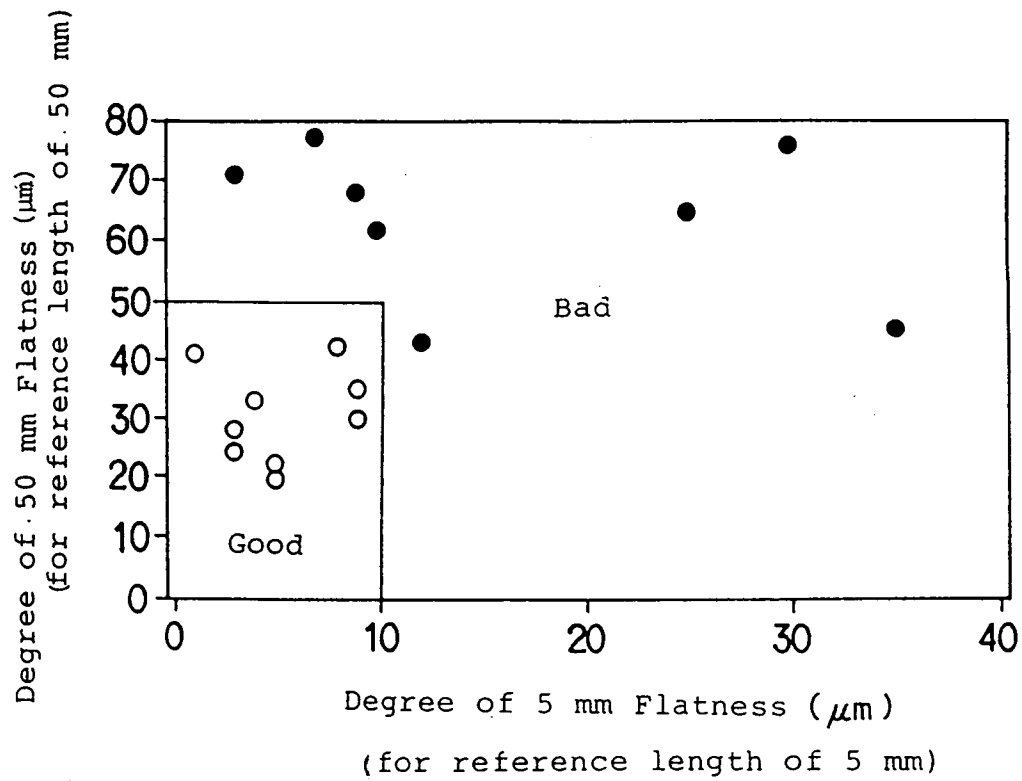


FIG.10

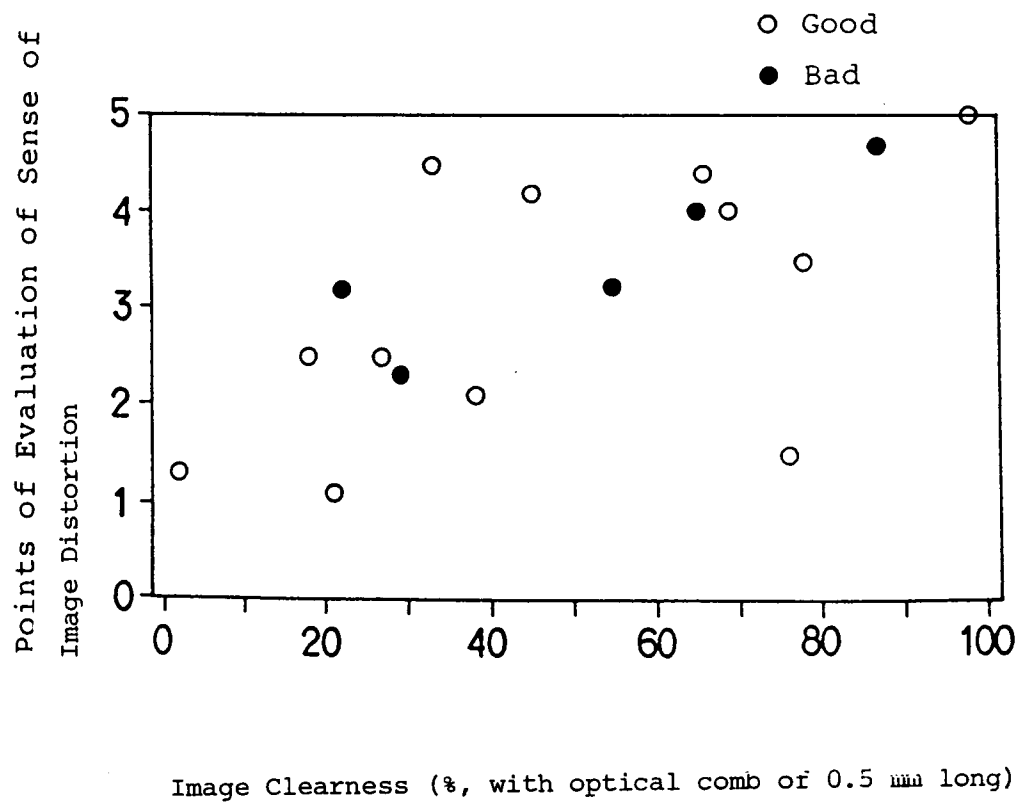


FIG.11

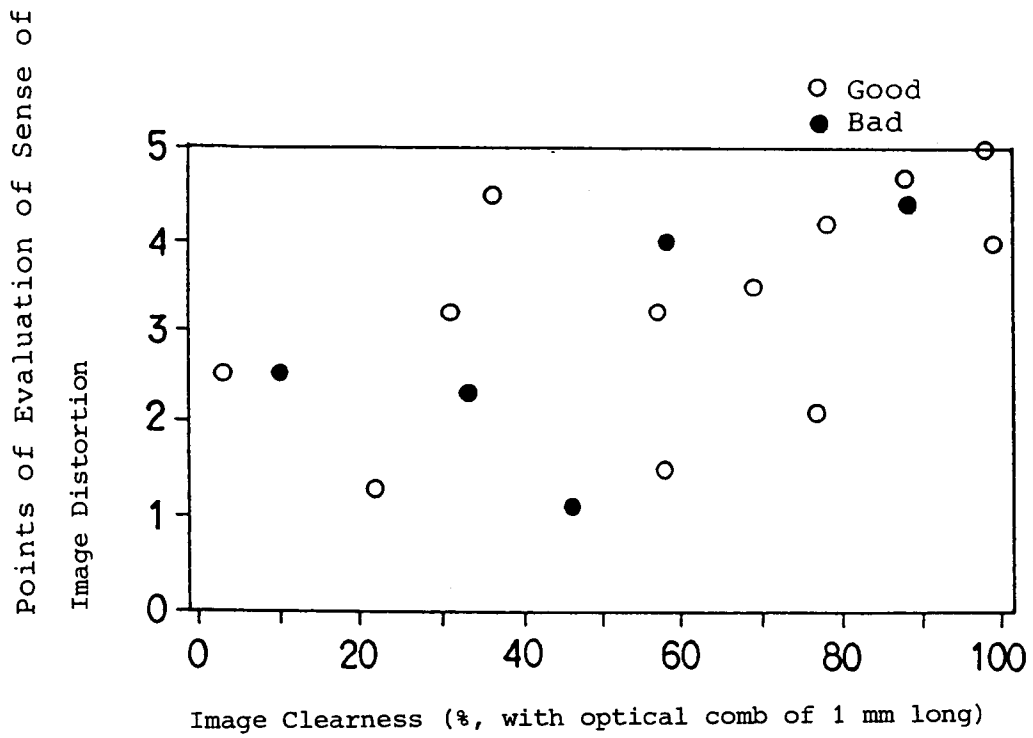


FIG.12

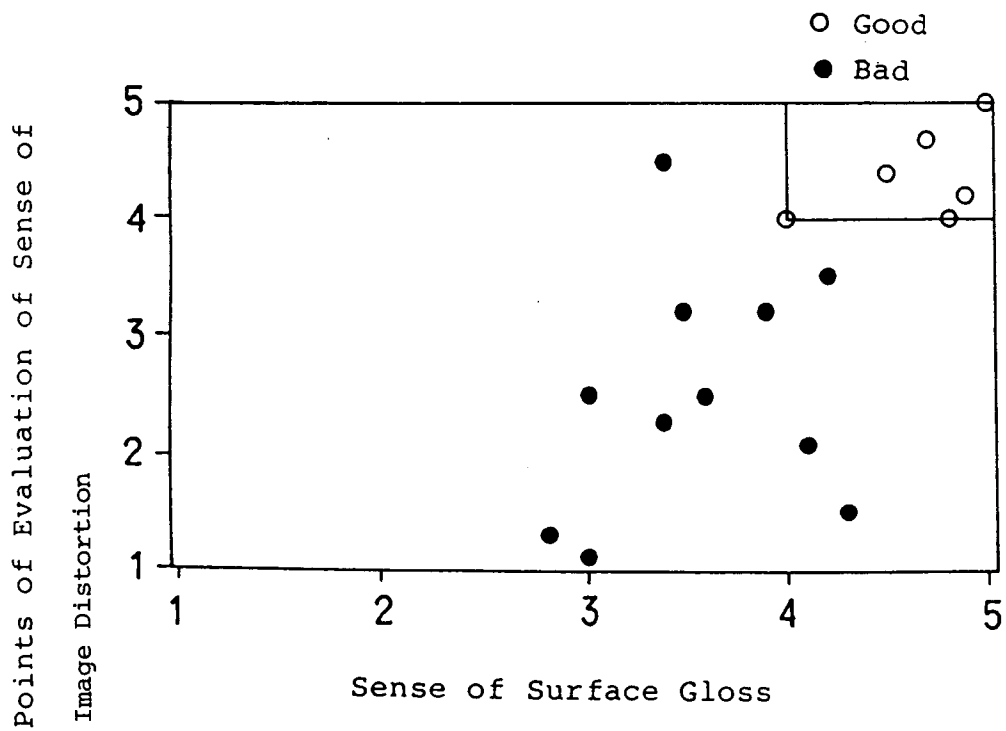


FIG.13

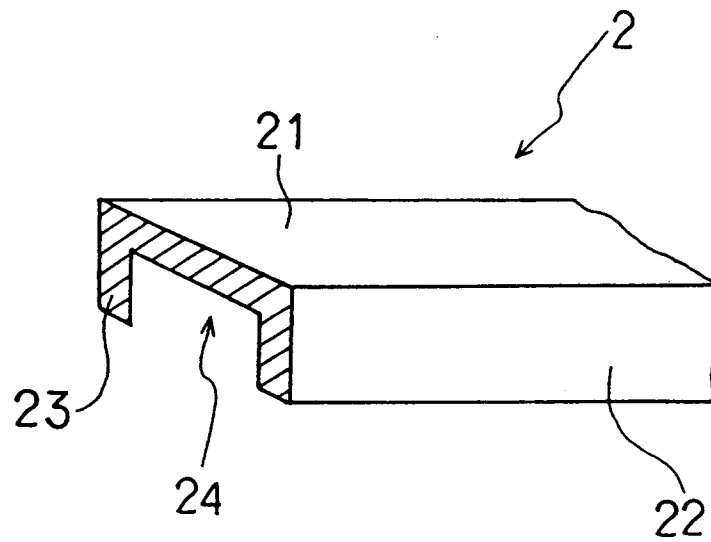


FIG.14

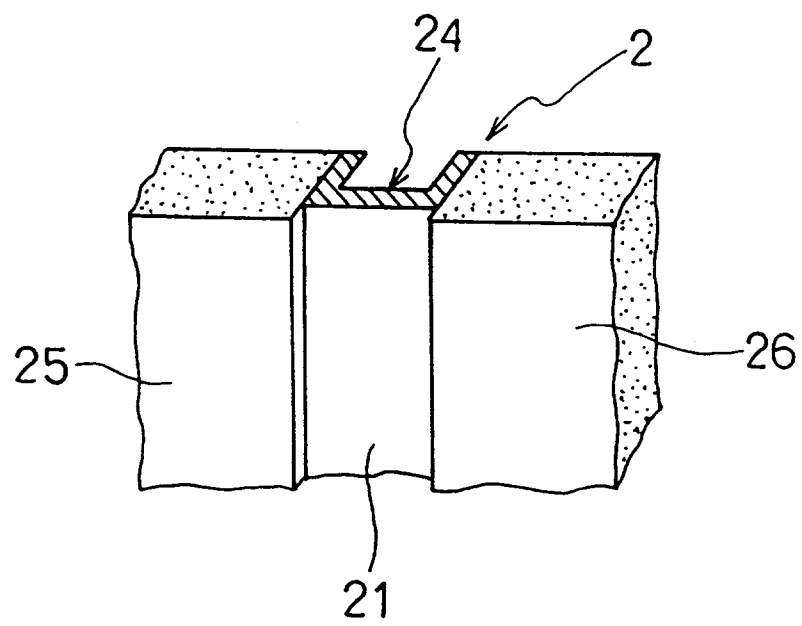


FIG.15

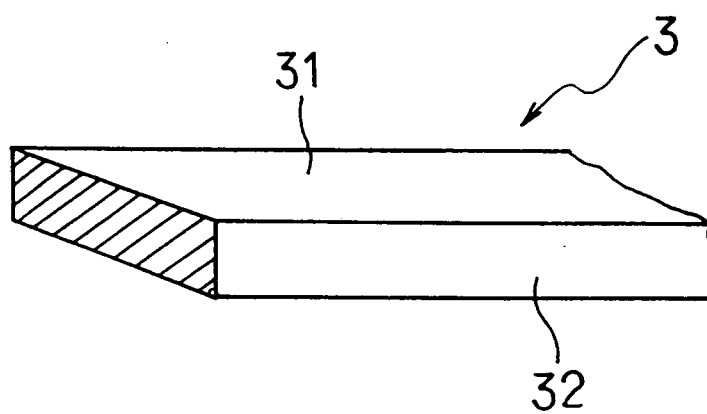
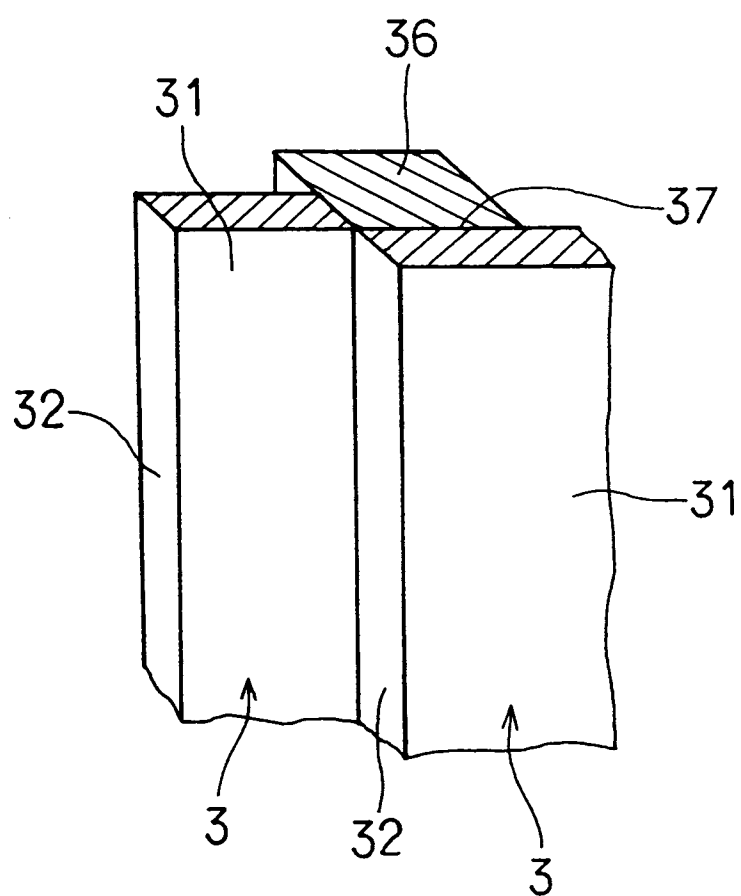


FIG.16





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 11 1822

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	WO-A-90 04047 (AVESTA AKTIEBOLAG) -----		C25F3/24
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			C25F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 10 November 1993	Examiner NGUYEN THE NGHIEP, N
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			