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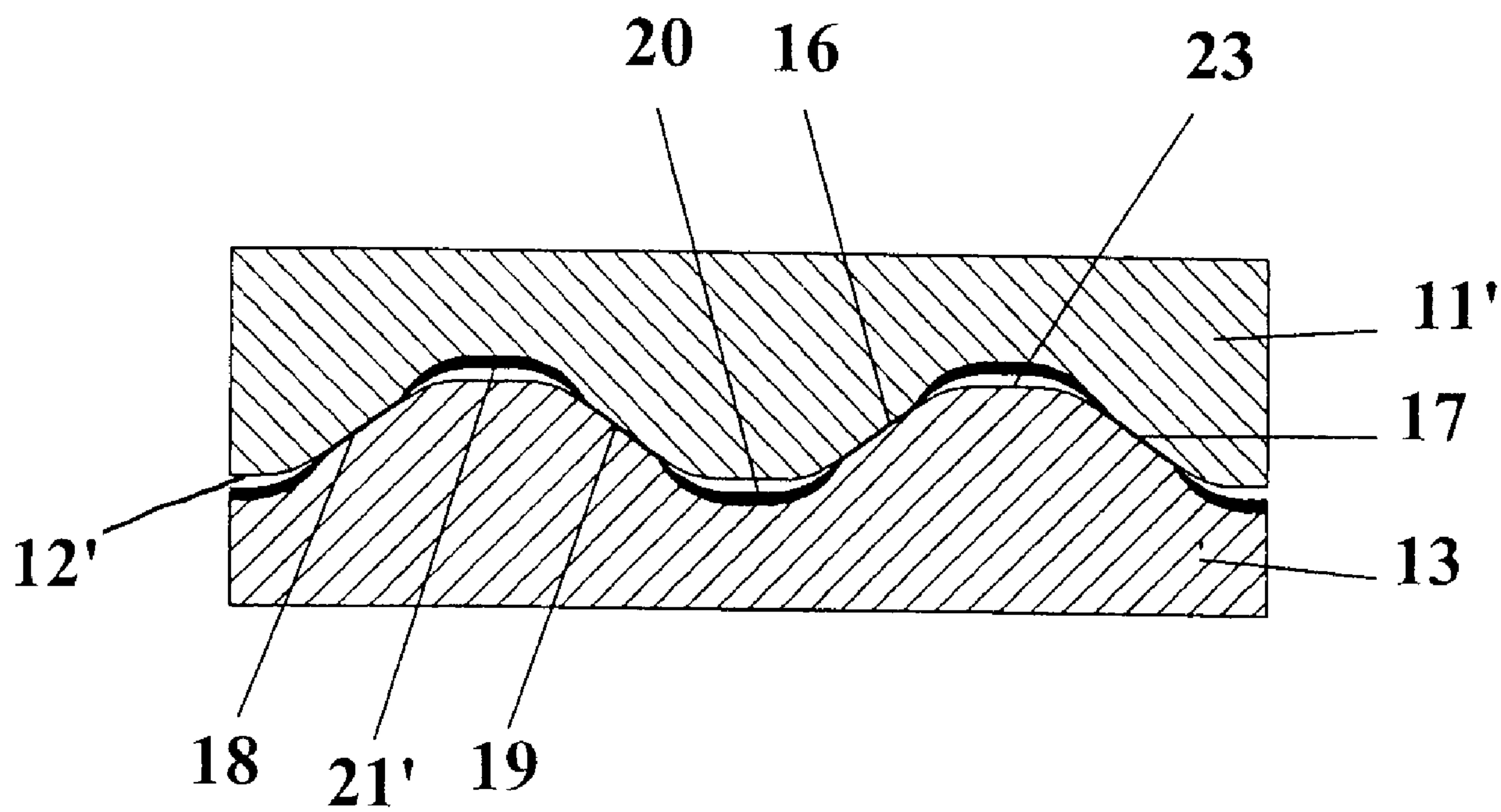
(54) Title: THREAD JOINT AND ROCK DRILL ELEMENT



(57) Abrégé/Abstract:
The present invention relates to a thread joint and a drill element for percussive drilling wherein flushing water is used, comprising at least one substantially cylindrical external thread as well as a substantially cylindrical internal thread (12). The external thread is provided on a spigot (13) intended to constitute an integral part of a first drill string component. The threads (12) comprise thread flanks (16, 17; 18, 19) and thread roots (20; 21) provided between the flanks. The thread roots (20) of the cylindrical external thread is provided substantially distant from associated crests (22) of the cylindrical internal thread (12). By coating the thread roots (20) of the cylindrical external thread with at least one layer of a material of higher electrode potential than the underlying steel such as nickel, chromium, copper, tin, cobalt, titanium or alloys thereof an increased life length for the threaded connection is obtained.

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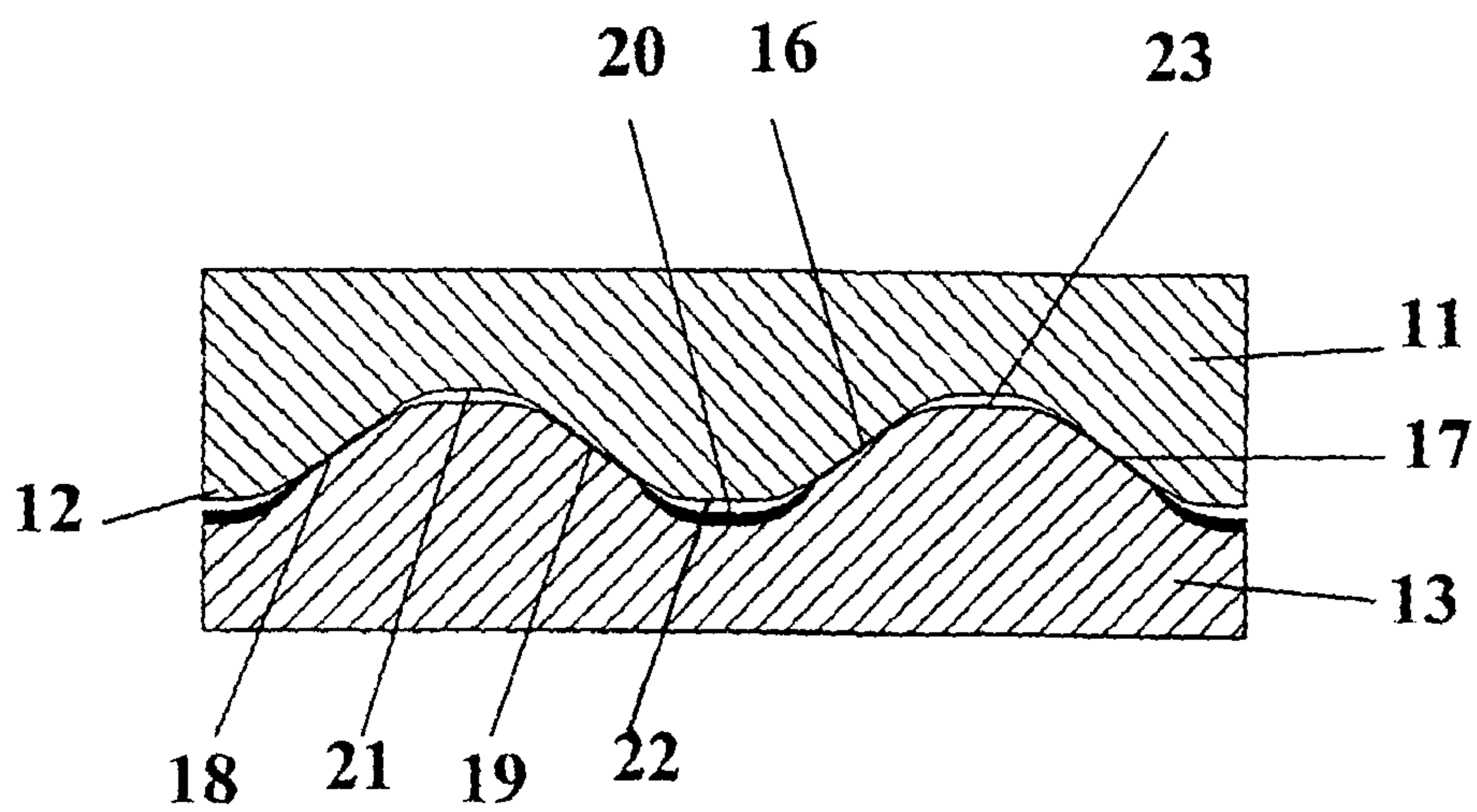
(54) Title: THREAD JOINT AND ROCK DRILL ELEMENT



(57) Abstract: The present invention relates to a thread joint and a drill element for percussive drilling wherein flushing water is used, comprising at least one substantially cylindrical external thread as well as a substantially cylindrical internal thread (12). The external thread is provided on a spigot (13) intended to constitute an integral part of a first drill string component. The threads (12) comprise thread flanks (16, 17; 18, 19) and thread roots (20; 21) provided between the flanks. The thread roots (20) of the cylindrical external thread is provided substantially distant from associated crests (22) of the cylindrical internal thread (12). By coating the thread roots (20) of the cylindrical external thread with at least one layer of a material of higher electrode potential than the underlying steel such as nickel, chromium, copper, tin, cobalt, titanium or alloys thereof an increased life length for the threaded connection is obtained.

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THREAD JOINT AND ROCK DRILL ELEMENT

Background of the invention

The present invention relates to a thread joint and a drill element for rock drilling in accordance with the preambles of the appended independent claims.

Prior art

During percussive rock drilling the drill element, i.e. bits, rods, tubes, sleeves and shanks adapters, are subjected to corrosive attacks. This applies in particular to underground drilling where water is used as flushing medium and where the environment is humid. The corrosive attacks are particularly serious in the most stressed parts, i.e. thread bottoms and thread clearances. In combination with pulsating stress, caused by shock waves and bending loads, so-called corrosion fatigue arises. This is a common cause for failure of the drill element.

Today low-alloyed, case hardened steels are normally used in the drill element. The reason for this is that abrasion and wear of the thread parts have generally been limiting for life lengths. As the drill machines and the drill elements have become more efficient, these problems have however diminished and corrosion fatigue has become a limiting factor.

The case hardening gives compressive stresses in the surface, which gives certain effects against the mechanical part of the fatigue. The resistance to corrosion at a low-alloyed steel is however poor and for that reason corrosion fatigue still happens easily.

In US-A-4,872,515 or 5,064,004 a drill element is shown wherein a threaded portion is provided with a metallic material, which is softer than the steel of the drill element. Thereby is intended to solve the problem of pitting in the threads by covering at least the parts of the thread of the drill element that cooperate with other parts of the threaded connection.

Objects of the invention

One object of the present invention is to substantially improve the resistance against corrosion fatigue of a drill element for percussive rock drilling.

Another object of the present invention is to substantially improve the resistance against corrosion fatigue in sections of reduced cross-sections in a drill element for percussive rock drilling.

Still another object of the present invention is to substantially improve the resistance against corrosion fatigue in the roots of the thread in a threaded portion in a drill element for percussive rock drilling.

Brief description of the drawings

These and the other objects have been achieved by means of a thread joint and a drill element which have obtained the features in accordance with the characterizing portions of the appended independent claims with reference to the drawings. Fig. 1 shows a drill element according to the present invention in a side view, partly in cross-section. Fig. 2 shows one end of the drill element in a side view. Fig. 3 shows an axial cross-section of the end. Fig. 4 shows an axial cross-section of an embodiment of a thread joint according to the present invention. Fig. 5 shows an axial cross-section of an alternative embodiment of a thread joint according to the present invention. Fig. 6 shows an axial cross-section of an alternative embodiment of a drill element according to the present invention.

Detailed description of the invention

The drill element or the first drill string component 10 for percussive drilling shown in Figs. 1 to 4 is a drill tube and is provided at one end with a sleeve portion or a female portion 11 with a cylindrical female thread or cylindrical internal thread 12. The female portion 11 constitutes an integral part of the drill tube 10. At its other end the drill tube 10 is formed with a spigot or male portion 13 according to the present invention provided with a cylindrical male thread or cylindrical external thread 14. The shown thread is a so-called trapezoid thread but other thread shapes can be used, for example a rope thread. Furthermore, the drill element has a through-going flush channel 15, through which a flush medium, usually air or water, is transferred. The male thread 14 comprises the thread flanks 16, 17 and thread roots 20 arranged between the flanks. The female thread 12 comprises the thread flanks 18, 19 and thread roots 21 arranged between flanks. At a tightened joint according to Fig. 4 the thread roots 20 of the male thread 14 are provided substantially distant from the associated crests 22 of the female thread.

According to the present invention the thread roots 20 of the drill element of the male portion are provided with a coating consisting of at least one surface modifying, corrosion protective layer. Only the most exposed portions, that is sections of reduced cross-section such as thread roots 20, restrictions 24 and clearances are coated. The greatest layer thickness is 0.002-5 mm, preferably 0.02-2 mm. The thread root has a first width, W1, and the thread, that is the thread crest 23 and the uncoated part of the tread flanks 16, 17 have a second width, W2 (Fig. 3), where the ratio W1/W2 is 0.02-1.2, preferably 0.3 - 0.8. For example a rope thread (R35) was covered by a 5 mm thick coating (W1). The thread pitch was 12.7 mm, which gave W2=12.7-5=7.7 and W1/W2=0.65.

Said corrosion protective layer in the coating of the drill element according to the invention is more electro-positive than the carrying or underlying steel, that is the layer has a more positive electrode potential, at least 50 mV, preferably at least 100 mV and most preferably at least 250 mV, in the actual environment, and thus has more resistance to corrosive attack. Examples of such protective material are nickel, chromium, copper, tin, cobalt and titanium as well as alloys of these, preferably corrosion resistant steels or Co- or Ni-base alloys. The remaining layers can be constituted of binder layers in order to increase the bond between the coating and the steel.

A number of different coating methods can be used to apply the layer, for example hot dipping, chemical or electrolytic plating, thermal spraying and welding, preferably welding by means of laser. In case the coating process gives a coating which covers more than some of the sections of reduced cross-sections, such as the thread root, the restriction or the clearance, this part of the coating is removed by means of machining before use or through wear after short period of use. With the latter is meant that coating of impact transferring surfaces is not advantageous. In the independent claims is consequently indicated that "at least one of the sections having a reduced cross-section comprises partly a layer of a material with higher electrode potential" wherein the word "partly" also comprises the cases when a possible layer on the impact transferring surfaces is worn away very quickly.

Example

During so-called production drilling of long holes an about 2 m long drill tube is used, Fig. 1, which is extended to long strings. The critical parts of the tubes are the bottoms 20 of the external threads 14 (Fig. 2). Flushing water and pulsating tensile stresses lead to corrosion fatigue that frequently results in fracture.

The thread roots of the external threads, according to Fig. 3, with six tubes of low-alloyed steel were covered by a layer of maximal thickness of 0.6-0.9 mm with laser welding. Two different alloys with electrode potentials and compositions according to below were used.

	%C	%Cr	%Ni	%Mo	%Fe	%Co	Electrode potential (mV)*
Test 1-4	0.25	27	2.5	6	1	Rest	+200
Test 5-6	0.03	21.5	5	2.7	Rest	-	+100

*Approximate value in sea-water, 10°C. Corresponding values for a low-alloyed steel is -500 mV.

The six tubes were used together with 14 conventional tubes in the same drill string in a rig for production drilling underground and were drilled until fracture or the tubes were worn-out. Following life lengths, measured in drilled meter, were obtained for the individual tubes according to the present invention:

Test 1	751 m
Test 2	881 m
Test 3	>1003 m
Test 4	>1003 m
Test 5	892 m
Test 6	1193 m

For tests 3 and 4 the life length was not reached due to breakage, since the drill string was stuck in the rock before any fracture occurred. The average life length for the above-captioned tests consequently became 954 m. The normal life length for conventional drill tubes is about 500 m, which means that coating of the drill element according to the present invention resulted in a striking improvement, i.e. almost a doubling of the life length.

In an alternative embodiment of a thread joint according to the present invention also the thread 12' of the female portion 11' is coated with a layer of a material of higher electrode potential than steel, Fig. 5. Consequently also sections of the female portion 11' of reduced cross-sections are provided with a coating consisting of at least one surface modifying, corrosion protective layer. Only the most exposed portions, that is sections of reduced cross-sections such as thread roots 21', restrictions and clearances are coated. What has been stated above about coating applies also to the case the coating is applied at the female portion 11'.

In an alternative embodiment of a drill element according to the present invention only the most stressed parts of the thread root, for example one (to the right in Fig. 6) or both (to the left) transitions from the thread root to the flank of a trapezoid thread are coated, that is where the drill element has its smallest radius, Fig. 6.

The invention consequently relates to a thread joint and a drill element for percussive drilling with a restricted portion which is coated by a corrosion protective layer in order to substantially improve the resistance to corrosion fatigue. The layer is preferably discontinuous in the axial direction to avoid deposition on and softening of the thread flanks.

Claims

1. A thread joint of steel for percussive drilling wherein flushing water is used, comprising sections of reduced transverse cross-section, at least one substantially cylindrical external thread as well as a substantially cylindrical internal thread, said threads comprising thread flanks and thread roots provided between the flanks, the thread roots of the cylindrical external thread being spaced from and facing respective crests of the cylindrical internal thread, at least one of said sections of reduced transversal cross-section partly comprising a layer of a material of higher electrode potential than steel, said layer being made from nickel, chromium, copper, tin, cobalt, titanium or alloys thereof,
wherein the external thread is provided on a spigot intended to constitute an integral part of a first drill string component and in that the layer on the external thread is situated merely in regions thereof located radially inwardly of the thread flanks on the external thread.

2. The thread joint according to claim 1, wherein the layer is made substantially only in the thread root of the thread, said thread root having a first width, W1, and the thread crest and the uncoated part of the tread flanks having a second width, W2, where the ratio W1/W2 is 0.02 to1.2.

3. The thread joint according to claim 2, wherein the ratio W1/W2 is 0.3 to 0.8.

4. The thread joint according to claim 1, 2, or 3, wherein the material in the layer has at least 50 mV higher electrode potential than steel, preferably at least 100 mV and more preferably at least 250 mV higher electrode potential than steel.

5. The thread joint according to any one of claims 1 to 4, wherein the greatest layer thickness is 0.002 to 5 mm.

6. The thread joint according to claim 5, wherein the greatest layer thickness is 0.02 to 2 mm.

7. The thread joint according to any one of claims 1 to 6, wherein one of the following coating methods has been used to apply the layer: hot dipping, chemical or electrolytic plating, thermal spraying and welding.

8. The thread joint according to claim 7, wherein the welding is by means of laser.

9. A drill element for a thread joint for percussive drilling of the type according to claim 1, wherein flushing water is used, said drill element comprising sections of reduced transversal cross-sections and at least one substantially cylindrical external thread, said thread comprising thread flanks and thread roots provided between the flanks, said thread roots of the cylindrical external thread being adapted to be spaced from and facing respective crests of a cylindrical internal thread, at least one of said sections of reduced transversal cross-section partly comprising a layer of a material of higher electrode potential than steel, said layer being made from nickel, chromium, copper, tin, cobalt, titanium or alloys thereof, wherein the external thread is provided on a spigot intended to constitute an integral part of a first drill string component and in that the layer on the external thread is situated merely in regions thereof located radially inwardly of the thread flanks on the external thread.

10. The drill element according to claim 9, wherein the layer is applied substantially only in the thread root of the thread, said thread root having a first width, W1, and the thread crest and the uncoated part of the tread flanks having a second width, W2, where the ratio W1/W2 is 0.02 to 1.2.

11. The drill element according to claim 10, where the ratio W1/W2 is 0.3 to 0.8.

12. The drill element according to claim 9 to 11, wherein the material in the layer has at least 50 mV higher electrode potential than steel.

13. The drill element according to claim 12, wherein the material in the layer has at least 100 mV higher electrode potential than steel.

14. The drill element according to claim 12, wherein the material in the layer has at least 250 mV higher electrode potential than steel.

15. The drill element according to any one of claims 9 to 14, wherein the greatest layer thickness is 0.002 to 5 mm.

16. The drill element according to claim 15, wherein the greatest layer thickness is 0.02 to 2 mm.

17. The drill element according to any one of claims 9 to 16, wherein one of the following coating methods has been used to apply the layer: hot dipping, chemical or electrolytic plating, thermal spraying and welding, preferably welding by means of laser.

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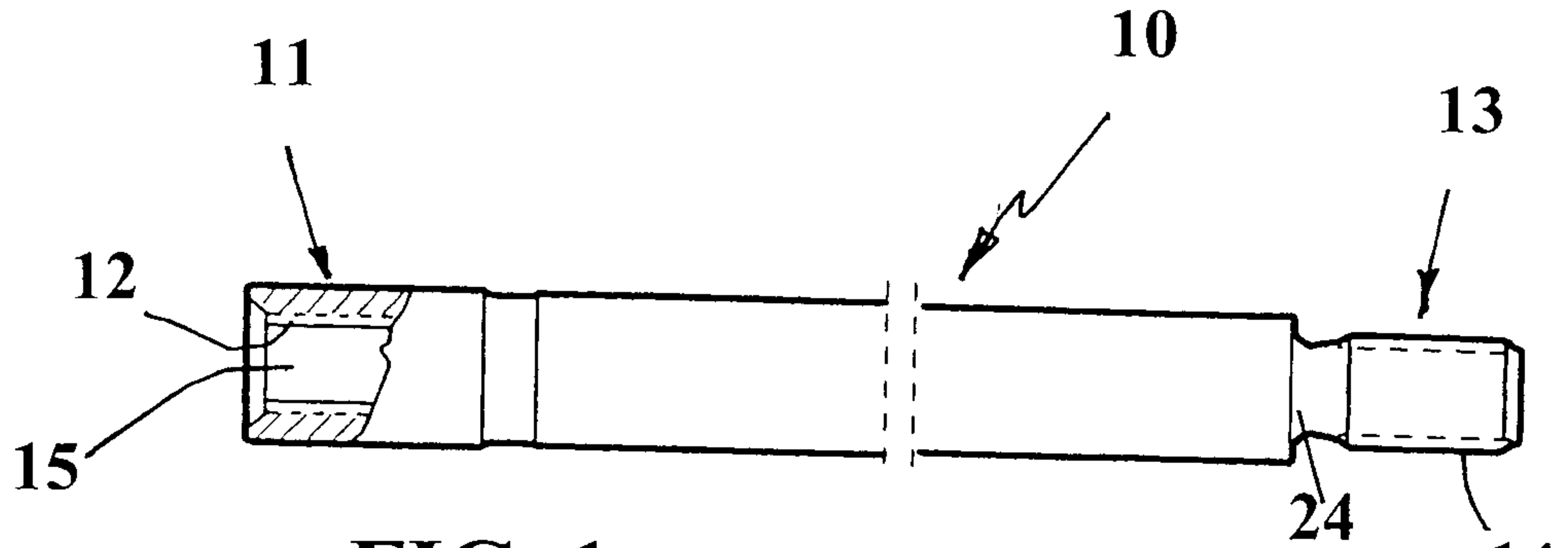

FIG. 1

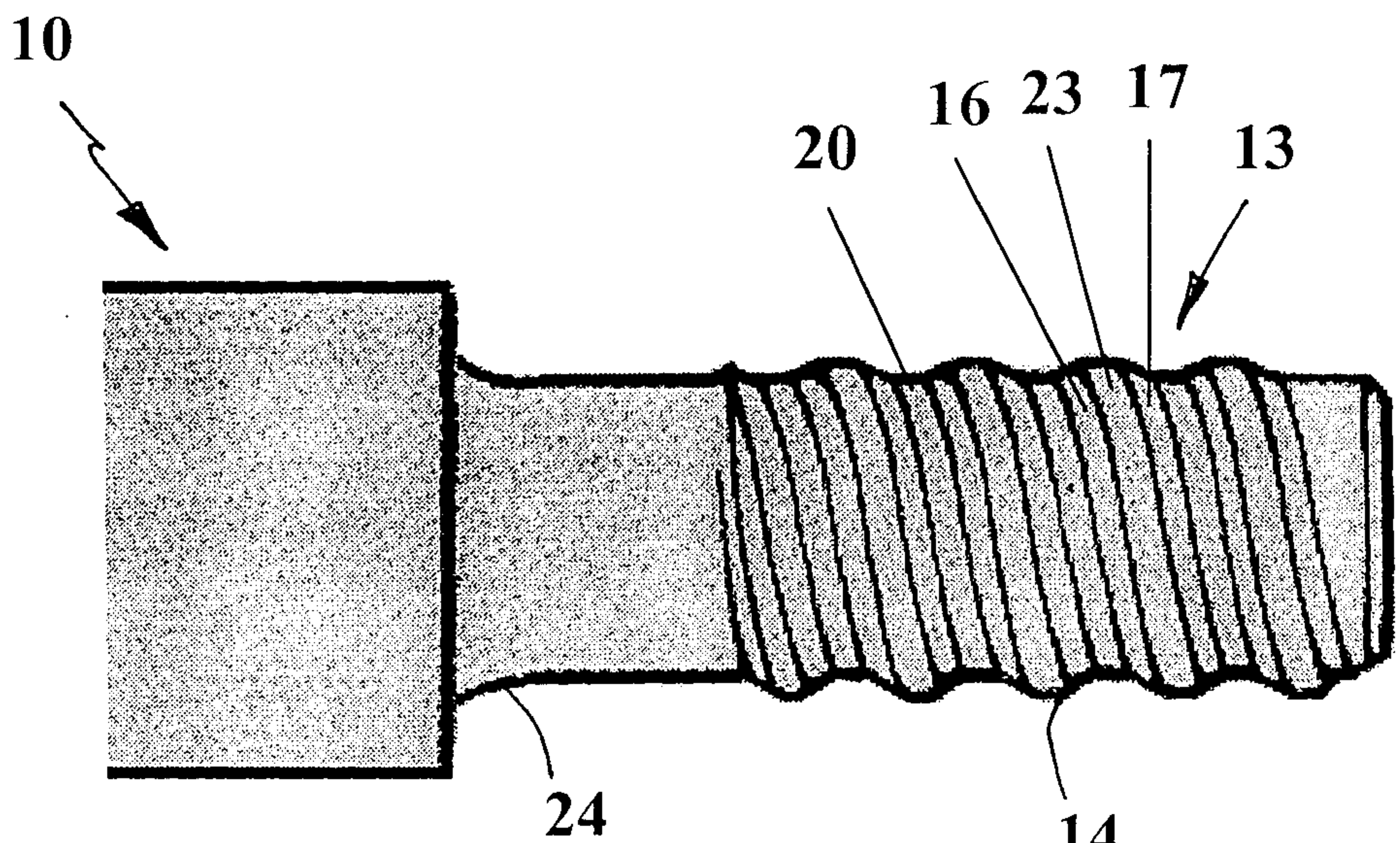

FIG. 2

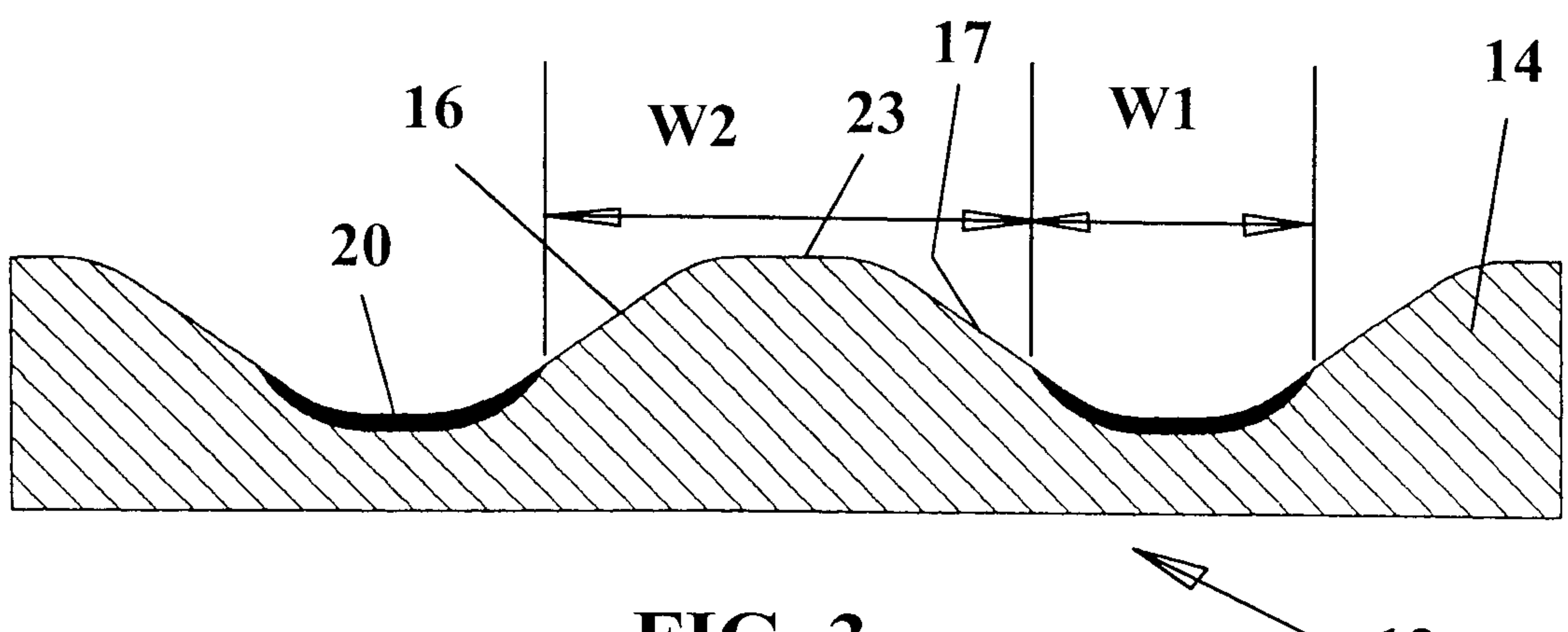

FIG. 3

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FIG. 4

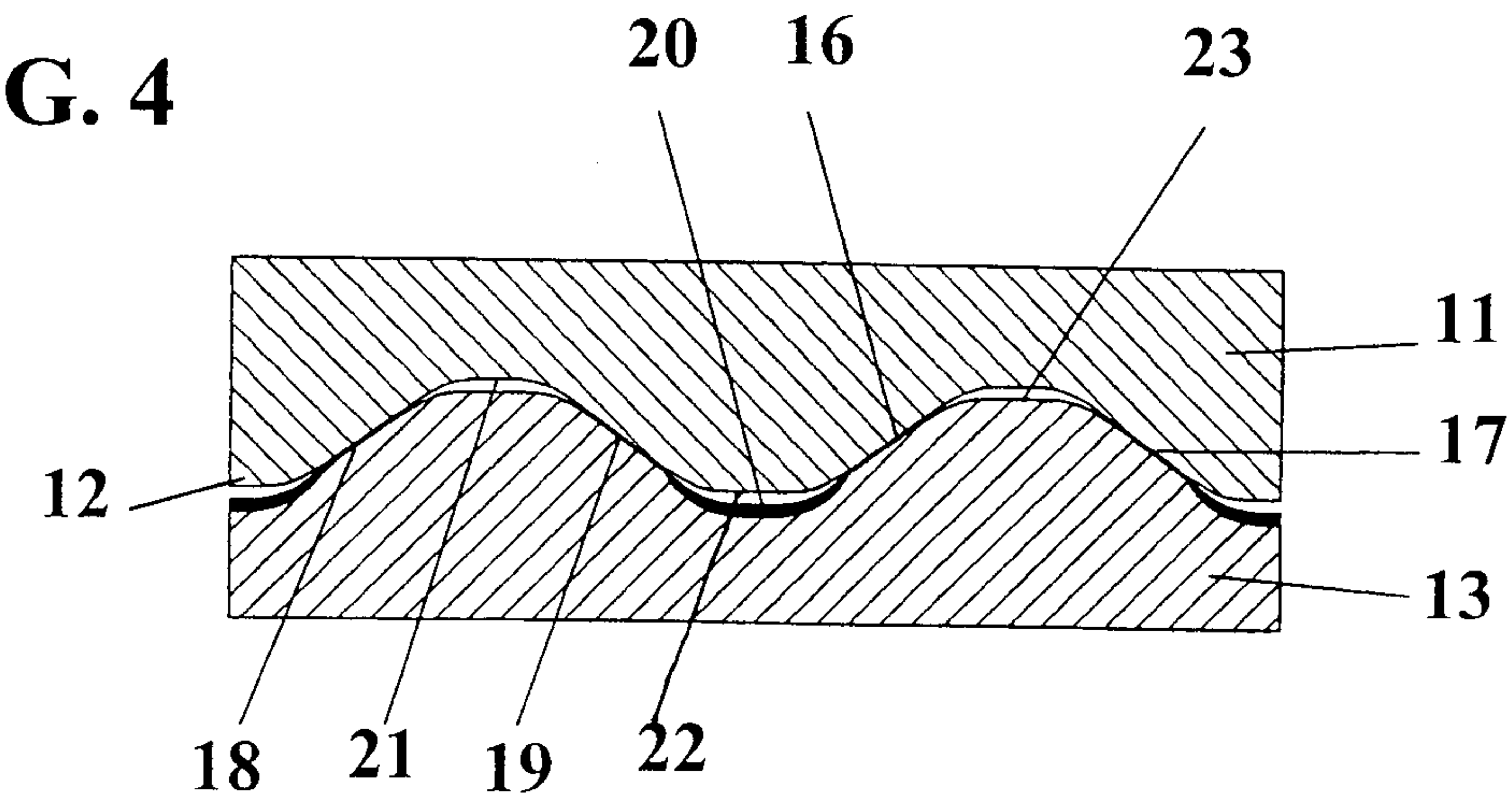


FIG. 5

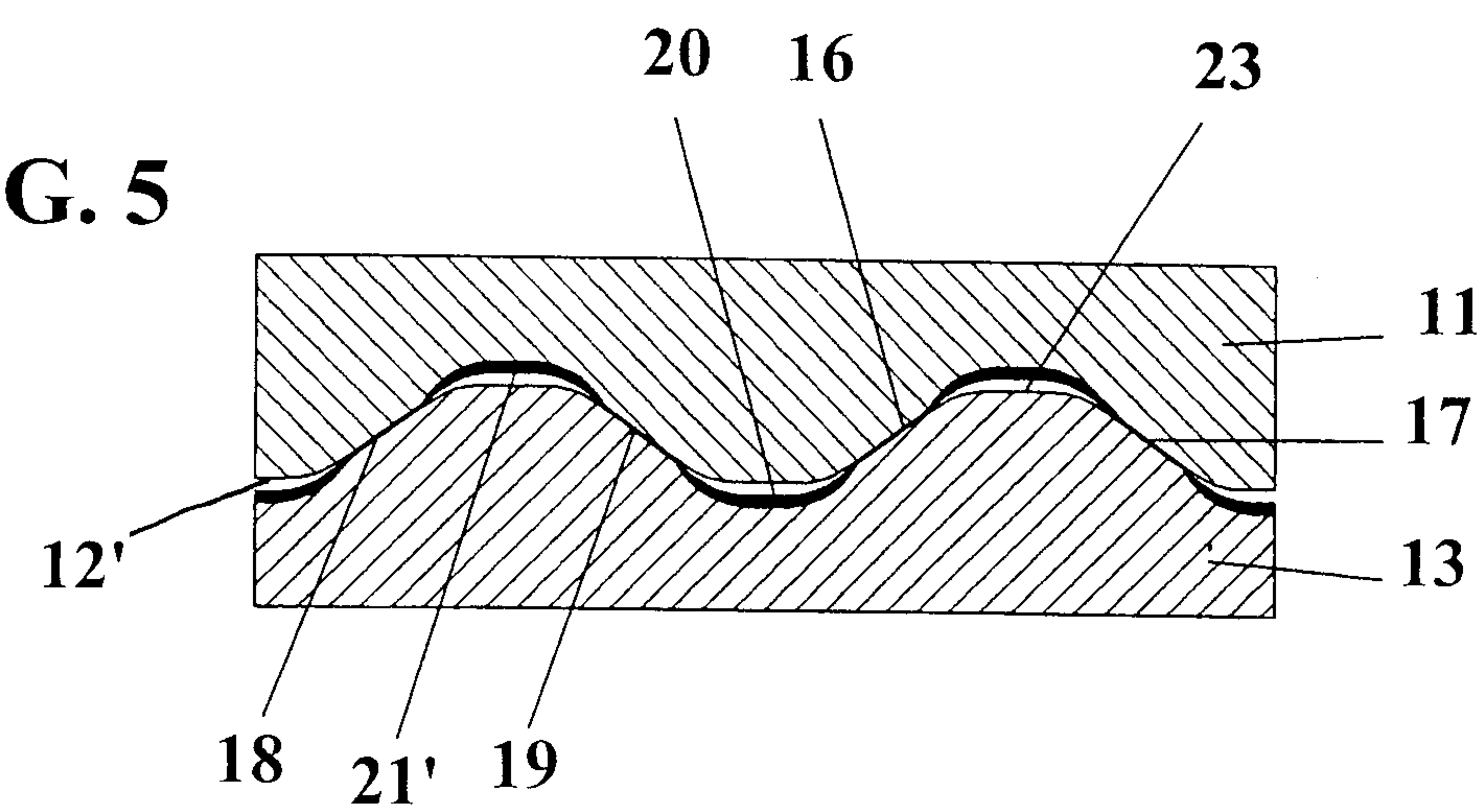
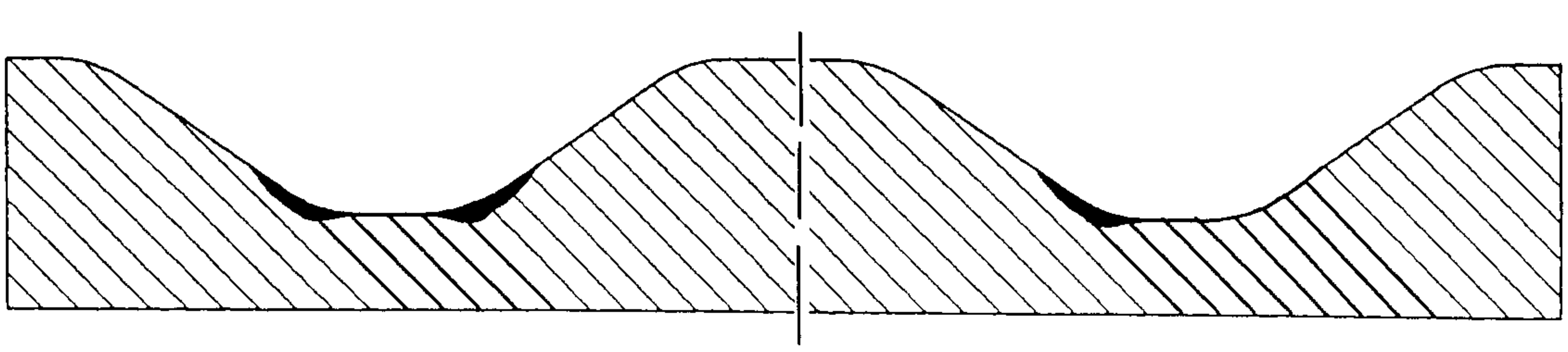


FIG. 6



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