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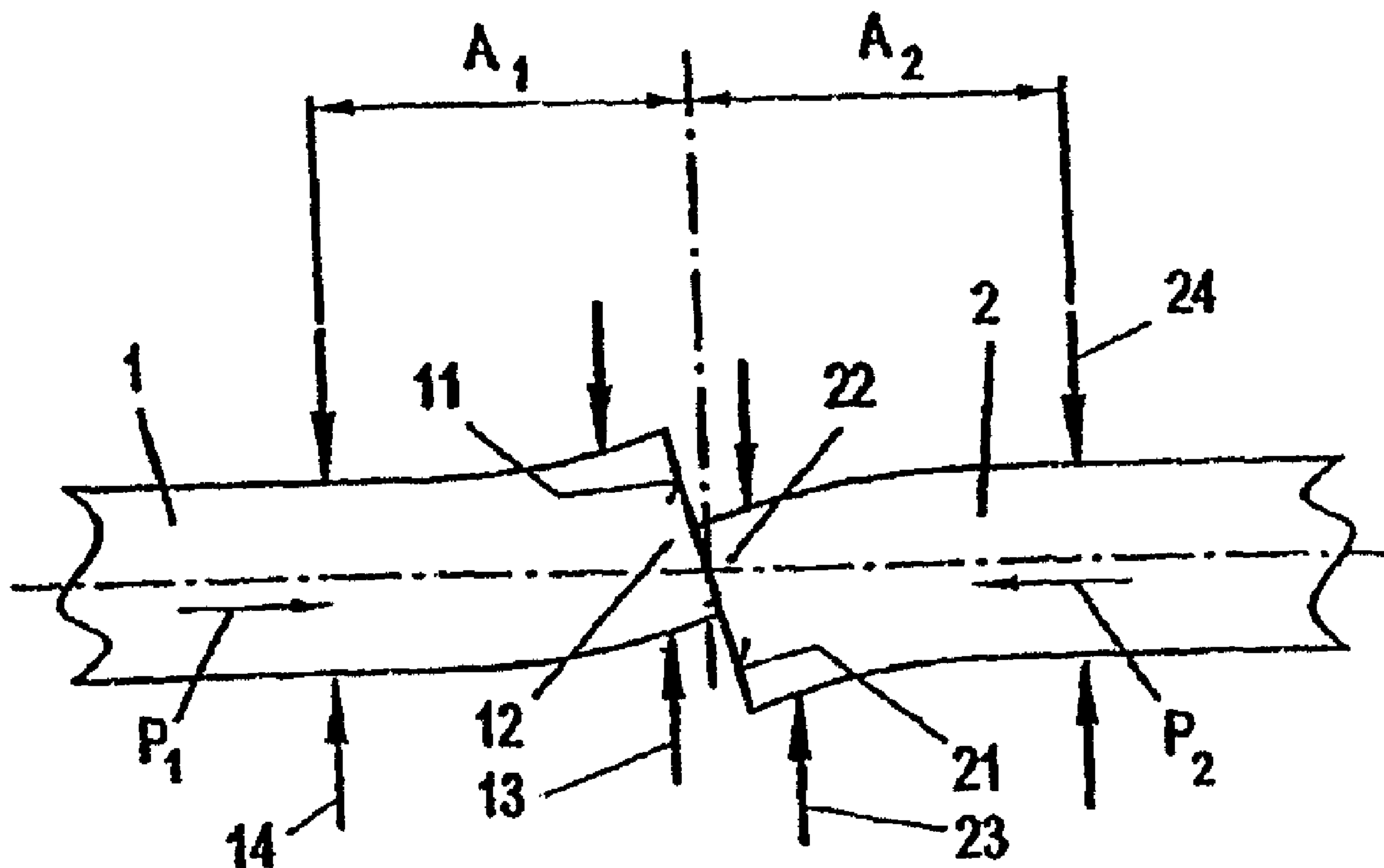
(72) Inventeur/Inventor:
PFEILER, HANS, AT

(73) Propriétaire/Owner:
VOESTALPINE SCHIENEN GMBH, AT

(74) Agent: MARKS & CLERK

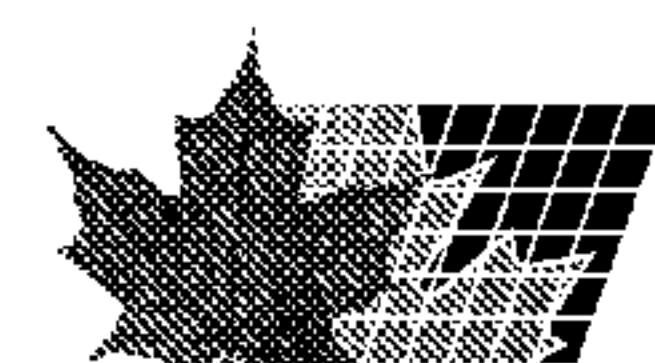
(54) Titre : PROCEDE D'ASSEMBLAGE METALLIQUE DE BARRES PAR SOUDAGE PAR FRICTION OSCILLANT

(54) Title: METHOD FOR METALLICALLY CONNECTING RODS BY MEANS OF OSCILLATING FRICTION WELDING



(57) Abrégé/Abstract:

The invention relates to a method for metalically connecting the faces or cross-sectional surfaces of rods (1, 2), optionally profiled rods, e.g., rails, with great longitudinal extension, by means of friction welding. According to the invention, it is thereby provided for a high-quality hot-pressure weld across the entire surface that an axially normal dressing of the rod ends and an axially aligned alignment of the rods (1, 2) are carried out, whereupon their dressed cross-sectional surfaces (11, 21) are placed against one another, pressurized and the two rod ends (12, 22) are moved in an oscillating manner in an opposite direction relative to one another, friction heat being generated at the contact surfaces, and when the criteria for a metallic connection are met, the pressurization (P_1 , P_2) of the cross-sectional surfaces (11, 21) is increased and the entire surfaces thereof are connected to one another.



Abstract

The invention relates to a method for metallicity connecting the faces or cross-sectional surfaces of rods (1, 2), optionally profiled rods, e.g., rails, with great longitudinal extension, by means of friction welding. According to the invention, it is thereby provided for a high-quality hot-pressure weld across the entire surface that an axially normal dressing of the rod ends and an axially aligned alignment of the rods (1, 2) are carried out, whereupon their dressed cross-sectional surfaces (11, 21) are placed against one another, pressurized and the two rod ends (12, 22) are moved in an oscillating manner in an opposite direction relative to one another, friction heat being generated at the contact surfaces, and when the criteria for a metallic connection are met, the pressurization (P_1 , P_2) of the cross-sectional surfaces (11, 21) is increased and the entire surfaces thereof are connected to one another.

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Method for Metallically Connecting Rods by Means of Oscillating Friction Welding

The invention relates to a method for metallically connecting the faces of rods, optionally of profiled rods, e.g., rails, with great longitudinal extension, by means of friction welding.

In principle, fusion-welding methods and hot-pressure welding methods, namely friction welding methods can be used to connect the ends of rods. In assembly technology, friction welding methods can have economic and qualitative advantages; however, experts think their use is not expedient for some types of joints, e.g., joining the faces of profiled rods.

With friction welding of parts, two surfaces to be joined are pressed together and moved relative to one another, whereby frictional heat is generated and the part areas are heated. Through the heating of the areas near to the friction surfaces, a plasticization of the material therein occurs, so that after the completion of the relative movement and an increased pressing apart of the parts, a metallic connection occurs through solid diffusion.

If it can be done at all, rods with great longitudinal extension and rods profiled in cross section can be produced axially aligned only with extraordinary effort by means of a rotational friction welding method, whereas a profile-aligned connection is an unsolved problem.

With a connection of the rods by a linear friction welding or an orbital friction welding, it is important to achieve a precise axially aligned alignment of the same in the connection area. In particular with a friction welding of profiled rods, such as rails, it is additionally of greatest importance to connect the cross-sectional surfaces with precision fit.

A method and a device for the friction welding of railway rails and comparable, similar carrier profiles is known from DE 19807457 A1, in which an intermediate piece is moved in linear or orbital oscillation between the rail ends to be connected and the rail ends are

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pressed toward one another onto the intermediate piece in order to generate the heat necessary for welding through frictional heat. Such a friction welding method has the advantage that an axial alignment of the stationary rails during friction welding can be achieved irrespective of the method; however, a formation of two connection surfaces per connection area is disadvantageous.

All the methods according to the prior art also have the disadvantage that a bending of the free ends of the rods, can bring their faces to be connected out of parallelism and thus impede a friction heating and plasticization of the material close the surface across the entire surface.

The object of the invention is now, while avoiding disadvantages, to create a method of the type mentioned at the outset, with which profiled rods can be metalically connected by the faces through friction welding in an axially aligned manner over the surface.

This object is attained with a generic friction welding method in that an axially normal dressing of the rod ends and an axially aligned alignment of the rods are carried out, whereupon their dressed faces or cross-sectional surfaces are placed against one another and are pressurized, whereby the two rod ends are moved in an oscillating manner in the opposite direction relative to one another and frictional heat is generated on the contact surfaces, whereupon, when the criteria for a metallic connection are met, the rod ends are axially aligned, the pressurization of the cross-sectional surfaces is increased and they are connected to one another over the entire surface.

The advantages obtained with the invention are essentially that the oscillation amplitude of a rod end is reduced to approximately half of the degree of oscillation to be provided according to the method. The relative speed between the two friction surfaces is thereby essentially twice as high as the speed of the oscillation of the respective rod ends or cross-sectional surfaces. According to the invention, the stress on parts of the friction welding device and the rod ends is thus reduced. A further essential advantage of the invention is that the faces or axially normal cross-sectional surfaces remain essentially

parallel at the ends of the rods through their oppositely directed bending and therefore ensure a virtually identical specific generation of frictional heat over the whole area. A material plasticization can thus be achieved and high connection quality established over the entire cross section of the two faces in their area close to the surface. The low oscillation speed and the like oscillation amplitude of the respective rod ends renders possible an axially aligned alignment of the rods that is simplified in implementation before the increased pressurization of the faces for creating the metal connection.

In a further development of the invention in which the relative movement between the rod ends is carried out in a orbitally circulating or elliptical manner, the essential advantage can be achieved that the accelerations and retardations are avoided which are to be imposed with a linear oscillating movement of the rod ends. Furthermore, through an orbital movement, the energy input in the zones of the rods close to the cross-sectional surfaces is increased, because negative accelerations and stoppages relative to one another of the two friction surfaces do not occur in the oscillation cycle.

High-grade, quality-assured friction welded joints can be achieved if, during a fixing of the rods in respectively stationary holders, the two rod ends are bent in the opposite direction towards one another by means of moving elements and are moved in an orbital manner in the opposite direction at the same angular velocity. It is thereby advantageous if the two rods are respectively clamped in the stationary holders with essentially the same spacing from their faces or cross-sectional surfaces.

To avoid brittle hard areas in and/or close to the weld seam, which areas can have or initiate cracks, it can be provided according to the invention that a heat treatment method of the rod ends is superimposed on the connection method of the same. Through such a method it is possible to establish an essentially homogenous, tough structure free of hardness peaks.

In one aspect, the invention provides a process for metallicity connecting the faces of rods, the process comprising:

axially normal dressing at least two rod free ends,

placing the cross sectional surfaces of the at least two rod free ends one against another

5 under pressure; and

oscillating the at least two rod free ends in directions opposite one another, such that a bending of the at least two rod free ends occurs;

whereby frictional heat is generated on the contact surfaces of the at least two rod free ends such that when the conditions for a metallic connection are met, the at least two rod

10 free ends are axially aligned, the pressurization of the cross sectional areas is increased and the at least two rod free ends are connected to one another over the entire surface.

In one aspect, the invention provides an apparatus for metallicity connecting at least two elements, the apparatus comprising:

15 a pressure device having at least two stationary holders structured and arranged to axially align the at least two elements and to exert pressure between free ends of the at least two elements; and

a moving device structured and arranged to move the free ends in an oscillating manner in directions opposite one another while under pressure from said pressure device such

20 that a bending of the free ends occurs.

In one aspect, the invention provides a process for metallicity connecting the faces of profiled rods, the process comprising:

axially normal dressing at least two profiled rod free ends,

25 placing the cross sectional surfaces of the at least two profiled rod free ends one against another under pressure; and

oscillating the at least two profiled rod free ends in directions opposite one another, such that a bending of the at least two profiled rod free ends occurs and the cross sectional surfaces remain essentially parallel through their oppositely directed bending;

30 whereby frictional heat is generated on the contact surfaces of the at least two profiled rod free ends such that when the conditions for a metallic connection are met, the at least two profiled rod free ends are axially aligned, the pressurization of the cross sectional

areas is increased and the at least two profiled rod free ends are connected to one another over the entire surface.

In one aspect, the invention provides a method for metallicity joining the end faces of
5 rails having a considerable longitudinal extent by friction welding, wherein axially
normal dressing of the rail ends and axially aligned orientation of the rails are carried out,
after which the rails which are to be joined are in each case clamped in stationary holders
at substantially the same distance from their dressed or cross-sectional faces, their
dressed end or cross-sectional faces are placed against one another, pressurised and the
10 two rail ends are bent by means of moving elements and moved in an oscillating manner
relative to one another in opposite directions, wherein frictional heat is generated at the
contact faces and, upon attaining the criteria for a metallic joint, the rod ends are axially
aligned, the pressurisation of the cross-sectional faces is increased and these are joined
together all over.

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The invention in only one embodiment will be shown in more detail on the basis of
diagrammatic drawings.

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They show:

Fig. 1 Geometric development of a rod end during an oscillating friction movement of the same

Fig. 2 Geometric development of the rod ends during their oscillating movement in opposite directions

Fig. 1 shows a geometric development of a rod end 22 of a rod 2 moved in an oscillating manner. A rod 1 is kept stationary at one end 12 by a holder or clamping means 14 and provides a static cross-sectional friction surface 11. A rod 23, the end 22 of which performs an oscillating movement by means of moving elements 23 with an oscillation amplitude S , is placed against the rod 1 with a pressurization P_2 directed against it. Bends of a moved free rod end 22 cause its face 21 to incline and cause it to rest against an opposite face 11 only in some areas, whereby frictional heat is generated only in these areas.

Such a method, which should be considered part of the prior art, as shown in Fig. 1, has the disadvantage of a so-called "india rubber effect" and associated unstable friction-welded joints.

If now, as shown in Fig. 2, according to the invention the ends 12, 22 of two rods 1, 2 are oscillated in an opposite direction relative to one another by moving elements 13, 23 with a vibration amplitude up to 4 mm, an elastic bending of the ends 12, 22 occurs thereby, whereby the faces or cross-sectional surfaces 11, 21 of the rods 1, 2 are aligned with the axial normal and are inclined to the same degree A_1 , A_2 , but still respectively feature parallelism. Homogenously distributed friction heat can thus be input into the face areas of the rods 1, 2 via the frictional surfaces 11, 21 to an equal extent, whereby the highest quality of the metallic connection can be achieved. An approximately equal spacing A_1 , A_2 of stationary holders 14, 24 of the rods to their faces 11, 21 promotes an input of frictional heat over the whole surface into the zone close to the faces of the rods 1, 2 and thus the quality of the friction-welded joint.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for metallicity connecting the faces of rods, the process comprising:
axially normal dressing at least two rod free ends,
placing the cross sectional surfaces of the at least two rod free ends one against another under pressure; and
oscillating the at least two rod free ends in directions opposite one another, such that a bending of the at least two rod free ends occurs;
whereby frictional heat is generated on the contact surfaces of the at least two rod free ends such that when the conditions for a metallic connection are met, the at least two rod free ends are axially aligned, the pressurization of the cross sectional areas is increased and the at least two rod free ends are connected to one another over the entire surface.
2. The process according to claim 1, wherein the rods are profiled rods.
3. The process according to claim 1 or 2, wherein the process for the metallicity connecting the at least two rod free ends of the rods is by friction welding.
4. The process according to any one of claims 1 to 3, wherein rods are rails.
5. The process according to any one of claims 1 to 4, wherein the relative movement between the at least two rod free ends is carried out in an orbitally circulating manner.
6. The process according to any one of claims 1 to 4, wherein the relative movement between the at least two rod free ends is carried out in an elliptical manner.
7. The process according to any one of claims 1 to 6, wherein at least two rods are secured in at least one stationary holder, and the at least two rod free ends of the two rods are respectively bent in the opposite direction by the moving devices and moved in an orbital circulating movement in the opposite direction at the same angular velocity.

8. The process according to any one of claims 1 to 6, wherein the two rods are clamped in at least one stationary holder axially aligned that have the same spacing from the respective rod free end cross sectional surfaces.
9. The process according to any one of claims 1 to 8, wherein a heat treatment process of the at least two rod free ends is superimposed on the process for metallicity connecting the at least two rod free ends of at least two rods.
10. An apparatus for metallicity connecting at least two elements, the apparatus comprising:
 - a pressure device having at least two stationary holders structured and arranged to axially align the at least two elements and to exert pressure between free ends of the at least two elements; and
 - a moving device structured and arranged to move the free ends in an oscillating manner in directions opposite one another while under pressure from said pressure device such that a bending of the free ends occurs.
11. The apparatus according to claim 10, wherein the at least two elements are rods.
12. The apparatus according to claim 11, wherein the at least two rods are profiled rods.
13. The apparatus according to claim 11 or 12, wherein for the metallicity connecting of the rods is by friction welding.
14. The apparatus according to any one of claims 11 to 13, wherein the at least two rods are at least two rails.
15. The apparatus according to any one of claims 10 to 14, wherein said moving device circulates in an orbitally circulating manner.
16. The apparatus according to any one of claims 10 to 14, wherein said moving device circulates in an elliptical manner.

17. The apparatus according to any one of claims 10 to 16, wherein the at least two rods are fixed in said stationary holder; and the rod free ends are bent in the opposite direction towards one another by said moving device, such that the at least two rods move in an orbital manner via said moving device in the opposite direction at approximately the same angular velocity.

18. The apparatus according to any one of claims 10 to 16, wherein the at least two rods are respectively secured in said stationary holder with approximately the same spacing from the respective cross sectional surfaces of the rod.

19. The apparatus according to any one of claims 10 to 14, wherein said moving device moves the free ends of the elements in an oscillating manner in an opposite direction to one another such that a frictional heat is generated on the free end surfaces; said pressure device applies pressure to the axially aligned elements and the elements are connected to one another over the entire cross sectional surfaces of the free end of the elements.

20. A process for metallogically connecting the faces of profiled rods, the process comprising:

- axially normal dressing at least two profiled rod free ends,
- placing the cross sectional surfaces of the at least two profiled rod free ends one against another under pressure; and
- oscillating the at least two profiled rod free ends in directions opposite one another, such that a bending of the at least two profiled rod free ends occurs and the cross sectional surfaces remain essentially parallel through their oppositely directed bending; whereby frictional heat is generated on the contact surfaces of the at least two profiled rod free ends such that when the conditions for a metallic connection are met, the at least two profiled rod free ends are axially aligned, the pressurization of the cross sectional areas is increased and the at least two profiled rod free ends are connected to one another over the entire surface.

21. A method for metallically joining the end faces of rails having a considerable longitudinal extent by friction welding, wherein axially normal dressing of the rail ends and axially aligned orientation of the rails are carried out, after which the rails which are to be joined are in each case clamped in stationary holders at substantially the same distance from their dressed or cross-sectional faces, their dressed end or cross-sectional faces are placed against one another, pressurised and the two rail ends are bent by means of moving elements and moved in an oscillating manner relative to one another in opposite directions, wherein frictional heat is generated at the contact faces and, upon attaining the criteria for a metallic joint, the rail ends are axially aligned, the pressurisation of the cross-sectional faces is increased and these are joined together all over.

22. The method according to claim 21, wherein the relative movement between the rail ends is executed in an orbitally circulating or elliptical manner.

23. The method according to claim 21 or 22, wherein the ends of the two rails are moved in an orbital manner in opposite directions at the same angular velocity.

24. The method according to any one of claims 21 to 23, wherein a method for the heat treatment of the rail ends is superimposed on the method for joining the latter.

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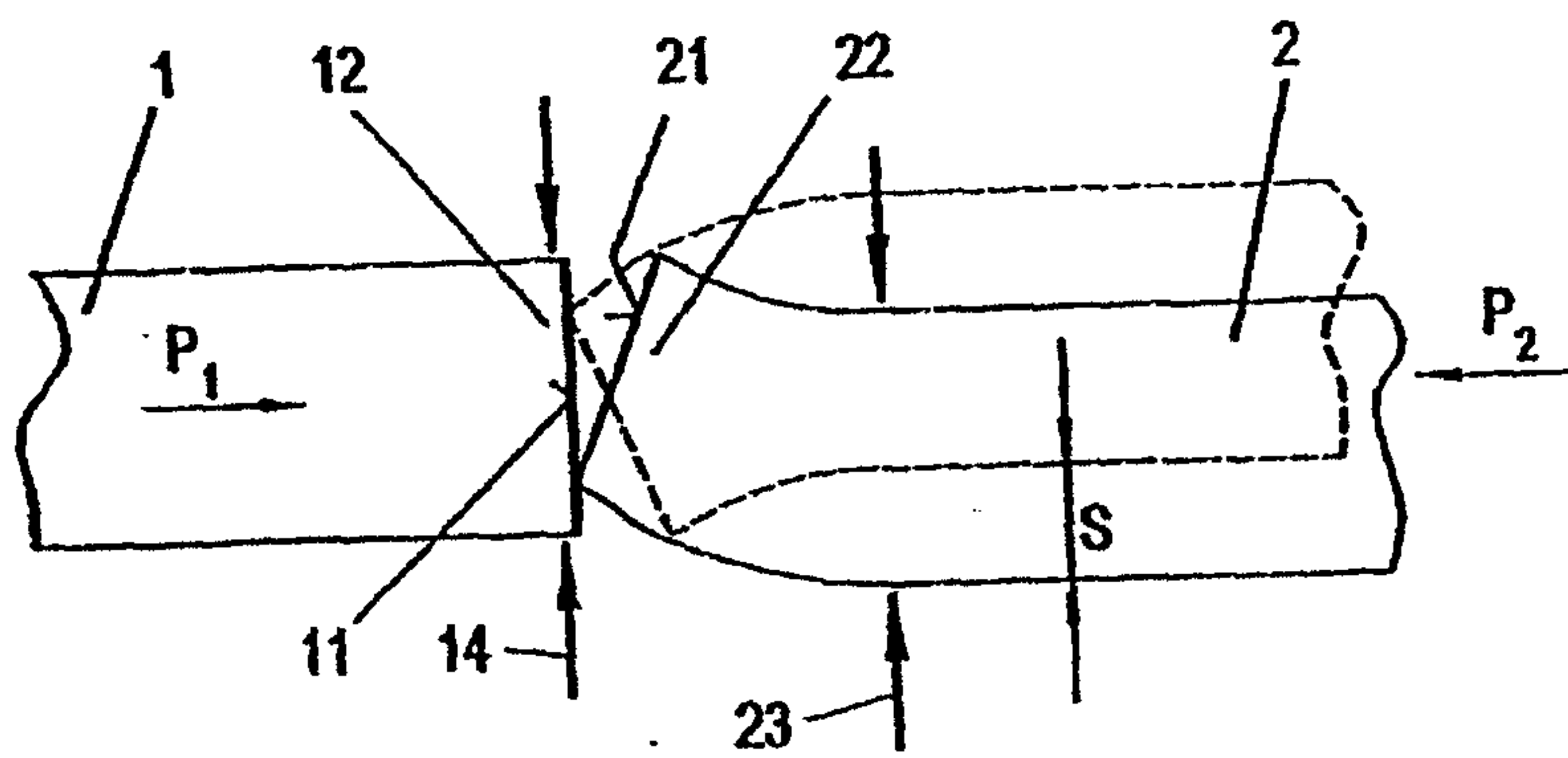


FIG. 1

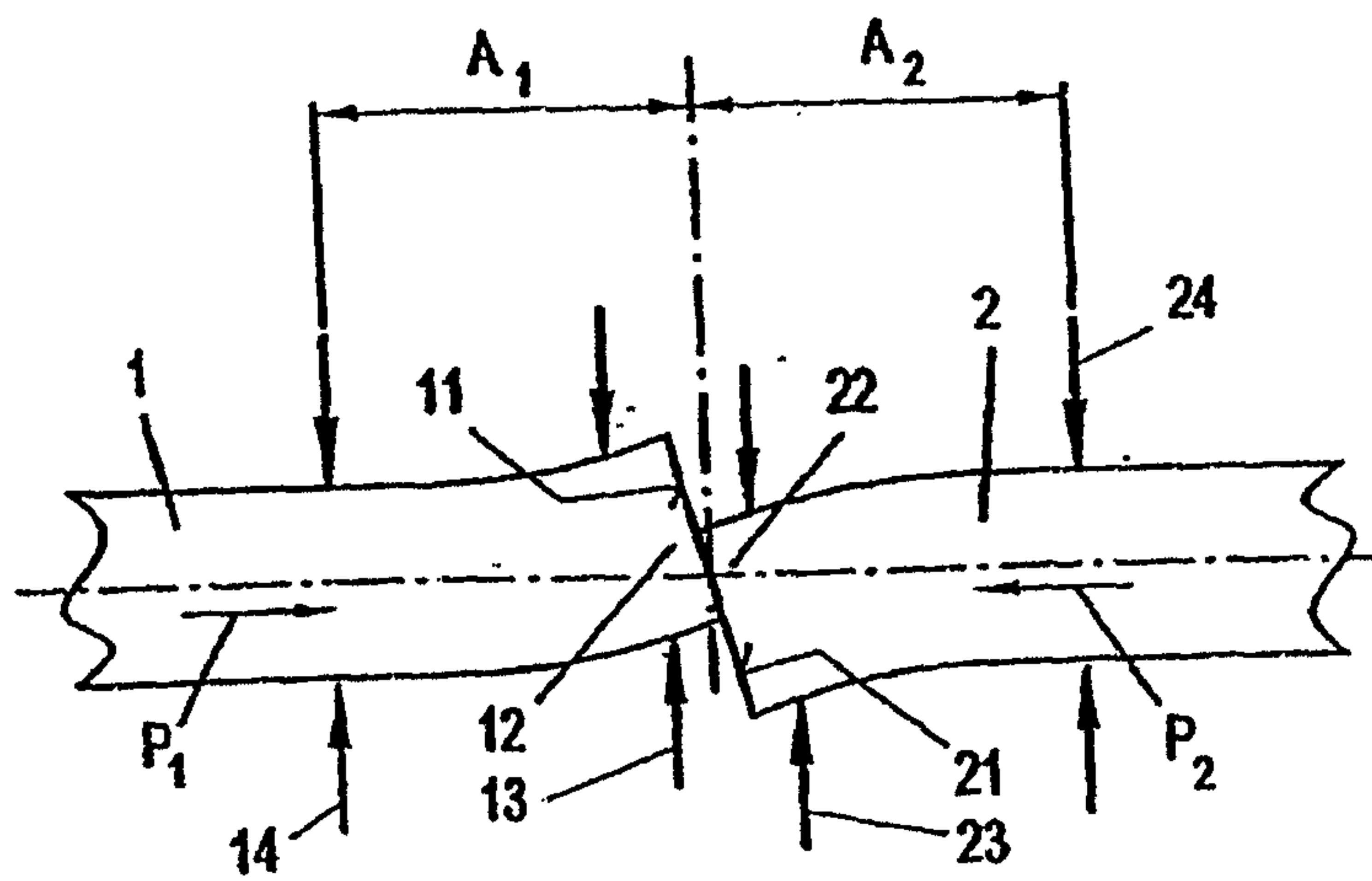


FIG. 2

