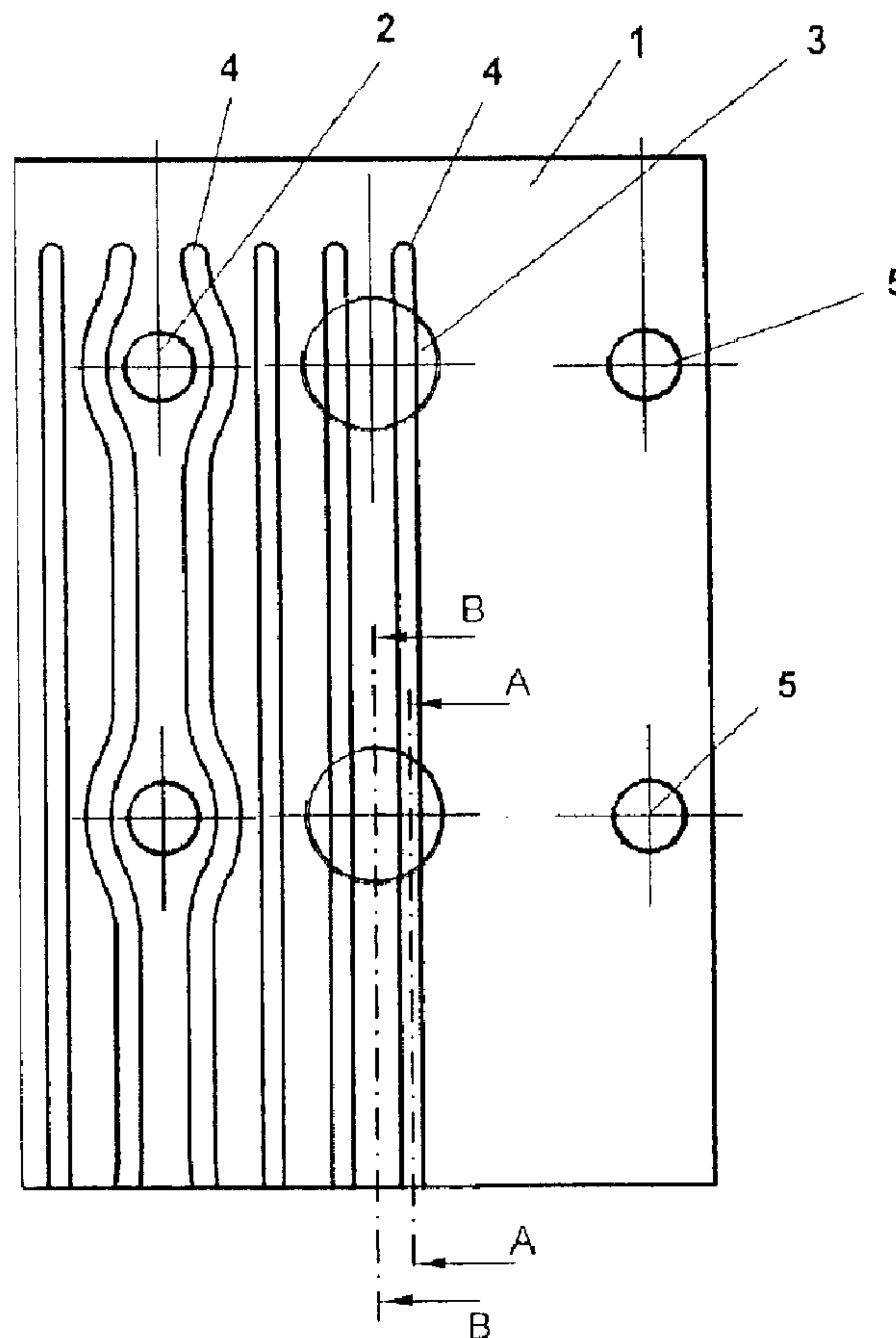




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(54) Title: EXTRUSION DIE



(57) Abrégé/Abstract:

The invention is directed to a continuous casting mold with mold plates which enclose the casting cross section and in which cooling channels extend, the mold plates being connected to a water box by means of screw elements, and the screw elements



(57) **Abrégé(suite)/Abstract(continued):**

are formed by fastening bolts with a threaded shank which can be screwed into fastening threads in the mold plate. In order to achieve a uniform cooling in a continuous casting mold of the type mentioned above, the fastening threads are arranged such that their center longitudinal axes extend between two adjacent coolant channels in each instance, the diameter of each threaded bore hole is greater than the distance between two adjacent cooling channels, and the bore holes for the fastening threads end at a distance from the floor of the cooling channels so as to define the screw-in depth of the fastening bolts.

Abstract

The invention is directed to a continuous casting mold with mold plates which enclose the casting cross section and in which cooling channels extend, the mold plates being connected to a water box by means of screw elements, and the screw elements are formed by fastening bolts with a threaded shank which can be screwed into fastening threads in the mold plate. In order to achieve a uniform cooling in a continuous casting mold of the type mentioned above, the fastening threads are arranged such that their center longitudinal axes extend between two adjacent coolant channels in each instance, the diameter of each threaded bore hole is greater than the distance between two adjacent cooling channels, and the bore holes for the fastening threads end at a distance from the floor of the cooling channels so as to define the screw-in depth of the fastening bolts.

EXTRUSION DIE

The invention is directed to a continuous casting mold with mold plates which enclose the casting cross section and in which cooling channels extend. The mold plates are connected to a water box by screw elements, and the screw elements are formed by fastening bolts with a threaded shank which can be screwed into fastening threads in the mold plate.

With the exception of tubular molds for billets, molds for the continuous casting of steel comprise a plurality of mold plates which together form a cavity. The molten metal is poured into this cavity, partially solidifies, and is conducted downward. The format varies between slabs, thin slabs, blooms, or beam blanks depending on the shape of this cavity.

The mold plates which are fashioned almost exclusively from copper alloys are acted upon by very high thermal and mechanical loads during the casting operation. The mold plates are fastened at the back to a water box so that the mold will retain its shape in spite of the forces acting on it during casting. In particular, this should prevent large gaps from forming in the area of contact between the individual mold plates of a mold. Also, the cooling water of the mold may not be allowed to escape freely and come into contact with the molten steel.

Depending on the construction and dimensions of the molds, the mold plates are fastened to the water boxes at the back in different ways.

Examples for the construction of the mold plates are disclosed in EP 1 398 099 B1 and WO 02/07915.

Usually, bore holes having threads into which bolts or screws are screwed are located on the back of the mold plates.

To ensure a strength sufficient to prevent the fastening elements from being torn out of the copper, the fastening threads or threaded bore holes must be sufficiently deep and have a sufficiently large diameter.

The dimensions, quantity and spacing of the threaded bore holes depend among other things on the strength of the mold material, the dimensions and shape of the mold plate and the loading during operation.

The back of the mold plates is needed not only for fastening purposes but also for dissipating the extremely large amounts of heat released during the solidification and cooling of steel.

Accordingly, cooling channels or cooling bore holes through which the cooling water is pumped at high pressure and velocity are located on the back of the molds.

For reasons relating to product quality and the lifetime of the mold plates that are used, it is necessary to ensure that cooling is as uniform as possible over the surface so that individual areas of the front side of the mold do not have a substantially higher temperature than other areas immediately adjacent to them.

When the cooling water is conducted in the mold plate through cooling bore holes, the fastening threads can be located behind the cooling plane. However, producing drilled mold plates is relatively cumbersome compared to mold plates with cut cooling channels. Further, the depth of cut cooling channels and therefore the distance between the cooling channels and the front side of the mold can be changed over the length and width of the mold plate and accordingly adapted to the occurring thermal loading.

WO 02/07915, cited above, discloses a mold arrangement in which coolant bore holes are provided parallel to one another in the copper plate. The fastening bolts are arranged so that their center longitudinal axes extend in the center between two adjacent coolant bore holes.

In this construction, the distance between the outer walls of the adjacent coolant bore holes is greater than the outer diameter of the fastening bolt or threaded bore hole into which the shank of the fastening bolt is screwed. In this arrangement, the supporting threaded portion is located in the wall between the adjacent coolant bore holes.

In the prior art, fastening bore holes and cooling channels in molds with cut cooling channels are located next to one another. Nevertheless, there are various possibilities for achieving the most uniform possible cooling of the mold plate. Additional cooling bore holes can be located in front of the threaded bore holes in the direction of the flow of heat or, rather than the cooling channels extending vertically over the height of the mold plate, at least the next channels adjacent to the row of fastening bore holes can pass around the fasteners at the smallest possible distance (slalom slot).

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It is the object of the invention to arrange and form the fastening bore holes and the cut cooling channels on the backs of mold plates in such a way that a virtually uniform cooling is achieved.

This object is met according to the invention by a continuous casting mold with mold plates which enclose the casting cross section and in which cooling channels extend, the mold plates being connected to a water box by means of screw elements, and the screw elements are formed by fastening bolts with a threaded shank which can be screwed into fastening threads in the mold plate. The fastening threads are arranged such that their center longitudinal axes extend between two adjacent cooling channels, and each threaded bore hole diameter is greater than a distance between the two adjacent cooling channels (4), and the bore holes for the fastening threads end at a distance from the floor of the cooling channels so as to define the screw-in depth of the fastening bolts.

Accordingly, the bore holes for the fastening threads are no longer located separately next to the cooling channels, but partially overlap the cooling channels or are intersected by them.

The fastening bolts project somewhat into the cooling channels when they are screwed into the fastening threads. However, the fastening bolts do not engage with the fastening threads in the area of the cooling channels because there is no fastening thread in this area. On the other hand, the fastening thread is also located in the wall areas of the adjacent cooling channels which face away from one another so that the tear-out strength is greater compared to fastening threads arranged in the middle in cooling bore holes.

Tests have been conducted which show that it is possible to produce these fastening threads without difficulty and the production does not differ from the production of fastening threads in solid material. Further, the fastening threads were examined to determine whether or not they possess sufficient tear-out strength. The tests show that, under load, the channel threads have a tear-out strength comparable to that of threads in solid material.

However, their diameter must be somewhat greater compared to solid threads so that they have the same supporting surface. By supporting surface is meant the supporting circumference $\times$ of the thread depth. The supporting circumference is the circumference of the thread minus the circular arcs that are cut out of the cooling channels.

It is crucial that the cooling channels are deeper than the bore holes for the fastening threads. In this way, there is cooling water below the thread (between the hot side of the

mold and the base of the fastening threads) and there is accordingly also a cooling effect in that location.

In order to ensure a uniform flow in the channels and to achieve higher flow rates, the channel cross section can be reduced above and/or below and to the sides of the fastening threads by filler pieces. There will then be islands remaining in the area of the fastenings for receiving the thread inserts.

The invention will be described more fully in the following with reference to the drawings.

Fig. 1 is a schematic view of the arrangement and construction of fastening threads in the back of a mold plate; and

Fig. 2 shows sections A-A and B-B from Figure 1.

The mold plate is designated by 1 in Figure 1.

A known arrangement of fastening threads, which has already been referred to above as slalom slots, is shown on the left-hand side.

The fastening threads 2 are enclosed, that is, surrounded in a slalom shape by the cooling channels 4.

In contrast, the fastening threads 3 shown in the center are arranged in such a way that they are intersected by, or partially overlap, the cooling channels 4.

Naturally, there is no fastening thread in the area where the cooling channels 4 intersect the bore holes 3 as can be seen from section A-A in Figure 2.

For the sake of comparison, Figure 1 shows fastening threads 5 on the right-hand side which are located outside of the cooling channels and are accordingly situated in solid material. In order to achieve the same tear-out strength and the same supporting surfaces, they need only have a smaller diameter than the fastening threads intersected by the cooling channels because there is no supporting fastening thread in the area of the cooling channels.

Section B-B in Fig. 2 shows a cross section through the solid material of the mold, where the bore hole 3 is not intersected by the cooling channel 4. The remaining fastening thread 2 is visible in the solid material.

As is shown in section A-A in Fig. 2, the depth of the fastening threads 2 and bore holes for these threads is smaller than the depth of the cooling channels 4 so that it is possible for coolant to flow through the cooling channel even when the fastening bolts are screwed in.

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CLAIMS:

1. Continuous casting mold with mold plates (1) which enclose a casting cross section and in which cooling channels (4) extend, the mold plates being connected to a water box by means of screw elements, and the screw
5 elements are formed by fastening bolts with a threaded shank which can be screwed into fastening threads (2, 3) in the mold plate (1), wherein the fastening threads are arranged such that their center longitudinal axes extend between two adjacent cooling channels, and each threaded bore hole diameter is greater than a distance between the two adjacent cooling channels (4), and the bore holes for
10 the fastening threads end at a distance from a floor of the cooling channels so as to define a screw-in depth of the fastening bolts.
2. Continuous casting mold according to claim 1, characterized in that the diameter of the fastening thread (3) is greater compared to fastening threads (5) in solid material so that they have the same supporting surface.
- 15 3. Continuous casting mold according to claim 1 or 2, characterized in that the channel cross section is reduced above and/or below and to the sides of the fastening thread (3) by filler pieces in order to ensure a uniform flow in the cooling channels and to achieve higher flow rates.

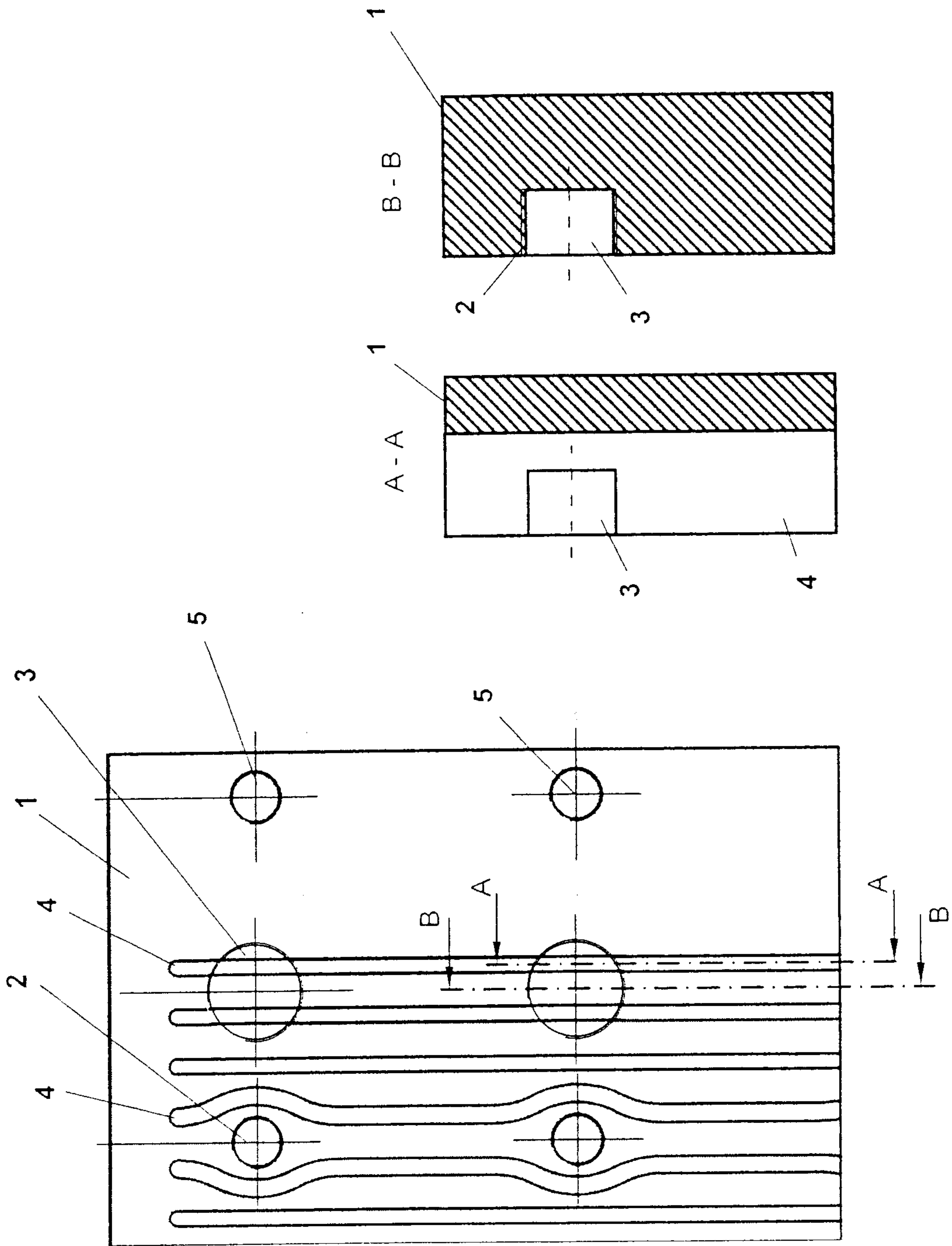


Fig. 1

Fig. 2

