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(54) Titre : DISTRIBUTION DE REFRIGERANT POUR LE REFROIDISSEMENT D'UN OUTIL
(54) Title: COOLANT DISTRIBUTION FOR COOLING A TOOL

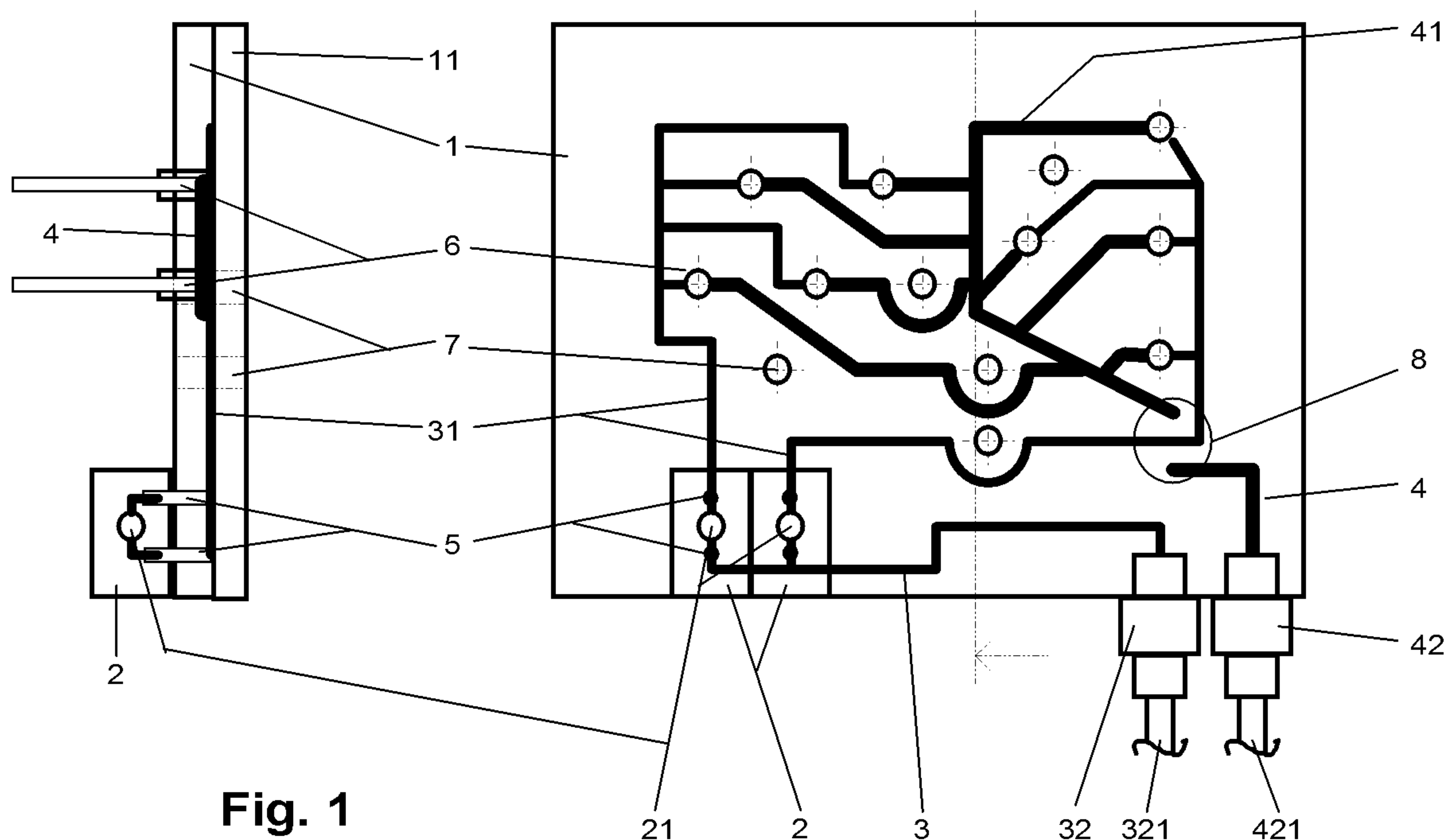


Fig. 1

(57) **Abrégé/Abstract:**

The invention relates to a cooling system for cooling a tool via cooling sites (6), these being composed of a capillary tube (64) associated with a supply pathway and of an expansion space (65) which is associated with a return pathway (41) and into which the capillary tube (64) leads, so that a coolant conducted in liquid form to the cooling sites (6) evaporates and is conducted away in the form of gas. A distributor block (1, 11), which can be connected to a coolant source and to a coolant sink, and into which coolant channels (3,31,4,41) have been moulded in at least one plane, has been designed so that it can be flanged onto a tool.



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(54) Title: COOLANT DISTRIBUTION FOR COOLING A TOOL

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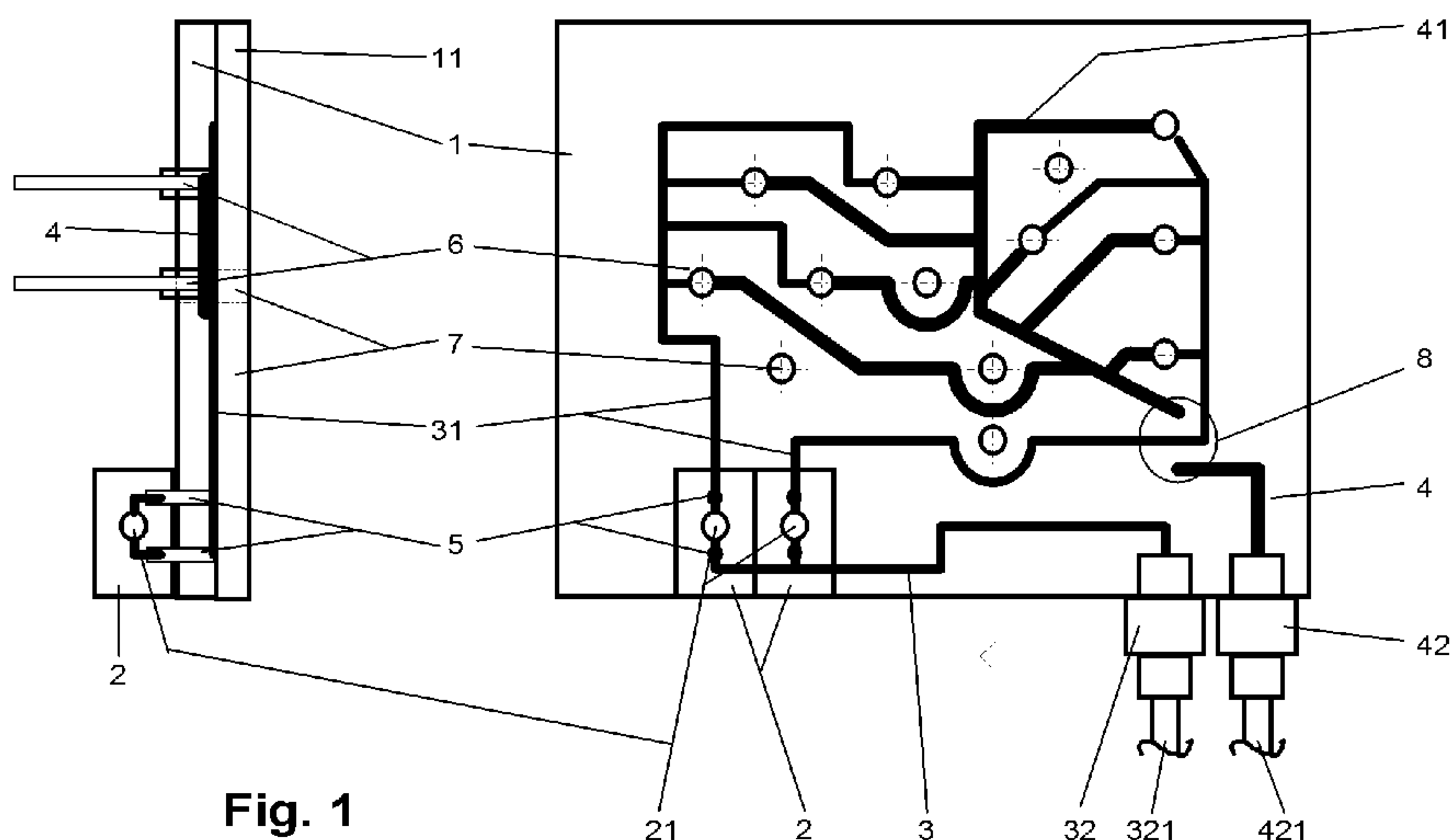


Fig. 1

(57) **Abstract:** The invention relates to a cooling system for cooling a tool via cooling sites (6), these being composed of a capillary tube (64) associated with a supply pathway and of an expansion space (65) which is associated with a return pathway (41) and into which the capillary tube (64) leads, so that a coolant conducted in liquid form to the cooling sites (6) evaporates and is conducted away in the form of gas. A distributor block (1, 11), which can be connected to a coolant source and to a coolant sink, and into which coolant channels (3, 31, 4, 41) have been moulded in at least one plane, has been designed so that it can be flanged onto a tool.

(57) **Zusammenfassung:** Die Erfindung betrifft ein Kühlsystem zur Werkzeugkühlung durch Kühlstellen (6), die aus mit einem Zuführstrang verbundenen Kapillarrohr (64) und einem mit einem

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Rückführstrang (41) verbundenen Expansionsraum (65) bestehen, in welchen das Kapillarrohr (64) mündet, so dass ein flüssig zu den Kühlstellen (6) geleitetes Kühlmittel verdampft und als Gas abgeleitet wird. Ein an eine Kühlmittelquelle und eine Kühlmittelsenke anschliessbarer Verteilerblock (1, 11) in wenigstens einer Ebene eingeförmte Kühlmittelkanäle (3, 31, 4, 41) auf und ist an ein Werkzeug anflanschbar ausgebildet.

Coolant Distribution for Tool Cooling

The tools of plastic processing machines, but also of die-casting machines, extruders, welding machines and similar systems, where heat is to be dissipated, are cooled point-wise or surface-wise, as soon as the working or processing action demands it. This draws off heat from the tool on one hand in a localized and on the other hand in an overall manner, so that the fastest possible cooling ensues and cycling times are shortened. The invention refers to such a cooling system.

The DE 199 18 428 C1 has made known a tool cooling process based on carbon dioxide (CO₂), designed to cool off tool areas with excess temperatures in a localized fashion. The application range of the known process extends, beyond sintered porous materials, to tools made of massive materials such as steel, aluminum, copper or other alloys. One advantage of the known process is seen in its prevention of locally occurring temperature peaks, which allows reducing cycling times and molded piece defects. The known process is characterized by the fact that pressurized carbon dioxide is, through a feeding system, directed to appropriate tool areas so as to cool these areas by a localized expansion of the carbon dioxide. The preferred tool areas are those where owing to excessive tool temperatures shiny spots or shining differences appear on the plastic articles, sagging points occur, deformation occasions problems or where generally excessive and/or tool damaging temperatures may arise. The feeding of compressed carbon dioxide occurs through tiny tubes or flexible hoses. Upon exiting from these feeding tubes, the compressed carbon dioxide expands, thus drawing off heat from the surrounding material. Due to the after-flowing carbon dioxide, the expanded gas is moved through the gap between the feeding tubes and the walls of the expansion chamber out of the tool, so as to enable it to escape into the atmosphere, be captured by a special system and subsequently re-processed. Apart from this surface-wide tool cooling, a water-jetting type cooling is known. The process is based on an open or closed cooling water system, where the tool is provided with flow channels conformed to appropriately fit the processing conditions and the geometry of the work-piece and the tool. This makes it possible to efficiently cool the tool and the injected masses and to substantially reduce the cycling times. However, the use of water as a coolant can lead to calcium scaling deposits in the flow channels, thus lowering the cooling effect.

In the worst cases, channel plugging and total ineffectiveness of the cooling system may occur. Another already known solution is described in DE 102 56 036 A1 as a tool cooling process and device based on the carbon dioxide expansion cooling principle. The known device is characterized by a plurality of boreholes, each of which is penetrated by a capillary tube open at its free extremity. The capillaries are connected with a gas-feeding collection tube, and the boreholes with a gas-collection channel for a gas return loop. However, this known solution fails to indicate how a large number of cooling points, which may possibly also be arranged in a locally distributed manner, may be supplied with a coolant efficiently and with adequate assurance, because a simple parallel arrangement of the capillaries cannot satisfy these requirements.

The task thus resulting for the invention is to create a tool cooling system of the kind mentioned at the beginning, to be distinguished by an improved feeding of the coolant to the cooling points in the form of its distribution, thus leading to enhanced manufacturing process efficiency and better product quality.

In accordance with the teaching of the principal claim, the task is solved by a coolant distribution to the cooling points that consists of a capillary tube connected to a feeding loop and an expansion chamber fitted with a capillary tube inlet and connected to a return loop, so as to allow a coolant conveyed to the cooling points in a liquid state to evaporate and be carried off as a gas. For this purpose, a hermetically sealed distribution block attachable to a coolant source and a coolant sump is fitted with coolant channels carved out in at least one plane and conformed to be capable of being flanged to a tool. The coolant channels are conformed as feeding loops branching out to the cooling points, and as return loops connecting the cooling points to a collector. The coolant feeding occurs from the coolant source to the feeding loops through a hose which is attached to an inlet conformed as a hose coupling, and through at least one magnetic switching unit inserted after the inlet. The coolant discharge from the return loop collector occurs through a hose leading to the coolant sump, while the outlet of the return collector is conformed as a hose coupling to which the hose is attached.

Advantageous improvements and configurations are given in the subordinate claims. The invention is characterized by conformations of the coolant channels that are

adaptable to various applications. A first advantageous conformation of the invention consists in the fact that the coolant channels are boreholes inserted into the distribution block, which lead to the cooling points through crossings forming junction points and/or directly to the cooling points, and are hermetically sealed toward the outside. Another advantageous conformation of the invention consists in the fact that the distribution block is made of at least two plates and the coolant channels are conformed as groove-like recesses in at least one plate and covered by another plate. Another advantageous conformation consists in the fact that the coolant channels are realized so that groove-like recesses are carved out in the distribution block, in which the coolant carrying tubes are irremovably disposed. The invention is further improved by attaching at least one magnetic switching unit to the feeding loop, using plug-in connections. The object of the invention further consists in the fact that the capillary tube is fastened to a connecting element fitted with an inlet and outlet, so that the capillary tube is tightly connected by the inlet to the feeding loop, and the expansion chamber is tightly connected by the outlet to the return loop. The invention is advantageously conformed by shaping the connecting element so as to enable it to be plugged into a supporting bushing set into the distribution block.

The characteristics of the invention will in the following be explained in greater detail with the aid of drawings, which show:

- In Fig. 1 a preferred form of embodiment of the invention, and
- In Fig. 2 a cooling point of the preferred form of embodiment.

Fig. 1 illustrates a simplified top view of a plate 1 fitted with coolant channels 3, 31, 4, 41 of a distributing block according to the invention, as well as a simplified cross-section through the distribution block supplemented with a cover plate 11. The plate 1 carries coolant channels 3, 31, 4, 41 milled into a first plane so that the feeding loops 31 are leading to all cooling points, and the return channels away from them. In laying out the looping system, care must be taken to consider the positions of the releasing pins 7 next to the cooling points, so that the looping paths can be provided with corresponding arcs. However, in practice and contrary to the representation simplified here for synoptic reasons, the looping paths are not presenting abrupt angles but curves with technically more favorable flow-through effects. The returning

loops 41 are joined in a collective conduit 4 leading to a hose coupling 42 through which, as well as through a hose 421 attached to the same, a coolant return flow can occur to the coolant sump, for instance a compressor inlet. By using an underpass 8, which may advantageously be conformed as a stamped bridge-like element, the collective return conduit 4 crosses a feeding loop 31. The feeding loops 31 represent ramifications of an inlet feeding loop 3, where the inlet feeding loop 3 is led to two magnetic switching units 2, each of which is fitted with a magnetic switch 21 from which the feeding loops 31 are further branched off to the cooling points 6. The magnetic switches 21 are advantageously inserted into the feeding loops 31 with plug-in connectors 5. The inlet feeding loop 3 is connected to a hose coupling 32 connected to a hose 321. The hose 321 leads to a coolant source, for instance the outlet of a compressor. A liquid coolant flows from the coolant source, through the hose 321, the hose coupling 32, the inlet feeding loop 3, the magnetic switch 21 and the feeding loops 31 to the cooling points 6, which will be described in detail with the aid of Fig. 2. The coolant evaporates in the expansion chambers 65 of the cooling points 6, turns gaseous, is conveyed through the return loops 41, the collective conduit 4, the hose coupling 42 and the hose 421 to the coolant sump to be re-liquefied, so as to form a cooling block hermetically sealed by the second plate 11 and fitted with an internal ramification and an inlet and outlet coupling, which can be connected to a plastic material forming tool by suitable devices.

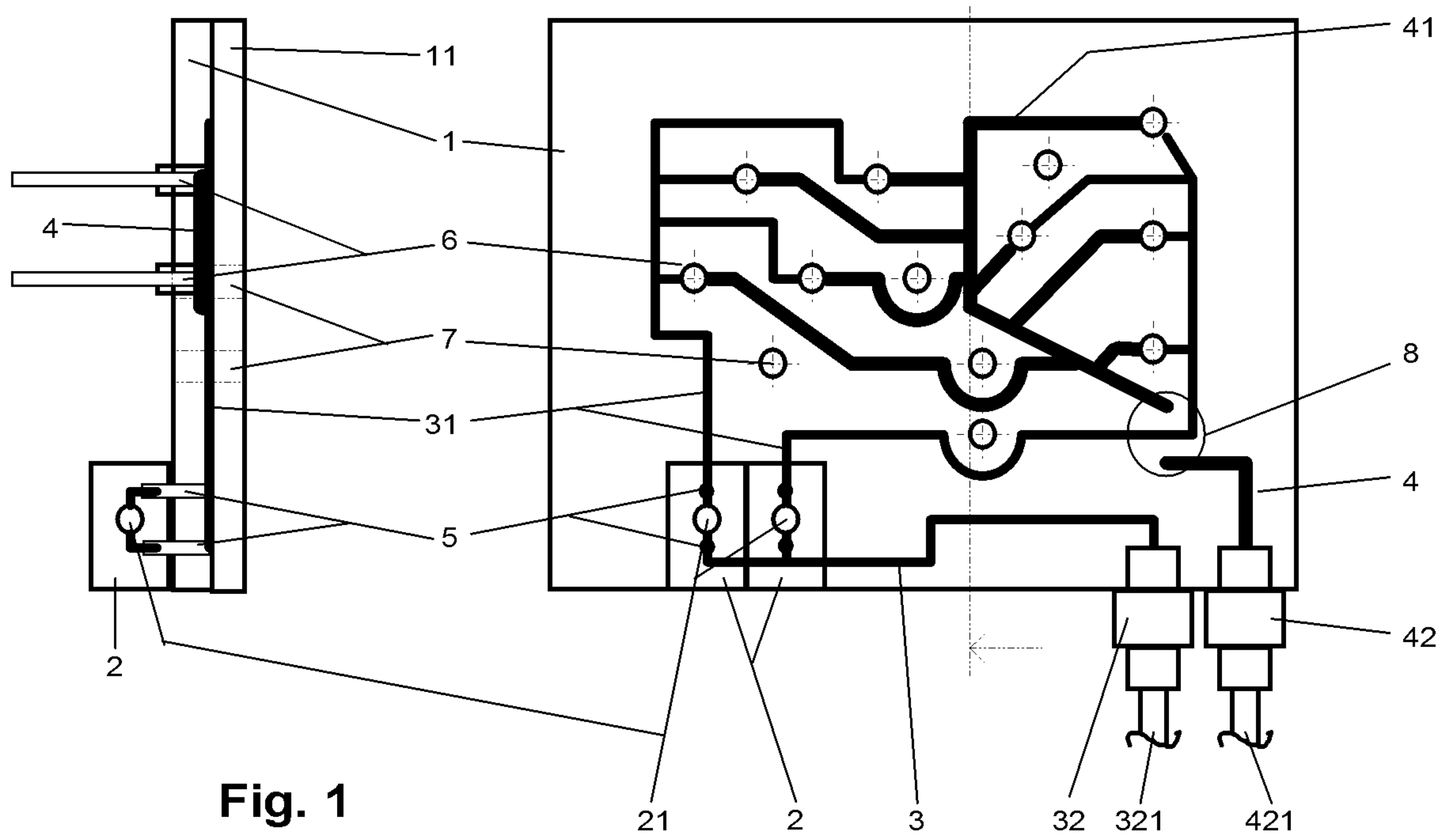
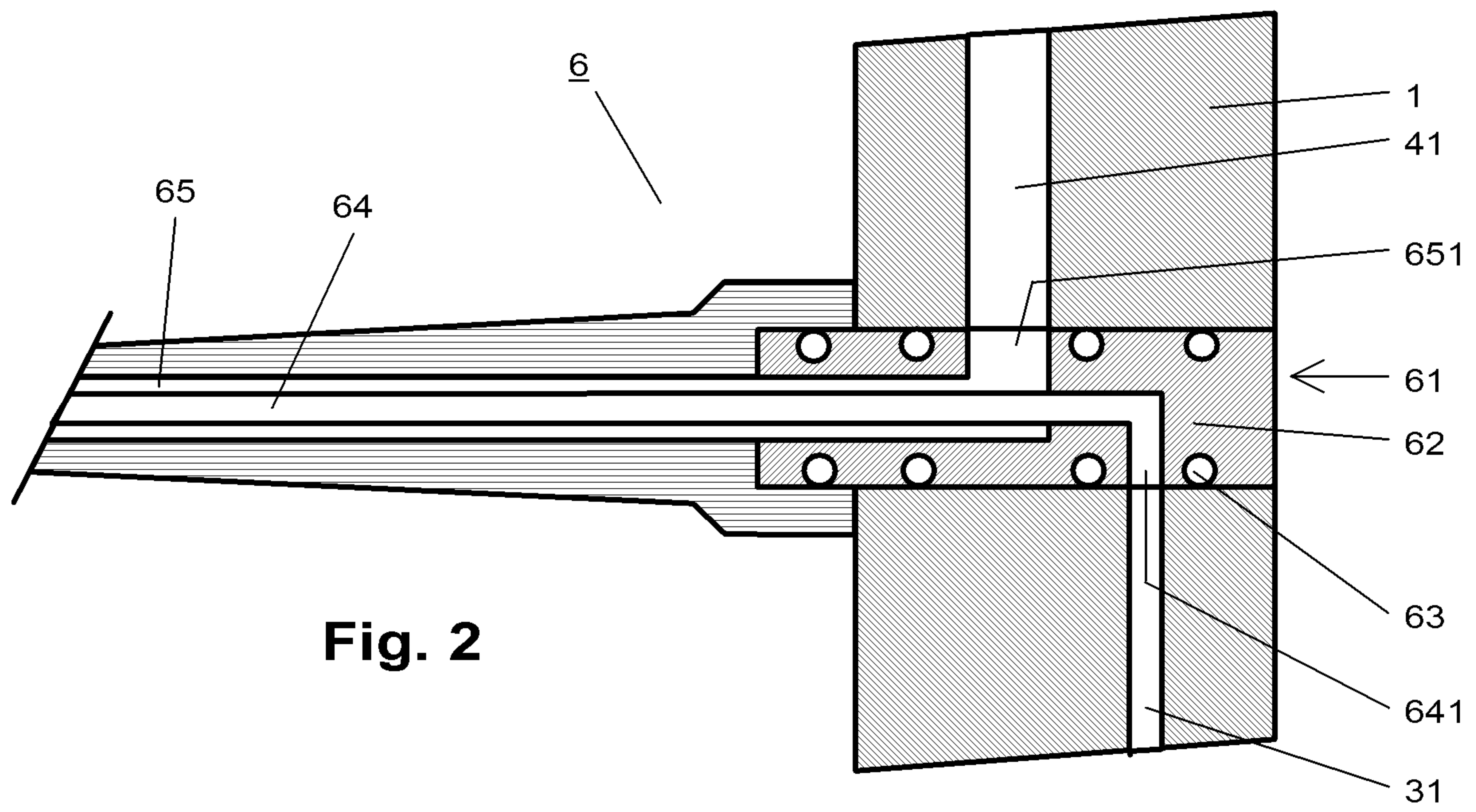
Fig. 2 illustrates a single cooling point 6 with a capillary tube 64 flowing into an expansion chamber 65. The capillary tube 64 is fastened to a connecting element 62 provided with two connectors 641, 651. The first connector 641 tightly connects the capillary tube 64 to the feeding loop 31. The second connector 651 tightly connects the expansion chamber 65 to the return loop 41. The connecting element 62 is fitted, through openings in the connectors 641, 651 and suitably arranged gasket elements 63, in a geometrically and force-induced plug-in manner, into a supporting bushing 61 correspondingly arranged in the plate 1.

Patent claims

1. Coolant distribution for the cooling of a tool through cooling points (6) that consists of a capillary tube (64) connected to a feeding loop (31) and an expansion chamber (65) connected to a return loop (41) into which the outlet of the capillary tube (94) opens so that a coolant conveyed in a liquid state to the cooling points (6) evaporates and is drawn off as a gas, characterized by the fact that a hermetically sealed distribution block (1, 11) attachable to a coolant source and a coolant sump is fitted with coolant channels (3, 31, 4, 41) carved out in at least one plane and conformed to be attachable to a tool by a flange, the coolant channels (3, 31, 4, 41) are conformed as feeding loops (3, 31) branching out to the cooling points (6) and as return loops (41) leaving the cooling points (6) to be joined in a collective conduit (4), the coolant feed occurs from the coolant source to the feeding loops (3, 31) through a first hose (321) attached to an inlet conformed as a hose coupling (32) and at least one magnetic switching unit (2) mounted after the inlet, and the coolant discharge occurs from the collective return conduit (4) through a second hose (421) to the coolant sump, where the outlet of the collective return conduit (4) is conformed as a hose coupling (42) to which the second hose (421) is attached.
2. Coolant distribution according to claim 1, characterized by the fact that the coolant channels (3, 31, 4, 41) are boreholes introduced into the distribution block (1), which lead to crossings forming connecting points and/or directly to the cooling points (6), and are hermetically sealed toward the outside.
3. Coolant distribution according to claim 1, characterized by the fact that the distribution block (1, 11) consists of at least two plates and the coolant channels (3, 31, 4, 41) and are conformed in at least one plate (1) as groove-like recesses and covered by another plate (11).
4. Coolant distribution according to claim 1, characterized by the fact that the coolant channels (3, 31, 4, 41) are realized so that grove-like recesses are

carved out in the distribution block (1), in which the tubes conveying the coolant are set in an irremovable manner.

5. Coolant distribution according to claims 1, 2, 3 or 4, characterized by the fact that at least one magnetic switching unit (2) is attached to the feeding loop (3, 31) by plug-in connectors (5).
6. Coolant distribution according to claims 1, 2, 3, 4 or 5, characterized by the fact that the capillary tube (64) is fastened to a connecting element (62) with an inlet and an outlet, so that the capillary tube (64) is tightly connected to the feeding loop (31) by the inlet, and the expansion chamber (65) is tightly connected to the return loop (41) by the outlet.
7. Coolant distribution according to claim 6, characterized by the fact that the connecting element (62) is conformed as a supporting bushing (61) set in the distribution block in a plug-in manner.

**Fig. 1****Fig. 2**

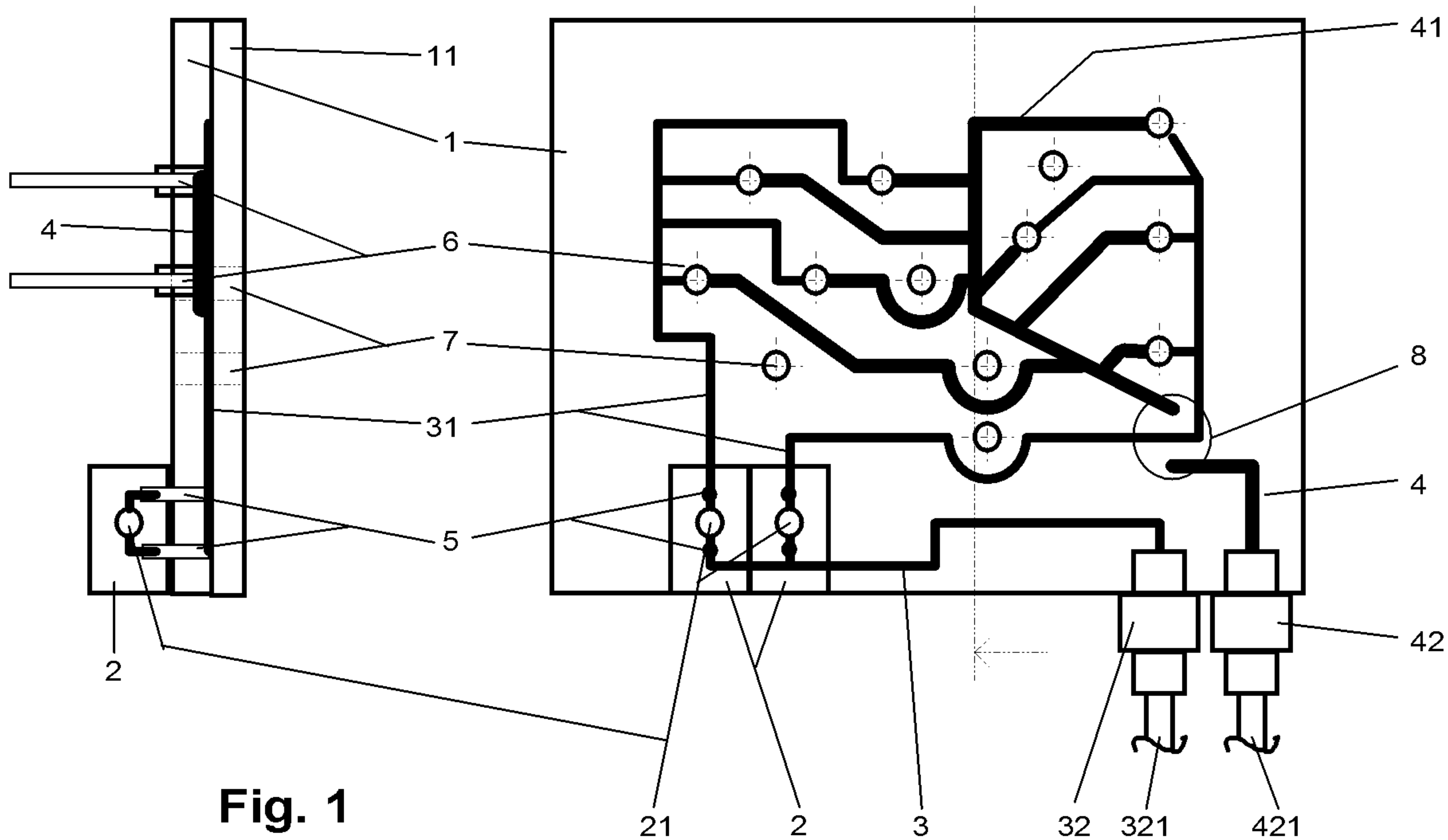


Fig. 1