

AUSTRALIA

Patents Act: 1990

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Section 2

PATENT REQUEST: CONVENTION PATENT

We, FLACHGLAS AKTIENGESELLSCHAFT, being the person identified below as the Applicant, request the grant of a patent to the person identified below as the Nominated Person, for an invention described in the accompanying standard complete specification

Full application details follow:-

Applicant: FLACHGLAS AKTIENGESELLSCHAFT
Address: Siemensstrasse 1-3, D-90766 Fürth, Germany
Nominated Person: FLACHGLAS AKTIENGESELLSCHAFT
Address: Siemensstrasse 1-3, D-90766 Fürth, Germany
Invention Title: PRESS-BENDING STATION FOR BENDING SHEETS OF GLASS
Names of actual Inventors: Dieter FUNK; Dieter BRUNS; Rolf WENNING; and Walter BRANS
Address for service in Australia: CALLINAN LAWRIE, 278 High Street, Kew 3101, Victoria, Australia

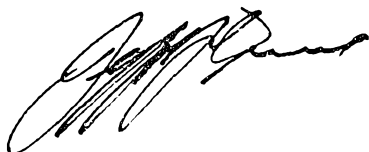
Attorney Code: CL
Convention Details

Application Number	Country	Country Code	Date of Application
P 44 12 747.2	Germany	DE	15 April 1994

Drawing number recommended to accompany the abstract - Fig. 1

D A T E D this 12th day of April, 1995.

FLACHGLAS AKTIENGESELLSCHAFT
By their Patent Attorneys:
CALLINAN LAWRIE



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✓
A U S T R A L I A

This is a Multiple Use Form Covering:
Convention
Non-Convention
PCT National Phase

PATENT

NOTICE OF ENTITLEMENT

Insert
name of
applicant

We, FLACHGLAS AKTIENGESELLSCHAFT, of Siemensstrasse 1-3, D-90766 Fürth, Germany

being the applicant in respect of the Australian Patent Application PRESS-BENDING STATION FOR BENDING SHEETS OF GLASS
state the following:-

Complete
only for
non-PCT
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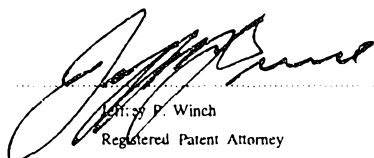
The person nominated for the grant of the patent:

- (ii) has entitlement from the actual inventors by virtue of being a person who would, if a patent was to be granted upon an application made by the actual inventors, be entitled to have the patent assigned to it; and
- (ii) is the applicant of the basic application.

Complete
for all
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ion
cases

The basic application listed:

- (i) on the request form
is the first application made in a Convention country in respect of the invention.


Jeffrey P. Winch
Registered Patent Attorney

12 April 1995
Date



AU9516387

(12) PATENT ABRIDGMENT (11) Document No. AU-B-16387/95
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 681760

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PRESS-BENDING STATION FOR BENDING SHEETS OF GLASS
- International Patent Classification(s)
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- (30) Priority Data
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- (43) Publication Date : **26.10.95**
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- (71) Applicant(s)
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- (74) Attorney or Agent
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- (56) Prior Art Documents
AU 16433/95 C03B 23/03
WO 93/14038
WO 90/15781
- (57) Claim

1. A press-bending station for bending sheets of glass during the course of automated production of identical motor vehicle windows within specified batch sizes, where said glass sheets to be bent are heated in a continuous furnace to a specified bending temperature and, directly after leaving said continuous furnace, are fed in a horizontal position with the aid of a horizontal conveyor into a press-bending station, which press-bending station incorporates in its press frame an upper male press mould and a lower female press mould taking the form of an annular mould, wherein:
- a) said male press mould is a cast full mould and consists of an aluminium alloy;
 - b) said male press mould possesses heating passages for fluid heating with the aid of a liquid heat transfer medium and is adapted to be heated with sufficiently homogeneous temperature distribution to a thermal expansion temperature which is below the bending temperature, and
 - c) the temperature of said male press mould is adapted to be controlled and/or regulated by means of said liquid heat transfer medium,

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the thermal expansion temperature of said male press mould being controlled and/or regulated such that the specific thermal expansion of said male press mould and the thermal expansion of said glass sheet to be bent, placed centrally on said female press mould at bending temperature, substantially correspond.

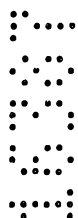
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PATENTS ACT 1990

COMPLETE SPECIFICATION

FOR A STANDARD PATENT

ORIGINAL



TO BE COMPLETED BY APPLICANT



Name of Applicant: FLACHGLAS AKTIENGESELLSCHAFT



Actual Inventor(s): Dieter FUNK; Dieter BRUNS; Rolf WENNING; and Walter BRANS

Address for Service: CALLINAN LAWRIE, 278 High Street, Kew, 3101, Victoria, Australia

Invention Title: "PRESS-BENDING STATION FOR BENDING SHEETS OF GLASS"

The following statement is a full description of this invention, including the best method of performing it known to me:-

Specification

The invention concerns a press-bending station for bending sheets of glass during the course of automated production of identical motor vehicle windows within specified batch sizes, where the glass sheets to be bent are heated in a continuous furnace to a specified bending temperature and directly after leaving the continuous furnace are fed in horizontal position with the aid of a horizontal conveyor into the press-bending station, which press-bending station incorporates in its press frame an upper male press mould and a lower female press mould taking the form of an annular mould. Of course, the plan view of the male press mould is matched to the geometry of the glass sheets to be bent. It possesses a glass sheet contact surface designed to suit the curvature of the glass sheets to be bent. The bending operation takes place in cyclic mode, one glass sheet follows the next. - English-language literature speaks of a male tool and a female tool. Of course, opening and closing of the press tools take place in the press-bending station, in the same way as in a press.

In the case of the known press-bending station from which the invention is derived (WO 90/11 973), importance is attached to the fact that the glass sheet contact surface is shaped to correspond to the curvature of the glass sheet to be bent. The configuration of the male press mould as a whole is left to choice. It is not heated and not cooled. The temperature which is reached in automatic operation of the press-bending station on the male press mould resp. on the glass sheet contact surface is taken into account and is regarded as suitable. In practice, during the course of the known measures described above, the male press mould is of multi-layered construction with interposed thermal insulating layers. Although the bent glass sheets remain in the press-bending station until the shape produced by the press-bending operation is sufficiently free from internal stresses in the bent glass sheets and consequently uniform cooling cannot lead to uncontrolled geometrical faults, during automated production of identical glass sheets within specified batch sizes, uncontrolled geometrical faults are to be found on the bent glass sheets. These are

troublesome, particularly when high standards are imposed on accuracy of manufacture.

The technical problem of the invention is, in the case of a press-station for bending glass sheets during the course of automated production of identical motor vehicle windows within specified batch sizes, to ensure that uncontrolled geometrical faults no longer occur on the finish-bent glass sheets.

To solve this problem, the subject of this invention is a press-bending station for bending glass sheets during the course of automated production of identical motor vehicle windows within specified batch sizes, where the glass sheets to be bent are heated in a continuous furnace to a specified bending temperature and directly after leaving the continuous furnace are fed in horizontal position with the aid of a horizontal conveyor into the press-bending station, which press-bending station incorporates in its press frame an upper male press mould and a lower female press mould taking the form of an annular mould, combination of the following features being realized:

- a) the male press mould is a cast full mould and consists of an aluminium alloy,
- b) the male press mould possesses heating passages for fluid heating with the aid of a liquid heat transfer medium and can be heated with sufficiently homogeneous temperature distribution to a thermal expansion temperature which is below the bending temperature,
- c) the temperature of the male press mould can be controlled and/or regulated by means of the liquid heat transfer medium,

the thermal expansion temperature of the male press mould being controlled and/or regulated such that the specific thermal expansion of the male press mould and the thermal expansion of the glass sheet to be bent, placed centrally on the female press mould at bending temperature, practically correspond. It should be repeated once more that the plan view of the male press mould is matched to

the geometry of the glass sheets to be bent and possesses a glass sheet contact surface designed to suit the curvature of the bent glass sheet. According to a preferred embodiment of the invention, the arrangement is such that at thermal expansion temperature the male press mould possesses a glass sheet contact surface corresponding to the curvature of the bent glass sheet. The glass sheet contact surface is machined and shaped.

The invention is derived from the principle that the uncontrolled variations described at the beginning in the geometry of otherwise identical bent glass sheets of a batch is due to differing thermal expansion of the glass sheets to be bent on the one hand, and the male press mould at least in the region of the glass sheet contact surface on the other hand, and prevents these differences in thermal expansion. Surprisingly, it is possible to utilize this to suppress the uncontrolled variations. Surprisingly, it is not problematical that the glass sheets themselves experience cooling during the bending operation, whilst the temperature of the male press mould remains practically unchanged during the bending operation. It is known in principle (DE 19 35 161) for spring-back of the bent glass sheets with similar press-bending operations to be countered by counter-cooling of the glass sheets themselves which is effected by heating the male press mould which can also consist of an aluminium alloy. Whilst here so to speak temperature correction is carried out on the bent glass sheets, according to the invention, thermal expansion correction takes place during bending of the glass sheets, that is to say with the aid of the principle of matching realized in combination with features a), b) and c). Within the scope of the known measures (WO 90/11 973, DE 19 35 161), it has not become known that matched temperature regulation and control is necessary in order to prevent the differences in thermal expansion at least on the glass sheet contact surface of the male press mould on the one hand and in the glass sheet on the other hand.

Within the scope of the invention, it is possible to work with the different aluminium alloys, for example with the alloys which are described in "Stoffhütte" (1967, published by Verlag Wilh. Ernst & Sohn, page 231). In particular, it is possible to work with

aluminium casting alloys which have been developed for the sole plates of textile irons and objects subjected to similar stresses and, in addition to their favourable thermal conductivity at the temperatures occurring, also possess relatively high strength.

In detail, there are several possibilities within the scope of the invention or further construction and design of a press-bending station according to the invention. In order to achieve extremely homogeneous temperature distribution in the male press mould, the invention teaches that the male press mould incorporates heating passages running transverse to the direction of travel of the horizontal conveyor which are connected to distributor pipes or manifolds and heat transfer medium can flow through them. The temperature of the male press mould can be controlled and/or regulated by means of the mass flow and/or the temperature of the heat transfer medium.

Within the scope of the invention, a wide variety of liquid substances are suitable as heat transfer media. Preferably, the male press mould is heatable with a synthetic oil or a mineral oil as heat transfer medium. With the glass sheets to be bent at a temperature of approximately 600 °C, the male press mould should be at a temperature of approximately 200 °C, at least in the region of its glass sheet contact surface.

Of course, in the case of the press-bending station according to the invention, the heating passages of the male press mould can be of different configurations. If an aluminium alloy is involved, which leads to practically pore-free male press moulds, the heating passages can take the form of drilled holes. It is simpler to provide the male press mould with heating passages which consist of cast-in tubes, for example of cast-in steel tubes. Steel tubes because they possess coefficients of expansion which are so close to one another that problems resulting from different coefficients of expansion between the aluminium material of the male press moulds on the one hand and the cast-in tubes on the other hand do not occur. In whatever way the heating passages are formed and configured, it is advisable for them to be suitable for a flow velocity of the heat transfer medium of approximately 1 litre/sec.

This is also recommended for control or regulation reasons with regard to the temperature of the male press mould resp. of the surface region of the male press mould at the glass sheet contact surface. If operated as described, the heating passages of the male press mould will generally possess an inside diameter in the region of 8 to 10 mm. If this geometry is implemented, the heat transfer medium should usefully possess a specific heat capacity in the region of between 1.5 and 2.5 kJ/kg. For this purpose, a synthetic oil or a mineral oil can be used which is resistant to evaporation at a temperature of approximately 300 °C.

The invention is explained in detail below with the aid of a drawing illustrating only one embodiment. The following are shown in diagrammatic form:

Fig. 1: the male press mould of a press-bending station according to the invention,

Fig. 2: a side elevation of the subject of Fig. 1,

Fig. 3: a plan view of the subject of Fig. 2 and

Fig. 4: the female press mould corresponding to the male press mould which is the subject of Fig. 1.

The press-bending station for which the objects illustrated are intended is intended for bending glass sheets during the course of automated production of identical motor vehicle windows within specified batch sizes. Its basic configuration may be designed like the known press-bending station described at the beginning (WO 90/11 973). The glass sheets to be bent, which are not illustrated in the Figures, will during the course of automated production be heated in a continuous furnace to a specified temperature and directly after leaving the continuous furnace will be fed in horizontal position into the press-bending station with the aid of a horizontal conveyor. The press-bending station possesses in its press frame an upper male press mould 1, which has been illustrated in Figures 1 to 3, and lower female press mould 2 in the form of an annular mould, reference being made to Figure 4. Of course, these

press tools 1, 2 are assigned to one another in the press frame and the kinematics are as normally equipped for presses. The press tools 1, 2 correspond in the plan view of their geometry to that of the glass sheets to be bent. Male press mould 1 possesses a glass sheet contact surface 3 designed to suit the curvature of the bent glass sheets. - In the example and according to the preferred embodiment of the invention, the arrangement is such that the bent glass sheets can be held in position under the male press mould 1 after the bending operation by vacuum. For this purpose, the male press mould 1 possesses holes and passages which are connected to a vacuum shaft. They have not been illustrated. When the press is open, they are deposited on a suitable means of conveyance. In this respect as well, reference is made to the state of the art.

From Figures 1 to 3, it can be seen that the male press mould takes the form of a cast full mould. According to the invention, it consists of an aluminium alloy. The male press mould possesses heating passages 4 for fluid heating with the aid of a liquid heat transfer medium. It can be heated with sufficiently homogeneous temperature distribution to a thermal expansion temperature which is below the bending temperature. The temperature of the male press mould 1 can preferably be controlled and/or regulated by means of the mass flow of the liquid heat transfer medium. The thermal expansion temperature of the male press mould 1 is controlled and/or regulated such that the specific thermal expansion of male press mould 1 and the thermal expansion of the glass sheet to be bent, placed centrally on the female press mould 2 at bending temperature, practically correspond. The annular female press mould 2 can also be heated in the contact region of the glass sheet. The male press mould 1 possesses at thermal expansion temperature a glass sheet contact area corresponding to the curvature of the bent glass sheet.

In the example and according to the preferred embodiment of the invention, the male press mould 1 incorporates heating passages 4 running transverse to the direction of travel of the horizontal conveyor which are connected to distributor pipes 5 or manifolds 6 running in the direction of travel and through which the heat transfer medium can flow. The temperature of the male press mould 1

can, as already mentioned, preferably be controlled or regulated by the mass flow of the fluid heat transfer medium. It can also be controlled or regulated by means of the temperature of the heat transfer medium. In the example, the male press mould 1 can be heated with a synthetic oil as heat transfer medium. When the temperature of the glass sheets to be bent is approximately 600 °C, the male press mould 1 is at a temperature of approximately 200 °C, at least in the region of the glass sheet contact area 3. The heating passages 4 may consist of cast-in tubes, in particular of cast-in steel tubes, which for reasons of scale cannot be seen in the Figures. With regard to the thermodynamic and hydrodynamic layout in detail, reference is made to the numerical values and the other features of claims 8 to 10.

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The claims defining the invention are as follows:-

1. A press-bending station for bending sheets of glass during the course of automated production of identical motor vehicle windows within specified batch sizes, where said glass sheets to be bent are heated in a continuous furnace to a specified bending temperature and, directly after leaving said continuous furnace, are fed in a horizontal position with the aid of a horizontal conveyor into a press-bending station, which press-bending station incorporates in its press frame an upper male press mould and a lower female press mould taking the form of an annular mould, wherein:
 - a) said male press mould is a cast full mould and consists of an aluminium alloy;
 - b) said male press mould possesses heating passages for fluid heating with the aid of a liquid heat transfer medium and is adapted to be heated with sufficiently homogeneous temperature distribution to a thermal expansion temperature which is below the bending temperature, and
 - c) the temperature of said male press mould is adapted to be controlled and/or regulated by means of said liquid heat transfer medium, the thermal expansion temperature of said male press mould being controlled and/or regulated such that the specific thermal expansion of said male press mould and the thermal expansion of said glass sheet to be bent, placed centrally on said female press mould at bending temperature, substantially correspond.
2. The press-bending station in accordance with claim 1, wherein said male press mould at thermal expansion temperature possesses a glass sheet contact area corresponding to the curvature of said bent glass sheet.
3. The press-bending station in accordance with claim 1 or claim 2 wherein, transverse to the direction of travel of said horizontal conveyor, said male press mould incorporates heating passages which are connected to distributor pipes or manifolds running in the direction of travel and through which the heat transfer medium is adapted to flow.

4. The press-bending station in accordance with any one of claims 1 to 3, wherein the temperature of said male press mould is adapted to be controlled or regulated by means of the mass flow and/or the temperature of said heat transfer medium.

5 5. The press-bending station in accordance with any one of claims 1 to 4, wherein said male press mould is adapted to be heated with a synthetic oil or a mineral oil as heat transfer medium.

6. The press-bending station in accordance with any one of claims 1 to 5 wherein, at a temperature of said glass sheet to be bent of approximately 600°C, said male press mould is at a temperature of approximately 200°C, at least in the region of said glass sheet contact area.

10 7. The press-bending station in accordance with any one of claims 1 to 6, wherein said male press mould incorporates heating passages which consist of cast-in tubes, for examples of cast-in steel tubes.

15 8. The press-bending station in accordance with any one of claims 1 to 7, wherein said heating passages of said male press mould are suitable for a flow velocity of the heat transfer medium of approximately 1 litre/second.

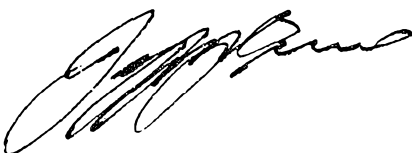
19 9. The press-bending station in accordance with any one of claims 1 to 8, where said heating passages of said male press mould possess a diameter in the region of from 8 to 10 mm.

20 10. The press-bending station in accordance with any one of claims 1 to 9, wherein as heat transfer medium a mineral oil is used which is resistant to evaporation at a temperature of approximately 300°C and possesses a specific heat capacity of from 1.5 to 2.5 kJ/kg.

25 11. A press-bending station for bending sheets of glass, substantially as described herein with reference to the accompanying drawings.

29 DATED this 12th day of April 1995.

30 FLACHGLAS AKTIENGESELLSCHAFT
By their Patent Attorneys:
CALLINAN LAWRIE



Abstract

Press-bending station for bending sheets of glass during the course of automated production of identical motor vehicle windows within specified batch sizes, where the glass sheets to be bent are heated in a continuous furnace to a specified bending temperature and directly after leaving the continuous furnace are fed in horizontal position with the aid of a horizontal conveyor into the press-bending station. It incorporates a male press mould and a female press mould. The male press mould is a cast full mould and consists of an aluminium alloy. The male press mould possesses heating passages for fluid heating with the aid of a liquid heat transfer medium and can be heated with sufficiently homogeneous temperature distribution to a thermal expansion temperature which is below the bending temperature. The temperature of the male press mould can be controlled and/or regulated by means of the liquid heat transfer medium. The thermal expansion temperature of the male press mould is controlled and/or regulated such that the specific thermal expansion of the male press mould and the thermal expansion of the glass sheet to be bent, placed centrally on the female press mould at bending temperature, practically correspond.

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Fig.1

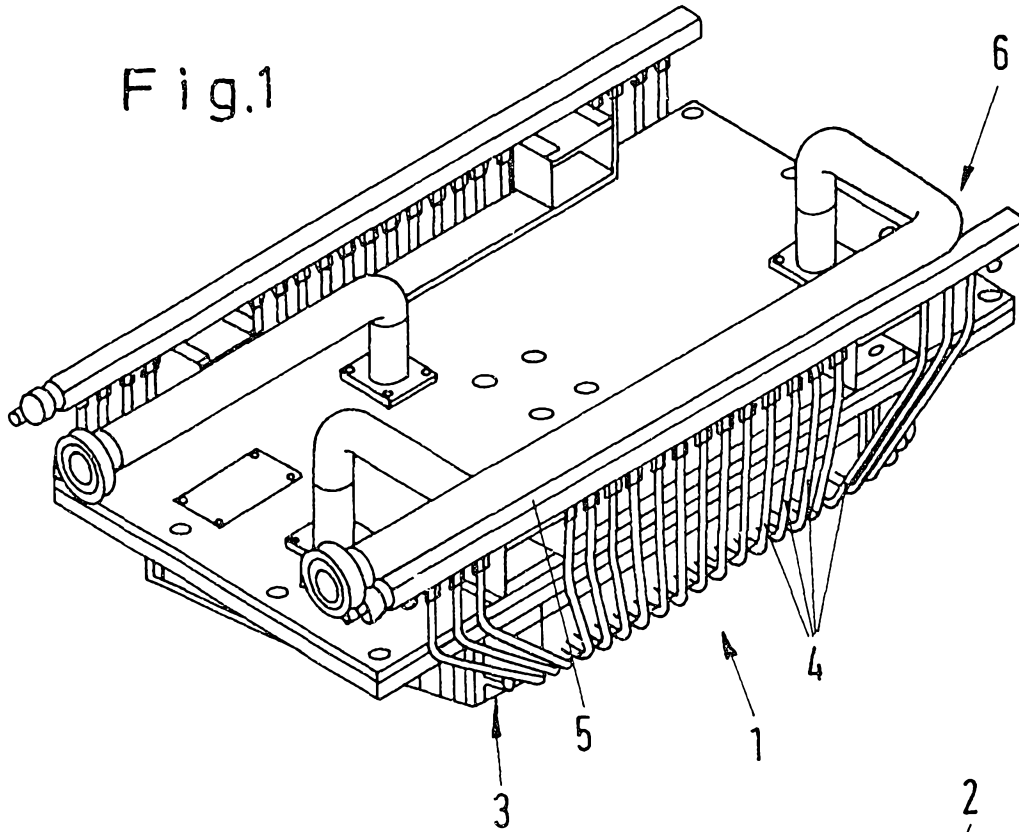


Fig.4

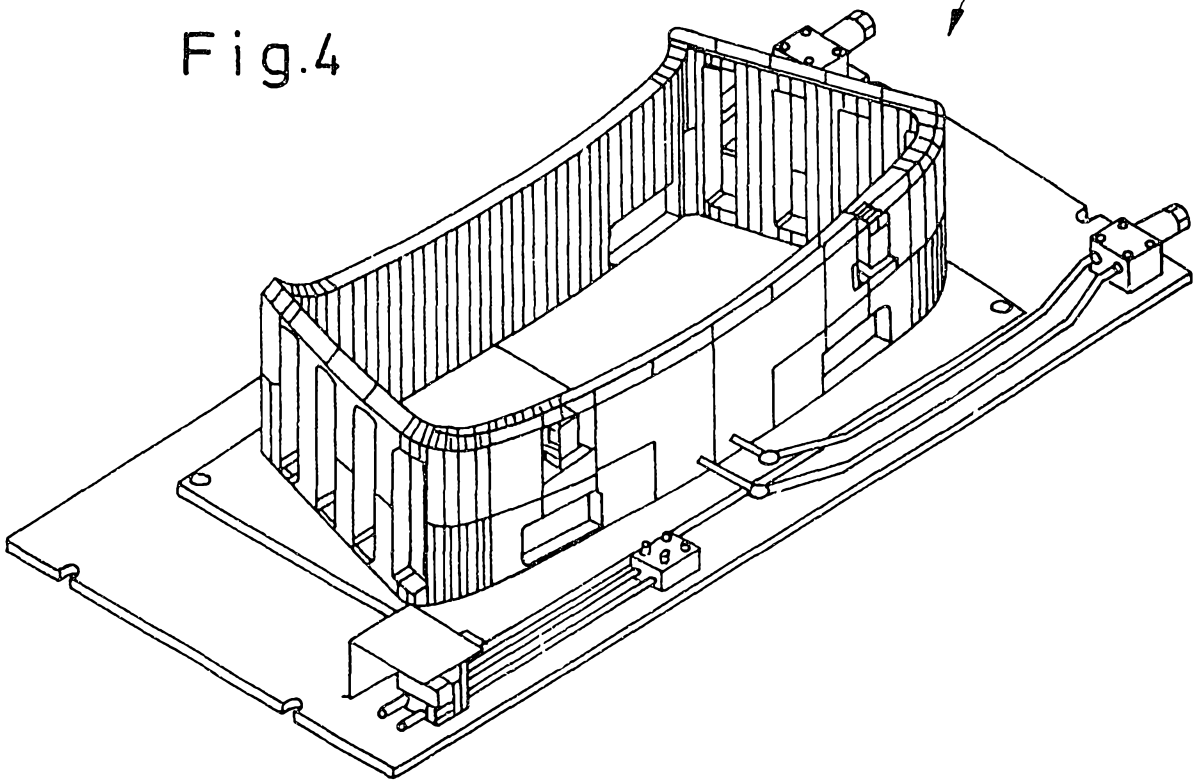


Fig.2

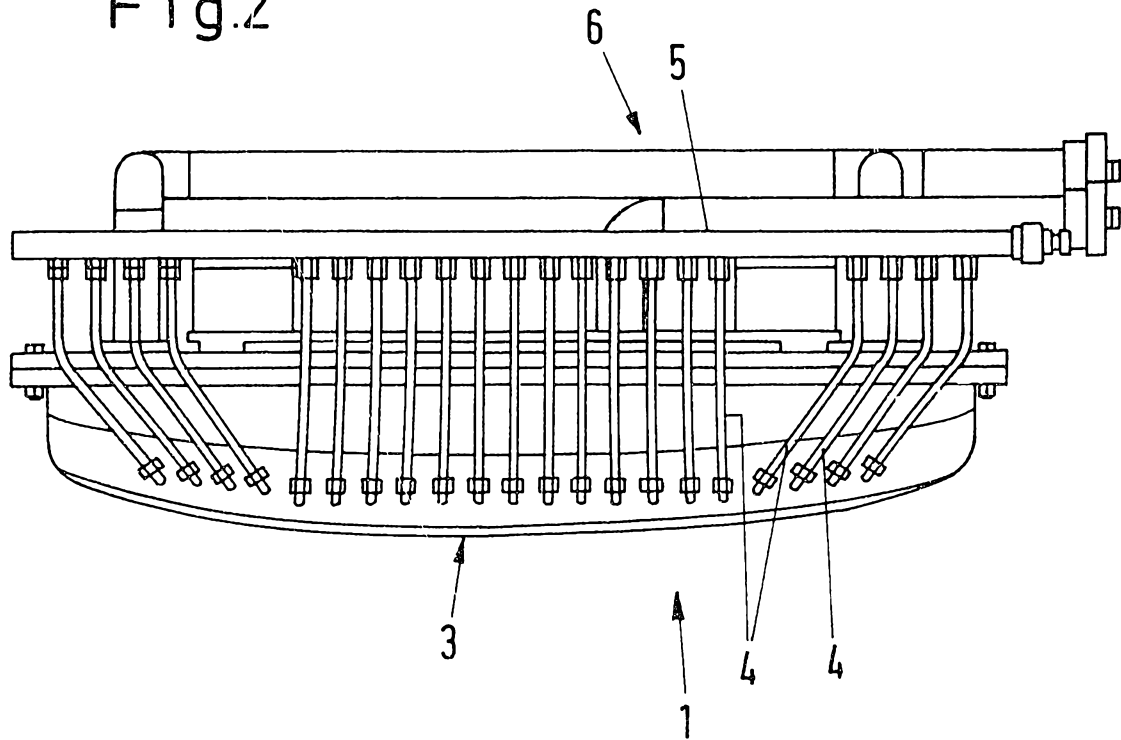


Fig.3

