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(54) **Device which can be enlarged with a controlled expansion.**

(57) This invention is embodied with a device (10) which can be enlarged with a controlled expansion and is suitable for carrying out a method for the moulding of concrete and which can process simple or reinforced concrete and comprises:

– impermeable, resilient sheath means (11) cooperating with at least one movable element (13-113), and

– a bearing structure (12),

at least one enlargeable element (14-114) being included between the bearing structure (12) of the device (10) and the movable element (13).

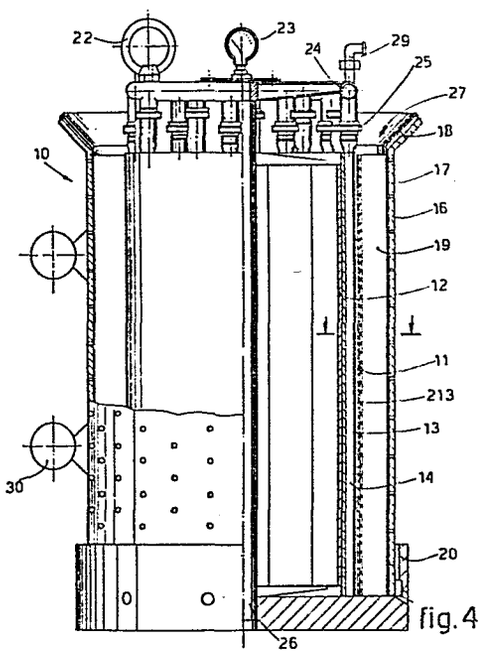

fig.4

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"DEVICE WHICH CAN BE ENLARGED WITH A CONTROLLED EXPANSION"

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This invention concerns a device which can be enlarged with a controlled expansion and is suitable for forming at least part of a shuttering to make concrete elements.

Such device of the invention can be employed to make either simple concrete elements or reinforced concrete elements, and such elements can consist of concrete which is prestressed or not.

This device enables concrete elements to be made with a moulding procedure without any limitation of form and can be included in shuttering to obtain linear elements, cylindrical elements, etc., whether such elements be full or contain one or more hollows.

A procedure to mould concrete is known which permits costs to be reduced, savings of materials to be obtained, quality to be improved and production times to be reduced.

The device of the invention enables the cast concrete to be compressed as poured into appropriate shuttering of any type and size by means of a pre-set, controlled displacement of one or more surfaces of the device.

The device of the invention may have such movable surfaces positioned inside or outside the element to be made, and such movable surfaces may involve a part or the whole of the inner and outer surfaces.

The device of the invention enables very slender thicknesses of concrete, even of the order of 30 mm. or less, to be obtained.

As we said earlier, it is also possible to make products of any required section; thus it is possible to obtain products having a section which is rectangular, circular, elliptic, angled, linear, curved, etc., and such products can be full or can contain one or more hollows.

The device of the invention can be readily manoeuvred either during filling or during withdrawal and can be worked by one single operator.

We shall refer hereinafter to a device working as an inner element of shuttering, that is to say, a device able to exert pressure from the inside outwards on a concrete product, which is therefore pre-supposed to be a product containing one or more hollow spaces.

However, it remains within the scope of the invention to embody also a device suitable for being fitted as the outer shuttering element or else for being made as a part of an outer or inner shuttering element.

Moreover,the invention can be embodied as a part of a shuttering element able to produce full elements containing no hollows.

The device of the invention can obtain controlled expansion with several forms and means, and the scope of the invention covers one or another equivalent device.

We shall describe hereinafter a device having hydraulic expansion, but it is also possible, as we shall indicate briefly below, to obtain the same expansion with other devices of an equivalent type.

The opposed shuttering (outer shuttering in the case we shall now describe) will consist advantageously of a structure perforated transversely so as to permit communication between

its outside and inside and lined inside with a material suitable for letting water pass through but able to withhold other substances, including the adhesives present in the concrete.

This lining material which is permeable to water but not to other substances is a material known in itself and we shall not dwell upon it further.

The opposed shuttering (outer shuttering in the case we shall describe) has, therefore, the shape required and a substantially perforated wall of steel plate lined, on its face in contact with the concrete, with the material which lets water and air pass through but not the adhesive substances.

The water and air contained in the cast concrete can therefore flow freely, following the shortest way and obtaining a perfect distribution of residual moisture throughout the whole body of the product.

Such uniformity of moisture is important since it corresponds to uniformity of compactness, which ensures a high degree of dimensional stability and safety as regards the specific requirements at all points in the product.

Where the device is positioned within the product to be made, such device which can be enlarged with a controlled expansion according to the invention is positioned on the inner side of the shuttering, a suitable hollow space being left between the outer and inner elements of the shuttering.

This enlargeable device has on its outside an impermeable sheath of resilient material, which fulfils the manifold tasks of a hydraulic insulation for the mechanical device located within itself, of a continuous element to distribute thrust and of a resilient element to cause return of the various component parts of the device.

Within the impermeable sheath of resilient material and in cooperation with such sheath are lodged various enlargeable elements that cooperate with a bearing structure.

These enlargeable elements can expand either owing to the expansion of a tubular element within which a fluid under pressure can enter or owing to the action of latches, wedges, cams, jacks, etc.

The invention is therefore embodied with a device which can be enlarged with a controlled expansion and is suitable for carrying out a method for the moulding of concrete and which can process simple or reinforced concrete and is characterized by comprising impermeable, resilient sheath means cooperating with at least one movable element, at least one enlargeable element being included between a bearing structure of the device and the movable element.

With the help of the attached figures, which are given as a non-restrictive example, let us now see a preferred embodiment of the invention; to facilitate the description, we shall describe a device able to work within hollow spaces comprised in concrete products. The figures show the following:-

Fig.1 gives a diagrammatic section of a device of an inside type in a closed position;

Fig.2 gives a diagrammatic section of the device of Fig.1 in an expanded position;

Fig.3 gives a mixed diagrammatic lengthwise view, both cutaway and not cutaway, of the device of Fig.1;

Fig.4 shows a device of the invention to make cylindrical pipes;

Fig.5 shows the device of Fig.4 from above;

Fig.6 shows a part of the expansion system according to a preferred crosswise section;

Figs.7a and 7b show a possible equivalent of the expansion means;

Fig.8 shows a variant of the intermediate elements.

In the figures a device 10 is an enlargeable device the expansion of which takes place along its whole periphery, and is

suitable for being fitted as an inner shuttering element to make concrete elements.

However,the scope of the invention also comprises the ability to embody the device also as an outer shuttering element or as a partial shuttering element.

In the example shown the device 10 comprises an impermeable, resilient sheath 11 which enwraps the device 10 about the whole periphery that comes into contact with the body of the concrete as cast.

Such sheath 11 performs the manifold functions of an insulation for the inner mechanism of the device 10, of a resilient element to cause return (in the event that the device 10 is able to permit this function) and of an element to even out the thrust pressure.

A bearing structure 12 is lodged within the impermeable, resilient sheath 11 and serves to support, guide and position the various elements of the device of the invention.

The bearing structure 12 cooperates with movable elements 13-113, which can be formed with various shapes to suit the shape of the concrete product to be made.

In the example of Fig.1 the structure 12 and movable element 13 respectively comprise guides 15 and 115 which cooperate with each other and are suitable for permitting a guided, controlled, straight movement.

Such guides 15-115 are shown better in Fig.6, in which it is possible to see that the movable element 13 comprises a plate 213 that serves as an intermediate means against the impermeable sheath means 11.

The movable element 13 comprises also abutments 121, which cooperate with abutments 21 included in the guides 15 of the bearing structure 12.

In this way the movable element 13 can be guided in its movement, and its greatest displacement is governed so as to ob-

viate excessive outward movements, deformations, etc.

In this example enlargeable elements 14 are provided in co-operation with the movable elements 13-113 and consist here of tubular elements within which a fluid under pressure can enter.

Thus Fig.1 shows the tubular elements 14 flattened, whereas in Fig.2 the tubular elements 14 are expanded by the action of the fluid under pressure.

The enlargement of the tubular elements 14 compels the elements 13-113 to be displaced, and this displacement is transmitted in turn to the impermeable, resilient sheath 11, which transmits this displacement in the form of pressure evenly distributed on the body of the cast concrete.

Fig.4 shows an application for the production of cylindrical concrete pipes. These cylindrical pipes can be of a type with or without a reinforcement. They can also be of a prestressed type or otherwise.

Fig.4 shows an outer shuttering structure 16 made of perforated steel plate and lined on its inside with a semi-impermeable covering 17.

This semi-impermeable covering 17 is able to let water and air pass through but withholds other substances, including the adhesives contained in the concrete.

An action of pressure on the concrete, therefore, allows the water and air to migrate outwards by the shortest way through the covering 17 and the holes in the outer structure 16.

In a preferred embodiment the outer structure 16 is positioned in a base 20, which may include some seatings for an alignment pin 26 able to cause automatic alignment of the enlargeable device 10.

The base 20 can include means able to drain the water leaving through the perforated structure 16. Such means can con-

sist, for instance, of channels, drip ducts or other types of drainage means able to discharge water.

Substantially tubular enlargeable elements 14 are provided in the movable elements 13 and are connected to a manifold 24 by joints 25,the working pressure of which can be checked with a pressure gauge 23, for example.

A safety valve 28 and one or more fluid intakes 29 can be provided on the manifold 24.

The device 10 can be equipped with one or more lifting rings 22 for handling by a lift truck, bridge crane or crane.

According to the invention, when the outer structure 16 together with the semi-impermeable covering 17 and a possible funnel-shaped shield 18 has been positioned, the device 10 is arranged in such a way that a required chamber is created between the device 10 and the outer shuttering structure.

The required quantity of concrete is poured through the zone 27 for pouring the concrete casting and the device 10 is then actuated.

One or more vibrators 30 may be provided to cooperate with the device 10 and may be positioned either on the outside of the outer structure 16 or on the inside of the device 10 itself or may be located in the base 20.

After the concrete has been poured through the zone 27, the fluid under pressure is sent into the manifold 24 and the pressure of such fluid is checked with a pressure gauge 23.

The fluid under pressure enters the enlargeable elements 14, which in this case consist of tubular elements, and expands them.

Such expansion causes a radial movement of the movable element 13, which transmits such radial movement to the impermeable sheath 11, thus provoking the required pressure against the body of a concrete casting 19.

Such pressure assists the discharge of the water and air

and thus facilitates and makes faster the compaction and drying process.

As we said earlier, the enlargeable elements 14 can be embodied as tubular elements which can be entered by fluid under pressure, or else can consist of cams 114, as in Figs.7, for instance, where the cams can be seen in their position of rest (Fig.7a) and in their position of maximum opening (Fig.7b).

Such cams 114 perform the same function as the enlargeable element 14 and are therefore equivalents.

Levers can be provided instead of the cams, or else wedges, jacks, etc. can be provided instead of the cams, that is to say, means can be provided which are able to obtain a controlled displacement of the element 13 in relation to the bearing structure 12.

If so required, the device 10, can be embodied as a part of a shuttering and in such an event will form only one side of the shuttering.

If the impermeable, resilient sheath 11 is not adequate for the function of resilient return of the movable elements 13-113 or cannot perform that function (for instance, in given cases where the device 10 is the outer shuttering element), suitable resilient means will be provided to cause return movement, or else the enlargeable elements 14-114 themselves will be able to obtain also a return action of the movable elements 13-113.

In given cases the impermeable, resilient sheath 11 cannot possess a resilient character greater than the natural character required for its action of pressure against two elements which are hardly capable of being deformed.

For instance, this will be the case where the device 10 is embodied on a straight side of an outer shuttering.

According to a variant shown diagrammatically in Fig.8 a plurality of elements 213 cooperating with each other by means

of teeth or equivalent means is provided. Such teeth serve to maintain proper circumferential alignment between the various elements 213. In Fig.8 the rubber sheath 11 has been removed.

INDEX

10 - device

11 - impermeable resilient sheath

12 - bearing structure

13 - movable element

113 - movable element

213 - intermediate movable plate

14 - enlargeable element

114 - enlargeable element

15 - guide

115 - guide

16 - outer shuttering structure

17 - semi-impermeable covering

18 - funnel-shaped shield

19 - concrete casting

20 - base

21 - abutment

121 - abutment

22 - lifting ring

23 - pressure gauge

24 - manifold

25 - joints

26 - alignment pin

27 - zone for pouring the concrete casting

28 - safety valve

29 - fluid intake

30 - vibrators.

CLAIMS

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1 - Device (10) which can be enlarged with a controlled expansion and is suitable for carrying out a method for the moulding of concrete and which can process simple or reinforced concrete and is characterized by comprising:

- impermeable, resilient sheath means (11) cooperating with at least one movable element (13-113), and
- a bearing structure (12),

at least one enlargeable element (14-114) being included between the bearing structure (12) of the device (10) and the movable element (13).

2 - Device (10) which can be enlarged with a controlled expansion as claimed in Claim 1, in which the movable element (13-113) cooperates with the bearing structure (12) through guides (15-115).

3 - Device (10) which can be enlarged with a controlled expansion as claimed in Claim 1 or 2, in which abutment means (21-121) are provided which cooperate between the movable element (13-113) and the bearing structure (12).

4 - Device (10) which can be enlarged with a controlled expansion as claimed in any of Claims 1 to 3 inclusive, in which the enlargeable element (14) comprises at least one tubular element that can be expanded by means of fluid under pressure.

5 - Device (10) which can be enlarged with a controlled expansion as claimed in any of Claims 1 to 3 inclusive, in which the enlargeable element (14) comprises at least a plurality of cams.

6 - Device (10) which can be enlarged with a controlled expansion as claimed in any of Claims 1 to 3 inclusive, in which the enlargeable element (14) comprises at least a wedge-wise system.

7 - Device (10) which can be enlarged with a controlled expan-

sion as claimed in any of Claims 1 to 3 inclusive, in which the enlargeable element (14) comprises at least a system with jacks.

8 - Device (10) which can be enlarged with a controlled expansion as claimed in any of Claims 1 to 3 inclusive, in which the enlargeable element (14) comprises at least a system with levers.

9 - Device (10) which can be enlarged with a controlled expansion as claimed in any claim hereinbefore, which comprises actuation means (24) that are common to a plurality of enlargeable elements (14).

10 - Device (10) which can be enlarged with a controlled expansion as claimed in any claim hereinbefore, which comprises handling means (22).

11 - Device (10) which can be enlarged with a controlled expansion as claimed in any claim hereinbefore, which comprises alignment means (26).

12 - Device (10) which can be enlarged with a controlled expansion as claimed in any claim hereinbefore, which cooperates with at least part of a shuttering made of perforated steel plate (16).

13 - Device (10) which can be enlarged with a controlled expansion as claimed in any claim hereinbefore, in which such part of a shuttering made of perforated steel plate (16) is lined with a semi-impermeable covering (17).

14 - Device (10) which can be enlarged with a controlled expansion as claimed in any claim hereinbefore, which constitutes a shuttering element cooperating with an inner hollow space within a product.

15 - Device (10) which can be enlarged with a controlled expansion as claimed in any of Claims 1 to 13 inclusive, which constitutes a shuttering element cooperating with the outside of a product.

16 - Device (10) which can be enlarged with a controlled expansion as claimed in Claim 14 or 15, which constitutes part of a shuttering.

17 - Device (10) which can be enlarged with a controlled expansion as claimed in any claim hereinbefore, which comprises a plurality of intermediate movable elements (213) provided with means for reciprocal alignment.

18 - Device (10) which can be enlarged with a controlled expansion as claimed in any claim hereinbefore, in which at least part of the shuttering (16) cooperates with vibrator means (30).

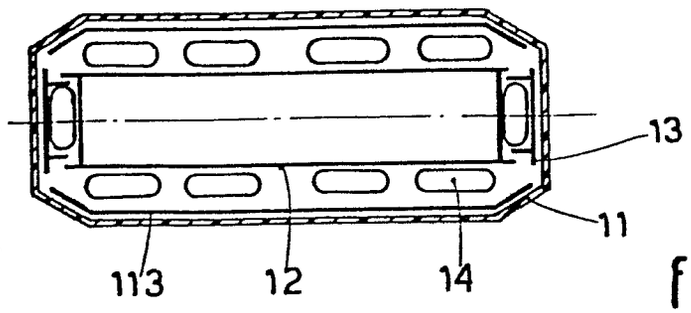


fig.1

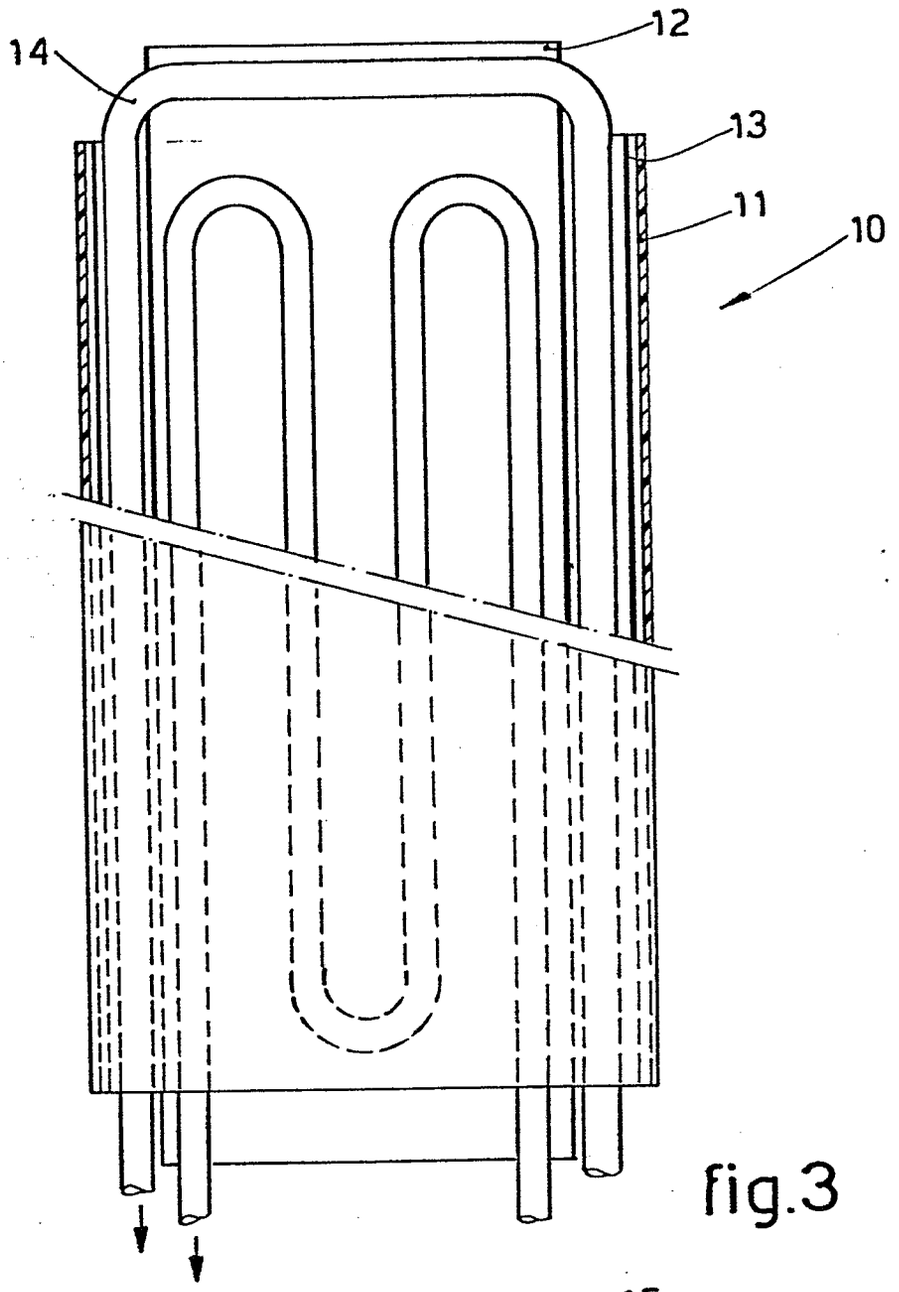
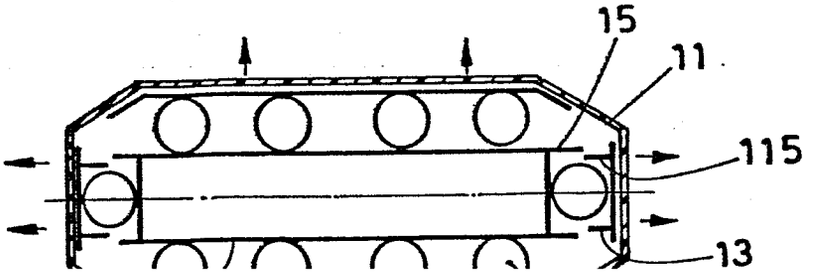


fig.3



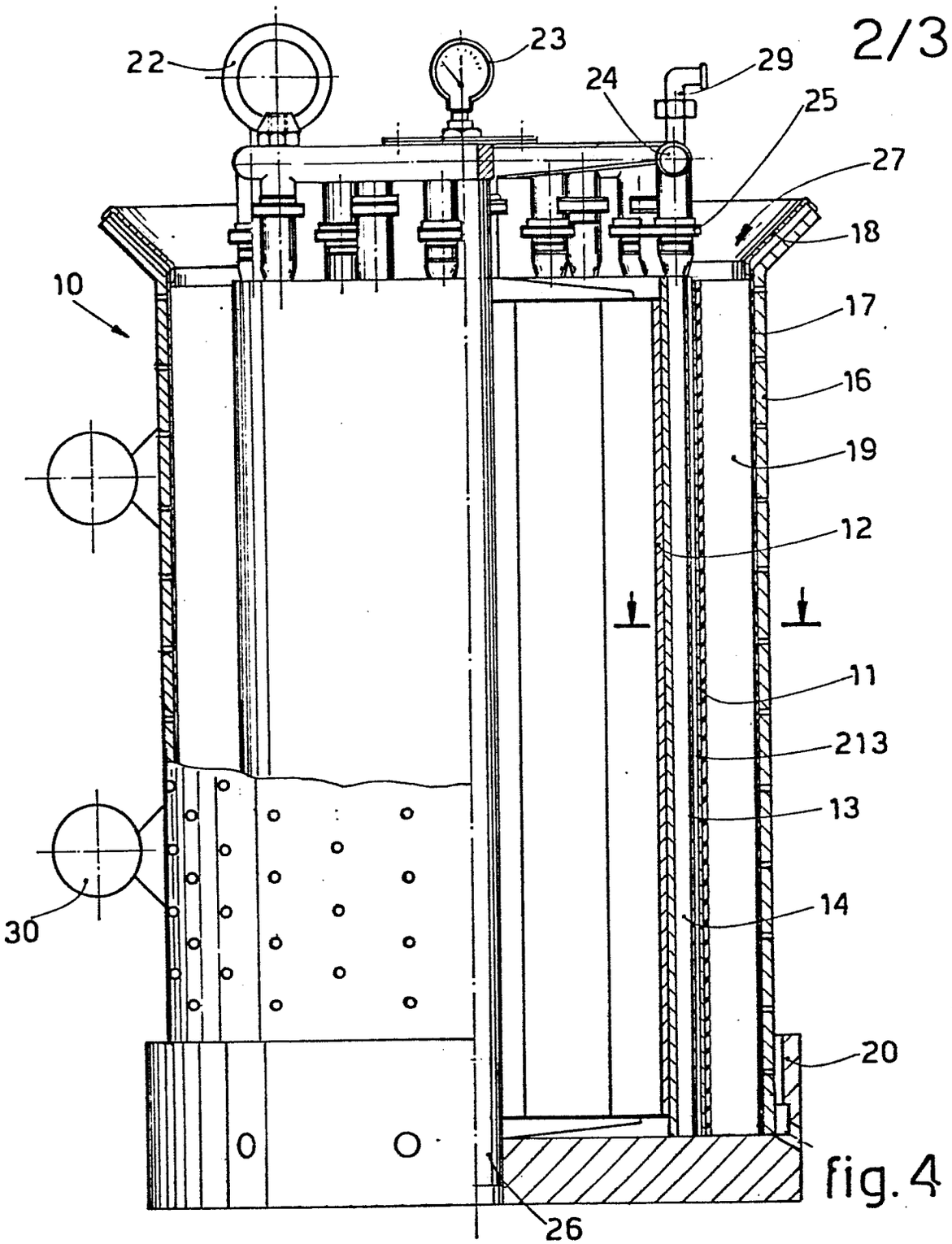

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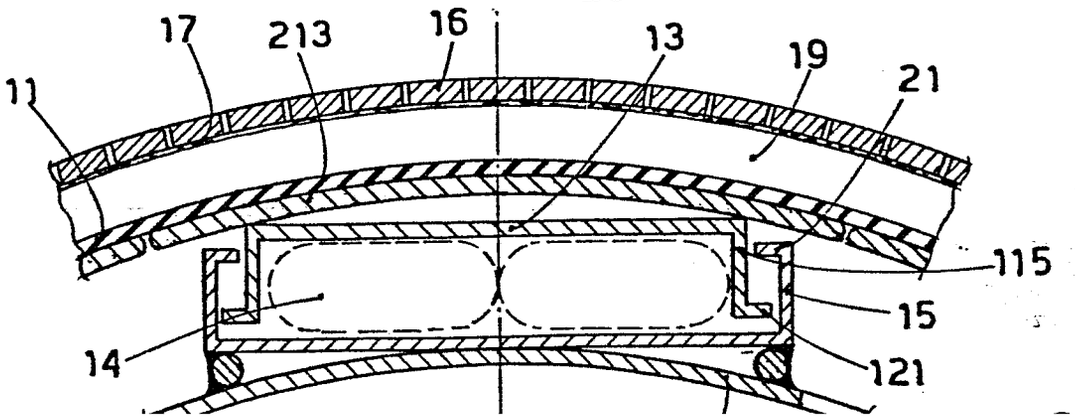
fig. 4


17
213
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19
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11
115
15
14
121

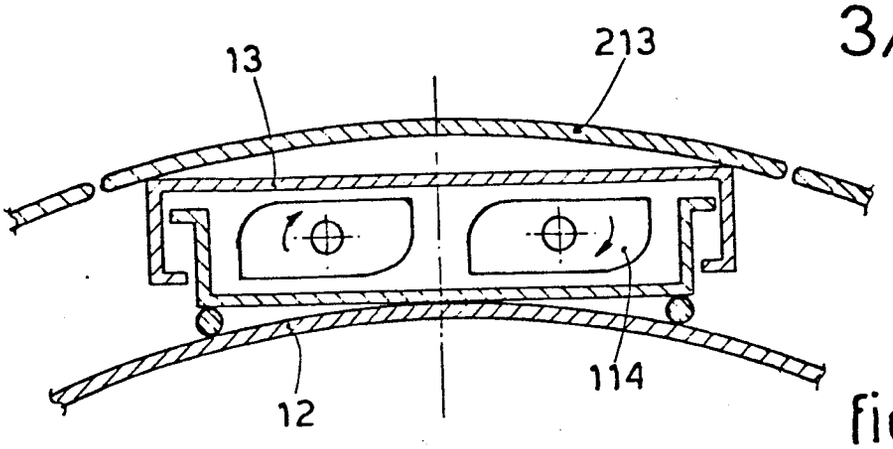


fig.7a

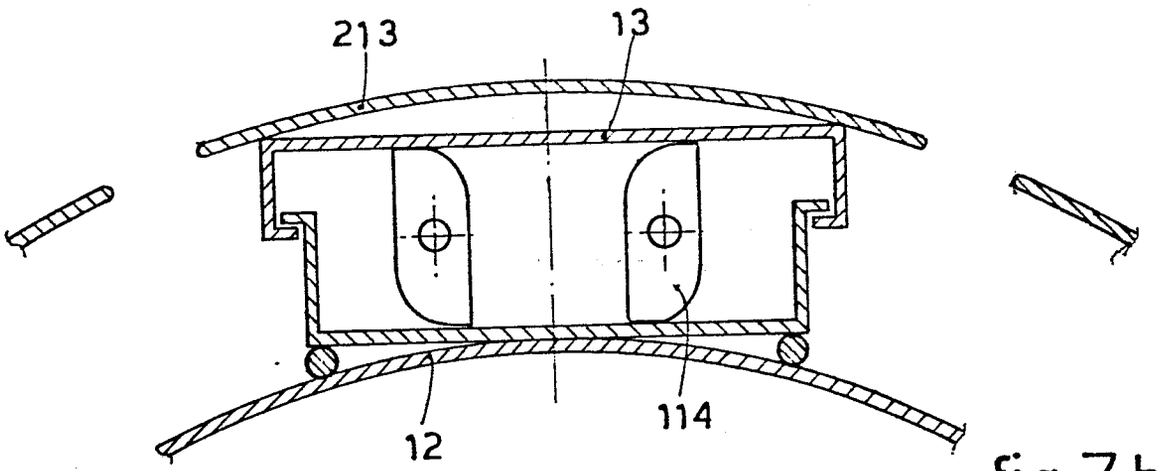
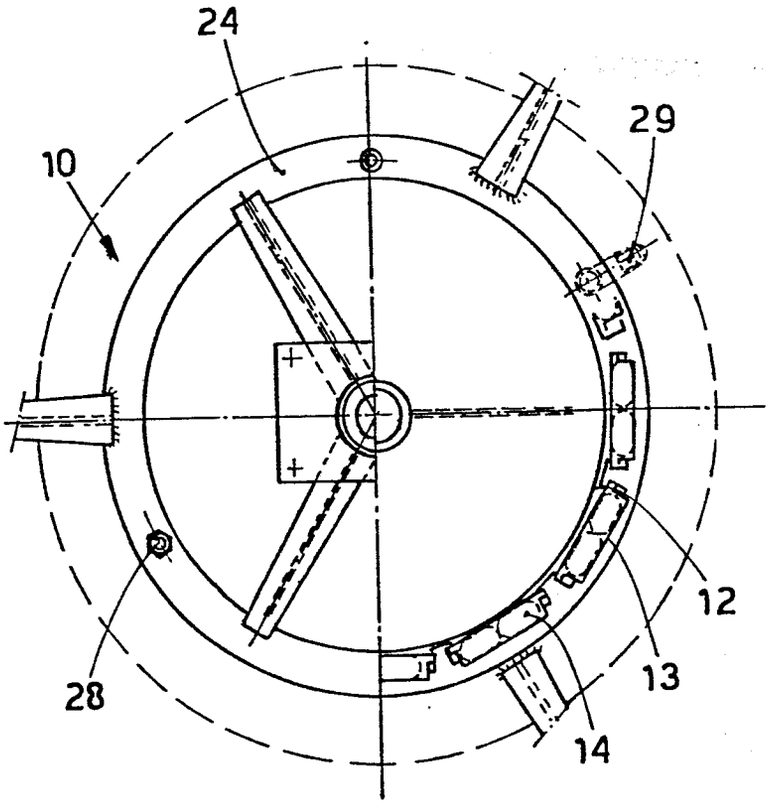


fig.7b



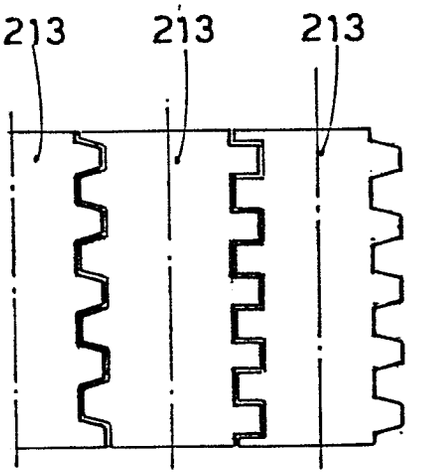


fig.8