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# (54) Branch connection

(57) A branch connection suitable for use in a manhole, an access chamber, a gully or a pipe junction. A main channel (2) of the connection communicates with a branch channel (8). The branch channel (8) is declivitous and has a cross-sectional shape that varies along its length. This reduce turbulence, back-flow and ponding. In another aspect, the main channel (2) is declivitous and is provided with a gradient greater than a feed pipe, to counteract decelerating effects upon fluid flow resulting from differences in diameter between the feed pipe and the main channel (2). In another aspect, the main channel is provided with an accelerating weir in a region where the branch channel (8) joins the main channel (2).

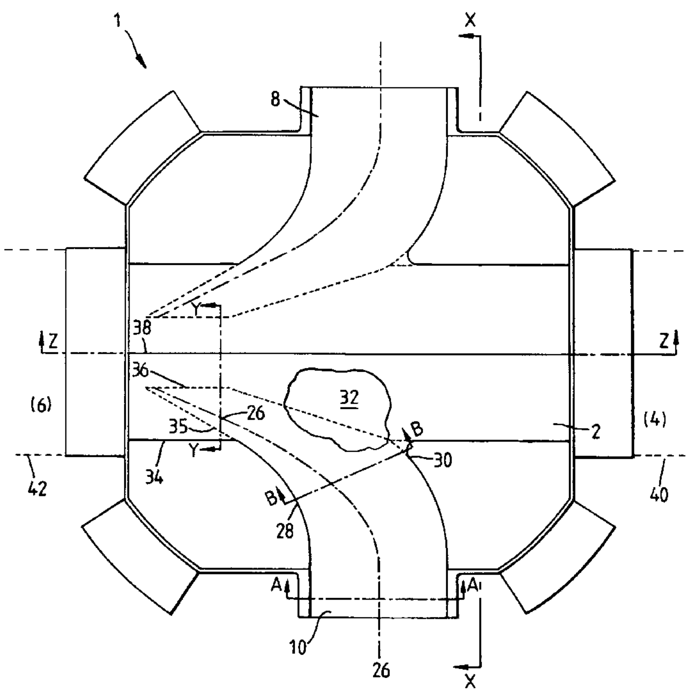


Fig. 1

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## Description

**[0001]** The present invention relates to a branch connection for a fluid transport network and has particular, although not exclusive, relevance to access chambers and manholes, such as used in foul water drainage systems. The invention also relates to conduits, coupled to such a branch connection for transporting fluids to and from the connection.

**[0002]** It has long been known in the fields of fluid transport and drainage that branch connections are necessary at which pipes are coupled together so as to carry fluid along a common conduit. For example, in a sewage network, one pipe may be carrying a mixture of sewage and water from a cess tank and another pipe may be carrying effluent from an industrial outlet. Rather than provide for these two pipes to run in parallel to a sewage processing plant, it is more economical to have the effluent from both carried in a common pipe.

**[0003]** Such branch connections are generally arranged so that a main pipe is tapped into at an angle by a branch pipe. Because high flow rates and large volumes of fluid per unit time must be catered for, it is necessary to ensure that the branch connection (and at least its outlet) are able to withstand the high fluid forces and turbulent flow generated when two moving bodies of fluid are brought together.

**[0004]** One problem which can occur with the above is that the effects of turbulent flow, in the region of the branch connection where the two flows meet, is so great that one or both flows can be interrupted somewhat. This can cause a build-up of fluid upstream of the connection point and thus places undue stress on the pipes and in particular at the couplings between individual components. Where two branch pipes are provided on opposite sides of a main pipe, flow from one can even cross the main pipe and intrude into the opposite branch pipe. This turbulence can restrict the flow of fluid through the connection and, in the case of foul water, can result in a build-up of debris or solid sewage. This, in itself, will cause an obstruction to fluid flow.

**[0005]** It is therefore an object of the present invention to at least alleviate the above shortcomings and provide a branch connection wherein the problems of turbulent flow are kept to a minimum.

**[0006]** It is a further object of the present invention to provide a series of conduits for use in a branch connection which are arranged to alleviate any build-up of fluids upstream of a branch connection.

**[0007]** According to a first aspect of the present invention there is provided a branch connection through which fluid may flow, the connection comprising:

a first channel having a first inlet and a first outlet; and

at least one further channel comprising a second inlet and a second outlet which is arranged to communicate with the first channel;

wherein a fluid constraining portion of the or each at least one further channel has a cross-sectional shape which varies along the length thereof.

**[0008]** By providing the at least one further channel with a cross sectional shape which varies along its length, the flow from the branch pipe is more controlled and the detrimental effects of turbulent flow at the junction of the first and at least one further channel are alleviated.

**[0009]** Preferably the first channel is configured to define a flow portion which presents a declivitous gradient to fluid flowing from the first inlet to the first outlet. In this way the build-up of debris within the chamber can be prevented.

**[0010]** Additionally or alternatively the or each at least one further channel is arranged to present a declivitous gradient to fluid flowing from the second inlet portion to the second outlet thereof, which declivitous gradient is steeper than the declivitous gradient of the first channel. This provision enables the at least one further channel to allow the fluid flowing therethrough to merge with the fluid flow in the first channel more readily and, again, help alleviate the detrimental effects of turbulent flow within the connection.

**[0011]** Advantageously the fluid flow path of the or each at least one further channel from the inlet portion to the outlet portion is non-linear and preferably curviform. Furthermore the variation in cross sectional shape of the flow surface of the or each at least one further channel is from being substantially semi-circular in a region adjacent the inlet portion to being asymmetric in a region adjacent the outlet portion. This enables the flow of fluid therewithin to be less turbulent than with a regular cross-sectional shape. The asymmetric shape is preferably defined by a substantially linear radially inner, first side wall meeting an arcuate radially outer, second side wall.

**[0012]** In a preferred embodiment, fluid is presented to the first inlet via a first external conduit and fluid is presented from the first outlet to a further external conduit, the first and further conduits presenting, to the fluid flowing therethrough, respective gradients, wherein the gradient of the further external conduit is at least as steep as the gradient of the first external conduit and preferably steeper. By ensuring that this relationship between the gradients of the respective conduits is maintained, the possibility of debris building up within the chamber in situations of low volume fluid flow is reduced.

**[0013]** Preferably, the declivitous flow path of the first channel has a gradient in a first region, at which the further channel communicates with the first channel, that is greater than a gradient in a second region which is adjacent the said first region and upstream thereof. This arrangement causes fluid flowing through the branch portion of the connection to be accelerated, thereby reducing turbulence caused by the branch flow and enhancing the branch flow itself.

**[0014]** Preferably the connection comprises two further channels intersecting the first channel at opposite points.

**[0015]** Preferably, the connection constitutes the base pan of an access chamber, manhole or gully.

**[0016]** According to a second aspect of the invention there is provided a branch connection through which fluid may flow; the connection comprising:

a first channel having a first inlet and a first outlet;
at least one further channel comprising a second inlet and a second outlet which is arranged to communicate with the first channel;
wherein the said first channel presents a declivitous flow path to fluid flowing from the first inlet to the first outlet, the said flow path having a gradient in a first region, at which the said further channel communicates with the said first channel, that is greater than a gradient in a second region which is adjacent the said first region and upstream thereof.

**[0017]** When a feed conduit supplies foul water to a component having a greater cross-sectional area than itself, it has been found that a reduction in velocity results. This can be detrimental at relatively low flow rates, because sewerage often relies upon the maintenance of predetermined velocities in order to achieve a self-cleansing effect and if these predetermined (self-cleansing) velocities are not maintained, solid debris drops out of the liquid. This debris can eventually build-up to the extent that it causes a serious flow restriction or even a complete blockage. This problem is particularly encountered in access chambers and manholes, where an increase in cross-sectional area is not uncommon.

**[0018]** A third aspect of the invention sets out to solve this problem.

**[0019]** According to a third aspect of the present invention there is provided in combination, a conduit connection including a channel having an inlet and an outlet through which fluid may flow; a first external conduit to present fluid to the inlet; and a further external conduit to receive fluid from the outlet; wherein each of the first external conduit, the channel and the further external conduit present to fluid flowing therethrough a particular declivitous gradient, the channel has a greater cross-sectional area than the first external conduit and the gradient of the channel is steeper than that of the first external conduit.

**[0020]** This relationship enables the connection to maintain a self-cleansing fluid velocity for relatively low fluid flows, because the gradient differential between the first external conduit and the channel counteracts the velocity-reducing effect of the cross-sectional area disparity. Preferably the gradient of the further external conduit is at least as steep as that of the first conduit.

**[0021]** The present invention will now be described, by way of example only, and with reference to the accompanying drawings, of which:

Figure 1 shows a part sectional view from above of a connection in accordance with the present invention;

Figure 2 shows a sectional view along the line X-X of Figure 1;

Figure 3 shows a sectional view along the line Z-Z of Figure 1;

Figure 4 shows a part cross-sectional view taken along line Y-Y of Figure 1;

Figure 5 shows a top-down sectional view of part of the connection of Figure 1; and

Figure 6 shows a series of cross sections taken through one of the branch pipes of the connection of Figures 1 to 5 in planes parallel to the sectional plane of Figure 3.

**[0022]** Referring now to Figures 1 to 6, there is illustrated a chamber base portion, shown generally as 1, formed from a fired clay or plastics material. The chamber 1 is formed in a known manner by utilizing molding techniques apparent to those skilled in the art. The chamber 1 includes a first channel 2 allowing the passage of fluid therethrough. The first channel 2 has an inlet 4 in Figure 1 and an outlet 6. Communicating with this first channel 2 are two branch pipes 8 and 10 which are mirror images of each other, but otherwise identical. Although two branch pipes 8, 10 have been shown in this example, there could be only one, or indeed, more than two. Two have been shown by way of example only. For simplicity only one will be described in detail below.

**[0023]** It can be seen, particularly from Figure 2, that the first channel 2 is shaped to have a generally semi-circular lower region. This is to allow the easy passage fluid through the channel 2. An upper region 24 of the channel 2 is formed with an angled profile. Hence, if the channel 2 becomes filled with fluid and debris (for example, as would be the case in a foul-water chamber), any debris in the upper regions is caused by these angled surfaces 24 to fall back into the base (i.e. semi-circular) region of the channel 2 as the level of fluid reduces. The debris is then carried away by fluid flowing in this lower base region. In this way, the build-up of debris in the chamber 1 is avoided.

**[0024]** Considering now the further branch pipe 10 shown particularly in Figure 1, it can be seen that the channel initially seeks to communicate with the chamber 1 in a direction orthogonal to that of the first channel 2. However, as one progresses along the length of the branch pipe 10, it can be seen that it turns to the left to intersect, and therefore directly communicate with, the first channel 2 at an acute angle. Furthermore, the line 26 of the lowest part of the base of the branch pipe 10 moves off-centre relative to the overall width of the pipe as one progresses along the length thereof. The reasons for this will be explained further below.

**[0025]** Figures 4, 5 and 6 illustrate the shape and configuration of the branch pipe 10 and its communication with the first channel 2 in more detail. Figure 4 is a cross-section along Y-Y in Figure 1. Figure 5 is a plan view of part of the base portion and corresponds to part of Figure 1. It will be seen that a number of section lines A-A to J-J are marked onto Figure 5. Figure 6 shows the profile of the branch pipe 10 and its relative position in each respective sectional plane.

**[0026]** From these figures, it can be seen that the branch pipe 10, when first communicating with the chamber 1, forms a lower region of generally semi-circular cross-sectional shape. Fluid passing through this first region of the branch pipe 10, therefore, is subject to the same fluid dynamics as that passing through the input region 4 of the first channel 2.

**[0027]** As one progresses further around the bend of the branch pipe 10, it can be seen that the cross sectional shape gradually changes to become that shown as section J in Figure 6. Here it can be seen that the base line 26 has moved so that the part-circular base region of the branch pipe 10 now has a different centre and a smaller radius. It has also gradually lowered, so as to define the declivitous flow path. The radially inner wall 28 as viewed from Figure 5 has become generally vertical. The radially outer wall 30 becomes inclined at around 40 ° to the vertical.

**[0028]** As the base of the pipe 26 starts to shift to the left, any fluid flowing through the pipe will also move generally to the left as it experiences this shift in the base line along its flow path. Hence, as the fluid flows through the branch pipe 10, it is gradually directed towards the radially inner wall 28 of the pipe 10. If the region of the pipe at J-J were to be of the same cross-sectional shape as that at the region A-A, then, when fluid entered into the region of the intersection between branch pipe 10 and first channel 2, clearly most of this would be occurring in the region marked 32 in Figure 1 and would thus cause turbulent flow in this region.

**[0029]** By obtaining a less turbulent flow where the branch pipe 10 feeds into channel 2, a more uniform flow of fluid through the entire chamber 1 occurs. This causes less build up of fluid in the upper regions both of the first channel 2 and its inlet portion 4 and in the branch pipe 10. Thus, particularly at periods of heavy fluid flow, less congestion of fluid flowing through the chamber 1 occurs than has hitherto been the case.

**[0030]** From Figure 4, it can be seen that the cross-sectional area of the first channel 2 in this region itself varies from that of the semi-circular region at inlet 4 due to communication with the branch pipes 10. It can be seen that the particular shape of the branch pipes 10 is continued here. The configuration is adapted in order to maintain guidance of the fluid flow as it passes into the region of communication between the branch pipes 10 and the channel 2. Accordingly, the cross-sectional shape of first channel 2 at the region Y-Y advantageously follows that of the branch pipe. Thus, it can be seen that the left-hand wall 34 of first channel 2 at this region follows the semi-circular cross-section of shape as shown in Figure 2, but that at region 35 it begins to follow the more steeply sided left hand wall as shown at 28 at region J-J. The mid-point 38 of main pipe 2 is the generally horizontal mid-point of the semi-circular region as shown in Figure 13. This cross-sectional shape again aids to prevent build up of turbulence at the point of communication between branch pipe 10 and first channel 2, so as to provide a means for enabling the two bodies of fluid to mix without undue turbulence occurring.

**[0031]** Between the region A-A and Y-Y of branch pipe 10, there is a declivitous gradient along the line 26. This assists in cases of low fluid flow volume to cause the body of fluid to move more readily therethrough. This also prevents any build-up of debris in the branch pipe 10. Because the fluid is accelerated, it will have greater momentum when it meets the main flow; thus it is less likely to be deflected by low velocity fluid in the first channel 2.

**[0032]** In the case of the first channel 2 itself having a declivitous gradient between its inlet portion 4 and outlet portion 6, it is desirable for the declivitous gradient of the branch pipe 10 to be steeper than that of the first channel 2. Once again, this is to enable a smooth mixture of fluid flow at the region of communication between the pipe 10 and the first channel 2.

**[0033]** It will be appreciated that it is advantageous for the branch pipe to have a declivitous gradient at the approach to, and intersection with, the first channel 2. This will particularly assist the flow of fluid therethrough at times of low volume fluid flow.

**[0034]** In the event of more than one further channel being used with a chamber such as that disclosed above, then each of the further channels (such as branch pipe 8) can have a variation in cross-sectional shape corresponding to that described above. Furthermore, the curviform shape of the length of branch pipe 10 can also be mirrored in any further branch pipes, as is the case with branch pipe 8.

**[0035]** Those skilled in the art will appreciate that the chamber 1 is generally not used on its own. It will normally form part of a larger network of conduits arranged to carry fluid from one place to another. In the present example, a first conduit 40, as shown in Figure 1, is used to transport fluid to the inlet portion 4 of the first channel 2. Similarly a second conduit 42 is used to transport fluid from the outlet portion 6 of first channel 2. In such a situation, the effective diameter of the first and second conduits 42 will typically be significantly smaller than the effective diameter of the first channel 2 (and indeed any other channel) of the chamber 1. This being the case, it will be understood from the basic principles of fluid dynamics, that any fluid passing through the first conduit 40 and entering the first channel 2 (having a larger diameter than that of the first conduit 40) will experience a decrease in velocity. This presupposes a uniform gradient as viewed from the perspective of the fluid flowing through the conduits 40, 42 and first channel 2.

**[0036]** The above situation, particularly at the interface between the inlet portion 4 of first channel 2 and the first conduit 40, can cause some problems at low feed velocities. This is because a chamber such as the one described is generally intended to work as a self-cleansing component. This relies upon the component passing fluid predominantly at above a "self-cleansing" velocity. At or above the self-cleansing velocity, debris will remain trapped within the fluid flow and thus be carried away from the component to the intended destination. However, below the self-cleansing velocity, debris will tend to drop out of the fluid and, in certain circumstances, accumulate within the component. In extreme cases, this can lead to serious obstructions and even a blockage. The disparity between the diameter of the inlet conduit 40 and the first channel 2 can increase the proportion of time that the fluid flow through the first channel 2 drops below the self-cleansing velocity - thereby increasing the risk of debris accumulation.

**[0037]** Referring to Figure 3, the first channel 2 has a declivitous gradient as between the first conduit 40 and second conduit 42. The first conduit will typically have a gradient of the order of 1:100 and the gradient of the channel 2 in a region 50 immediately downstream of the first conduit 40 is set greater than this at 1:30. Because the gradient of the first channel 2 is greater than that of the first conduit 40, the fluid entering the channel 2 experiences an accelerating effect which counteracts the decelerating effect caused by the disparity in diameters. The net effect is that the through-flowing fluid maintains its input velocity and, hence, does not drop below the self-cleansing velocity.

**[0038]** In circumstances of low volume of fluid flow, the overall declivitous gradient 44 also assists in allowing movement of debris to occur through the chamber 1 and therefore this, in itself, will assist avoiding any extraneous causes of turbulent flow to occur in the region of communication between branch pipe 10 and first channel 2.

**[0039]** A further benefit is achieved by providing an overall gradient 44 along the length of first channel 2. This is that any fluid flowing through the first channel 2, which is subject to an increase of velocity caused by the declivitous gradient 44, will help "pull" fluid entering the communication region 32 between the first channel 2 and branch pipe 10 towards the outlet. This leads to a more efficient flow at the region of communication between channel 2 and pipe 10. This effect is enhanced by providing a gradient in communication region 52 of channel 2, that is even steeper than the rest 50 of the gradient 44. In this case region 52 has a gradient of 1: 100. Region 52 corresponds with the inlets from the further pipes 10, so as to provide an acceleration weir which increases the flow rate of the fluid in the first channel 2 as it merges with the flows from the branch pipes 10.

**[0040]** Intermediate regions 50 and 52, is a region 51, this has a gradient of 1:40 in this embodiment. Immediately downstream of region 52 is a final incline 53 which feeds to the outlet 42. This final incline has a gradient of 1:60.

**[0041]** It will be apparent to those skilled in the art that there is no compulsion for the declivitous gradient profile 44 to occur in conjunction with the described configuration of the branch pipe 10. These two features may occur separately in individual chambers. However, a clear synergistic benefit occurs when both features are combined in the one chamber.

**[0042]** Although the foregoing embodiment has been described in relation to the base or pan of an access chamber, it has equally valuable applications in a manhole, a gully or even at a simple junction between a main pipe and a branch pipe.

## Claims

1. A branch connection through which fluid may flow, the connection comprising:

   a first channel having a first inlet and a first outlet;

   at least one further channel comprising a second inlet and a second outlet which is arranged to communicate with the first channel;

   wherein a fluid constraining portion of the or each at least one further channel has a cross-sectional shape which varies along the length thereof.

2. A connection according to claim 1, wherein the first channel is configured to define a flow path which presents a declivitious gradient to fluid flowing from the first inlet to the first outlet.

3. A connection according to claim 2, wherein the said declivitous flow path of the first channel has a gradient in a first region, at which the said further channel communicates with the said first channel, that is greater than a gradient in a second region which is adjacent the said first region and upstream thereof.

4. A connection according to any preceding claim, wherein the or each at least one further channel is arranged to present a declivitous gradient to fluid flowing from the second inlet to the second outlet thereof.

**5.** A connection according to claim 4 wherein the declivitous gradient of the or each at least one further channel is steeper than the declivitous gradient of the first channel.

**6.** A connection according to any one of the preceding claims wherein the fluid flow path defined by the or each at least one further channel from the second inlet to the second outlet does not follow a straight line.

**7.** A connection according to claim 6 wherein the fluid flow path of the or each at least one further channel is curviform.

**8.** A connection according to any one of the preceding claims wherein the cross-sectional shape of the said fluid constraining portion of the or each at least one further channel varies from being substantially semi-circular in a region adjacent the second inlet to being asymmetric in a region adjacent the second outlet.

**9.** A connection according to claim 8, wherein the asymmetric shape is defined by a substantially linear radially inner first side wall meeting an arcuate radially outer, second side wall.

**10.** A connection according to any one of the preceding claims, wherein fluid is presented to the first inlet via a first external conduit and fluid is presented from the first outlet to a further external conduit, the first and further conduits presenting, to the fluid flowing therethrough, respective gradients, and wherein the gradient of the further external conduit is at least as steep as the gradient of the first external conduit.

**11.** A connection according to any one of the preceding claims wherein the at least one further channel comprises two further channels.

**12.** A branch connection through which fluid may flow; the connection comprising:

a first channel having a first inlet and a first outlet;
at least one further channel comprising a second inlet and a second outlet which is arranged to communicate with the first channel;
wherein the said first channel presents a declivitous flow path to fluid flowing from the first inlet to the first outlet, the said flow path having a gradient in a first region, at which the said further channel communicates with the said first channel, that is greater than a gradient in a second region which is adjacent the said first region and upstream thereof.

**13.** A connection according to any preceding claim and forming at least part of a base portion of an access chamber, manhole or gully.

**14.** A connection substantially as hereinbefore described with reference to the accompanying drawings.

**15.** In combination; a conduit connection including a channel having an inlet and an outlet through which fluid may flow; a first external conduit to present fluid to the inlet; and a further external conduit to receive fluid from the outlet; wherein each of the first external conduit, the channel and the further external conduit present to fluid flowing therethrough a particular declivitous gradient, the channel has a greater diameter than the first external conduit and the gradient of the channel is steeper than that of the first external conduit.

**16.** The combination of claim 15, wherein the connection is a chamber according to any one of claims 1-14.

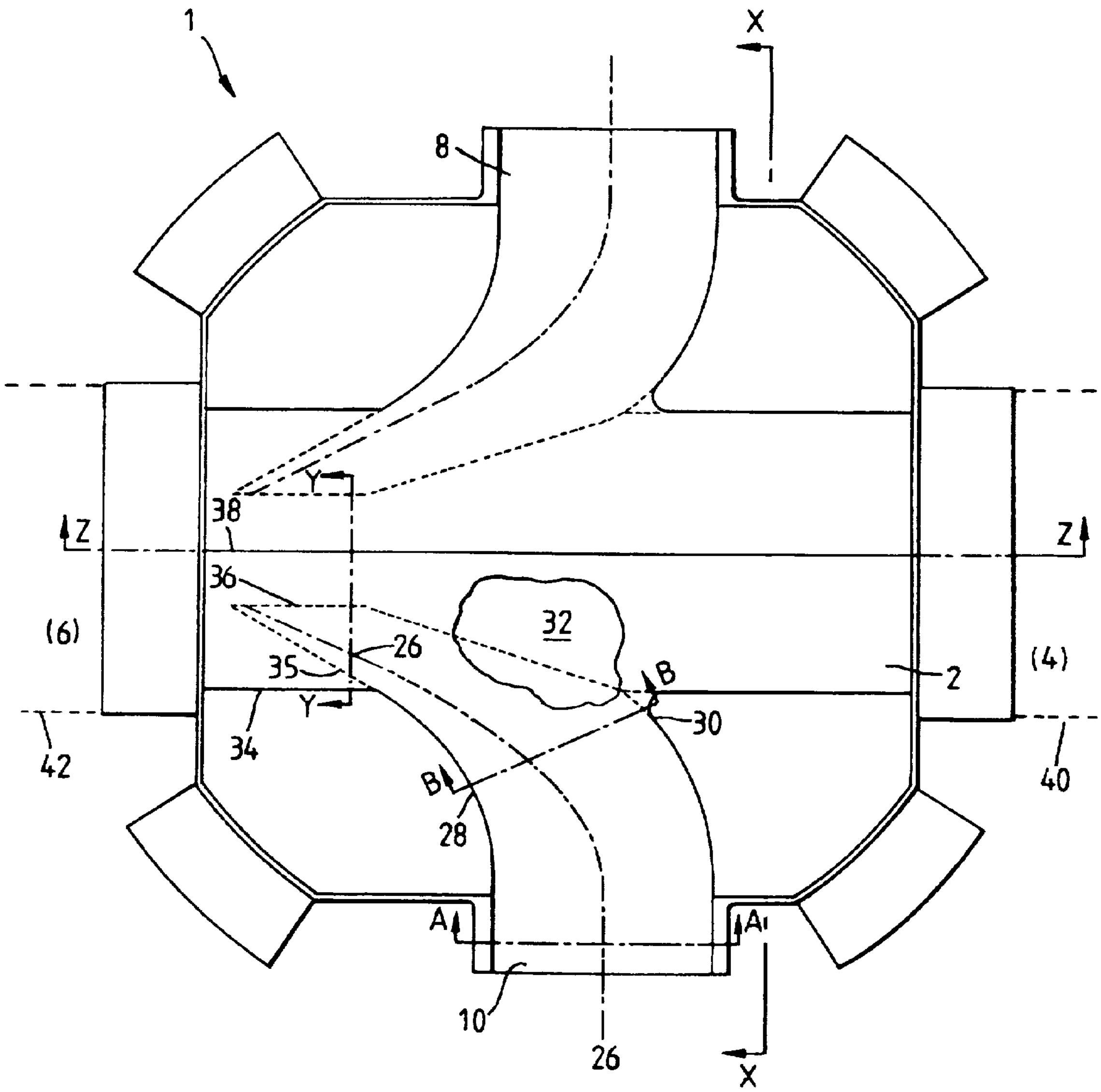



Fig. 1

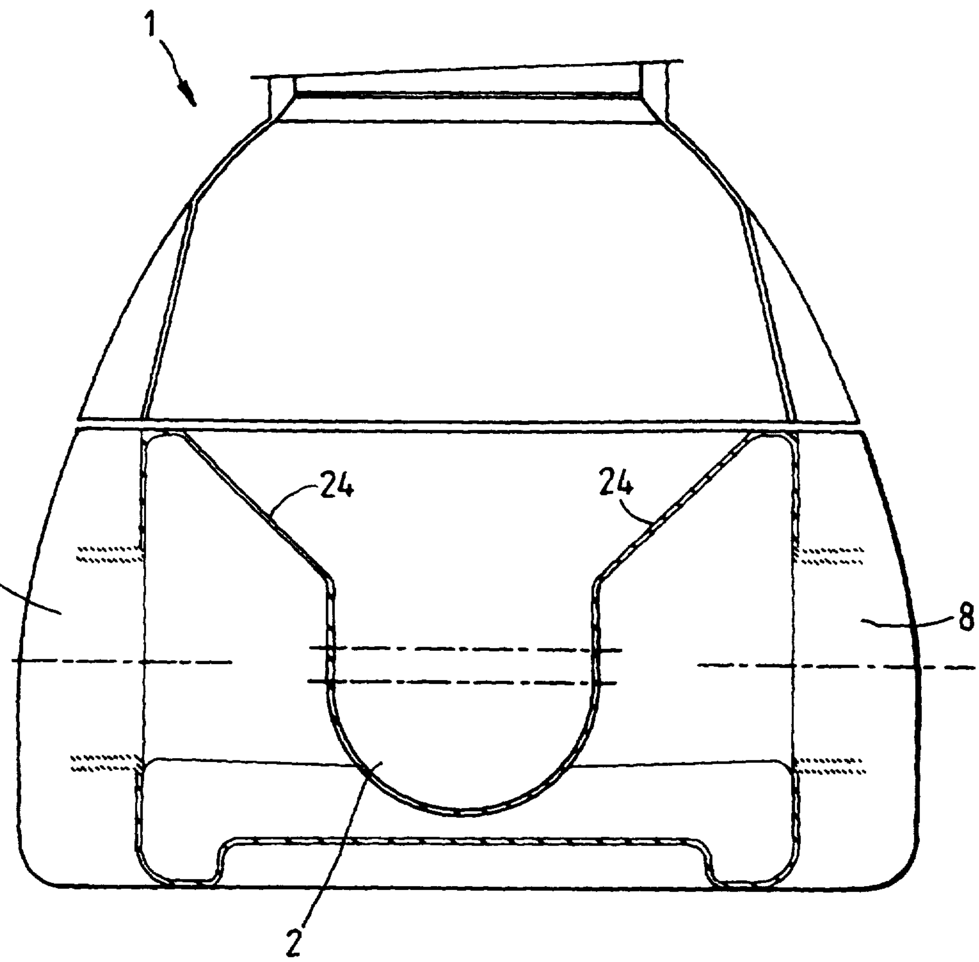
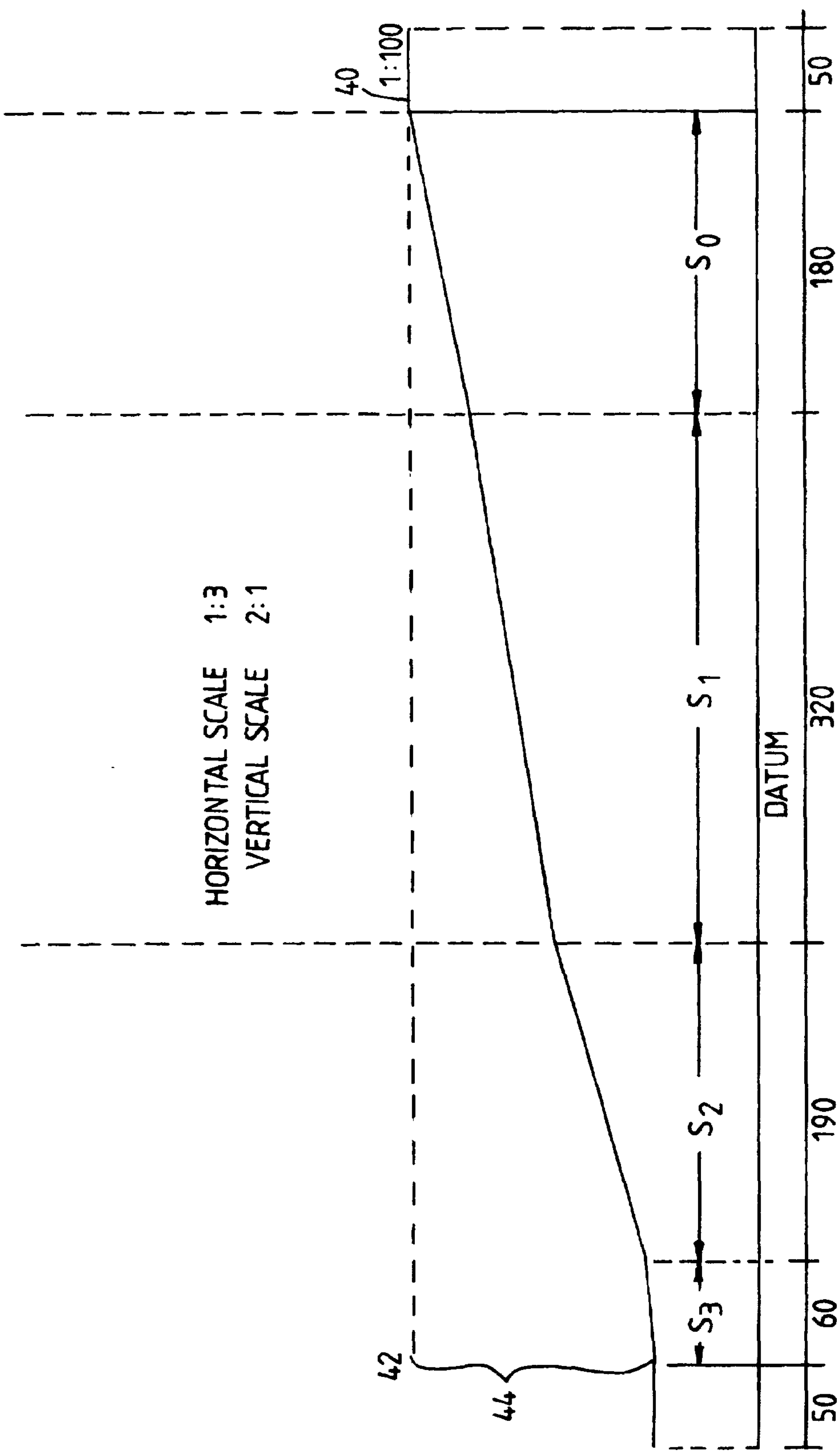



Fig. 2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VERTICAL SCALE 2:1
40
1:100
42
44
$S_0$
$S_1$
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DATUM
50
180
320
190
60
50

Fig. 3

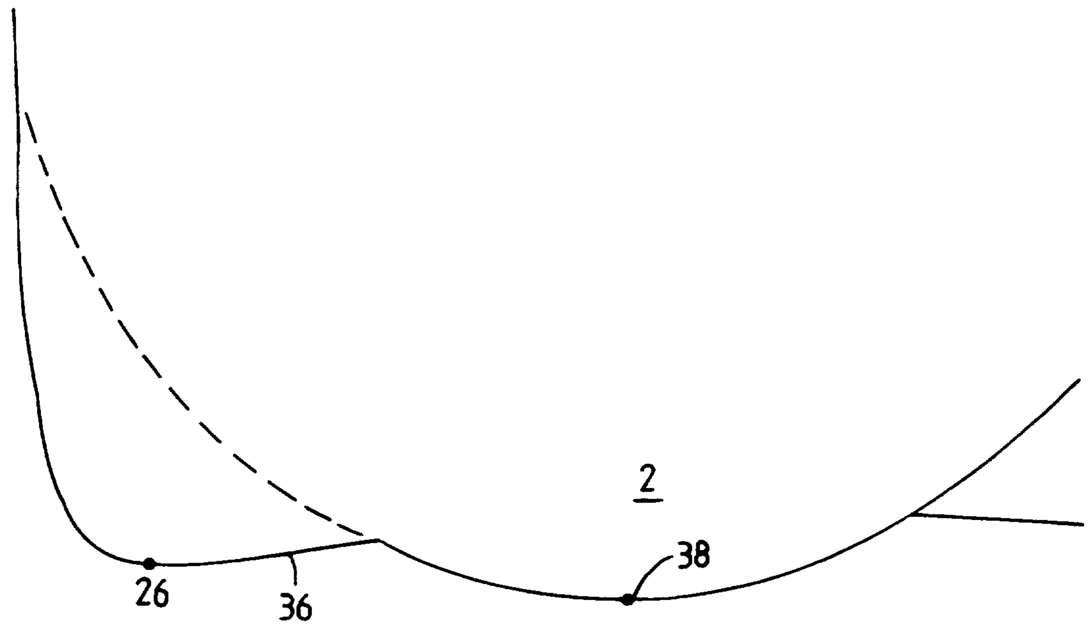


Fig. 4

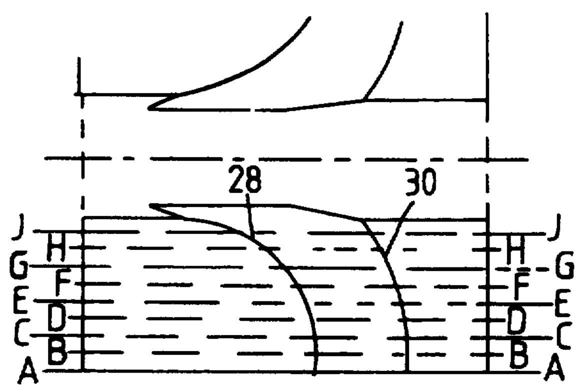


Fig. 5

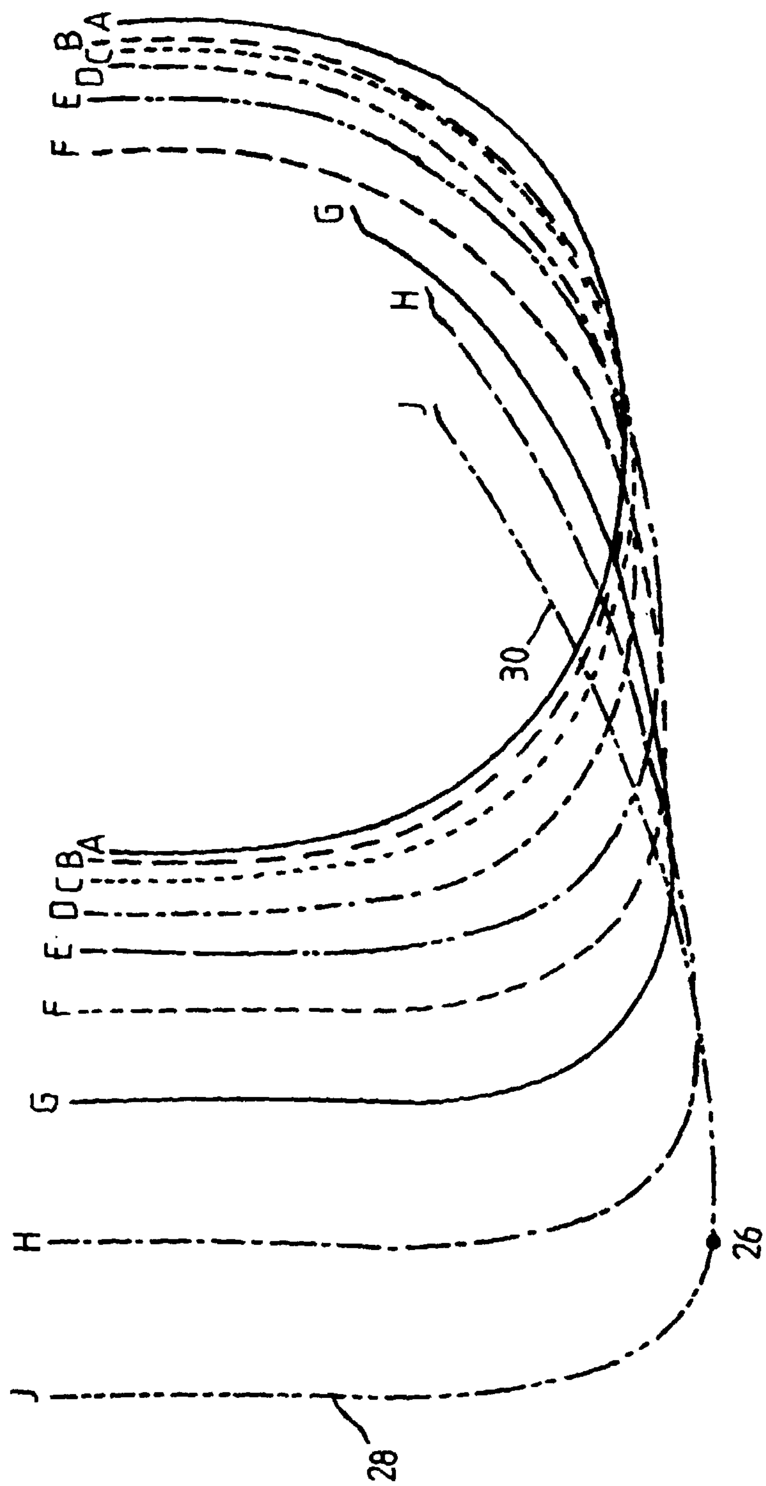


Fig. 6