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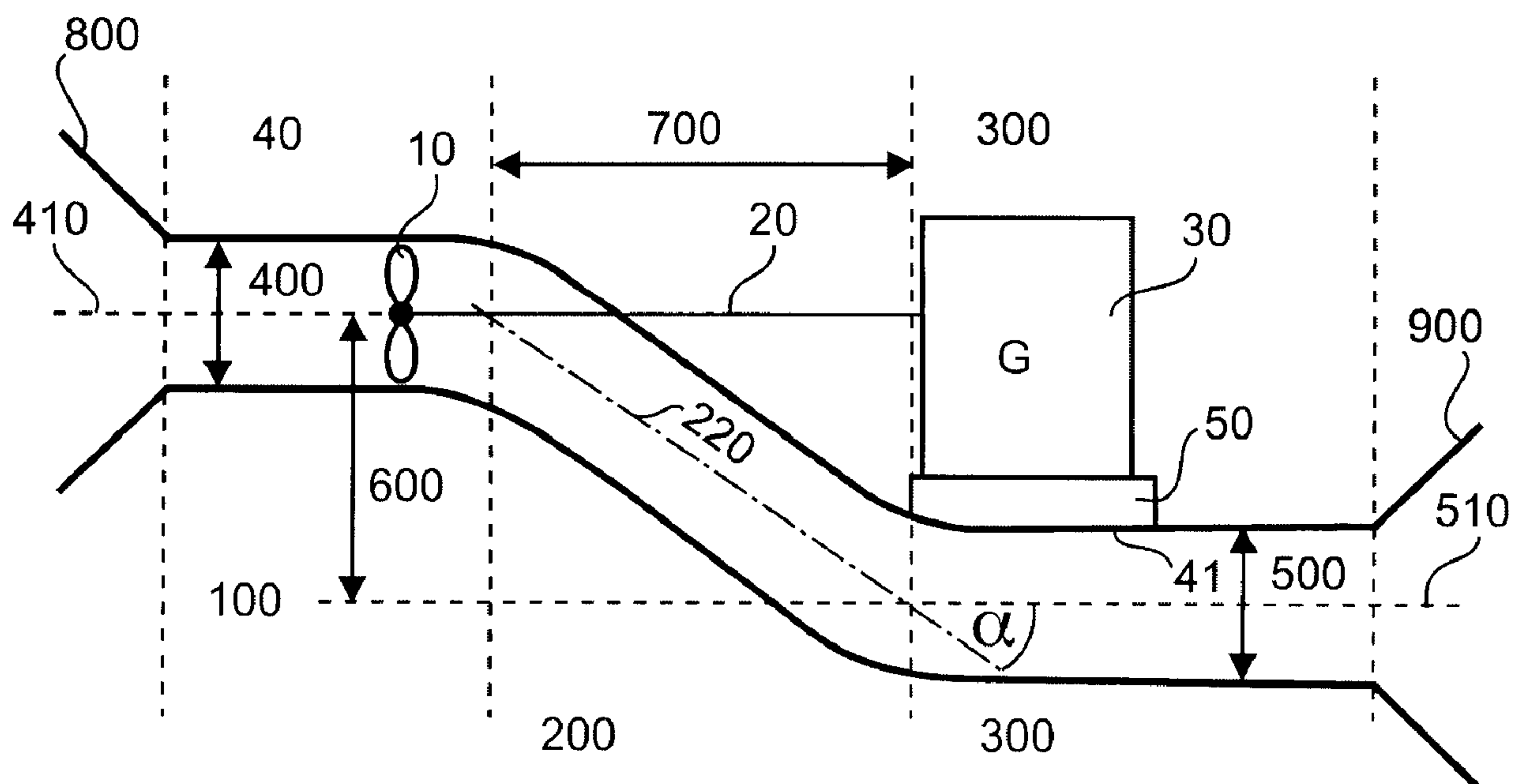


Fig. 2

(57) **Abrégé/Abstract:**

There is provided a hydropower plant having a flow passage (40) in the form of an S-pipe and having first, second and third portions (100, 200, 300). The flow passage (40) has a first diameter (400) and a first center line (410) in the first portion (100) and a second diameter (500) and a second center line (510) in the third portion (300). A spacing (600) is provided between the first and second center lines. The hydropower plant further has turbine blades (10) in the first portion (100) and a generator (30) coupled to the turbine blades (10) by a shaft (20) in the third portion (300). The flow passage (40) substantially comprises steel in the region of the generator (30).

Abstract

There is provided a hydropower plant having a flow passage (40) in the form of an S-pipe and having first, second and third portions (100, 200, 300). The flow passage (40) has a first diameter (400) and a first center line (410) in the first portion and a second diameter (500) and a second center line (510) in the third portion (300). A spacing (600) is provided between the first and second center lines. The hydropower plant further has turbine blades (10) in the first portion (100) and a generator (30) coupled to the turbine blades (10) by a shaft (20) in the third portion (300). The flow passage (400) substantially comprises steel in the region of the generator (30).

HYDROPOWER PLANT

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The present invention concerns a hydropower plant.

Various hydropower plants are known.

An example of a known hydropower plant having an S-pipe geometry is shown in Figure 1. In this case a flow passage 40 can be of an S-shaped configuration having first, second and third portions 100, 200, 300. In this case the first and third portions 100, 300 can be substantially straight and the first and second portions are arranged at a spacing from each other. The second portion 200 serves to connect the first and third portions 100, 300. The rotor with the turbine blades 10 can be provided in the region of the first portion. The turbine blades 10 can be coupled to a generator 30 by way of a shaft. The turbine blades 10 are driven by the flow of water flowing through the flow passage 40 and that rotary movement is converted into electrical energy in the generator. The generator 30 is usually arranged on a foundation 50 of concrete.

20 As state of the art attention is directed to FR 2 550 826, US No 4 319 142, US No 1 859 215 and JP 60-008474 A.

An object of the present invention is to provide a hydropower plant having improved efficiency.

That object is attained by a hydropower plant as set forth in claim 1.

25 Thus there is provided a hydropower plant having a flow passage in the form of an S-pipe and having first, second and third portions. The flow passage has a first diameter and a first center line in the first portion and a second diameter and a second center line in the third portion. A spacing is provided between the first and second center lines. The hydropower plant further has turbine blades in the first portion and a generator coupled to the turbine blades by a shaft in the third portion. The flow passage substantially comprises steel in the region of the generator.

In an aspect of the present invention the ratio between a length of the second portion to the spacing between the first and second center lines is between 2 and 4 and preferably 3.

5 In accordance with a further aspect of the present invention a foundation for the generator is provided in the region of a roof of the flow passage in the third portion. The roof can be for example in the form of a steel structure.

10 In a further aspect of the invention the foundation is of such a design configuration that it can carry away the hydrodynamic loads in the flow passage in the third portion.

In a further aspect of the present invention there is provided a first and second enlargement at the first or third portion.

15 The invention is based on the realisation that typically only the situation in front of and behind the rotor blades is considered. In that respect it can happen that losses occurring in the flow passage and in the suction intake pipe are disregarded. In particular the design configuration of the third portion should be such that the hydrodynamic loads occurring in the suction intake pipe are carried away. The ceiling of the flow passage in the third portion must be of a suitable configuration for that purpose.
20 However the configuration of the ceiling of the flow passage in the third portion also influences the gradient in the suction intake pipe or in the second portion of the flow passage. The required gradient in the second portion can be reduced by virtue of the ceiling of the flow passage in the third portion being of an improved configuration. That can be effected for
25 example by using steel for carrying away the hydrodynamic loads. It is thus possible to achieve a lower gradient, larger radii of curvature and more advantageous flow properties in the flow passage 40.

Further configurations of the invention are subject-matter of the appendant claims.

30 Embodiments by way of example and advantages of the invention are described in greater detail hereinafter with reference to the drawing.

Figure 1 shows a diagrammatic view of a hydropower plant according to the state of the art,

Figure 2 shows a diagrammatic view of a hydropower plant according to the a first embodiment,

Figure 3 shows a diagrammatic plan view of a hydropower plant in accordance with a second embodiment, and

5 Figure 4 shows a diagrammatic view of a hydropower plant in accordance with the second embodiment.

Figure 2 shows a diagrammatic view of a hydropower plant in accordance with a first embodiment. The hydropower plant has first, second and third portions 100, 200, 300. A flow passage 40 is substantially
10 in the form of an S-pipe and extends through the first, second and third portions 100, 200, 300. In the first portion 100 the flow passage is substantially straight and has a first diameter 400 and a first center line 410. In the third portion 300 the flow passage is also substantially straight and has a second diameter 500 and a second center line 510. The second
15 portion 200 connects the first to the third portions 100, 300. The first and second center lines 410, 510 are arranged spaced relative to each other by a first spacing 600.

In the region of the first portion 100 there is provided the rotor having the turbine blades 10. A generator 30 is arranged on a foundation
20 50 in the region of the third portion 300. The rotor 10 is connected to the generator 30 by way of a shaft 20.

Optionally a first or second enlargement 800, 900 of the flow passage can be provided at the first and/or third portion 100, 300. The second portion 200 can have a center line 220. The center line 220 can
25 have a gradient of α , wherein α can be between 10° and 30° , in particular between 18° and 22° and can preferably be 21° .

The pressure region is provided in the first portion 100 and the suction intake region of the flow passage is provided in the portion downstream of the turbine 10.

30 In this respect the first, second and third regions 100, 200, 300 are of such a configuration that the flow does not break away from the passage wall. The second portion 200 can be longer than in the state of the art by

virtue of the configuration of the flow passage 40 in accordance with the first embodiment.

The roof 41 of the flow passage 40 in the third portion is of such a configuration that it can carry the hydrodynamic loads occurring. The roof
5 41 can comprise for example steel for carrying away the hydrodynamic loads. The roof 41 or the portion of the flow passage 40 in the region beneath the generator 30 optionally comprises steel and in particular high-quality steel. High-quality steel is used in particular for the surface in contact with the water. Thus the flow passage 40 can be substantially made
10 from concrete, wherein the region beneath the generator 30 is provided of (high-quality) steel.

In accordance with the first embodiment the generator 30 can be arranged on steel rails or steel bearers as the foundation 50, which can be combined with the roof 41. The steel bearers serve to carry the
15 hydrodynamic loads of the flow passage.

The generator 30 can preferably be coupled without a transmission to the shaft 20 or the rotor blades. It is possible in that way to avoid fewer losses in the drive train and rapidly rotating components. This is particularly advantageous because a lower level of maintenance
20 complication and expenditure and a lower level of use of oil-bearing operating fluids is required. The rotor 10 can preferably be in the form of an upstream rotor, which permits optimum afflux flow conditions. The impeller can be in the form of a supporting structure so that a minimum number of installation fitments is required in the drive water passage. The
25 design configuration of the hydropower plant and in particular that of the flow passage 40 make it possible to avoid small deflection radii so that there are minimum water head losses at the turbine.

Figure 3 shows a plan view of a hydropower plant according to a second embodiment. The hydropower plant has first, second and third
30 portions 100, 200, 300 with a flow passage 400. In addition turbine blades 10 and a shaft connected thereto are provided in the flow passage 40. A generator 30 is provided on a foundation 50 outside the flow passage 40.

Figure 4 shows a diagrammatic view of a hydropower plant in accordance with a second embodiment. The hydropower plant has first, second and third portions 100, 200, 300. A flow passage 40 is substantially in the form of an S-pipe and extends through the first, second and third portions 100, 200, 300. In the first portion 100 the flow passage is substantially straight and has a first diameter 400 and a first center line 410. In the third portion 300 the flow passage is also substantially straight and has a second diameter 500 and a second center line 510. The second portion 200 connects the first to the third portion 100, 300. The first and second center lines 410, 510 are arranged spaced from each other by a first spacing 600.

The rotor with the turbine blades 10 is arranged in the region of the first portion 100. A generator 30 is arranged in the region of the third portion 300 on a foundation 50. The rotor 10 is connected to the generator 30 by way of a shaft 20.

Optionally a first or second enlargement 800, 900 of the flow passage can be provided at the first and/or third portion 100, 300. The second portion 200 can have a center line 220. The center line 220 can have a gradient of α , wherein α can be between 10° and 30° , in particular between 18° and 22° , and can preferably be 21° .

The first and second diameters 400, 500 can be between 4m and 6m, preferably between 4.50 m and 5 m and in particular can be 4.8 m. The length 700 of the second portion 200 can be between 15 m and 21 m, preferably 18 m. The spacing 600 between the two center lines 410, 510 can be between 4 m and 8 m, preferably being 6 m.

The ratio of the length 700 of the second portion 200 to the spacing between the first and second center lines 410, 510 is between 2 and 4, preferably 3.

In an embodiment of the invention the ratio between the first and second diameters 400, 500 and the length 700 of the second portion 200 can be between 0.15 and 0.35 and in particular 0.267. In a further aspect of the invention the ratio of the first or second diameter 400, 500 to the angle α can be between 0.2 and 0.3 and in particular 0.229.

The configuration according to the invention of the S-pipe or the flow passage makes it possible to achieve a harmonic transition between the first and second and between the second and third portions. That is particularly advantageous as that makes it possible to reduce turbulence
5 effects in the flow passage.

CLAIMS

1. A hydropower plant comprising
a flow passage (40) in the form of an S-pipe and having first, second and third portions (100, 200, 300), wherein the flow passage (40) has a first diameter (400) and a first center line (410) in the first portion and a second diameter (500) and a second center line (510) in the third portion (300), wherein a spacing (600) is provided between the first and second center lines,
turbine blades (10) in the first portion (100) and a generator (30) coupled to the turbine blades (10) by a shaft (20) in the third portion (300),
wherein the flow passage (400) substantially comprises steel in the region of the generator (30) in the third portion (300).
2. A hydropower plant as set forth in claim 1 wherein the ratio between a length (700) of the second portion (200) to the spacing (600) between the first and second center lines (410, 510) is between 2 and 4.
3. A hydropower plant as set forth in claim 1 or claim 2 wherein the ratio between the length (700) and the spacing (600) is 3.
4. A hydropower plant as set forth in claim 1, claim 2 or claim 3 wherein a foundation (50) for the generator (30) is provided in the region of a roof (41) of the flow passage (40) in the third portion (300) and is preferably in the form of a steel structure.
5. A hydropower plant as set forth in claim 4 wherein the foundation (50) is of such a design configuration that it can carry away the hydrodynamic loads in the flow passage (40) in the third portion (300).

6. A hydropower plant as set forth in one of claims 1 through 5 comprising a first and/or second enlargement (800), 900) at the first and/or third portion (100, 300).

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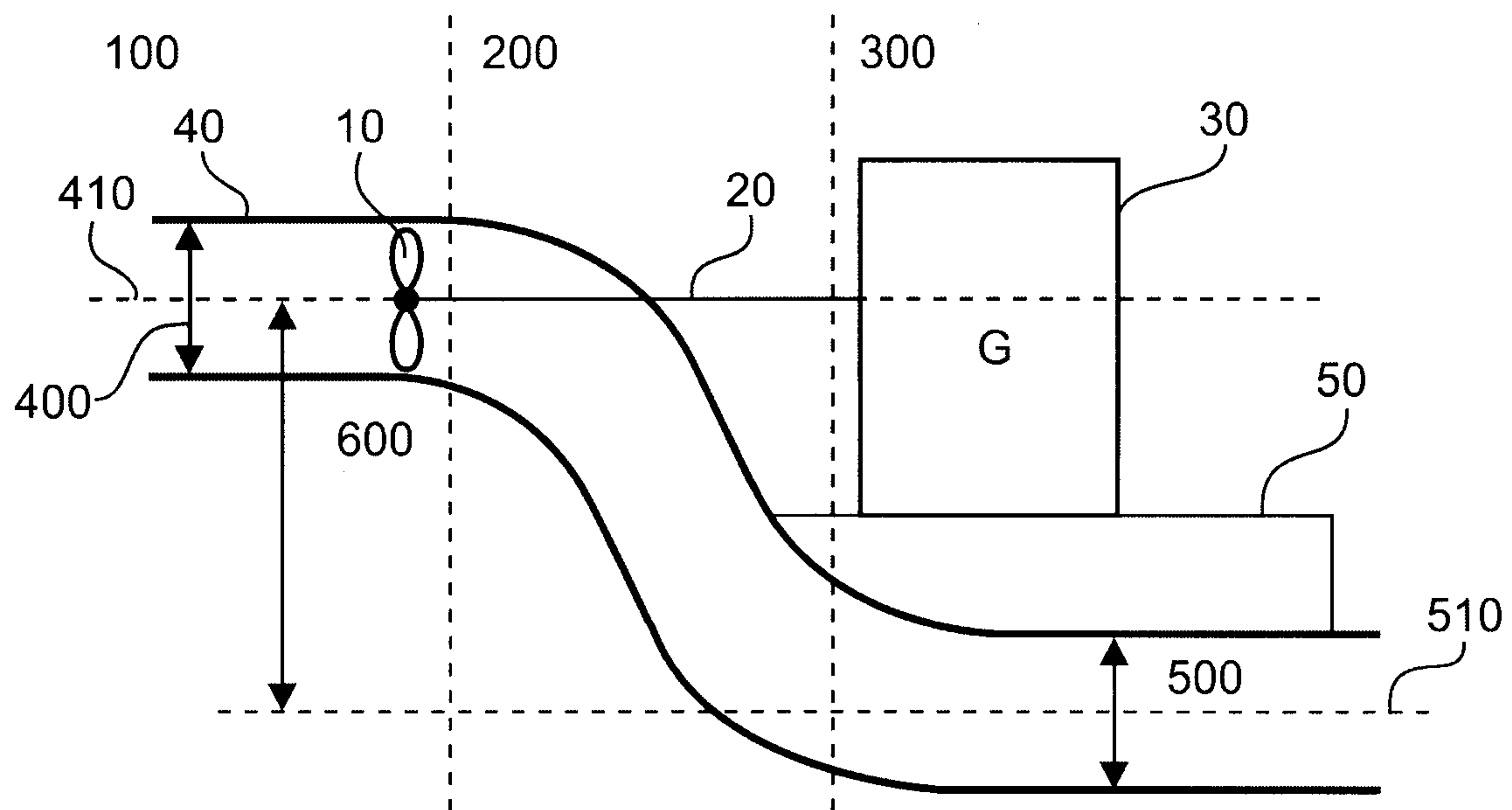


Fig. 1

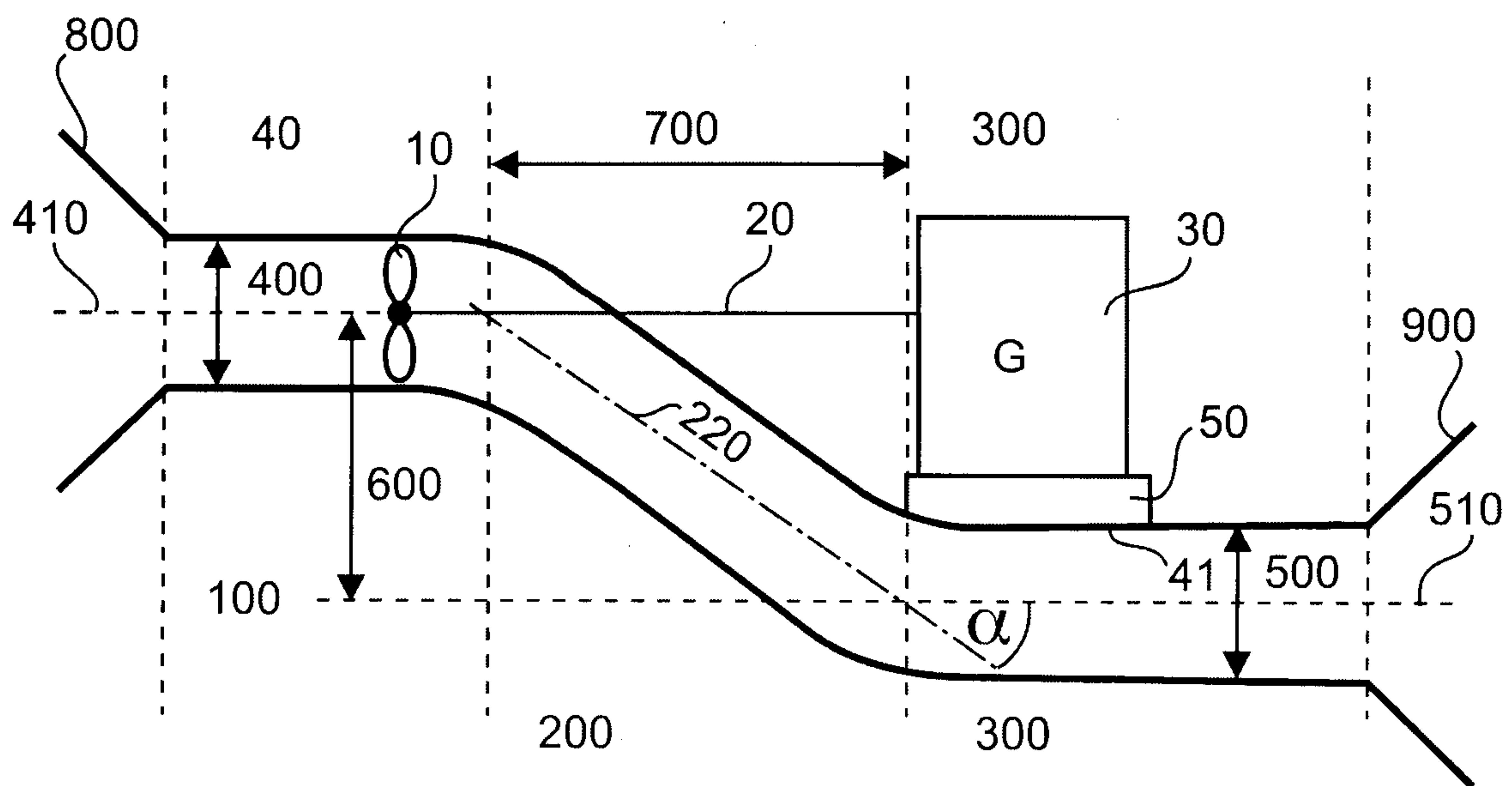


Fig. 2

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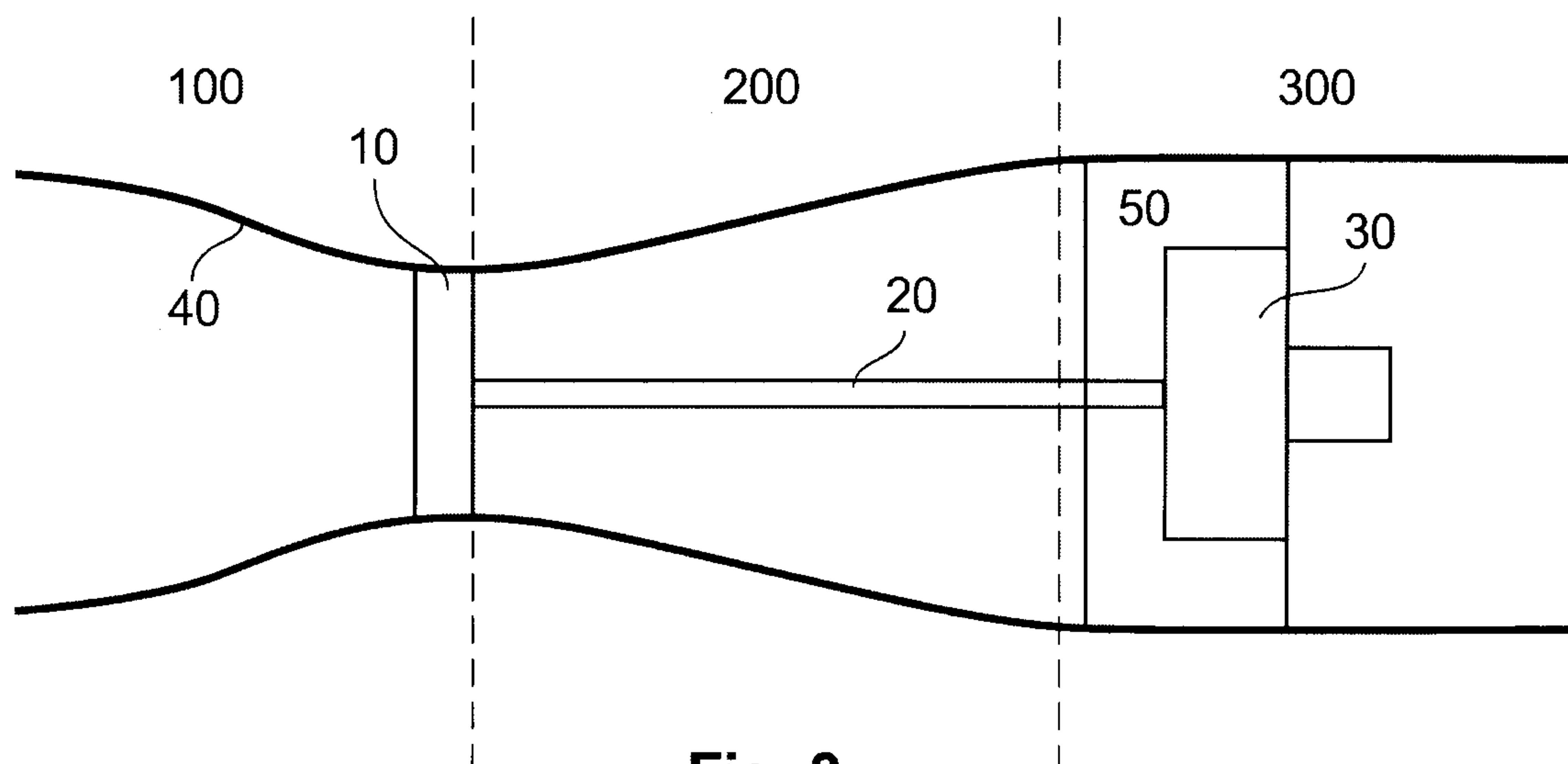


Fig. 3

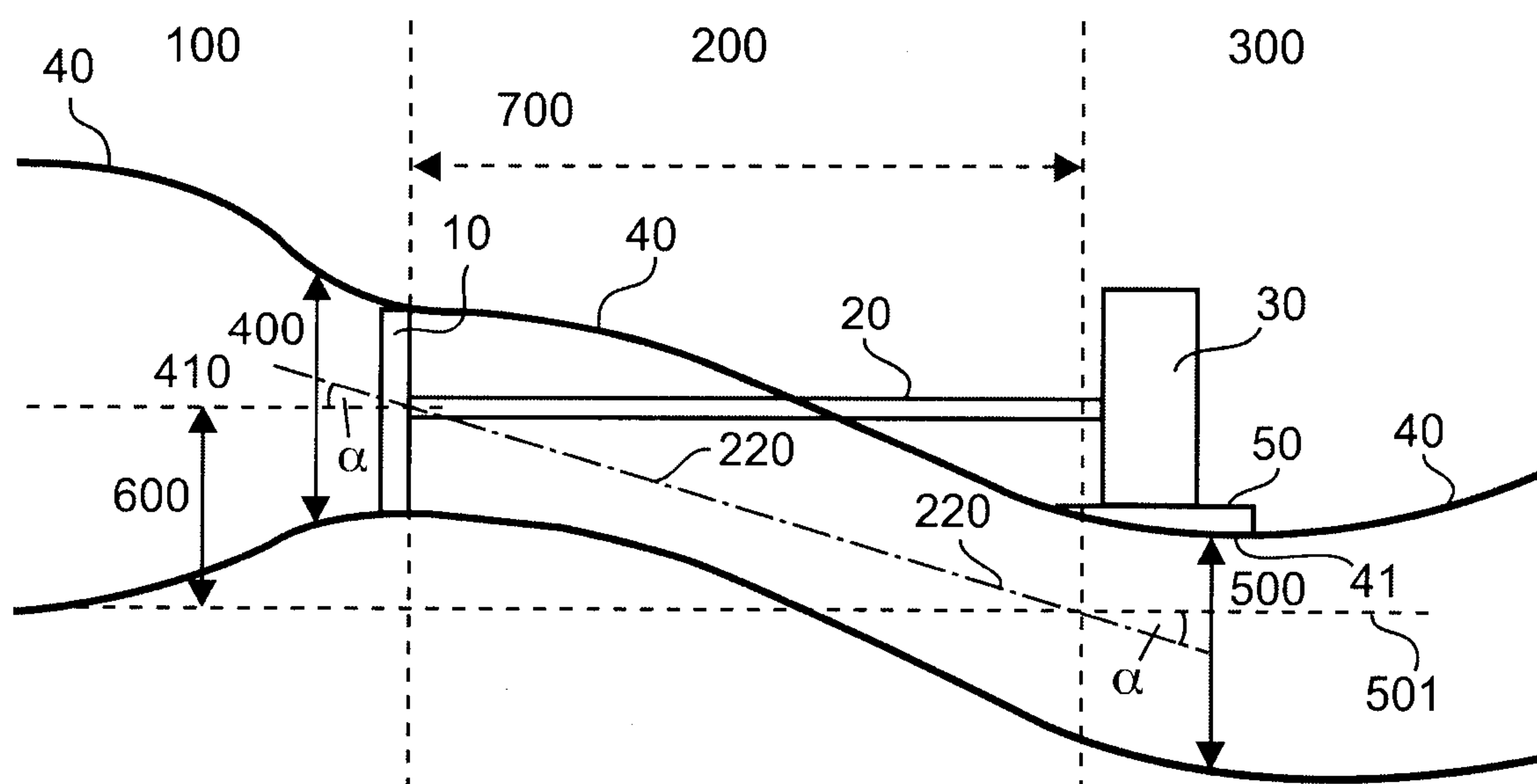


Fig. 4

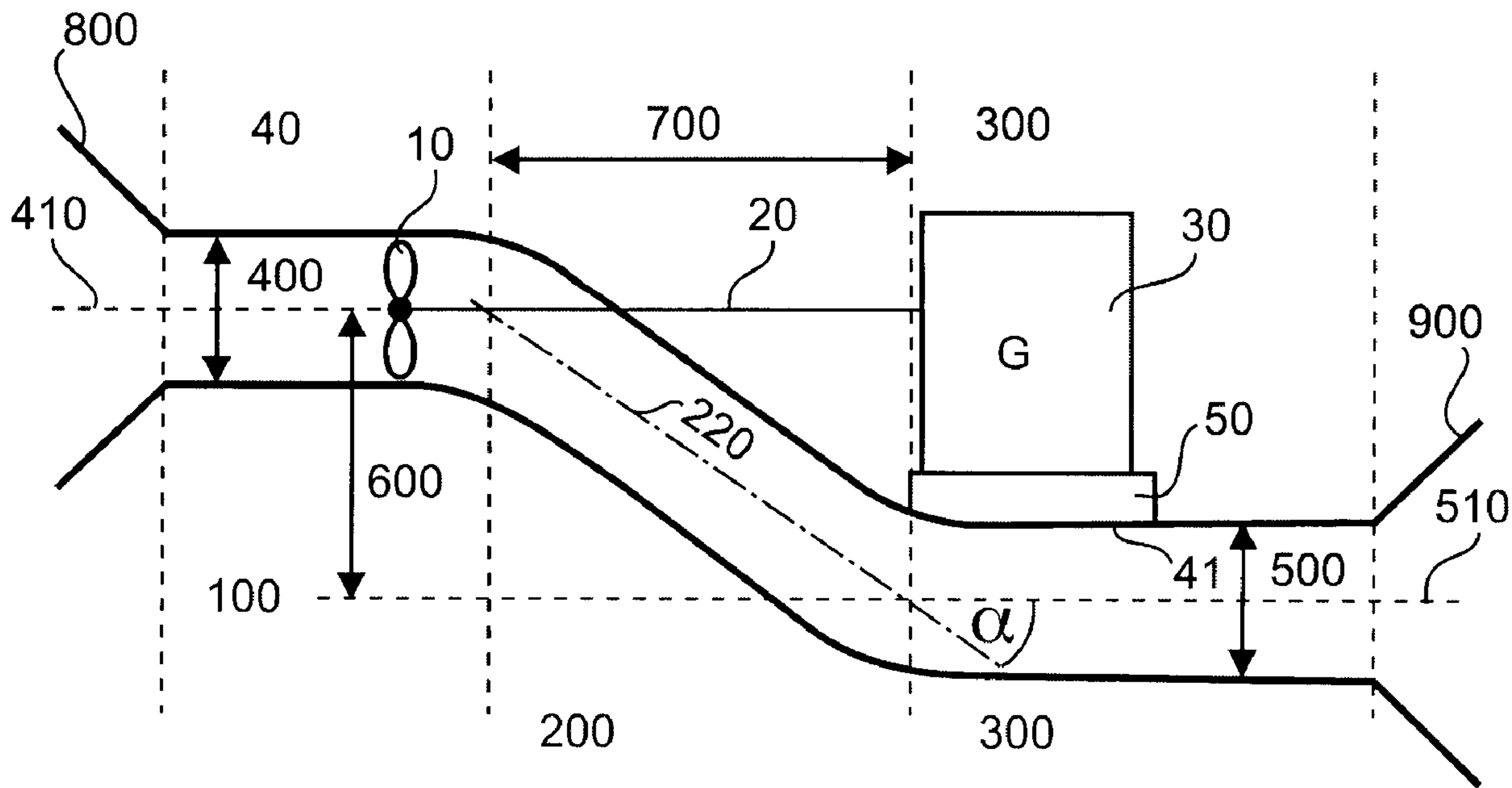


Fig. 2