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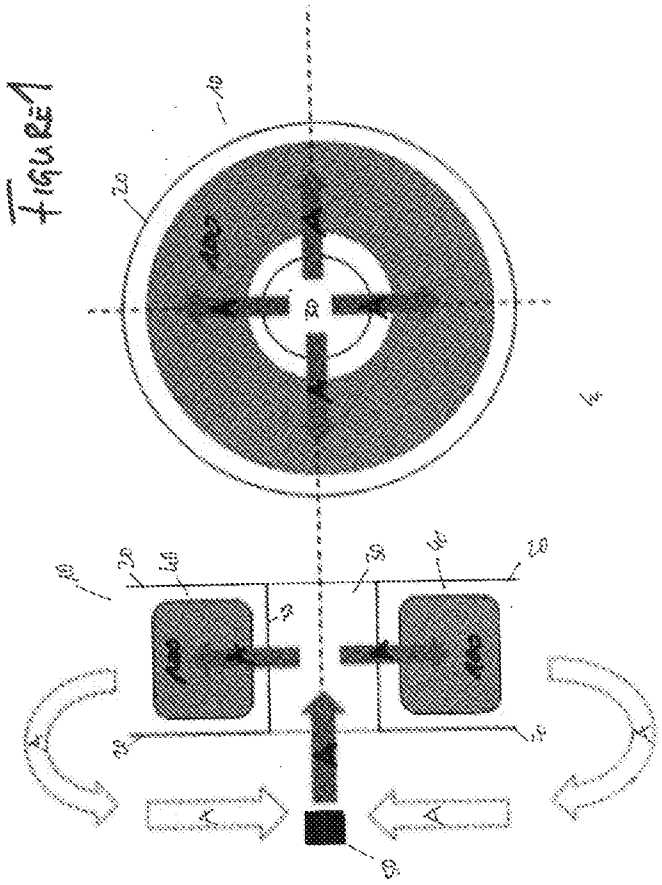
(73) Titulaire(s):
BigRep GmbH – 10961 Berlin (Allemagne)

(72) Inventeur(s):
WORMS Paul – 10961 Berlin (Allemagne), MITNA Christoph – 10961 Berlin (Allemagne)

(74) Mandataire(s):
ABP BURGER Rechtsanwaltsgesellschaft mbH – 80331 München (Allemagne)

(54) **Filament Spool Drying System and Method.**

(57) A filament spool, a drying system and a method for dying filament spool is disclosed. The filament spool comprises at least two rims and a middle section having an inner space, wherein the filament spool has a filament space between the rims and the middle section, and at least one of the middle section and the rims is/are permeable with respect to the filament space.



Title: Filament Spool Drying System and Method

FIELD

[0001] The present invention relates to additive manufacturing. In particular, the present invention relates to a filament spool, a filament spool kit, a drying system and method for drying filament spools.

BACKGROUND

[0002] In the field of additive manufacturing, filament is used as the additive material, for example in FFF (fused filament fabrication). This filament can be provided on a spool. The additive manufacturing machine (a so-called 3D-printer) and in particular, a print head of the 3D-printer pulls the filament from the spool and feeds the filament into a so called hotend to build up a workpiece by extruding the filament.

SUMMARY

[0003] A well-known issue in processing thermoplastic polymers is the moisture content or humidity of the polymer material. In order to get the highest quality possible, filaments of polymer material should be preconditioned and/or dried under repeatable and well-defined conditions. The drying process and handling of the filament should result ideally in constant polymer moisture content for the extrusion process in the hotend. Inconsistencies result in varying processing conditions, e.g. variations in viscosity, flowrates and consequently affect the properties of the workpiece being built from the filament.

[0004] There is also the well-known issue of overdrying the thermoplastic material in the field of processing thermoplastic polymers. By overdrying some additives in the thermoplastic material may outgas. This can result in undesired properties of the workpiece being built by such thermoplastic material as well as unpredictable behavior of the thermoplastic material during the extrusion process while building the workpiece. The climatic conditions of the filament in use in the 3D-printer as

well as the storing and/or transport conditions of the filament. It is thus desirable to achieve constant properties of the filament regarding temperature and/or its humidity independent from the above

[0005] There are various attempts to dry the filament prior to the printing process. Documents WO 2018029187 A1 and DE 202017101571 U1 as well as the apparatus mentioned in the search report of WO '187 are directed to the drying of the filament. However, these disclosures are difficult to be implemented in a 3D-printer and/or do not result in a uniformly dry filament.

[0006] It is thus the object of the present application to provide a filament spool, a filament spool kit, a drying system and a method for drying filament spools according to the appended independent claims to overcome the above inconveniences. Selected embodiments are comprised in the dependent claims. Each of which, alone or in any combination with the other dependent claims, can represent an embodiment of the present application.

[0007] According to one aspect of the present application a filament spool comprises at least two rims that are located axially spaced from each other and a middle section. The middle section has an inner space. The filament spool has a filament space located axially between the rims and radially outside the middle section and the at least one of the middle section and the rims is/are permeable with respect to the filament space. This has the advantage that a fluid, e.g. air or gas, can flow between the filament space and the inner space of the filament spool. If the fluid is led from the inner space through the filament space or vice versa, the fluid can be used to dry a filament wound onto the filament spool. A further advantage is that a flow path of the fluid lies in the filament space. Hence, the fluid flows through the entire filament wound onto the filament spool within the filament space.

[0008] According to another aspect of the present application, the filament spool further comprises a permeable wall. The permeable wall is arranged between the inner space of the middle section and the filament space. The middle section may

be a hollow cylinder. The hollow cylinder may have a polygonal or cylindric base. The hollow cylinder may be designed as a cage wherein the permeable wall is set up by rods that are connected to the polygonal or cylindric base of the cylinder at each side.

[0009] According to another aspect of the filament spool according to the present application, the inner space is a through hole through the filament spool. This has the advantage that the filament spool can be easily installed in a 3D-printer and further that the fluid can easily enter/exit the filament spool.

[0010] According to another aspect of the filament spool according to the present application the inner space is shut at one side or axial end. This has the advantage that the filament spool e.g. does not have to be sealed on one side or axial end to establish a flow of fluid through the inner space and filament space. Further, the handling is easier because the filament spool can only be attached to a support from one side.

[0011] According to another aspect of the filament spool according to the present application, at least one of the middle section and the rims comprise at least one of holes, slits, membrane or perforation. This has the advantage that the fluid flow can be facilitated while the filament spool can be produced cost efficiently.

[0012] According to another aspect of the filament spool according to the present application at least one of the rims is permeable in the vicinity of the middle section. This has the advantage that the fluid flow between the middle section and/or the rims and the filament space passes through the entire amount of filament wound onto the spool.

[0013] According to another aspect of the filament spool according to the present application the filament spool further comprises a casing that houses the filament spool, wherein the casing comprises at least one port. This has the advantage that a flow of fluid can be controlled and contained within the casing. Further, the

filament spool might be rotary in the casing. The at least one port serves to guide the flow of fluid into and/or out of the casing.

[0014] According to another aspect of the filament spool according to the present application the ports comprise at least one valve. This has the advantage that the port can be sealed and for example a hose can be disconnected without disturbing the atmosphere inside the casing.

[0015] According to another aspect of the filament spool according to the present application the valves comprise at least one check valve. This has the advantage that even in case a hose for example gets accidentally disconnected from the casing, the atmosphere inside the casing remains undisturbed. Further, the handling of the casing gets easier.

[0016] According to another aspect of the filament spool according to the present application, the filament spool further comprises at least one permeable protrusion that protrudes from the inner space into the filament space. This has the advantage, that the flow of fluid can be guided deeper into the filament space.

[0017] According to another aspect of the present application a filament spool kit comprises any of the above-mentioned filament spools and further comprises a filament being wound on the filament spool. This has the advantage that the filament can be dried on the filament spool.

[0018] According to another aspect of the filament spool kit according to the present application, the filament wound onto the filament spool has a structured surface. This has the advantage that the structured surface causes space between the individual strings of the filament wound onto the filament spool. The space permits the flow of fluid to pass easier between the individual strings of the filament. The structured surface can be any structure as long as it comprises raisings and depressions. Also, the structured surface increases the size/amount of the surface and humidity contained within the filament can easier escape from the material because the flow of fluid can reach more surface of the filament.

[0019] According to another aspect of the filament spool kit according to the present application, the filament is surrounded by a permeable wrapping. This has the advantage that the permeable wrapping separates the individual filament strings wound onto the filament spool from each other and consequently the flow of fluid can easier penetrate / flow through the entirety of filament strings wound onto the filament spool.

[0020] According to another aspect of the filament spool kit according to the present application, a permeable filament or hose is co-wound with the filament onto the filament spool. This has the advantage that the permeable wrapping separates the individual filament strings wound onto the filament spool from each other and consequently the flow of fluid can easier penetrate / flow through the entirety of filament strings wound onto the filament spool. Further, the flow of fluid can be guided through the permeable hose and also easier penetrate / flow through the entirety of filament strings wound onto the filament spool.

[0021] According to another aspect of the filament spool kit according to the present application, the filament is wound onto the filament spool in layers and between each layer a permeable sheet is arranged. This has the advantage that individual layers of filament are separated from each other by the permeable sheet and consequently the flow of fluid can easier penetrate / flow through the entirety of filament strings wound onto the filament spool. Further, the flow of fluid can be guided by or through the permeable sheet arranged between each layer.

[0022] According to another aspect of the present application a drying system for filament spools comprises a filament spool according to one of the preceding aspects and a ventilation system. The filament spool/the ports is/are further connected to a ventilation system. This has the advantage that a flow of fluid, e.g. air or gas, can be let through the filament space and also a volume flow of the fluid can for example be measured and/or controlled by means of the ventilation system.

[0023] According to another aspect of the drying system, according to the present application, the ventilation system comprises a dehydrating system. This has the advantage that the fluid flowing through the filament space can be controlled with respect to its humidity and consequently the humidity of the filament in the flow path of the fluid can be controlled. The dehydrating system can be silica material, for example.

[0024] According to another aspect of the present application the drying system further comprises a hygrometer and/or dewpoint sensor. This has the advantage that the humidity in the flow of fluid can be determined and for example components of the drying system or the drying system itself can be controlled dependent on results of the hygrometer.

[0025] According to another aspect of the present application the drying system further comprises inner space sealing elements. This has the advantage that the fluid flow path can be controlled and confined to a desired area.

[0026] According to another aspect of the present application the drying system further comprising at least two filament spools wherein inner space sealing elements are arranged between the at least two filament spools. This has the advantage that multiple filament spools can be stacked together, and the flow of fluid can be guided through all stacked filament spools.

[0027] According to another aspect of the drying system according to the present application, the ventilation system comprises a heating system. This has the advantage that warm fluid usually has a higher capacity to absorb humidity.

[0028] According to another aspect of the present application the drying system further comprises a spool axle supporting the filament spool and rotating the spool, wherein the ventilation system guides the flow of fluid into the spool axle and further into the filament spool. This has the advantage, that the filament is not pulled off the filament spool, but the filament is fed towards a hotend of the 3D-

printer by rotating the filament spool. A further advantage is that the filament spool can be rotated and dried at the same time.

[0029] According to another aspect of the present application the drying system further comprises a filament humidity sensor. The filament humidity sensor detects the humidity of the filament that is unwound from the filament spool and fed to the hotend. This has the advantage that the drying system or each of its abovementioned systems can be controlled dependent on the measurements of the filament humidity sensor. This has the further advantage that the humidity of the filament can be detected right before the filament enters the hotend and thus in close proximity of its point of use.

[0030] According to another aspect of the present application a method for drying filament spools comprises the steps of connecting a filament spool to a ventilation system and guiding a flow of fluid from the ventilation system through the filament spool. This has the advantage that a fluid flow through the filament spool can be established.

[0031] According to another aspect of the present application the method further comprises measuring the humidity in the flow of fluid and further controlling, for example, the ventilation system or drying system based on this measurement. This has the advantage that the ventilation system or drying system can be controlled more accurately and accordingly the condition/properties of the filament wound onto the filament spool can be controlled more accurately.

[0032] According to another aspect of the present application the method further comprises that the flow of fluid is guided in a loop between the ventilation system and the filament spool. This has the advantage that properties of the fluid can be controlled more accurately.

[0033] According to another aspect of the present application the flow of fluid changes directions. This has the advantage that the flow of fluid enters the filament wound onto the filament spool from different directions, e.g. an inner

space of the spool and a radially opposite/outer end of the filament spool. Consequently, a filament wound onto the filament spool, for example, can be dried more smoothly/homogeneous since the flow of fluid enters the filament wound onto the filament spool from different directions. Further, the change in directions advantageously always creates new flow paths of the flow of fluid within the filament wound onto the filament spool.

[0034] According to another aspect of the present application the flow of fluid is pulsating. This has the advantage that due to the pulsating the flow conditions of the flow of fluid within the filament wound onto the spool change and thus constantly create new flow paths of the flow of fluid and the filament wound onto the filament spool can, for example, be dried more smoothly/homogeneous.

[0035] According to another aspect of the present application the humidity in the flow of fluid exiting the filament spool is measured. This has the advantage that properties of the flow of fluid can be controlled even more accurate.

[0036] According to another aspect of the present application the flow of fluid is heated. This has the advantage that warm fluid usually has a higher capacity to absorb humidity.

[0037] According to another aspect of the present application the flow of fluid is heated according to a temperature profile. This has the advantage that the drying of the filament wound onto the spool can be controlled more accurately.

[0038] According to another aspect of the present application the humidity in a filament being fed to a hotend is measured. This has the advantage that the method can be controlled more precisely. For example, each of the above mentioned steps can be controlled based on the measurements of the humidity in a filament being fed to hotend and/or a humidity of the flow of fluid.

[0039] A further advantage of the above is that the filament wound onto the filament spool can be influenced in its material properties if a reactive gas is used

as the fluid flowing through the filament space of the filament spool. Effects can be at least one of avoiding the oxidation of the filament wound onto the spool, the activation of the surface of the filament wound onto the spool and avoiding the outgassing from additives from the filament wound onto the spool.

[0040] The above aspects of the method can be applied to all the above aspects regarding the filament spool, he filament spool kit or the drying system.

BRIEF DESCRIPTION OF THE FIGURES

[0041] Further advantages and features of the present disclosure will be apparent from the appended figures. The figures are of merely informing purpose and are not limiting character. The figures schematically describe various embodiments and variations of the present application.

[0042] Figure 1 shows a schematic view from two sides of an embodiment of the present disclosure.

[0043] Figure 2 shows schematically another aspect of the embodiment depicted in Figure 1.

[0044] Figure 3 shows a schematic cross sectional view of another variation of the present disclosure.

[0045] Figure 4 shows a schematic cross sectional view of another variation of the present disclosure.

[0046] Figure 5 shows a schematic cross sectional view of another variation of the present disclosure.

[0047] Figure 6 shows a schematic cross sectional view of another variation of the present disclosure.

[0048] Figure 7 shows a schematic cross sectional view of another variation of the present disclosure.

[0049] Figure 8 shows a schematic cross sectional view of another variation of the present disclosure.

[0050] Figure 9 shows a schematic cross sectional view of another variation of the present disclosure.

[0051] Figure 10 shows a schematic cross sectional view of another variation of the present disclosure.

[0052] Figure 11 shows a schematic cross sectional view of another variation of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0053] Initially referring to figure 1 an embodiment of the present disclosure is depicted. A drying system comprises a filament spool 10 having two axially distanced rims 20, each radially extending from a middle section outwards. The right hand side of figure 1 shows a side elevation of the filament spool 10. The left hand side of figure 1 shows a cross section of the same spool 10. The middle section having an inner space 30. A filament space 40 is between the two rims 20 and the middle section. A circumferential wall 39 is permeable for a flow of fluid with regard to the filament space 40 and the inner space 30. The flow of fluid (e.g. air or inert gas) is depicted with flashes A. The inner space 30 is here a through hole that extends across the filament spool 10.

[0054] The flow of fluid is driven by a ventilation system (not shown). The hygrometer 50 can also be a dewpoint sensor. There can be also a hygrometer and a dewpoint sensor. The ventilation system can comprise a heating and/or a dehydrating system. The heating and/or the ventilation the system and/or dehydrating system can be controlled dependent on measurements of the hygrometer and/or dewpoint sensor. Further, the heating can also be controlled according to a preset temperature profile that my also include data from the hygrometer and/or dewpoint sensor. The ventilation system can drive the flow of

fluid in pulsating manner such that the flow of fluid is pulsating when it flows through the filament wound onto the spool. Further, the ventilation system can variably control the volume flow of fluid through the filament wound onto the filament spool. As shown on figure 1, the flow of fluid is a loop that is driven by the ventilation system (not shown). The ventilation system may be any known in the art to drive a flow of fluid. The drying system may further comprise a filament humidity detector that detects the humidity of the filament being unwound from the filament spool and fed to the hotend. The ventilation system and/or heating and/or dehydrating system can be controlled based on the measurements of the filament humidity sensor.

[0055] The drying system of figure 1 further comprises a hygrometer 50. The hygrometer 50 is arranged in the flow of fluid A and determines the humidity in the flow of fluid A and can also determine the dew point of the flow of fluid A. In the depicted embodiment the flow of fluid A enters the middle section of the filament spool 10, here, the inner space 10. Then the flow of fluid A enters the filament space 40 via the permeable wall 39 being arranged between the inner space 10 and the filament space 40. A filament 100 is wound onto the filament spool 10 in the filament space 40. Hence, the flow of fluid A enters, traverses and finally exits the filament 100.

[0056] The flow of fluid A is then guided and driven by a ventilation system (not shown) towards the hygrometer 50. After the hygrometer 50 and before and again entering the filament spool 10 the flow of fluid A might be heated and/or dehumidified by means of commonly known apparatuses.

[0057] Figure 2 depicts essentially the above configuration, however, in case of the embodiment of depicted in figure 2 the flow of fluid A is opposite to the flow of fluid A depicted in figure 1.

[0058] Figure 3 depicts part of drying system having filament spool 10 that is essentially of the same configuration as described above. However, the inner space 30 of the filament spool 10 is shut at one axial end 35. Accordingly, the flow

of fluid A entering the filament spool 10 from the right hand side in figure 3 has no further way as entering the filament space 40 and thus the filament 100 via the permeable wall 39.

[0059] The drying system depicted in figure 3 further comprises a pressure plate 90 and an inner space sealing element 70 (e.g. an O-ring) being arranged between the pressure plate 90 and a rim 20 of the filament spool 10. The flow of fluid A can enter or exit the filament spool 10 via an opening in the pressure plate 90 as indicated by the two headed flashes in figure 3. The inner space sealing element 70 prevents the flow of fluid A exiting between the pressure plate 90 and the filament spool 10.

[0060] Figure 4 depicts a filament spool 10 that is essentially the same as described above, however here, the permeable wall 39 is depicted having slits 32 and/or holes 31 to allow the flow of fluid A to traverse the permeable wall 39 to enter or exit the filament space 40 towards the inner space 30.

[0061] Figure 5 depicts another variation depicted in Figure 3 having filament spool 10 that comprises a through hole as inner space 30 (see above) and further comprises the pressure plate 90 and a further pressure plate 95. The further pressure plate 95 is not permeable to the flow of fluid A, contrary to the pressure plate 90 being permeable for the flow of fluid A. Here, inner space sealing elements 70 are also comprised and provide for a seal between the respective rim 20 of the filament spool and the regarding pressure plate 90 or 95.

[0062] Figure 6 depicts another variation depicted in Figure 5 having filament spool 10 where additionally to the permeable wall 39 also the rims 20 are each permeable in the area of the middle section. In figure 6 the rims 20 are permeable between the inner space sealing element 70, the pressure plates 90 and 95 and the through hole of the inner space 30. Consequently, as indicated with flashes A, the flow of fluid A cannot only enter or exit the filament space 40 via the permeable wall 39, but also via the rims 20 in an area between the inner space sealing elements 70 and the through hole forming the inner space 30. Of course, only one rim 20 can be permeable and/or the permeable wall 39 can be omitted.

[0063] Figure 7 depicts another variation depicted in Figure 6 that is identical but for the omission of the permeable wall 39 of figure 6. Hence, the flow of fluid can only enter or exit the filament space 40 via the rims 20 of the filament spool 10 as described above.

[0064] Figure 8 depicts a variation of a filament spool 10. Here, the configuration as described e.g. with figure 5 is slightly altered. The pressure plates 90 and 95 reach into the inner space 30 of filament spool 10 depicted in figure 8. Further, a casing 60 houses the filament spool 10. The casing is air tight. The casing 60 further comprises two ports 65 that are connected the inside of the casing 60 containing the filament spool 10 and the outside of the casing 60. The flow of fluid A can enter and exit the casing 60 and the filament spool 10 via the pressure plate 90 and the ports 65.

[0065] Figure 9 depicts a variation of the arrangement depicted in figure 4. In figure 9, a spool axle 120 that supports and rotates together with the filament spool 10 is disclosed. The filament spool 10 depicted in figure 9 is essentially the same as e.g. in figure 1. The spool axle 120 has holes 31 and/or slits 32. Inner space sealing elements 70 are arranged between the filament spool 10 and the spool axle 120.

[0066] The flow of fluid A enters or exits the spool axle 120, passes through the holes 31 and/or slits 32 and the permeable wall 39 and enters or exits the filament space 40.

[0067] In figure 10 another variation of the present disclosure is depicted. Here, three filament spools 10 as for example disclosed in figure 1 are stacked together. An inner space sealing element 70 is arranged between each filament spool 10 as well as already disclosed between the pressure plates 90 and 95.

[0068] A flow of fluid A that enters or exits each filament spool 10 or the pressure plate 90 passes through the respective inner space 30 and filament space 40 of

each filament spool. In this way, several filament spools 10 (the disclosure is not limited to three filament spools) can be dried.

[0069] In figure 11 another variation of the present disclosure is depicted. Here, the drying system is essentially the same as depicted in figure 1. However, there is a protrusion 130 that protrudes from the middle section into the filament space 40. The protrusion 130 is permeable such that the flow of fluid A can pass through the protrusion 130. In figure 11 the wall separating the inner space 30 from the filament space 40 is not permeable for the flow of fluid A. However, the wall can be also the permeable wall 39 as described above.

CLAIMS

1. Filament spool (10) comprising at least two rims (20) which are located axially distanced from each other and a middle section having an inner space (30), wherein the filament spool has a filament space (40) located axially between the rims and radially outside the middle section, and wherein the middle section and/or at least one of the rims is/are permeable with respect to the filament space.

2. Filament spool (10) according to claim 1, further comprising a permeable wall (39), wherein the permeable wall (39) is arranged between the inner space (30) and the filament space (40).

3. Filament spool (10) according to claim 1 or 2, wherein the inner space (30) is a through hole through the filament spool (10).

4. Filament spool according to claim 3, wherein the inner space (30) is shut at one axial end (35).

5. Filament spool (10) according to one of the preceding claims, wherein at least one of the middle section and the rims comprise at least one of holes (31), slits (32), membrane or perforation.

6. Filament spool (10) according to one of the preceding claims, wherein at least one of the rims (20) is permeable in the vicinity of the middle section.

7. Filament spool (10) according to one of the preceding claims, further comprising a casing (60) that houses the filament spool, wherein the casing (60) comprises at least one port (65).

8. Filament spool (10) according to claim 7, wherein the at least one port (65) comprise at least one valve.

9. Filament spool (10) according to claim 8, wherein the valve comprises at least one check valve.

10. Filament spool kit comprising a filament spool according to one of the preceding claims, further comprising a filament (100) being wound onto the filament spool.

11. Filament spool kit according to claim 10, wherein the filament (100) has a structured surface.

12. Filament spool kit according to claim 10 or 11, wherein the filament (100) is surrounded by a permeable wrapping.

13. Filament spool kit according to one of claims 10 to 12, wherein a permeable filament or hose is co-wound with the filament onto the filament spool.

14. Filament spool kit according to one of claims 10 to 13, wherein the filament (100) is wound onto the filament spool (10) in layers and between each layer a permeable sheet is arranged.

15. Filament spool kit according to one of claims 10 to 14, further comprising at least one permeable protrusion (130) that protrudes from the middle section into the filament space (40).

16. Drying system for filament spools, the drying system being configured to hold a filament spool (10) according to one of the preceding claims, wherein the drying system comprises a ventilation system, which is configured to be connected to the filament spool (10).

17. Drying system according to claim 16, wherein the ventilation system comprises a dehydrating system.

18. Drying system according to claim 16 or 17, further comprising a hygrometer (50) and/or dewpoint sensor.

19. Drying system according to one of claims 16 to 18, further comprising at least a pressure plate (90, 95).

20. Drying system according to one of claims 16 to 19, further comprising inner space sealing elements (70).

21. Drying system according to one of claims 16 to 20, further comprising at least two filament spools (10) wherein inner space sealing elements (70) are arranged between the at least two filament spools (10) or between the filament spool (10) and a pressure plate (90, 95).

22. Drying system according to one of claims 16 to 21, further comprising a filament humidity sensor.

23. Drying system according to one of claims 16 to 22, wherein the ventilation system comprises a heating system.

24. Drying system according to one of claims 16 to 23, further comprising a spool axle (120) supporting the filament spool (10) that rotates the filament spool, wherein the ventilation system guides a flow of fluid into the spool axle and further into the filament spool.

25. Method for drying filament spools, comprising the steps of connecting a filament spool to a ventilation system and guiding a flow of fluid from the ventilation system through the filament spool.

26. Method for drying filament spools according to claim 25, further comprising measuring the humidity in the flow of fluid and further controlling the ventilation system based on this measurement.

27. Method for drying filament spools according to claim 25 or 26, further comprising that the flow of fluid is guided in a loop between the ventilation system and the filament spool.

28. Method for drying filament spools according to one of the preceding method claims, wherein the flow of fluid changes directions.

29. Method for drying filament spools according to one of the preceding method claims, wherein the flow of fluid is pulsating.

30. Method for drying filament spools according to one of the preceding method claims, wherein the humidity in the flow of fluid exiting the filament spool is measured.

31. Method for drying filament spools according to one of the preceding method claims, wherein the flow of fluid is heated.

32. Method for drying filament spools according to one of the preceding method claims, wherein the flow of fluid is heated according to a temperature profile.

33. Method for drying filament spools according to one of the preceding method claims, wherein the humidity in a filament being fed to a hotend is measured.

Übersetzung Ansprüche Patentanmeldung „Filament spool drying system and method"
Anmelder: Fa. BigRep, Berlin, Deutschland
Vertreter: Ludwig LINDERMAYER, München, Deutschland

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ANSPRÜCHE

1. Filamentspule (10) umfassend zumindest zwei Kränze (20), welche voneinander axial beabstandet angeordnet sind, und eine Mittelsektion mit einem Innenraum (30), wobei die Filamentspule einen Filamentraum (40) hat, der axial zwischen den Kränzen und radial auswärts der Mittelsektion befindlich ist, und wobei die Mittelsektion und/oder zumindest einer der Kränze durchlässig bezüglich dem Filamentraum sind.

2. Filamentspule (10) nach Anspruch 1, weiterhin umfassend eine durchlässige Wand (39), wobei die durchlässige Wand (39) zwischen dem Innenraum (30) und dem Filamentraum (40) angeordnet ist.

3. Filamentspule (10) nach Anspruch 1 oder 2, wobei der Innenraum (30) ein Durchgangsloch durch die Filamentspule (10) ist.

4. Filamentspule (10) nach Anspruch 3, wobei der Innenraum (30) an einem Axialende (35) geschlossen ist.

5. Filamentspule (10) nach einem der vorangegangenen Ansprüche, wobei zumindest eines von der Mittelsektion und den Kränzen zumindest eines umfassen von Löchern (31), Schlitzen (32), Membrane oder Perforation.

6. Filamentspule (10) nach einem der vorangegangenen Ansprüche, wobei zumindest einer der Kränze (20) durchlässig in der Nähe der Mittelsektion ist.

7. Filamentspule (10) nach einem der vorangegangenen Ansprüche, weiterhin umfassen ein Gehäuse (60), welches die Filamentspule einhaust, wobei das Gehäuse (60) zumindest einen Anschluss (65) umfasst.

8. Filamentspule (10) nach Anspruch 7, wobei der zumindest eine Anschluss (65) zumindest ein Ventil umfasst.

9. Filamentspule (10) nach Anspruch 8, wobei das Ventil zumindest ein Rückschlagventil umfasst.

10. Filamentspulen Kit umfassend eine Filamnetspule nach einem der vorangegangenen Ansprüchen und weiterhin umfassend ein Filament (100), welches auf die Filamentspule (10) gewunden ist.

11. Filamentspulen Kit nach Anspruch 10, wobei das Filament (100) eine strukturierte Oberfläche aufweist.

12. Filamentspulen Kit nach Anspruch 10 oder 11, wobei das Filament (100) von einer durchlässigen Umhüllung umgeben ist.

13. Filamentspulen Kit nach einem der Ansprüche 10 bis 12, wobei ein durchlässiges Filament oder ein Schlauch mit dem Filament auf die Filamentspule gewunden ist.

14. Filamentspulen Kit nach einem der Ansprüche 10 bis 13, wobei das Filament (100) in Lagen auf die Filamentspule (10) gewunden ist und zwischen jeder Lage ein durchlässiges Blatt angeordnet ist.

15. Filamentspulen Kit nach einem der Ansprüche 10 bis 14, weiterhin umfassend zumindest einen durchlässigen Vorsprung (130), welcher von der Mittelsektion in den Filamentraum (40) vorsteht.

16. Trocknungssystem für Filamentspulen, wobei das Trockungssystem dazu konfiguriert ist eine Filamentspule (10) nach einem der vorangegangenen Ansprüchen zu halten, wobei das Trocknungssystem ein Ventilationssystem umfasst, welches dazu konfiguriert ist mit der Filamentspule (10) verbunden zu werden.

17. Trocknungssystem nach Anspruch 16, wobei das Ventilationssystem ein Trocknungssystem umfasst..

18. Trocknungssystem nach Anspruch 16 oder 17, weiterhin umfassend ein Hygrometer (50) und/oder einen Taupunktsensor.

19. Trocknungssystem nach einem der Ansprüche 16 bis 18, weiterhin umfassend zumindest eine Druckplatte (90, 95).

20. Trocknungssystem nach einem der Ansprüche 16 bis 19, weiterhin umfassend Innenraumdichtelemente (70).

21. Trocknungssystem nach einem der Ansprüche 16 bis 20, weiterhin umfassend zumindest zwei Filamentspulen (10), wobei Innenraumdichtelemente (70) zwischen den zumindest zwei Filamentspulen (10) oder zwischen der Filamentspule (10) und einer Druckplatte (90, 95) angeordnet sind.

22. Trocknungssystem nach einem der Ansprüche 16 bis 21, weiterhin umfassend einen Filamentfeuchtigkeitssensor.

23. Trocknungssystem nach einem der Ansprüche 16 bis 22, wobei das Ventilationssystem ein Heizsystem umfasst.

24. Trocknungssystem nach einem der Ansprüche 16 bis 23, weiterhin umfassend eine Spulenachse (120), welche die Filamentspule (10) trägt und die Filamentspule dreht, wobei das Ventilationssystem einen Fluidfluss in die Spulenachse und weiter in die Filamentspule leitet.

25. Verfahren zur Trockung von Filamentspulen, umfassen die Schritte von Verbinden einer Filamentspule mit einem Ventilationssystem und Leiten eines Fluidflusses von dem Ventilationssystem durch die Filamentspule.

26. Verfahren zur Trockung von Filamentspulen nach Anspruch 25, weiterhin umfassend Messen der Feuchtigkeit in dem Fluidfluss und weiterhin Steuern des Ventilationssystems basierend auf dieser Messung.

27. Verfahren zur Trockung von Filamentspulen nach Anspruch 25 oder 26, weiterhin umfassend, dass der Fluidfluss in einem Kreislauf zwischen dem Ventilationssytem und der Filamentspule geleitet wird.

28. Verfahren zur Trockung von Filamentspulen nach einem der vorangegangenen Verfahrensansprüchen, wobei der Fluidfluss die Richtung ändert.

29. Verfahren zur Trockung von Filamentspulen nach einem der vorangegangenen Verfahrensansprüchen, wobei der Fluidfluss pulsiert.

30. Verfahren zur Trockung von Filamentspulen nach einem der vorangegangenen Verfahrensansprüchen, wobei die Feuchtigkeit in dem Fluidfluss, der die Filamentspule verlässt, gemessen wird.

31. Verfahren zur Trockung von Filamentspulen nach einem der vorangegangenen Verfahrensansprüchen, wobei der Fluidfluss geheizt wird.

32. Verfahren zur Trockung von Filamentspulen nach einem der vorangegangenen Verfahrensansprüchen, wobei der Fluidfluss entsprechend einem Temperaturprofil geheizt wird.

33. Verfahren zur Trockung von Filamentspulen nach einem der vorangegangenen Verfahrensansprüchen, wobei die Feuchtigkeit in einem Filament, das einem Hotend zugeführt wird, gemessen wird.

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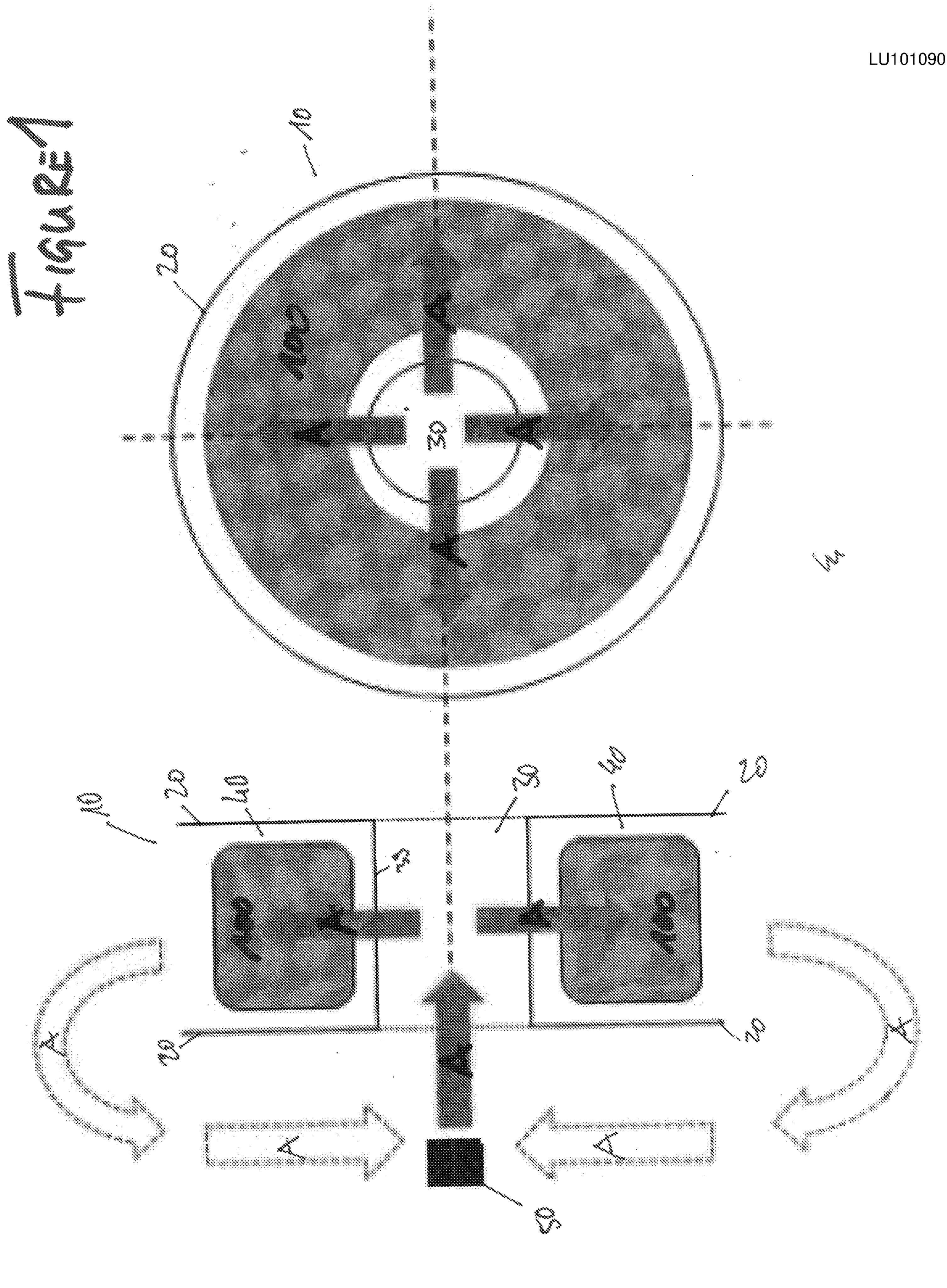

FIGURE 2

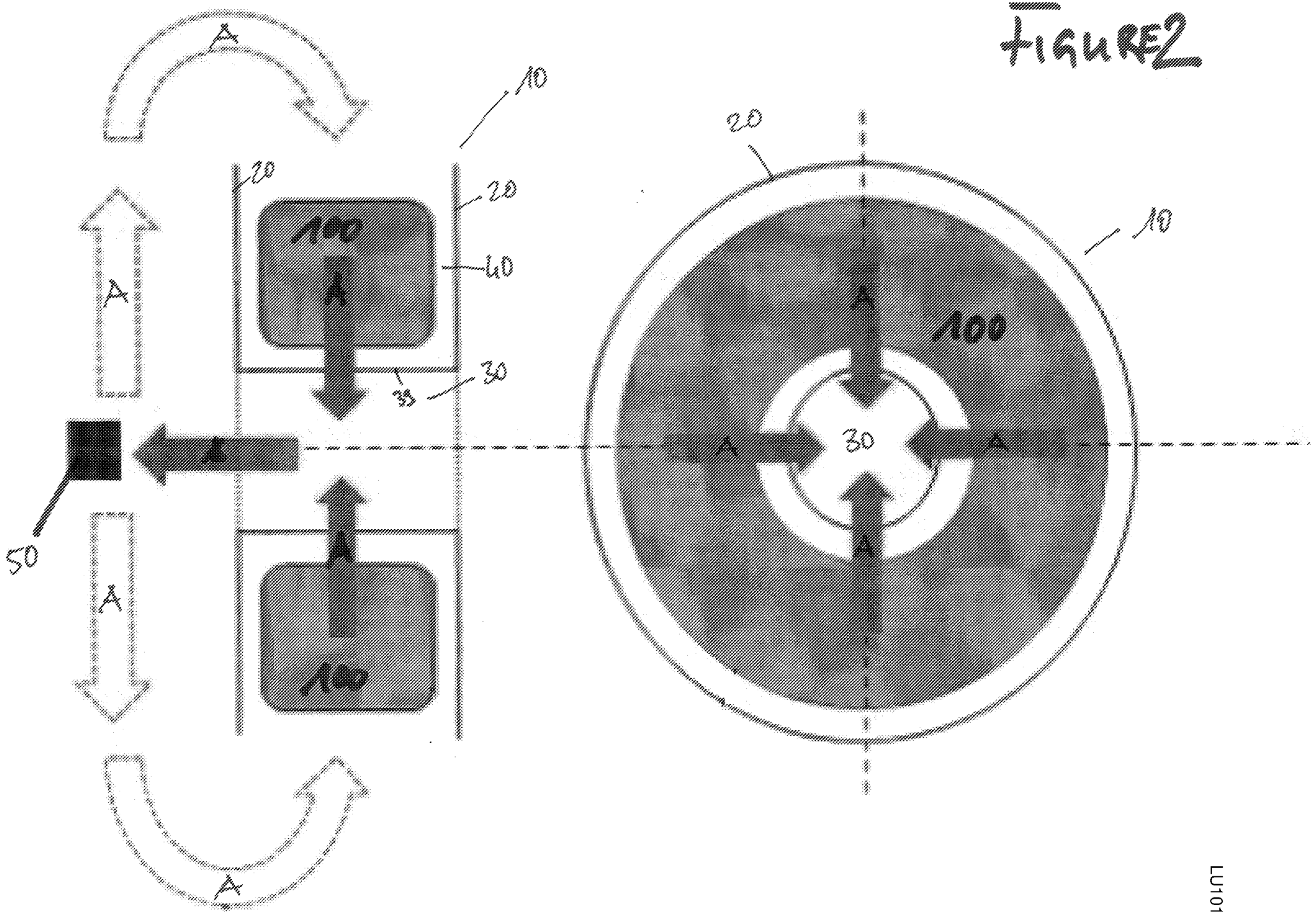

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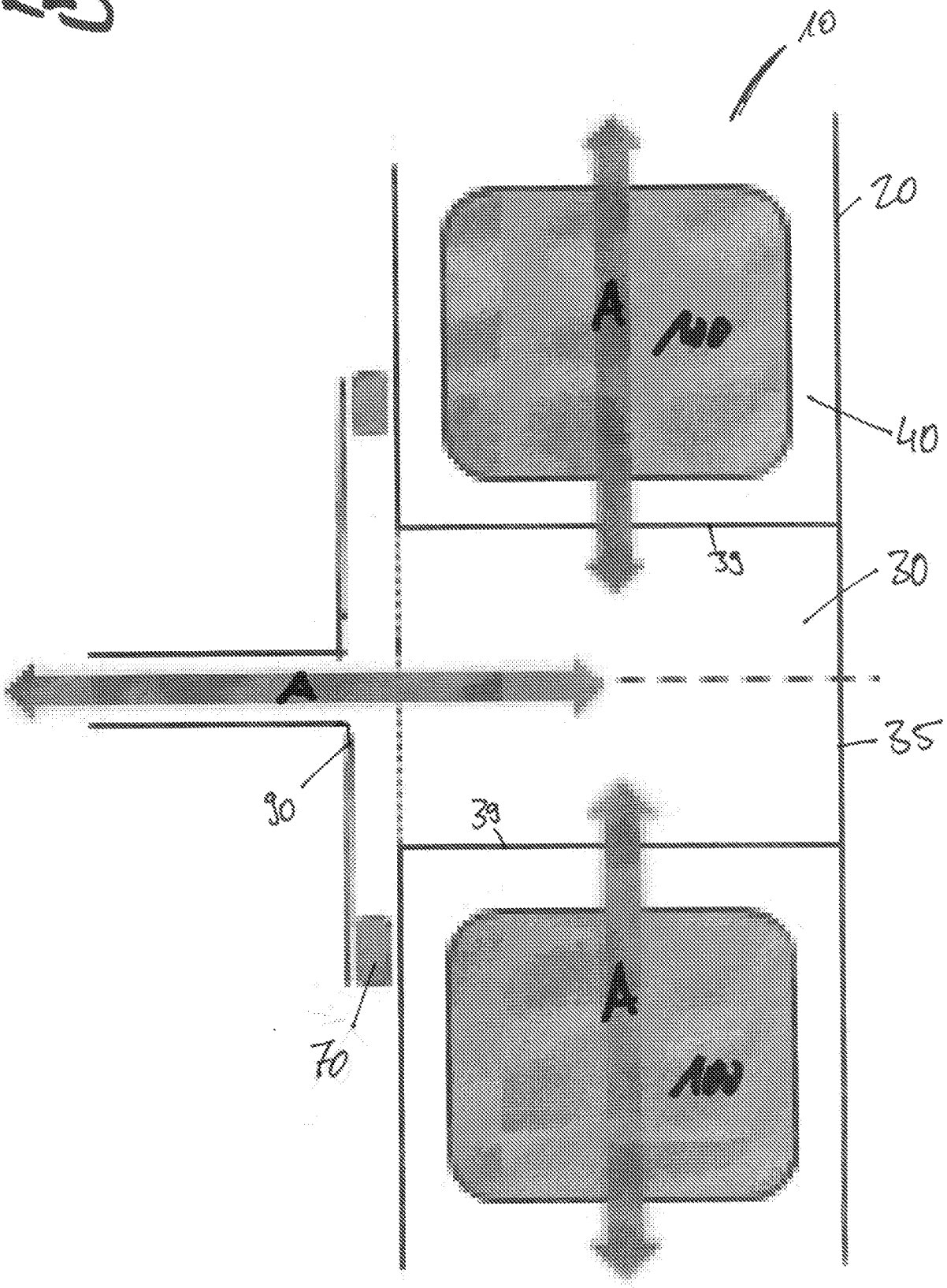
Figure3



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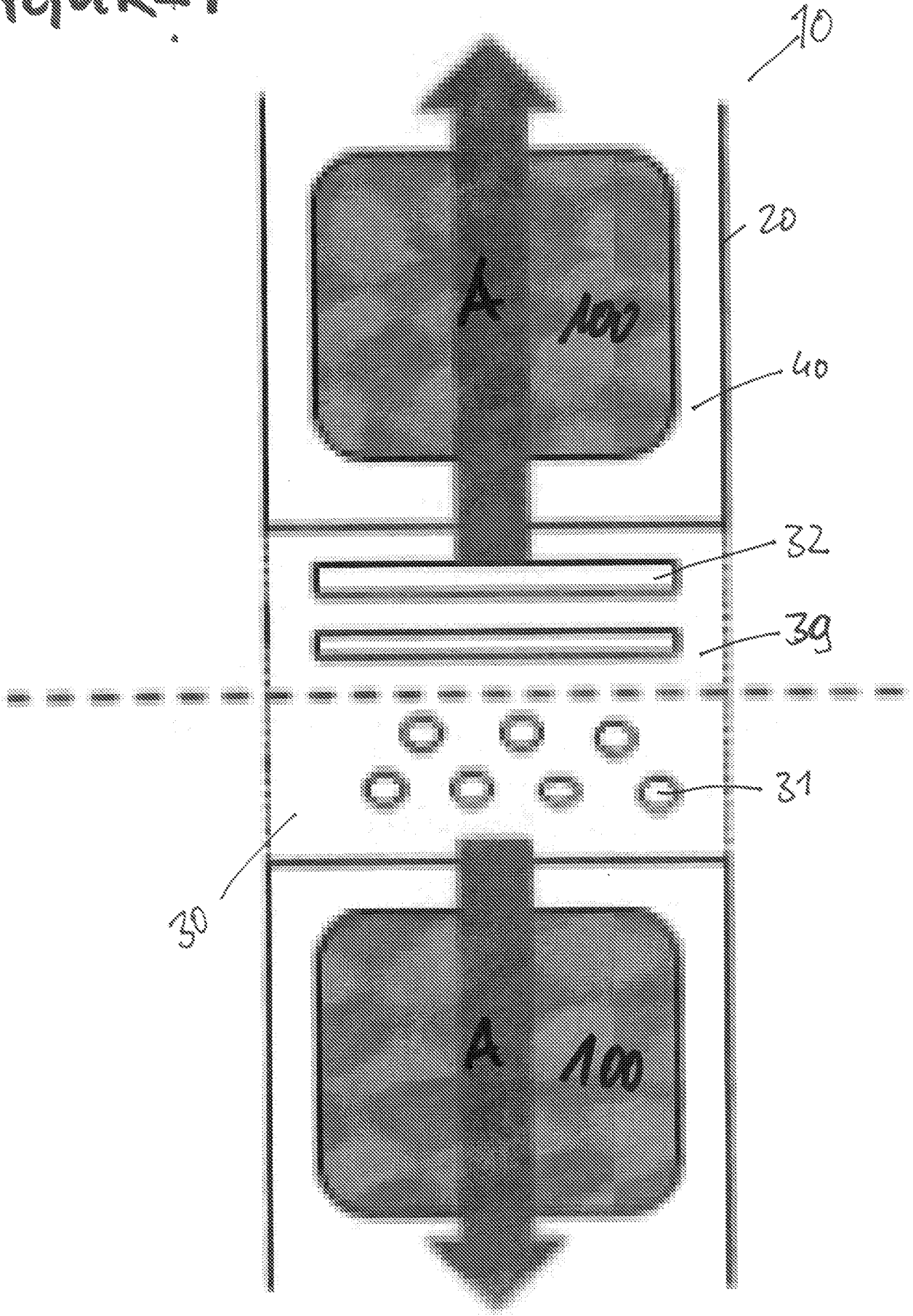

FIGURES

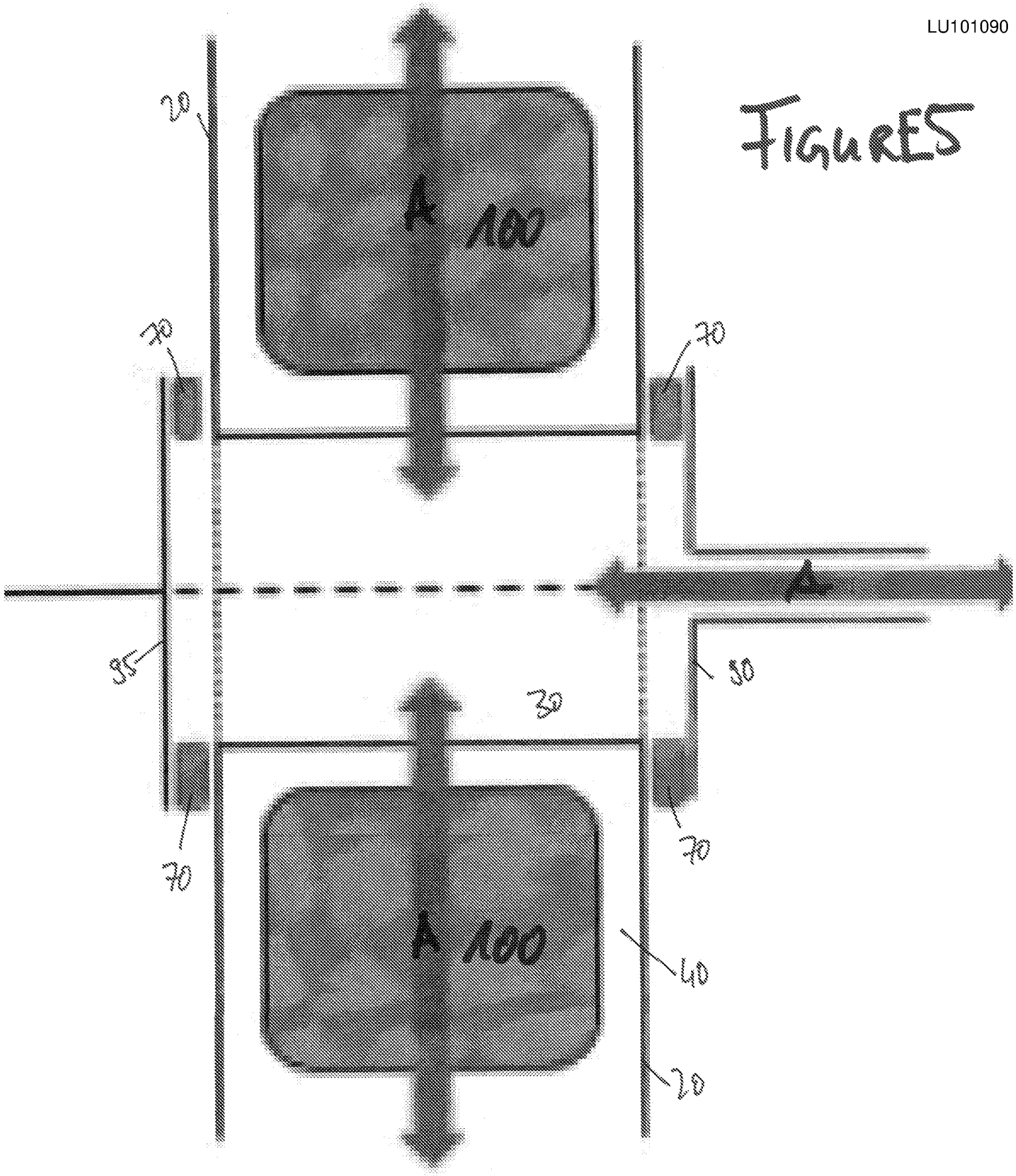

Figure 6

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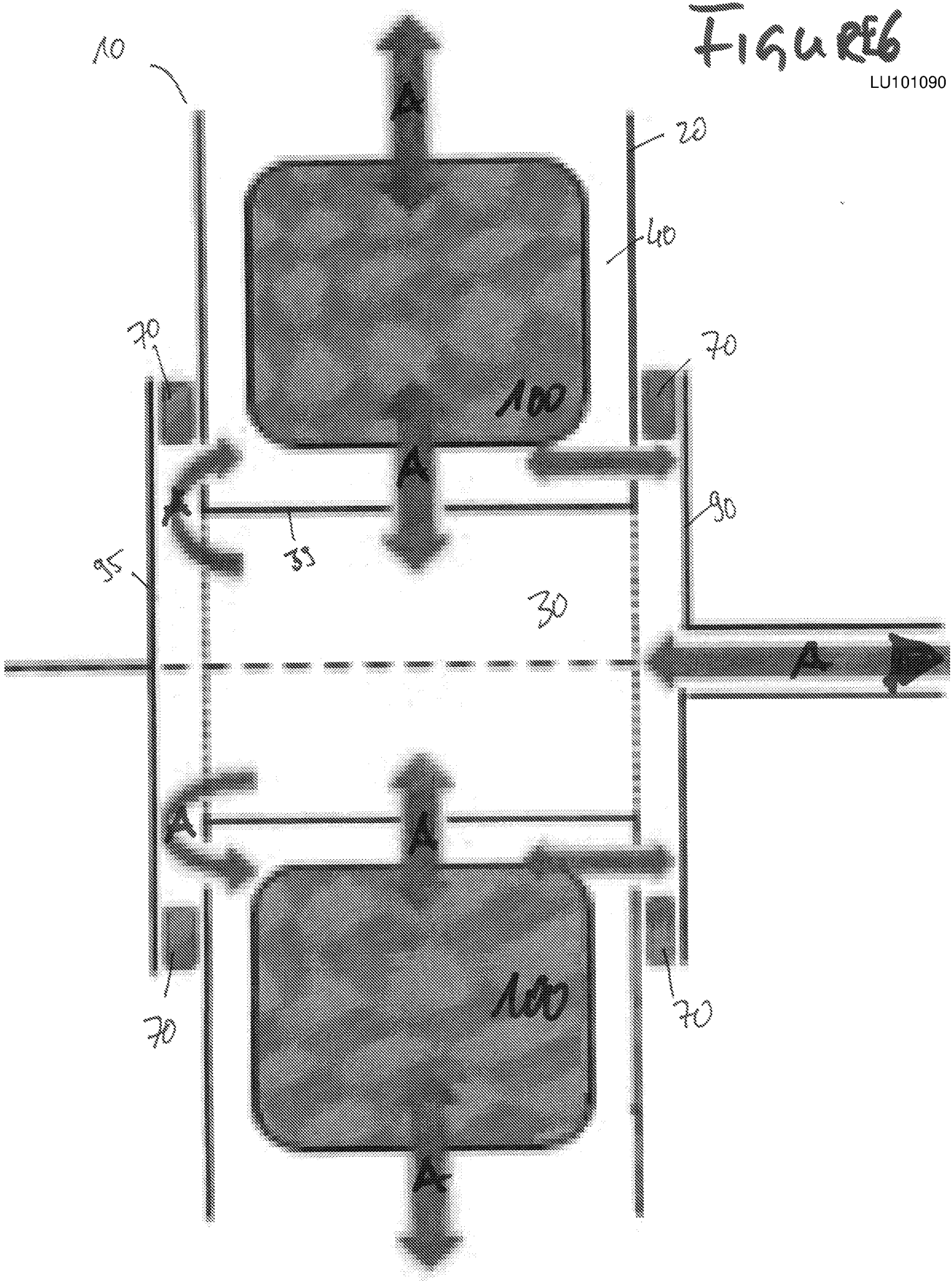

FIGURE 7

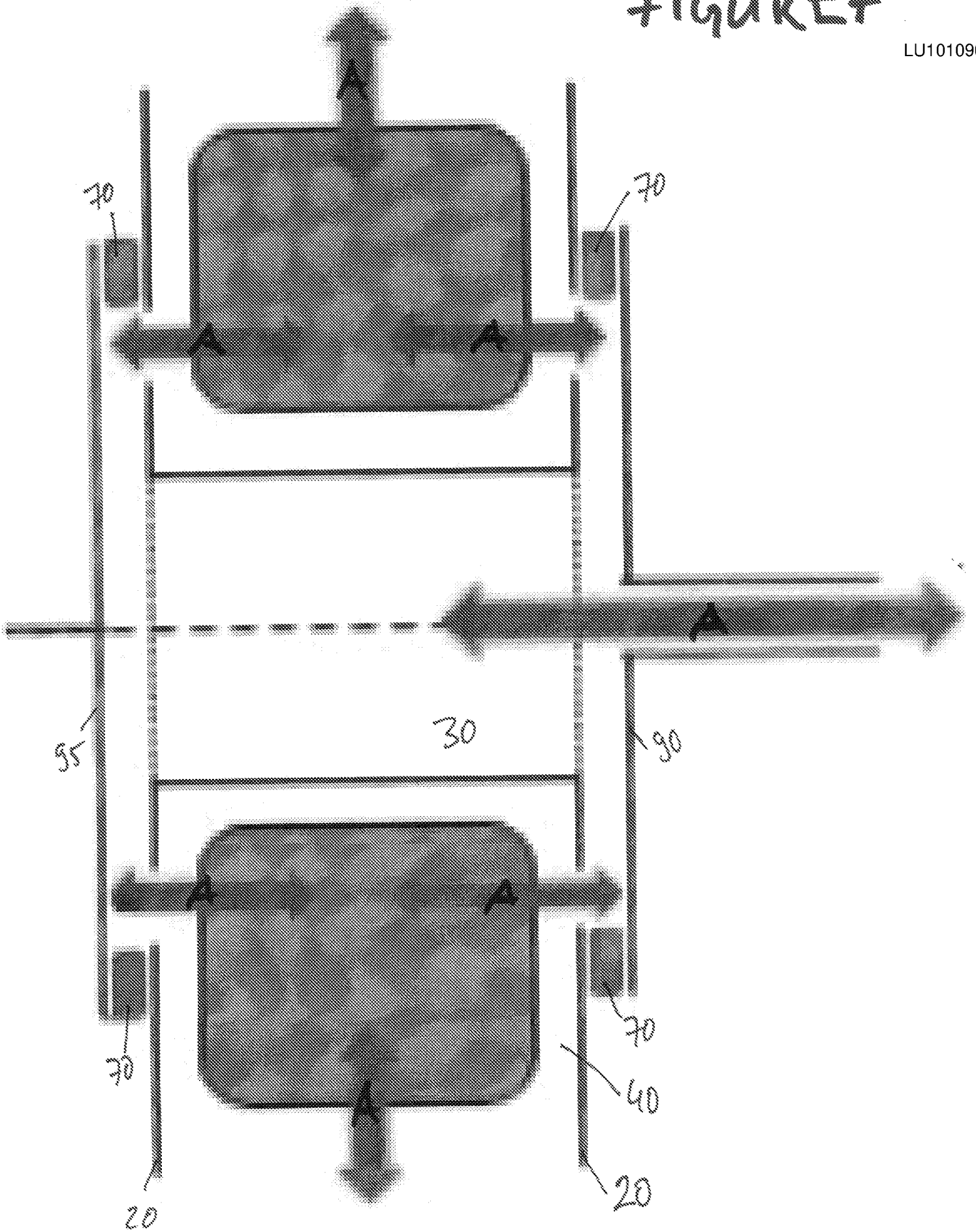

FIGURE 8

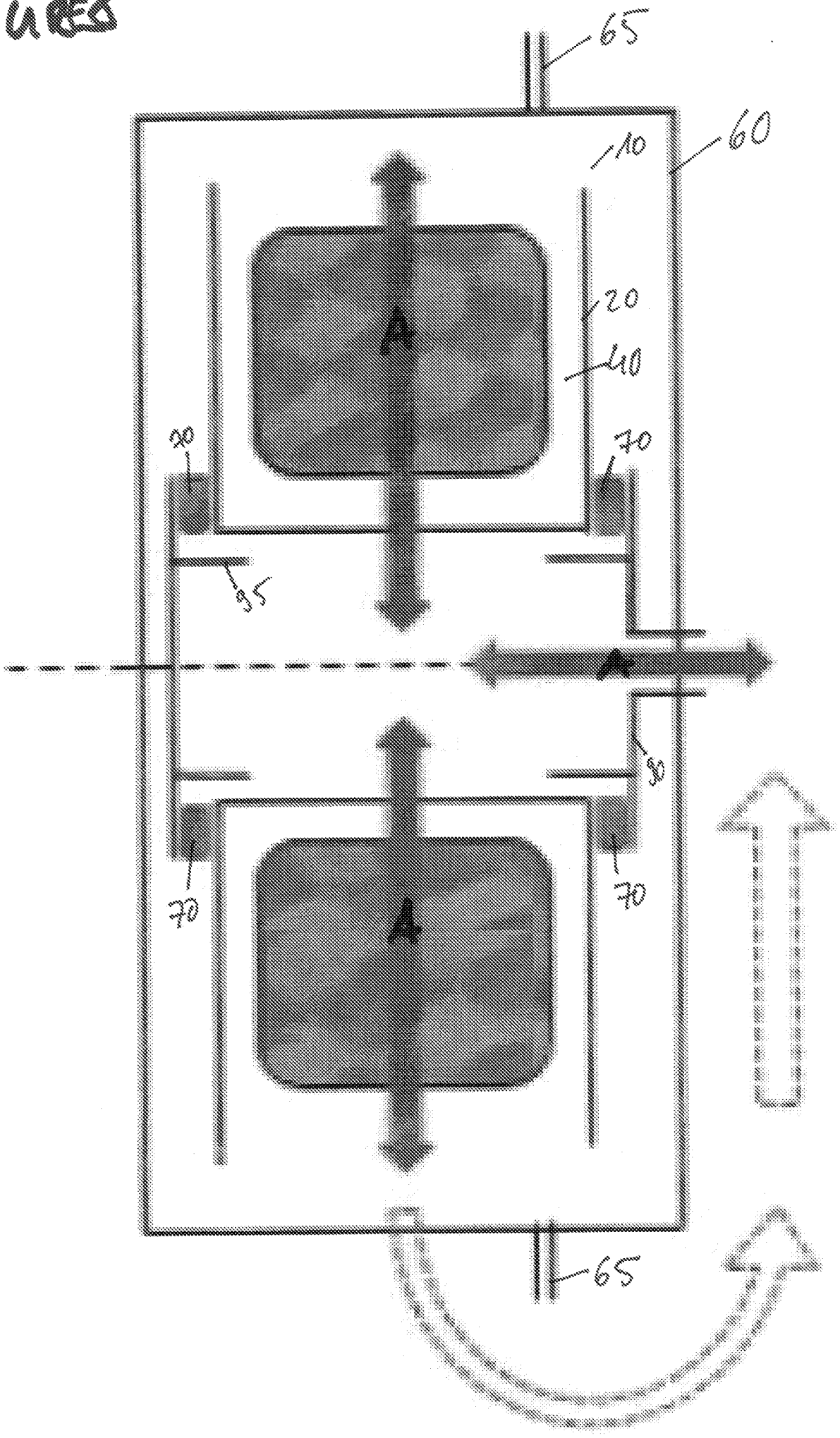

FIGURE 9

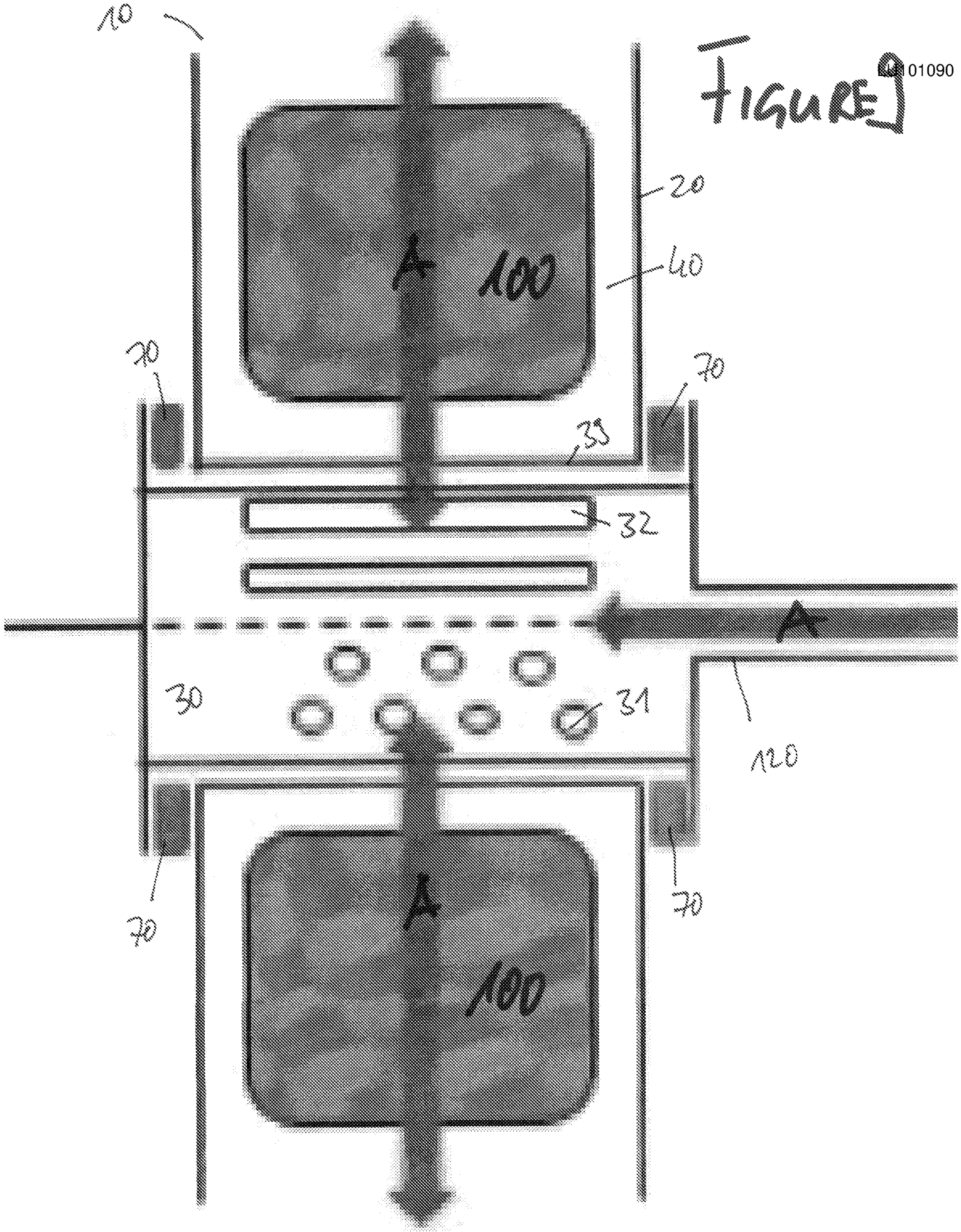

FIGURE 10

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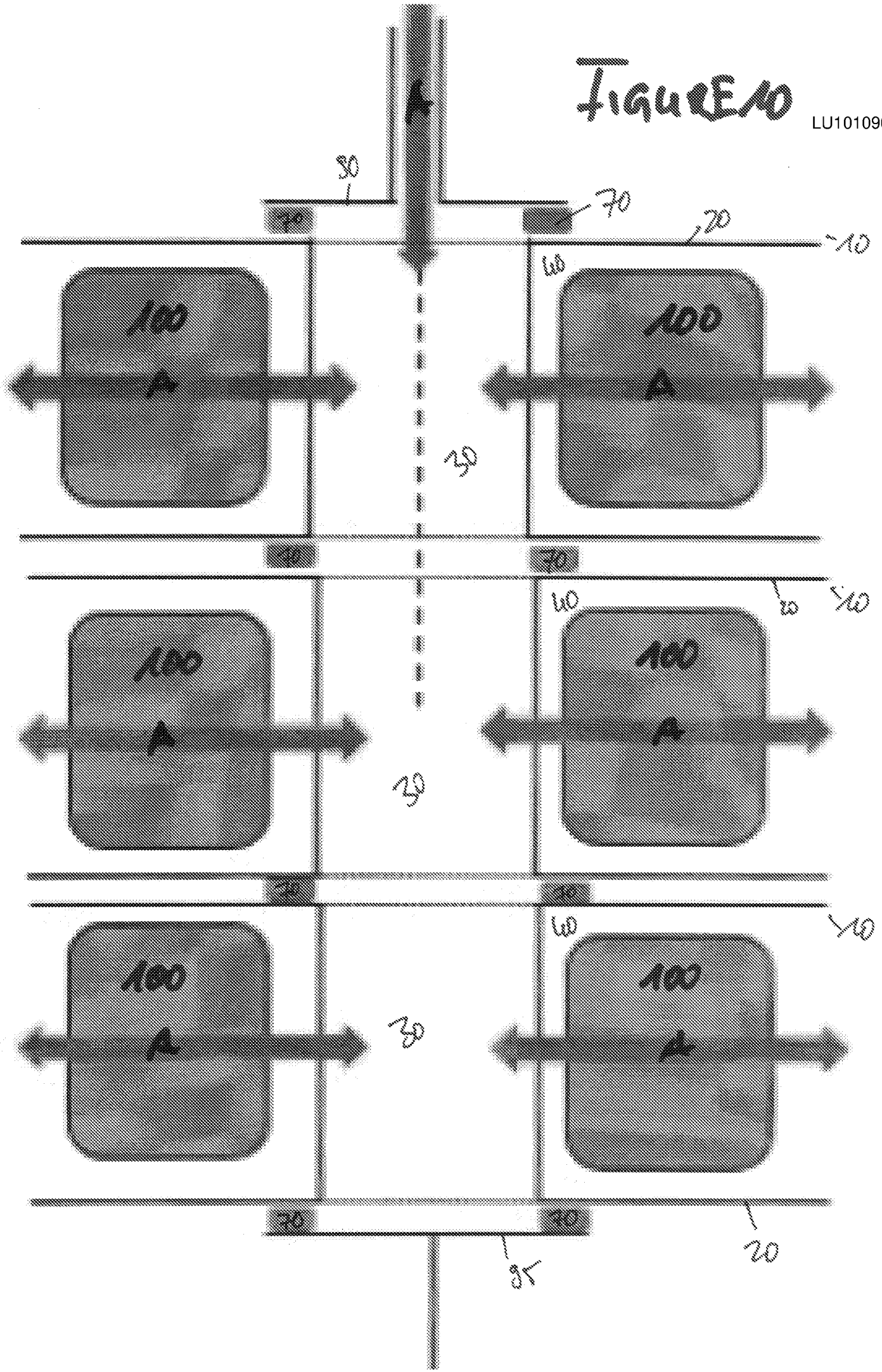

FIGURE 11