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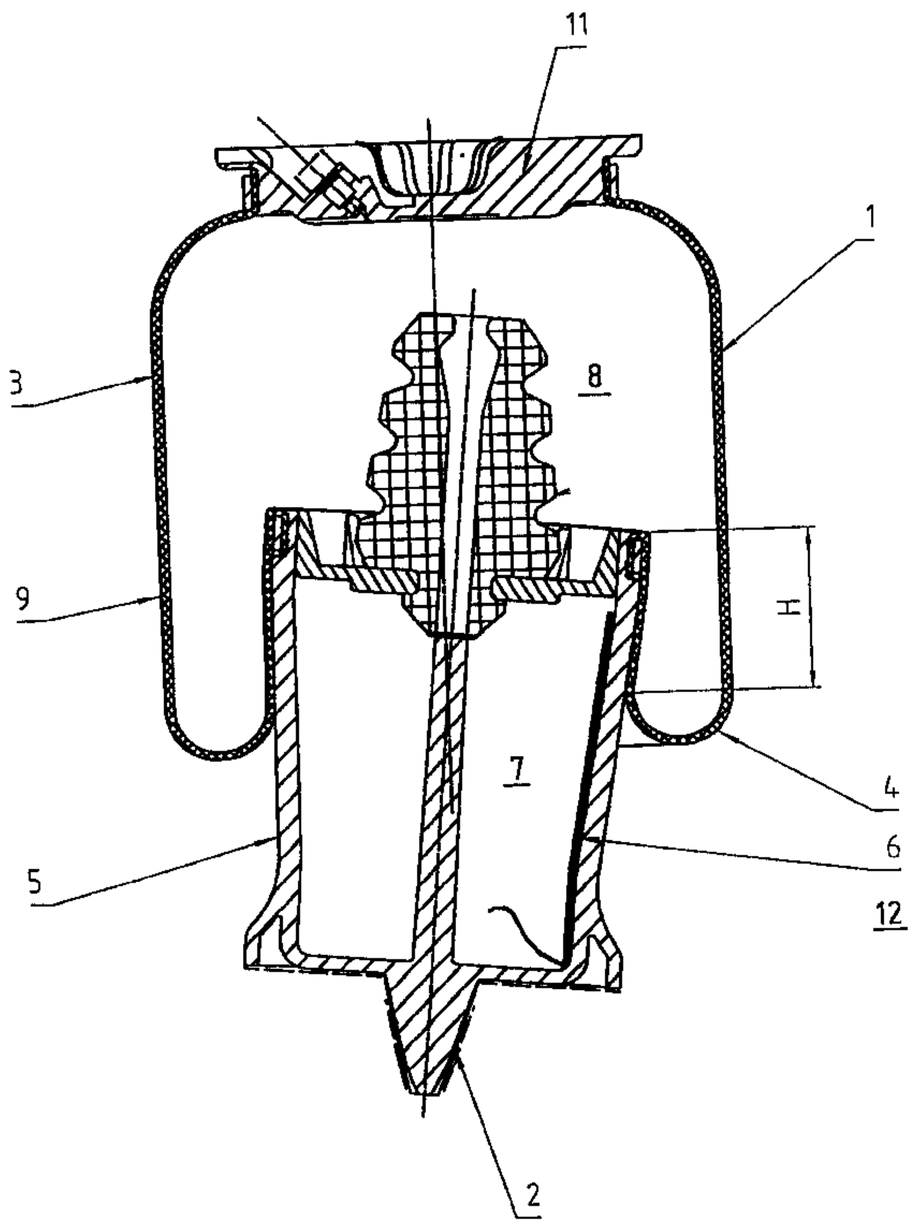
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(54) Titre : RESSORT PNEUMATIQUE
(54) Title: AIR SPRING



(57) Abrégé/Abstract:
An air spring (1), consisting of a plunger (2) and a diaphragm (3) with a rolling fold (4) that can roll over the wall (5) of the plunger (2), as well as at least one flat sensor (6), which is activated by the rolling movement of the diaphragm (3) and produces a height-dependent signal, whereby the sensor (6) is incorporated into the wall (5) of the plunger (2) or located on the side of the wall (5) facing the chamber (7) of the plunger (2).

Abstract

An air spring (1), consisting of a plunger (2) and a diaphragm (3) with a rolling fold (4) that can roll over the wall (5) of the plunger (2), as well as at least one flat sensor (6), which is activated by the rolling movement of the diaphragm (3) and produces a height-dependent signal, whereby the sensor (6) is incorporated into the wall (5) of the plunger (2) or located on the side of the wall (5) facing the chamber (7) of the plunger (2).

Air Spring

Technical Area

The invention concerns an air spring consisting of a plunger and a diaphragm with a rolling fold that can roll over the wall of the plunger, as well as at least one flat sensor, which is activated by the rolling movement of the diaphragm and produces a height-dependent signal.

Background of the Invention

This type of air spring is known from DE 101 30 507 A1. This already-known air spring is used on motor vehicle axle suspensions. Essentially, the air spring consists of a plunger and a diaphragm that rolls over the plunger. In motor vehicle suspensions using air springs, levelling adjustment is required to ensure that the height of the vehicle is kept constant. The level can be adjusted using sensors incorporated into the air spring. The sensors are located on the outer side of the plunger and determine the insertion depth of the diaphragm. Since the air spring is located near the vehicle's axle, it is subject to severe mechanical influences such as stone hits. Due to these mechanical influences, the sensors are protected by embedding them in an elastomer coating around the outer circumference of the plunger.

Summary of the Invention

The purpose of this invention is to further develop the already-known air spring in such a way that it is inexpensive, easy to produce and better protected against outside influences.

Characteristics of Claims 1 and 4 of this invention solve this problem. The remaining claims concern advantageous implementations of the invention.

To solve this problem, the sensor is incorporated into the wall of the plunger or on the side of the wall facing the chamber of the plunger. Integrating the sensor into the wall of the plunger

protects it against external influences such as stone hits and moisture. Since the sensor is incorporated into the wall of the plunger, or located on the side of the wall facing the chamber, it is protected directly by the plunger, which is highly resistant to mechanical influences. No special protection is required and the sensor is installed in a friction- and maintenance-free location. Because the sensor is incorporated into the plunger, the air spring is simple to make and has few parts. This reduces the number of production steps and makes the air spring cheap to produce. Locating the sensor on the side of the plunger facing the chamber is particularly cost effective. Locating the sensor inside the wall protects it particularly well against damage.

The plunger can be made by synthetic material (plastic) injection molding. Parts can be made in a simple and inexpensive manner, using synthetic material injection molding. The material is cheap. Complicated forms can be produced. Incorporating the sensor is particularly simple in the case of plungers made by synthetic material injection molding. In another implementation, the plunger can be made of aluminum. Aluminum is a light and stable material and can be processed by injection molding. In another implementation, the plunger can be made from steel. Due to its strength, plungers made of steel can be produced with very thin walls.

The wall material can be injected around the sensor. In this way, the sensor is installed in the form during the injection molding process and is completely enclosed in synthetic material during the process. The sensor is thus protected against damage and is installed inside the plunger in a friction- and maintenance-free location.

The wall can be constructed in two parts and the sensor can be located between the two parts. This makes it possible to use heat-sensitive sensors that cannot be incorporated into the plunger by synthetic material injection molding.

The problem is also solved by an air spring, whereby the sensor is located on the side of the wall of the diaphragm facing the inner air space. The sensor is thus protected against mechanical damage, for example by stone hits or moisture. The sensor can be affixed in a simple and inexpensive manner, for example, with an adhesive, to the side of the diaphragm facing the inner air space.

The sensor located on the wall of the diaphragm can be in the form of a flex-sensitive foil. With the flex-sensitive foil, the position of the fold of the diaphragm can be determined, from which the insertion depth of the plunger can then be calculated.

Several sensors can be distributed over the circumference of the plunger or the diaphragm. Each sensor detects the insertion depth of the plunger. Due to acceleration, deceleration and the effect of surface bumps, the plunger moves not only vertically in relation to the diaphragm, but also makes pitch and yaw movements. When several sensors are installed over the circumference of the plunger or the diaphragm, pitch and yaw movements of the plunger can be detected.

An integrated circuit can be provided to determine the average insertion depth of the plunger from the individual sensor signals. With the integrated circuit, the average insertion depth that is necessary to constantly regulate the level of the vehicle can be determined from the detected pitch and yaw movements.

Brief Description of the Drawings

Implementation examples of the air spring of the invention are explained in greater detail with the figures below. These show schematically the following:

Fig. 1 An air spring with a sensor located on the side of the wall of the plunger facing the chamber.

Fig. 2 An air spring with a sensor incorporated into the wall of the plunger.

Fig. 3 An air spring in accordance with Figure 2 with a two-part wall.

Fig. 4 An air spring with a sensor on the side of the diaphragm facing the inner air space.

Fig. 5 A plunger with several sensors distributed around the circumference.

Fig. 6 A diaphragm with several sensors distributed around the circumference.

Description of the Invention

Figure 1 shows an air spring (1) with a plunger (2), an air spring cover (11) located at some vertical distance above the plunger (2), a diaphragm (3) with a rolling fold (4) made of an elastomer material that joins the air spring cover (11) and the plunger (2) to each other and with the formation of a volume-elastic inner air space (8), can roll along the wall (5) of the plunger (2). The plunger (2) is made by synthetic material injection molding. Alternatively, the plunger can be made of aluminum or steel. On the side of the wall (5) facing the chamber (7) of the plunger (2), a sensor (6) is installed to detect the height state of the air spring (1). The sensor (6) consists of an expansion-sensitive foil and detects changes in the tension of the wall (5) resulting from the rolling movement of the diaphragm (3) on the wall (5). The sensor (6) detects, in particular, the expansion distribution of the plunger (2) in the vertical direction. The chamber (7) of the plunger (2) is hydraulically joined to the inner air space (8), so that the pressure in the chamber (7) is equal to that in the inner air space (8). The area of the wall (5) that is covered by the diaphragm (3) is tension free because there is no difference in pressure. In the area of the wall (5) that is not covered by the diaphragm (3), the difference in pressure between the chamber (7) and the environment (12) creates a tension in the wall (5) that is detected by the sensor (6). The degree of coverage of the diaphragm (3) corresponds to the insertion depth (H). A change in height state produces a specific change in maximum expansion and the expansion distribution in the vertical direction in the wall of the plunger (2), which is detected by the sensor. For this purpose, it can be subdivided into one or more segments. Since the amplification factor of sensor (6) is high, even slight changes in the tension of the wall (5) are detected. The height of the air spring is regulated based on the measured insertion depth (H). This makes it possible to regulate the level of all vehicles equipped with airs springs (1) by regulating the height state.

Figure 2 shows an air spring constructed as in Figure 1. However, unlike in Figure 1, the sensor (6) is incorporated into the wall (5) of the plunger (2). The plunger (2) is made by synthetic material injection molding. The sensor (6) is located in the injection molding form when the plunger (2) is manufactured and synthetic material is injected around it. Thus, the sensor (6) is completely surrounded by synthetic material and isolated from the environment (12) and the chamber (7). Because of the direct bond, the contact of the

sensor (6) with the wall (5) is always maintenance- and friction-free. As in the example in Figure 1, the sensor (6) consists of a pressure-sensitive foil and detects tension changes in the wall (5) resulting from the rolling movement of the diaphragm (3) on the wall (5).

Figure 3 shows an air spring in accordance with Figure 2. In this implementation example, the wall (5) is made in two parts. The wall is formed of the two wall parts (13, 14). The sensor (6) is located between the two wall parts (13, 14).

Figure 4 shows an air spring (1) consisting of a plunger (2) made by synthetic material injection molding, an air spring cover (11) located at some vertical distance above the plunger (2), a diaphragm (3) with a fold (4) made of an elastomer material that joins the air spring cover (11) and the plunger (2) together and with the formation of a volume-elastic inner air space (8), can roll along the wall (5) of the plunger (2). The sensor (6) is fixed to the side of the wall (9) of the diaphragm (3) facing the inner air space (8) with an adhesive. The sensor (6) is made as a flex-sensitive foil. The sensor (6) detects the position of the fold (4) on the diaphragm (3) and the expansion of the plunger (2) this produces. This gives a measurement for the insertion depth (H) of the plunger (2). The height state of the air spring (1) is regulated based on the measured insertion depth (H). This makes it possible to regulate the level of all vehicles equipped with airs springs (1) by regulating the height state.

The plunger (2) moves not only with a vertical plunging movement around an axis inside the plunger (2), but also with pitch and yaw movements. The pitch and yaw movements result from acceleration and deceleration processes and from vibration of the air spring (1). If only one sensor (6) is provided, these pitch and yaw movements would produce false measurement results. By installing several sensors (6) around the circumference, an average insertion depth can be determined and pitch and yaw movements can be eliminated.

Figure 5 shows a plunger (2) with several sensors (6) distributed around its circumference. The sensors (6) can be incorporated into the wall (5) or be fastened to the inner side of the wall (5). The sensors are designed as pressure-sensitive foils and can also be subdivided vertically. The sensors (6) are connected to an integrated circuit. A separate insertion depth is detected by each

sensor (6). The measured values of the individual sensors (6) are transmitted to an integrated circuit (10) where the average insertion depth of the plunger (2) is calculated from the individual measured values.

Figure 6 shows a diaphragm (3) with an air spring cover (11) with several sensors (6) distributed around the circumference of the diaphragm (3), which are stuck to the wall (9) on the side facing the inner air space (8). The sensors (6) are designed as flex-sensitive foils. The sensors (6) are connected to an integrated circuit (10). Each sensor (6) detects a separate insertion depth. The measured values of the individual sensors (6) are transmitted to an integrated circuit (10), where an average insertion depth of the plunger (2) is calculated from the individual measured values.

Claims

1. An air spring (1), consisting of a plunger (2) and a diaphragm (3) with a rolling fold (4) that can roll over the wall (5) of the plunger (2), as well as at least one flat sensor (6), which is activated by the rolling movement of the diaphragm (3) and produces a height-dependent signal, characterized in that the sensor (6) is incorporated into the wall (5) of the plunger (2) or located on the side of the wall (5) facing the chamber (7) of the plunger (2).

2. An air spring in accordance with Claim 1, characterized in that the plunger (2) is made of an injection molded synthetic material, aluminum or steel.

3. An air spring in accordance with Claim 2, characterized in that the wall material is injected around the sensor (6).

4. An air spring in accordance with Claim 1 or 2, characterized in that the wall (5) is made in two parts (13, 14), with the sensor (6) being located between the two wall parts (13, 14).

5. An air spring (1), consisting of a plunger (2) and a diaphragm (3) with a rolling fold (4) that can roll over the wall (5) of the plunger (2), as well as at least one flat sensor (6), which is activated by the rolling movement of the diaphragm (3) and produces a height-dependent signal, characterized in that the sensor (6) is located on the side of the wall (9) of the diaphragm (3) facing the inner air space (8).

6. An air spring in accordance with Claim 4, characterized in that the sensor (6) is in the form of a flex-sensitive foil.

7. An air spring in accordance with Claims 1 to 5, characterized in that several sensors (6) are located around the circumference of the plunger (2) or the diaphragm (3).

8. An air spring in accordance with Claim 7, characterized in that there is an integrated circuit (10) that determines an average insertion depth of the plunger (2) from the signals from the individual sensors (6).

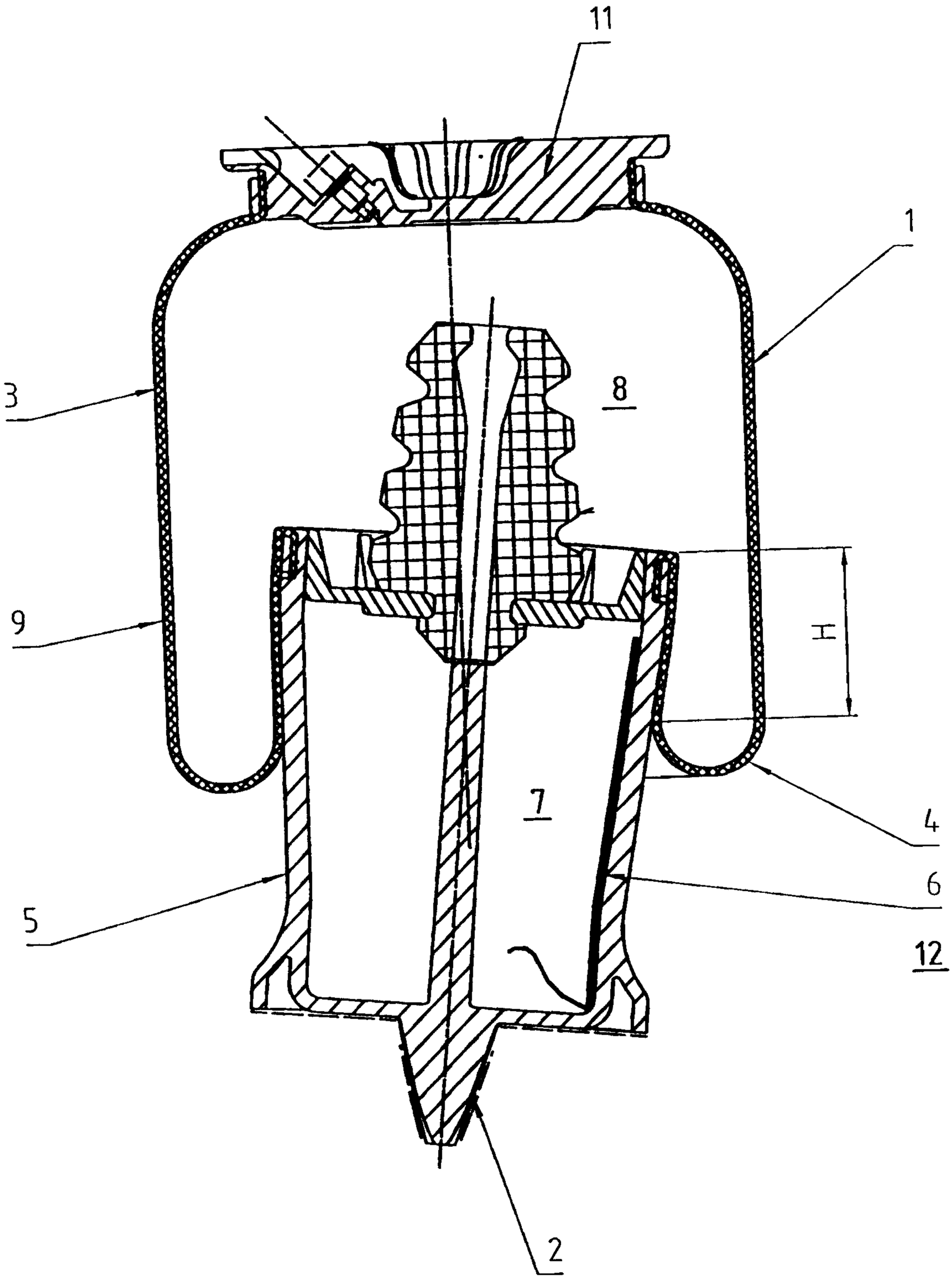


Fig. 1

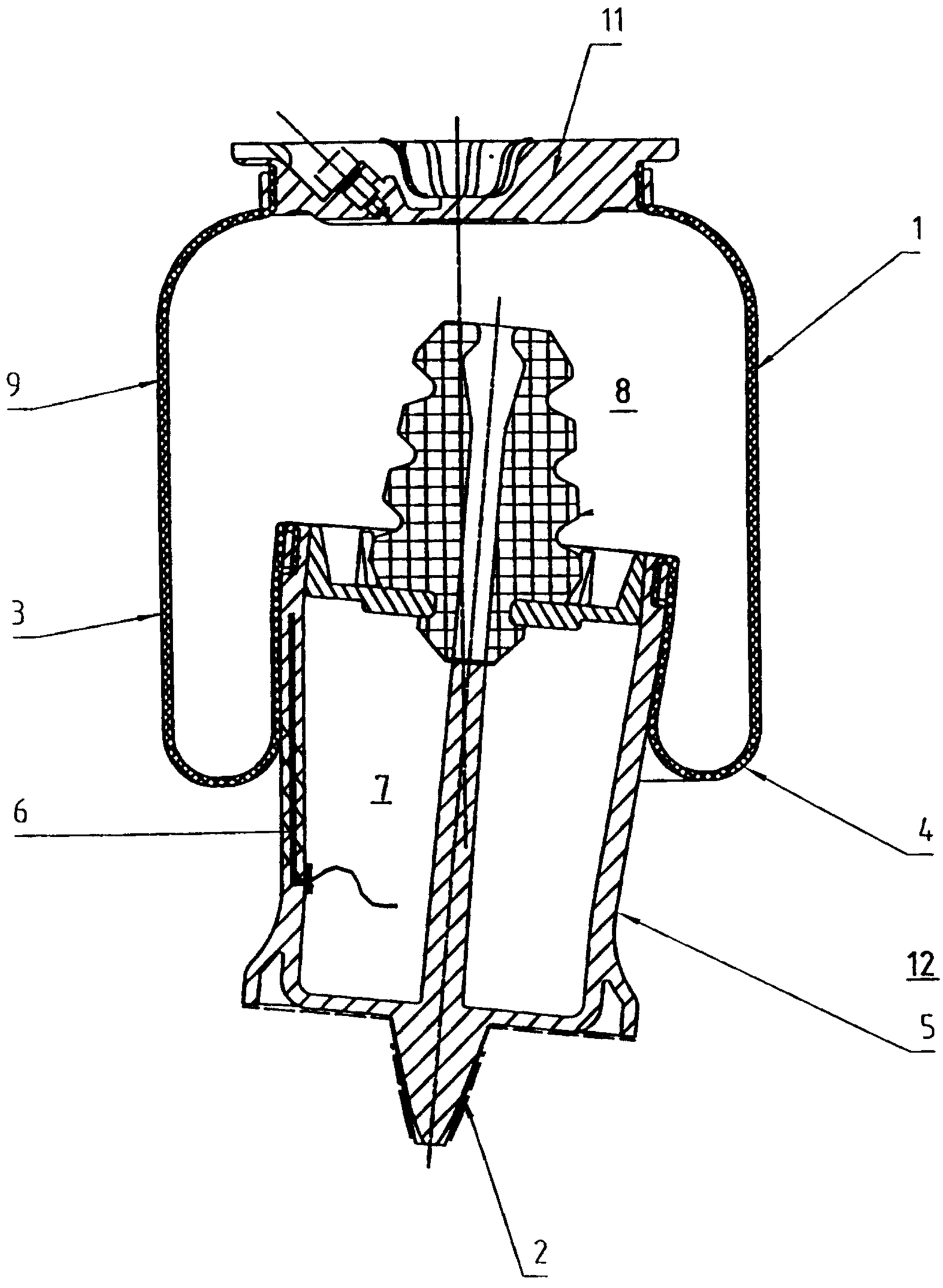


Fig. 2

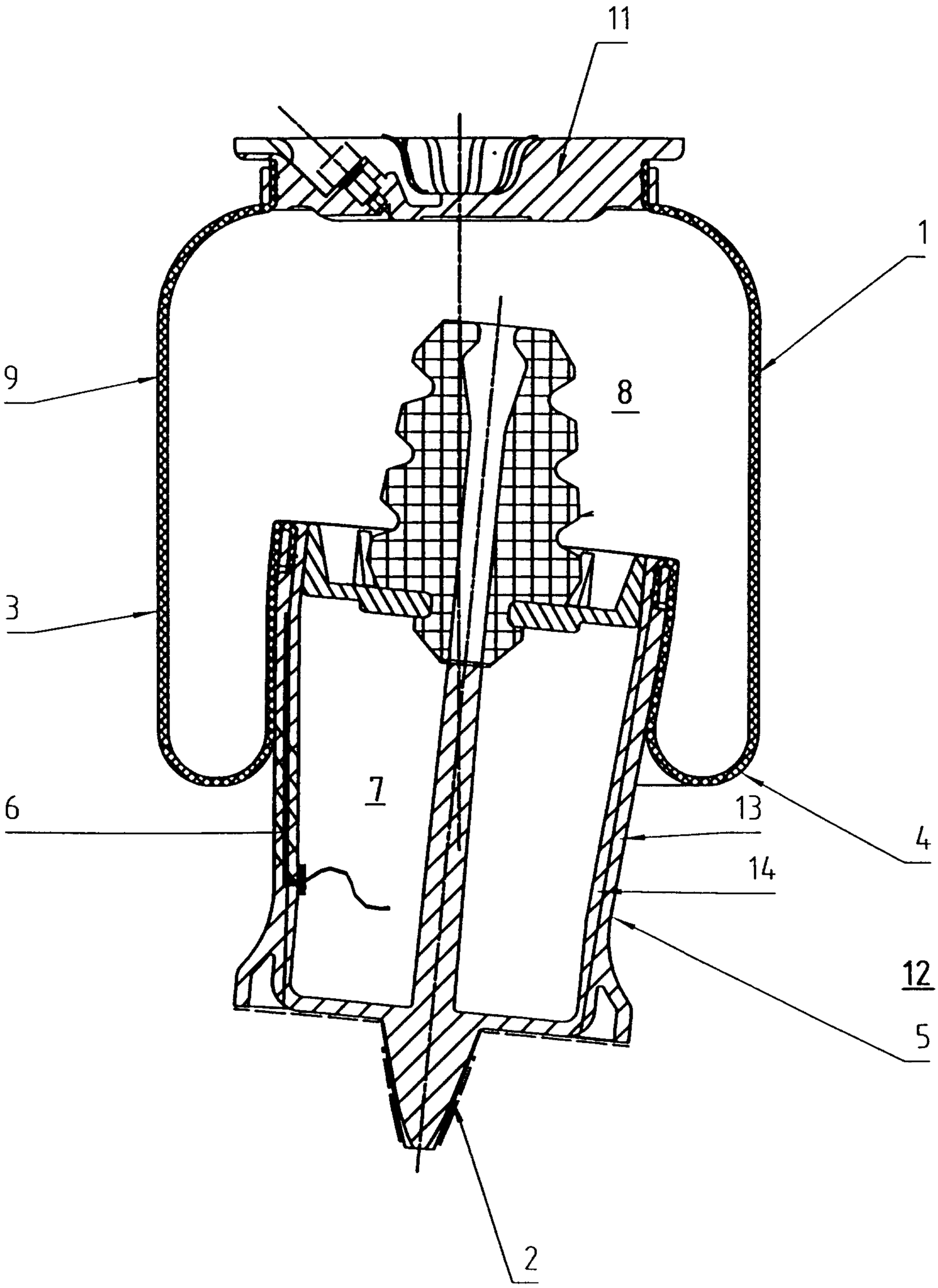


Fig. 3

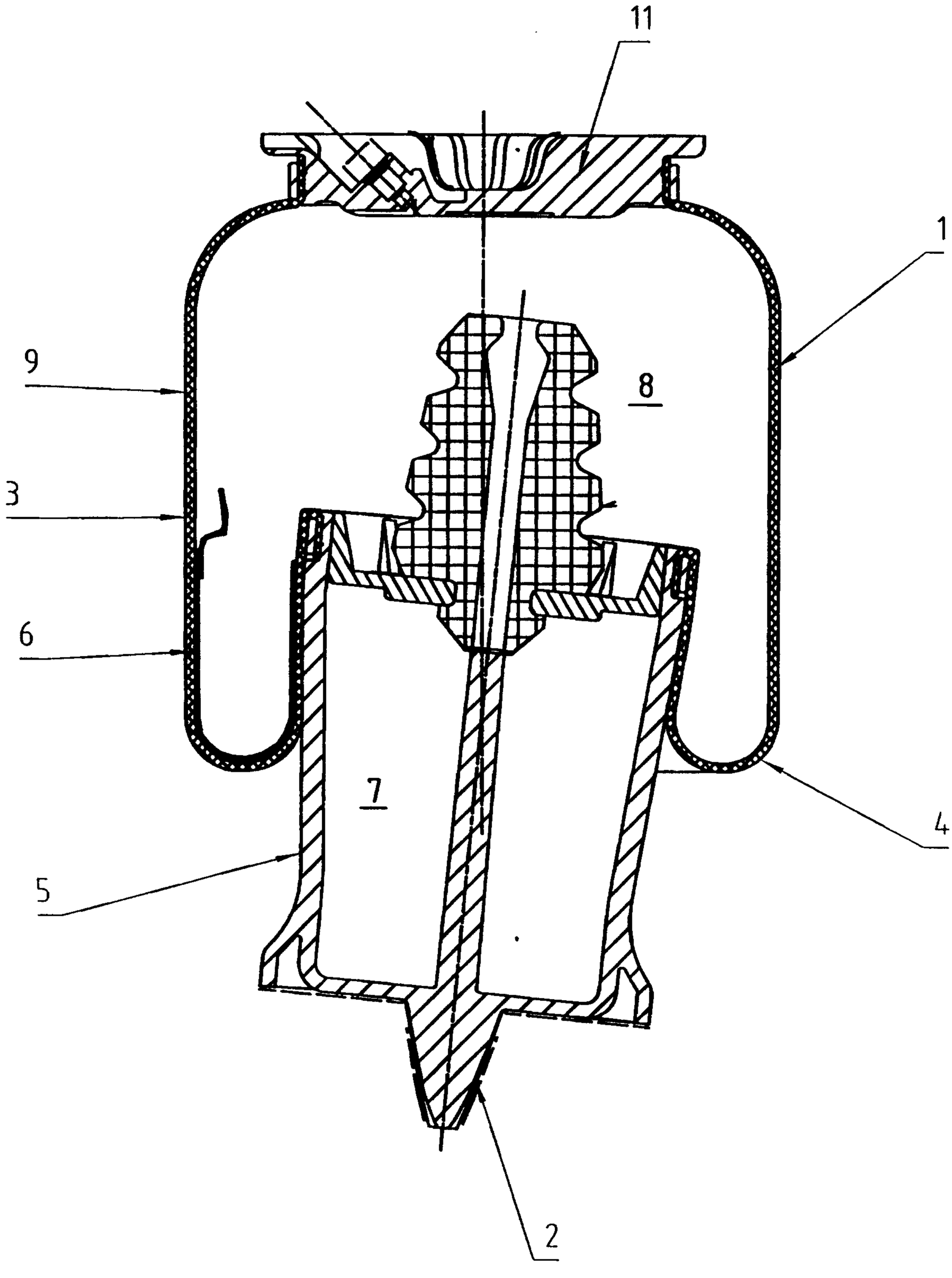


Fig. 4

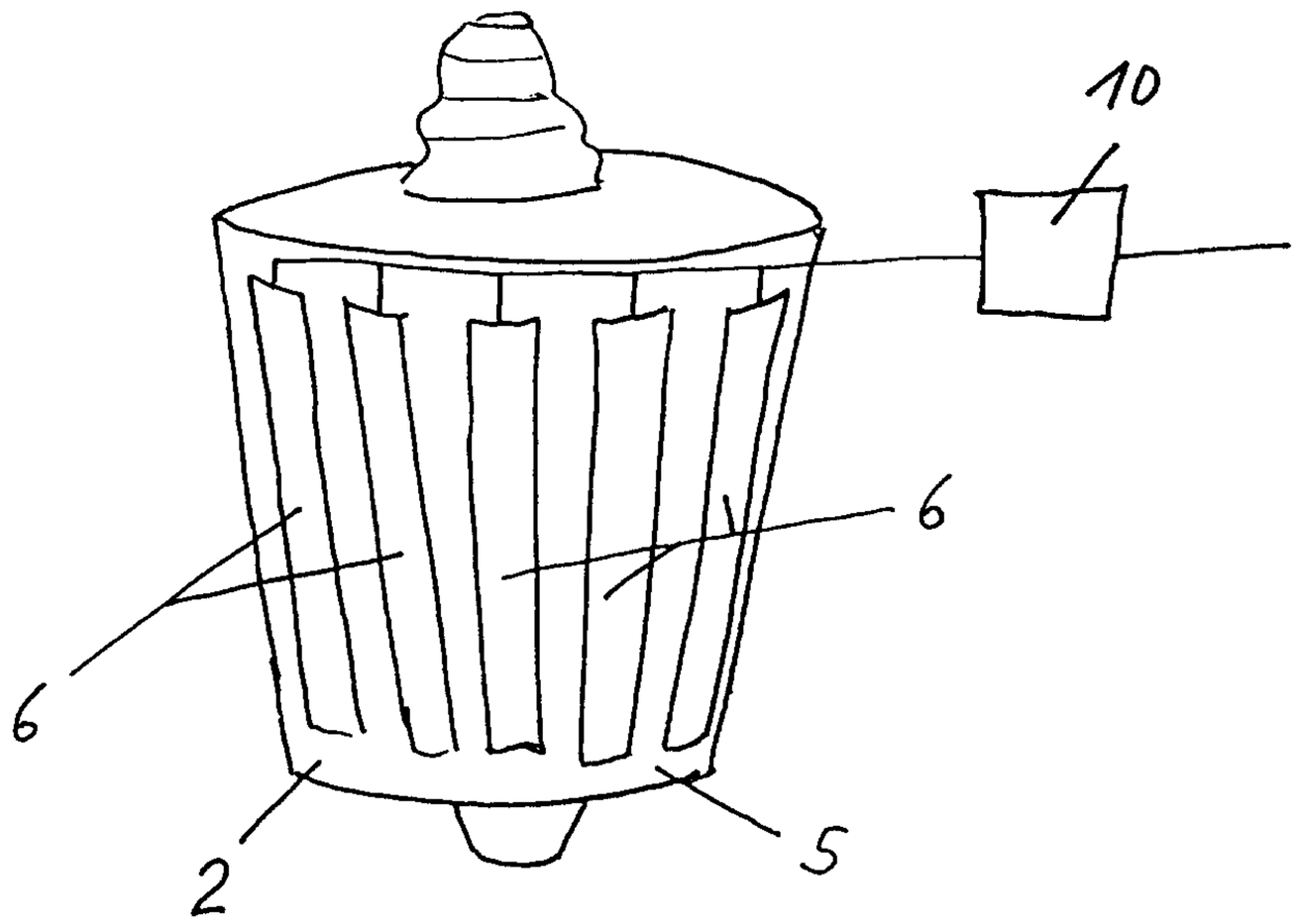


Fig. 5

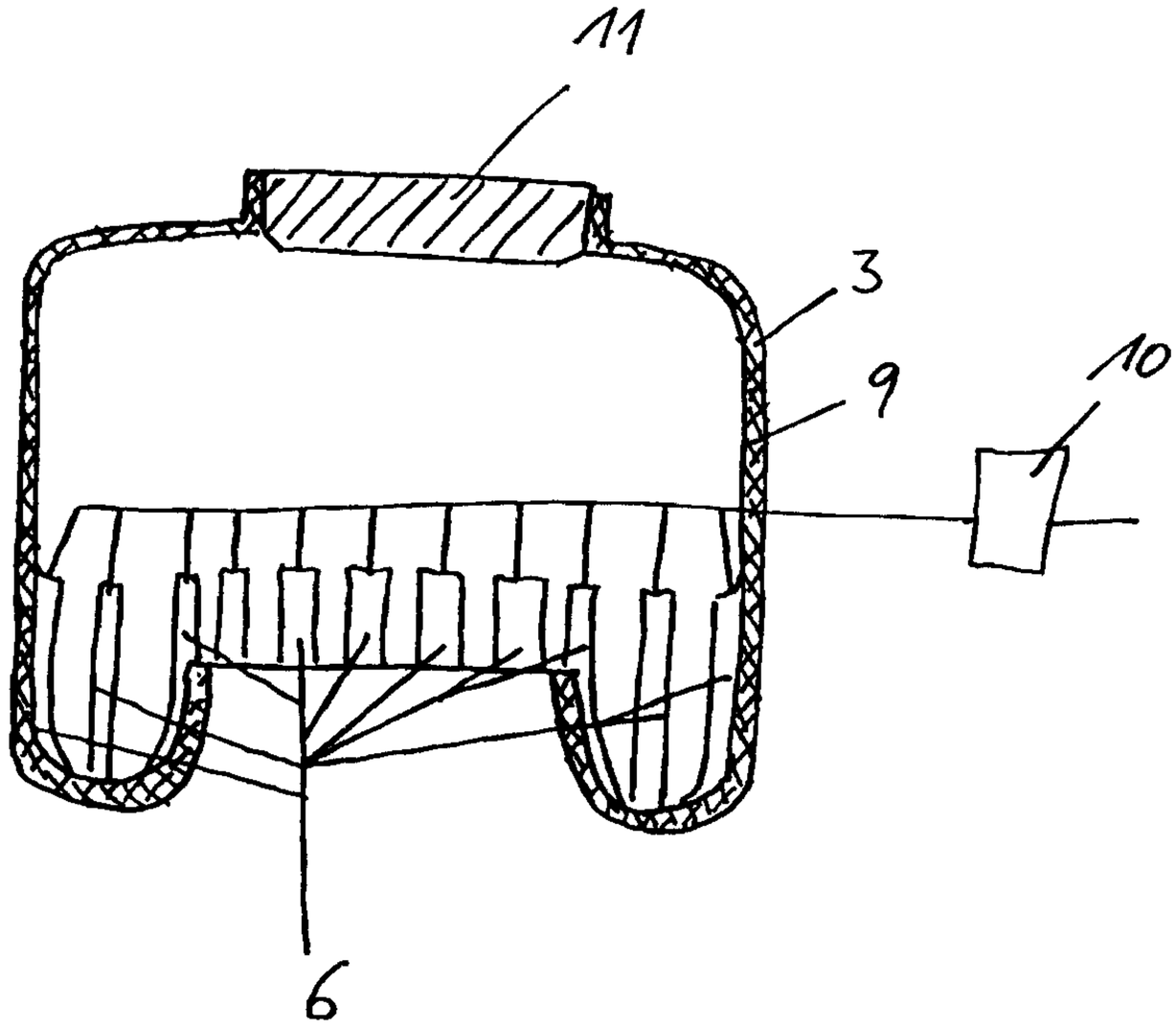
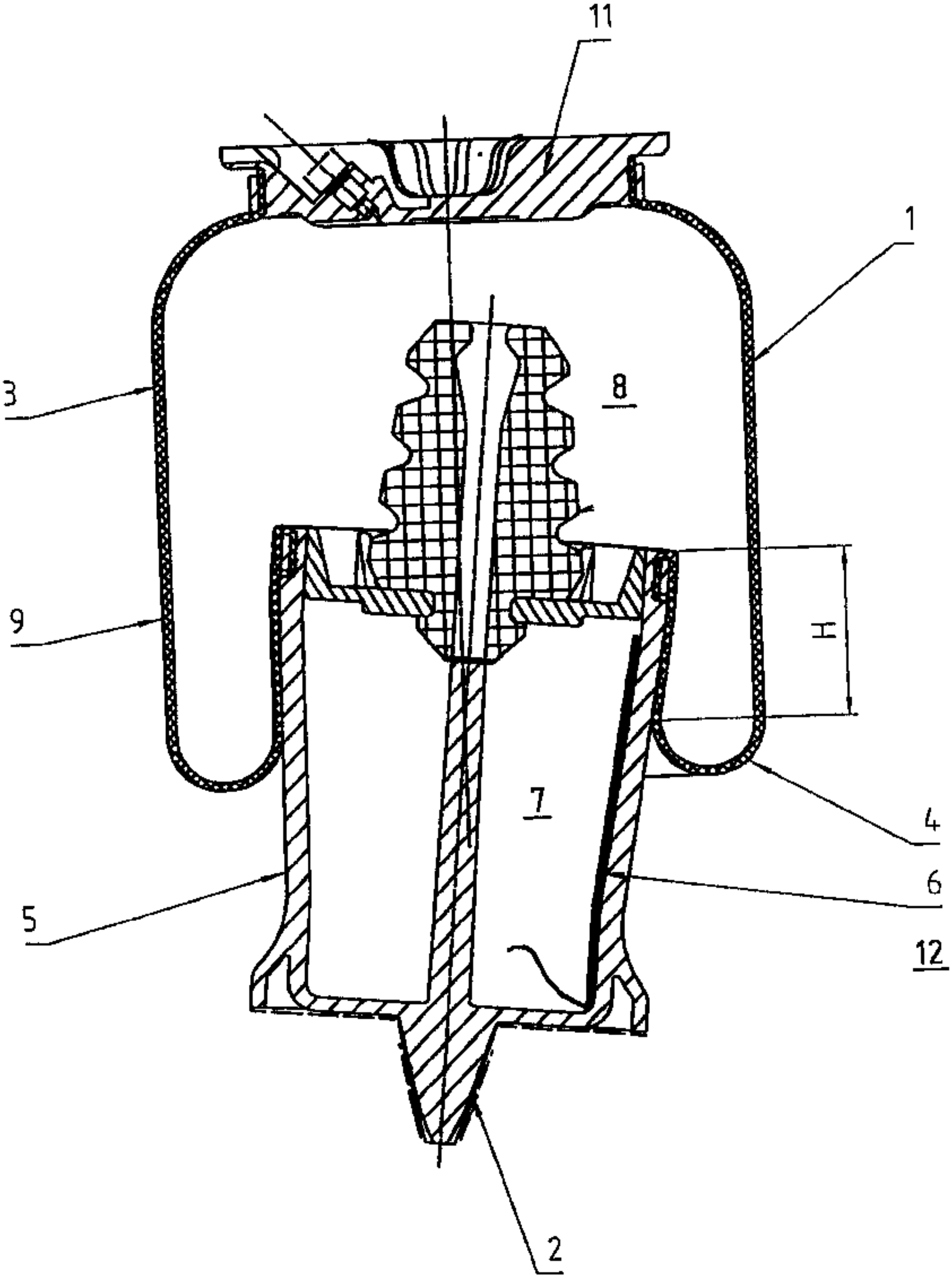


Fig. 6


11
1
3
8
9
H
7
4
5
6
12
2