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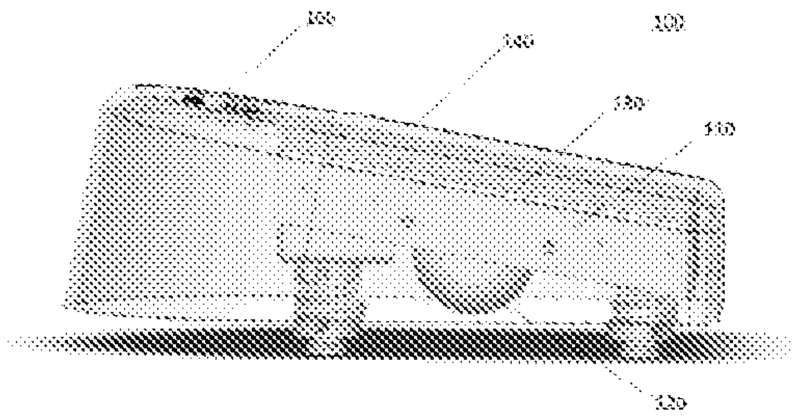
(54) An apparatus suitable for promoting healing of a pre-tibial laceration, and for preventing occurrence and reoccurrence

(57) The present invention relates to an apparatus comprising:

- a chassis with a support plate, and a lateral rim delimiting the support plate, which lateral rim preferably extends downwards relative to said support plate;
- an electric vibration motor fastened to the lower face of the support plate;
- an electric infrared emitting plate element comprising a carbon membrane and being positioned above or on top of said support plate; and
- a cover plate of a polymeric material and adapted to cover at least the support plate and the electric infrared emitting plate element.



Deze publicatie komt overeen met de oorspronkelijk ingediende stukken.

An apparatus suitable for promoting healing of a pre-tibial laceration, and for preventing occurrence and reoccurrence

Technical field of the invention

The present invention relates to an apparatus suitable for promoting healing of a pre-tibial laceration, and for preventing reoccurrence.

Background of the invention

Pre-tibial laceration is defined as lacerations to the anterior aspect of the lower leg. Research into the treatment of these lacerations is limited. Treatment with heparin has shown a positive effect, however, the treatment is complex. As an example, US5037810 discloses that a 69-year-old female presenting torn skin of the left leg above the tibia resulting from injury to a subcutaneous hematoma was treated with heparin. Heparin solution was applied twice daily to the infected, weeping, necrotic wound, by the physician in the office or by the patient at home, for 12 days. Day 1, topical heparin dose was 20,000 I.U., twice daily; reduced progressively to 2,500 I.U., twice daily, on day 12. Heparin, in 10,000 I.U. dose, was parenterally administered by injection into subcutaneous fat, once daily for 3 days.

Hence, there is a need for a simple solution for promoting healing of a pre-tibial laceration, and for preventing occurrence and reoccurrence.

Summary of the invention

One object of the present invention is to provide a method and means for promoting healing of a pre-tibial laceration, and for preventing occurrence and reoccurrence.

A first aspect relates to an apparatus comprising:

- a chassis with a support plate, and a lateral rim delimiting the support plate, which lateral rim preferably extends downwards relative to said support plate;
- an electric vibration motor fastened to the lower face of the support plate;
- an electric infrared emitting plate element comprising a carbon membrane and being positioned above or on top of said support plate; and

- a cover plate of a polymeric material and adapted to cover at least the support plate and the electric infrared emitting plate element.

A second aspect relates to an apparatus comprising:

- a chassis with a support plate, and a lateral rim delimiting the support plate, which lateral rim preferably extends downwards relative to said support plate;
- an electric vibration motor fastened to the lower face of the support plate;
- an electric infrared emitting plate element being positioned above or on top of said support plate; and
- a cover plate of a polymeric material and adapted to cover at least the support plate and the electric infrared emitting plate element.

The inventor has surprisingly found that the combination of infra-red radiation with vibration directed to the foot of a patient with pre-tibial lacerations, result in a markedly reduced healing time. When testing only one foot of a patient with pre-tibial lacerations on both shins, with the apparatus of the present invention, the healing time of the pre-tibial laceration was reduced with two weeks compared to the untreated foot. The same patient was at a later stage tested with only vibration, and inferior results was observed. The apparatus according to the present invention is also thought to prevent or alleviate many vascular-related disorders in the feet and lower limbs, such as the shins.

The part of the cover plate covering the support plate and the electric infrared emitting plate element is adapted to receive and support a user's feet. The user is preferably seated on a chair while resting his or her feet on the cover plate. The apparatus vibrates and emits infrared radiation at the same time. The vibrations are formed by an electric vibration motor, e.g. by two or three electric vibration motors. In order to provide stability to the apparatus, a chassis is incorporated. The chassis is preferably made from metal, such as steel or aluminum, but other materials such as reinforced polymeric materials may also be used. The chassis comprises a support plate, and a lateral rim delimiting the support plate. The lateral rim preferably extends downwards relative to said support plate to function as a fastening plate for the cover plate and/or for the legs. In one or more embodiments, a part of each leg is formed from the lateral rim.

In one or more embodiments, the support plate is made from sheet metal with embossing's to improve the rigidity.

The apparatus may further include a control module. The control module controls the speed of the electric vibration motor. The apparatus may additionally include a control panel, where the control panel allows a user to change one or more settings, such as the oscillation frequency, controlled by the control module. The apparatus may also include a display, where the display is configured to show the current settings to a user.

In one or more embodiments, the electric vibration motor is configured for lateral vibration and/or oscillation of the support plate, and hence also the cover plate; i.e. the cover plate moves up and down (or in and out) contrary to a side to side movement.

In one or more embodiments, another electric vibration motor is configured for pivotal vibration and/or oscillation of the support plate.

In one or more embodiments, the electric vibration motor(s) is(are) a DC motor.

In one or more embodiments, the electric vibration motor(s) is(are) an AC motor.

The inventor has found that the electric vibration motor should preferably be an Eccentric Rotating Mass (ERM) vibration motor capable of operating with a power strong enough for the user's leg muscles to contract and relax, thereby inducing the muscle pump system. Apart from the power of the vibrations that the apparatus is vibrated with, the specific frequency is also important. The inventor has found that the electric vibration motor should preferably configured to operate at a power of at least 20 watts, and at a speed of at least 900 RPM, such as within the range of 900-3000 RPM. In one or more embodiments, the electric vibration motor is configured to operate at a power of 20-100 watts, such as within the range of 25-95 watts, e.g. within the range of 30-80 watts, such as within the range of 35-75 watts, e.g. within the range of 40-70 watts, such as within the range of 45-65 watts, e.g. within the range of 50-60 watts. In one or more embodiments, the electric vibration motor is configured to operate at a speed of 900-3000 RPM, such as within the range of 950-2950 RPM, e.g. as within the range of 1000-2900 RPM, such as within the range of 1050-2850 RPM, e.g. as within the range of 1100-2800 RPM, such as within the range of 1150-2750 RPM, e.g. as within the range of 1200-2700 RPM, such as within the range of 1250-2650 RPM, e.g. as within the range of 1300-2600 RPM, such as within the range of 1350-2550 RPM, e.g. as within the range of 1400-2500 RPM, such as within the range of 1450-2450

RPM, e.g. as within the range of 1500-2400 RPM, such as within the range of 1550-2350 RPM, e.g. as within the range of 1600-2300 RPM, such as within the range of 1650-2250 RPM, e.g. as within the range of 1700-2200 RPM, such as within the range of 1750-2150 RPM, e.g. as within the range of 1800-2100 RPM, such as within the range of 1850-2050 RPM, e.g. as within the range of 1900-2000 RPM. Preferably, the electric vibration motor should preferably be configured to operate at a power of 20-35 watts, and at a speed of 1200-1500 RPM.

In one or more embodiments, the electric vibration motor is an Eccentric Rotating Mass vibration motor, or ERM, also known as a pager motor. The ERM motor is a DC motor with an offset (non-symmetric) mass attached to the shaft. As the ERM rotates, the centripetal force of the offset mass is asymmetric, resulting in a net centrifugal force, and this causes a displacement of the motor. With a high number of revolutions per minute, the motor is constantly being displaced and moved by these asymmetric forces. It is this repeated displacement that is perceived as a vibration. Many mechanical engineering textbooks discuss the characteristics of ERMs, as a 'rotating unbalance', and do so in a negative context. Often engineers are trying to minimize the source of vibration from rotating machinery, because it generates noise and causes excessive machine wear and fatigue. As a result, there is little literature on the theory of maximizing the amplitude of vibration in applications. The strength of vibration produced by the motor is affected by the mass of the eccentric weight, the distance between the eccentric mass and motor shaft, and the speed of rotation. The motor itself and what it is built into will also affect the equivalent values for stiffness of spring, the dampening characteristics, and mass of the ERM, which in turn will affect the level of vibration.

In one or more embodiments, the apparatus further comprises one or more springs supporting the chassis. Preferably, the springs are part of the apparatus' legs.

In one or more embodiments, the apparatus further comprises a plurality of legs connected to the chassis. In one or more embodiments each leg comprises a spring adapted for supporting the chassis, or alternatively, each leg consists of an elastomeric material, such as rubber. The feet may be of the suction cup type, or simply of rubber, to prevent the apparatus from moving along the surface, during use, on which the apparatus is resting.

In one or more embodiments, the lateral rim extends downwards relative to said support plate, and wherein the cover plate is mounted to said lateral rim.

In one or more embodiments, the cover forms a space in front of the chassis. This space may be used for fitting the control module that may be fastened to the chassis.

The electric infrared emitting plate element is preferably of a size capable of treating most of the foot sole surface area of the user, such as having a surface area of at least 300 square centimeters, e.g. within the range of 300-1600 cm^2, such as at least 400 cm^2, e.g. within the range of 400-1500 cm^2, such as at least 500 cm^2, e.g. within the range of 500-1400 cm^2, such as at least 600 cm^2, e.g. within the range of 700-1300 cm^2, such as at least 800 cm^2, e.g. within the range of 800-1200 cm^2, such as at least 900 cm^2, e.g. within the range of 900-1100 cm^2, such as at least 1000 cm^2.

In one or more embodiments, the electric infrared emitting plate element is able to emit infrared radiation at a wavelength of within 6-14 microns. The term mid infrared (MIR) generally covers the spectral region from approximately 3–50 microns according to ISO 20473. The inventor of the present invention has found that a narrower range (6-14 microns, such as within 7-13 microns, e.g. within 8-12 microns, such as within 9-11 microns, and preferably within 9-10 microns) of infrared radiation is suitable for the present purpose, as it is the wave length that is used in some infra-red saunas for therapeutic use.

In one or more embodiments, the electric infrared emitting plate element is emitting infrared waves at a frequency of within 6-14 microns, such as within 7-13 microns, e.g. within 8-12 microns, such as within 9-11 microns, and preferably within 9-10 microns.

In one or more embodiments, the cover plate is made of either i) a thermoplastic material or polymer that transmits more than 30% of incident infrared radiation in the wavelength spectrum of 6-14 microns, or ii) a plate glass that transmits more than 30% of incident infrared radiation in the wavelength spectrum of 6-14 microns. A cover plate of a traditional material, such as e.g. polyesters, and polyamides, is opaque to infrared waves in the 6-14-micron frequency range. Hence, specially selected polymeric compositions are preferably needed to obtain a rapid treatment by infrared waves. Otherwise the cover plate will first have to be heated by the infrared waves, and then subsequently act as an infrared transmitter itself. Thus, the cover plate material should

preferably transmit more than 30%, e.g. more than 40%, such as within 50-99%, e.g. within 55-95%, such as within 60-90%, e.g. within 65-85%, such as within 70-80% of the infrared waves at a frequency of within 6-14 microns, such as within 7-13 microns, e.g. within 8-12 microns, such as within 9-11 microns, and preferably within 9-10 microns. Suitable examples of such material may be polyethylene, polypropylene, or mixtures thereof. The front cover plate is needed for two reasons. First, the user should not be able to touch the infrared emitting elements, and second, the infrared emitting elements should be cleaned between sessions to remove sweat, grease, and dirt that otherwise absorb or block the infrared waves at a frequency of within 6-14 microns.

The electric infrared emitting plate element comprises a carbon membrane. The carbon membrane may be made by coating a backing material, such as a metal or polymer plate or a textile, with a mixture of a binder and a carbon source, such as graphite, charcoal, carbon black in the form of fibers or powder. The binder should be suitable for use at temperatures of within 0-100 degrees Celsius. Suitable examples of carbon membranes may be found in US20110081135 and US6549809, hereby incorporated by reference. As a nonlimiting example, the electric infrared emitting plate element comprises electrodes on both ends, in contact with a carbon black layer. When the carbon black layer is energized through the electrodes, the entire carbon black layer heats up by resistance heating, thereby radiating far infrared rays.

The carbon source layer may be coated onto any suitable backing, e.g. a FR-4 plate. FR-4 is a composite material composed of woven fiberglass cloth with an epoxy resin binder that is flame resistant (self-extinguishing).

As another example, the electric infrared emitting plate element may comprise a frame, a thin layer, a grounding circuit board, a cloth layer and a second layer. The thin layer includes a carbon membrane and a printed circuit board. Two wires are used to connect the carbon membrane with a control module. The grounding circuit board includes a grounding layer, a circuit board, and a wire. The wire is used to connect the grounding circuit board with the ground. The grounding layer of the grounding circuit board may comprise a temperature regulating device, which can regulate the temperature of the electric infrared emitting plate element. The second layer may have a crisscross pattern, and a plurality of fixing devices, and is used to fixedly hold the thin layer, grounding circuit board, and cloth layer in the frame.

It should be noted that embodiments and features described in the context of one of the aspects of the present invention also apply to the other aspects of the invention.

Brief description of the figures

Figure 1 shows a side view of an apparatus in accordance with various embodiments of the invention, where the cover plate is made transparent;

Figure 2 shows a perspective view of an apparatus in accordance with various embodiments of the invention;

Figure 3 shows a perspective view of an apparatus in accordance with various embodiments of the invention, where the cover plate has been removed;

Figure 4 shows a perspective view of an apparatus in accordance with various embodiments of the invention, where the cover plate and the electric infrared emitting plate element have been removed; and

Figure 5 shows a bottom view of the apparatus as shown in Figure 4.

Detailed description of the invention

Referring to Figure 1, the general scheme of the invention is shown. Figure 1 shows a side view of an apparatus 100 in accordance with various embodiments of the invention, where the cover plate is made transparent. The apparatus 100 comprises a chassis 110, an electric vibration motor 120, an electric infrared emitting plate element 130, a cover plate 140, and a control module 160. Figure 2 shows a perspective view of the apparatus, where the cover plate is not made transparent. The length of the apparatus is 46 cm, and the width is 40 cm.

In order to provide stability to the apparatus 100, a chassis 110 is incorporated. The chassis 110 is preferably made from metal, such as galvanized or stainless steel or aluminum, but other materials such as reinforced polymeric materials may also be used. The chassis 110 (Figure 3) comprises a support plate 112, and a lateral rim 114 delimiting the support plate 112. The lateral rim 114 extends downwards relative to the support plate 112 to function as a fastening plate for the cover plate 140.

The apparatus vibrates and emits infrared radiation at the same time. The vibrations are formed by an electric vibration motor 120. The electric vibration motor 120 is fastened to the lower face 116 of the support plate 112.

Figure 3 shows a perspective view of an apparatus in accordance with various embodiments of the invention, where the cover plate has been removed to show the infrared emitting plate element 130. The electric infrared emitting plate element 130 is positioned on top of the support plate 112. The electric infrared emitting plate element 130 has a surface area of about 850 square centimeters.

The cover plate 140 is made of a polymeric material and adapted to cover the support plate 112 and the electric infrared emitting plate element 130. The polymeric material may be polyethylene or polypropylene.

The apparatus 100 includes a control module 160. The control module 160 controls the speed of the electric vibration motor 120. The control module is shown comprising a control panel that allows a user to change one or more settings, such as the oscillation frequency, controlled by the control module.

The apparatus 100 further comprises four springs 150 supporting the chassis 110.

Figure 4 shows a perspective view of an apparatus 100 in accordance with various embodiments of the invention, where the cover plate and the electric infrared emitting plate element have been removed. The support plate 112 is made from sheet metal with two embossing's 113 to improve the rigidity.

Figure 5 shows a bottom view of the apparatus 100 as shown in Figure 4.

References

100	Apparatus
110	Chassis
112	Support plate
113	Embossing
114	Rim
115	Upper face
116	Lower face
120	Vibration motor
130	Infrared emitting plate element
140	Cover plate
150	Spring
160	Control module

Conclusies

1. Inrichting (100), omvattende:

- een chassis (110) met een steunplaat (112) en een laterale rand (114) die de steunplaat (112) begrenst, waarbij de laterale rand (114) zich bij voorkeur naar beneden uitstrekt ten opzichte van die steunplaat (112);
- een elektrische trilmotor (120) bevestigd aan de onderkant (116) van de steunplaat (112);
- een elektrisch infrarood uitstralend plaatelement (130) omvattende een koolstofmembraan en dat is gepositioneerd boven of bovenop de steunplaat (112); en
- een afdekplaat (140) van een polymeer materiaal en die is ingericht om ten minste de steunplaat (112) en het elektrische infrarood uitstralende plaatelement (130) af te dekken.

2. Inrichting (100) volgens conclusie 1, verder omvattende een of meer veren (150) die het chassis (110) ondersteunen.

3. Inrichting (100) volgens conclusie 1, verder omvattende een veelheid van poten die zijn verbonden met het chassis en a) elk een veer (150) omvat die is ingericht om het chassis te ondersteunen, of b) elk uit een elastomeer materiaal, zoals rubber, bestaat.

4. Inrichting (100) volgens willekeurig welke conclusie 1 tot en met 3, waarbij de laterale rand (114) zich naar beneden uitstrekt ten opzichte van die steunplaat (112) en waarbij de afdekplaat (140) op die laterale rand (114) is gemonteerd.

5. Inrichting (100) volgens willekeurig welke conclusie 1 tot en met 4, waarbij het elektrische infrarood uitstralende plaatelement (130) een oppervlakte heeft van ten minste 300 vierkante centimeter.

6. Inrichting (100) volgens willekeurig welke conclusie 1 tot en met 5, waarbij de elektrische trilmotor (120) is ingericht om te werken bij een vermogen van ten minste 20 watt en bij een snelheid van ten minste 900-300 tpm.

7. Inrichting (100) volgens willekeurig welke conclusie 1 tot en met 6, waarbij de steunplaat (112) is gemaakt van plaatmetaal met structuren (113) om de stijfheid te verbeteren.

8. Inrichting (100) volgens willekeurig welke conclusie 1 tot en met 7, waarbij de steunplaat (112) 1-20 graden is gekanteld ten opzichte van het oppervlak waarop de inrichting (100) rust en waarbij het gedeelte van de afdekplaat (140) dat de steunplaat (112) afdekt in dezelfde mate is gekanteld.

9. Inrichting (100) volgens willekeurig welke conclusie 1 tot en met 7, waarbij het gedeelte van de afdekplaat (140) dat de steunplaat (112) afdekt 1-20 graden is gekanteld ten opzichte van het oppervlak waarop de inrichting (100) rust.

10. Inrichting (100) volgens willekeurig welke conclusie 1 tot en met 9, waarbij de afdekplaat (140) is gemaakt van of bestaat uit een thermoplastisch materiaal of polymeer, zoals polyethyleen of polypropyleen of mengsels daarvan.

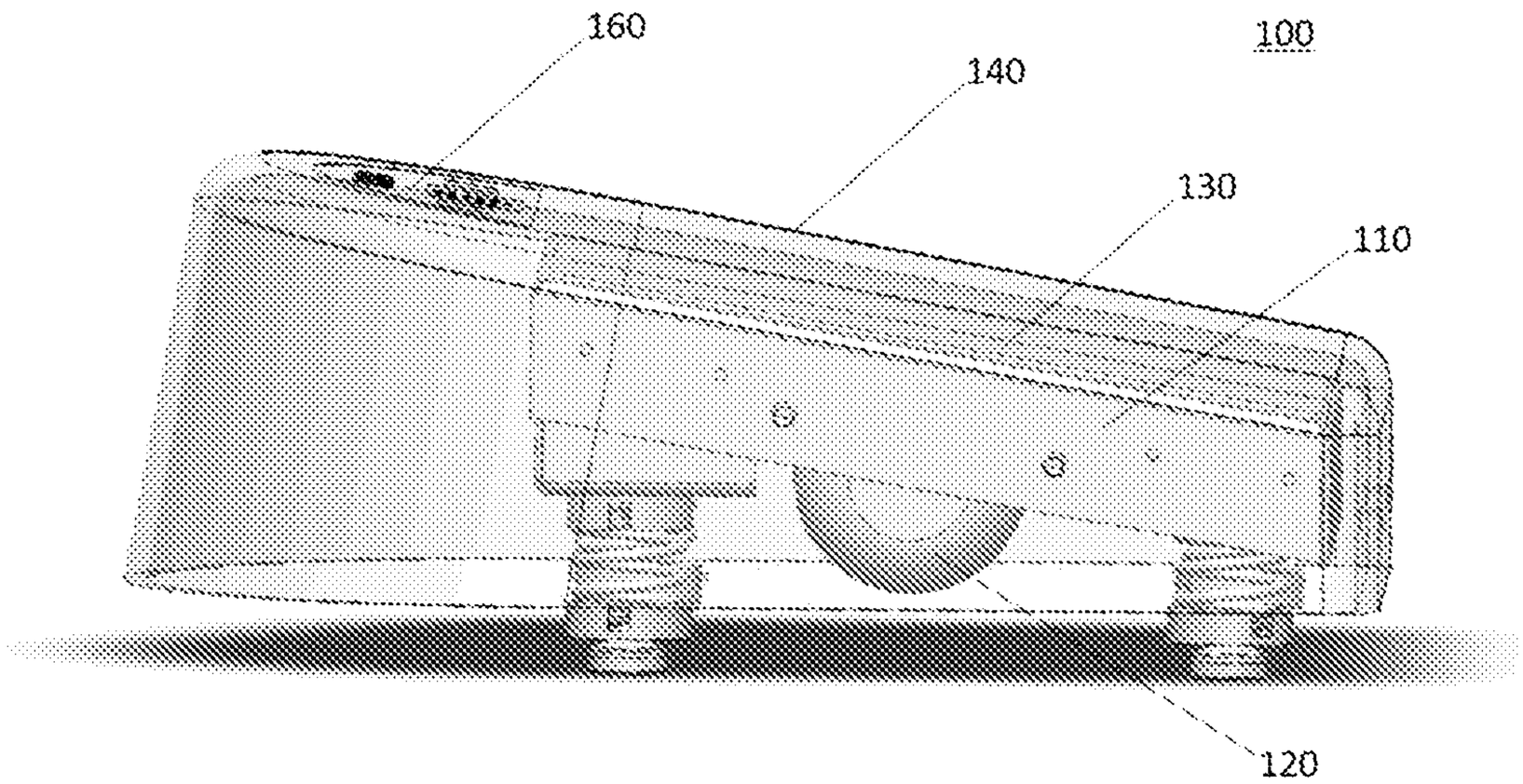


Fig. 1

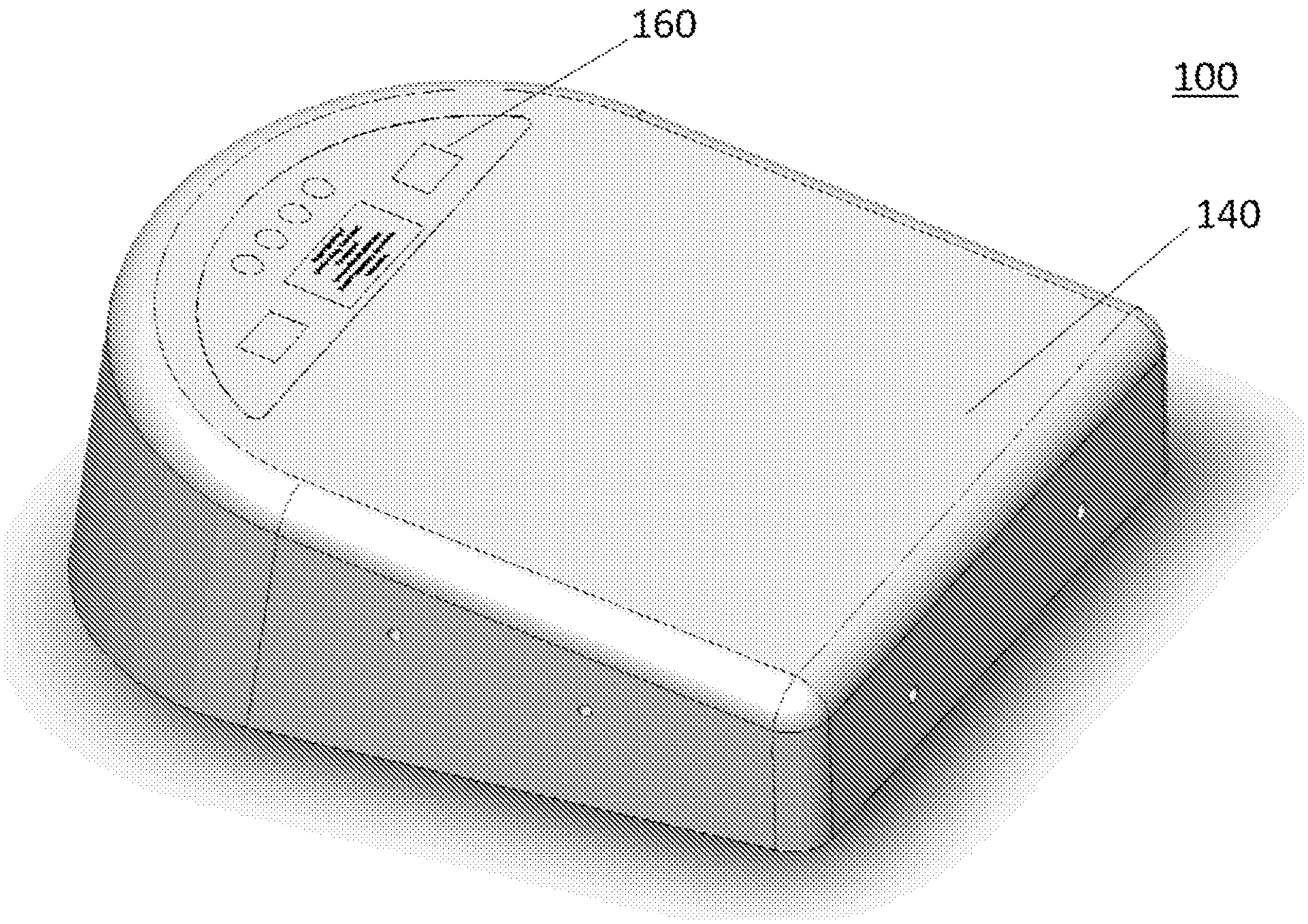


Fig. 2

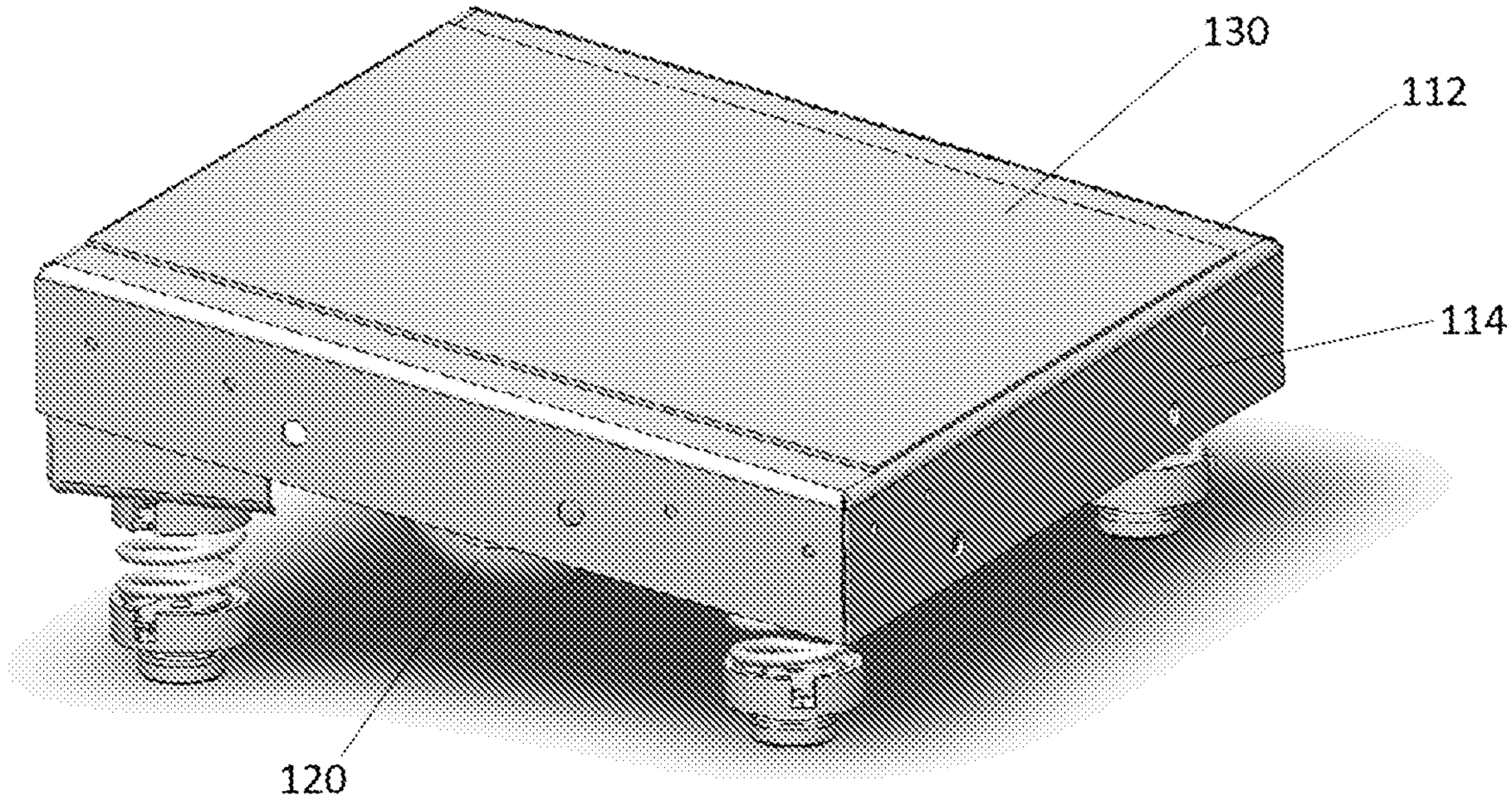


Fig. 3

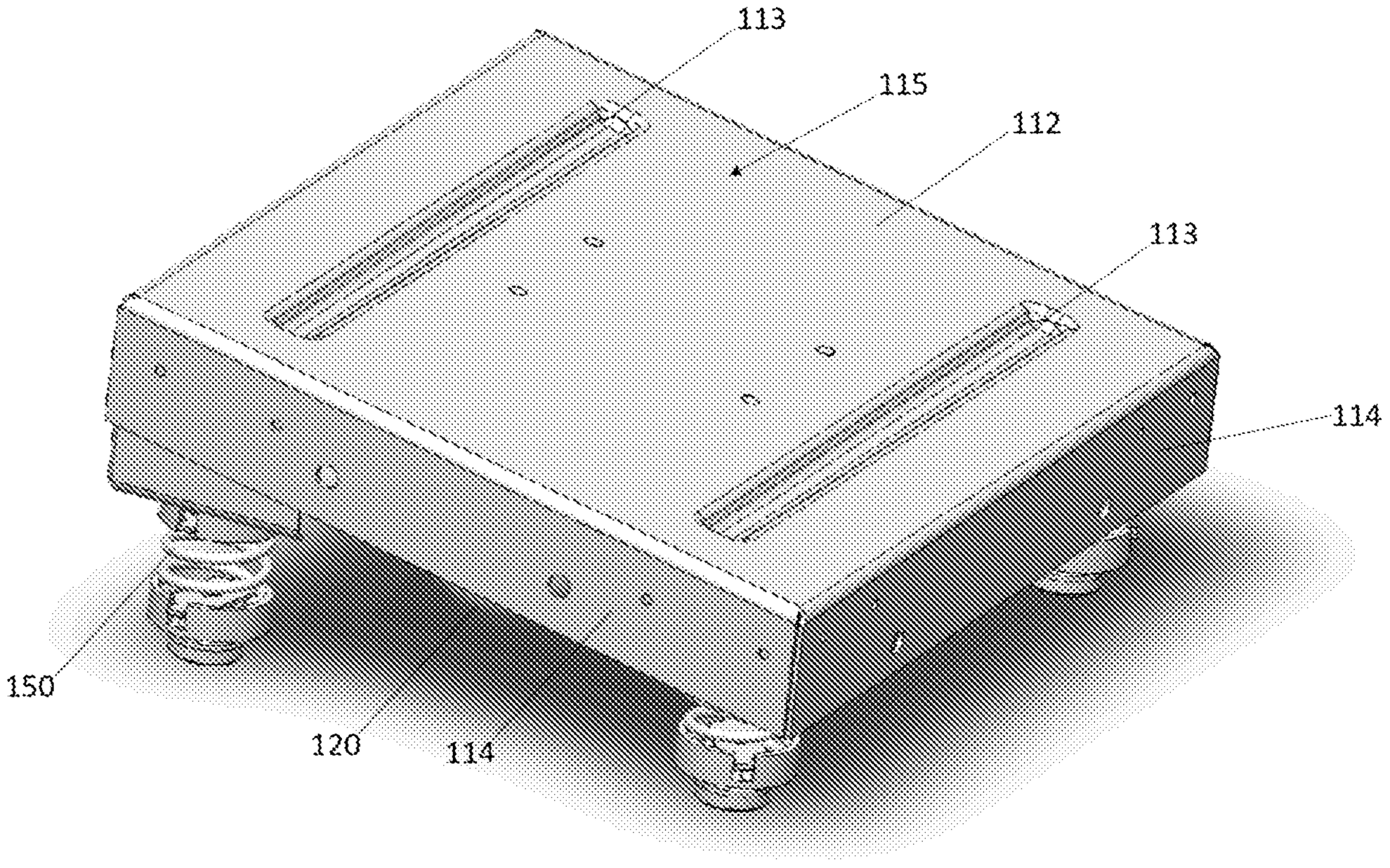


Fig. 4

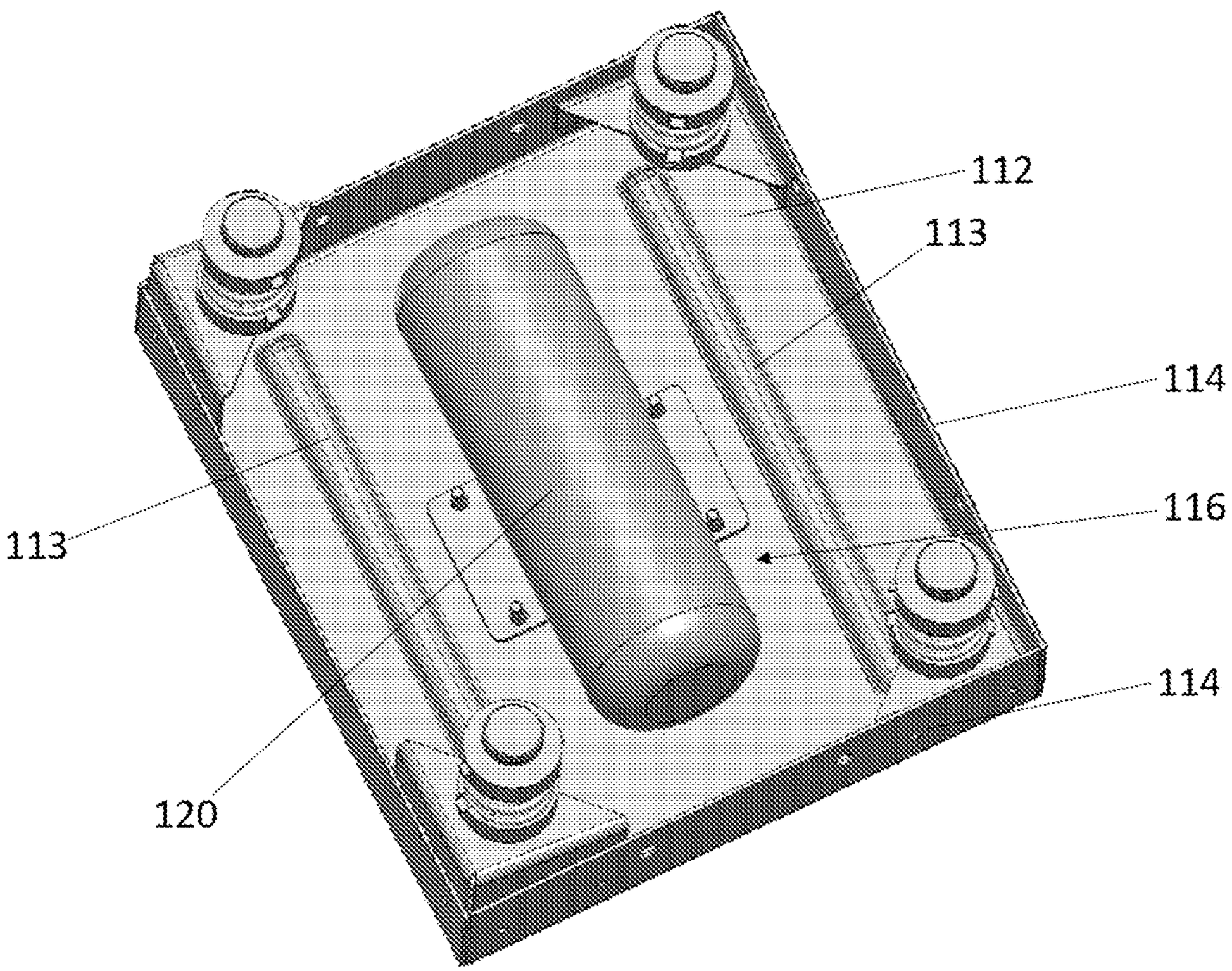


Fig. 5