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(71) Applicant: SCALETHINGS SP. Z O.O. [PL/PL]; 15 Zygmunta Slominskiego St., 00-195 Warsaw (PL).

(72) Inventor: AVRAMOVICH, Eyal; 17 Yeshuroon St., 4520029 Hod Hasharon (IL).

(74) Agents: KORAKH, Eliav et al.; Korakh & Co. Advocates & Patent Attorneys, P.O.B. 58100, 6158002 Tel Aviv (IL).

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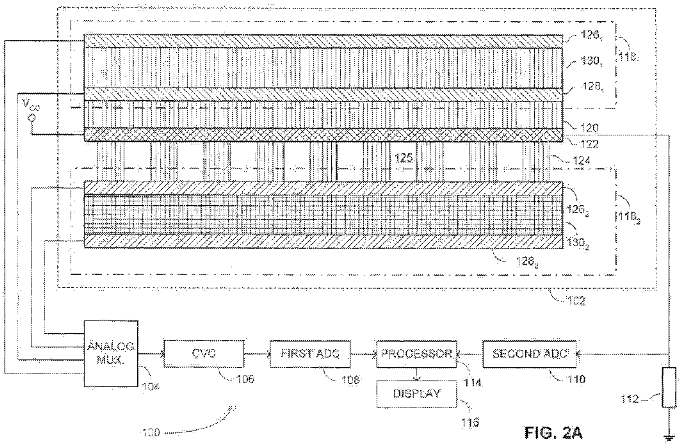

FIG. 2A

(57) Abstract: A flexible weight sensor which includes a plurality of flexible capacitive weight sensors and at least one flexible-resistive-pressure-sensor, each flexible capacitive weight sensor exhibits a respective dynamic range of the response to a respective range of weights. The flexible capacitive weight sensors are arranged in a stack. The linear dynamic range respective of each the flexible capacitive weight sensors starts at a weight not higher than the saturation point of the linear dynamic range of the flexible capacitive weight sensor above it. The at least one flexible-resistive-pressure-sensor is coupled between each pair of flexible capacitive weight sensors. Each flexible-resistive-pressure-sensor measures information relating to the saturation weight of the flexible capacitive weight sensor above the flexible-resistive-pressure-sensors, when the weight of a load applied on the weight sensor exceeds the dynamic range of the flexible capacitive weight sensor above the flexible-resistive-pressure-sensor.

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A SCALE WITH COMPOSITE FLEXIBLE CAPACITIVE WEIGHT SENSOR

FIELD OF THE DISCLOSED TECHNIQUE

The disclosed technique relates to weight scales in general, and to a composite capacitive weight sensor and methods there for, in particular.

BACKGROUND OF THE DISCLOSED TECHNIQUE

In general, known in the art weight scales exhibit a solid structure having thickness on the order of tens of millimeters (e.g., 20 millimeters). Such a solid structure with such thickness may become inconvenient and present a harmful obstacle, for example when positioned near hallways in a home especially for mobility challanged persons, small children or in the dark.

Furthermore, the weight distribution of a load on the scales may not always be uniform. Reference is now made to Figure 1, which is a schamatic illustration of pressure distribution of feet as known in the art. As depicted in Figure 1, the weight is not evently distributed over the area of each foot. Further more, while high pressure areas, such as the heels, may exhibit similar weight distributation, other areas, such as the soft edges of the foot do not exhibit uniform ditstribution and certain parts of the feet do not even come into contact with the weight sensor.

U.S. Patent 3,565,195, to Miller et al, entitled ”Electrical Weighing Appartus Using Capacitive Flexible Mat” directs to a weighing mat formed by a sandwich of three electrically conductive-strata separated by two elastomeric dielectric layers to create a two-section electrical capacitor. The dielectric layers, in turn, are composed of a plurality of spaced elastomeric separator elements either separate or joined, and the central conductive stratum is also of a deformable elastomeric material.

When the mat is loaded, the capacitor varies linearly in capacitance with the applied load. However, when the load reaches the point at which the deformation of the dielectric elements become nonlinear, the central conductive stratum also begins to deform producing in effect an extended range of linear variation of mat capacitance with loading.

U.S. Patent 7,578,195 DeAngelis entitled ”capacitive sensor” describes a capacitive sensor which includes three conducting layers with dielectric layers between the conducting layers and a protective layer on the sides thereof. The capacitive sensor to DeAngelis senses incremental changes in pressure based on the changes in the capacitance of the sensor. The protecitve layer reduce electromagnetic interferences to increase resolution of sensed capacitive value.

U.S. Patent 5,693,886 to Seimiya et al entiled “Pressure Sensor” also directs to a capacitive sensor having multiple conductinve layers weith with the same compressibility properties of each layer.

U.S. Patent 8,627,716, to Son entitled ”Capacitive proximity tactile sensor” relates to a capacitive proximity tactile sensor formed by one electrode layer having a grid and one compressible non-conductive layer.

SUMMARY OF THE PRESENT DISCLOSED TECHNIQUE

It is an object of the disclosed technique to provide a novel scale with composite flexible capacitive weight sensor method for determining the weight of a load on a composite capacitive weight sensor. In accordance with the disclosed technique, there is thus provided a flexible weight sensor which includes a plurality of flexible capacitive weight sensors and at least one flexible resistive pressure sensor. Each flexible capacitive weight sensor exhibits a respective dynamic range of the response to a respective range of weights. The flexible capacitive weight sensors are arranged in a stack. The linear dynamic range respective of each the flexible capacitive weight sensors starts at a weight not higher than the saturation point of the linear dynamic range of the flexible capacitive weight sensor above it. The at least one flexible resistive pressure sensor is coupled between each pair of flexible capacitive weight sensors. Each flexible resistive pressure sensor measures information relating to the saturation weight of the flexible capacitive weight sensor above the flexible resistive pressure sensor, when the weight of a load applied on the weight sensor exceeds the dynamic range of the flexible capacitive weight sensor above the flexible resistive pressure sensor.

In accordance with a further aspect of the disclosed technique, there is thus provided a scale system including a composite flexible capacitive weight sensor, a first analog to digital converter, a second analog to digital converter and a processor. The composite flexible capacitive weight sensor includes a plurality of flexible capacitive weight sensors and at least one flexible resistive pressure sensor. Each flexible capacitive weight sensor exhibits a respective dynamic range of the response to a respective range of weights. The flexible capacitive weight sensors are arranged in a stack. The linear dynamic range respective of each the flexible capacitive weight sensors starts at a weight not higher than the saturation point of the linear dynamic range of the flexible capacitive weight sensor above it. The at least one flexible resistive pressure sensor is coupled between each pair of flexible capacitive weight sensors. Each flexible resistive pressure sensor measures information relating to the saturation weight of the flexible capacitive weight sensor above the flexible resistive pressure sensor, when the weight of a load applied on the weight sensor exceeds the the dynamic range of the flexible capacitive weight sensor above the flexible resistive pressure sensor. The first analog to digital converter is coupled with each of the flexible capacitive weight sensors for sampling the capacitance or each of the flexible capacitive weight sensors. The second analog to digital converter is coupled with each of the flexible resistive pressures, for sampling the resistance of each of the flexible resistive pressure sensor. The processor is coupled with the first analog to digital converter and with the second analog to digital converter. The processor determines a measured weight respective of each of the flexible capacitive sensors. The processor determines the saturation area respective of each of the flexible capacitive weight sensors. The processor determines the weight corresponding to the saturation area of each one of the flexible capacitive weight sensors and determines the total weight of the load by adding the measured weights and subtracting the saturation weights.

In accordance with a further aspect of the disclosed technique, there is thus provided a method for determining the weight of a load on a composite capacitive weight sensor. The method includes the procedures of measuring the weight on a first capacitive sensor, measuring the weight on a second capacitive sensor and determining the saturation area of the first capacitive weight sensor. The method further includes the procedures of determining the weight corresponding to the saturation area of first capacitive weight sensor and determining the total weight of the load by subtracting the weight corresponding to the saturation area of first capacitive weight sensor from the combined measure weight of the two capacitive weight sensors.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed technique will be understood and appreciated more fully from the following detailed description taken in conjunction with the drawings in which:

Figure 1, which is a schamatic illustration of pressure distribution of feet as known in the art;

Figure 2A is a schematic illustration of a scale system constructed and operative in accordance with an embodiment of the disclosed technique;

Figure 2B is an isometric receding view of a composite capacitive weight sensor in accordance with an embodiment of the disclosed technique;

Figure 2C is a schematic illustration of a graph of an exemplary strain versus force with two exemplary curves in accordance with an embodiment of the disclosed technique;

Figure 2D is a schematic illustration of a cross-section of a weight sensor with a load applied thereon in accordance with an embodiment of the disclosed technique;

Figures 3A, 3B and 3C are exemplary configuration of a compressible insulating layer in accordance with another embodiment of the disclosed technique; and

Figure 4 is a schematic illustration of a method for determining the weight of a load on a composite capacitive weight sensor in accordance with a further embodiment of the disclosed technique.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The disclosed technique overcomes the disadvantages of the prior art by providing a scale with a composite capacitive weight sensor which includes a plurality of flexible capacitive sensors stacked one on top of the other, with flexible resistive pressure sensors in between. Each one of the flexible capacitive sensors exhibits a respective linear dynamic range of weight, and measures weights within a respective weight range. The linear dynamic range of the each capacitive sensor starts at a weight not higher than the saturation point of the linear dynamic range of the capacitive sensor above it. When a first flexible capacitive sensor saturates, the flexible capacitive sensor below it measures the weight within the respective weight range thereof. The weight measure by flexible capacitive sensors on top, when these flexible capacitive sensors saturates, is compensated by employing the measurements from the flexible resistive pressure sensor or sensors as further explained below.

Reference is now made to Figures 2A, 2B, 2C and 2D. Figure 2A is a schematic illustration of a scale system, generally referenced 100, constructed and operative in accordance with an embodiment of the disclosed technique. Figure 2B is an isometric receding view of a composite capacitive weight sensor 102 in accordance with an embodiment of the disclosed technique. Figure 2C is a schematic illustration of a graph 150 of an exemplary strain versus force with two exemplary curves, first curve 152 and second curve 154 as further explained below and Figure 2D is a schematic illustration of a cross-section of weight sensor 100 with a load 132 applied thereon both in accordance with an embodiment of the disclosed technique.

Scale system 100 includes composite capacitive weight sensor 102, an analog multiplexer 104, a capacitance to voltage converter (CVC) 106, a first analog to digital converter (ADC) 108, a second ADC 110, a reference resistor 112, a processor 114 and a display 116. In the example brought forth in Figure 2A, composite capacitive weight sensor 102 includes two flexible capacitive sensors, a first flexible capacitive sensor 118_1 and a second flexible capacitive sensor 118_2. Composite capacitive weight sensor 102 further includes a flexible insulating layer 120, a flexible resistive layer 122 and a compressible insulating layer 124.

First flexible capacitive sensor 118_1 includes a compressible dielectric layer 130_1 between two flexible conductive layers, flexible conductive layer 126_1 and flexible conductive layer 128_1. Second flexible capacitive sensor 118_2 includes a compressible dielectric layer 130_2 between two flexible conductive layers, flexible conductive layer 126_2 and flexible conductive layer 128_2. Compressible dielectric layers 130_1 and 130_2 are made, for example, from silicon polymer, polyurethane foam, python film and the like. Flexible conductive layers 128_1 and 128_2 are made, for example, from metals such as silver, silver fabric, copper, Indium Tin Oxide (ITO) coating and the like.

Flexible Insulating layer 120 and compressible insulating layer 124 are attached, to opposite sides of flexible resistive layer 122. The other side of flexible insulating later 120 is attached to flexible conducting layer 128_1 and the other side of compressible insulating layer 124 is attached to flexible conducting layer 126_2. Compressible insulating layer 124 is in the form of a perforated mesh which includes perforations such as perforation 125. Furthermore, compressible insulating layer 124 and compressible dielectric 130_1 exhibit substantially the same linear compressibility range. First flexible capacitive sensor 118_1 is employed as a first weight sensor and second flexible capacitive sensor 118_2 is employed as a second weight sensor as further explained below in conjunction with Figure 2C. Flexible insulating layer 120, flexible resistive layer 122, compressible insulating later 124 and flexible conducing layer 126_2 define a flexible resistive pressure sensor also as further explained below in conjunction with Figure 2C which measures information relating to the saturation weight of first flexible capacitive weight sensor 118_1, as further explained below.

Processor 114 is coupled with the output of first ADC 108 and the output of second ADC 110 and with display 116. The output of CVC 106 is coupled with the input of first ADC 108 and the input of CVC 106 is coupled with analog multiplexer 104. The input of analog multiplexer 104 is coupled with flexible conductive layers 126_1, 128_1, 126_1 and 128_2. Also, the anode of flexible resistive layer 122 is coupled with a supply voltage (demarked ‘Vcc’ in Figure 1) and the cathode of flexible resistive layer 122 is coupled with the input of second ADC 110 and with a reference resistor 112.

As mentioned above, first flexible capacitive sensor 118_1 is employed as a first weight sensor and second flexible capacitive sensor 118_2 is employed as a second weight sensor. With reference to Figure 2B, curve 152 depicts the strain (i.e., deformation resulting from displacement between particles relative to a reference length) versus the logarithm of the force applied on compressible dielectric layer 130_1 and compressible insulating layer 124. This curve is also referred to herein as ‘compressibility curve’. Compressibility curve 154 depicts the strain versus the logarithm of the force applied on of compressible dielectric layer 130_2. In general, the compressibility of first compressible dielectric layer 130_1 and compressible insulating later 124 (and thus of first capacitive sensor 118_1 and the resistive pressure sensor) is greater than the compressibility of second compressible dielectric layer 130_2. In other words, first capacitive sensor 118_1 and the resistive pressure sensor are more flexible than second capacitive sensor 118_1.

In the example brought forth in Figure 2B, the compressibility of first compressible dielectric layer 130_1 and compressible insulating later 124 exhibits a linear relationship between 10 grams/centimeter (g/cm) and 100 g/cm. Thus, the capacitance of first flexible capacitive sensor 118_1

also exhibits a linear relationship between 10 grams/centimeter (g/cm) and 100 g/cm. The compressibility of dielectric layer 130_2 exhibits a linear relationship between 100g/cm and 1000g/cm. Thus, the capacitance of second flexible capacitive sensor 118_2 also exhibits a linear relationship between 100 g/cm and 1000 g/cm. Applying a pressure which exceeds 100g/cm on first compressible dielectric layer 130_1 and compressible insulating layer 124, results in a saturation of the first flexible capacitive sensor 118_1. In other words, 100g/cm is the saturation point of first flexible capacitive sensor 118_1. The saturation point of a flexible capacitive sensor herein relates to the state in which the pressure applied by the load exceeds the linear dynamic range of the flexible capacitive sensor and any increase in the load results in substantially no change in the capacitance of the capacitor. Similarly, applying a force below 100g/cm, on second compressible dielectric layer 130_2, results in a change in capacitance of second flexible capacitive sensor 118_2 below the sensitivity level thereof. Thus, first flexible capacitive sensor 118_1 is configured to measure (i.e., respond to) a first range of weights and second flexible capacitive sensor 118_2 is configured to measure a second range of weights, higher than the first range of weights. The linear dynamic range of second flexible capacitive sensor 118_2 starts at a weight not higher than the saturation point of first flexible capacitive sensor 118_1. In the example brought forth in Figure 2B the linear dynamic range of second flexible capacitive sensor 118_2 starts at 100 g/cm which is the saturation point of first flexible capacitive sensor 118_1. It is however noted that the linear dynamic range of second flexible capacitive sensor 118_2 may start at a weight lower than 100 g/cm. Placing first flexible capacitive sensor 118_1 on top of second flexible capacitive sensor 118 extends the linear dynamic range of the composite capacitive weight sensor 102, and thus of scale system 100, to be within both the first and second ranges (e.g., between 10 gram/cm to 1000 gram/cm). It is noted that the terms weight force and pressure are used herein interchangeably.

It is noted that, linear dynamic range of the composite capacitive weight sensor 102, and thus of scale system 100, depicted in Figure 2B is brought herein as an example only. In general, a system, such as scale system 100, shall be designed to exhibit a selected linear dynamic range according to the requirements form the system. For example, a scale system designed to weigh elephants shall exhibit a linear dynamic range between 100 kilograms and 5 tons while a scale system designed to weigh humans shall exhibit a linear dynamic range between 1 kilogram and 200 kilograms and a scale system designed to weigh trucks shall exhibit a linear dynamic range between 1 ton and 20 tons.

When the pressure applied on composite capacitive weight sensor 102 is within the first range of first flexible capacitive sensor 118_1, first flexible capacitive sensor 118_1 measures the weight. When the pressure applied is above the first range, first flexible capacitive sensor 118_1 shall saturate and second capacitor 118_2 shall measure the weight. However, simply adding the resulting weights of the two flexible capacitive sensors, results in an erroneous weight. To alleviate this error, the above mentioned flexible resistive pressure sensor is employed.

Flexible resistive layer 122 exhibits a known resistance between the anode and the cathode thereof and is made, for example, from PVC film coated with resistive and conductive ITO. However, when a force larger that the linear dynamic range of compressible insulating layer 124 is applied on weight sensor 100, flexible resistive layer 122 comes into physical contacts with conductive layer 126_2 (i.e., via the perforations in compressible insulating layer 124). Consequently, the resistivity of flexible resistive layer 122 reduces as the contact area between flexible resistive layer 122 and conductive layer 126_2 increases. Thus, the contact area between resistive layer 122 and conductive layer 126_2 can be determined by determining the resistivity of resistive layer 122.

With reference to Figure 2C, a load 132 is applied on weight sensor 100 which exhibits a weight of, for example 2300 grams. In Figure 2C, the cross-section of sensor 100 is depicted as partitioned into sections, however, it is noted that such a partition does not generally exist and is depicted in Figure 2C as an explanatory aid. As depicted in Figure 2C the weight of load 132 is not evenly distributed over composite capacitive weight sensor 102. As such, larger pressure shall be applied to certain sections of capacitive weight sensor 102 than others. In the example brought forth in Figure 2C, no pressure is applied on sections 1, 2, 3, 12, 13 and 14. A weight of 50 grams is applied on sections 4 and 11. A weight of 200 grams is applied on sections 5 and 10, a weight of 400 grams is applied on sections 6 and 9 and a weight of 500 grams is applied on sections 7 and 8.

Also as depicted in Figure 2C, the weight applied on sections 4 and 11 is below the saturation level of first flexible capacitive sensor 118_1 as well as below the sensitivity level of second flexible capacitive sensor 118_2. However, the weight applied on sections 5-10 is above the saturation level of first flexible capacitive sensor 118_1 and above the sensitivity level of second flexible capacitive sensor 118_2. In sections 5-10, flexible resistive layer 122 comes into physical contacts conductive layer 126_2. Thus, the resistivity of flexible resistive layer 122 is reduced. This change in resistivity results in a change of voltage across flexible resistive layer 122 and across reference resistor 112.

In operation, and referring to Figure 2A, analog multiplexer 104 alternately connect first flexible capacitive sensor 118_1 and second flexible capacitive sensor 118_2 to CVC 106 (e.g., according to a switching regime). CVC 106 converts the capacitance of first flexible capacitive sensor 118_1 and second flexible capacitive sensor 118_2 to corresponding voltages. First ADC 108 samples the voltages corresponding to the capacitance of first flexible capacitive sensor 118_1 and second flexible capacitive sensor 118_2 and provides these samples to processor 114. Also, second ADC 110 samples the voltage across reference resistor 112 and provides these samples to processor 114. Processor 114 receives the samples corresponding to the capacitance of first flexible capacitive sensor 118_1, second flexible capacitive sensor 118_2 and the voltage across reference resistor 112.

Processor 114 determines the voltage across flexible resistive layer 122 according to the voltage across reference resistor 112 (i.e., since the values of V_{cc} and reference resistor 112 are known). In the example brought forth in Figure 2C, the change in capacitance of flexible capacitive sensor 118_1 relates to a total applied weight of 700g. The total capacitance of flexible capacitive sensor 118_2 shall relate to a total applied weight of 2200g. The resistance across flexible resistive layer 122 relates to a resistance corresponding to 8 sections out of 14 sections (e.g., 8 ohms instead of 14 ohms). Thus, processor 114 determines that 6 sections of first flexible capacitive sensor 118_1 are saturated corresponding to a total weight of 600g, referred to herein as ‘the saturation weight’. Thus, the flexible resistive sensor measures information relating to the saturation weight of first flexible capacitive sensor 118_1. To determine the correct weight of load 132, processor 114 subtracts the saturation weight from the weight measured by first flexible capacitive sensor 118_1 and adds the weight measured by second flexible capacitive sensor 118_2 as follows:

$$1^{st} cap.\ weight = 1^{st} cap.\ measure - Sat. weight\ 1^{st}\ cap. \quad (1)$$

$$Total\ Weight = 2^{nd} cap. measure + 1^{st} cap.\ weight \quad (2)$$

Processor 114 provides the determined weight to display 116 (e.g., an LCD display) which displays the determined weight to the user.

In general, a scale system according to the disclosed technique may include a matrix of weight sensors which include two capacitive sensors exhibiting each exhibiting different linear dynamic range as described above (i.e., without the resistive pressure sensor). In such a case, the weight of the load is determined as the sum of the weights measured by each sensor cell. However, when the upper sensor cell is saturated, the measurement thereof is ignored.

Reference is now made to Figures 3A, 3B and 3C, which are exemplary configuration of a compressible insulating layer such as compressible insulating layer 124 (Figure 1), in accordance with another embodiment of the disclosed technique. As mentioned above compressible insulating layer is in the form of a perforated mesh made off, for example, from silicon polymer, polyurethane foam, python film and the like.

With reference to Figure 3A, compressible insulating layer 150 is in the form of a square mesh. With reference to Figure 3B, compressible insulating layer 152 is in the form of a hexagonal mesh. With reference to Figure 3C, compressible insulating layer 154 is in the form of a mesh of circles.

Reference is now made to Figure 4, which is a schematic illustration of a method for determining the weight of a load on a composite capacitive weight sensor in accordance with a further embodiment of the disclosed technique. In procedure 200, the weight on a first flexible capacitive sensor is measured. With reference to Figure 2A, analog multiplexer 104 couples first flexible capacitive sensor 118_1 to CVC which converts the capacitance of first flexible capacitive sensor 118_1 to corresponding voltage. ADC 108 samples the voltage corresponding to the capacitance of first flexible capacitive sensor 118_1 and provides the samples to processor 114. Processor 114 determines the measured weight on first flexible capacitive sensor 118_1. After procedure 200 the method proceeds to procedure 206.

In procedure 202, the saturation weight of the first capacitive weight sensor is determined. The saturation weight relates to the area where the load exceeds the linear dynamic range of the first flexible capacitive sensor and any increase in the load results in substantially no change in the capacitance of the capacitor. This weight is determined according to the change in resistance of the flexible resistive layer when this layer comes into contact with the upper conductive layer of the second flexible capacitive sensor. With reference to Figure 2A, when first flexible capacitive sensor 118_1 saturates, flexible resistive layer 122 comes into physical contacts conductive layer 126_2 thus changing the resistivity of flexible resistive layer 122. The change in resistivity relates to the contact area between flexible resistive layer 122 and conductive layer 126_2. ADC 110 samples the voltage across reference resistor 112 and thus across flexible resistive layer 122. Processor 114 determines the saturation area of first flexible capacitive sensor 118_1 according to this voltage.

In procedure 204, the weight of a second flexible capacitive sensor is measured. With reference to Figure 2A, analog multiplexer 104 couples first flexible capacitive sensor 118_2 to CVC which converts the capacitance of first flexible capacitive sensor 118_2 to corresponding voltage. ADC 108 samples the voltage corresponding to the capacitance of first flexible capacitive sensor 118_2 and provides the samples to processor 114. Processor 114 determines the measured weight on second flexible capacitive sensor 118_2. After procedure 204 the method proceeds to procedure 208.

In procedure 206, the weight corresponding to the saturation area of the first capacitive weight sensor is determined. With reference to Figure 2A, processor 114 determines the weight corresponding to the saturation area of first capacitive weight sensor 118_1.

In procedure 208, the total weight of the load is determined by subtracting the weight corresponding to the saturation area of first capacitive weight sensor from the combined measure weight of the two capacitive weight sensors as described above in equations (1) and (2). With reference to Figure 2A, processor 114 determines the total weight of the load.

It will be appreciated by persons skilled in the art that the disclosed technique is not limited to what has been particularly shown and described hereinabove. Rather the scope of the disclosed technique is defined only by the claims, which follow.

CLAIMS

1. A flexible weight sensor comprising:

a plurality of flexible capacitive weight sensors, each flexible capacitive weight sensor exhibiting a respective dynamic range of the response to a respective range of weights, said flexible capacitive weight sensors being arranged in a stack, the linear dynamic range respective of each the flexible capacitive weight sensors starts at a weight not higher than the saturation point of the linear dynamic range of the flexible capacitive weight sensor above it; and

at least one flexible resistive pressure sensor coupled between each pair of flexible capacitive weight sensors, each flexible resistive pressure sensor measuring information relating to the saturation weight of the flexible capacitive weight sensor above said flexible resistive pressure sensor, when the weight of a load applied on said weight sensor exceeds said the dynamic range of the flexible capacitive weight sensor above said flexible resistive pressure sensor.

2. The flexible weight sensor according to claim 1, wherein each one of said capacitive weight sensors includes a compressible dielectric layer between two flexible conductive layers, each compressible dielectric layer exhibiting respective compressibility.

3. The flexible weight sensor according to claim 1, wherein each one of said at least one flexible resistive pressure sensor includes a flexible insulating layer, flexible resistive layer and perforated compressible insulating layer,

wherein, said flexible Insulating layer and said perforated compressible insulating layer are attached to opposite sides of said flexible resistive layer, wherein, the other side of flexible insulating layer is attached to the flexible conducting layer respective of the flexible capacitive sensor located above said flexible insulating layer, and

wherein and the other side of said perforated compressible insulating layer is attached to the flexible conducting layer respective of the flexible capacitive sensor located below said perforated compressible insulating layer.

4. The flexible weight sensor according to claim 1, wherein when a force larger that the linear dynamic range of said compressible insulating on said flexible weight sensor, said flexible resistive layer comes into physical contacts with said flexible conducting layer respective of the flexible capacitive sensor located below said perforated compressible insulating layer through the perforations in said perforated compressible insulating layer,

wherein, the resistivity of said flexible resistive layer reduces as the contact area between said flexible resistive layer, and said flexible conducting layer respective of the flexible capacitive sensor located below said perforated compressible insulating layer increases.

5. A scale system comprising:

a composite flexible capacitive weight sensor including:

a plurality of flexible capacitive weight sensors, each flexible capacitive weight sensor exhibiting a respective dynamic range of the response to a respective range of weights, said flexible capacitive weight sensors being arranged in a stack, the linear dynamic range respective of each the flexible capacitive weight sensors starts at a weight not higher than the saturation point of the linear dynamic range of the flexible capacitive weight sensor above it;

at least one flexible resistive pressure sensor coupled between each pair of flexible capacitive weight sensors, each flexible resistive pressure sensor measuring information relating to the saturation weight of the flexible capacitive weight sensor above said flexible resistive pressure sensor, when the weight of a load applied on said weight sensor exceeds said the dynamic range of the flexible capacitive weight sensor above said flexible resistive pressure sensor;

a first analog to digital converter, coupled with each of said flexible capacitive weight sensors for sampling the capacitance or each of said flexible capacitive weight sensors;

a second analog to digital converter coupled with each of said flexible resistive pressures, for sampling the resistance of each of said flexible resistive pressure sensor;

a processor, coupled with said first analog to digital converter and with said second analog to digital converter, said processor determining a measured weight respective of each of said flexible capacitive sensors, said processor determining the saturation area respective of each of said flexible capacitive weight sensors, said processor determining the weight corresponding to the saturation area of each one of said flexible capacitive weight sensors and determining the total weight of the load by adding the measured weights and subtracting the saturation weights.

6. The scale system according to claim 5, wherein each one of said capacitive weight sensors includes a compressible dielectric layer between two flexible conductive layers, each compressible dielectric layer exhibiting respective compressibility.

7. The scale system according to claim 5, wherein each one of said at least one flexible resistive pressure sensor includes a flexible insulating layer, flexible resistive layer and perforated compressible insulating layer,

wherein, said flexible Insulating layer and said perforated compressible insulating layer are attached to opposite sides of said flexible resistive layer,

wherein, the other side of flexible insulating layer is attached to the flexible conducting layer respective of the flexible capacitive sensor located above said flexible insulating layer, and

wherein and the other side of said perforated compressible insulating layer is attached to the flexible conducting layer respective of the flexible capacitive sensor located below said perforated compressible insulating layer.

8. The scale system according to claim 5, wherein when a force larger that the linear dynamic range of said compressible insulating on said flexible weight sensor, said flexible resistive layer comes into physical contacts with said flexible conducting layer respective of the flexible capacitive sensor located below said perforated compressible insulating layer through the perforations in said perforated compressible insulating layer,

wherein, the resistivity of said flexible resistive layer reduces as the contact area between said flexible resistive layer, and said flexible conducting layer respective of the flexible capacitive sensor located below said perforated compressible insulating layer increases.

9. The scale system according to claim 5, further including a display, coupled with said processor, for display said total weight of the load.

10. A method for determining the weight of a load on a composite capacitive weight sensor said method comprising the procedures of:

measuring the weight on a first capacitive sensor;

measuring the weight on a second capacitive sensor;

determining the saturation area of the first capacitive weight sensor;

determining the weight corresponding to the saturation area of first capacitive weight sensor; and

determining the total weight of the load by subtracting the weight corresponding to the saturation area of first capacitive weight sensor from the combined measure weight of the two capacitive weight sensors.

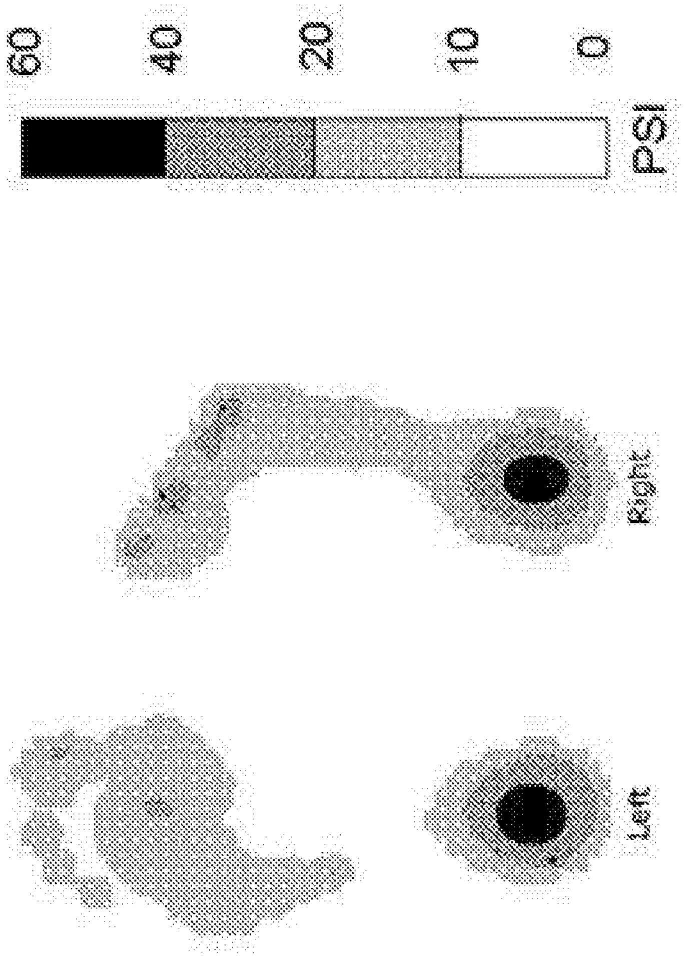
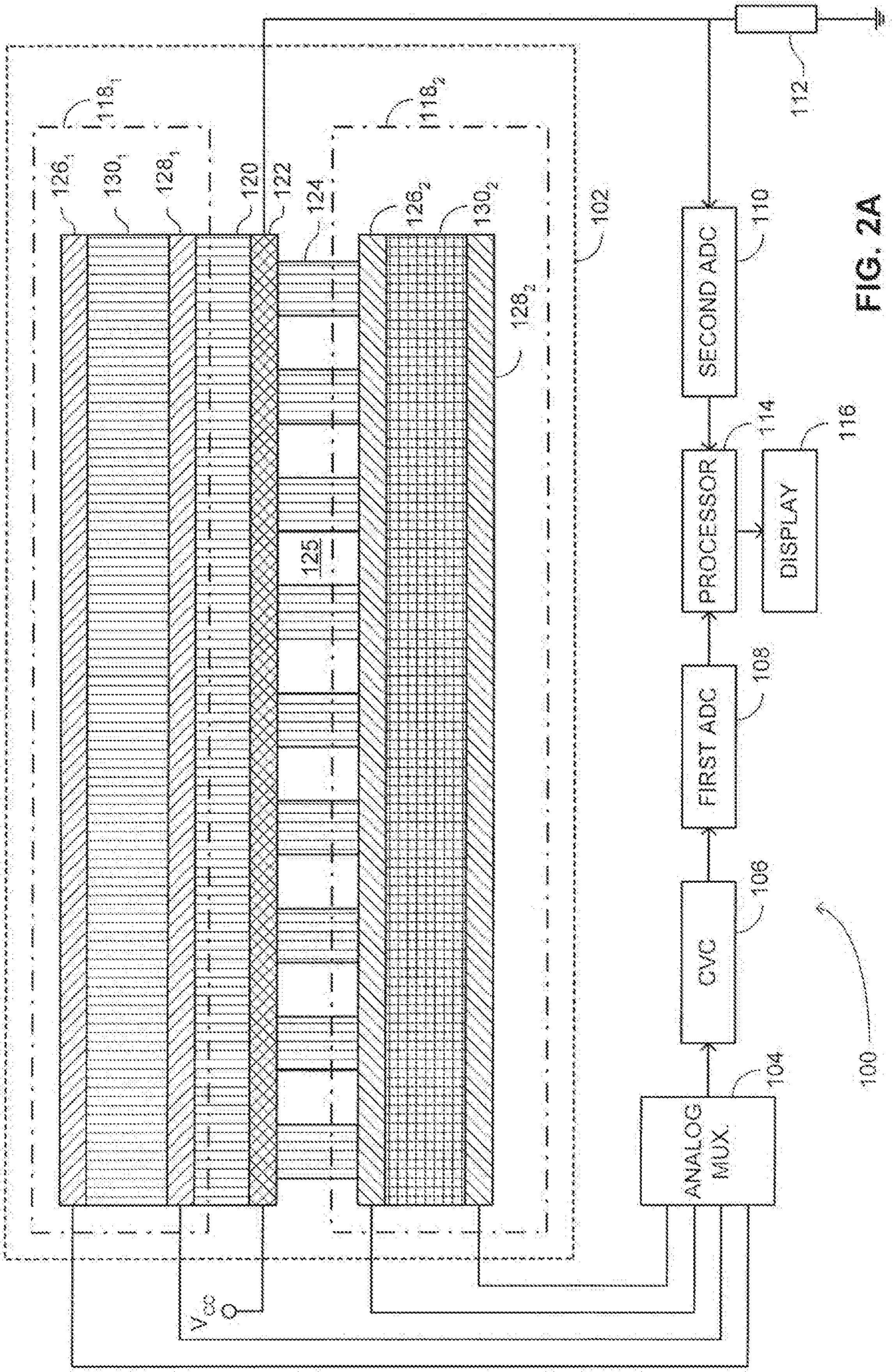


FIG. 1
PRIOR ART



112
SECOND ADC
110
PROCESSOR
114
DISPLAY
116
FIRST ADC
108
CVC
106
ANALOG MUX
104
100
102
118₁
118₂
126₁
130₁
128₁
120
122
124
125
126₂
130₂
128₂
Vcc

FIG. 2A

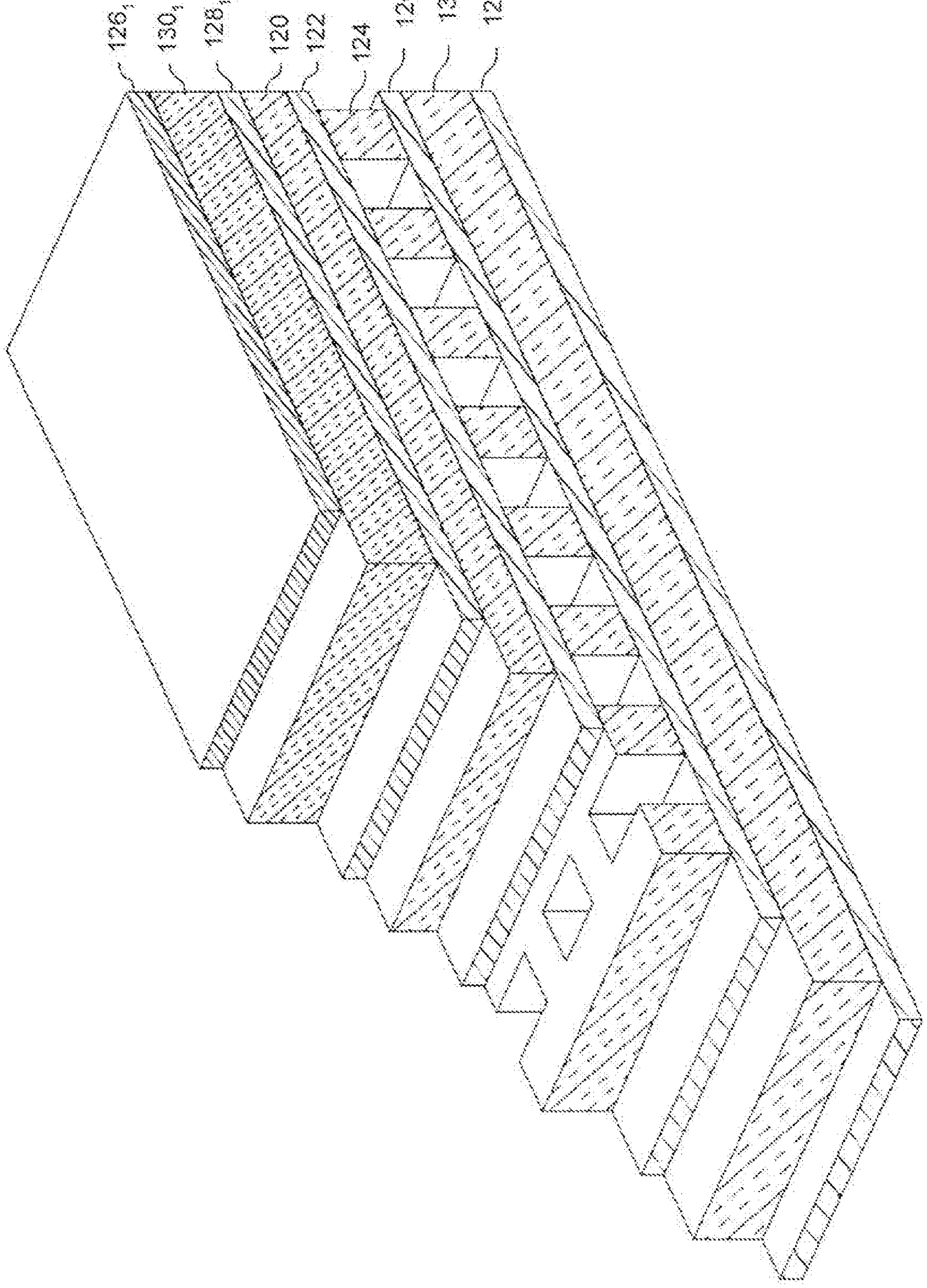


FIG. 2B

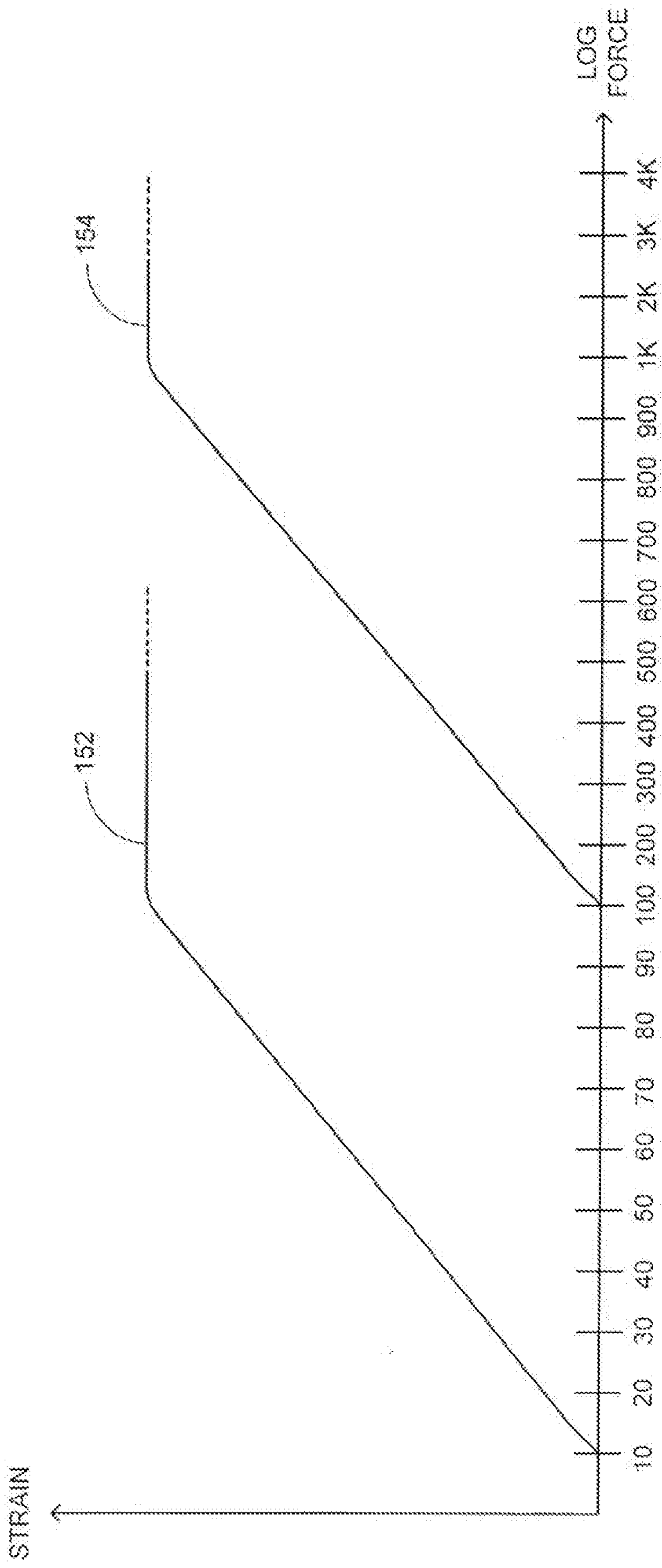
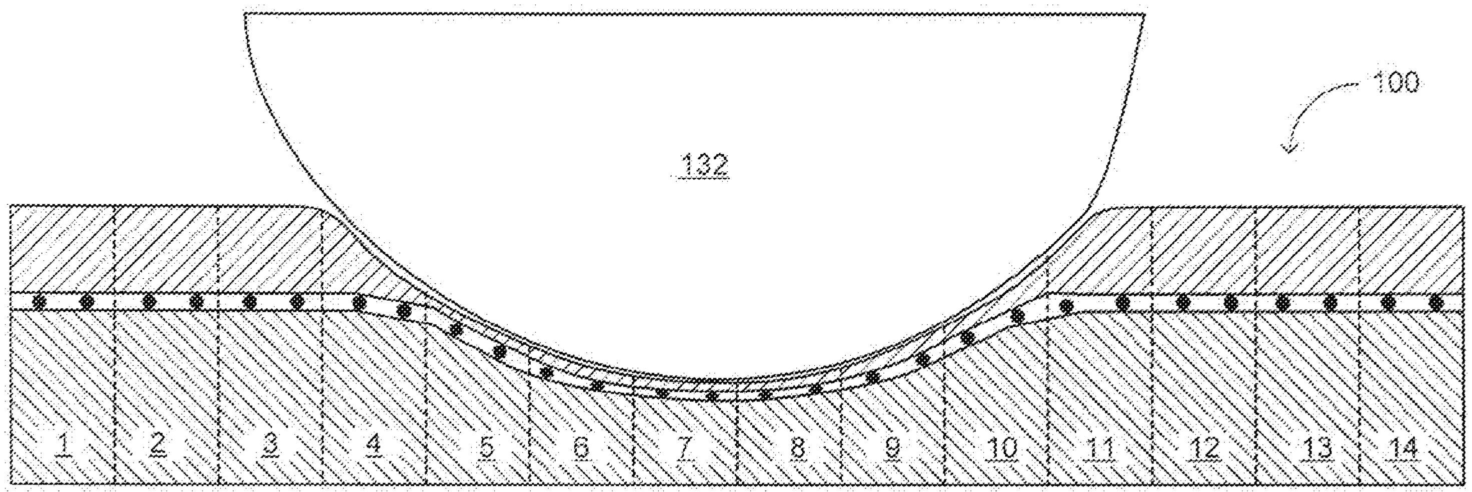

150
152
154
STRAIN
LOG FORCE
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800
900
1K
2K
3K
4K

FIG. 2C



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Tot.
CAP. A	0g	0g	0g	50g	100g	100g	100g	100g	100g	100g	50g	0g	0g	0g	700g
RES. SENSOR	1 Ω	1Ω	1Ω	1Ω	0 Ω	0Ω	0Ω	0Ω	0Ω	0Ω	1Ω	1Ω	1Ω	1Ω	8Ω
COMP. CAP. A	0g*1Ω =0	0g*1Ω =0	0g*1Ω =0	50*1Ω =50	100g*0Ω =0	100g*0Ω =0	100g*0Ω =0	100g*0Ω =0	100g*0Ω =0	100g*0Ω =0	50g*1Ω =50	0g*1Ω =0	0g*1Ω =0	0g*1Ω =0	100g
CAP.B	0g	0g	0g	0g	200g	400g	500g	500g	400g	200g	0g	0g	0g	0g	2200g
TOTAL	0g	0g	0g	50g	200	400g	500g	500g	400g	200g	50g	0g	0g	0g	2300g

FIG. 2D

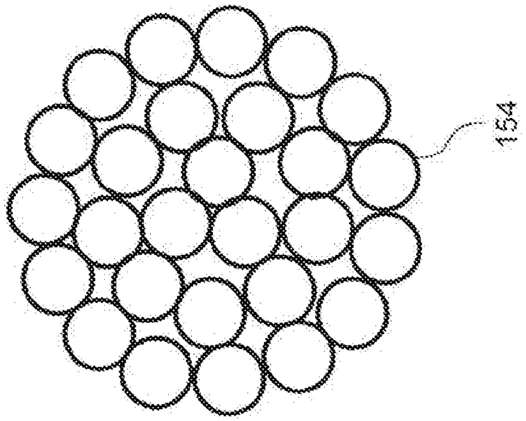


FIG. 3C

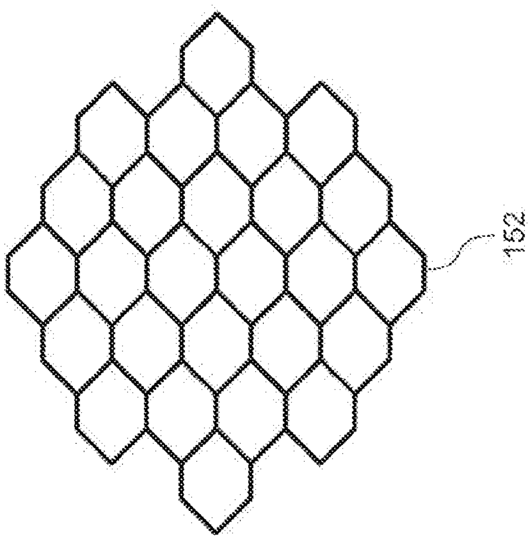


FIG. 3B

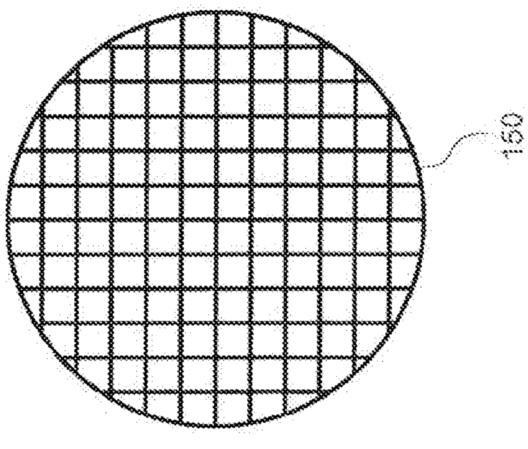


FIG. 3A

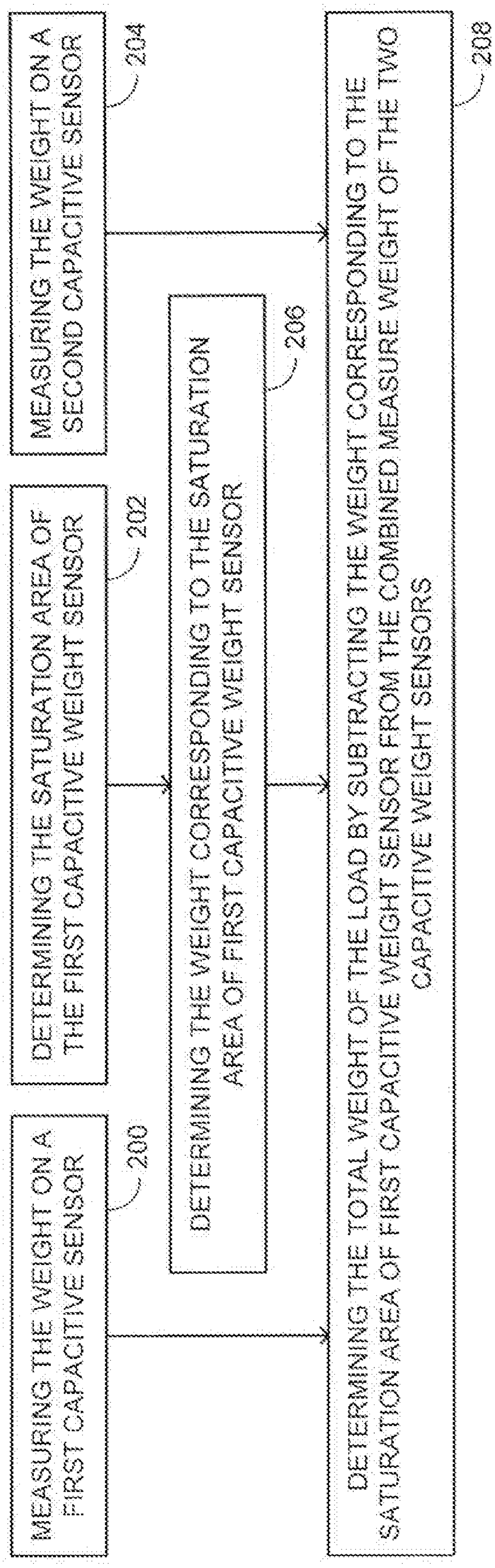

MEASURING THE WEIGHT ON A FIRST CAPACITIVE SENSOR
200
DETERMINING THE SATURATION AREA OF THE FIRST CAPACITIVE WEIGHT SENSOR
202
MEASURING THE WEIGHT ON A SECOND CAPACITIVE SENSOR
204
DETERMINING THE WEIGHT CORRESPONDING TO THE SATURATION AREA OF FIRST CAPACITIVE WEIGHT SENSOR
206
DETERMINING THE TOTAL WEIGHT OF THE LOAD BY SUBTRACTING THE WEIGHT CORRESPONDING TO THE SATURATION AREA OF FIRST CAPACITIVE WEIGHT SENSOR FROM THE COMBINED MEASURE WEIGHT OF THE TWO CAPACITIVE WEIGHT SENSORS
208

FIG. 4