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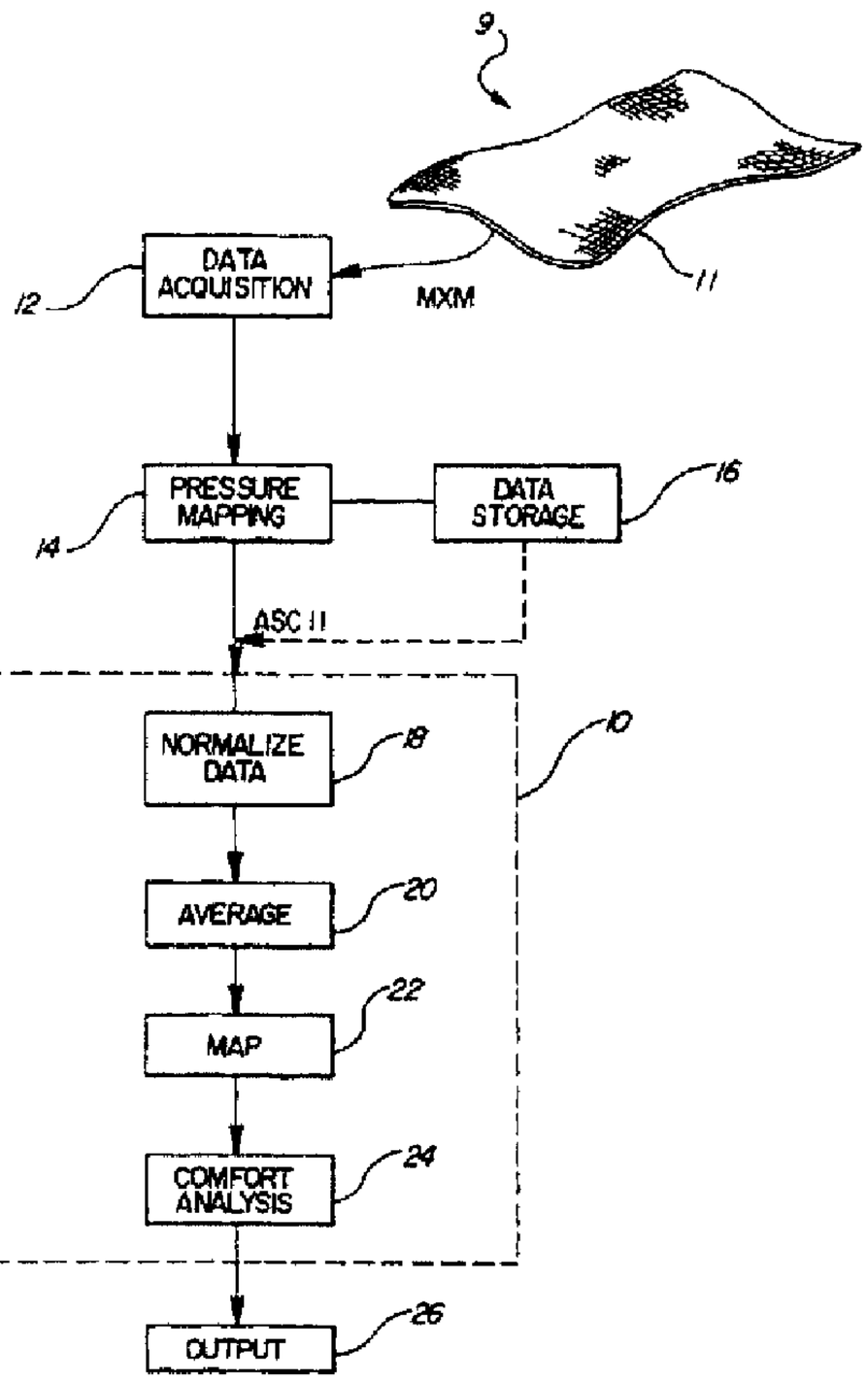
(30) 1998/06/03 (60/087,796) US

(54) PROCEDE DE MAPPAGE DE PRESSION POUR PREDIRE LE CONFORT D'UN SIEGE AUTOMOBILE

(54) METHOD OF PRESSURE MAPPING FOR PREDICTION OF COMFORT IN AN AUTOMOTIVE SEAT



(57) L'invention concerne un procédé quantitatif de mappage d'un siège automobile pour prédire le confort d'un siège. Ce procédé consiste à connecter un ordinateur pour mémoriser et visualiser des mappages de pression produits à l'aide d'un système de mappage de pression. Ce système comprend un mappage placé sur le siège et se composant d'un ensemble d'éléments résistifs

(57) A quantitative method of mapping of an automotive seat for prediction of seat comfort includes connecting a computer for storing and displaying pressure maps produced from a pressure mapping system. The pressure mapping system includes a map placed on the seat comprising an array of resistive elements connected to a data acquisition board and utilizing pressure mapping

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connectés à une carte d'acquisition de données et utilisant un logiciel de mappage de pression. Une force exercée sur le mappage modifie la résistance des éléments qui sont envoyés à la carte d'acquisition de données et transformés en un ensemble de valeurs de pression par le logiciel pour définir un mappage de pression. Plusieurs mappages de pression différents sont générés par différentes forces exercées sur le siège, normalisées par un mappage de pression de référence commun et mémorisés. La moyenne des données du mappage de pression normalisé est calculée et traitée par une étape de prédiction ou d'analyse de confort qui compare la moyenne du mappage de pression à la valeur de référence du mappage. Ces résultats sont visualisés en fonction d'une différence de rapport entre la moyenne du mappage de pression et le mappage de référence pour quantifier le confort du siège. Les résultats sont évalués en fonction de la charge de pression totale, du pourcentage de la charge de pression sur des zones délimitées spécifiées du siège, du pourcentage de pressions ponctuelles et de la charge du gradient de mappage de pression.

software. A force exerted on the mat changes the resistance of the elements which are sent to the data acquisition board and converted to an array of pressure values by the software to define a pressure map. A plurality of different pressure maps are generated by different forces exerted on the seat, normalized with a common reference pressure map and stored in memory. The normalized pressure map data is then averaged and processed through a comfort analysis or prediction step which compares the averaged pressure map to the reference pressure map. The results are displayed based on a ratio difference between the averaged pressure map and the reference pressure map to quantify seat comfort. The results are rated based on total pressure loading, percent pressure loading of specified delineated areas on the seat, percent point pressures and pressure map gradient loading.

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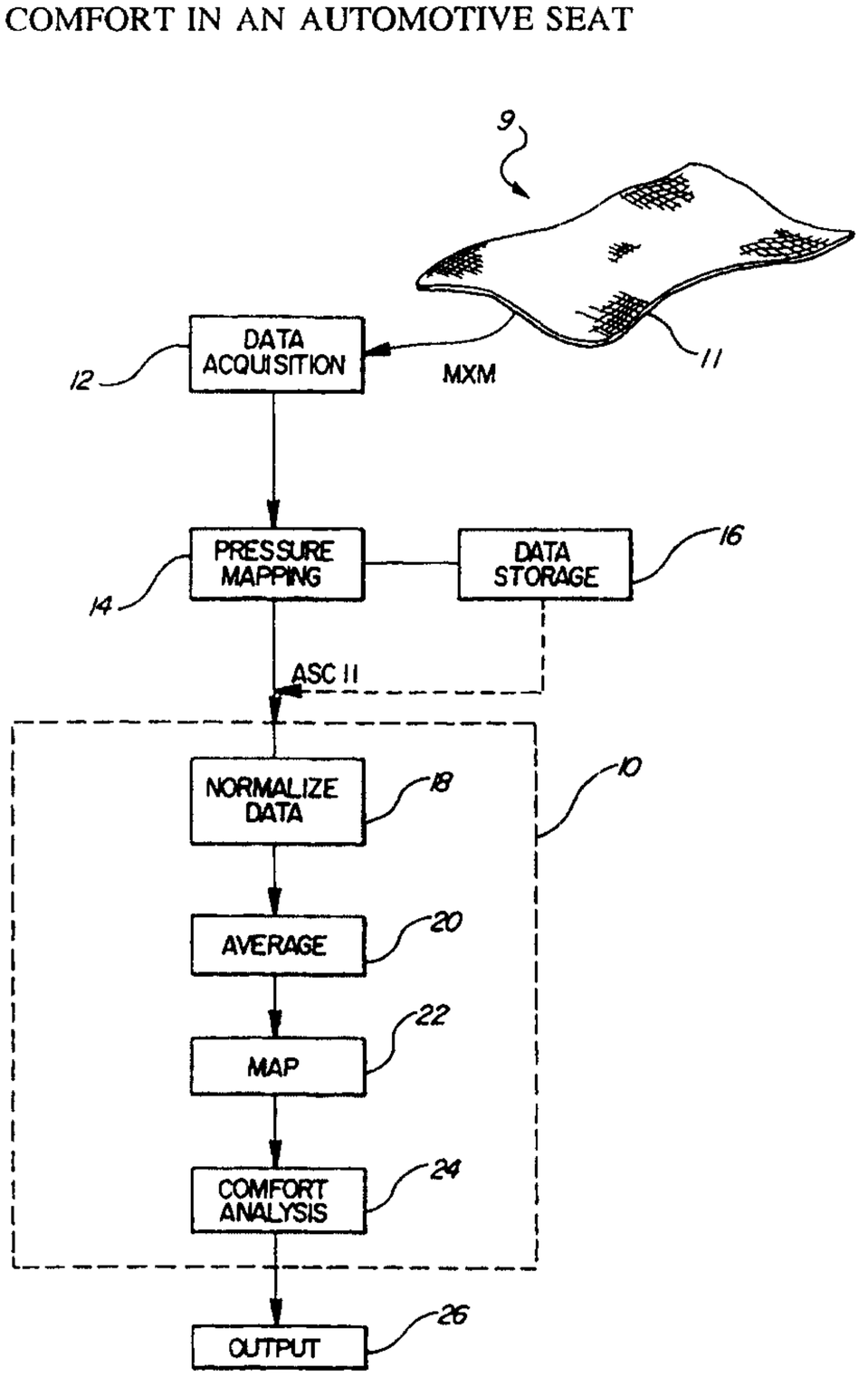
(54) Title: METHOD OF PRESSURE MAPPING FOR PREDICTION OF COMFORT IN AN AUTOMOTIVE SEAT

(57) Abstract

A quantitative method of mapping of an automotive seat for prediction of seat comfort includes connecting a computer for storing and displaying pressure maps produced from a pressure mapping system. The pressure mapping system includes a map placed on the seat comprising an array of resistive elements connected to a data acquisition board and utilizing pressure mapping software. A force exerted on the mat changes the resistance of the elements which are sent to the data acquisition board and converted to an array of pressure values by the software to define a pressure map. A plurality of different pressure maps are generated by different forces exerted on the seat, normalized with a common reference pressure map and stored in memory. The normalized pressure map data is then averaged and processed through a comfort analysis or prediction step which compares the averaged pressure map to the reference pressure map. The results are displayed based on a ratio difference between the averaged pressure map and the reference pressure map to quantify seat comfort. The results are rated based on total pressure loading, percent pressure loading of specified delineated areas on the seat, percent point pressures and pressure map gradient loading.



METHOD OF PRESSURE MAPPING FOR PREDICTION OF COMFORT IN AN AUTOMOTIVE SEAT

Technical Field

The subject invention relates to a method of pressure mapping for prediction of comfort in an automotive seat. In particular, the subject invention relates to a quantitative method for designing comfortable automotive seats.

Description of the Prior Art

There are several commercial systems available for producing pressure maps. A pressure map is used by seat designers for predicting how a particular seat will react with a particular person sitting in the seat. However, since drivers and passengers come in all different sizes, shapes and weights, it is difficult for a designer to design for an "average" person. Many sample pressure maps must be reviewed by the designer to arrive at an "average" pressure map. However, this "average" is qualitative which makes repeatability of comfortable designs difficult, if not impossible.

The disadvantages of the prior art may be overcome by providing a quantitative method of pressure mapping for prediction of comfort in an automotive seat.

Summary of the Invention

A method of mapping pressure on an automotive seat for prediction of seat comfort. The method comprises the steps of measuring a first array of pressure point values exerted on the seat to define a first pressure map and measuring a second array of pressure point values exerted on the seat, different from the first array, to define a second pressure map. The first and second pressure maps are stored as data in a storage memory device. The data is then normalized with predetermined threshold values of a reference pressure map. The normalized data from each the pressure maps is averaged to generate data of a single averaged pressure map. Finally, the method includes comparing the data from the averaged pressure map to the data from the reference pressure map and generating a rating of seat comfort based on the ratio difference between the data of the averaged pressure map and the data of the reference pressure map to thereby quantify the comfort of the seat.

Brief Description of the Drawings

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 is a flowchart illustrating the method of the present invention;

Figure 2 is a topographical output of the present invention for a sample seat cushion;

Figure 3 is a topographical output of the present invention for a sample ischial region;

Figure 4 is a topographical output of the present invention for a sample seat back; and

Figure 5 is a topographical output of the present invention for a sample spinal region.

Detailed Description of the Preferred Embodiment

The method 10 of the present invention is illustrated in the flowchart of Figure 1. The method is preferably enabled through a C++ computer code and operated on a personal computer. The personal computer is connected to a pressure mapping system. Pressure mapping systems are commercially available under the trademark TEKSCAN.

The pressure mapping system generally comprises a mat 9 with an array of resistive elements 11, a data acquisition board 12 and pressure mapping software 14. The resistive elements 12 are correlated such that when a person sits on the mat, there will be a corresponding change in resistance in the resistive elements. The changes in resistance are then transferred to a personal computer via the data acquisition board 12. The pressure mapping software 14 then correlates the change in resistance to a pressure and graphically outputs the result as an array of pressure point values defining a pressure map. The output from the pressure mapping system is preferably in an ASCII format.

Pressure map data is collected for a number of persons, representing a sample of the driving population. That is, at least first and second arrays of differing data defining first and second pressure maps are measured. The pressure maps are stored as data in a storage memory device 16. Preferably, at least four samples, or pressure maps, are

required. The four samples should be representative of a relatively high percentile of the driving population.

The next step, as indicated at 18 in the flow chart of Figure 1, is to normalize the data from each of the pressure maps to a common reference. In other words, the data of each of the pressure maps is normalized with a predetermined threshold data values of a reference pressure map. In the preferred embodiment, the H points of each data set are aligned. The pressure value for each corresponding cell is then statistically averaged, as indicated at 20, to generate a single "average" map, as indicated at 22.

The "average" map is then processed through a comfort analysis or prediction step, indicated at 24, and displayed as an output at 26. Specifically, the data from the averaged pressure map is compared to the data from the reference pressure map. The comfort analysis, or prediction, 24 is an iterative method to measure the "average" map in terms of total seat loading, that is, loading of delineated areas of the pressure map, such as right and left lateral regions, right and left trochanteric regions, right and left ischial regions and a sacral region. The data cells are scanned to determine whether any cell exceeds a predetermined threshold and flag such cells. Next, the data cells are processed for a determination of point pressures for ratioed results. The results are then rated based on total load, percent loading of specified delineated areas, percent point pressures and map gradient loading. Preferably, the output is in a format which can be read by a WINDOWS EXCEL macro for easy interpretation.

With reference to Figures 2-5, an example of the present invention is illustrated. In the present example, an automotive seat was selected having a seat back angle of 27°.

The following predetermined criteria for measurement was selected:

Characteristic	Seat Cushion	Ischial Region	Seat Back	Spinal Region
% Pressure	>75%	35-60%	>60%	3-8%
Avg. Max. Point Pressure	<1.16 psi	<1.16 psi	<1.16 psi	<1.16 psi
% Avg. Point Pressure	0%	0%	0%	0%
Max Pressure Range (psi)	1.7867-0.6803	1.7867-1.071	1.5175-0.3775	0.935-0.6395
Min. Pressure Range (psi)	0.0823-0.0137	0.1306-0.0206	0.955-0.0143	0.1147-0.0288

The observed and derived pressures are tabled as follows:

Characteristic	Seat Cushion (Fig. 2)	Ischial Region (Fig. 3)	Seat Back (Fig. 4)	Spinal Region (Fig. 5)
% Pressure	74.4898	37.8343	39.7959	14.2857
Avg. Max. Point Pressure	1.7867	1.7867	1.5175	0.935
Total Pressure (psi)	661.352	379.191	224.55	38.4799
Avg. Pressure (psi)	0.321357	0.531079	0.109111	0.305396
% Avg. Point Pressure	0.270159	0.471188	0.675796	2.42984

Based on the observed and derived results, the method 10 can then quantify seat comfort. The seat cushion in the present example obtained a four out of five (4/5) rating, while the seat back obtained a three out of five (3/5) rating to produced an average 3.5 rating. The seat cushion obtained a 4/5 rating because of its low "% Avg. Point Pressure". Calculations shown in the chart are based on sample population averages. Each sample

has a "Maximum Point Pressure" for each region and a "Total Pressure" for each region, which are used to calculate the "% Point Pressure" for each region. The sum of the individual regional "% Point Pressure" divided by the number of samples in the population will give for each region, a population "% Avg. Point Pressure".

The rating analysis is based on the following criteria:

1. Points loads in excess of 1.16 psi are not acceptable;
2. Load distribution in the direction of height on the seat back yields load sharing from the seat cushion, which allows for a more forgiving seat cushion design by taking loads off of the ischial bones.
3. The necessity of lateral pressure is determined by the character of the seat rather than by the quality of the seat.
4. A comfortable seat should exhibit lumbar contact, but not along the spinal column.
5. Symmetry should be exhibited.
6. Pressure should be distributed.
7. Sacral pressures aid in supporting the unstable pelvis and stops it from rocking; as the pelvis rocks, the lower vertebrae respond by muscle contractions, which can lead to fatigue and lower back pain.

The factors can be weighted to provide a value representative of quantitative assessment of a seat. As is now apparent to those skilled in the art, other factors and weighing systems could be used, provided that the system is applied uniformly for making comparisons. This rating can be used to assess various designs of automotive seats on a quantitative basis.

The above-described embodiment of the invention is intended to be an example of the present invention and alterations and modifications may be affected thereto, by those of skill in the art, without departing from the scope of the invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practice other than as specifically described.

What is claimed is:

1. A method of mapping pressure on an automotive seat for prediction of seat comfort, said method comprising the steps of:

measuring a first array of pressure point values exerted on the seat defining a first pressure map;

measuring a second array of pressure point values exerted on the seat, different from the first array, defining a second pressure map;

storing the first and second pressure maps as data in a storage memory device;

normalizing the data with predetermined threshold values of a reference pressure map;

averaging the normalized data from each the pressure maps to generate data of a single averaged pressure map;

comparing the data from the averaged pressure map to the data from the reference pressure map; and

generating a rating of seat comfort based on the ratio difference between the data of the averaged pressure map and the data of the reference pressure map to thereby quantify the comfort of the seat.

2. The method as set forth in claim 1 further including generating a rating of seat comfort based on total pressure load of the averaged pressure map compared to the reference pressure map.

3. The method as set forth in claim 1 further including generating a rating of seat comfort based on percent loading of predetermined delineated area on the seat of the averaged pressure map compared to the reference pressure map.

4. The method as set forth in claim 1 further including generating a rating of seat comfort based on average pressure points of the averaged pressure map compared to the reference pressure map.

5. The method as set forth in claim 1 wherein said measuring of pressure point values includes placing a mat with an array of resistive elements on the seat, applying a force on the mat and measuring the change in resistance of the resistive elements in the mat.

6. The method as set forth in claim 5 wherein said measuring of pressure point values includes converting said change in resistance of the resistive elements to a pressure value.

FIG-1

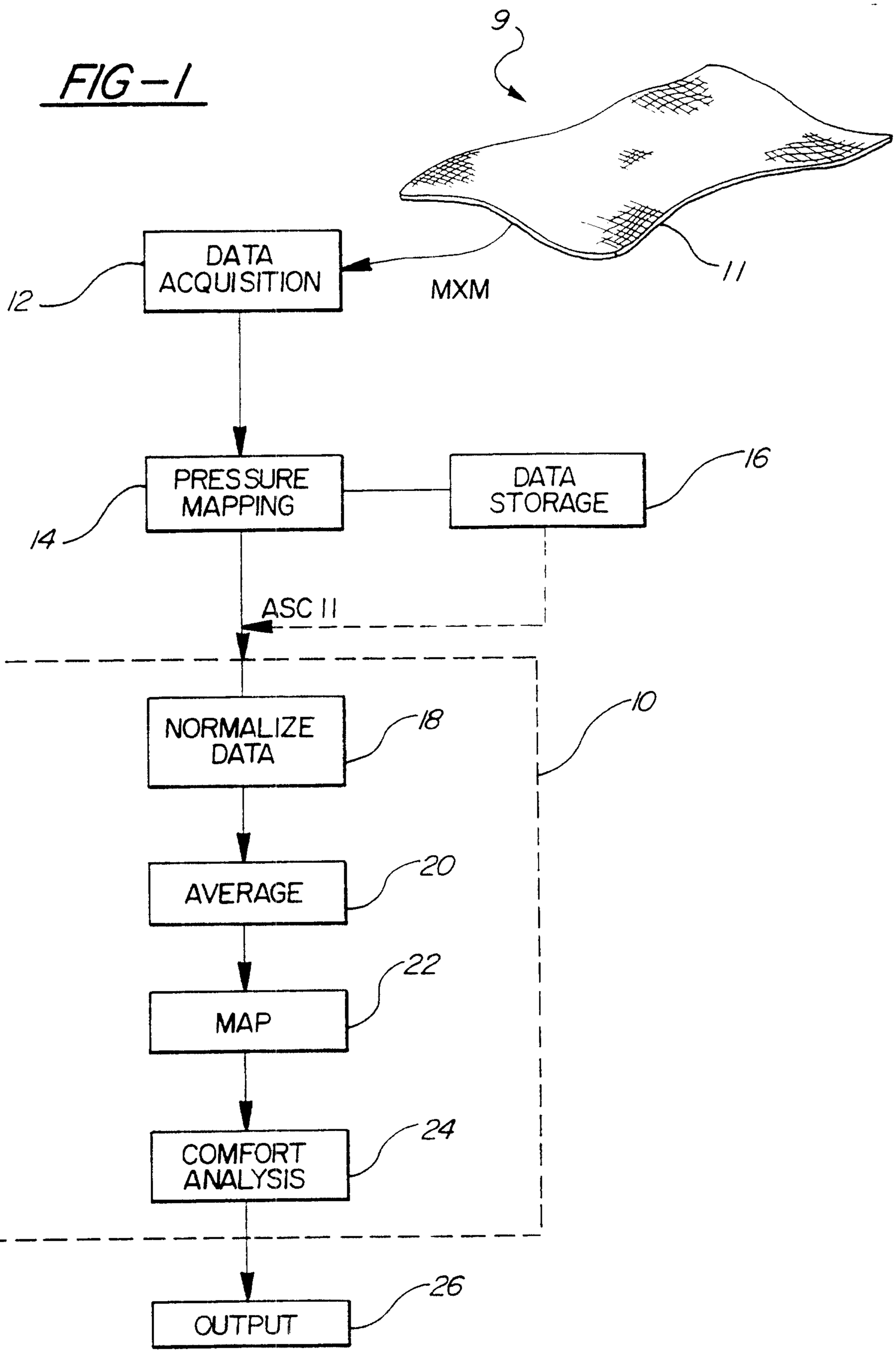

9
11
DATA ACQUISITION
12
MXM
PRESSURE MAPPING
14
DATA STORAGE
16
ASC II
NORMALIZE DATA
18
10
AVERAGE
20
MAP
22
COMFORT ANALYSIS
24
OUTPUT
26

FIG-2

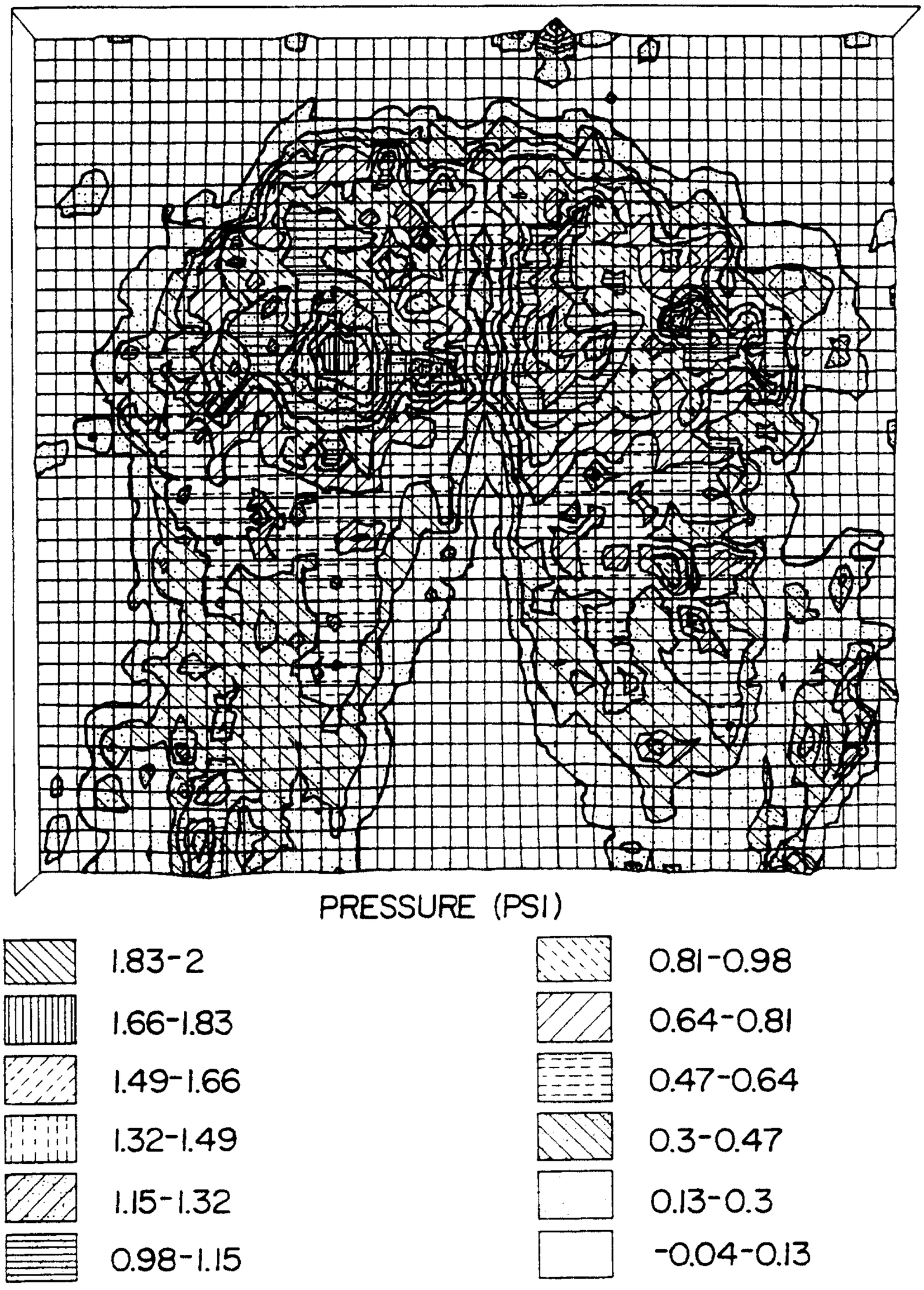

PRESSURE (PSI)
1.83-2
1.66-1.83
1.49-1.66
1.32-1.49
1.15-1.32
0.98-1.15
0.81-0.98
0.64-0.81
0.47-0.64
0.3-0.47
0.13-0.3
-0.04-0.13

FIG -3

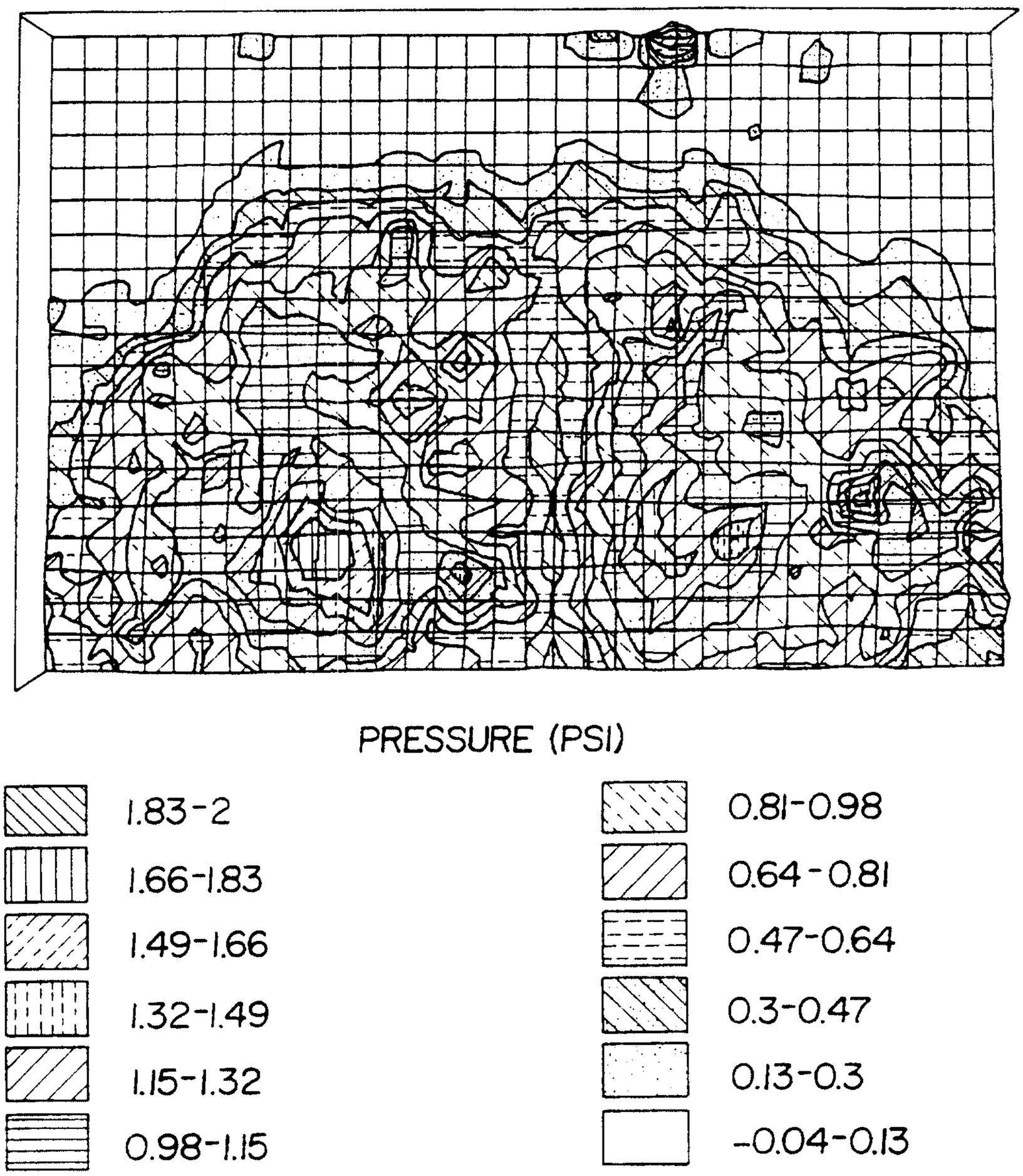

PRESSURE (PSI)
1.83-2
1.66-1.83
1.49-1.66
1.32-1.49
1.15-1.32
0.98-1.15
0.81-0.98
0.64-0.81
0.47-0.64
0.3-0.47
0.13-0.3
-0.04-0.13

FIG-4

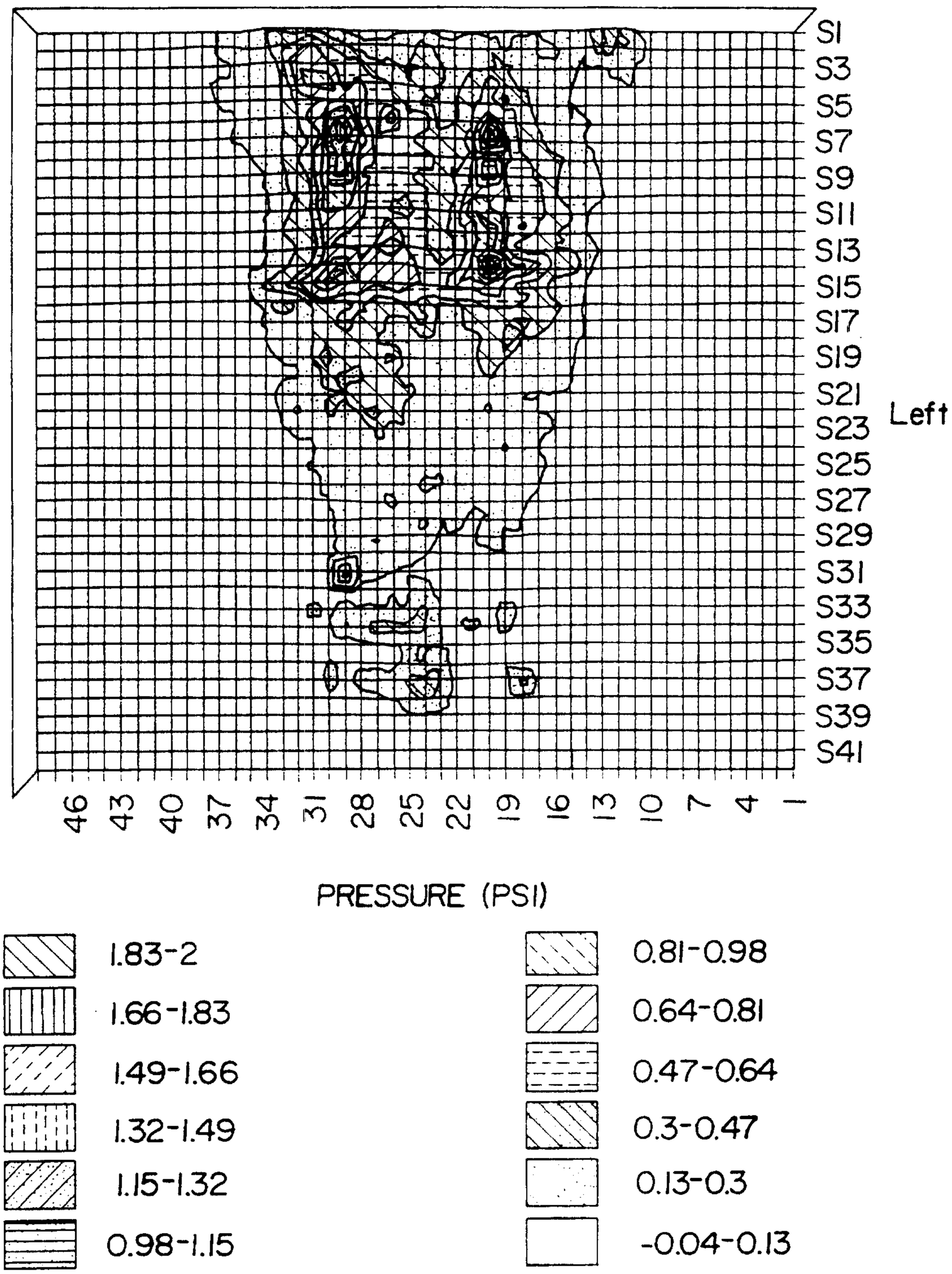
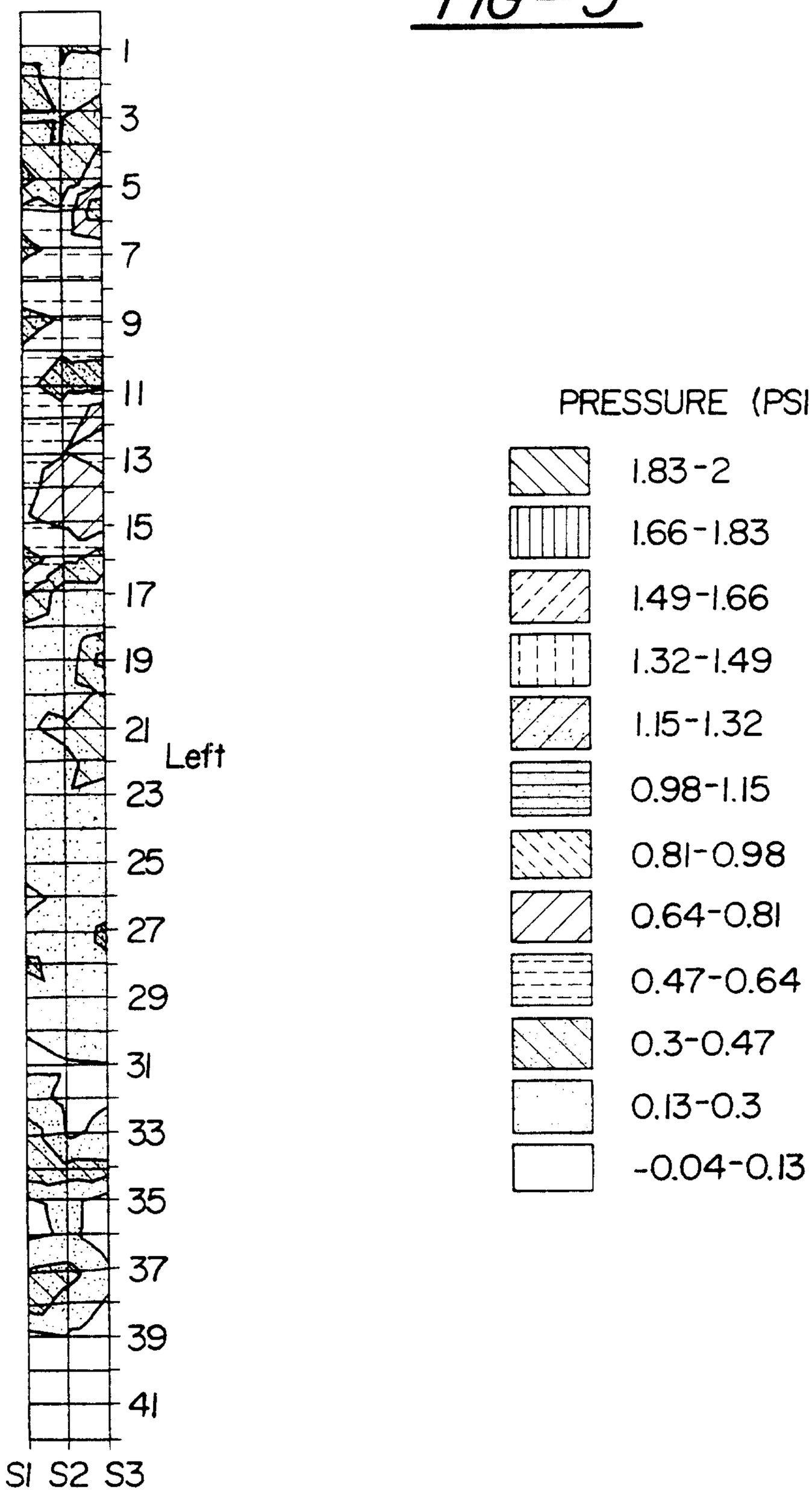

S1
S3
S5
S7
S9
S11
S13
S15
S17
S19
S21
S23
S25
S27
S29
S31
S33
S35
S37
S39
S41
Left
46 43 40 37 34 31 28 25 22 19 16 13 10 7 4 1
PRESSURE (PSI)
1.83-2
1.66-1.83
1.49-1.66
1.32-1.49
1.15-1.32
0.98-1.15
0.81-0.98
0.64-0.81
0.47-0.64
0.3-0.47
0.13-0.3
-0.04-0.13

FIG-5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39
41
S1 S2 S3
PRESSURE (PSI)
1.83-2
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1.49-1.66
1.32-1.49
1.15-1.32
0.98-1.15
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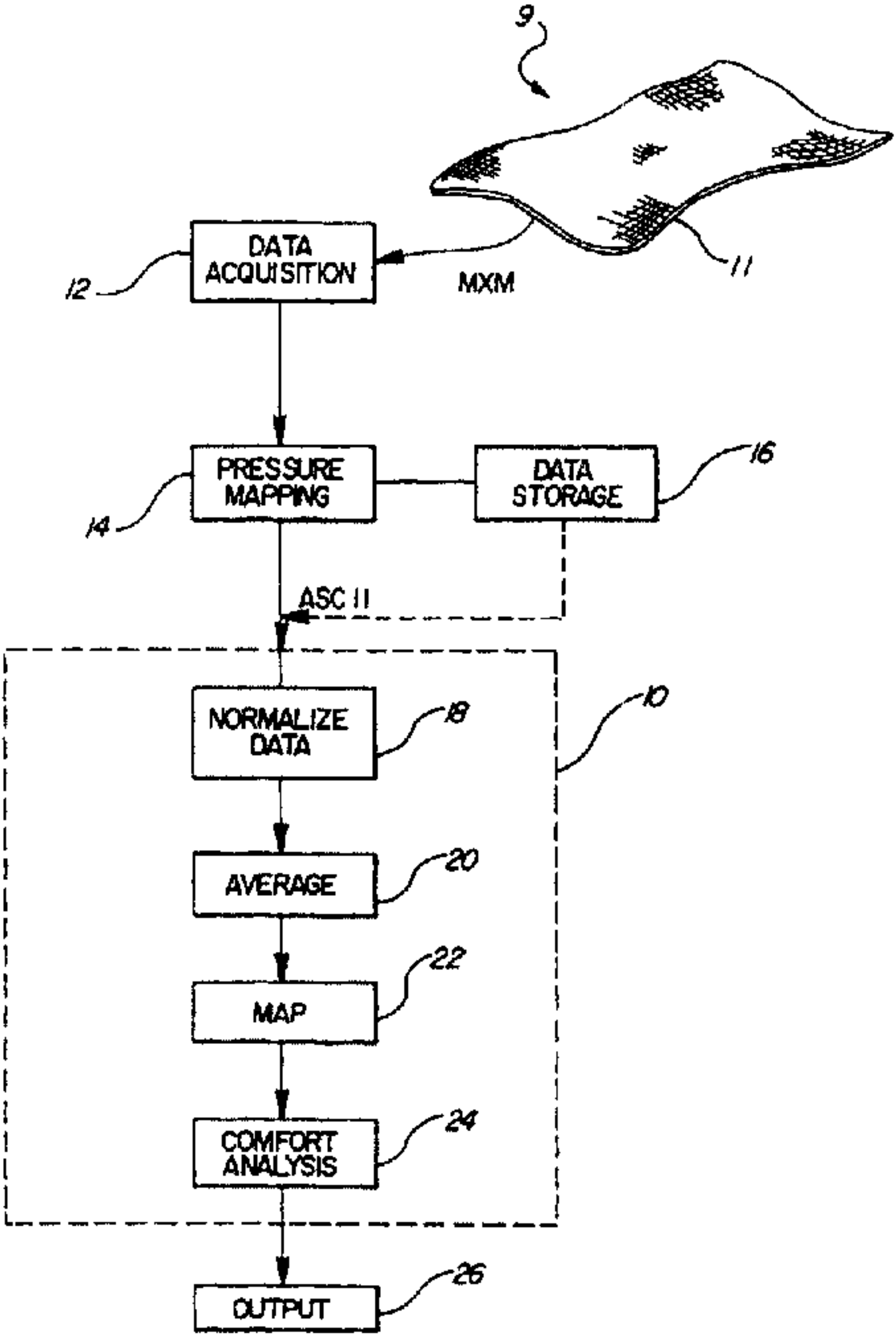
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DATA ACQUISITION
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MXM
PRESSURE MAPPING
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DATA STORAGE
16
ASC II
NORMALIZE DATA
18
10
AVERAGE
20
MAP
22
COMFORT ANALYSIS
24
OUTPUT
26