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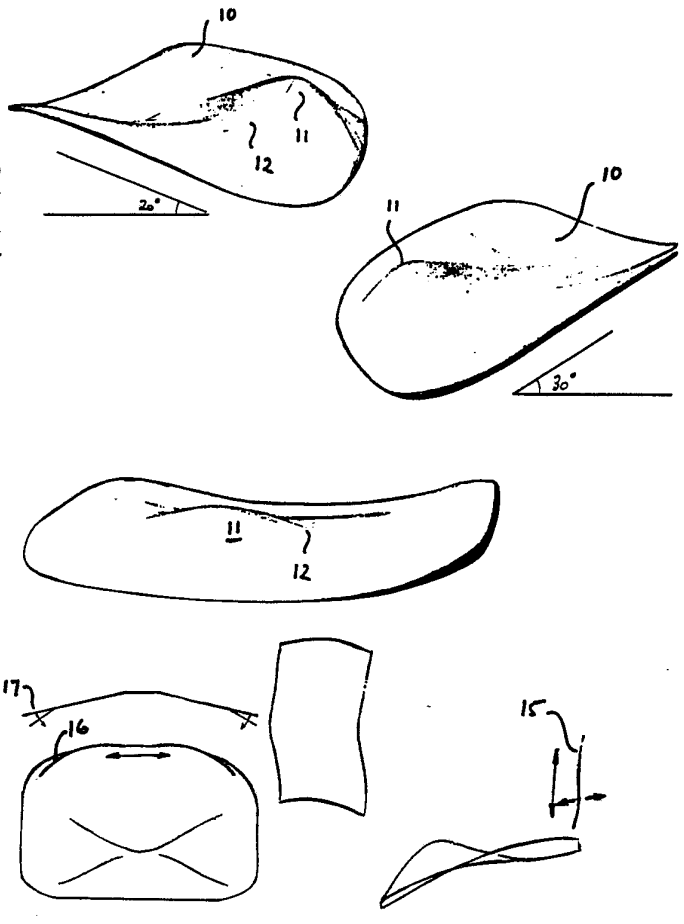
(57) Abstract

A seat which provides a seating position which is physiologically desirable and which has a seat member so arranged that a user is guided to sit with the thighs obtusely opened whereby the sacrum is caused to adopt a position such that it is properly wedged between the ilia and supported by the inward thrust of the ilia by the position of the legs.



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S E A T

This invention relates to a seat and in particular to a seat which has a wide range of uses and in each of which provides a seating position which is physiologically desirable.

In particular, the seat of the invention is designed to give correct support to the sacro-iliac joints (hereafter called the S/I joint).

The basis for seating has historically been in taking weight off the feet, resting the legs and it was believed that this position also rested the rest of the body. Until recently, little thought or concern was given to supporting the spine.

With the introduction of 'ergonomics' - support has centered around maintaining a lumbar lordosis so as to duplicate a standing posture while seated. This has been thought as being the least stressful of vertical body positioning.

It is now evident that seating to date has not satisfactorily supported all body types and/or each person's individual needs. In most seating, with certain exceptions which will be discussed later, the seat itself allows for support under the ischia and thighs - thigh support is generally long enough to extend, for many, to the back of the knee. In some cases, this support is too long, thereby pushing the user's lower leg forward and causing the user either to move their pelvis forward or to sit with leg pushed out in front.

A back to the chair may or may not offer support. Generally an attempt has been made to support the lumbar spine; some seats offer thoracic and even cervical and head support, but the sacro-iliac region has been overlooked.

While seated on most chairs, the user's body weight is placed directly onto the ischia and their pelvis rocks backward and their lordotic curve is lost immediately they slump into the seat.

Ergonomists, Doctors, Scientists and Researchers have stated that the best posture while seated is to maintain a minimum lordortic curve in the lumbar spine. Therefore the emphasis in most cases has been on providing a forward push, by a back support, to the lumbar spine. This, however, is dependent on the user being hard up against the back support and this support being of the correct height and shape to support their lumbar spine. In most cases this has not been achieved satisfactorily.

The two basic exceptions which are generally known, and there may be others, are the 'Balan' chair and the 'Ergoform' (Trade Marks) tilting seat concepts. Both of these, because of the forward tilt of the actual seat, allow the possibility for a person to maintain a lordosis in the lumbar spine more easily than on a conventional chair.

The lumbar lordosisis is dependent on the position of the pelvis. When the pelvis is rocked posteriorly, the lumbar lordosis (forward curve) is lost (hypolordosis). When rocked anteriorly the lumbar lordosis is increased (hyperlodosis). (Fig. 1 illustrates these positions with Fig. 1(a) illustrating posterior slump (hypolordosis), Fig. 1(b) the normal pelvic position and Fig. 1(c) anterior slump (hyperlordosis.)

Hypolordosis is due to the user slumping back on sitting, a loss of the lordosis in the lumbar spine is followed by the hunching forward of the upper body. The sacrum is tipped posteriorly (backwards), pushing the ilia laterally (to the side). This is the most usual position to which people slump when sitting.

The postion of the legs and support of them is critical in establishing whether or not the pelvis maintains a vertical/normal stable position or an unstable posterior (backward) or anterior (forward) rocked position. Thigh or leg support permits this slump on most seats by transfering the body weight onto the ischia. If there is no posterior pelvic support, or the support is not used correctly the slump is increased. A normal sitting position is illustrated in Fig. 7 in which Fig. 7(a) is a lateral view, Fig. 7(b) is a posterior-oblique view and Fig. 7(c) is a coronal view.

As illustrated in this Figure, most current seating provides thigh support with a seat that is horizontal or tipped backwards. The spine's position is further aggravated where a seat is concave, as viewed from the front. The concavity causes the leg to be rolled inwardly, the inferior aspects of the ischia and ilia are rotated outwardly opening the inferior part of the sacro - iliac joints.

Seating generally has continued to offer this type of inadequate support except for the forward tilting seats. The forward tilt shifts the body weight forward which increases the likelihood of maintaining a lumbar lordosis. However as people need to change searing postures during extended seated times a pelvic posterior slump is inevitable when the body weight is transferred backwards.

Forward tilting seats can create still another problem, an ability for the pelvis to go into a forward (anterior-inferior) downward slump of the pelvis opposite to the

posterior slump. This is illustrated in Fig. 8 in which Fig. 8(a) shows a lateral view using a 'Balan' type chair and Fig. 8(b) shows a posterior-oblique view.

Should the user slump the pelvis into a forward tilt the pelvis rocks forward and down accentuating the lumbar lordosis by increasing the lumbo-sacral disc angle. Added to this, the gravitational weight line which is anterior to the lumbo-sacral junction, provides a greater force forward adding to the anterior tilt.

If the legs are together the ilia are pulled outwardly at the posterior, together with a forward tilt, sacral stability is totally dependent on the strength of the S/I joint ligaments, the geometry of the interlocking of the joints and the psoas muscles in particular. Fatigue in this position can be faster than the posterior pelvic tilt.

Therefore seating to date has generally not solved the problem of maintaining a relaxed and comfortable posture nor enabled the user to change their seated position and still remain supported. Generally, the simpler and less expensive the seat the worse the problem.

Even expensive seats that provide mechanisms for virtually 'moulding' the shape to conform to an individual's own needs, still have overlooked what are seen as the fundamentals of good seating.

The S/I joints have historically been overlooked by researchers as having any significant effect on postural problems. This has been mainly due to the long held belief that the S/I joints were synchondrosis joints (immoveable) and/or that due to the strong ligaments supporting the area, that a force of between 400-2600 lbs was necessary to severely disrupt the pelvic girdle.

It is now understood that the joints are amphiarthrodial with a diarthrodal synovial part (moveable). However this has not yet translated into understanding that stress to the joints can have an effect on the structure and posture of the body.

According to Bodjuk and Twomey, (Clinical Anatomy of the Lumbar Spine) ligaments subjected to the force well within their load bearing capacity, creep (elongate and weaken) over a prolonged period of sustained stress. Restoration of the ligament's normal length and strength is slower than the period of time of deformation. This deformation if severe may persist indefinitely. The ligament therefore is unable to perform normally and under average stress may be considerably weaker following a period of prolonged stress.

Experiments by Noyes, Delucas and Torvik indicate ligament failure being up to 31% greater at a slow prolonged strain than a fast rapid or sudden strain. (Experimental time difference 1 x 100 (0.64 sec to 63.00 secs)). Clinical evidence suggests that if the prolonged strain is in hours and not in seconds then the failure rate could be even greater than those experiments show.

The S/I joints have no direct muscle to support them, the spinal and lumbo-pelvic musculature have to act in a supportive role when these joints are placed under undue stress. In both the posterior and anterior positions the pelvic ligaments of the S/I joints are placed under continued stress and the subsequent muscular support becomes evident. Muscular tiredness results, further weakening the pelvic and spinal structures.

Delmas (quoted by Kapandji) relates the degree of flexibility of the S/I joint to their architecture. Chiropractic researchers like Janse and Illi who's work suggested the vulnerability of the S/I joints is due to the precarious construction of the biomechanical nature of the area, have long advocated the importance of the S/I joint in posture and spinal integrity. Their knowledge however has generally been rejected by orthodox science.

The object of the present invention is to provide a seat which causes the user to adopt a position where the S/I joints of a user are correctly located and supported, effectively by the user using the seat and thus which will minimize or overcome the difficulties described previously herein.

The principal object of the present invention is to provide a seat which minimizes the difficulties of previous seats and which is physiologically desirable.

The invention in its broadest sense includes a seat member so arranged that a user is guided to sit with the thighs obtusely opened and the body weight is distributed between the thighs and the ischia whereby the sacrum is caused to adopt a position such that it is properly wedged between the ilia and supported by the inward thrust on the ilia by the position of the legs.

In another aspect it provides a seat as described above wherein the seat is formed so that there is an effective upward extension along the centreline thereof and at least near the front of the seat whereby, when a user is seated, the extension guides a leg onto either side thereof so that the required orientation of the thighs is achieved.

Preferably the formation of the upward extension is such that the user's legs are not only guided onto each side thereof but are also caused to roll slightly outwardly.

I also prefer that behind the extension there is a dished gluteal area shaped to generally correspond to the human buttocks.

In a further aspect of the invention I provide a seat as described herein above wherein the seat is relatively shallow and is directed downwardly from the back to the front so that the user's feet can rest naturally substantially below and/or behind his/her knees.

If required it may, in some circumstances, be more comfortable if the thighs are supported over a greater part of their length.

The seat as described herein may be provided with a seat back which provides S/I support, effectively enabling the user to change their seated posture whilst still maintaining adequate S/I joint support.

In order that the invention may be understood, reference will be made to the accompanying drawings, in which:-

Fig. 1 shows the pelvis in the three positions previously referred to:
Fig. 1(a) the position where there is a posterior slump and the lumbar lordosis is lost (hypolordosis),
Fig. 1(b) the normal position, which is the standing position and also the use of the chair of the invention, and
Fig. 1(c) a position where there is an anterior slump position in which the lumbar lordosis is increased (hyperlordosis);
The lumbo-sacral disk angle is shown as

Fig. 2 shows various views of S/I joints:
Figs. 2(a) to (c) being superior coronal views; Fig. 2(a) the anterior segment, Fig. 2(b) the middle segment and Fig. 2(c) the posterior segment,
Fig. 2(d) being a lateral view, and
Fig. 2(e) being an anterior view;

Fig. 3 shows a view of the lower spine and the pelvis in a standing position both from a lateral view (Fig. 3(a)) and posterior-oblique view (Fig. 3(b)) showing the direction of force on the S/I joints.

Fig. 4 shows superior (Fig. 4(a)), posterior-oblique (Fig. 4(b)) and lateral (Fig. 4(c)) views of the pelvis for a person who is seated on the ground or in a meditation position;

Fig. 5 shows the lateral (Fig. 5(a), superior (Fig. 5(b)) and posterior-oblique (Fig. 5(c)) views of a person on the seat of invention with feet behind their knees;

Fig. 6 shows the lateral-superior (Fig. 6(a)) and posterior-oblique (Fig. 6(b)) views of a person using the seat of the invention with their feet extended in front of their knees;

Fig. 7 shows the lateral (Fig. 7(a)), posterior-oblique (Fig. 7(b)) and superior (coronal) (Fig. 7(c)) views of the pelvis in a normal seat having thigh support and concave surface;

Fig. 8 shows lateral (Fig. 8(a)) and posterior-oblique (Fig. 8(b)) views of a person on a 'Balan' type chair.

Fig. 9 shows posterior-oblique comparison views of the pelvis in the standing and different seated positions with arrows indicating the lines of force on the pelvic structure:-
Fig. 9(a) shows the seat of the invention with the user's feet under the seat,
Fig. 9(b) shows the seat of the invention with the user's feet forward,
Fig. 9(c) shows a 'Balan' or 'Ergoform' arrangement,
Fig. 9(d) shows a normal seat,
Fig. 9(e) shows the pelvis in meditation position, and
Fig. 9(f) shows the pelvis in a standing position;

Fig. 10 shows, schematically, a seat member which incorporates the features of the invention. In this Figure:-
Fig. 10(a) is a lateral-oblique view of the seat, at a relatively flat angle,
Fig. 10(b) is a lateral view from the other side at a higher angle of view,
Fig. 10(c) is a front view from slightly above,

Fig. 10(d) is a plan view of a form of seat,
Fig. 10(e) is a plan view of an alternative seat back
Fig. 10(f) is a schematic side elevation; and
Fig. 10(g) is a perspective of the back of the seat of Fig 10(f).

The architecture of the S/I joint indicates a wedge type structure (see Fig. 2) with the superior (top) and the anterior (front) parts having a wider opening than the inferior (bottom) and posterior (back). The sacrum can be likened to a 'key stone' in an arch. It is obvious that to stabilize the joints and reduce the stress on the ligaments and muscles, the sacrum needs to be pushed backwards and down into the ilia. In the standing position, the ilia (Fig. 3) are forced together because of the positioning of the acetabulum and the line of direction of the femoral neck. The force is directed superior and medially with a posterior to anterior torque.

In the normal seated position, the ilia thrust is lost due to force coming from the ischia. This puts a spreading type force on the posterior aspect of the ilia and the binding effect of the ilia and the 'key stone' effect of the sacrum is lost.

Before chairs were developed, man usually sat on the ground either with the thighs obtusely opened and the forelegs crossed or in a squatting position, with the legs open obtusely and the body weight distributed through the legs. (Fig 4.)

In both these positions the lumbar spine is virtually straight, losing most of its lordosis. These positions are held for long periods, as is noted in native man and in those who hold a meditation posture for a number of hours, and even days, with no evidence of low back strain.

The common factor is spreading of the thighs to cause an obtuse angle and the body weight distributions being either in part or all through the legs. This effectively supports the S/I joint. The force is directed from the acetabulae, (hip joints); through the ilia to the S/I joint. The sacrum is forced posteriorly and inferiorly, this whole action has a stabilizing effect on both joints. There is therefore virtually no 'work' for the S/I joint ligaments. The body in this position tends to sit into the pelvis and little or no muscular effort is involved. It is therefore a relaxing position.

The chair of the invention guides each individual into assuming this position with a posterlateral compression force on the ilia approximating that of the femurs in the standing posture. This position is also the most comfortable, stable and energy

conserving postural position. It provides for the sacral 'key stone' effect with resultant S/I joint stability and relaxation of spinal muscles, from the pelvis through the lumbar, thoracic and cervical regions.

When the legs are opened in an obtuse angle and the feet are placed back under the seat body weight is moved forward and becomes distributed between the upper thighs and ischia, there is less strain on the S/I joints and this position can be held for a limited period without back support. The sacral 'key stone' effect is then similar to the standing position - sacrum is wedged between the supported ilia (Fig. 5). However, when the legs are moved forward body weight is transferred backwards onto the ischia and a pelvic back support is necessary and as the pelvis rests into that support, its shape pushes the ilia together duplicating the compressing force of the femurs in the standing position (Fig. 6).

The angle and contours of the ischial - buttock support part of the seat, create the effect of actually sitting into the pelvis. This action and angle prevent an anterior pelvic slump.

In areas where the seat is subject to movement such as in transport applications, a higher back support is necessary. This support may extend through the full height of the user. However the essential support is at the S/I joint.

There are very small differences in measurements between pelvic bones. Height of ischiato S/I joint and width between S/I joints is no greater than 3cm to 4cm, therefore virtually all body types can be supported with one basic seat, ischial - buttock seat and posterior pelvic support. This means that the seat of the invention can satisfactorily be used by effectively all adults and children from about the age of 12.

It will be appreciated that the concept of the invention can be applied to seats and the actual arrangements can vary.

However, particular forms are illustrated in Fig. 10.

The seat member has a dished gluteal area 10 which is basically arranged to comfortably arranged to receive the human buttocks and an upward extension or raised portion 11 forward of the gluteal area and which prevents forward slide and slump of the pelvis.

Thigh supports 12 contour downwardly from the extension 11 towards the gluteal region and towards the front and these supports 12 both ensure that the legs of a user are separated and also provides an outward rolling of the thighs.

Fig. 10(f) shows a side elevation and shows the general view of a rear support 15 and this support may be adjustable, as indicated by the arrows in the S/I region. The adjustment can b up and down and forward and back.

Two different forms of back are illustrated in Figs 10(d) and 10(e). The form of 10(d) shows curved side members 16 which may be transversly adjustable.

The form of Fig. 10(e) is an open V and the outer edge 17 can be adjustable as senn by the arrows.

The location of the S/I joint support is such as to prevent any posterior rocking of the pelvis when the user is seated in the chair.

The actual shape of the support may vary but in one particular application I may use a shallow "V" or curved form extending upwardly from the rear of the seat member and this could if required have curved outer sides to provide lateral support for the pelvis.

Because the support is required for the S/I region it does not need to extend fully up the back of a user and indeed could be as low as some 20 cm high.

It may be adjustable both forwardly and rearwardly or it may be fixed.

The angle can be between 80^{o} to 100^{o} to the vertical, but this is not limiting.

It will be appreciated that the support may be made in any required manner, depending upon the aesthetics required for the chair with the critical portion being that area adjacent the S/I region.

Whilst in the Figures I have shown the seat having its various features exposed it will be understood that it would be possible, for example, to form the seat of materials having different densities so that the seat could, when not being used, give the appearance of being a normal seat but, when being used, is so formed that the user is caused to adopt the required position.

I have described herein, at substantial length, the background to the invention and the necessary features which must be provided for the invention to be satisfactorily applied.

It will be appreciated that this description effectively provides the constraints which must be met by chairs made in accordance with the invention and, whilst I have described, generally, certain embodiments, it will be appreciated that chairs made in accordance with the invention may vary widely, provided they remain within the constraints of the invention.

I claim:-

1. A seat having a seat member so arranged that a user is guided to sit with the thighs obtusely opened and the body weight is distributed between the thighs and the ischia whereby the sacrum is caused to adopt a position such that it is properly wedged between the ilia and supported by the inward thrust of the ilia by the position of the legs.

2. A seat as claimed in Claim 1 wherein there is a seat back adapted to provide sacro-iliac support when the body weight is transferred backwards onto the ischia.

3. A seat as claimed in either Claim 1 or Claim 2 wherein the seat member is formed so that there is an effective upward extension along the centreline thereof at least near the front of the seat whereby, when a user is seated, the extension guides the thighs to the required obtusely open position.

4. A seat as claimed in Claim 3 wherein the formation of the extension causes the thighs to roll slightly outwardly.

5. A seat as claimed in Claim 3 or Claim 4 wherein the upward extension comprises a portion of the seat member which is firmer than the surrounding portion so that deformation of the surrounding portion under the weight of the user is greater than that of the upward extension thus causing the user to adopt the required position.

6. A seat as claimed in any one of Claims 3 to 5 wherein behind the extension there is a dished gluteal area shaped to generally correspond to the human buttocks.

7. A seat as claimed in any one of the preceding claims wherein the seat member is directed downwardly from the back to the front so that the user's feet can rest naturally substantially below and/or behind his/her knees.

8. A seat as claimed in Claim 2 or any claim appended thereto wherein the seat back is in the form of a shallow V-shaped or curved member.

9. A seat as claimed in Claim 8 wherein the sides of the V-shaped curved member wrap around to give support to the sides of the pelvis.

10. A seat as claimed in Claim 8 or Claim 9 herein the seat back is adjustable forwardly and rearwardly, laterally and for height.

11. A seat as claimed in any one of claims 8 to 10 wherein the sides of the seat back are adjustable to effect change in the width of the support.

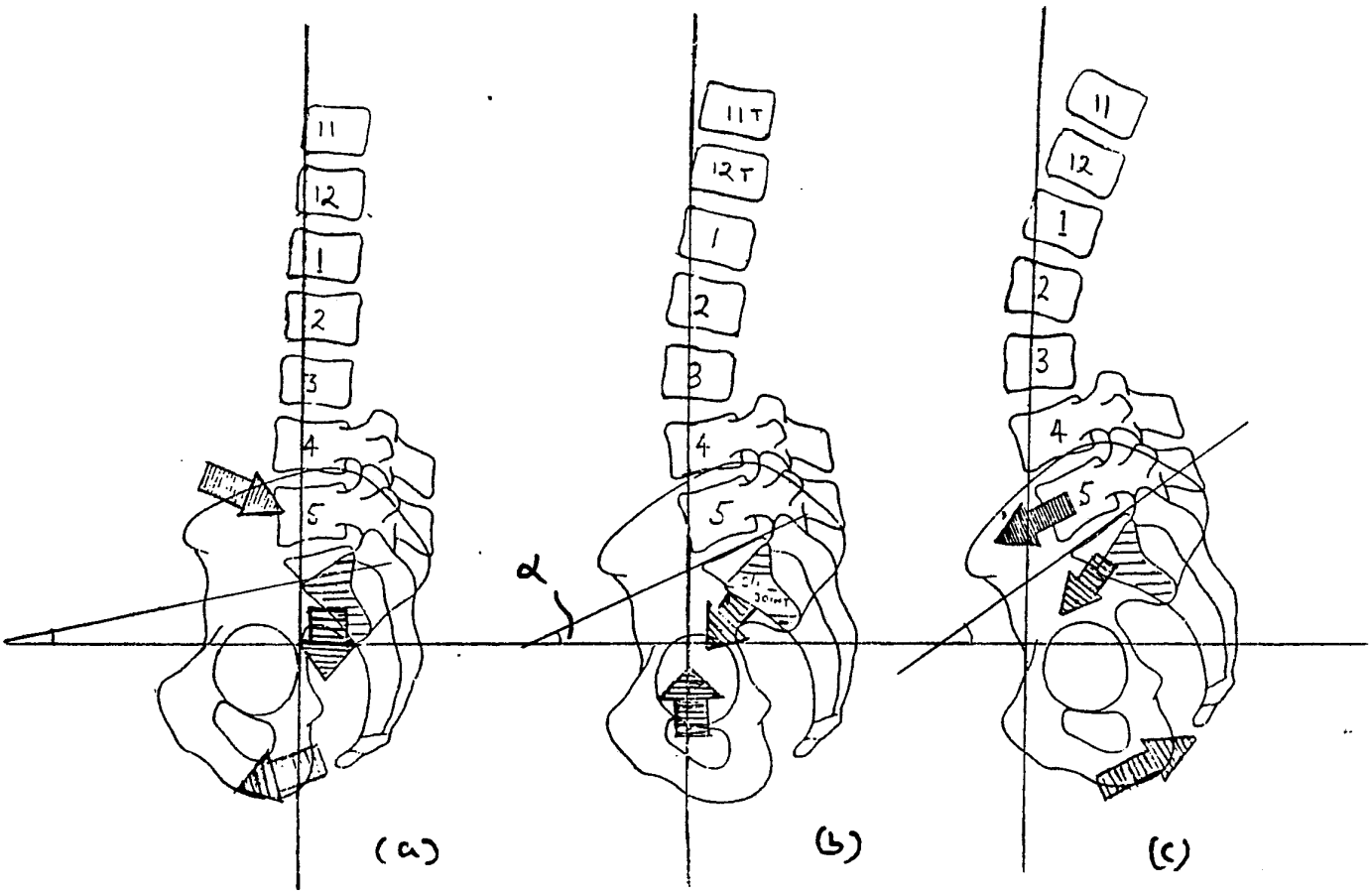
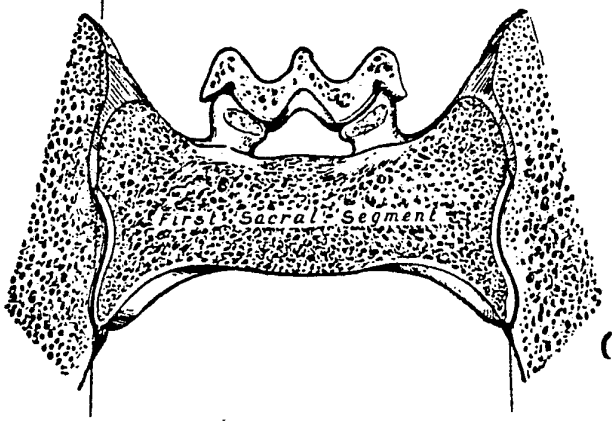
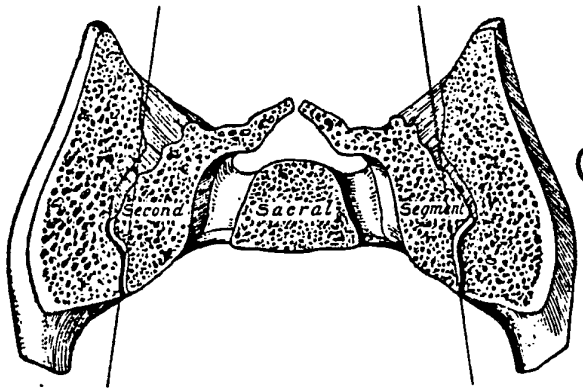


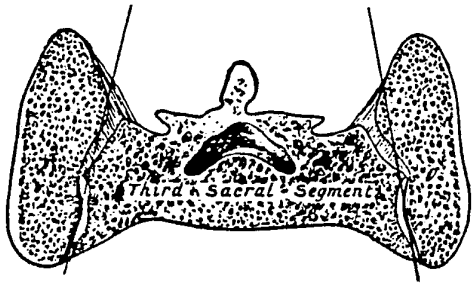
FIG.1


First Sacral Segment

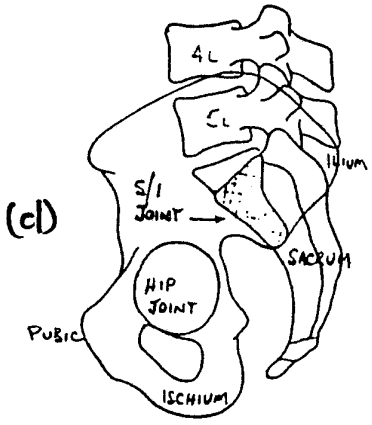
(a)


Second Sacral Segment

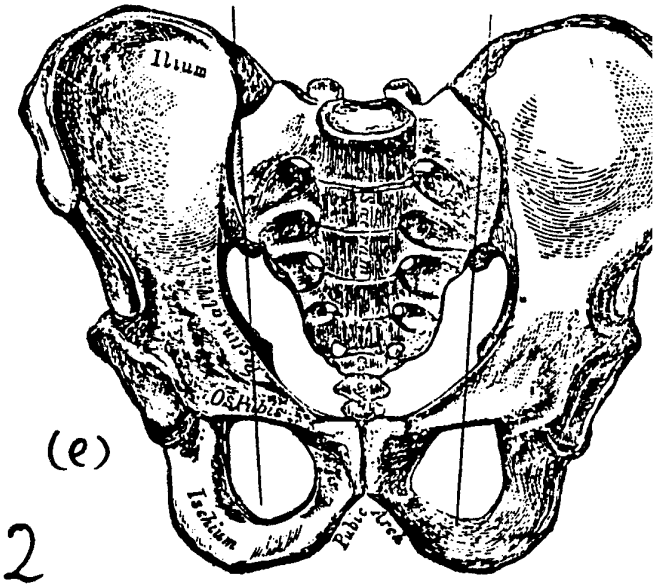
(b)


Third Sacral Segment

(c)


4L
5L
Ilium
S/I JOINT
SACRUM
HIP JOINT
PUBIC
ISCHIUM

(d)


Ilium
Ischium
Public Arch

(e)

FIG. 2

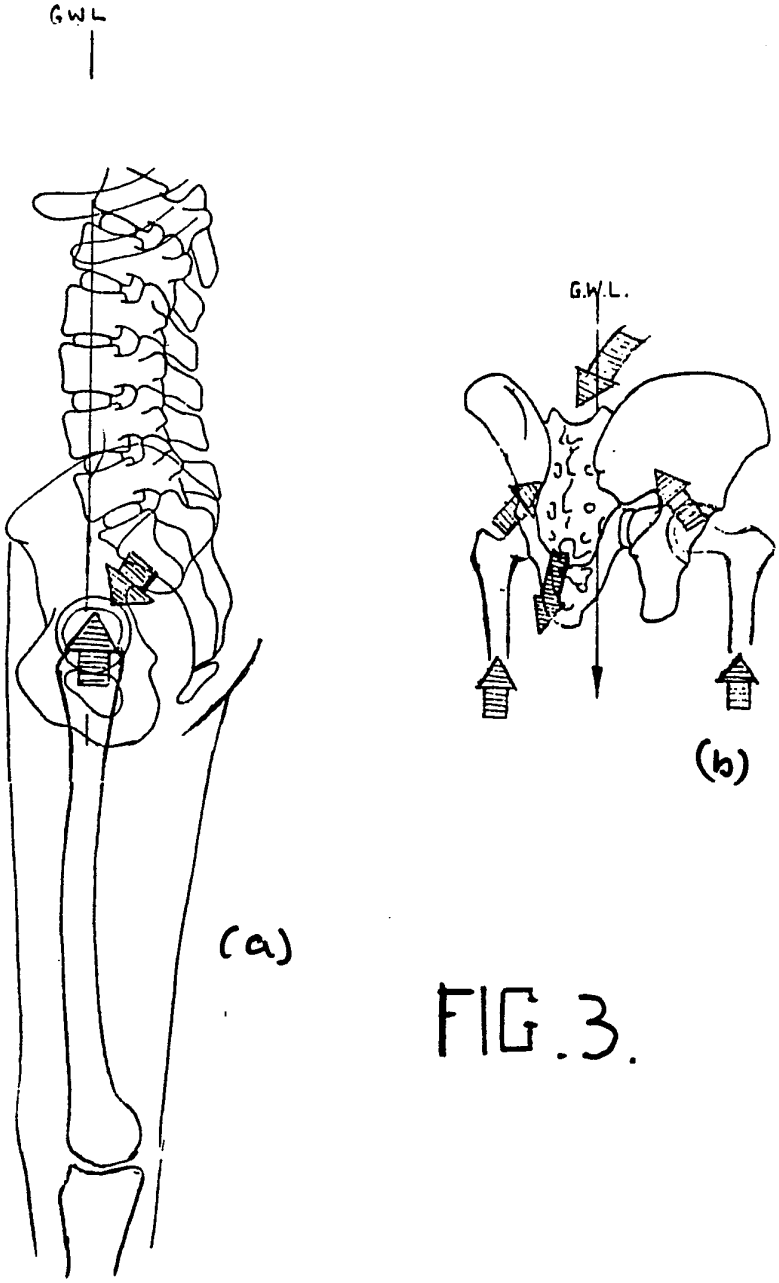


FIG. 3.

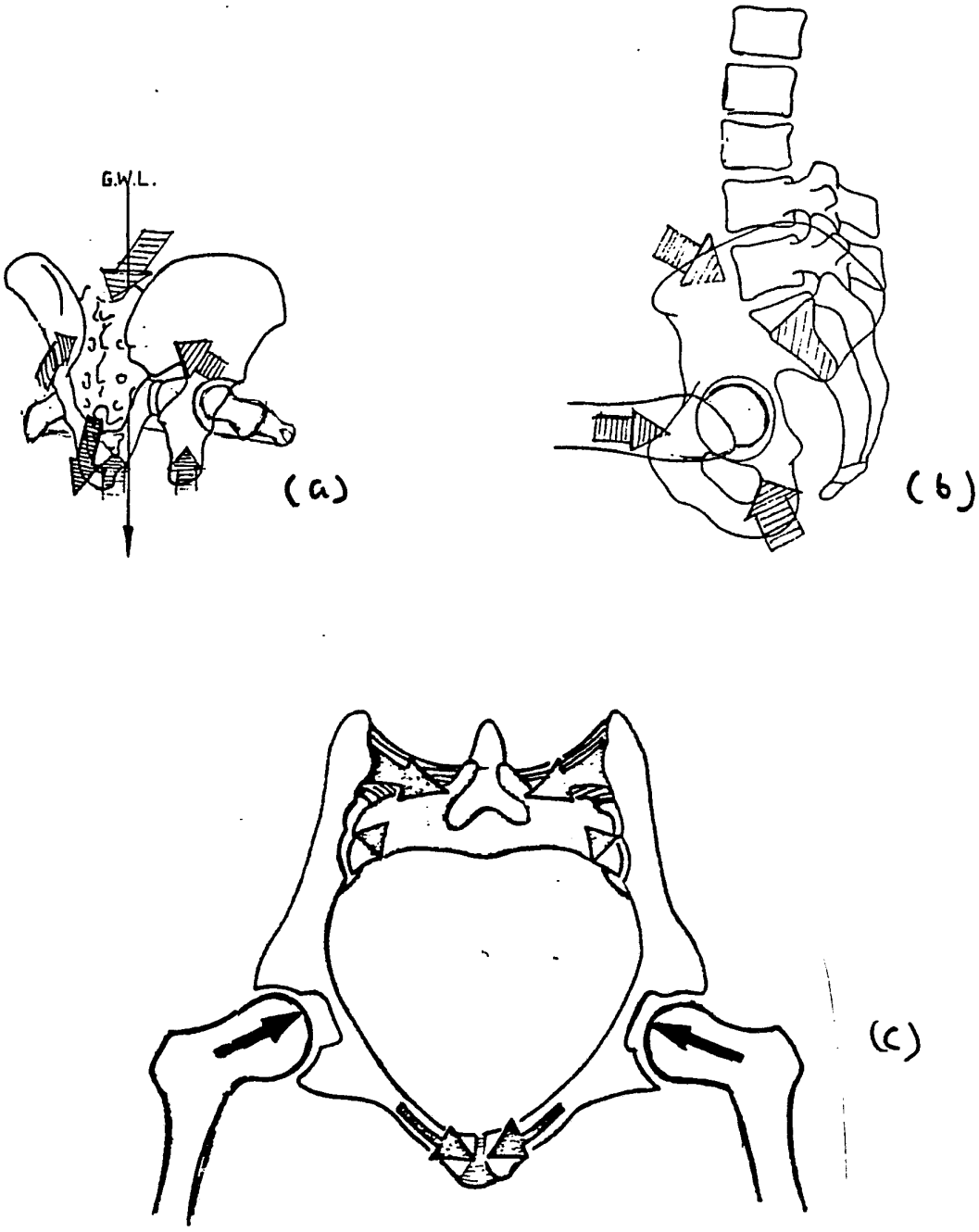


FIG. 4

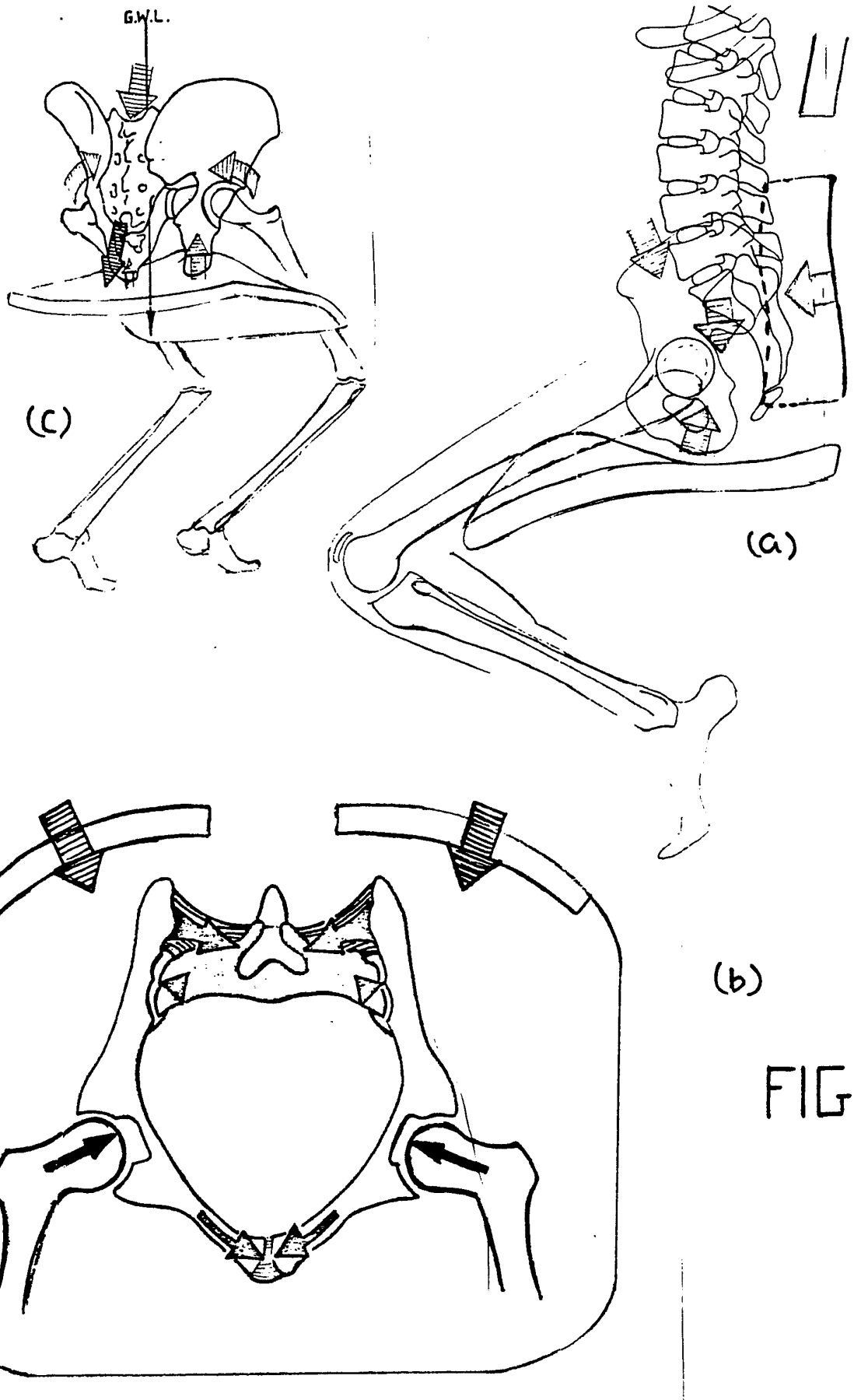


FIG.5

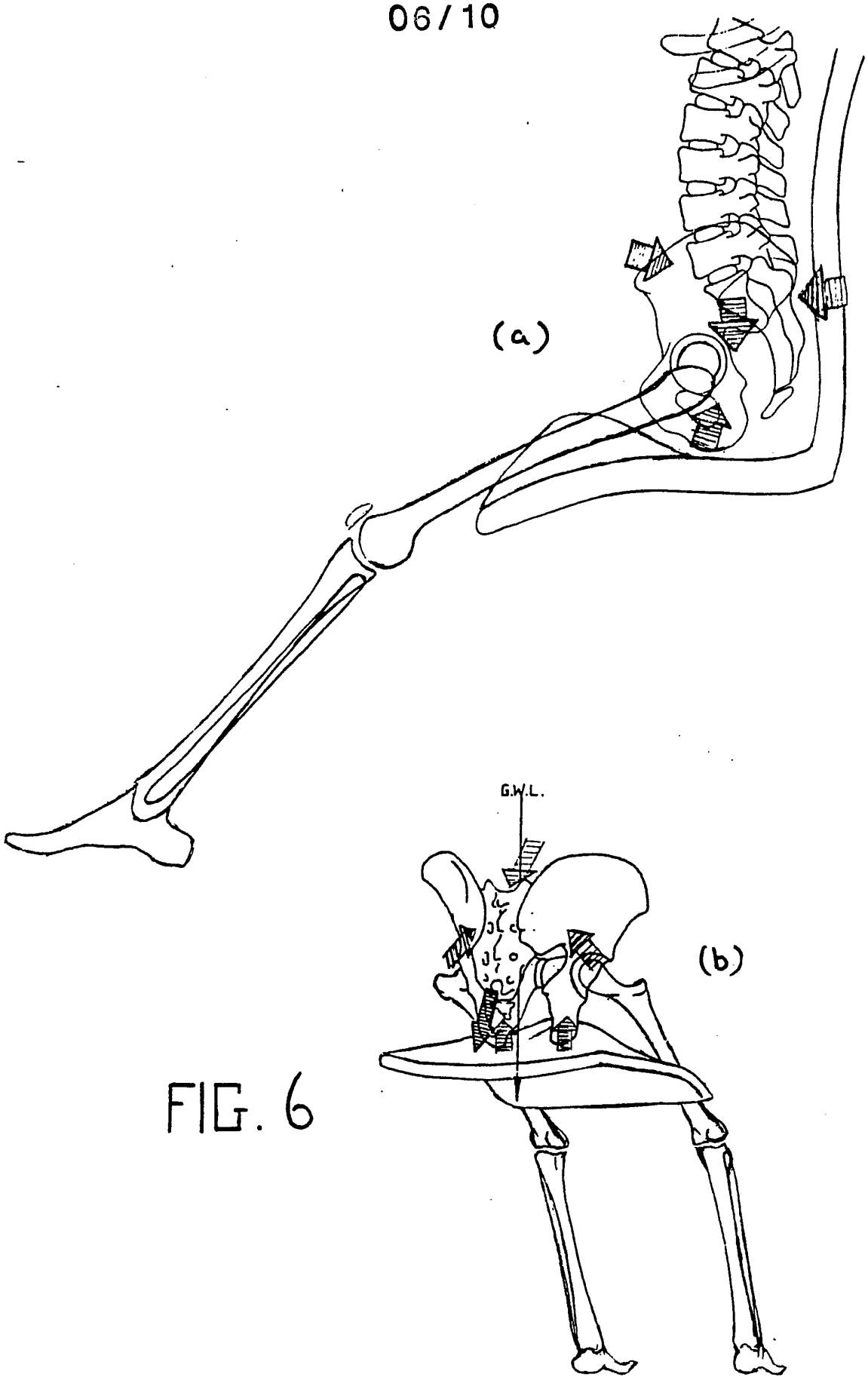


FIG. 6

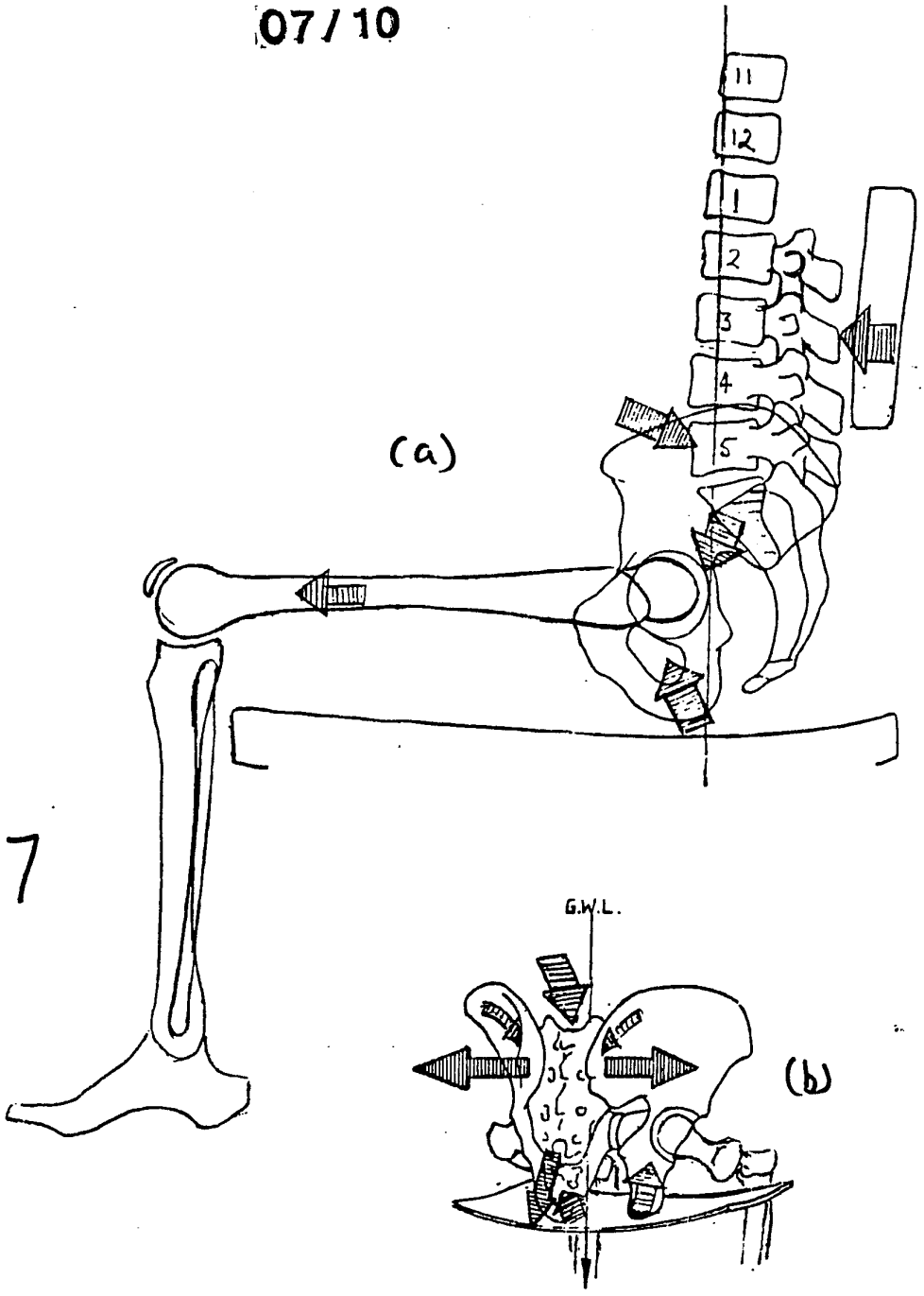


FIG. 7

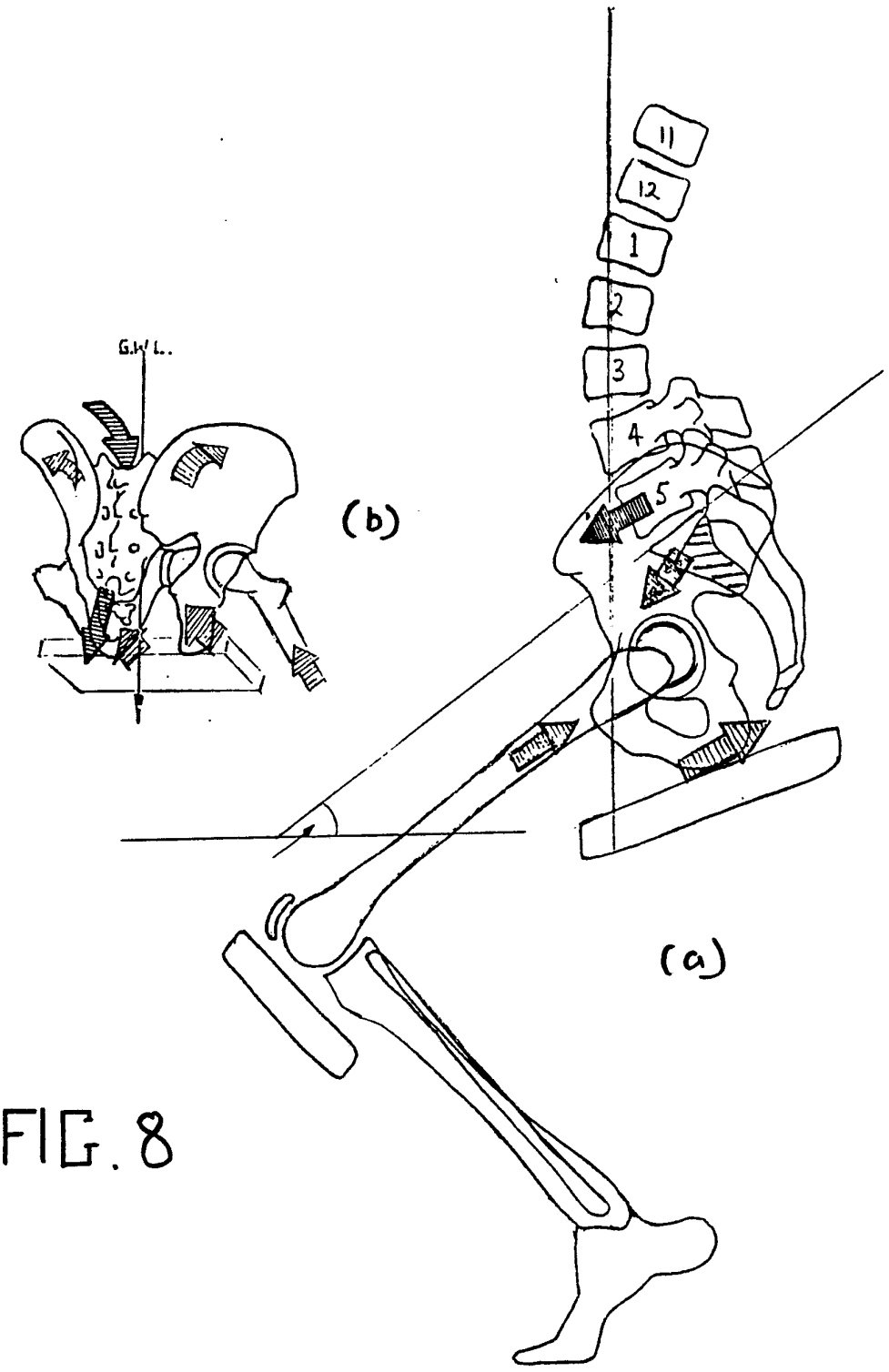
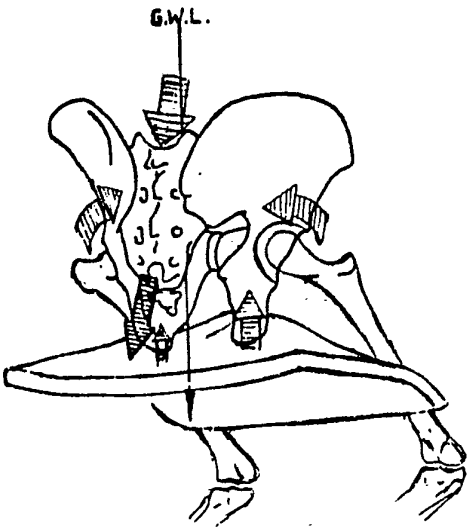
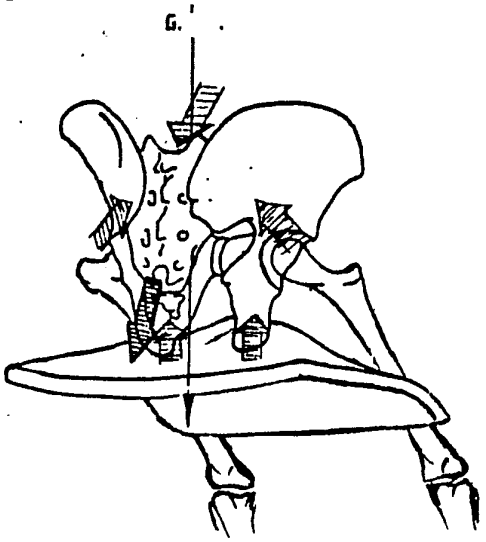


FIG. 8



(a)



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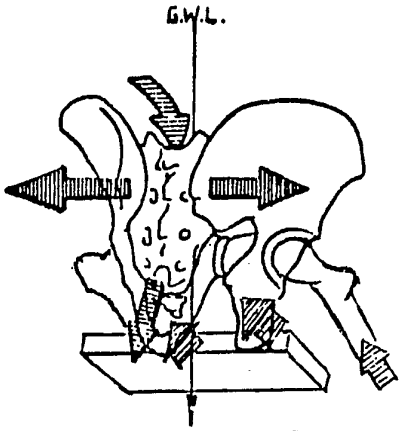
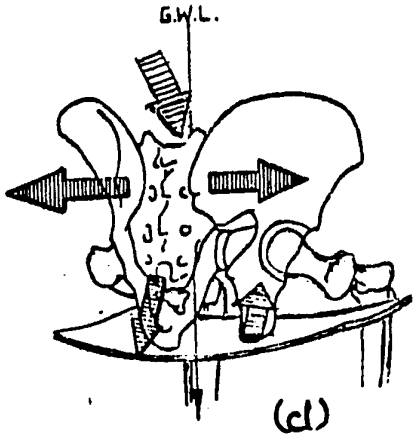
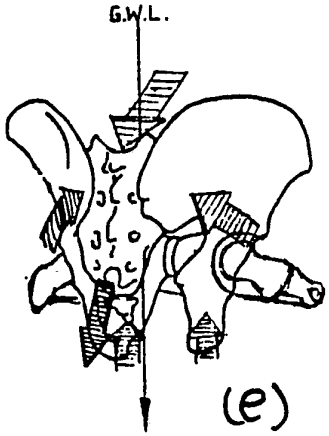


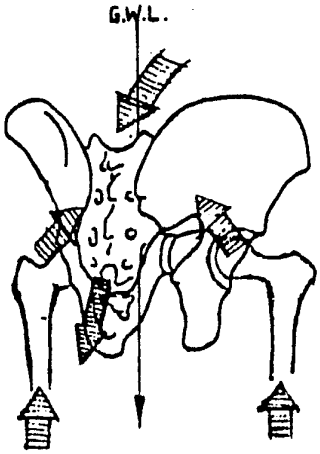
(c)



(d)



(e)



(f)

FIG. 9

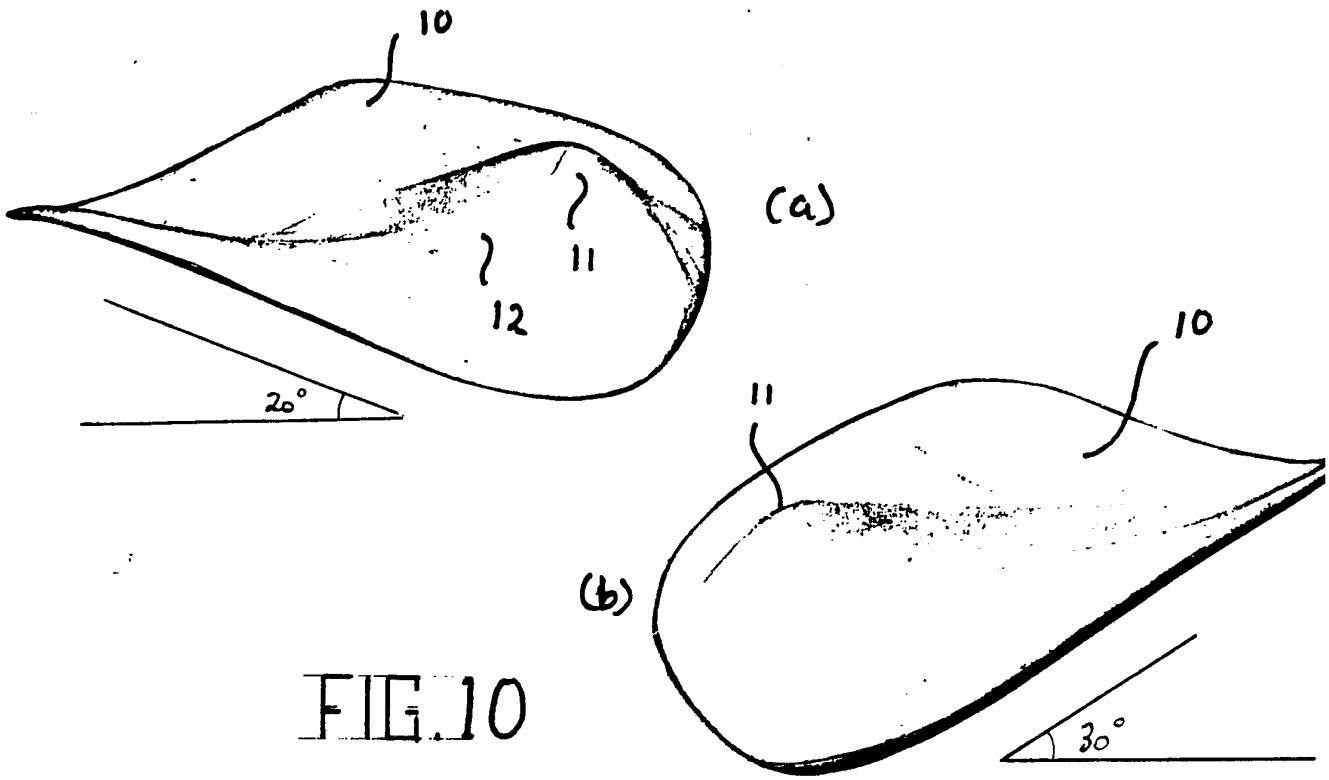
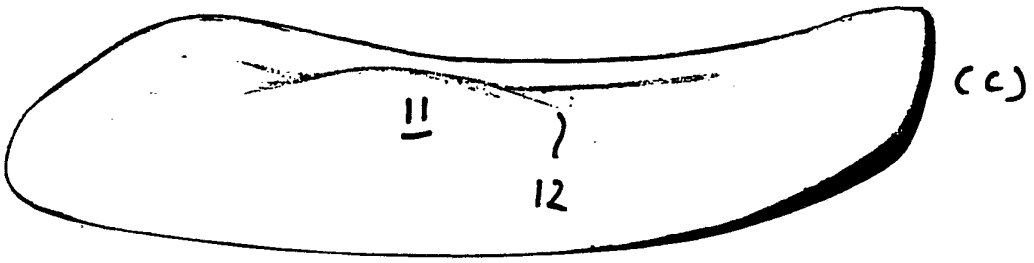
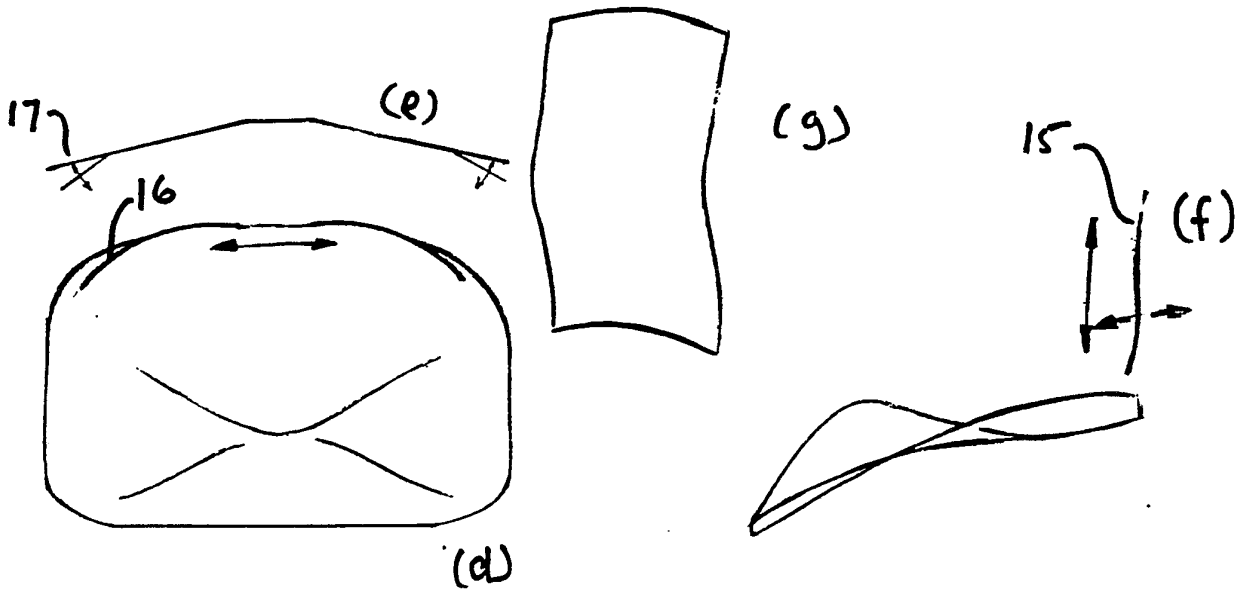


FIG.10





INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 90/00437

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[5] A47C 7/02

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
IPC	A47C 7/02

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category*	Citation of Document, [11] with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
X	EP,A, 0163437 (OPSVIK) 4 December 1985 (04.12.85) (all specification)	(1-11)
X	US,A, 3572830 (STORER) 30 March 1971 (30.03.71) (all specification)	
X	US,A, 1756545 (FORTNEY) 29 April 1930 (29.04.30)	

* Special categories of cited documents: 10

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15 November 1990 (15.11.90)	26 November 1990
International Searching Authority	Signature of Authorized Officer
Australian Patent Office	B.R. DASHWOOD

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 90/00437

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members					
EP 163437	AU	36411/84	CA	1230042	DK	2032/85
	FI	851695	JP	60242808	NO	841844
	NZ	211987	SU	1369663	US	4607882

END OF ANNEX