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 [73] Assignee **said Irwin assignor to said Pile**

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3,336,917	8/1967	Pile et al.	128/2

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[54] **BONE STRUCTURE MISALIGNMENT
 DETERMINING APPARATUS HAVING
 POSITIONING MECHANISM FOR SEATED
 PATIENT**

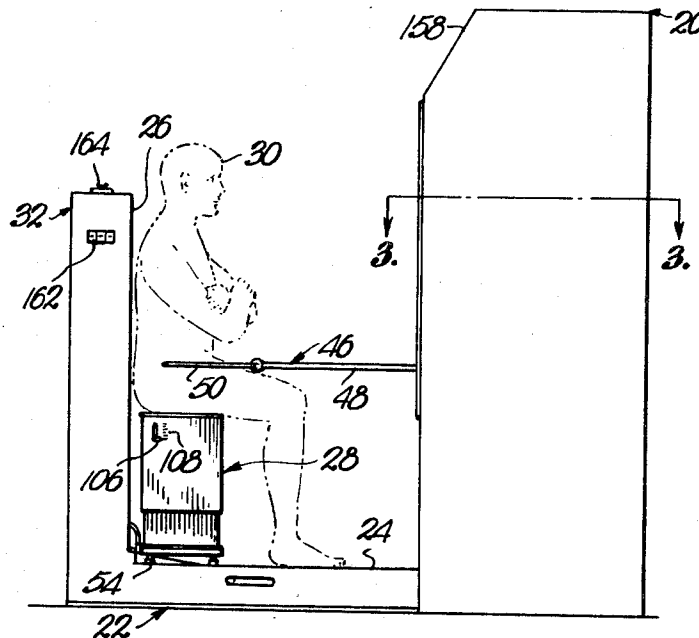
10 Claims, 10 Drawing Figs.

[52] U.S. Cl. **128/2,**
 33/174, 73/172
 [51] Int. Cl. **A61b 5/10**
 [50] Field of Search **128/2;**
 73/172; 33/174 (D)

[56] **References Cited**
UNITED STATES PATENTS

2,021,566	11/1935	Millard	128/2X
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ABSTRACT: Apparatus for use by chiropractors and other medical professionals has a seat for receiving a patient suspected of having misaligned bone structure. In particular, contact tips are shifted into engagement with the notches below the anterior-superior crests of the ilia and any deviation from the proper positions thereof is detected. The seat is provided with a pair of flat, pivotal members supporting the ischia of the patient which may be individually raised to compensate for any measured deviation. The required degree of movement of a given member is registered on a dial, the data thus obtained being used to prepare an ischial lift for the patient.



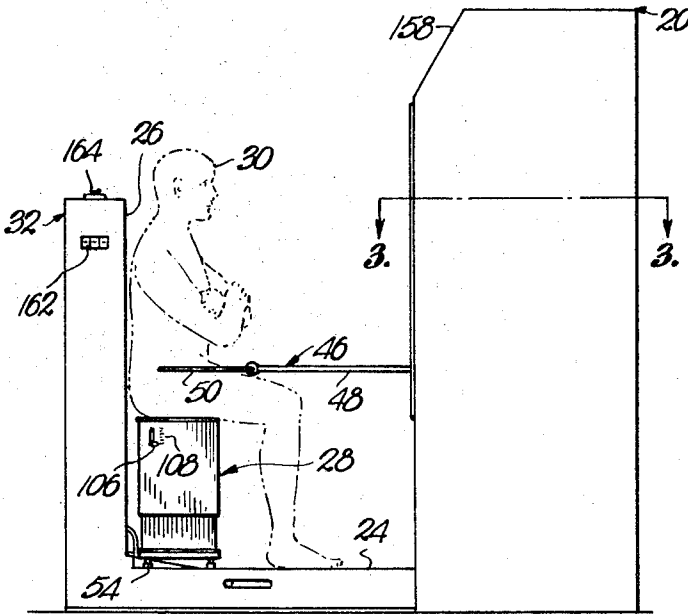


Fig. 1.

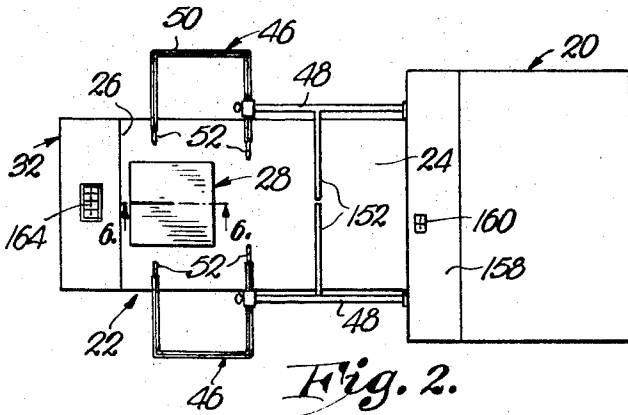


Fig. 2.

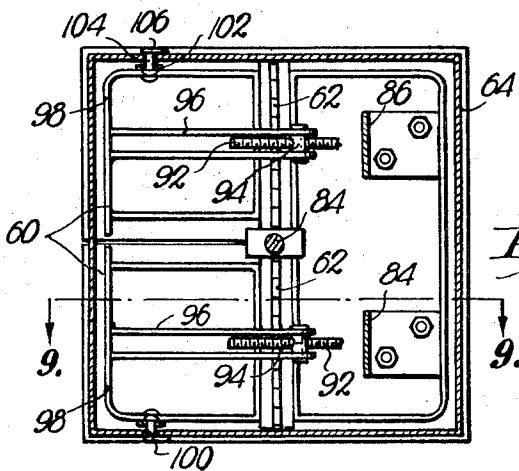


Fig. 7.

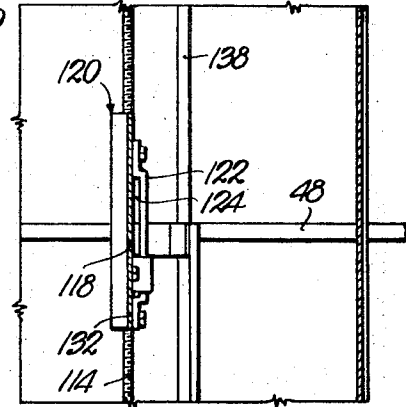


Fig. 5.

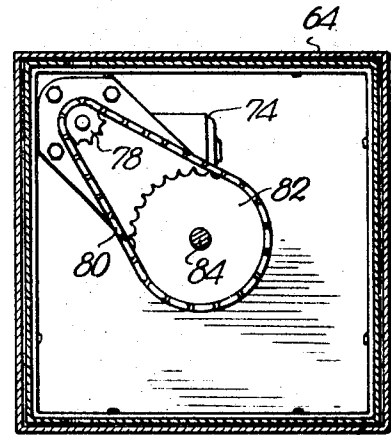


Fig. 8.

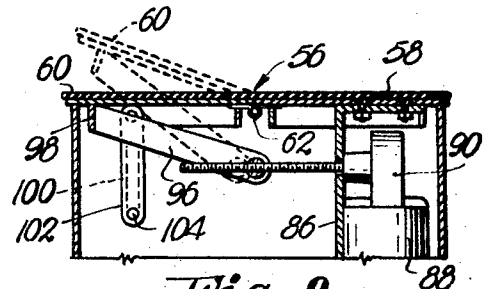


Fig. 9.

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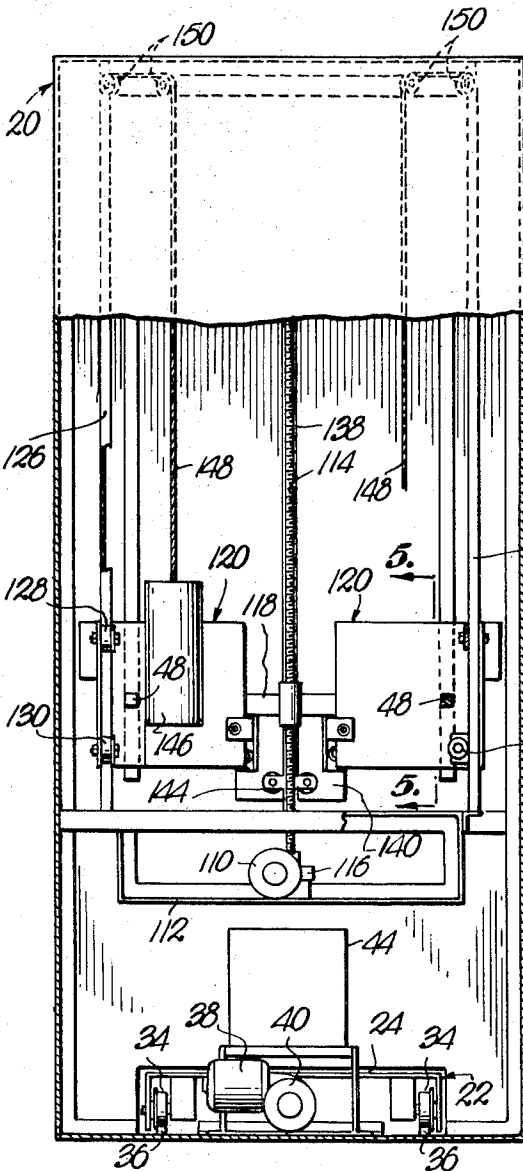


Fig. 4.

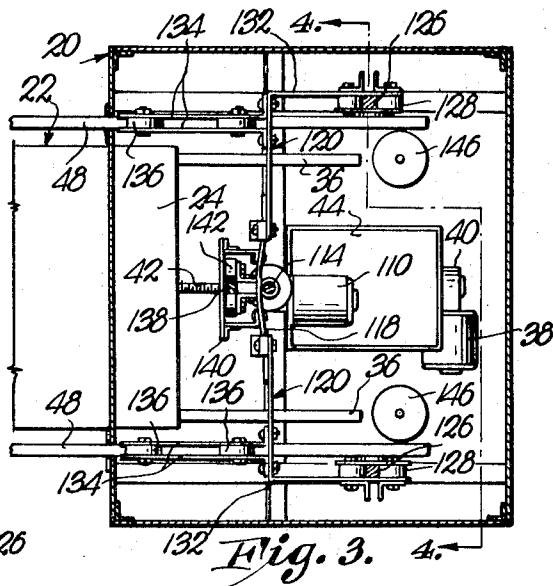


Fig. 3.

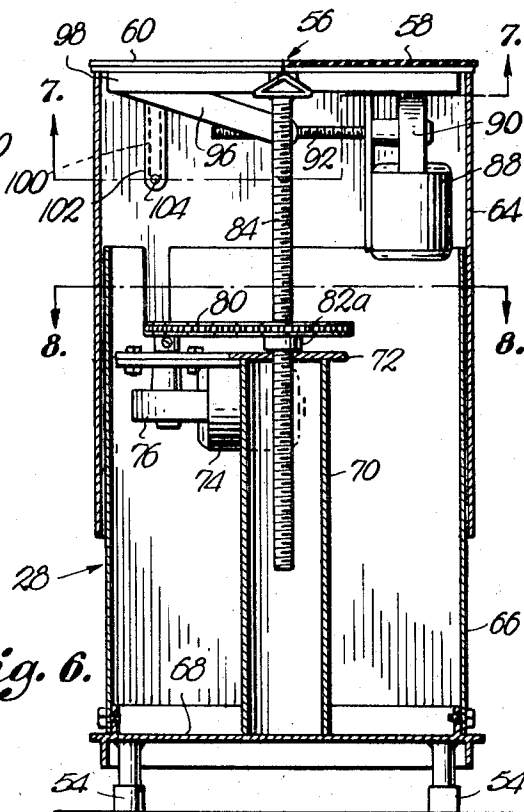


Fig. 6.

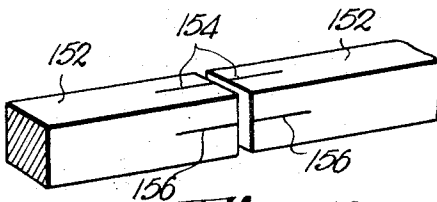


Fig. 10.

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BONE STRUCTURE MISALIGNMENT DETERMINING APPARATUS HAVING POSITIONING MECHANISM FOR SEATED PATIENT

In U.S. Pat. No. 3,336,917, owned by the assignee herein, apparatus is shown and described for determining misalignment of bone structure within the hip and lower back regions of a standing patient. Such apparatus has proven to be highly satisfactory as a practical and relatively inexpensive substitute for X-ray equipment and is capable of three-dimensional positional determinations which are difficult with two-dimensional radiographs. By utilizing the patented apparatus to both determine the proper dimensions of heel and arch supports and to accurately check such supports once prepared, prior cut-and-try methods are rendered obsolete as an up-to-date technique.

In many instances, however, a patient spends a considerable portion of his waking hours in a seated position rather than standing. Arch pads and heel lifts, of course, have no affect while the patient is seated, requiring that corrective supports for the ischia be employed if proper bone alignment in the pelvic regions is to be maintained. An ischial lift for placement in the patient's chair is used for this purpose, but must be accurately prepared as in the case of heel and arch supports to assure that a proper bone alignment correction is actually produced when the patient is seated on the lift.

Accordingly, it is the primary object of this invention to provide apparatus for determining the proper dimensions of a corrective ischial lift without relying on radiation photography as a means of furnishing the required data, and which is also less expensive in initial cost than X-ray equipment, virtually cost-free from an operational standpoint, and capable of readily ascertaining the exact relative three-dimensional positions of selected skeletal features of the patient.

A further and important object of the invention is to provide apparatus as aforesaid having a seat for the patient provided with shiftable, ischia-supporting members that may be individually raised to rotate the pelvis and move the patient to a sitting position where the pelvic regions of the patient are properly disposed.

Still another important object of the invention is to provide apparatus as aforesaid which registers the amount of pelvic movement required to properly align the notches below the anterior-superior crests of the ilia in order to provide data for use in preparing a corrective ischial lift. In the drawings:

FIG. 1 is a side elevational view of the apparatus showing a patient on the seat thereof;

FIG. 2 is a top plan view of the apparatus shown in FIG. 1;

FIG. 3 is an enlarged, horizontal sectional view taken along line 3-3 of FIG. 1;

FIG. 4 is a vertical sectional view taken along line 4-4 of FIG. 3 and looking into the rear of the main console;

FIG. 5 is a fragmentary, vertical sectional view taken along line 5-5 of FIG. 4 and on a larger scale than FIGS. 3 and 4;

FIG. 6 is an enlarged, vertical sectional view of the seat mechanism taken along line 6-6 of FIG. 2;

FIG. 7 is a horizontal sectional view taken along line 7-7 of FIG. 6 and looking upwardly;

FIG. 8 is a horizontal sectional view taken along line 8-8 of FIG. 6 and looking downwardly;

FIG. 9 is a fragmentary, vertical sectional view taken along line 9-9 of FIG. 7; and

FIG. 10 is a greatly enlarged, fragmentary, detail view showing the two indicator elements in perspective.

Referring initially to FIGS. 1-4, an upstanding housing 20 is shown in the form of a main console, and carrier 22 is illustrated having a horizontal platform 24 provided with an upstanding rest 26. A positioning mechanism 28 for a patient 30 seated thereupon is supported on platform 24 adjacent the rest 26, the latter forming one panel of a housing 32 in the form of a secondary console which is in horizontally spaced relationship to the main console 20.

The carrier 22 is provided with rollers 34 which rest upon a track 36 and permit reciprocation of the carrier 22 toward and away from the main console 20. Movement of the carrier 22 is

effected by a reversible DC motor 38 mounted in the main console 20, the motor 38 being coupled to a gear reduction transmission 40 having an externally threaded output shaft 42 extending in parallelism with the path of travel of the carrier 22 and into threaded engagement with a nut (not shown) mounted on the underside of the platform 24. The rectangular unit 44 shown adjacent the motor 38 is an inverter for providing direct current for motor 38 (and other motors in the consoles to be hereinafter described) from an available alternating current source.

A pair of measuring structures 46 extend outwardly from the main console 20 toward the patient 30, each structure 46 comprising a horizontally reciprocable arm 48 provided with a U-shaped rod 50 having a pair of contact tips 52 adapted for engagement with the patient 30. The rods 50 are secured to respective arms 48 by adjustable clamps which permit selective positioning of the contact tips 52 and horizontal movement of the rods 50 toward and away from each other. The legs of the rods 50 are of different lengths and may be selectively inserted in the respective clamps to permit either pair of laterally opposed contact tips 52 to be brought into contact with the patient. This arrangement provides ultimate flexibility in accommodating patients of various sizes. In FIGS. 1 and 2, the opposed contact tips 52 on the shorter legs of the rods 50 are illustrated in use with each such tip contacting the notch below the anterior-superior crest of the ilium of the respective side of the patient 30.

In the aforesaid patient, a patient under treatment stands upon the platform 24 against the rest 26 with his feet in overlying relationship with respect to vertically shiftable arch- and heel-supporting elements (not shown) in the platform 24. In the present invention, however, the patient 30 is seated on the positioning mechanism 28 as shown in FIG. 1 and discussed hereinabove, the mechanism 28 having depending feet 54 that support the same adjacent the rest 26 in overlying relationship to the mentioned arch and heel-supporting elements utilized with a standing patient. It may be appreciated, therefore, with reference to the aforesaid patent, that the positioning mechanism 28 is illustrated herein as an attachment or supplemental unit to be employed when it is desired to utilize the measuring structures 46 to detect bone structure misalignment when the patient is seated rather than standing. In practice, it may be desired to construct the secondary console 32 and the carrier 22 with the mechanism 28 as a part of the composite structural assembly, rather than employing the mechanism 28 as an attachment as illustrated herein. However, the attachment arrangement increases the versatility of the apparatus in that the mechanism 28 may be removed from platform 24 so that the latter may receive a standing patient in accordance with the teachings of the aforesaid patent.

The positioning mechanism 28 for the seated patient 30 is shown in detail in FIGS. 6-9. A flat seat is broadly denoted 56 and includes a stationary, horizontal front section 58 and a pair of pivotal, side-by-side rear members 60. A pair of coaxial hinges 62 mount respective members 60 for swinging movement about a horizontal axis extending laterally of the patient 30, the members 60 being in the nature of flaps which underlie and support the ischia of the seated patient. The hinges 62 are on the underside of the seat 56 and are centrally disposed front-to-rear to essentially pivotally mount the members 60 on the rear edge of the front seat section 58. Normally, the members 60 are horizontally disposed and thus cooperate with the stationary front section 58 to present a horizontal surface upon which the patient 30 is initially seated.

The seat 56 is supported upon an elongated, upright, rectangularly shaped, outer housing 64 which is telescoped over a similarly configured inner housing 66. The bottom end of the inner housing 66 is rigid with a baseplate 68 from which the feet 54 depend. A tubular center post 70 stands on baseplate 68 and has a bearing plate 72 closing the upper end thereof. A reversible electric motor 74 is mounted on the post 70 and, through a gear reduction transmission 76, drives a

sprocket 78 about which a drive chain 80 is trained. A driven sprocket 82 is threaded on a vertical center screw 84 that extends through the bearing plate 72 axially of the tubular post 70. The sprocket 82 has a hub 82a which overlies and bears against the plate 72 as is clear in FIG. 6. The upper end of the screw 84 is rigidly affixed to the center of the seat 56, as seen in FIGS. 6 and 7.

A pair of mounting brackets 86 depend from the front seat section 58 and support a pair of reversible electric motors 88 that control the attitudes of the pivotal seat members 60. Each motor 88 has its output coupled to a gear reduction transmission 90 which is provided with a threaded output shaft 92 received by a tapped follower 94 carried by a pair of side-by-side links 96 rigid with the respective seat member 60. The pairs of links 96 are angularly disposed and are secured to corresponding members 60 by such means as welding the upper ends thereof to ribs 98 on the underside of members 60.

In order to register the displacement of individual members 60 away from their normal, horizontal dispositions, each sidewall of housing 64 has a vertical slot 100 therein near the top thereof adjacent the corresponding member 60. An upright link 102 is pivotally attached at its upper end to the rib 98 on the bottom of each member 60 at the side thereof, the lower end of each link 102 being provided with a laterally projecting pin 104 which extends through the corresponding slot 100. A pointer 106 is secured to the outer end of each pin 104 and is thus outside the housing 64. The position of each pointer 106, and hence the elevation of the associated seat member 60, is indicated by a series of vertically spaced graduations 108 (FIG. 1) on the sidewall of housing 64 adjacent the slot 100.

In order to bring a selected, opposed pair of the contact tips 52 into engagement with desired skeletal features of the seated patient 30, each of the measuring structures 46 is independently shiftable along orthogonal paths of travel extending horizontally and vertically. As in the aforesaid patent, a reversible electric motor 110 is supported in the main console 20 by a mount 112, the motor 110 serving as a prime mover for a vertically extending screw 114 which forms the output shaft of a speed reduction transmission 116. A link or strap 118 threadably receives the screw 114 and interconnects a pair of carriages 120 which support respective structures 46 and are laterally spaced from screw 114 on opposite sides thereof. Particularly in FIG. 5, it may be seen that each end of the strap 118 is coupled with the corresponding carriage 120 by a lost motion connection 122 in the form of a bracket defining a vertically extending slot 124 receiving the associated end of strap 118.

A vertical guide 126 is associated with each of the carriages 120 and is received by upper and lower roller assemblies 128 and 130 mounted on the associated carriage 120. Each of the upper roller assemblies 128 comprises a pair of opposed rollers, while each lower assembly 130 utilizes three rollers in engagement with the respective vertical guide 126. Each carriage 120 includes a main, L-shaped plate 132 as viewed in a horizontal plane, one leg of which extends laterally of console 20 with the other leg extending rearwardly toward the respective vertical guide 126. The roller assemblies 128 and 130 are mounted on the rearwardly extending legs of the plates 132 as is clear in FIG. 3.

The horizontal arm 48 of each measuring structure 46 is received by a horizontal guide extending forwardly from plate 132 of a corresponding carriage 120, such guide comprising a pair of upright plates 134 which mount two pairs of vertically opposed rollers 136. In FIG. 3, only the upper roller 136 of each pair is visible, each arm 48 being received between the two vertically spaced rollers 136 of each of the two pairs thereof associated with the corresponding guide plates 134.

The carriages 120 are movable vertically along guides 126 and are additionally supported by a vertical center guide 138 extending in closely spaced, parallel relationship to the vertical screw 114. Bracket structure 140 is secured to the plates 132 of carriages 120 and supports three rollers 142

which bear against the sides and rear of the center guide 138 as is clear in FIG. 3. The bracket structure 140 also mounts a pair of opposed rollers 114 beneath the three rollers 142 which engage opposite sides of the guide 138.

From the foregoing it is apparent that, as screw 114 rotates, the strap 118 will rise or fall depending on the direction of rotation of screw 114. This, in turn, carries bracket structure 140 and the carriages 120 upwardly or downwardly. Once the carriages 120 are disposed at the desired height, the lost motion connections 122 permit manual movement of the carriages through a displacement of several inches. In order to maintain each carriage 120 at the proper height when it is moved within the confines of its lost motion connection 122 to a desired elevation and then released, a counterweight 146 is connected to each carriage 120 respectively by a cable 148 which is trained over a pair of pulleys 150 mounted adjacent the top of the console 20.

The relative positions of the two measuring structures 46 are indicated by a pair of horizontal bars 152 carried by respective arms 48 which extend toward each other with their terminal ends in close proximity, as seen in FIGS. 2 and 10. Each bar is in the nature of an indicator element having an upper mark 154 and a lateral mark 156 thereon at its terminal end, alignment of the marks 154 and 156 being indicative of proper anterior-posterior and superior-inferior alignment of the skeletal features contacted by the opposed tips 52. When either pair of the opposed tips 52 is in both horizontal and vertical alignment, the indicator marks 154 and 156 are likewise aligned as in FIG. 10.

The console 20 is provided with a control panel 158 upon which a pair of double-throw switches 160 are mounted for the purpose of controlling the reversible motors 38 and 110 that drive the carrier 22 and raise and lower the carriages 120. A bank of three double-throw switches 162 is mounted on the side of the secondary console 32 for the purpose of controlling the reversible motors 74 and 88 of the positioning mechanism 28, the switches 162 being connected to the motors of mechanism 28 by a conductor cable (not shown) provided for such purpose. The bank of switches 164 mounted on the top of the secondary console 32 control the heel and arch supporting elements shown and described in the aforesaid patent, and are not used in the operation of the present invention.

OPERATION

Initially, the pivotal seat members 60 are in their normal positions illustrated in full lines in FIG. 9 where both the members 60 and the stationary front section 58 of the seat 56 cooperate to present a flat, horizontal surface. The patient 30 is measured while in a sitting position on seat 56 as illustrated in FIG. 1, a selected, opposed pair of contact tips 52 being brought into engagement with selected skeletal features. It is assumed that such features are the notches below the anterior-superior crests of the ilia, it being desired that the notches be maintained in the same vertical and horizontal planes while the individual is seated. When so aligned, the ischia provide a proper foundation level for the pelvis in the sitting position.

Maximum flexibility is provided by the apparatus in the positioning of the patient 30 with respect to the measuring structures 46. By operation of motor 74 of the mechanism 28, the seat 56 may be raised and lowered as desired. Movement of the patient 30 toward and away from the console 20 is effected by operation of the drive motor 38 for the carrier 22. The carriages 120 are raised and lowered as discussed previously by operation of motor 110 with final adjustment of the heights of the contact tips 52 being effected manually by virtue of the provision of the lost motion connections 122. Horizontal movement of the measuring structures 46 is also effected manually by shifting the horizontal arms 48 in the guide plates 134.

With the contact tips 52 properly located, the operator views the marks 154 and 156 on the bars 152 to determine if

any misalignment is present. If a misalignment condition is found, one of the two seat members 60 is elevated by energizing the appropriate drive motor 88 to swing the member 60 about its hinge 62 as illustrated by the broken lines in FIG. 9. It may be appreciated that the raising of one of the members 60 out of the normal plane of the seat 56 by the illustrated pivotal movement also causes the raised member 60 to impart forward movement to the portion of the pelvis supported thereby. Thus, one side of the pelvis is rotated by a wedge action with the force being directed against the ischium on that particular side.

In compensating for the misalignment condition, normally only one of the members 60 is raised out of the plane of the seat 56 to move the posterior ischium forward until proper alignment of the pelvic notches is obtained. Such proper alignment will be immediately apparent by viewing the marks 154 and 156. It should be understood that the rotative movement of the individual members 60 is also advantageous in that it enables the apparatus to accommodate patients of widely varying physical sizes.

Once proper alignment is obtained, the operator reads the indication of the pointer 106 of the raised member 60 to obtain data for the preparation of a corrective ischial lift. The graduations 108 may, for example, indicate elevation in millimeters at the radial distance of the pointer 106 from the pivotal axis defined by the hinges 62. Once the corrective lift is prepared, it may be appreciated that its accuracy is readily checked by placing the lift on the seat 56 with the members 60 in their normal, horizontal dispositions, whereupon the patient then seats himself on the lift and is again measured by the structures 46. If the lift is not correct, it will be apparent to the operator by viewing the marks 154 and 156 which, of course, will still indicate that a misalignment condition is present.

We claim:

1. Apparatus for determining bone structure misalignment including:
 - a seat for receiving a patient;
 - means supporting said seat at an elevation permitting the patient to assume a normal sitting position when the patient is on the seat;
 - measuring means adjacent said seat and adapted to contact selected skeletal features of the seated patient for detecting any deviation of said features from the proper positions thereof;
 - said seat having a pair of shiftable members for supporting the ischia of the seated patient; and
 - selectively operable means coupled with said members for individually raising and lowering the latter, whereby the positions of said selected skeletal features may be changed while the patient is on the seat to compensate for any deviation from the proper positions thereof detecting by said measuring means.
2. Apparatus as claimed in claim 1;
 - said seat being flat and said members having normal dispositions in which the seat presents a generally horizontal surface for supporting the patient;
 - said selectively operable means, upon said raising and lowering of individual members, shifting the latter out of the plane of said surface.
3. Apparatus as claimed in claim 1; said seat being provided with means mounting each of said members for pivotal movement about a generally horizontal axis and in a forward direction with respect to the seated patient as the member is raised.
4. Apparatus as claimed in claim 1; said seat having a flat, generally horizontally disposed front section and being provided with means mounting said members in side-by-side relationship behind said front section for pivotal movement about a generally horizontal axis disposed substantially

between the front section and said members and extending laterally with respect to the seated patient.

5. Apparatus as claimed in claim 1; said measuring means including a pair of measuring structures each having a contact tip adapted for engaging a respective selected skeletal feature, means mounting said measuring structures adjacent said seat for movement of each measuring structure along orthogonal paths of travel toward and away from the seated patient and along the length of the patient above the seat, whereby to bring the tips into contact with respective features, and means operably associated with said measuring structures for indicating the degree of relative movement of the measuring structures away from a predetermined, normal relative disposition corresponding to proper alignment of the skeletal features contacted by said tips, whereby misalignment thereof is indicated if relative movement of said measuring structures away from said normal relative disposition is required to bring said tips into contact with respective features.

6. Apparatus as claimed in claim 5; said mounting means including a pair of vertically reciprocable carriages for said measuring structures, each carriage having a guide receiving the respective measuring structure for reciprocal, horizontal movement thereof with respect to the carriage, whereby to provide said orthogonal paths of travel of each of said measuring structures.

7. Apparatus as claimed in claim 5; said indicating means including a pair of indicator elements carried by respective measuring structures and extending therefrom toward each other into closely spaced interrelationship; each of said elements having a pair of marks thereon disposed to represent anterior-posterior and superior-inferior deviations in accordance with the degree of misalignment of corresponding marks of the respective elements.

8. Apparatus as claimed in claim 1; and means responsive to shifting of each of said members away from a normal disposition thereof for registering the degree of movement of a shifted member away from its normal disposition required to effect proper positioning of said selected skeletal features, whereby the data thus obtained may be used to prepare an ischial lift for the patient.

9. Apparatus as claimed in claim 1; said seat being flat and said members having normal dispositions in which the seat presents a generally horizontal surface for supporting the patient; said selectively operable means, upon said raising of an individual member, shifting the latter upwardly out of the plane of said surface; and means responsive to said upward shifting of an individual member for registering the amount of upward movement thereof from its normal disposition required to effect proper positioning of said selected skeletal features, whereby the data thus obtained may be used to prepare an ischial lift for the patient.

10. Apparatus as claimed in claim 1; said measuring means including a pair of measuring structures each having a contact tip adapted for engaging a respective selected skeletal feature, and means horizontally spaced from said seat and mounting said measuring structures for reciprocal movement of each measuring structure along vertical and horizontal paths of travel;

said supporting means including a horizontally reciprocable carrier supporting said seat for movement toward and away from said mounting means, and means for raising and lowering said seat, whereby to facilitate positioning of the patient for contact by said tips.