March 13, 1973 R. BERGMANN ET AL 3,720,442

CHAIR

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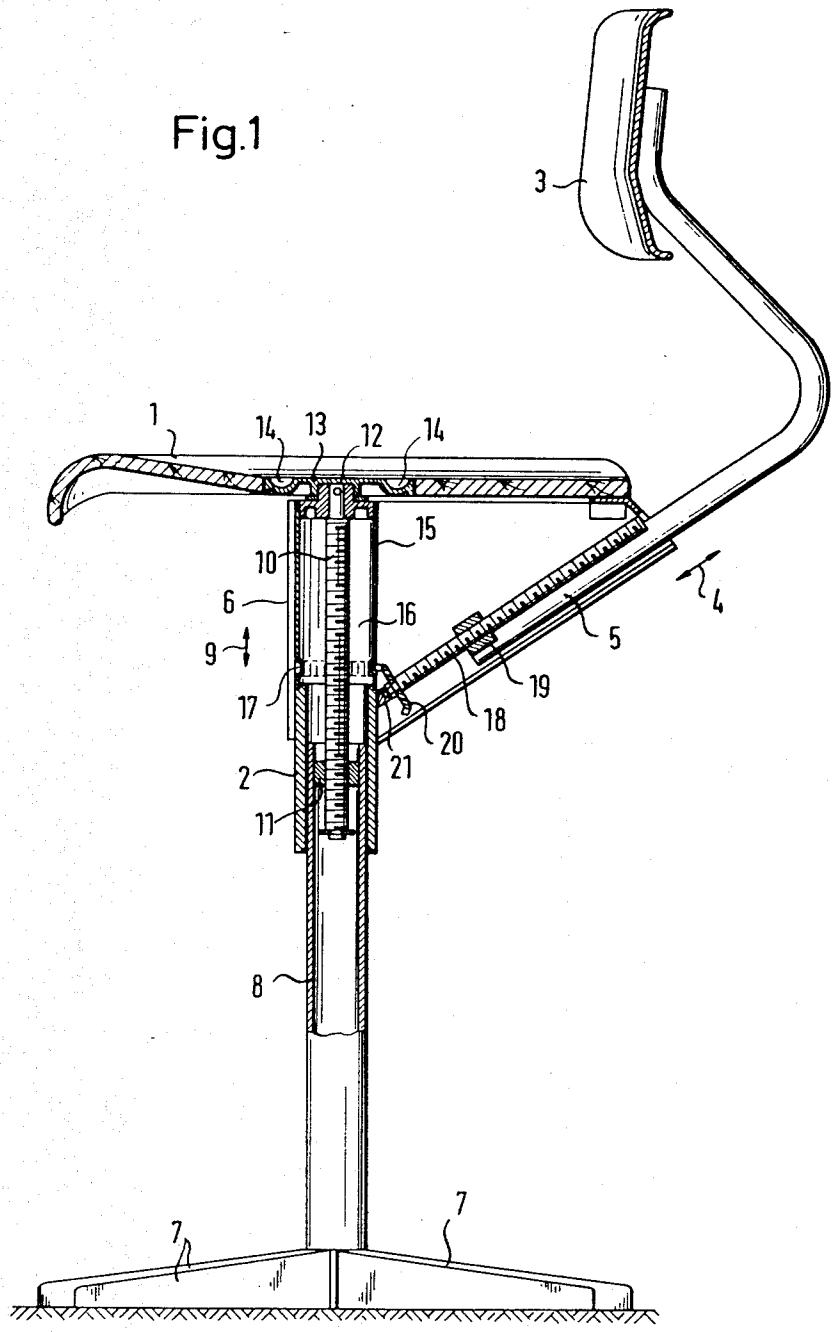
Fig.1



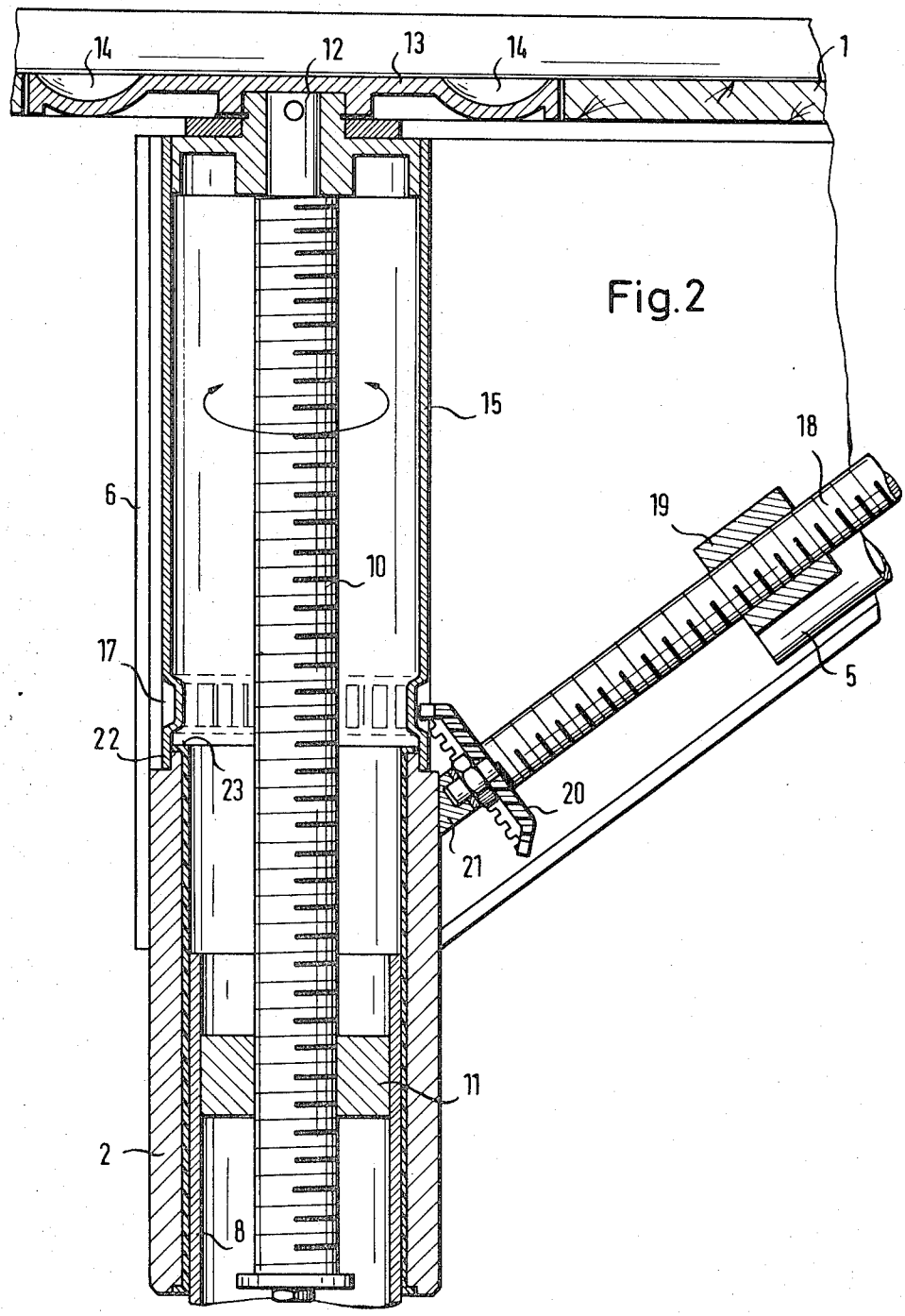


Fig.2

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CHAIR

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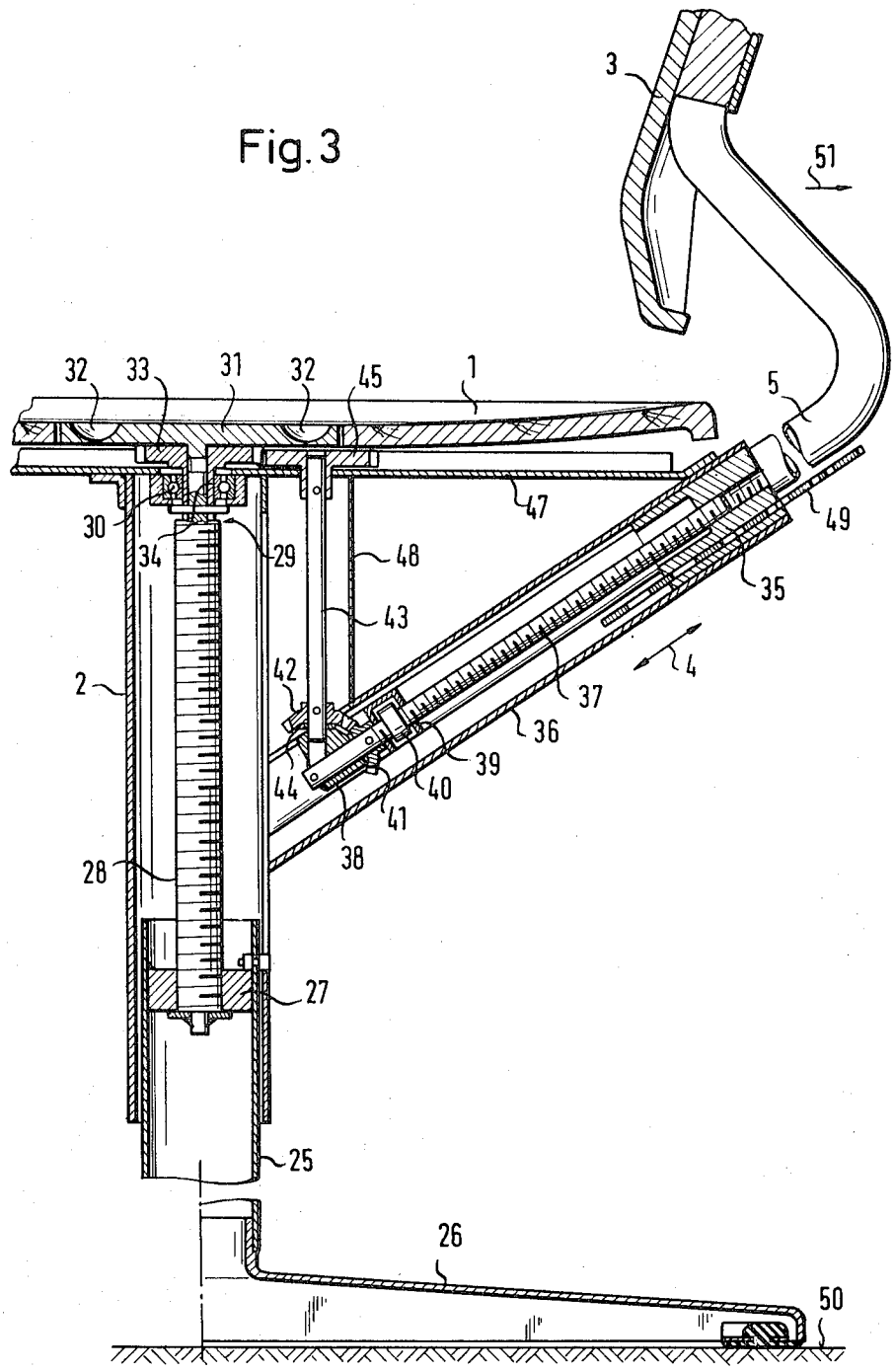
Fig. 3



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CHAIR

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Int. Cl. A47c 3/20, 3/40
U.S. Cl. 297—348 26 Claims

ABSTRACT OF THE DISCLOSURE

A chair having a base adapted to rest on the floor, a seat adjustable to different heights from the base, a back rest adjustable in an upwardly inclined direction from the rear side of the seat to different distances from the base and from the seat, and common means for adjusting the seat and back rest so as to increase or reduce their heights and positions simultaneously but differently from each other.

The present invention relates to a chair which comprises a base which is adapted to rest on the floor, a seat which is adjustable to different heights from the base, a back rest which is adjustable in an upwardly inclined direction from the rear side of the seat to different heights from the base and from the seat, and common means for adjusting the seat and back rest simultaneously.

It is an object of the present invention to provide a chair of the type as mentioned above which is primarily intended for use in schools for pupils of different ages and sizes.

School children may vary considerably in size even if they belong to the same age group. This is true to a still greater extent if they belong to different age groups. If the chairs for all of these children are to be of of a standard construction, the heights of the seats and back rests of these chairs must be considerably adjustable. Some modern school systems provide that the pupils of the same class and age groups attend their lectures in different subjects in different classrooms of their school in which previously lectures might have been held for pupils of different age groups. The chairs according to the invention should therefore be designed so as to permit them to be very quickly adjusted in accordance with the particular sizes of the pupils who are to sit on them so as not to lose any time or as little time as possible which is to be devoted to the lectures.

It is another object of the invention to design such a chair so as to permit not only its seat to be quickly raised or lowered, but also its back rest which, however, must be adjustable to a different extent from the seat not only in its height from the floor so as to vary its level with respect to the level of the seat, but also to vary the distance of the vertical plane of the back rest from the vertical plane extending through the front edge of the seat. This is necessary because a taller person not only requires his seat to be at a higher level from the floor and his back rest to be at a higher level from that of the seat of a shorter person, but in accordance with the other development of his body structure the taller person also requires the back rest to be located more toward the rear of the seat. Even though the bodily development of persons of the same height may also vary noticeably, the amount which the back rest of a chair should be shifted in relation to the seat when the latter is being raised or lowered for persons of an average bodily development may be determined by available statistics.

Further objects of the invention are to design a chair as previously described so as to be as sturdy as possible

especially in view of the rough usage to which it may be subjected by very lively school children, and to permit such a chair to be adjusted as easily as possible and without requiring it for any adjustment to be displaced from its normal position on the floor since such movements of the chair might not only result in damage to this chair but also to damage of other furniture in the schoolroom.

For attaining these objects, the invention provides that the seat of the chair is mounted on a substantially vertical post which is axially adjustable to different heights from the base or foot of the chair; that the back rest is mounted on an arm which is adjustable in an upwardly inclined direction relative to the seat for changing the height of the back rest from the base and also from the seat and also for shifting the vertical plane of the back rest relative to the vertical planes of the front and rear edges of the seat; and that both adjustments of the seat and back rest may be carried out simultaneously by a common adjusting mechanism.

A further object of the invention consists in designing the chair despite its adjustability so as preferably to prevent its seat from being rotatable relative to its base. This last object is of importance especially for chairs for school children since the seat of a chair which is rotatable relative to its base practically invites a child or pupil sitting on it to rotate back and forth with the seat and thus to be playful and inattentive during a lesson. However, for special purposes the chair should also permit it to be modified so as to permit its seat to be turned relative to its base without affecting the adjustments of the seat and back rest.

A further object of the invention consists in designing the chair so as to prevent any adjustments thereof to be made as long as a person is sitting thereon. This is intended for preventing a child from playing with the adjusting mechanism during class so that the child's attention will not be diverted from the lesson.

The features and advantages of the present invention will become further apparent from the following detailed description thereof which is to be read with reference to the accompanying drawings, in which:

FIG. 1 shows, partly in section, a side view of the chair according to the invention;

FIG. 2 shows an enlarged vertical section of the drive means for adjusting the chair as shown in FIG. 1; while

FIG. 3 shows a vertical section of a modification of the drive means for adjusting the chair.

Referring particularly to FIGS. 1 and 2 of the drawings, the chair according to the invention comprises a base or foot **7** to the center of which a vertical tubular post **8** is secured on which a gear housing **6** to which a seat plate **1** of a suitable contour is secured is vertically slidable in the direction of the arrow **9** together with the seat plate **1**. Seat plate **1** is further connected to a tubular member **2** which is likewise slidable in the vertical direction relative to post **8**. The back rest **3** of the chair is connected to the upper end of an arm **5** the lower part of which is slidably mounted within the gear box **6** so as to be movable obliquely in the upward or downward direction as indicated by the arrow **4**. Gear housing **6** is interposed between the seat plate **1** and the tubular member **2** and rigidly connected to the latter. Seat plate **1** together with gear housing **6** may be rotatable but is preferably nonrotatable relative to post **8**. The tubular seat-supporting member **2** is telescopically slidable along the outer surface of the vertical post **8** which, in turn, is secured to the base **7**. By suitable means, not shown, for example, a tongue and groove joint, the two telescoping members **2** and **8** may be prevented from turning relative to each other. The means for sliding the tubular member **2** along post **8** comprise

a threaded spindle **10** which is movable in the vertical direction of the arrow **9** by being screwed into a nut **11** which is secured to the inner wall of post **8**. The upper end **12** of spindle **10** is connected to the seat plate **1** so as to be rotatable but not vertically slidable relative thereto. This upper end of spindle **10** is also rigidly secured to a rotary knob **13** the upper surface of which is in alignment with the upper surface of the adjacent parts of seat plate **1** and is provided either with recesses into which a key may be inserted or with concave thumb recesses **14** for easily turning the spindle **10**.

The upper end **12** of spindle **10** is further secured to a cylindrical tube **15** which extends along a part of the length of spindle **10** and surrounds the same by leaving an annular gap **16**. The lower end **22** of this tube **15** is rotatably mounted on the upper end **23** of the tubular member **2** which is for this purpose provided with a step-shaped recess which engages laterally and with the lower end surface of the part **22** of tube **15**. The inner diameter of tube **15** corresponds at least to the outer diameter of post **8** so that tube **15** is likewise telescopically slidable over the post **8**. Directly above its lower end **22**, tube **15** is provided with a set of gearlike teeth **17** in its peripheral surface.

At the inside of gear housing **6** another threaded spindle **18** is rotatably mounted the axis of which extends in the direction of the arrow **4** and coincides with the axis of the lower part of arm **5** which carries the back rest **3**. Spindle **18** is screwed into a nut **19** which is rigidly connected to the arm **5**. Arm **5** is nonrotatably mounted by suitable means at the inside of gear housing **6**. The upper part of arm **5** may also be bifurcated to provide a firmer support for the back rest **3**.

The lower end of spindle **18** carries a gear **20** which in the particular chair construction as illustrated forms a bevel crown gear which may be molded of plastic. This crown gear **20** meshes with the set of gear teeth **17** in the peripheral surface of tube **15**. The lower end of spindle **18** is rotatably mounted in a thrust bearing **21** which is rigidly secured to the tubular member **2**. Thus, a pressure which might be exerted in the longitudinal direction upon the arm **5** will be taken up by this thrust bearing **21** and will not affect the proper engagement of crown gear **20** with gear **17**.

Gear housing **6** is further provided with an aperture through which a tool may be inserted into spindle **18** for turning the latter about its axis so as to permit an adjustment of seat plate **1** and back rest **3** also from this point. Between posth **8** and the tubular member **2** a compression spring (not shown) may be inserted which acts in the upward direction upon seat plate **1**. Spindles **10** and **18** are screwed with a self-locking action into nuts **11** and **19**.

When knob **13** is turned, seat plate **1** will be raised or lowered, while arm **5** of back rest **3** may be moved obliquely upwardly or downwardly in the direction of the arrow **4**. The inclination of arm **5** and the transmission ratios between the adjusting means of seat plate **1** and the arm **5** of back rest **3** are determined in accordance with statistic data concerning the human body structure in such a manner that, when the seat plate **1** is raised, the back rest **3** is also moved obliquely upwards and toward the rear so that in any position of adjustment the seat and the back rest will be in the best possible positions as seen from a physiological standpoint.

According to the modification of the invention as illustrated in FIG. 3, the seat plate **1** is likewise connected to a tubular member **2** which is slidable in the vertical direction,while the back rest **3** is connected to an arm **5** which is slidable obliquely in the upward or downward direction, while the back rest **3** is connected to an arm member **2** is telescopically slidable along, and rotatable or nonrotatable relative to the vertical post **25** which is likewise tubular and rigidly secured at its lower end to the base or foot **26** of the chair. To the inner side

of post **25** a nut **27** is welded into which the seat-adjusting spindle **28** is screwed the upper end **29** of which is rotatably mounted in a ball bearing **30**. The outer race of this ball bearing is mounted in a fixed position relative to the tubular member **2**.

The seat-adjusting spindle **28** may be turned by a hand wheel **31** which is inserted into an aperture in seat plate **1**. Hand wheel **31** is for this purpose provided with thumb recesses **32** into which an operator or the person using the chair may insert his fingers. To the lower side of the hand wheel **31** a gear **33** is secured which has a downwardly projecting flange **34** which is fitted into the inner race of ball bearing **30** and is tightly connected to the upper end **29** of spindle **28**. If hand wheel **31** is turned, spindle **28** will be likewise turned within the nut **27**. Depending upon the direction in which hand wheel **31** is turned, the tubular seat-supporting member **2** will be raised or lowered relative to the vertical post **25**.

Arm **5** carrying the back rest **3** is rigidly connected to or integral with a nut **35** which is slidable longitudinally back and forth in the direction of the arrow **4** within a guide tube **36**. The upper end of a back-rest adjusting spindle **37** is screwed into nut **35**. This nut **35** is designed so as also to form a guide member for nonrotatably guiding the arm **5** along the inside of guide tube **36**.

The lower end of the adjusting spindle **37** is rotatably mounted in a bearing block **38**. An end bearing **39** containing a collar **40** which is rigidly secured to spindle **37** prevents the latter from shifting in the direction of the arrow **4**.

Between bearing block **38** and the end bearing **39** a bevel crown gear **41** is nonrotatably mounted on the lower end of spindle **37**. This gear **41** meshes with a similar gear **42** which is secured to a drive rod **43** near the lower end thereof which is likewise rotatably mounted in the bearing block **38** which also serves as a thrust bearing for spindle **43** by engaging with a washer **44** which is inserted between gear **42** and bearing block **38**. To the upper end of drive rod **43** a gear **45** is secured which meshes with gear **33**.

Gears **33** and **45** are of an identical shape which likewise applies to the bevel crown gears **41** and **42** which simplifies the manufacture of these gears.

The upper end of guide tube **36** for the arm **5** of back rest **3** is secured to an arm **47** which, in turn, is secured to the upper end of the tubular seat-supporting member **2**, and the lower end of guide tube **36** is likewise secured to the seat-supporting member **2**. These parts together thus form a rigid unit for supporting the adjusting mechanism. Drive rod **43** is covered toward the outside by a cover plate **48**.

The connecting arm **47** is provided in the form of a flat plate of sheet metal which covers at least partly the lower side of seat plate **1** and carries the housing of ball bearing **30** and the upper bearing of drive spindle **43**. Gears **33** and **45** are located above this connecting arm **47**.

Nut **35** for guiding the arm **5** carrying the back rest **3** has a member **49** forming a measuring scale rigidly connected thereto so as to pass together with the nut **35** into the guide tube **36** or to project therefrom.

FIG. 3 illustrates the chair when adjusted to its highest or upper end position. The adjusting mechanism of this chair operates as follows: If the seat plate **1** is to be lowered toward the base **26** on the floor **50**, hand wheel **31** is turned in the direction in which spindle **28** will be screwed downwardly in nut **27**. Spindle **28** then carries out the same rotary movement as the gear **33** which transmits this movement through gear **45**, drive rod **43** and crown gear **42** to the crown gear **41** which is secured to the lower end of the back-rest adjusting spindle **37**. Therefore, the more the seat-adjusting spindle **28** is screwed downwardly, the more the back-rest adjusting spindle **37** will be screwed into the nut **35**. Arm **5** carry-

ing the back rest 3 will thus be drawn downwardly in the longitudinal direction of guide tube 36.

The raising of seat plate 1 and back rest 3 is carried out accordingly, and when this is being done, the position of back rest 3 is also shifted outwardly in the direction of the arrow 51 and thus more toward the rear of the seat plate 1.

Depending upon the distance to which the scale member 49 passes into the guide tube 36, the operator of the chair may read on it the height to which the seat plate 1 is adjusted above the floor 50 and, they may thus determine whether the chair is properly adjusted for a particular age group of children. Since these chairs are primarily intended for use in schools, it should be a responsibility of the teachers to check on the measuring scales 49 whether the chairs are correctly adjusted. Such a measuring scale 49 may also be made of different colors to indicate the different heights to which the seat plate 1 is adjustable.

Although our invention has been illustrated and described with reference to the preferred embodiments thereof, we wish to have it understood that it is in no way limited to the details of such embodiments but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed our invention, what we claim is:

1. A chair comprising a base, a seat, first connecting means for connecting said seat to said base, first adjusting means for varying the effective length of said first connecting means and for thus varying the height of said seat from said base, a back rest, second connecting means for connecting said back rest to said first connecting means and extending obliquely upwards relative to said base and to said seat in a direction toward a rear side of said seat, second adjusting means for varying the effective length of said second connecting means, and common control means acting upon said first and second adjusting means for simultaneously varying the effective lengths of said first and second connecting means.

2. A chair as defined in claim 1, further comprising a housing connected to said seat, said common control means being partly mounted in said housing.

3. A chair as defined in claim 2, in which said second connecting means comprise an arm to the upper end of which said back rest is connected, the lower part of said arm extending obliquely upwards from said first connecting means and mounted in said housing so as to be slidable in its axial direction.

4. A chair as defined in claim 3, in which said first connecting means comprise a plurality of substantially vertical members slidable along each other, said first adjusting means comprising a substantially vertical threaded spindle rotatably mounted at its upper end on said seat and threadedly connected to one of said members and when turned about its axis adapted to vary the effective total length of said members and thus the height of said seat from said base, said second adjusting means comprising a second threaded spindle rotatably mounted in said housing and also extending in said oblique direction and threadedly connected to the lower part of said arm for shifting the same in its axial direction, said common control means comprising means for turning said vertical spindle and gear means for transmitting the movements of said vertical spindle to said second spindle.

5. A chair as defined in claim 4, in which said vertical members comprise a first member of a tubular shape surrounding and rigidly secured to said spindle so as to be rotatable therewith, said gear means comprising a set of gear teeth on the peripheral wall of said first member and a gear secured to said oblique spindle and meshing with said set of gear teeth.

6. A chair as defined in claim 5, in which said first tubular member has a shorter length than said vertical spindle.

7. A chair as defined in claim 5, in which said vertical members further comprise a tubular post having a lower end secured to said base, a second tubular member rotatably connected at its upper end to the lower end of said first tubular member and telescopically slidable along the outer surface of said post, and a nut rigidly secured to the inside of said post, said spindle being screwed into said nut.

8. A chair as defined in claim 7, in which said seat has an aperture in its upper side through which an element for turning said vertical spindle relative to said seat may be connected to the upper end of said spindle.

9. A chair as defined in claim 8, in which said element comprises a rotary knob mounted in said aperture and secured to the upper end of said vertical spindle and having an upper surface substantially flush with the upper surface parts of said seat adjacent to said aperture.

10. A chair as defined in claim 9, in which the upper surface of said knob is provided with recesses into which a person may insert his fingers for turning said knob.

11. A chair as defined in claim 7, in which said housing is secured to said second tubular member and also at least partly encloses said first tubular member.

12. A chair as defined in claim 11, in which said gear on said oblique spindle and said set of gear teeth on said first tubular member are at least partly enclosed by said housing.

13. A chair as defined in claim 7, further comprising a thrust bearing secured to said second tubular member for rotatably mounting the lower end of said oblique spindle.

14. A chair as defined in claim 7, further comprising a nut screwed on said oblique spindle and secured to said oblique part of said arm carrying said back rest.

15. A chair as defined in claim 4, in which said housing has an aperture through which a tool may be inserted for turning said oblique spindle.

16. A chair as defined in claim 14, in which said spindles are threaded with a self-locking effect into said nuts.

17. A chair as defined in claim 3, in which said first connecting means comprise a plurality of substantially vertical members slidable along each other, said first adjusting means comprising a substantially vertical threaded spindle rotatably mounted at its upper end on said seat and threadedly connected to one of said members and when turned about its axis adapted to vary the effective total length of said members and thus the height of said seat from said base, said second adjusting means comprising a second threaded spindle rotatably mounted in said housing and also extending in said oblique direction and screwed into a tapped axial bore in the lower end of the lower part of said arm for shifting said lower part in its axial direction, said common control means comprising a member on the upper end of said vertical spindle for turning the same about its axis, a drive rod rotatably mounted in said housing, a first pair of gears secured to the upper end of said vertical spindle and to one end of said drive rod, respectively, and meshing with each other, and a second pair of gears secured to the other end of said drive rod and to said oblique spindle near the lower end thereof, respectively, and meshing with each other so that, when said turning member is turned, its movement is transmitted directly to said vertical spindle and through said gears and said drive rod to said oblique spindle.

18. A chair as defined in claim 17, in which the two gears of each of said pairs have a substantially identical size and shape.

19. A chair as defined in claim 17, in which said vertical members comprise a tubular post secured at its lower end to said base and a substantially vertical tubular member secured to and forming a part of said housing and telescopically slidable along the outer surface of said post, a nut secured to said post near its upper end, said vertical spindle being screwed into said nut, said housing further comprising an oblique tubular member enclosing said oblique spindle and nonrotatably guiding the lower oblique part of said arm containing said tapped bore for

movement in its axial direction, the lower end of said oblique tubular member being directly secured to said vertical tubular member, and a substantially horizontal connecting member connecting the upper end of said oblique tubular member to the upper end of said vertical tubular member.

20. A chair as defined in claim **19**, in which said horizontal connecting member comprises a substantially flat plate at least partly covering the lower side of said seat.

21. A chair as defined in claim **20**, further comprising bearing means for the upper ends of said vertical spindle and said drive rod mounted on said plate.

22. A chair as defined in claim **21** in which said first pair of gears is located above said plate and said bearing means.

23. A chair as defined in claim **21**, further comprising a common bearing block within said oblique tubular member and secured thereto for rotatably supporting the lower ends of said drive rod and said oblique spindle.

24. A chair as defined in claim **19**, further comprising a measuring scale on said oblique part of said arm for

determining the length to which said oblique part projects from the upper end of said oblique tubular member at any adjustment of said oblique part in its axial direction.

25. A chair as defined in claim **1**, further comprising means for preventing a rotation of said seat relative to said base.

26. A chair as defined in claim **3**, further comprising means for preventing a rotation of said arm carrying said back rest relative to said seat and said base.

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