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Peddinghaus

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[54] **BENDING MACHINE FOR BARS, WIRES AND SECTIONS**

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[51] **Int. Cl.** **B21j 7/26**

[58] **Field of Search** ..... 72/7, DIG. 4, DIG. 22, 72/21, 22, 6, 29, 702

[56] **References Cited**

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Assistant Examiner—M. J. Keenan
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[57] **ABSTRACT**

A bending machine for bars in which there are provided bending angle circuits corresponding to the main bending angles, and a programme store circuit with a number of storage locations greater than the number of the main bending angles, with the bending angle circuits being connectible to the programme store circuit to follow programmes stored therein, with the programme store circuit being arranged to switch progressively at each switching step by one storage location.

9 Claims, 4 Drawing Figures

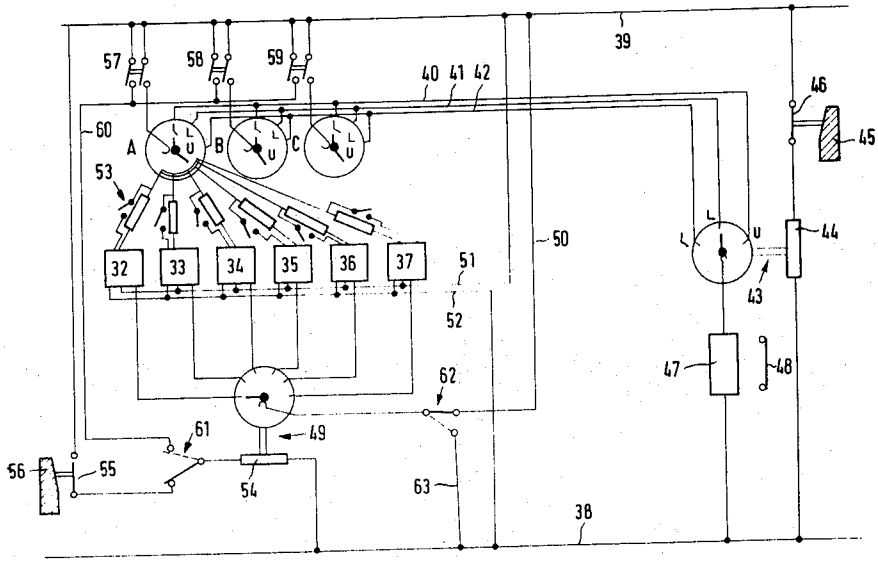

FIG. 1

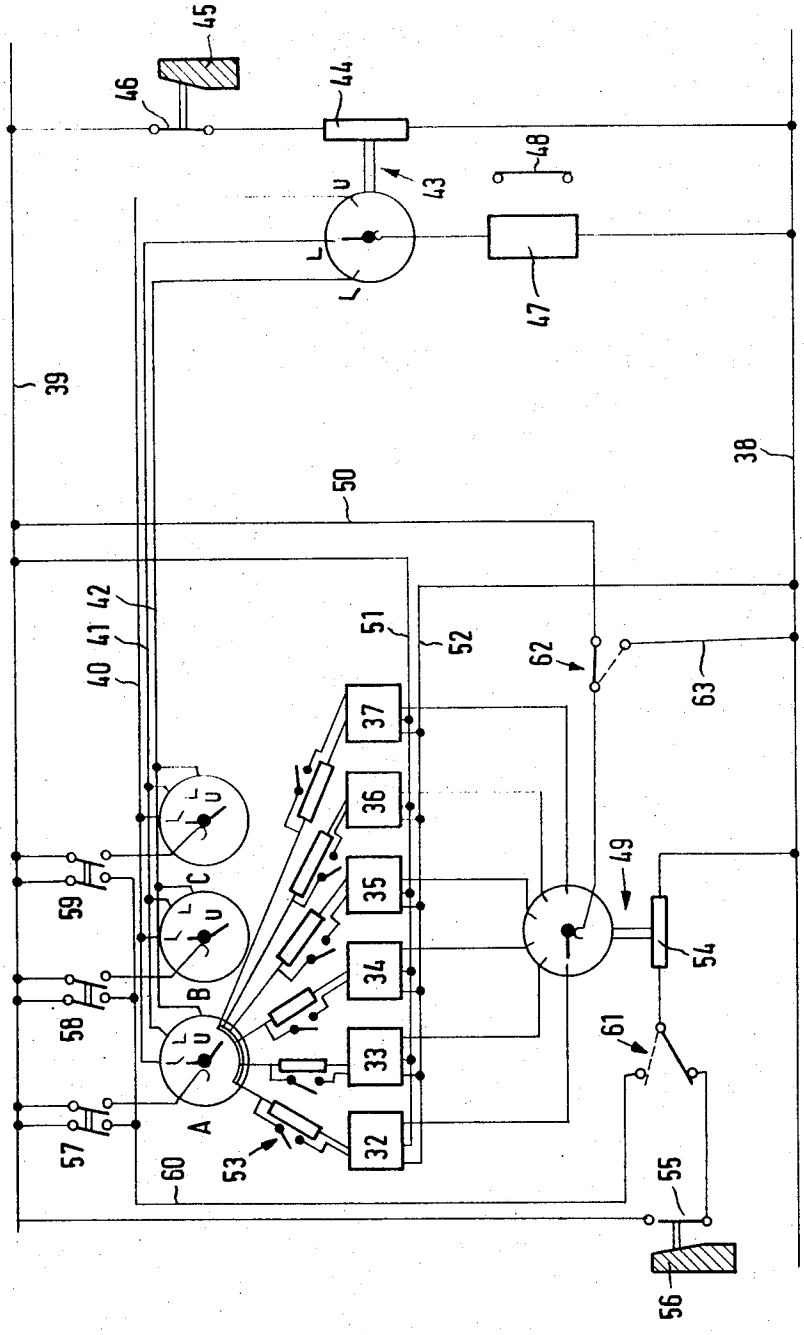

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FIG. 2

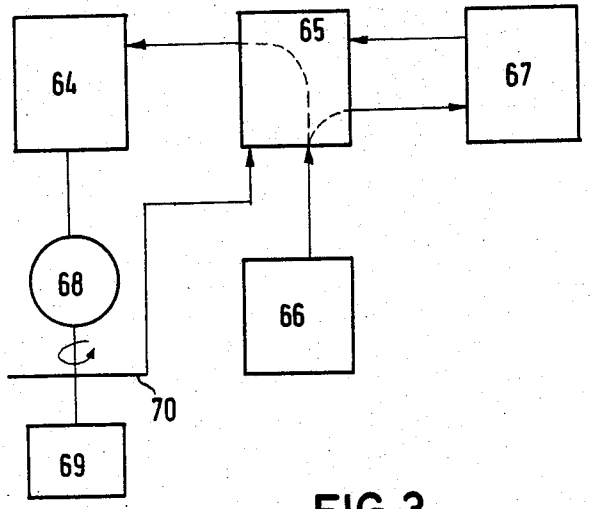


FIG. 3

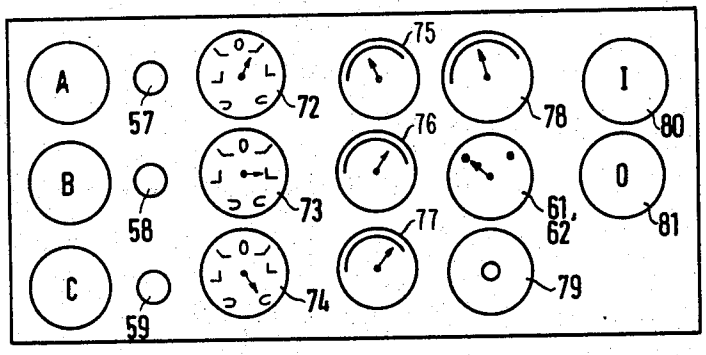
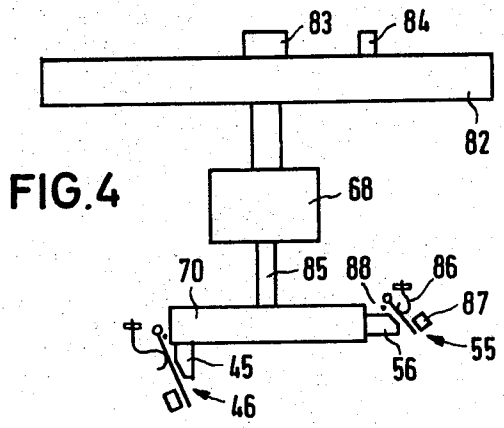


FIG. 4



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BENDING MACHINE FOR BARS, WIRES AND SECTIONS

BACKGROUND OF THE INVENTION

The invention relates to a bending machine for bars, wires and sections of steel and similar materials, the machine having a bending plate carrying bending tools and capable of being driven for rotation in either angular direction and a signal transmitter connected therewith for various main bending angles which are to be carried out in any desired sequence. Such a bending machine is described in my prior application Ser. No. 879,428, now abandoned wherein the bending process, after any desired predetermined bending angle has been reached, is continued by means of an electrical control circuit associated with each bending, and which automatically switches progressively from bending to bending, with the control circuits in their entirety forming a bending sequence programme.

Such a bending machine has been proposed particularly as a machine for bending steel reinforcement rods for concrete. In this case as soon as a prescribed bending angle has been reached, the direction control reverses the drive of the bending plate so that this runs back to its zero position in which the bar being bent can be advanced so as to have the next bending in its new position. The advantage of this arises from the fact that each individual bending angle can be preset in a programme store in which the number of storage locations can be large. This number corresponds to the largest possible number of individual bendings that a bar can have. The programme store must thus be correspoindingly sufficiently large as regards its storage locations.

Such a construction of the programme store makes a considerable expenditure in electrical circuit means necessary. Thus, one requires more particularly for each individual storage location a setting switch which must be capable of being set to any one of the few main bending angles and with which corresponding further electrical or electro-mechanical circuit means must be associated so that when the prescribed main bending angle has been reached the reversal of the drive of the bending plate and the further switching within the control circuit can be effected.

OBJECTS AND SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a bending machine for bars, wires and sections of steel and similar materials, including a bending plate, a drive, a control circuit for the drive, bending angle circuits corresponding to the main bending angles, a programme store circuit with a number of storage locations exceeding the number of the main bending angles, said bending angle circuits each being connectable at choice in the programme store circuit, said programme store circuit switching progressively at each switching step by one storage location and in its turn can be switched over to the control circuit of the drive, in which position the programme store circuit switches progressively after each bending likewise by one storage location.

The separation of the bending angle circuits from the programme storage circuit makes it possible to restrict the comparatively expensive bending angle circuits to the actual number of main bending angles. This number is comparatively small. In practice, main bending angles of for example 45°, 90° and 180° which can be applied in the right and also in the left direction will suffice. Consequently, only three bending angle circuits in each case are necessary, but the total number of bends which can be applied to a bar is considerably greater. For example, in a conventional programme for the bending of steel reinforcement rods it may be assumed that there will be six to eight possible individual bends for a single bar. The programme storage circuit is then designed for the greatest possible number of individual bends, that is for eight storage locations.

The programme store circuit is preferably a relay circuit which switches progressively over its storage locations by means of current impulses. Such circuits involve comparatively little expense and also are very reliable because the individual relays are totally enclosed and therefore are only slightly liable to danger of damage due to climatic influences or to dirt. In contradistinction thereto, in the case of the bending angle circuits access from outside must be possible. Since, however, the latter are very restricted in numbers it is possible to choose reliable constructions without increasing the total cost. Moreover, the bending angle circuits can be improved in their efficiency by means of auxiliary circuits as will be shown below so that in a similar manner incorrect bends depending upon the material strength and the mechanical properties of the material can be excluded.

The connection between the bending angle circuits and the programme storage circuit is effected preferably through impulse switches. It is then not necessary to touch the setting switches of the bending angle circuits, for given material thicknesses and material strengths of the bars to be bent, after the bending angle together with any necessary corrections has once been set, since only the impulse switches require to be actuated. Each of these is associated with a bending angle circuit. As soon as the programme stroage circuit is free for inserting a programme, its storage locations can be associated by actuating the impulse switches, with the bending angle circuits set to the various main bending angles. Simultaneously with each operation the programme storage circuit switches on to the next following storage location in the manner described.

In order, on the occasion of a bending stoppage or the like due to a fault in operation, not to have to allow the whole bending sequence programme to continue up to the breakdown point, it is of advantage to be able to switch the bending angle circuits selectively directly into the control circuit. For this purpose there is a suitable change-over switch arranged in the vicinity of the setting switches of the bending angle circuits. In this way also special bends can easily be undertaken which are required only once and for which the insertion of a complete programme is not advantageous. Also it is possible to undertake separate test bends in order to discover whether the bending angles actually obtained correspond to the pre-set main bending angles. If this is not the case use is made of cut-out delays capable of being set for the various thicknesses and strengths of the material of the bars to be bent and preferably associated with the individual bending angle circuits, through which the bending operation is continued further after the bending plate has reached a predetermined position when the actual bend corresponds with what was intended.

The bending angle circuits in their turn are preferably capable of being set to impulses which correspond

to the main bending angles and by which the setting members connected with the bending plate are released.

In an advantageous embodiment of the invention for this purpose, a setting member rotatable with the bending plate is a cam disc provided with cam means which actuate at least one impulse giving switch which is stationary with respect to the cam disc. In order that the bending angle circuits do not have to be constructed for taking account of more impulses than necessary, said cam means preferably comprise as many switch cams as the number of main bending angles, the angular positions of the switch cams corresponding to the main bending angles. Instead of determining the actual angular position of the bending plate by means of impulses initiated by cams, it may be advantageous if the bending angle circuits operate simply with time controls. These time value controls are time value transmitters which can be set to the time values corresponding to the bending angles. In this case there is needed only one impulse initiated by the setting member connected with the bending plate, which determines the beginning of the timing period and preferably occurs after the bending plate or the setting member connected therewith has moved through a very small angle from its zero position.

For further explanation of the invention reference is now made to the accompanying drawings which refer to constructional examples.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a simplified circuit diagram;

FIG. 2 is a block circuit diagram;

FIG. 3 shows the arrangement of the operating switches of the bending angle circuits;

FIG. 4 shows a setting member rotating with the bending plate.

DETAILED DESCRIPTION OF THE INVENTION

In the circuit diagram of FIG. 1 there are shown firstly two current supply conductors **38** and **39** in which a control current flows at a relatively small voltage. Further, there are three bending angle circuits. A, B and C in each of which, for the sake of clearness, only three main bending angles of 45°, 90° and 180° in only one direction are provided and indicated by corresponding angle symbols. The bending angle circuits are set to these angle symbols by means of setting knobs or similar manual means. In practice, switching possibilities for the three main bending angles are provided for both right hand and left hand operation.

Each connection of a main bending angle of a bending angle circuit is connected through conductors **40, 41** and **42** with the corresponding connections of the other bending angle circuits, which in their turn lead to three correspondingly characterized connections of a step counter **43.** This step counter is arranged to be actuated by current impulses which act upon its coil **44.** In the example illustrated, impulses are initiated by switch cams **45,** which are connected with a setting member rotating with a bending plate, through impulse switches **46.** For example, a cam **45** can be provided on this setting member which rotates with the bending plate at each of three positions corresponding to the angles 45°, 90° and 180°.

Alternatively, instead of the described impulse transmission from a setting member rotating with the bending plate, it is also possible to use a time control for the bending process. Such time control, which is not shown in the associated diagram, is usually effected by means of RC members and has the advantage that a corresponding electric signal is obtained without mechanical switch means being necessary.

Referring again to FIG. **1,** the step counter **43** is connected through a relay coil **47** to the current supply **38.** The relay coil **47** is arranged to actuate a change-over switch **48** (which is indicated only diagrammatically) by which the drive of the bending plate, which is not shown in FIG. **1,** can be reversed in such a manner that the bending plate runs back from its provided bending position to its zero position and stays in this position in order then to carry out the next bending.

The last mentioned exciting current circuit for the reversal of the drive is completed through one of the bending angle circuits A, B or C, one of storage locations **32** to **37** of the programme storage circuit connected therewith (to be hereinafter described), a step counter **49** and a conductor **50.**

As shown, the bending angle circuits A, B and C are respectively connected with various storage locations **32** to **37** of the programme store. For the sake of simplicity only six storage locations are shown and also for the sake of simplicity the connection of these six storage locations is only shown to the bending angle circuit A. Each of the storage locations **32** to **37** has a current supply through conductors **51** and **52.** Further, an essential constituent of each storage location is a holding relay indicated at **53** in the connecting conductors of the bending angle circuit A to the left hand storage location **32.**

Each storage location **32** to **37** is further connected to the individual connections of a step counter **49,** which is arranged to be actuated by current impulses which are fed to its coil **54.** These impulses are initiated either by an impulse transmitter **55** which, for this purpose, co-operates with switch cams **56,** which latter cams are preferably arranged on the setting member rotating with the bending plate in such a manner that in the zero position of the bending plate a current impulse is initiated. Alternatively, the impulses can also be initiated by one of three scanning switches **57, 58** or **59** associated respectively with the three bending angle circuits A, B and C. These scanning switches are double switches, of which each when actuated makes a connection between the supply conductor **39** and conductor **60.** The conductor **60** leads to a change-over switch **61** which selectively establishes the connection between the coil **54** of the step counter **49** either with the impulse transmitter **55** or with the scanning switches **57, 58** and **59.** In addition each one of the scanning switches **57, 58** or **59** when actuated establishes a connection between the supply conductor **39** and the associated bending angle circuit A, B or C belonging to it.

Normally, each of the bending angle circuits A, B and C is switched to one of the three main bending angles. This setting will remain unaltered. When the scanning switch **57** is actuated, assuming the switch **61** is set into its position shown in broken lines, there is a current flow in the connection between the beinding angle circuit A and the storage location **32** which latter is connected to the current supply **38** through the step

counter 49, switch 62 (in its broken line position) and branch conductor 63. The holding relay 53 then goes into the holding position and causes among other things in the circuit of the storage location 32 a further switching operation as a result of which the connection of the bending angle circuit A on the one hand and the step counter 49 on the other hand remain established When the initiating current impulse is absent. This is the case when the step counter 49 advances another step. This is effected with a delay which is necessary for reasons of switching technique, with the change-over switch 61 being still in its position shown in broken lines.

At the same time during this operation, the change-over switch 62 which can be coupled in a suitable manner with the switch 61 is, as aforesaid, also in the position shown in broken lines.

As will immediately be clear, the storage locations of the programme circuit can be associated in any desired manner (by actuation of the scanning switches 57, 58 or 59) with pre-set bending angle circuits, thus setting any desired programme. Since the step counter 49 advances at each switch operation, double connections are excluded.

When the programme setting is concluded, the switches 61 and 62 are moved to the positions shown in full lines. The circuit previously established in the storage locations 32 to 37 remain held by the corresponding relays because the storage locations have their own current supply. Then, the desired bending programme can be started which continues in such a manner that from one bend to the next, the step counter 49 is continuously advanced in order to switch in the next higher storage location. On completion of the bending programme, the step counter 49 is again in its initial position so that the next bar can be bent.

The co-operation of the individual circuits is illustrated in FIG. 2 in which corresponding block circuit elements are used. A main current supply circuit 64 is fed from the current supply mains and contains in the usual manner fuses, cut-outs, transformers and rectifiers so that on the one hand a driving motor 68 of a bending machine 69 and on the other hand a control circuit 65, a bending angle circuit 66 and a programme store circuit 67 are supplied. The bending angle circuit 66 by which, in the manner described above, main bending angles can be set is connected selectively either with the programme storage circuit 67 or the control circuit 65. This possibility of choice makes it possible to control the bending machine drive directly through the control circuit 65 with the programme storage circuit cut out. For a bending process which follows a normal programme, the bending angle circuit 66 is connected with the programme storage circuit 67. This is connected with the main current supply 64 through the interposed control circuit 65 and through this effects in the manner described the switching on, reversing, and switching off of the driving motor 68 of the bending machine 69. A setting member 70 rotating with the bending machine 69 has switch cams corresponding to at least one of the zero positions with which a current impulse is initiated and which is fed through conductor 71 to the control circuit 65 and causes the advancing of the step counter so that for the bending process the individual circuits stored in the storage locations 32 to 37 can be called up.

FIG. 3 shows the switch panel which is preferably constructed as the front plate of the housing containing the bending angle circuits. It shows the three above mentioned scanning switches 57, 58 and 59 which are associated with the three bending angle circuits A, B and C. Setting hand controls 72, 73 and 74 make it possible to set the bending angle circuits A, B and C to different main bending angles. In addition, setting potentiometers 75, 76 and 77 are provided of which each corresponds to a bending angle circuit and makes possible the switching in of a time period during which time the drive of the bending machine after reaching the pre-set main bending angle remains switches on until the bar to be bent has actually reached the desired angle. The three setting potentiometers are capable of being set by a common potentiometer 78 to, for example, different strength properties of the material to be bent.

There are also shown the switches 61, 62 for switching over the programme storage circuit. In the one switch position, the circuits are initially programmed, while in the other switch position they are called up from the store for successive bends when a bending programme is being carried out.

A switch 79 serves for cutting out the set programme, which can be effected by interrupting the current supply to the storage locations. Then, the relays which were forerly in the holding position are released so that the bending angle circuits set thereby are interrupted.

Finally, there are the two switch knobs 80 and 81 for the switching on of the main current supply and for switching it off.

FIG. 4 illustrates the giving of impulses by the setting member 70 which rotates with a plate 82 of the bending machine. This bending machine plate 82 carries bending tools 83 and 84 and is driven by the motor 68 as described. On a shaft 85 also driven by said motor 68 is a disc-shaped setting member 70 provided with a peripheral switch cam 56 which corresponds to the null position of the bending plate. This switch cam actuates the impulse switch 55, the switch arm of which is acted upon by a contact spring 86 and comes to bear on a contact 87 or on a stop 88. The setting member 70 may carry further switch cams 45 which each correspond to a definite angle, with only one of such cams 45 being illustrated. These switch cams co-operate with the impulse giving switch 46 which may be constructed in a corresponding manner to the impulse giving switch 55. The cams 45 and 56 are preferably arranged in a differentiated position, e.g. in different height positions on the curved surface of the cylindrically constructed setting member 70, or, as shown in the drawing, one on the cylindrical curved surface and the other on the end surface of the cylindrically constructed setting member 70. What is claimed is:

1. A bending machine for bars, wires and sections of steel and similar materials, including a bending plate, a drive, a control circuit for the drive, bending angle circuits corresponding to the main bending angles, a programme store circuit with a number of storage locations exceeding the number of the main bending angles, said bending angle circuits each being connectable at choice in the programme store circuit, said programme store circuit switching progressively at each switching step by one storage location and in its turn can be switched over to the control circuit of the drive, in which position the programme store circuit switches

progressively after each bending likewise by one storage location.

2. The bending machine as claimed in claim **1**, characterised in that the programme store circuit is a relay circuit which switches progressively over its storage locations by means of current impulses.

3. The bending machine as claimed in claim **1** characterised in that the bending angle circuits are connected with the programme store circuit through impulse scanning switches.

4. The bending machine as claimed in claim **1** characterised in that the bending angle circuits are directly switchable at choice into the control circuit for the drive.

5. The bending machine as claimed in claim **1**, including a setting member rotatable with the bending plate, in that the bending angle circuits are adjustable to impulses corresponding to the main bending angles which can be initiated by said setting member.

6. The bending machine as claimed in claim **5** including at least one impulse transmitter switch which is stationary with respect to the setting member, characterised in that said setting member is a cam disc which is rotatable with the bending plate and which has cam means arranged to actuate said at least one impulse transmitter switch.

7. The bending machine as claimed in claim **6** characterised in that said cam means comprises as many switch cams as the number of the main bending angles, with the angluar positions of said switch cams corresponding to said main bending angles.

8. The bending machine as claimed in claim **1** characterised in that the bending angle circuits are constructed with cut-out delays which can be varied for different thicknesses and strengths of material.

9. The bending machine as claimed in claim **1** characterised in that the bending angle circuits are provided with timers which can be set to time values corresponding to the bending angles.

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