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Sun protection apparatus

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(73) Proprietor(s)
Josef Gartner & Co

(Incorporated in FR Germany)

Postfach 20/40
8883 Gundelfingen
Federal Republic of Germany

(72) Inventor(s)
Fritz Gartner Dr-Ing
Winfried Heusler

(74) Agent and/or
Address for Service
S Jones-Robinson & Co
The Laurels
320 London Road
Charlton Kings
Cheltenham
Gloucestershire GL52 6YJ

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US 3504962 A
WO 83/00378

(58) Field of search

As for published application
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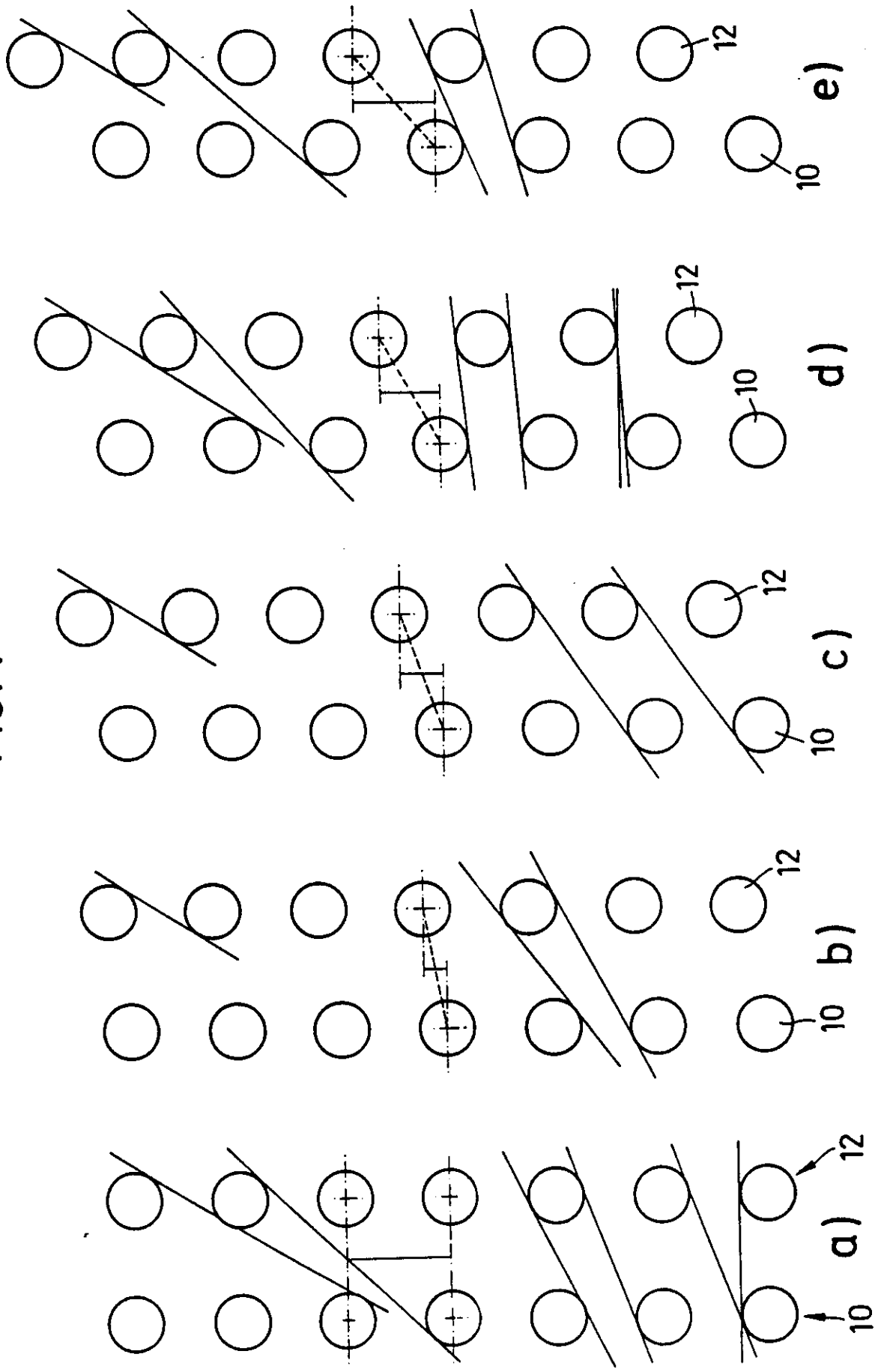
UK CL **E1J E1R**
updated as appropriate

FIG. 1



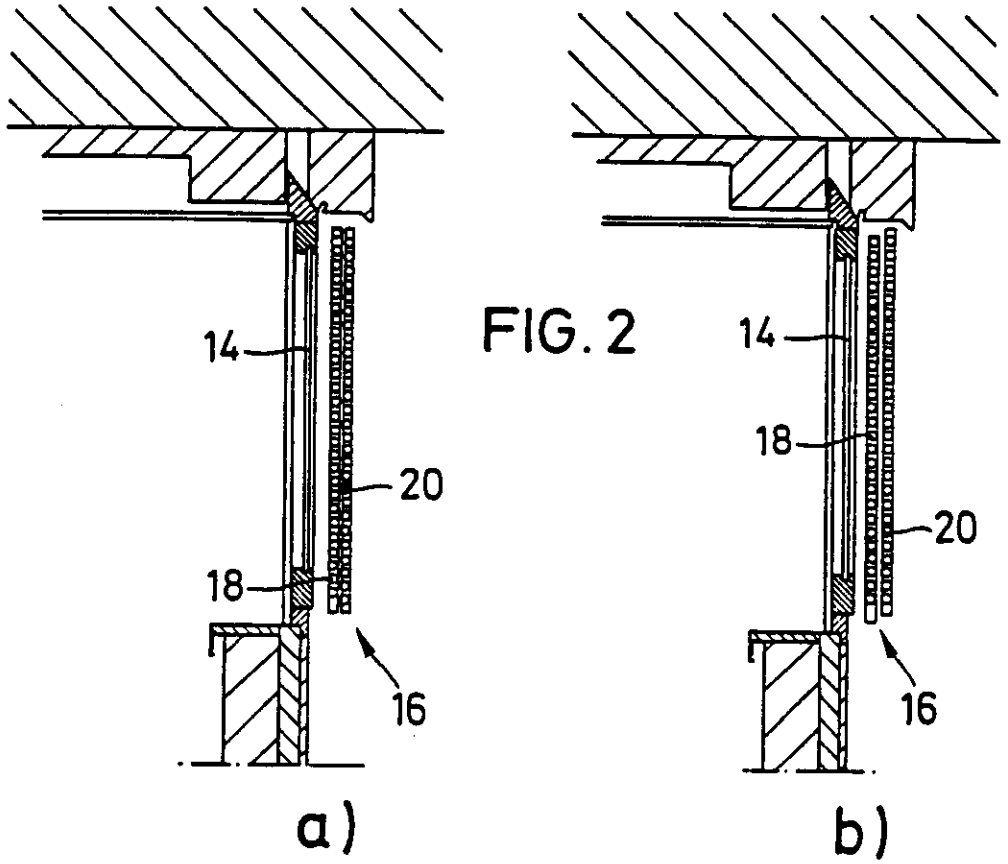


FIG. 2

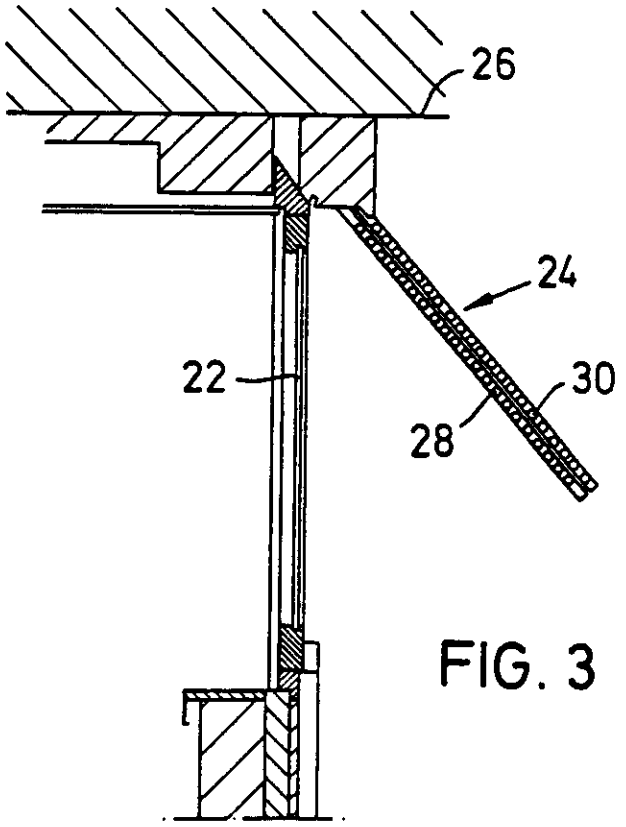


FIG. 3

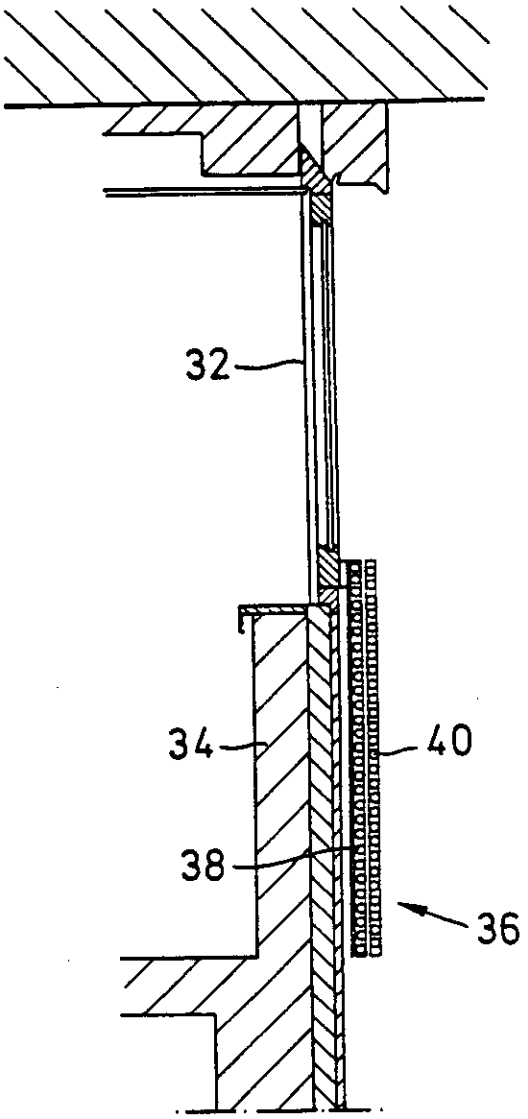


FIG. 4

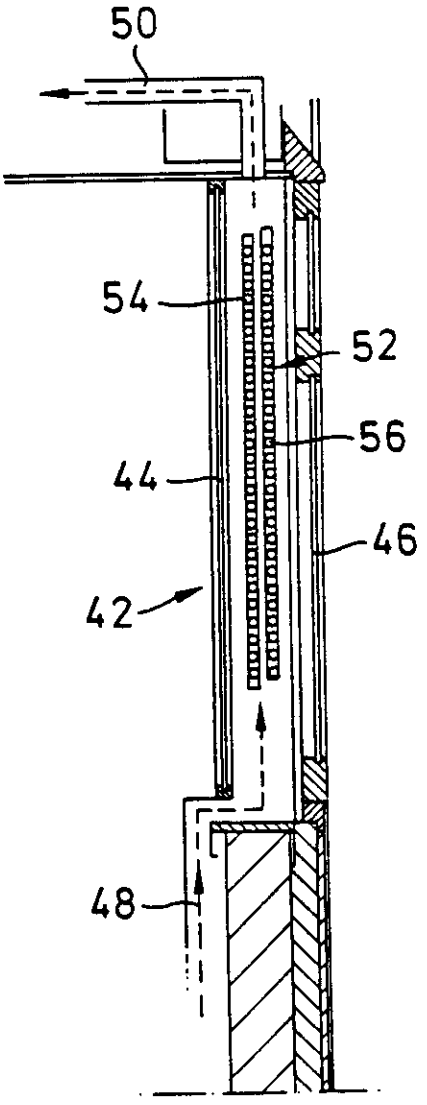


FIG. 5

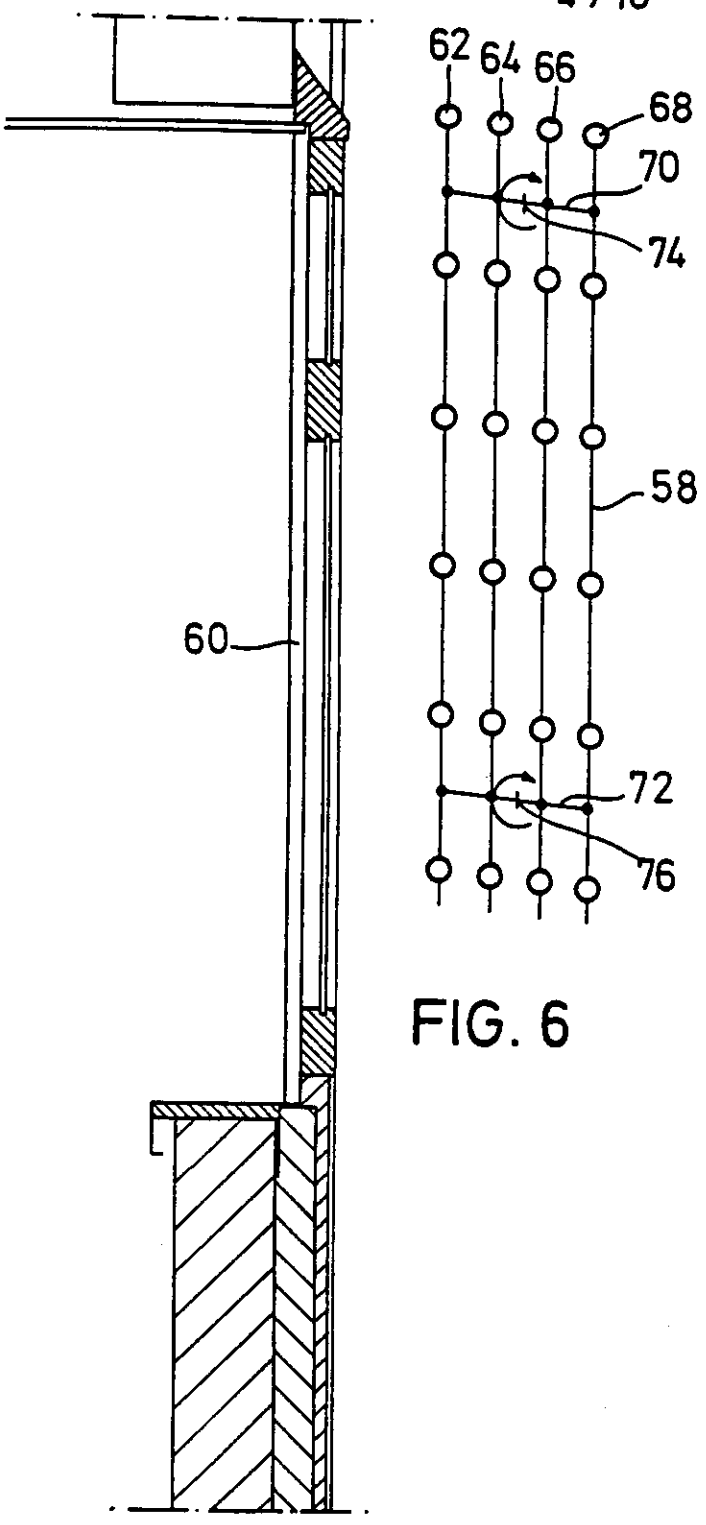

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FIG. 6

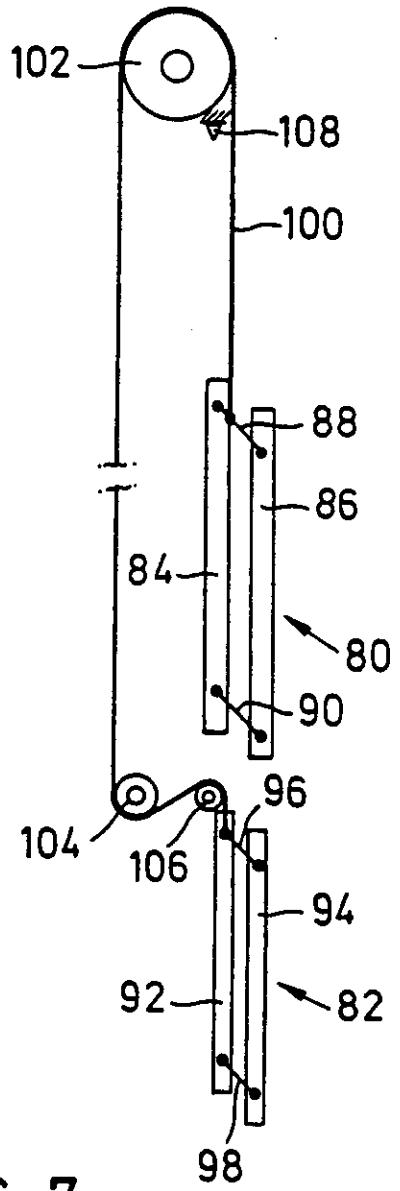
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FIG. 7


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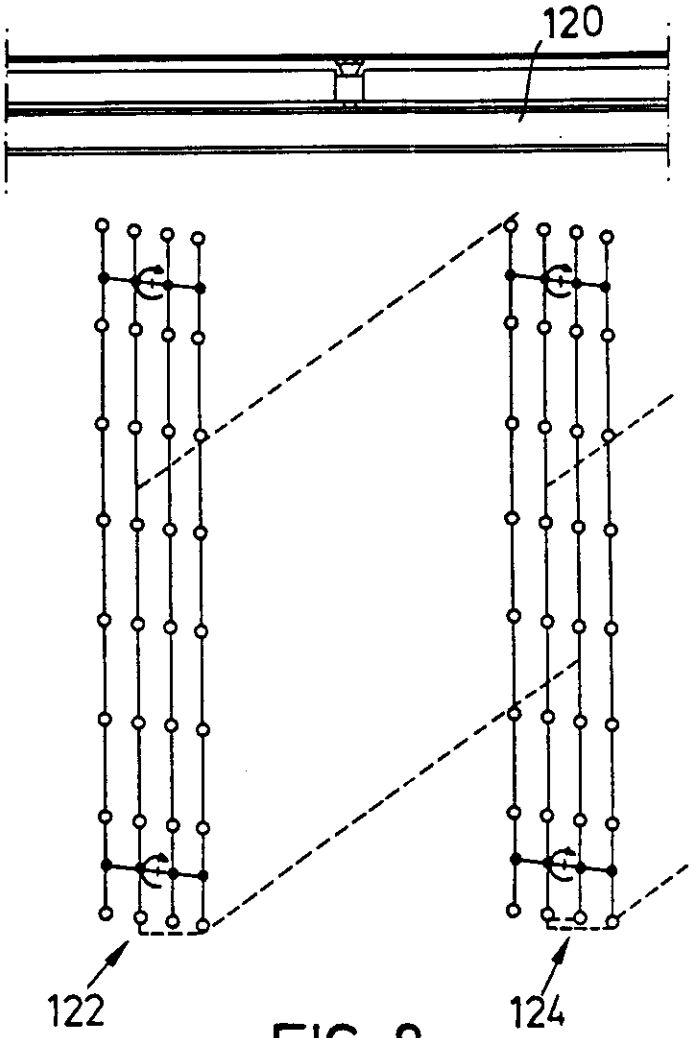

FIG. 8

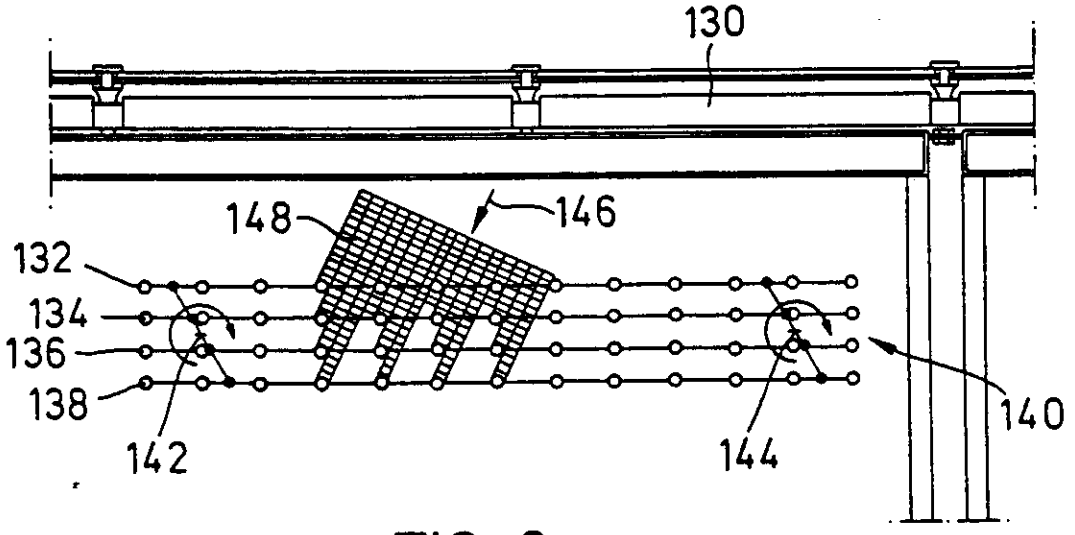

FIG. 9

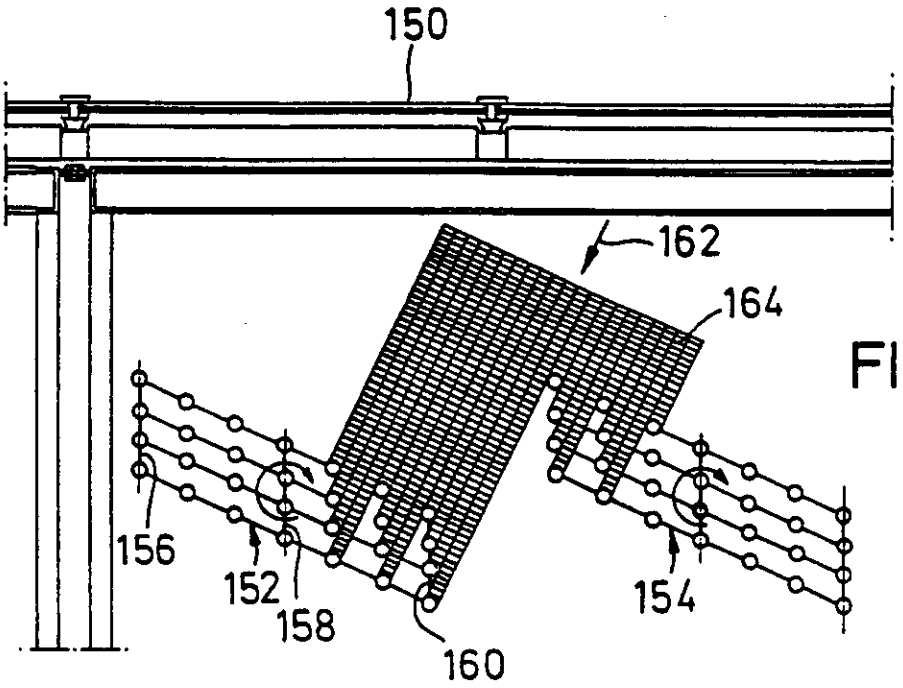
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FIG. 10

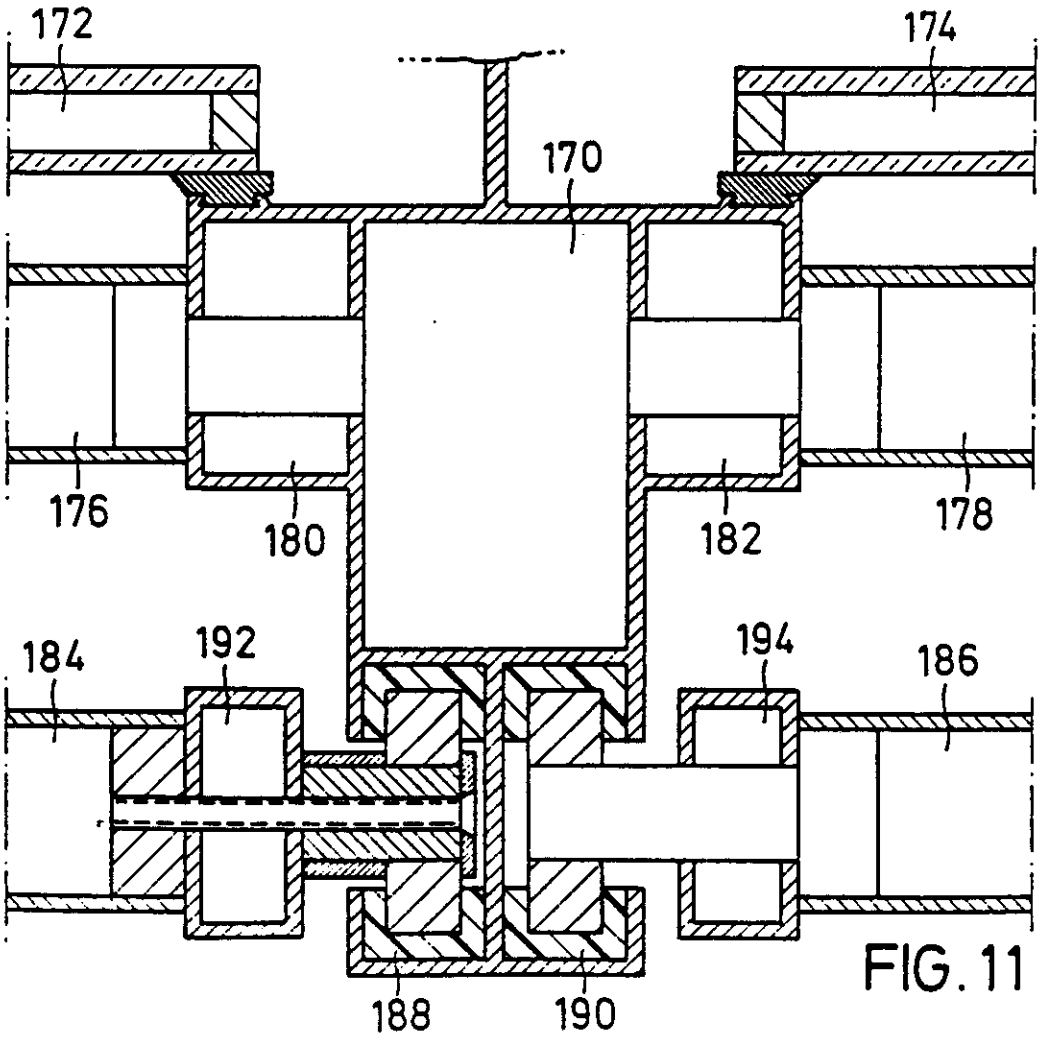
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FIG. 11

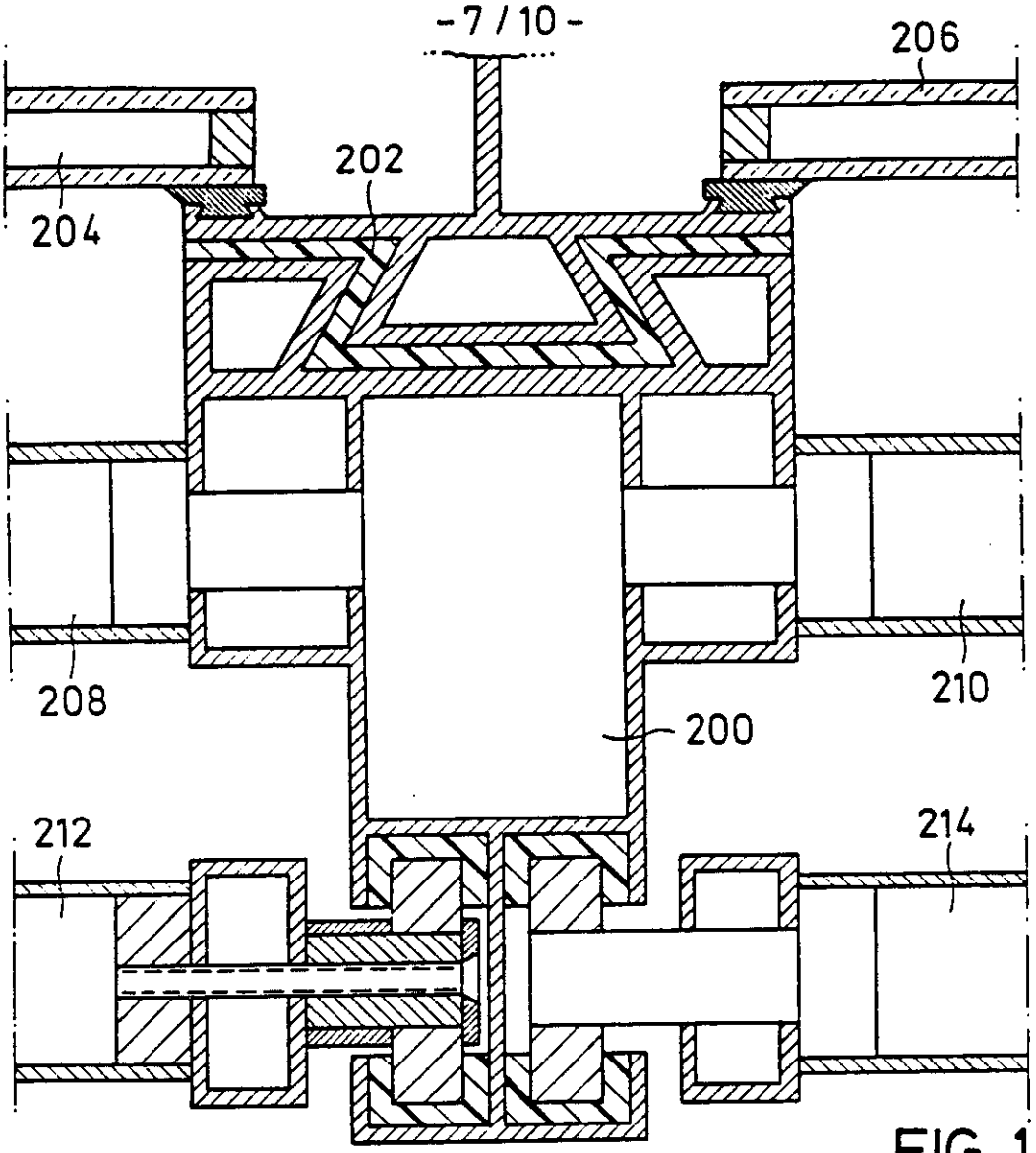
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FIG. 12

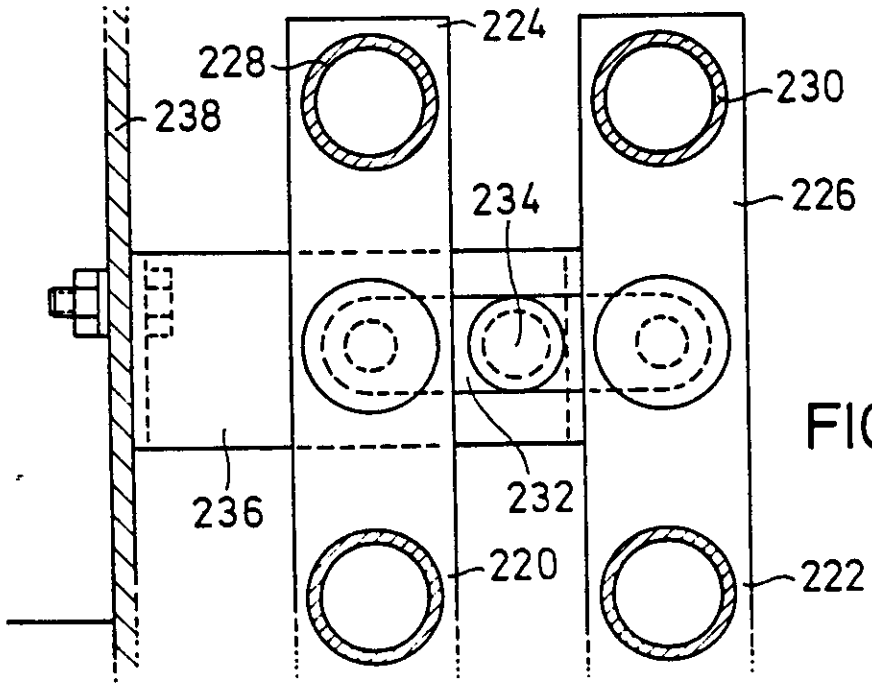
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FIG. 13

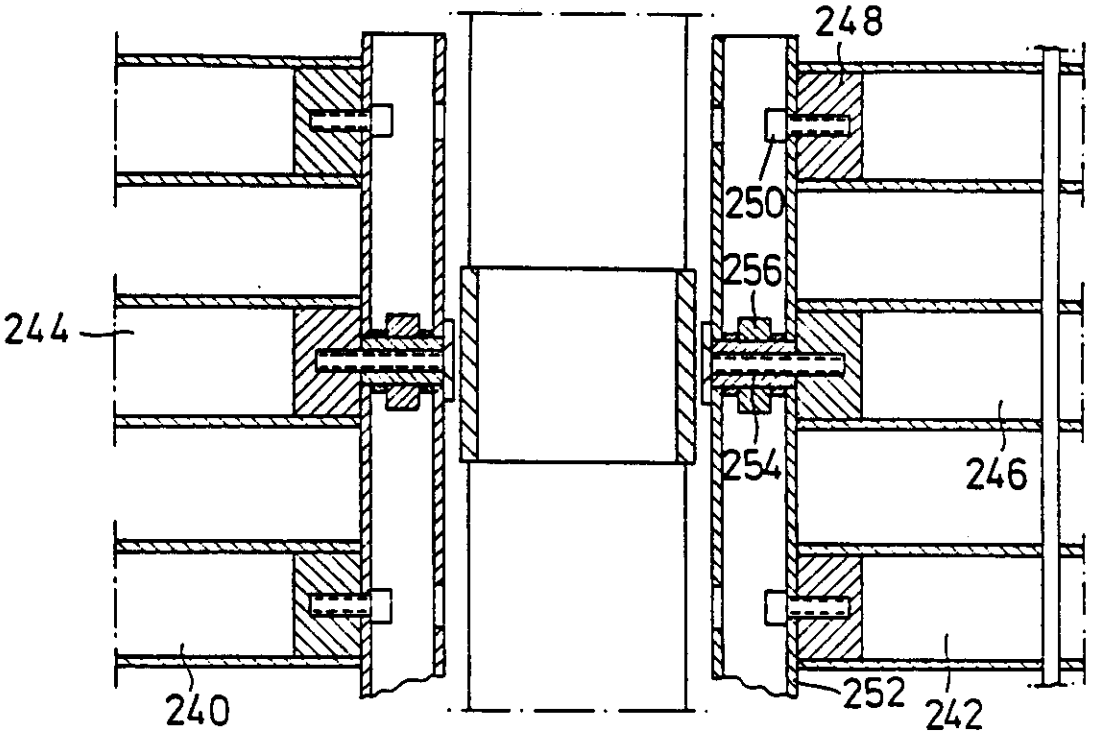

FIG. 14

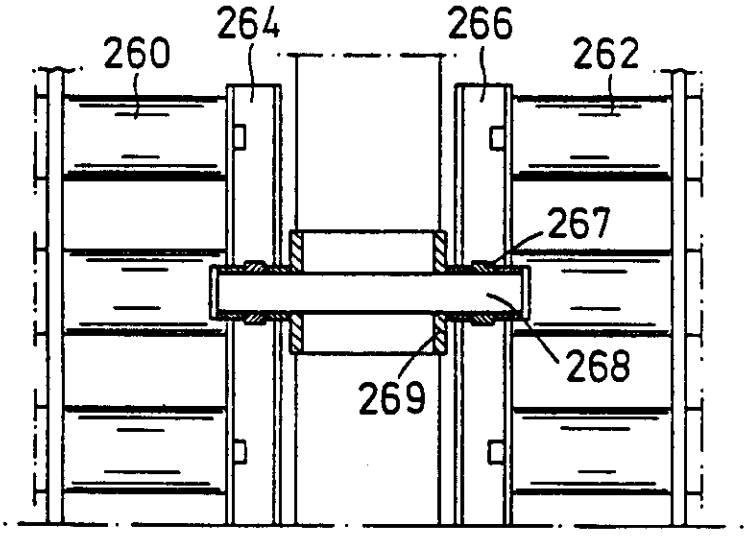

FIG. 15

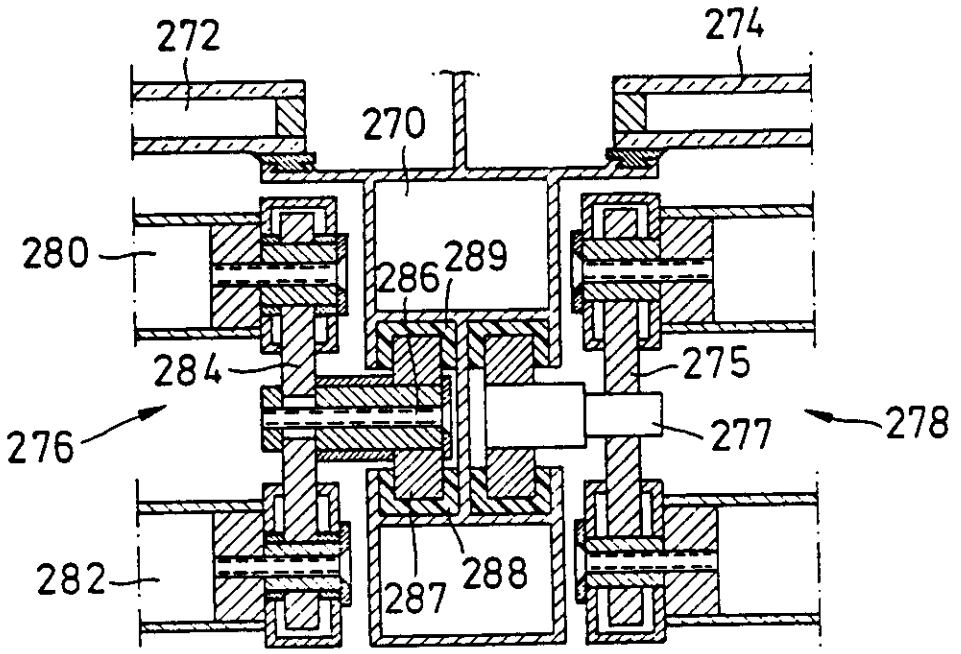
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FIG. 16

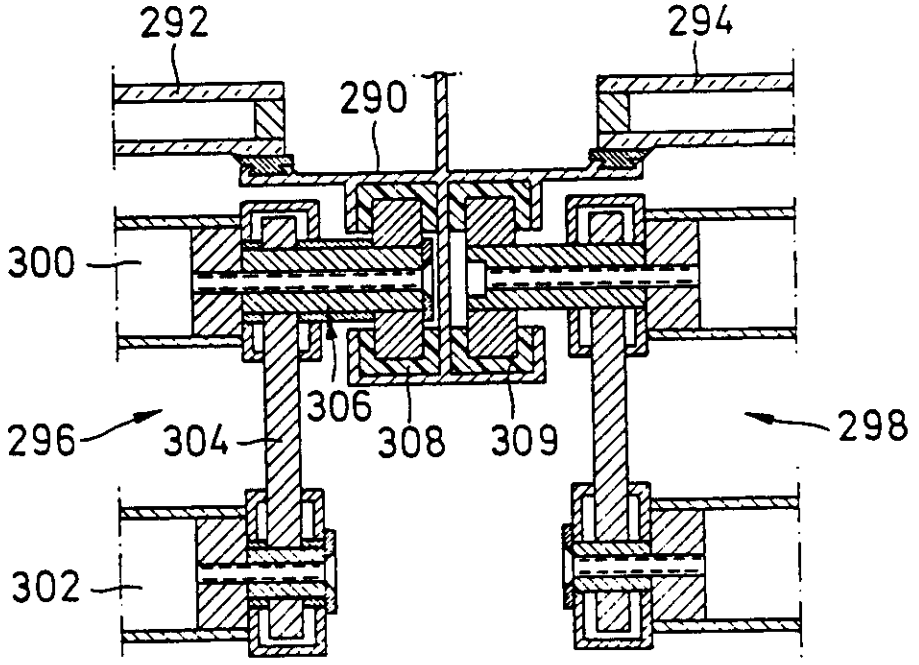
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FIG. 17

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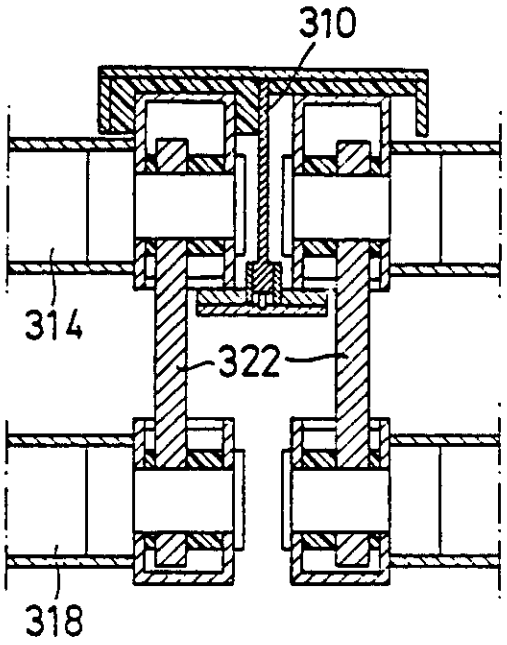

FIG. 18

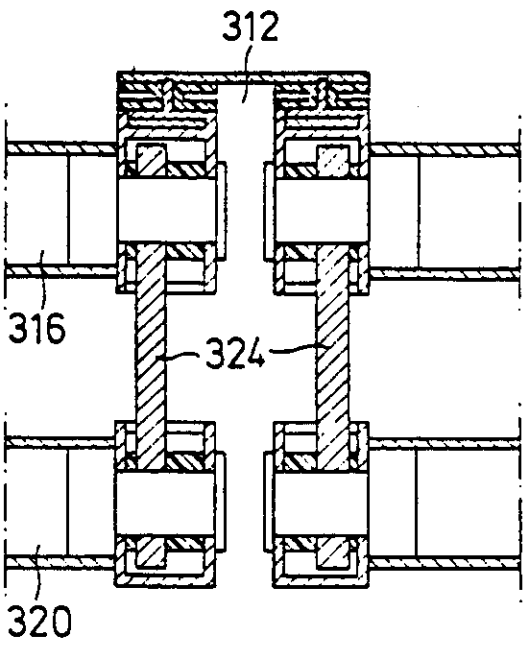

FIG. 19

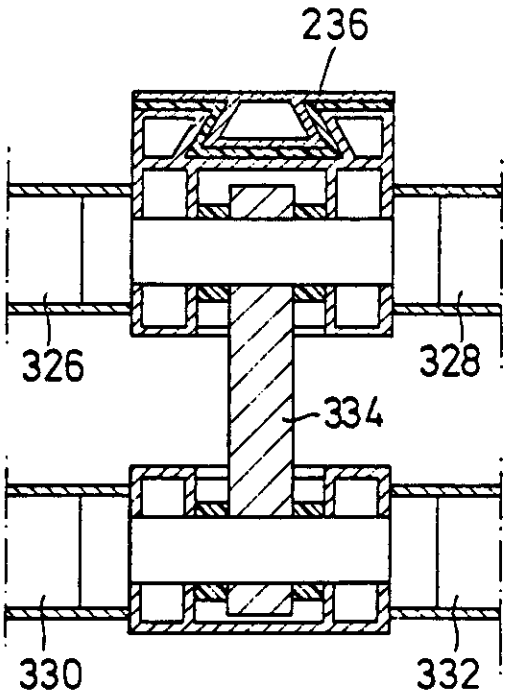

FIG. 20

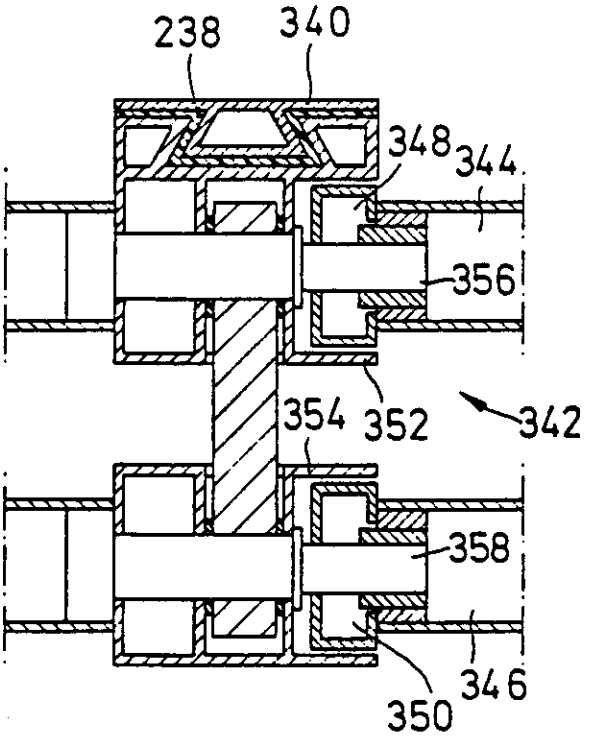

FIG. 21

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"SUN PROTECTION APPARATUS"

The invention relates to a sun protection apparatus for shading a building access, in particular from direct solar radiation.

Sun protection apparatuses are known for building accesses such as windows, inclined roof windows, or the like in which lamellae or fabric webs are guided at their edges so that they are held parallel to the window surfaces. Under intense solar radiation such sun protection apparatus must be set so that no direct solar radiation can enter the room. In particular at the times of day when the light of the sun is most intense artificial light must frequently be switched on inside the building because the known sun protection devices or apparatuses also greatly reduce the diffuse celestial radiation.

Furthermore, flaps equipped in many cases with complicated mechanisms are known which can be adapted to the position of the sun to produce adequate protection from direct solar radiation in the interior of the building. These known sun protection apparatuses are complicated and expensive. Moreover, a sun protection glass is known which is firstly expensive and secondly is a source of dazzling because the solar rays are reflected from such sun protection glass. Conventional sun protection glasses prove disadvantageous because their daylight transparency cannot be changed. With a clouded sky this leads to inadequate light conditions in the room. Glasses with variable transparency so far cannot be made with large areas.

The problem underlying the invention is to provide a simple sun protection apparatus which can be manufactured economically and which can rapidly be adapted to changing light conditions.

This problem is solved according to the invention by at least two spaced-apart bar gratings which are adjustably displaceable relatively to each other or jointly relatively to the direction of incidence of the solar radiation. A "bar grating" as that term is used herein is a rigid grating comprising a plurality of parallel bars or rods which are connected together at their ends.

By providing such gratings displaceable relatively to each other, or jointly, a shading of building accesses can take place in dependence upon the position of the sun. Depending on the altitude of the sun the gratings can be displaced so that in spite of complete shading from direct solar radiation the transparency for diffuse solar radiation can be kept constant throughout the day. In contrast to sun protection glass no dazzling of the surroundings by reflecting surfaces occurs. By using the gratings an acceptable visual communication remains from the interior of the building to the outside in every position of the gratings. The sun protection apparatus according to the invention is weather-resistant and light-resistant and due to its simple mechanics not prone to mechanical trouble. Since a stable construction is possible it is unaffected by precipitations and winds. Furthermore, the sun protection apparatus according to the invention is free from noise, ie no troublesome flapping occurs under winds. Due to the simple construction and the simple mechanics the apparatus is easy to operate and maintain. Moreover, the sun protection apparatus according to the invention can serve at the same time as protection against burglary.

According to preferred embodiments the gratings are maintained parallel and are either linearly displaceable or pivotal relatively to each other. In the first case the distance between the gratings is retained whilst in the

case of gratings pivotally connected together the distance between the gratings depends on the pivot angle.

Furthermore, the grantings may be pivotable together about an axis so that for example when they are articulately connected to the upper edge of a window and the position of the sun is high they can be swung upwardly, the shading from direct solar radiation into the interior of the building thereby not being impaired whilst the daylight incidence and the visibility to the outside are improved. The bars of a sun protection apparatus

may be rigidly connected to each other in this case. The displacement of the bars relatively to the incident solar radiation is then by pivoting the apparatus.

In a further development of the invention the gratings may be movable together over, beneath or adjacent the building access in front of which they are arranged for screening from direct solar radiation. This makes it possible when the sky is cloudy to obtain adequate illumination of the interior of the building by moving the sun protection apparatus into the inoperative, i.e. parked position.

The gratings may be disposed between two glazings whose intermediate space is preferably ventilatable on perpendicular or horizontal building openings.

It is also possible to arrange a plurality of gratings one behind the other and to connect the gratings with each other via pivot levers.

To simplify the mechanism and reduce drive power two grating pairs can be movable via a pulley mechanism and guide rollers by the counter balance technique in front of building accesses. In this case gratings may be articulately connected to each other and the cable mechanism is secured in each case to a pivot lever of a pair and for a grating of each pair a stop is provided. With this mechanism a grating can be moved upwardly in front of a vertical building access whilst simultaneously the other grating pair can be moved downwardly in front of another building access. The necessary power for this movement is only to overcome the frictional forces of the cable and roller mechanism. From the instant they reach the stop position onwards the individual gratings are displaceable relatively to each other by the cable movement.

According to a further preferred embodiment one grating is disposed stationary in front of the building access and the other grating is guided in rails for relative displacement with the stationary grating. The rails may be formed integrally with facade profiles.

The connecting levers between the gratings may preferably be articulately mounted centrally or at one end.

Furthermore, the gratings may consist of modules which can be individually displaced or pivoted.

According to a further preferred embodiment the bars of a grating may be arranged displaceably so that the spacings between the bars are variable.

The bars of the gratings may extend perpendicularly or horizontally. According to preferred embodiments the bars may be tubes with polygonal, circular or oval cross-section.

Advantageously, a heating or cooling medium may be conducted through the tubes and the support frames for the bars may form collecting passages for the entry and exit of the media.

According to a further preferred embodiment the bars may be formed in channel manner, the convex side preferably being directed towards the sun.

The parallel displacement or pivoting of the gratings with respect to each other may be effected manually or controlled by computer depending upon the position of the sun. The gratings may consist of metal or plastic. In particular, the bars of the gratings may be extruded.

In a further development of the invention the bars may be filled with a phase-change material for heat storage, the

material executing a phase change for example in the temperature range between 20° and 60°C.

The apparatus according to the invention provides a sun protection and shade for outer surfaces of buildings of any arrangement, the apparatus consisting of at least two spaced-apart rows of bars or tubes disposed parallel to each other. These bars or tubes of a plane can be so displaced with respect to acutely effective solar radiation angle of incidence relatively to the bars or tubes disposed in the other plane that the direct solar radiation passing through the outer array of the bars or tubes impinges on the bars or tubes lying further inwards and thus achieves a strip-free shading whereas diffuse undirectional atmospheric or celestial radiation can pass between the gaps formed between the tubes or bars to provide adequate illumination in the interior room.

The geometry and the surface of the bars or tubes is preferably such that the direct solar radiation is dispersed at them and thus a dazzle-free room illumination with daylight is achieved. With a cloudy sky the apparatus can be moved away from the region of the window and with a clear sky can shut out direct solar radiation and allow diffuse radiation from other directions to enter. Dazzling effects within the interior of the building are avoided because a strip-free shading is achieved, as required in particular in rooms with display screen working stations. This provides a reduction of the illumination intensity in the area of the window and an increase in the illumination intensity in the depth of the room because the incident radiation is dispersed. This provides an equalization of the illumination within the interior of the building. In contrast to solar protection glass a spectrally neutral transmission of daylight is achieved.

The movability of the apparatus permits an optimum adaptation to the position of the sun (altitutude, azimuth) and condition

of the sky (clear, cloudy).

Examples of embodiment of the invention will be explained hereinafter in detail with the aid of the drawings, wherein:

Figs. 1a to 1e represent a schematic illustration of various relative positions of the gratings of a sun protection apparatus,

Figs. 2a + 2b show a sun protection apparatus in front of a window in two positions,

Fig. 3 shows a sun protection apparatus which can be pivoted upwardly,

Fig. 4 shows a sun protection apparatus which can be moved downwardly,

Fig. 5 shows a sun protection apparatus disposed between two glazings,

Fig. 6 shows a sun protection apparatus comprising four gratings disposed parallel to each other,

Fig. 7 is a basic diagram of two sun protection apparatuses connected together via a cable and roller mechanism,

Figs. 8 to 10 show various embodiments of sun protection appratuses beneath a horizontal building opening, and

Figs. 11 to 21 show various embodiments of sun protection apparatuses.

Figs. 1a to 1e show a sun protection apparatus consisting of two gratings 10, 12 disposed parallel to each other. The bars of the gratings 10 and 12 are constructed as tubes. Fig. 1a shows the position of the gratings 10 and 12 with the bars in coincidence in series. This position of the gratings 10 and 12 serves for shading direct solar radiation with the sun in a high position. Figs. 1b to 1e show the relative displacements between the two gratings 10 and 12 with other angles of incidence of the solar radiation. In Fig. 1d the parallel displacement of the gratings 10 and 12 is to such an extent that the bars of the grating 12 run centrally between the bars of the grating 10. In this position a direct view out of a building access in perpendicular direction to the bars is not possible although a view is possible at an inclined angle downwardly and upwardly between the bars of the gratings 10 and 12. In the embodiment of Fig. 1 pivoting up of the grating 12 is effected with respect to the stationary grating 10 so that the distance between the gratings becomes increasingly smaller.

Fig. 2 shows a window 14 in front of which a sun protection apparatus 16 is hung which consists of an inner grating 18 and an outer grating 20. In Fig. 2a the outer grating 20 is pivoted downwardly so that it almost engages the grating 18. In this position a low sun is prevented from entering the building interior through the window 14. In Fig. 2b the outer grating 20 is pivoted upwardly with respect to the inner grating 18 so that firstly the bars of the two bars 18 and 20 extend in the horizontal direction adjacent each other and secondly the spacing between the grating 18 and the grating 20 has assumed a maximum value. In the position shown in Fig. 2b the sun protection apparatus serves to prevent direct radiation from a high sun from entering the interior of the building.

Fig. 3 shows a window 22 in front of which a sun protection apparatus 24 is articulately mounted with its upper edge to suitable bearing means beneath a facade panel 26. The sun protection apparatus 24 consists of an inner grating 28 and an outer grating 30. The gratings 28 and 30 may be pivoted together out of a position parallel to the window 22 into the position shown in Fig. 3. Relatively to the sun this results in a displacement between the gratings 28 and 30 so that direct solar radiation can be screened off from various positions of the sun although the two gratings 28 and 30 are rigidly connected to each other.

Fig. 4 shows a perpendicular section through a part of a building comprising a window opening 32 and a panel 34 beneath the window 32. In front of the panel 34 a sun protection apparatus 36 is disposed which can be drawn upwardly via a mechanism, not shown, in front of the window 32 and, when no direct solar radiation is present, lowered in front of the panel. The sun protection apparatus 36 consists of an inner grating 38 and an outer grating 40 which are again relatively displaceable to each other so that when the sun protection apparatus 36 is disposed in front of the window 32 different positions of the sun can be taken into account so that direct sunlight into the interior of the building can be prevented.

Fig. 5 shows a ventilated window 42 consisting of an inner glazing 44 and an outer glazing 46. Through the space between the glazings 44 and 46 an air stream is led which enters at 48 in the region of the window parapet and is supplied via a conduit 50 of an air-conditioning system to a heat store or heat exchanger. Between the glazings 44 and 46 a sun protection apparatus 52 is disposed which consists of an inner grating 54 and an outer grating 56. The gratings 54 and 56 are displaceable relatively to each other so that the bars of the gratings either lie in the same planes adjacent each

other or the bars of the one grating can assume any possible intermediate position between the bars of the other grating. The heat forming at the bars by absorption of the solar radiation is dissipated by convection with the air flow.

Fig. 6 shows a solar protection apparatus 58 which is disposed in front of a window 60. The solar protection apparatus 58 consists of four gratings 62, 64, 66 and 68 which are disposed parallel to each other. The gratings 62 to 68 are connected together via pivot levers 70 and 72. The pivot levers are disposed centrally on the pivot bearings 74 and 76. By pivoting the levers 70 and 72 in the clockwise direction the gratings 66 and 68 are lowered whilst the gratings 62 and 64 are raised. This makes it possible whilst maintaining a good vision from the window and through the sun protection apparatus to obtain adequate shading from direct sunlight. On pivoting anticlockwise the gratings 62 and 64 are lowered and the gratings 66 and 68 raised. In this position direct sunlight from a low sun can be shut out.

Fig. 7 shows in principle the mechanism for moving and regulating two sun protection apparatuses 80 and 82. The sun protection apparatus 80 consists of an inner grating 84 and an outer grating 86. The gratings 84 and 86 are connected together via pivot levers 88 and 90. The sun protection apparatus 82 consists of an inner grating 82 and an outer grating 94. A connection of the gratings 92 and 94 is via pivot levers 96 and 98. The sun protection apparatus 80 is connected to a cable 100 which is attached to the pivot lever 88 between the grating 84 and the grating 86.

The cable 100 is led via an upper guide roller 102 and lower guide rollers 104 and 106 to the sun protection apparatus 82. At the latter the cable 100 is attached to the joint of the

grating with the pivot lever 96. On the building side stops 108 and 110 are provided for the upper sun protection apparatus 80 and the lower sun protection apparatus 82 respectively. If the sun protection apparatuses 80 and 82 are not required in front of the building apertures shown, for example when the sky is cloudy, the upper sun protection apparatus is moved into the lower position shown and the lower sun protection apparatus 82 into the upper position shown. Under intense sunlight the sun protection apparatus 80 is pulled upwardly and at the same time the sun protection apparatus 82 is let down. To achieve a relative displacement between the gratings 84 and 86 and 92 and 94 respectively the grating 84 engages the stop 108 and the grating 94 of the lower sun protection apparatus 82 bears on the stop 110. On further pulling of the cable 100 the pivot lever 88 and thus the grating 86 is pivoted upwardly. At the same time the grating 92, since the cable is released downwardly, is further lowered so that an identical relative displacement results between the gratings 92 and 94. With the mechanism shown in Fig. 7 it is possible with simple means and little energy, utilizing the balance weight principle, to actuate the sun protection apparatuses 80 and 82.

Figs. 8 to 10 show sun protection apparatuses which are disposed above or below horizontal building openings such as for example glass roofs.

Fig. 8 shows a glass roof 120 beneath which perpendicularly disposed sun protection apparatuses 122 and 124 are disposed. Depending on the dimensions of the glass roof 120 several such sun protection apparatuses are provided. The sun protection apparatuses 122 and 124 each consist of four gratings which are arranged parallel to each other and the mechanism of which is constructed and actuated as in the example of embodiment according to Fig. 6. Alternatively, the tubes

could be displaceably mounted on the lateral holding rails so that depending upon the position of the sun at that time the tube axis spacing can be varied. The shallower the angle of incidence of the solar radiation the closer the tubes are pushed together.

Fig. 9 shows a glass roof 130 beneath which a sun protection apparatus 140 consisting of four gratings 132, 134, 136 and 138 is disposed. The gratings 132 to 138 are articulately connected to pivot levers 142 and 144. The pivot levers 142 and 144 are preferably pivotally mounted at the centre. The arrow 146 schematically indicates the direction of incidence of the solar radiation and the lattice 148 indicates the principle of the shading. The solar rays passing through the outer plane are intercepted at the planes lying further to the inside. It can be seen that with the sunlight illustrated adequately diffused refracted light enters the interior of the building but direct sunlight is shut out.

Fig. 10 shows a glass roof 150 beneath which two inclined sun protection apparatuses 152 and 154 are disposed. The sun protection apparatuses 152 and 154 each consist of four gratings which are rigidly connected together in the embodiment illustrated via the profiles 156, 158 and 160. The sun protection apparatus 152 is pivoted in dependence upon the actual position of the sun about the fulcrum on the connecting profile 158. The arrow 162 indicates the angle of incidence of the solar radiation decisive for the pivot position illustrated. The grid 164 indicates at which bars the direct solar radiation incident parallel to the arrow 162 is intercepted. Between the bars the diffuse celestial radiation incident from other directions can enter the room. The shallower the angle of incidence of the solar radiation the steeper the position of the sun protection apparatuses 152 and 154. This increases the gap formed between them, thereby

improving the entry of daylight and the free view perpendicularly upwardly.

When the sky is cloudy the sun protection apparatuses are pivoted into a position perpendicular to the glass roof 150, permitting transmissivity of daylight.

Figs. 11 to 21 show various embodiments of facade elements on which sun protection apparatuses consisting of gratings are disposed. Fig. 11 shows a facade upright 170 on which glazings 172 and 174 are disposed. Directly in front of the glazings 172 and 174 gratings 176 and 178 are arranged stationary. The gratings consist of tubes which can be traversed for example by a heating or cooling medium such as water or air. Passages 180 and 182 formed on the facade upright 170 may serve as collecting passages for the heating or cooling medium flowing through the bars of the gratings. In front of the gratings 176 and 178 gratings 184 and 186 are disposed whose bars are guided at the ends in C-shaped sliding bearings 188 and 190 formed on the facade upright 170. The gratings 184 and 186 are displaceable parallel to the stationary gratings 176 and 178, the distance between the gratings always remaining constant. The bars of the gratings 184 and 186 may also be traversed by a heating or cooling medium and at the ends of the tubes forming the bars collecting passages 192 and 194 are formed.

Fig. 12 shows an embodiment which differs from the embodiment of Fig. 11 in that the sun protection apparatuses consisting of the gratings 208, 210, 212 and 214 are displaceable via the dovetail guide 202 on the facade. When the sky is cloudy the sun protection apparatus is moved out of the region of the window openings 204 and 206. The sliding bearing 202 serves at the same time as thermal separation between facade and sun protection apparatus.

Fig. 13 shows two gratings 220 and 222 which consist of tubes 228 and 230 respectively secured to support frames 224 and 226. Between the gratings 220 and 222 a pivot lever 232 is articulately connected which in turn is mounted on a pivot mounting 234. The pivot mounting 234 is secured to a jib 236 which is screwed to a facade upright 238.

Fig. 14 shows a vertical section through the sun protection apparatus shown in Fig. 13 in the plane of the tube axes of the grating 220. The tubes surround with their ends discs 248 which are secured via screws 250 to lateral profiles 252. This permits simple assembly of the gratings forming the sun protection apparatus. The support profile 252 of the tubes 242, 246 and 248 is rotatably attached via the bolt 254 to the pivot lever 256.

Fig. 15 shows a section through the sun protection apparatus illustrated in Fig. 13 in the plane of the pivot bearing 234. The pivot lever 267 is articulately mounted on the pin 268 which in turn is secured to the jib 269.

Fig. 16 shows a facade upright 270 to which glazings 272 and 274 are attached. In front of the glazings 272 and 274 identical sun protection apparatuses 276 and 278 are disposed. The sun protection apparatus 276 consists of an inner grating 280 and an outer grating 282 each comprising tubes. The gratings 280 and 282 are articulately connected to the ends of a pivot lever 284 which is centrally mounted rotatably on a pin 286. On pivoting of the lever 284 the gratings 280 and 282 are either raised or lowered. The sun protection apparatus 276 can be moved in front of the facade with the support profile 287 in the sliding bearings 288 and 289. Whereas the pivot lever 284 is rotatably secured on the pin 286 in the form of a fixed bearing the pivot lever 275 on the pin 277 forms the loose bearing for taking up thermal expansions.

Fig. 17 shows a facade upright 290 comprising glazings 292 and 294. In front of the glazings 292 and 294 identical sun protection apparatuses 296 and 298 respectively are disposed. The sun protection apparatus 296 consists of an inner grating 300 and an outer grating 302. In the plane of the grating 300 a pivot lever 304 is disposed on a pivot bearing 306. To the outer end of the pivot lever 304 the grating 302 is articulately connected. On setting the sun protection apparatus 296 the outer grating 302 is either raised or lowered by pivoting the pivot lever 304 whilst the inner grating 300 retains its position.

The sun protection apparatuses 296 and 298 may be moved parallel in front of the facade in the sliding bearings 308 and 309 which are secured to the facade upright 290. The mounting of the sun protection apparatus 296 is again a fixed bearing and that of the sun protection apparatus 298 a loose or movable bearing for taking up thermal expansions.

Figs. 18 and 19 show further sun protection apparatuses on facade uprights, the differences being mainly in the configuration of the mounting for up and down displacement of the sun protection apparatuses in the facade uprights 310 and 312 respectively. In front of inner gratings 314 and 316 outer gratings 318 and 320 are disposed pivotally via pivot levers 322 and 324 respectively. Sun protection apparatuses disposed in front of adjacent building accesses or openings are actuatable independently of each other.

Fig. 20 shows an embodiment in which sun protection apparatuses with inner gratings 326 and 328 and outer gratings 330 and 332 can be actuated via a pivot lever 334. The displacement of the sun protection apparatuses is jointly in the dovetail sliding bearings 236.

Fig. 21 shows a facade upright 340 to which a sun protection apparatus 342 is attached. The sun protection apparatus 342 consists of an inner grating 344 and an outer grating 346. The gratings are formed by tubes which with their ends are in fluid communication with the collecting passages 348 and 350 so that apart from providing protection from direct sunlight the sun protection apparatus 342 can also perform heating or cooling functions. The support frames 348 and 350 are displaceably arranged in C-shaped profiles 352 and 354 on the pins 356 and 358 respectively for taking up thermal expansions.

CLAIMS:

1. Sun protection apparatus for shading a building access, in particular from direct solar radiation, comprising at least two spaced-apart bar gratings which are adjustably displaceable relatively to each other or jointly relatively to the direction of incidence of the solar radiation.

2. Sun protection apparatus according to claim 1, wherein the bar gratings are displaceable parallel or perpendicularly to each other.

3. Sun protection apparatus according to claim 1, wherein the gratings are pivotal with respect to each other.

4. Sun protection apparatus according to any one of claims 1 to 3, wherein the gratings are pivotal together about an axis.

5. Sun protection apparatus according to any one of claims 1 to 3, wherein the gratings can be moved together or individually or in opposite directions to each other above, below or adjacent the building access.

6. Sun protection apparatus according to any one of claims 1 to 5, wherein the gratings are disposed between two glazings.

7. Sun protection apparatus according to any one of claims 1 to 6, wherein a plurality of gratings are arranged one behind the other and the gratings are articulately connected to pivot levers.

8. Sun protection apparatus according to any one of claims 1 to 7, wherein two pairs of gratings are movable

via cable means and guide rollers in accordance with the balance weight principle in front of the building access.

9. Sun protection apparatus according to claim 8, wherein the gratings are articulately connected together, the cable means is secured to a pivot lever or a grating, and for each grating of each pair thereof a stop is provided.

10. Sun protection apparatus according to any one of claims 1 to 9, wherein one of the gratings is disposed stationary in front of the building access and the other grating is guided in rails or can be pivoted relatively to said one grating.

11. Sun protection apparatus according to claim 10, wherein the rails are made integrally with a facade profile.

12. Sun protection apparatus according to any one of claims 1 to 11, wherein the connecting levers between gratings are articulately mounted centrally, slightly eccentrically or at one end.

13. Sun protection apparatus according to any one of claims 1 to 12, wherein the gratings are disposed in front of or behind windows, or on roof areas.

14. Sun protection apparatus according to any one of claims 1 to 13, wherein the bars of the gratings are disposed vertically or horizontally.

15. Sun protection apparatus according to any one of claims 1 to 14, wherein the bars are tubes of polygonal, circular or oval cross-section.

16. Sun protection apparatus according to claim 15,

wherein a heating or cooling medium is conducted through the tubes, and support frames for the tubes form collecting passages.

17. Sun protection apparatus according to any one of claims 1 to 14, wherein the bars are made in channel form.

18. Sun protection apparatus according to any one of claims 1 to 17, wherein parallel displacement or pivoting of the gratings takes place manually or is controlled by computers depending on the position of the sun.

19. Sun protection apparatus according to any one of claims 1 to 18, wherein the gratings consist of metal or plastics.

20. Sun protection apparatus according to claim 19, wherein the bars of the gratings are of extruded form.

21. Sun protection apparatus according to any one of claims 1 to 20, wherein the gratings consist of modules which can be displaced or pivoted individually.

22. Sun protection apparatus according to any one of claims 1 to 21, wherein the spacings of the bars of a grating are variable.

23. Sun protection apparatus according to any one of claims 1 to 22, wherein the bars are filled with a phase-change material.

24. Sun protection apparatus constructed and arranged substantially as herein particularly described with reference to any one of the accompanying drawings.

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Applicant/Proprietor
JOSEF GARTNER & CO, Incorporated in the Federal Republic of Germany, Postfach 20/40, 8883 Gundelfingen, Federal Republic of Germany
[ADP No. 00537142001]

Inventors
FRITZ GARTNER DR -ING, Gartnerstrasse 24, 8883 Gundelfingen, Federal Republic of Germany [ADP No. 03956513001]

WINFRIED HEUSLER, Alemannenstrasse 17, 8883 Gundelfingen, Federal Republic of Germany [ADP No. 03956521001]

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Address for Service
S JONES-ROBINSON & CO, The Laurels, 320 London Road, Charlton Kings, Cheltenham, Gloucestershire, GL52 6YJ, United Kingdom
[ADP No. 00000984001]

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