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(54) A sliding roof for vehicles

(57) A sliding roof for vehicles, comprises a panel 12 which can be lowered from a closed position (Fig. 2), in which the panel closes a roof aperture 11, Fig. 3 in a fixed roof surface 10, and slid along lateral guide rails 16 provided on a roof frame 13 rearwardly under the fixed roof surface 10. A displacing mechanism (41) provides vertical displacement of at least the rear of the guide rails 16 as a function of the panel position, to increase the headroom when the panel is in the forward end position. The roof frame 13 together with the guide rails 16, is of rigid construction and can be displaced as a unit relative to the fixed roof surface 10 by vertical displacement element 40, Fig. 7.

FIG. 2

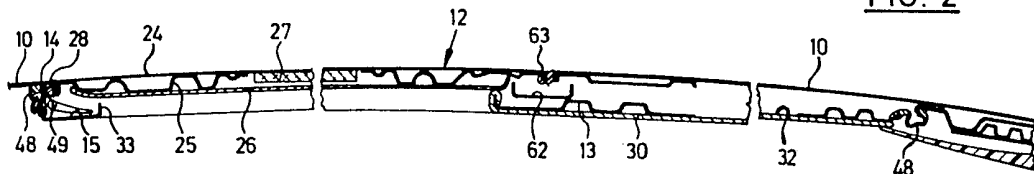


FIG. 6

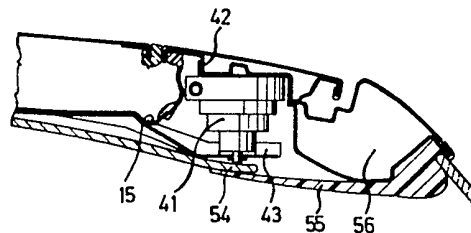




FIG. 2

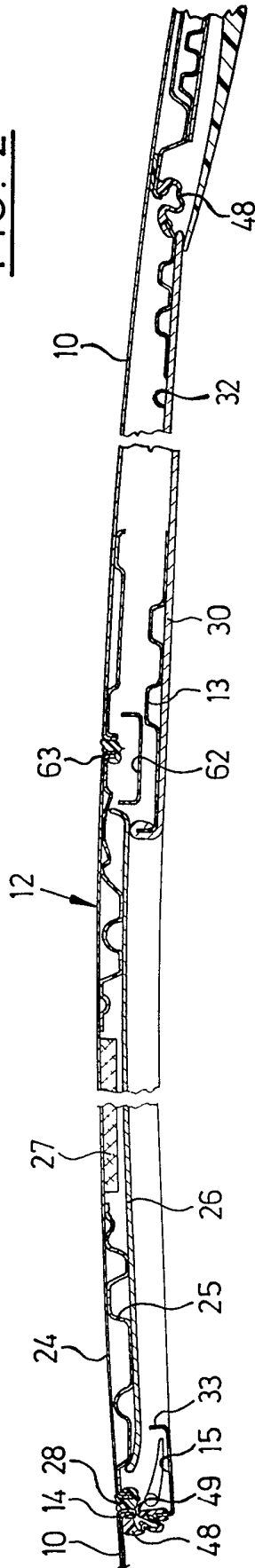


FIG. 3

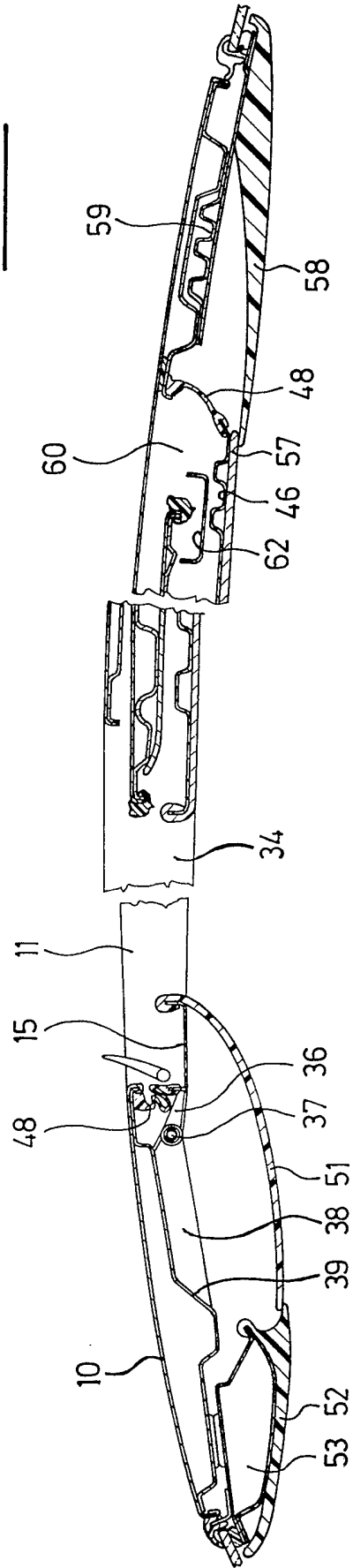


FIG. 4

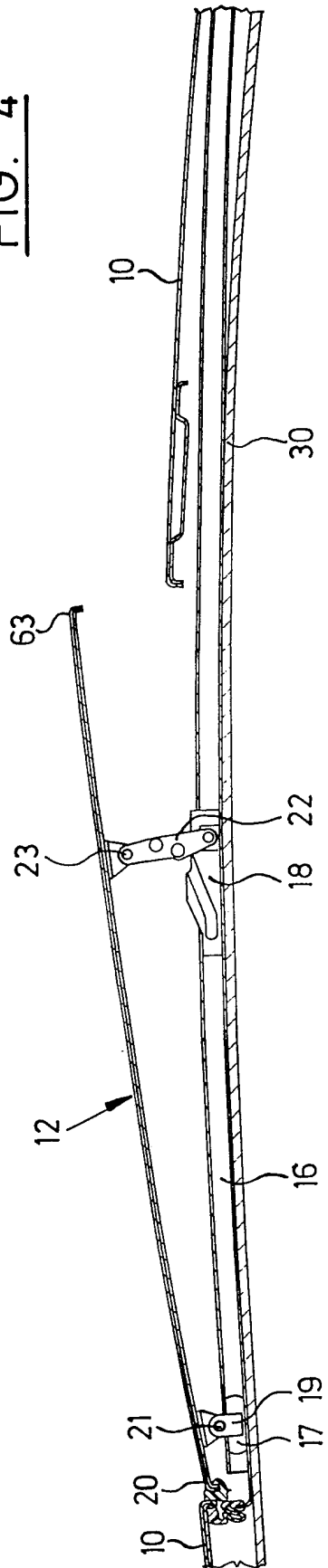


FIG. 6

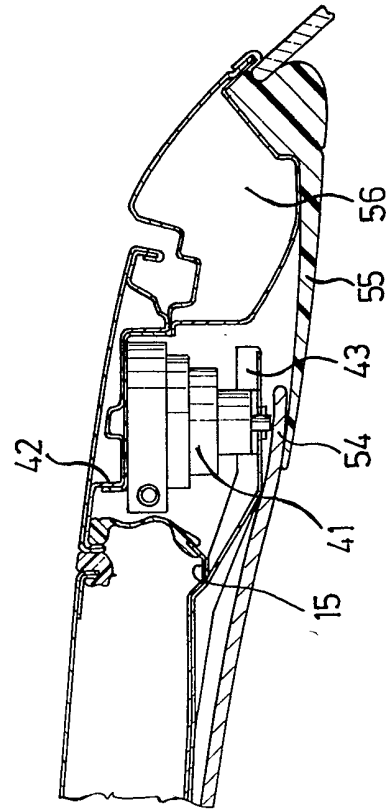
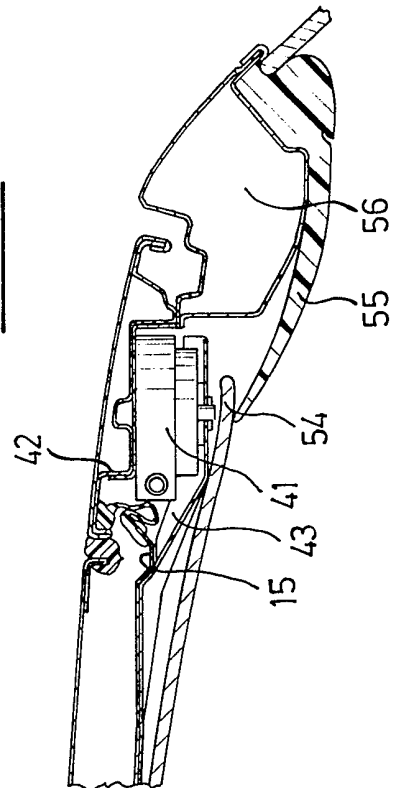


FIG. 5



## SPECIFICATION

### A sliding roof for vehicles

- 5 The invention relates to a sliding roof assembly for vehicles, having a panel which in use can be lowered from a closed position, in which the panel closes a roof aperture in the fixed roof surface, and can be slid along
- 10 lateral guide rails provided on a roof frame rearwardly under the fixed roof surface, and also having a displacing mechanism for vertical displacement of the guide rails as a function of the panel position, for the purpose of the
- 15 increasing the headroom when the panel is in the forward end position.

- In known sliding roofs of this type (DE-AS 12 89 439 and US-PS 42 98 226), the roof frame and the guide rails are split in longitudinal direction. The two frame parts are interconnected in articulated manner for pivotal movement about a central pivot axis which extends parallel and near to the rear edge of the roof aperture. Moreover, the front frame part and rear frame part are pivotably supported, at the front and rear respectively, on the fixed roof parts. When the panel is moved into its closed position, the displacing mechanism ensures that the split roof frame is
- 20 raised in the vicinity of the central pivot axis. When the panel is moved out of the closed position, the central pivot axis is lowered so as to make room for the panel to be pushed under the fixed roof surface. The split construction of the roof frame and guide rails increases production and assembly costs. Because of the articulated mounting of the roof frame parts at both roof frame ends and the additional articulated connection between the
- 25 two roof frame parts, the stability of the entire assembly leaves much to be desired. The operating conditions to which vehicles are exposed, for example during travel over uneven road surfaces, can lead to undesirable movements or vibrations of the roof frame, thereby resulting in rattling noises, leaks and increased loading of the seal which in sliding roofs seals the peripheral gap between the panel rim and roof aperture. Furthermore, in known sliding
- 30 roofs the increase in headroom in the panel closed position is limited substantially to the area situated, in the longitudinal direction of the vehicle, near to the rear edge of the roof aperture; it merely benefits the passengers in the front seats of a motor car but not the passengers in the rear seats thereof.

- The present invention provides a sliding roof assembly for a vehicle, comprising a roof frame including or carrying a pair of laterally
- 35 disposed longitudinally running guide rails which frame and guide rails form a rigid unit, a roof panel carried for sliding roof opening movement on said guide rails, and a displacing mechanism for lowering at least the rear
- 40 of said frame relative to a fixed support in

use.

- Examples of sun roofs will be described hereafter which through embodying the invention are generally of particularly low construction height at least when the panel is closed and which are distinguished both by a high degree of stability and by comparatively low production and assembly costs.

- This object is achieved in that the roof
- 45 frame, together with the guide rails, is of rigid construction and can be displaced as a rigid unit relative to the fixed roof surface.

- In the development according to the invention the two-part construction of the roof frame and guide rails is dispensed with, as is the central pivot axis present in the known sliding roofs discussed above. The roof frame and the guide rails mounted on the roof frame or formed by the roof frame itself can be
- 50 formed in one-piece. A particularly robust construction is achieved, while by corresponding displacement of the roof frame, depending on the respective position of the panel, it is possible to ensure that the construction height of the sliding roof is kept to a minimum when the panel is in the forward end position.

- At its front end the rigid roof frame can be pivotably mounted relative to the fixed roof surface. In that case the displacing mechanism
- 55 can preferably have two vertical displacement elements which engage laterally in the rear zone of the roof frame or one vertical displacement element which engages in the centre of the rear edge of the roof frame.
- However, according to a modified form of embodiment of the invention, the rigid roof frame can be displaced vertically parallel or almost parallel to the fixed roof surface, the displacing mechanism preferably having vertical displacement elements engaging at the
- 60 four corners of the roof frame.

- The sliding roof according to the invention may be designed as a simple sliding roof whose panel can slide only between the closed position and a pushed-back position uncovering the roof aperture. However, it is also possible for the sliding roof to be designed as a sliding and tilting roof, wherein the panel is not only displaceable in the longitudinal direction of the vehicle but, optionally, can also be pivoted out at its rear edge above the fixed roof surface. In this case a water channel, which in the panel closed position engages under the peripheral gap between the panel rear edge and the adjacent rim of the roof aperture, can preferably be guided displaceably by the guide rails in a set vertical position in relation to the guide rails in the direction of panel displacement. With the solution
- 65 according to the invention it is not necessary for the water channel to be raised when the panel is in the forward end position, in the manner disclosed for example in DE-OS 32 38 454, since the water channel can be mounted as close as desired to the panel rear edge and

can fully underpin the latter. This further assists in reducing production and assembly costs.

5 A panel canopy or shield can be disposed under the panel, the relative position of which to the panel is the same in all panel positions and which can be securely fastened to the panel in particular. This represents a further simplification in comparison with known sliding roofs, in which the distance between the panel and panel canopy varies when the panel is lowered and in which, if a sliding and tilting roof is involved, the panel canopy has to be raised when the panel is pivoted out (e.g. DE-  
10 GM 81 07 603).

The peripheral gap between the outer periphery of the roof frame and the fixed roof surface can advantageously be closed by means of a deformable cover. Preferably, the  
20 displacing mechanism can have one or more threaded spindles engaging on the roof frame. In the case of a panel operated by motor, the displacing mechanism is provided, in a further development of the invention, with at least  
25 one additional drive motor. Preferably, the underside of the roof frame can have a lining which cooperates with lining portions applied to the fixed roof parts, so as to provide an attractive appearance from below, irrespective  
30 of the particular position of the roof frame in relation to the fixed roof. The roof frame lining together with the fixed roof surface can define a space to accommodate the pushed-back panel.

35 Embodiments of the invention will be illustrated in more detail below by way of example and with reference to the accompanying drawings, wherein:

40 Figure 1 shows a top view of a sliding and tilting roof designed in accordance with the invention;

Figure 2 shows a section along the line II-II in Figure 1, with the panel in the closed position,;

45 Figure 3 shows a section along the line III-III in Figure 1, with the panel pushed back;

Figure 4 shows a section along the line IV-IV in Figure 1, with the panel pivoted out;

50 Figure 5 shows a section along the line V-V in Figure 1, with the roof frame raised;

Figure 6 shows a section corresponding to Figure 5, with the roof frame lowered;

55 Figure 7 shows a top view similar to Figure 1 of a sliding roof according to a modified embodiment of the invention.

As is evident from the drawings, a fixed roof surface 10 is provided with a roof aperture 11 which can be closed or at least partly uncovered by means of a rigid panel 12. A  
60 roof frame 13 is disposed beneath the fixed roof surface 10 and forms a water channel 15 under the front edge 14 and the two side edges of the roof aperture 11. The roof frame 13 is provided with a respective guide rail 16  
65 (Figure 4) extending longitudinally on either

side of the roof aperture 11 in the longitudinal direction of the vehicle, these guide rails 16 being formed by the roof frame 13 itself or being connected securely thereto. The guide  
70 rails 16 and the other components of the sliding and tilting roof are designed to be substantially mirror-inverted symmetrical to a longitudinal axis of symmetry.

75 Front and rear slide members 17 and 18 respectively can slide along each of the guide rails 16. The front slide member 17 is mounted on a slide member carrier 19 which is connected via a pivot 21 to the panel 12 near to its front edge 20. One end of a pivoting-out lever 22 is articulated to the rear slide member 17 and its other end is connected in an articulated manner at 23 to the panel 12.

In the embodiment illustrated the panel 12 has a panel outer plate 24, (Figure 2), a panel  
85 frame 25 situated under the outer plate 24, a panel canopy 26 secured to the panel frame 25 and a heat and sound-insulating intermediate layer 27 disposed between the outer plate 24 and the panel canopy 26. The panel outer plate 24 and the panel frame 25 are bevelled  
90 downwards at their outer edge and a seal 28 is mounted on the bevelled portion, which seal 28 extends around the panel 12 and in the closed position of the panel (Figure 2)  
95 seals the annular gap between the rim of the roof aperture 11 and the panel 12.

In the embodiment illustrated by way of example, the roof frame is formed by a one-piece bent sheet metal part and a lining 30 is  
100 mounted on its underside. The roof frame 13 has a cutaway portion and, with a view to saving weight, a rear cutaway portion 32 (Figure 2). The rear cutaway portion 32 is covered by the lining 30. In the vicinity of the front cutaway portion of the roof frame 13 the lining 30 is also cut away and provided  
105 with an upright section 33 which defines a frame opening 34 (Figure 3) aligned with the roof aperture 11. As illustrated, the dimensions of the roof opening 34 are somewhat smaller than that of the roof aperture 11. In the panel closed position the panel canopy 26 rests on the section 33 of the lining 30 (Figure 2).

115 A respective forwardly projecting pivot arm 36 (Figure 3) is secured to the front end of the roof frame 13 on both sides thereof. Each of the pivot arms 36 is connected via an articulation 37 to a bearing block 38 which, in turn, is mounted on a front roof reinforcement  
120 39. The articulations 37 define a horizontal pivot axis, situated just in front of the front edge 14 of the roof aperture 11 and directed transversely to the longitudinal direction of the vehicle, about which axis the roof frame 13  
125 can be pivoted as a rigid unit relative to the fixed roof surface 10. A displacing mechanism is used to pivot the roof frame 13 and, in the embodiment illustrated by way of example, it has two vertical displacement elements 40 en-  
130

gaging laterally in the rear zone of the roof frame 13 and taking the form of threaded spindles. Each of the threaded spindles is provided with a plurality of spindle parts which in telescopic manner can be retracted (Figure 5) and extended (Figure 6), the two outer spindle parts being mounted respectively on a roof reinforcement 42 and a laterally projecting arm 43 of the roof frame 13. The displacing mechanism is also associated with a drive motor, indicated at 44 in Figure 1, which drives the vertical displacement elements (threaded spindles) 40 in the same direction, for example via flexible shafts 45.

Instead of two vertical displacement elements engaged laterally in the rear zone of the roof frame 13, it is also possible, for example, to provide a displacement element which engages in the centre of the rear end 46 of the roof frame 13. The threaded spindle acting as vertical displacement element 40 may be designed, for example, in the manner known from DE-PS 27 10 193.

A deformable cover 48 is mounted on the outer edge of the roof frame 13, the edge of which remote from the roof frame 13 is connected with the fixed roof surface 10. The cover 48 ensures in the full pivotal range of the roof frame 13 watertight sealing of the peripheral gap 49 between the outer periphery of the roof frame 13 and the fixed roof surface 10. In its front region 51 the lining 30 of the roof frame 13 is disposed pivotably with its front end on a lining part 52 of a front roof member 53. The side edges 54 of the lining 30 each engage over a lining part 55 of lateral roof members 56. The rear edge 57 of the lining is disposed on a lining part 58 of a rear roof member 59. The lining parts 55, 58 can be resiliently deflected when the roof frame 13 is lowered at its rear end by means of the vertical displacement elements 40 (Figures 3 and 6). Because of their resilient restoring force, they remain in contact with the lining 30 when the roof frame 13 is pivoted up (Figures 2, 4 and 5). In the lowered position of the roof frame 13, the roof frame and its lining 30 define a space 60 for accommodating the pushed-back panel 12. With respect to its sliding movement the panel 12 is coupled to a water channel 62 which in the panel closed position engages under the peripheral gap between the panel rear edge 63 and the adjacent rim of the roof aperture 11. The water channel 62 is securely connected to slide members (not shown) which engage in the guide rails 16 and can be displaced along the guide rails 16. Therefore, independently of any pivoting of the panel 12 between a closed position and a pivoted-out position, the water channel 62 occupies a fixed vertical position with respect to the guide rails 16. In the illustrated embodiment another drive motor 64 (shown schematically in Figure 1) is provided to displace the panel 12, which

motor can be in driving connection with the rear slide members 18, in a conventional manner for sliding roofs or sliding and tilting roofs, via rigid drive cables (threaded cables). Likewise in known manner (DE-OS 34 33 600) a two-stage transmission can be coupled between the drive motor 64 and the drive cable.

When the panel is closed (Figure 2) the roof frame 13 is pivoted up. The distance between the fixed roof surface 10 and the underside of the lining 30 of the roof frame 13 is minimised. In this position, the construction height of the sliding and tilting roof is, for example, in the order of magnitude of 30 mm. Therefore, the sliding and tilting roof offers substantial headroom both to the front and rear seats of a motor car. If the panel 12 is to be slid rearwards so as to uncover the roof aperture 11, firstly the drive motor 44 is actuated so as to pivot, via the vertical displacement elements 40, the roof frame 13 together with the guide rails 16 and lining 30 about the articulation 37 and bring it into the lowered position shown in Figures 3 and 6. In this position the construction height of the sliding and tilting roof can lie, for example, in the order of magnitude of 45 mm. The drive motor 64 is then cut in. A displacing force is applied to the rear slide members 18 which enables the panel 12 together with the water channel 62 to be pushed rearwards into the space 60. To close the panel 12, the drive motors 44 and 64 are operated in reverse direction and order. To pivot the panel 12 out with its rear edge 63 above the fixed roof surface 10, starting from the closed position, the rear slide members 18 are displaced further forwards, thereby straightening the pivoting-out lever 22. The panel 12 pivots about the pivot axis defined by the articulations 21. The panel canopy 26 follows this pivotal movement. The roof frame 13 is still raised so that even when the panel 12 is pivoted out the maximum amount of headroom is assured. The panel 12 thus carries out pivotal movements relative to the roof frame 13 only in the transition from the closed position into the pivoted-out position but not when displacing the panel 12 between the closed position and the pushed-back position. During this last-mentioned displacing movement, the relative pivotal position between the panel 12 and the roof frame 13 remains unaltered.

In the case of the modified embodiment according to Figure 7, vertical displacement elements 40, for example in the form of threaded spindles, engage at all four corners of the roof frame 13. In this way the vertical displacement elements 40 enable vertical displacement of the roof frame 13 to be carried out parallel or almost parallel to the fixed roof surface 10.

Optionally, the pivoting-out function of the panel 12 may also be omitted, namely the roof described may be designed purely as a

sliding roof. Moreover, it is to be understood that the invention is not limited to the use of threaded spindles as vertical displacement elements. For example, it is also possible to provide as vertical displacement elements springs which preload the roof frame 13 in its lowered position and against the force of which the roof frame 13 can be raised by means of a wire or cable line. Vertical displacement elements of this type are known from DE-OS 32 28 699.

#### CLAIMS

1. A sliding roof assembly for a vehicle, comprising a roof frame including or carrying a pair of laterally disposed longitudinally running guide rails which frame and guide rails form a rigid unit, a roof panel carried for sliding roof opening movement on said guide rails, and a displacing mechanism for lowering at least the rear of said frame relative to a fixed support in use.

2. An assembly according to Claim 1, wherein the rigid roof frame comprises means for pivotably mounting a front portion of the frame to a fixed support.

3. An assembly according to Claim 2, wherein the displacing mechanism comprises two vertical displacement elements which engage laterally spaced locations in the rear zone of the roof frame.

4. An assembly according to Claim 2, wherein the displacing mechanism has one vertical displacement element which engages the centre of the rear end of the roof frame.

5. An assembly according to Claim 1, wherein the displacing mechanism is such that the rigid roof frame is downwardly displaceable parallel or almost parallel to its starting orientation.

6. An assembly according to Claim 5, wherein the displacing mechanism comprises vertical displacement elements engaging at an adjacent the four corners of the roof frame.

7. An assembly according to any one of the preceding claims, wherein the panel is mounted for upward pivoting out of its rear edge and also for sliding roof opening movement, at the users option.

8. An assembly according to Claim 7, wherein a water channel is provided mounted such that in the panel closed position the water channel engages in overlapping relationship under the panel rear edge and such that the water channel can be displaced under guidance by the guide rails in the direction of panel displacement in a set vertical position in relation to the guide rails.

9. An assembly according to any one of the preceding claims, wherein a panel canopy is disposed under the panel in a fixed position relative to the panel.

10. An assembly according to any one of Claims 1 to 8, comprising means for securely fixing a panel canopy in a fixed position rela-

tive to the panel.

11. An assembly according to any one of the preceding claims, comprising a deformable cover positioned for closing in use a peripheral gap between the outer periphery of the roof frame and a fixed roof surface to which the frame is installed.

12. An assembly according to any one of the preceding claims, wherein the displacing mechanism has at least one threaded spindle engaging on the roof frame.

13. An assembly according to any one of the preceding claims, comprising a motor connected for displacement of the panel and wherein the displacing mechanism of the roof frame comprises at least one additional drive motor.

14. A sliding roof assembly, substantially as hereinbefore described with reference to Figures 1 to 6 or Figure 7 of the accompanying drawings.

15. A vehicle sliding roof comprising an assembly as claimed in any preceding claim mounted to close an aperture in a fixed roof.

16. A sliding roof according to Claim 15, wherein the frame is provided with a lining which cooperates with lining portions, applied to the fixed roof.

17. A sliding roof according to Claim 16, wherein the roof frame and/or its lining together with the fixed roof surface defines a space to accommodate the panel when slid back.

18. A sliding roof according to Claim 16 or 17, wherein the panel is provided with a panel canopy and the lining of the frame has an upright section which defines a frame opening aligned with the roof aperture and on which the panel canopy rests in the panel closed position.

19. A vehicle having a roof as claimed in any one of Claims 16 to 18.

20. A sliding roof for vehicles, having a panel which can be lowered from a closed position, in which the panel closes a roof aperture in the fixed roof surface, and slid along lateral guide rails provided on a roof frame rearwardly under the fixed roof surface, and also having a displacing mechanism for vertical displacement of the guide rails as a function of the panel position, for the purpose of increasing the headroom when the panel is in the forward end position, wherein the roof frame, together with the guide rails, is of rigid construction and can be displaced as a rigid unit relative to the fixed roof surface.

21. A sliding roof according to Claim 20, wherein the rigid roof frame is pivotably mounted at its front end relative to the fixed roof surface.

22. A sliding roof according to Claim 21, wherein the displacing mechanism has two vertical displacement elements which engage laterally in the rear zone of the roof frame.

23. A sliding roof according to Claim 21,



wherein the displacing mechanism has one vertical displacement element which engages in the centre of the rear end of the roof frame.

5 24. A sliding roof according to Claim 20, wherein the rigid roof frame is vertically displaceable parallel or almost parallel to the fixed roof surface.

25. A sliding roof according to Claim 24,  
10 wherein the displacing mechanism has vertical displacement elements engaging at the four corners of the roof frame.

26. A sliding roof according to any one of Claims 20 to 25, wherein the panel can be  
15 pivoted out optionally at its rear edge over the fixed roof surface.

27. A sliding roof according to Claim 26, wherein a water channel, which in the panel closed position engages under the peripheral  
20 gap between the panel rear edge and the adjacent rim of the roof aperture, can be guided displaceably by the guide rails in a set vertical position in relation to the guide rails in the direction of panel displacement.

28. A sliding roof according to any one of Claims 20 to 27, wherein a panel canopy can be disposed under the panel, the relative position of which to the panel is the same in all panel positions.

29. A sliding roof according to Claim 28, wherein the panel canopy can be securely fastened to the panel.

30. A sliding roof according to any one of Claims 20 to 29, wherein a peripheral gap  
35 between the outer periphery of the roof frame and the fixed roof surface is closed by means of a deformable cover.

31. A sliding roof according to any one of Claims 20 to 30, wherein the displacing  
40 mechanism has at least one threaded spindle engaging on the roof frame.

32. A sliding roof according to any one of Claims 20 to 31, wherein the panel can be displaced by motor and the displacing mechanism of the roof frame has at least one additional drive motor.

33. A sliding roof according to any one of Claims 20 to 32, wherein the roof frame is provided with a lining which cooperates with  
50 lining portions applied to the fixed roof parts.

34. A sliding roof according to Claim 33, wherein the roof frame and/or its lining together with the fixed roof surface can define a space to accommodate the pushed-back  
55 panel.

35. A sliding roof according to Claim 33 or 34, wherein the lining of the roof frame has an upright section which defines a frame opening aligned with the roof aperture and on  
60 which the panel canopy rests in the panel closed position.