

July 18, 1961

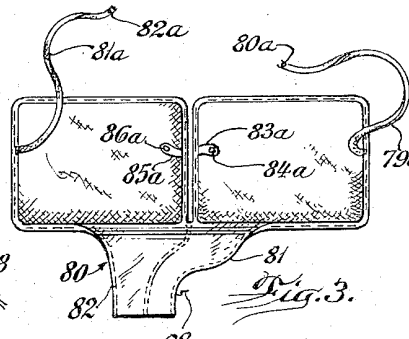
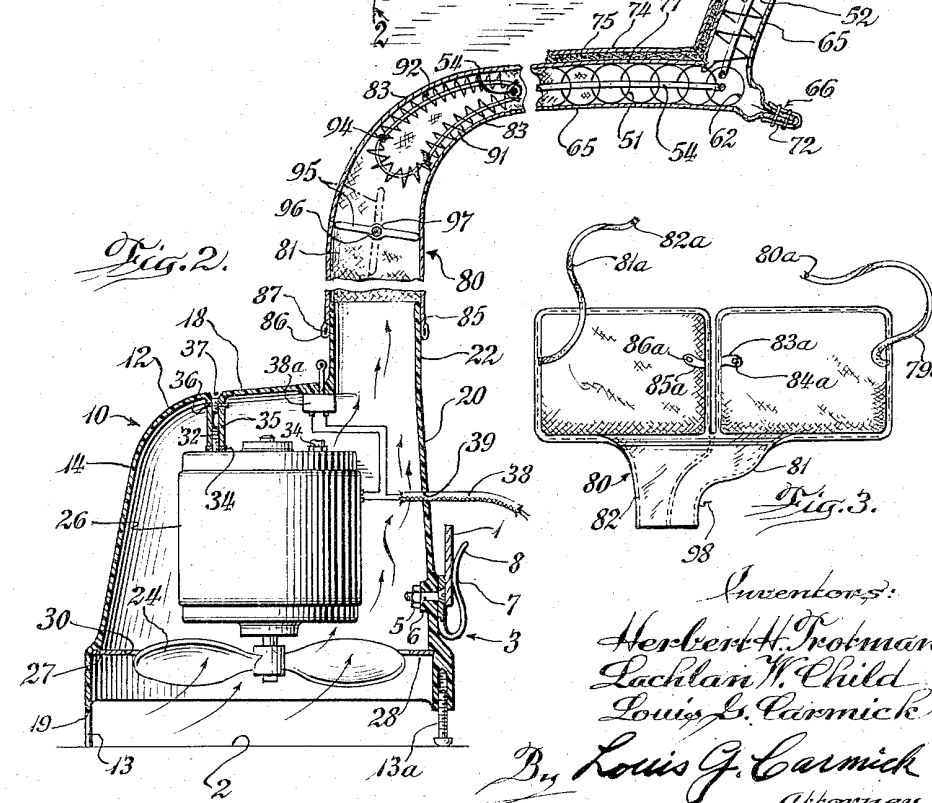
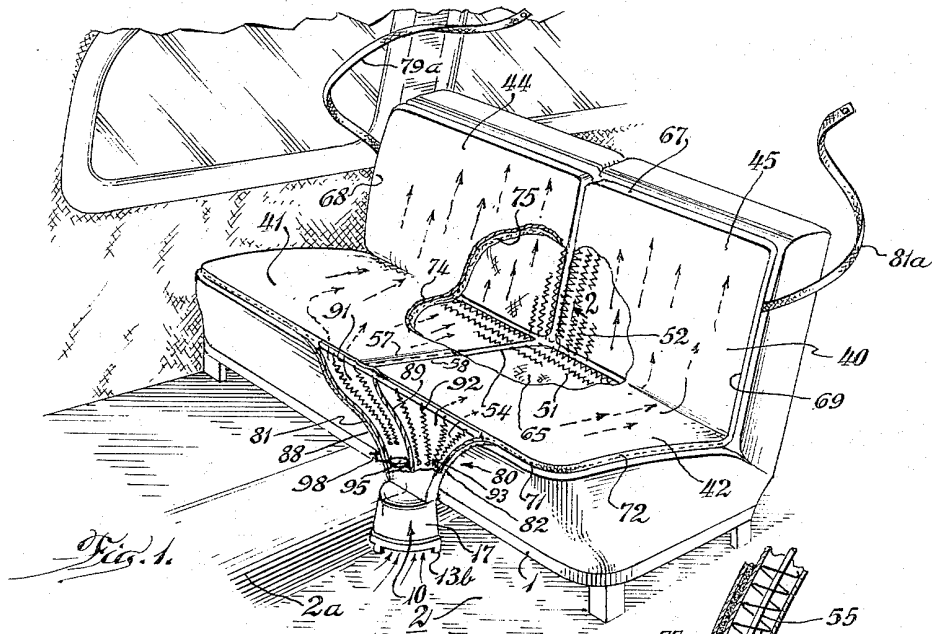
H. H. TROTMAN ET AL

2,992,604

FORCED AIR UNDER BODY VENTILATING DEVICE

Filed June 9, 1958

4 Sheets-Sheet 1



Inventors:
Herbert H. Trotman
Lachlan W. Child
Louis G. Carmick
By Louis G. Carmick
Attorney

July 18, 1961

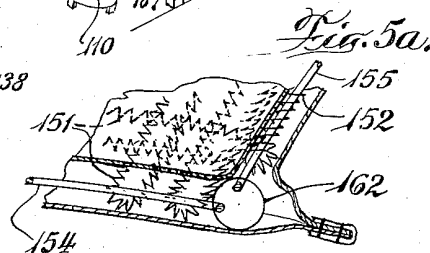
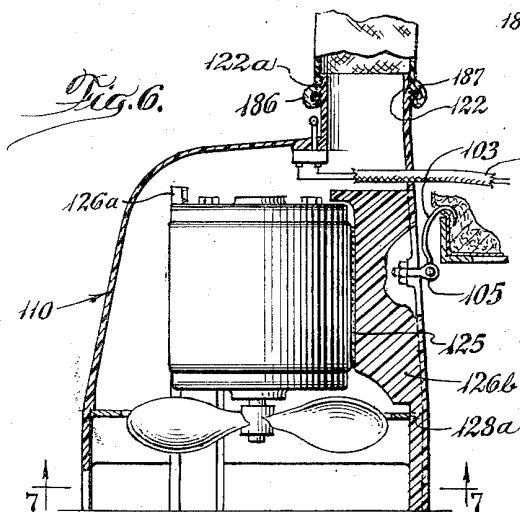
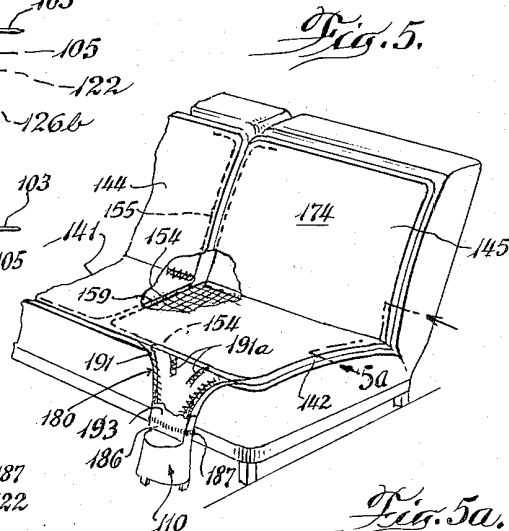
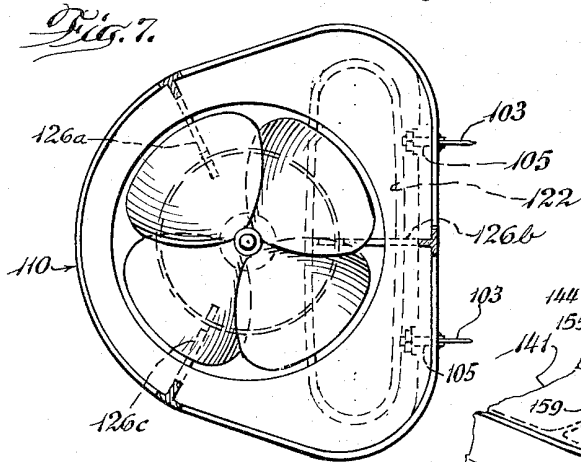
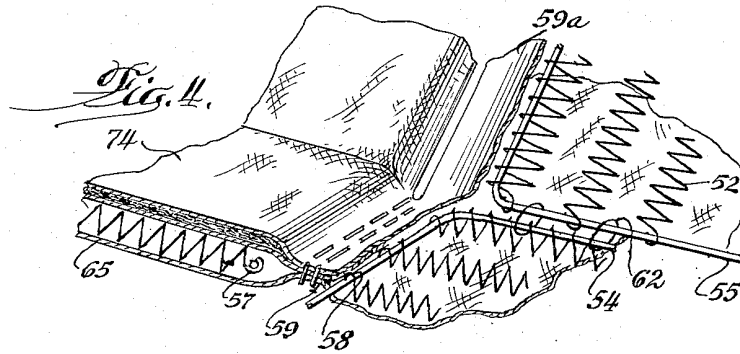
H. H. TROTMAN ET AL

2,992,604

FORCED AIR UNDER BODY VENTILATING DEVICE

Filed June 9, 1958

4 Sheets-Sheet 2



Inventors:
Herbert H. Trotman
Lachlan W. Child
Louis G. Carmick
By Louis G. Carmick
Attorney

July 18, 1961

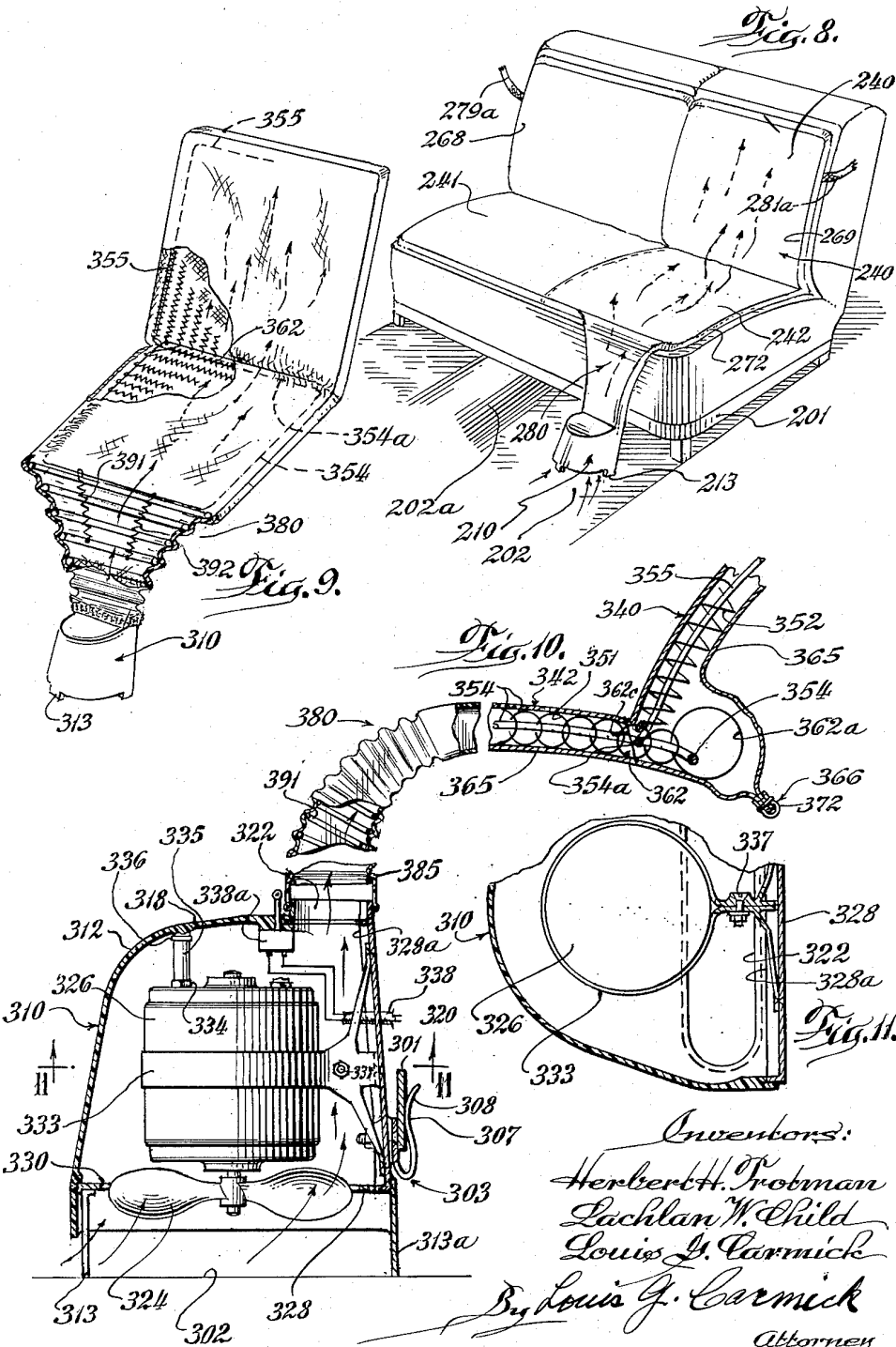
H. H. TROTMAN ET AL

2,992,604

FORCED AIR UNDER BODY VENTILATING DEVICE

Filed June 9, 1958

4 Sheets-Sheet 3



Inventors:
 Herbert H. Trotman
 Lachlan W. Child
 Louis G. Carmick
 By Louis G. Carmick
 Attorney

July 18, 1961

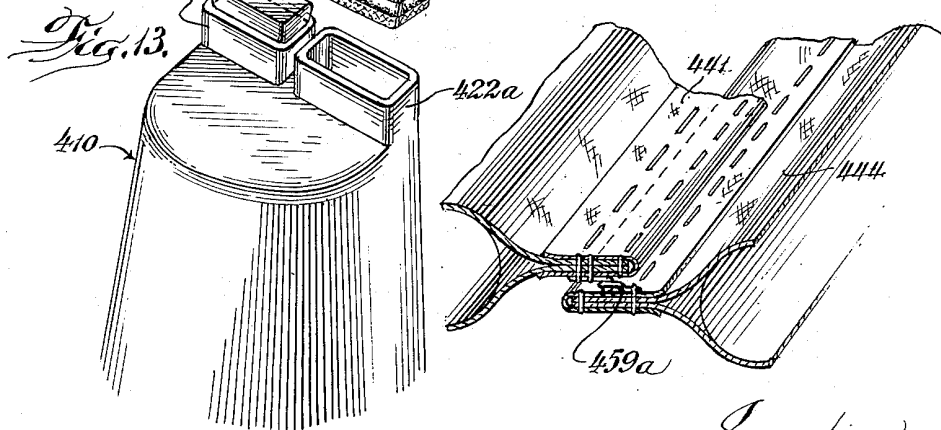
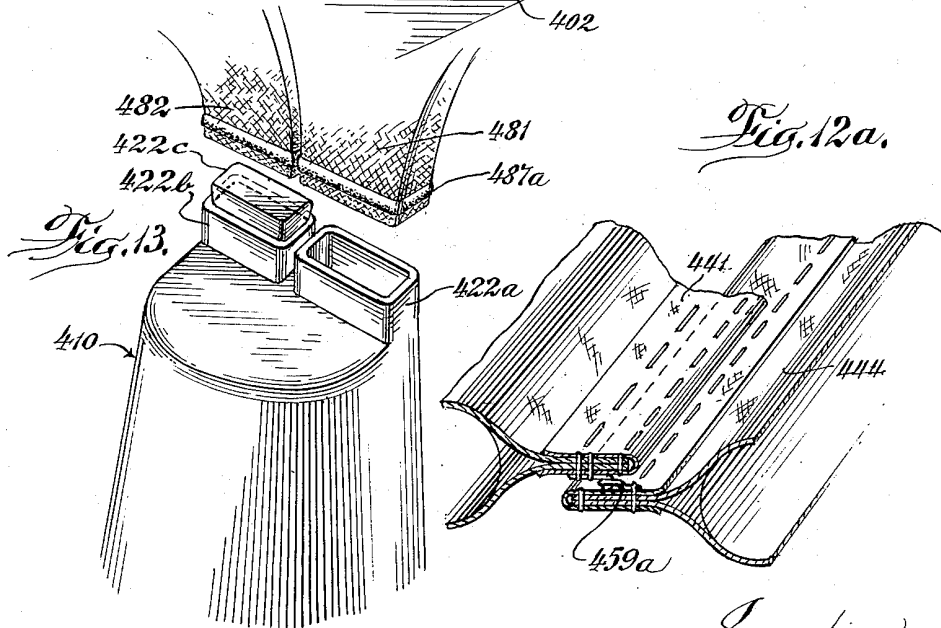
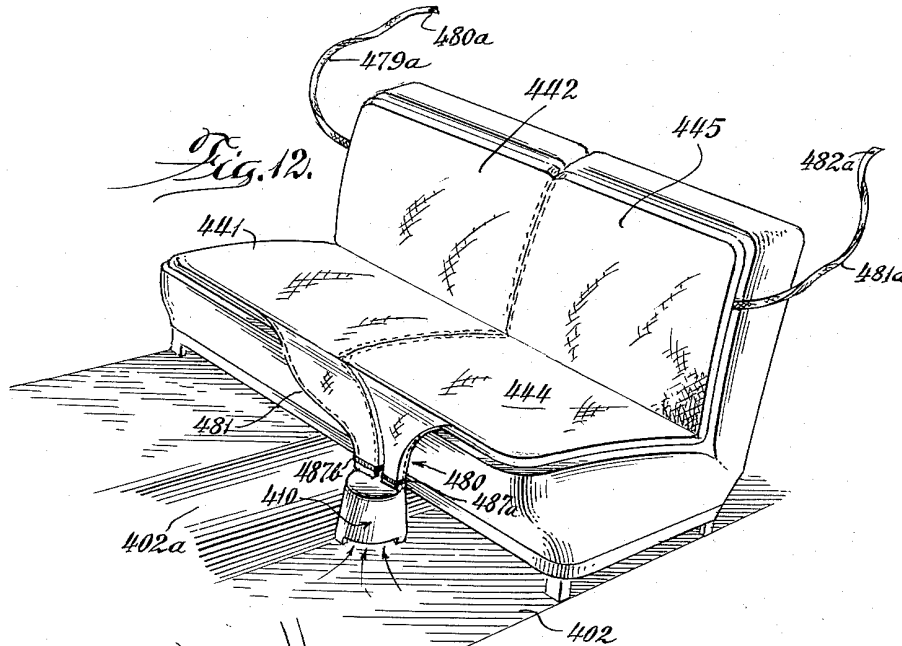
H. H. TROTMAN ET AL

2,992,604

FORCED AIR UNDER BODY VENTILATING DEVICE

Filed June 9, 1958

4 Sheets-Sheet 4



Inventors:

Herbert H. Trotman

Lachlan W. Child

Louis G. Carmick

By Louis J. Carmick

Attorney

1

2,992,604

**FORCED AIR UNDER BODY VENTILATING
DEVICE**

Herbert H. Trotman, Riverside Farms, Churchland, Va.,
Lachlan W. Child, Detroit, Mich., and Louis G. Carmick,
Chicago, Ill.; said Child and said Carmick assignors to said Trotman

Filed June 9, 1958, Ser. No. 740,884
22 Claims. (Cl. 98—2)

This invention relates broadly to improved means for supplying a forced flow of ventilating air under supported human body portions.

More specifically, this invention relates to pad attachments or flexible air conducting cover units for use on the existing cushions and spring structures of human body supports to efficiently supply a controlled blower-forced flow of ventilating air under and to the supported portions of the body. While such body supports may include various kinds of seats, chairs, beds, couches, or other types of support in the broader aspects of this invention, the illustrated devices are particularly intended for use as attachments over the seat and back cushions of present conventional passenger automobiles, which present certain special problems.

The general objects of our invention are to provide improved devices of the type described herein combining simplicity of design and low manufacturing cost in both materials and fabrication with efficient performance in providing the desired forced air flow distribution only where needed, together with a neat fit and attractive appearance when in use on different slopes and sizes seats and the retention or improvement of the original seating comfort.

Other objects of our invention are to provide, in devices of this type, the following features:

A thin, air-carrying pad for use on the cushions of seats or the like, which pad is highly flexible for comfort and yet is highly resistant to collapse, to thus always freely conduct forced air flow as a low velocity conducting and distributing passageway or plenum chamber having a minimum of resistance to air flow and requiring a minimum of thickness.

An appliance for use on existing seat cushions and having a relatively thin pad which forms a forced air carrying and distributing passage held against collapse in use by thin spring wire members freely bendable for flexibility, said thin wire members having a minimum of resistance to air flow so as to form a plenum chamber-like air distributing passage, thus permitting the use of a correspondingly low air distributing restriction value for the porous top cover of said pad to give a minimum air flow pressure drop through the whole appliance, and to thereby permit the use of a low cost electric motor and axial flow fan.

A device and pad of this type which, with its connected flat air supplying conduit and motor-blower unit, has simple adjustments and can easily be installed by the customer without any appreciable work or modification to give a neat and well-tailored looking fit on a number of different seats, particularly those of almost any recent United States passenger automobile, and which can be used with either split back or solid back seats, as well as front or back seats, with equal facility.

Such a pad and conduit, in a device of this type, as will retain their appearance, shape, and thickness without partial sagging or collapse after long use.

An attachment of this type (and particularly one in which one blower supplies all of a three-passenger seat and back) in which the motor-blower unit and the connecting air supply conduit are designed, connected, and positioned for a minimum of interference with comfort

2

or normal use of the automobile and yet give an efficient and low cost air delivery system which is resistant to injury.

A device of this type which is designed to be foldable and in part detachable for compact and convenient packaging in merchandising and in subsequent handling by the customer and yet does not sacrifice any material cost or air flow efficiency in achieving this convenience.

In a device of this type, an improved form and arrangement of the motor-blower unit and its casing so designed as to be attractive and to occupy the minimum of usable space in a wide range of automobiles, to be of low cost and low noise level, and to be efficient. In particular, the motor, blower, and casing unit is especially arranged and shaped to cooperate with the arrangement and shape of the seats in almost all recent passenger automobiles.

The pad and its connected air supply duct should supply a forced air carrying and distributing passageway of minimum thickness, restriction, and cost, and yet be of a maximum flexibility to preserve or retain in use the comfort built into the seat cushions on which this pad is to be used. It is a general object of this invention to provide an optimum of these several features in a practical combination.

It is also important and an object of this invention to provide always for a low noise level, even when the pad is fully occupied.

It is desirable and an object of this invention that the fan, motor, and whole air flow system of this ventilating pad combination be efficient, not only to permit the use of a lower capacity, and hence lower cost, motor, but also to reduce the current drain on the already overloaded automobile battery and generator.

Further and more detailed objects or advantages of our invention are set forth in the attached specification, drawings, and claims, or will be apparent from these disclosures to those skilled in this art.

In the attached drawings:

FIGURE 1 is a partial perspective view with surface portions broken away to show under-structure, and showing an embodiment of our invention installed on the front seat of a passenger automobile.

FIGURE 2 is an enlarged, partial, vertical transverse section taken on the line 2—2 of FIGURE 1.

FIGURE 3 is a reduced size rear perspective view of the device of FIGURE 1.

FIGURE 4 is an enlarged detail perspective view, partly in section, taken in the central portion of FIGURE 1.

FIGURE 5 is a partial perspective view showing a second embodiment of this invention in use on an automobile front seat.

FIGURE 5A is an enlarged partial section and perspective taken on the line 5A—5A of FIGURE 5.

FIGURE 6 is an enlarged, partial, vertical, front to rear section taken through the lower portion of the blower unit of FIGURE 5.

FIGURE 7 is an enlarged partial section taken on the line 7—7 of FIGURE 6.

FIGURE 8 is a front perspective view showing a third embodiment of our invention in use on an automobile seat.

FIGURE 9 is a front perspective view showing a fourth embodiment of our invention.

FIGURE 10 is an enlarged vertical, front to rear section taken through the seat to back hinge of FIGURE 9.

FIGURE 11 is a partial section taken on the line 11—11 of FIGURE 10.

FIGURE 12 is a front perspective view showing a fifth embodiment of our invention in use on an automobile front seat.

FIGURE 12A is an enlarged detail view showing the

3

overlapping seams used for the two pad parts of FIGURE 12.

FIGURE 13 is an enlarged partial perspective view of the lower portion of FIGURE 12 shown in exploded or disassembled form.

In the first embodiment of FIGURES 1 to 4, the conventional three-passenger front seat of a recent type of full-size U.S. passenger automobile is indicated as a whole by 1. This seat 1 is shown as the front seat of a two-door sedan, the seat having its back divided to give the usual two separately-hinged back portions. While this division is here shown as in the middle of the seat, it will be understood that in some cars the seat is divided to one side of the center.

The floor of this same conventional automobile is indicated as a whole by 2, in which 2a is the usual transmission hump or raised portion in the center of the car floor.

The motor-blower or forced-air-supplying unit is designated as a whole by 10. In order to manufacture at low cost, the particular upwardly-tapered or wide and deep base shape (shown with all of its corners rounded) of the outer casing 12 is preferably formed in one piece (at least as far as its exposed top, sloped sides, and curved sloped front are concerned). In the present embodiment this curved, one-piece, outer casing is of light and low cost molded plastic or laminate material for vibration absorption and silence in use. It is preferably of generally upward and inward tapered shape. For a more comfortable and space-saving installation in most cars, the back wall is similarly sloped, as illustrated in FIGURE 3. The molded plastic is preferred here on a cost and noise level basis. No painting is necessary.

Within the broader purview of this invention, this casing may be a stamping of similar shape, with the back integral or separate, or it may be a die casting of aluminum or the like. If of metal, the inside of casing 10 should be flocked to damp out vibration and silence it.

The rounded and generally conical or sloped front 14 curves or merges smoothly into the two sloped side walls 16 and 17 and into the forwardly and downwardly sloped generally flat top 18. The generally flat and integral back wall 20 has similar rounded corners and edges in joining the sides and top. The flat base 19 is open for insertion of the fan and motor and for the air intake.

Suitable retaining means are provided to readily and detachably secure the back of the casing 10 to the lower front part of a wide variety of automobile front and rear seats to thus hold unit 10 against forward motion and also to retain it against lateral sliding. While various forms of securing means may be used, we here prefer the two spring clamps 3, made of spring wire or springy steel strip, as shown, and having an inner portion 4 clamped against and held on to the casing rear wall as by the bolts and nuts 5 through a hole in suitably reinforced or thickened wall portions 6. The upwardly turned legs or portions 7 are resiliently biased inwardly and have out-turned upper ends 8 to engage easily under the lower front edge of the seat (which may be a heavy wire or a strip of different thickness) by rotating or turning each clamp 3 so that its free end can be swung up behind the seat front's lower edge. These clamps are pivoted low enough on the casing 10 to thus engage under the front edges of most car seats.

The upwardly directed air delivery conduit connecting extension 22 is integrally formed into the top wall and is of elliptical or oval cross section, with its greatest width extending across the entire top width of the casing to provide a smoothly curved passage of reduced cross-sectional area (compared to the fan disk area) for a non-turbulent and hence quiet air flow and a certain low pressure drop in the forced air flow therethrough.

While this extension or neck 22 need only be of sufficient height (from about one-half to less than one inch) to provide for an adequate overlap and grip by the here-

4

inafter-described flexible duct extension, yet we here prefer to make 22 higher (two to three inches or over) to permit a telescopic or adjustable height of clamping engagement by the lower end of the flexible duct extension of the pad.

This particular type of general shape for the motor-blower unit casing has a number of advantages peculiar to the particular problems occurring in a removable appliance of this type for use in an ordinary passenger automobile. Aside from the attractive appearance which combines well with the rest of the appliances in use, this shape is the most compact one possible to house an axial flow, multi-blade, propeller type fan on the shaft of a small electric motor, and to give low restriction air flow for this desirable arrangement, in which the wider fan 24 is below and the smaller diameter little electric motor 26 is above it in the casing and cooled by the forced air flow.

The small and compact-looking casing also has a high stability due to its larger base 19, and gives the minimum of objectionable interference with the driver's or passenger's legs. The smoothly curved surfaces prevent catching of women's hose.

The air passage as a whole (from the fan blades up into the ventilating pads) is progressively widening and becoming correspondingly thinner to maintain an adequate cross-sectional area throughout and with no sharp bends or abrupt changes in direction, all to give a low but definite restriction to air flow in this reduced cross section neck 22 and in the similar size and shape of flexible conduit-forming material thereabove.

All of the front, side, and back walls extend outwardly a short distance (here about one-eighth inch), this extension being spaced about one inch above the bottom 19 to form a downwardly directed shelf or abutment 27 on the inside of the casing's bottom walls, with a corresponding outward projection or ledge on the lower outside of the casing. The plate 28 (which is preferably of plastic reinforced paper or other laminate for silence) is shaped to fit the inside contours of the casing interior and is suitably detachably secured (as by a friction fit or by screws or the like 23) up against the shelf 27 to serve as the air inlet shroud for the fan 24, which has approximately the upper one-third of its height or thickness of blades extending above plate 28 through the circular hole 30 which is nearly of the maximum diameter to fit the inside of the casing. The use of plate 28 gives a better entrance condition.

The motor 26 is suitably removably secured in the case, for example, to the lower side of the top 18 by the usual rearwardly extending motor assembly bolts 32 having threaded sleeve extensions 35 screwed on to these bolt ends 32 beyond their end clamping nuts 34. Sleeves 35 may abut directly or through washers 36 and be pulled up against the top wall 18 by short bolts or screws 37 whose Allen heads are recessed below the smooth outer surface of the top which may be suitably thickened or reinforced at those points.

The current supply wires 38 (live and ground wire) for the motor may be led out through the open bottom or through a hole 39 in the back of the casing. The on-off switch 38a for the little D.C. motor (6 or 12 volt when for use in passenger automobiles) is connected on one of the wires 38 and conveniently located. A convenient and low cost location for a toggle throw type of switch is to mount it projecting up through a hole in the casing top 18 back out of the way against the upward extension neck 22.

For an easy installation by the customer, the current supply wire (or wires) may be shoved (as by a flexible steel member or suitable stick) under the slightly raised floor mat and suitably connected behind the instrument panel or by a cigar lighter socket matching plug.

The open bottom 19 of casing 12 is suitably spaced above the car floor (about an inch or more in the present

form) to provide for an entry by suitable legs or the three extensions 13, 13a, and 13b, integral with the casing base portion 19.

In order that the fan unit 10 may stand level and yet be located far enough to the right in the front of cars with a wide or long slope for the transmission hump, the right hand leg 13a is of the adjustable length screw type. It can also be removed.

The forced air distributing and cushioning pad (indicated as a whole by 40) includes the two foldably-hinged-together seat portions 41 and 42, the two separately-swingable back sections 44 and 45 which are foldably hinged to the seat portions, and the flexible air supply conduit extension portion 80. If the automobile types for which the present air distributing pad is designed have swingable seat back portions (as in a two-door sedan), then the back sections 44 and 45 are divided to match the location of the seat back division.

These seat and back portion pads form plenum-like air distributing passages, whose substantially open or unobstructed interior thickness is defined and maintained by a flexible but non-collapsible layer of fine springy wires, and which in my preferred embodiment are the side-by-side and suitably connected (as by being interwoven or interthreaded) horizontally extending, spring steel wire coil springs 51 forming the open center body or air passage for the seat portions 41 and 42 and the similar interconnected coil springs 52 forming the open center body for the two back pad portions 44 and 45.

While various arrangements of springs such as 51 and 52 may be employed (of which some others are illustrated in other modifications herein), in this first modification we prefer to have the springs 51 and 52 disposed at right angles, with the back portion's springs 52 extending up and down for somewhat more flexibility or easier bending around the upright sides of the seated person's back. These interconnected spring bodies hinge on each other for somewhat easier bending or flexing of the layer in this direction, that is, along lines parallel to the spring lengths. For flexing in the other direction, each individual coil spring is bent. For the seat portions 41 and 42, we here prefer the somewhat greater flexibility obtained by hinge action along lines parallel to the front edge of the seat for greater seating comfort in a multi-passenger or bench type seat.

The springs 51 and 52, as illustrated here, are formed of approximately 0.030 inch spring steel wire in helices whose diameter and pitch are preferably about equal, and in this instance are one-half inch. Such springs will not collapse appreciably or take any permanent set from any loads normally applied to these cushion pads, or even under a man standing on the pad on one foot. However, these pads are highly flexible and bend freely in any direction. Thus they readily conform to deflections in the supporting cushion seat or back beneath these pads, and retain substantially the seating comfort of the car's seat and back cushions. Also, they always maintain an almost constant open thickness to conduct and distribute the forced air. The cross-sectional area of the high strength fine wire of the springs is so small that the resulting restriction to the forced air flow is hardly measurable by ordinary methods. The springy steel in these horizontally extending coils is, as a practical matter, never stressed beyond, or even close to, its elastic limit, and fatigue is no problem here. Hence there is no permanent set causing sagging or partial collapse, such collapse or sagging being quite common in even the best grade of curled hair cushions or in various open forms of plastic or rubber. Also, for a given thickness of pad, hair, rubber, and plastic will obstruct the air flow much more than steel if used to form the open mats, since they are much weaker. They are therefore more costly and much less desirable for present purposes.

It will be appreciated that a considerable number of various arrangements or forms of spring wire coils or

other spring wire forms may be used within the broader purview of this invention.

The mats or bodies of interconnected springs such as 51 and 52 may be inclosed and connected along all four sides by light, spring, rectangular frame members with rounded corners, such as the frames 54 for the seat portions and the frames 55 for the back portions. Specifically, these frames are here of approximately one-eighth inch diameter spring steel wire welded into the closed loop frames. These frames are resiliently deformable in use.

The coil springs at the ends of the interconnected mat-forming row are threaded over or enclose the adjacent frame sides, while the spring ends at the other two sides of the mats are connected to the other two sides of each frame, as by the permanently deformed loops or bent-over portions 57 and 58 in the spring wire at each end of each spring, so that these spring ends are slidable along the frame sides. This slidable freedom along all four sides of each frame, taken with the springy bending of the frames, increases the ability of the mat to conform to cushion deflections and as a result increases the comfort of the user.

The under or cushion-engaging surfaces of the seat and back portions 41, 42, 44, and 45 are covered by a non-porous sheet material such as a flexible plastic film or sheet above or under a decorative cloth, or preferably by a latex or plastic treated layer 65 of cloth which is preferably of a closer or tighter weave than the top layer. This air impervious backing 65 may be in one piece for all four portions. As shown, the backing piece (or pieces) 65 is loose or has extra length to allow for plenty of air moving room as it goes around hinge springs 62. A seam 66 may be formed at this point.

The backing also extends up around certain of the edges as shown at the top of the back at 67, at the sides 68 and 69, and at parts of the front edge at 71. It is also reinforced by a suitable extra layer at these edges, such as the tape 72 which forms a flattened-out edge seam. The upper surfaces of all four portions 41 to 45 are covered by the porous cloth layer 74, which also may be in one piece. This outer cover 74 is preferably of a wear-resistant material, coarsely woven of a heavy or coarse yarn (or a low cost twisted, paper-like material), to supply an attractive and comfortable upper surface which will be sufficiently porous to permit the even and non-jet-like flow therethrough of the forced air but which will have a small restrictive effect or back pressure adequate to force a sufficiently equal distribution of the forced air flow through the different unit areas of the whole of the upper body ventilating surfaces of the air distributing pad 40. This equalized distribution is also important in giving the desired air circulation under and against the passenger's body and in permitting a low-cost and small motor-fan to handle the whole job satisfactorily.

In this case, the outer cover 74 is also of strands heavy enough to effectively cushion or bridge between the exposed turns of the coil springs so that they are not individually felt by a seated person.

While it is not essential in lower cost forms, the surface softness and comfort may be increased by a relatively thin (one-eighth to one-half inch thick) layer of springy sponge or open foam material 75, which may be used under the cover 74 to give a softer seating surface and to slightly increase the very slight porous restriction and thus help give the desired distributed forced air flow. This layer 75 is of a very open or low restriction springy foam rubber or a somewhat similar form of the various plastic or other foams or the like which may be available. Preferably the layer is about one-eighth inch thick and is protected from the spring coils under it by a layer 77 of very coarse open weave cloth or fiber netting to prevent the wires of the spring coils from working up into the sponge layer. In this case a lighter and more open weave

7

top cover may be used to keep the desired low but definite air flow resistance adjacent the pad's discharge surface.

An edge (or edges) of the pad 40 is extended to form a flexible air supply duct 80 connected or integral along an adequate length of edge and preferably with the same thickness (gradually increasing as the width decreases) to thus maintain an adequate air-carrying cross-sectional area all the way down to the blower unit 10.

In the first form the duct or air supply conduit extension 80 is in two parts or forms two different air passages 81 and 82, one to each of the separate seat mat portions 41 and 42.

The neck 22 and/or the lower part 85 of flexible duct 80 or their interconnection should provide for an adjustment in length to take care of the different heights from the car floor to the cushion top in various makes and styles of automobiles. This extensibility or telescopic adjustment may be provided in various ways, certain of which are indicated in the several illustrated modifications.

The common lower end 85 is adapted to be clamped in selected telescopically adjusted position on neck 22 by tightening up a suitable clamp such as the adjustable hose type clamp band 87 held in seam 86. Duct 80 comprises the air impervious top and bottom cover 83 (which may be of the same material as the pad bottom 65) and has a similar edge binding tape 88. It is divided into the two passages by cloth partition 89 extending down not quite to its lower end. Each flexible passage 81 and 82 is held against collapse by coil springs 91 and 92 extending along their sides and middle portions. The springs here may be of the same diameter and similar to those in pad 40. Each passage has a thickness equal to 40 where they join, and these passages increase in thickness as they narrow or decrease in width toward their lower end 85. The upper ends of springs 91 and 92 are positioned by being twisted or looped over the frame sides.

This decreasing width and increasing thickness may be defined and maintained against collapse by having the coil springs 91 and 92 angled closer together to give the decreasing width, their ends being secured (as by looped-over portions) to flat, oval, end frame wires 93 and 94. This gives the increasing thickness.

An air-flow-regulating sheet metal valve or damper 95 may be mounted in the lower end of passage 81 below the ends of the thickness-maintaining springs. Damper 95 has a pivot 96 at one end in hole 97 in the partition 89, and a pivot and handle 98 through hole 99. When closed, 95 can relatively tightly fill this passage and so send almost all of the air to the driver's side when desired. The exact amount can be controlled by only partially closing the damper 95.

For front seat use, the lower end 85 is located to position the motor-blower unit 10 just to the left of the transmission hump of almost all cars. Thus 10 comes just to the right of the driver's right foot. While 10 may be located centrally (which would put it on top of the transmission hump in front seat use), this position is not preferred, since the higher blower unit would be much more in the way and could not be placed as far to the rear or partly in under the overhang of the front seat cushion as it is in the illustrated position.

It will be seen that the unit shown for use on a divided-back front seat can be used with equal facility on a solid-back front seat or on a rear seat.

In order to fit a wide range of different seat sizes, all of these units are preferably made of slightly less depth and width than the smaller sizes of seats, so that their edges do not extend quite as near to the edges of a larger seat cushion.

The longer elastic straps 79a and 81a may have their ends secured together by snap fittings 80a and 82a to hold the back pad portions 44 and 45 up on solid back seats. The shorter elastic straps 83a and 85a, secured by snap fittings 84a and 86a, unite the centers of the two back

8

portions. In a split back seat, each seat back portion is individually banded as by 79a and 80a, and connected to 83a and 84a. Adjustable buckles may be used in lieu of these elastic straps.

For ease of folding and packaging, the two seat portions 41 and 42 are, in this embodiment, connected by a flexible but non-air-conducting hinge seam 59 (including tapes 59a and several lines of stitching).

In the second embodiment of FIGURES 5 to 8 (and in the other embodiments), the structures and arrangements are similar to those of the first form, except as noted, and similar reference numerals, increasing by hundreds, are used where possible to save needless repetition of description.

As shown in this form, the seat and back mat portions 141 and 144 and their frames 154 and 155 may be hingedly connected for air flow therebetween (or to form, in effect, one continuous air plenum or passage) by the hinge coil spring 159 embracing the two adjacent frame sides. Spring 159 may be similar to the other coil springs and of the same diameter.

Thus it is not essential that there be a separate air passage to each mat portion. Here the lower cost and shorter air supply duct extension 180 is symmetrical and has its wider upper end connected along the right hand front portion of the edge of the left hand or driver's mat 142, as shown, and extends down to the narrower and thicker portion connecting to the blower unit 110 located on the car floor as in the first form. The thickness and shape-maintaining springs 191 for flexible duct 180 may be of tapered form as shown and closer together at the bottom to give the smaller width and greater thickness. Extra short lengths 191a of the mat thickness springs may be added at the top. The upper and lower ends of these springs are secured (as in the first form) to the frame 154 and to a lower cross wire 193. The flexible, air-impervious cover 183 for duct 180 may have a suitable elastic or gripping rubber band 187 in its lower seam 186 to tightly engage the neck 122 in selected vertical position. Neck 122 may have serrations 122a to cooperate with this gripping action. The rear hinge springs 162 may be appreciably larger in size (one inch or more), as shown, and the impervious back cloth 165 may be loose around the hinge to give plenty of room for bending and air flow. These larger springs 162 give a lower restriction for air flow up into the backs, and also can have most of their bulk shoved in and clamped between the seat and back cushions to help retain the pad 140 in normal position, since the inclosed frame sides can freely swing together.

The plastic molded (or cast metal) casing 112 may be strengthened by internal, integral, vertical vanes 126a, 126b, and 126c, shaped to tightly grip and hold motor 126 in position. For this purpose these vanes may have rubber or other friction material 125 on their motor-engaging surfaces. These vanes may also be shaped to help remove swirl from the fan delivery and thus increase its efficiency. The lower ends of the vanes may be extended to form (with the extended parts of the side wall) the leg portions 113, 113a, and 113b. This arrangement permits a stronger, lighter, and lower cost plastic or metal casing which can be cast. As shown, these vanes may be notched or set back to form abutments 127 to engage the air entry shroud plate 128. Thus the outward extension of the casing side walls of FIGURE 1 may be omitted. The plate 128 may be secured in position by having slots 128a cut to tightly fit the vanes 126a, 126b, and 126c.

The rear of casing 112 may carry securing means such as the spring wire pointed hooks 103, of which one or more are suitably secured to the casing back and can swing down about its pivot and swivel mounting 105 to the case back to engage through the cloth of the lower seat cushion front and over a horizontal frame wire or strip therein.

As noted above, various types or arrangements of col-

lapse-resisting, spring wire, thickness spacers for the open mats may be employed under this invention, but horizontally extending and spaced coils of spring wire are preferred. Rows of such coil springs may be laid out double-spaced or more widely spaced, and transverse or cross-
 5 ing, as shown by springs 151 and the transverse and interwoven or suitably interconnected row of springs 152 (of which all are of the same diameter). Here the same pattern is employed in the back and in the seat portions, and the edges of these mats are suitably and slidably connected to the sides of the frames 154 and 155 by a continuous length of spring being bent around such a frame
 10 or having its free end formed into a small frame-engaging loop. It will be appreciated that one long continuous spring may be arranged to provide the rows in both directions in one or more mats. The transverse coils may be interwoven or, if desired, one layer merely laid down into the under and transverse layer and suitably additionally interconnected, if it seems advisable. Transverse rows of such springs and other possible arrangements are intended to be embraced in claims to one layer of parallel springs.

Since individual tastes differ, and particularly since more air flow (usually about three times as much feels good at first as is desirable for steady use) is often wanted for the first few minutes of use, provision should be made for varying or controlling the air flow or delivery pressure. Thus the motor speed control unit and switch 138a here provides for "on-off" control and a variable speed rheostat, or else a conventional multi-speed resistor control may be used, providing for "off" and at least two "on" speeds, the low speed for the fan being about one-third of the high speed to give about one-third of the high volume of air flow.

As noted above, the open-cell foam or sponge layer 75 and its under layer 77 of the first form may be omitted, especially in a lower cost application. As shown in this second form, the coarse and relatively heavy strands of the porous outer cover 174 supply a sufficient padding for the spring coil wires to give a very comfortable and flexible pad.

As indicated in the third modification of FIGURE 8, the blower casing 212 can advantageously be positioned as shown to be between the driver's legs (which are normally extended), thus supplying air up through the symmetrical duct extension 280 (which may be like that of the second embodiment) into the left hand portion of the front edge of the left seat mat.

As shown in the fourth embodiment of FIGURES 9 to 11, the pad 340 may be of a size for only one passenger (for the driver only or for use in a chair or seat other than in an automobile). In this case the one seat frame 354 and the one back frame 355 enclose and are slidably connected to mats of spring wire helices formed and arranged according to either of the first two embodiments herein. These frames 354 and 355 are hingedly connected by the mat thickness and interconnected coil spring 362 which here is located slightly forward from the rear end of the seat frame 354 and may, if desired, enclose a welded-in, extra, cross frame, heavier wire member 354a. The rearwardly projecting portion of frame 354 and its mat may be slightly bent downward, and at its end and around its frame side may be a materially larger diameter (one inch or more) coil spring 362a. The lower portion of back frame 355 (with its mat) it bent rearwardly as shown. The impervious back cover 365 extends loosely from under the bottom of mat 341 around larger spring 362a and up the rear of back mat 344. As shown, the porous outer cover 374 extends into (and may be stitched in place in) the sharp or oblique angle formed between mats 341 and 344 to give a much more finished or seat cover-like appearance and better comfort. This arrangement also gives a desirable larger air-carrying and distributing cross section at the bend, and is an effective pad-retaining means. The larger spring can be shoved

into position by the seat mat frame to be tightly held in operative position between the back and seat cushions. It may be shoved in more or less to give a degree of adjustment for different widths of seats. Here the frames 354 and 355 may advantageously be made of a somewhat heavier gauge of bendable or less springy wire, so that they may be preformed to fit the seat and back contours, and yet resist all service loads.

As shown at 380, the centrally located and symmetrical air supply duct extension is of the above-described two-way tapered shape. However, as shown here, it may be formed of a molded flexible plastic sheeting, or seamed at the rear so that its side edges are without seams and are rounded. It may also be elastically contractile after the fashion of various stretchable vacuum cleaner and other hoses. Here its thickness is maintained and it is biased to shorten by the inner steel spring 391 having oval helix-like turns of increasing width and decreasing thickness towards its upper end. All, or only the lower portion of, cover 383 is deeply and spirally corrugated inward between the spring turns so that this duct is biased towards its shortest length and has and adequate extensibility for all sizes of seats. The lower end may be suitably secured (for instance, by elastic, as above disclosed) to tightly fit on the serrated short length neck of the casing 312. The center of the wider upper part of duct 380 may be prevented from collapse by one or more short lengths of centrally located and longitudinally extending mat thickness coil spring such as 392. Springs 391 and 392 are secured to the side wire of frame 354 as disclosed above. In this case the inner dimensions of the corrugated flexible duct are to be adequate to carry the required air flow without excessive restriction.

As also shown in the fourth embodiment of FIGURES 9 to 11, the blower casing 312 may be manufacture at low cost by an all or part stamped construction in which the sloped, curved, and decorative front top and side walls (which are all that show) may be a one-piece sheet steel stamping, or may be molded of plastic or cast of aluminum or the like. Only the curved front and side walls (which show) of the neck 322 are integral with the one-piece casing front, top, and sides. The back of the neck 322, the back of the casing 312, and the approximately 90° bent air inlet shroud plate 328 are stamped or otherwise formed from one piece of sheet steel stiffened by the integral, inwardly-turned side edges 328a to engage over or, preferably, to fit neatly inside of the side walls 312a of the casing 312 and its neck 322 and to be suitably secured therein. Suitable projections such as 328c may be used to limit the inward motion of this stamped back, which may also have one or more clips such as the spring steel member 303 rotatably riveted onto the back as by 305 to engage up under the front seat edge. The motor 326 may be removably secured to this back piece stamping alone, as by a length of strap steel 333 bent to be removably engaged around the motor by screw 337 and having its free ends bent out as shown and welded to the inside of the back member. Plate portion 328 of this sheet steel member may be engaged under the lower edges of the front wall and side walls of the casing front. Thus plate portions 328 may also carry the three or more support legs such as 313, 313a, 313b, which may be integral or welded on as shown.

As shown in the fifth modification of FIGURES 12 and 13, the three-passenger or full width seat pad assembly may be generally similar to that of FIGURES 1 to 4, inclusive, but made in two pairs or sets of connected seat and back portions such as set 441 and 444, and set 442 and 445, which may be detachably connected as by hooks and eyes 459a or by snap fittings underneath, or even by a more costly zipper along the line of the seam 59 of FIGURE 1. The duct passageways 481 and 482 are similarly detachably connected by fastenings and overlapping seams along the line of the partition 89 of FIGURE 1. As shown, the neck 422 for the blower

unit 410 may be divided into two parts 422a and 422b so that either or both may be operatively connected or, when not in use, plugged as by a plug 422c. As shown, there are separate clamp means 487a and 487b on each one of the lower ends of duct passages 481 and 482.

As will be seen, these two pad units, each of one and one-half person width (and which are here lefts and rights), permit the separate or subsequent (and lower priced) sale or replacement of either one of the pads independently of the considerably longer-lived motion-fan unit. The pad unit may be stained, dirtied, or otherwise damaged in used and need replacing sooner than the motor-blower unit.

Operation, preferred constants and values for the whole air flow system, and other features

The general operation of the several forms has been covered in the foregoing description.

In general, the pad should be highly flexible (or bendable to shape), as disclosed above, for a nicely fitting installation on different shapes of seats.

The air flow from the porous upper surface such as 74 should be reasonably evenly distributed to be effective over the whole seat and back. A sufficiently high value of the porous surface restriction achieves this, as described above.

While the lower cost propeller (or axial flow) type of blower is preferred and illustrated for use in the present specific embodiments, yet it is to be understood that various other types of blowers, including centrifugal or semi-centrifugal types (i.e., with radial or inclined discharge directions) may be employed within the broader scope and claims of this invention. This term "blower" is used generically herein (and in the claims hereof).

Centrifugal or semi-centrifugal types are preferred for more expensive or larger furniture or bed applications requiring a relatively large flow volume with a very low level of blower noise. The blowers referred to and claimed under this invention are of a generally small size, ranging from about two inches up to a maximum of about fourteen inches in outside diameter, with linear top velocities in the general range of from about twenty-five to one hundred feet per second, with the required maximum (unoccupied) volume of flow being in the range of from 8 to about 100 c.f.m., and with the range of static pressures of from two-tenths up to about one-third of an inch of water from minimum to maximum pressures for the different sizes and different applications under the broader scope of this invention. The blowers to be used in automotive applications such as those illustrated herein will use smaller blowers of from about one and three-quarters up to six inches in diameter.

Within the broader scope of this invention, the blowers may be of the low pitched type (i.e., have tip pitches of under eighteen degrees), which, however, are noisier and of higher speed.

The high pitch and high pressure type of blower is preferred under more limited aspects of this invention. This preferred type (which has a higher volume and is quieter) may be characterized as having a tip pitch of from over eighteen degrees up to the maximum usable in a particular application, or up to about thirty degrees in a small axial flow fan.

The preferred type of blower may also be characterized or defined (particularly in the case of generally axial flow type fans) as having an unstable (and noisier) region well below its maximum static pressure. This unstable or stall region is approached gradually as volume decreases in an axial flow fan. It is undesirable to operate in this noisier unstable region in which a decrease in delivery volume is not accompanied by a corresponding increase in static pressure as the blades stall under the increased pressure.

Another characteristic of the preferred high pitch and high pressure type of blower is a large blade area. This

projected blade area should be from 50% to slightly over 100% (and up to 110% in the case of small, sheet metal, propeller type fans) of the effective blade discharge area (or the effective disk area in the case of an axial flow fan), with larger blade areas preferred. These blades should have an efficient shape for the pitch, speed, and pressure ranges used, or have a high lift/drag ratio. Similarly, the hubs and air inlets or air approaches and discharge portions should be efficiently shaped.

The preferred high pitch blowers are preferably operated at volumes of flow greater than, and static pressures less than, their stall points and thus less than their peak efficiencies. They are to be used below their unstable static pressures and thus be safely beyond their stall and noise point along the system characteristic curve of static pressure versus volume delivered for the whole air flow system (including the characteristics of the blades, the motor, and all passages and their resistances). Accordingly, operation is to be in the lower portion of their pressure versus volume system curves and beyond the unstable area in the direction of increased c.f.m. values.

In general, for all the forms covered herein, we have discovered (and physical tests have confirmed that it is important) that there should to a fixed or non-varying resistance which is larger than the variable resistance. This is particularly true in this system using a high pressure or relatively large pitch and large blade area type of blower, including but not limited to the small propeller types of fan which are shown here. This feature of a larger fixed resistance is also useful and important if a low pitched fan or blower is used in this invention.

The maximum or occupied operating pressure of the system should always be below the stall point pressure as a maximum value. As a minimum, this fully occupied static pressure should not be less than 40% of the stall pressure, with higher values preferred.

The variable resistance of only the air distributing pad (such as 40) and its porous upper surface is, of course, increased as its open porous area is reduced by persons seated thereon. This porous area may thus be reduced to about two-thirds or more of its unobstructed area, but the total system resistance is not much or materially increased, since the increase of the resistance of this pad or porous covered passage is only linear with the increase in the volume or velocity. Furthermore, due to the steep curve of rate of pressure increase for a small change in volume of flow (in the preferred region on the correct type of system characteristic curve), the maximum change in c.f.m. or volume due to even a maximum passenger obstruction of the seat pad surface is relatively low.

It is important that the system characteristic be designed, and the fixed resistance be large enough, to obtain this limited or relatively low change in flow rate for maximum service demands. This is another way of defining or characterizing the preferred fan and flow system under the more limited aspects of this invention. This maximum reduction or change in the air flow rate should always be less than one-half, and preferably less than one-third, of the maximum (unoccupied) air flow rate. This pressure reduction may desirably be materially less than this in an efficient automobile pad system according to the present teachings.

While the total or sum of these two resistances should be small for low wattage for a given c.f.m. of air delivery, yet we have discovered that for either low or high pitch blowers or fans the fixed resistance should be larger than (and preferably from twice to eight times as great as) the variable resistance of the unoccupied pad. This fixed resistance limits the air flow through the pad or through the coil spring chamber passage of a chair or bed when it is entirely or partly unoccupied. We have found that a better over-all system, with lower cost parts,

less noise, and less current consumption, results from this relationship.

In general, the air inlet passages, including the duct or ducts and their connections from the blower to supply forced air to the distributing pad, can be used to advantage to provide all, or a part of, this desired fixed and smooth flow resistance. This also reduces the size and cost of these passages and their connections, and permits an easier installation by the customer and a less bulky and better appearance for the whole appliance.

Thus the air passages (as in casing 12), the neck (such as 22), and the tapered flexible conduit (such as 80), may advantageously provide a part or even all of this small but desirable and fixed air flow restriction. As noted, this relationship is important in permitting the use of a lower cost motor and axial flow fan combination, and especially in preventing too great a relative or proportionate increase in the total restriction or pressure (as by added seated passengers) which would cause the fan blades to reach the stalling point and also to become undesirably noisy due to the resulting turbulent delivery of air flow.

It is therefore important that the total air flow be kept low. This is provided for by the horizontally-extending, open, coil-spring-formed passages in the pad, and by the porous, open weave, outer cover, as disclosed herein. This in turn determines the total resistance.

The entire flexible pad should be as thin as possible consistent with comfort, low cost, and low restriction for the forced air flow. The major air-carrying ability is due to the passage defined or held open by the coil springs, which have given good results when of about one-half inch diameter. They may be of smaller size, and, while not preferred for the present specific forms, they may define a thicker passage, especially for very long pads or in covering larger areas, such as a bed. A plurality of superimposed layers of coils may be used, but is not preferred.

For use in already cushioned seats or chairs, the overall or total thickness of the pad, including covers and any sponge layer or the like, should be under one inch for low cost, easy packaging, and minimum distortion of the seat shape. However, pad thicknesses up to about two inches may be employed to advantage in special cases, or where either separate or built-in pads are used on very large areas, such as beds. It will be understood that in furniture, beds, and the like, the pad (here disclosed) can be eliminated and the spring or cushion body enclosed and used in lieu of the present separate pad for a builtin installation.

The total static pressure across the blower, including both fixed and minimum variable resistance, should be under one-third of an inch of water or lower, and preferably closer to a minimum of about two-tenths of an inch, for a total flow of from 50 to 90 c.f.m. through an unoccupied three-passenger seat appliance as disclosed, and proportionately for smaller areas or other sizes of pads. Here the three-passenger pad (including its seat and back portions) has a total surface area of about twelve square feet. The single-passenger seat and back, as illustrated, has an area of about four and two-thirds square feet.

As non-limiting examples, it may be noted that the high pressure type propeller fans to be used in the present pad appliance may run from about two to five inches in outer diameter and in the speed range of from about 2000 to 7000 r.p.m.

The illustrated stamped sheet metal fan 24 had a diameter of about four and three-quarters inches, a projected blade area of about 110% of its disk area, a blade pitch of from 25 to 30 degrees, and a speed of about 2400 r.p.m. for one-eighth inch of water total static pressure at its maximum designed or unoccupied delivery of about 60 c.f.m.

When well designed and having a good lift/drag ratio

for this type of application, such preferred propeller type fans should have efficiencies of about 50%.

The motors (which are to be of the lowest cost and also of low current consumption) are here illustrated as being of the standard automobile defroster type, which is larger than needed, but which is in large volume production and hence of low cost. These small D.C. defroster type motors may run from about 15 to 30 watts input rating and have an efficiency of about 50%. They thus have considerable excess capacity for this use. It will be understood that smaller motors and higher speed and smaller diameter blowers of various types may be used within the present teachings and the scope of this invention.

As noted above, and under this invention, the restriction for the greatest (i.e., the unoccupied) air flow through the pad (such as 40) should be kept low with just enough porous restriction in the woven upper layer or cover to provide a reasonably even distribution of the spread-out air flow. This pad restriction may be as high as 0.06 to 0.08 inch of water static pressure for a unit flow of four to six cubic per square foot of surface area, and with a preferred lower or minimum value of about 0.02 inch of water. Good results have been obtained in tests using a pad having such a static pressure value of 0.03 inch of water for these particular flow rates. This pad restriction is almost all due to the porous upper layer of cloth or the like, with very little caused by the very small cross section of the strong steel coil springs. These flow rates are examples only, and are not intended to be limiting in all applications.

Due to its very low air flow resistance and the relatively low air velocity therein, this coil-defined passage may properly also be regarded as like, or as a, plenum chamber.

In this disclosure the total static pressure referred to is the total static pressure drop across the blower, neglecting the small velocity pressure which is negligible in this system.

While the desired or optimum rates of air flow per unit area of porous or air-discharging, body-supporting areas according to this invention may vary with the weather, the clothing, and the personal tastes or preferences of the individual, after the first few minutes of use a much lower volume of air flow is desirable for steady or continued use.

Values of from about 4 c.f.m. down to slightly less than 1 c.f.m. (or down to as low as $\frac{1}{2}$ c.f.m., as for use in a bed for certain people) per square foot of porous area are needed for steady use in the range of different applications. For automobile seat use in warm weather, this flow rate for steady use should be from 2 to 4 c.f.m. for most people. Preferably, there should be provision for a manual selection of the desired flow rate, as provided above. These rates are given for an unoccupied pad for convenience. They will not be materially changed when the pad is occupied if the system is designed as taught herein.

For sales and demonstration purposes, and also for the first few minutes of use until the excess air becomes objectionable, it is desirable to have a maximum temporary flow rate of at least twice, and preferably three times, the normal flow rate. In any particular design, this maximum value of unoccupied or occupied air flow rate may be limited by practical considerations of cost, blower and motor size, and the like.

As noted above, good results have been obtained in this specific application with maximum or temporary flow rates of from 4 to 6 c.f.m. per square foot of porous area, with means to reduce the flow for steady use.

A lower cost appliance of this type can be made to supply only about 2 c.f.m. per square foot of pad area. Here there is no provision for the first few minutes of use. This much lower value of maximum air flow will not

need as large passages and pads, and will permit a very competitive price.

The proper values of the fixed restriction for the air-supplying passages (including the neck 22 and the flexible duct 80) are best determined by tests and pressure readings to obtain the desired relationships. Accordingly, no specific dimensions are given or recommended for these parts, since length, bends, and other factors affect the actual desired restriction values in various designs. These passages are designed to have a definite fixed resistance, which is larger than the resistance these parts would have if they were designed for minimum resistance.

As one example only, in the above-disclosed specific forms the blower casing discharge neck and the lower part of the flexible duct have a minimum area of about four square inches to provide about all of the fixed restriction for 60 c.f.m. of maximum air flow.

While, as noted above, it is not feasible to give exact directions or dimensions for the areas of the neck 22 and flexible duct 80 or their equivalents in all cases, yet in general, if they are supplying all or a substantial part of the desired fixed resistance, their minimum cross-sectional area (which preferably should be smoothly tapered) should be from less than one-half to about one-fifth of the maximum blower discharge area or the disk area in the case of the propeller type fan shown. The length of passages, their surface conditions, and other factors affect this resistance. These passages will, of course, be larger if it is desirable to employ some other or extra resistance for this purpose.

It should be noted also that the interior of all substantial sized metal parts or areas of the motor-blower unit should be flocked for a non-vibrating or quiet unit. This is especially desirable for thin metal parts and for higher speed motors.

To realize all of the benefits of this invention, it is desirable that the entire pad, including its seat and back covering portions and the air-flow-conducting hinge between them (or at least the entire upper portion of the air supply duct or extension for the pad), should all be flexible in order to be comfortable at all times and to avoid any rigid portions under the user's supported body portions. The foldability for packaging should also apply to the flexible air supply duct. This foldability permits better packaging and easier handling and installation.

It will also be understood that even though the illustrated preferred forms here are all shown as pads for use on cushioned seats, this invention (in certain of its broader aspects and as set forth in the claims) may be used, or built into, a seat cushion or other type of body support, such as a bed. Also, similar pads may, within the present teachings, be used in a number of different applications.

There may be various other modes of carrying out, or of using, the invention as disclosed herein and within the scope of the appended claims.

We claim:

1. A forced air circulating pad device for use on cushioned seats comprising, in combination, a flexible pad having edges and being freely bendable in use to conform to cushion deflections, said pad including a layer of collapse resisting spring coils of small diameter wire spaced apart to form an air passage of shallow thickness but of low air flow resistance, flexible thin sheet means enclosing said layer and being air impervious on the under surfaces of said layer and porous on its upper surfaces for distribution of forced air flow from said passage to a seated person, a flexible air supply duct having therein collapse resisting spring coils of small diameter wire spaced apart for low flow resistance, said duct having two ends, one of which is flat and of substantially the same thickness as said pad, said flat end being connected to an edge of said pad along a substantial length thereof for low air flow restriction, said duct changing shape into an adjacent open outer end

of increased thickness, and a blower unit operatively connected to said open end.

2. A forced air circulating pad device for use on cushioned seats comprising, in combination, a flexible pad having a front edge and being freely bendable in use to conform to cushion deflections, said pad including a substantially air impervious, thin, flexible bottom sheet and a flexible and open mat of flexibly interconnected, collapse resisting members of substantially uniform heights of about one-half inch or less spaced apart to always define and maintain the thickness of said pad substantially the same as the height of said spaced-apart members and to form a generally rectangular, upwardly open pad portion providing for low resistance flow of forced air under and to a seated person, said flexible pad having a substantially co-planar extension portion of generally the same thickness and type of construction continuously connected along, and supplying forced air into, a length of said front edge of said rectangular portion adequate for low air flow resistance, said extension portion being substantially enclosed by a thin, flexible, impervious sheet, said flexible air supplying extension portion changing shape into a thicker open end of materially less width than its said connected portion, and a forced air supplying blower connected thereto at least partially inside of said open end.

3. A forced air circulating pad device for use on cushioned automobile seats comprising, in combination, a flexible pad having a front edge and being freely bendable in use to conform to cushion deflections, said pad including a substantially air impervious, thin, flexible bottom sheet and a flexible and open mat of flexibly interconnected, collapse resisting members of substantially uniform heights spaced apart to always define and maintain the thickness of said pad substantially the same as the height of said spaced-apart members and to form a generally rectangular, upwardly open pad portion providing for low resistance flow of forced air under and to a seated person, and forced air supplying means for said pad including a substantially co-planar pad extension of generally the same thickness and type of construction continuously connected along, and supplying forced air into, a length of said front edge of said rectangular portion adequate for low air flow resistance, said extension being substantially enclosed by a thin, flexible, impervious sheet, said flexible air supplying extension being bendable to fit and curve down comfortably under a seated person's knees and over the curved front of said automobile seat cushion and tapering two ways to merge smoothly into a lower open end of increased thickness and decreased width, said extension portion having a length to normally position its open end adjacent to the bottom of such seat cushions, and securing means at said open end to normally hold a forced air supplying blower unit.

4. A cushion pad device, for use on the seat and back cushions of automobile seats to supply forced air under seated people, comprising a flexible pad including a back cushion covering portion, a connected seat cushion covering portion having edges, and a forced supplying means including a conduit portion connected to a free edge of said seat covering portion, all portions of said pad including a substantially open layer of collapse resisting, flexibly interconnected, pad thickness defining members spaced apart to freely permit the flow of forced air there-through and thin, flexible, impervious sheet material enclosing said pad to prevent the escape of forced air therefrom except at its upper and body engaging surfaces, said flexible back portion being connected to receive air supply along substantially the entire back edge of said seat cushion covering portion and said flexible conduit portion being connected for air supply along a substantial length of another edge of said seat cushion covering portion, said conduit portion being bendable to fit and extend down over a side of said seat cushion, having an

open lower end of greater thickness and less width than its upper connected end and having a length which will normally position said open end close to the bottom of said seat cushion, means adjacent said open end to operatively connect directly to a forced air supplying blower unit, said seat covering portion comprising two sections having an air conducting hinge connection to permit folding and said back portion comprising two sections having an air conducting hinge connection to permit folding, whereby said four mat portions can be folded to the area of one such section for shipment.

5. A cushion pad device, for use on the seat and back cushions of automobile seats to supply forced air under seated people, comprising a flexible pad including a back cushion covering portion, a seat cushion covering portion having edges, and a forced air supplying means including a conduit portion connected to an edge of said seat covering portion, all portions of said pad including a substantially open layer of collapse resisting, flexibly interconnected, pad thickness defining members spaced apart to freely permit the flow of forced air therethrough and thin, flexible, impervious sheet material enclosing said pad to prevent the escape of forced air therefrom except at its upper and body engaging surfaces, said flexible back portion being connected to receive air supply along substantially the entire back edge of said seat cushion covering portion and said flexible conduit portion being connected for air supply along a substantial length of another edge of said seat cushion covering portion, said conduit portion being bendable to fit and extend down over a side of said seat cushion, having an open lower end of greater thickness and less width than its upper connected end and having a length which will normally position said open end close to the bottom of said seat cushion, and means adjacent said open end to operatively connect directly to a forced air supplying blower unit, said seat cushion covering portion and said back covering portion each comprising two sections connected side-by-side by a flexible but non-air-conducting hinge to permit folding of said four sections into the area of one section for shipment, said flexible extension having portions connected along a length of the front of each of the sections of said seat covering portion.

6. A forced air pad device for use on cushioned seats comprising, in combination, a flexible seat cushion pad having free edges and a swingably connected flexible back cushion pad, said pads each including a layer of collapse resisting spring coils of small diameter wire spaced apart to form an upwardly open air passage of shallow thickness but of low air flow resistance and impervious flexible sheet means preventing escape of air from the bottom of said layer, flexible duct means operatively connected to one of said free edges of said seat cushion pad, and a blower unit connected to said duct means, said back cushion pad having its spring coils swingably connected to the similar spring coils of said seat cushion pad at the rear edge thereof by a hinge forming, collapse resisting, and forced air flow conducting coil spring which is at least as large in diameter as the spring coils of said pads to maintain an open and non-collapsed air passage through said hinge when it is in the juncture of the back and seat cushions in normal use.

7. As an article of manufacture, an upright blower unit to be positioned on an automobile floor to supply forced air to a seat-cushion-overlying, flexible, ventilating pad, said blower unit comprising a casing having a larger lower end, with supports to space it above the automobile floor, enclosing an upright-axis propeller type fan on the downwardly extending shaft of an upright axis and smaller diameter electric motor secured in said casing, the larger bottom of said casing being open for the fan air intake, the front and the side walls of said upright casing sloping inwardly and the rear wall being substantially flat and upright but providing adequate cross-sectional area for

low restriction air flow past said motor to cool it, and the top of said casing having an upwardly directed air discharge portion to connect to said pad to supply forced air flow thereto.

8. A cushion pad device, for use on the seat and back cushions of automobile seats to supply forced air under seated people, comprising a flexible pad including two back cushion covering portions forming two adjacent but separately swingable parts, a seat cushion covering portion having edges, and a forced air supplying means including a conduit portion connected to an edge of said seat covering portion, all portions of said pad including a substantially open layer of collapse resisting, flexibly interconnected, pad thickness defining members spaced apart to freely permit the flow of forced air therethrough and thin, flexible, impervious sheet material enclosing said pad to prevent the escape of forced air therefrom except at its upper and body engaging surfaces, said flexible back portions being connected to receive air supply along substantial length of another edge of said seat cushion covering portion, said conduit portion being bendable to fit and extend down over a side of said seat cushion, having an open lower end of greater thickness and less width than its upper connected end and having a length which will normally position said open end close to the bottom of said seat cushion, and means adjacent said open end to operatively connect directly to a forced air supplying blower unit.

9. A cushion pad device to supply body ventilating forced air, said device comprising a pad including a flexible, substantially uniform thickness, rectangular main portion and a connected, flexible extension portion of substantially the same thickness as said main portion adjacent their junction, both for use on, and both conforming freely to, the shape of seat cushions as deflected in use, both portions of said pad including a substantially open layer of collapse resisting, flexibly interconnected, pad thickness defining members spaced apart to freely permit the flow of forced air therethrough, and thin flexible air impervious sheet material enveloping said pad except for its body engaging upper surfaces, said rectangular main portion having a front edge to extend along the front edge of a seat cushion, said extension portion being communicatively connected along a substantial length of said front edge adequate for the low flow resistance supply of forced air into said main portion and having a lower open end, securing means adjacent said open end, and a forced air supplying blower unit operatively held at least partially in said open end by said securing means.

10. A cushion pad device, for use on the seat and back cushions of automobile seats to supply forced air under seated people, comprising a flexible pad including a back cushion covering portion, a seat cushion covering portion having edges, and a forced air supplying means including a conduit portion connected to an edge of said seat covering portion, all portions of said pad including a substantially open layer of collapse resisting, flexibly interconnected, pad thickness defining members spaced apart to freely permit the flow of forced air therethrough and thin, flexible, impervious sheet material enclosing said pad to prevent the escape of forced air therefrom except at its upper and body engaging surfaces, said flexible back portion being connected to receive air supply along substantially the entire back edge of said seat cushion covering portion and said flexible conduit portion being connected for air supply along a substantial length of another edge of said seat covering portion, said conduit portion being bendable to fit and extend down over a side of said seat cushion, having an open lower end of greater thickness and less width than its upper connected end and having a length which will normally position said open end close to the bottom of said seat cushion, and means to operatively connect a forced air supplying blower to said lower open end, said back cushion cover-

ing portion having a surrounding frame of metal which is manually bendable to retain various permanent deformations to fit different shapes of back cushions.

11. A forced air circulating pad device for use on automobile cushioned seats having a front overhang comprising, in combination, and including an air impervious bottom sheet and an open layer of flexibly interconnected, collapse resisting members on said sheet and spaced apart to freely permit the flow of forced air therethrough to form an upwardly open pad for low resistance flow of air therefrom to a supported person, said pad having a front edge, air supplying duct means having a flexible upper portion with collapse resisting means connected to a substantial length of said front edge and curved to extend down over the side of said cushioned seat to a lower open end, and a blower unit at least partly in said open end and fitting at least partly in under said front overhang, said blower unit comprising an upper and upright-axis electric motor and a lower and larger diameter axial flow fan directly connected to said motor.

12. A forced air circulating pad device for use on cushioned seats comprising, in combination, a flexible pad having a front edge and being freely bendable in use to conform to cushion deflections, said pad including a substantially air impervious, thin, flexible bottom sheet and a flexible and open mat of flexibly interconnected, collapse resisting members of substantially uniform heights of about one-half inch or less spaced apart to always define and maintain the thickness of said pad substantially the same as the height of said spaced-apart members and to form a generally rectangular, upwardly open pad portion providing for low resistance flow of forced air under and to a seated person, forced air supplying means including a substantially co-planar pad extension portion of generally the same thickness and type of construction continuously connected along, and supplying forced air into, a length of said front edge of said rectangular portion adequate for low air flow resistance, said extension portion being substantially enclosed by a thin, flexible, impervious sheet, said flexible air supplying extension portion changing shape into a thicker open end of materially less width than its said connected portion, and means adjacent said open end to connect to a forced air supplying blower, said pad comprising a plurality of sections foldably connected to prevent air flow therebetween, and said air supply portion comprising a separate passage portion connecting each of such pad sections to the same blower unit.

13. A forced air pad device for use on cushioned automobile seats comprising, in combination, a flexible back cushion pad swingably connected to receive forced air from the rear edge of a flexible seat cushion pad having free edges, said pads each including an upwardly open layer of flexibly interconnected, collapse resisting and thickness maintaining members and impervious flexible sheet means to prevent escape of air from their under sides, means to supply forced air to said seat cushion pad including a thin, wide, flexible air duct means including collapse resisting means and connected along a substantial length of the front edge of said seat cushion to flexibly extend down over the front of said automobile seat cushion, said duct means having a lower end, and front means and rear means to cooperatively hold said flexible seat cushion pad down and flexibly fitted and stretched over said automobile seat cushion, said rear means including a flexibly connected and spaced, enlarged, collapse resistant means to be held in place by the seat and back cushions in their juncture and said front means being connected to said flexible duct means adjacent its lower end.

14. A device for yieldably supporting and supplying forced air under a person, said device comprising body supporting means having a flexible upper surface means open for low resistance to flow of forced air therethrough,

an open air passage and plenum chamber forming layer of flexibly interconnected, supporting members, spaced apart for low resistance forced air flow therebetween, under and supporting said upper surface means, said layer including air leakage preventing enclosing means, and forced air flow supplying means operatively connected to supply, with said layer, air passages for the low resistance delivery of forced air flow into said layer and to a supported person, said supplying means including a small electric motor and a directly connected blower of the high pressure type which is unstable at a given operating pressure, said blower having blades of a high tip pitch of from 18 to 30 degrees, and means, including all of said low resistance air passages, providing a low restriction and a maximum blower operating pressure which is less than said unstable pressure of said blower, to thus maintain at all times a low noise level operation for a high air delivery volume and to permit the use of a low cost electric motor and blower.

15. A device for yieldably supporting and supplying forced air under a person, said device comprising body supporting means having a flexible upper surface means open for low resistance to flow of forced air therethrough, an open air passage and plenum chamber forming layer of flexibility interconnected supporting members, spaced apart for low resistance forced air flow therebetween, under and supporting said upper surface means, said layer including air leakage preventing enclosing means, and forced air flow supplying means operatively connected to supply, with said layer, air passages for the low resistance delivery of forced air flow into said layer and to a supported person, including a small electric motor and a directly connected blower of the high pressure type which is unstable at a given operating pressure, said blower having blades of large area and of a high tip pitch, and means, including all of said low resistance air passages, providing a low restriction and a maximum blower operating pressure which is less than said unstable pressure of said blower, to thus maintain a low noise level operation at all times for a high air delivery volume and to permit the use of a low cost electric motor and blower, said body supporting means comprising a thin, flexible pad to be supported on a yieldable surface and said forced air flow supplying means including a flexible air supplying conduit means having a thin flat end connected to communicate from said blower into an adequate low resistance length of said edge of said layer, said forced air supplying means having the highest resistance to forced air flow between said blower and said person, and providing a fixed and non-turbulent restriction higher than that of the resistance of said layer and its open upper surface means when occupied.

16. A device for yieldably supporting and supplying forced air under a person, said device comprising body supporting means having a flexible upper surface means open for low resistance to flow of forced air therethrough, an open air passage and plenum chamber forming layer of flexibly interconnected supporting members, spaced apart for low resistance forced air flow therebetween, under and supporting said upper surface means, said layer including air leakage preventing enclosing means, and forced air flow supplying means operatively connected to supply, with said layer, air passages for the low resistance delivery of forced air flow into said layer and to a supported person, including a blower and comprising a small electric motor, a directly connected blower of the high pressure type which is unstable at a given operating pressure, said blower having blades of a high tip pitch of from 18 to 30 degrees, and means, including all of said low resistance air passages, providing a low restriction and a maximum blower operating pressure which is less than said unstable pressure of said blower, to thus maintain at all times a low noise level operation for a high air delivery volume and to permit the use of a low cost electric motor and blower, said flexible upper sur-

face means being a cloth-like and porous cover to slightly restrict and aid in the distribution of air flow, and said open air passage and plenum chamber forming layer, with its said porous cover, having a resistance of from 0.02 to 0.08 inch of water pressure drop for an air flow therethrough of from one to six c.f.m. per square foot of porous area of said cover.

17. A device for yieldably supporting and supplying forced air under a person, said device comprising body supporting means having a flexible upper surface means open for low resistance to flow of forced air therethrough, an open air passage and plenum chamber forming layer of flexibly interconnected supporting members, spaced apart for low restriction forced air flow therebetween, under and supporting said upper surface means, said layer including air leakage preventing enclosing means, and forced air flow supplying means operatively connected to supply, with said layer, air passages for the low resistance delivery of forced air flow into said layer and to a supported person, including a small electric motor and a directly connected blower of the high pressure type which is unstable at a given operating pressure, said blower having blades of large area and of a high tip pitch, and means, including all of said low resistance air passages, providing a low restriction and maximum blower operating pressure which is less than said unstable pressure of said blower, to thus maintain at all times a low noise level operation for a high air delivery volume and to permit the use of a low cost electric motor and blower, said device including means to vary the air flow from a maximum to a minimum volume comprising electrical means to selectively reduce the motor speed and the resulting volume of air flow to a minimum of at least one half of the maximum, for comfort during long continued use, from a maximum volume which provides an excess of air for initial and temporary comfort, said minimum air flow being at a pressure greater than said unstable pressure of said blower.

18. A pad device for use on a cushioned surface, for supporting and supplying forced air to a person, comprising a thin, flat, flexible, forced air carrying, and distributing passage forming pad including connected seat and back portions each having flexibly connected spring wire coils therein to maintain its thickness against collapse in use and spaced apart for low restriction of forced air flow therethrough, thin, flexible sheet means enclosing said coils and passage to prevent escape of air therefrom and providing an open upper surface of low resistance to forced air flow, said seat portion of said pad having edges and being flexibly connected along a length of an edge thereof to a flat, flexible air duct forming extension of similar construction and including similar spring coils and enclosing means, said extension having a similar thickness adjacent its connection to said pad and having an open end, a forced air supplying blower unit connected to said open end and comprising an electric motor and a high pressure and unstable type blower, said extension providing, with said pad, air passages from said blower to said person, means including all of said passages providing a low air flow restriction and a maximum blower delivery pressure less than that of the unstable pressure of said blower, to thus permit the use of a low cost blower unit, said seat and back pad portions and their thin spring wire coils being connected for relative swinging by means including a collapse resisting, flexible, air flow conducting and hinge forming coil spring, providing a rearwardly extending and enlarged portion enclosed in said flexible sheet means, to provide more air flow room through said hinge when positioned in the juncture of the seat and back cushions of a seat.

19. A device for yieldably supporting and supplying forced air flow under a person, comprising body supporting and air flow passage forming means including flexible upper surface means open for low restriction air flow

therethrough, an open layer of flexibly interconnected supporting members, spaced apart for low restriction forced air flow therebetween, under and supporting said upper surface means, air leakage preventing enclosing means, forced air flow supplying means operatively connected to supply, with said layer, air passages for the low restriction delivery of forced air flow into said layer and to a supported person, said air flow supplying means including an operatively connected, high pressure type of small axial flow fan having blades with a projected area of from 50% to 110% of its disk area to have an unstable operation at a high operating pressure, and means, including all of said low resistance air passages, to provide a flow resistance which is always less than the unstable pressure of said fan, said flow resistance of said air passages of said unoccupied device corresponding to a forced air pressure of more than 40% of said fan's minimum operating pressure, said fan pressure being safely below its unstable pressure when said device is occupied and said device having an air delivery reduction of less than one third from its unoccupied to its occupied condition.

20. A device for yieldably supporting, and for supplying forced air flow under, a supported person, comprising a layer of upwardly open, flexibly interconnected, body supporting members spaced apart for low resistance to forced air flow therebetween and air leakage preventing means otherwise enclosing said layer, forced air flow supplying means operatively connected to said layer to supply low air flow resistance passages for delivery of forced air flow to a supported person, said air flow supplying means including an operatively connected forced air supplying blower and a small electric motor directly connected to said blower, and means, including all of said low resistance air passages, providing a low total resistance to the flow of said forced air and a low maximum blower pressure which is always less than the maximum pressure of said blower, said passages also including restriction means between said blower and said layer to provide an additional and fixed restriction which is over twice as great as the non-occupied air flow resistance of said upwardly open layer and forms part of said low total air flow resistance.

21. A device for yieldably supporting, and for supplying forced air flow under, a supported person, comprising a layer of upwardly open, flexibly interconnected, body supporting members spaced apart for low resistance to forced air flow therebetween and air leakage preventing means otherwise enclosing said layer, forced air flow supplying means operatively connected to said layer to supply low air flow resistance passages for delivery of forced air flow to a supported person, said air flow supplying means including an operatively connected forced air supplying blower, and means, including all of said low resistance air passages, providing a low total resistance to the flow of said forced air and a low maximum blower pressure which is always less than the maximum pressure of said blower, said passages also including restriction means between said blower and said layer to provide an additional and fixed restriction which is from twice to a maximum of eight times as great as the non-occupied air flow restriction of said layer and its said upper surface openings, said forced air flow supplying means including a flexible air supplying conduit means connected between said blower and said layer and providing said additional fixed restriction.

22. A device for yieldably supporting and supplying forced air under a person, comprising a generally horizontal layer of flexibly interconnected supporting members spaced apart for low resistance to the flow of forced air therebetween and providing an upwardly open, air distributing, plenum chamber, means to prevent escape of air from the bottom of said layer, means to supply forced air to said layer including an operatively connected blower unit forming, with said layer, low resistance air pas-

sages for the low resistance delivery of air to a supported person, said blower unit comprising a small electric motor and a directly connected, high pressure type of axial flow fan having high pitch blades of large blade area and becoming unstable at a particular operating pressure, means, comprising said low resistance passages, providing a corresponding low operating pressure for said fan, which operating pressure is at all times below said fan's unstable pressure when said device is unoccupied, and restriction means in said means to supply forced air, providing a fixed resistance greater than that of said unoccupied layer and forming part of said low restriction of said passages.

5

10

References Cited in the file of this patent

UNITED STATES PATENTS

1,537,460	Campbell	May 12, 1925
1,777,982	Popp	Oct. 7, 1930
2,122,964	Sweetland	July 5, 1938
2,158,801	Petterson	May 16, 1939
2,235,966	Summers	Mar. 25, 1941
2,512,559	Williams	June 20, 1950
2,722,266	Kersten	Nov. 1, 1955
2,791,956	Guest	May 14, 1957
2,801,681	Crane	Aug. 6, 1957
2,804,912	Pickard	Sept. 3, 1957