Dec. 22, 1964 H. H. TROTMAN 3,162,489

FORCED AIR UNDER-BODY VENTILATING PAD DEVICES

Filed Aug. 31, 1962 2 Sheets-Sheet 1

FIG. 1

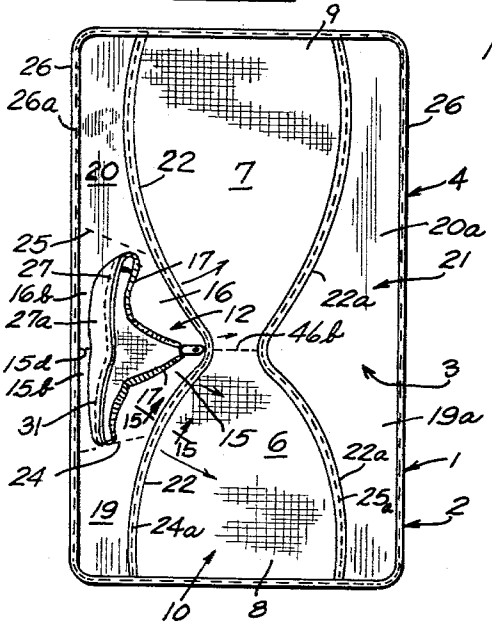


FIG. 2

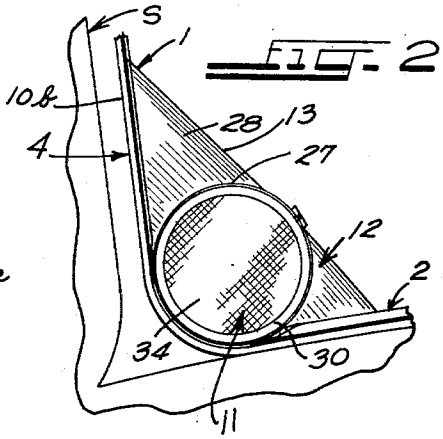


FIG. 3

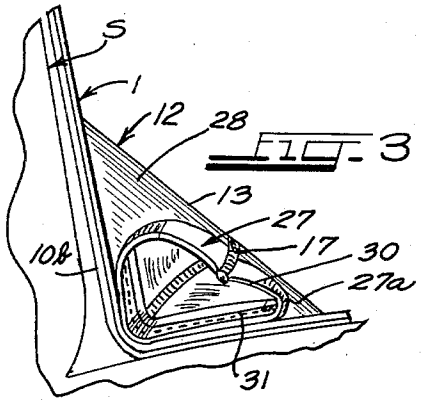


FIG. 4

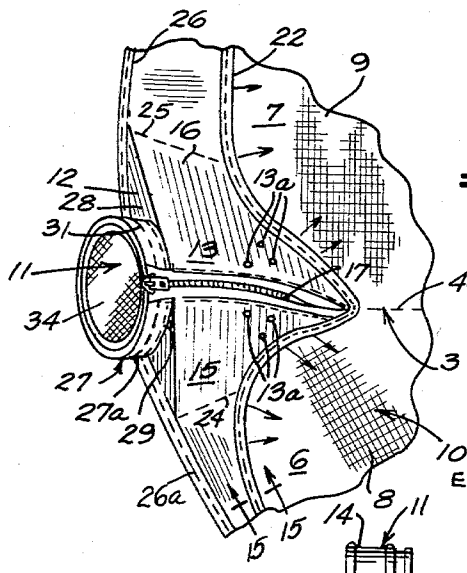


FIG. 5

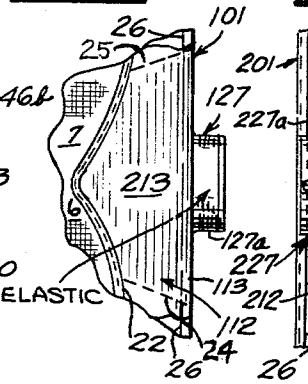


FIG. 6

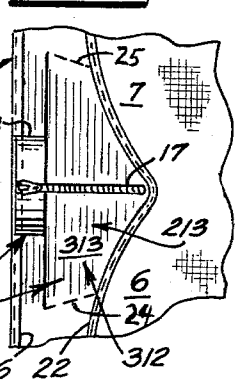
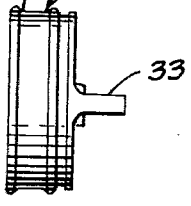


FIG. 7



INVENTOR.
HERBERT H. TROTMAN
BY Louis J. Carmick
ATT'Y.

Dec. 22, 1964 H. H. TROTMAN 3,162,489

FORCED AIR UNDER-BODY VENTILATING PAD DEVICES

Filed Aug. 31, 1962 2 Sheets-Sheet 2

FIG. 8

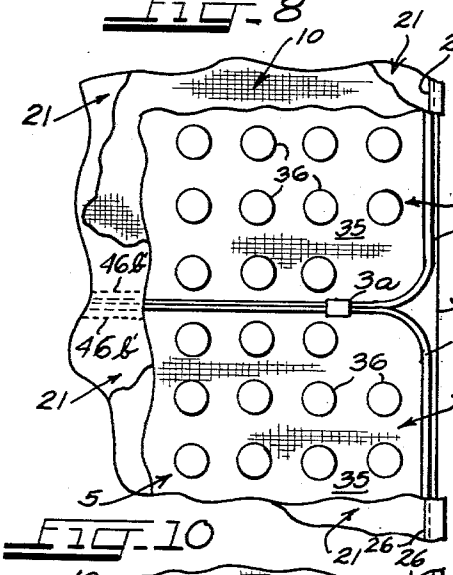


FIG. 9

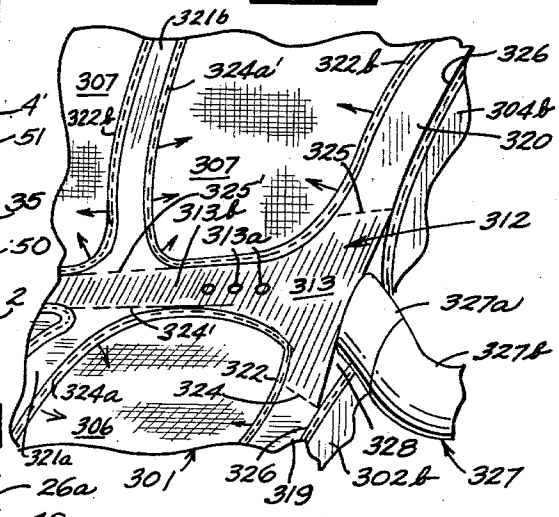


FIG. 10

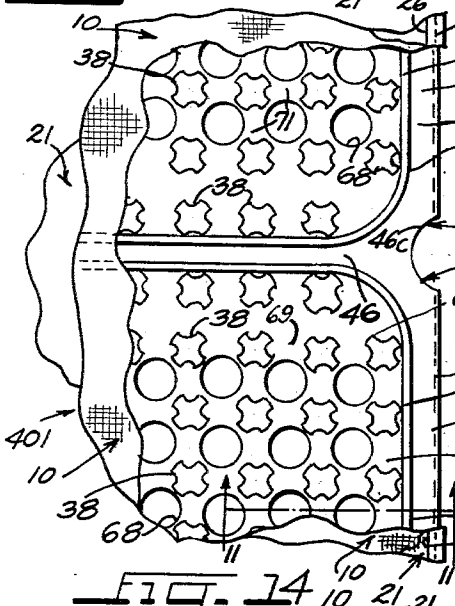


FIG. 11

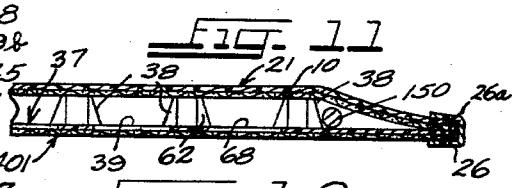


FIG. 12

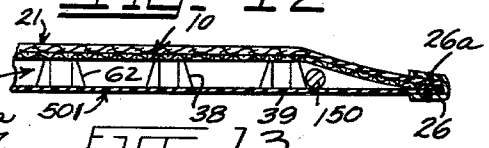


FIG. 13

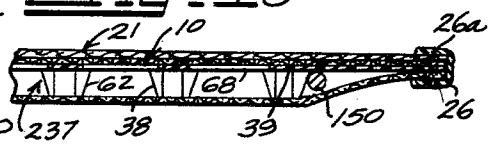


FIG. 14

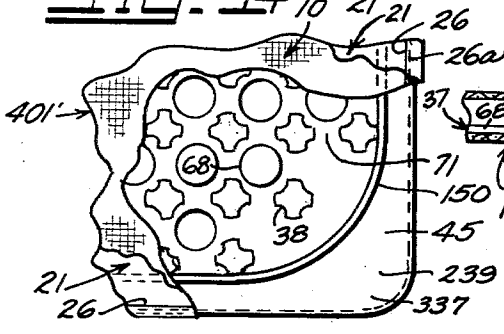
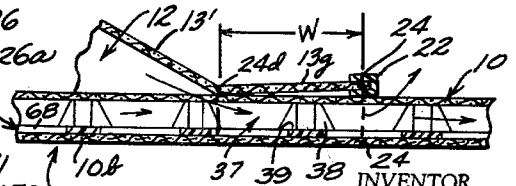


FIG. 15



INVENTOR.
HERBERT H. TROTMAN
BY Louis J. Cornick
ATTY.

United States Patent Office 3,162,489 Patented Dec. 22, 1964

3,162,489

FORCED AIR UNDER-BODY VENTILATING PAD DEVICES

Herbert H. Trotman, Churchland, Va., assignor, by mesne assignments, to Phillips Petroleum Company

Filed Aug. 31, 1962, Ser. No. 220,614
20 Claims. (Cl. 297—453)

This invention relates broadly to improved means for supplying forced ventilating air under and to supported portions of a human body, and especially to flexible pad or layer devices for this purpose and for use on cushioned surfaces to retain the comfort provided by the under cushion by bending in two directions and curving down relatively freely into such a cushioned surface when the pad hereof is flexibily deformed under a supported person's body, to which an adequate forced air flow is supplied and directed.

More particularly, the present invention relates to such pad devices intended to solve problems unique to automotive vehicle cushioned seats and designed for such use, and especially to the forced air feature and to related aspects and combinations, particularly in free types of such devices or in unitary or electric appliance devices of this general type and of low cost.

My two copending applications filed of even date herewith for "Air-Carrying Flexible Layer for Under-Body Ventilating," Serial No. 220,612, and for "Hinged and Marginally-Stiffened Under-Body Ventilating Pad," Serial No. 220,613, disclose and claim certain features and combinations usable with forms of this invention or disclosed herein, including (for the first said application) improved forms and constructions of a body-supporting and air-carrying layer per se and particularly a plastic sheet with body-supporting projections spaced apart for any type of air flow therebetween and (for the second said application) hinge, marginal stiffening, and related means for the several pad parts. The disclosures of these two said applications are intended to be included herein by this reference, as are the disclosures of my (jointly with others) prior Patents Nos. 2,992,604 and 2,992,605.

In general, while the objects of the present invention include certain of the broader objects of my above-referred-to applications and prior patents, they relate here to improvements over my prior patents or to the provision of forced air pad devices which may (if desired) employ certain of the features of my above-referred-to copending applications.

The broader objects hereof also relate to the provision of forced air pad devices which are more comfortable, have a better and more effective forced air distribution to and under each supported person, permit the use of thinner (and hence more flexible and cheaper) pads to carry the forced air under a person, have improved such pads and are of lower cost and longer lasting.

The broader objects hereof also relate to such flexible pad devices for use on cushioned surfaces, whether they are to supply forced air under one or a plurality of people and whether they are of the tied-down, built-in, or permanently installed types (held down or stretched out as by a cushion cover or stretched seat cover) or are of the more particularly described free-type, with marginal stiffening means, hinge means, and other features as disclosed herein.

Additional and more specific objects of this invention are to provide:

An improved forced-air-supplying and distributing conduit chamber having its entry at a side of a flexible and air-carrying pad and formed in part by the pad and its bottom enclosure and in part by upper and preferably flexible walls, said chamber extending entirely or only part way across the width of said pad and having a preferably flexible entry portion which may either extend down the side of the pad or have its open end adjacent the pad side to receive therein a seat-supported tubular member for supplying the forced air, and, more particularly, with a rigid such forced-air member being used to hold a flexible entry portion open or distended.

An improved forced-air-supplying and distributing conduit chamber over the hinge area to efficiently distribute forced air to a flexible forced-air-carrying pad for a seat and separately to its swingably-connected and similar pad for the seat back from a common and preferably flexible side entry portion and, more particularly, such a chamber which is generally triangular in cross-section and which is formed in part by the bottom enclosed seat and back pads and also by a flexible sloped upper wall which is at least partly closed to efficiently direct forced air flow in to the faces of the two pads.

An improved forced-air-supplying and distributing conduit chamber formed in part by (and perferably flexible and tensioned between) the hinged-together and bottom-enclosed seat and back pads, particularly such a chamber which is of generally triangular cross-section to extend along the hinge across all or part of the width of a single-person or multi-person type pad device and particularly to supply forced air into and around the periphery of a restricted-opening top area for each such person from under forced-air-carrying areas which are beneath impervious flexible top cover portions and which are positioned alongside of each supported person.

A generally tetrahedron-shaped air entry and distributing chamber, located to one side and above the hinge of a two-part hinged pad device, for supplying forced air to said pad device, said air entry, more particularly, having at least its upper walls flexible, having the tetrahedron shape of said chamber formed in part by the hinged pads, and having upper walls extending across and tensioned between said hinged pads.

An improved arrangement to limit the upper open discharge area or areas for one or more people in a forced-air-supplying pad, and more particularly by the supplying of forced air under impervious flexible top covers along side of and opening into each said top discharge area.

A simplified forced-air-supplying layer or pad requiring no impervious bottom cover.

A flexible forced-air-supplying and distributing chamber to completely enclose and cover the sides of a forced-air blower unit located over and adjacent the hinge of a two-part flexible pad for use on vehicle seats.

A flexible forced-air supplying chamber opening in along flat margins of a body-supports-carrying sheet as well as directly in between said body supports to improve the forced air distribution and increase the cross-sectional area for its flow.

Other and more detailed objects and advantages of this invention, including cooperating or related features or arrangements, are set forth in or will be apparent from the attached specification, drawings and claims.

In the attached drawings:

FIGURE 1 is a plan view looking down on an opened-out pad of this invention with its blower unit removed;

FIGURE 2 is a partial view in side elevation of the front of FIGURE 1 in its operative condition but moved forward on the vehicle seat;

FIGURE 3 is a view like FIGURE 2, with the blower unit removed but with its air-supplying chamber sides connected and tensioned;

FIGURE 4 is a perspective view looking generally down from the front of FIGURE 2;

FIGURE 5 is a partial view of a modification of the air entry portion of FIGURE 1;

FIGURE 6 is a view like FIGURE 5, showing another modified form of the air entry;

FIGURE 7 is a side elevation of the blower unit;

FIGURE 8 is a partial plan view like FIGURE 1, with outer parts broken away to show one form of the interior layer of supports, marginal stiffening and hinge structures;

FIGURE 9 is a view like FIGURE 4, but showing a modified and multi-person pad device with a modified air entry portion;

FIGURE 10 is a view like FIGURE 8, but showing an integral plastic layer of supports, marginal, and hinge structures in another form preferred for lowest cost free-type pads;

FIGURE 11 is an enlarged section taken on the line **11–11** of FIGURE 10, with a central portion broken away and omitted to show the inner edge of the impervious top cover, and showing one way of using and one form of the body-supporting plastic sheet with holes therethrough;

FIGURE 12 is a view like FIGURE 11 with holes and the air-impervious bottom cover omitted;

FIGURE 13 is also a view showing a plastic sheet just like that of FIGURE 11 except that the sheet is inverted to have its projections on its under face;

FIGURE 14 is a view like FIGURE 10 of the interior but showing an outer corner of the seat part of the plastic sheet and stiffening frame of FIGURE 10 around this corner and also illustrating a modified arrangement of the projections and holes of the plastic sheet; and

FIGURE 15 shows a modification of the forced-air-flow-directing flexible walls of the pad by a section taken through the pad as on line **15—15** of FIGURE 4.

In the foregoing drawings and in their descriptions, for convenience in following this disclosure the same reference numerals are used in the differing arrangements of the several modifications for parts which are or may be otherwise essentially the same. In these modified forms, certain differing but generally similar parts are distinguished by the use of the same reference numerals increased by 100 in the succeeding modifications.

As indicated above, this invention relates to tied-down or built-in forced-air pad devices as well as to the free type. As used herein, the terms "free-type," "substantially non-tied-down" or the like are intended to define seat or seat and back pad devices requiring no particular installation and which need their own stiffening, but which may include well-known types of partial holding or locating means (such as a member, located at the pad rear or in back of the pad's hinge, to be forced in between the seat and back cushions, or hooks, clips or the like to hold the back pad up), so long as such pad devices are not "built-in" or stretched out or flattened over the seat or back cushions (as by a stretched cushion cover, full seat cover, or the like). Similarly, this invention also relates to such forced-air devices for several people as well as to types for only one person.

Various known or other suitable forms of forced-air-carrying flexible pads or layers (with various known or suitable types of spaced-apart or open body supports) may be employed. They may be used on various kinds and types of cushioned, springy, or padded surfaces, including beds, furniture, or the like, all within the broader purview of the present invention. However, the pads as disclosed herein are intended particularly for use on a cushioned automobile seat, designated as a whole by S in FIGURES 2 and 3. The two-part pad, designated as a whole by **1**, is peculiarly adapted for such automotive use in its more specific features and relationships. Pad **1** comprises the seat pad portion (designated as a whole by **2**) and the similar seat back portion (designated as a whole by **4**) which are connected by suitable hinge means (designated as a whole by **3**). Thus **2** and **4** may be considered as two pads, independent except for their hinge means **3**, or else as two parts of one divided or hinged pad, into which forced air is supplied to flow along in the suitably confined layer space for discharge out through an open area so arranged as to be mostly or substantially

under or behind the average person's body. This pad **1** includes an interior layer of flexibly or bendably connected body supports suitably enclosed for forced-air delivery to a person.

FIGURES 1 to 6 and 9 may employ the forced-air-carrying and inner layer **5** of FIGURE 8 or the plastic sheet forced-air-carrying layer **37** of FIGURES 10, 11, 12, 13 and 14, which is preferred for lower cost devices of the free type.

The seat pad **2** has the top discharge portion or restricted-opening area indicated as a whole by **6**, while the back pad **4** has the similar discharge portion or restricted-opening area designated as a whole by **7**, with each here extending from the ends (front and top) of the complete pad **1** to give full length forced-air supply under the seated person's upper legs and also under the seated person's back down nearly to (or with diminished flow adjacent to) the hinge means **3**.

While areas **6** and **7** may be entirely open or free of any covers within the broader aspects of this invention, yet for comfort as well as appearance it is usually preferable to provide a suitable foraminous thin flexible sheet as a top cover **8** over opening **6** and a similar sheet **9** over opening **7**. As illustrated, and for economy as well as better appearance and strength, air porous covers **8** and **9** are formed by one piece, designated as a whole by **10**. This piece **10** may be of any suitably attractive, long-wearing and porous textile fabric, such as knitted or woven cloth. In general, it may be of the various known automobile seat upholstery materials having an adequate porosity.

In this connection, attention is directed to the disclosures in my above-referred to jointly-invented prior patents, and particularly 2,992,605, with respect to the desired total discharge restriction beyond the high-delivery-type, high pitch and unstable type of blower. While not essential in all forms hereof, it is preferred to use this type of blower unit in the present device. The correct restriction values according to these prior patents are intended to be provided here by the foraminous covers **8** and **9**, together with the restrictions of all of the air flow passages beyond the fan of the compact electric motor-blower unit designated as a whole by **11**.

In general, the foraminous covers can and should be quite porous or open woven or knitted fabric when the remaining said restriction is comparatively much higher.

As noted above, the forced-air-flow-carrying pad portions should be flexible for comfort. Thus, where such layers or pads are not of the free type, but are intended for tied-down use on a cushion (as by being held flat under a conventionally fitted and held-down seat cover or the like, with suitable porous areas), then no marginal stiffening means are ordinarily required. In this use, the pad itself (including its interconnected supports) may be much more flexible, since it does not have to hold itself locally flat or against undesirable curling or bending up, particularly adjacent its edges. All such forms may be employed within the broader aspects hereof. For free types of pad devices there should be a marginal stiffening means for the seat pad portion and for the back pad portion, suitably hinged together. With such marginal stiffening means or frames of adequate stiffness (as by steel rod-like frames), the support-carrying layer can be of cloth or the like and the supports may be in various forms (including suitably-attached yieldable or soft columns of solid material), depending on price, the desire for a high local yieldability or surface softness, and other factors.

For the lowest cost forms of such free types, it is preferable to use the hereinafter-discussed low-cost plastic supports or projections on a thin plastic sheet having (especially between said supports) a limited springy stiffness to hold itself generally flat and yet permit the above-mentioned flexible bending under a body for comfort, all as disclosed in my first copending application and

preferably with certain of the hinge and edge stiffening means of my second said copending application (both being set forth above).

It is also to be noted that broadly (or price permitting) there may be several independent layers of such interconnected and spaced-apart body supports, or they may project out from the two faces of a single sheet. However, it is preferred that there be only one such layer for simplicity and low cost.

It is intended that the improved forced-air supply chamber conduit of this invention and other features of the invention may be employed in all of such different types and uses.

The side-entry forced-air-supplying and distributing conduit chamber of this invention, designated as a whole by **12**, is shown here as dividing or distributing the forced air in separate streams to the two hinged pad portions. Chamber **12** has its lower and rear walls provided by parts of the hinged-together pad portions and has an outer or upper wall part **13** which may, if desired, be narrower in front-to-rear dimension at its inner portion and extend all the way across the seat width. Preferably, and as shown, chamber **12** is wider at its entry side alongside of the user to provide an adequate plenum volume, and slopes into the seat and back portions to one side of the supported person. Preferably (but not necessarily in all cases), the parts of wall **13** engageable by a person may be made flexible. As illustrated here, the entire extent of wall **13** is flexible. This provides comfort when the supported person engages this wall **13**. Further, flexibility of wall **13** permits a more compact and lower cost device which can be folded flat (as in packaging) with flexible wall **13** doubled up in between the folded-together hinged pad parts.

The forms of this invention where the conduit chamber **12** is entirely at one side of the pad and the blower unit is seat-supported are readily usable with the blower unit on either side. FIGURES 1, 2, 3, 4, and 6 show the blower to the user's right, while FIGURES 5 and 9 show it on his left.

Since most of the herein-disclosed pad devices for only one person (with a seat-supported blower unit) are used by or sold to automobile drivers, it has been found desirable to locate the blower unit of this type on the driver's right-hand side to give him easier entry and exit from a normal left-hand drive vehicle and since the center part of the usual bench seat is less-often used. However, a passenger alongside the driver can also use this same right-hand blower pad. Price permitting, right- and left-hand models of such one-person pad devices may be provided.

For multi-person models or full bench seat width types with the side blower unit seat-supported, it is also preferred to have the blower unit at the driver's right-hand side or end of the bench seat (for normal left-hand drive private vehicles), since the driver gets in and out more often. Either side may be used in this full width type.

In the case of a seat-supported air supply tube or blower unit, chamber **12** has at least its side or lateral end or entry portion (designated as a whole by **27** and hereinafter described in more detail) provided with means to removably receive and preferably also to tightly engage and retain in place a sufficiently rigid forced-air-supplying tubular member or the blower unit **11**.

In certain forms, and as illustrated in one embodiment by FIGURE 9, the entry end or portion **327***b* may be flexible and extend down or behind the seat to a suitable and remote source of forced air.

As shown in FIGURE 5, retaining means for an air tube or for a blower unit located on the seat may be provided by making portion **127** flexible and elastic or by including an elastically stretchable inset. It is preferred to provide a more positive means by having portion **27** and at least the side portions of wall **13** in two detachably connected parts. This is illustrated in FIGURES 1, 2, 3, 4, and 6 by part **15** for the seat pad portion **2** and by part **16** for the back pad portion **4**. These two parts **15** and **16** may be provided with a suitable fastener means at their joined ends, such as the "zipper" type fastener means **17**.

In FIGURE 1, the blower unit **11** is shown as removed and the flexible impervious sheet wall parts **15** and **16** are shown as disconnected and loose. They are shown connected in FIGURES 2, 3, and 4 and with the blower unit **11** in place in FIGURES 2 and 4.

Flexible wall **13** (including its parts **15** and **16**) is shown as tensioned and held out by one means in FIGURE 2 and by another different means in FIGURE 3. Both may be used.

FIGURE 2 shows the blower unit **11** inserted and adequately tightly held in place by the tension of connected-together wall parts **15** and **16**. Here, however, the blower unit **11** also engages (and bends at least the margins of) the flexible pad portions **2** and **4** at and across their hinge means **3** so that the rigid member **11** also holds the pad back **4** upright and against any substantial swinging in either direction. Thus both parts **15** and **16**, as well as the margin or engaged means of the flexible pad parts, are bent to form a cylinder to fit unit **11**.

To illustrate these two different means for holding flexible wall **13** out (and also for limiting the swing of the seat back), FIGURE 2 shows the pad device **1** in its operative condition but moved forward from the seat back to illustrate that the back pad **4** is held in position as described above, while FIGURE 3 shows pad device **1** similarly located but without its blower **11**, so that the seat back pad **4** is held against rearward swinging (at a slightly greater angle from the folded condition than that of FIGURE 2) only by the tension in flexible chamber **12**. The upper sloped wall **13** of chamber **12** is tensioned from its highest ridge well down into the apex of this generally triangular-shaped piece. Also, the generally triangular-shaped end closure or wall, here designated as **28**, is also tensioned well down into its lower corner or apex.

Thus it will be apparent that such an all-flexible chamber (or flexible-top chamber) can be held open for air flow by either of these two means. As one example, the hereafter described FIGURE 9 shows one of the numerous possible cases where the tensioning alone is used to hold the chamber or conduit open.

FIGURES 2, 4, and 5 show the use of an inserted duct or blower for this purpose, while FIGURE 6 with its blower unit out to one side is part way between these two types.

It is also to be noted that these two different means (i.e., the tensioning of the flexible chamber between seat and back or the insertion of the tube or blower unit) also serve another useful purpose in that they both hold the seat back as shown in FIGURES 2 and 3 and discussed above. This is useful in handling the assembled pad device. Here, as noted above, the inserted blower unit or the like holds the back pad against swinging in either direction and is aided by the above described tensioning. The top wall **13** need be but little additionally deformed by the insertion of unit **11**.

It is important that the restriction of chamber **12**, including its entry and discharge portion, be kept generally the same, since the flow resistance of chamber **12** is part of the total restriction to forced air flow beyond the preferred stallable type fan of the blower unit **11** and forms a material part of the needed restriction or resistance to air flow, as described in my above-referred-to prior patents. It may be noted that the very low pressure in pressure or plenum chamber **12** will not inflate it or move its walls.

For only one person, as shown in FIGURE 1, this tensioned flexible wall **13** may extend in only part way and slope in and down alongside of the person. A similar flex-

ible and tensioned wall may be provided on each side of each person in hinged-type pads.

Also, a wall generally like 13 may be extended all the way across the pad width to form a passage of generally triangular cross-section for supplying forced air to one continuous wide open area or to the separated limited discharge areas for a plurality of people, as shown in FIGURE 9 and described in more detail below.

In FIGURE 1 it will be seen that wall 13 (or its two parts 15 and 16) forms a generally triangular-shaped area with its top flattened and curved over into generally triangular end wall 28 which includes the entry portion. Further, it will be apparent that the other two of the four walls of chamber 12 (FIGURES 1 through 5) are provided by generally triangular areas of the seat pad 2 and the back pad 4, each of which includes a suitable bottom air enclosure means. Thus this form of chamber 12 is substantially a tetrahedron.

Referring back to the detachable connection, such as 17, between the two parts 15 and 16, it is to be noted that the several flexible pieces can be sewed flat and thus economically by having this detachable connection 17, which desirably extends to the inner apex of the generally triangular-shaped wall 13.

Since sloped triangular wall 13 of FIGURES 1 through 6 may engage against the side of a supported person, this flexible wall 13 may be provided with some, or a limited amount of, air openings or foraminous areas indicated by 13*a*, so long as wall 13 substantially encloses and directs the forced air. A similar tensioned and sloped wall like 13 (and with similar limited openings, if desired) may be provided on the other side of the person to give a yieldable bucket-seat fit on each side and a chamber like 12 on each side. Both such chambers may be supplied with forced air, if desired.

Wall 13 may be considered as sloping two ways, or from front to rear and from side to side, since its inner and main extent is a plane sloping up at an acute angle from the seat pad 2 and sloping out at an acute angle from the back pad 4. Wall 13 is sufficiently air impervious to separately direct the forced air directly into each open area 6 and 7 along an adequately long boundary (here curved) and also in under the impervious side covers 19 and 20. Thus wall 13 directs forced air diagonally into and across areas 6 and 7 and also in along their sides. The slope or convergence of wall 13 into the pads 2 and 4 progressively and smoothly re-increases the velocity of the air from the plenum or pressure distributing volume formed by chamber 12.

Parts 15 and 16 are suitably connected to the top faces of pads 2 and 4. When porous top covers are used, 15 and 16 are sewed to the porous top covers 8 and 9 of pads 2 and 4 respectively. Pad 2 has the flexible impervious side top cover 19 and pad 4 has the similar side top cover 20, as shown. Preferably 15 is an integral extension of 19 and 16 is an integral extension of 20, for greater strength, economy in manufacture and better appearance. The juncture or connection of 15 to 19 is sewed down through the porous cover 8 by the single line of stitches 24. The juncture of 19 with 20 is similarly sewed at 25. The single lines of stitches 24 and 25 are but lightly stressed, due to the shallow angle of 15 to 19 and of 16 to 20 and to the fact that 15–19 and 16–20 are integral.

Similarly shaped impervious side covers 19*a* and 20*a* are provided on the other side of each pad 2 and 4 and are preferably integral for economy and appearance to form the one common piece designated as a whole by 21.

These generally air-imprevious top cover portions 15–19, 16–20, 21, and also the impervious flexible back 10*b* of pad 1 when needed, may be of any suitable materials. For appearance and low cost, it has been found satisfactory to use a thin artificial leather type of material, such as a plastic-surfaced cloth.

For economy and for better appearance, it is desirable that the sloping upper wall 13 curve over into and be integral or in one piece with the triangular end wall 28. In more detail, portion 15–19 has an integral end wall portion and portion 16–20 also has an integral end wall portion, both sewed to separate piece 27*a* as disclosed below.

Side wall portions 15–19 on the one side and 21 on the other define the side boundaries of open area 6 as do portions 16–20 and 21 for open area 7, to provide a combined open area (for 6 and 7 taken together) of generally hourglass shape. Put another way, this combined area is materially but smoothly necked in at each side of the hinge means 3 to reduce unneeded or wasted forced-air discharge in this hinge area which usually does not need as much forced air. Among other advantages, this feature permits the use of a smaller motor and fan to give a lower cost and a materially more compact unit 11.

Turning now to the forced-air-distributing action and to certain additional structural aspects of conduit chamber 12, it will be noted that its common intake portion 27 is shown in all figures as having a reduced cross-sectional area (relative to the rest of chamber 12) and as being generally tubular or cylindrical (when its sides 15 and 16 of FIGURE 1 are connected together). This tubular portion is intended to fit over a suitable relatively rigid forced-air-supplying tube, such as housing 14 of blower unit 11.

Forced air from 27 expands into the larger plenum portion of chamber 12 and is then separately directed and distributed into the upper faces of the two thin air-carrying layers of the two pad portions 2 and 4 along adequately long air flow connections which preferably again speed-up the forced air by smoothly converging or sloping into pad 2 and into pad 4. This arrangement provides low cost, comfortable, and low air-flow-restriction connections directly into the thin forced-air-carrying layers of pads 2 and 4. This arrangement also supplies the forced air to each pad part directly into the areas where it is needed most and by the shortest possible practical air flow paths to the seat and back from a common conduit. Further, these two paths are each generally straight and lead diagonally in under or behind the person's body. Thus the forced air is supplied into the pads in the most desirable directions. All of this materially reduces the resistance to the force-air flow, which in turn permits the use of a thinner (and hence lower cost and more comfortable) layer of body supports and/or a smaller and lower-cost blower unit. These advantages apply to all of the forms shown, including that of FIGURE 9.

It will be appreciated from this disclosure that chamber 12 may be fabricated or arranged in various ways. One desirable type, for forced-air delivery in alongside of a person's seat and back (but not, as in FIGURE 9, through a similar such passage extended along the hinge to supply other people on a multi-person model of such device) is shown in several variations in FIGURES 1 through 6, and described here in connection with the pad covers.

For economy in manufacture and for greater strength, the porous top covers 8 and 9 extend out to the edges of each pad, as do the imprevious side top covers 19 (including 15) and 19*a* for the two side boundaries of area 6 of pad 2, and the impervious side top covers 20 (including 16) and 20*a* for area 7 of pad 4. The edges of 19, 15, 16, and 20 (on the air entry side of combined areas 6 and 7) are covered and embraced by a strengthening and decorative plastic-surfaced cloth piping or binding 22, which desirably may be along one side of areas 6 and 7. Binding 22 is sewed through to porous covers 8 and 9 by a single line of stitches 24 which are gripped or locked by the plastic of 22. There is a similar common piping or binding 22*a* over the inner edges of 19*a* and 20 for the other side boundary of areas 6 and 7, similarly sewed down by the line of stitches 25.

The outer edges of all of these top covers, as well as

an impervious flexible bottom cover **10***b* and the outer edges of the interconnected layer of body supports, are all embraced by a suitable piping of edging **26** around the entire periphery of pad **1**. This piping **26** may be of plastic-coated material like **22** but wider, or a bent over strip of thin plastic sheet. A line of stitches **26***a* is sewed through (and gripped by) **26** and its said embraced covers and other edges, as set forth above.

As hereinafter described, separate marginal stiffening means are provided around the outer edges or margins of each free type pad part **2** and **4**. Such conventional stiffening frames or the like are located inside of stitches **26***a*.

For economy in fabricating, entry portion **27** is formed by a separate piece **27***a* (of the same material as used for **15–19** and **16–20**) suitably connected into a generally circular opening cut out from the curved-over end wall portion **28** of wall **13**. This opening is cut out from the end wall portions of **15** and **16**. Piece **27***a*, which is open at its upper side so that it may be secured to the fastener **17**, forms the tubular entry part for chamber **12**. Part **27***a* can be secured in place, as shown, by the stitched seam **29**, which extends all the way around and under it. This entry part **27***a* is spaced from (and connected to) the edge of pad **1** adjacent its hinge by extensions **15***b* and **16***b* of the end wall portions **15** and **16**. These extensions extend under part **27***a* or between it and the edge binding **26**. Extensions **15***b* and **16***b* are sewed into piping **26** by the above-described single line of stitches **26***a*. While extensions **15***b* and **16***b* may be integral, it is preferred to sew them together at **15***d*.

This arrangement (shown in FIGURE 1) desirably flexibly spaces entry portion **27***a* away from the hinged pads **2** and **4**. At the outer open end **30** of part **27***a* the material may be turned in and sewed by stitches **31**.

In one preferred form, all the outer flexible walls of chamber **12** (except for the bottom portions, which are defined by the hinged-together pad parts **2** and **4**, including their impervious bottom closures) may be formed of the same material as the impervious top side covers or the impervious bottom cover **10***b*. This material may be a thin upholstery type of plastic-surfaced cloth.

The tubular entry part **27***a* (in FIGURES 1 through 4) is preferably nearly as long as the axial length of the fan shroud casing **14** of the blower unit **11**. The outer end of casing **14** is entirely covered by part **27***a*. The discharge end of casing **14** projects into larger chamber **12**. This arrangement retains unit **11** and covers the entire length of its casing **14**. This concealed casing **14** need not be decorated or have a final surface finish.

The flexible chamber **12** with its entry portion **27** may be provided in different arrangements or configurations. In the form of FIGURES 1 through 4, the casing **14** has its axial length extending across the pad edge. This length of **14** extends partly out from the pad side and partly in over a bendable side region of the pad. Preferably casing **14** is materially outward from the marginal stiffening means or frames discussed below, so that the margin of the pad **1** can bend to substantially fit casing **14**.

As shown in the one-passenger pad **101** of FIGURE 5, the axial length of casing **14** lies entirely out beyond the user's left-hand edge of this pad device **101**. Thus no bending of the pad edges or margins to fit casing **14** is required. The free-type device of FIGURE 5 may thus have its stiffening frames out at its edges as shown in FIGURE 8, if desired.

As shown in FIGURE 6, the axial length of casing **14** (when entirely covered) is adjacent to but lies entirely inside of the side edge of the pad **201**. In this form, the above-noted bendable side margin outside of the stiffening frames is made wide enough to lie alongside of casing **14**. Alternatively, only the discharge end of casing **14** (or of some other type of forced-air-supplying tubular member) may be inserted into **227**.

As shown in FIGURE 9, the pad **301** has its tubular and generally flexible entry part **327***a* extended as (or connected to) a preferably flexible forced-air conduit portion **327***b* extending down or to the rear for connection to a suitable source of forced air. Parts **327***a* and **327***b* may be conventionally held expanded enough for forced air flow. Both **327***a* and **327***b* need not be cylindrical. They may be elongated or flattened from front to rear to reduce the height of **327***a* up from the seat.

While FIGURES 1 to 4 have particularly illustrated the two-part pads for only one passenger, yet it is intended and will be apparent to those skilled in this art that multi-person hinged pads (such as those of FIGURES 5, 6, and 9) may be provided under the teachings hereof. In such cases, the chamber **12** may be at either or both sides. A plurality of side-by-side open and generally hourglass-shaped areas (like **6** and **7** taken together) may be suitably interconnected for forced air supply from a common chamber like **12** and in the manner of FIGURE 9.

While other blower forms may be employed within the scope of this invention, the preferred blower is intended to be in accordance with the teachings of my above-referred to prior Patent No. 2,992,605. The outermost axial-type fan and its closely connected small electric motor, shown and described in this patent, need not be illustrated again here.

The outer fan shroud casing **14** of unit **11** is preferably of plastic (although sheet metal has proven satisfactory), and has a small outer diameter which should be of less than about six inches (and has been found to provide a better pad device with a diameter of less than five inches, to reduce its bulk on the seat).

The axial length of cylindrical casing **14** should be materially less than its diameter. Good results have been obtained with a casing length of about two inches.

Casing **14** is shown in FIGURE 5 as having two rearward horizontally-extending narrow legs **33** which are provided to carry between them a suitably connected and formed electric motor supporting bracket means. Such a motor supporting means is not illustrated here since suitable such means are well known to those skilled in arts relating to fans and motors and since such means may, if desired, be constructed in accordance with my said prior Patent No. 2,992,605.

The exposed outer end of unit **11** (which is immediately adjacent to the fan blades) is covered by a suitable low-flow-restriction grille or screen **34** suitably retained in the outer end of cylinder **14**, all as will be well understood by those skilled in the fan or blower arts. This screen prevents insertion of children's fingers or other objects.

Reviewing the several modifications or arrangements of the outer pad structure as shown in FIGURES 5, 6, and 8, it will be noted that FIGURE 5 shows the pad **101** of the same general construction as described for FIGURE 1 (with the same parts carrying the same numbers), except that the duck-like part **127***a* is shown as elastic (in any known or suitable fashion) so that it will stretch to receive and hold casing **14**. This form may, if desired, have its marginal stiffening means out at its edges in the manner shown in FIGURE 8.

FIGURES 5 and 6 may be for one or for a plurality of people and of the free type or the tied-down type.

FIGURE 6 shows a pad **201** which may be of the same construction as FIGURE 1, so that the same numbers are used for the same parts. Here, however, entry portion **227***a* is disposed entirely inward from the pad edge as discussed above.

Referring again to the structure of the flexible chamber **12**, FIGURE 1 shows the lower side of the outer end of empty flexible entry portion **27** folded back inward to show the sewed-together connection **15***d* between the

integral extensions 15*b* and 16*b* of the two pieces 15–19 and 16–20, and also to show the above-referred-to piece 27*a* and its sewed connection at seam 29, as well as end stitches 31 for the turned-in end of 27*a*. Thus, the tube-forming piece 27*a* is sewed into a suitable hole formed in the end wall 28. FIGURE 3 shows the interior of this tube 27*a* with its inner end folded down so that the rear of the fastening 17 is seen.

In the form of FIGURE 8 (in which pad 1' is otherwise like pad 1 of FIGURE 1), lost-motion connections are not needed and are hence not shown. In this form, the stiffening frames 50 and 51 are located out adjacent the outer edge binding 26. The soft body supoprts 36 may, if desired, extend out to frames 50 and 51 and adjacent the edges of sheet 35. Thus the frames are larger for a given size of pad in this form than in the form of FIGURE 1.

While the stiffening frames 50 and 51 of FIGURE 8 are shown with their hinge ends aubtting, these ends may be overlapped if desired. These hinge ends are held in the pad by the two lines of stitching 46*b'* through the outer covers and through the inner sheets. These lines of stitching are close to the frame ends and are on each side thereof.

When stiffening frames 150 and 151 are used, they are held in place in the pad by the short single line of stitching 46*b* through the covers and through the plastic sheet, as shown in FIGURE 1.

FIGURE 9 is partially discussed above. Its pad 301 (including the connected seat and back parts 302 and 304) is here illustrated as being of the installed or complete seat cover type. It has full seat-cover-like side, top, and front extensions, like 302*b* and 304*b*, to extend over the front, sides, and top of a bench-type seat. Its general construction, including the arrangement and sewing of its top covers, is generally like FIGURE 1 and carries numbers increased by 300.

FIGURE 9 discloses one form having a plurality of side-by-side and spaced-apart sets of open areas 306 and 307. Each set provides separated seat and back open areas for one person. Each of these restricted-opening areas is bounded by edging 322 (like 22 of FIGURE 1) and by the outer edge edging 326 (which is generally like 26 of FIGURE 1). The several spaced-apart areas 306 and 307 are in each case supplied with forced air from the common chamber 312 (which is generally like 12). The forced air is supplied into each of the open areas 306 and 307 in the same general directions and manner as described for FIGURE 1.

Here, however, the sloped generally-triangular wall 313 does not come to a point or apex, as does 13 of FIGURE 1, but is continued or extended by portion 313*b* over the hinge across the full pad width (or far enough to supply the several sets of areas 306 and 307). The flexible and generally impervious wall 313*b* is held tensioned between the seat pad 302 and the back pad 304 (like 13 of FIGURE 3) by stitches 324' and 325', which are extensions of the stitches for bindings 322 and 322*b* or 324*a* and 324*a'*, respectively. Stitches 324*a* and 324*a'* are like stitches 24*a* and 25*a* of FIGURE 1. This arrangement provides a generally-triangular cross-sectional passage under wall 313*b* to supply forced air to 306 and 307 of each set.

These areas 306 and 307 are shaped and formed generally like 6 and 7 of FIGURE 1, except that they end and are bounded at their hinge ends by the flexible and generally impervious wall portion 313*b*, which may have its holes or foraminous portion 313*a* like 13*a* of FIGURES 1 to 4.

The wall portion 313*b* may be a separate piece, but is preferably in one piece, designated as a whole by 313 with impervious side wall portions 321*a* and 321*b* between areas 306 and also between areas 307. This one-piece wall portion may also be separate from, but is preferably integral with impervious sides 319 and 320. These impervious sides 319 and 320 may be formed in any suitable manner. Preferably they are shaped and sewed and connected to 327*a* like sides 19 and 20 of FIGURE 1.

Forced air is supplied and directed into areas 306 and 307 around their boundaries substantially as in FIGURE 1, but here from under generally impervious flexible walls 313*b*, 321*a*, 321*b*, 319 and 320, all as shown by the air-flow-indicating arrows in FIGURE 9. Similar arrows are used in FIGURES 1 and 4. As shown in the forms of FIGURES 1 to 4 and 9, the tensioned, flexible, sloped, and generally impervious walls such as 13, 313, or 313*b* serve to smoothly and progressively increase the velocity of the forced air just before it emerges into the open under-body areas (such as 6, 7, 306, or 307). This is desirable since it gives a nozzle-like action and carries the forced air farther in under the supported person's body. In these cases (such as walls 13, 313, or 313*b*) the forced-air-flow-directing walls slope down practically to the edges of the open areas, such as 6, 7, 306, or 307 (except for the relatively narrow width of bindings 22, 22*a*, or 322).

In certain cases, it is quite desirable to increase the nozzle effect so that the forced air is carried farther along layer 37 or the like, and farther under a supported person before it rises. Put another way, the nozzle-forming portion 13*g* increases the percentage of the forced air that will move horizontally along the layer such as 37 in under the supported body. The nozzle effect also decreases the percentage of the forced air that would otherwise rise up through the open top area (such as 6 or 7) immediately adjacent binding 22 if such an open area were not covered by a person's body. This is useful if the open areas are quite wide or if the seated person's body is not over or close to the sloped boundary of an open area. In such cases, the modified boundary or edge structure of the pad 1'' of FIGURE 15 may be employed for the air exit from walls 13, 313, or 313*b*.

In FIGURE 15 (which is shown as a section taken on line 15—15 of FIGURE 4) the straight or parallel-sided end of the slot-like nozzle is elongated at its exist, as shown as a whole by 13*g*. In this modification of FIGURE 15, there is at least one line of adequately strong stitching 24*d* spaced inward by a width W from the stitches 24 through the binding 22 shown in FIGURE 1. Both stitches 24*d* and 24 extend through all outer covers (including top covers 15–19 and 10 and bottom cover 10*b*), as well as through plastic sheet 39 (in which they are gripped and locked, as disclosed above).

In this FIGURE 15, the air flow and its velocity increase, and its discharge into, along, and up out of layer 37 is shown by the arrows in FIGURE 15.

Tensioned and two-way-sloped walls (generally like 13 of FIGURES 1 and 4) may be positioned on either side of open areas generally like 6 and 7 for a pad for one person. Such an arrangement is quite useful for use on a bucket-type automobile seat. It affords lateral support on each side of the user, and forced air may be supplied through such lateral walls by openings such as 13*a*.

It will be appreciated that the thicknesses of sheets or like portions (such as covers 10, 10*b*, 19, 20, and 21 and bindings 22, 22*a*, and 26, as well as the plastic sheets like 39) are necessarily exaggerated in the drawings in order to show thickness by double lines. Thus, the relative proportions of certain parts are distorted. As will be readily understood by those skilled in this art, the total thickness of the binding 26 of FIGURES 11, 12, and 13 will be very much less than the total thickness of sheet 39 and its projections (here shown as about one-quarter inch), even though the binding embraces the edges of the plastic sheet and the several covers. Similarly, binding 22 of FIGURE 15 will rise but little above the surface of porous cover 10.

FIGURE 9 may use the interior air-carrying layer of

FIGURE 8 or of FIGURES 11 to 14, but without the stiffening frames in the case of a built-in or full seat cover type.

Various forms of interior forced-air-carrying layers may be used. One of such possible forms is illustrated by FIGURE 8. The interior forced-air-carrying layers of the above-described two-part pads may be quite flexible. A sheet 35 of cloth-like material or loose open cloth is used in the layer 5 of FIGURE 8. The rectangular sheet 35 extends to the rounded corners and edges of pad parts 2 and 4 and under the hinge means 3 of FIGURE 1. Piece 35 carries suitable upright body supports 36 on one or both of its faces. Supports 36 are here shown as being suitably secured only on the upper face of sheet 35.

These separate supports 36 may be of any desired form, including solid upright generally cylindrical members, as shown, formed of a non-metallic material of adequate strength. Since they are solid, they may be materially yieldable under a supported body and thus at least one-half inch in height. They should have a base width or diameter of three-quarters of an inch or more, to prevent excess tilting in normal use, since sheet 35 is highly flexible. These supports 36 are spaced apart in all directions by materially more than their widths or diameters to provide adequate space for forced air flow between them. The supports 36 may extend out to or adjacent the edges of sheet 35.

Marginal stiffening means in the form of rectangular frames 50 and 51 with rounded or cut-off corners and of steel rod-like wire of about one-eigth inch or more in diameter are provided for pad parts 2 and 4, respectively. These frames are arranged around and close to the outer edges of sheet 35 around supports 36. The hinge sides of these resiliently bendable stiffening frames 50 and 51 are adjacent each other, or preferably abutting, as shown in FIGURE 8. These abutting sides are swingably connected by suitable metal clips or rings 3*a* to form a hinge. The frames 50 and 51 have a limited springy bending under a person, especially from front to rear in the seat pad 2. The outer edges of freely-stretchable sheet 35 are extended out beyond (or, if desired, stretched over) the frames 50 and 51 and sewed inside of a suitable common outer embracing piping or edging 26', which may be like the above-described edging 26, but wider, if desired.

In this free-type device of FIGURE 8, the highly flexible and stretchable layer 5 formed by cloth-like sheet 35 with its supports 36 is easily deformed or curved down under the body. The same applies to the covers. However, this layer 5 or sheet 35 has no stiffness of its own, so that in a free-type device it does not hold itself locally flat when not in use. It thus requires relatively heavy marginal stiffening frames or the like. Further, sheet 35 affords no anti-tilt support for the body supports 36, which thus must each be of a relatively large base width to prevent excess tilting thereof in normal use.

It is desirable to provide a materially lower cost form of the above-disclosed forced-air-supplying appliance, and particularly one of greater general durability and longer service life by including features of my two above-referred-to applications, whose advantages need not be repeated here. This appliance is improved by having a much thinner and more efficient forced-air-carrying layer formed by body supports which do not collapse or tilt excessively in normal use and thereby objectionably reduce the forced-air-carrying thickness of the layer. This appliance is also improved by a materially smaller and lower cost blower unit.

For these reasons, it is preferred in many cases to use the constructions of my two above-referred-to applications, which are shown in part by FIGURES 10 through 14.

It is intended that any of these constructions or arrangements may be used here.

Since FIGURES 10 to 14 (with all related data and modified forms) are fully described in my two above-referred-to applications, these disclosures are to be considered as set forth at this point. In order to avoid unnecessarily lengthening this specification, these disclosures are only in part repeated in the following abbreviated discussion of FIGURES 10 through 14, as used for forced air flow.

These figures show the improved forced-air-carrying layer, designated as a whole by 37, of flexibly interconnected body supports 38, preferably integral with thin plastic sheet 39. This layer 37 may be provided in several specific but closely related forms.

Accordingly, this layer is designated as a whole by 37 in FIGURES 10 and 11, by 137 in FIGURE 12, by 237 in FIGURE 13, and by 337 in FIGURE 14. In like manner, only slightly changed parts have their numbers increased by 100 to indicate their similiarity and yet distinguish them. However, component parts which remain identical carry the same reference numerals.

For convenience in the referenced disclosures, the reference numerals in FIGURES 10 through 14 here are the same as those for the same parts in my two above-referred-to applications.

FIGURES 10 and 11 (and also, generally, FIGURES 12, 13, and 14) show layer 37 as comprising the thin sheet 39. This sheet 39 has a thickness in the range of from eight to twenty mils and preferably less than fifteen mils, which is relatively uniform after forming. It uses but a small amount of a suitably strong non-brittle plastic (disclosed as set forth above). The integral hollow frusto-conical (preferably polygonal) three-dimensionally-deformed and body-supporting projections 38 have generally flat outer ends of about one-half their base areas. Projections 38 are preferably rapidly mass-produced in a single sheet by vacuum-type forming on a single die, with their wall thicknesses but little reduced from the web thickness or from the original sheet thickness. Preferably, this thickness reduction is less than about one-third. Further, sheet 39 with projections 38 has little (preferably less than ten percent) orientation or locked-in stress to be released in a sun-heated automobile. Preferably these upright supports 38 are of less than one-half inch in height and may be only about one-quarter inch, to provide a very thin forced-air-carrying layer 37 which will not have its thickness materially reduced in normal use. They have their side walls sloped about as shown for best columnar stiffness and collapse resistance, and are corrugated to form tapering ribs 62 as shown (preferably at the polygonal corners), thus greatly increasing their body-supporting stiffness.

For low resistance to the flow of forced air in layer 37, supports 38 are spaced apart in all directions, as shown, and are proportioned so that their horizontal cross-sectional areas are in the range of from only one-tenth to a maximum of one-third, and preferably about one-eighth, of the body supporting areas.

These projections 38 are integrally connected and prevented from tilting excessively by web or flat portions 69 which have a limited springy stiffness to locally hold sheet 39 and layer 37 generally flat and yet provide sufficient springy flexibility for the unstiffened areas of pads 2 and 4 to permit relatively free or flexible curving down into the under cushion to provide comfort. This also prevents materially obstructing or changing the effective thickness of forced air flow by abrupt bends in layer 37. Preferably layer 37 or the whole pad has only one plastic sheet materially stressed by this bending, to avoid uncomfortable beam-type stiffness in the forced-air-carrying structure.

In certain cases, holes 68 may be provided between projections 38 and spaced apart for relatively uniform distribution of forced air to a supported body. They are die-cut or punched through webs 69 between the supports 38, as shown. As shown, holes 68 are preferably materially larger than the bases of the projections for economy in the punching operation. They provide a total forced-

air-carrying area in a range of from one-quarter to one-half, and preferably about one-third, of the body-supporting areas, to provide an adequately low resistance to forced-air flow therethrough. These holes also define or form strip-like or elongated members 71 extending between and connecting projections 38. Strips 71 are more flexible because they can deform by simple bending across their relatively narrow widths. They extend from side to side and from front to rear for bending under a person in these two directions. Strips 71 retain an adequate limited stiffness to hold sheet 39 generally flat locally, thus preventing abrupt bends or high air-flow-resistance portions in the air-carrying passage of thin layer 37.

Supports 38 are arranged in a suitable two-way pattern in body-supporting area 47 of the seat pad portion 39*a* of one-piece sheet 39. As shown, this area is rectangular, with corners cut away to clear or prevent interference with the hereinafter-noted stiffening frames and their two-way lost-motion connections.

Similar area 48 of the pad part 39*b* of sheet 39 is spaced from area 47 to provide the flat and hinge-forming integral or common margin 46. Relatively narrow margin 46 bends in flexure for the hinge action. That is, sheet 39 has an integral flexure hinge whose bending is limited to a narrow area by the stiffening frames and especially by the stiffening of sheet 39 on each side of the hinge as by the omission of a row of holes on each side as shown.

Areas 47 and 48 are also spaced in from the side and end edges of sheet 39 to provide peripheral margin 45 of about the same or slightly less width than hinge margin 46. Margin 45 provides a sufficiently smooth or unobstructed region or flat sheet face alongside of the straight sides of outermost projections of areas 47 and 48 to provide for the relative outward lost-motion travel of the frame sides in those areas or cases where such lost-motion is needed.

It is to be noted that while the layer 37 or the like in this application is intended to be in accordance with the disclosures of my first above-referred-to application, yet to avoid undue lengthening of this disclosure only certain of the forms and arrangements of this plastic air-carrying layer are specifically illustrated or mentioned here.

Various known or suitable marginal stiffening means may be used about all or parts of one or both of areas 47 and 48. Preferably (but not necessarily) such stiffening means are in accordance with the disclosures of my second above-referred-to application. Only certain of such disclosures are illustrated or mentioned here, for the sake of brevity. To use the most extreme case (or the case wherein the lost-motion for the marginal stiffening means is most needed), the present application specifically shows and discusses only the one form of the two closed rectangular marginal stiffening frames for the one-piece plastic sheet from my second above-referred-to application. It is to be understood, however, that various other forms of hinges and marginal stiffening means or frames (including the several other forms of my second above-referred to application) may be used in free-type seat pads or where needed.

It is to be noted that the springy steel wire, as referred to herein for the stiffening frames, is intended to refer to the usual low-cost and non-tempered steel now ordinarily used for such frames in the coil spring types of similar seat pads.

In general, there will be at least two opposite sides of a frame or the like which are relatively rigidly spaced or held apart by a frame side and thus, when sheet 39 is curved down under a supported person, pulling its sides in, would highly tension sheet 39 (and its connecting stitches) if sheet 39 were directly connected or sewed to such opposite frame sides. Lost-motion means are provided to prevent resulting possible tearing, or in any case undesirable stressing, of thin plastic sheet 39, and of the stitches. In the case illustrated here, where one of the outer edge-sewn flexible covers for pad 1 also provides the means to hold the stiffening frame intermediate the heights of the projections 38, this same lost-motion means may also permit the use of a low-cost single line of relatively untensioned stitches connecting sheet 39 to its outer cover or covers.

FIGURES 10 though 14 show closed four-sided frames 150 and 151 which are rectangular with rounded or cut-off corners. For low cost, they may be like springy frames 50 and 51 and similarly have a limited springy bending under a person. For the same size of pad 1, here shown as being about twenty-one inches by thirty-four inches over-all, frames 150 and 151 will be smaller (in area) than frames 50 and 51. For this reason, and also due to the important limited springy stiffness of sheet 39, frames 150 and 151 desirably may be of lighter or materially smaller diameter springy steel wire or the like than the frames 50 and 51, which will result in lower cost and better under-body comfort. If desired, frames 150 and/or 151 may slightly compress sheet 39 from front to rear, from side to side, or both ways. As shown, and when pad 1*a* is unoccupied, frames 150 and 151 may engage a face of margins 45 and 46 around the projections to limit their relative motion in that direction. Suitable means are provided to normally hold the frame sides generally intermediate the heights of marginal projections 38 or to hold them in the other direction transverse to sheet 39.

The frames 150 and 151 have a lost-motion-type connection to sheet 39 and for relative lost-motion travel generally along or in the plane of sheet 39. The inward direction of this lost-motion travel is limited by the normal (or unoccupied pad condition) engagement of frames 150 and 151 with marginal projections 38.

Sheet 39 has or carries suitable means, located out near its outermost edges, to limit the other direction of lost-motion travel and thus hold the frames and the sheet 39 together or in operative relation in a complete pad. This last means is illustrated in only one of the possible forms disclosed by references and in FIGURES 10 through 14. In these figures, the sewing of (preferably all) edges of sheet 39 and of at least one of the outer flexible pad covers (either the top or bottom cover which is on the same face as the projections and the frames) into the edging 26 by the single line of stitches 26*a* (with the stitches locked as disclosed above) performs two functions. First, this low cost and simple construction holds the said flexible outer cover generally in against the marginal projections 38 so that this said flexible outer cover prevents removal of the frames 150 or 151 outwardly from sheet 39. Second, the held-down portion of this said flexible cover inward from stitches 26*a* (or, indirectly, the line of stitches 26*a* itself) serves to limit the outward lost-motion travel of the frame sides relative to the sheet 39 or its projections 38.

An adequate effective amount of such lost-motion travel (of preferably from at least about one-eight to one-quarter inch for the above-noted particular size pad 1) is provided on each side of pad 1 for frames 150 and 151 and side-to-side curving down sheet 39. However, these FIGURES 10 through 14 show a preferred and lower cost form in which all (or substantially all) of the lost-motion travel required for the other direction of pad bending (or from front to rear of pad 2 and from top to bottom of pad 4) is located at the outer ends or in or along the front margin 45 of sheet part 39*a* and in the top margin 45 of sheet part 39*b*. This arrangement provides an improved hinge structure wherein the single line of stitches 46*b* (as shown in FIGURE 1) is relatively quite close to (and between) the adjacent hinge sides of frames 150 and 151 to reduce or eliminate lost-motion travel adjacent the hinge and thus not interfere with the desired action of this flexure hinge. Preferably, there is at least as much total lost-motion travel provided at the outer pad ends as disclosed above for the two side lost-motion clearances. The slight bending of frame 150 (or frame

151) from front to rear in use helps reduce the amount of lost-motion travel needed for front to rear bending.

Since both these lost motions are determined in part by the margin width, it is important that the margins, and particularly 45, be of an adequate width, materially greater than the support base width or the hole diameters, and preferably greater than the projection-to-projection interval as shown.

Interference at the corners of projection areas 47 and 48 (which would tend to hinder lost-motion travel in both directions) is prevented here by an outward clearance of the frame from the projections at these corners, as noted above.

It is also to be noted that the imperviously-covered areas of layer 37 at or adjacent the above-described hinge means and also those under 19, 20, 19*a* and 19*b*, all provide marginal passages for forced-air flow (as part of 37) distribution into the open top areas 6 and 7 of pad 1, with these areas being extended by flow along margins 45 and 46.

The following notes the differences between the several arrangements in FIGURES 10 through 14.

FIGURES 10 and 11 show pad 401 comprising porous top cover 10, impervious back cover 10*b*, and layer 37, in which sheet 39 has its projections 38 facing up and includes holes 68.

FIGURE 12 is like FIGURE 11, except that its pad 501 has its bottom cover omitted and its layer 137 has its plastic sheet 139 with the holes 68 omitted.

FIGURE 13 shows pad 601 with top and bottom covers as in FIGURE 11. However, layer 237 of FIGURE 13 has the same plastic sheet 39 of FIGURE 11 turned over so that its projections 38 face downward.

FIGURE 14 shows pad 401′ with its layer 337 comprising the modified plastic sheet 239 in which the same projections 38 (of FIGURE 10) are differently orientated so that here projections 38′ have the sides of their generally square cross-sections diagonal to the sides and ends of sheet 239 and disposed between or facing the holes 68 to provide more clearance for the hole cut-outs or room for larger holes. This is in contrast to the orientation of the projections in FIGURE 10 wherein they have their sides parallel to the sides and ends of sheet 39 and their corners disposed between or facing the holes 68.

It may be noted again that the plastic sheet 39 has stiffened regions on either side of its unitary flexure-spring-forming hinge margin 46, or on either outer side of the frame sides at the hinge. This causes the bending to occur mainly in the hinge portion of the plastic sheet 39, especially between the hinge sides of the two frames 150 and 151. This action cooperates with the above-described absence of lost-motion adjacent the hinge. This absence of lost-motion avoids permanent deformation of the plastic sheet in the region adjacent the hinge. It also helps in the distribution of forced air in layer 37 adjacent the hinge.

It may be noted that it is desirable in free types of such pad devices (especially for use on automobile seats or the like), and where no other means is provided to hold the seat back pad part 4 up in place, to have the top cover or covers (including the porous cover) slightly looser or less tensioned from end to end of the entire pad than the air-carrying layer (such as the plastic sheet 39) and/or the back covers.

Thus the slight relative tensioning of the air-carrying layer or sheet 39 or the slight tensioning of its back cover helps hold the hinged back pad part 4*a* up in place or against falling forward when unoccupied. However, it is usually desirable to otherwise connect the several flexible covers slightly loosely to the edges of the plastic sheet 39, especially from side to side.

It may also be noted that the soft or porous rubber supports of FIGURE 3 may have rounded tops generally in the form of hemispheres, with their wider bases secured to the flexible sheet.

While only certain of the numerous possible forms and arrangements contemplated by this invention are specifically described in the foregoing specification or by reference to my above-referred-to prior patents and copending applications, it is to be understood that this invention may include and it is intended to cover by the appended claims various other forms or arrangements including the use of features hereof in other relations, all within the teachings and spirit of this invention.

I claim:

1. A forced-air under-body ventilating flexible pad device of the free type for substantially non-tied-down use on cushioned automobile seats or the like, comprising
frame-like marginal stiffening means for each of seat and back portions connected by hnige means and each comprising
at least one layer of interconnected body supports spaced apart for forced air flow therebetween and enclosed by substantially impervious means except for an open top area shaped to supply forced air under at least one person
and common means to supply forced air directly into the upper faces of both said seat and back portions, including
a distributing chamber and conduit adapted to be connected to a forced air source,
located above and having its air entry at one side of said pad,
with its discharge portions extending materially to either side of said hinge means
and defined in part by areas of said hinged seat and back portions and also by substantially air-impervious wall means extending across the angle between and over said seat portion and said upright back portion.

2. The pad device of claim 1, in which
said chamber conduit has a normally horizontally directed air entry conduit portion extending out beyond the sides of said seat and back portions.

3. The pad device of claim 1, in which
said impervious means of said pad portions includes thin flexible top covers having impervious side marginal portions and
said wall means of said chamber conduit is flexible, extends only part way across the pad width, and slopes down into and is connected to the said top covers of said seat portion and said back portion
and in which said pad is flexibly foldable between the upper faces of said two portions for stowing or packaging.

4. The pad device of claim 1, in which
said wall means of said chamber conduit comprises a flexible seat part and a flexible back part having a detachable connection between them extending generally along said hinge means to removably receive a relatively rigid separate forced-air-supplying blower unit to hold said seat back up and against material swinging in either direction.

5. The pad device of claim 1, in which
said impervious means of said pad portions includes thin flexible covers having impervious side marginal portions alongside of a foraminous area, and in which said wall means comprises flexible integral extensions of said impervious side marginal portions of said covers held tensioned out from said hinge means across the angle between the seat portion and the upright back portion to limit rearward swinging of said back portion.

6. The pad device of claim 1, in which
said impervious means includes thin flexible marginal top cover parts for said seat portion and for said back portion,
each being of material width extending alongside of said open area which has a foraminous top cover,

and in which said chamber conduit opens into the upper faces of both said layers of body supports in under said wall means which is flexible to supply forced air directly in under said foraminous top cover and also directly into said layers under marginal impervious top cover parts.

7. A forced-air under-body ventilating flexible pad device for use on cushioned automobile seats, comprising at least one layer of body supports interconnected and spaced apart for forced air flow therebeteween with substantially impervious enclosing means including a thin flexible top cover having an open area to supply forced air under a person and an impervious marginal part

and means to supply forced air into said layer including

a thin flexible impervious sheet over said layer and connected as an extension of said impervious marginal part of said top cover to define a wall of an air supply passage

opening in from an edge of said pad, said air supply passage being also defined by said layer of said pad and its enclosing means to form a generally tubular air intake portion adjacent the pad edge.

8. The pad device of claim 7, in which

said layer is part of a generally rectangular seat pad with said air supply passage located at its rear edge and side corner

and having its air entry end opening in from the same side of said seat pad.

9. A forced-air under-body ventilating device for cushioned vehicle seats comprising

a flexible generally rectangular seat pad and a flexible generally rectangular back pad having means connecting them end to end,

each said flexible pad being of a width to support a plurality of people and comprising a layer of bendably-connected and spaced-apart body supports for forced air flow therebetween along said layer and out under a supported human body,

each pad including a plurality of side by side but laterally spaced-apart discharge areas and at least an under enclosing means and each being shaped to supply forced air under only one person's bottom and back, a flexible foraminous cover over each said one-person area and flexible substantially air-impervious top cover portions along the sides of said open areas to substantially separate them laterally,

means forming a common forced-air-suppling and distributing chamber and conduit which is generally triangular in its upright cross section and extends across the width of said spaced-apart one-person open areas and across said connecting means,

the bottom and rear walls of said chamber being formed by adjacent and connected areas of said seat pad and said back pad respectively and their under enclosing means,

the sloped upper wall of said chamber being a thin flexible and at least partially air-enclosing sheet operatively connected to the said flexible top covers of said seat pad and said back pad at and along a boundary of each said one-person open area of each said pad for direct forced air discharge into each said pad and to and under each said impervious top cover portion between said open areas to supply forced air into the layer under said impervious portions,

said chamber closure means including a generally triangular portion including a tubular flexible entry means for supply of forced air, said triangular portion being connected between said bottom and rear walls and sloped wall adjacent the side of said pads.

10. In a forced-air under-body ventilating pad device for use on cushioned seats,

a flexible pad comprising hinged-together and foldable seat and back portions each having

means to supply forced air thereto

and a layer of interconnected body supports spaced apart for forced air flow therebetween

with enclosing means impervious except for a foraminous flexible top cover opening over at least one area to supply forced air under only one person,

said open foraminous area for only one person being of generally hour glass shape, necked inwardly at the hinge to reduce air escape area in this region not normally directly engaging a supported person, with the hour glass shape extending generally from the front of the seat portion to the top of the back portion.

11. A forced-air under-body ventilating flexible pad device for non-tied down use on cushioned automobile seats or the like, comprising

a sheet of thin substantially-uniform-thickness plastic of limited springy stiffness to normally hold itself generally flat,

said sheet having upright supports extending out from at least one face over an area shaped to support at least one human body and spaced apart for relatively unimpeded forced air flow therebetween and to a supported body by flat connecting sheet portions which are relatively flexibly bendable down into a cushioned surface under a supported body,

said plastic sheet having integral flat springy support-free margins wider than said supports about said area of supports and about its free edges,

a metal marginal stiffening means operatively connected to said margins and located on one face of the edge of said margins adjacent said area of supports,

enclosing means including covers which are impervious except for a thin flexible pervious top cover open over an area to supply forced air under a supported body

and conduit means connected to said covers to supply forced air into a face of said sheet and between its supports and also along said flat margins outside of said stiffening means and then in between said supports.

12. The pad device of claim 11, in which

said flexible pervious top cover extends out to and is secured at the edges of said plastic sheet outside of said marginal stiffening means

and said enclosing means includes a thin flexible air impervious top cover overlies and is secured to marginal areas along the sides of said pervious top cover and also secured at the edges of said plastic sheet outside of said marginal stiffening means.

13. In a forced-air under-body ventilating device having a flexible seat pad over a cushioned seat and a flexible back pad over the cushioned back of such a seat, with said pads being generally rectangular and connected end to end, and with each having means to enclose forced air at least under a layer of bendably-connected and spaced-apart body supports for forced air flow therebetween along said layer and out under a supported human body through an open top area, in combination,

means forming a generally tetrahedron-shaped common forced-air-supplying and distributing chamber,

of which the bottom and rear walls, as the first and second of its four walls, are formed by connected generally triangular areas at the side and connected ends of said under-enclosed seat and back pads, respectively,

said chamber means having a generally triangular

member operatively connected to the upper faces of said seat pad and said back pad, respectively, to provide the sloped upper and third wall of said chamber and to direct forced air separately into each of said pads,

said chamber means also having a generally triangular fourth wall closure connected to each of the other three said walls and including a tubular common entry portion for forced air.

14. The device of claim 13, in which

said third wall and said fourth wall, including its entry portion, are each

flexible to fold between said flexible pad portions and

substantially imperforate to enclose the forced air,

said tubular entry portion has a cross-sectional area materially less than that of said fourth wall, with said chamber providing a plenum volume from which forced air is speeded up into said layers of each of said pads by the convergence of said third wall into said bottom and rear walls and

said third wall is connected to each of said first and second walls along material lengths of the boundaries of said open top areas of said pads and at least helps define said boundaries.

15. A flexible forced-air under-body ventilating pad device for use on cushioned surfaces, comprising

a sheet of thin plastic of limited springy stiffness to normally hold itself generally flat,

with integral upright hollow projections extending up from only its upper face over an area to support at least one human body and materially spaced apart for forced air flow therebetween by sheet portions which are relatively flexibly bendable under a supported body down into a cushion,

said sheet being substantially imperforate over at least said area to provide enclosing means to prevent undesired downward escape of the forced air and eliminate the need for an under cover for this purpose,

additional enclosing means including a flexible foraminous top cover portion over said area for forced air supply to a supported body

and means to supply forced air, including a passage means connected to the spaces between said projections.

16. The pad device of claim 15, including seat and back portions for use on an automobile seat and in which

said sheet of plastic is one piece common to said seat and back portions and forms an integral hinge means therebetween and

said passage means is located over said hinge means and is connected to supply forced air directly to each of said seat and back portions.

17. A forced-air under-body ventilating device including

a flexible seat pad and a flexible back pad,

said pads being generally rectangular and having means to swingably connect them end to end,

each said flexible pad comprising a layer of bendably-connected and spaced-apart body supports for forced air flow therebetween along said layer and out under a supported human body, each layer having at least an under enclosing means and an open top discharge area,

and means forming a common forced-air-supplying and distributing chamber generally triangular in its upright cross-sectional area and extending across at least a material part of the width of said pads at their said connecting means,

the bottom and rear walls of said chamber being seat pad and said back pad, respectively, and with their said under enclosing means,

formed by adjacent and connected areas of said

the sloped upper wall of said chamber being flexible and operatively connected to the upper faces of said seat pad and said back pad to direct forced air separately into each of said pads along a material length across each said pad, and

said chamber having a closure adjacent the side of said pads and connected between said bottom wall, said rear wall and said sloped upper wall, said closure including a tubular entry means for forced air.

18. The device of claim 17, in which

each said pad includes marginal stiffening means and said pads together form a free-type pad unit for use on cushioned automobile seats,

said chamber is at one side of said pads and extends only part way across their widths,

said closure and at least the adjacent portion of its tubular entry means are flexible,

each said pad has a flexible top cover including a foraminous area and a substantially air impervious area to one side thereof and

said sloped upper wall is tensioned between said seat and back pads to hold said chamber operatively open for air flow and has at least substantially air impervious portions connected to and as extensions of said air impervious area at one side of the top cover of each said pad to provide forced air flow into said layers under said impervious top cover areas and also is connected to and along material lengths of the boundaries of said foraminous areas of the top cover of each said pad.

19. A forced-air, under-body ventilating, flexible pad device for use on cushioned surfaces, comprising

a layer of spaced-apart supports providing for forced air flow therebetween,

enclosing means including flexible and substantially imperforate covers and an open-for-air-flow top face area to support at least one person,

a forced-air confining and directing margin extending about, and opening into, at least a material part of said open-for-air-flow area,

held open for forced air flow by peripheral edge portions of said layer of supports,

and enclosed by said flexible covers,

and a forced-air-supplying and flexible conduit means connected to and extending along an appreciable length of said forced-air-flow-directing means.

20. A flexible forced-air under-body ventilating pad device for use on cushioned seats, comprising

hingedly-connected seat and back pad portions each having

flexible covers with an upper open-for-forced-air-flow area, and

a layer of supports spaced apart for forced air flow therebetween, located in said covers, and

a flexible forced air supplying conduit portion which is

common to and has portions connected to said seat pad portion and said back pad portion by flexible sheets which are extensions of said flexible covers,

said portions lying over and within the outline of said pad device and across its hinge.

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