Feb. 3, 1959 J. D. CHATHAM ET AL 2,871,849

BODY CONSTRAINING SUIT FOR AVIATORS

Filed Aug. 19, 1952 3 Sheets-Sheet 1

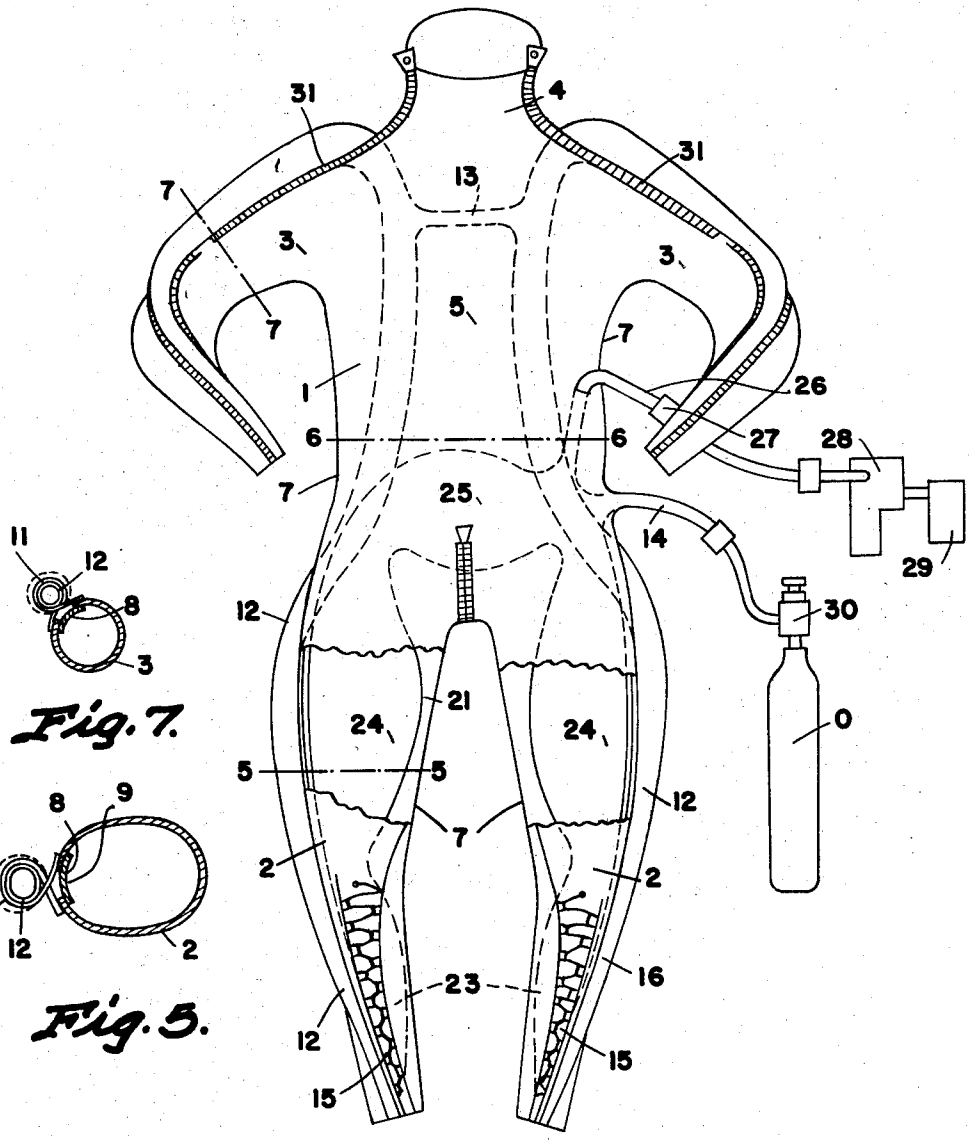


Fig. 1.

Fig. 7.

Fig. 5.

INVENTORS
JOSHUA D. CHATHAM
DAVID M. CLARK
BY Owen W. Kennedy
ATTORNEY

Feb. 3, 1959 J. D. CHATHAM ET AL 2,871,849

BODY CONSTRAINING SUIT FOR AVIATORS

Filed Aug. 19, 1952 3 Sheets-Sheet 2



Fig. 8.

Fig. 2.

INVENTORS
JOSHUA D. CHATHAM
DAVID M. CLARK
BY Owen M. Kennedy
ATTORNEY

Feb. 3, 1959 J. D. CHATHAM ET AL 2,871,849

BODY CONSTRAINING SUIT FOR AVIATORS

Filed Aug. 19, 1952 3 Sheets-Sheet 3

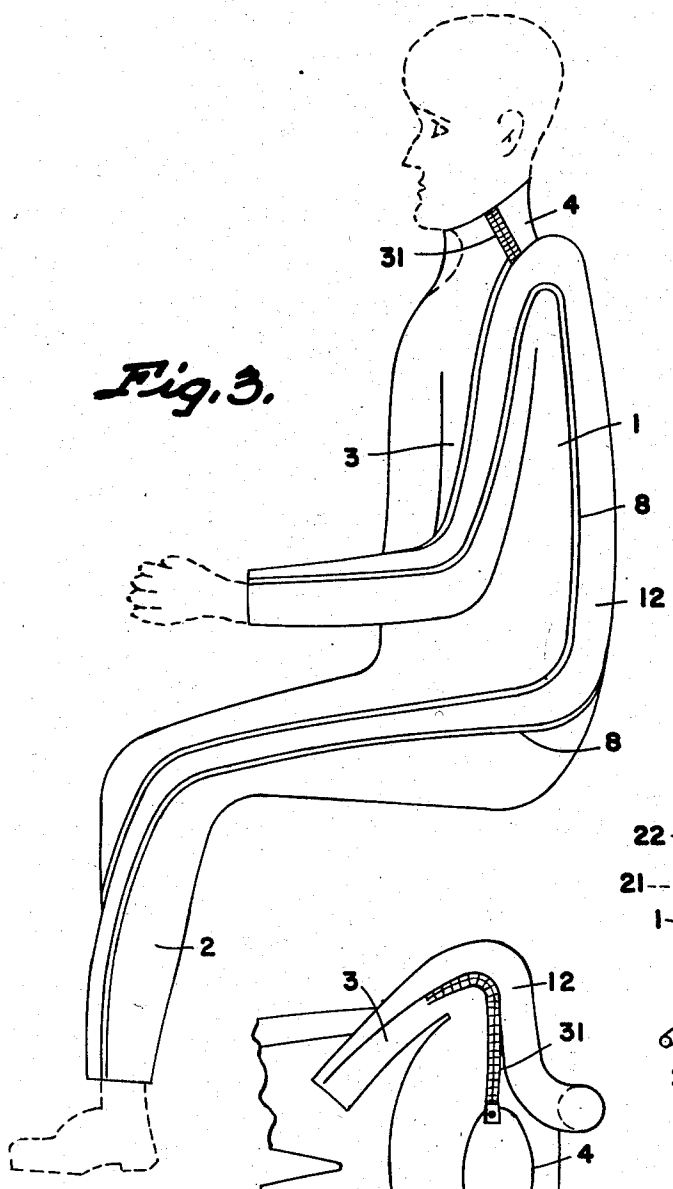


Fig. 3.

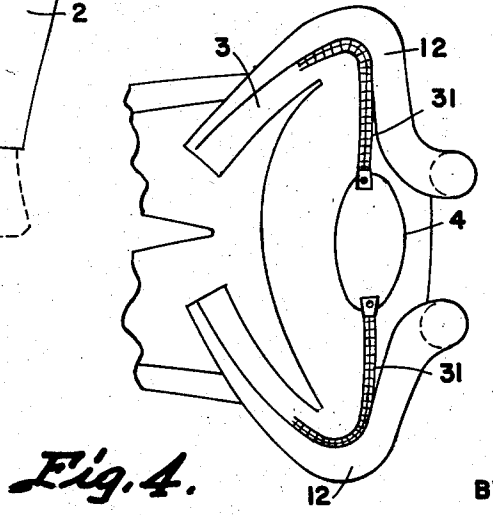


Fig. 4.

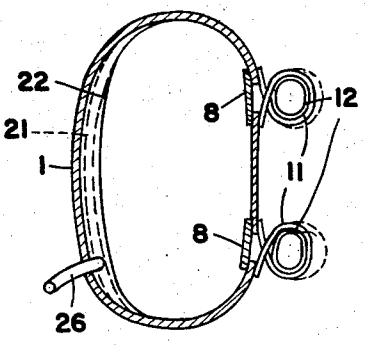


Fig. 6.

INVENTORS
JOSHUA D. CHATHAM
DAVID M. CLARK
BY Oscar W. Kennedy
ATTORNEY

United States Patent Office

2,871,849

Patented Feb. 3, 1959

2,871,849

BODY CONSTRAINING SUIT FOR AVIATORS

Joshua D. Chatham, Dayton, Ohio, and David M. Clark, Worcester, Mass.; said Chatham assignor to said Clark

Application August 19, 1952, Serial No. 305,148

5 Claims. (Cl. 128—1)

The present invention relates to garments worn by aviators engaged in high altitude flying and has for its obect to provide an improved suit that is adapted to contain and restrain against expansion all the portions of an aviator's body from ankles and wrists to a point just below the ears.

The need for such a suit arises from the fact that at progressively higher altitudes, the various body fluids vaporize or boil at temperatures approaching that of the human body, so that should the means for pressurizing the cabin of a high altitude aircraft fail, due to accident or enemy action, the body of an aviator might be very near to or possibly above the vaporization or boiling point of its various fluids at the particular altitude at which the aircraft is traveling. Under such conditions, in the absence of any restraining force, the body of an aviator would tend to expand and swell to such an extent as to result in damage to body tissues, with possible loss of consciousness.

The object of the present invention is to provide an aviator's suit so designed as to fit snugly around the entire body of the wearer when seated in an aircraft. Furthermore, the suit is so constructed that the material thereof is adapted to be tightly drawn into close engagement with all portions of the body in response to the inflation of tubes extending along the arms and legs and across the body, which tubes, when pressurized, conform to the shape of the wearer's body in a sitting position. The improved suit also incorporates inflatable bladders, which are positioned at pressure points of the circulatory system of the wearer in order to prevent the aviator from blacking out when multiple gravity forces obtain as during maneuvers at high speeds, which bladders are always held in proper position by the snug fit of the suit itself.

The above and other advantageous features of the invention will hereinafter more fully appear from the following description, considered in connection with the accompanying drawings, in which,

Fig. 1 is a view in front elevation of a complete suit embodying the present invention.

Fig. 2 is a view in rear elevation of the suit shown in Fig. 1.

Fig. 3 is a side view of the suit shown in Fig. 1 with parts of the wearer's body in dotted outline.

Fig. 4 is a fragmentary plan view of the suit shown in Fig. 1.

Fig. 5 is a transverse sectional view along the line 5—5 of Fig. 1.

Fig. 6 is a sectional view along the line 6—6 of Fig. 1.

Fig. 7 is a sectional view along the line 7—7 of Fig. 1.

Fig. 8 is a fragmentary view showing a portion of an inflating tube on an enlarged scale, with the tube cover removed.

Referring first to Figs. 1 and 2, there the invention is shown for purposes of illustration as being embodied in a complete aviator's suit, which includes a body 1, legs 2, arms 3, and a neck portion 4. The wearer's protruding or exposed body portions are shown in dotted outline in Fig. 3, from which it will be apparent that the suit completely encloses the wearer's body from ankles and wrists to just below the ears. It will also be apparent from a consideration of Fig. 3 that the legs 2 are made so as to have a bend at the knees, with the result that the legs conform closely to wearer's body when the latter is seated in normal position to operate an aircraft.

As best shown in Figs. 1 and 2, the suit is composed of a front portion 5 and a rear portion 6, which front and rear portions are made from pieces of fabric extending lengthwise of the suit and cut to such shape that, generally speaking, a complete suit will be formed when the front and rear portions 5 and 6 are secured together. In other words, the body 1, legs 2, arms 3 and neck 4 of the suit are created by bringing the front and rear portions 5 and 6 together and connecting them by seams 7, which extend around the outlines of the various portions and, for the most part, run lenghtwise of the body and limbs of the wearer. As a result the suit is characterized by the absence of any seams extending around the torso, legs or arms, it being particularly noted that the sleeves 3 are created without the use of any conventional armhole seams.

As a result of the above described manner of fabricating the suit from portions that are connected only by seams extending lengthwise of the wearer's body members, it is possible to conform all portions of the suit to the contours of the wearer's body. Furthermore, as previously pointed out, the suit provides means for pulling the material thereof tightly around the engaged body members of the wearer, so as to completely contain the body and restrain it from expansion.

For the above described purpose, the suit provides a pair of pleats 8 in the form of continuous strips 9, extending along the outside of each leg 2, then rearwardly in spaced relation across the back of the body 1, then over the shoulders just below neck 4 and downwardly to the lower extremities of the arms 3. It is to be noted that the strips 9, constituting the pleats 8 progressively increase in width from the extremities of the legs 2 and 3 to where the pleats pass along the body 1 and over the shoulders. The sides of the pleats 8 are reinforced by stitching 10 which serves to also secure in position a series of tapes 11 in the form of loops extending crosswise of the pleats. Each series of pleat loops encircle a pressure tube 12, which extends along the entire length of a pleat and is connected at intervals to the tapes 11 by stitching. Each tube 12 begins at a point just above the angle on a leg 2 and extends upwardly across the back of the body 1 and then over the shoulder and down along an arm 3 to a point above the wrist. Each tube 12 is of varying cross section throughout its length, with the tube being smallest at the ends of the arm and leg and gradually increasing in size until the largest cross section is reached where the tube passes along the back.

It will be apparent from a consideration of Fig. 1 that the tubes 12 are identical in form and are symmetrically arranged with respect to the central axis of the body of the wearer. The tubes 12 are connected together by a short cross tube 13 near the shoulders and one tube 12 provides a hose 14 with a suitable coupling whereby it may be connected to a source of air pressure. Therefore, upon the admission of air under pressure through hose 14, both tubes 12 will be expanded simultaneously, whereupon the pleats 8 will be drawn together along their edges by the combined pulls of the large number of tapes 11, looped around the tubes 12.

The action of pulling the edges of a pleat together is best shown in Fig. 5, which shows in full lines the tube 12 in its unexpanded condition. The tapes 11 are then

relatively loose and the pleat 8 is open to substantially its full width. This represents the condition which exists when the suit is put on and adjusted to the body of the wearer in a manner later to be described. At that time the tubes 12 are not connected to the pressure source so that the body, legs and arms of the suit make only a snug fit without exerting a restraining action.

However, upon the admission of air under pressure to the tubes 12, each tube will be expanded into relatively round form, as indicated by dotted lines in Fig. 5. When this occurs, the loops of tape 11 extending around each tube 12 will conform to the contour of the tube so that the ends of each loop will exert a pull at the point where it is connected to the edge of a pleat 8. Since the pulls at the ends of a given loop are exerted in opposite directions, the net result of inflating each tube 12 is to draw the edges of each pleat 8 together, thereby pulling the material of the suit into close engagement with the body of the wearer from both sides, as shown in Fig. 6, as well as the wearer's legs and arms, as shown in Figs. 5 and 7. Thus a restraining force will be applied over the entire body of the wearer, with the degree of this force depending upon the pressure within the tubes 12. This restraining force will effectively prevent the wearer's body from expanding should the body be exposed to surrounding air pressure less than the normal atmospheric pressure to which the body is accustomed.

As previously pointed out, the suit provides means for adjusting the same so as to properly fit the body of the wearer before the tubes 12 are inflated. For this purpose the suit provides a pleat 15 extending along the inner side of the pleat 8 of each lower leg portion. The edges of each pleat 15 are adapted to be drawn together by a lacing 16, so that when the garment is put on, the wearer may adjust each lacing 16 so as to conform the garment to each lower leg portion. Furthermore, each upper leg portion provides a pleat 17 on the opposite side of the pleat 8, which pleat extends upwardly into the back of the garment. A lacing 18 is provided by each pleat 17 so that the thigh portions and back of garment can be fitted from each side to meet the proportions of the wearer. Lastly, each arm 3 provides a pleat 19 extending along the top of the arm and over the shoulder so that a portion of this pleat is parallel to pleat 17. A lacing 20 is provided by each pleat 19 so that the suit can be readily fitted to the arms and shoulders of the wearer.

The pleats 15, 17 and 19, with their lacings 16, 18 and 20 respectively, permit the wearer of the suit to make the necessary adjustments, after putting it on so as to insure that all portions of the suit properly fit different portions of the body without any looseness in the material. Generally speaking, when the adjustments have been made, the two main pleats 8 that are associated with the tubes 12 lie substantially flat against the wearer's body, since at that time the loops of tape 11 are free to spread apart at their ends, as indicated in full lines in Fig. 5. Therefore, when the admission of pressure medium to the tubes 12 causes them to expand, the resulting enlargement of the loops takes place simultaneously along the entire length of both pleats 8 so that all portions of the previously fitted suit are drawn tightly around the enclosed limb or body portion of wearer, so as to exert a definite restraining pressure all over the body, which pressure will prevent the body expanding should it be subjected to extremely low atmospheric pressures encountered at high altitudes.

As previously pointed out, the suit also incorporates inflatable bladders which are positioned at critical points of the circulatory system of the wearer in order to prevent the aviator from blacking out, due to the abnormal forces to which his body is subjected as a result of rapid and extreme changes in the aircraft's speed and direction of flight. As indicated in the broken away portions of

Fig. 1, the suit is provided with a unitary bladder 21 contained within suitable pockets 22 provided by the legs 2 and at the front of the abdominal area of the body 1.

For purposes of illustration, the bladder 21 is shown as being of the type disclosed in Patent No. 2,475,479, issued July 5, 1949, to David M. Clark, one of the inventors herein, Earl H. Wood and Henry A. Schroeder. The bladder 21 provides enlarged portions 23 and 24 extending downwardly on either side of a central portion 25 and inflation of the bladder will result in the application of pressure to the calves of the legs by the portions 23, to the thighs by the portions 24 and over the abdominal area by the portion 25, all as set forth in the aforesaid patent.

By reason of the fact that the bladder 21 is positioned in pockets 22 provided by the suit, it follows that the expansion of the tubes 12 in the manner previously described will result in the application of the bladder portions 23, 24 and 25 to the associated body parts in a most effective manner. In other words, whenever conditions require inflation of the tubes 12, the simultaneous inflation of the bladder 21 will result in the application of localized pressure to those portions of the circulatory system of the body, which are most vital in preventing blackout.

For the purpose of inflating the bladder 21, a tube 26 leads therefrom, which tube is connected by a suitable coupling 27 to a control valve 28, which is adapted to regulate the amount of pressure admitted to the bladder in proportion to the centrifugal or other abnormal forces to which wearer of the suit is subjected, as a result of changes in speed and direction of flight of the aircraft. The particular construction of the control valve 28 forms no part of the present invention and it is sufficient for an understanding of the functions of the bladder 21 to state that the valve 28 operates automatically to control the admission of air under pressure from a pressure source 29 in response to the acceleration forces.

The hose, through which pressure medium is admitted to the tubes 12, is adapted to be connected to the usual oxygen supply for the aviator in any suitable manner, as by means of the valve 30. Under normal conditions of flight when the cabin is pressurized to maintain a condition comparable to normal atmospheric pressure, the tubes 12 are not inflated and the wearer of the suit would not be subjected to any appreciable body constraining effect. However, should the pressure in the cabin in the aircraft fall to a point appreciably below normal atmospheric pressure or should the aviator be forced to bail out, the valve 30 will automatically function to connect the tubes 12 to the oxygen supply O to cause inflation of the tubes to a degree sufficient to tighten the entire suit around the body of the wearer and thereby restrain the body against expansion and swelling.

In order to facilitate putting on the suit, it is provided on either side with slide fasteners 31, extending downwardly from the top of the suit at opposite points of the neck 4. Each fastener continues across the top of the shoulder and upper arm to a point approximately midway between the shoulder and elbow. Therefore, when both fasteners 31 are opened it is an easy matter for any one to don the suit, since the upper portion thereof is entirely open almost down to the waist, due to the fact that the sleeves 3 do not provide any armhole seams as in a conventional suit construction. Each leg 2 also provides a slide fastener 32 which when open permits ready passage of the feet through the legs.

The ease with which the suit may be opened at both top and bottom through operation of the fasteners 31 and 32 make it possible for the suit to be donned very quickly. This is a very important feature of the suit from a practical standpoint, since under combat conditions every second saved in getting a pilot aloft is of vital importance. Assuming that the aviator has previously

made the necessary adjustments of the pleats 15, 17 and 19 so as to initially conform the suit to his body, no further adjustment will be necessary after putting on the suit and closing the fasteners 31 and 32. While the suit will fit snugly, the wearer will not be conscious of any body constraining effect until the tubes 12 are inflated under the conditions described above.

From the foregoing it is apparent that by the present invention there is provided an improved body constraining suit to be worn by aviators engaged in high altitude flying, which suit is characterized by its ability to constrain and restrain against expansion or swelling all the surfaces of an aviator's body from the ankles to the wrists to just below the ears. Furthermore, the suit of the present invention is so constructed that the application of the constraining force is graduated in proportion to the size of different parts of the body, due to the fact that each pressure applying tube is of gradually increasing diameter from the extremities of the corresponding arm or leg toward the thigh and shoulder, with the tube having its greatest diameter across the back when the body is thickest. As a result of this graduated pressure effect in proportion to the size of the different body members, the wearer of the suit is not conscious of the application of the restraining effect at any given point, but is only aware of a substantially uniform effect evenly distributed over the entire body.

We claim:

1. A body constraining garment for aviators comprising separate sections of flexible material joined together along their edges to form a complete suit adapted to enclose and conform to the contours of the body, legs and arms of a wearer, with one of said sections being in the form of a pleat extending continuously along one side of the garment from a point just above the ankle enclosing portion, along the outside of the thigh, along the back and over the shoulder to a point adjacent to the wrist of the arm enclosing portion, an inflatable element extending the entire length of said pleat, means for holding said element in position by attaching members secured to the edges of said pleat, whereby inflation of said element will draw the edges of the pleat together to cause the remaining material of the suit to be held in close engagement with the enclosed body portions of the wearer to constrain such portions against expansion.

2. A body constraining garment for aviators comprising separate sections of flexible material joined together along their edges to form a complete suit adapted to enclose and conform to the contours of the body, legs and arms of a wearer, with one of said sections being in the form of a pleat extending continuously along one side of the garment from a point just above the ankle enclosing portion, along the outside of the thigh, along the back and over the shoulder to a point adjacent to the wrist of the arm enclosing portion, an inflatable tube extending along the entire length of said pleat, a series of loops encircling said tube and having their ends attached to the edges of said pleat whereby inflation of said tube will draw the edges of the pleat together to cause the remaining material of said suit to be held in close engagement with the enclosed body portions of the wearer to constrain such portions against expansion.

3. A body constraining garment for aviators comprising separate sections of flexible material joined together along their edges to form a complete suit adapted to enclose and conform to the contours of the body, legs and arms of a wearer, with one of said sections being in the form of a pleat extending continuously along one side of the garment from a point just above the ankle enclosing portion, along the outside of the thigh, along the back and over the shoulder to a point adjacent to the wrist of the arm enclosing portion, an inflatable tube extending along said pleat on each side of the garment, said tube being of varying cross section which is greatest in the vicinity of the body portion of the wearer with the cross section decreasing where said tube extends along the arms and legs, whereby inflation of said tube will draw the edges of the pleat together to cause the remaining material of the suit to be held in close engagement with the enclosed body portions of the wearer with a force varying in proportion to the size of the body portion along which the tube extends.

4. A body constraining garment for aviators, comprising a casing composed of flexible, nonstretchable material in a form of a complete suit adapted to enclose and snugly fit the body, legs and arms of a wearer, a pleat extending continuously on each side of said casing beginning at a point just above the ankle enclosing portion of the thigh along the back and over the shoulder and then downwardly along the arm to a point adjacent to the wrist of the arm enclosing portion of the casing, each pleat progressively increasing in width from the extremities of the legs and arms to where the pleat passes along the body and over the shoulders, a series of tapes in the form of loops extending crosswise of the pleats and an inflatable element extending the entire length of a pleat within said loops which loosely engage said element, and means for inflating said element to expand the same whereby the edges of a pleat will be drawn together by the combined pulls of said tapes.

5. A body constraining garment for aviators, comprising a casing composed of flexible, nonstretchable material in the form of a complete suit adapted to enclose and snugly fit the body, legs and arms of a wearer, a pleat extending continuously on each side of said casing beginning at a point just above the ankle enclosing portion of the thigh along the back and over the shoulder and then downwardly along the arm to a point adjacent to the wrist of tht arm enclosing portion of the casing, each pleat progressively increasing in width from the extremities of the legs and arms to where the pleat passes along the body and over the shoulders, a series of tapes having their ends connected to the sides of said pleat in the form of loops extending crosswise thereof, an inflatable tube received freely within said loops the entire length of a pleat and connected to the tapes at intervals, said pleat being open to substantially its full width when said tube is uninflated, and means for inflating said tube whereby said loops are adapted to exert a pull in opposite directions to reduce the width of the pleat and draw the remaining material of the casing into close engagement with the enclosed body portions of the wearer.

References Cited in the file of this patent

UNITED STATES PATENTS

2,104,758	Poppen	Jan. 11, 1938
2,109,172	Green et al.	Feb. 22, 1938
2,139,865	Stephenson	Dec. 13, 1938
2,335,474	Beall	Nov. 30, 1943
2,397,710	Versoy et al.	Apr. 2, 1946
2,475,479	Clark et al.	July 5, 1949

FOREIGN PATENTS

418,683	France	Oct. 6, 1910