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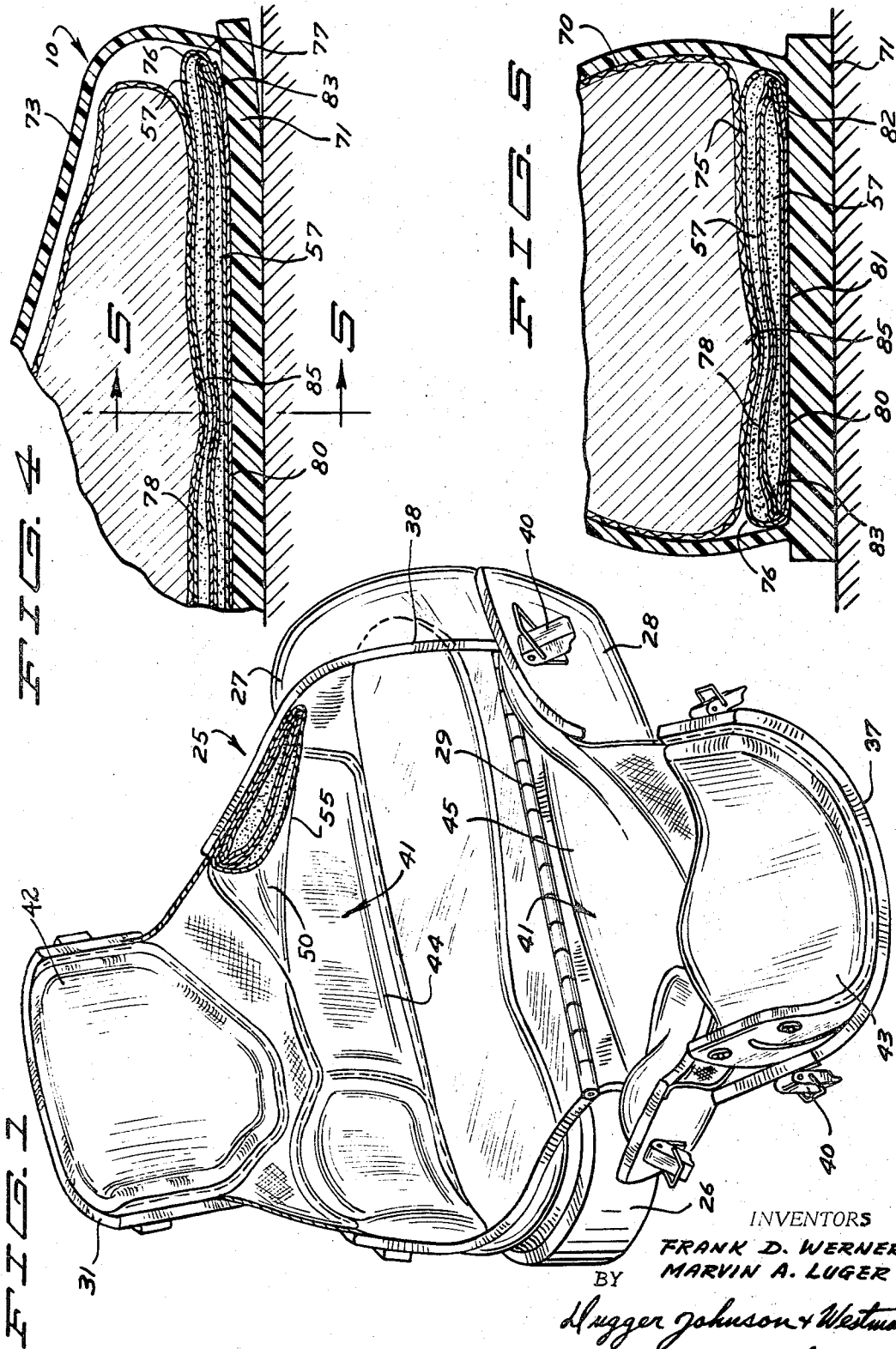
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3,407,406

CONFORMABLE PAD AND MATERIAL FOR USE THEREIN

Filed June 14, 1965

3 Sheets-Sheet 1



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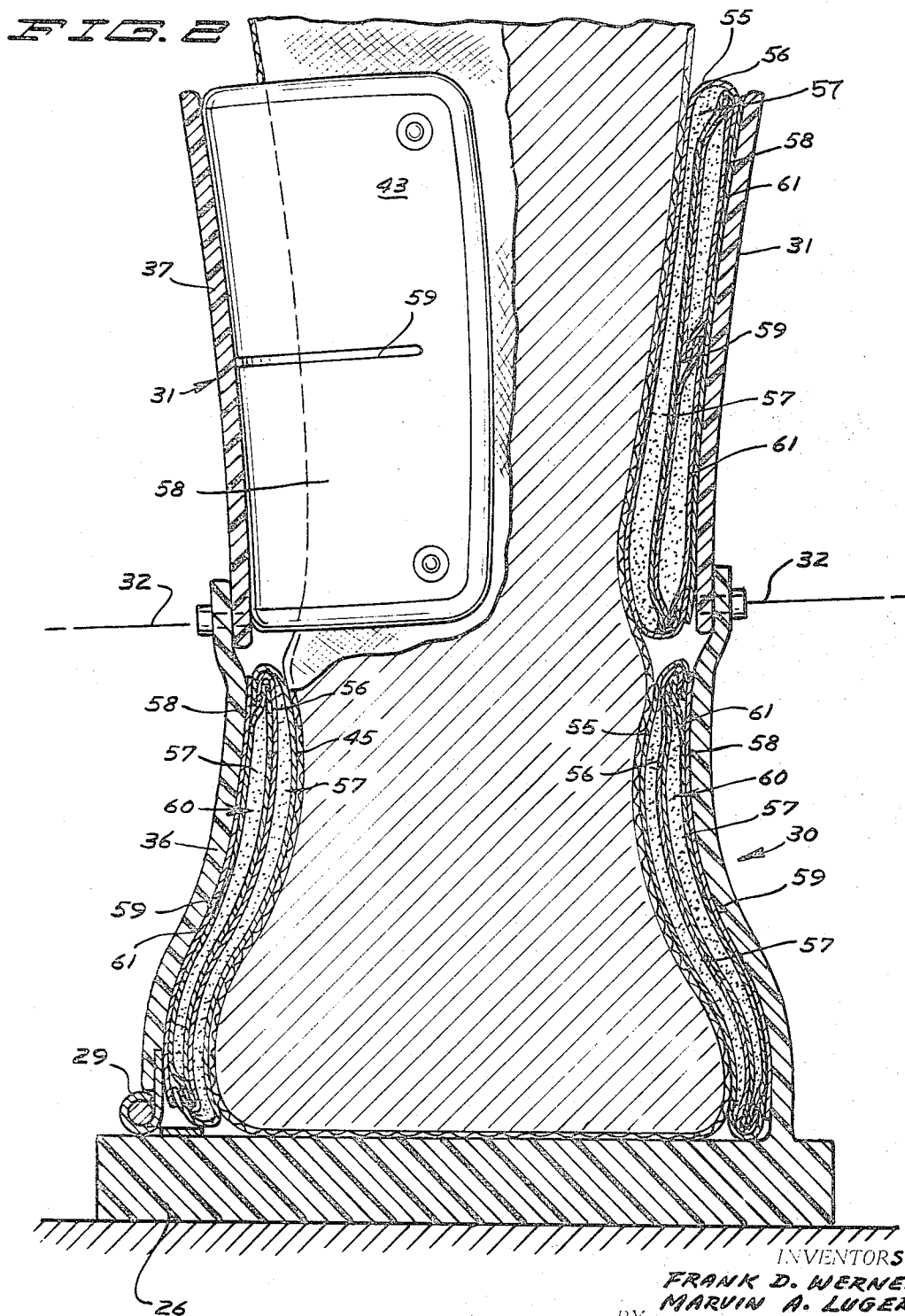
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3 Sheets-Sheet 2



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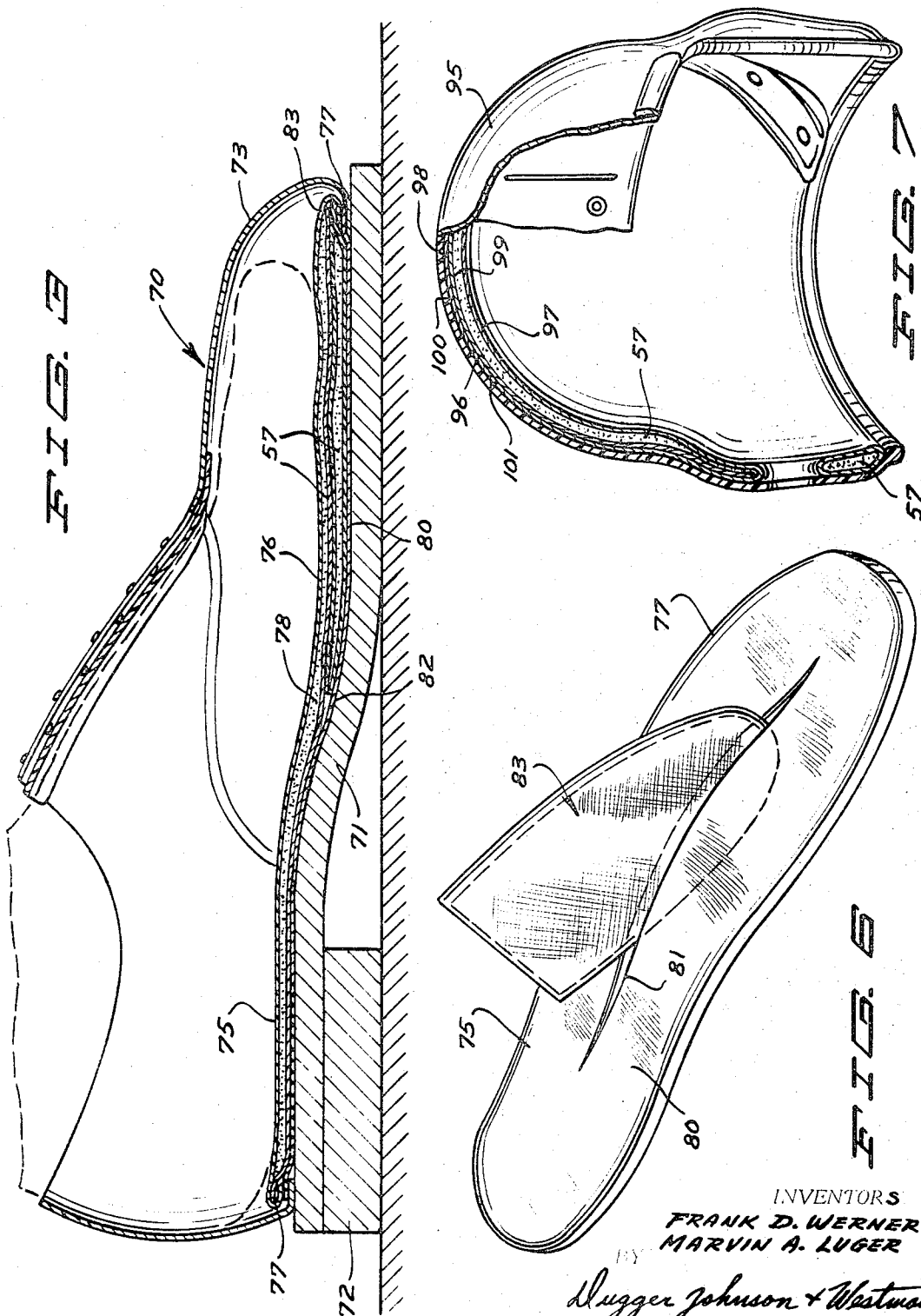
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CONFORMABLE PAD AND MATERIAL FOR USE THEREIN

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3 Sheets-Sheet 3



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3,407,406 CONFORMABLE PAD AND MATERIAL FOR USE THEREIN

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Continuation-in-part of applications Ser. No. 318,370, Oct. 23, 1963, and Ser. No. 362,723, Apr. 27, 1964. This application June 14, 1965, Ser. No. 463,757
23 Claims. (Cl. 2—3)

ABSTRACT OF THE DISCLOSURE

A pad capable of conforming to portions of the human body comprising an envelope made up of a flexible material and having a filling consisting essentially of microspheres or small spherical particles and a minimal amount of a special coating material which forms a film over the surfaces of each of the particles. The pad finds use in cushioning the head, feet, and other irregular portions of the human body and the material as disclosed will conform to these irregular portions and retain its shape indefinitely until it is disturbed by external forces.

The present invention is a continuation-in-part of our co-pending application, Ser. No. 318,370, filed Oct. 23, 1963, for Ski Boot and Conformable Pad for Same, now abandoned, and of our co-pending application Ser. No. 362,723, filed Apr. 27, 1964, on Ski Boot which issued as U.S. Patent No. 3,325,920 on June 20, 1967.

The present invention relates to pads and more particularly to pads which will conform to irregular shapes and will retain this irregular shape when the object has been removed from the pad, thereby making the pads suitable for use for holding feet in ski boots; treating orthopedic difficulties; and also for retaining or supporting any object of irregular or different shapes and sizes, particularly in connection with the human body.

The need has long been recognized for a pad which will conform to an irregular shape, particularly in the area of the foot, and which will retain the configuration to which it is shaped after the foot has been removed. The feet of each individual have peculiarities which make mass production of items that fit the foot exactly impractical.

This has been recognized in the manufacture of ski boots in particular. It is desirable, of course, to have a ski boot fit onto the foot as snugly as possible and therefore the interior of the boot should match exactly the configuration of the foot that is in the boot. Also, the requirement for close fitting shoe pads has long been recognized because of the trouble which people who are on their feet a good deal have, such as calluses, bunions and similar disorders.

The pads of the present invention, and the material within the pads, were first recognized as having facility for use in connection with ski boots having rigid or semi-rigid outer shells with the pads between the foot and the shell. The material in the pad conforms to the shape of the foot in the boot and thus the pads insure that the foot will be held very snugly and the foot cannot slide around inside the boot. Yet, the pads are comfortable inside the boot because the material inside the pad will flow, and will not cause points of high pressure and consequent soreness.

During the course of the experimentation with the material and the pads within the ski boots, it was found that these pads were extremely comfortable even after long

and continued use. This is true even though the boot would be quite snug on the foot. We believe the reason was that the material would fit into each cavity on the surface of the foot and around each protuberance of the foot so that the unit pressure against the foot caused by a given pad was reasonably uniform. This means that there were no high pressure areas which can cause discomfort.

The potential of such pads was immediately recognized and further experimentation was carried out in various usages. It was found that the pads, containing the material used in connection with the ski boot pads, were extremely effective in relieving soreness of foot disorders, such as bunions, calluses and other problems encountered by people who were on their feet a good deal.

A unique way of using these pads and obtaining the advantage of a conformable material and yet having the pads so that they could be adjusted to different sizes and shapes of feet is also advanced and is presented herein. It is particularly useful where a number of different people are going to use the same general type of pad, but each pad must individually conform to a different size and shape of foot.

Likewise, this ability to change the effective size of the pad is useful in a ski boot art, inasmuch as a rigid, hard outer shell ski boot is made considerably larger than the foot inside the boot. It has been found that by adding padding, the same outer shell configuration of boots can be used for four normal shoe size ranges. The different size feet are compensated by adding or removing padding.

The pads are comprised as one or two layers of conformable material with suitable containing layers. Two top sheets of material form a top envelope having a filler of the special conformable material. A relatively stiff back wall is also attached to the edges of the intermediate sheet of material to form a second compartment. The back wall is slit to permit inserting small "pillows" or envelopes which are also filled with conformable material. These pillows or envelopes are slipped into the space between the back wall and the intermediate layer to take up space as necessary. The material in the envelopes is a conformable material which will seek its own position and exactly conform to the shape of the foot inside the ski boot, or the foot which is utilizing a shoe pad made according to the present invention.

Another use is in hard shelled football helmets. Here, likewise, a large number of head sizes can be accommodated in one outer shell merely by adding to or taking from the padding inside the helmet. The special conformable material will conform exactly to the head and will distribute the force of blows received by the helmet over a large surface area of the head thereby keeping the unit pressure against the head low to provide a relatively safe football helmet.

Other uses could include the padding for an invalid's bed or other prosthetic appliance where the unit pressure on the skin of the invalid should be kept low in order to prevent bed sores and other problems. The conformable material of the present invention will do this inasmuch as it will conform closely to the form or configuration of the outer skin of the invalid. The protrusion of bones and joints is easily accommodated. The pads, of course, can be used in ice skates or other athletic boots, if desired, as well as the seats used for space travel.

The conformable pad material, as presented, is in the preferred embodiment made up of discrete particles, (hollow spheres sold under the trademark "Microballoons" and sold by Union Carbide Corporation, New York, N.Y., work very well) on which a very thin liquid coating is provided. Usually, the liquid is a lubricant such as oil or grease and the coating is as thin as possible.

The coating must substantially coat the surface of each one of the discrete particles.

As disclosed, spherical particles are used as the discrete particles. These Microballoon particles are very small, typically 25 to 125 microns diameter. When the special liquid coating has been added to the material, the small spheres will tend to stick together and will hold a given shape unless forceably disturbed. The force for such disturbance is very small but not zero. Thus, when subjected to small (but more-than-zero) pressures, the material will flow from the area of high pressure toward the area of low pressure. It will flow more readily if disturbed by shearing forces or a kneading or rubbing action such as may occur when used on a foot. When thus caused to flow, it flows slowly in the sense that a very high viscosity liquid flows slowly as compared to a low viscosity liquid. This means that the material will not "work" back and forth in the pads as the foot moves but will support the foot sturdily, and yet will "flow" sufficiently to conform exactly to the shape which is against the pad.

The Microballoons can be made of a phenolic resin which is common, and is commercially available, or can be of other plastic material or even made of glass. The hollow spheres make a lighter pad material and add insulation properties to the padding. This is especially important in ski boots so that the feet do not get cold.

Therefore, it is an object of the present invention to present conformable pads which will conform to the shape of the object they are adjacent and will thereby evenly distribute the pressures from the object across the entire mating surfaces thereof.

It is a further object of the present invention to present a material for use in conformable pads which has new properties of flowability under appreciable pressure variations particularly in the presence of shear, and retention of its shape unless further disturbed in this way.

It is a still further object of the present invention to present a new type of pad which has provision for insertion of additional pillows of padding so that the size of the padding can be changed as desired.

It is another object of the present invention to present a pad which is conformable to a shape of a foot and is helpful in obtaining comfort and also in treatment of foot disorders, such as bunions and calluses, particularly plantar (under-foot) calluses.

It is still a further object of the present invention to present a pad having a new material which will conform to irregular shapes and which is light in weight and has good insulation properties.

It is a still further object of the present invention to present a method of treating foot deformities using the pads and pad material of the present invention.

In the drawings:

FIG. 1 is a perspective view of a ski boot utilizing interior padding made according to the present invention and showing a side access flap in open position;

FIG. 2 is a vertical sectional view of the ski boot of FIG. 1 taken through the ankle portion on the boot with ankle padding shown partially in place on the wearer's leg;

FIG. 3 is a longitudinal sectional view of a shoe having an insole pad made according to the present invention installed therein;

FIG. 4 is a fragmentary enlarged sectional view of the toe portion of the oxford of FIG. 3;

FIG. 5 is a sectional view taken as on line 5—5 of FIG. 4;

FIG. 6 is a perspective view of the normal bottom side of the insole pad as shown in FIG. 3 and illustrating the way auxiliary pads are slipped into the insole pad; and

FIG. 7 is a front view of a football helmet utilizing a liner filled with pad material made according to the

present invention with parts in section and parts broken away.

Referring to the drawings and the numerals of reference thereon, the pads of the present invention are shown illustrated in a first form of the invention inside a ski boot that in turn is illustrated generally at 25. The boot 25 includes a sole member 26 and a main boot section 27 that is attached to the sole member. The boot portion 27 has a mating side flap member 28 which is attached to the sole with hinge 29.

The boot is divided into two portions, one the lower portion 30, which covers the lower part of the foot, and the other an ankle member portion 31. The ankle portion 31 is mounted to the opposite sides of the lower portion 30 about a pivotal axis 32. The ankle portion is mounted on suitable pins. The ankle portion will pivot about axis 32 and in directions fore and aft about this axis to permit pivotal movement of the lower leg of a wearer of the boot, with respect to the foot. The flap member 28 includes a flap lower section 36 and a flap ankle section 37. The flap member 28 separates from the main boot portion along a parting line 38.

It can thus be seen that the ankle portion 31 of the boot is made with two members 36 and 37, both of which separate when the flap member 28 is opened.

The flap will move from an open position as shown in FIG. 1 to a closed position wherein the boot forms an enclosure for the foot.

When the flap is closed, it can be held in its closed position with suitable clamps 40 that can be of the over-center or luggage clamp variety. If desired, these clamps can be made adjustable.

The boot is preferably made of a material which is substantially rigid, such as metal, fiberglass, reinforced plastic or other suitable plastic material. The boot material should not stretch when wet or soften when exposed to water. The utility of the conformable padding need not be limited to boots having a rigid or semi-rigid outer shell, however. In leather boots, it can still be expected to improve the distribution of pressure against the foot.

The interior of the boot is lined with suitable pads illustrated generally at 41. The pads, as shown, include a pair of ankle pads 42 and 43, one attached to the ankle member on the main boot portion and the other attached to the flap ankle section 37. If desired, the ankle pad can be made continuous so that it will encircle the ankle and be attached to only one of the ankle sections and not attached to the other section. In addition, there are side foot pads 44 and 45, one attached to the main portion of the boot and one attached to the flap of the boot. An instep pad 50 is also provided. Further, any additional pads can be used if desired, for example the insole of the boot can be padded.

The pads are each removably attached to the shell of the boot in a suitable manner, such as by the use of "Velcro" fasteners, snap fasteners or pressure sensitive adhesives. The basic idea is that the pads are constructed so that pillows of additional padding can be inserted into the main pad and held in place to accommodate different sizes of feet within one size of boot outer shell.

As shown, the pads in the boot each have an outer cover 55 which is shaped to the desired shape of the pad and which is attached at its outer marginal edges to an intermediate piece of cloth 56. These two parts, the outer cover 55 and the cloth piece 56 are fastened together at their marginal edges to form an envelope in which a suitable conformable filling material 57 is placed. This filling material will be more fully described later. A relatively thin layer of the filling material is utilized in the compartment formed by the outer cover 55 and the cloth 56. In addition, the outer cover 55 is attached adjacent its terminal edges to a suitable backing strip 58 through the use of adhesives, stitching, or any desired means.

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In normal construction, the outer cover 55, which is adjacent the foot of the wearer is made of a soft leather, such as kangaroo leather and the intermediate strip of cloth 56 is made of a nylon which can be coated with a suitable material to make it substantially non-breathing, if desired. The nylon, of course, is relatively thin material. The bottom or backing member 58 can be of a split suede leather which is relatively stiff and provides some body or stiffness to the back of the pad.

Each of the backing strips 58 has a suitable slit 59 provided thereon which provides access to a compartment 60 of the pad formed between the backing member 58 and the intermediate strip of cloth 56.

In order to accommodate the feet of the wearer, a pillow or auxiliary pad 61 which has an outer covering of any suitable material sewed along its marginal edges to form an envelope or enclosed pad is filled with the filling material 57 and can be inserted through the slit 59 into the chamber 60 formed in the individual pad. The pillow 61 will take up space inside the boot and, because they are filled with the special material 57 which will be subsequently described, will conform to the foot and serve to hold the foot and ankle snugly inside the outer shell of the ski boot 25. The material is confined in the respective pillows 61 and cannot flow or move out of the pillows.

It should be noted again that each of the pads inside the boot, regardless of its positioning, size or shape, is removably attached so that the pad can be lifted outwardly from its place of attachment and suitable pillows 61 (also called auxiliary insert pads) are inserted through the slip 58 of each of the pads to take up any space which is present between the boot shell and the foot. The clamps 40 will hold the flap closed and exert the necessary clamping effect on the foot through the pads.

The pads are filled with a special material 57 that is able to conform to the shape of the foot and the ankle, particularly in irregularities such as a bunion or bone, and retain this shape when the foot is removed from the ski boot so that the pads do not have to be custom fit each time the boot is put on. The material must be firm and provide a support in transient or short-time movement of the foot and at the same time, yield and as fully as possible, accommodate to the normal position and shape of the foot. The material must not take a permanent shape as the foot shape changes slightly from day to day and the material and pads must accommodate these changes.

In the ski boot art, as well as in orthopedic treatment, many different pad filling materials have been advanced, but none have appeared to be commercially acceptable. Some liquids have been used for filling pads but these will provide a shifting and rolling action for the foot and this is not desirable in skiing, in particular, because control of the skis is necessary at all times and the skis must immediately respond to movement of the foot and legs of the wearer. Liquids and air, which have been used as pad filling, will leak through very small pin holes in the pad covering. Therefore, the material filling the pads should be something that does not easily leak or bleed through the pads.

The material consisting of discrete particles, each surrounded by a thin layer of what we refer to as a "special liquid" material, which may be a lubricant and is waxy, greasy or oily, such as oil or grease, has the desired properties of firm support, conformability, retention of shape and no leakage. It has been found that a lubricating liquid, such as a grease or oil has been very satisfactory. For example, a material filling the pads which is illustrated at 57 and consists of a mixture of small discrete hollow spheres of material sold under the trademark Microballoons, surrounded by a lubricant which has a silicone base, is found to be suitable. The lubricant is either a grease or oil and is termed a liquid in this speci-

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fication (even though a grease is not strictly a liquid) for convenience of nomenclature. (Grease will flow and coat the particles and any material which will coat the particles uniformly when mixed thoroughly is considered a special liquid.) For purposes of this application the term "special liquid coating" means a grease, oil, soft or liquid wax, glycerine, soft soaps or other substantially non-hardening material which will yield under pressure variations, particularly in the presence of shear and will work as a coating on the discrete particles, at the temperatures encountered during use. The special liquid coating should also be substantially non-evaporating, non-toxic, non-allergenic and fairly odor free. This material is then enclosed within the outer covers as shown.

It has been found that a mixture of hollow Microballoon spheres of phenolic resin (spheres of other plastic or glass also work) which are microscopic bubbles varying in size from .0002 inch to .005 inch and having an average diameter of about .0017 inch mixed with a special liquid coating comprising a silicone base oil or grease in a ratio of 20 to 1 by weight (20 parts of the spheres to 1 part of the grease) has the desired characteristics. After mixing the particles have a very thin coating and each of the particles is substantially coated over its entire surface yet the amount of coating will not be so great that it will bleed out of the pads through the seams or covers and yet the material mixture will conform adequately to the irregular shapes of the foot.

When reference is made to the material "bleeding" out of the pads, it is meant that when leather or fabric is used for the pad covering, the pad will not become palpably stained at any time even after extended use. It is therefore inherent that the film on the particles is thin enough so it does not separate or become disassociated from the particles to cause this staining. This is another important limitation to the amount of special liquid coating used.

The specific gravity of the Microballoon spheres is low compared to the oil or grease, so the volume of the spheres is very large compared to the volume of the special liquid coating. The bulk density of phenolic Microballoon spheres is about 3-5 pounds per cubic foot.

A general spherical shape of discrete particle is very desirable because a sphere inherently has good strength properties and also the smooth surfaces permit the particles to slide by each other when conforming to the object supported. The spheres have the same resistance to flow in all directions (i.e. no sharp corners or elongated portions that will crush before they slide past each other). The spheres don't have to be hollow to obtain these benefits, but hollow spheres are lighter.

The preferred size of the particles range from about .0002 inch to about .025 inch, for maximum comfort. Particles in this general size range will be termed microspheres for purposes of this specification and also in the appended claims.

It was found that ordinary sand particles mixed with the coating also functioned satisfactorily, as well as other discrete particles ranging up to about 1/8 inch in major dimension. The larger the particles, the more harsh the feel on the foot and therefore more auxiliary padding which would be necessary between the foot and the particle itself. It is also important that the discrete particles used are somewhat rigid, or in other words have their own structural strength and will retain their shape under load.

Only a very thin coating of the special liquid on the particles is necessary. There is always a chance that the foot will change in shape or size somewhat due to swelling or other influences. At that time, the conformable pads as disclosed can be reshaped to fit the foot exactly so that discomfort will not result. Also each time a person steps, the foot changes in shape. The material 57 will accommodate these changes to give foot comfort at all times.

The particular ratio of the special liquid coating to the particles is, of course, dependent on the size of the particles and the amount of firmness desired in the pads. The particles must be coated with a sufficient amount of coating to cause the particles to tend to stick together so that the pad retains the shape of the foot after the foot has been removed. This cannot be done with liquid or air filled bags. The amount of the special liquid coating is preferably equal to or less than the void volume of the particles. If the volume of the special liquid exceeds the void volume (the volume of the interstitial spaces in a quantity of particles) of the particles, the pad will have substantially the flow properties of the special liquid coating and not the desired properties, and the containing leather or fabric bags would have to be able to contain the special liquid and not merely the discrete particles (or the bags would get palpable stains during use).

The small microspheres of material (.0002 to .025 inch in diameter) that are preferred resemble dust before the special liquid is added to the material. Therefore, in the dry state the microspheres will "dust" through very small openings in the covering. The microspheres can blow away and will shift easily from external forces when dry. Once the special liquid coating has been added the spheres will no longer be readily lost through the pad seams (if the pads are sewed) by dust passage nor will the material voluntarily lose its configuration when the feet are removed from the boot. Functions of the special liquid coating are to form a film that will tend to hold the particles in place when the foot is removed, to keep the light particles from floating off like dust in the air during the pad filling process, and to contribute the flowable characteristics. It is desirable to minimize the weight in the pads as well as provide good heat insulation, if possible. Therefore, the hollow spheres are very desirable. The material mixture (particles having a special liquid coating) has the characteristic of transmitting axial force and moving under shear. This means that transient or short-time forces on the pads and material while skiing will not cause any changes in shape. Further, when the foot is removed, the material will retain its configuration until it is moved by an external force, meaning a force other than gravity which acts from outside the pad.

In FIGS. 3 through 6, a shoe pad using the material of the present invention is disclosed. The pad for shoes is used for treatment of orthopedic problems, such as bunions, corns and similar foot disorders, because of the ability of the material to conform exactly to an irregular shape, distribute the load uniformly on all parts of the load bearing surface of the foot, and to retain this shape. Also the pad material has the ability to change slightly in shape as the foot or shoe changes size from day to day. It has been found that persons having foot disorders can gain greater comfort using foot pads filled with this material than with previous pads.

As shown, a shoe 70 has a sole 71 and a heel 72. The shoe upper 73 encloses the foot and suitable laces are provided for tightening the shoe onto the foot. The upper 73 is attached to the edges of the sole in a conventional manner. The interior of the sole has an insole pad 75 made according to the present invention installed thereon. The insole pad 75, of course, is cut to fit the particular size of the shoe and, as shown, extends throughout the length of the shoe.

The pad is constructed in the following manner. A top or outer layer of soft leather 76 is cut to the desired shape to fit within the shoe 70 and along its marginal edges 77 the layer 76 is attached to an intermediate layer of cloth 78. The intermediate layer 78 is cut to the proper shape and is made of a suitable cloth coated to make it substantially non-porous. A nylon cloth treated with a plastic sold under the trademark Hypalon has been found satisfactory. The outer layer 76 and the intermediate layer 78 are stitched or otherwise fastened at their mating marginal edges and together form an envelope in which the

pad material 57, which was previously described, is placed. The edges of the top layer 76 can be rolled over slightly before the intermediate layer is attached thereto. In this form of the invention the amount of the material 57 between layers 78 and 76 is quite small, so that the thickness of the material is between .8 millimeter and 6 millimeters. The material is placed in the pad before the pad is completely sewed shut. A backing or bottom layer 80 made of a semi-rigid material, such as a relatively stiff suede leather, is also cut to size and attached to the marginal edges 77 of the top layer. Usually, a suitable adhesive is used for joining the back layer 80 to the edges 77. The backing layer 80 has a slit 81 which provides access to the compartment 82 formed between the back or bottom surface of intermediate layer 78 and the backing layer 80. The slit 81 is of substantial length and extends along the center portion of the pad.

The top layer 76 is made of a soft leather, for example kangaroo leather to present a sealing or containing surface which has little resistance to conforming.

In the treatment of a disorder of the foot, such as a bunion, corn or callus, it is then sometimes necessary to insert pillows or auxiliary pads 83 into the compartment 82 in the area where the callus or other malformation is located. The pillows 83 are constructed by making an outer covering of two layers of suitable material, such as a nylon, and sewing them along their marginal edges to make a hollow compartment. The pillows are filled with the material 57 previously described before they are completely sewed shut. The pillow is inserted in the proper area of the pad, with the pad in the shoe. The foot is placed into the shoe and the material 57 will conform to the shape of the bottom of the foot, after walking a few steps or a few dozen steps. Likewise, the upper filling of material 57 (between layers 76 and 78) will also conform to the foot, as shown in FIG. 5 and the foot will be supported approximately equally in the general vicinity of a callus, even underneath the callus itself. The callus is shown at 85, and the material will conform exactly to this shape. This material will flow slowly until it reaches this shape and then when the foot is removed will retain this shape, unless some external force, other than gravity, disturbs the material. There will be no high pressure point under the callus.

If more than one pillow is needed or desired in the pad, the upper layer of material in the pad will provide a "smoothing out" effect between the pillows and the material in each of the pillows will flow to make the exact conforming possible. The material is confined inside the pad so it will only flow until it is held in place. There will always be a layer of material under the affected area, provided of course, a sufficient thickness of pillow or pillows is used.

It has been found that treating calluses by inserting a pad of this type into a shoe, and adding sufficient pillows of material to the pad so that the material can conform around the callus and supporting the callus evenly on the general vicinity thereof so that the callus does not contact the bottom of the shoe itself, has given great comfort and relief to patients and in some cases has resulted in the complete clearing of the callus or deformity where other pads and methods of treatment have failed. Of course, if space in the shoe permits, a pad having only one layer of the special material of sufficient thickness can be provided. The pillows increase the versatility of the pads.

The following case histories are representative of actual case histories of a group of patients treated by a podiatrist in a leading clinic in the United States. Results were good. The group selected for the treatment were from patients who were on their feet a good deal.

Case #1.—Female; age 22; height 5'2"; weight 110; occupation—desk attendant at a clinic.

The patient had calluses since she was in grade school. Previously, in 1962, treatment with two different types

of shoe inlays had been attempted. A felt latex was used for an inlay in the shoe to make the callus comfortable, but this was unsatisfactory. Then a molded leather insole was also made and this didn't work either. These were discarded by the patient after a short time of wear.

A shoe pad made according to the present invention was then installed in her shoe and suitable pillows placed under the callus so that the conformable material in the pad would support the callus. After five months of treatment, the callus has been reduced in size and she states she is as comfortable as she has ever been.

Case #2.—Female; age 21; height 5' 8"; weight 137; occupation—licensed practical nurse.

The patient walks on hard terrazzo floors for at least eight hours each day. Calluses had been present on the patient's feet for about two years and she had attempted the home treatment of these calluses during this time. After installing a pad made according to the present invention and suitable pillows under the calluses, and after four months of treatment, the callus has almost disappeared. The patient is very comfortable and happy with the pad. Her feet are in much better shape than before.

Case #3.—Female; age 67; height 5' 4"; weight 110; occupation—housewife.

The patient suffers from rheumatoid arthritis. The patient was first treated for an infected callus caused by nodules resulting from the arthritis on the left foot. First an inlay of felt latex was made but did not help and the nodules were continually breaking down and becoming infected and ulcerous.

A pad made according to the present invention was installed and after six months of treatment the patient is very comfortable. There was one break down of a nodule on the foot during treatment, but there have been no other break downs. The patient is as comfortable as she has ever been and the nodules do not break down with the regularity normally associated with rheumatoid arthritic patients.

The treating podiatrist attributes the success of these pads to the ability of the conformable material within the pad of the present invention to conform closely to the configuration of the patient's foot so that the pressure is distributed properly and is not concentrated in the callus area. This prevents the callus from carrying more than its proper share of the load so that little or no discomfort is present when the patient walks on the pad.

Of the complete group, approximately 15% of the patients' calluses flaked off in about two months and another 25% showed marked improvement of the callus itself. The remaining 60% of the patients stated that the pads were comfortable and liked the pads and insoles after wearing them for this length of time. Therefore, it is evident that the pads, containing the conformable material as disclosed, will give relief to irritated painful areas and will make the patient much more comfortable. The insole padding can also be used for post-operative foot padding.

If the insole pad is fitted closely within the shoe, it is not likely to slide out of position even if it is loose. If the insole pad is a little small it may tend to slide forward. However, to prevent this, pieces of tape having adhesive on both sides can be used at the heel portion between the shoe insole and the insole pad disclosed. Once the proper thickness of the pad (including the pillows) has been determined in order to properly support the callus or bunion, the insole pad can be glued in place, if desired. It must be remembered that the auxiliary pads or pillows must be sufficiently thick to adequately nest the callus so that the callus is supported across its entire surface and its immediate vicinity. This will result in no points of high pressure, which cause additional irritation or calluses. If necessary the patient should buy new shoes to permit the installation of adequate padding.

In the pads utilized in the experimental group mentioned previously, the thickness of the top layer of material 57 ranged from approximately .8 millimeter to 1.6 millimeters. The pillows, generally, are in the range of two to four millimeters thick and different thicknesses can be provided.

In the treatment of foot disorders, using insole pads having an upper chamber filled with the conformable material described, an insole pad is placed into the shoe of the patient so that the conformable material will form a thin layer across the entire insole of the shoe. The pad is then lifted and suitable pillows 83 filled with the conformable material are inserted into the compartment formed in the pad directly underneath the callused area.

The patient is then permitted to walk on the pad until the material conforms to the callus. If necessary, additional pillows will be added to the second compartment to provide uniform support across the entire bottom of the foot, as needed.

Once the pad conforms to the shape of the foot, the material will retain its shape and the next time the patient puts the shoe on, the foot will be properly supported immediately.

In addition to the uses previously described, the pads of the present invention can be utilized as shown in FIG. 7 for the lining of a football helmet. The same construction will also be used here but the initial padding will be somewhat thicker to absorb the shocks which are normally encountered in playing football. As shown, a helmet 95 comprised of a conventional hard plastic outer shell is constructed in the usual manner for football helmets. A liner 96 which is formed into the shape of the helmet is made of a soft leather inner layer 97 which is adjacent the head, and which has a nylon cloth layer 98 attached to it along its marginal edges to form a compartment 99 in which the material 57 is placed. The layer of conformable material adjacent the head can be thick and the pad divided into several compartments, if necessary to keep the material from shifting. A third layer 100 is attached adjacent the peripheral edges of the inner layer 97 and will form a separate compartment with the cloth 98 for the insertion of additional pillows or auxiliary pads constructed in the same manner as in the previous form of the invention, and which are filled with the conformable material 57. The auxiliary pads are inserted through slits 101 in the back layer 100. The auxiliary pads for the helmet will be shaped as desired and will be envelopes of cloth filled with the conformable material.

The liner 96 inside the helmet can be fastened in place with suitable fasteners, such as snaps (as shown), Velcro fasteners (sometimes called nylon zippers or nylon tape), or pressure sensitive adhesive. The liner can be folded back to permit insertion of pillows or auxiliary padding where the helmet does not fit the head properly. Once the helmet is installed on the head, the material 57 will flow to accommodate any irregularities of the head. The material, as stated previously, is made of small hollow spheres having a light coating of special liquid coating and particularly when these spheres are made of a plastic material, such as phenolic resin, they will absorb some of the shock by slight compression. Further, by having the inner liner of the helmet closely conformed to the head, the pressure on the head is minimized because the forces are absolutely evenly distributed and are not localized on a bump or protrusion of the head, as is common when the liner does not exactly conform to the head.

This insures that there will be no injury to the head of the wearer of the helmet, and also that the helmet will fit a large range of sizes because the additional pillows of padding can be inserted between the third layer 100 and the cloth 98 through provided slits such as 101, in the back layer 100.

The pad material, in addition, has uses in many other

types of pads. The property of the small discrete particles to conform to a shape until it supports the load thereon and not shift when the load is removed is a new property not previously obtained.

The key to obtaining proper characteristics is to have a thin or light coating of the special liquid coating (oily, greasy or waxy material) that covers the surface of each of the discrete particles used so that the particles will remain in the position in which they are placed from external forces. Still the volume of the coating material must be kept low. The volume of the special liquid coating is no greater than the volume of the interstitial spaces in the quantity of discrete particles used.

The specific gravity of the silicone lubricant used for the special liquid coating is in a listed range of from .76 to 1.3. The mix ratio by weight of the hollow Microballoon spheres to the silicone base lubricant works satisfactorily across the normal range of specific gravity of the lubricant.

The pillows used as auxiliary padding can be made in various sizes and outer shapes. The material 57 will flow to the desired configuration after the pillows are installed, thereby eliminating the need to make the pillows to precise custom fitting configurations.

What is claimed is:

1. A pad which will conform to an irregular shape and will retain said shape until disturbed by external forces, said pad comprising an outer cover forming an envelope, a quantity of material filling said envelope consisting essentially of microspheres and a minimal amount of an oily lubricant that will form an adherent film over the surface of each particle.

2. The pad of claim 1 wherein the microspheres are hollow shells of a generally spherical shape.

3. The pad of claim 1 wherein the volume of the oily lubricant is no greater than the volume of the interstitial spaces of the microspheres in said pad.

4. The pad of claim 1 in combination with an article of footwear wherein said irregular shape is a human foot and means for locating said pad in position, with respect to the foot of a wearer within said article of footwear.

5. A pad which will conform to an irregular shape and will retain said shape when relieved of pressure, said pad comprising an outer cover having at least one side thereof which is as porous as leather, a quantity of microspheres disposed within said cover, and a sufficient amount of special liquid coating material mixed with said microspheres to thinly coat substantially the entire outer surface of each of said microspheres, the volume of the special liquid coating being such that the cover acquires no palpable stains from the coating during use of the pad.

6. The combination as specified in claim 5 wherein said particles are Microballoon spheres made of a phenolic resin.

7. A pad which will conform to an irregular shape and will retain said shape when relieved of pressure, said pad comprising an outer cover having at least one side thereof which is as porous as leather, a quantity of discrete particles disposed within said cover, and a sufficient amount of silicone base lubricant mixed with said discrete particles to coat substantially the entire outer surface of each of said discrete particles, the volume of the silicone base lubricant being such that the outer cover acquires no palpable stains from the lubricant during use of the pad.

8. The pad of claim 7 in combination with an article of footwear wherein the irregular shape is a human foot and means for locating said pad in position, with respect to the foot within the article of footwear.

9. A pad capable of conforming to a human body and for use between a portion of the human body and an outer member, said pad comprising an outer envelope of flexible material, said envelope having a filling comprising

a mixture of a quantity of discrete particles up to about one-eighth inch in major dimension and a sufficient amount of a special liquid coating so that a thin film of the coating is present on each of the particles and the volume of the special liquid coating is less than the volume of the interstitial spaces of the quantity of particles alone.

10. The pad of claim 9 wherein the discrete particles are microspheres.

11. The pad of claim 10 wherein said discrete particles range in size from about .0002 inch to about .025 inch in diameter.

12. The pad of claim 11 wherein said microspheres are hollow spheres having a bulk density of about three to five pounds per cubic foot.

13. The pad of claim 10 wherein said special liquid coating is an oily lubricant and is restricted to an amount such that the coating does not bleed out of the filling after use.

14. The pad of claim 9 and a separate layer of sheet material attached at its peripheral edges to the edges of one surface of the envelope to form a compartment, a slit in said separate layer opening to said second compartment and being of size to permit insertion of additional pads into said second compartment.

15. The pad of claim 9 wherein said special liquid coating is an oily lubricant and the volume of the liquid coating is restricted to an amount so the film on the particles does not become disassociated from the particles after use.

16. The pad of claim 9 in combination with an article of footwear and means for locating said pad in position, with respect to the foot of a wearer within said article of footwear.

17. An insole pad comprising a flexible outer covering comprising two sheets of material having peripheral edges shaped so as to fit within a shoe and being joined along said peripheral edges to form an enclosure, said enclosure being filled with microspheres.

18. The pad of claim 17 wherein each of the microspheres are coated with a thin coating of a special liquid coating.

19. An insole pad comprising a flexible covering forming an enclosure having peripheral edges shaped to fit within a shoe filled with a material mixture comprising substantially 20 parts by weight of hollow Microballoon spheres and 1 part by weight of a silicone base lubricant.

20. A pad for the insole of footwear comprising first and second layers of material cut to the shape of the insole and joined together at their marginal edges to form a first compartment, a filling of padding material between said first and second layers, a third layer of material cut substantially to the shape of the insole and attached at its marginal edges to the other layers to form a second compartment separated from the first compartment, said third layer having a slit provided therein and being of size to permit insertion of separate self-contained pads into said second compartment, said padding material comprising a quantity of microspheres having a thin covering of a special liquid coating thereon, a sufficient amount of said padding material being placed in said first compartment to have an average thickness of between .8 millimeter and 6 millimeters and said separate self-contained pads comprising separate envelopes having a filling of a material made up of a mixture of microspheres covered with a thin coating of a special liquid coating.

21. An article to be supported by a human head having a structural outer form member, and pad means attached to the form member characterized by said pad means comprising an enclosure having a flexible surface for contacting the head and containing a material mixture comprising a quantity of discrete particles and a minimal amount

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of a special liquid coating, the volume of said coating being sufficient so that the coating clings to individual particles and restricted so the coating does not bleed out of the material during use.

22. A football helmet or the like having an exterior shell, a pad within said shell, comprising enclosure means lining the interior of the shell, said enclosure means containing a layer of material mixture comprising a quantity of microspheres having a thin coating of special liquid coating on the surfaces thereof, said enclosure fitting the head of a wearer of the helmet.

23. The combination as specified in claim 22 wherein the enclosure means comprises a two compartment pad, a first compartment being adjacent the head of a wearer and containing the material mixture, a second compartment being normally unfilled and having access means provided thereto to permit insertion of separate pads into the second compartment.

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References Cited

UNITED STATES PATENTS

1,729,725	10/1929	Krebs	128—605
2,057,510	10/1936	Block	128—606
2,439,545	4/1948	Matlas	128—594
2,487,691	11/1949	Boos	128—606
2,531,763	11/1950	Andre	36—2
2,546,827	3/1951	Lavinthal	128—595
2,684,541	7/1954	Hirschl	128—594
2,760,281	8/1956	Cosin	128—595
2,797,201	6/1957	Veatch et al.	260—2
2,806,509	9/1957	Bozzacco et al.	
3,146,060	8/1964	Canevari	21—60
3,237,319	3/1966	Hanson	36—71
3,039,109	6/1962	Simpson	2—3

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U.S. DEPARTMENT OF COMMERCE

PATENT OFFICE

Washington, D.C. 20231

**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,407,406

October 29, 1968

Frank D. Werner et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 12, line 9, "discrete particles" should read -- microspheres --;
line 12, "microspheres" should read -- discrete particles --.

Signed and sealed this 3rd day of March 1970.

(SEAL)

Attest:

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Attesting Officer

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Commissioner of Patents