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W. H. SMAROOK
COLD-FORMABLE SPLINTS
Filed March 11, 1963

3,176,685

FIG. 1

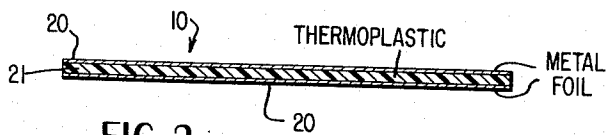
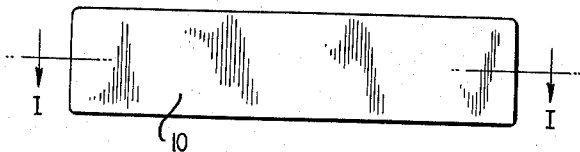


FIG. 2

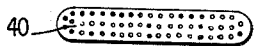


FIG. 4

FIG. 3

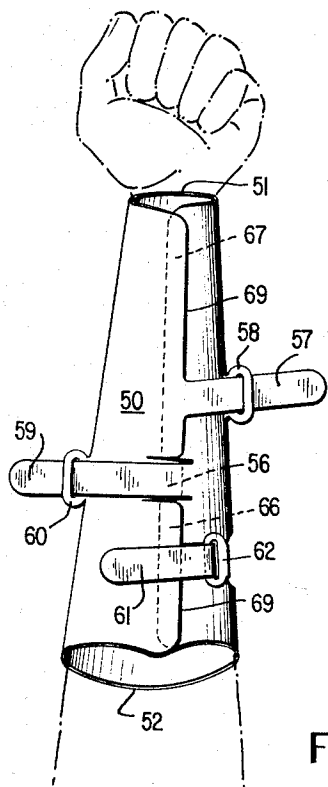
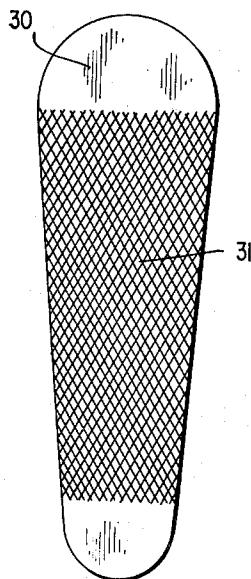
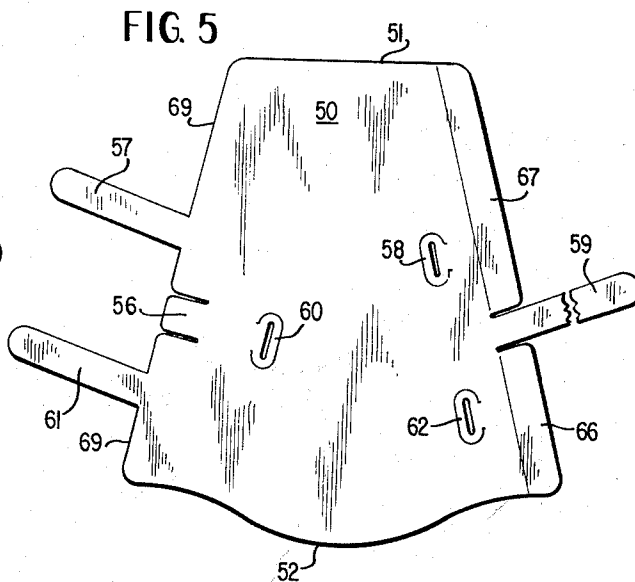


FIG. 6



INVENTOR
WALTER H. SMAROOK
BY
James C. Covantes
ATTORNEY

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COLD-FORMABLE SPLINTS

Walter H. Smarook, Somerville, N.J., assignor to Union Carbide Corporation, a corporation of New York
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This invention relates to splints. More specifically, this invention relates to cold-formable splints.

It is an object of the present invention to provide cold-formable splints having a relatively thick thermoplastic core which is surfaced on both sides with relatively thin metal foil.

It is a further object of the present invention to provide splints which are capable of being cold-formed to the shape of a body member, and when applied thereto, effectively immobilizing the same.

It is another object of the present invention to provide a one piece splint which is particularly adaptable for emergency first aid use in that it can be cold-formed to the shape of the body member which is to be immobilized.

Among other objects and advantages, the splints of the present invention: can be readily cut from a composite material having a relatively thick thermoplastic core surfaced on both sides with relatively thin metal foil, as will be more fully described subsequently, to form splints which are of any desired size or shape; can be cold-formed to the shape of the member to be immobilized with a minimum of effort; are not adversely affected by moisture or by environmental temperature extremes; are not susceptible to damaging attack by fungi or by dry rot; and are compact and capable of being stored flat or rolled up thereby requiring a minimum of storage space.

Still other objects and advantages will be apparent from the following detailed description taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a plan view of one embodiment of a splint of the present invention, shown in the form of an arm splint;

FIGURE 2 is a cross sectional view taken along line I-I of FIGURE 1;

FIGURE 3 is a plan view of another embodiment of a splint of the present invention, shown in the form of a leg splint;

FIGURE 4 is a plan view of yet another embodiment of a splint of the present invention, shown in the form of a finger splint;

FIGURE 5 is a plan view of a preferred embodiment of a splint of the present invention;

FIGURE 6 is a perspective view of the splint of FIGURE 5 shown fitted to a forearm.

Referring to the drawings and specifically referring to FIGURES 1 and 2, there is shown a splint 10, in a form suitable to be applied to an arm, comprising a thermoplastic core 21, surfaced on both sides with metal foil 20.

The splints shown in FIGURES 3 and 4, identified by numerals 30 and 40, are adaptable to be used to immobilize a leg and finger respectively, as previously stated.

It is to be pointed out that one or both metal surfaces of the splints of the present invention can be roughened, as shown in FIGURE 3 by numeral 31, by any convenient means, in order to insure that the means, such as bandages, used to secure splints shown in FIGURES 1-4, to a body member, will not slip.

Splints of the present invention can also be perforated, as shown in FIGURE 4, to allow the skin covered by the splint to "breathe." If desired, the splints of the present invention can also be provided with a layer of cushioning material, as for example, urethane foam secured to that surface of the splint which would be normally placed in contact with a body member.

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Referring now to FIGURE 5, where there is shown a preferred embodiment of the splint of the present invention, the splint, as shown, is a one piece "universal" splint which can be fitted to any portion of a body member to which splints can normally be applied. There is shown in FIGURE 6, by way of illustration only, such a splint fitted to a forearm.

The "universal" nature of the preferred embodiment of the splints of the present invention provides distinct advantages over conventional emergency first-aid splints. The preferred splints of the present invention can be cold-formed to conform to the shape of a body member which is to be immobilized and secured thereto in such a manner as to attain equalized pressure distribution to the immobilized member at all points thereof. This provides for complete immobilization of a body member with a minimum discomfort to the person involved.

The cold-formable splint shown in FIGURE 5 includes an elongated member 50 and as integral parts thereof straps 57, 59 and 61, alternatively connected to opposite sides of elongated member 50 and spaced a convenient distance from leading edges 51 and 52 of elongated member 50. The actual number of straps is not critical and will depend upon the length of elongated member 50, provided that elongated member 50 has at least three straps.

Each strap, at a side of elongated member 50 opposite thereto, has a complementary tab for receiving each strap so that each strap is wrapped about the body member being immobilized and then passed through its complementary tab. As shown in FIGURE 5, tab 53 is complementary to strap 57; tab 62 is complementary to strap 61; and tab 60 is complementary to strap 59.

Immediately forward of each tab is a flap, integral with elongated member 50, the function of which will be described subsequently. As can be seen in FIGURE 5, flap 56 is immediately forward of slit 60; flap 67 is immediately forward of tab 58; and flap 66 is immediately forward of tab 62.

In applying the splint shown in FIGURE 5 to a body member, about which the splint may overlap, the splint is first cold-formed to the shape of the body member to be immobilized. The splint is then held in place, immobilizing the body member, by first passing each strap about the body member, and then passing each strap through its complementary tab. In so doing, strap 59 passes over flap 56 and then is passed through its complementary tab 60. Straps 57 and 61 also pass over the body member, and then through their respective complementary tabs 53 and 62. With the arrangement as described, flaps 67 and 66 ride under an edge of side 69, as shown in FIGURE 6. Once through their respective tabs, the straps can then be folded back over themselves, and will retain the position into which they are formed.

Also, if desired, the leading edges 51 and 52 of elongated member 50 can be contoured to provide a comfortable fit with respect to the body member against which they bear, as is shown in FIGURE 5.

The splint, as discussed with reference to FIGURE 5, is capable of lateral movement insuring a proper fit with a minimum of effort. Also, the overlapping feature of the splint allows it to be adjusted, within limits, to the size of the body member being immobilized.

The splints of this invention comprise a thermoplastic core of from about 0.005 inch to about 1.4 inches thick having secured to both surfaces thereof metal foil of from about 0.00025 inch to about 0.01 inch thick. Particularly desirable splints are those comprising a thermoplastic core of from about 0.025 inch to about 0.075 inch thick having secured to both surfaces thereof a metal foil of from about 0.001 inch to about 0.005 inch thick. It is also to be

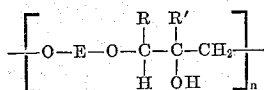
understood that the thermoplastic core has a thickness greater than the combined thickness of the metal foil laminae, and that the metal foil laminae have a yield strength in tension and a yield strength in compression, the sum of which is greater than the sum of the yield strength in tension and the yield strength in compression of the thermoplastic core, but less than the shear strength of the metal-thermoplastic interfaces and less than the shear strength of the thermoplastic core itself. A complete definition of these terms and test procedures used to evaluate these strengths are contained in the following:

- ASTM C273-53-----Shear strength of metal-thermo-
plastic interfaces.
ASTM D638-60T-----Yield strength in tension of
thermoplastics.
ASTM D695-54-----Yield strength in compression
of thermoplastics.
ASTM D732-46-----Shear strength of plastics.
ASTM E6-60T-----Definitions of strength terms.
ASTM E8-57T-----Yield strength in tension of
metals.
ASTM E9-59T-----Yield strength in compression
of metals.

Stated in different terms, the metal laminae must possess sufficient strength to overcome the inherent elasticity of the thermoplastic core. This in effect renders the splints of this invention cold-formable. But, at the same time this strength of the metal laminae must be less than the bond strength in shear of the metal-thermoplastic interfaces and less than the shear strength of the thermoplastic core. If the strength of the metal laminae is greater than either of these strengths of the interfaces or of the core, the splint will fail in shear at the interface or the core itself will rupture upon cold-forming.

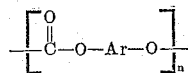
The composite material from which the splints of the present invention are formed can be prepared in any convenient manner as is known to those skilled in the art, such as in compression molding presses, by an extrusion coating process, a calendering process and other such processes. If desired, the thermoplastic core can be secured to the metal foil using adhesives as for example, epoxide resins and the like, and the metal foil can be coated by suitable means with a thin film (e.g., about 0.005 inch) of thermoplastic prior to lamination to a core of the same or a different thermoplastic. In addition, the metal foil lamina can be coated by suitable means, for instance by extrusion coating, with a thermoplastic to a thickness equal to one-half of the core thickness desired, and the composite laminate can be formed by laminating the two halves together. The surface or surfaces of the thermoplastic core material and/or the metal foil can be pretreated mechanically, chemically, thermally, and electrically to improve bonding. Any metal foil can be used for purposes of this invention. Exemplary of suitable metal foils are those made from aluminum, copper, steel, brass and the like, with aluminum being preferred. It is to be understood that the metal laminae of a given composite splint can be of the same metal or of different metals, and each of the metal lamina can be of the same or different thickness.

Illustrative of suitable thermoplastics which can be used in this invention are the following: olefinic thermoplastic polymers such as polyethylene, polypropylene, copolymers and terpolymers thereof, as for example, copolymers of ethylene and ethyl acrylate; polyamides; polyhydroxyethers, that is, thermoplastics containing the following repeating unit:



wherein E is the nucleus of a dihydric polynuclear phenol and R and R' are either hydrogen or methyl; polycar-

bonates, that is, thermoplastics containing the following repeating unit:



wherein Ar is the residue of an aromatic dihydric phenol; thermoplastic vinyl polymers formed from one or more of the following monomers; vinyl aryls such as styrene, o-methoxystyrene, p-methoxystyrene, m-methoxystyrene, o-nitrostyrene, m-nitrostyrene, o-methylstyrene, p-methylstyrene, m-methylstyrene, p-phenylstyrene, o-phenylstyrene, m-phenylstyrene, vinyl naphthalene and the like; vinyl and vinylidene halides such as vinyl chloride, vinylidene chloride, vinylidene bromide and the like; vinyl esters such as vinyl acetate, vinyl propionate, vinyl butyrate, vinyl chloroacetate, vinyl chloropropionate, vinyl benzoate, vinyl chlorobenzoate and the like; acrylic and alpha-alkyl acrylic acids, their alkyl esters, their amides and their nitriles such as acrylic acid, chloroacrylic acid, methacrylic acid, ethacrylic acid, methyl acrylate, ethyl acrylate, butyl acrylate, n-octyl acrylate, 2-ethylhexyl acrylate, n-decyl acrylate, methyl methacrylate, butyl methacrylate, methyl ethacrylate, ethyl ethacrylate, acrylamide, N-methyl acrylamide, N,N-diethyl-methacrylamide methacrylamide, N-methyl methacrylamide, N,N-dimethyl methacrylamide, acrylonitrile, chloroacrylonitrile, methacrylonitrile, ethacrylonitrile and the like; alkyl esters of maleic and fumaric acid such as dimethyl maleate, diethyl maleate and the like; vinyl alkyl ethers and ketones such as vinyl methyl ether, vinyl ethyl ether, vinyl isobutyl ether, 2-chloroethyl vinyl ether, methyl vinyl ketone, ethyl vinyl ketone, isobutyl vinyl ketone and the like; also vinyl pyridine, N-vinyl carbazole, N-vinyl pyrrolidine, ethyl methylene malonate and the like. The preferred thermoplastic to be used with this invention is polyethylene, and, if desired, foamed thermoplastic materials of any of the above-mentioned polymers can be used for the core of the composite splints of this invention. It is to be understood that the thermoplastics to be used with this invention can contain various additives as is well-known in the art, as for example dyes, pigments such as titanium dioxide, stabilizers, lubricants, antioxidants such as 4,4'-thio-bis-(3-methyl-6-tert-butylphenol), fillers such as carbon black, talc, clay and the like, and cross-linking agents such as bis-(alpha,alpha-dimethyl benzyl) peroxide.

The splints of the present invention may be conveniently formed by any means known to those skilled in the art. As an illustration, splints may be cut from composite material by hand, and may be punched with steel cutting dies to form flat splints in a continuous operation.

The splints of the present invention can be readily cold-formed by hand or by the use of simple hand tools either prior to fitting onto a body member, or directly on a body member.

What is claimed is:

1. A cold-formable splint comprising an elongated member having a thermoplastic core of from 0.005 inch to 1.4 inches thick, said core having secured to both surfaces thereof a metal foil of from 0.00025 inch to 0.01 inch thick, wherein said thermoplastic core has a thickness greater than the combined thickness of the metal foil laminate, and wherein the sum of the yield strength in tension and the yield strength in compression of the said metal foil laminae is greater than the sum of the yield strength in tension and the yield strength in compression of said thermoplastic core, but less than the shear strength of the metal-thermoplastic interfaces of said composite laminate, and less than the shear strength of said thermoplastic core.
2. A cold-formable splint comprising an elongated member having a thermoplastic core of from 0.025 inch to 0.075 inch thick, said core having secured to both surfaces thereof a metal foil of from 0.001 inch to 0.005 inch thick, wherein said thermoplastic core has a thickness greater than the combined thickness of the metal foil

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laminae, and wherein the sum of the yield strength in tension and the yield strength in compression of the said metal foil laminae is greater than the sum of the yield strength in tension and the yield strength in compression of said thermoplastic core, but less than the shear strength of the metal-thermoplastic interfaces of said composite laminate, and less than the shear strength of said thermoplastic core.

3. The splint described in claim 1 wherein said thermoplastic core is polyethylene.

4. The splint described in claim 1 wherein said metal foil is aluminum.

5. The splint described in claim 1 wherein one of said metal foil laminae has a roughened outer surface.

6. The splint described in claim 1 wherein said splint has a series of perforations therein.

7. A cold-formable splint as defined in claim 1 wherein said elongated member is adapted to be cold-formed to the shape of a body member, and has a plurality of straps alternatively attached to opposite sides thereof, each of said straps, at a side of said elongated member opposite thereto, having a complementary tab for receiving said straps, a flap integral with said elongated member immediately forward of each of said tabs, said straps adapted

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to be passed about the body to be immobilized, and through their complementary tabs.

8. A cold-formable splint as defined in claim 1 wherein said elongated member is adapted to be cold-formed to the shape of a body member, and has at least three straps alternatively attached to opposite sides thereof, each of said straps, at a side of said elongated member opposite thereto, having a complementary tab for receiving said straps, a flap, integral with said elongated member, immediately forward of each of said tabs, said straps adapted to be passed about the body to be immobilized, and through their complementary tabs, said flaps allowing for adjustment of said splint to the size of the body member being immobilized.

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