This invention relates to molded surgical and medical supports, and has for its objects the provision of an improved cast material which is light in weight, transparent, convenient to apply, non-flammable, and resistant to water, acids, alkalis, alcohol and aliphatic hydrocarbon liquids. By means of my invention direct support can be provided for injured limbs, or movement of an injured body member can be restrained until the injured member has healed or improved in strength to such an extent that its support or restraint is no longer required.

The present practice of supporting fractured, sprained or otherwise injured members of the body involves, besides rigid splints, the use of one of two different types of cast materials, as classified with respect to the manner in which these materials assume a rigid state from a moldable state. One type of cast material, an example of which is plaster of Paris, consists of a material which is a powder in its moldable state, but which is capable of forming a dense, rigid, supporting structure upon being hydrated. The other type of cast material, an example of which is a fabric bandage impregnated with a solution of cellulose nitrate, consists of a material which is sufficiently flexible when wet with solvent to permit its being wrapped about the injured member, but which is capable of forming a supporting cast when the solvent is evaporated.

Cast materials in current use have certain serious disadvantages which are not encountered with the compositions which constitute my invention. The materials belonging to the class which depend for their action upon hydration yield casts which are bulky and heavy, and which are somewhat attacked by water and acids. Furthermore, these casts are so dense that X-ray pictures of body members enclosed in them can usually be taken only by high voltage technique, and such pictures are less satisfactory than those obtained with low voltage X-rays. The materials belonging to the class which depend for their action upon solvent evaporation are objectionable because of the highly inflammable character of the solvents and dissolved substances, and because of the odor of the solvents employed. Both classes of materials are inconvenient to apply; both require relatively long periods of time for setting to a rigid state; and neither permits visual examination of the injured member enclosed by it.

The material of this invention is not a member of either of the foregoing classes, but depends for its operation upon its novel thermoplastic properties. It has the property of assuming a moldable plastic state at temperatures above room temperatures, but not so high as to cause injury to the patient, and yet it is relatively strong and rigid at room temperatures. My invention comprises a composition of a resinous base material to which a suitable plasticizing material has been added, as will be more fully described herein.

The class of materials embraced by this invention has proved to be superior to the cast materials now in use, and yields supporting casts which are not attacked by any of the substances normally encountered in the use of cast materials. For example, the cast material of this invention exhibits great resistance to water, acids, alkalis, alcohol and aliphatic hydrocarbon liquids. In addition, X-ray pictures of body members enclosed in the new plastic compositions may be taken with low voltage X-rays, thus assuring a picture of greater clarity and detail. Other advantages include the ease with which my cast materials can be applied, the rapidity with which they become rigid, the cleanliness of their application, involving, as it does, no liquid setting agents, the transparency of the resulting casts which permits visual examination of the injured member while supported within the cast, the non-flammable character of the cast materials, the absence of odors or fumes both in application and in use, the marked reduction in bulk and weight of the casts, and the provision which can be made for ventilation by perforation of the material.

I have discovered that desirable thermoplastic properties can be imparted to a conjoint polymer of a vinyl ester of an aliphatic acid and a vinyl halide by incorporating certain plasticizing substances with the resin. I prefer to use a resinous base material which is a conjoint polymer composed of 5% to 30% of vinyl acetate and 70% to 95% of vinyl chloride in the molecular weight range of 5,000 to 20,000, the average molecular weight being 7,000 to 12,000. The molecular weights are determined from the specific viscosity of dilute solutions of the resin according to Staudinger's method.

A considerable number of compatible plasticizing materials may be used to yield the desired thermoplastic properties when incorporated in relatively small amounts with this base material. Among these substances are the halogen-substituted hydrocarbons, such as iodoform and chlorinated diphenyl; alicyclic ketones, such as camphor and pyrones, as illustrated by de-
A second composition contained 80.7 parts by weight of a conjoint polymer resin analyzing 10% to 15% vinyl acetate and 85% to 90% vinyl chloride and having an average molecular weight of 8,000 to 12,000, together with 0.8 part of a heat stabilizer consisting of a mixture of dibutyl tin maleate and dibutyl tin dilaurate in equal proportions, 1.0 part of castor oil, 0.5 part of stearic acid, 5.0 parts of triphenyl phosphate and 12 parts of trimethylolpropane (paratertiarybutylphenyl) phosphate. This composition was more pliable at temperatures ranging from the maximum atmospheric to those endurable by the human body than the composition of Example 1, besides being somewhat more workable when the calender forming process was used to form sheets. With these exceptions the physical properties were substantially identical with those of the composition of Example 1.

Example 3—A third composition contained 81.7 parts by weight of a conjoint polymer resin analyzing 10% to 15% vinyl acetate and 85% to 90% vinyl chloride and having an average molecular weight of 8,000 to 12,000, together with 0.8 part of a heat stabilizer consisting of a mixture of dibutyl tin maleate and dibutyl tin dilaurate in equal proportions, 1.0 part of castor oil, 0.5 part of phenyl salicylate, a light stabilizer, 10.0 parts of triphenyl phosphate and 6.0 parts of tri(paratertiarybutylphenyl) phosphate. This composition possessed substantially the same physical properties as the composition of Example 2 with the added economy resulting from the replacement of part of the tri(paratertiarybutylphenyl) phosphate content by triphenyl phosphate.

Thermoplastic cast materials can be used in the form of splints, sheets, strips, or fabric impregnated bandages. For example, a splint of 1/4 inch thick and softened to a readily moldable state by immersion in hot water, cooled to a temperature which would not cause the patient discomfort, and then molded by hand manipulation about the region where support was required. Any excess material remaining after cutting can be easily cut away, and the resulting splint secured firmly in place by binding it with surgical adhesive tape or otherwise. The material also has been used in strip form having, for example, the dimensions 2 inches by 0.010 inch, and in cloth-backed form in which the material was calendared or otherwise secured in a thin layer on a cloth bandage. When strips and coated bandages are used, a small blast of hot air is sufficient to soften the material to a moldable plastic condition. When the material is in strip form it is desirable to secure adhesion between successive layers to prevent lateral slipping. Good adhesive action in this case can be obtained at moldering temperatures by coating the strips with a thin layer of melted triphenyl phosphate or benzoyl acetone, or with a solution of these substances in some solvent which does not affect the base material. At room temperatures these adhesives form dry powdery
surfaces which are not tacky and do not cause the strips to adhere prematurely. When the strip is heated the adhesive material melts and penetrates the resin sufficiently to bond successive strip layers securely and thus to prevent lateral slipping and displacement between the layers.

The expression “supporting casting material” as used herein refers to a material which is formed or formable into casts which may be used, for instance, by being applied to a person’s body to support an injured member until it is healed.

Many different embodiments of this cast material and variations in its use, other than as described in the foregoing examples are possible without departing from the scope of the invention.

I claim:

Supporting cast material characterized by

hardness, strength, rigidity and toughness at room temperatures and at body temperatures and by ready moldability at higher temperatures endurable by the human body comprising a mixture containing a resinous base material which is a conjoint polymer of vinyl chloride and vinyl acetate, said resin having a macromolecular weight of approximately 5,000 to 20,000 and a combined vinyl chloride content of approximately 70% to 95% by weight and a plasticizing material which is a mixture of triphenyl phosphate and tri(paratertiarybutylphenyl) phosphate, said composition being substantially free from volatile solvent and containing sufficient plasticizer within the range of about 10% to 25% by weight of plasticizer based on the weight of the composition to give the material the aforesaid characteristics.

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