This invention relates to improvements in construction practices using a particular type of resilient sheet material as flashing.

It has been standard construction practice to use flashing in exposed angles between roof and gutter, or in valleys between intersecting roof surfaces, over fascia boards, at joints between masonry or metal and wood as where chimneys or vent pipes intersect a roof and where masonry parapet walls abut a wooden roof, and between wood and masonry members of sill structures at floors or windows, as well as in many other places where similar problems exist. The nature of the flashing employed has varied according to the type and intended permanence of the structure. The better flashings heretofore employed have been sheet copper and sheet lead. Less permanent flashing has been made of galvanized iron or of a tar-impregnated "roofing paper."

Each of the conventional prior flashings has some recognized defects. Thus, the sheet metalflashings are difficult to seal tightly, especially at joints involving wooden structural supports, as nails driven through the flashing to hold it in place establish potential leaks and these may become progressively worse as electrolysis occurs at the point of contact between the nail and the flashing. There are atmospheric conditions, especially in factory districts or in coal burning communities, which exert an accelerated corrosive effect on metal flashings. Joints in metal flashing must be made by welding (as in the case of lead) or soldering, and such operations are slow and expensive. Flashings made of roofing paper are weak, as they age they tend to develop leaks around nail holes, they become brittle in cold weather, and they are combustible. None of the prior flashings has been resilient enough to be walked on safely without permanent or damaging deformation.

In attempting to overcome some of the defects of prior flashing materials, some use has been made of rubber sheeting. While this has been easy to apply, it is not long-lived, as it oxidizes and becomes brittle and weak in the course of a very few years.

Accordingly, it would be desirable, and it is the principal object of this invention to provide a long-lived, resilient and non-combustible flashing for use in construction which is corrosion resistant, remains flexible at low temperatures, is easily sealed to other sheets of like material, forms a tight seal around nails driven through it, and is not damaged or permanently deformed when subjected to temporary localized stress. A related object is the provision of improved structural members comprising the new flashing.

The flashing of the present invention is a sheet, generally of the order of 0.06 inch thick, of a polymeric composition essentially of a copolymer of from 82 to 88 percent vinylidene chloride and complementarily from 18 to 12 percent acrylonitrile, from 0.2 to 0.5 part by weight of plasticizer for the copolymer for each part by weight of copolymer, from 0.3 to 0.6 part by weight of a soft reinforcing carbon per part of the copolymer, and from 0.01 to 0.06 part of a nitrogenous vulcanizing or curing agent for each part of the copolymer. Such compositions are comprehended within the broader disclosure of U.S. Patent No. 2,614,692, entitled "Insulflame Copolymeric Vinylidene Chloride Composition," issued on October 14, 1952, to the assignee of John H. Reilly, and some of the specific compositions useful here are the subject of pending application Serial No. 506,068, filed May 4, 1955, by the present inventor and others (now abandoned), entitled "Acid-Resistant Polymeric Composition." The new flashing material is in the uncured or unvulcanized state when introduced into the structure of which it forms a part, and becomes cured or vulcanized in place, with advantages to be described, on aging.

It is only when the vinylidene chloride-acrylonitrile copolymer is prepared from the recited range of proportions of the monomers that the highly useful and advantageous product of this invention is obtained. Greater proportions of vinylidene chloride give copolymers which cannot be compounded to a useful, vulcanizable state to give resilient sheets, and the same is true of those having higher than the stated proportions of acrylonitrile.

The composition requires the presence of a plasticizer in the stated range of proportions if the product is to have the required workability in the raw or uncured, thermoplastic state and the required toughness and resilience when cured or vulcanized. The plasticizers may be any of the known plasticizers for vinylidene chloride copolymers. Thus, ester plasticizers such as dibutyl phthalate, dioctyl phthalate, dibutyl sebacate, ethyl phthalyl ethyl glycolate, butyl phthalyl butyl glycolate, tributyl acointate, and acetyl tributyl citrate may be used, to name a few. Other useful plasticizers include the polychloroibiohnyls, of which the pentachioroibiohnyls are preferred. The nature and identity of the plasticizer is not critical so long as it is compatible with the copolymer in the stated proportions. It should be apparent that the least volatile plasticizers will normally give compositions having the longest useful life.

The carbon used in the compositions from which the new flashing is made is any carbon black of the kind widely used in the rubber art and there designated as a "soft reinforcing carbon." Numerous commercial brands of such carbon are available from the carbon black industry and from suppliers of chemicals to the rubber industry. The presence of an amount of carbon in the stated range serves at least the dual purpose of strengthening the sheets made from the composition and aiding in the thermal curing of such sheets after their installation in a structure due to the effect of the black portion on the heat absorption and retention properties of the sheet.

The curing agent is a nitrogen compound, either organic or inorganic, which has a basic reaction and a dissociation constant (K) greater than 10^-4. The preferred curing agents have dissociation constants between 10^-8 and 10^-4. An especially desirable, effective, and readily available material is the condensate of aniline and butyraldehyde. Numerous amines and ammonium compounds are also effective curing agents, as has been described in the prior art.

Known rubber accelerators may be incorporated in the composition, if desired, as may pigments and fillers in amounts insufficient to give stiff or rigid sheets.

The preparation of the composition can be effected in many ways. One which has been found to be convenient involves mixing together the powdered copolymer, carbon black, and accelerator (if any is used) and then, suitably after warming the mixture, adding the plasticizer and continuing mixing until a uniform, homogeneous mass is obtained. It may be advantageous at this stage to add small amounts of stearic acid or other roll-release agent. The resulting mixture is compounded on rolls, and the nitrogenous curing agent is worked into the mass shortly before the latter is sheeted from the rolls. The addition of the curing agent is preferably made while the composition is relatively cool, especially if the sheeted composition is to be stored for very long before installation as flashing in a building. For use as flashing, the sheets are preferably
made in thicknesses from 0.03 to 0.12 inch, and a convenient and generally useful thickness is about 0.06 inch.

It is important that the sheet still be in an essentially uncreased condition when installed in a structure as flashing. Thus, this makes possible the formation of a permanent bond between overlapping areas of adjoining sheets or strips of the flashing, as well as the formation of a tight bond to metal or masonry surfaces. Such bonds between adjoining sheets of the composition are made by moistening the contiguous faces of the lapped sheets with a solvent which is preferably a ketone, such as acetone, methyl ethyl ketone or methyl isobutyl ketone, and then pressing the so-moistened surfaces together. When there is no combustion hazard, as in the installation of flashing or waterproof sheathing on sub-grade masonry foundations, for example, joints between sheets of the flashing may be made by playing a flame as from a blowtorch, or heat from infrared lamps, on the overlapped sheets. Bonds between the new flashing and metal or masonry surfaces are made readily by applying to one or both of the intended contacting surfaces and adhesive comprising as part of its solvent component a ketone or a cyclic ether, such as dioxan or tetrahydrofururan, capable of superficially softening the flashing. An especially useful adhesive comprises a ketone solution of a vinyl polymer. Commonly a dilute adhesive of this type is applied as a prime coat on the metal or masonry surface, or it is allowed to dry to a tacky state, and there is applied over it a more concentrated adhesive. The new flashing is pressed into place before the adhesive has dried. A useful commercial adhesive for the purpose, having a vinyl ester polymer dissolved as a ketone, is sold by Amercoat Corporation, Southgate, California, under the name "Amercoat 20-Y adhesive." It may be desirable in some parts of a structure to secure the flashing to wooden members by means of an adhesive, in which case the type of adhesive described above is satisfactory, but in many types of installation the flashing will be fastened to wooden members by nailing. In the latter case, especially when large headed roofing nails are used, no washer or gasket is required about the nail, since the flashing is not under such tension as to tear away from the nail, and there is no danger of embrittlement.

FIGS. 1-5 of the accompanying drawings show several typical installations of the new flashing, each of which will be described in the following exemplifications.

In FIG. 1, which is a perspective view of a roof of a building, there are shown four typical sites for the installation of flashing. Thus, where a chimney penetrates the roof 11, flashing 12 is applied to the framework around the chimney and is lapped up against the chimney and then flanged inwardly and secured between two courses of brick above the roof line, during construction. The regular roofing 13 (FIG. 2) is applied so as to cover the flashing to the juncture of the roof and chimney. This is shown in more detail in the enlarged fragmentary view constituting FIG. 2.

FIG. 1 also shows the installation of flashing 14 about a vent pipe 15 where the latter penetrates a roof 11. Before the roofing is applied, a sheet of the new flashing composition of the size desired is cut to provide a centrally disposed hole about one-fourth the outer diameter of the vent pipe. The hole is stretched to accommodate the pipe, and the sheet of flashing is drawn down over the pipe, and roofing is applied over the flashing to the base of the projecting pipe. The described procedure gives a tight fit about the pipe, but a more positive seal can be obtained by applying one of the described adhesives to the pipe before positioning the flashing.

The flashing 16 in a gutter formed between intersecting roofs 11, 17, as in gable or dormer construction, and the flashing 18 along junctures between a roof 11 and an upwardly projecting wall 19 of such gable or dormer are also shown in FIG. 1.

FIGS. 3-5 illustrate the application of the new flashing as a protective sheath about the faceplate or fascia board found about the edge of flat roofs and on many buildings of modern style. The first step, illustrated in FIG. 3, is the formation of a projecting strip of the flashing 20 to the protruding end or edge of the roof deck 21. The flashing 20 should be of a width greater by several inches than the perimeter of the intended fascia 22. The fascia board 22 is nailed in place, as shown in FIG. 4, and, suitably after applying a coat of adhesive thereto, the flashing 24 is drawn tightly about the fascia 22. The free edge of flashing 20 is nailed or tacked to the upper surface of the roof deck 21. Thereafter, an appropriate roofing is applied over the roof extending to the fascia. As illustrated in FIG. 5, the roofing may be built-up tarred felt and gravel roof. FIG. 6 illustrates several applications of flashing in or about a parapet wall adjacent the roof of a steel and masonry building. Thus, flashing 23 is shown between cope or cornice 28 and parapet 29; flashing 24 is shown extending from a block 25 inset in the parapet, over a cant strip 26 or 27; flashing 28 is shown extending between masonry courses and running upward along the inner surface of the wall beneath the roof; and flashing 31 extends from an outer face of the masonry-supporting angle 32, between the masonry courses of which it is an outer face. FIG. 7 illustrates the use of the new flashing in the construction of masonry walls about window sills 34, floor joists 35, and just above floor level 36.

FIG. 8 shows an application of the new flashing 37 between a preexisting masonry wall 38 and a subsequently annexed rigid awning or roof 39. In the illustrated structure, the flashing is bonded to the abutting wall and roof members by means of an adhesive, as described.

FIG. 9 illustrates the application of the flashing as a waterproof sheath over the subsurface masonry walls of a building, extending from the footing to a point above grade where it is inserted between courses of the masonry.

The new polymeric flashing has been installed in each of the types of locations illustrated in the drawings. Examination of these experimental installations has shown that there is no adverse effect of cement or mortar or soil acids on the resilient sheet; that the flashings exposed to weather and sunlight become cured and increasingly insensitive to solvents, vapors and fumes after a few weeks; that temperatures from less than 0° F. to over 100° F. do not affect the flexibility, toughness or utility of the flashing; that the flashing does not weather-check, crack, or creep or pull away from joints or nails; and that exposed areas of the flashing can be walked on safely without damage to the flashing.

I claim:
In the process of construction and repair of building structures, the improvement which consists in fastening securely as flashing over leakage-prone joints in such structures an uncured resilient thermoplastic sheet whose composition consists essentially of one part by weight of a copolymer of from 82 to 88 percent acrylic acid and complementarily from 18 to 12 percent acrylonitrile, from 0.2 to 0.5 part by weight of a plasticizer for the copolymer, from 0.3 to 0.6 part of a soft reinforcing carbon, and not to exceed 0.06 part of a nitrogenous curing agent having a basic reaction and a dissociation constant greater than 10^-14.

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