The present invention relates to fasteners, and in particular wire reinforced plastic filament staples, such as staples, bookeeping stitches, nails and the like, adapted to be driven into or through material to be fastened, an object of the invention being to provide a fastener of this character which may be economically produced in a variety of colors, and which has advantages in holding power, ease of penetration, freedom from corrosion, increased columnar strength, etc. over conventional wire or coated wire fasteners heretofore in use.

Other objects and advantages of the invention will become apparent from a consideration of the following detailed description taken in connection with the accompanying drawings wherein a satisfactory embodiment of the invention is shown. However, it will be understood that the invention is not limited to the details disclosed but includes all such variations and modifications as fall within the spirit of the invention and the scope of the appended claims.

In the drawings:

FIG. 1 is a perspective view of a plastic staple according to the invention;

FIG. 2 is an end elevation;

FIG. 3 is a top plan view;

FIG. 4 is a horizontal sectional view on an enlarged scale, taken along the line 4--4 of FIG. 1;

FIGS. 5, 6 and 7 are sectional views, similar to FIG. 4, showing modified forms of the invention;

FIG. 8 is a view partially in end elevation and partially in section, showing a staple according to the invention driven into a wood block or the like;

FIG. 9 is a horizontal sectional view on an enlarged scale, taken along the line 9--9 of FIG. 8, showing the cross-sectional shape of the driven staple leg;

FIG. 10 is a sectional view similar to FIG. 8, showing in section the bridge of the staple as driven by a special driver;

FIG. 11 is a perspective view showing a stick of staples according to the invention;

FIG. 12 is an enlarged sectional view showing the manner in which the staples in the stick are held together by an adhesive coating;

FIG. 13 is a view similar to FIG. 12, and showing the manner in which the staples in the stick are held together by bending;

FIGS. 14 and 15 are fragmentary side elevations showing modified end formations of the staple legs; and

FIGS. 16 and 17 are sectional views, similar to FIG. 4, showing further modified forms of the invention.

Referring to the drawings, and particularly to FIGS. 14--4, the invention is shown embodied in a staple 10, which comprises a conventional inverted U-shape and is formed from a cut-off section of filament having the cross-sectional form of the staple. The manner of forming and assembling the individual staples in a stick is substantially similar to that heretofore practised with conventional staples, the staple legs or shanks 11 being bent downwardly with respect to the bridge 12 either before or after the cut staple forming lengths are adhered together in stick form.

The driving ends of the staple legs each have a chisel cut 13 which is disposed at a relatively steep angle in one direction at one side of the staple, and in the opposite direction at the other side of the staple, for a purpose presently to more fully appear.

As shown in FIG. 4, the filament from which the staple lengths are cut comprises a pair of spaced parallel reinforcing wires or cone members 14 and 15, which may be of steel or non-ferrous metal and of circular or other suitable cross-section, depending upon the particular end use, and which are contained within a plastic body 16. The plastic body is of thermoplastic plastic material firmly bonded to the reinforcing wires, so that the staple may be driven into hard wood or other suitable material without fracture or stripping back of the plastic material. The plastic material is bonded to the wires and is externally shaped by passage through suitable extrusion dies to provide the desired cross-sectional shape, which, as shown in FIG. 4, is flat or rectangular with rounded corners, but which may be of any suitable shape. It has been found in practice that a satisfactory material is a thermoplastic with cold flow properties, examples being nylon and polypropylene. In the process of extrusion this material is molecularly oriented to give it increased tensile strength in the linear direction of the filament, as well as to effect a firm bond with the reinforcing wires. Plastic materials of this type have long chain-like molecules which in the mass of material prior to extrusion have a haphazard arrangement like the straws in a haystack. However, when subjected to the drawing pressure of extrusion the long-chain molecules become oriented, taking on an orderly arrangement in parallel relation to the extrusion axis, with the result that the extrusion has an increased tensile and columnar strength.

The body of plastic material completely covers the spaced wires and constitutes a substantial area of the material between the wires, so that a substantial percentage of the material making up the filament is plastic. The intermediate portion of the plastic material which transversely spans and fills the space between the wires has its transverse exposed surfaces disposed outwardly of the transverse planes in which the opposite sides of the pair of wires lie, so that upon the application of pressure to force the wires toward each other the intermediate portion of the plastic body will be compressed and its transverse exposed surfaces will bulge outwardly. The composition of the thermoplastic material is such that it has an elastic memory recovery factor, is compressible, relatively hard, tough and flexible to thereby withstand scrubbing and bending. By varying the spacing of the wires, as well as the size and the cross-sectional shape of the plastic material, the strip may be formed to provide any desired variation in the percentage between the wire material and the plastic material, depending upon the requirements of the particular type of staple. A satisfactory proportion of wire material to plastic material is 50% of each, in cross-sectional area.

The wires are disposed adjacent the edges of the filament with a relatively thin wall of the plastic material between the wire and the edges of the filament. This gives a maximum of metal in the width of the staple for greatest stiffness and driving power. In the case of the chisel cut end 13 the arrangement disposes the bevel cut end of one of the wires adjacent the entering point of the cut end at its most advantageous point for penetrating the wood or other material into which the staple is driven. In certain types of staples, particularly those in which the legs are clinched at the opposite side of the material being stapled from the staple bridge, the cut ends may be beveled inwardly and downwardly, as at 13a in FIG. 14, or they may have a V-shaped cut, as at 13b in FIG. 15.

It will be noted that the ends of the reinforcing wires are exposed in the cut ends of the staple legs, and, due
to their closeness to the edges of the staple legs, as well as their increased area resulting from their bevel cuts, an effective point is provided for penetrating hard wood or other suitable materials. The cut ends of the wires are surrounded by the plastic material, thus eliminating the rough burrs usually present on all metal staple and resulting in less tearing of the paper or fabric that may be penetrated by the staple.

It is pointed out that in addition to pre-formed inverted U-shaped staples the invention contemplates other forms of fasteners, as, for instance, binding posts, etc., wherein, instead of a filament constituting the fastener, and whether the fastening is accomplished by embedding the filament or a shank portion thereof in the fastened material as, for instance, by driving into wood, or by penetrating the material and clinching, as, for instance, by bending the legs of a staple upon the opposite side of the fastened material from the bridge of the staple. In certain types of stapling machines, as well as in bookbinding machines, the fasteners are successively cut from a length of filament, usually in the form of a coil or spool, and the invention contemplates fasteners of this type.

An important feature of the invention is the orientation of the plastic material in relation to the reinforcing wire, by which advantages are obtained peculiarly related to the function of the fastener. The orientation of the plastic material, which results from extruding it about the reinforcing wire, is such that the greater the degree of orientation the greater the columnar strength of the filament. Also, the highest degree of orientation takes place adjacent the surfaces of the reinforcing wires, and as the bonding to the wires increases with the increase of the orientation, it will be seen that the greatest resistance to skinning back or peeling is present at the most effective points, and particularly in the thin areas on the plastic material adjacent the edges. The combined oriented plastic material and the reinforcing wires complement each other, the plastic material giving increased columnar strength to the reinforcing wires and the reinforcing wires lending formability to the plastic material which would be stiff or bristly otherwise. The arrangement makes possible the provision of reinforcing wires of relatively small size in relation to the overall cross-sectional dimension of the filament, and of various tempers to give desired results based upon the end use.

In the case of a clinched staple, where the staple legs are bent with respect to the staple bridge, it has been found that increased orientation of the plastic material takes place in the bends, with the result that the staple legs have a tendency to lay "dead," or with less spring-back and curvature upon the fastened surface, than is the case with an all metal staple. Hence, a tighter and snuger fitting of the staple is obtained. It has also been found that the oriented plastic material in the bend so supports the bend of the reinforcing wires that the latter may be bent back from their clinched positions with less tendency to fracture than is the case with all metal staples.

Other advantages of the plastic wire reinforced staple of the invention are the ability to obtain any desired colors, chemical and corrosion resistance, resistance to weather, dielectric properties, reduction of wear in tools for forming, etc.

In FIGS. 8 and 9 the staple is shown driven into a wood structure thereto. It will be seen that the chisel cut ends 13 of the staple legs cause the staple legs to be deflected in the direction of the entering points, the staple leg at one side curving in one direction and the staple leg at the other side curving in the other direction. The arrangement of the wires is such that they can bend independently of each other in the planes of the staple legs, despite the fact that the staples are of substantially greater width than thickness, and as a result the holding power of the staple is greatly increased. Also, during the penetration of the staple legs the reinforcing wires are pressed toward each other, as a result of the compressibility of the plastic and the fact that the bevel cut end of the wire adjacent the upper end of the cut end 13 tends to wedge toward the cut end of the wire adjacent the entering point. This causes the plastic body of the staple to be bulged outwardly between the wires through cold flow of the plastic material, as shown in FIG. 9, thus in effect locking the staple legs into the wood or other material into which they are driven. In the case of the wood, the forcing of the plastic against the fibers of the wood results in a very high bonding or anchorage factor. Substantially the same result is obtained in the case of a staple leg driven straight into wood or other suitable material, the reinforcing wires being pressed toward each other and the plastic material being bulged outwardly into increased bonding or anchoring relation.

The staple of the invention also makes possible the wedging of the staple bridge to increase its width and cause the plastic material to be cold flowed in relation to the material being stapled. As seen in FIG. 10, the driving tool 19, which may form an operative part of a stapling machine of conventional type, is provided with a specially shaped swaging surface 20 adapted to depress the plastic material of the staple bridge between the reinforcing wires, thus spreading the bridge and increasing its gripping power on the material being held. For example, if used to attach screening or cloth to make the plastic material will flow over and around the screen, giving greater anchorage than would be obtained when using conventional flat wire staples. The plastic material may also be heated to make the material being fastened, this being especially advantageous in staple fastening employed in woven fabrics, garments, or the like.

In FIG. 5 there is shown a modification in which the wire reinforcing of the plastic staple is of substantially dumbbell shape in cross-section, and consists of a pair of round wire strips 14a and 15a joined by a straight web 21. In FIG. 6 there is shown a further modification, substantially similar to that shown in FIG. 5, but in which the round wire strips 14a and 15a are joined by a transversely curved web 22. In both of these arrangements the wire strips can be compressed toward each other, the web 21 being shown in FIG. 5 bending in either direction and the web 22, as shown in FIG. 6, bending in the direction of its curvature. In FIG. 7 there is shown another modification in which the plastic body 16a is of oval cross-section. FIG. 16 shows a modification in which the reinforcing wire 14b and 15b are of rectangular cross-section. In FIG. 17 there is shown another modification in which the plastic body 16b is of circular cross-section.

FIGS. 11–13 show the manner in which the staples of the invention may be secured together to provide a staple stick 23. As shown in FIG. 12, the individual staples 19 are adhered together by means of an adhesive coating 24, and as seen in FIG. 13, the individual staples 16 are secured together by bonding the plastic material at the points of contact between adjacent staples, as indicated at 25.

What is claimed is:

1. A fastener having at least a shank portion thereof in the form of a filament and wherein said shank of said fastener has its leading end of substantially no greater cross-sectional area than any other portion of the shank and is drivable lengthwise into material to be fastened and wherein the holding power of said shank is increased, said shank comprising a reinforcing metallic core comprising continuous longitudinally extending transversely spaced parallel members defining a longitudinal pocket between them, said longitudinal pocket being of a cross-sectional area at least as large as the cross-sectional area of one of said reinforcing core members, and a thermoplastic material bonded to each of said core members throughout the length thereof and completely encasing same in sur-
5. The fastener as defined in claim 1, further characterized by a transverse web integral with and connecting said core members and transversely bendable through said relative lateral movement of said core members toward each other.

6. The fastener as defined in claim 1, wherein said filament is of inverted U-shape staple form having a bridge portion and a pair of shank portions drivable lengthwise into material to be fastened, and wherein the bends between said bridge and shank portions are along transverse lines parallel to a plane passing through the longitudinal axes of said core members.

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